STATE FAUNA SERIES, 16

FAUNA of GOA

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State Fauna Series, 16

FAUNA OF GOA

Edited by
Director, Zoological Survey of India, Kolkata



Zoological Survey of India
Kolkata

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FAUNA OF GOA

STATE FAUNA SERIES

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Zool. Surv. India
Fauna of Goa, State Fauna Series, **16** : 1-8, 2008

AN OVERVIEW

ANIL MAHABAL
Zoological Survey of India, Western Regional Station, Pune-411044

INTRODUCTION

GOA is India's smallest state, and is relatively a narrow strip of land, about 105 kms in length and 65 kms wide, covering an area of 3702 sq kms. It lies on the West Coast of Peninsular India. Goa was liberated on 19th December 1961 from 451 years of Portuguese Colonial rule. It remained the Union Territory till 30th May 1987 when it was formed the 25th State in the Union of India.

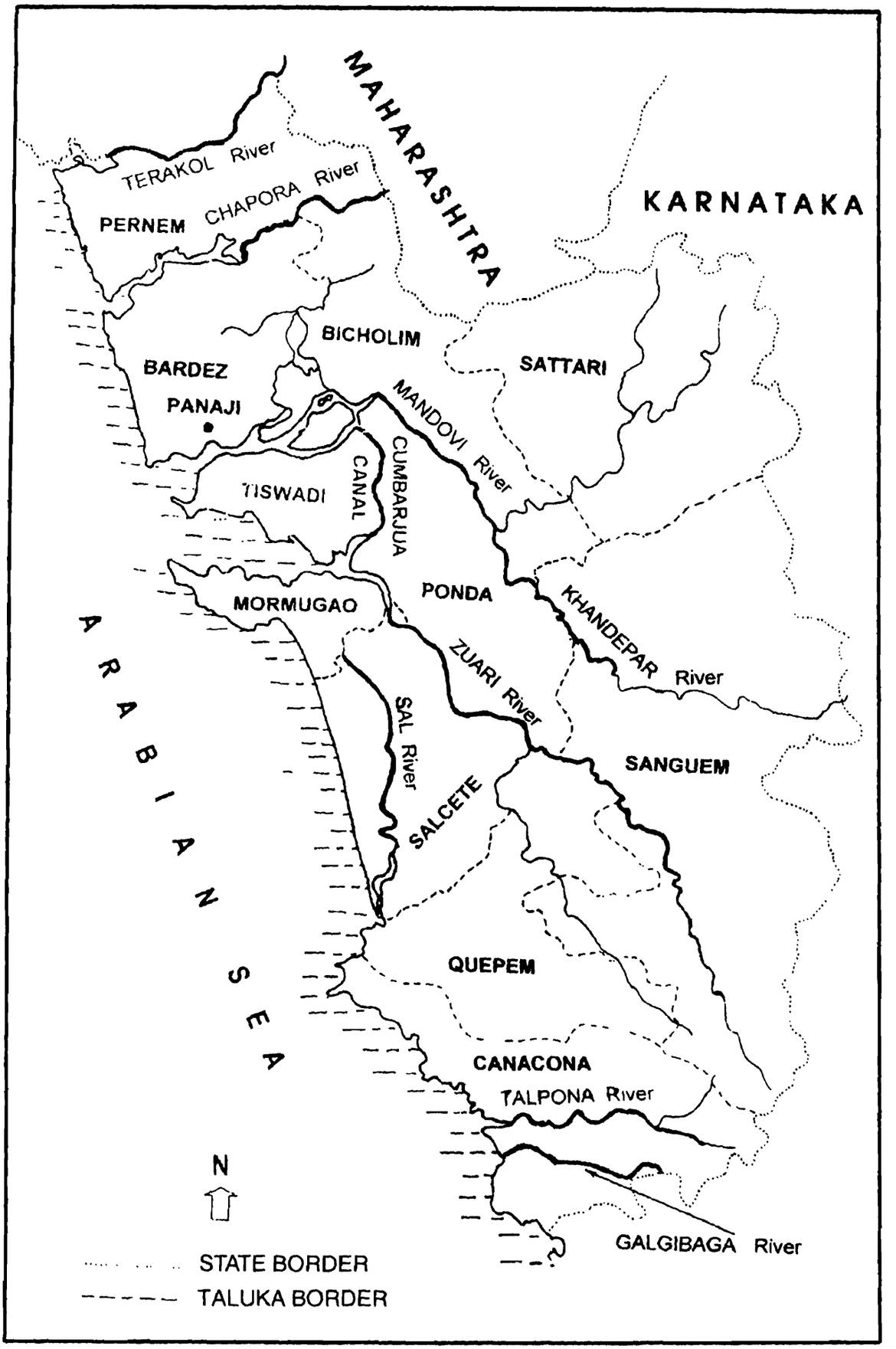
GEOGRAPHY

Location and Boundaries

The State of Goa has an area of 3,701 sq kms and the population of 1.30 million as per the Census of 2001. It is flanked by the Arabian Sea in the West and the Western Ghats (or Sahyadris) in the East. Its geographical position is marked by 15°48'00" and 14°53'54" N Latitude and 74°20'13" and 73°40'33" E Longitude. Altitude of Goa varies from the Sea level to 1022 metres. The boundaries of the State partly confirm to the geographical features. The North, Goa shares its northern boundary with the Sawantwadi taluka of Sindhudurg district and the North-east by Kolhapur district of the Maharashtra State; (the mouth of the Tiracol river lies within Goa and includes the Tiracol Fort, across the mouth). To the East and South, it is shared by Belgaum, Dharwar and North–Kanara districts of the Karnataka State. Goa has two districts; the North Goa (1736 sq kms. with 689 sq kms. forest cover) and the South Goa (1966 sq kms. with 1226 sq. kms. forest cover) (Ministry of Environment and Forests Report 2001 cited by Islam and Rahmani, 2004). Their headquarters are at Panaji and Margao respectively. A total of 11 talukas constitute the State viz. Tiswadi, Bardez, Pernem, Bicholim, Satari, Ponda, Sanguem, Canacona, Quepem, Salcete and Marmugao. Panaji is the capital city of Goa, which lies at a distance of 225 nautical miles by Sea and 594 kms by road from Mumbai.

Temperature : The average annual rainfall is about 3100 mm, received mainly between June to September during the Southwest monsoon period. The relative humidity is very high and during dry season it is above 60%. Mean average temperature and rainfall prevailing in Goa for one year are given below :

Month	Temperature		Rainfall mm
	Mean Max.°c.	Mean Min.°c.	
Jan.	32.2	20.9	2
Feb.	31.5	20.9	0
March	32.9	24.6	4
April	33.1	25.2	17
May	33.5	26.3	18
June	29.1	23.8	580
July	28.8	24.2	892
Aug.	28.6	23.9	341
Sept.	30.4	24.1	277
Oct.	30.6	22.7	122
Nov.	33.0	21.2	20
Dec.	33.3	21.3	37


MAHARASHTRA
KARNATAKA
TERAKOL River
CHAPORA River
PERNEM
BICHOLIM
SATTARI
BARDEZ
PANAJI
MANDOVI River
CUMBARJUA CANAL
TISWADI
MORMUGAO
PONDA
KHANDEPAR River
ZUARI River
SAL River
SALCETE
SANGUEM
ARABIAN SEA
QUEPEM
CANACONA
TALPONA River
GALGIBAGA River
N
STATE BORDER
TALUKA BORDER

MAP OF GOA

Transport

Air : All major cities are connected to Goa. The airport is at Dabolim, 29 Kms from Panaji.

Rail : The Konkan Railway connects the State to Mumbai and several other important cities in the country.

Sea : Nearest port Panaji.

Road : National Highways NH 4 A, NH 17, NH 17A pass through Goa. Several interstate buses are operated on these routes.

Physical Geology

There are three main physical divisions of the Goa state : 1. the hilly region of the Western Ghats in the East, 2. the midland region with its plateaus and 3. the low-lying river basins with the coastal plains in the West.

1. The Western Ghats

The ranges of Western Ghats or Sahyadri run roughly North to South in an area of hills. The 125 kms long crest line meets the neighbouring state of Karanataka. Tropical wet evergreen forest occurs in strands and patches in the deeper valleys over an area of about 200 sq kms. Tropical moist deciduous and semi evergreen forests cover about 400 sq kms. Average elevation is 800 meters. Geologically this is the "Goa gap" between adjoining high sections of North and South Western Ghats. Basaltic cliffs with horizontal layers seem reminiscent of South Maharashtra hills, while much larger central and southern parts are of densely wooded hills characteristic of North - Kanara Ghats of the South. Mostly Tropical Wet Evergreen Forest and Tropical Moist Deciduous Forrest occur in this Western Ghats Region.

Biogeographically, Goa lies at the point of transition from the Northern to the Southern Sahyadris. This point can be judged lying around Valpoi. Study of migratory and resident avifauna found in the area is in confirmation with the statement (Lainer, 2004). Large parts of Goa's Western Ghats strip are inaccessible.

2. The Midland region

The intermediate area between the Western Ghats and the Coastal plains consists largely of laterite plateaus, a characteristic feature of Goa and the entire South Konkan. This region is with an elevation from 30 to 200 meters and adjoins the sea in many places. These plateaus are covered with stunted cashew trees, thorn scrub and coarse grass. Locally known as 'Jamba' the laterite stones are extensively used for house construction and compound walls, because they can be easily cut and dressed when quarried and get hardened on weathering. Dense semi-evergreen forest exists on patches and strands where areas are deeply notched by ravines and valleys along the hills. Numerous perennial springs feed intensive cultivated areas where coconut, spice, fruits and paddy are grown. In several places plateaus advance deep into the coastal belt and form rocky headlands where forts are raised like Tirakol, Chapora, Aguda, Calo Raj Nivas, Mormugao and Cabode Rama.

3. The Coastal belt and river basins

The ecologically distinct zone extending in width of about 12-15 kms along Goa's coastal line also contains about 80% population of Goa. This 133 kms long coastal belt with sandy bays, beaches and rocky high lands broken by wide estuaries of the Mandovi and Zuari rivers makes the important tourist places of Goa. An integral part of these coastal ecosystems are river basins. These alluvial extensions of the coastal belt reach in the form of low-land bays along the rivers up to 45 kms into the midlands. Extensive laterites, attributed to the tropical moist climate with vast seasonal changes are another interesting and significant feature of this landscape. There are limited outcrops of older rocks, metamorphic schists and shales, mostly belonging to the Dharwar series of the geology. More important are the recent alluvia spread along the courses of rivers and the coastal plains. These and the sandy deposits along the coastline are the most recent formations.

The major riverine plains in Goa are those of the Mandovi and Zuari which, together, constitute

a major alluvial embayment in the otherwise narrow and uneven aspect of the whole Konkan Coastland. Goa is intersected by extensive network of waterways. Other important rivers are Tiracol, Chapra, Sal and Talpona. All these rivers have their origin in the Sahyadri Ranges and flow eastwards into the Arabian Sea. They break the long coastline into enchanting estuaries and bays which are studded with palm fringed beaches like Arambol, Vagator, Anjuna, Baga Calangute in the North and Colva, Betul, Palolem in the South. All these beaches are world famous for their natural beauty. Rivers serve as inland waterways being navigable mostly in tidal reaches. Lakes also constitute a scenic feature of Goa. Thus Goa attracts tourists from all over the world.

Important Rivers

Of the many rivers and streams that drain the land of the state, the Tiracol, Mandovi, Zuari, Galgibag, Sal and Talpona are most important because of the extent of their drainage areas and the human attraction they hold.

Mandovi : The Mandovi takes its rise in the main Sahyadries of the Karnataka State. With rivers Rogaro and Kushavati as the main left bank tributaries and the Nanorem, Nanus, Valvota and Mapusa as the main right bank tributaries, the Mandovi has the largest drainage basin in Goa. In Goa, the river has a length of about 77 kilometres and wide meandering course through the irregular and increasingly plateau-like forms.

Zauri : The Zauri is the southern counterpart of the Mandovi, and the twin estuaries of these rivers, provide inland waterways. The Zuari's water source lies entirely within the district of Goa, with the inter-state boundary almost following the water divide.

Lakes and Wetlands

The more important lakes of Goa are Maem, Chimbel, Carambolim, Calapur, Cacoraa and Curchotem, out of which Carambolin is declared as Wetland and is also included in the Important Bird Areas of India under IBA Site Code as IN-GA-02 (Islam and Rahmani, 2004).

Mineral deposits

The chief economic minerals of Goa are associated with the Dharwarian complex and the basalts of the Sahyadrian range and their minor extensions in Goa ending with the low level laterite plateaus. The major deposits are : iron, manganese, bauxite, high magnesia, limestone and clay. There are substantial reserves of bauxite and aluminous laterite, especially in the southern parts of Goa. This area is irreversibly degraded by large scale open cast and strip mining of iron and manganese ore. In recent times at several places government sponsored industrial estates and large factories are established resulting in pollution extremes. At present iron and manganese mining are the major extractive industries of Goa.

The Vegetal Cover

The scenic charm of Goa must be principally attributed to its vegetal cover consisting of three main categories : 1. The typical tropical monsoonal forests of the Sahyadrian Ghats and their extensions along the project hill ranges towards the coast-lands, 2. The poor cover of grass and scrub on its laterite plateaus, and 3.The fringing belts of vegetation along its estuaries and shoreline.

FORESTS

Forests are mostly confined to the eastern portion of the Western Ghats in the foothill slopes of Satari, Sanguem and Canacona talukas. Scattered in patches are several private forests owned by the village communities, temples and private individuals that cover an area of about 256 sq kms. The Government forests admeasure about 28.4% of the total land area.

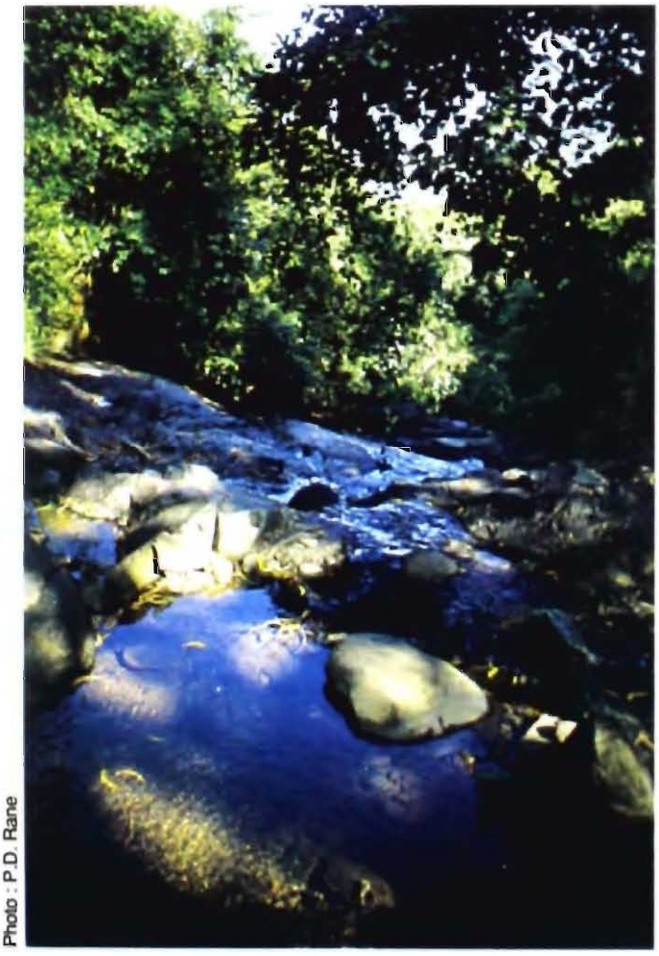
1. Evergreen and Semi-Evergreen Forests

The tropical wet evergreen forests occur in strands in the deeper valleys of the Ghats. This is a rich vegetation of evergreen types with a variety of species. These have an area of 250 sq kms but are dispersed in patches. Tall trees, dense canopy, sparse middle layer, climbing creepers and dense humus matting are characteristic. Along the north-

PLATE-I



Panoramic view of evergreen forest near Keri



Hill stream near Keri



Doodhsagar waterfall in Molem Wildlife Sanctuary

PLATE-IV



Photo P D Rane

Migratory birds
near Penginieum



Collection being made near
Bhagwan Mahavir Wildlife Sanctuary

Photo : R.M. Sharma



Photo D B Bastawade

Frogs; *Limnonectus limnocharis* in the
hide out in the leaves of *Canna* spp.

PLATE-V



Megalomorph spider species
Chilobrachus fimlrriatus Pocock ♀

Photo D B Bastawade



Photo : D.B. Bastawade

Egg cocoon of Megalomorph spider species
Chilobrachus fimlrriatus Pocock ♀



Mobea spp. ♀ Collected
from large stone crevices

PLATE-VI



Photo : D.B. Bastawade

Landscape photograph
at Penguim, Goa

An entrance gate for
Molem Wildlife Sanctuary



Photo : D.B. Bastawade



Photo : A.S. Mahabal

Cattle Egret in search of food

PLATE-VII



Common Green Whip Snake
Ahaetulla nasutus Lacep.

Photo : P.D. Rane



Photo . P.D. Rane

Hump-nosed Pit Viper,
Hypnale hypnale (Merrem)



Common palm Civet,
Paradosurus hermaphroditus (Pallas)
died in road accident

PLATE-VIII



Photo : S.G. Patil

A small water body near Khandepar River



Photo : S.G. Patil

Spotted deer, *Axis axis* in
Bhagwan Mahavir Wildlife Sanctuary



Photo : S.G. Patil

Collection of aquatic fauna
near Gagangiri village

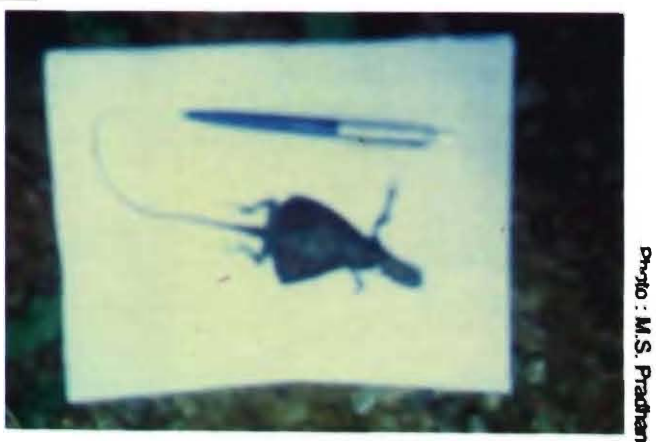


Photo : M.S. Pradhan

South Indian Flying Dragon or (Flying Lizard)
Draco dussumieri Dum. & Bibr. in core area of
Bhagwan Mahavir Wildlife Sanctuary

eastern and south-eastern portions bordering Karnataka state, little evergreen and semi-evergreen vegetation occur in the deep gorges and ravines of Sanguem, Satari and Canacona talukas. On the precipitous aspect, the tree growth is mostly stunted having low timber value. In this zone of forests, the annual rainfall varies from 510 cm to 760 cm. The trees of common occurrence are Bobbi (*Calophyllum wightianum*), Jambul (*Syzygium cumuni*), Amba (*Mangifera indica*), Onval (*Mimusops elengi*), Otamb (*Ariocarpus lakoocha*), Patpanas (*Artocarpus hirsuta*), Nag Gulum (*Meusa ferrea*), Hopea wightiana, Bhirand (*Garcina indica*), Gulum (*Machilus macarantha*), Dalchini (*Cinnamomum zeylanicum*), Chandodo (*Macaranga peltate*), Bhenoro (*Sterculia guttata*), Kalezad (*Diospyros embryopteris*), *etc.* The undergrowth is comprised of *Colebrookea oppositifolia, Wendlandia* spp. *Triumfetta rhomboidea, Hemigraphis* spp. *Callicarpa lanata, Scultia indica, Ixora brachiata, etc.* The common bamboos occurring in these forests are Velu (*Bambusa arundinacea*), and Kanaki (*Dendrocalamus strictus*). Bhet (*Calamus tannuas*) is the important cane of evergreen belt. *Acacia intsia, Entada pusaetha, Tinospora, Cordifolia, Coculus macrocarpus, Stephania hernandifolia and Cissampelos pereira* are the common climbers of these dense forests.

2. Moist Deciduous Forests

The tropical moist deciduous forests occupy a large area of Goa towards Sahyadri ranges. These include important strands of teak which are estimated to occupy about 400 sq kms of land along the foot hill slopes of hill tract traversing from north to south and spurs leading towards west, in the talukas of Ponda, Canacona, Quepem, Sanguem and Satari. There are commercially potential forests categorized as "B" class for exploitation of the forest produce by the State to earn maximum profits and for regeneration of the crop on perpetual basis. The prominent tree species in this zone are Maretha (*Terminalia crenulate*), Quinzol (*Terminalia paniculate*), Zambo (*Xylia xylocarpa*), Nano (*Lagerstroemia lanceolata*), etc. In the under storey, the common tree species found are Dhaman (*Grewia illiaefolia*), Shiras (*Albizzia lebbek*), Belati (*Albizzia procera*), Bel (*Aegie marmelos*), Kadukavath (*Hydnocarpus laurifolia*), etc. The ground vegetation consists mostly of Galai (*Randia dumetorum*), Karvi (*Strobilanthes callosus*), Karvand (*Carissa carandas*), etc. The common climbers of these forests are Ukshi (*Calycopteris floribunda*), Krishnasarva (*Ichnocarpus frutescens*), etc

3. The fringing belt along with the estuaries and shoreline

The vegetal growths in marshy lands and the sandy shores have undergone little floristic change. It appears that they have shrunk in area due to extension of cultivation and mining activities. The mangrove forests are extensive in the estuaries of the Mandovi and Zauri, particularly in the silted up fringes of the Cumbarjua canal. They are also found in the minor estuaries in north and south Goa. Above the tidal limits, wherever the relief allows formation of beaches, typical beach flora tends to occur with shrubs and maritime grasses. The more common and extensive is the planted species of Casuarina.

FLORA

A total of 1,115 species of Angiosperms belonging to 657 genera arranged into 144 families have been recorded.

FAUNA

Zoological Survey of India, Kolkata and its Western Regional Station, Pune conducted few faunistic surveys of the area of Goa state to collect samples and to record the faunal diversity. The results are available mainly as departmental reports. The research papers published contain the work of ZSI scientists like Vazirani, 1970 (Aquatic beetles : Insecta : Coleoptera) ; Sharma 1976 (Records of Reptiles); Tandon and Shishodia, 1977 (Insecta : Orthoptera : Acridoidea); Ghosh and Ghosh, 1977 (Crustacea : Stomatopoda); Saha and Mukherjee, 1981; Saha and Dasgupta, 1992; Nandi, and Mondal, 1985 and Prasad, 1995 (Insecta : Odonata). Other workers mainly

confined to the study of Birds of Goa, Daniel (1988); Santharam (2003); and Lainer (2004). Sekar (1991) provided key to 'Amphibians of Goa state' Detail account of important wild animals, snakes and fishes is available in the Gazetteer of Goa 1979 (Ed. By Gune, 1979). Species of wild animals and snakes as mentioned in the gazetteer are listed below :

Wild animals : Slender Loris (*Loris tardigradus*), Monkey (*Macaca radiata*), Langur (*Presbytis entellus*), Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), Toddy Cat (*Paradoxurus hermaphroditus*), Jungle Cat (*Felis chaus*), Common Mongoose (*Herepestse edwardsi*), Bhalu (*Melvrsus ursinus*), Jackal (*Canis aureus*), Common Otter (*Lutra lutra*), Fulvous fruit Bat (*Rousettus leshenaulti*), Flying Fox (*Pteropus gigantius*), Short-nosed fruit Bat (*Cynopterus sphinx*), Shankro (*Ratufa bicolour*), Palm Squirrel (*Funambulus palmarum*), Indian Field Mouse (*Mus booduga*), House Rat (*Rattus rattus*), Indian Gerbille (*Tatera indica*), Koli Undir (*Bandicota indica*), Indian Porcupine (*Hystrix indica*), Hares (*Lepus nigricollis ruficaudatus*), Gav reda or Gaur (*Bos gaurus*), Meru (*Cervus unicolour),* Chital (*Axix Axis*), Barking Deer (*Muntiacus muntjak*), Mouse Deer (*Tragulus memina*), Ran Dukar–the Wild boar (*Sus scrofa*) and Pangolin (*Manis crassicaudata*).

Snakes

Non-poisonous : Blind snake (*Typhlops braminus),* Torava *(Uropeltis ocellatus),* Sand Boa *(Eryx conicus),* Indian Python (*Python molurus),* Indian Wart snake (*Acrochordus granulatus),* Trinket Snake (*Elaphe helena),* Dhaman or Indian Rat snake (*Ptyas mucosus), Oligodon taniolatus, Ahaetulla ahaetulla,* Painted Bronze- back snake (*Ahaetulla grandoculis),* Golden Tree snake (*Chrysopetea ornate),* Common Wolf snake *(Lycodon aulicus),* Checkered Keelback *(Natrix piscator),* Striped Keelback (*Natrix stolata),* Beddon's Keelback (*Natrix beddomei),* Green Keelback (*Macropisthodon plumbicolor),* Indian Gamma (*Boiga trigonata)* and Common Green Whip snake (*Dryhopis masutus*).

Poisonous : Indian Cobra *(Naja naja),* King Cobra or (Raj nag) (*Naja hannah),* Common Indian Krait *(Bungarus caruleus),* Coral snake (*Callophis nigrescens),* Kusada (Konkani language) *(Enhydrina schistose),* Sea snake (*Hydrophis caerulescens),* Sea snake (*Lepemis curtus),* Russel's Viper (*Vipera russeli),* Saw scaled Viper (*Echis carinatus) and* Bamboo Pit Viper (*Trimeresurus gramineus),* (Gune ed.1979).

Scientific names of few species have been changed and few species in this list have not been supported by additional evidence. Thus a total of 83 species of mammals and 100 species of reptiles included in the present volume be considered as the most recent and updated.

Wildlife Sanctuaries

The State has seven Wildlife Sanctuaries; those were constituted after the liberation of Goa. 1. Mollem National Park, Sanguem (107 sq kms.); 2. The Bhagwan Mahavir Wildlife sanctuary, Sangem (133 sq kms.); 3. Netravadi Wildlife Sanctuary, Sanguem (211.05 sq kms.); 4. Mhadei Wildlife Sanctuary, Sattari (208.48 sq kms.); 5. Cotigao Wildlife Sanctuary, Canacona, (86 sq kms.); 6. Bondla Wildlife Sanctuary, Ponda (7.89 sq.kms.) and 7. Dr. Salim Ali Bird Sanctuary, Tiswadi (1.8 sq kms.). The Wildlife Sanctuaries provide maximum protection to the wild animals within their area. Shooting of animals in these sanctuaries is completely banned and adequate facilities for drinking water and grazing are provided to the animals. Common wild animals found in these sanctuaries are the leopard, wild boar, sambar, spotted deer, gaur, barking deer, hares, mouse deer, pangolins, slender loris, jungle cats, jackals, giant squirrels and civet cats and many colourful birds. Among reptiles, pythons and cobras are quite common. Jungle fowls are also found in the sanctuaries. The wildlife sanctuaries were constituted under the enactment of wild animals and wild birds protection Act, 1965. The wildlife sanctuaries cover an area of 75,496 ha constituting 20.39% of the geographic area of the state. These protected areas are located mainly on the foot hills of the Western Ghats. Of these, Bhagwan Mahavir Wildlife sanctuary,

Cotigao Wildlife Sanctuary and Mhadei Wildlife Sanctuary are included in the Important Bird Areas of India with IBA site code as–IN-GA–01, IN–GA–03 and IN–GA–04 respectively (Islam and Rahmani, 2004).

FAUNISTIC SURVEYS AND RESULTS

Altogether, six faunistic surveys were conducted in various parts of Goa State during 1993–1995 and 2000–2002 by the Western Regional Station of the Zoological Survey of India and faunal samples of various groups were collected. Observations alone were recorded for higher groups like Reptiles, Birds and Mammals. Comprehensive account of the studies conducted by Western Regional Station, ZSI, Pune, on the faunal diversity of the state, belonging to 1326 species of 17 groups is given in Table-1.

Table-1. Faunal Diversity of Goa State

Sl. No.	Group	Order	Family	Subfamily	Genera	Species
1.	Prasitic Protozoa	3	8	-	11	103
2.	Mollusca (Land & Freshwater)	6	12	6	15	25
3.	Chilopoda (Centipede)	1	1	2	4	8
4.	Cladocera	1	6	3	29	44
5.	Isopoda (Land & Marine)	1	2		3	7
6.	Crabs (Marine & Esturine)	1	9	15	33	47
7.	Anomuran Crabs	1	3		4	11
8.	Crustacea	1	2		2	5
9.	Odonata	1	8	12	24	39
10.	Mantodea	1	4	7	8	9
11.	Lepidoptera	1	5	18	141	251
12.	Arachnida	5	16		33	50
13.	Pisces (Freshwater)	8	20		31	58
14.	Amphibia	2	5		17	28
15.	Reptilia	3	20		57	100
16.	Aves	20	71	9	238	458
17.	Mammalia	12	31	25	57	83
	Total	**68**	**223**	**97**	**707**	**1326**

SUMMARY

An account of species from Goa state is provided in this volume. It cannot be claimed that this is the full account of total biodiversity of the Goa State. Collection belonging to other faunal groups still remains to be identified and may be published at a later date.

ACKNOWLEDGEMENTS

My sincere thanks are due to Dr. J.R.B. Alfred and Dr. A.K. Ghosh (ex-Directors, Z.S.I. Retd.) for providing all the facilities and their keen interest in completing the project. Thanks are also due to Dr. G.M. Yazdani (Retd.) and Dr. M.S. Pradhan, the then In-charge of Western Regional Station, for running the project successfully during their tenure. I am grateful to the Chief Wildlife Warden, Conservator of Forests and Deputy Conservator of Forests, Govt of Goa, Panji; for their kind cooperation in providing special purpose permits for surveys and collection of samples for identification of various groups of fauna available in the State of Goa. I would like to record my sincere thanks to the members who participated in the surveys and also to other staff members of the station. I extend my sincere thanks to the scientists of the Zoological Survey of India, who have contributed chapters on various faunal groups for this volume.

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PARASITIC PROTOZOA : BLOOD PROTOZOA (HAEMOFLAGELLATES, HAEMOGREGARINES, HAEMOSPORIDIANS AND PIROPLASMS)

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INTRODUCTION

Parasitic protozoa, herein, particularly blood protozoa of Goa, compared to other states in India (Nandi, 1984; Nandi and Bennett, 1997), have been intensively investigated in so far as avian blood parasites are concerned during the first half of twentieth century by de Mello and his co-workers (1916-1937). Subsequently, Ray and Choudhury (1981, 1984) as well as Nandi and Mandal (1985) reported some species of blood inhabiting protozoan parasites from this state. As a result, a total of 103 species of blood protozoa belonging to 4 suborders *viz.*, Trypanosomatina (Haemoflagellates), Adeleina (Haemogregarines), Haemosporina (Haemosporidians) and Piroplasmidea (Piroplasms) could be listed. These reports, being scattered, are collated and compiled herein to depict the occurrence and distribution of these fluid tissue parasites, both plasma parasites (e.g., *Trypanosoma*) and corpuscular parasites (e.g., *Plasmodium*), from this part of the country.

A systematic list, a host-parasite list and a systematic account of these parasites are included in this paper along with an addendum dealing with intestinal parasites to indicate the occurrence of some other parasites *viz.*, opalinids, balantidiids and nyctotherids hitherto known from this state.

MATERIAL AND METHODS

Although no recent survey was made on protozoan parasites of Goa, the present author had the privilege to examine the materials collected during 1970s by Dr. A. K. Mandal and party of this department. The materials pertaining to blood parasites of birds were worked out and communicated by Nandi and Mandal (1985). However, the present paper is based on the existing literatures of parasitic protozoa fauna from Goa, mostly of de Mello and his co-workers (1916-1937), Ray and Choudhury (1983, 1984) and Nandi and Mandal (1985).

The methods of staining and examining blood parasites adopted during earlier survey work conducted by this department can be consulted from Nandi and Mandal (1985). Blood smears can be drawn on clear and grease free slides, air-dried, fixed and/or stained with Giemsa's stain. However, for collection and preservation of parasitc protozoa, in general, methodology given by Mandal and Nandi (1980), Mandal *et al.* (1990), Das *et al.* (1993), Nandi (2004) and Nandi *et al.* (2004) may be adopted for parasitological study.

SYSTEMATIC LIST OF BLOOD PROTOZOA

The systematic list of blood protozoa along with locality records hitherto known from Goa State is as follows :

Parasite	*Host*	Locality (Reference)
	Kingdom PROTISTA	
	Subkingdom PROTOZOA	
	Phylum SARCOMASTIGOPHORA	
	Subphylum MASTIGOPHORA	
	Class ZOOMASTIGOPHOREA	
	Order KINETOPLASTIDA	
	Suborder TRYPANOSOMATINA	
	Family TRYPANOSOMATIDAE	
	Genus ***Trypanosoma*** Gruby, 1843	
	A. *Trypanosoma* of fishes	
T. clariae batrachi de Mello and Valles, 1936	*Clarias batrachus*	Goa (de Mello and Valles, 1936)
	B. *Trypanosoma* of amphibians	
T. chattoni Mathis and Leger, 1911	*Bufo melanostictus* *Bufo stomaticus* *Microhyla ornata* *Rana cyanophlyctis* *Rana limnocharis* *Rana tigrina* *Rhacophorus maculatus* *Rhacophorus malabaricus*	Goa : Volpoi, Molem and Bondla (Ray and Choudhury, 1983)
T. malabarica Ray and Choudhury, 1983	*Rana malabarica*	Volpoi (Ray and Choudhury, 1983)
T. rotatorium (Mayer, 1843)	*Bufo melanostictus* *Bufo stomaticus* *Rana cyanophlyctis* *Rana limnocharis* *Rana tigrina* *Rhacophorus maculatus* *Rhacophorus malabaricus*	Molem, Volpoi and Bondla (Ray and Choudhury, 1983)
	C. *Trypanosoma* of birds	
T. avium (Danilewsky, 1885)	*Lonchura malabarica*	Goa (Nandi and Mandal, 1985)
T. centropi de Mello, 1937	*Centropus sinensis parroti*	Daman (de Mello, 1937)
T. cuculi de Mello, 1937	*Cuculus micropterus*	Volpoi (Satari) (de Mello, 1937)
T. fulicae da Fonseca, 1938	*Fulica atra*	Goa (da Fonseca, 1938)
T. gymnorhidis de Mello and da Fonseca, 1938	*Gymnorhdis* (*Petronia*) *xanthocollis*	Goa (de Mello and da Fonseca, 1938)
T. hannae de Mello *et al.*, 1917	*Columba livia*	Goa (de Mello *et al.*, 1917)
T. ixobrychi de Mello, 1937	*Ixobrychus minuta minuta*	Diu (de Mello, 1937)
T. lobivanelli de Mello, 1937	*Lobivanellus indicus indicus*	Diu (de Mello, 1937)

Parasite	*Host*	Locality (Reference)
T. moruoni de Mello, 1937	*Copsychus saularis*	Taleigao (Ilhas) (de Mello, 1937)
T. nycticoracis de Mello, 1937	*Nycticorax n. nycticorax*	Diu (de Mello, 1937)
T. turdoides de Mello, 1937	*Turdoides sommervillei*	Old Goa (de Mello, 1937)
T. sp.	*Buteo vulpinus*	Daman (de Mello, 1937)
T. sp.	*Copsychus saularis saularis*	Goa (Nandi and Mandal, 1985)
T. sp.	*Pycnonotus jocosus*	Goa (Nandi and Mandal, 1985)
T. sp.	*Streptopelia chinensis*	Goa (Nandi and Mandal, 1985)
T. sp.	*Tockus griseus griseus*	Goa (Nandi and Mandal, 1985)
Phylum APICOMPLEXA Class SPOROZOEA Subclass COCCIDIA Order EUCOCCIDA Suborder ADELEINA Family TOXOPLASMATIDAE Genus ***Toxoplasma*** Nicolle and Manceaux, 1908		
T. butasturis de Mello, 1937	*Butastur teesa*	Goa (de Mello, 1937)
T. columbae Yakimoff and Kohl-Yakimoff, 1912 (Syn. *Haemogregarina francae* de Mello, 1915 and *Leucocytogregrina francae* de Mello *et al.*, 1917 and also *Toxoplasma francae*, Wenyon, 1926)	*Columba livia*	Mapuca (Bradez) (de Mello, 1915, cited from Wenyon, 1926)
T. fulicae de Mello, 1935	*Fulica atra* (Lungs)	Carambolin and Taleigao (de Mello, 1935)
Family HAEMOGREGARINIDAE Genus ***Haemogregarina*** Danilewsky, 1885		
A. *Haemogregarina* of fishes		
H. thyrsoideae de Mello and Valles, 1936	*Thyrsodea macrurus*	Goa (de Mello and Valles, 1936)
B. *Haemogregarina* of amphibians		
H. berestneffi Castallani and Willey, 1905	*Rana tigrina*	Goa (de Mello *et al.*, 1917)
C. *Haemogregarina* of reptiles		
H. laverani Simond, 1901	*Lissemys punctata granosa*	Goa (de Mello, 1932)
H. malabarica de Mello, 1932	*Lissemys punctata granosa*	Goa (de Mello, 1932)

Parasite	*Host*	Locality (Reference)
H. rodriguesi de Mello *et al.*, 1917	*Hemidactylus brooki*	Goa (de Mello *et al.*, 1917)
H. vittatae Robertson, 1908	*Lissemys punctata granosa*	Goa (de Mello, 1932)
H. xaveri de Mello, 1932	*Lissemys punctata granosa*	Goa (de Mello, 1932)
Genus ***Karyolysus*** Labbe, 1894		
K. jorgei de Mello and de Meyrelles, 1937	*Calotes versicolor major*	Goa (de Mello and de Meyrelles, 1937)
Suborder HAEMOSPORINA Family PLASMODIIDAE Genus ***Plasmodium*** Marchiafava and Celli, 1885		
A. *Plasmodium* of reptiles		
P. passertae da Fonseca, 1938	*Passerita mycterizans*	Goa (da Fonseca, 1938)
B. *Plasmodium* of birds		
P. herodiadis de Mello, 1935	*Herodiadis intermedia*	Goa (de Mello, 1935
P. relictum (Grassi and Feletti, 1891) (Syn. *P. centropi* de Mello, 1937; *P. chloropsidis* de Mello, 1935; *P. gallinulae* de Mello, 1935)	*Centropus sinensis parroti* *Chloropsis aurifrons davidsoni* *Gallinula chloropus*	Goa (de Mello, 1935) Daman (de Mello, 1937)
C. *Plasmodium* of mammals		
P. mackiei de Mello and de Sa, 1916	*Vespertilio muricola*	Arjuna (Bardez) (de Mello and de Sa, 1916)
P. narayani de Mello and Dias, 1936	*Lutra lutra*	Nagoa (de Mello and Dias, 1936)
P. tyrio de Mello *et al.*, 1928	*Manes* (= *Manis*) *pentadactyla*	Goa (de Mello *et al.*, 1928)
D. *Plasmodium* of man		
P. falciparum (Welch, 1897)	*Homo sapiens*	Goa (Pers. com.)
P. malariae (Grassi and Feletti, 1892)	*Homo sapiens*	Goa (Pers. com.)
P. vivax (Grassi and Feletti, 1890)	*Homo sapiens*	Goa (Pers. com.)
Family HAEMOPROTEIDAE Genus ***Haemoproteus*** Kruse, 1890		
H. aegithinae de Mello, 1936	*Aegithina tiphia* *Chloropsis aurifrons*	Nagoa (Salcete) (de Mello, 1937); Goa (Nandi and Mandal, 1985) Goa (Nandi and Mandal, 1985)
H. anthi de Mello, 1936	*Anthus rufulus*	Nagoa (Salcete) (de Mello, 1936, 1937)
H. antigonis de Mello, 1936	*Antigone virgo*	Junagad near Diu (de Mello, 1936, 1937)

Parasite	*Host*	Locality (Reference)
H. asturisdussumieri de Mello, 1936 emend. Levine and Campbell, 1971)	*Astur badius dussumieri*	Corlim (de Mello, 1936, 1937)
H. centropi de Mello, 1936	*Centropus sinensis parroti*	Diu (de Mello, 1937)
H. columbae Kruse, 1890	*Columba livia* *Streptopelia chinensis*	Goa (de Mello and Bras de Sa, 1916; de Mello *et al.*, 1917; de Mello, 1937) Diu (de Mello, 1937); Goa (Nandi and Mandal, 1985)
H. coraciae de Mello and Affonso, 1935 (Syn. *H. coraciae bengalensis* de Mello and Affonso, 1935)	*Coracias b. benghalensis*	Goa (de Mello and Affonso, 1935)
H. cornuata Bennett and Nandi, 1981	*Megalaima viridis* *Megalaima zeylanica inornata*	Goa (Nandi and Mandal, 1985) Goa (Nandi and Mandal, 1985)
H. danilewskyi Kruse, 1890	*Dendrocitta vagabunda*	Goa (Nandi and Mandal, 1985)
H. dicruri de Mello, 1936	*Dicrurusm. M. macrocercus*	Pragana (de Mello, 1937)
H. elani de Mello, 1936	*Elanus caeruleus vociferus*	Daman (de Mello, 1937)
H. fallisi Bennett and Campbell, 1972	*Copsychus s. saularis*	Goa (Nandi and Mandal, 1985)
H. fringillae Labbe, 1894 (Syn. *H. moruony* de Mello and Braz da Sa, 1915)	*Copsychus s. saularis*	Goa (de Mello and Braz da Sa, 1915; de Mello *et al.*, 1917; Nandi and Mandal, 1985)
H. gallinulae de Mello, 1936	*Gallinula chloropus*	Carambolim Lake (de Mello, 1936, 1937)
H. halcyonis de Mello, 1936	*Halcyon s. smyrnensis* *Halcyon smyrnensis fusca*	Canacona (de Mello, 1937) Goa (Nandi and Mandal, 1985)
H. lanii de Mello, 1936	*Lanius schach*	Goa (de Mello, 1936)
H. majoris Laveran, 1902 (Syn. *H. machlolophi* de Mello, 1935)	*Machlolophus xanthogenys*	Goa (de Mello, 1935)
H. meropis Zargar, 1945	*Merops o. orientalis*	Goa (Nandi and Mandal, 1985)
H. noctuae Celli and Sanfelice, 1891 (Syn. *H. bramae* de Melo, 1937 and *H. glaucidii* de Mello, 1937)	*Athene brama* *Glaucidium radiatum*	Nagoa (Salcete) (de Mello, 1937) Canacona (de Mello, 1937)

Parasite	*Host*	Locality (Reference)
H. orioli de Mello, 1936	*Oriolus oriolus kundoo*	Goa (de Mello, 1937)
H. orizivorae Anschutz, 1909 (Syn. *H. moruony* de Mello and Braz da Sa, 1915 and *H. garnhami* of Nandi and Mandal, 1985)	*Copsychus s. saularis*	Goa (de Mello and Braz da Sa, 1915; de Mello *et al.*, 1917; Nandi and Mandal, 1985)
	Lonchura malabarica	Goa (Nandi and Mandal, 1985)
H. otocompsae de Mello, 1936	*Otocompsa emeria*	Malim (Bardez) (de Mello, 1937)
H. passeris Kruse, 1890 (Syn. *H. gymnorhidis* de Mello, 1936)	*Gymnorhis xanthocollis*	Pragana (de Mello, 1936, 1937)
H. pastoris de Mello, 1936 (Syn. *H. morneti* Tendeiro, 1947 and *H. sturni* de Mello, 1936)	*Acridotheres fuscus mahrattensis*	Goa (Nandi and Mandal, 1985)
	Pastor roseus	Goa (de Mello, 1937)
	Sturnus malabaricus	Ponda (de Mello, 1937)
H. plateleae de Mello, 1936	*Platelea leucorodia major*	Diu (de Mello, 1937)
H. raymundi de Mello and Raimundo, 1934	*Leptocoma zeylanica*	Goa (de Mello and Raimundo, 1934)
H. sanguinis Chakravarty and Kar, 1945	*Pycnonotus cafer*	Goa (Nandi and Mandal,1985)
	Hypsipetes indicus ictericus	Goa (Nandi and Mandal, 1985)
	Hypsipetes indicus indicus	Goa (Nandi and Mandal, 1985)
H. tephrodornis de Mello, 1936	*Tephrodornis pondiceriana*	Pragana (de Mello, 1937)
	Coracina novaehollandiae macei	Goa (Nandi and Mandal, 1985)
H. thereicerycis de Mello, 1936 (Syn. *H. thereicerycis zeylanicus* de Mello, 1936)	*Megalaima viridis*	Goa (Nandi and Mandal, 1985)
	Thereiceryx zeylanicus inornatus	Corlim (Ilhas) (de Mello, 1937); Goa (Nandi and Mandal, 1985)
	Thereiceryx z. zeylanicus	Malim (Bradez) and Sanquelim (de Mello, 1937)
H. upupae de Mello, 1936	*Upupa epops*	Daman (de Mello, 1937)
H. wenyoni de Mello *et al.*, 1917	*Orthotomus sutorius*	Goa (de Mello *et al.*, 1917)
H. sp.	*Corvus splendens*	Goa (de Mello *et al.*, 1917)
H. sp.	*Corvus macrorhynchus*	Goa (de Mello *et al.*, 1917)
H. sp.	*Strix ocellata*	Pragana (de Mello, 1937)
H. sp.	*Cerchneis tinnunculus objurgatus*	Pragana (de Mello, 1937)
H. sp.	*Otus b. bakamoena*	Goa (Nandi and Mandal, 1985)
H. sp.	*Turdoides striatus somervillei*	Goa (Nandi and Mandal, 1985)

Parasite	*Host*	Locality (Reference)
H. sp.	*Harpactes fasciatus malabaricus*	Goa (Nandi and Mandal, 1985)
	Family LEUCOCYTOZOIDAE Genus ***Leucocytozoon*** Sambon, 1908	
L. ardeae Rodhain, Pons, Vandenbranden and Bequaert, 1913 (Syn. *L. ardeolae* de Mello, 1936)	*Ardea grayi*	Pragana (de Mello, 1936)
L. brimonti Mathis and Leger, 1910 *(L. molpastis* de Mello, 1936)	*Pycnonotus cafer*	Goa (Nandi and Mandal, 1985)
L. chloropsidis de Mello, 1935	*Chloropsidis aurifrons davidsoni*	Goa (de Mello, 1935)
L. enriquesi de Mello, 1937	*Chloropsidis jerdoni*	de Mello, 1937
L. eurystomi Kerandel, 1913 (Syn. *L. coraciae bengalensis* de Mello and Affonso, 1935; *L. coraciae* de Mello and Affonso, 1935, emend Bhatia; *L. melloi* Bhatia, 1938)	*Coracias b. benghalensis*	Goa (de Mello and Affonso, 1935)
L. sakharoffi Sambon, 1908	*Dendrocitta vagabunda*	Goa (Nandi and Mandal, 1985)
L. toddi Sambon, 1908	*Accipiter badius dussumieri*	Goa (Nandi and Mandal, 1985)
L. sp.	*Oriolus oriolus kundoo*	Goa (de Mello, 1937)
L. sp.	*Oriolus oriolus xanthornus*	Goa (de Mello, 1937)
L. sp.	*Pycnonotus jocosus*	Goa (Nandi and Mandal, 1985)
L. sp.	*Turdoides striatus sommervillei*	Goa (Nandi and Mandal, 1985)
L. sp.	*Tockus g. griseus*	Goa (Nandi and Mandal, 1985)
	Subclass PIROPLASMIA Order PIROPLASMIDA Suborder PIROPLASMIDEA Family BABESIIDAE Genus ***Babesia*** Starcovici, 1893	
B. canis Piana and Galli-Valerio, 1895 (Syn. *Piroplasma canis*, de Mello *et al.*, 1917)	*Canis familiaris*	Goa (de Mello *et al.*, 1917)
	INCERTAE SEDIS Family ANAPLASMIDAE Genus ***Anaplasma*** Theiler, 1910	
A. sp.	*Perca fluviatilis*	Goa (de Mello *et al.*, 1917)
A. sp.	*Rana tigrina*	Goa (de Mello *et al.*, 1917)
A. sp	*Rana esculenta*	Goa (de Mello *et al.*, 1917)

Parasite	*Host*	Locality (Reference)
A. sp.	*Hemidactylus brooki*	Goa (de Mello *et al.*, 1917)
A. sp.	*Coluber blumenbachi*	Goa (de Mello *et al.*, 1917)
A. sp.	*Naja naja*	Goa (de Mello *et al.*, 1917)
A. sp.	*Chitra indica*	Goa (de Mello *et al.*, 1917)
A. sp.	*Homo sapiens*	Goa (de Mello *et al.*, 1917)
	Genus ***Paraplasma*** Seidelin, 1912	
P. sp.	*Homo sapiens*	Goa (de Mello *et al.*, 1917)
	Genus ***Bertarellia*** Carini, 1930	
B. calotis de Mello and de Meyrelles, 1937	*Calotes versicolor*	Goa (de Mello and de Meyrelles, 1937
B. carinii de Meyrelles, 1938	*Lissemys punctata granosa*	Goa (de Meyrelles, 1938)
B. sp.	*Lissemys punctata granosa*	Goa (de Mello and de Meyrelles, 1937)

HOST-PARASITE LIST

A list of host with their parasites and references is provided hereunder for ready reference.

Host group / species	Parasite	Reference
Phylum CHORDATA Class OSTEICHTHYES		
Clarias batrachus	*Trypanosoma clariae batrachi*	de Mello and Valles, 1936
Perca fluviatilis	*Anaplasma* sp.	de Mello *et al.*, 1917
Thyrsodea macrurus	*Haemogregarina thyrsoideae*	de Mello and Valles, 1936
Class AMPHIBIA		
Bufo melanostictus	*Trypanosona chattoni*	Ray and Choudhury, 1983
	Trypanosona rotatorium	Ray and Choudhury, 1983
Bufo stomaticus	*Trypanosona chattoni*	Ray and Choudhury, 1983
	Trypanosona rotatorium	Ray and Choudhury, 1983
Microhyla ornata	*Trypanosona chattoni*	Ray and Choudhury, 1983
Rana cyamophlyctis	*Trypanosona chattoni*	Ray and Choudhury, 1983
	Trypanosona rotatorium	Ray and Choudhury, 1983
Rana esculenta	*Anaplasma* sp.	de Mello *et al.*, 1917
Rana limnocharis	*Trypanosona chattoni*	Ray and Choudhury, 1983
	Trypanosona rotatorium	Ray and Choudhury, 1983
Rana malabarica	*Trypanosona malabarica*	Ray and Choudhury, 1983
Rana tigrina	*Anaplasma* sp.	de Mello *et al.*, 1917
	Haemogregarina berestneffi	de Mello *et al.*, 1917
	Trypanosona chattoni	Ray and Choudhury, 1983
	Trypanosona rotatorium	Ray and Choudhury, 1983
Rhacophorus maculatus	*Trypanosona chattoni*	Ray and Choudhury, 1983
	Trypanosona rotatorium	Ray and Choudhury, 1983

Host group / species	Parasite	Reference
Rhacophorus malabaricus	*Trypanosona chattoni*	Ray and Choudhury, 1983
	Trypanosona rotatorium	Ray and Choudhury, 1983
Class REPTILIA		
Calotes versicolor major	*Bertarellia calotis*	de Mello and de Meyrelles, 1937
	Karyolysus jorgei	de Mello and de Meyrelles, 1937
Chitra indica	*Anaplasma* sp.	de Mello *et al.*, 1917
Coluber blumenbachi	*Anaplasma* sp.	de Mello *et al.*, 1917
Hemidactylus brooki	*Anaplasma* sp.	de Mello *et al.*, 1917
	Haemogregarina rodriguesi	de Mello *et al.*, 1917
Lissemys punctata granosa	*Bertarellia carinii*	de Meyrelles, 1938
	Bertarellia sp.	de Mello and de Meyrelles, 1937
	Haemogregarina laverani	de Mello, 1932
	Haemogregarina malabarica	de Melo, 1932
	Haemogregarina vittatae	de Mello, 1932
	Haemogregarina xaveri	de Mello, 1932
Naja naja	*Anaplasma* sp.	de Mello *et al.*, 1917
Passerita mycterizans	*Plasmodium passertae*	da Fonseca, 1938
Class AVES		
Accipiter badius dussumieri	*Leucocytozoon toddi*	Nandi and Mandal, 1985
Acridotheres fuscus mahrattensis	*Haemoproteus pastoris*	de Mello, 1936
Aegithina tiphia	*Haemoproteus aegithinae*	de Mello, 1936; Nandi and Mandal, 1985
Anthus rufulus	*Haemoproteus anthi*	de Mello, 1936, 1937
Antigone virgo	*Haemoproteus antigonis*	de Mello, 1936, 1937
Ardea grayi	*Leucocytozoon ardeolae*	de Mello, 1936, 1937
Astur badius dussumieri	*Haemoproteus asturisdussumieri*	de Mello, 1936, 1937
Athene brama	*Haemoproteus noctuae*	de Mello, 1936, 1937
Butastur teesa	*Toxoplasma butasturis*	de Mello, 1936, 1937
Buteo vulpinus	*Trypanosoma* sp.	de Mello, 1936, 1937
Centropus sinensis parroti	*Haemoproteus centropi*	de Mello, 1936, 1937
	Plasmodium relictum	Nandi and Mandal, 1985
	Trypanosoma centropi	de Mello, 1936, 1937
Cerchneis tinnunculus objurgatus	*Haemoproteus* sp.	de Mello, 1936, 1937
Chloropsis aurifrons	*Haemoproteus aegithinae*	de Mello, 1936, 1937
Chloropsidis aurifrons davidsoni	*Leucocytozoon chloropsidis*	de Mello, 1935
	Plasmodium relictum	de Mello, 1935
Chloropsidis jerdoni	*Leucocytozoon enriquesi*	de Mello, 1936, 1937

Host group / species	Parasite	Reference
Columba livia	*Haemoproteus columbae*	de Mello, 1936, 1937
	Toxoplasma columbae	de Mello, 1915
	Trypanosoma hannae	de Mello *et al.*, 1917
Coracias b. benghalensis	*Haemoproteus coraciae*	de Mello and Afonso, 1935
	Leucocytozoon coraciae	de Mello and Afonso, 1935
Coracina novaehollandiae macei	*Haemoproteus tephrodornis*	de Mello, 1936, 1937
Copsychus s. saularis	*Haemoproteus fallisi*	Nandi and Mandal, 1985
	Haemoproteus fringillae	Nandi and Mandal, 1985
	Haemoproteus orizivorae	Nandi and Mandal, 1985
	Trypanosoma moruoni	de Mello, 1936, 1937
	Trypanosoma sp.	Nandi and Mandal, 1985
Corvus splendens	*Haemoproteus* sp.	de Mello *et al.*, 1917
Corvus macrohynchus	*Haemoproteus* sp.	de Mello *et al.*, 1917
Cuculus micropterus	*Trypanosoma cuculi*	de Mello, 1936, 1937
Dendrocita vagabunda	*Haemoproteus danilewskyi*	Nandi and Mandal, 1985
	Leucocytozoon sakharoffi	Nandi and Mandal, 1985
Dicrurus m. macrocercus	*Haemoproteus dicruri*	de Mello, 1937
Elanus caeruleus vociferus	*Haemoproteus elani*	de Mello, 1937
Fulica atra	*Toxoplasma fulicae*	de Mello, 1935
	Trypanosoma fulicae	da Fonseca, 1938
Gallinula chloropus	*Haemoproteus gallinulae*	de Mello, 1936, 1937
	Plasmodium relictum	de Mello, 1935, 1937
Glaucidium radiatum	*Haemoproteus noctuae*	de Mello, 1937
Gymnorhis xanthocollis	*Haemoproteus passeris*	de Mello, 1936, 1937
	Trypanosoma gymnorhidis	de Mello and da Fonseca, 1938
Halcyon s. smyrnensis	*Haemoproteus halcyonis*	Nandi and Mandal, 1985
Halcyon smyrnensis fusca	*Haemoproteus halcyonis*	Nandi and Mandal, 1985
Harpactes fasciatus malabaricus	*Haemoproteus* sp.	Nandi and Mandal, 1985
Herodias intermedia	*Plasmodium herodiadis*	de Mello, 1935
Hypsipetes indicus ictericus	*Haemoproteus sanguinis*	Nandi and Mandal, 1985
Hypsipetes indicus indicus	*Haemoproteus sanguinis*	Nandi and Mandal, 1985
Ixobrychus minuta minuta	*Trypanosoma ixobrychi*	de Mello, 1937
Lanius schach	*Haemoproteus lanii*	de Mello, 1936, 1937
Leptocoma zeylanica	*Haemoproteus raymundi*	de Mello and Raimundo, 1934
Lobivanellus indicus indicus	*Trypanosoma lobivanelli*	de Mello, 1937
Lonchura malabarica	*Haemoproteus orizivorae*	Nandi and Mandal, 1985
	Trypanosoma avium	Nandi and Mandal, 1985
Machlolophus xanthogenys	*Haemoproteus majoris*	de Mello, 1935
Megalaima viridis	*Haemoproteus cormuata*	Nandi and Mandal, 1985
	Haemoproteus thereicerycis	Nandi and Mandal, 1985

Host group / species	Parasite	Reference
Megalaima zeylanica inornata	*Haemoproteus cornuata*	Nandi and Mandal, 1985
Merops o. orientalis	*Haemoproteus meropis*	Nandi and Mandal, 1985
Nycticorax n. nycticorax	*Trypanosoma nycticoracis*	de Mello, 1937
Oriolus oriolus kundoo	*Haemoproteus orioli*	de Mello, 1937
	Leucocytozoon sp.	de Mello, 1937
Oriolus oriolus xanthormus	*Leucocytozoon* sp.	de Mello, 1937
Orthotomus sutorius	*Haemoproteus wenyoni*	de Mello *et al.*, 1917
Otocompsa emeria	*Haemoproteus otocompsae*	de Mello *et al.*, 1917
Otus b. bakamoena	*Haemoproteus* sp.	Nandi and Mandal, 1985
Pastor roseus	*Haemoproteus pastoris*	de Mello, 1937
Platelea leucorodia major	*Haemoproteus plateleae*	de Mello, 1937
Pycnonotus cafer	*Haemoproteus sanguinis*	Nandi and Mandal, 1985
	Leucocytozoon brimonti	Nandi and Mandal, 1985
Pycnonotus jocosus	*Leucocytozoon* sp.	Nandi and Mandal, 1985
	Trypanosoma sp.	Nandi and Mandal, 1985
Streptopelia chinensis	*Haemoproteus columbae*	Nandi and Mandal, 1985
	Trypanosoma sp.	Nandi and Mandal, 1985
Strix ocellata	*Haemoproteus* sp.	de Mello, 1936, 1937
Sturnus malabaricus	*Haemoproteus pastoris*	de Mello, 1936, 1937
Tephrodornis pondiceriana	*Haemoproteus tephrodornis*	de Mello, 1936, 1937
Thereiceryx zeylanicus inornatus. (= *Megalaima zeylanica inornata*)	*Haemoproteus thereicerycis*	de Mello, 1936, 1937
Thereiceryx z. zeylanicus	*Haemoproteus thereicerycis*	de Mello, 1936, 1937
Tockus griseus griseus	*Leucocytozoon* sp.	Nandi and Mandal, 1985
	Trypanosoma sp.	Nandi and Mandal, 1985
Turdoides striatus somervillei	*Haemoproteus* sp.	Nandi and Mandal, 1985
(= *Turdoides sommervillei*)	*Leucocytozoon* sp.	Nandi and Mandal, 1985
	Trypanosoma turdoides	de Mello, 1936, 1937
Upupa epops	*Haemoproteus upupae*	de Mello, 1936, 1937
Class MAMMALIA		
Canis familiaris	*Babesia canis*	de Mello *et al.*, 1917
Homo sapiens	*Anaplasma* sp.	de Mello *et al.*, 1917
	Paraplasma sp.	de Mello *et al.*, 1917
	Plasmodium falciparum	Pers. comm.
	Plasmodium malariae	Pers. comm.
	Plasmodium vivax	Pers. comm.
Lutra lutra	*Plasmodium narayani*	de Mello and Dias, 1936
Manes pentadactyla	*Plasmodium tyrio*	de Melo *et al.*, 1928
Vespertilio muricola	*Plasmodium mackiei*	de Mello and de Sa, 1916

Note : Host names in most cases reflect the scientific names that appeared/ cited by the author.

SYSTEMATIC ACCOUNT

Phylum SARCOMASTIGOPHORA

Subphylum MASTIGOPHORA

Class ZOOMASTOPHOREA

Order KINETOPLASTIDA

Suborder TRYPANOSOMATINA

Family TRYPANOSOMATIDAE

Diagnosis : Body characteristically leaf-like; a single nucleus, a blepharoplast, a flagellum and an undulating membrane present; blepharoplast giving rise to the flagellum; exclusively parasitic; a number of species responsible for serious diseases of man and domestic animals.

Genus ***Trypanosoma*** Gruby, 1843

1843. *Trypanosoma* Gruby, *C. R. Acad. Sci.*, **17** : 1134.

Diagnosis : Body highly flattened, pointed at flagellate end, and bluntly rounded, or pointed at the other; usually pleomorphic; nucleus central; a blepharoplast near aflagellate end; a flagellum arising from the blepharoplast run towards the opposte end, making the outer boundary of the undulating membrane; in most cases flagellum extending freely beyond the body; many with myonemes; multiplication by binary fission; parasitic in the circulatory system of vertebrate; transmitted by blood sucking invertebrate vectors.

Key to the species

A. Key to the species of *Trypanosoma* of fishes

The key to the species is not given since a single species is known from this state.

B. Key to the species of *Trypanosoma* of amphibians

1(4) Body leaf-like

2(3) Trypomastigote form monomorphic, cell body 24 μm × 3.9 μm without striations, nucleus located at the posterior half of the body ..... *T. malabarica*

3(2) Trypomastigote form pleomorphic, cell body 23-24 μm with 2-3 striated myonemes along longitudinal axis, nucleus locted at middle to posterior two-third of the body .... *T. rotatorium*

4(1) Body spherical, 21.8 μm in diameter and 373.6 μm^2 in area ..... *T. chattoni*

C. Key to the species of *Trypanosoma* of birds

As there is considerable disagrement regarding the validity of most of the species of trypanosomes described by de Mello (1935) from Goa State, key to the species is not given. Only two species of trypanosome *viz.*, *Trypanosoma avium* and *T. hannae* are considered valid following Baker (1976).

A. Trypanosoma of fishes

1. ***Trypanosoma clariae batrachi*** de Mello and Valles 1936

1936. *Trypanosoma clariae batrachi* De Mello and Valles, *Proc. Indian Acad. Sci.*, **3** : 120.

1984. *Trypanosoma clariae batrachi* : Mandal, *Tech. Monograph* No. **9** : 9. *Zool. Surv. India.*

Diagnosis : Monomorphic trypanosome with longitudinal striations at the middle and pointed extremities ; posterior end rostrum-like ; cytoplasm irregularly vacuolated with volutin granules in front of the nucleus; cell body measuring 12.5-30.0 μm, with long flagellum of 9-32 μm in length ; nucleus oval, located located at the middle or at the anterior third with compact chromatin granules ; kinetoplast compact, lodged in front by oval alveole; undulating membrane distinct.

Host : *Clarias batrachus* (Linnaeus) ; site of infection : blood.

Distribution : India : Goa (locality not mentioned).

Remarks : de Mello and Valles (1936) described this species from *Clarias batrachus*. Mandal (1984) incorporated this species in his monograph on fish trypanosomes but he could not come across any parasite from the same host materials (10 examples) collected from Molem, Goa.

B. Trypanosoma of amphibians

2. *Trypanosoma chattoni* Mathis and Leger, 1911

1911. *Trypanosoma channai* Mathis and Leger, *C. r. Seanc. Soc. Biol.*, **70** : 956.

1983. *Trypanosoma chattoni* : Ray and Choudhury, *Tech. Monograph* No. **8** : 24. *Zool. Surv. India.*

Diagnosis : Body rounded, spherical, sometimes irregular, measuring 21.8 μm in diameter and 373.6 μm^2 in area with smooth or wrinkled surfaces; cytoplasm deep blue in colour and always containing innumerable metachromatic granules and fine vacuoles; nucleus characteristically circular, measuring 6.6 μm in diameter and 29.2 μm^2 in area, located almost at the centre; kinetoplast very small, circular or elliptical, situated very close to or superimposed upon the surface of the nucleus; flagellum very short, either straight or curved, 4.6 μm in length, sometimes lying in clear narrow canal-like space, emerging from the basal granules adjoining the kinetoplast.

Host : *Bufo melanostictus, Bufo stomaticus, Rana limnocharis, Rana tigrina, Rhacophorus maculatus, Rhacophorus malabaricus, Microhyla ornata*; site of infection : blood.

Distribution : India : Goa (Volpoi, Molem and Bondla).

Remarks : Ray and Choudhury (1983) recorded this parasite in a number of hosts from Goa, indicating multiple choice of anuran hosts belonging to the family Bufonidae, Ranidae, Rhacophoridae and Microhylidae.

3. *Trypanosoma malabarica* Ray and Choudhury, 1983

1983. *Trypanosoma malabarica* Ray and Choudhury, *Tech. Monograph* No. **8**: 32. *Zool. Surv. India.*

Diagnosis : Monorphic trypanosome; cell body slender, elongated and very thin, measuring 24 μm in length excluding free flagellum and 3.9 μm in width; cytoplasm densely granulated, without costae or striations; nucleus small, rounded to oval in structure with a central distinct karyosome and located at the posterior half of the body; kinetoplast dot-like, situated on the posterior end of the body ; free flagellum 18-23.5 (20.0) μm in length ; undulating membrane with 4-7 folds.

Host : *Rana malabarica* (Type host) and *Rana limnocharis* Wiegmann ; site of infection : blood.

Distribution : India : Goa (Volpoi).

Remarks : Ray and Choudhury (1983) recorded this species in *Rana limnocharis* from the same locality as a slightly larger parasite in comparison to those of the type host, *Rana malabarica.*

4. *Trypanosoma rotatorium* (Mayer, 1843)

1843. *Amoeba rotatoria* Mayer, 'Spicilegium observationum anatomicarum de organo electrico in *Ralis anelictricis* et de Haematozois'. Bonnae : Chaussat, 1850. *Des hematozoaires* (Ph. D. Thesis, Paris).

1983. *Trypanosoma rotatorium* : Ray and Choudhury, *Tech. Monograph* No. **8** : 5. *Zool. Surv. India.*

Diagnosis : Pleomorphic trypanosome with slender, 23-24 μm, flat, leaf-like, 28-30 μm and larger, compact, 29-34 μm, forms; cytoplasm densely granular in posterior two-thirds of the body, having 2-3 striated myonemes along longitudinal axis; nucleus usually oval and situated at the posterior half of the body in both slender and leaf-like forms, while spherical or oval with a prominent karyosome and located at the middle of the body in larger compact forms; free flagellum measuring 13.6 μm, 24.6 μm and 6.3 μm in slender, flat leaf-like and larger compact forms respectively.

Host : *Bufo melanostictus, Bufo stomaticus, Rana limnocharis, Rana tigrina, Rhacophorus maculatus, Rhacophorus malabaricus, Microhyla ornata.*

Distribution : India : Goa (Molem, Volpoi and Bondla), West Bengal, Assam, Tripura and Andaman Islands

C. Trypanosoma of birds.

5. *Trypanosoma avium* (Danilewsky, 1885)

1885. *Trypanosoma avium* Danilewsky, *Biol. Zentrabl* **5** 529.

Material examined : A few exs., Molem, 4.x.1977, A. K. Mandal

Diagnosis : Pleomorphic forms measuring 30-55 μm in length; kinetoplast small, elliptical, staining deep red; nucleus round or oval, located at about the middle of the cell body; free flagellum short.

Host : *Lonchura malabarica.*

Distribution : India : Goa, Delhi, Jammu and Kashmir, Andhra Pradesh, West Bengal.

Remarks : It is a cosmopolitan species with worldwide distribution. Nandi and Mandal (1985) reported this species from this state.

6. ***Trypanosoma centropi*** de Mello, 1935

1935. *Trypanosoma centropi* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 500-502.

Diagnosis : Body 18-21 μm in length excluding free flagellum and 4-6 μm in breadth; posterior end pointed and lodging the kinetoplast in a vacuole; nucleus central, roundish, 3-4 μm in diameter and weekly stained; undulating membrane stained deep blue; free flagellum not detected.

Host : *Centropus sinensis parroti*; site of infection : blood.

Distribution : India : Daman (earier under Union Territory of Goa).

Remarks : de Mello (1935) described this speceis from this state.

7. ***Trypanosoma cuculi*** de Mello, 1935

1935. *Trypanosoma cuculi* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 500-502.

Diagnosis : Body 42-49 μm in total length excluding indistinct free flagellum and 6 μm in breadth; posterior extremity ending in a rostrum; cytoplasm alveolar and denser at the anterior half; nucleus central, oval or triangular, located at 15-20 μm away from posterior end; kinetoplast very conspicuous and lodged in a vacuole; undulating membrane ending at the anterior very pointed extremity.

Host : *Cuculus micropterus.*

Distribution : India : Goa (Volpoi).

Remarks : de Mello (1935) described this species based on two specimens, one found in a blood smear and the other in a lung smear. The species was originally written "*T. cuculli*", based on mis-spelling of host's name, but Baker (1976) corrected it as an inadvertant error according to the International Code of Zoological Nomenclature, article 32(a) (ii).

8. ***Trypanosoma fulicae*** da Fonseca, 1938

1938. *Trypanosoma fulicae* da Fonseca, *Arch. Esc. Med. Cirug.*, **12** : 315-317.

Diagnosis : Not available.

Host : *Fulica atra.*

Distribution : India : Goa.

Remarks : This species is described by da Fonseca (1938) from this state.

9. ***Trypanosoma gymnorhidis*** de Mello and da Fonseca, 1938

1938. *Trypanosoma gymnorhidis* de Mello and da Fonseca, *Proc. Indian Acad. Sci.*, **6B** : 213-219.

Diagnosis : Not available.

Host : *Gymnorhidis* (= *Petronia*) *xanthocollis.*

Distribution : India : Goa.

Remarks : This species is described by de Mello and da Fonseca (1938) from this state.

10. ***Trypanosoma hannae*** Pittaluga, 1905

1905. *Trypanosoma hannae* Pittaluga, *Rev. Real Acad. Cienc. Exac. Fis. Nat. Madrid*, **2** : 331-379.

1917. *Trypanosoma hannai* : de Mello, de Sa, de Sousa, Dias, and Noronha, *Ann. Sci. (Faculd. Med.) Porto*, **3** : 5-24.

Diagnosis : Not available.

Host : *Columba livia.*

Distribution : India : Goa

Remarks : According to Baker (1976), the species name often unjustifiably emended to "*T.*

hannai" as article 32 (a) (ii) states that "improper latinization (and certain other mal formations) are not to be considered inadvertant errors" De Mello *et al.* (1917) recorded this species from this state.

11. ***Trypanosoma ixobrychi*** de Mello, 1935

1935. *Trypanosoma ixobrychi* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 500-502.

Diagnosis : Mostly trypomastigote forms, measuring 22-25 μm x 4-10 μm; anterior end as a short truncated tail-like appendage of 3-10 (5) μm and posterior end very pointed; kinetoplast, a very syderophyl chromatic dot, located at 1-2 μm away from the posterior end, staining dark violet surrounded by a white halo constituting the vacuole; axoneme bordering the undulating membrane appearing like a dark blue line and not taking any chromatic tinge; cytoplasm alveolar, staining light blue; nucleus subcentral, situated at 7-20 (11.8) μm away from the posterior end, containing a large karyosome and surrounded by a clear membrane; no volutin granules but with a small chromatic body in some specimens.

Host : *Ixobrychus m. minuta* Linn.; site of infection : blood.

Distribution : India : Goa (Diu).

Remarks : This species is described by de Mello (1935) from this state.

12. ***Trypanosoma lobivanelli*** de Mello, 1935

1935. *Trypanosoma lobivanelli* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 500-502.

Diagnosis : Dimorphic represented as Type I and Type II forms; *Type I* forms narrow, 23-25 μm excluding free flagellum and 3.5-4.5 μm in breadth; with terminal kintoplast surrounded by a small clear zone corresponding to the lodging in vacuole; posterior end pointed; nucleus central with distinct nuclear membrane; cytoplasm with minute alveoles; undulating and free flagellum, 6-7 μm in length, faintly visible; Type II forms smaller, 18-20 μm, but broader, 5.5-6.0 μm, with subterminal kinetoplast lodged in a distinct vacuole; cytoplasm with large alveoles; other characteristics as in Type I.

Host : *Lobivanellus indicus indicus.*

Distribution : India : Goa (Diu).

Remarks : This species is described by de Mello (1935) from this state.

13. ***Trypanosoma moruni*** de Mello, 1937

1937. *Trypanosoma moruni* de Mello, *C. R. 12th Int. Congr. Zool.*, **2** : 1391-1445

Diagnosis : Body 37-61 μm in length excluding free flagellum, not homogenous in constitution and with some longitudinal bands; nucleus 5-6 μm in diameter, located in the middle, very clear and generally triangular; kinetoplast strongly stained and surrounded by a vacuole, situated very far from the posterior extrmity; posterior end rostrum-like; undulating membrane with its anterior part very prominent and spindle-shaped; free flagellum, 7-8 μm in length, very slender and generally almost invisible.

Host : *Copsychus saularis.*

Distribution : India : Goa (Taleigao).

Remarks : This species is described by de Mello (1937) from this state.

14. ***Trypanosoma nycticoracis*** Stephens and Christophers, 1908

1908. *Trypanosoma nycticoracis* Stephens and Christophers, *The Practical Study of Malaria and Other Blood Parasites*, 3rd. ed., University Press, Liverpool

1937. *Trypanosoma nycticoracis* de Mello, *C. R. 12th Int. Congr. Zool.*, **2** : 1391-1445.

Diagnosis : Polymorphic, narrow forms and stout forms, measuring 16-22 μm × 5-8 μm; cytoplasm alveolar; kinetoplast terminal, lodged in a vacuole; nucleus central; undulating membrane bordered by axoneme; free flagellum 6-8 μm in length, very slender but clearly distinguishable.

Host : *Nycticorax n. nycticorax.*

Distribution : India : Goa.

Remarks : This species is reported by de Mello (1937) from this state, presuming it as the same that described by Stephens and Christophers (1908).

15. ***Trypanosoma turdoidis*** de Mello, 1935

1935. *Trypanosoma turdoidis* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 500-502.

Diagnosis : Body 20-22 μm in length excluding free flagellum and 10-12 μm in breadth; posterior end rostrum-like and lodging a conspicuous kinetoplast, situated a little forward; nucleus oval, with chromatic masses collected irregularly around the membrane; undulating membrane ending by a very slender flagellum; free flagellum 5-7 μm in length.

Host : *Turdoides sommervillei* Sykes; site of infection : blood.

Distribution : India : Goa (Old Goa).

Remarks : de Mello (1935) originally described this parasite as a new species from this state.

16. ***Trypanosoma*** sp.

Diagnosis : Body 30-40 μm in length without free flagellum and 3.0-3.5 μm in breadth; posterior end very pointed and rostrum-like; kinetoplast surrounded by a very narrow, sometimes almost indistinct, vacuole, located 3.5-4.0 μm from the extremity; nucleus rather subcentral, circular or ovoid; undulating membrane very slender, distinctly visible; free flagellum 6-10 μm in length.

Host : *Buteo vulpinus.*

Distribution : India : Goa (Daman).

Remarks : de Mello (1937) reported this unnamed species from Daman (earlier under union territory of Goa).

17. ***Trypanosoma*** sp.

Host : *Copsychus saularis saularis.*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) recorded this unnamed species from this state.

18. ***Trypanosoma*** sp.

Host : *Pycnonotus jocosus.*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) recorded this unnamed species from this state.

19. ***Trypanosoma*** sp.

Host : *Streptopelia chinensis.*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) recorded this unnamed species from this state.

20. ***Trypanosoma*** sp.

Host : *Tockus griseus griseus.*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) recorded this unnamed species from this state.

Phylum APICOMPLEXA

Clas SPOROZOEA

Subclass COCCIDIA

Oder EUCOCCIDA

Suboredr ADELEINA

Family TOXOPLASMATIDAE

Genus ***Toxoplasma*** Nicolle and Manceaux, 1908

Diagnosis : Euryxenous parasite, small, elongated, slightly curved with a central nucleus, producing pseudocyst; meronts in many types of cell; host cell nucleus outside meront wall; reproducing by endodyogeny.

Remarks : The species dealt herein are of doubtful validity and as such no key is provided.

21. ***Toxoplasma butasturis*** de Mello, 1937

1937. *Toxoplasma butaturis* de Mello, *C. R. 12th Congr. Int. Zool.*, **2** : 1391-1445.

1938. *Toxoplasma butasturis* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London, : 203.

Diagnosis : Parasite small, resembling ring forms; larger schizonts with somewhat distinct nuleus, showing division by binary fission; often with two or more parasites in one host cell.

Host : *Butastur teesa.*

Distribution : India : Goa.

Remarks : de Mello (1937) reported this species from this state.

22. ***Toxoplasma columbae*** Yakimoff and Kohl-Yakimoff, 1912
(Syn. *Haemogregarina francae* de Mello, 1915; *Leucocytogregarina francae* de Melo *et al.*, 1917)

1912. *Toxoplasma columbae* Yakimoff and Kohl-Yakimoff, *Arch. Inst. Pasteur Tunis*, **6** : 198.

1938. *Toxoplasma columbae* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa*. Taylor and Francis, London, : 204.

Diagnosis : Parasite circular, small or large forms, 3-7 μm in size, occurring in mononuclear leucocytes; nucleus strongly refringent in fresh condition, appearing a brilliant red when stained with Giemsa's stain; cytoplasm clear and faintly blue; schizogony in hepatic cells, rarely in the peripheral blood and bone marrow; sporogony unknown.

Host : *Columba livia.*

Distribution : India : Goa.

Remarks : This species is reported by de Mello (1915, 1935, 1937) from this state.

23. ***Toxoplasma fulicae*** de Mello, 1935

1935. *Toxoplasma fulicae* de Mello, *Proc. Indian Acad. Sci.*, **1B** : 735-739.

1938. *Toxoplasma fulicae* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa*. Taylor and Francis, London : 206.

Diagnosis : Parasite free or inside endothelial cells or mononuclear leucocytes; young intracellular stages ovoid, fusiform or falciform; large ovoid full grown forms occupying most of the host cell, but not invading host cell nucleus; schizonts showing sexual differentiation in staining reaction ; multiplication by binary fission.

Host : *Fulica atra* (in lung smears).

Distribution : India : Goa.

Remarks : This species is reported by de Mello (1937) from this state.

Family HAEMOGREGARINIDAE

Diagnosis : Oocysts producing sporoblasts, each of which develop into a spore with 2 or 4 sporozoites; life cycles in two hosts, occurring in the circulatory system of vertebrates and in the digestive system of invertebrates.

Genus ***Haemogregarina*** Danilewsky, 1885

Diagnosis : Oocysts small, with 8 or more naked sporozoites without sporocysts; infection of vertebrate host by the bite of an invertebrate; schizogony in erythrocytes of vertebrates; merogony in internal organs of cold blooded vertebrates; sporogony in invertebrates; no sporokinetes.

Remarks : Only key to the species of reptilian haemogregarines is furnished as both piscean and amphibian haemogregarinres are represented by single species.

Key to the species of *Haemogregarina* from reptiles

1(2) Parasitic in lizards

a) Gametocytes capsulated, occurring in two forms, elongate and stumpy forms ..... *H. rodriguesi*

2(1) Parasitic in turtles

3(4) Gametocytes monomorphic, reniform, with two large refringent ovoid granules ..... *H. laverani*

4(3) Gametocytes dimorphic

5(6) Relatively smaller in dimension, vermicular and broadly oval or reniform, and with considerably shorter tail ..... *H. xaveri*

6(5) Relatively large in dimension

a) Vermicular form (17-22 μm) and reniform or bean-shaped (8-12 μm), and with a long caudal appendage ..... *H. malabarica*

b) Broad massive form and recurved form (22-26 μm) with two limbs equally long ..... *H. vittatae*

A. ***Haemogregarina*** of fishes

24. ***Haemogregarina thyrsoidae*** de Mello and Valles, 1936

1936. *Haemogregarina thyrsoideae* de Mello and Valles, *Proc. Indian acad. Sci.*, **4** : 403-404.

Diagnosis : Ovoid with conspicuous nucleus and cytoplasm staining blue in youngest form; full grown parasite elongated, somewhat sausage-shaped, with irregular vacuolization of the cytoplasm and generally central nucleus; nucleus often divided into two or more irregular masses; nuclear membrane indistinct and volutin granules minute; nucleus composed of two nuclear masses located at one pole; sometime two nuclear masses situated one at each pole.

Host : *Thyrsoidea macrurus.*

Distribution : India : Goa.

Remarks : This species is described by de Mello and Valles (1936) from this state.

B. ***Haemogregarina*** of amphibians

25. ***Haemogregarina berestneffi*** Castellani and Willey, 1905

1905. *Haemogregarina berestneffi* Castellani and Willy, *Quart. J. Microsc. Sci.*, **49** : 383-402.

1938. *Haemogregarina berestneffi* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London : 119.

Diagnosis : Intra-corpuscular forms varying in shapes and sizes, often with a characteristic pink-staining sheath; free gregariniform parasites motile in blood plasma; parasite embracing the displaced host cell nucleus like a halteridium, lying with both ends rounded and curved within a strongly refringent colourless capsule.

Host : *Rana tigrina* Daud.; site of infection : blood.

Distribution : India : Goa, Maharashtra, Tamil Nadu.

Elsewhere : Sri Lanka.

Remarks : This species is known to occur in three species of frogs *viz.*, *Rana tigrina*, *R. limnocharis*, *R. hexadactyla.* de Mello *et al.* (1917) recorded this species from this state.

C. ***Haemogregarina*** of reptiles

26. ***Haemogregarina laverani*** Simond, 1901

1901. *Haemogregarina laverani* Simond, *Ann. Inst. Pasteur*, **15** : 319-351.

1932. *Haemogregarina laverani* : de Mello : *Arch. Esc. Med.-Cirurg. Nova Goa* (Ser. A), **8** : 1411-1425.

1939. *Haemogregarina laverani* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London : 122.

Diagnosis : Parasite amoeboid, 3 μm in diameter in young stage, usually vermicular, 17-22 μm in length, consisting of a sausage-shaped body with a caudal appendages applied to the body along its concave border; nucleus situated at pole and on the convex border having thicker protoplasm; body filled with metachromatic granules; parasitized corpuscles hypertrophied; reniform parasite with central nucleus, measuring 8-12 μm in length, vacuolated at poles and occurring in smaller number; schizogony taking place in the liver resulting in both large and small merozoites.

Host : *Lissemys punctata granosa* (Schoepff).

Distribution : India : Goa

Remarks : This species is described by de Mello (1932) from this state.

27. ***Haemogregarina malabarica*** de Mello, 1932

1932. *Haemogregarina malabarica* de Mello, *Arch. Esc. Med.-Cirurg. Nova Goa* (Ser. A), **8** : 1411-1425.

1938. *Haemogregarina malabarica* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London : 124.

Diagnosis : Parasite usually vermicular, 17-22 μm in length, consisting of a sausage-shaped body with a caudal appendages applied to the body along its concave border; nucleus situated at pole and on the convex border having thicker protoplasm; body filled with metachromatic granules ; parasitized corpuscles hypertrophied; reniform parasite with central nucleus, measuring 8-12 μm in length, vacuolated at poles and

occurring in smaller number; schizogony taking place in the liver resulting in both large and small merozoites.

Host : *Lissemys punctata granosa* (Schoepff).

Distribution : India : Goa

Remarks : This species is described by de Mello (1932) from this state.

28. ***Haemogregarina rodriguesi*** de Mello *et al.*, 1917

1917. *Haemogregarina rodriguesi* De Mello, de Sa, De Sousa, Dias, and Noronha, *Ann. Sci. (Faculd. Med.) Porto*, **3** : 5-24.

1938. *Haemogregarina rodriguesi* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London, : 134.

Diagnosis : Parasite with a large clear capsule and one or two vacuoles in the centre; occurring in two forms, elongate or shorter and stumpy forms; short stumpy forms equally broad at both poles, and having a less extensive capsule; parasite nucleus large, elongated, rectangular, compact, rarely vesicle-like, located at one or other extremity; occupying a large part of the parasite; extra-corpuscular parasite gregariniform.

Host : *Hemidactylus brooki* Gray.

Distribution : India : Goa.

Remarks : This species is described by de Mello *et al.* (1917) from this state.

29. ***Haemogregarina vittatae*** Robertson, 1908

1908. *Haemogregarina vittatae* Robertson, *Spolia Zeylanica*, **5** : 178-185.

1938. *Haemogregarina vittatae* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London, : 139.

Diagnosis : Parasite dimorphic such as broad massive form and recurved form with pale cytoplasm; broad form possessing reticulate dense cytoplasm and somewhat delicate loose nucleus, larger parasites with two plastid-like bodies at one end; recurved form, 22-26 μm in total length, usually with two limbs equally long and with dense nucleus; schizogony occurring in spleen and liver, producing eight merozoites enclosed in a delicate boat-shaped capsules in pairs.

Host : *Lissemys punctata granosa.*

Distribution : India : Goa.

Elsewhere : Sri Lanka.

Remarks : This species is reported by de Mello (1932) from this state.

30. ***Haemogregarina xaveri*** de Mello, 1932

1932. *Haemogregarina xaveri* de Mello, *Arch. Esc. Med.-Cirurg. Nova Goa* (Ser. A), **8** : 1411-1431.

1938. *Haemogregarina xaveri* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London, : 140.

Diagnosis : Dimorphic forms such as broadly oval or reniform and elongate or vermicular form. Oval form, 7.5-13.5 μm × 2.5-6.2 μm, with alveolar cytoplasm, containing two or more rounded vacuoles at poles; nucleus central with granules or rods of chromatin, compact or variously dispersed; parasitized corpuscles generally not altered; parasitized cell nucleus displaced to one side. Elongate form, 9-10 μm × 4 μm, with or without capsule, possessing occasionally a tail-like structure; cytoplasm alveolar, sometimes with one or two indistinct vacuoles at one pole; schizogony in lungs, spleen, liver etc.

Host : *Lissemys punctata granosa.*

Distribution : India : Goa

Remarks : This species is described by de Mello (1932) from this state.

Genus ***Karyolysus*** Labbe, 1894

Diagnosis : Sporogony in the gut-epithelium of a mite, producing an oocyst with a number of sporoblasts; vermiform sporokinete entering host ova; spores in the gut epithelium discharged in faeces, swallowed by lizards; liberated sporozoites entering endothelial cells to initiate schizogony; merozoites entering erythrocytes to become gametocytes.

Remarks : The very name *Karyolysus* indicates that the host cell nucleus is karyolysed and

fragmented. This character can not be regarded as of generic significance.

31. ***Karyolysus jorgei*** de Mello and de Meyrelles, 1937

1937. *Karyolysus jorgei* de Mello and de Meyrelles, *Proc. Indian Acad. Sci.*, **5B** : 119-141.

1938. *Karyolysus jorgei* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa*. Taylor and Francis, London : 155-156.

Diagnosis : Gametocytes elongate oval, 5–11 μm × 1.5–2.5 μm, sexually differentiated, marked by strong limiting membrane, having a large central nucleus, a smaller paranuclear body and polar capsule-like structure, occurring in erythrocytes; endoglobular cycle in the capillary circulation; merozoites invading the endothelial cells of lungs and liver, producing microcysts; sporogony unknown.

Host : *Calotes versicolor major.*

Distribution : India : Goa.

Remarks : This species is described by de Mello and de Meyrelles (1937) from this state.

Suborder HAEMOSPORINA

Family PLASMODIIDAE

Diagnosis : Pigmented gametocytes in mature erythrocytes; asexual cycles in blood cells and tissues of vertebrate host; sexual cycles in mosquito.

Genus ***Plasmodium*** Marchiafava and Celi, 1885

Diagnosis : Asexual stages (trophozoites, schizonts, etc.) and gametocytes, round or elongated, forming haemozoin pigment; exoerythrocytic schiziogony in various internal organs; sexual reproduction in Culicidae.

Remarks : Key to the species of human malaria may be consulted from earlier State Fauna Series (Das *et al.*, 1993; Nandi *et al.*, 2004), while most of the other plasmodial species require review/ further study. However, *Plasmodium* species may be consulted from Garnham (1966), Greiner *et al.* (1975) Bennett *et al.* (1993) for more information.

A. ***Plasmodium*** of reptiles

32. ***Plasmodium passertae*** de Mello and da Fonseca, 1938

1938. *Plasmodium passertae* de Mello and da Fonseca, *Proc. Indian Acad. Sci.*, **7** : 47-48.

1938. *Proteosoma passertae* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa*. Taylor and Francis, London, : 388.

Diagnosis : Ring form measuring 1-3 μm, with small dots of pigments scattered all over the body and with compact or more or less vacuolated cytoplasm; schizonts minute, pyriform or amoeboid, devoid of pigment, chromatin forming 2-4 merozoites, usually 3-4 μm in size and arranged in cross-like manner; infected red corpuscles unaltered.

Host : *Passerita mycterizans.*

Distribution : India : Goa.

Remarks : This species is reported by de Mello and da Fonseca (1938) from the green snake. According to Bhatia (1938) apart from pigmented ring stage, the parasite bears striking resmblances with *Babesia quadrigemina*. Laird (1960) refers that this parasite, if it is indeed a true *Plasmodium*, represents *Plasmodium minasense* in a different host. Garnham (1966) considers that this parasite was probably a *Haemoproteus* or a piroplasm. As such, this species is considered herein as *species inquernda* until further study.

B. ***Plasmodium*** of birds

33. ***Plasmodium herodiadis*** de Mello, 1935

1935. *Plasmodium herodiadis* de Mello, *Proc. Indian Acad. Sci.*, 1B : 349-358.

1938. *Proteosoma herodiadis* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa*. Taylor and Francis, London, : 252.

Diagnosis : Ring stage with a granular or rod-like chromatinic dot; older trophozoite pyriform or rounded, with irregularly scattered brownish-black pigment; rosette with 5-10 chromatinic

bodies; male gametocytes roundish, with a larger, irregular nucleus; female gametocytes somewhat oval, with a round nucleus; parasitized erythrocytes almost unaltered.

Host : *Egretta intermedia intermedia* Wagler.

Distribution : India : Goa.

Remarks : This species is reported from this state by de Mello (1935). Bhatia (1938) reported it as *Proteosoma herodiadis*. Greiner *et al.* (1975) considered it as a *species incertae sedis*.

34. ***Plasmodium relictum*** (Grassi and Feletti, 1891)

1891. *Haemamoeba relicta* Grasi and Feletti, *Bull. mens. Acad. gioania Sci. nat. Catania*, **16** : 16.

1966. *Plasmodium relictum* (Grassi and Feletti) : Garnham : *Malaria Parasites and other Haemosporidia*, Blackwell Scientific Publications, Oxford, : 522.

Diagnosis : Ring forms commonly occurring in immature red cells; fully formed segmenters with 8-32 merozoites; gametocytes round or oval, erythrocytic stages in peripheral blood, pigment fine, dot-like, host-cell nucleus markedly displaced or expelled by mature forms; periodicity variable, usually with high parasitemia and relatively high mortality.

Host : *Centropus sinensis* (Family : Cuculidae) and *Chloropsidis aurifrons* (Irenidae).

Distribution : India : Goa, West Bengal.

Elsewhere : Cosmopolitan.

Remarks : This species is not reported as *Plasmodium relictum* as such from this state. But de Mello (1935, 1936) recorded two new species *viz.*, *Plasmodium centropi* and *Pkasmodium chloropsidis* from erstwhile Portuguese India (now Goa State) which are synonymised with *Plasmodium relictum* by Garnham (1966).

C. ***Plasmodium*** of mammals

35. ***Plasmodium mackei*** de Mello and de Sa, 1916

1916. *Plasmodium mackiei* de Mello and de Sa, *Indian J. Med. Res.*, **2B** : 731-737.

Diagnosis : Young parasite bacillary forms, precocious division of chromatin; constancy of six merozoites in the roseta; circular ovoid-shaped gametocyte.

Host : *Vespertilio muricola*.

Distribution : India : Goa.

Remarks : This malarial parasite of *Vespertilio* is recorded by de Mello and de Sa (1916) from this state. The parasite is considered herein as *species inquirenda*.

36. ***Plasmodium narayani*** de Mello and Dias, 1936

1936. *Plasmodium narayani* de Mello and Dias, *Proc Indian Acad. Sci.*, **3B** : 212-213, 377.

1966. *Plasmodium narayani* : Garnham : *Malaria Parasites and other Haemosporidia*, Blackwell Scientific Publications, Oxford, : 994.

Diagnosis : Parasites very scanty; ring stage pyriform or fusiform; trophozoites triangular, rarely with a few black pigments; later stage becoming round, more heavily pigmented and with divided nuclei; rosette showing 12 "merozoites" and a few specks of pigment; in lung smear; female gametocytes small oval in shape, with irregularly distributed pigment granules or rods; infected erythrocytes slightly hypertrophied and dehaemoglobinized, sometimes contained double infections.

Host : *Lutra lutra*.

Distribution : India : Goa.

Remarks : This species is reported by de Mello and Das (1928). The presence of pigment granules suggests the malarial origin of the parasite. However, further studies are needed to confirm its identity.

37. ***Plasmodium tyrio*** de Mello, Fernandes, Correio and Lobo, 1928

1928. *Plasmodium trio* de Mello, Fernandes, Correio and Lobo, *Bull. Soc. Path. Exot.*, **21** : 205-206.

1966. *Plasmodium tryio* de Mello, Fernandes, Correio and Lobo : Garnham : *Malaria Parasites and other Haemosporidia*, Blackwell Scientific Publications, Oxford : 995-996.

Diagnosis : Young trophozoite circular or oval, very regular; fusiform or aberrant forms rare; ring forms showing early division of nucleus into 2 or 3 granular masses united together; schizonts irregular, not encroaching the entire area of the corpuscle; pigment granules large and black, appearing irregularly in the cytoplasm of the parasite; merozoites 4 to 8 in numbers; gametocytes spherical or ovoid; male gametocytes almost devoid of pigment, dispersed in the form of fine dark granules round the nucleus when present; female gametocytes having a more deeply staining cytoplasm, smaller nucleus and large black pigment granules.

Host : *Manes pentadactyla.*

Distribution : India : Goa.

Remarks : This parasite is reported by de Mello *et al.* (1928) from peripheral blood, and also in liver and lungs smears of the anteater popularly known as the "Trio" The presence of pigment and the division of the schizont indicate it to be a malarial parasite, Further studies are needed to confirm its identity as according to Garnham (1966) the illustrations are more suggestive of a *Nuttalliia.*

D. ***Plasmodium*** of man

38. ***Plasmodium falciparum*** (Welch, 1897)

1897. *Haematozoon falciparum* Welch, *Syst. Pract. Med.*, **1** : 17.

1966. *Plasmodium falciparum* (Grassi and Feletti) : Garnham : *Malaria Parasites and other Haemosporidia*, Blackwell Scientific Publications, Oxford, : 357.

Diagnosis : Small ring forms with double dots of chromatin; usually with crescentic gametocytes, macrogametocyte 12-14 μm long; trophozoite compact, rarely seen in peripheral blood; schizont irregular in form, 5 μm in diameter, 8-32 merozoites, irregularly arranged filling half to two-third the erythrocyte, with early clumping of coarse dark pigments, rarely occur in peripheral circulation.

Host : *Homo sapiens.*

Distribution : India : Goa and in almost all over India (Knowles, Senior White and Das Gupta, 1930; Bhatia, 1938; pers. comm.). This species is mainly distributed in tropics and subtropics.

Remarks : This species causes malignant tertian malaria and is known as the greatest killer of human race over most parts of Africa and elsewhere in the tropics (Garnham, 1966).

39. ***Plasmodium malariae*** (Grassi and Feletti, 1892)

1892. *Haemamoeba malariae* Grassi and Feletti, *Atti. Acad. Zioenia Sci. nat. Catania*, Memoir, **5** : 1-80.

1966. *Plasmodium malariae* (Grassi and Feletti) : Garnham : *Malaria Parasites and other Haemosporidia*, Blackwell Scientific Publications, Oxford, : 257.

Diagnosis : 'Ring' form, one in each red cells; trophozoite compact, often band-like, schizont rounded, 7 μm in diameter, nearly filling the erythrocyte, 6-12 merozoites, typically arranged in circle; schizogony in 72 hours; gametocyte round or ovoid, 9 μm in diameter, with brown-black pigments.

Host : *Homo sapiens.*

Distribution : India : Goa and all over India (Bhatia, 1938; pers. comm.).

Remarks : This species causes quartan malaria in man. It is not very pathogenic, but chronic infection may lead to a lethal kidney condition.

40. ***Plasmodium vivax*** (Grassi and Feletti, 1890)

1890. *Haemoeba vivax* Grassi and Feletti, *Arch. ital. Biol.*, **13** : 297.

1966. *Plasmodium relictum* (Grassi and Feletti) : Garnham : *Malaria Parasites and other Haemosporidia*, Blackwell Scientific Publications, Oxford, : 116.

Diagnosis : Ring froms large about one-third diameter of erythrocyte, round or oval, usually one in each red cell; trophozoite amoeboid; schizont irregular, filling half to two-third the erythrocyte; schizogony usually at interval of 48 hours, 12-24 merozoites in irregular grape-like cluster, with small brown pigment granules usually collected in a single mass; gametocyte large, round or ovoid, 10 μm in diameter; host erythrocyte

enlarged, stippled with red dots known as Schuffner's dots.

Host : *Homo sapiens.*

Distribution : India : Goa and all over India (Bhatia, 1938; pers. comm.). This species is worldwide in distribution, occurring mainly in tropics, subtropics and warmer temperate regions (Knowles *et al.*, 1930; Garnham, 1966).

Remarks : This species causes benign tertian malaria in man and is the commonest and the most widely distributed species.

Family HAEMOPROTEIDAE

Diagnosis : Pigmented gametocytes in erythrocytes of the circulating blood, asexual cycle in tissue cells of the vertebrate host; sexual phase in insects other than mosquitoes.

Genus ***Haemoproteus*** Kruse, 1890

1890. *Haemoproteus* Kruse, *Mitt. Virchows Archiv.*, **121** : 359-372.

Diagnosis : Pigmented gametocytes in erythrocytes, usually halter-shaped, partly encircling the host cell nucleus; schizogony in the internal organs, lung, liver, kidney capillary endothelium etc.; sporogony in Hippoboscidae and Ceratopogonidae; oocysts either large with more than 500 short sporozoites or small with less than 50 relatively large sporozoites; usually in birds and also other vertebrates.

Remarks : Avian haemoproteids are studied and reviewed at the host family level. Bennett and his co-researchers (1972 onwards) made valuable contribution towards taxonomic review of haemopriteids for many avian host families. Levine and Campbell (1971) and subsequently Bennett *et al.* (1994) have made useful checklist to deal with avian haemosporidan species. Herein, the species that are well reviewed are brought under key to the species following morphological forms and features given in the annotated checklist of Bennett and Peirce (1988). The haemoproteid species *viz.*, *Haemoproteus asturidussumieri*, *H. raymundi* and *H. tephrodornis* are not included in the key to the species.

Key to the species of *Haemoproteus* in birds

1(18) Parasites normally circumnuclear or halteridial

a) Parasites with outline entire, pigment granules averaging 23 in number, parasitic in the avian family Corvidae .... *H. danilewskyi*

2(3) Parasites circumnuclear, with outline amoeboid and 13 pigment granules, occupying approximately 75% of the erythrocyte-parasite complex, occurring in the avian family Strigidae..... *H. noctuae*

3(2) Parasites not circumnuclear, but halteridial

4(7) Halteridial parasites, with marked displacement of host cell nucleus

5(6) Parasites occupying 70% or more of the host cell-parasite complex

a) Pigment granules 10-15 in number, parasitic in the avian family Estrildidae .... *H. orizivorae*

b) Pigment granules averaging 16 in number, parasitic in the avian family Irenidae .... *H. aegithinae*

c) Pigment granules averaging 14 in number, parasitic in the avian family Cuculidae ... . *H. centropi*

d) Pigment granules averaging 12 in number, occurring in the avian family Laniidae.... ..... *H. lanii*

6(5) Parasites occupying about 50-70% of the host cell-parasite complex,

a) Pigment granules 6-9 in number, occurring in the avian family Sturnidae .... *H. pastoris*

b) Pigment granules averaging 12 in number, occurring in the avian family Accipitridae ..... *H. elani*

c) Pigments in granules or clusters, irregularly distributed, parasitic in the avian family Upupidae ..... *H. upupae*

d) Pigments 24 granules per parasite, randomly distributed, occurring in the avian family Alcedinidae ..... *H. halcyonis*

7(4) Halteridial parasites, without marked displacement of host cell nucleus

8(15) Parasites with outline entire

9(10) Halteridial or broadly sausage-shaped parasites, occupying about 75% of the host cell-parasite complex

a) Pigments averaing 31 granules per parasite, parasitic in the avian family Capitonidae ..... *H. thereicerycis*

b) Pigments averaing 11 granules per parasite, parasitic in the avian family Motacillidae ..... *H. anthi*

c) Pigments averaging 8 granules per parasite, parasitic in the avian family Paridae..... ..... *H. majoris*

10(9) Parasites not broadly sausage-shaped, occupying less than 75% of the host cell-parasite complex

11(14)Parasites occupying 65-75% of the host cell parasite complex

12(13) Parasites with inner lateral margins invaginated to form a pair of "horns" pigments small, scattered, averaging 28 in number per parasite, parasitic in the avian family Capitonidae ..... *H. cornuata*

13(12) Parasites without any 'horns"

a) Pigments averaging 13 granules per parasite, parasitic in the avian family Passeridae ..... *H. passeris*

b) Pigments averaging 19 granules per parasite, parasitic in the avian family Gruidae ..... *H. antigonis*

c) Pigments averaging 21 and 14 granules per macro- and microgametocyte respectively, parasitic in the avian family Oriolidae .... *H. orioli*

d) Pigments averaging 24 granules per parasite, parasitic in the avian family Muscicapidae (Subfamily Sylviinae) .... *H. wenyoni*

14(11)Parasites occupying about 50-65% of the host cell parasite complex

a) Pigments averaging 32 granules per parasite, parasitic in the avian family Rallidae ..... *H. gallinulae*

b) Pigments averaging 30 granules per parasite, parasitic in the avian family Columbidae ..... *H. columbae*

c) Pigments averaging 15 granules per parasite, parasitic in the avian family Dicruridae ..... *H. dicruri*

d) Pigments averaging 15 granules per parasite, parasitic in the avian family Pycnonotidae ..... *H. sanguinis*

15(8) Parasites with amoeboid or entire outline

16(17)Immature parasite amoeboid, mature entire, about 8 pigment granules per parasite, parasitic in the avian family Coraciidae .. .. *H. coraciae*

17(16) Parasites usually entire, sometimes amoeboid, averaing 14 pigment granules per parasite, parasitic in the avian family Meropidae ..... *H. meropis*

18(1) Parasites microhalteridial,

a) Parasites bilobed, outline entire, parasitic in the avian family Fringillidae .... *H. fringillae*

b) Parasites small, not bilobed, outline with amoeboid poles, parasitic in the avin family Muscicapidae (Subfamily Turdinae) .... *H. fallisi*

41. ***Haemoproteus aegithinae*** de Mello, 1937

1937. *Haemoproteus aegithinae* de Mello, *C. R. 12th Int. Congr. Zool.*, **2** : 1391-1445.

1990. *Haemoproteus aegithinae* : Bennett and Peirce, *J. nat. Hist.*, **24** : 939-947.

Type materials : *Neohapantotype* : Blood film No. 37408 from *Aegithina tiphia* (Linnaeus), Coll. H. E. McClure, Maharashtra, India, 24.vii.1969;

Parahapantotype : Blood film No. 11727 from *Chloropsis aurifrons* (Temminck), Coll. H. E. McClure, Chiang Mai, Thailand, 14.v.1964.

Materials examined : Sev. exs., Molem, 4.x.1977, A. K. Mandal.

Diagnosis : Macrogametocytes halteridial, medium-sized, 15.1 (1.3) μm x 2.7 (1.6) μm and 45.4 (4.2) μm^2 in area, occupying 60-70% of host erythrocyte; margins entire; frequently appearing dumbbell-shaped due to narrowing of the portion of parasite adjacent to the erythrocyte nucleus; cytoplasm finely granular; parasite nucleus compact, central to sub-cetral in location and frequently appressed to the outer wall of the parasite; host erythrocyte hypertrophy less than 10%; little lateral displacement of host erythrocyte nucleus; pigment granules averaging 16 per parasite, scattered randomly throughout the parasite; volutin granules absent.

Type host : Common iora, *Aegithina tiphia* (Linnaeus).

Type locality : Goa, India.

Additional host : *Chloropsis cyanopogon* (Temminck).

Distribution : India : Goa and Maharashtra.

Elsewhere : Thailand and presumably throughout the distributional range of the avian family Irenidae.

Remarks : de Mello (1937) and Nandi and Mandal (1985) recorded this species from this state. de Mello (1937) did not designate type materials and his collection could not be traced (Nandi, 1985). Bennett and Peirce (1990) designated neohapantotype from the type host from Maharashtra, India, close to the original locality.

42. ***Haemoproteus anthi*** de Mello, 1935

1937. *Haemoproteus anthi* de Mello, *C.R. 12th Int. Congr. Zool.*, **2** : 1391-1445.

1990. *Haemoproteus anthi* : Bennett and Peirce, *J. nat. Hist.*, **24** : 939-947.

Type materials : *Neohapantotype* : Blood film No. 11337 from *Anthus hodgsoni* (Richmond), Coll. H. E. McClure, Maharashtra, India, 19. iv. 1968; *Parahapantotype* : Blood film No. 40388 from *Motacilla alba* Linnaeus, Coll. H. E. McClure, Chinchup-Myun, South Korea, 22. viii. 1965; Blood film No. 104085 from *Motacilla capensis* Linnaeus, Coll. A. Harris, Tweeling, Republic of South Africa, August 1988 and Blood film No. 10621 from *Motacilla cinerea* Tunstall, Coll. H. E. McClure, Dalton Pass, Philippine Islands, 2.x.1965.

Diagnosis : Macrogametocytes broadly halteridial and highly pleomorphic, medium to large-sized, 15.6 (2.0) μm × 3.2 (0.5) μm and 49.4 (8.5) μm^2 in area, occupying 70-80% of host erythrocyte; margins entire; frequently appearing dumbbell-shaped due to narrowing of the portion of parasite adjacent to the erythrocyte nucleus; cytoplasm finely granular; parasite nucleus compact, usually central to sub-central in location and normally appressed to the outer margin of the parasite; host erythrocyte hypertrophied in area and a variable amount of lateral displacement of host erythrocyte nucleus; pigment granules large, averaging 10 per parasite, scattered usually randomly throughout the parasite, but occasionally clumped near the poles; volutin granules absent.

Type host : Paddyfield pipit, *Anthus novaeseelandiae* (Gmelin).

Type locality : Goa, India.

Additional host : *Anthus leucophrys* Vieillot; *A. spinoletta* (Linnaeus); *A. trivialis* (Linnaeus); *Motacilla flava* (Linnaeus); *Dendronanthus indicus* (Gmelin).

Distribution : India : Goa and Maharashtra

Elsewhere : South Korea, South Africa and Philippine Islands and throughout the Old World distribution of the avian family Motacillidae.

Remarks : de Mello (1935) described this species from this state. The deposition of type slides for species described by de Mello and his co-workers (1916-1937) is not known.

43. ***Haemoproteus antigonis*** de Mello, 1935

1935. *Haemoproteus antigonis* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 469-475.

1975. *Haemoproteus antigonis* : Bennett, Forrester, Greiner and Campbell, *Can. J. Zool.*, **53** : 72-81.

Type materials : *Neotype* : Blood film No. 72637 from Sandhill crane, *Grus canadensis* L., from K. D. Ranch, Florida, 16.xii.1970, deposited in the United States National Museum; *Paratypes* : Blood film Nos. 29788-29790, collected from the same host species and localities as in neotype, deposited in the collection of the WHO International Reference Centre for Avian Malaria Parasites renamed as International Reference Centre for Avian Haematozoa (IRCAH), Canada, presently located at Queensland Museum, Australia.

Diagnosis : Macrogametocytes broadly sausage-shaped to rarely slightly halteridial, 13.0 μm x 4.8 μm and 60.3 μm^2 in area, constituting 70% or more of the host cell-parasite complex; margins entire, not amoeboid; cytoplasm coarse, staining deep blue; nucleus median, large, broadly ovoid, staining pale to deep pink; pigment granules prominent, randomly distributed, averaging19 per parasite; volutin granules large, deep-purple-staining and frequently present; erythrocyte nucleus markedly displaced laterally, somtimes to periphery of the host cell.

Type host : *Antigone* (= *Anthropoides*) *virgo* (L.)

Type locality : Junagad, India.

Distribution : India : probably Goa (may be in Gujarat).

Elsewhere : Africa, America and probably throughout the range of of the Gruidae.

Remarks : De Mello (1935) described this species without illustration accompanying the description. However, in 1936-1937, de Mello further described and illustrated *H. antigonis*. Bennett *et al.* (1975) redescribed this species designating neotype and paratypes.

44. ***Haemoproteus asturisdussumieri*** de Mello, 1935

1935. *Haemoproteus asturis dussumieri* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 469-475.

1938. *Haemoproteus asturis* : Bhatia, *The Fauna of British India including Ceylon and Burma* : *Protozoa* : *Sporozoa*, Taylor and Francis Ltd. : 212.

1973. *Haemoproteus asturisdussumieri* : Levine and Campbell, *J. Protozool.*, **18** : 475-484.

Type materials : Not known.

Diagnosis : Macrogametocytes generally oval, rarely halter-like with alveolar, light blue staining cytoplasm and pale rose nucleus; microgametocytes colourless with more conspicuous nucleus; pigment granules of different sizes, irregularly scattered in both kinds of gametocytes.

Type host : *Astur badius dussumieri.*

Type locality : Corlim (Ilhas), Goa.

Distribution : Goa, India.

Remarks : De Mello (1935) described this species as *Haemoproteus asturis dussumieri* from post-mortem blood and tissue smears which shows usual distortion of the parasites in the post-mortem preparations. Bhatia (1938) discarded trinomial designation of this species and termed it as *Haemoproteus asturis* to avoid confusion with unnamed *Haemoproteus* from the same host genus/ allied species. Levine and Campbell (1973) emended de Mello's species as *Haemoproteus asturisdussumieri*. Being distorted parasite, it is considered as *species incertae sedis* as declared by Peirce *et al.* (1990).

45. ***Haemoproteus centropi*** de Mello, 1935

1935. *Haemoproteus centropi* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 469-475.

1977. *Haemoproteus centropi* : Peirce : *E. Afr. Wildl. J.*, **15** : 57-60.

Type materials : Unknown.

Diagnosis : Macrogametocytes halteridial, 16.2 (1.7) μm x 2.9 (0.3) μm and 52.6 (6.1) μm^2 in area; margin entire, not amoeboid; parasite lateral to erythrocyte nucleus, measuring 13.2 x 4.0 μm and 51.5 μm^2 in area, occupying more than 80% of the host cell-parasite complex; cytoplasm slightly granular, with small vacuoles; pigments yellow-brown, in the form of granules or rodlets,

discrete scattered as well as in small cluster, and averaging 14.5 (3.2) granules per parasite; devoid of volutin granules; parasite nucleus median to submedian, compact, round to oval, staining pale pink; erythrocyte nucleus only slightly displaced laterally; host cell hypertrophied in length (9.1%), width (8.7%) and in area (16.0%); and host cell nucleus atrophied (32.1%) in area.

Type host : *Centropus sinensis parroti* (Family Cuculidae).

Type locality : Goa (Diu), India.

Additional hosts : *Centropus senegalensis* and *Clamator jacobinus*.

Distribution : India : Goa and Maharashtra.

Elsewhere : Portuguese Guinea and Kenya.

Remarks : De Mello (1935, 1937) described and subsequently redescibed this species. Peirce (1977) also redescribed it and synonymised *Haemoproteus froilanoi* described by Tendeiro (1947) from *Centropus senegalensis* in Potuguese Guinea (now Guinea Bissau), but his redescription is based on materials from a different host, *Clamator jacobinus* from Kenya.

46. ***Haemoproteus columbae*** Kruse, 1890

1890. *Haemoproteus columbae* Kruse, *Arch. Pathol. Anat.*, **120** : 359.

1990. *Haemoproteus columbae* : Bennett and Peirce, *J. Nat. Hist.*, **24** : 311-325.

Material examined : Sev. exs. Molem, 2.x.1977, A. K. Mandal.

Diagnosis : Macrogametocyte halteridial, measuring 12.6 μm × 3.4 μm and 34.3 μm^2 in area; inner and polar margin amoeboid, outer margin entire, occupying about 60% of the host cell-parasite complex; pigment yellowish-black, discrete, round, scattered, about 30 granules per parasite; nucleus round-oval, median to submedian, 2.5 μm × 1.8 μm and 3.2 μm^2 in area; host cell relatively unchanged, host cell nucleus atrophied 25.8% in area.

Host : *Streptopelia chinensis*.

Distribution : India : Goa, Delhi, Rajasthan, Maharashtra–a cosmopolitan species occurring throughout the distributional range of the Columbidae (Bennett and Peirce, 1990).

Remarks : *Haemoproteus columbae* is commonly occurring in pigeons and other birds belonging to the family Columbidae. Nandi and Mandal (1985) reported this species in *Streptopelia chinensis* from this state.

47. ***Haemoproteus coraciae*** de Mello and Afonso, 1935

1935. *Haemoproteus coraciae* de Mello and Afonso, *Proc Indian Acad. Sci.*(B), **2** : 67-73.

1986. *Haemoproteus coraciae* : Bishop and Bennett : *Can. J. Zool.*, **64** : 1860-1863.

Type materials : *Neohapantotype* : Blood film No. 87992 from *Coracias benghalensis* (L.), the Indian Roller, collected by H. E. McClure in February, 1979 from Hyderabad, Andhra Pradesh, India.

Diagnosis : Macrogametocyte moderate in size, measuring 15.0 μm × 2.6 μm and 48.5 μm^2 in area, occupying more than 50% of the erythrocyte–parasite complex; usually halteridial but sometimes dumbbell-shaped; margins usually entire but occasionally amoeboid; pigment granules large deep brown-yellow and usually scattered randomly throughout the cytoplasm but occasionally grouped in one or more clumps; parasite nucleus small, dense, round or ovoid and situated centrally.

Host : *Coracias benghalensis* and *Coracias indica* (Family Coraciidae).

Distribution : India : Goa, Andhra Pradesh and Maharashtra.

Elsewhere : Africa, Asia east to the Philippine Islands.

Remarks : de Mello and Afonso (1935) first reported this species as *Haemoproteus coraciae* and also a variety viz., *H. coraciae* var. *benghalensis* from this state. The variety has been brought under the synonym of *H. coraciae*. Subsequently, Valles (1938) reported an identical paraste under the same name, which she found in

Coracias indica. This is treated herein as junior homonym.

48. ***Haemoproteus cornuata*** Bennet and Nandi, 1981

1981. *Haemoproteus cornuata* Bennett and Nandi, *Can J. Zool.*, **59** : 2064-2071.

Type materials : *Type* : Blood film No. 37082 from *Megalaima asiatica*, Coll. H. E. McClure, West Bhutan, 6.x.1968; *Paratype* : Blood film No. 37118 from *Megalaima viridis*, Coll. H. E. McClure, Maharashtra, India, 26.iv.1969.

Materials examined : Sev. exs., Volpoi, 21.ix.1977, A. K. Mandal.

Diagnosis : Macrogametocytes large, broadly sausage-shaped and hateridial, 21.9 (2.3) μm x 4.3 (0.6) μm and 73.1 (9.1) μm^2 in area constituting 68% of the host cell-parasite complex; with ends reflexing to form a deep invagination at the inner lateral margins adjacent to erthrocyte nucleus, thus forming a pair of 'horns'; margins entire except at terminalia; cytoplasm coarsely granular, staining deep blue; nucleus small, compact, ovoid, usually median or submedian, representing 9% of the parasite area; pigment granules small, usually randomly scattered throughout, averaging 28.2 (6.4) per parasite; erythrocyte hypertrophied in length (11%), width (3.6%) and in area (19.7%); erythrcyte nucleus atrophied (11.5% in area) and displaced laterally

Type host : *Megalaima asiatica* (Latham).

Type locality : West Bhutan.

Additional hosts : *Megalaima franklinii* and *M. zeylanica.*

Distribution : India : Goa, Maharashtra.

Elsewhere : Bhutan and Thailand.

Remarks : Four species of *Haemoproteus viz., H. bilobata, H. cornuata, H. thereicerycis* and *H. xantholaemae* were reported from the avian family Capitonidae (Bennett and Nandi, 1981). However, *H. cornuata* can easily be differentiated from other species by the "cornua" or horns, which is unique among the haemoproteids. Nandi and Mandal (1985) recorded this species from this state.

49. ***Haemoproteus danilewskyi*** Kruse, 1890

1890. *Haemoproteus danilewskyi* Kruse, *Arch. Pathol. Anat.*, **120** : 359.

1990. *Haemoproteus danilewskyi* : Bishop and Bennett, *Can. J. Zool.*, **68** : 251-2256.

Type materials : *Paraneohapantotype* : Blood films Nos. 14239, 97138 and 97139 from *Corvus corone* L. Coll. A. L. Helmy Mohammed, Cairo, Egypt, 1949.

Materials examined : Sev. exs. Bondla, 8.x.1977, A. K. Mandal.

Diagnosis : Macrogametocyte slender, halteridial, margin entire, 12.0 μm x 2.6 μm and 33.5 μm^2 in area, occupying about 60% of the host cell-parasite complex; nucleus compact, round-oval, median to submedian, 2.2 μm^2 in area; pigment granules round, yellow-brown, 10-25 granules per parasite, usually scattered randomly throughout the cytoplasm; host cell hypertrophied (10-15%) in area.

Type host : *Corvus corone* L.

Type locality : Naples, Italy.

Additional hosts : Several species belonging to the avian family Corvidae (Bishop and Bennett, 1990).

Distribution : India : Goa, West Bengal.

Elsewhere : Holarctic to Southeast Asia and India.

Remarks : This species is a highly pleomorphic haemoproteid with a wide range of morphological forms (Bishop and Bennett, 1990). Nandi and Mandal (1985) recorded this species in *Dendrocitta vagabunda* from this state.

50. ***Haemoproteus dicruri*** de Mello, 1935

1935. *Haemoproteus dicruri* de Mello, *Proc Indian Acad. Sci.*, **2B** : 469-475.

1984. *Haemoproteus dicruri* : Peirce, *J. nat. Hist.*, **18** : 789-791.

Type materials : Unknown.

Diagnosis : Macrogametocytes halteridial, 12.6 (0.3) μm x 2.5 (0.2) μm and 36 μm^2 in area, lateral to host cell nucleus, only partially embracing it, occupying about 60% of the host cell-parasite complex; margins entire; cytoplasm finely granular and staining light blue; nucleus compact, submedian, round-oval or triangular, staining pink; pigments yellow-brown in the form of rodlets or granules, discrete, scattered or in groups, and averaging 17 (2.6) granules per parasite; volutin granules absent; erythrocyte nucleus not markedly displaced; host cell hypertrophied in length (13.6%) width (10.3%) and in area (19.2%); erthrocyte nucleus atrophied (3.4%) in area.

Type host : *Dicrurus adsimilis macrocercus* (Vieillot).

Type locality : Pragana, Goa.

Distribution : India : Goa, Orissa, West Bengal

Elsewhere : Asia, Africa.

Remarks : De Mello (1935, 1937) briefly described and subsequently redescribed *Haemoproteus dicruri* from a single host of *Dirurus macrocercus* from Goa.

51. ***Haemoproteus elani*** de Mello, 1937

1937. *Haemoproteus elani* de Mello, *C.R. 12th Congr. Zool.*, **2** : 1391-1445.

1990. *Haemoproteus elani* : Peirce, Bennett and Bishop, *J. nat. Hist.*, **24** : 1091-1100.

Type materials : *Neohapantotype* : Blood film No. 105003 from *Buteo lineatus* (Gmelin), Coll. D. J. Forrester, Florida, USA, 3.iv.1979; *Parahapantotype* : Blood film No. 46699 from *Accipiter cooperi* (Bonaparte), Coll. A. Kocan, Oklahoma, USA, 3.iii.1976; Blood film No. 105005 from *Aquila rapax rapax* (Temminck), Coll. J. E. Cooper, Nakuru, Kenya, 22.ii.1972; Blood film No. 23515 from *Buteo lineatus* (Gmelin), Coll. C. M. Herman, California, USA, 16.vi.1947; Blood film No. 105004 from *Buteo lineatus* (Gmelin), Coll. D. J. Forrester, Florida, USA, 7.vii.1974.

Diagnosis : Macrogametocytes of moderate size, 16.0 (1.8) μm x 3.1 (0.4) μm and 56. (5.7) μm^2 in area, occupying 60-70% of host erythrocyte and causing little host cell hypertrophy; highly pleomorphic with most forms broadly halteridial while some forms almost circumnuclear; margins entire but amoeboid in some specimens; cytoplasm granular and containing small vacuoles; pigment granules prominent, yellow-brown, averaging 15 per parasite, randomly scattered throughout cytoplasm; nucleus compact, small centrally located, staining deep red; erthrocyte nucleus somewhat laterally displaced; volutin granules rare, but if present concentrated at the poles.

Type host : Black-shouldered kite, *Elanus caerueus* (Desfontaines).

Type locality : Goa, India.

Additional hosts : Several species of birds belonging to the family Accipitridae as mentioned by Nandi (1984) and Peirce *et al.* (1990).

Distribution : India : Goa.

Elsewhere : Asia, North America, Europe, Africa and Middle East.

Remarks : De Mello (1937) described this species from a dead bird and observed common occurrence of volutin granules. Peirce *et al.* (1990) synonymised three species *viz.*, *Haemoproteus buteonis* Wingstrand, 1947; *H. figueiredoi* Santos Dias, 1953 and *H. circus* Yakunin and Zhazyltaev, 1977 with this species.

52. ***Haemoproteus fallisi*** Bennett and Campbell, 1972

1972. *Haemoproteus fallisi* Bennett and Campbell, *Can J Zool.*, **50** : 1269-1275.

1991. *Haemoproteus fallisi* : Bennett, Bishop and Peirce, *J. Nat. Hist.*, **25** : 41.

Type materials : *Hapantotype* : Blood film No. 21819 from *Turdus migratorius* L., Coll. G. F. Bennett, on June 10, 1971, from St. John's, Newfoundland, Canada

Materials examined : Sev. exs., Volpoi, Goa, 26.ix.1977, A. K. Mandal.

Diagnosis : Macrogametocytes small, halteridial, 11.8 (1.2) μm x 2.6 (0.3) μm and 37.3 (3.2) μm² in area, occupying 50-60% of host cell-parasite complex; lateral margins entire but polar margins somewhat amoeboid; pigment granules rod-shaped, yellow-brown, scattered, averaging 13.4 per parasite; nucleus round to slightly ovoid, compact, subterminal in position; host cell hypertrophy 10% in area; erythrocyte nucleus markedly displaced laterally; volutin granules absent.

Type host : American Robin, *Turdus migratorius* (L.).

Type locality : St John's, Newfoundland, Canada.

Additional hosts : Probably all records of haemoproteids in thrushes belonging to the avian subfamily Turdinae as recorded by Bennett *et al.* (1982) and Bishop and Bennett (1992).

Distribution : India : Goa and Orissa.

Elsewhere : Virtually throughout the distributional range of the Turdinae.

Remarks : This species is reported from *Copssychus saularis* from this state by Nandi and Mandal (1985).

53. ***Haemoproteus fringillae*** Labbe, 1894

1894. *Haemoproteus fringillae* Labbe, *Arch. Zool. Ex. Gen.*, : 55.

1992. *Haemoproteus fringillae* : Burry-Caines and Bennett, *Can. J. Zool.*, **70** : 1149-1160.

Type materials : *Neohapantotype* : Blood film No. 92411 from *Fringilla coelobs*, Coll. M. A. Peirce; Bramley, Hants., United Kingdom, 28.vi. 1981; *Paraneohapantotype* : blood film No. 67603 from *Fringilla coelobs*, Coll. J. Kucera, Prague, Czechoslovakia, 21.v.1975; Blood film No. 58131 from *Fringilla coelobs*, Coll. C. Mead, Portugal.

Material examined : Sev. exs., Volpoi, Goa, 26.ix.1977, A. K. Mandal.

Diagnosis : Macrogametocytes medium to large size, 16.1(0.8) μm x 2.0 (0.4) μm and 41.7 (4.8) μm² in area, halteridia-shaped; margins entire, and usually appressing the host cell nucleus; bilobed, with a marked constriction at the middle of the convex margin, occupying about 60-70% of the host cell-parasite complex, no host cell hypertrophy; cytoplasm finely granular; nucleus mostly round, 2.1 μm in diameter, central or sub-centrally located at the periphery; pigments dark-yellowish and scattered granules; host cell nucleus rarely displaced to the periphery.

Host : *Copsychus saularis* (Linnaeus).

Distribution : India : Goa and Andhra Pradesh.

Remarks : Nandi and Mandal (1985) identified this species in *Copsychus saularis* (Family Turdidae, Subfamily Turdinae) from this state based on the key to the haemoproteids of the avian Family Turdidae given by Bennett and Campbell (1972). Since long '*H. fringillae/ H. orizivorae* complex' (Peirce, 1984) was reported from many passerine families for their frequent occurrence together–as a small halteridial parasite ('*fringillae*-like) and a larger, broader parasites similar to *H. orizivorae* of the family Estrildidae. Burry-Caines and Bennett (1992) in their review of the haemoproteids of the avian family Fringillidae states that assigning *H. fringillae* to such a broad range of passerine hosts is in error, and it should be limited to the Fringillidae until experimental evidence clearly indicates a wider host spectrum. However, in the absence of detailed taxonomic review of passerine families, this species is considered as *H. fringillae* based on Bennett and Campbell (1972).

54. ***Haemoproteus gallinullae*** de Mello, 1935 (Syn. *Haemoproteus fulicae* da Fonseca, 1938)

1935. *Haemoproteus gallinulae* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 469-475.

1938. *Haemoproteus fulicae* da Fonseca, *Esc. Med. Cir. Nova Goa*, Ser. A, **12** : 315-317.

1980. *Haemoproteus gallinulae* : Bennett, *Can. J. Zool.*, **58** : 321-325.

Diagnosis : Macrogametocytes of medium size, usually halteridial, the ends of the parasite occasionally almost surrounding the host cell

nucleus, covering 46.5(5.8) μm^2 in area, constituting 63% of host cell-parasite complex; margins entire; cytoplasm granular staining deep blue; nucleus large, ovoid, median or submedian in position; pigment granules numerous, scattered, occasionally clumping at poles, averaging 32.3 (3.5) per parasite; host cell only slightly hypertrophied (6.5% in area); host cell nucleus atrophied (14.4% in area), representing 12% of host cell-parasite complex and slightly displaced laterally.

Type host : *Gallinula chloropis* L.

Type locality : Carambolim Lake, Goa, India.

Additional hosts : Seven species of the family Rallidae.as mentioned by Bennett (1980).

Distribution : India : Goa.

Elsewhere : cosmopolitan, presumably throughout the distributional range of the Rallidae.

Remarks : De Mello (1935) described this species from Goa. Bennett (1980) redescibed this species and declared *Haemoproteus fulicae* from *Fulica atra* also from Goa as a synonym of *H. gallinulae.*

55. ***Haemoproteus halcyonis*** de Mello, 1935

1935. *Haemoproteus halcyonis* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 469-475.

1973. *Haemoproteus halcyonis* : Bennett and Campbell, *J. Parasitol.*, **59** : 337-343.

Type materials : *Neotype* : Slide No. I C 1 from the white collared kingfisher, *Halcyon chloris*, Coll. H. E. McClure, 9.ii.1961, from Rantau Panjang, Selangor, Malaysia; *Paraneotype* : Slide No. I C 2 from the same host and locality, coll. H. E. McClure, 26.x.1961, deposited as mentioned for *Haemoproteus antigonis.*

Materials examined : Sev. exs., Volpoi, 25. ix. 1977, A. K. Mandal.

Diagnosis : Macrogametocytes sausage-shaped, 14.4 μm × 4.3 μm and 60.0 μm^2 in area, lying fully extended in host cell, occupying 70% of the erythrocyte-parasite complex; cytoplasm granular, dense, staining deep blue or magenta; nucleus terminal or subterminal, staining pink or light magenta; pigment granules randomly distributed, averaging 24.4 per parsite; host erythrocyte negligibly hypertrophied; host cell nucleus displaced laterally towards periphery.

Type host : Kingfisher, *Halcyon smyrnensis smyrnensis* (L.)

Type locality : Goa, India.

Additional hosts : Several species of kingfishers (Family Alcedinidae) as mentioned by Bennett and Campbell (1973).

Distribution : India : Goa.

Elsewhere : Borneo, Malaya, New Guinea, Philippines, Thailand and Uganda.

Remarks : De Mello (1935) described this species from Goa without designating type materials. Nandi and Mandal (1985 recorded this species also from this state.

56. ***Haemoproteus lanii*** de Mello, 1937

1937. *Haemoproteus lanii* de Mello, *C. R. 12th Int. Congr Zool.*, **2** : 1391-1445.

1990. *Haemoproteus lanii* : Bennett, Peirce and Earle, *S Afr J. Zool.*, **25**(3) : 194-198.

Type materials : *Neohapantotype* : Blood film No. 41809 from *Lanius schach* Linnaeus, Coll. H. E. McClure, Gujarat, India, 13.ix.1970; *Parahapantotypes* : Blood film Nos. 41831, 11814, 19223, 97837, 103280, 104663 and 104668 from *Lanius* species from India, Tanzania and South Africa (*vide* Bennett *et al.*, 1990).

Diagnosis : Macrogametocytes medium-sized, halteridial, measuring 15.4 (1.7) μm × 3.5 (0.6) μm and 54.0 (6.5) μm^2 in area and occupying about 75% of the infected erythrocyte, usually causing little hypertrophy or distortion of the host erythrocyte; cytoplasm coarsely granular; parasite nucleus small, dense, median to submedian in location and staining deep red with Giemsa's; erthrocyte nucleus only slightly displaced laterally; pigments yellow-brown, rod-like to broadly ovoid in shape, normaly scattered randomly throughout

the cytoplasm, averaging 12 granules per parasite; volutin granules rare in occurrence.

Type host : Long-tailed shrike, *Lanius schach* Linnaeus.

Type locality : Goa, India.

Additional hosts : A number of species belonging to the genus *Lanius* from Europe, Africa and Asia (*vide* Bennett *et al.*, 1990).

Distribution : India : Goa, Gujarat, Maharashtra and Orissa.

Elsewhere : Europe, Africa and Asia and presumably throughout the distributional range of the subfamily Laniinae (*vide* Bennett *et al.*, 1990).

Remarks : De Mello (1937) described this parasite from *Laniks schach* from this state.

57. ***Haemoproteus majoris*** (Laveran, 1902) (Syn. *Haemoproteus machlolophi* de Mello, 1935)

1902. *Haemamoeba majoris* Laveran : *C. R. Soc. Biol.*, **54** : 1121-1125.

1935. *Haemoproteus machlolophi* de Mello : *Proc. Indian Acad. Sci.*, **1** : 349-358.

1981. *Haemoproteus majoris* : Peirce : *J. Nat. Hist.*, **15** : 151-154.

Type materials : *Neosyntype* : dated 9.x.1972, deposited to IRCAH, Canada (now in Queensland Museum, Australia).

Diagnosis : Macrogametocytes halteridial, cytoplasm slightly granular staining greyish blue; outline entire; pigment golden-yellow, 8 granules per parasite; nucleus compact, central, round, oval or irregular, often markedly displaced to the periphery; volutin granules present occasionally in small numbers.

Type host : *Parus major.*

Type locality : France.

Additional hosts : A number of species belonging to the family Paridae.

Distribution : India : Goa.

Elsewhere : U.K. and the distributional range of Paridae.

Remarks : De Mello (1935) reported this species from *Machlolophus xanthogenys* from this state as *H. machlophi*, which is considered herein as synonym of *H. majoris*. Peirce (1981) redescribed this halteridial species which is readily separable from the other discoid haemoproteid species, *H. parus* described by Bennett (1989) on the basis of morphology (halteridial vs discosomal).

58. ***Haemoproteus meropis*** (Zargar, 1945)

1945. *Haemoproteus meropi* Zargar, *Proc. Indian Acad. Sci.*(B), **21** : 124-127.

1978. *Haemoproteus meropis* (Zargar) : Bennett : *Can. J. Zool.*, **56** : 1721-1725

Materials : Blood film Nos. 3006, 3007, 37193, 37198, 43146 and 44959 from *Merops viridis* and *Merops albicollis* deposited in the International Reference Centre for Avian Haematozoa (IRCAH) as mentioned by Bennett (1978).

Materials examined : Sev. exs., Bondla, 10.x.1977, A. K. Mandal.

Diagnosis : Macrogametocytes broadly sausage-shaped to halteridial, measuring 13.9 μm x 3.2 μm and 44.5 μm^2 in area, constituting 65% or more of the host cell-parasite complex; outline usually entire, somewhat amoeboid; pigment granules prominent, randomly distributed throughout parasite, averaging 14 granules per parasite; parasite occasionally with large, deep purple-staining volutin granules; parasite nucleus median, round to broadly ovoid, occupying about 3.3 μm^2 in area; host cell hypertrophied 15% in length, 3% in width, and 18% in area; host cell nucleus slightly displaced laterally; Nuclear Displacement Ratio (NDR) = 0.7.

Host : *Merops orientalis* (Family Meropidae).

Distribution : India : Goa, Andhra Pradesh, Maharashtra and Orissa.

Elsewhere : Malaysia, Philippines, Thailand and Africa.

Remarks : Nandi and Mandal (1985) reported this species from *Merops o. orientalis* from this state.

59. ***Haemoproteus noctuae*** Celli and Sanfelice, 1891

(Syn. *Haemoproteus bramae* de Mello, 1936 and *Haemoproteus glaucidii* de Mello, 1936 *in partim*, from Goa among others as cited by Bishop and Bennett, 1989)

1891. *Haemoproteus noctuae* Celli and Sanfelice, *Ann. Inst. Igien. Speriment. Univ. Roma*, **1** : 33-63.

1987. *Haemoproteus noctuae* : Bishop and Bennett, *Can J. Zool.*, **67** : 2676-2684.

Type materials : *Neohapantotype* : Blood film No. 80420 from Eurasian tawny owl, *Strix aluco*, Coll. C. Mead, Woburn, Bedfordshire, England, 30.v. 1978; *Parahapantotype* : Blood film No. 11080 from Philippine boobook owl, *Ninox philippensis* Coll. H. E. McClure, Siaton, Negros Oriental, Philippine Islands, 3.ii.1965.

Diagnosis : Macrogametocytes circumnuclear of medium to large size, 25.3 (1.9) μm × 3.0 (0.4) μm and 74.5(8.3) μm^2 in area, occupying approximately 75% of the erythrocyte-parasite complex; cytoplasm finely granular, staining deep blue; margins amoeboid, entire or a combination of the both, with neither the inner nor the outer margin adhering to the erythrocyte nucleus or host cell membrane; nucleus median, compact, oval to elongate, staining bright pink; pigment granules yellow-brown, round to oval, scattered throughout the parasite; volutin granules present, staining dark blue to violet, randomly distributed or clumped at both ends, even blocking the appearance of the pigment granules; host cell hypertrophied in area; host cell nucleus usually atrophied but rarely displaced.

Type host : *Athene brama* (Scopoli).

Type locality : Rome, Italy.

Additional hosts : Various species belonging to the family Strigidae as mentioned by Bishop and Bennet (1989).

Distribution : India : Goa.

Elsewhere : various parts of Asia, Africa, Europe, North and South America, and potentially throughout the range of the Strigidae (Bishop and Bennett, 1989).

Remarks : *Haemoproteus glaucidii* described by de Mello (1936, 1937) from *Glaucidium radiatum* shot at Canacona, Goa and *Haemoproteus bramae* also described by de Mello (1936, 1937) from *Athene brama* shot at Nagoa (Salcete), Goa are considered herein as synonyms of *Haemoproteus noctuae* as reviewed by Bishop and Bennett (1989).

60. ***Haemoproteus orioli*** de Mello, 1935

1935. *Haemoproteus orioli* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 469-475.

1984. *Haemoproteus orioli* : Peirce, *J. nat. Hist.*, **18** : 785-787.

Diagnosis : Macrogametocytes halteridial, occupying a lateral position in the erythrocyte; margins entire, with smooth, curved ends; cytoplasm staining pale blue; nucleus indefinite shaped, usually terminal, forming a plug or band around the pole and staining pink; pigment dark yellow-brown granules, averaging 21 granules per parasite, sometimes black, small, round or slightly elongated and usually randomly scattered; host cell hypertrophied in length and atrophied in width; host cell nucleus displaced to periphery.

Type host : *Oriolus oriolus*.

Type locality : Goa, India.

Additional hosts : *Oriolus auratus*.

Distribution : India : Goa.

Remarks : De Mello (1935) described this species from *Oriolus oriolus kundos* from this state.

61. ***Haemoproteus orizivorae*** Anschutz, 1909

1909. *Haemoproteus oryzivorae* Anschutz, *Zentrlbl Bakterriol. Parasitenkd. Infektionskr. Hyg. Abt I Orig.*, **51**, : 654.

1991. *Haemoproteus oryzivorae* : Bennett and Peirce, *J. Nat. Hist.*, **25** : 7-22.

Type materials : *Neohapantotype* : Blood film No. 40878 from *Lonchura orizivora* (L), Coll. H. E. McClure in west Java, Indonesia on 27 May, 1968; *Parahapantotype* : Blood film No. 40848 and 40851 from *Lonchura malabarica* (L.) Coll. H. E. McClure in Gujarat state, India on 15 and 16 November, 1970, respectively; blood film No. 12132 from *Lonchura punctulata* (L.) Coll. H. E. McClure at Bangkok, Thailand on 21 September, 1964.

Material examined : Sev. exs., Volpoi, Goa, 26.ix.1977, A. K. Mandal.

Diagnosis : Macrogametocyte halteridial, sometimes sausage-shaped, 12.0-15.0 μm × 3.5-4.0 μm, margins entire, occupying about 70% of the host cell-parasite complex; nucleus round or ovoid, central to subterminal, located on the outer margin of the parasite; pigment granules small, scattered, 10-15 yellow to dark-yellow brown granules; host cell hypertrophy more than 30% in area; host cell nuclear atrophy about 10% in area with marked displacement to the periphery.

Type host : *Padda* (= *Lonchura*) *orizivora* (L.).

Type locality : Buenos Aires, Argentina (imported bird).

Host : *Copsychus saularis* (Linnaeus).

Distribution : India : Goa, Gujarat, Orissa, West Bengal and Andhra Pradesh.

Elsewhere : Possibly thoughout the distributional range of avian subfamily Poephilinae (munias and manakins) as stated reviewed by Bennett and Peirce (1991).

Remarks : Nandi and Mandal (1985) identified this species in *Copsychus saularis* (Family Turdidae, Subfamily Turdinae) from this state. The species, '*H. fringillae/ H. orizivorae* complex' (Peirce, 1984) was reported from many passerine families for their frequent occurrence together – as a small halteridial parasite ('*fringillae*-like) and a larger, broader parasites similar to *H. orizivorae* of the family Estrildidae. Bennett and Peirce (1991) in their review of the haemoproteids of the weaver finches and states that assigning *H orizivorae* to such a broad range of passerine hosts is in error, and it should be limited to the avian subfamily Poephilinae of the family Estrildidae until experimental evidence clearly indicates a wider host spectrum. However, in the absence of detailed taxonomic review of passerine families, this species is considered as *H. orizivorae* based on the earlier review and key of Bennett and Campbell (1972).

62. ***Haemoproteus otocompsae*** de Mello, 1935

1935. *Haemoproteus otocompsae* de Mello, *Proc. Indian Acad. Sci.* **2B** : 469-475.

1983. *Haemoproteus otocompsae* : Peirce, *J. nat. Hist.*, **18** : 965-967.

1987. *Haemoproteus otocompsae* : Rahal Bishop and Bennett, *Can J. Zool.*, **65** : 322-328.

Diagnosis : Macrogametocytes semihalteridial with rounded ends; 16.7 (1.9) μm × 3.3 (0.7) μm and 49.2 (5.7) μm^2 in area; parasite lateral to and markedly displacing host cell nucleus; margins entire; cytoplasm coarsely granular, staining blue and vacuolated; nucleus median to submedian, round to ovoid, staining pink; pigment granules yellow-brown, discrete, randomly distributed; host cell hypertrophied in length and area with no change in width; host cell nucleus atrophied in length width and area.

Type host : *Pycnonotus jocosus* (L.).

Additional host : As recorded by Rahal *et al.* (1987).

Type locality : Malim (Bradez) Goa.

Distribution : India : Goa.

Elsewhere : Africa and Asia.

Remarks : De Mello (1935, 1936) described and redescribed this species from *Otocompsa emeria* of Goa state.

63. ***Haemoproteus passeris*** Kruse, 1890 (Syn. *Haemoproteus gymnorhidis* de Mello, 1936 from Goa among others cited from Bennett and Pierce, 1991)

1890. *Haemoproteus passeris* Kruse, *Arch. Pathol. Anat.*, **120** : 541-560.

1991. *Haemoproteus passeris* Kruse : Bennett and Peirce : *J. nat. Hist.*, **25** : 7-22.

Type materials : *Neohapantotype* : Blood film No. 68927 from *Passer domesticus* L., Coll. M. A. Peirce, Weybridge, Surrey, England on 25 June, 1973; *Parahapantotype* : Blood film No. 40848 and 68926 and 108459 from *Passer domesticus* L., Coll. M. A. Peirce, Weybridge, Surrey, England on 25 June, 1973 and Ascot England on 12 May, 1972 respectively, and some other materials as recorded by Bennett and Peirce (1991).

Diagnosis : Macrogametocyte of medium size, usually halteridial and occasionally broadly sausage-shaped, measuring 13.6 (1.5) μm × 3.2 (0.6) μm and 48.2 (8.4) μm^2 in area, occupying 65-70% of the area of the host erythrocyte-parasite complex; margins entire; pigment granules yellow to yellow-brown, rod-shaped and scattered randomly throughout the cytoplasm, averaging 13 granules per parasite; parasite nucleus round to ovoid or triangular, terminal to sub-terminal in location; host cell hypertrophied 5-10% in length and breadth and 15% in area; host cell nucleus hypertrophied 15% and displaced laterally towards the margin; volutin granules of common occurrence and, when present, effectively concealed the true pigment granules.

Type host : House sparrow, *Passer domesticus* Linnaeus.

Type locality : Naples, Italy.

Additional hosts : Several species belonging to the family Passeridae *vide* Bennett and Pierce (1991).

Distribution : India : Goa (Ponda), Andhra Pradesh, Orissa and Kashmir; Outside India : throughout the natural distributional range of the family Passeridae.

Remarks : In 1936, de Mello described *Haemoproteus gymnorhidis* from *Gymnorhis* (=*Petronia*) *xanthocollis* shot in Goa. In their taxonomic review Bennett and Peirce (1991) considered *Haemoproteus gymnorhis* as a synonym of *Haemoproteus passeris*.

64. ***Haemoproteus pastoris*** de Mello, 1935 (Syn. *Haemoproteus sturni* de Mello, 1935, *H. morneti* Tendeiro, 1947 and *H. morneti orientalis* Travassos Santos Dias, 1953 as cited from Bishop and Bennett, 1990)

1935. *Haemoproteus pastoris* de Mello, *Proc. Indian Acad Sci.* (B), **2** : 469-475.

1935. *Haemoproteus sturni* de Mello, *Proc. Indian Acad. Sci.* (B), **2** : 469-475.

1988. *Haemoproteus pastoris* : Bishop and Bennett, *Can. J. Zool.*, **68** : 2251-2256.

Type materials : *Neohapantotype* : Blood film No.104762 from the Wattled starling, *Creatophora cinerea* (Meuschen), Coll. R. A. Earle, Pellissier, Republic of South Africa, 20.v.1989; *Paraneohapantotypes* : Blood film No. 9478 from the Bald coleto, *Sarcops calvus* (Linnaeus), Coll. R. E. Kuntz, Tayc, Siaton, Negros Oriental, Philippine Islands, 11.ii.1965; Blood film Nos. 12246, 61343, 11255, 38717, 38696 and 104764 from a variety of starlings and mynas from Africa and Asia (*vide* Bishop and Bennett, 1990). These type materials were earlier located at the International Reference Centre for Avian Haematozoa (IRCAH), Memorial University of Newfoundland, Canada, but at present shifted to the Queensland Museum, Australia.

Diagnosis : Macrogametocyte halteridial, medium to large-sized, 13.5 (1.4) μm × 2.8 (0.7) μm and 41.3 (7.7) μm^2 in area; margins usually entire, sometimes amoeboid occupying about 70% of the host cell-parasite complex; cytoplasm granular, staining dark blue; nucleus round to ovoid, sub-central to central in location; pigment granules medium to large, usually scattered, averaging 12 brown-yellow granules per parasite; host cell hypertrophy about 15% in area; without marked host cell nuclear atrophy but host cell nucleus displaced toward the parasite.

Type host : Rose-coloured starling, *Sturnus roseus* Linnaeus.

Type locality : Pragana, Goa, India.

Additional hosts : A wide number of species of starlings and mynas (*vide* Bishop and Bennett, 1990).

Distribution : India : Goa (Pragana and Ponda), Andhra Pradesh, Maharashtra and West Bengal.

Elsewhere : Africa, Indonesia, Thailand and Philippine Islands.

Remarks : De Mello (1935) did not designate type materials and his collection could not be traced (Nandi, 1976). Bishop and Bennett (1990) designated neohapantotype from a host from South Africa, stating it to be the closest to the original host and locality. However, type designation from original host and type locality is welcome from future researchers of haemoproteid taxonomy. Nandi and Mandal (1985) reported *Haemoproteus morneti* from *Acridotheres fuscus mahrattensis* from this state. Based on the review of Bishop and Bennett (1990) *H. morneti* is considered herein as a synonym of *H. pastoris*.

65. ***Haemoproteus plataleae*** de Mello, 1935 (Syn. *Haemoproteus galatheae* Laird and Laird, 1959)

1935. *Haemoproteus plataleae* de Mello, *Proc. Indian Acad. Sci.* (B), **2** : 469-475.

1975. *Haemoproteus plataleae* : Bennett, Greiner and Campbell, *Can J. Zool.*, **53** : 634-638.

Type materials : *Neotype* : Neotype of *H. plataleae* is from *Theshkiornis moluccca pygmaeus* Mayr, Coll. M. Laird and E. Laird, 19.viii.1953, from Rennell Island, British Soloman Islands, deposited in the Dominion Museum, Wellington, New Zealand.

Diagnosis : Macrogametocytes halteridial, 12-14 μm x 3.8-4.2 μm and 72 μm^2 in area in type host, *Threshkiornis molucca* and 14.4 (1.6) μm x 4.8 (0.6) μm and 74 (5.0) μm^2 in area in white ibis, *Eudocimus alba*, occupying 96% or more of the host cell-parasite complex; margins entire; cytoplasm deep blue, coarsely granular; nucleus subterminal to central, discrete, large, staining pink; pigment granules yellow-brown, randomly distributed either singly or in small clumps, averaging 45 per parasite; host cell hypertrophied, in length (10%), breadth (5%) and in area (20%); erythrocyte nucleus slightly atrophied in length (11%) in width (10%) and in area (20%); host cell nucleus displaced laterally to periphery of host cell.

Type host : *Platalea leucorodia major* Temminck.

Type locality : Goa, India.

Additional hosts : *Ibis aethiopica* (Latham), *Guara rubra* Linnaeus, *Platalea leucorodia* Linnaeus

Distribution : India : Goa.

Elsewhere : Asia, Australasia, North America; probably cosmopolitan.

Remarks : de Mello, 1935 described this species from *Platalea leucorodia major* from this state. Bennett *et al.* (1975) redescribed this species designating neotype from *Threskiornis molucca pygmaeus* from Rennell Island, British Solomon Islands and synonimised *Haemoproteus galatheae* described by Laird and Laird (1959).

66. ***Haemoproteus raymundi*** de Mello, 1934

1934. *Haemoproteus raymundi* de Mello, *Proc. Indian Acad. Sci.*, **1B** : 97-99.

Diagnosis : Macrogaetocytes halteridial or reniform; cytoplasm finely vacuolated; nucleus elliptical; pigment deep brown; host cell hypertrophied. Other characters referrable as mixed malarial infection with post-mortem changes (Bennett *et al.*, 1985).

Type host : *Leptocoma* (=*Nectarinia*) *zeylanica*.

Type locality : Goa, India.

Distribution : India : Goa.

Remarks : De Mello and Raimundo (1934) described this species from this State. Bennett *et al.* (1985) reviewed the haemoproteids of the avian family Nectarinidae and remarked about the possibility mixed infection and post mortem changes of *H. raymundi*, and declared it as *species incertae sedis*.

67. ***Haemoproteus sanguinis*** Chakravarty and Kar, 1945

1945. *Haemoproteus sanguinis* Chakravarty and Kar, *J. Asiat. Soc. Bengal*, **11** : 36-39.

1983. *Haemoproteus sanguinis* : Peirce, *J. nat. Hist.*, **18** : 965-967.

1987. *Haemoproteus sanguinis* : Rahal Bishop and Bennett, *Can J. Zool.*, **65** : 322-328.

Material examined : Sev. exs., Molem, 3.x. 1977, A. K. Mandal.

Diagnosis : Macrogametocytes halteridial, 13.8 (1.3) μm x 2.4 (0.3) μm and 35.5 (5.2) μm^2 in area; located lateral to and slightly displacing host cell nucleus, occupying 53% of the host cell-parasite complex; margin entire, not amoeboid; cytoplasm coarsely granular, vacuolate, staining pale blue; nucleus submedian to subterminal, roughly ovoid, staining pink; pigment granules yellow-brown, discrete, randomly distributed; host cell hypertrophied in length and area; host cell nucleus atrophied in length, width and area.

Type host : *Pycnonotus jocosus* (L.).

Additional hosts : Several species of bulbuls as mentioned by Rahal *et al.* (1987).

Type locality : Calcutta, West Bengal, India.

Distribution : India : Goa, West Bengal.

Elsewhere : Asia and Africa.

Remarks : Although Peirce (1984) synonymized *Haemoproteus sanguinis* with *Haemoproteus otocompsae* on the basis of published descriptions, Rahal *et al.* (1987) compared these two parasites and observed that they are clearly distinguishable both qualitatively and quantitatively. *H. otocompsae* is a large broad haemoproteid, occupying approximately 75% of the host cell-parasite complex and characteristically displacing the host cell nucleus to the periphery of the erythrocyte. This is in contrast to *H. sanguinis*, which is a relatively slender parasite, occupying only about 50% area of the host cell-parasite complex and causing little host cell nuclear displacement. *H. sanguinis* is, therefore, considered herein as a valid species as resurrected by Rahal *et al.* (1987). Nandi and Mandal (1985) recorded this parasite, *H. sanguinis*, from *Pychonotus cafer, Hypsipetes indicus ictericus* and *Hypsipetes indicus indicus* from this state.

68. ***Haemoproteus tephrodornis*** de Mello, 1935

1935. *Haemoproteus tephrodornis* de Mello, *Proc. Indian Acad. Sci.* **2B** : 469-475.

Materials examined : A few exs. on slide, Molem, 4.x.1977, A. K. Mandal.

Type materials : Unknown.

Diagnosis : Materials insufficient for description. The description given by de Mello (1935) is as follows : "Sexual dimorphism. ♀ haltheride or ovoid, blue not uniformly as many places are completely unstained. Nucleus oval, central or sub-central. ♂ oval, light greyish, small indistinct nucleus. Pigment black, sepia colour, in granules or rods often disposed in lines or clusters along the concave border. Red cell hypertrophied, nucleus displaced."

Type host : *Tephrodornis p. pondiceriana*.

Type locality : Goa (Pragana), India.

Additional hosts : *Coracina novaehollandiae*.

Distribution : India : Goa.

Remarks : De Mello (1935) described this species from this State. Nandi and Mandal (1985) recorded this species also from Goa based on a few examples from *Coracina novaehomandiae maeei*. The description of this species is inadequate and requieres review (Bennett and Peirce, 1988).

69. ***Haemoproteus thereicerycis*** de Mello, 1935

1935. *Haemoproteus thereicerycis* de Mello, *Proc. Indian Acad. Sci.* **2B** : 469-475.

1935. *Haemoproteus thereicerycis* var. *zeylanica* de Mello, *Proc. Indian Acad. Sci.* **2B** : 469-475.

1981. *Haemoproteus thereicerycis* : Bennett and Nandi, *Can. J. Zool.*, **59** : 2064-2071.

Materials examined : Sev. exs., Volpoi, 21.ix.1977, A. K. Mandal.

Type materials : *Neotype* : Blood film No. 37133 from *Megalaima zeylanica*, Coll. H. E. McClure, Andhra Pradesh, India; *Paratypes* : Blood film Nos. 11119, 11502, 11641, 37083, 37086 and 37126, collected by H. E. McClure from five different species of *Megalaima* (Family

Capitonodae) from India, West Bhutan and Thailand.

Diagnosis : Macrogametocytes broadly sausage-shaped to halteridial, 16.3 (1.8) μm × 4.9 (0.9) μm and 80.2 μm² in area, constituting 75% of the host cell parasite complex; margins entire; cytoplasm granular staining deep blue; nucleus medium size, compact, dense, ovoid, usually median or submedian, representing 11% of the parasite area; pigment granules small, usually scattered throughout the parasite, averaging 31.3 (2.9) per parasite; parasitized erythrocyte hypertrophied in length (12%), width (6.3%) and in area (20%); parasitized erythrocyte nuleus atrophied in area (4%) and markedly displaced laterally, sometimes enucleated or displaced to pole.

Type host : *Thereiceryx zeylanica inornata* Walden (=*Megalaima zeylanica*).

Type locality : Corlim, Goa, India.

Additional hosts : Several species of barbets (Family Capitonidae) as mentioned by Bennett and Nandi (1981).

Distribution : India : Goa, Andhra Pradesh, Maharashtra.

Elsewhere : Throughout the distributional range of the Capitonidae.

Remarks : De Mello (1935, 1937) described and subsequently redescribed this species. Bennett and Nandi (1981) redescribed it designating type materials, which were then deposited in the collection of the International Reference Centre for Avian Haematozoa (IRCAH), Canada, now located at Queensland Museum, Australia. Nandi and Mandal (1985) recorded this parasite in *Megalaima zeylanica inornata* from this state.

70. ***Haemoproteus upupae*** de Mello, 1935

1935. *Haemopriteus upupae* de Mello, *Proc. Indian Acad. Sci.*, **2B** : 469-475.

Type materials : Unknown.

Diagnosis : Macrogametocytes halteridial; outline entire; nucleus spherical, ovoid or ribbon-like, compact, subcentral, staining deep rose; pigments in granules or clusters, irregularly distributed; host cell nucleus markedly displaced.

Type host : *Upupa epops orientalis.*

Type locality : Goa, India.

Distribution : India : Goa.

Elsewhere : Southern Russia and possibly throughout the distributional range of the family Upupidae.

Remarks : De Mello (1935) described this species from this state.

71. ***Haemoproteus wenyoni*** de Mello, Braz da Sa, de Sousa, Dias and Noronha, 1916

1916. *Haemoproteus wenyoni* de Mello, Braz da Sa, de Sousa, Dias and Noronha, *Ann. Facult. Cienc. Porto,* **3** : 181-200.

1984. *Haemoproteus wenyoni* : Peirce, *J. nat. Hist.*, **18** : 555-557.

1991. *Haemoproteus wenyoni* : Bennett, Bishop and Peirce, *J. nat. Hist.*, **25** : 23-43.

Type materials : *Neohapantotype* : Blood film No. 41446 from *Orthotomus sutorius* (Pennant), Coll. H. E. McClure, Gujarat, India, 13. Vii. 1970; *Paraneohapantotypes* : Blood film No. 11330 from *Acrocephalus aedon* (Pallas), Coll. H. E. McClure, Chiang-mai, Thailand, 13.V.1967; Blood film No. 10598 from *Acrocephalus arundinaceus* (Linnaeus), Coll. H. E. McClure, Kuala Lumpur, Malaysia, 28.x.1966; Blood film No. 11288 from *Acrocephalus dumetorum* Blyth, Coll. H. E. McClure, Bharatpur, Rajasthan, India, 29. i. 1968. These type materials were earlier located at the International Reference Centre for Avian Haematozoa (IRCAH), Memorial University of Newfoundland, Canada, but at present shifted to the Queensland Museum, Australia.

Diagnosis : Macrogametocytes halteridial, medium to large in size, measuring 12.4 (0.8) μm × 6.5 μm and 63.2 μm² in area, occupying 70-75% of the host erythrocyte area; with entire margins; sometimes causing up to 15% hypertrophy in area and 7% in length; cytoplasm finely granular and lacking small vacuoles;

pigment granules small and dust-like, randomly distributed and averaging 24 granules per parasite; parasite nucleus round to ovoid, compact and subterminal in location; erythrocyte nucleus only slightly displaced laterally; volutin granules rare in occurrence.

Type host : Common tailorbird, *Orthotomus sutorius* (Pennant).

Type locality : Goa, India.

Additional hosts : A number of species of birds belonging to the subfamily Sylviinae as recorded by Bennett *et al.* (1991).

Distribution : India : Goa, Gujarat, Rajasthan.

Elsewhere : Across the range of the subfamily Sylviinae.

Remarks : De Mello *et al.* (1916) from the tailorbird, *Orthotomus sutorius*, first described this species. Peirce (1984) redescribed this species from Zambian bird, *Cisticola erythrops*. However, the present diagnosis is based on the redescription given by Bennett *et al.* (1991) who designated neohapantotype slide from Gujarat about 500 km north of type locality.

72. ***Haemoproteus*** sp

Host : *Corvus splendens*.

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

73. ***Haemoproteus*** sp.

Host : *Corvus macrorhynchus*.

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

74. ***Haemoproteus*** sp.

Host : *Strix ocellata*.

Distribution : India : Goa.

Remarks : de Mello (1937) reported this unnamed species from this state.

75. ***Haemoproteus*** sp.

Host : *Cercheneis tinnunculus objurgatus*.

Distribution : India : Goa.

Remarks : de Mello (1937) reported this unnamed species from this state.

76. ***Haemoproteus*** sp.

Host : *Otus b. bakamoena*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) reported this unnamed species from this state.

77. ***Haemoproteus*** sp.

Host : *Turdoides striatus sommervillei*.

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) reported this unnamed species from this state.

78. ***Haemoproteus*** sp.

Host : *Harpactes fasciatus malabaricus*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) reported this unnamed species from this state.

Family LEUCOCYTOZOIDAE

Diagnosis : Unpigmented gametocyes in the peripheral blood, schizogony in tissue cells of a vertebrate host, sporogony in insects other than mosquitoes.

Genus ***Leucocytozoon*** Sambon, 1908

Diagnosis : Unpigmented parasites in erythroblasts, erythrocytes, and (rarely) leucocytes of birds; host cell grossly hypertrophied, fusiform in some species, nucleus of the host cell always distorted and displaced peripherally (the form of distortion frequently of diagnostic value); first schizogonic cycle hepatic, subsequently in other tissues; schizonts with cytomeres; prepatent period short; sporogony in Simulidae and Ceratopogonidae; oocysts small, unpigmented,

usually containing fewer than 100 merozoites, 9-13 μm in length, one end more pointed than the other.

Remarks : Since most of the species require review at least at the family level, and as such key to the species of *Leucocytozoon* occurring in birds from Goa is not included herein. Bennett and his co-workers (1975 onwards) have made some studies in this direction. However, for host records of *Leucocytozoon* and other blood parasites Bennett *et al.* (1982) and Bishop and Bennett (1992) may be consulted.

79. ***Leucocytozoon ardeae*** Rodhain, Pons, Vandenbranden and Bequaert, 1913

1913. *Leucocytozoon ardeae* Rodhain, Pons, Vandenbranden and Bequaert, *Arch. Protistenk.*, **29** : 259-278.

1936. *Leucocytozoon ardeoleae* de Mello, *J. R. Asiat. Soc. Bengal*, **2**(2) : 95-122.

1992. *Leucocytozoon ardeae* : Bennett, Earle, Du Toit, Huchzermeyer, *Onderstepoort J. vet. Res.*, **59**, 1-73.

Type materials : Unknown.

Diagnosis : Macrogametocytes monomorphic, round to ovoid; cytoplasm alveolated; nucleus circular, staining pale rose. Host cell nucleus covering 80-90% of the circumference of the parasite.

Type host : *Ardea goliath.*

Type locality : Goa, India.

Additional hosts : *Ardeola grayii.*

Distribution : India : Goa.

Remarks : De Mello (1936, 1937) recorded *Leucocytozoon ardeolae* from *Ardeola grayii* from this state. Fallis, Desser and Khan (1974) referred *Leucocytozoon ardeolae* as *species inquirenda.* Bennett *et al.* (1992) considered it as synonym of *L. ardeae*. However, leucocytozoids of the avian family Ardeidae requires review.

80. ***Leucocytozoon brimonti*** Mathis and Leger, 1910

(Syn. : *Leucocytozoon molpastis* de Mello, 1937)

1910. *Leucocytozoon brimonti* Mathis and Leger, *C. R. Seances Soc. Biol.*, **69** : 330-332.

1992. *Leucocytozoon brimonti* : Bennett, Earle and Peirce : *Onderstepoort J. vet. Res.*, **59** : 235-247.

Material examined : Sev. exs., Bondla, 10.x.1977, A. K. Mandal.

Diagnosis : Macrogametocytes small, round to broadly ovoid, 10.3–12.8 μm in diameter and 103.7 (19.7) μm^2 in area, occupying 80% of the area of the host cell-parasite complex; parasite nucleus round to ovoid, sometimes elliptical, occupying 7.5% of the area of the paraste; cytoplasm granular with some vacuoles; volutin granules uncommon; host cell nucleus forming a short band about the parasite covering 35% of the periphery of the parasite and occupying19% of the area of the host cell-parasite complex.

Type host : *Ixus hainanus* (=*Pycnonotus sinensis*).

Type locality : Hanoi, Vietnam.

Additional hosts : The species is widely distributed in birds belonging to the family Pycnonotidae.

Distribution : India : Goa; elsewhere : throughout the range of the Old World family Pycnonotidae.

Remarks : Nandi and Mandal (1985) reported this species in *Pycnonotus cafer* from this state.

81. ***Leucocytozoon chloropsidis*** de Mello, 1935

1935. *Leucocytozoon chloropsidis* de Mello, *Proc. Indian Acad. Sci.*, **1B** : 349-358.

Type materials : Unknown.

Diagnosis : Macrogametocytes round or oval; cytoplasm alveolar, staining deep blue; nucleus round or oval, staining pale rose.

Type host : *Chloropsis aurifrons jerdoni.*

Type locality : Goa, India.

Distribution : India : Goa.

Remarks : De Mello (1935) described this species from this state from the type host. Fallis, Desser and Khan (1974) considered this species as *species inquirenda.*

82. ***Leucocytozoon enriquesi*** de Mello, 1936

1936. *Leucocytozoon enriquesi* de Mello. *J. R. Asiat. Soc. Bengal*, 2(2) : 95-122.

Type materials : Unknown.

Diagnosis : Macrogametocytes round; cytoplasm alveolar; nucleus round, ovoid or sausage-shaped, well stained.

Type host : *Chloropsis jerdoni.*

Type locality : Goa, India.

Distribution : India : Goa.

Remarks : De Mello (1936, 1937) recorded this species from this state. Fallis, Desser and Khan (1974) considered this species as *species inquirenda.*

83. ***Leucocytozoon eurystomi*** Kerandel, 1913 (Syn. *Leucocytozoon coraciae* de Mello and Afonso, 1935, emend Bhatia, 1938; *L. francae* Tendeiro, 1947 emend Hsu *et al.*, 1973; *L. leitaoi* Tendeiro, 1947, emend Bray, 1964; *L. melloi* Bhatia, 1938)

1913. *Leucocytozoon eurystomi* Kerandel. *Ann. Inst. Pasteur Paris*, 27 : 421-439.

1993. *Leucocytozoon eurystomi* : Bennett, Earle, Peirce and Nandi. *S. Afr. Tydskr. Dierk.*, 28(2) : 74-80.

Type materials : *Neohapantotype* : Blood film No. 46093 from *Coracias abyssinica* from Dakar, Senegal, 24.iv.1976, deposited in the International Reference Centre for Avian Haematozoa (IRCAH), Canada, presently located at Queensland Museum, Australia.

Diagnosis : Macrogametocytes with both round and fusiform morphs; round morph small, round to broadly ovoid, occupying 80% of the area of host cell-parasite complex, measuring 11.2-13.4 μm in diameter and 128.7 μm^2 in area; nucleus round to ovoid, usually with marked karyosome, occupying 7% of the area of the parasite; fusiform morph of large size, ovoid to elliptical in shape, 9.1-28.0 μm in diameter and 182.0 μm^2 in area, occupying 90% of the area host cell-parasite complex; nucleus small, ovoid to elliptical with marked karyosome, occupying 6% of the area of the parasite; cytoplasmic horns of the fusiform parasite rather short and generally sharply pointed.

Type host : Blue-throated Roller, *Eurystomus gularis* Meillot.

Type locality : Haute Sangha, Belgian Congo.

Additional hosts : Probably all *Leucocytozoon* infections recorded from the avian family Coraciidae (Bennett *et al.*, 1982).

Distribution : India : Goa; elsewhere : Africa and probably throughout the Old World distribution range of the family Coraciidae.

Remarks : De Mello and Afonso (1935) described two species of leucocytozoids from the Indian Roller, *Coracias benghalensis* without illustration accompanying the description. The parasites were of two types viz., Type A, fusiform parasite and Type B, round parasite. The Type A fusiform parasite was given trinomial nomenclature, *Leucocytozoon coraciae benghalensis*, which was subsequently emended by Bhatia (1938) to *Leucocytozoon coraciae*. De Mello (1937) considered the round parasite (Type B) a second species of leucocytozoid under a new genus *Legerozoon*. Bhatia (1938) compiled and raised the de Mello and Afonso's Type B parasite to a specific status *Leucocytozoon melloi*. Bennett *et al.* (1993) reviewed the leucocytozoid species of the family Coraciidae and synonymised these two species as well as *Leucocytozoon francae* Tendeiro, 1947 emend Hsu *et al.*, 1973 and *Leucocytozoon leitaoi* Tendeiro, 1947 emend Bray, 1964 with *Leucocytozoon eurystomi*, which is agreed and endorsed herein.

84. ***Leucocytozoon sakharoffi*** Sambon, 1908

1908. *Leucocytozoon sakharoffi* Sambon. *J. Trop. Med. Hyg.* 11 : 325-328.

Materials examined : A few exs., Bondla, 6.x.1977, A. K. Mandal.

Diagnosis : Macrogametocytes round; host cell nucleus thin band-like, covering around 80-90% around the circumference of the parasite.

Type host : *Corvus corax.*

Additional hosts : *Dendrocitta vagabunda* from Goa, India. However it is a cosmopolitan parasite of the avian family Corvidae (Bishop and bennett, 1992).

Distribution : India : Goa.

Elsewhere : Cosmopolitan.

Remarks : Nandi and Mandal (1985) reported this species in *Dendrocitta vagabunda* from this state.

85. ***Leucocytozoon toddi*** Sambon, 1908

1907. *Leucocytozoon toddi* Sambon, *J. Tro: Med. Hyg.*, **11** : 325-328.

1977. *Leucocytozoon toddi* Sambon : Greiner and Kocan : *Can. J. Zool.*, **55** : 761-770.

Materials examined : Sev. exs., Molem, 3.x.1977, A. K. Mandal.

Type host : *Kaupifalco monogrammicus.*

Type locality : Congo.

Diagnosis : Macrogametocyte round (14.0 × 10.0 μm) or elongated (20.5 × 8.2 μm and 133.2 μm^2 in area); cytoplasm vacuolated; nucleus oval to round or elongated, host cell nucleus 21.0 μm^2 in area, usually applied laterally to gametocyte, occasionally encircled by gametocyte and often shorter than gametocyte length; infected host cell spindle-shaped with wings of variable size, measuring 38.0 × 10.5 μm and 186.2 μm^2 in area; host nuclear index 1.7; parasite index 2.0 and host-parasite index 2.7.

Additional hosts : Presumably all *Leucocytozoon* infections recorded from the avian order Falconiformes (Bennett *et al.*, 1982).

Distribution : India : Goa, Andhra Pradesh; elsewhere : throughout the range of the avian order Falconiformes (Greiner and Kocan, 1977). Nandi and Mandal (1985) reported this species in *Accipiter badius dussumieri*.from this state.

86. ***Leucocytozoon*** sp.

Host : *Oriolus oriolus kundoo.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1937) reported this unnamed species from this state.

87. ***Leucocytozoon*** sp.

Host : *Oriolus oriolus xanthornus.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1937) reported this unnamed species from this state.

88. ***Leucocytozoon*** sp.

Host : *Pycnonotus jocosus.*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) reported this unnamed species from this state.

89. ***Leucocytozoon*** sp.

Host : *Turdoides striatus sommervillei.*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) reported this unnamed species from this state.

90. ***Leucocytozoon*** sp.

Host : *Tockus g. griseus.*

Distribution : India : Goa.

Remarks : Nandi and Mandal (1985) reported this unnamed species from this state.

Subclass PIROPLASMIA

Order PIROPLASMIDA

Suboredr PIROPLASMIDEA

Family BABESIIDAE

Genus ***Babesia*** Starcovici

Diagnosis : Parasites pyriform, intra-corpuscular, unpigmented, mostly in pairs, ring-shaped or elliptical; transmission by ticks.

91. ***Babesia canis*** Piana and Galli- Valerio, 1895

1895. *Pyrosoma bigeminum* var. *canis* Piana and Galli-Valerio, *Moderno Zooiatro*, **9** : 163.

1938. *Babesia canis* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London, : 307.

Diagnosis : Parasites typicaly pear-shaped, 4-5 μm in length, rounded and bulbous at one end and pointed at the other; cytoplasm with a vacuole; nucleus deeply stained granules situated at the pointed end, with a string of fine granule extending from it; parasites passing through a series of stages, initially rounded with a large vacuole and a string of chromatin granules; parasites becoming amoeboid with the disappearance of the vacuole and the string of chromatin withdrawn into the large granule; schizogony by budding; multiple parasites as many as 16 in a single corpuscle; transmitted by ticks.

Host : *Canis familiaris.*

Distribution : India : Goa; Tamil Nadu, Punjab and central province.

Elsewhere : Asia, Africa and southern Europe.

Remarks : The parasite was first discovered as the cause of malignant jaundice of dogs in Italy and is at present widely distributed. De Mello *et al.* (1917) reported this unnamed species from *Caris familiaris* from this state. In addition to dogs, wolf and jackal appear to be natural hosts.

INCERTAE SEDIS

Family ANAPLASMIDAE

Genus *Anaplasma* Theiler, 1910

Diagnosis : Parasites spherical, intra-coruscular, chromatic body, usually less than 0.5 μm in diameter, situated at or near the edge or towards the centre of the red blood corpuscles; transmission by ticks.

92. ***Anaplasma*** sp.

Host : *Perca fluviatilis.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

93. ***Anaplasma*** sp.

Host : *Rana tigrina.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

94. ***Anaplasma*** sp.

Host : *Rana esculenta.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

95. ***Anaplasma*** sp.

Host : *Hemidactylus brooki.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

96. ***Anaplasma*** sp.

Host : *Coluber blumenbachi.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

97. ***Anaplasma*** sp.

Host : *Naja naja.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

98. ***Anaplasma*** sp.

Host : *Chitra indica.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

99. ***Anaplasma*** sp.

Host : *Homo sapiens.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

Genus ***Paraplasma*** Seidelin, 1912

Diagnosis : Parasitesppolymorphic, intra-corcuscular, varying in size from a small chromatic granule to large bodies consisting of a chromatic granule with a shaft of cytoplasm.

100. ***Paraplasma*** sp.

Host : *Homo sapiens.*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

Genus ***Bertarellia*** Carini, 1930

Diagnosis : Parasites polymorphic, intra-corpuscular, round or oval, varying in size from as small as cocci to as large as 1-2 um in diameter; infecteded cells remaining unaltered.

Remarks : Key to the species is not given as there are only two named species, one occurring in lizards and the other in turtle.

101. ***Bertarellia calotis*** de Mello and de Meyrelles, 1937

1937. *Bertarella calotis* de Mello and de Meyrelles, *Proc. Indian Acad. Sci.*, **6B** : 98-108.

1938. *Bertarella calotis* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London : 326-327.

Diagnosis : Parasite circular, intra-corpuscular or free, with refringent greenish cytoplasm, dividing by budding; showing a variety of forms, either as a small round chromatin dot of anaplasmoid nature or like a vacuole devoid of central granule; cytoplasm often surrounded by a circular halo; chromatin granule central or located at the periphery attached to the membrane; infected erythrocyte unaltered even in case infected with 2 or 3 parasites.

Host : *Calotis versicolor.*

Distribution : India : Goa.

Remarks : de Mello and de Meyrelles (1937) reported this species from this state.

102. ***Bertarellia carinii*** de Meyrelles, 1938

1938. *Bertarella carinii* de Meyrelles, *Proc. Indian Acad. Sci.*, **7B** : 49-53.

1938. *Bertarella carinii* : Bhatia : *The Fauna of British India, including Ceylon and Burma. Protozoa : Sporozoa.* Taylor and Francis, London, : 389.

Diagnosis : Parasite central, polar or peripheral in position; usually roundish or elliptical, rarely oval, pyriform or ring-like; each anaplasmoid body surrounded by a clear halo; parasitized erythrocyte sometimes containing more than one parasite.

Host : *Lissemys punctata granosa.*

Distribution : India : Goa.

Remarks : de Meyrelles (1938) reported this species from this state.

103. ***Bertarellia*** sp.

Host : *Lissemys punctata granosa*

Distribution : India : Goa.

Remarks : de Mello *et al.* (1917) reported this unnamed species from this state.

ADDENDUM

Besides blood protozoa a considerable number of species of other parasitic protozoa belonging to opalinids, adeline coccidians as well as balantidiid and nyctotherid ciliates inhabiting the digestive tracts, intestinal lumen or rectal content, of mostly anuran hosts as well as one species each of mollusc and dictyopteran hosts have been recorded from this state by de Mello (1921, 1930, 1931, 1932). These species are listed herein to indicate the extent of investigation made on this subject. The symbiotic protozoan flagellate species recorded from this state by de Mello and his co-workers are not included in this list.

Parasite	Host	Locality (Reference)
	Phylum SARCOMASTIGOPHORA	
	Subphylum OPALINATA	
	Class OPALINATEA	
	Order OPALINIDA	
	Family OPALINIDAE	
	Genus ***Cepedea*** Metcalf, 1920	
C. longa (Bezzenberger, 1904)	*Rhacophorus malabaricus*	Goa (de Mello, 1930, 1931)
C. seychelensis var. *angusta* de Mello, 1932	*Bufo melanostictus*	Goa (de Mello, 1932)
	Rana tigrina	Goa (de Mello, 1932)
C. subcylindrica de Mello, 1932	*Bufo melanostictus*	Goa (de Mello, 1932)
C. thiogi de Mello, 1930	*Rhacophorus maculatus*	Goa (de Mello, 1930, 1931)
	Genus ***Opalina***	
O. coracoidea Bezzenberzer, 1904	*Rana cyanophlyctis*	Goa (de Mello, 1932)
O. lata Bezzenberger, 1904	*Rana limnocharis*	Goa (de Mello, 1932)
O. lata var. *cordata* de Mello, 1932	*Rana cyanophlyctis*	Goa (de Mello, 1932)
	Rana malabarica	Goa (de Mello, 1932)
O. ranarum (Ehrenberg, 1831)	*Bufo melanostictus*	Goa (de Mello, 1932)
	Rana cyanophlyctis	Goa (de Mello, 1932)
	Rana tigrina	Goa (de Mello, 1932)
O. scalpiformes Ghosh, 1919	*Bufo melanostictus*	Goa (de Mello, 1932)
O. triangularis Ghosh, 1919 (Syn. *Opalina obtrigonoidea* de Mello, 1932)	*Bufo melanostictus*	Goa (de Mello, 1932)
	Phylum APICOMPLEXA	
	Class SPOROZOEA	
	Subclass COCCIDIA	
	Order EUCOCCIDA	
	Suborder ADELEINA	
	Family ADELEIDAE	
	Genus ***Adelea*** Schneider, 1875	
A. pachelabrae de Mello, 1921	*Pachelabra moestra* (Mollusca)	Goa (de Mello, 1921)
	Phylum CILIOPHORA	
	Clas KINETOPRAGMINIPHOREA	
	Oredr TRICHOSTOMATIDA	
	Family BALANTIDAE	
	Genus ***Balantidium*** Claparde and Lachman, 1858	
B. gracilis Bezzenberger, 1904	*Rana tigrina*	Goa (de Mello, 1932)
B. helenae Bezzenberger, 1904	*Rana cyanophlyctis*	Goa (de Mello, 1932)
	Rana limnocharis	Goa (de Mello, 1932)
	Rana tigrina	Goa (de Mello, 1932)

Parasite	Host	Locality (Reference)
	Class POLYHYMENOPHOREA Order HETEROTRICHIDA Family NYCTOTHERIDAE	
	Genus ***Nyctotheroides*** Grasse, 1928	
N. cordiformis (Ehrenberg, 1938)	*Rana limnocharis*	Goa (de Mello, 1932)
	Rana malabarica	Goa (de Mello, 1932)
	Rana tigrina	Goa (de Mello, 1932)
	Genus ***Nyctotherus*** Leidy, 1849	
N. fletcheri de Mello, 1919	*Leucotermes indicola* (= *Heterotermes indicola*)	Goa (de Mello, 1919)
N. ovalis Leidy, 1849	*Periplaneta americana*	Goa (de Mello *et al.*, 1934)
N. papillatus Dobell, 1910	*Rhacophorus maculatus*	Goa (de Mello, 1930-1932)
	Family SICUOPHORIDAE Genus ***Sicuophora*** de Puytorac and Grain, 1969	
S. macropharyngea (Bezzenberger, 1903) (Syn. *Nyctotherus macropharyngeus*)	*Rana cyanophlyctis*	Goa (de Mello, 1932)
	Rana limnocharis	Goa (de Mello, 1932)
	Rana tigrina	Goa (de Mello, 1932)
S. malabarica de Mello, 1932 (Syn. *Nyctotherus magnus* var. *malabarica* de Mello, 1932)	*Rana tigrina tigrina*	Goa (de Mello, 1932)

GENERAL REMARKS

Goa, which attains its statehood in 1987 with 3,702 sq. km. in area, is the smallest state in India with 13,43,998 population (2001 census), while Daman and Diu together cover an area of 112 sq. km. with 1,58,059 population (2001 census) retain its earlier status of Union Territory. However, in the present paper, erstwhile Portuguese India, presently Goa State as well as Daman and Diu, is taken into consideration for this study for convenience of the future researchers as the works of de Mello and his co-workers (1915-1938) relate to all these three parts of the country.

SUMMARY

This paper deals with a total of 103 species of blood protozoa belonging to 11 genera and 8 families under 3 orders 2 classes and 2 phyla inhabiting in 88 species and subspecies of vertebrate hosts from erstwhile Protuguese India, presently Goa state and Daman and Diu territories. In adition to above an addendum dealing with a list of intestinal parasites (excluding symbiotic protozoa) reported from this part of the country is also included in this paper. There are 20 species of blood protozoa representing the phylum Sarcomastigophora and 83 species under phylum Apicomplexa.

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LAND AND FRESHWATER MOLLUSCS

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INTRODUCTION

The phylum Mollusca among invertebrate is one of the important group because it is the second largest group of animal kingdom on the basis of its species number. They found on land, freshwater and most of them are marine. Out of the seven classes of Mollusca only five classes found in India. We are dealing herewith only two classes i.e. Gastropoda and Bivalvia.

Mollusca are soft bodied animals and the body in many species are protected by calcareous shell. We are giving herewith only freshwater and land Mollusca. Terrestrial Mollusca are generally found near moist places, under leaf, bark of tree and under stones, whereas freshwater Mollusca are found in varied places like lentic and lotic water or embankment or on weed grasses or among macrophytes. The estimated number of Mollusca today various from 80,000 speciess Boss (1971) to 1,35,000 species Abott (1989). The present site comes under Western Ghats which is known for its rich fauna and flora.

Mollusca play a very important role as link in food chains, they are detritus feeder, improve quality of bottom sediments and soil condition. Some Mollusca are widely distributed. The freshwater Mollusca are good indicators of quality of water, the genera like *Thiara* and *Indoplanorbis* thrive well in slightly polluted environment. Similarly the members of genera *Lymnaea* are opportunistic and thrive in polluted water. Terrestrial Gastropods are easily collected and serve as indicators of leaf-litter biodiversity.

SOCIO-ECONOMIC SIGNIFICANCE

Already a list of edible Mollusca is given by Subba Rao (1989). In Northeastern India Shellfish market exists and species like *Bellamya bengalensis, Lamellidens marginalis, L. corrianus* and *Pila globosa* are proved to be food for many aquatic animals as well as man. In Dongarwadi near Pune, villagers eat *Cyclophorus* as a source of protein cheap food, when the cost of fish is more. Mavinkurve *et al.* (2004) in coastal Karnataka *Pila globosa* is used in treatment of throat diseases and in wound healing of fowls. Bivalve Mollusca *Lamellidens marginalis, L. corrianus* are reported to produce pearls. Use of shell material for preparing buttons and for manufacturing poultry feed is well known.

Some of them are intermediate host for trematode parasites for spread of many diseases. The present study includes freshwater Gastropods and Bivalvia and few land Mollusca from Goa State. A perusal of literature reveals the work of many Malacologists; mention may be made of Hude (1914, 21), Preston (1915) Annandale and Prasad (1919); Hora (1926a); Tonapi and Mulherkar (1963); Tonapi (1971) Subba Rao and Mitra (1975a). Surya Rao *et al.* (2002); Madhyastha *et al.* (2002); Mavinkurve *et al.* (2004), Sandya et al. 2004 and Patil and Talmale (2005); Patil and Ramakrishna (2004).

GENERAL INFORMATION

Goa is a small tiny emrald Land on West coast of India. The area of this state is 3,702 sq. kms

and the altitude above sea level is 1,022 metres. Summer maximum temperature reaches to 32.7°C and winter minimum temperature 21°C and the rainfall from June to September is 3,200 mms. Its location lies between latitude 15°48′00″N 17°53″N and longitude 74°20′13″E and 73°40′33″E.

Administratively Goa State is divided in two zones north and south with headquarters at Panjim and Margoa respectively, the dividing line is Zuari river. The Western Ghats region of Goa constitutes an important component of Sahyadri which is spread over three talukas *viz.* Sattari, Sanguem and Conacona. Molem Sanctuary is the oldest and was set up in 1968. The other protected area in the region are Bondla Wildlife Sanctuary and Cotigao Wildlife Sanctuary and Ali Bird Sanctuary (Chorao) for conservation of Mangroove vegetation and estuarine fauna. In Goa State following river flow *viz.* Tarekhol, Chapora, Mandovi, Zuari, Bal, Khandepor, Taipan and Gulsibag. The two water falls Dudhsagar and Horavelem falls in this region. Many species of animals like Python, flying Lizard, King cobra, Giant squirrel, Malabar frog, Crested serpant eagle, Indian Sikara, Owl species, bush quail, Pea fowl, Spur fowl, Wood pecker etc., are observed in this area.

The present work is an attempts to provide an information on Molluscan fauna of freshwater and land habitats based on collection made by Western Regional Station, Pune. In all 25 species from land and freshwater environs of Goa State have been recorded for–the first time from this region.

LIST OF MOLLUSCA (FRESHWATER)

Phylum MOLLUSCA
Class GASTROPODA
Order MESOGASTROPODA
Family VIVIPARIDAE
Subfamily BELLAMYINAE

1. *Bellamya bengalensis f. typica* (Lamarck)
2. *Bellamya bengalensis annandalei* (Kobelt)
3. *Bellamya dissimilis* (Mueller)

Family PILIDAE

4. *Turbinicola saxea* (Reeve)

Family THIARIDAE
Subfamily THIARINAE

5. *Thiara (Thiara)* scabra (Mueller)
6. *Thiara (Melanoides) tuberculata* (Mueller)
7. *Thiara (Tarebia) linaeta* (Gray)

Order BASOMMATOPHORA
Family LYMNAEIDAE

8. *Lymnaea (Pseudosuccinia) acuminata f. typica* (Lamarck)
9. *Lymnaea (Pseudosuccinia) luteola f. typica* Lamarck

Family PLANORBIDAE
Subfamily BULININAE

10. *Indoplanorbis exustus* (Deshayes)
11. *Gyraulus convexiusculus* (Hutton)

Class BIVALVIA
Order UNIONOIDA
Family UNIONIDAE

12. *Lammellidens corrianus* (Lea)
13. *Lamellidens consobrinus* (Lea)
14. *Lamellidens marginalis* (Lamarck)

Family AMBLEMIDAE

15. *Parreysia (parreysia) corrugata* (Mueller)
16. *Parreysia (p) favidens* (Benson)

Order VENEROIDA
Family CORBICULIDAE

17. *Corbicula striatella* Deshayes

B. LAND MOLLUSCS

Class GASTROPODA
Order MESOGASTROPODA
Family CYCLOPHORIDAE

18. *Cyclophorus (Litostylus) indicus* (Deshayes)

Order STYLOMMATOPHORA
Family CERSTUIDAE
Subfamily NEPACINAE
Genus ***Rachis*** Albers

19. *Rachis punctatus* Anton

Family SUBULINIDAE

20. *Lamellaxis gracile* (Hulton)

Family ARIOPHANTIDAE

Subfamily ARIOPHANTINAE

21. *Ariophanta bajadera* (Pfeiffer)
22. *Ariophanta laevipes* (Muller)
23. *Cryptozona (Nilgiri) semirugata* (Beck)

Genus ***Macrochlamys*** Gray

Subfamily MACROCHLAMYDINAE

24. *Macrochlamys teniuacula* (H. Adams)
25. *Macrochlamys* sp. pedina B.S.

Key to the families

Key to the families recorded in this paper is provided and identifications of the genus may be made with the help of key of each family.

1. Shell with one valve 2
- Shell with two valves 10
2. Shell with operculum 3
- Shell without operculum 7
3. Shell Subglobular collemuller part expanded ovate or subcircular opertuse 4
- Shell elongate or globose collemuller area unexpanded aperture ovate or subcircular... 4
4. Shell moderately large, last whorl sufficiently inflated, Operculum with concentric growth lines 5
- Shell small to moderately long. Last whorl less inflated Operculum with spiral growth lines 6
5. Operculum calcareous shell globose and large aperature Ovate, body whorl inflated and larger than spire ..... PILIDAE
- Operculum horny shell pyramidal; whorls regularly increase in size, aperture subcircular ..... VIVIPARIDAE
6. Shell above 10 mm, sculpture distinct, animal with broad pouch, mantgle border fringed ..... THIARIDAE
- Shell below 10 mm, sculpture not very distinct, without broad pouch
7. Shell extended elongate with distinct spire, dextrally coiled, columeller axis typically twisted ..... LYMANAEIDAE
- Shell discoidal, spire depressed, columeller axis not twisted ..... PLANORBIDAE
8. Pallial sinus absent 9
- Pallial sinus present 10
9. Shell small thin hinge curved .....
- Shell moderate to large size and thick hinges not curved 10

Shell transversely elongate or sub rhomboid with out striae, ligament internal..... ..... UNIONIDAE

10. Shell ovately trigenal, and distinct concentric striae ligament external CORBICULADAE
- Shell sub rhomboid or transversely elongate concentric striae absent, lingament strong and internal..... UNIONIDAE

Order MESOGASTROPODA

Family VIVIPARIDAE

Subfamily BELLAMYINAE

Genus ***Bellamya*** Jousseoume, 1886

Shell rather thin, smooth with bands or with faint spiral striae. Inhabitant of stagnant water among vegetations, last whorl usually rounded, the following species identified among material studied.

Key to Species

1. Shell with distinct spiral band .... *Bellamya bengalensis* (Lamark)
- Shell without spiral band or pigmentation... 2
2. Shell thin, whorls, gradually increasing, less rounded and with rather straight .... *Ballamya annandalei* (Kobelt)

– Last whorl of shell subangulate, imporforate shell oval ..... *B. dissimilis* (Mulfer)

SYSTEMATIC ACCOUNT OF EACH SPECIES

Phylum MOLLUSCA

Class GASTROPODA

Subclass PROSOBRANCHIA

Order MESOGASTROPODA

Family VIVIPARIDAE

Subfamily BELLAMYINAE

Genus ***Bellamya*** Jousseaume 1886

1. *Bellamya bengalensis f. typica* Lamarck

Common name **Banded pond snail**

1822. *Paludina bengalensis* Lamarck, *Hist. nat. Anim. Sans. Vert.*, **6,** 2 : 174.

1921. *Vivipara bengalensis* Annandale, *Rec. Indian Mus.*, **22** : 267.

1980. *Vivipara bengalensis forma typica* (Lamarck) Subba Rao, Das and Mitra, *Rec. zool. Surv. India,* **77,** 225, p 1, fig. 5.

Material examined : 3 exs., River near Chandor Village, Goa Date 2/3/2002, Coll. S.G. Patil; 4 exs., Tulsimal river, date 23/2/2002, Coll. S.G. Patil; 2 exs., Bondla Sanctuary date 25/9/99, Coll. M.S. Pradhan.

Distribution : Goa, Maharashtra, Common throughout rest of India.

Elsewhere : Bangaladesh, Myanmar, Sri Lanka.

Status : Most common throughout.

2. *Bellamya bengalensis f. annandalai* (Kobelt)

1908. *Vivipara anandalai* Kobelt, *Nachar. Malak, Geseu.*, Frankfurt, **60** : 161–162.

1921. *Vivipara bengalensis* Phase *annandalai*, Annandale & Sewell, *Rec. Indian Museum;* Calcutta, **22,** 276, pl. 2 figs 5–8.

Material examined : 4 exs., River near Chandor Village Goa, date 2/3/2002, Coll. S.G. Patil; 2 exs., Forested area near Usgaon Ponda, date 30/9/93, Coll. M. S. Pradhan.

Distribution : Goa, Maharashtra, Andhra Pradesh, Bihar, Orissa, Rajasthan, Tamil Nadu and West Bengal.

Remarks : Shell usually thinner, Translusent with steady increasing whorls which are less rounded.

3. *Bellamya dissimilis* (Mueller)

1774. *Nertia dissimilis* Mueller, *Hist. Verm. Terr. Fluv.* **2** : 184.

1960. *Viviparus dissimilis* : Satyamurti, *Bull. Madras Govt. Mus;* **6**(4) : 33–34.

Material examined : 2 exs., Bhagwan Mahavir Sanctuary, date 30/11/93, Coll. P.D. Rane; 2 exs., Khandepar river, date 27/2/03, Coll. S.G. Patil.

Distribution : Goa, Maharashtra, Orissa, West Bengal, Peninsular and Northern India.

Remarks : Body whorl subangulate at the periphery.

Family PILIDAE

Genus ***Pila*** Roeding, 1798

Shell characters are generally variable, shell very large, usually dextral, globose, spire little raised, aperture rather large, operculum calcareous with a lateral nucleus.

Key to species

– Shell globose and spacious, spire depressed and upper surface of whorls obliquely flattened ..... *Pila globosa* (Swainson)

Genus ***Turbinicola*** Annandale And Prashad 1921

Members of this genus are restricted to hill streams of Western Ghats, India and Myanmar. Generally resemble like *Pila* but some anatomical changes occur due to its habitat. Two species are Indian and one Burmese. The shell in Burmese species is more globose generally smooth than Indian species.

4. *Turbinicola saxea* (Reeve, 1856)

1956. *Ampullaria saxea* Reeve. *Conch Icon.*, 10 *Ampullaria* pl. xxii, fig. 109. *Type Locality* : Stream near Khandala (Prashad, 1925).

1925. *Turbnicola saxea* : Prashad. *Mem. Indian Mus.*, **8** : 87 pl. xiv, fig. 10–12.

Material examined : 2 exs., Chandor Village, Goa State, Date 2/3/02, Coll. S.G. Patil.

Distribution : Goa; Maharashtra : Hill streams around Khandala and Igatpuri, Western Ghat.

Family THIARIDAE

Subfamily THIARINAE

Genus ***Thaira*** Roeding, 1798

Moderately large scale (upto 5 cms.) nodulus usually with spines, sculptured with striae without canal or groove, operculum thin, angulate above with a basal nucleus, aperature ovate, ovoviparous with neck broad pouch.

Key to subgenera

1. Shell shape pagoda like, spires on shells descend in regular steps with spines..... ..... ***Thiara s. Str.***
- Shell shape elongated, spire on shell descend evenly without spines 2
2. Shell with number of whorls upto 12, with crisscrossing striae, giving it a tubercle appearance ..... ***Melanoides***
- Shell with crisscrossing ridges giving it a granular appearance and the number of whorls upto nine ..... ***Tarebia***

5. ***Thiara (Thiara) scabra*** (Mueller)

1774. *Buccinum scabrum* Mueller. *Hist. Verm. Ten Fluv.*, **2** : 136. *Type locality* : Tranquebar.

1850. *Melania acanthica* Lea. *Proc. Zool. Soc. Lond.* : 334.

1973. *Thiara (Thiara) scabra* Pace, *Malac Review Suppl.* **1** : 52, pl. 12, fig. 1, 2 pl. 13, fig. 3.

Material examined : 2 exs., Stream near Molem, date 28/2/2002, Coll. S.G. Patil, 2 exs., Colem river, date 26/2/2002, Coll. S.G. Patil.

Status : Common throughout India except Kashmir.

Distribution : Goa, Maharashtra, Throughout except Kashmir.

Elsewhere : Coasts of Indo-Pacific from Zanjibar to New Hebrides, North to the Philippines, various Pacific Islands.

6. ***Thiara (Melanoides) tuberculata*** Mueller

1974. *Nerita tuberculata* Muller. *Hist. Verm. Torr Fluv.*, **2** : 191. *Type locality* : Coromandel coast.

1836. *Melania pyramis* Benson. *J. Asiat. Soc. Beng.* **5** : 357. Type locality : Ganges.

1969. *Melanoides (Melanoides) peddamunjgalensis* Roy and Toy Chowdhuri. *Proc. Zool. Soc.*, Calcutta **22** : 48 p. 14, fig. 12-17. Type locality : Peddamunigal Nagarjunakonda Nalgonda dist. A.P.

Material examined : 2 exs., Chandor village, Goa, date 2/8/2002, Coll. S.G. Patil; 4 exs., river near Keri Rest House, 24/2/2002, Coll. S.G. Patil.

Distribution : Goa, Maharashtra, Orissa throughout India except Kashmir.

Elsewhere : North and South Africa, Eastern Mediterranean countries, South East Asia, Southern China, Malaysia, Malay Archipelago, North Australia, various Pacific Islands and North to Ryukyu Islands of Japan, New Hebrides.

Remarks : Shells are typically narrowly elongate and distinctly sculptured and differ from the shells collected from sandy river beds, rounded whorl, distinctly sculptural with vertical ribs and spiral striae and also with dark brown dots or streaks here and there.

7. ***Thiara (Tarebia) lineata*** Gray

1828. *Helix lineata* Gray. In woods's Index Test supp 24, fig. 68. *Type locality* : Ganges.

1915. *Thiara (Tarebia) lineata* Preston *Fauna of British India. Mollusca* (Freshwater Gastropoda Pelecyponda) : 34.

Material examined : 4 exs., Chandor village, Goa, Date 21/3/2002, Coll. S.G. Patil.

Distribution : Goa, Assam, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal.

Elsewhere : Bhutan, Burma and Sri Lanka.

Order BASOMMATOPHORA

Family LYMNAEIDAE

Genus ***Lymnaea*** Lamarck, 1911

Ovate shell or pyramidal thin and light with a large strongly inflated last whorl collumella spirally twisted, spine pointed.

Key to species

Shell spire comparatively shorter but more acuminate, widely expanded Outertip .... *L. acuminata* Lamarck

Shell spire comparatively large less acuminate, more or less straight Outertip .... *L. luteola* (Lamarck)

8. ***Lymnaea (Pseudosuccinea) acuminata f. typica*** Lamarck

1822. *Lymnaea acuminata* Lamarck. *Hist. Nat. Anim. Sans. Vert.* **6.** pt. 2 : 160.

1925 *Lymnaea (Pseudosuccinea) acuminata* Annandale & Rao, *Rec. Indian Mus.*, **27** : 177.

Material examined : 2 exs., Chandor village, Goa, Date 2/3/2002, Coll. S.G. Patil; 3 exs., Stream near Arjuna dam, Date 25/2/2003, Coll. S.G. Patil.

Distribution : Goa, common throughout India.

9. ***Lymnaea (pseudosuccinea) luteola f. typica*** Lamarck

Freshwater snail

1822. *Limnaea luteola* Lamark, *Hist. Nat. Anim. Sans. Vert.* **6** pt. 2 : 160.

1925. *Limnaea (Pseudosuccinea) luteola,* Annandale & Rao, *Rec. Indian Mus.*, **27** : 183.

Material examined : 2 exs, Chandor village, Goa, Date 2/3/2002, Coll. S.G. Patil; 2exs., Bondla Sanctuary, Date 25/9/93, Coll. M.S. Pradhan.

Status : Common throughout India.

Distribution : India, Maharashtra.

Elsewhere : Sri Lanka and Myanmar.

Remarks : This species is reported to be very particular about its habitat and is often found in temporary waterbodies. They burry themselves in dormant conditions. It is reported to be a pest to paddy and Azole, Intermediate host for many parasites of live stocks. Producers of biofertilizer in some part of West Bengal Subba Rao (1989). This species can be distinguished from its mere ovate shell with narrower aperature and less pointed spine.

Family PLANORBIDAE

Subfamily BULININAE

Genus ***Indoplanorbis*** Annandale and Prashad 1921

Key to the genera

Comparatively large shell (More than 10 mm), with convex whorls, aperture ear shaped with convex whorls ....***Indoplanorbis*** Annandale & Prashad

Animal shell rather smaller in size, less 10 mm, Paurispiral depressed with flattened whorls aperture wide ....***Gyraulus*** Charpentier

10. ***Indoplanorbis exustus*** (Deshayes)

1834. *Planorbis exustus* Deshayes, in Belanger, *Voy Indes. Orientalis,* : 417, pl. 1. figs. 11–13. *Type locality* : Malabar Coast.

1956. *Indoplanorbis exustus* Bentham Jutting. *Treubia* **23**(2) : 471. Rajgopal and Subba Rao, 1968. *Proc. Symposium on Mollusca,* pl. 1 : 110.

Material examined : 4 exs., Bhagwan Mahavir Sanctuary, Date 30-11-93, Coll. P.D. Rane; 2 exs., Tulsimal river, Date 23/2/02, Coll. S.G. Patil.

Distribution : Goa, Maharashtra, Throughout the plains of India, Jammu and Kashmir,

Elsewhere : Pakistan, Persia, Sri Lanka, Burma, Malaya, Indo-China, Thailand, Sumatra, Java, Celebes.

Remarks : This species is a known vector snail is implicated as intermediate host for the largest number of parasites.

Gyraulus (Clessin, 1886)

11. ***Gyraulus convexiusculus*** (Hutton)

1849. *Planorbis convexiusculus* Hutton. *J. Asiat. Soc. Beng.*, **18**(2) : 657.

1956. *Gyraulus convexiusculus* Benthem Jutting *Treubia*, **23**(2) : 463.

Material examined : 2 exs., Kasjal village, date 5/3/2002, Coll. S.G. Patil.

Distribution : India : Goa, Maharashtra, Common throughout.

Elsewhere : Extends from Iran to Philippines.

Remarks : Maximum diameter rarely exceeds 5 mm., whorls 4 or 5 rounded, suture well defined peripheri subangulate, closely and obliquely striate, umbilicus wide all the whorl distinctly seen above, aperature ovate lunate.

Class BIVALVIA

Order UNIONOIDA

Family UNIONIDAE

Equivalves nacreous hinge with two cardinal and two posterior lameller teeth in left valve and one each in right valve.

Key to the Genera

Shell round to subrhomboid, beak with strong sculpture, cardinals rugged and vertically strial ..... ***Parreysia*** Conrad

Shell rather elongate, without sculpture beak, compressed cardinal and elongate .... ***Lamellidens*** Simpson

Genus ***Lamellidens*** Simpson, 1900

Elongate shell, elliptical and pointed behind beaks, with curved thin radiating ridges, cardinal teeth elongate compressed.

Key to the species

Umbo prominent, shell broad colour brown with lighter band along margin .... *L. marginalis* (Lamarck)

Umbo less prominent and shell less broad, colour uniformly dark .... *L. corrianus* (Lea)

Umbo more inflated, shell rhomboidal, dorsal margin curved ..... *L. consobrinus* (Lea)

12. ***Lamellidens corrianus*** Lea

1834. *Unio corrianus* Lea. *Trans. Amer. Phil. Soc.* **5**(2) : 65, pl. 9, fig. 25.

1922. *Lamellidens corrianus* : Prashad. *Rec. Indian Mus.*, **24** : 106.

Material examined : 14 exs., Cotigao Sanctuary, Date 30/9/93, Coll. M.S. Pradhan.

Distribution : Goa, Maharashtra, Common throughout India.

Elsewhere : Bangladesh and Myanmar.

13. ***Lamellidens consorbrinus*** (Lea)

1859. *Unio consorbrinus* Lea. *Proc. Acad. Nat. Sci.*, Philad. **3** : 331, *Type Locality* : China.

1921. *Lemellidens consorbrinus* Prashad. *Rec. Indian Mus.*, **22** : 608.

Material examined : 2 exs., Stream near Molem, Date 28/2/2002, Coll. S.G. Patil.

Distribution : Goa, Maharashtra.

Elsewhere : Sri Lanka.

Remarks : Shell rhomboidal, thick, umbones more inflated than in *L. marginalis*, dorsal margin curved and obliquely truncate, posterior side obtusely angled, anterior side rounded, left valves with two ragged cardinals.

14. ***Lamellidens marginalis*** (Lamarck, 1819)

1819. *Unio marginalis* Lamarck. *Hist. Nat. Anim Sans Vert.* **4** : 79. Type Locality : Bengal.

1950. *Lamellidens marginalis* Simpson. *Proc. U.S natn Mus.*, **22** : 854, Prashad. 1921. *Rec. Indian Mus.*, **22** : 606, fig. 29.A.

Material examined : 3 exs., Dubel river Cotigaon, Date 21/9/93, Coll. S.G. Patil.

Shell oblong, ovate thin very smooth, Periostracum blackish brown shinning, light brown border along the ventral margin, posterior side broad, roundedly angular two curved lateral teeth.

Distribution : Goa, Maharashtra, Assam, Bihar, Manipur, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar and Pegu.

Family AMBLEMIDAE

Subfamily PARREYSIINAE

Genus ***Parreysia*** Conrad 1853

Round to rhomboidal Shell, inflated with zig zag ribs on beaks, periostracum smooth bright red cardinal teeth heavy, lamellar teeth short duplicating in right valves.

Subgenus ***Parreysia*** *S. str.*

Shell oval to elliptical, thick, ventral margin convex.

Key to species

1. 3 or more cardinal teeth, very strong .... *P. favidens* Benson
- less than 3 cardinal teeth, strong 2
2. Black periostracum 3
3. Shell less elongate posterior ridgeprominent and more inflated beak..... ..... *P. corrugata* (Mueller)

15. ***Parreysia (Parreysia) favidens*** Benson

1860. *Unio favidens* Benson, 1860, *Ann. Mag. Nat. His.*, **10** : 188.

1989. *Parreysia (parreysia) favidens* Subba Rao, *Handbook of Freshwater Mollusca of India* : 180, fig. 466, 467, 484, 485.

Material examined : 3 exs., Talpan river near Canacona date 20/9/93 Coll. M.S. Pradhan.

Thicker larger more inequilateral, both anterior and posterior margins angulate, cardinal teeth strong and broad.

Distribution : Goa, Maharashtra, Common throughout.

Elsewhere : Bangladesh, Burma and Pakistan.

16. ***Parreysia (Parreysia) corrugata*** (Mueller)

1774. *Mya corrugata* Mueller. *Verm. Terr. et. Fluv.*, Pt. 2 : 214, No. 398. *Type Locality* : Rivers of coromondel.

1900. *Parreysia corrugata* Simpson *Proc. U.S. natn. Mus.*, **22** : 841. Preston, 1912, *Rec. Indian Mus.*, **7** : 297.

Material examined : 2 exs., Talpan river near Canacona, date 20/9/93, Coll. M.S. Pradhan.

Shell green elliptic to oval scarcely inequilatgeral; Ventral margin convex, lunule well marked, cardinal teething strong, not lameller, sculptured somewhat at radiating, oblique linear ridges.

Distribution : Common with wide range of distribution, Goa, Andhra Pradesh, Bihar, Karnataka, Maharashtra, Punjab.

Elsewhere : China and Bangaladesh.

Order VENEROIDA

Family CORBICULIDAE

Genus ***Corbicula*** Megerle Von Muehlfeld 1811

Shell subtrigenal thick with strong concentric striae umbones prominent, well developed periostrucum hinge with strong cardinal and lateral teeth.

Key to the genera

Shell less than 5 cms in length strongly and evenly rubbed, lateral teeth serrated..... ..... ***Corbicula*** Megerle Von Muhlfeld

Key to species

Shell thin, with very fine concentric striae, microscopic ..... *C. bensoni* Deshayes

Shell thick, very strong and with prominent concentric striae ..... *C. striatella* Deshayes

17. ***Corbicula striatella*** Deshayes

1854. *Corbicula striatella* Deshayes. *Proc. Zool. Soc. Lond.*, **22** : 344. *Type locality* : Pondicherry, Prashad, 1928, *Mem. Indian Mus.*, **9** : 18, Pl. iii, fig. 9–11.

1861. *Corbicula subradiata*, Prime. *Proc. Acad. Nat. Sci. Phild* : 128, Prashad, 1921, *Rec. Indian Mus.*, **22** : m 613.

Material examined : 5 exs., Keri Rest House, date 24/2/2002, Coll. S.G. Patil.

Shell thick, large, tumid, triangular ovate to ovate, dorsal margin arched more on the anterior

side than on the posterior, umbones prominent. Periostracum shining lemon yellow in young, darker and often brownish in full grown species, striae regular, concentric and raised into ridges, pallial lines with trace of sinus; muscle scars fairly deeply developed.

Distribution : Goa, Commonest Indian species and occurs throughout India, Maharashtra.

Elsewhere : Myanmar, Pakistan, Peshawar, Sindh.

LAND MOLLUSCA

Class GASTROPODA

Order MESOGASTROPODA

Key to the family

Animal shell widely umbilicate with an operculum ..... CYCLOPHORIDAE

Animal with broad shell ovate, usually with band ..... CERASTUIDAE

Animal with narrow shell, cylindrically turrected Without bands ..... SUBULINIDAE

Animal shell turbinate to conoid imperforate or Not widely umbilicate .... ARIOPHANTIDAE

Family CYCLOPHORIDAE

Genus ***Cyclophorus*** Montfort, 1810

Shell moderately large, subglobuley turbinate, usually broader than high openly widely umblicate, smooth or sculptured, peristoma usually continuous, operculum thorny or calcareous, thin circular.

18. ***Cyclophorus indicus*** (Deshayes)

1832. *Cyclostoma indicum* Deshayes, in Belanagar *Voy. Ind. Oright. Zooli.* 415, Pl. 1, fig. 4, 5.

1921. *Cyclophorus indicus*, Gude, *Fauna of British India*, Mollusca III : 63.

Material examined : 4 exs., Bhagwan Mahavir Sanctuary Goa, date 30/11/93, Coll. S.G. Patil; 2 exs. Devil canyon and Molem Sanctuary date 14/9/03 Coll. M.S. Pradhan.

Distribution : India : Goa, Pune, Maharashtra. Restricted to sloppy region of elevation.

Order STYLOMMATOPHORA

Family CERASTUIDAE

Subfamily NAPACINAE

Genus ***Rachis*** Albers, 1850

19. ***Rachis puntatus*** Anton

1839. *Butinus punctatus* Anton. *Verzeich conch* : 42.

2004. *Rachis punctatus* Mitra Dey, & Ramakrishna. *Pictorial Handbook on snails (In press).*

Material examined : 3 exs., Keri Rest House, Date, 24/2/2002, Coll. S.G. Patil.

Distribution : Goa, Maharashtra, Tamil Nadu, Uttar Pradesh, Orissa and West Bengal.

Family SUBULINIDAE

Genus ***Lamellaxis*** Strebel & Pfeifer, 1882

Shell whorls flatty convex, usually narrowly perforate, blunt apex, aperture ovate, oviparous in nature, egg shape spherical.

20. ***Lamellaxis gracile*** Hutton

1833. *Bulinus* Hutton, *J. Asiatic Soc. Bengal*, 3 : 84, 93

1914. *Opeas gracile* Hutton. *Fauna of British India, Mollusca* 2 : 365.

1989. *Lamellaxis gracile*, Subba Rao, Thakur and Mitra *Fauna of Orissa, State Fauna Series 1, Mollusca Terrestrial*, : 26, Fig. 22.

Material examined : 4 exs., Keri Rest House, Date 24/2/2002, Coll. S.G. Patil.

Distribution : Goa, Common throughout India.

Elsewhere : East Africa, Burma, China, Japan, Pakisthan, Sri Lanka and Polynesia.

Family ARIOPHANTIDAE

Subfamily ARIOPHANTINAE

Genus ***Ariophanta*** Desmoulins, 1829

Shell convex, last whorls rounded or angulate striae, aperture, oplique wide, peristome thin,

helicoids or depressed turbinate, sinistral, broad animal and depressed.

21. ***Ariophanta bajadora*** Pfeiffer

1850. *Helix bajadora*, Pfeiffer. *Zeitschr. Mal.* P. 69.

1963. *Ariophanta bajadora*, Tonapi and Mulherkar. *J. Bombay nat. Hist. Soc.*, **60**(1) : 116.

Material examined : 4 exs., Keri Rest House, date 24/2/04, Coll. S.G. Patil.

Distribution : Bombay, South Narbada ranging east to Nagpur common on Western Ghat near Bombay.

22, Genus ***Ariophanta laevipes*** Muller (1774)

1774. *Ariophanta laevipes* Muller. *Hist. Ver.* **ii**, p. 221.

1795. *Helix trifasciata*, Chemn. *Mart. & Chemn. System. Conch.* Cab. **XI**, p. 308, pl. 213, figs. 3018–19.

Material examined : 2 exs., near Tulsimal river Date 23/2/2002, Coll. S.G. Patil,.

Distribution : Goa, Maharashtra, Bombay, Gujarath, Surat.

Remark : Shell rather thin, depressed, obliquely striated and decusted with fine spiral line above. Whitish with three spiral cestnut band; spine low, conoidal, whorls fine slightly convex.

Genus ***Cryptozona*** Moerch, 1872

23. ***Cryptozona (Nilgiri) semirugata*** (Beck)

1837. *Gataxi semirugata*, Beck *Index Moll.*, **1** : 42.

1961. *Cryptozona (xestina) semirugata*, Ray, *Tocubix*, **23**(3) : 228.

Material examined : 2 exs, Colem river Molem, date 26/2/02, Coll. S.G. Patil.

Distribution : Goa, Gujarat, Maharashtra, West Bengal in North.

Elsewhere : Ceylon in South.

Subfamily MACROCHLAMYDINAE

Genus ***Macrochlymys*** Gray 1847

Shell moderately large, perforate, depressd helicoid to subglobosely turbinate, fine striae with convex whorls, last one rounded rarely subangulate aperature more or less wide, peristome thin.

24. ***Macrochlamys (Macrochlamys) tenuicula*** A. Adams

1868. *Macrochlamys tenusicula* A. Adams, *Proc. Zool. Soc. Lond* : 14, Pl. 4, Fig. 9. (type Locality : Satara Maharashtra).

1908. *Macrochlamys tenuicula* : Blanford & Godwin Austen, *Fauna of British India, Moll.*, : 130.

Material examined : 3 exs., Keri Rest House, date 24/2/02, Coll. S.G. Patil; 2 exs, Poinginim, date 19/9/93, Coll. M.S. Pradhan.

Distribution : Goa, Bombay and Western Ghats Khandala, Satara, Surat, Rajpipla Hills at Dholgaun.

Remarks : Shell is easily recognized by its turbinate shape and longitudinal microscopic structure, Pedina (Helix).

25. ***Macrochlamys pedina*** (Benson)

1901. *Helix vitrinoides* Pfeiffer (Pt.). *Mart. & Chem.* (nee Desh) *Syst. Conch. Cab.*, pl. 110, figs. 10–12.

Material examined : 2 exs. Tulsimal river, Date : 23/2/2002, Coll. S.G. Patil.

Shell rather perforate, conoid depressed, peristome very thin.

Distribution : Goa, Maharashtra, Bombay, Khandala, Pune, Ahmednagar, South Canara.

SUMMARY

Based on collection available at Western Regional Station, Zoological Survey of India, Pune from Surveys of the Goa State, 25 species of land and freshwater Mollusca have been recorded. Out of these 25 species 17 species belong to freshwater and only 8 eight species under 6 genera and 4 families were recorded from land Mollusca. Goa State being a part of Western Ghats there is much value of these species. Freshwater Mollusca are presented by 17 species, 9 genera and 8 families and it does not show much variations to the nearby Maharashtra State fauna. The genus *Cremnoconchus* which is a native of Western ghats

was not observed in the present collection. The families Viviparidae, Thiaridae and among Bivalvia Unionidae were better presented in the present freshwater mollusca collection. The land mollusca collection is inadequate and one or two species of each genera were recorded from this region. The Molluscan fauna of Goa State is quite interesting and considerably rich on the river side. More detail study of this area on land Mollusca in appropriate season may reveal the existence of more species of land Mollusca than what is known now.

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CHILOPODA : SCOLOPENDROMORPHA

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INTRODUCTION

Centipedes are soil arthropods of economic importance, playing a major role in terrestrial food chain. Indian fauna of centipedes is represented by 102 species pertaining to 11 genera and 2 families (Khanna, 2001). Centipede fauna of Deccan peninsula, especially Maharashtra is fairly well documented by the studies of Jangi & Dass (1984), Yadav (1993a,b, 2004), Yadav (2005, 2006), Yadav & Sureshan (2006) etc., The knowledge about centipedes is practically very little from the state of Goa, though fairly good number of centipede species are reported from the adjacent states. As part of the studies on the fauna of Goa state, Zoological Survey of India, Western Regional Station, Pune, has conducted periodic surveys to the state during the years 1993, 2002-2003. The present account is based on the study of a small collection of centipedes brought from the state of Goa during the above surveys. A total of 8 species of scolopendrid centipedes belonging to 4 genera and 2 subfamilies are now known to occur in the state.

Family SCOLOPENDRIDAE

21 or 23 pairs of legs; simple eyes present as a group of 4 ocelli on each side of cephalic plate; tarsi two jointed; sternites with a pair of longitudinal sutures, only exceptionally with unpaired median suure, never with transverse one.

Key to subfamilies

1. Spiracles triangular with spiracular cavity divided into an inner and outer chamber by a tripartite valve. ..... SCOLCPENDRINAE

– spiracles oval or round, with spiracular cavity undivided and fully exposed ....OTOSTIGMINAE

Subfamily SCOLOPENDRINAE

Key to tribes

1. Terminal leg segment with coxopleural pores .....Tribe **Scolopendrini**

– Terminal leg segment without coxopleural pores (Collection not in the present paper) ..... Tribe **Asanadini**

Key to genera of Tribe Scolopendrini

1. Legs mostly with tarsal spur, 1st tergite anteriorly overlaid by cephalic plate .... ***Scolopendra*** Linn. 1758

– All legs without tarsal spur ....***Cormocephalus*** Newport 1844

Tribe Scolopendrini

– 20th pair of legs without tarsal spur, prefemur of anal legs ventrally with 9 spines arranged in 3 rows of 3 each ....*S. amazonica* (Bucherl)

Key to the species of genus *Cormocephalus*

1a. 21st tergite with a longitudinal median sulcus, 6½ to 13 basal antennal segments glabrous.

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Lateral margination from 3rd to 5th tergites. ..... *C. westwoodi dispar* Porath

1b. 21st tergite without a longitudinal median sulcus. Lateral margination present on tergites anterior to 21st 2

2a. Maxillipedes with prefemoral process, anal legs in both sexes smooth .... *C. dentipes* Pocock

2b. Maxillipedes without prefemoral process, anal legs in both sexes may be smooth. .... *C. nigrificatus* Verhoeff

Subfamily OTOSTIGMINAE

Tribe **Otostigmini**

Key to genera of Otostigminae

1. 9 pairs of spiracles one on each leg bearing segments 3, 5, 8, 12, 14, 16, 18 & 20, femur of anal leg in male with posteromedial process, claw of 2nd maxilla without spur..... ..... ***Digitipes*** Attems 1930

– 10 pairs of spiracles one each on leg bearing segments 3, 5, 7, 8, 10, 12, 14, 16, 18 & 20; prefemur of maxillipede with median dental process, no sexual dimorphism present..... ..... ***Rhysida*** Wood 1862

Key to the species of genus *Digitipes*

1. Coxopleural process tipped with 4 spines and bearing two lateral spines; tergite punctate with complete paramedian sutures on 6-20, 21st tergite little broader than long and its lateral margins only slightly convex .... *D. coonoorensis* Jangi & Dass

– Porous area of coxopleuron almost touching dorsal margin; coxopleural process tipped with 2 diminutive spines and with one lateral spine, 20th leg with tarsal spur .... *D. barnabasi* Jangi and Dass

1. Tergites preceeding 21st leg bearing segments orginarily not marginate laterally and if at all hardly couple incompletely .... *R. nuda* (Newport)

– Tergites preceeding 21st leg bearing segment clearly marginate laterally. Tergites except anterior one with complete paramedian sutures ..... *R. logipes longipes* (Newport)

SYSTEMATIC ACCOUNT

Class CHILOPODA

Order SCOLOPENDROMORPHA

Family SCOLOPENDRIDAE

Subfamily SCOLOPENDRINAE

Tribe **Scolopendrini**

1. ***Scolopendra amazonica*** (Bucherl)

1946. *Scolopendra morsitana amazonica* Bucherl. *W. Mem. Inst. Butantan,* **19** : 135-137.

1984. *Scolopendra amazonica*, Jangi & Dass. *J. Scient. Indl. Res.*, **43**(2) : 29.

Diagnostic characters : Body elongate, flat with 21 pairs of legs, spiracles triangular, cephalic plate overlapping the first tergite, 20 th pair of legs without tarsal spur; prefemur of anal legs ventrally with 9 spines arranged in 3 rows of 3 each.

Distribution : Cosmopoliton.

Remarks : Though it is a common species, not represented in the present collection. According to Jangi & Dass (1984) the species has been reported from Asavani, Canacona, Coranzalem,, Durgini Hills, Marmagao, Mollem and Nannus in Goa.

2. ***Cormocephalus dentipes*** Pocock

1891. *Cormocephalus dentipes* Pocock, *Ann. Nat. Hist. Ser.* **6, 7** : 66.

1984. *Cormocephalus pseudonudipes*, Jangi & Dass. *J. Scient. Indl. Res.*, **43**(2) : 37.

2001. *Cormocephalus dentipes*, Khanna, *Ann. For.*, **9**(2) : 203.

Diagnostic characters : All legs without tarsal spur. 21st tergite without a longitudinal median sulcus. Lateral margination present on tergites anterior to 21st, maxillipedes with prefemoral process, anal legs in both sexes smooth.

Material examined : 1 ex. Valvanti river near Tulshimala village, 15 kms NW of Valpoi, 17-iii-1993, Coll. G.M. Yazdani & party (Reg. No.I/1992).

Distribution : India : Andaman and Nicobar Islands, Bihar, Delhi, Himachal Pradesh, Meghalaya, Mizoram, Madhya Pradesh, Orissa, West Bengal, Uttar Pradesh and Uttaranchal.

Remarks : It is an endemic Indian species, Jangi & Dass (1984).

3. ***Cormocephalus westwoodi dispar*** Porath

1872. *Cormocephalus dispar* Porath *ofv. Ak. Forh.* **28** : 1155.

1984. *Cormocephalus westwoodi*, Jangi & Dass, *J. Scient. Indl. Res.*, **43**(2) : 34.

2001. *Cormocephalus westwoodi dispar*, Khanna, *Ann. For.*, **9**(2) : 204.

Diagnostic Characters : 21st tergite with longitidunal median sulcus, 6½ to 13 basal antennal segments glabrous. Lateral margination on 3rd to 5th tergites.

Material examined : 1 ex., Karanjalem, Dona Paula, Panji, 10-ii-1993, Coll. G.M. Yazdani & Party, (Reg. No. I/1994).

Distribution : India : Gujarat, Maharashtra.

Elsewhere : South Africa, Transvaal, Natal, Zimbabwe, Madagascar, Sri Lanka.

Remarks : It is polytypic old world species.

4. ***Cormocephalus nigrificatus*** Verhoeff

1937. *Cormocephalus nigrificatus* Verhoeff, *Zool. Anz. Leipzig*, **120** : 81.

1984. *Cormocephalus nigrificatus*, Jangi & Dass, *J. Scient. Indsl. Res.*, **43**(2) : 36.

2001. *Cormocephalus nigrificatus*, Khanna, *Ann. For.*, **9**(2) : 204.

Diagnostic Characters : 21st tergite without a longitudinal median sulcus, lateral margination absent on tergites anterior to 21st; maxillipedes without prefemoral process.

Material examined : 1 ex., Rest House, Bondla Wildlife Sanctuary, 13-iii-1993, G.M. Yazdani & party (Reg. No. I/1993).

Distribution : India : Trivandrum (Kerala).

Remarks : It is the first record from Goa State.

Subfamily OTOSTIGMINAE

Tribe **Otostigmini**

5. ***Rhysida longipes longipes*** (Newport)

1845. *Brachiostoma longipes* Newport,. *Trans. Linn. Soc., London.* **19** : 411.

1930. *Rhysida longipes, Attems, Das Tierr. Scolopendromorpha*, **54**(2) : 194.

2001. *Rhysida longipes longipes*, Khanna. *Ann. For.*, **9**(2) : 212.

Diagnostic characters : Prefemur of anal leg with posteromedial spiny process; coxopleural process with lateral spine; tergites preceding 21 st leg bearing segment clearly marginate laterally and several of them involved; tergites except anterior one with complete paramedian sutures.

Material examined: 1ex. Forested area on Tambdi Surla, Bondla. Wildlife Sanctuary 27.ix..2003, coll. M.S. Pradhan & party (Reg. No. I/2023).

Distribution : India : Assam, Andaman & Nicobar Islands, Delhi, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, Uttaranchal, Uttar Pradesh, West Bengal, Arunachal Pradesh, Goa, and Karnataka.

Remarks : A cosmopoliton species, but known in the Deccan from few places only. It is also reported from Marmugao Bay in Goa (Jangi & Dass, 1984).

6. ***Rhysidsa nuda*** (Newport)

1845. *Brachiostoma nudum* Newport, *Trans Linn. Soc.*, **19** : 412.

1984. *Rhysida nuda*, Jangi & Dass, *J. Scient. Indsl. Res.*, **43**(2) : 50.

Diagnostic Characters : Tergites except anterior ones with complete paramedian sutures, tergites preceding 21st leg bearing segments ordinarily not marginate laterally and if at all hardly couple incompletely.

Material examined : 1 ex., Nanodi river, Kudal, 15 km NE of Valpoi, Tal. Sateri, 17-iii-1993, Coll. G.M. Yazdani & party, (Reg. No. I/1992).

Distribution : India : Andhra Pradesh, Karnataka, Maharashtra, Orissa, Tamil Nadu.

Elsewhere : Sri Lanka.

Remarks : It is a common species but due to damage, subspecific treatment cannot be given.

7. ***Digitipes coonoorensis*** Jangi & Dass

1984. *Digitipes coonoorensis* Jangi & Dass. *J. scient. Indl. Res.* **43**(2) : 48.

2001. *Digitipes coonoorensis* Jangi & Dass. Khanna, *Ann. For.*, **9**(2) : 212.

Diagnostic characters : Coxopleural process tipped with 4 spines and bearing 2 lateral spines; tergites punctate and with complete paramedian sutures on 6-20; 21 st tergite a little broader than long and having its lateral margins only slightly convex; antennae with 17 articles, 3 basal glabrous.

Material examined : 3exs. (2 damaged) Forested area on Tambdi Surla, Bondla. Wildlife Sanctuary 27.ix.2003, coll. M.S.Pradhan & party (Reg. No. I/2023); 1 ex. Stream near Gagan giri vill, 5.3.2002, coll. S.G.Patil & party (Reg. No. I/ 3296); 1ex. Vilanbhati range. Bhali, S.Goa, 25.i.2002, coll. P.P. Kulkarni & party (Reg.No. I/ 3267); 1 ex (damaged), Maem lake tal. Bicholim, 28.ix.1993, coll. M.S. Pradhan & party (Reg. No. I/2044); 1ex. Choras bird sanctuary, Mapusa rd. belt. Panaji, 29.ix.1993, coll. M.S. Pradhan & party (Reg. No. I/2058).

Distribution : India : Tamil Nadu, Maharashtra, Goa.

Remarks: Commonly occurring species in the area. Only few records of the species are available previously from places outside the type locality.

8. ***Digitipes barnabasi*** Jangi & Dass

1984. *Digitipes barnabasi,* Jangi & Dass. *J. scient. Indl. Res.* **43**(2) : 44.

2001. *Digitipes barnabasi* Khanna, *Ann. For.*, **9**(2) : 210.

Diagnostic characters : Porous area of coxopleuron almost touching dorsal margin; coxopleural process bearing a lateral spine and tipped with a pair of rather diminutive ones; 20th leg with tarsal spur; legs 5-20 with a single tarsal spur.; paramedian sutures complete on tergites 6-20; broken on 5th.

Material examined : 2 ♀♀, 1 ♂. Forested area on Tambdi Surla, Bondla. Wildlife Sanctuary 27.ix.2003, coll. M.S. Pradhan & party (Reg. No. I/2023); 1 female. Stream 10 km. from Molem on Phonda road, 28.ii.2002, coll. S.G.Patil & party (Reg. No. I/3247); 1ex. Choras bird sanctuary, Mapusa rd. belt. Panaji, 29.ix.1993, coll. M.S. Pradhan & party (Reg. No. I/2058).

Distribution : India : Tamil Nadu, Maharashtra, Goa.

Remarks: Uncommon species mainly known from Maharashtra.

SUMMARY

The present study records 8 species of Scolopendrid centipedes belonging to 4 genera under 2 sub families and 2 tribes from the state of Goa. The species *Digitipes coonoorensis* Jangi & Dass is found commonly occurring in the state. An extensive attempt of field collection may yield records of many more species from the area, since a good number of centipede species are known to occur in the adjacent states of Karnataka and Maharashtra.

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CLADOCERA

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INTRODUCTION

Goa, is a small state, was conferred statehood on 30th may 1987. It is a state with gifted scenic natural beauty and has long and hoary past. "Pearl of the East", "Rome of East" thus spoke by the travellers, colonizers, poets and Evangelists over the centuries. The Goa state with scenic beauty and chequered historical background offers a host of attraction for holidaymakers and connoisseurs of art. Area is about 3800 sq. kms., situated esconced on the slopes of Western Ghats, fringed by evergreen forest. It stretches out to length of 105 kms. from North and South and is about 60 kms. from East to West; situated at Latitude 14°20′ North and 74°00′ East longitude and altitude from 0 to 1020 meters on West coast. Goa has very large cost line of 97 kms. Climate summer 32°C at day and 24°C at night, winter 32°C at day and 22°C at night. Rain fall about 3200 mm and heaviest in July.

Perusal of available literature reveals that there is no published record on occurrence of any Clodocera species from the Goa state and so far no attempt has been made to study the Goa state fresh water Cladocera comprehensively. Hence, this study was initiated. Several Zooplankton samples were collected by various tour parties of Zoological Survery of India, Western Regional Station, Pune from various fresh water habitats. Present study based on above material.

MATERIAL AND METHODS

This study focuses on the taxonomy and distribution of Cladocera in Goa State as a whole. In Goa State the order Cladocera is represented by six families namely : (Sididae, Daphniidae, Moinidae, Bosminidae, Macrothricidae and Chydoridae).

During this survey many limnetic and littoral regions of freshwater habitats such as marshes ponds, reservoirs, lakes, dams, rivers and miscellaneous water bodies were sampled throughout Goa State. Cladocera samples were collected by using plankton nets with circular mouth of 45 cms. in diameter, made up of bolting silk. The fauna were usually collected in sallow water, among the vegetations, and in open water by taking both vertical and horizontal hauls. The nets also dragged close to the bottom to avoid excessive stirring of mud to collect cladocera living on the substratum. All samples preserved in 5% fomalin in field itself, and the zooplankton samples, brought in the laboratory were examined with the binocular microscope and specimens were sorted out for further study. Temporary slides were made using glycerin and important diagnostic characters were studied by using steroscopic compound microscope with higher magnification. Drawings were made with use of camera lucida and measurements taken by using a calibrated occular micrometer.

INTRODUCTION TO THE GROUP MORPOLOGY AND TERMINOLOGY

Crustacean order Cladocera is an interesting group not only for taxonomic and distributional studies but also in view of their interesting ecological and reproductive strategies shown in

their life cycles, with alternating partenogenetic and gamotogenetic phases and rare occurrance of distinctly dimorphic males. The Cladocera order belong to the Subclass Branchiopoda which includes minute crustaceans in the size range from 0.2 to 5 mm are commenly known as "Water fleaes" are mostly inhabits in fresh waters in littoral, limnatic and benthic zones of lakes, ponds, rivers etc. Most species are transparent, especially those which inhabits in the open waters while other found among the weed beds of littoral and benthic zones are darkly pegmented with shades of yellow, brown and red. The body is not clearly segmented, and the great majority of the species, the thoracic and abodominal regions are covered by a single bivalve shaped carapace and all have a distinct head. In lateral view, the carapace is variously shaped. There are often surface reticulation, or other types of markings. The head also shows variation is some taxa. Two light sensitive organs, the compound eye and the ocellus are present on the head. The eye has numerous or few lenses and capable of being rotated by three muscles on each side. The compound eye usually present the ocellus is sometimes absent. The head bears two pairs of sensory appendages; first antenna or the antennules and second antenna usually called merely antenna. First is organ of sensation and second is main organ of locomotion or swimming organ. The month parts–the mandibles maxillules, maxillae, are of little taxonomic value except the labral plate which varies in morphology in Macrothricidae and Chydoridae. The shape of the head shield and middorsal pores are of important taxanomic values in Chydoridae. The axies of head may continue to that of body in front of eye is known as vertex. There is usually a beaklike part infront of head which is known as rostrum, which size and shape has taxonomic value. The carapace, though called bivalve, is really in one piece. It has very different shapes: as seen from the side it may apperar nearly square, oval or round; it may bears hairs, or toothed spines at various places over its body. The carapace encloses 5-6 pairs of trunk limbs (thoracic leg). First leg modified in to stout hook shaped structure in males which serves to clasp the females. The posterior part of the body ends in variously shaped postabdomen also called as abreptor. Which bears anus. Two long natatorial setae, two terminal claws, basal spines and usually a series of anal denticles and lateral spinules.

SYSTEMATIC ACCOUNT

Phylum ARTHROPODA
Class CRUSTACEA
Subclass BRANCHIOPODA
Superorder DIPLOSTRACA
Order CLADOCERA
Suborder EUCLADOCERA
Superfamily SIDOIDEA
Family I SIDIDAE Baird, 1850

Genus ***Diaphanosoma*** Fischer, 1850

1. *Diaphanosoma senegal* Gauthier, 1951
2. *Diaphanosoma excisum* Sars, 1885

Genus ***Pseudosida*** Herrick, 1884

3. *Pseudosida bidentata* var. *szalayi* (Daday, 1898)

Genus ***Latonopsis*** Sars, 1888

4. *Latonopsis australis* Sars, 1888

Family II. DAPHNIIDAE Straus 1820

Genus ***Ceriodaphnia*** Dana, 1853

5. *Ceriodaphnia cornuta* Sars, 1885
6. *Ceriodaphnia reticulata* (Jurine, 1820)

Genus ***Daphnia*** O.F. Muller, 1785

7. *Daphnia lumhotzi* Sars, 1885
8. *Daphnia cephalata* (King, 1853)
9. *Daphnia carinata* King, 1853

Genus ***Scapholeberis Schoedler***, 1858

10. *Scapholeberis kingi* Sars, 1903 b

Genus ***Simocephalus*** Schoedler, 1858

11. *Simocephalus vetulus* (O.F. Muller, 1776)
12. *Simocephalus serrulatus* (Koch, 1841)

Family III. MOINIDAE Goulden, 1968

Genus ***Moinodaphnia*** Herrick, 1887

13. *Moinodaphnia macleaye* (King 1853)

Genus ***Moina*** Baird, 1850

14. *Moina micrura* Kurz, 1874
15. *Moina brachiata* (Jurine, 1820)

Family IV. BOSMINIDAE Sars, 1865

Genus ***Bosmina***, Baird 1845

16. *Bosmina longirostris* (O.F. Muller, 1776)

Genus ***Bosminopsis*** Richard, 1895

17. *Bosminopsis deitersi* Richard, 1895

Family V. MACROTHRICIDAE Baird, 1845

Genus ***Macrothrix*** Baird, 1843

18. *Macrothrix spinosa* King. 1853

Genus ***Echinisca*** Lievin, 1848

19. *Echinisca capensis monodi* Gauthier, 1930
20. *Echinisca triserialis* (Brady, 1886)

Genus ***Ilyocryptus*** Sars,1862

21. *Ilyocryptus spinifer* Herrick 1882

Family VI. CHYDORIDAE, Stebbing, 1902

Subfamily CHYDORINAE Frey, 1967

Genus ***Pleuroxus*** Baird 1843

22. *Pleuroxus aduncus bhigawanensis* Rane, 2002
23. *Pleuroxus denticulatus* Birge, 1879

Genus ***Alonella*** Sars, 1862a

24. *Alonella excisa* (Fischer, 1854)

Genus ***Chydorus*** Leach, 1816

25. *Chydorus faviformis* Birge, 1893
26. *Chydorus ventricosus* Daday, 1898
27. *Chydorus barroisi* Richard, 1894

Genus ***Dunhevedia*** King, 1853

28. *Dunhevedia crassa* King, 1853
29. *Dunhevedia serrata* Daday, 1898

Genus ***Pseudochydorus*** Freyer, 1968

30. *Pseudochydorus globosus* (Baird, 1843)

Subfamily ALONINAE Frey, 1967

Genus ***Alona*** Baird, 1843

31. *Alona rectangula* Sars, 1862
32. *Alona davidi punctata* (Daday, 1898)
33. *Alona monacantha tridentata* (Stingelin, 1904)
34. *Alona pulchella* King, 1853

Genus ***Camptocercus*** Baird, 1843.

35. *Camptocercus rectirostris* Schoedler, 1862

Genus ***Graptoleberis*** Sars, 1862a

36. *Graptoleberis testudinaria* (Fischer, 1851)

Genus ***Leydigia*** Kurz, 1875

37. *Leydigia acanthocercoides* (Fischer, 1854)

Genus ***Biapertura*** Smirnov, 1971

38. *Biapertura affinis* (Leydig, 1860)
39. *Biapertura karua* (King, 1853)

Genus ***Oxyurella*** Dybowski and Grochowski 1894

40. *Oxyurella singalensis* (Daday, 1898)

Genus ***Kurzia*** Dybowski and Grochowski, 1894

41. *Kurzia longirostris* (Daday, 1898)

Genus ***Eryalona*** Sars, 1901

42. *Eryalona orientalis* (Daday, 1898)

Genus ***Notoalona*** Rajapaksha and Fernando, 1987

43. *Notoalona globulosa* (Daday, 1893)

Genus ***Indialona*** Petkovaski, 1966

44. *Indialona ganapati* Petkovski, 1966

Key to the families of CLADOCERA

1a. Six pairs of legs of similar structure ..... SIDIDAE Baird, 1850

b. Five pairs of legs of different structure 2

2a. Dorsal ramus of antennae 4 segmented, ventral ramus 3 segmented 5

3a. Antennules not mobile ..... DAPHNIIDAE Straus, 1820

b. Antennules mobile 4

4a. Antennules situated on anteroventral end of head ..... MACROTHRICIDAE, Baird, 1843

b. Antennules situated on the ventral margin of the head but not at anterior end ..... MOINIDAE Goulden, 1967

5a. Antennules fused with the rostrum, forming a probosis like structure ..... BOSMINIDAE Sars, 1895

b. Antennules are at base, ocellus covered by head shield of rostrum .... CHYDORIDAE Stebbing, 1902

Family I SIDIDAE

Key to the genera and species of Sididae

(Generic diagnosis of the genera with only one species are not given)

1a. Postabdomen without anal spines ....***Diaphanosoma*** Fishcer, 1850

b. Postabdomen with anal spines 2

2a. Rostum present .... *Pseudosidda bidentata* var. *szalayi* (Daday, 1898)

b. Rostum absent .... *Latonopsis australis* Sars, 1884

Genus ***Diaphanosoma*** Fischer, 1850

Key to the species of *Diaphanosoma*

1a. Large head, dorsal part of ventral shell margin with short row of gradually diminishing setae followed by long row of many denticles ....*Diaphanosoma senegal* Gauthier, 1951

b. Distal part of ventral shell margin with large spines 2

2. Comparative small head, posteroventral corner of valve with 6-7 spines ....*Diaphanosoma excisum* Sars, 1885

1. ***Diaphanosoma senegal*** Gauthier, 1951

1951. *Diaphanosoma senegalensis* Gauthier, *Alger*, : 43-45, pl. IX, a-j.

1952. *Diaphanosoma hydrocephalus* Brehm, *Zool. Anz.* **149** : 138-140, abb 1-4.

Material examined : Goa : 2exs., Shakhalum pond, 19.11.02 (Coll. P.D. Rane); lex., Mayem lake Bicholium, 24.9.93; 2exs., freshwater tank at Maxem, 19.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Carapace oblong with posterodorsal corner with distinct angle and dorsal margin slightly arched. Ventral margin almost straight; distal part of ventral shell margin with short gradually decreasing setae, followed by row of denticles. Shell duplicature narrow. Head and eye markedly large. Eye located near the anterior ventral margin of head. Antennae not reaching posterior end of valves. Claw short; with three basal spines which increasing in length distally and setae on the concave margin.

Distribution : India : Madhya Pradesh, Maharashtra, and South India.

Elsewhere : Africa.

2. ***Diaphanosoma excisum*** Sars, 1885

1885. *Diaphanosoma excisum* Sars. *Norske, vidensk Selsk. Forhandl. Christiania.*, **8** : 13-18, pl. 2, figs 1-3.

1933a. *Diaphanosoma paucispinosum* Brehm, *Arch. Hydrobiol.*, Suppl. **11** : 656-659, fig. 3.

Material examined : Goa–2exs., Valpai, 22.2.02; 5exs., Chandor water body, 2.3.02 (Coll. S.G. Patil); lex., Devils Corryon near Molem, 14.9.93; 10 exs., Fresh water pond near Maxem (Painginium), 19.9.93; 5exs., Mayem lake, Bichollium, 24.9.93 (Coll. M.S. Pardhan); 2exs., Shakhalum, 19.11.02; 5exs., Arevellem near Honda, 10.11.02; lex., Patridevi, 8.12.93; 2exs., Uge, 13.10.02 (Coll. P.D. Rane).

Diagnosis : Female : Body large and rounded anteriorly, Eye small. Posteroventral corner broadly rounded with variable number of (mostly 6-7) marginal denticles followed by delicate cilia. Postabdomen narrow with fine setules. Claw with three basal spines, decreasing in size proximally. Claw serrated on the distal convex surface.

Distribution : India : Andaman and Nicobar Islands, Rajasthan, Tamil Nadu, Tripura, Maharashtra, Kerala, Assam and West Bengal.

Elsewhere : Australia, common in tropical regions.

Genus ***Pseudosida*** Herrick, 1884

3. ***Pseudosida bidentata* var. *szalayi*** (Daday, 1898)

1884. *Pseudosida bidentata* Herrick, *Geol. & Nat. Hist. Survey Minnesota. Ann. Rep.*, **12** : 1-191.

1898. *Pseudosida szalayi* Daday, *Termes Fuzetek., Budapest*, **21** : 64-66, figs. 33 a-d.

1953. *Pseudosida szalayi* Brehm, *Ost. Zool. Zett.*, 4 : 241-345.

Material examined : Goa–lex., 23.11.93, Navelium; lex., Zuna; lex., Dudhasagar., 13.10.02 (Coll. P.D. Rane); lex., Pond at Maxem; lex., Mayem lake, Bicholium, 19.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Body elogated, oval; short head; eye relatively small situated near the anteroventral corner. Rostrum present; no fornix or cervical glands. Antennules unsegmented, long and attached to the posteroventral part of head, with long basal part, with olfactory setae on each side and a long flexible flagellum. Antenna not extending beyong the posterior margin of valves. Ventral margin of valve with series of long setae followed by series of spinules on the posteroventral corner. Postabdomen with about 10 clusters of spinules. Claw long with 3 basal spines and a very small spine proximal to them.

Distribution : India : Andaman and Nicobar Islands, Rajasthan, Tamil Nadu, Tripura and Maharashtra.

Elsewhere : Many parts of tropics and near tropics, Sumatra, Srilanka, Malaysia, South Africa, South America and South–East Asia.

Remarks : Present forms are of *Pseudosida bidentata* var. *szalayi* Daday similar to the subspecies recorded and mentioned by Tomas in 1961 with median projection near the base of claw of the postabdomen.

Genus ***Latonopsis*** Sars, 1886

4. ***Latonopsis australis*** Sars, 1886

1888. *Latonopsis australis* Sars, *Fortn. Vidensk. Selsk. Christiania*,. 7 : 6-15. pl.1, figs.1-6.

1892. *Latonopsis occidentalis* Birge, *Trans. Wis. Acad. Sci. Arts and Letts.*, 4 : 383-386, pl. 13, figs.1-5.

Material examined : Goa-2exs., Mayem lake, Bicholium, 24.9.93 (Coll. M.S. Pradhan); lex., Mandavi river pool., Tiswadi, 10.3.93 (Coll. G.M. Yazadani); lex., Uge farm tank, East of Sange, 17.11.02; lex., Pond at East of Bhagawan Mahavir sanctury near Dudhasagar, 1.12.93 (Coll. P.D. Rane).

Diagnosis : Female : Head large with antennules on the ventral side. Antennules with sparsely-spaced setae. Antennule on a thick base and its length about 60% of body length. Antennule setae 4-7/0-1-4. Two ventral most setae of triarticulate branch especially large and their ends hooked. Eye large, situated very near to anterior margin of head; Ocellus conspicuous. setulated setae of valve edges mounted on conical bases. These setae longer on anterior and posterior edges of valves. The ventroposterior corner of valve has 3 especially long, naked, diverging setae, mounted on larger and deflexed bases. A few groups of spinnules on inside surface of posterior margin of valve. Postobdomen relatively small, averaging 33% of body length, slightly dilated in proximal part. Anal teeth small, 7-9 in number, and situated closer to distal end of postabdomen. Number of small setules on the lateral surface of postabdomen, arranged in oblique rows. Claw much incurved with two basal spines. Female with one embryo.

Distribution : India : Rajasthan, Tripura, Tamil Nadu, Maharashtra.

Elsewhere : Australia.

Family II DAPHNIIDAE Straus, 1820

(IV) Key to the genera of Daphniidae

1a. Ventral side of head with small rostrum, valve with elongated posterodosrsal spine 2

b. Valves with out posterior spine 3

2a. Valve with only one posterior spine long in size ..... ***Daphnia*** O.F. Muller, 1785

b. Valve with more than one spine, ventral margin convex, short and less visible, rostum absent ..... ***Ceriodaphnia*** Dana, 1852

3a. Ventral margin straight ending a large spine at posteroventral corner .... ***Scapholeberis*** Schoedler, 1853

b. Ventral margin curved ending smoothly at posteroventral corner, postabdomen large, wide, indented on its distal side .... ***Simocephalus*** Schoedler, 1858

Key to the species of Daphniidae Schoedler, 1858

1. Head produce anteriorly in to small conical beak, head small and depressed. Valve oval and rounded, no posterior extension of postabdomen. Claw not pectinate .... *Ceriodaphnia cornuta* Sars, 1865

2. Head without anterior spine, claw pectinate ..... *Ceriodaphnia reticulata* (Jurine, 1820)

Genus ***Ceriodaphnia*** Dana, 1852

5. ***Ceriodaphnia cornuta*** Sars, 1885

1885. *Ceriodaphnia cornuta* Sars, *Norske, vidensk. Selsk. Fornandl. Christiania.*, **8** : 26-28, pl. 5, figs. 1-3.

1894b. *Ceriodaphnia rigudi* Richard, *Revue, Biol. Nord. France*, **6** : 367.

Material examined : Goa–10exs., Talpan river near Canacone, Painginum, 20.9.93; 2exs. Khandapur river of Ponda-Molem, 15.9.93 (Coll. M.S. Pradhan);5exs. Britona, Mandavi River near Koshi, 7.3.93; 2exs., Caranzalem tank., 10.3.93 (Coll. G.M. Yazadani); Chandor Water pool, 2.3.02 lex., Tulshimal river, 23.2.02 (Coll. S.G. Patil); 5exs., Zuna river pool 5 kms East of Sange, 13.10.02; 4 exs., Navelium tank, 23.11.93 (Coll. P.D. Rane).

Diagnosis : Female : Head small depressed and separated from the carapace by a dorsal impression; with out a rostrum. Head with an acute beak on the ventral side. Antennules short and broad, with long seta and group of sensory setae on the apex. Eye large, ocellus small. Valves reticulate with large polygonal or hexagonal meshes. Postabdomen moderately broad with four to five curved denticles. Claw stout, curved with a series of setules along the concave surface.

Distribution : India : West Bengal, Bihar, Andhra Pradesh, Mysor, Madhya Pradesh, Rajasthan, Tamil Nadu, Meghalaya, Gujarat, Maharashtra, Andaman and Nicobar Isalnds, Truipura.

Elsewhere : Eastern Australia, and S. Australia, Japan, China, South East Asia, South Africa, Egypt and S. America, Palestine and other tropical regions.

6. ***Ceriodapohnia reticulata*** (Jurine, 1820)

1820. *Monoculus reticulatus* Jurine, *Historie des monocles, quise trouvent aux environs de geneve, Paris*, : 139, pl. 14, figs. 3,4.

1901. *Ceriodaphnia reticulata* Sars, *Arch. Math. Nat.*, **23** pl. 21.

Material examined : Goa-lex., Patridevi. 8.12.93, lex., Uge tank, 13.10.02 (Coll. PD. Rane); 2exs., pond near Maxem, Painginum, 19.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Carapace rounded oval, produced posteriorly in to small protuberance. Valve reticulated. Antennule small; sensory seta near apex of antennule; Eye large, ocellus small and rounded. Postabbdomen with 7 marginal anal teeth. Claw large with a distinct pecten of 6 teeth.

Distribution : India : Rajasthan, Bihar, Madhya Pradesh.

Elsewhere : Holartic, Neotropical and Ethiopion region.

Key to the species of genus *Daphnia*

1. Anterior end of head produced into head spine of variable lengths. Fornices well developed like wing .... *Daphnia lumholtzi*, Sars, 1885....2

2. Head with large crest above the heart. Rostrum acute, well away from ventrolateral carpace margin. Antennular mounds at some distance from rostrum .... *Daphnia cephalata* King, 1853....3

3. Head without any crest. Rostrum recurved, generally close to or in contact with ventrolateral carapace margin. Antennular mounds set close to rostrum ....i..... *Daphnia carinata* King 1853

Genus ***Daphnia*** O.F. Muller, 1785

7. ***Daphnia lumholtzi*** Sars, 1885

1885. *Daphnia lumholtzi* Sars, *Norske. Vidensk. Selsk. Forland. Christiania*, **8** : 18-26, pl. I, figs. 1-10.

Material examined : Goa- Several females from Mayem lake Bicholium, 24.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Carapace broadly oval with posterior long spine. Head produced anteriorly in the form of a helmet of variable length. Dorsal and ventral margin of valve with a series of small spines. Rostrum somewhat variable in shape. Antennual mounds very well developed, situated close to rostrum. Eye large, ocellus small. Fornices extremely well developed, produced in to a spine. Postabdomen tapering distally, with 10-13 anal spines and group of lateral setae. Claw stout, curved, with three groups of setae.

Distribution : India : West Bengal, Orissa, Andra Pradesh, Rajasthan, Tamil Nadu, Bihar, Tripura.

Elsewhere : Australia, Egypt and wide spread in Asia.

8. ***Daphnia cephalata*** (King, 1863)

1853. *Daphnia carinata* var. *cephalata* King, *Pap. Proc. R. soc. Van diemans land*, **2** : 254.

1877. *Daphnia cephalata* Schoedler, *Jahrb. Dorotheenstadt. Realschule, Berlin*, : 13

Material examined : Goa-lex., Dudhasagar falls, 13.10.02; Novellium 23.11.93 (Coll. P.D. Rane); lex., pond near Painginum, 19.9.93 (Coll. M. S. Pradhan).

Female : Carapace oblong, and ventral carapace margin broadly oval. Posterior spine long and turn up wards. Head produces prominent dorsal helmet extending posteriorly. In small juvenile specimens projecting dorso–anteriorly. Antennular mounds very small and situated well away from tip of rostrum. Tail varies from two thirds to greater than length of carapace. Eye and small ocellus present. Postabdomen tapering distally with 11-14 anal spines. Claw curved with three combs of teeth.

Distribution : India : Tamil Nadu, Maharashtra.

Elsewhere : W. Australia, Srilanka, Argentina.

9. ***Daphnia carinata*** King, 1853

1853. *Daphania carinata* King, *Pap and Proc. R. soc. Van diemen land, hover Town*, **2**(2) : 246, pl. I and VI A.

Material examined : Goa–2exs., Devils carryon near Molem, 14.9.93 (Coll. M.S. Pradhan); lex., fresh water tank in Bhagawan Mahavir Sanctury near Molem. 20.11.02 (Coll. P.D. Rane); lex., Water pool at Chandor 2.3.02 (Coll. S.G. Patil).

Diagnosis : Female : Carapace reticulate, dorsal margin evenly arched; posterior spine elongated and slightly upturned. Posterior spine with small spines on the dorsal and ventral margin. Head large, semicircular at anterior margin. Rostrum recurved in contact with ventrolateral margin. Antenna very small close to rostrum. Ocellus small. Abdominal processes three. Postabdomen conically tapering distally with 10-12 and spines. Claw short, and curved with three sets of teeth.

Distribution : India : Hymachal Pradhesh, Karnataka, Uttar Pradesh, Gujarat, Rajsthan, Tamil Nadu, Bihar, West Bengal, Manipur, Andra Pradesh, Punjab, Haryana.

Elsewhere : Australia, Africa, Indonesia, Srilanka.

Genus ***Scapholeberis*** Schoedler, 1858

10. ***Scapholeberis kingi*** Sars, 1903

1903 *Scopholeberis kingi* Sars, *Archiv. Math Natur Christiania*, **25** : 8-10, pl.I. figs. a-c.

1853. *Daphnia mucronata* King, *Proc. R. soc. Van Diemans Land*, **2**, pl. 2E.

Material examined : Goa–5exs., Arevellum near Honda Tal. Sattari, 10.11.2002; 2exs., Zauri River, 5.12.93 (Coll. P.D. Rane); 10 exs; Freshwater pond at Maxim near Painginum; 4 exs., Mayem lake, Bicholium 24.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Body oval- quadragular and rounded dorsally. Head small, slightly depressed, rostrum rounded and projecting ventrally. Eye large, ocellus small situated closer to the rostrum than to the eye. Antennule short located behind the rostrum. Posteroventral corner of each valve produced in to short spine pointing back wards. Valves with lines and reticulations. Postabdomen short and broad with 5-6 anal spines. Claw curved dorsally with spinules along the concave surface.

Distibution : India : Andaman and Nicobar Islands, Assam, Kashmir, Meghalaya, Rajasthan, Tamil Nadu, Maharashtra, West Bengal, Tripura.

Elsewhere : Africa, Australia, North and South America, Srilanka, Germany, China, Thailand, Indonesia, South-East Asia.

Genus ***Simocaphalus*** Schoedler, 1858

Key to the species of genus *Simocephalus*

1a. Vertex rounded, without spines, ocellus elongated ..... *Simocaphalus vetulus* (O.F. Muller, 1776)

b. Vertex angulate, spinous, ocellus rhomboidal, fornices not well developed and not expanded ..... *Simocephalus serrulatus* (King, 1853)

11. ***Simocephalus vetulus*** (O.F. Muller, 1776)

1776. *Daphnia vetula* O.F. Muller, *Zool. Daniac prodcomus seu Animalim Norvegiae, etc; Havniae*, p. 199, no 2399.

1889. *Simocephalus vetuloides* Sars, *Zool. Mus. Imp. Acad. Sci.*, **3** : 5-6, pl.VI, figs. 11-12.

1971. *Simocephalus elizabethae* (King): Biswas, *Rec. zool. Soc. India* **16**, p. 114, figs. 3G, 4H, G.2

Material examined : Goa–10exs., Khandapur river near Dudhasager, 17.9.93; 2exs., Devil Carryon near Molem, 14.9.93; 5exs., Dabel river near Cotigoa, 21.9.93 (Coll. M.S. Pradhan); 2exs., Zuna River, 18.10.02; lex., Mandavi river, 3.12.93; 5exs., East Mahavir sanctuary near Dudhasagar falls, 17.3.93; Mandvi river near Tiswadi, 10.3.93 (Coll. G.M. Yazadani); 4exs., Chandor stream water pool, 2.3.02 (Coll. S.G. Patil).

Diagnosis : Female : Carapace broadly oval or rhomboid in shape. Dorsal margin moderately to strongly arched. No posterior spine present. Posterior corner with blunt angle; posterior part of dorsal margin with distinct denticles. Head small with large eye and elongated ocellus. Postabdomen very broad, deeply emarginated with about 10 anal spines and a long curved and denticulate claw.

Distribution : India : West Bengal, Tamil Nadu, Rajasthan, Punjab, Kashmir, Bihar, Uttar Pradesh, Andaman & Nicobar Islands, Tripura, Maharashtra.

Elsewhere : Tibet, England, Australia, Switzerland, Turkey, Russia, Srilanka, North and South America.

12. ***Simocephalus serrulatus*** (Koch, 1841)

1841. *Daphnia serrulatus* Koch, *Friedrich, Pustel, Rosemberg, Hefts*; **8** : 35-37.

1900. *Simocephalus serrulatus* Lillijeborg, *Nova acta Regiae. Societalus Scientiarum, Upsalicusis*, **3**(19) : 179, pl. 20, figs. 9-16.

1951. *Simosa surrulatus* Gauthier, *Alger*, : 49. pl. 10, figs. F-J.

Material examined : Goa–lex., Chandor water pool, of Chandor stream, 2.2.02 (Coll. S.G. Patil); 2exs., Valvanti river at Tulshimala, 16.3.93 (Coll. G.M. Yazadani); 5exs., Mayem lake, Bicholium, 24.9.93 (Coll. M.S. Pradhan); lex., Shakhalum, 19.11.02; 2esx., Dudhasagar, 13.10.02 (Coll. P.D. Rane).

Diagnosis : Female : Carapace broadly oval or ramboidal outline, strongly widened behind at posterior region. Dorsal margin evenly arched and ventral margin bulging in middle and posterior protuberance slightly above the median axis of body. Posterior part of dorsal margin and the protuberance denticulated. Head small with large eye and ocellus small. Anterior most region of head with a number of minute denticles. Rostral projection small. Postabdomen with about 8 denticles. Claw long, slender, with fine setules an its concave margin.

Distribution : India : Tamil Nadu, Meghalaya, Rajasthan, Tripura, Maharashtra.

Elsewhere : Australia, Srilanka, Africa, China, Europe, South East Asia North and South America, Java, New Zelands.

Family III. ***Moinidae Goulden***, 1968

Key to the genus and species of *Moinidae*

1a. Ocellus present ..... *Moinodaphnia macleayi* (King, 1853)

b. Ocellus absent, small species, claw without pecten ..... *Moina micrura*, Kurz, 1874

c. Large species, claw with a distinct pecten with 11-14 teeth .... *Moina brachiata* (Jurine, 1820)

Genus ***Moinodaphnia*** Herrick, 1887

13. ***Moinodaphnia macleayi*** (King, 1853)

1853. *Moina macleayi* King, *Pap. Proc. R. Soc. Van Diemans, Land.*, **2** : 252-252, pl. 5.

1886. *Moina submucronata* Brady, *Journal of the Linnean society Zoology*, **19** : 294., pl. 37., figs., 4; 5.

Material examined : Goa–2exs., Freshwater pond at Maxem, Pain-ginium, 19.9.93; lex., Mayem lake, Bichholium, 24.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Head small, rounded and trigonal in shape, with distinct cervical depression, eye large, filling up anterior part of head. Ocellus small, situated closer to antennules than to eye. Antennules slender with long lateral setae and group of sensory setae on the apex. Ventral margin of valve rounded with series of short marginal spines. Abdominal process large, horse shoe shaped. Postabdomen with an elongated distal end, with 8-10 feathered teeth and one bident tooth, but with out anal denticles. Claw with fine setae on concave margin.

Distribution : India : Andaman and Nicobar Islands, Rajasthan and Tamil Nadu, West Bengal, and South India.

Elsewhere : Widly distributed in Tropics (Tropicopolitan species) and Australia.

14. ***Moina micrura*** Kurz, 1874

1820. *Monoculus rectirostris* Jurine, *Paris*, : 134-145 pl. 13, figs.3-4

1874. *Moina micrura* Kurz, *Sitzber K. Acad. Wiss. Wein. Math. Nat.*, **69** : 13-15, pl. I, Fig. 1.

1892. *Moina dubia* Guerne et. Richard, *Mem. Soc. Zool. France*; **5** : 527–530, figs 1-2.

Material examined : Goa–2exs., Novaband Sal river, Concollium, 23.9.93; 4exs., Khandapur River of Ponda-Molem, 15.9.93 (Coll. M.S. Pradhan); lex., Dudhasagar, 13.10.02; lex., Mandavi River, 3.12.93 (Coll. P.D. Rane).

Diagnosis : Female : Head large with well developed supraocular depression. Eye large. No setules either on head or valve. Ventral margin of valve with 11-20 long setae followed by groups of short setae on posterior margin. Antennule large, thin, with long basal seta. Postabadomen short, slender with distal conical part. Postabdomen distal margin with bident tooth and 5-9 feathered lateral setae decreasing size proximally. Claw large and curved, ventral base of claw with pecten of 3-7 teeth.

Distribution : India : Tamil Nadu, Maharashtra, Kerela, Rajasthan, West Bengal, Punjab, Haryana, Bihar, Karnataka, Tripura.

Elsewhere : Africa, Syria, USSR, France, Phillipines, N. America, South East Asia, Europe.

15. ***Moina brachiata*** (Jurine, 1820)

1820. *Monoculus brachiatus* Jurine, *Historie Monocles, Geneve, Geneva and Paris*, : 131, pl. 12, figs., 1. 2

1850. *Moina brachiata* Baird, *Natural History, Brit. Entom Ray Soc. London*, 102, pl. IX, figs 1. 2.

Material examined : Goa–lex., Tere Khol river ditch near Valpoi, 16.3.93; lex., Mandavi near Tiswadi, 10.3.93. (Coll. G.M. Yazadani); lex., Tusimal river, 23.2.02 (Coll. S.G. Patil).

Diagnosis : Female : Head broad;eye of moderate in size situated near the dorsal margin of head. Antennules long and thin with setae arranged in rings, sensory seta located on lateral anterior margin of antennules, valves rectangular; with granular surface and distinct reticulation. Ventral margin of valve with about 35-41 long setae on valve margin. Postabdomen large and rather long, dorsal margin of its with long bident tooth and 9-12 feathered teeth. Claw with pecten of 10-12 teeth, its distal half with short setae; ventral base of claw with 5-8 thin teeth.

Distribution : India : Kashmir, Rajasthan, Meghalaya, Maharashtra.

Elsewhere : W. Pakistan, Europe, Africa, N.America, England, Russia, Mongolia, Italy and Philippines.

Family IV. BOSMINIDAE Sars, 1865

Key to the genera and species of *Bosminidae*

1a. Antennules of female not united at the base, almost parallel to each other ....*Bosmina longirostris* (O.F. Muller, 1776)

b. Antennule united at base and diverging at apex .... *Basminopsis deitersi* Richard, 1895

Genus ***Bosmina*** Baird, 1845

16. ***Bosmina longirostris*** O.F. Muller, 1776

1776. *Lynceus longirostris* (O.F. Muller), *Havnia*, : 76, tab 10 figs.7-8.

1862. *Bosmina longirostris* Sars, *Forhandl, vidensk, Selesk. Chritiania*, : 162.

Material examined : Goa–20 exs., Zauri River, 35 kms from Donapaula, 9.3.93; 2exs., Khandapur river near Colem, 13.3.93 (Coll. G.M.Yazadani); 50exs., Noveband Sal river Cuncollium, 23.9.93 (Coll. M.S. Pradhan); 4exs., Keri-Chorium 9.11.02; 10exs., Dudhasagar downsteram near colem, 13.10.02 (Coll. P.D. Rane).

Diagnosis : Female : Body oval, with highest width in the middle and dorsal side evenly curved. Body transparent, color whitish yellow. Ventro-posterior margin with two mucrones. Two antennules markedly bent at tips, with olfactory setae situated one third portion away from base. Antenna very small. Rostrum small with thin setae on the upper margin. Eye large, present near the base of rostrum with distinct eye lenses. Postabdomen quadrate with two pectinate claw; proximal with 5-7 teeth and distal with 3-4 teeth. Lower part of postabdomen slightly protrudes out with 3-4 large curved spines.

Distribution : India : Kashmir, Meghalaya, Tripura, Maharashtra.

Elsewhere : Cosmopolitan.

Genus ***Bosminopsis*** Richard, 1895

17. ***Bosminopsis deitersi*** Richard

1895. *Bosminopsis deitersi* Richard, *Bull. Soc. Zool. Defrance.*, **20** : 96, figs. 1-4.

Material examined : Goa–50exs. Fresh water pond near Maxem, Painginum, 19.9.93; 10 exs. Noveband Sal River, Cuncollium, 23.9.03 (Coll. M.S. Pradhan); 4exs., Shakhalum, 19.10.02 (Coll. P.D. Rane).

Diagnosis : Female : Body oval, posterodorsal corner of valves distinct; posteroventral corner with small macro-like process and one or two spinnules before it. Head large with a long rostrum with two lateral branches. Eye large. Antennules long, united with each other at basal part and with 5-6 sensory setae on the ventral side near apex. Valve with polygonal reticulation. Dorsal margin with cervical depression. Postabdomen broad and tapering distally with about 4-6 small spines on the post anal edge followed by a row of setae proximally. Claw large, separated with large basal spine.

Distribution : India : Delhi, Rajasthan, Maharashtra, West Bengal, Tripura, Kashmir.

Elsewhere : South East Asia, Africa, North and South America.

Family V. MACROTHRICIDAE Baird, 1843

Key to the genera and species of *Microthricidae*

1a. Postabdomen with small spines. Exopodite of leg IV with three bristles .... ***Microthrix*** Baird, 1843....2

b. Exopodite of leg IV with two bristles ....***Echinisca*** Lievin, 1848

2. Postabdomen with long spines .... ***Ilyocryptus*** Sars, 1862

Genus ***Macrothrix*** Baird, 1843

18. ***Macrothrix spinosa*** King, 1843

1853. *Macrothrix spinosa* King, *Pap. Proc. R. Soc. Van. Diemans Land.* **2** : 256, pl. vif.

1915. *Macrothrix spinosa dentata* Phyfair, *Proc. Linnean Soc. N.S. Wales*, **34** : 140-141, pl. 8 figs 1-2.

Material examined : Goa-lex., Caranzalem, 10.3.93 (Coll. G.M. Yazadani); 2exs., Tulsimal River, 23.2.02 (Coll. S.G. Patil); 4exs., East Mahavir Sanctuary, Dudhasagar, 1.12.93 (Coll. P.D. Rane).

Diagnosis : Female : Body rounded–oval, dorsal margin finely serrated in places–edge of head and valves. Head rounded, ventral margin slightly concave with slightly pointed prominance at anteroventral corner near rostral region. Antennules enlarged at apex; anterior margin with several fine incision and rows of setules. Dorsal surface of shell with squamous sculpturing. Eye large, ocellus small located near the tip of rostrum. Postabdomen short, bilobed with row of small and strong anal denticles along the dorsal edge and row of minute lateral spines. Claw short and serrated on the concave surface.

Distribution : Andaman and Nicobar Islands, Manipur, Tripura, Rajasthan, TamilNadu, Maharashtra.

Elsewhere : Cosmopolitan.

Genus ***Echinisca Lievin***, 1848

Key to the species of *Echinisca*

1a. Posteroventral margin of valve fringed with long setae ..... *Echinisca capensis monodi* Gauthier, 1930

b. Posterioventral margin with short setae .... *Echinisca triserialis* (Brady, 1886)

19. ***Echinisca capensis monodi*** Gauthier, 1930

1930. *Macrothrix capensis* var. *monodi*, Gauthier, *Bull. Mus. Nat. hist. Natur. Paris*, II : 92-116.

1969. *Guernella monodi* Rey and Saint Jean, *Annales De Limnologie* : 177-182.

Material examined : lex., Shakhalum, 19.11.02; lex., East Mahavir Sanctury near Dudhasagar, 1.12.93; lex., Zuna River, 16.11.02 (Coll. P.D. Rane).

Diagnosis : Female : Body shape oval, dorsal margin broadly rounded, posterodorsal corner with or without projection. Antennules cylidrical typical of the genus, longest setae armed with a series of fine setules and large spines in between, which decrease in size distally. Carapace convex dorsally, ventral margin evenly rounded with a series of long setae at the posteroventral corner. Postabdomen bilobed, dorsal distal margin rounded with 4-5 denticles on anal groove. Claw short and curved.

Distribution : India : Tripura, This is the second record of this species from India.

Elsewhere : Srilanka, Malaysia, and Africa.

20. ***Echinisca triserialis*** (Brady, 1886)

1886. *Macrothrix triserialis* Brady, *J. Linn. Soc. lond. (Zool.), London*, **19** : 295, pl. 47, figs. 16-20

1907. *Macrothrix triserialis* Gurney, *Rec. Indian Mus., Calcutta*, **1** : 25, pl. 2 figs. 81-83.

1976. *Echinisca triserialis* Smirnov, *Zool. Inst. Acad. Nauk, Ossr, New Ser.* 112: 109-110, figs., 81-83.

Material examined : Goa–2exs., Dabel river near Cotigoa, Painginum, 21.9.93; lex., Mayem lake, Bicholium, 24.9.93 (Coll. M.S. Pradhan); lex., Uge farm east of the Sange, 17.11.02 (Coll. P.D. Rane).

Diagnosis : Female : Body oval. Dorsal margin of valve with slight cervical depression. Eye large, ocellus small and situated nearest to the apex of rostrum than to eye. Antennule long with long lateral setae, and notches on anterior margin and sensory seta situated near the base. Antennae short with a logest seta having two or three longer spines in the middle. Postabdomen bilobed with rows of spines increasing in size proximally. Claw short and serrated without basal spines.

Distribution : India : Andaman and Nicobar Islands, Madhya Pradesh, Rajasthan, Tamil Nadu, Kerala, West Bengal and Maharashtra.

Elsewhere : Cosmotopical.

Genus ***Ilyocryptus*** Sars, 1862

21. ***Ilyocryptus spinifer*** Herrick, 1882

1882. *Ilyocryptus spinifer* Herrick, *10th Annual Rep Geol. and Nat. Hist. Survey, Minn.*, : 246, pl. 8, figs-1-5

1913. *Ilyocryptus halyi longiremis* Stinglin, *Mem new chatel Sci. Nat.* **5** : 618-619, figs. 20

Material examined : lex., Arevellem near Honda, 10.12.02 (Coll. P.D. Rane).

Diagnosis : Female : Body oval, triangular; posterior and ventral edge of valves rounded and

bearing long, usually branched and feathered setae. Head with keel; dorsal crest on valves absent or small. Head small. Eye large, ocellus small, situated about halfway between eye and base of antennules. Antennules long with group of sensory setae on distal end. Postabdmen large, broad and compressed with slight depression on the middle. Preanal margin with 12 denticles up to anal groove and five long and short spines on the lateral surface. Claw long, slightly curved and with two basal spines of unequal length.

Distribution : India : West Bengal, Rajasthan, Meghalaya, Tripura, Adaman and Nicobar Islands, Tamil Nadu, Maharashtra.

Elsewhere : South East Asia, Australia, and North and South America.

Family VI CHYDORIDAE Stabbing, 1902

Keys ot subfamilies of CHYDORIDAE

1a. Two separate main pores and two small pores situated between main pores .... ***Chydorinae*** Stabbing, 1902

b. Two or three main pores and two small pores situated lateral to main pores at distance ... . ***Aloninae*** Frey, 1967

Key to the genera and species of *Chydorinae* Frey, 1967

1a. Valves with setae on the entire posteroventral margin 2

b. Valves with setae on inner side of posteroventral margin 3

2a. Rostrum short, Ventral side of carapace with denticles, and large setae entire margin ....*Pleuroxus aduncus bhigawanensis* Rane, 2002

b. Rostrum short but no row and denticles on ventral margin of valve .... *Pleuroxus denticulatus* Birge, 1879

c. Rostrum short and blunt .... *Alonella excisa* (Fischer, 1854)

3a. Posteroventral corner with more than one spine .....***Dunhevedia*** *King*, 1853

b. Posteroventral corner without spine 4

4a. Labrum with out plate shaped process ....*Pseudochydorus globosus* (Baird, 1843)

b. Labrum with plate shaped processes..... ..... ***Chydorus*** (Leach, 1816)

Genus ***Pleuroxus*** Baird, 1843

22. ***Pleuroxus aduncus bhigawanensis*** Rane, 2002

2002. *Pleuroxus aduncus bhigawanesis* Rane, *Zool. Surv., India, Fauna of Ujani Wetland*, **1-4** : 77-78, figs. 1-5.

Material examined : Goa–5exs., feshwater ditch near Zuna river, 18.11.02 (Coll. P.D. Rane).

Diagnosis : Female : Body with strongly convex dorsal margin. Posteroventral corner of valve with 2 denticles on each valve directed posteriorly. Ocellus smaller that eye. Ventral marginal setae, about 30 which are thin but thickened at their bases and look like rounded denticles. Rostrum long, pointed downwards. Plate of labrum convex, anteriorly with pointed apex. Postabdomen with preanal part projecting with 10 to 12 small anal denticles. Claw with two basal spines at the base.

Distribution : India : Endemic, earliar recorded from Ujani wetland Maharashtra state. This is only second record of this subspecies form India.

23. ***Pleuroxus denticulatus*** Birge, 1879

1879. *Pleuroxus denticulatus* Birge, *Trans. Wis. Acad. Arts and Letts.* **4** : 20-21., pl. 1 figs. 21

Material examined : Goa–2exs., roadside weedy pond near Shakhalum, 19.11.02 (Coll. P.D Rane).

Dignosis : Female : Body shape broadly oval with striated carapace. Posteroventral corner and vlave with 2-4 denticles. Rostrum long and pointed. Ocellus situated near to the eye than to apex of rostrum. Antennules ending far from apex of rostrum. Postabdomen tapering distally with 14-16 denticles, with two basal spines on the claw, distal much larger that proximal. Group, of lateral setae present. Postabdomen elongated and preanal corner slightly projecting.

Distribution : India : Andaman and Nicobar Islands, Tripura, West Bengal.

Elsewhere : North and South America, Africa, China, Europe, United Kingdom and France.

Genus ***Alonella*** Sars, 1862

24. ***Alonella excisa*** (Fischer, 1854)

1853. *Lynceus nanus*, Lilljeborg, *lund*, : 206.

1854. *Lynceus excisus* Fischer, *Bull. Soc. Imp. nat. Mosc.* **27** : 428-429; pl. 3 figs 11-13.

1900. *Allonella excisa* Lilljeborg, *Nova Acta. Reg. Soc. Upsala, Ser.*, III 19, VI,: 510-513, p 187, figs. 9.19.

1971. *Alonella excisa* Smirnov, *USSR, Acad. Sci. Zool. Institue Nova Ser.* No.101, *Leningrad*, : 260-262, figs 262-264.

Material examined : Goa–4exs., Mayem lake, Bicholium, 24.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Body oval, dorsal margin of valve arched, posterior margin straight with a sharpened at the posteroventral corner or one blunt denticle. Valve with reticulation to form honey comb pattern or fine longitudinal lines and dots inside each polygon. Rostrum blunt and directed downwards. Postabdomen short with blunt preanal corner. Postabdomen with 6-8 anal denticles and lateral groups of setules. Claw with two basal spines.

Distribution : India : Kashmir, Madhya Pradesh, Tripura, U.P. Kerala, Maharashtra.

Elsewhere : Cosmopolitan.

Genus ***Chydorus*** Leach, 1816

Key to the species of genus *Chydorus*

1a. Valves without deep polygons 2

b. Valves with deep polygons .... *Chydorus faviformis* Birge, 1893

2a. Plate of labrum with denticles .... *Chydorus barroisi* (Richard, 1894)

b. Plate of labrum without denticles 3

3. Plate of labrum pointed ventrally .... *Chydorus ventricosus* Daday, 1898

25. ***Chydorus faviformis*** Birge, 1893

1901. *Chydorus eurynotus* Sars *Arch. Bath. Nat.* **23** 1- 102.

1893. *Chydorus faviformis* Birge, *Trans. Wis. Acad. Sci. Arts and letts.* **4** : 77-109.

Material examined : Goa–2exs., Talpan near Cancona, 20.9.93; lex., Noveband Sal Near cunocollium, 23.9.93 (Coll. M.S. Pradhan). lex., Patridevi, 8.12.93; lex., Zuna, 16.10.02, 2exs., Keri –Chorium, 9.11.02 (Coll. P.D. Rane).

Diagnosis : Female : Body shape rounded or oval. Posteroventral and posterodorsal corners of valve not distinct. Valve and head shield with deep hexagonal cells. Ocellus smaller than eye situated much closer to the eye than apex of rostrum. Labral plate with convex anterior margin and blunt apex. Postabomen with 8-10 anal spines. Claw with two basal spines.

Distribution : India : Kashmir, Tripura.

Elsewhere : South East Asia, Australia, China and North America.

26. ***Chydorus ventricosus*** Daday, 1898

1898. *Chydorus ventricosus* Daday, *Termes. Fuzetek*, **21** 28-27 figs. 10, a-d.

Material examined : Goa–3exs., Freshwater pond near Maxim 19.9.93 (Coll. M.S. Pradhan); 5exs., Dudhasagar Stream, 13.10.02 (Coll. P.D Rane).

Diagnosis : Female : Body oval, posterodorsal and posteroventral corners of valves rounded, without denticles. Ventral margin strongly bulged in the middle, with marginal setae anterior to the bulge and submarginal setae posterior to bulge. Valve with faint polygon. Rostrum long, pointed. Antennules thick about half length of rostrum. Labral plate long broadly rounded. Postabdomen long with distinct preanal corner with 9-10 anal denticles at dorsal margin. Claw situated along concave surface with two basal spines.

Distribution : India : Andaman and Nicobar Islands, Tripura, Gujarat, Rajasthan, Tamil Nadu, and Maharashtra.

Elsewhere : South East Asia, Srilanka, China and Africa.

27. ***Chydorus barroisi*** Richard, 1894

1894a. *Pleuroxus barroisi* Richard, *Revue. Biol. Nord. France*, **18** : 375-377, figs. 9-12.

1895. *Chydorus barroisi* Sars, *Vidensk Selesk Skrifter I math. Naturv. Klasses* : 1-56.

1982. *Ephemeroporus barroisi* (Richard) Frey, *Hydrobiologia*, **86** : 233-237, pl. 1.

Material examined : Goa–10exs., East Bhagawan Mahavir Sanctury temporary pond, 1.12.93; 2exs., reservoir at Dudhasagar falls on Coleum road, 13.10.02; lex., Roadside weedy pond at Ponda forest, Panaji road 12.11.02 (Coll. P.D. Rane); 3exs., Mandavi at Tiswadi, 10.3.93 (Coll. G.M. Yazdani).

Diagnosis : Female : Body elliptical in shape with a spine in the poseroventral corner. Rostrum with apical notch. Plate of labrum with produced apex and with 3-5 denticles on the anterior margin. Carapace body ornamented with striations and hexagonal cells. Postabdomen with 7-9 unequal anal spines and long basal spines. Claw with two basal spines. Claw with two basal spines and setae on the concave margin.

Distribution : India : Andaman and Nicobar Island, Gujarat, Rajasthan, Tamil Nadu, Maharashta, Tripura, West Bengal, Kerala.

Elsewhere : Cosmotropical.

Genus ***Dunhevedia*** King, 1853

Key to the species of genus *Dunhevedia*

1a. Plate of labrum without denticles..... ..... *Dunhevedia crassa* King, 1853

b. Plate of labrum with denticles..... .....*Danhevedia serrata* Daday; 1898

28. ***Dunhevedia crassa*** King, 1853

1853. *Dunhevedia crassa* King, *Pap. And Proc. Roy. Soc. Van. Diemens Land.* **2** : 261, pl. VII f.

1970. *Dunhevedia crassa crassa* Smirnov, *USSR Acad. Sci. Zool. Institue Nova Ser.* 101, *Leningread* : 539.

Material examined : Goa–2exs., Khandapur near Colem, 13.3.93; lex., Mandavi near Koshi, 7.3.93 (Coll. G.M. Yazadani); lex., Chandor top. 2.3.02 (Coll. S.G. Patil); lex., Zuna, 15.10.02 (Coll. P.D. Rane).

Diagnosis : Female : Body curved dorsally, oval in outline and maximum height slightly before the middle. Posteroventral corner with one denticle. Ventral margin of valve with feathered setae which are longest in the middle. Rostrum blunt. Labrum rounded with pointed apex. Antennules thick, lateral setae situated on tubercle. Postabdomen oval with 15-18 anal spines and numerous lateral groups of scattered spinnules. Claw setulated with one basal spine.

Distribution : India, Andaman and Nicobar Islands, Gujarat, Rajshtan, Tamil Nadu, Tripura, Kerala, Maharashtra, and West Bengal.

Elsewhere : Holarctic region, Ethiopian, Indo-Malayan, Australia, Srilanka and USSR.

29. ***Dunhevedia serrata*** Daday, 1898

1898. *Dunhevedia serrata* Daday, *Termes. Fuzetek.*, **21** : 1-123.

Material examined : Goa–2exs., Roadside weedy pond Arevellem near Honda, 10.11.02; lex., Roadside water reservoir at East Mahavir Sanctury, Dudhasagar, 1.12.93 (Coll. P.D. Rane); Devils of Caryon near Molem, 14.9.93; lex., Talpan river at Canacone, 20.9.93 (Coll. M.S. Pradhan); 2exs., Tusimal Water reservior, 23.2.02 (Coll. S.G. Patil).

Diagnosis : Female : Body evenly curved dorsally, maximum height slightly before middle. Valves with distinct longitudinal lines. Rostrum blunt. Ocellus smaller than eye, plate of labrum rounded and serrated on the anterior margin with pointed apex. Dorsal surface of postabdomen covered with groups of scattered spinnules, denticles slightly increasing in size distally. Claw with one basal spine.

Distribution : India : Andaman and Nicobar Islands, Rajasthan, Maharashtra, Tamil Nadu, Tripura.

Elsewhere : Africa, Srilanka, New Guinea, and North America.

Genus ***Pseudochydorus*** Fryer, 1968

30. ***Pseudochydorus globosus*** (Baird, 1854)

1843. *Chydorus globosus* Baird, *Ann. Mag. Nat. Hist.* **68** : 90, pl. III, Figs 1-4.

1968. *Pseudochydorus globosus* Fryer, *Phil. Trans. Roy. Soc.*, **254** : 324-328, figs. 92-111.

Material examined : Goa–lex., Sonal Village, 13.3.93; 2exs., Terekhol river near Valpoie, 16.3.93 (Coll. G.M. Yazadani); lex., Tusimal, 23.2.02 (Coll. S.G. Patil); 3exs., Valvanti River at Tulsimal, 16.9.93; lex., Carambolum, Mayam lake, 24.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Body almost spherical, slightly longer than high; posteroventral corner of valve rounded without denticle. Valve with pattern of polygons, rostrum pointed and ventrally directed. Postabdomen narrow, almost uniformaly wide; anal spines about 20, decreasing in size proximally. Group of lateral setae present. Claw with two basal spines and row of setae on concave margin.

Distribution : India : West Bengal, Meghalaya, TamilNadu, Maharashtra, Tripura.

Elsewhere : Holastic, Indomalayan, Australia, Africa, USSR, Srilanka, New Guinea, and North America.

Subfamily ALONINAE Frey, 1967

Key to the genera and species of subfamily ALONINAE

1a. Lateral setae of postabdomen large .... *Leydigia acanthocercoides* (Fischer, 1854)

b. Lateral setae of postabdomen not large 2

2a. Postabdomen tapering distally and short 3

b. Postabdomen straight and long 4

3a. Two or three main head pores ....***Alona*** Baird 1843

b. One main head pore 5

4a. Body much longer than height .... *Eryalona orientalis* (Daday,1898)

b. Body rounded .... *Oxyurella singalensis* (Daday, 1898)

5a. Posteroventral corner with small spines on the margin, postabdomen with long about 15-17 amal denticles .... *Camptocercus rectirostris* Schoedler 1862

b. Posteroventral corner without spines.....6

6a. Carapace with strong rectangular reticulation ..... *Graphtoleberis testudinaria* (Fischer, 1848)

b. Carapace without reticulation 7

7a. Plate of labrum with serrated anteroventral margin claw with small basal spine, postabdomen widen at base of claw .... *Notoalona globulosa* (Daday, 1898)

b. Plate of labrum without serration large insize, with long postabdomen ..... ***Kurzia*** Dybowski and Growchowski, 1898

c. Plate of labrum not serrated comparative smaller insize, claw with large basal spine, postabdomen tapering towards base of claw ..... *Indialona ganapati*, Petkovski

Genus ***Alona*** Baird, 1843

Key to the species of *Alona*

1a. Valve with longitudinal and transverse line forming rectangular pattern ventral margin straight, ... *Alona rectangula* Sars, 1862

b. Valve with only longiludinal lines..... 2

2a. Ventral margin of valve forming an angle, postabdomen widest in the middle with group of anal spines, posteroventral coner without denticles, ... *Alona davidi puntata* (Daday, 1898)

b. Ventral margin of valve not forming angle, posteroventral corner with 1-3 denticles. Anal spine on postabdomen isolated not grouped ..... *Alona monacantha tridentat* (Stingeline, 1904)

c. Postabdomen comparatively large, valve smooth, posteroventral corner without denticle, ...*Alona pulchella* King, 1853

Genus *Alona* Baird. 1843

31. *Alona rectangula* Sars, 1862

1862. *Alona rectangula* Sars, *Forh. vedensk. Selask. Christiania* : 160.

1971. *Alona rectangula rectangula* Smirnov, *USSR Acad. Sci. Zool. Institute Nova Ser.* 101 Leningrad, : 539.

Material examined : Goa–1ex., Uge farm of Sange, 17.11.02; 3exs., Shakhalum, 19.11.02 (Coll. P.D. Rane); 4exs., Mayem lake at Carambolium, 23.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Shape rectangular, maximum height slightly before middle. Posteroventral corner without denticles. Valve with strations forming rectangular pattern. Antennules not reaching apex of rostrum. Ocellus smaller than eye. Postabdomen with 7 anal spines and group of lateral setae, some projecting beyond the margin of postabdomen. Claw with basal spine and setae on the concave margin.

Distribution : India : Ladhakh, Gujarat, Rajsthan, Tripura, Maharashtra, Meghalaya, Kashmir, West Bengal.

Elsewhere : South-East Asia, Africa, USSR.

32. *Alona davidi punctata* (Daday, 1898)

1898. *Alona davidi punctata* (Daday) *Termes, Fuzlek*, **21** : 39-40, figs 18 a-e.

1939. *Alona davidi* var *punctata* Gauthier, *Bull: Inst. fr. Afr. noire*, **1** : 176-182, figs. 10.

Material examined : Goa–3exs., Britona, 7.3.93; lex., Nandi river ditch, 17.3.93 (Coll. G.M. Yazdani). lex., Devils of Canyon near Molem (Coll. M.S. Pradhan); lex., Nevelium pond, 23.11.93 (Coll. P.D. Rane).

Diagnosis : Female : Body almost oval, maximum height slightly before the middle. Posterodorsal of valve rounded. Posteroventral corner without denticles. Ventral margin of valve projecting in the middle, with feathered setae passing on posteroventral corner into row of short setules which continue on the posterior margin. Valve punctate. Rostrum blunt and plate of labrum rounded. Ocellus smaller that eye. Postabdomen widest in the middle with 10-12 anal spines which are in groups and grouped setae laterally. Claw with rather large basal spine and small spinules on the concave margin.

Distribution : India : West Bengal, Maharashtra, Tamil Nadu.

Elsewhere : Ethiopian and Australian region, Argentina and Sri Lanka.

33. *Alona monacantha tridentata* (Stigelin, 1904)

1904. *Alona acuticostata* var *tridentata* slingelin, *Zool. Jahrb.* Syst. **21** : 327-367.

1971. *Alona monacantha tridentata* Smirnov, *USSR Acad. Sci. Zool. Institute, Nova ser 10, Leningrad*, : 539.

Material examined : Goa–2exs., roadside pond Navelium 10.12.02 (Coll. P.D. Rane); lex., weedy pond near Valpoi, 22.2.02 (Coll. S.G. Patil); lex., fresh water muddy ditch at Caranzalem, 10.3.93 (Coll. G.M. Yazadani).

Diagnosis : Female : Body rectangular, valve with longitudinal lines. Posteroventral corner with 1-3 denticles, attached submarginally. Ocellus smaller that eye. Antennules not reaching the apex of roustrum. Plate of labrum with a denticle on the apex portion at anterior margin. Postabdomen with 7-8 anal denticles. Claw with long basal spine.

Distribution : India : Rajasthan, Maharashtra, Tripura, Tamil Nadu.

Elsewhere : South- East Asia.

34. *Alona pulchella* King, 1853

1854. *Alona pulchella* King, *Pap. Proc. R. Soc. van. Dieman Land;* 2 : 260, pl.VIIIB.

1933. *Alona arenaria* Brehm, *Arch, Hydrobiol. Sup.*, **11** : 631-771.

Material examined : Goa–3exs., A ditch near Dudhasagar stream near Colem, 13.10.02 (Coll. P.D. Rane); 5exs., Novebond Sal river at Cuncollium, 23.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Body oval, valve generally punctate or with reticulation. Rostrum blunt. Plate of labrum with convex anterior margin and slightly pointed apex. Ocellus situated halfway

between eye and anterior margin and slightly pointed apex. Postabdomen with almost straight dorsal and ventral margins. Postabdomen with 7-8 anal denticles and groups of lateral setae; distal setae in each group longest. Claw with one basal spine of medium size.

Distribution : India : Gujarat, Rajasthan, Maharashtra, Tamil Nadu, Tripura.

Elsewhere : Cosmotropical.

35. *Camptocerus rectirostris* Schoedler, 1862

1851. *Lynceus macrurus* Fischer, *Mem. Acad. Sci. St.Petersh. Mem. Sav. ent rang.*, 7 : 188-189, pl. VII, fig. 8. pl. IX, figs. 1-2.

1862. *Camptocercus rectirostris* Schoedler, *Berlines Jahrb. Dorotheenstadt. Realschule. Berom*, p. 25, pl. II, figs. 43.

Material examined : Goa–lex., Mayem lake at Bicholium, 24.9.93; lex., Fresh water pool near maxim, Painginium, 19.9.93 (Coll. M.S. Pradhan); lex., Arevellum near Honda, 10.11.02 (Coll. P.D. Rane).

Diagnosis : Female : Body oval greatly compressed with keel on head and back. Valves with longitudinal lines, marked with curved stripes. Posterodorsal corner of valves rounded; posteroventral corner with 3-5 denticles. Rostrum pointed and directly anteriorly. Antennules with rounded apex. Postabdomen long, narrow, with 15-17 anal denticles; lateral seate small and in groups. Claw long, with basal spine and row of setae becomes longer distally.

Distribution : India : Kashmir, Gujarat, Meghalaya, West Bengal.

Elsewhere : Holarctic, Ethiopian, Indo–Malayan, New Zealand and European USSR.

Genus *Graptoleberis* Sars, 1862

36. *Graptoleberis testudinaria* (Fischer, 1851)

1843. *Alona reticulata* Baird, *Ann. Mag. Nat. His.*, **68** : 93, pl. III, fig. 12.

1851. *Lynceus tesaudinaria* Fischer, Mem, *Acad. Sci. st. Petersb. Mem Sav. etrang*, 7 : 191, pl. IX, fig. 12.

1891. *Graptoleberis testudinaria* Sars, *Forth. Vidensk. Selsk. Christiania*, : 13.

Material examined : Goa–5exs., Freshwater pond near Maxim, Painginium, 19.9.93 (Coll. M.S. Pradhan); 2exs., Navelum pond, 23.11.93 (Coll. P.D. Rane).

Diagnosis : Female : Dorsal margin of body, convex, ventral margin almost straight. Ventral margin of valve with setose setae. Posteroventral corner of valves with two denticles. Reticulation of carapace with distinct rectangular cells with shape of tetragonal, pentagonal or hexagonal cells. Rostral margin very wide. Antennule with a sensory seta at distal end. Plate of larbram with rounded apex. Ocellus is smaller than eye. Postabdomen tapering distally. Anal margin with row of anal spines., appears in groups. Several groups of lateral setae. Claw with small basal spine and fine setae on the concave margin.

Distribution : India : West Bengal. Kashmir, Kumaon, Western Himalayas, Maharashtra, Tamil Nadu.

Elsewhere : Cosmopolitan.

Genus *Leydigia* Kurz, 1875

37. *Leydigia acanthocercoides* (Fischer, 1854)

1854. *Lynceus acanthocercoides* Fischer, *Bull. Soc Imp. Nat. Mosc.*, **27** : 431-433, pl. III, figs., 21-22.

1875. *Leydigia acanthocercoides* Kurz, *Sitzber. K. Acad. Wiss. Wein Math. Nat.* **70** : 59-60.

Material examined : Goa–lex., Patridevi tank, 8.12.93 (Coll. P.D. Rane).

Diagnosis : Female : Valves with longitudinal lines, running parallel to the anterior margin. Rostrum blunt, antennules not reaching apex of rostrum. Ocellus larger than eye, situated closer to eye than apex of rostrum. Labrum rounded with fine setae on the anterior margin. Postabdomen broadly rounded and margin concave, with about 10 grouped lateral large setae consist of two setae each with distal most largest in each group, also present 18 marginal denticles. Claw without basal spine.

Distribution : India : West Bengal, Andaman and Nicobar Islands, Gujarat, Rajsthan, Tamil Nadu, Maharashtra, and Tripura.

Elsewhere : Holarctic, Ethiopian, Indo-Malayan region, Neotropical European USSR and South East Asia.

Genus ***Biapertura*** Smirnov, 1971

Key to the species of Genus *Biapertura*

1. Two main head pores, connected by narrow channel, situated in the middle line of head shield and with two small lateral head pores ..... *Biapertura* Smirnov, 1973
2. Postero-ventral corner of valves without denticles, species comparatively large form, postabdomen not widening distally. Anal spines large, lateral setae not projecting beyond margin of postabdomen .... *Biapertura affinis* (Leydig, 1860)
3. Posteroventral corner of valves with denticles, postabdomen widening distally .... *Biapertura karua* (King, 1853)

38. ***Biapertura affinis*** (Leydig, 1860)

1860. *Lynceus affinis* Leydig, *Naturgeschicted der. Daphmiden, Tubingen*, 223, pl. IX., figs.68-69.

1971. *Biapertura affinis Smirnov, USSR, Acad. Sci. Zool. Institue. Nova. Ser.* No. 101, *Leningrad*, 467-462, figs. 582-587.

Material examined : Goa–2exs., Navelium, 23.11.93; lex., Shakhalum, 19.11.02 (Coll. P.D. Rane).

Diagnosis : Female : Body oblong, posteroventral corner of valve with row of groups setae continuing as a row of spinules on the posterior margin. Valve marked with longitudinal lines. Plate of labrum with convex anterior margin. Ocellus is smaller that eye. Postabdomen unifromly wide, dorsal margin rounded with 12-16 anal denticles. Claw with large basal spines and setae on the concave margin.

Distribution : India : Kashmir, Meghalaya, Gujarat, West Bengal, Maharashtra.

Elsewhere : Cosmopolitan, USSR and Central Asia.

39. ***Biapertura karua*** (King, 1853)

1853. *Alona karua* King, *Pap. Proc. R. Soc. van. Diemans Land.*, **2** : 260, pl. VIII

1971. *Biapertura karua* Smirnov. *USSR, Acad. Sci. Zool. Institue, Nova. Ser. No. 101, Leningrad*, : 479-480, figs. 600-603.

Material examined : Goa–2exs., Valvanti near Tulshimala, 16.3.93 (Coll. G.M. Yazadani).

Diagnosis : Female : Body oval, Posteroventral corner of valve with 3 denticles followed by row of setules. Valve straited with distinct lines and polygonal pattern. Antennules almost reaching apex of rostrum. Plate of labrum rounded. Postabdomen broadly rounded with 7-8 spines present with lateral groups of setae. Claw with small basal spine.

Distribution : India : Tripura, Andaman and Nicobar Islands, Meghalaya, Tamil Nadu, Maharashtra, West Bengal.

Genus ***Oxyurella*** Dybowski and Grochowski, 1894

40. ***Oxyurella sigalensis*** (Daday, 1898)

1898. *Alonopsis singalensis* Daday, *Terems, Furetek*, **21** : 43-45, fgis. 20, a-b.

1957. *Oxyurella singalensis* Fryer, *Arch. Hydrobiol*, f3 : 232.

Material examined : Goa–lex., Shakhalum, 19.11.02 (Coll. P.D. Rane); lex., Arevellem near Honda–Sattari 10.11.02 (Coll. P.D. Rane).

Diagnosis : Female : Valve evenly rounded with parallel lines to the ventral margin. Rostrum blunt, antennules not reaching the apex of rostrum. Ocellus smaller than eye and situated closer to the eye then to the apex of rostrum. Laburm rounded. Postabdomen long with 10-12 large and denticles which decrease in size. Claw long with large basal spine and additional 2-3 sub-basal spines. Lateral setae in groups and arranged in rows.

Distribution : India – West Bengal, Andaman and Nicobar Isalnds, Rajasthan, Tamil Nadu Tripura.

Elsewhere : South East Asia, Etuiopian, indo–Malayan and North east China.

Genus ***Kurzia*** Dybowski and Grochowski, 1894

41. ***Kurzia longirostris*** (Daday, 1898)

1898. *Alona longirostris*, Daday, *Termes fuzetek*, **21** : 34, figs. 14. a-b.

1901. *Pseudalona longirostris* Sars, *Arch. Math. Nat.*, **23** : 87-88, pl. XXI, figs. 3, 3.a-b.

1957. *Kurzia longirostris* Harding, *Explor. Hydrobiol. Lac. Tanganyika. Result Scientifique* **3**, 6 : 73, fig. 15.

Material examined : Goa–lex., Mayem lake Bicholium 24.9.93; lex., Freshwater pond near Maxem, Painginium 19.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Body compressed, posterodorsal and posteroventral corner of vlave rounded. Valve marked with longitudinal lines. Rostrum long and slightly curved ventrally. Antunnule reaching middle of rostrum. Antenna not reaching apex of the rostrum. Plate of labrum with pointed apex. Postabdomen tapering distally, with distal corner produced. Anal dinticles 18-20. Claw with basal spine and setae on the concave margin.

Distribution : India : West Bengal, Tamil Nadu, Maharashtra.

Elsewhere : Cosmotropical, Australia, Srilanka.

Genus ***Eryalona*** Sars, 1901

42. ***Eryalona orientialis*** (Daday, 1898)

1898. *Alonopsis orientalis* Daday, *Termes, Fuzetek*, **21** : 45-48, figs. 21-22.

1905. *Eryalona orientalis* Daday, *Zoologica Stuttgart*, **18** : 180-181, pl. XI, fgis. 14-15.

Material examined : Goa–lex., Talpan near Cnacona, 20.9.93; lex., Novebond–Sal near Cuncollium, 23.9.93 (Coll. M.S. Pradhan); lex., Mahamadi near Panjie, 3.12.93 (Coll. P.D. Rane).

Diagnosis : Female : Body alomost quadrangular. Valve with rectangular reticulation. Postroventral margin of valve with series of setae. Rostrum blunt. Antennules almost reaching apex of rostrum. Labrum rounded with nipple–like structure on apex. Postabdomen long with 20 pointed denticles decreasing in size prioximally. Claw with short basal spine. Anus situated in proximal part of postabdomen.

Distribution : India : Tamil Nadu, West Bengal, Maharashtra.

Elsewhere : Shore of Gulf Maxico, Northest China, Indo–Malayan, Ethiopian and Neotropical regions.

Genus ***Notoalona*** Rajapaksa and Fernando, 1987

43. ***Notoalona globulosa*** (Daday, 1893)

1898. *Alona globulosa* Daday, Termes, *Fuzetek*, **21** 1-123

1897. *Notoalona globulosa* Rajpaksa and Fernando, *Hydrobiologia*, **144** : 131-153.

Material examined : Goa–Several specimens from Mayam lake, Bicholium 24.9.93 (Coll. M.S. Pradhan).

Diagnosis : Female : Valve with striations. Rostrum short and blunt, antennules not reaching apex of rostrum. Ocellus smaller than eye, situated closer to the eye than to the apex of rostrum. Labrum serrated on anteroventral margin. Postabdomen long with 12 to 13 anal denticles. Claw long with short basal spine.

Distribution : India : Andaman and Nicobar Islands, Madhya Pradesh, Maharshtra and Tamil Nadu.

Elsewhere : South- East Asia, Neotropical and Neoarctic region.

Genus ***Indialona*** Petkovski, 1966

44. ***Indialona ganapati*** Petkovski, 1966

1966. *Indialona ganapati* Petkovski, *Fragmenta Balcanica Musei Macedonici Scientia rau naturalium*, V 2 157-165, pl. 1-9.

Material examined : Goa–Several examples from Mayem lake, 13.10.02 (Coll. P.D. Rane).

Diagnosis : Female : Body almost oval, posterodorsal corner of valves distinct and posteroventral corner rounded without spinule. Valve with spares setae on ventral margin.

Antennules almost reaching apex of the rostrum. Ocellus smaller than eye situated halfway between eye and apex of rostrum. Postabdomen, tapering towards base of claw with out dorsal corner, with 4-5 groups of setae on lateral surface. Pre and postanal parts of postabdomen with anal denticles almost absent. Claw with one basal spine.

Distribution : India : Gujarat (Ashmedaba); Madhya Pradesh (Bhopal); Maharshtra (Ujani weland).

Elsewhere : Endemic species only–found in India.

SUMMARY

This paper deals with diagnosis, distribution and key for identification of 6 families of Cladocera. Forty species and four subspecies have been recorded from Goa state, belonging 29 genera. Larger species of *Daphnia, Simocephalus* are well represented. Species from family *Bosmidae* are seen in very large numbers and abundent in the collections. The *Echinisca capensis monodi* earliar only recorded from the Gumti reservoir of Tripura and that recordes second time from Inida in this study. The fauna of Cladocera from Goa harbour Indo–Malayan and Palaerctic elements. In this study family Chydoridae is having largest species found. As no study was ever carried out on fauna of Goa state, all Cladocera species are recorded first time from this state.

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Fauna of Goa, State Fauna Series, **16** : 103-107, 2008

LAND AND MARINE ISOPODS
Oniscidae, Sphaeromatidae (Crustacea : Isopoda)

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INTRODUCTION

Isopoda is one of the 9 orders in the crustacean superorder Peracarida. They are readily distinguished from other peracarids and crustaceans by the following characteristics : (i) body usually flattened (except in Anthuridea and Phreatoicidea); (ii) head (cephalon) compact with unstalked compound eyes and two pairs of antennae (first pair minute in Oniscidea), mouth parts made up of a pair of mandible, two pairs of maxillae (maxillules and maxillae) and a pair of maxillipeds; (iii) a long thorax of eight thoracomeres, first (and also the second in Gnathiidae) fused with head bearing the maxillipeds, rest seven (called pereonites) free and collectively comprising of a body division called the pereon; (iv) seven pairs of uniramous legs or pereopods (with the exception of gnathids which possess five pairs of walking legs), all more or less alike and hence "iso-pods"; (v) appendages never chelate, *i.e.*, the subterminal article or propodus which works with the terminal article or dactyl as a true claw is not modified into "hand"; (vi) a relatively short abdomen (pleon) comprising of six somites or pleonites, at least one of these always fused to the terminal plate (telson) to form a pleotelson; (vii) six pairs of biramous pleonal appendages containing five pairs of plate-like respiratory/natatory pleopods and a single pair of fan-like or stick-like, uniarticulate (unjointed) uropod; (viii) heart located primarily in the pleon; (ix) biphasic molting, *i.e.*, the posterior half of the body molts before the anterior half (Brusca, 1997).

Isopods are broadly divided into two groups– "short-tailed" (primitive) and "long-tailed" (more advanced) forms. In the former category (Phreatoicidea, Asellota, Oniscidea, Microcerberidea and Calabozoidea), telsonic region is very small and the anus and uropods are either terminal or subterminal on the pleotelson whereas, in the later group (Gnathiidea, Anthuridea, Flabellifera, Valvifera and Epicaridea), the telsonic region is very much elongated and the anus and uropods are shifted to a subterminal position on the pleotelson.

Isopoda is a large diverse order containing 10 suborders, of which, all but two (Microcerberidea and Calabozoidea) occur in India. They are met with in all seas, occurring at all depths in fresh and brackishwater as well as on land (Oniscidea). About 10,000 described species of this group are known globally which contains elements from marine, terrestrial and freshwater environments. However, the isopod fauna of the state of Goa is poorly known. Santhakumaran (1983a,b) and Ramakrishna (1995) reported six species and a subspecies belonging to the families Sphaeromatidae and Oniscidae. In the course of survey works during 2002-2004, the author could collect one more species of sphaeromatid, namely, *Sphaeroma walkeri* from the Goa coast These have been dealt with in the present paper. In this communication, family and generic descriptions are based on Purushotham and Rao (1971) and Nair and Salim (1994) while keys have been prepared following Ramakrishna (*op. cit.*) and Pillai (1961).

LIST OF SPECIES REPORTED*

Family ONISCIDAE

1. *Philoscia javanensis* Richardson, 1922
2. *Philoscia londensis* Ramakrishna, 1969
3. *Porcellio assamensis* Chopra, 1924

Family SPHAEROMATIDAE

4. ***Sphaeroma terebrans* Bate, 1866**
5. *Sphaeroma annandalei* Stebbing, 1911
6. *Sphaeroma annandalei travencorensis* Pillai, 1955
7. *Sphaeroma walkeri* Stebbing, 1905

* Besides Oniscidae and Sphaeromatidae, other two families namely, Bopyridae (*Probopyrus pica)* and Ligidae (*Ligia exotica)* also occurs in Goa (Chopra, 1923; Nandi *et al.*, 2007.

SYSTEMATIC ACCOUNT

Family ONISCIDAE Brandt, 1851

Diagnosis : Body oblong or oval, fairly convex, lateral parts of segments expanded, hardly contractile or conglobate. Antennules small; second antenna slender consisting of 1–4 joints.

Key to genera of the family ONISCIDAE

- Flagellum of second pair of antenna three jointed, uropodia short, stout and non-cylindrical ..... ***Philoscia***
- Flagellum of second pair of antenna two-jointed, uropodia flattened ..... ***Porcellio***

Genus ***Philoscia*** Latreille, 1804

1804. *Philoscia* Latreille, *Hist. Nat. Crust. Ins.*, **7** : 43.

1995. *Philoscia* Ramakrishna, *Fauna of India and the Adjacent Countries (Crustacea : Oniscidae)* : 29.

Diagnosis : Cephalon rounded in front, lateral lobes not projected. Mandibles bearing a single pencil behind the cutting edge. Uropoda not much projected, inner ramus not attached so far in front of outer branch.

Remarks : The genus contains 8 species from India, of which, two species occur in Goa.

Key to species of the genus *Philoscia*

Outer ramus of uropod longer than the basal, inner ramus narrow and linear, no yellow patches on lateral sides of thorax .... *P. londensis*

- Outer ramus of uropod nearly twice as long as basal joint; inner ramus cylindrical, circular yellow patches present on lateral sides of thoracic segments ..... *P. javanensis*

1. ***Philoscia londnensis*** Ramakrishna, 1969

1969. *Philoscia londnensis* Ramakrishna, *Bull. Syst. Zool. Calcutta*, **1**(2) : 67.

1995. *Philoscia londnensis*, Ramakrishna, *Fauna of India and the Adjacent Countries (Crustacea : Oniscidae)* : 35, text-fig. 9A-I.

Diagnosis : Body oblong oval, elongated. Telson sub-triangular, culminating posteriorly to a blunt rounded point and reaching beyond middle of basal segment of uropod. First segment of flagella of second antenna longest, second and third subequal.

Distribution : India : Goa; Maharashtra; Karnataka; Kerala; Tamil Nadu; Orissa; West Bengal; Madhya Pradesh; Rajasthan; Assam; Meghalaya; Manipur and Arunachal Pradesh.

Elsewhere : Bhutan, Myanmar, Malay, Singapore, Hong Kong and China.

2. ***Philoscia javanensis*** Richardson, 1922

1922. *Philoscia javanensis* Richardson, *Proc. U. S. Nat. Mus.*, **60**(24) : 1.

1995. *Philoscia javanensis*, Ramakrishna, *Fauna of India and the Adjacent Countries (Crustacea : Oniscidae)* : 55, text-fig. 18.

Diagnosis : Body oblong-oval, smooth, about twice as long as broad; head oval, about twice as broad as long. Telson more than twice as broad as long, with apex bluntly triangular. All three segments of flagella of second antenna sub-equal.

Distribution : India : Goa, Karnataka, Kerala, Tamil Nadu, West Bengal, Uttar Pradesh, Madhya Pradesh, Himachal Pradesh, Haryana, Arunachal Pradesh, Assam and Nicobar Islands.

Elsewhere : Bhutan, Myanmar and Java.

Genus ***Porcellio*** Latreille, 1804

1804. *Porcellio* Latreille, *Hist. Nat. Crust. Ins.*, **7** : 45.

1995. *Porcellio*, Ramakrishna, *Fauna of India and the Adjacent Countries (Crustacea : Oniscidae)* : 57.

Diagnosis : Cephalon partly flanked by lateral plates of the first thoracic segment, lateral lobes well developed. Mandibles with several pencils. Uropod projecting, outer branch lanceolate, inner ramus originating in front of former.

Remarks : The genus *Porcellio* is represented by 12 species in India, of which, only one species occur in Goa.

3. ***Porcellio assamensis*** Chopra, 1924

1924. *Porcellio assamensis* Chopra, *Rec. Indian Mus.*, **26**(1) : 51.

1995. *Porcellio assamensis*, Ramakrishna, *Fauna of India and the Adjacent Countries (Crustacea : Oniscidae)* : 60, text-fig. 19, 20.

Diagnosis : Body oval, head quadrangular, frontal margins developed into two conspicuous lobes, apex of median lobe ending in a broad process. Telson triangular with its apex drawn out to a long pointed process posteriorly.

Distribution : India : Goa; Karnataka; Kerala; Tamil Nadu; Orissa; West Bengal; Arunachal Pradesh; Bihar; Manipur; Meghalaya; Madhyay Pradesh and Andaman and Nicobar Islands.

Elsewhere : Bhutan and Myanmar.

Family SPHAEROMATIDAE Latreille, 1825

Diagnosis : Body oval, convex, pleon composed of two distinct free somites including the telson. First and second antenna with peduncles consisting of 3 and 5 articles respectively. Uropods lateral, exopod free and movable, endopod firmly attached to peduncle and immovable.

Genus ***Sphaeroma*** Bosc, 1801

1801. *Sphaeroma* Bosc, *Hist. Nat. Crust.*, **2** : 182.

1961. *Sphaeroma*, Pillai, *Wood-boring Crustacea of India* : 1.

1971. *Sphaeroma*, Purushotham and Rao, *J. Timb. Dev. Ass. India*, **17**(3) : 17.

1994. *Sphaeroma*, Nair and Salim, *Rec. zool. Surv. India, Occ. Paper No.* **159** : 52.

Diagnosis : Fourth to fifth joints of maxillipeds not produced into lobes. Pereopod 1-3 slender with long natatory setae. Outer ramus of third pleopod jointed. Outer margin of outer ramus of uropod distinctly serrated. Marsupial plates overlapping at mid-line.

Key to species of the genus *Sphaeroma*

1. Entire dorsal surface of body tuberculate, epistome broad throughout, telson with longitudinal rows of tubercles .... *S. walkeri*

   Only posterior half of the dorsal surface of body tuberculate, epistome triangular, telson with transverse rows of tubercles 2

2. Epistome broader than long, apex of telson angular ..... *S. terebrans*

   Epistome longer than broad, apex of telson rounded 3

3. Seventh peraeon segment with transversely elongated tubercles, submedian pairs on telson similar, distal border of telson not raised .... *S. annandalei*

   Seventh peraeon segment with large ridge-like tubercles, submedian pairs on telson dissimilar, distal border of telson raised .... *S. annandalei travancorensis*

4. ***Sphaeroma terebrans*** Bate, 1866

1866. *Sphaeroma terebrans* Bate, *Ann. Mag. nat. Hist.* (3), **17** : 28, pl. 2, fig. 5

1961. *Sphaeroma terebrans*, Pillai, *Monograph of Wood-boring Crustacea of India* : 2, pl. 1, fig 1 and T figs. 2-3.

1994. *Sphaeroma terebrans*, Nair and Salim, *Rec. zool. Surv. India, Occ. Paper No.* **159** : 52, pl. 10, fig. 2.

Diagnosis : Epistome triangular, almost as long as broad, apex subtruncate. Telson with transverse rows of tubercles, apex of telson angular. Sixth and seventh thoracic segment each bearing four tubercles—two submedian and two lateral, pleon also bearing equal number of tubercles. Border of exopod of uropod five toothed.

Distribution : India : Goa; Gujarat; Mangalore; Kerala; Tamil Nadu; Andhra Pradesh; Orissa; Andaman Islands.

Elsewhere : California, Florida, Costa Rica, Brazil, Congo, West Africa, South Africa, Mozambique, Zanzibar, Mediterranean, Sri Lanka, Australia and New Zealand.

Remarks : This species was reported to be abundant both in live and dead mangroves along the Goa coast (Santhakumaran, 1983b).

5. ***Sphaeroma annandalei*** Stebbing, 1911

1911. *Sphaeroma annandalei* Stebbing, *Rec. Indian Mus.*, **6**(4) : 181, pl. 10.

1961. *Sphaeroma annandalei*, Pillai, *Monograph of Wood-boring Crustacea of India* : 13, pl. 1, fig. 4 and T. figs. 6-7.

1994. *Sphaeroma annandalei*, Nair and Salim, *Rec. zool. Surv. India, Occ. Paper No.*, **159** : 53, pl. 10, fig. 1.

Diagnosis : Only posterior half of thorax tuberculate. Epistome triangular. Telson with transverse rows of non-setose tubercles, apex rounded and not raised distally. Seventh thoracic segment with transversely elongated tubercles.

Distribution : India : Goa; Gujarat; Maharashtra; Karnataka; Kerala; Tamil Nadu; Andhra Pradesh; Orissa; West Bengal.

Elsewhere : Brazil, Zululand and Natal (South Africa).

Remarks : Santhakumaran (1983b) recorded this species as abundant both in live and dead mangroves along the Goa coast.

6. ***Sphaeroma annandalei travancorensis*** Pillai, 1955

1955. *Sphaeroma annandalei travancorensis* Pillai, *Bull. Cent. Res. Inst., Trivandrum*, (C), **4**(1) : 135, figs. 36-37.

1961. *Sphaeroma annandalei travancorensis*, Pillai, *Monograph of Wood-boring Crustacea of India* : 17, pl. 2, fig. 1 and T. fig. 8.

Diagnosis : Tuberculation similar to *S. annandalei* but the lateral longitudinal row comprising of 2 tubercles instead of 3. Distal spine of propodus of first pair of peraeopod shaped differently. Ischium of seventh peraeopod comparatively small, merus bearing 9 outer setae, carpus with 16 outer and 5 inner spines, propodus of uniform width.

Distribution : India : Goa; Kerala.

Remarks : This species is restricted to India and so far, it is reported from the west coast only. It was stated to be rare in mangroves along Goa coast (Santhakumaran, 1983b).

7. ***Sphaeroma walkeri*** Stebbing, 1905

1905. *Sphaeroma walkeri* Stebbing, *Ceylon Pearl Oyster Fisheries Report*, **4** : 31, pl. 7.

1961. *Sphaeroma walkeri*, Pillai, *Monograph of Wood-boring Crustacea of India* : 8, pl. 1, figs. 2-3 and T. figs. 4-5.

1994. *Sphaeroma walkeri*, Nair and Salim, *Rec. zool. Surv. India, Occ. Paper No.*, **159** : 55.

Material examined : 4 ex., Bogmolo, 01. 12. 2002, Dr. M. K. Dev Roy, Reg. No. C 5529/2; 18 ex., Durbat Ferry Point, Ponda, 28. 11. 2002, Dr. M. K. Dev Roy, Reg. No. C 5530/2; 1 ex., 20. 11. 2002, Charao Island, Dr. M. K. Dev Roy, Reg. No. C 5531/2.

Diagnosis : Entire dorsal surface of carapace tuberculate. Epistome broad. Telson with longitudinal rows of tubercles.

Distribution : Goa; Maharashtra; Kerala; Tamil Nadu; Andhra Pradesh; Lakshadweep.

Elsewhere : California, Florida, Puerto Rico, Brazil, South Africa, Suez, Egypt, Sri Lanka, Hong Kong, Australia and Hawaii.

Remarks : This species is pan-tropical. This species was collected from mangroves as well as from drifted wood on the beach.

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SUMMARY

The paper deals with taxonomy and distribution of land, marine and estuarine isopods pertaining to two families namely, Oniscidae and Sphaeromatidae of the state of Goa. Three species belonging to Oniscidae and three species and a subspecies of the family Sphaeromatidae have been dealt with in this communication.

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MARINE AND ESTUARINE CRABS
(Crustacea : Decapoda : Brachyura)

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INTRODUCTION

Goa, the smallest state among Indian territories is situated along the central west coast of India between 14°49′–15°52′ N. latitude and 73°38′–74°44′ E longitude with a geographical area of about 3702 sq km. It is bounded on the north by Maharashtra, on the south and east by Karnataka while on the west it is bordered by the vast Arabian Sea. It comprises of two districts namely, North Goa and South Goa. The coast line is short, about 120 km long. The coastal area is drained by a number of west flowing rivers which meet the Arabian sea. Important rivers are Mandovi, Zuari, Terekhol, Chapora and Betul. All these rivers are navigable forming a network of internal waterways and are virtually the life lines of Goa's economy. Mandovi-Zuari along with Cambarjua canal form the largest estuarine complex, rich in marine and estuarine fauna. Some of these species contribute to important fisheries of the region, fetching foreign exchange.

Brachyuran faunal component of Goa is very inadequately known. Kemp (1917, 1919 a, b) reported 6 species pertaining to only two families namely Hymenosomatidae and Ocypodidae from the state. These contained 4 new species of hymenosomatid and 2 species of ocypodid crabs. After a long gap, Ansari and Harkantra (1975) dealt with the edible crabs of Goa while Guinot (1985) in the course of her rivisionary work on the genus *Parapanope* recorded a single species of this genus from the state. However, while studying mangrove crustaceans of Goa, Dev Roy and Nandi (2005) recorded as many as 12 brachyuran crabs in a short communication from this state. In the present paper, a consolidated account of brachyuran fauna of the state has been presented for the first time.

MATERIALS AND METHODS

The present paper is based on two surveys conducted by the senior author during 2002 and 2004. A small collection of crabs were also made available for study by the Officer-in-Charge, Zoological Survey of India, Western Regional Station, Pune. In addition, the materials present in the National Zological Collection (N.Z.C.) were also identified and included in this report. Dichotomous key has been provided to facilitate identificarion. All keys to the species and higher taxa related to the concerned taxa from Goa are mostly based on the descriptions given by Alcock (1895-1900), Banerjee (1960), Barnes (1967), Crane (1975), Davie (1989), Galil and Clark (1994), Laurie (1906), Lucas (1980) and Serène and Soh (1970). Terminology used in the present paper is followed after Dev Roy and Das (2000).

All measurements are in millimeter and were measured with the help of a Vernier Caliper or an eyepiece scale according to size. The general measurement of size is expressed as carapace width which is taken at its widest part and length on the median, from anterior to posterior margin. Unless otherwise stated, lateral spines and rostrum are excluded while measuring carapace width and length respectively. The abbreviations used in this work are from Dev Roy and Bhadra (2005).

SYSTEMATIC LIST

Phylum and Subphylum CRUSTACEA Pennant, 1777

Class MALACOSTRACA Latreille, 1806

Subclass EUMALACOSTRACA Grobben, 1892

Order DECAPODA Latreille, 1803

Suborder PLEOCYEMATA Burkenroad, 1963

Infra-order BRACHYURA Latreille, 1803

Section OXYSTOMATA H. Milne Edwards, 1834

Superfamily LEUCOSIOIDEA Samouelle, 1819

Family CALAPPIDAE de Haan, 1833

Subfamily MATUTINAE de Haan, 1835

1. *Ashtoret miersi* (Henderson, 1887)
2. *Matuta victor* (Fabricius, 1781)

Family LEUCOSIIDAE Samouelle, 1819

Subfamily LEUCOSIINAE Samouelle, 1819

3. *Philyra scabriuscula* (Fabricius, 1798)

Superfamily HYMENOSOMATOIDEA MacLeay, 1838

Family HYMENOSOMATIDAE MacLeay, 1838

4. *Elamenopsis alcocki* (Kemp, 1917)
5. *Elamenopsis demeloi* (Kemp, 1917)
6. *Elamenopsis octagonalis* (Kemp, 1917)
7. *Elamena truncata* (Stimpson, 1858)
8. *Elamena xavieri* Kemp, 1917

Section BRACHYRHYNCHA Borradaile, 1907

Superfamily PORTUNOIDEA Rafinesque, 1815

Family PORTUNIDAE Rafinesque, 1815

Subfamily PORTUNINAE Rafinesque, 1815

9. *Scylla serrata* (Forskål, 1775)
10. *Scylla tranquebarica* (Fabricius, 1798)
11. *Portunus pelagicus* (Linnaeus, 1758)
12. *Portunus sanguinolentus* (Herbst, 1790)
13. *Charybdis (Charybdis) affinis* Dana, 1852
14. *Charybdis (Charybdis) annulata* Fabricius, 1798
15. *Charybdis (Charybdis) callianassa* (Herbst, 1801)
16. *Charybdis (Charybdis) feriatus* (Linnaeus, 1758)
17. *Charybdis (Charybdis) lucifera* (Fabricius, 1798)
18. *Charybdis (Charybdis) riversandersoni* Alcock, 1899
19. *Charybdis (Goniohellenus) hoplites* Wood-Mason, 1877
20. *Thalamita crenata* (Latreille, 1829)

Superfamily XANTHOIDEA MacLeay, 1838

Family XANTHIDAE MacLeay, 1838

Subfamily ZOSIMINAE Stimpson, 1907

21. *Atergatis integerrimus* (Lamarck, 1801)
22. *Atergatis laevigatus* A. Milne Edwards, 1865

Subfamily XANTHINAE MacLeay, 1838

23. *Leptodius exaratus* (H. Milne Edwards, 1834)
24. *Demania baccalipes* (Alcock, 1898)

Family PILUMNIDAE Samouelle, 1819

Subfamily PILUMNINAE Samouelle, 1819

25. *Eurycarcinus orientalis* A. Milne Edwards, 1867

Subfamily RHIZOPINAE Stimpson, 1858

26. *Benthopanope indica* (de Man, 1888)

INCERTAE SEDIS

27. *Parapanope hextii* (Alcock, 1898)

Family ERIPHIIDAE MacLeay, 1838

Subfamily OZIINAE Dana, 1851

28. *Epixanthus frontalis* (H. Milne Edwards, 1834)
29. *Lydia annulipes* (H. Milne Edwards, 1834)

Subfamily MENIPPINAE Ortmann, 1893

30. *Menippe rumphii* (Fabricius, 1798)
31. *Myomenippe hardwickii* (Gray, 1831)

Superfamily GRAPSIDOIDEA MacLeay, 1838

Family GRAPSIDAE Dana, 1851

Subfamily GRAPSINAE MacLeay, 1838

32. *Grapsus albolineatus* Lamarck, 1818
33. *Metopograpsus messor* (Forskål, 1775)

Subfamily VARUNINAE H. Milne Edwards, 1853

34. *Varuna litterata* (Fabricius, 1798)

Subfamily SESARMINAE Dana, 1852

35. *Chiromantes bidens* (de Haan, 1835)
36. *Parasesarma plicatum* (Fabricius, 1798)
37. *Episesarma taeniolata* (White, 1847)
38. *Pseudosesarma edwardsi* (de Man, 1887)
39. *Nanosesarma andersoni* (de Man, 1887)
40. *Clistocoeloma merguiense* de Man, 1888

Superfamily OCYPODOIDEA Rafinesque, 1815

Family OCYPODIDAE Rafinesque, 1815

Subfamily OCYPODINAE Rafinesque, 1815

41. *Ocypode ceratophthalma* (Pallas, 1772)
42. *Uca dussumieri* (H. Milne Edwards, 1852)
43. *Uca lactea* (de Haan, 1833)

Subfamily DOTILLINAE Stimpson, 1858

44. *Dotilla myctiroides* (H. Milne Edwards, 1852)
45. *Ilyoplax gangeticus* (Kemp, 1919)
46. *Scopimera proxima* Kemp, 1919

Subfamily MACROPHTHALMINAE Dana, 1851

47. *Macrophthalmus (Mareotis) pacificus* Dana, 1851

Key to families of Marine and Estuarine Crabs

1. Carapace narrowed anteriorly forming a distinct rostrum, orbits usually incomplete .. .. HYMENOSOMATIDAE
- Carapace broadened anteriorly, rostrum reduced or absent, orbits well developed ...2
2. Mouth frame triangular 3
- Mouth frame quadrate 4
3. Carapace subcircular with a very long prominent lateral spine ..... CALAPPIDAE
- Carapace circular and without such lateral spine ..... LEUCOSIIDAE
4. Carapace broad or transversely oval 5
- Carapace square or squarish 8
5. Last pair of leg flattened and adapted for swimming ..... PORTUNIDAE
- Last pair not adapted for swimming 6
6. Male abdomen five segmented .... XANTHIDAE
- Male abdomen with more than five segments 7
7. Carapace transversely oval, second pleopod in male extremely short never exceeding that of the first ..... PILUMNIDAE
- Carapace xanthoid shaped, length of second pleopod produced much beyond the first..... ..... ERIPHIIDAE
8. A rhomboidal gap left between the external maxillipeds, front broad ..... GRAPSIDAE
- No rhomboidal gap between external maxillipeds, front narrow .... OCYPODIDAE

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* **Note** : 1. The possible occurrence of the gecarcinid crab, *Cardisoma carnifex* (Family Gecarcinidae) was reported by Dev Roy and Nandi (2005) from Goa. Though such mounds of *C. carnifex* have been recorded from Agacaim and Salim Ali Bird Sanctuary, the species is not included in the present communication for not being able to collect a single specimen. The report and description of local villagers also suggest the possible occurrence of the species in and around mangroves of these areas.

2. At Agacaim, in the muddy sand substratum the fiddler crab, *Uca vocans* was seen in plenty but because of inaccessibility no specimen could be collected. Their population was also noticed in good numbers at Betim.

SYSTEMATIC ACCOUNT

Family CALAPPIDAE de Haan, 1833

1833. Calappidea de Haan, In : Siebold, *Fauna japon. (Crust.)* (1) : xiii, 67, 119. 124[corrected to Calappidae by White, 1847a : 44 ; name no. 371 on Official List, in Opinion 712, *Bull. zool. Nomencl.*, **21**(5) : 341(1964)].

1997. Calappidae, Galil, In : A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM, Vol. 18. *Mém. Mus. Natn. Hist. nat.*, **176** : 2.

2000. Calappidae, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.*, **185** : 18.

Diagnosis : Carapace oval or circular in outline. Front almost as broad as orbit. Lateral borders either with (1) a small tooth or strong spine at the junction of antero-lateral and postero-lateral borders or (2) a postero-lateral vault-like expansion over the walking legs. Antenna small, antennules folding obliquely. External maxillipeds may or may not close the buccal cavity fully; their palps remaining either concealed in repose or always exposed. Efferent branchial channels together forming a deep channel in the endostome, afferent branchial openings near bases of chelipeds. Chelipeds massive, greatly enlarged, almost symmetrical in size (asymmetrical in the size of fingers). Palm enormous, often very prominent. Abdomen consisting of five segments in adult male (third to fifth tergafused together) and of seven separate female and young males respectively. Gills nine on each side. Male genital openings coxal.

Remarks : The family is represented by a single subfamily, Matutinae.

Subfamily MATUTINAE de Haan, 1835

1835. Matutoidea de Haan, In : Siebold, *Fauna japon (Crust.)* (1) : xiii, 119, 126.

1896. Matutinae, Alcock, *J.Asiat. Soc. Bengal*, **65(2)** : 138.

2000. Matutinae, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.*, **185** : 19.

Diagnosis : Carapace circular with a stout spine at the junction of antero- and posterolateral borders. Merus of external maxillipeds elongate with acute tip, concealing flagellum fully in repose.

Remarks : The subfamily is now splitted into four genera (Galil and Clark, 1994), of which, only two are represented in the present collection.

Key to the genera of the subfamily MATUTINAE

Mid-palmar ridge granular and parallel to lower margin of fixed finger, dactylar ridge smooth throughout, carpus of leg bicarinate ..... ***Ashtoret***

Mid-palmar ridge smooth and oblique, dactylar ridge strongly milled throughout, carpus of last pair of leg unicarinate ..... ***Matuta***

Genus *Ashtoret* Galil and Clark, 1994

1994. *Ashtoret*, Galil and Clark, *Zool. Verh. Leiden*, **294** : 4.

2005. *Ashtoret*, Dev Roy and Bhadra, *Zool., Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 381.

Diagnosis : Carapace subcircular, strongly convex, bearing tubercles. Regions indistinct. Front wider than orbit, trilobate, median lobe projecting. Antero-lateral margin arcuate, tuberculate; postero-lateral margin sharply convergent; lateral spines acute. Antenna rudimentary. Orbits obliquely cut, communicating with antennular fossa. Eyestalk stout, elongate, its lower surface thickly covered with long plumose setae. Pterygostomial region bearing several rows of elliptoid tubercles serving as stridulatory organ. Third maxilliped elongate, extending almost up to the anterior margin of carapace. Chelipeds subequal; merus short, trigonal, lower margin tuberculate; palm almost twice its height and sculptured to its external surface; upper margin cut into three teeth, diminishing in size distally; mid-palm with a series of tubercles and spines parallel to its lower margin; outer surface of dactylus with a finely milled ridge in male, absent in female. Ambulatory legs with first propodus bearing a triangular teeth on lower margin, penultimate carpus bicarinate, propodus of last pair greatly extended posteriorly. Sternum anteriorly ogival. Male abdomen five segmented,

telson 1.5 times as long as wide at base with conspicuously tuberculate carina on third abdominal tergite.

Remarks : This genus consists of eight species in the Indo-Pacific (Galil and Clark, 1994). It is represented by a single species in Goa.

1. ***Ashtoret miersi*** (Henderson, 1887)
(Pl. 1, Fig. 1)

1887. *Ashtoret miersi* Henderson, *Madras J. Litt. Sci.*, **29** : 66, figs. 1-4.

1994. *Ashtoret miersi*, Galil and Clark, *Zool. Verh. Leiden*, **294** : 13, pl. 4a-b, figs. 2c-d.

2005. *Ashtoret miersi*, Dev Roy and Bhadra, *Zool. Surv. India State Fauna Series* **5** : *Fauna of Andhra Pradesh* (Part 5) : 382.

Material examined : 1(M), Caranzalem, 20.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5461/2.

Measurement :

W = 21.45 F = 5.3 L = 18.15.

Diagnosis : Carapace with six prominent tubercles, surface finely granular bearing minute red dots, especially on the anterior half. Front with straight lobes laterally and a slightly emarginated rostrum medially. Mid-palm of cheliped consisting of a five- lobed ridge, second and fourth lobes enlarged and acute. Outer surface of palm devoid of milled ridge. Lower margin of palm with a row of triangular tubercles terminating at base of fixed finger.

Distribution : Indo-Pacific. India : Goa; Andhra Pradesh; Tamil Nadu.

Elsewhere : Sri Lanka, Japan.

Remarks : This species was hitherto known only from the east coast of India (Dev Roy and Bhadra, *op. cit.*). As such, the present report extends its further distribution in the west coast and is a new record to Goa.

Genus ***Matuta*** Weber, 1795

1795. *Matuta* Weber, *Nomencl. ent. Syst. Fabr.* : 92.

2005. *Matuta*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 383.

Diagnosis : Carapace more or less flat, subcircular. Front almost as broad as orbit, trilobed, middle one more prominent than the others. Postero-lateral borders strongly convergent, bearing a spine at the junction of antero-lateral and postero-lateral borders. Antenna extremely small, inconspicuous. Antennules folded almost longitudinally. Orbits large, oval, with a deep groove in the lower border. Eye-stalks long, stout. External maxillipeds elongate, covering the buccal cavity fully; endostomial septum not separated from the efferent canals. Chelipeds massive, equal; stridulatory organ consisting of two elevated obliquely striated areas proximal one linear and the distal one either oval or subcircular on inner surface of upper margin of palm of cheliped along with a double series of transversely elongate tubercles on the pterygostomial region; palm compressed, its upper border cristate and outer surface sculptured. Legs adapted for swimming and burrowing, propodus and dactylus broadened enormously in first and last pair. Abdomen of adult male consisting of five segments in female and young males; first tergum in both sexes concealed under carapace completely.

Remarks : The genus is represented by a single species in Goa.

2. ***Matuta victor*** (Fabricius, 1781)
(Pl. 1, Fig. 2)

1781. *Cancer victor* Fabricius, *Species Insectorum Exhibentes*, **2** : 502.

1994. *Matuta victor*, Galil and Victor, *Zool. Verh. Leiden*, **294** : 39, figs. 7a-b, pl.13a-b

1997. *Matuta victor*, Ng and Huang, *Zoological Studies*, **36(4)** : 264, figs. 1G-H and 2 A-B.

2005. *Matuta victor*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 385, pl. 1, fig. 3.

Material examined : 3(M), 4(F), Colva, Margao, 02. 12. 2002, Dr. M. K. Dev Roy, Reg. No. C 5378/2; 2M, 1F, Calangute, 19.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5372/2; 2F, Colva beach, Margao, 02. 12. 2002, Dr. M. K. Dev Roy,

Reg. No. C 5413/2; 1(M), Cavelossim, 27. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5456/2; 1(F), Miramar Beach, 3 km south of Panaji, 20. 12. 1975, Dr. Y. M. Yazdani, Reg. No. WRS 3/ 2806; 4(M), Goa, 09. 12. 1973, Dr. B. S. Lamba, Reg. No. WRS 3/2279.

Measurement :

W = 35.1	F = 8.1	L = 31.4
34.65	8.5	31.4

Diagnosis : Carapace covered with minute red dots; of the six tubercles, anterior two either absent or faintly indicated. Two very conspicuous tubercles on mid-palm of chelipeds, below this surface of palm smooth excepting its lower border; dactylus strongly milled in male, milling present or absent in female.

Distribution : Indo-West Pacific. India : Goa; Maharashtra; Malabar; West Bengal; Orissa; Tamil Nadu; Pondicherry; Andaman Islands.

Elsewhere : Mozambique, Madagascar, Comoros, Tanzania, Somalia, Red Sea, Gulf of Aden, Gulf of Oman, Pakistan, Sri Lanka, Myanmar, Thailand, Peninsular Malaysia, Singapore, Philippines, Hong Kong, China, Taiwan, Japan, Indonesia, Timor, Australia, New Caledonia, New Hebrides, Norfolk, Ovolan and Fedjee.

Remarks : This species is widely distributed all over the Indo-West Pacific region. However, it is recorded for the first time from Goa.

Family LEUCOSIIDAE Samouelle, 1819

1819. Leucosiadae Samouelle, *Entom. Useful Compend.*: 91[corrected to Leucosiidae by Miers, 1879 : 671; Name No. 374 on Official List, in Opinion 712, *Bull. zool. Nomencl.*, **21**(5) : 341(1964)].

2005. Leucosiidae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series,* **5**(Part 5) : 386.

Diagnosis : Carapace subcircular, oval or polygonal. Front narrow but much wider than orbit. Orbits and eyes very small. Antennules obliquely folded, antennae small often obsolete. Inhalent branchial channels opening at bases of third maxillipeds. Gills less than nine. Chelipeds symmetrical. Abdominal segments seldom separate distinctly, usually third to sixth terga in both sexes intim ately fused with or without obliteration of sutures. Male openings sternal.

Remarks : The family Leucosiidae is now divided into four subfamilies as discussed earlier by Dev Roy and Bhadra (2001, 2005). It is represented by a single subfamily in the present collection.

Genus ***Philyra*** Leach,1817

1817. *Philyra* Leach, *Zool. Miscell.*, **3** : 18, 22.

2005. *Philyra*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series,* **5**(Part 5) : 396.

Diagnosis : Carapace circular, depressed; its margin bounded by a continuous beaded line originating just behind the front; hepatic and branchial regions fairly defined by grooves or creases. Front quadridentate. Edges of pterygostomial ridges and tips of buccal cavity projecting beyond the front. Epistome very small. Buccal cavern transversely oblong. Exopod of third maxilliped broader than merus of endopod. Antennules transversely folded. Chelipeds symmetrical and more massive than the legs. True legs small. Male abdomen consisting of 3 or 4 pieces, that of female of four, fusion lines often quite distinct.

Remarks : The genus is represented by a single species in Goa.

3. ***Philyra scabriuscula*** (Fabricius, 1798) (Pl. 1, Fig. 3)

1798. *Leucosia scabriuscula* Fabricius, *Ent. Syst. Suppl.* : 349.

2005. *Philyra scabriuscula*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series,* **5**(Part 5) : 397.

Material examined : 83(M), 22(F), Cavelossim beach, 27. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5462/2; 6(M), Goa, 09. 12. 1973, Dr. B. S. Lamba, Reg. No. WRS-3/2279; 6(M), 3(F),

Canacona, 23. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5499/2.

Measurement :

W = 12.6	F = 2.65	L = 13.15
9.6	2.45	10.2

Diagnosis : Carapace discoidal, slightly longer than broad, surface finely pitted and ornamented with vesiculous granules extending more or less over the branchial, cardiac-intestinal and gastric regions; branchio-cardiac grooves prominent. Margins of carapace closely beaded, beading continued anteriorly up to pterygostomial ridges below eye without any notch or interruption. Chelipeds slender, symmetrical; arm subcylindrical bearing rows of bead-like granules along the upper and inner surfaces, granules petering out distally; inner margin of wrist with a single row of granules; palm twice as long as broad, dactylus hook-like and almost as long as palm ; fingers meeting at tips, their opposed margins denticulate. Leg joints slender, smooth; meropodites with a line of microscopic granules ventrally. Segments 1 and 2 of male abdomen extremely short, almost sunken, 3-6 fused (suture between 5 and 6 not obliterated), sixth tergum without tubercle.

Distribution : Indian Ocean. India : Goa; Karnataka; Kerala; Orissa; Andhra Pradesh; Tamil Nadu; Nicobar Islands.

Elsewhere : South Africa, Persian Gulf, Red Sea, Pakistan, Tavoy, Mergui Archipelago, Mekran coast, Indonesia and Australia.

Remarks : This species was encountered in abundance at Cavelossim beach. Large number of this crab were found to drift on the shore with the ingress of high tide and became visible with the receding water. These were found to bury themselves under the sand before the approach of the next wave.This crab exhibited colour polymorphism. Some of them had purely white carapace while others were having blackish or red band on it, still a few had only a red carapace. Many were found in pairs. However, males (79.17%) outnumbered the females (20.83%). Most of the females were in berried condition. Of the total 25 females examined, gravid females were 22 (88%). The smallest and largest ovigerous females ranged between 8.4 and 10.25 mm respectively across their carapace width. This crab is a new record to Goa state though it was earlier reported from both the coasts of India as well as the Nicobar Islands.

Family HYMENOSOMATIDAE MacLeay, 1838

1838. Hymenosomidae MacLeay, In : *Smith. Illustr. Zool S. Afr. (Invert.)* : 68.

1980. Hymenosomatidae. Lucas, *Rec. Aust. Mus.*, 33(4) 151.

Diagnosis : Cephalothorax thin dorsoventrally, cuticle not heavily calcified, without hooked setae; carapace flattish, often with gastro-cardiac and contiguous grooves. With very incomplete orbits or without it, eyes exposed and slightly retractile. Antennae fused with epistome (when present), second segment slender; antennular fossae shallow and poorly defined. Ischium of outer maxillipeds well developed, palp articulating near antero-lateral angle of merus.Chelipeds not more than twice its carapace width in females and most males, fingers not bent at an angle to palm; male and female abdomens with not more than five segments (excluding telson). Male genital opening sternal, that of female on sternites of first walking legs (second pereiopods).

Remarks : Majority of the hymenosomatid crabs occur in the tropical and subtropical shelf waters of the Indo-West Pacific region and adjacent inland waters. The family consists of 12 genera and 72 valid species (Alcock, 1900; Kemp, 1917; Tesch, 1918; Sakai, 1938; Melrose, 1968; Lucas, 1980; Ng and Chuang, 1996). A considerable number of species belonging to eight genera also inhabits the temperate and cold-temperate regions to the south (Lucas, *op. cit.*). From India, only 13 species under 4 genera have so far been reported.

The present collection from Goa consists of 5 species under 2 genera.

Key to genera of the family HYMENOSOMATIDAE

- Rostrum broadly truncate or triangular never tridentate or trilobate, ischium of external maxillipeds often much longer than merus, male chelipeds may or may not be stouter than legs ..... ***Elamena***
- Rostrum tridentate or trilobed, merus of external maxillipeds longer than ischium, chelipeds stouter than walking legs..... ..... ***Elamenopsis***

Genus ***Elamenopsis*** A. Milne Edwards, 1873

1873. *Elamenopsis* A. Milne Edwards, *Nouv. Arch. Mus. Hist. nat., Paris*, **9** : 324.

1900. *Hymenicus*, Alcock, *J. Asiat. Soc. Bengal*, **69**(2) : 387.

1917. *Rhynchoplax* Kemp, *Rec. Indian Mus.*, **13**(5) : 251.

1980. *Elamenopsis*, Lucas, *Rec. Aust. Mus.*, **33**(4) : 190.

Diagnosis : Carapace depressed, circular, octagonal or hexagonal in outline, surface with well defined grooves dorsally, with rim continuous across base of rostrum. Rostrum tridentate or trilobed, epistome short, bounded anteriorly by a sharp ridge. External maxillipeds narrow and well separated, ischium shorter than merus along lateral edge. Chelipeds stouter than walking legs especially in larger males. Dactyli of walking legs often with a subterminal tooth or a row of teeth. Female abdomen with segments 3-5 fused; in male, either segments 3-5 or 4-5 fused. First male pleopods with a stout base and a thinner distal portion, curved towards sternum distally.

Remarks : The genus *Elamenopsis* A. Milne Edwards, 1873 has been revised and presently it is splitted into three genera namely, *Elamenopsis sensu stricto*, *Neorhynchoplax* Sakai,1938 (previously synonymised under *Elamenopsis*) and *Crustaenia* Ng and Chuang, 1996. The genus *Elamenopsis sensu stricto* currently consists of 19 species from the Indo-Pacific region, of which, 7 species namely, *E. woodmasoni* (Alcock, 1900), *E. inachoides* (Alcock, 1900), *E. alcocki* (Kemp, 1917), *E. octagonalis* (Kemp, 1917), *E. demeloi* (Kemp, 1917), *E. nasalis* (Kemp, 1917) and *E. tuberculata* (Chopra and Das, 1930) occur in India. Only three species referrable to this genus have been recorded from Goa.

Key to species of the genus *Elamenopsis*

1. A large forwardly directed tooth or process on either side of carapace above base of first walking leg, a sharp post-ocular tooth visible in dorsal view 2
- No tooth on side of carapace above base of first walking leg ..... *E. demeloi*
2. Carapace subcircular, antero-lateral border armed with a single tooth, merus of cheliped with several strong teeth on its upper border, dactylus of last three legs armed with a series of small teeth ..... *E. alcocki*
- Carapace octagonal, antero-lateral border devoid of teeth, merus of cheliped without any teeth on its upper border, dactyli of last three legs with a single large tooth near apex ..... *E. octagonalis*

4. ***Elamenopsis alcocki*** (Kemp, 1917) (Pl. 1, Fig. 6)

1917. *Rhynchoplax alcocki* Kemp, *Rec. Indian Mus.*, **13**(5) : 253, figs 3, 4a-g.

1980. *Elamenopsis alcocki*, Lucas, *Rec. Aust. Mus.*, **33**(4) : 190.

Material examined: 3(M), 2(F), Rachol and Mandovi Rivers, September 1916, S. Kemp, Reg. No. C 9735/10.

Measurement :

W = 4.5	F = 1.5	L = 4.7
4.5	1.5	4.8

Diagnosis : Carapace subcircular, slightly produced anteriorly, lateral sides flattened and almost parallel, its breadth nearly equal to its length (excluding rostrum); surface hairy with the usual distinct grooves. Post ocular tooth sharp, visible in dorsal view; a blunt tooth present just behind it; besides, a large stout forwardly directed dentiform process present on the margin of carapace near base of first leg. Rostrum consisting of three lobes, middle one longer and much stouter

than the laterals with a rounded apex. Chelipeds unequal; in male, outer edge of merus bearing a conical tooth almost at its middle followed by a series of five blunt denticles; carpus smooth; chela much compressed, about one and a half times as long as high; fingers leaving a wide gape when closed and meet only at their tips; dactylus about twice the length of upper border of palm and bearing near its basal third a large quadrilateral tooth and 2-3 denticles in front of it, fixed finger with three teeth, middle one much larger; in female, chela much slenderer, twice as long as its high, its merus either bearing an obscure teeth or lacking it altogether, fingers meet throughout their length, their cutting margins with regularly spaced teeth. Legs slender; anterior border of merus ending with an obscure tooth; dactyli very much slender, curved and armed with a large recurved tooth almost at its tip; in 3-5 th pairs, a series of 8-11 recurved denticles present extending almost over the entire length of posterior margin.

Distribution : Indian Ocean. India : Goa; Tamil Nadu.

Remarks : Prabhadevi and Saraswathy Ammal (1997) reported the species from Thengapattanam estuary in Kanyakumari district, Tamil Nadu. They wrongly referred that the species was earlier recorded from Cochin, Alleppy and Paravur backwaters of Kerala by Gravely (1927) instead of Chopra (1930). This species collected on stone pavements was encrusted with small filamentous algae and calcareous tubes of the polychaete worm of the genus *Serpula*, while Kemp (1917) obtained the species living on the posts of a jetty thickly covered with hydroid. A few specimens were collected by dredging muddy bottom at a depth of 1.5 to 4.5 fathoms (= 2.73 8.19 m). This crab is endemic to India.

5. ***Elamenopsis demeloi*** (Kemp, 1917) (Pl. 1, Fig. 5)

1917. *Rhynchoplax demeloi* Kemp, *Rec. Indian Mus.*, **13**(5) : 258, figs. 6–9.

1980. *Elamenopsis demeloi*, Lucas, *Rec. Aust. Mus.*, **33**(4) : 190.

Material examined : 4(M), 9(F), Nova Goa, August-September, 1916, S. Kemp, Reg. No. C 9742/10.

Measurement :

W = 5.5	F = 1.5	L = 4.5
4.5	1.0	3.5

Diagnosis : Carapace circular. Rostral processes three, extremely short, middle one squarish, slightly broader than long, remaining two much broader than long. Chelipeds stout, much larger in male than female; merus and carpus without teeth; fingers meet throughout their length, their cutting marginsarmed with 5-6 broad interlocking teeth diminishing in size from back to front, dactylus about twice the length of upper border of palm. Second walking leg slightly the longest, dactyli quite flat, very broad and slightly curved.

Distribution : Arabian Sea. India : Goa.

Remarks: This species was collected at low water under stones in muddy bottom (Kemp, *op. cit.*). The species is endemic to Goa. There is no report of fresh collection of this crab during the last ninety years. An attempt to recover the species from its type locality by the authors during survey of crustacean fauna of the state proved to be futile.

6. ***Elamenopsis octagonalis*** (Kemp, 1917) (Pl. 1, Fig. 8)

1917. *Rhynchoplax octagonalis* Kemp, *Rec. Indian Mus.*, **13**(5) : 256, fig. 5.

1968. *Rhynchoplax* prox. *octagonalis*, Chhapgar, *J. Bombay nat. Hist. Soc.*, **65**(3) : 612, pl. 11a.

1938. *Neorhynchoplax octagonalis* Sakai, *Studies on Crabs of Japan*. III. Brachyrhyncha, Oxyrhyncha : 200 (not seen)

1980. *Elamenopsis octagonalis*, Lucas, *Rec. Aust Mus.*, **33**(4) : 190.

Material examined : 1(F), Vareeg Islet, Mormugao Bay, August-September, 1916, S. Kemp, Reg. No. C 9740/2.

Measurement :

W = 4.5 F = 1.5 L = 3.5

Diagnosis : Carapace distinctly octagonal in shape, broader than long (carapace and rostrum

aken together) flat, surface covered with short pubescens, the usual grooves well outlined, margin continuous from side to side across the base of rostrum and entire, a large conspicuous forwardly directed tooth on the side wall above base of first walking leg. Rostrum consisting of three separate spine-like lobes fringed with short setae, median lobe larger than the laterals. Chelipeds stouter than legs in female, palm not compressed, fingers longer than palm and meet throughout their length, their inner margin bearing a regular series of 5-6 teeth. Ambulatory legs not much slender, second pair about twice the length of carapace and rostrum; anterior border of merii terminting to a stout tooth; dactylus of first leg unarmed, rest three provided with a stout recurved tooth close to their apices. Chelipeds bearing scattered hairs; those in the posterior margin being much denser. Male abdomen narrow, segments 3-5 fused without sutures, fused article and telson elongate similar to *E. demeloi.* First male pleopod slightly curved, tapering from stout base to a long thin distal portion.

Distribution : Indian Ocean. India : Goa.

Elsewhere : Australia.

Remarks : Kemp (1917) described the species on the basis of a single female specimen. Quite recently, Lucas (1980) has described male specimen of this species from Australia. This crab was collected beneath stones at low water in mangroves (Kemp, *op. cit.*).

Genus ***Elamena*** H. Milne Edwards, 1837

1837. *Elamena* H. Milne Edwards, *Hist. Nat. Crust.*, **2** : 33.

1917. *Elamena*, Kemp, *Rec. Indian Mus.*, **13**(5) : 270.

1980. *Elamena*, Lucas, *Rec. Aust. Mus.*, **33**(4) : 170.

Diagnosis : Carapace with rostrum, polygonal to pear-shaped; dorsal surface usually without well defined grooves but often a gastro-cardiac groove present. Rostrum truncated or triangular, continuous with carapace surface hiding antennae, antennules and most of the eyes. Rostral keel deep forming a distinct T-shape with rostrum rim anteriorly or poorly developed or absent. Epistome long, almost as long as broad; pterygostomial regions with 1 or 2 prominent lobules. Third maxillipeds broad, ischium subequal to or longer than merus along lateral edge. Chelipeds stouter than walking legs. Dactyli of walking legs with two subterminal teeth. Female abdomen circular to ovate, generally without fused segments; male abdomen without fused segments or with segments 3-4 fused. First male pleopod strongly curved and twisted above a stout base, generally with a large subterminal setae.

Remarks : The genus contains 13 species in the Indo-Pacific region. Only 4 species namely, *E. cimex* Kemp, 1915, *E. xavieri* Kemp, 1917, *E. cristatipes* Gravely, 1927 and *E. truncata* (Stimpson, 1858) are recorded from India, of which, only two species occur in Goa.

Key to species of the genus *Elamena*

Rostrum broad and squarely truncate..... ..... *E. truncata*

– Rostrum triangular ..... *E. xavieri*

7. ***Elamena truncata*** (Stimpson, 1858) (Pl. 1, Fig. 7)

1858. *Trigonoplax truncata* Stimpson, *Proc. Acad. nat. Sci. Philad.*, **10** : 109.

1917. *Elamena truncata*, Kemp, *Rec. Indian Mus.*, **13**(5) : 272, figs. 22, 23.

1980. *Elamena truncata*, Lucas, *Rec. Indian Mus.*, **33**(4) : 172, figs. 2D, 6D, 8B, 10H.

Material examined : 1(M), Zuari River near Panchabati, 27.11.2002, Dr. M. K. Dev Roy, Reg. No. C. 5666/2.

Measurement :

W = 3.5 F = 1.0 L = 3.0

Diagnosis : Carapace broader than long, orbiculate-ovate, smooth, flat, without distnction of regions, margins unarmed. Front slightly produced beyond carapace and broadly truncated. Chelipeds stouter than legs; palm compressed, its height exceeding length of upper border of palm, fingers armed with minute teeth and short hairs on their margins. Anterior border of merus of legs culminating to a strong tooth.

Distribution : Indo-West Pacific. India : Goa; Andamans; Nicobars.

Elsewhere : Japan, Indonesia, New Caledonia.

Remarks : Dactylus of walking legs are not triunguiculate at the apex in the specimen studied by us. This species is recorded for the first time from mainland India and that too from Goa. It was collected from muddy habitat of mangroves.

8. ***Elamena xavieri*** Kemp, 1917
(Pl. 1, Fig. 4)

1917. *Elamena (Trigonoplax) xavieri* Kemp, *Rec. Indian Mus.*, **13**(5).: 275, figs. 24–27.

1980. *Elamena xavieri*, Lucas, *Rec. Aust. Mus.*, **33**(4) : 171.

Material examined : 2(M), 3(F), Mandovi River, Nova Goa, September 1916, S. Kemp, Reg. No. C 9750/10.

Measurement :

W = 6.5	F = 2.0	L = 7.0
8.5	2.5	9.5

Diagnosis : Carapace glabrous, flat; regions undefined, margins not upturned. Rostrum a large triangular plate, flat above and bearing a sharp forwardly directed tooth on the underside near its base. Post ocular teeth visible if viewed from beneath only. Chelipeds alike in two sexes, not much stouter than walking legs, almost as long as carapace and rostrum; fingers shorter than palm, meet throughout their lengths and bearing a series of small recurved teeth extended from base to apex. Second pair of walking legs little longer than the first or third, fourth one smallest, merus and carpus culminating to a stout tooth; dactyli slender, curved, inner margin densely fringed hairand bearing two stout recurved teeth near the apex; merus and propodus much elongated, dactylus shorter than propodus. Last segment of male abdomen broad and triangular with a pair of pits near its base, female abdomen slightly sinuous distally.

Distribution : India : Goa.

Remarks : During 2002 and 2004, attempts were made by the authors to recover the species from its type locality as well as from other locations of the state after the discovery of the species by Kemp *(op. cit.)* but were unsuccessful. The species is restricted to the Arabian Sea.

Family PORTUNIDAE Rafinesque, 1815

1815. Portunidia Rafinesque, *Analyse Nature*: 97 [corrected to Portunidae by Samouelle 1819 : 93; name no. 69 on Official List, in Opinion 394, *Bull. zool. Nomencl.* (1956)].

2000. Portunidae, Dev Roy and Das, *Rec. Zool. Surv. India, Occ. Paper No.* **185** : 25.

Diagnosis : Carapace depressed, slightly convex, hexagonal, subquadrate, elongate ovate or subcircular, usually broader than long, rarely areolated; regions generally not well defined. Front broad, horizontal and cut into 2–6 teeth or lobes. Antero-lateral borders cut into 4–9 teeth. Antennal flagella usually long and slender, antennules obliquely or transversely folded. Epistome of fair length antero-posteriorly or linear and sunken, palate well defined anteroirly. Buccal frame quadrate, usually broader than long, merus of external maxillipeds never remarkably long. Chelipeds massive. Last pair of legs usually modified for swimming, with at least last two joints flattened, broadened and paddle like. Male genital openings coxal.

Remarks : The family contains six subfamilies but only a single subfamily is represented in the present collection.

Subfamily PORTUNINAE Rafinesque, 1815

Diagnosis : Carapace distinctly broad and of typical Portunid- shape. Front broad. Antero-lateral teeth from 4–9. Orbits of normal size.

Remarks : The subfamily is represented by four genera namely, *Scylla*, *Portunus*, *Charybdis* and *Thalamita*.

Key to genera of the subfamily PORTUNINAE

1. Carapace oval, antero-lateral borders cut into nine teeth 2

– Carpace hexagonal, antero-laeral borders never cut into nine teeth 3

2. Carapace smooth, without distinction of regions, propodus of chelipeds prismatic and costate ..... ***Scylla***

– Carapce not smooth, regions well defined, propodus of chelipeds prismatic and costate ..... ***Portunus***

3. Antero-lateral border of carapace cut into six teeth ..... ***Charybdis***

Antero-lateral border of carapace cut into five teeth ..... ***Thalamita***

Genus *Scylla* de Haan, 1833

1833. *Scylla* de Haan, *Fauna japon (Crust.)* : 11.

1998. *Scylla*, Keenan, Davie and Mann, *Raffles Bull. Zool.*, **46**(1) : 228.

2005. *Scylla*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 419.

Diagnosis : Carapace broad, transverse, moderately convex with an almost even surface. Front cut into four teeth. Antero-lateral borders cut into nine subequal teeth (including the outer orbital tooth), postero-lateral borders shorter than the antero-laterals. Basal antenna joint short, broad, its antero-external produced to form a lobule lying in the orbit, flagellum small and lodged in the orbital hiatus. Antennules transversely folded. Epistome not produced, buccal cavity squarish. Chelipeds massive, wrist and palm smooth, without ridges, palm inflated. Legs stout, in the last pair merus and carpus shortened and broadened, propodus and dactylus typically foliaceous for swimming. Male abdomen broadly triangular, five segmented, third to fifth terga fused, first tergum much concealed beneath the carapace.

Remarks : The genus contains only two species from India both of which occurs in Goa.

Key to species of the genus *Scylla*

Frontal lobes low, tips rounded ; antero-lateral teeth broad ..... *Scylla tranquebarica*

Frontal lobes high, tips bluntly pointed; antero-lateral teeth narrow ..... *Scylla serrata*

9. *Scylla serrata* (Forskål, 1775) (Pl. 2, Fig. 2)

1775. *Cancer serratus* Forskål, *Descr. Anim.* : 90.

1998. *Scylla serrata*, Keenan, Davie and Mann, *Raffles Bull. Zool.*, **46**(1) : 228, figs.7A, 8A, 9A, 10.

2005. *Scylla serrata*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 420.

Material examined : 2(M), 2(F), Talpona River, Canacona, 23. 01. 2004, Reg. No. C 5384/2; 1(M), 2(F), Betul, Goa, 25. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5387/2; 1(F), Chorao Island, 25. 03. 2002, S. R. Das, Reg. No. C 5451/2.

Measurement :

W = 60.8	F = 13.1	L = 41.95
49.1	11.45	64.25

Diagnosis : Frontal lobes high, bluntly pointed their margins concave. Antero-lateral teeth narrow, outer margin straight or slightly concave. Chelipeds and legs marked with polygonal patterning in both sexes and on abdomen of female only.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Maharashtra; Karnataka; Kerala; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu; Andaman and Nicobar Islands.

Elsewhere : South Africa, Red Sea, Mauritius, Indonesia, Philippines, Taiwan, Japan, Timor, East and West coasts of Australia, Western Samoa, Solomon Island, Fiji and New Caledonia.

Remarks : This species occurs very widely throughout the Indo-Pacific from South Africa to Tahiti, northward to Okinawa and southward to Port Hacking in Australia and Bay of Islands, New Zealand (McLay, 1988, cited from Keenan *et al.* 1998). In Goa, this crab is caught in large numbers from the estuarine ecosystems and are sold in local markets.

10. *Scylla tranquebarica* (Fabricius, 1798) (Pl. 2, Fig. 1)

1798. *Portunus tranquebaricus* Fabricius, *Ent. Syst. Suppl.* : 366.

1998. *Scylla tranquqbarica*, Keenan, Davie and Mann, *Raffles Bull. Zool.*, **46(1)** : 230, figs.7B, 8B, 9B, 11.

2005. *Scylla tranquebarica*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 421, pl. 2, fig. 1.

Material examined : 1(M), 27. 01. 2004; 1(M), 2(F), Betul, 25. 01. 2004, Dr. M. K. Dev Roy, Reg. No.C; 1(M), 4(F), Talpona River, Canacona, 23. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5385/2; 1(M), 1(F), Cavelossim beach, 27. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5371/2.

Measurement :

W = 70.15	F = 16.25	L = 49.4
76.35	18.0	53.45

Diagnosis : Frontal lobes low (04 times the frontal width when measured between mid-orbital suture) with rounded apices. Antero-lateral teeth broad, outer margin convex. Polygonal patterning weakly present on chelipeds and first two pair of legs but strongly marked in last two pair of legs in both sexes; polygonal patterning absent from male abdomen but variable in female abdomen.

Distribution: Indo-Pacific. India : Goa; West Bengal; Andhra Pradesh; Tamil Nadu.

Elsewhere : Pakistan, Malaysia, Singapore and Philippines.

Remarks : This is also another widespread species commonly distributed from South China Sea to various locations around the Indo-Pacific (Keenan *et al.*, *op. cit.*). Like the previous species, it is also sold in local markets in good quantities. This crab is a new record to Goa

Genus ***Portunus*** Weber, 1795

1795. *Portunus* Weber, *Nomencl. ent. Syst. Fabr.* : 93.

2001. *Portunus*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 422.

Diagnosis : Carapace transversely broad, depressed or slightly convex. Front broad and cut into 3-6 teeth. Antero-lateral borders cut into nine regular teeth, last tooth often enlarged. Basal antanna joint short, its antero-external produced to form a lobule or spine extending into the orbit, flagellum lodged in the orbital hiatus. Antennules transversely folded. Orbit with two fissures or sutures on the upper border; lower border also with a suture or fissure near the outer angle, inner angle tooth-like and usually very distinct. Epistome short or linear, often prolonged at the middle forming a spine beneath the inter-antennulary septum. Buccal cavity squarish. Chelipeds long, massive, palm prismatic with longitudinal ridges, fingers almost as long as palm and strongly dentate. Legs compressed, in last pair merus and carpus broadened and shortened, propodus and dactylus typically foliaceous and paddle-like for swimming. Male abdomen five-jointed, third to fifth segments fused.

Remarks : The genus is represented by two species both of which can be distinguished by the following key.

Key to species of the genus *Portunus*

- Posterior border of merus of chelipeds without any spine at its distal end, three blood-red spots on carapace ..... *P. sanguinolentus*
- Posterior border of merus of chelipeds armed with a spine at its distal end, carapace devoid of any blood-red spot and covered with miliary granules ..... *P. pelagicus*

11. ***Portunus pelagicus*** (Linnaeus, 1758) (Pl. 2, Fig. 3)

1758. *Cancer pelagicus* Linnaeus, *Syst. Nat.* 10th. ed., 1 626.

2005. *Portunus pelagicus*, Dev Roy Bhadra, *Zool. Surv India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 423.

Material examined : 1(M), Calangute, 23. 11. 2002, Reg. No. C 5380/2; 1(F) Karmali, Goa, 19.11.2002, Dr. M. K. Dev Roy, Reg. No. C5460/2; 1 (M), 2(F), Station-2, Panji, Goa, 19.11.2002, Dr. M. K. Dev Roy, Reg. No. C5520/2; 1(M),

Canacona, Goa, 27. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5412/2; 3M, Canacona, Goa, 27. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5407/2; 1(M), Margao, Goa, 01. 12. 2004, Dr. M. K. Dev Roy, Reg. No. C 5374/2; 6(M), 3(F), Melim, 17.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5403/2.

Measurement :

W = 69. 65	F = 17.4	L = 43.45
47.0	13.6	30.0

Diagnosis : Dorsal surface of carapace studded with whitish or bluish miliary granules. Posterior border of arm of cheliped armed with a spine at its distal end; palm bearing three spines-two just behind the finger-joint side by side and one near apex of the wrist-joint.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Maharashtra; Karnataka; Kerala; West Bengal; Andhra Pradesh; Orissa; Tamil Nadu; Andaman Islands.

Elsewhere : East and South coasts of Africa, the Mediterranean, Red Sea, Persian Gulf, Sri Lanka, Mergui Archipelago, Singapore, Philippines, Hong Kong, Japan, Australia, New Zealand, New Caledonia and Tahiti.

Remarks : This crab is extensively fished all along the coast of this state and sold in local markets. It inhabits muddy or sandy bottoms in bays, estuaries or river mouths.

12. ***Portunus sanguinolentus*** (Herbst, 1790) (Pl. 2 Fig. 4)

1790. *Cancer sanguinolentus* Herbst, *Versuch. Naturgesch Krabben Krebse*, **1**(2) : 161, pl.8, figs.56, 57.

2005. *Portunus sanguinolentus*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 424, pl. 2, fig. 2.

Material examined : 1(M), Station-2, Panaji, Goa, 19.11.2002, Dr. M. K. Dev Roy, Reg. No. C5521/2; 3(F), Calangute, 19. 01. 2004, Reg. No. C.; 2(M), Canacona, Goa, 27. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5411/2; 1(M), Margao, Goa, 01. 12. 2002, Dr. M. K. Dev Roy, Reg. No. C 5375/2.

Measurement :

W = 63.55	F = 8.55	L = 33.2
61.0	7.2	32.75

Diagnosis : Carapace characterized by having three blood-red spots on its surface. Posterior border of arm of chelipeds with no spine ; a single spine on palm just behind the finger-joint.

Distribution : Indo-West Pacific. India : Goa; Karnataka; Kerala; Maharashtra; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu; Andaman and Nicobar Islands.

Elsewhere : East Africa, Red Sea, Persian Gulf, Sri Lanka, Peninsular Malaysia, Philippines, Hong Kong, Taiwan, Japan, Australia, New Zealand and as far as Hawaii.

Remarks : This crab is also caught in appreciable quantities along with *P. pelagicus* in bays and of the state estuaries.

Genus ***Charybdis*** de Haan, 1833

1833. *Charybdis* and *Oceanus* de Haan In: Siebold, *Fauna japon. (Crust.)* : 9, 10.

1861. *Goniosoma* Milne Edwards, *Archs. Mus. natn. Hist. nat. Paris, Ser.* 1, **10** : 367.

2005. *Charybdis*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 428.

Diagnosis : Carapace hexagonal, moderately broad, depressed or slightly convex with more or less distinct transverse granular ridges in the anterior half. Front cut into six lobes or teeth (excluding the supraorbital angles). Antero-lateral teeth varying from 5–7 but commonly six. Basal antenna-joint short, broad ; its outer angle lobule-like, filling the orbital hiatus, meeting the front and excluding flagellum from the hiatus. Antennules transversely folded. Orbitals as in *Portunus*. Epistome considerably long, buccal cavity as in *Portunus*. Chelipeds, legs and male abdomen as in *Portunus*.

Remarks : The genus is represented by two subgenera namely, *Charybdis* and *Goniohellenus* both of which can be separated by the following key.

Key to subgenera of the genus *Charybdis*

- Antennal flagellum not excluded from the orbital hiatus, no spine on the posterior border of arm of cheliped ..... ***Charybdis***
- Antennal flagellum completely excluded from the orbital hiatus, a spine may or may not be present on the posterior border of arm of cheliped ..... ***Goniohellenus***

Subgenus ***Charybdis*** de Haan, 1833

1833. *Charybdis* de Haan, In : Siebold, *Fauna japon (Crust)* : 9, 10.

2005. *Charybdis*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 428.

Diagnosis : Four median teeth of the front nearly of same size. Antero-lateral teeth usually six, often seven. Posterior border of arm of cheliped without any spine.

Key to species of the subgenus *Charybdis*

1. With a transverse ridge on the cardiac region 2
- No transverse ridge on the cardiac region 5
2. First antero-lateral tooth anteriorly truncated and notched, sixth male abdominal segment curved with gradually convergent sides, a brown cross mark on carapace .... *C.(C.) feriatus*
- First antero-lateral tooth acute, sides of sixth male abdominal segment parallel or slightly divergent at the distal third, carapace without any brown cross mark 3
3. A sharply dentiform lobule at outer end of lower border of orbit, two large white circular spot on each side of branchial region especially in live or freshly preserved specimens ..... *C. (C.) lucifera*
- Lobule at outer end of lower border of orbit not dentiform, branchial region of carapace devoid of any white circular spot 4
4. Last antero-lateral spine smaller than the preceeding three spines ..... *C. (C.) annulata*
- Last antero-lateral spine spiniform, not smaller than the preceeding three spines, epibranchial region markedly swollen .... *C. (C.) riversandersoni*
5. Carapace flat, upper surface of palm with five spines, sides of sixth segment of male abdomen straight at basal two-thirds and becoming convergent at anterior third..... .....*C. (C.) affinis*

   Carapace convex, upper surface of palm with three spines, sides of sixth male abdominal segment parallel for half of their extent .... *C. (C.) callianassa*

13. *Charybdis (Charybdis) affinis* Dana, 1852

1852. *Charybdis affinis* Dana, *Proc. Acad. nat. Sci. Philad.*, 6 : 85; 1852, *U. S. Explor. Exped. Crust.*, 13(1) 286; 1855 : pl. 17, figs. 12a-c.

2005. *Charybdis (Charybdis) affinis*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 429, pl. 2, fig. 3.

Material examined : 1(M), Melim, Goa, 17.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5404/2.

Measurement :

W = 30.0 F = 8.15 L = 20.0

Diagnosis : Carapace and chelipeds covered with short hairs, cardiac region with transverse ridges. Anterior border of arm and upper surface of palm with three and five spines respectively. Sixth segment of male abdomen curved and gently convergent.

Distribution : Indo-Pacific. India : Goa; Karnataka; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu.

Elsewhere : Myanmar, Malaysia, Singapore, Hong Kong, China and Indonesia.

Remarks : This crab is a new record to Goa.

14. *Charybdis (Charybdis) annulata* (Fabricius, 1798)

1798. *Portunus annulatus* Fabricius, *Ent. Syst. Suppl.* 364

2005. *Charybdis (Charybdis) annulata*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 430.

Material examined: 2(M), 6(F), Vagator, 18.01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5401/2.

Measurement :

W = 26.55	F = 8.6	L = 19.1
27.5	7.4	17.55

Diagnosis : Carapace smooth, convex. Frontal teeth sharp. First and second antero-lateral teeth subequal in size, third to fifth broad at base, last tooth smallest. Major diameter of orbit nearly a fourth the breadth of the front. Palm armed with five spines two spines immediately behind the finger-joints tuberculiform. In last pair of legs, merus about twice as long as broad. Sixth male abdominal segment almost as long as broad with its sides parallel for three-fourth of their extent.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Kerala; Maharashtra; Orissa; Andhra Pradesh; Tamil Nadu.

Elsewhere : East coast of Africa, Strait of Hormuz, Gulf of Oman, Pakistan, Sri Lanka, Mergui Archipelago, Malay Peninsula, Thailand, Java and as far as Tahiti.

Remarks : This crab occurs in both the coasts of India. However, it is recorded for the first time from Goa.

15. ***Charybdis (Charybdis) callianassa***
(Herbst, 1801)
(Pl. 2, Fig. 5)

1801. *Cancer callianassa* Herbst, *Versuch. Naturgesch. Krabben Krebse*, **3**(2) : 45, pl. 54, fig. 7.

2005. *Charybdis (Charybdis) callianassa*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 431.

Material examined: 1(M), Station–2, Panaji, 19.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5522/2.

Measurement :

W = 33.0	F = 8.0	L = 24.0

Diagnosis : Carapace convex, pubescent with a transverse granular ridge on cardiac region. First antero-lateral tooth notched anteriorly, last one spiniform, free edges of all teeth finely serrated. Anterior border of arm of cheliped with two spines, palm inflated bearing three spines.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Maharashtra; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu.

Elsewhere : South Africa, Pakistan, Gulf of Thailand, Malay Archipelago, Singapore, Indonesia, Philippines, Hong Kong, China, Japan and Australia.

Remarks : This is an addition to the crab fauna of the state.

15. ***Charybdis (Charybdis) feriatus***
(Linnaeus, 1758)
(Pl. 2, Fig. 6)

1758. *Cancer feriatus* Linnaeus, *Syst. Nat.*(10th. ed.), **1** : 627.

2005. *Charybdis (Charybdis) feriatus*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 432, pl. 2, fig. 4.

Material examined : 2(M), Calangute, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5400/ 2; 2(M), 1(F), Colva, 02. 12. 2002, Dr. M. K. Dev Roy, Reg. No. C 5376/2; 1(M), Melim, 17. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C; 1(M), Margao, 01.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5373/2.

Measurement :

W = 96.65	F = 22.0	L = 64.3
68.85	22.4	47.8

Diagnosis : Dorsal surface of carapace marked with purplish brown longitudinal bands arranged in the form of a cross. First antero-lateral spine truncated and notched anteriorly, second to fourth very broad, last one spine-tipped. Major diameter of orbit about a third the width of front. In chelipeds, fingers almost as long as their palm. Propodus of last pair of leg bearing 1 or 2 inconspicuous denticles near the distal end of its posterior border. Sixth male abdominal segment much broader than long with gently curved sides.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Kerala; Maharashtra; West Bengal;

Andhra Pradesh; Orissa; Tamil Nadu; Andaman and Nicobar Islands.

Elsewhere : East coast of Africa, Madagascar, Pakistan, Bangladesh, Malay Peninsula, Singapore, Hong Kong, China, Taiwan, Japan and Australia.

Remarks : This crab occurs in both the coasts of India. However, it is recorded for the first time from Goa.

16. *Charybdis (Charybdis) lucifera* (Fabricius, 1798)

1798. *Portunus lucifer* Fabricius, *Ent. Syst. Suppl.* : 364.

1938. *Charybdis (Charybdis) lucifera*, Leene, *Siboga Expeditie Monogr., Leiden*, **39C** : 57, figs. 23-25.

2005. *Charybdis (Charybdis) lucifera*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 434.

Material examined : 2(M), 1(F), Colva 02.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5377/2; 1(M), 1(F), Melim, 17.01.2004, Reg. No. C; 1(M), Margao, 02.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5377/2; 1(M) Baga, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5398/2; 1(F), Calangute, Goa, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5399/2.

Measurement :

W = 88.25	F = 19.95	L = 60.65
31.5	11.25	28.95

Diagnosis : Carapace very broad and marked with two large white spots on either side of branchial region. Antero-lateral teeth six, claw-shaped. Lower border of orbit with an acutely dentiform lobule at its outer end. Chelipeds subequal, palm with five spines. Sides of sixth male abdominal segment parallel or slightly divergent in two-thirds of its extent.

Distribution : Indo-Pacific. India : Goa; Kerala; Andhra Pradesh; Tamil Nadu.

Elsewhere : Sri Lanka, Java, Thailand, Japan and Australia.

Remarks : In juvenile specimens, tips of frontal teeth are obtusely rounded and the antero-lateral teeth sharper. Dentiform lobule of sub-orbital border is rounded in smaller specimens of both sexes, in larger specimens it is acute.This is the first report of the occurrence of this species from this state

18. *Charybdis (Charybdis) riversandersoni* Alcock, 1899

1899. *Charybdis (Goniosoma) rivers-andersoni* Alcock, *J. Asiat. Soc. Bengal*, **68**(2) : 53 and *Illustr. Zool. "Investigator" Crust.* : pl. 56, fig. 3.

1976. *Charybdis (Charybdis) riverandersoni*, Sakai, *Crabs of Japan and the Adjacent Seas* : 358, pl. 125.

Material examined: 3(M), 3(F), Station–18, Chicolna Bay, Mormugao Bay, August-September, 1916, S. Kemp, Reg. No. C 721/2.

Measrement :

W = 28.1	F = 8.7	L = 20.6
28.1	8.95	21.3

Diagnosis : Carapace broad glabrous, surface smooth and polished, transverse ridges obscure, epibranchial region markedly tumid. Front cut into six teeth (excluding the laterals), outermost pair on either side slender. Antero-lateral teeth broad at base, first two teeth smaller than the next three teeth, first tooth obliquely truncated with the inner angle very acute, last one projecting sideways. Chelipeds massive, smooth and unequal; anterior border of arm with three spines, distal most spine largest; inner surface of wrist bearing a very strong pointed spine, outer surface with three spinules; palm with five spines one near apex of wrist-joint, two pointed spines medially and other two side by side just behind the finger-joint; fingers crossing each other. In the last pair of legs, merus nearly twice as long as broad with the usual spine at distal end of posterior border. Sixth segment of male abdomen slightly broader than long with the sides almost straight.

Distribution : Indo-Pacific. India – Goa; Tamil Nadu.

Elsewhere : Japan.

Remarks : During the course of present investigation, the propodus of last pair of legs of this species was found to bear 4-5 spinules. As

early in 1899, Alcock reported the species from Konkan coast but thereafter, there is no fresh report of collection of the crabs from India for over 100 years.

Subgenus ***Goniohellenus*** Alcock, 1899

1899a. *Goniohellenus* Alcock, *J. Asiat. Soc. Bengal*, **68**(2) : 48.

2005. *Goniohellenus*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 436.

Remarks : The subgenus is represented by a single species in Goa.

19. *Charybdis (Goniohellenus) hoplites* (Wood-Mason, 1877) (Pl. 2, Fig. 7)

1877. *Goniosoma hoplites* Wood-Mason, *Ann. Mag. nat. Hist. Ser.*, 4, **19** : 422.

1938. *Charybdis (Goniohellenus) hoplites*, Leene, *Siboga Expeditie Monogr.*, Leiden, **39C** : 99, figs. 53, 54a-c.

2005. *Charybdis (Goniohellenus) hoplites*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh State Fauna Series*, **5**(Part 5) : 436.

Material examined : 7(M), 1(F), Canacona, Goa, 27. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5410/2; 2F, Calangute, Goa, 19. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5414/2.

Measurement :

W = 34.7	F = 9.0	L = 24.25
23.3	6.6	20.25

Diagnosis : Carapace thick, pubescent; epibranchial area swollen. Last antero-lateral spine larger than any of the others. Anterior border of arm of chelipeds with two large spine and a spinule, posterior border with a single spine, palm six costate, costae with squamiform sculpturings. Sixth segment of male abdomen truncate-triangular.

Distribution : Indian Ocean. India : Goa; Gujarat; Orissa; Tamil Nadu.

Elsewhere : Red Sea, Persian Gulf, Indus Delta, Akyab, Hong Kong.

Remarks : This species of crab is reported for the first time Goa. It occurs abundantly in the trawl catches. The smallest and largest ovigerous female measured during this investigation were 16.25 and 24.15 mm respectively.

Genus ***Thalamita*** Latreille, 1829

1829. *Thalamita* Latreille, In : G. Cuvier, *Règne Anim. Crust.*, (ed. 2), **4** : 33 (footnote).

2005. *Thalamita*, Dev Roy and Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 439.

Diagnosis : Carapace roughly hexagonal, broad, depressed or slightly convex, Surface usually marked with prominent transverse ridges. Front cut into 2–6 rounded or subquadrate teeth or lobes. Antero-lateral borders cut into five teeth, fourth tooth often rudimentary or absent. Basal antenna-joint broad, apical lobe long and in contact for its entire length with the inner orbital tooth, antenna excluded from the orbit. Epistome long, buccal cavity as in *Charybdis*. Chelipeds, legs and male abdomen as in *Portunus* and *Charybdis*.

20. *Thalamita crenata* (Latreille, 1829) (Pl. 2, Fig. 8)

1829. *Portunus crenatus* Latreille, *Collection du Museum* : 33.

2005. *Thalamita crenata*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 440, pl. 2, fig. 6.

Material examined : 2(M), 2(F), Talpona River, Canacona, 23.01.2004, Dr. M. K. Dev Roy, Reg. No. C; 2(M), 2(F), Betul, Goa, 25.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5386/2; 7(M), 4(F), Canacona, Goa, 23.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5409/2; 8(M), 2(F), 23.01.2004, Canacona, Dr. M. K. Dev Roy, Reg. No. C 5406/2.

Measurement :

W = 38.8	F = 15.4	L = 27.75
35.9	15.0	25.45

Diagnosis : Carapace slightly convex, smooth, transverse ridges obscure. Frontal teeth six, broad, rounded and almost of same size. Antero-lateral

margins cut into five claw-shaped teeth-first three teeth larger than the last two; antero-lateral teeth decreasing in size from front to back. Anterior border of arm of cheliped with three spines; inner corner of wrist bearing a strong spine, outer surface with three spinules; upper surface of palm armed with four spines in two rows and one near the apex of wrist-joint. Sixth male abdominal segment broader than long with gently curved sides.

Distribution : Indo-West Pacific. India : Goa; Maharashtra; Orissa; Andhra Pradesh; Tamil Nadu; Pondicherry; Andaman and Nicobar Islands.

Elsewhere : East coast of Africa, Red Sea, Pakistan, Sri Lanka, Mergui Archipelago, Singapore, Indonesia, Philippines, Japan, Australia, New Zealand, Samoa, Hawaii and Society Islands.

Remarks : This crab was found to occur in good numbers in fishing nets at Talpona river, Canacona.

Family XANTHIDAE MacLeay, 1838

1838. Xanthidae MacLeay, *Entom. Useful Compend.* : 59 [Name No. 73 on Official List; therein dated from Dana, 1851, in error].

2005. Xanthidae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 448.

Diagnosis : Carapace transversely oval, hexagonal or subquadrate, often subcircular, usually broader than long. Front broad or broadish but never rostrum-like or acute. Antero-lateral borders usually arched with lobes, teeth or spines. Antennules transversely or obliquely folded, antennary flagella short and slender. Anterior margin of buccal cavity very distinct, not covered by the external maxillipeds. Chelipeds symmetrical or asymmetrical. Leg joints adapted for walking. Male abdomen five-jointed.

Remarks : The family is divided into 12 subfamilies, of which 11 occurs in India. The present collection from Goa is, however, represented by two subfamilies namely, Xanthinae and Zosiminae.

Key to subfamilies of the family XANTHIDAE

- Antero-lateral border entire, front with or without a crest and weakly bilobed, ambulatory legs with a crest on the anterior margin, especially on carpus and propodus. ..... ZOSIMINAE
- Antero-lateral border of carapace cut into teeth, spines or lobes, front without a marginal crest and bilobed, ambulatory legs often carinated on the margins of some segments ..... XANTHINAE

Subfamily ZOSIMINAE Alcock, 1898

1898. Zosimoida Alcock, *J. Asiat. Soc. Bengal*, **67**(2) : 77.

2000. Zosiminae, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 49.

Diagnosis : Carapace broad, transversely oval. Front weakly bilobed, with or without a marginal crest. Antero-lateral borders sharp, crest-like, thin and entire (often fissured only) or divided intio four large teeth. Chelipeds subequal and similar, anterior border of palm more or less carinated. Upper border of leg-joints especially that of merus, carpus and propodus sharply cristate.

Remarks : This subfamily is represented by a single genus.

Genus *Atergatis* de Haan, 1833

1833. *Atergatis* de Haan, In : Siebold, *Fauna japon. (Crust.)* : 4, 17.

1898. *Atergatis*, Alcock, *J. Asiat. Soc. Bengal*, **67**(2): 94.

2000. *Atergatis*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 50.

Diagnosis : Carapace very broad, convex; surface smooth or pitted; regional boundaries absent or very faintly indicated; lower surface of carapace wings hollowed to contain the wrists and palm in flexion. Front narrow, deflexed, its free edge shaped like a Cupid's bow. Antero-lateral margins curved with keel-like edge, postero-laterals strongly convergent and straight. Basal antenna-joint short, meeting the front at their antero-external angle, flagellum shorter than major diameter of the orbit. Antennules transversely

folded. Eye-stalks thick, short; eyes small. Anterior margin of external maxillipeds nearly transverse. Chelipeds subequal. Legs with upper margins of merus, carpus and propodus and lower margin of merus and propodus sharply carinate. Male abdomen five-jointed, 3rd-5th segments fused together.

Remarks : The genus *Atergatis* contains 7 species from India, of which, only two species have been recorded from Goa.

Key to species of the genus *Atergatis*

- Crest-like edge of antero-lateral border turned in at the lateral epibranchial angle forming a stout ridge, no fissure on antero-lateral border, crest on the superior margin of palm of chelipeds distinctly defined .... *A. integerrimus*
- No ridge at the lateral epibranchial angle, antero-lateral border cut into four lobes by fine fissures, Cheliped with only traces of a crest on the superior margin ... *A. laevigatus*

21. ***Atergatis integerrimus*** (Lamarck, 1801)
(Pl. 3, Fig. 1)

1801. *Cancer integerrimus* Lamarck, *Hist. Nat. Anim. Sans. Vert.*, **1** : 272.

1835. *Cancer (Atergatis) integerrimus*, de Haan, In : Siebold, *Fauna japon. (Crust.)* : 45, pl. 14, fig. 1.

1898. *Atergatis integerrimus*, Alcock, *J. Asiat. Soc. Bengal*, **67**(2) : 95.

2000. *Atergatis integerrimus*, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 52, pl. 2, fig. 8 and pl. 11, figs. 3, 4.

Material examined : 4(M), 1(F), Baga, North Goa, 23. 11. 2002, Dr. M. K. Dev Roy, Reg. No. C 5463/2.

Measurement :

W = 101.4	F = 16.25	L = 64.25
76.3	14.65	47.5

Diagnosis : Carapace broad, transversely oval, without indication of regions except the cardiac marked by faint creases, surface bearing irregularly and distantly disposed pits. Antero-lateral margin crest-like forming a stout ridge at the lateral epibranchial angle. Front bilobed but each lobe not conspicuously produced. Outer surface of external maxillipeds devoid of hair. Chelipeds equal and stout; upper border of merus sharply cristate, fingers stout, dactylus longer than upper border of palm and their cutting edges strongly dentate. Leg joints crested without comb-like tuft of hair, their outer surfaces pitted.

Distribution : Indo-Pacific. India: Goa; Gujarat; Karnataka; Maharashtra; Tamil Nadu.

Elsewhere : Zanzibar, Mauritius, Sri Lanka, Singapore, Philippines and Australia.

Remarks : In live or freshly preserved specimens, this crab has a dark red hue, pits of dorsal surface of carapace exhibit white colouration and fingers chocolate black with whitish tip. This is a common crab in rocky areas of the coast. This species is an addition to the crab fauna of Goa State.

23. ***Atergatis laevigatus*** A. Milne Edwards, 1865
(Pl. 3, Fig. 2)

1865. *Atergatis laevigatus* A. Milne Edwards, *Nouv. Arch. Mus. Hist. nat., Paris*, **1** : 241, pl. 15, fig. 4, 4a.

1893. *Atergatis laevigatus*, Henderson, *Trans. Linn. Soc. Lond. Zool.*, ser. 2, **5** : 352.

1984. *Atergatis laevigatus*, Serène, *Fauna Tropicale*, **24** : 147, pl. 21B.

Material examined: 1(M), Calangute, 23.11. 2002, Dr. M. K. Dev Roy, Reg. No. C 5507/2; 1(F), Baga, 23. 11. 2002, Dr. M. K. Dev Roy, Reg. No. C 5508/2.

Measurement :

W = 78.05	F = 15.75	L = 47.4
69.4	14.7	42.45

Diagnosis : Carapace convex from front to back and from side to side, without distinction of regions. Antero-lateral borders ending simply at its posterior end, not continued into a transverse ridge and cut into four lobes by very fine fissures. Front broad, about one-fifth of the greatest breadth of carapace, sinuous at the middle and notched but not bilobed. Chelipeds strong and stout, subequal in female; wrist produced into a broad

blunt tooth at its inner angle; palm not carinated superiotly, fingers broad, chocolate black in colour, hollowed at tips, their cutting margins strongly dentate. Ambulatory legs strongly carinated, dactylus bearing dense hair at its upper and lower borders and terminating into a horny claw. Abdomen consist of seven distinct segments in both sexes, sixth segment larger than broad in male but broader than long in female.

Distribution : Indian Ocean. India : Goa; Malabar; Tamil Nadu.

Elsewhere : Red Sea.

Remarks : Carapace, wrist and palm of chelipeds and leg jonts are covered with minute depressions or pits distributed scattered over the surface. However, these are not giving them a rugose appearance as in *Atergatis roseus* (Rüppell, 1830). In live condition, carapace and its appendages of this crab has a hue resembling roof-tiles. This crab was collected from rocky area at Bogmolo and from fisherman's net at Calangute. The type locality of this species is Malabar coast. The present collection constitutes its first record from Goa.

Subfamily XANTHINAE MacLeay, 1838

1838. Xanthidae MacLeay, In : Smith, *Illustr. Zool. S. Afr. (Invert.)* : 59.

2005. Xanthinae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series,* 5(Part 5) : 451.

Diagnosis: Carapace transversely oval or hexagonal, usually broader than long. Front almost linear or cut into two lobes, without a marginal crest and fissured at the middle. Antero-lateral teeth usually four or more.

Remarks : The subfamily is represented by two genera, *Leptodius* and *Demania* from the state.

Key to genera of the subfamily XANTHINAE

- Carapace broadly oval, fingers of chelipeds excavated at tips ..... ***Leptodius***
- Carapace pentagonal in shape, fingers of chelipeds solid ..... ***Demania***

Genus ***Leptodius*** A. Milne Edwards, 1863

1863. *Leptodius* A. Milne Edwards, *Annls. Sci. nat. (zool.), sér.* 4, **20** : 284.

2000. *Leptodius*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 55.

Diagnosis : Carapace broad, suboval, moderately convex in the anterior half, flat in the posterior half, regions distinct and well lobulated in anterior two-thirds, but not in the posterior one-third. Front slightly deflexed, sublaminar, notched medially and separated from supra-orbital margin by a notch or groove. Antero-lateral borders curved, generally cut into four teeth or lobes, often more; postero-lateral borders as long as the chord of antero-laterals and convergent moderately. Basal antennal joint short, flagellum nearly as long as orbit, meeting the front at inner angle and lodged in the orbital hiatus. Antennules transversely folded. Orbits suboval, its lower edge with a prominent teeth at inner angle. Anterior border of merus of external maxillipeds transverse and usually with a denticle near the antero-lateral angle. Chelipeds unequal in both sexes, fingers pointed. Legs thick, subcylindrical, their upper margins often sharp. Male abdomen five-jointed, third to fifth segments fused.

24. ***Leptodius exaratus***
(H. Milne Edwards, 1834)
(Pl. 3, Fig. 3)

1834. *Chlorodius exaratus* H. Milne Edwards, *Hist. nat. Crust.*, **1** : 402.

1898. *Xantho (Leptodius) exaratus*, Alcock, *J. Asiat. Soc. Bengal*, **67**(2) : 118.

2000. *Leptodius exaratus*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 56, pl. 3, fig. 2 and pl. 11, figs. 7, 8.

Material examined : 1(M), Vagator, 18.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5509/2.

Measurement :

W = 19.6 F = 6.95 L = 13.1

Diagnosis : Carapace transversely oval, moderately convex, regional and subregional lobules well outlined by deep grooves. Front narrow, bilaminar; lobes squarish, their free edges

slightly concave, granular and inconspicuous. Antero-lateral borders cut into four acuminate teeth (excluding the outer orbital angle) first tooth small, second one broad, low, acuminate and the last two teeth sharply acuminate anteriorly; postero-lateral border equal in length to the chord of antero-lateral border. Chelipeds unequal; outer surface of arm smooth; upper and outer surface of wrist somewhat dimpled and wrinkled, inner corner with a blunt conical tooth; palm smooth, its upper surface roughened with reticulating wrinkles; fingers broad and stout, their tips hollowed.

Distribution : Indo-West Pacific. India- Goa; Gujarat, Maharashtra; Tamil Nadu; Andaman Islands.

Elsewhere : East coast of Africa, Red Sea, Persian Gulf, Sri Lanka, Myanmar, Malay Peninsula, Indonesia, Philippines, Japan, Polynesia, Australia and Hawaii.

Remarks : This species is recorded for the first time from Goa state. It was collected from rocky part of the shore.

Genus ***Demania*** Laurie, 1906

1815. *Xantho* Leach, *Trans. Linn. Soc. Lond.*, **11** : 320

1861. *Lophoxanthus* A. Milne Edwards, *Miss. Sci. Crust.*, : 256.

1906. *Demania* Laurie, In : W.A. Herdmann (ed.) *Ceylon Pearl Oyster Fisheries, Supplementary Reports*, **5** : 396.

Diagnosis : Carapace pentagonal, moderately convex from front to back, flattened from side to side, regons well areolated and subdivided into many lobules, surface smooth. Antero-lateral borders blunt, cut into four lobes by shallow grooves, postero-lateral borders straight and strongly convergent. Front distinctly bilobed, its breadth about a third the greatest breadth of carapace. Orbits large with three prominent sutures near its outer angle, eyes on short, thick stalks. Antennules folded in a transversely oblique direction. Basal joint of antenna broad, flagellum very much shortened and lodged in the orbital hiatus. No ridges delimiting efferent branchial channels on the endostome. Merus of external maxillipeds pointed anteriorly. Chelipeds equal in both sexes, fingers not hollowed at tips. Legs with the upper border of merus, carpus and propodus and lower margin of propodus carinated.

25. ***Demania baccalipes*** (Alcock, 1898)

1898. *Xantho (Lophoxanthus) scaberrimus* var. *baccalipes* Alcock, *J. Asiat Soc. Bengal*, **67**(2) : 117.

1957. *Xantho (Lophoxanthus) scaberrimus baccalipes* Chhapgar, *J. Bombay nat. Hist. Soc.*, **54**(2) : 427, pl. 8, figs. l-o.

1986. *Demania baccalipes*, Deb, *Rec. zool. Surv. India*, **83**(4) : 132, pl. 2, fig. 4.

Material examined : 1(M), Baga, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5416/2; 1(M), Calangute, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5425/2.

Measurement :

W = 60.9 F = 12.7 L = 46.55

Diagnosis : Carapace deep, about 3/4th as long as broad, moderately convex in anterior two-thirds, regions distinctly outlined; surface tuberculate, worn out tubercles also present on maxillipeds, sternum, chelipeds and pereiopods of leg joints. Front bilobed, little produced beyond the orbital edge, their free margins entire and sinuate. Antero-lateral teeth four, first one inconspicuous, rest three triangular and more prominent. Chelipeds symmetrical, upper border of arm bearing a row of large tubercles, distal most being most prominent; outer surface of wrist tuberculate, inner corner produced into a blunt tooth, a denticle present just beneath it; both outer and inner surfaces of palm bearing tubercles arranged in longitudinal series; fingers stout, shorter than palm, their cutting edges armed with 4–5 obtuse teeth. Upper border of merii of leg joints bearing a row of berry-like tubercles, upper edges of carpus and propodus roughly crenulate, dactyli styliform, regularly decreasing in size from first to last, their upper and lower margins fringed with two longitudinal rows of hairs. Six segment of male abdomen squarish, slightly longer than broad.

Distribution : Indo-Pacific. India : Goa; Maharashtra.

Elsewhere : Sri Lanka, Malacca Strait, Japan.

Remarks : In live or freshly collected specimens, this crab has a dark red hue with fingers of chelipeds dark brown in their basal half and white at tips.

This species of crab is a new record to Goa. It occurs in rocky areas of the coast.

Family PILUMNIDAE Samouelle, 1819

1819. Pilumnidae Samouelle, *Entom. Useful Compend.*: 86.

1984. Pilumnidae, Serène, *Faune Tropicale*, **24** : 11.

2005. Pilumnidae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series* 5(Part 5) : 458.

Diagnosis : Carapace thin or thick, inflated or not, surface sharply or plainly granular. Antero-lateral borders generally shorter than the postero-laterals and usually armed with spines or teeth. Front bilobed, outer angle of each forming an independent tooth or spine-like lobule, separated from the supra-orbital angle by a notch or groove. Basal joint of antenna may or may not be in contact with front. Abdomen elongated, narrow, covering most of sternite 4 and provided with a locking mechanism. Genital openings coxal or coxo-sternal.

Remarks : The family Pilumnidae is divided into 10 subfamilies (Dev Roy and Bhadra, 2005), of which, 7 occurs in India. Only two subfamilies namely, Pilumninae and Rhizopinae are represented in the present collection.

Key to subfamilies of the family PILUMNIDAE

- Carapace transversely oval or subquadrilateral, regions well marked and areolated, front entire, fixed with a strong molariform tooth ..... PILUMNINAE
- Carapace hexagonal, regions poorly indicated and no areolations, front distinctly bilobed, fixed finger without molariform tooth .... RHIZOPINAE

Subfamily PILUMNINAE Samouelle, 1819

1819. Pilumnidae Samouelle, *Entom. Useful. Compend.* : 86.

2005. Pilumninae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 461.

Diagnosis : Carapace generally granular, sometimes spinose, covered with setae on most of its surface and near antero-lateral margins. Regions more or less distinct. Anterolateral borders cut into three prominent teeth behind the outer orbital angle. Chelipeds dissimilar, strongly granular or even spinose and at least partly covered with setae.

Remarks : It is represented by a single genus *Eurycarcinus*.

Genus ***Eurycarcinus*** A. Milne Edwards, 1867

1867. *Eurycarcinus* A. Milne Edwards, *Ann. Soc. ent. Fr.* sér. 4, **7** : 276.

1898. *Eurycarcinus*, Alcock, *J. Asiat. Soc. Bengal*, **67**(2) 209.

Diagnosis : Carapace transversely oval, convex, without distinction of regions. Front moderately broad, straight, squarish. Antero-lateral margins with three notches. Orbits shallow, upper margin entire, a gap at lower margin below the outer angle. Basal joint of antenna short, not reaching up to the front; flagellum long, standing in the orbital hiatus. Antennules transversely folded. Anterior margin of third maxilliped not notched. Buccal cavern wider anteriorly than posteriorly. Chelipeds unequal in both sexes, finger tips pointed, not hollowed. Male abdomen seven jointed.

Remarks : The genus contains two species from Indian coasts, of which, only one occurs in Goa.

26. ***Eurycarcinus orientalis*** A. Milne Edwards, 1867 (Pl. 3, Fig.4)

1867. *Eurycarcinus orientalis* A. Milne Edwards, *Ann. Soc. ent. Fr.*, sér. 4, **7** : 277.

1957. *Eurycarcinus orientalis*, Chhapgar, *J. Bombay nat Hist. Soc.*, **54(2)** : 436, pl. 11, figs. d-f.

2005. *Eurycarcinus orientalis*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 462.

Material examined : 2(M), Canacona, 23.01. 2002, Dr. M. K. Dev Roy, Reg. No. C 5436/2; 1(M), 1(F), Diwadi Island, 22.01.2002, Dr. M. K. Dev Roy, Reg. No. C; 5(M), 5(F), Zuari River near Rassaim, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5435/2; 1(M), Bogmolo, 01.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5434/2; 12(M), 10(F), Zuari River near Agacaim, Dr. M. K. Dev Roy. Reg. No. C 5446/2; 1(M), 1(F), 2 km south of Chodan, Chorao Island, 20.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5490/2; 1(F), Near Kadamba Bus stand, Panaji, 23.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5498/2.

Measurement :

W = 11.35	F = 4.35	L = 8.1
11.9	5.1	8.15

Diagnosis : Carapace broad, transversely oval and smooth but finely granulate under the lens. Antero-lateral border cut into four lobes by three notches first lobe low, gently rounded, continuous with external orbital angle and least prominent; second one broadly truncate but more prominent than the first, third and fourth lobes anteriorly acuminate; last lobe smallest and directed forwards. Sub-orbital border finely denticulate. Chelipeds assymetrical, immobile finger armed with a strong molariform tooth at its base.

Distribution : Indian Ocean. India : Goa; Maharashtra; Kerala; Andhra Pradesh; Andaman Islands.

Elsewhere : Pakistan and Thailand.

Remarks : This species was found to be very common in mangroves where it occurred among the adjacent embankment of porous rocks and boulders of Mandovi and Zuari estuaries. The cracks and tunnels of these rocks were favourite sites of this species. As these crabs are very sluggish in movement, probably this sort of rocks help them to escape from enemies. This crab was also collected by breaking rocks covered with dead oyster. The smallest and largest ovigerous females measured during this study were 11.75 and 6.65 mm. respectively. This species of crab occurs in both the coasts of India, however, it is reported for the first time from the state of Goa.

Subfamily RHIZOPINAE Stimpson, 1858

1858. Rhizopidae Stimpson, *Proc. Acad. nat. Sci. Philad.*: 41.

2005. Rhizopinae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 464.

Diagnosis : Antero-lateral corners of carapace cut away and rounded off. Front either square-cut and broad or narrow, almost distinctly bilobed and deflexed. Antennules transversely folded, very often crampled and folded obliquely or sometimes not at all folded in their fossae; antennal flagellum usually short. Eye-stalks often fixed, cornea small or obsolete, infra-orbital border running downwards toward the epistome. Buccal cavity squarish, often diminished in breadth anteriorly. External maxillipeds completely close the buccal cavern or with a gap left between them. Epistome either well defined and prominent or ill defined and sunken. Male abdomen not covering all the space between the last pair of legs.

Remarks : The subfamily contains a single genus from Goa.

Genus ***Benthopanope*** Davie, 1989

1898. *Heteropanope*, Alcock, *J. Asiat. Soc. Bengal*, **67**(2) : 207.

1989. *Benthopanope* Davie, *Mem. Qd. Mus.*, **27(2)** : 143.

2005. *Benthopanope*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 465.

Diagnosis : Carapace convex along mid-line, regions strongly defined by granular dorsal crests, gastro-cardiac grooves distinct. Frontal margin protruding with distinct lateral lobules. Suborbital margin with a large triangular tooth at inner end Sternite 8 distinctly visible laterally beside the male abdomen.

Remarks : The genus is represented by a single species.

27. ***Benthopanope indica*** (de Man, 1888)
(Pl. 3, Fig. 5)

1888. *Heteropanope indica* de Man, *J. Linn. Soc. London*, **22** : 53, pl. 3, figs.1,2.

1989. *Benthopanope indica* Davie, *Mem. Qd. Mus.*, **27**(2) : 144.

1998. *Heteropanope indica*, Deb, *Zool. Surv. India, Fauna of West Bengal, State Fauna Series*, **3**(Part 10) : 374.

2005. *Benthopanope indica*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 465.

Material examined : 3(M), Station-26, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5237/1; Verem Bay, Nova Goa, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 956/2.

Measurement :

W = 10.75	F = 4.7	L = 7.55
8.05	4.2	5.6

Diagnosis : Carapace small, hexagonal, broader than long, slightly convex, surface finely granular and bearing a few, sparsely distributed short hairs especially near the margins. Regions poorly indicated; two short transverse elevated granular ridges present on each side of the epigastric lobe; another two transverse ridges also run on each side of the protogastric lobe of which outer ridge about half of its inner ridge ; below this another pair of slightly oblique elevated granular line extend near the third and fourth antero-lateral teeth. Front broad, bilobed, outer angle dentiform and well separated from the supra-orbital edges, free frontal edge crenated. Antero-lateral borders deeply cut into four prominent teeth (including the outer orbital angle)-first tooth broad, low, squarish; second tooth also broad but much narrower than the first, high and acuminate; third and fourth triangular but rather acute and directed obliquely forward, third being the most prominent; fourth tooth smallest; outer margin of all the teeth crenated. Chelipeds markedly unequal in both sexes but more so in male; in larger cheliped, upper border of arm marked with a strong, broad and curved acute tooth at its distal end, outer surface finely granular near the upper part smooth otherwise; inner corner of wrist adorned with a short but strong tooth, outer surface granular; outer surface of palm pitted and covered with microscopic granules on the upper part, rest smooth; fingers stout, chocolate brown in colour, meeting at tips, their cutting edges armed with 3-4 large teeth; in smaller cheliped, upper margin of palm crenated and outer surface roughened with larger granules, fingers ridged longitudinally. Leg joints hairy, dactylus almost as long as the propodus culminating in small horny tips; upper and lower border of leg joints and their outer surfaces granulated. Male abdomen consisting of seven distinct segments, penultimate segment sub-quadrate, slightly broader than long.

Distribution : Indo-Pacific. India : Goa; Karnataka; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu; Andaman Islands.

Elsewhere : Sri Lanka, Myanmar and Japan.

Remarks : This species is reported for the first time from Goa.

Incertae sedis

Genus ***Parapanope*** de Man, 1895

1895. *Parapanope* de Man, *Zool. Jb. (Syst.)*, **8** 513; *Abh. Senckenb. Naturforsch. Ges.*, **25** : 595 (note).

1898. *Hoploxanthus* Alcock, *J. Asiat. Soc. Bengal*, **67**(2) 125.

1985. *Parapanope*, Guinot, *Bull. Mus. natn. Hist nat. Paris*, sér. 4, **7** : 678.

Diagnosis : Carapace hexagonal, broad, convex from front to back, regions distinct and well outlined. Antero-lateral margins thin, crested and on a much lower plane than rest of carapace and ending with a large horizontal lateral epibranchial spine in female only; postero-lateral margins straight, moderately convergent and almost as long as the antero-laterals. Front conspicuous, horizontal and notched in the middle. Orbital margin with two faint notches or sutures above and a small triangular gap just below the outer orbital angle, inner angle of sub-orbital margin forming a strongly projecting tooth. Antennules obliquely folded; basal antennal joint slender and in contact with the front, flagellum in orbital

hiatus. Anterior margin of outer maxillipeds transverse. No ridges delimiting efferent branchial channels on endostome. Chelipeds unequal, fingers pointed. Legs slender. Male abdomen seven-segmented.

Remarks : The genus *Parapanope* de Man has been revised by Guinot (1985) and currently it consists of eight species namely, *P. euagora* de Man, 1895 (type species), *P. hextii* (Alcock, 1898), *P. cultripes* (Alcock, 1898), *P. pagenstecheri* (Neumann, 1878), *P. hexacarpus* Garth and Kim, 1983, *P. serenei*, Ng and Guinot, 1985, *P. siamensis* Guinot, 1985 and *Parapanope* sp. distributed in the Indo-Pacific. The species *P. singaporensis* Ng and Guinot, 1985 is presently synonymised with *P. euagora* de Man, 1895 (Guinot and Ng, 1987). In India, this genus is represented by two species *P. hextii* (Alcock, 1898) and *P. serenei* Guinot, 1985, the former is recorded from Goa and the latter from Madras (= Chennai). These are small sized crabs usually found in muddy or coralline habitats.

Systematic position of the genus *Parapanope* is problematic. de Man (1895) dealt this genus under the family Xanthidae and placed it under the subfamily Xanthinae. Sakai (1976) treated it under the alliance Xanthoida and placed it near the genera *Cycloxanthops* Rathbun and *Neoxanthops* Guinot, 1968. Garth and Kim (1983) also attributed the genus under the subfamily Xanthinae. He observed male pleopod as curved and tapering, hooked ventrally at terminal portion in *Parapanope euagora hexacarpus*. In 1969, Guinot while studying affinities of the genera *Parapanope* de Man, 1895 and *Halimede* de Haan, 1835 observed differences from Xanthinae. She noted differences in pleopod structure in between the two genera and found its affinity more towards Pilumninae notably among certain species of *Actumnus* Dana 1851 and treated it under the family Pilumnidae and subfamily Pilumninae. However, controversy still exists and in this communication, it has been treated under *incerta sedis* for the time being till its systematic position is resolved as also suggested by Davie (personal communication, 2002).

27. ***Parapanope hextii*** (Alcock, 1898)

1898. *Hoploxanthus hextii* Alcock, *J. Asiat. Soc. Bengal*, **67**(2) : 126.

1899. *Hoploxanthus hextii*, Alcock and Anderson, *Illustr. Zool. "Investigator" Crust.*, pl. 37, fig. 1, 1a.

1985. *Parapanope hextii*, Guinot, *Bull. Mus. natn. Hist., Paris*, sér. 4, **7** : 683, fig. 1A-B, pl. 1, 1-4.

Material examined : 1(F), Mormugao Bay, S. Kemp, Reg. No. C 1705/2; 1(M), 1(F), Station–26, Mormugao Bay, S. Kemp, Reg. No. C 3664/2.

Measurement :

W = 9.55	F = 3.15	L = 7.35
16.0	4.6	10.8

Diagnosis : Carapace hexagonal, thick, convex from front to back, surface smooth, regional boundaries prominent. Front square-cut, bilaminar, extended much beyond the orbit and separated from it by a notch. Antero-lateral margins thin, sharp and cut into four triangular laciniate teeth, last tooth acute with a prominent spine in female; postero-lateral margins elegantly granular, nearly straight and sharply marked off from the carapace by a distinct postero-lateral facet. Chelipeds unequal, wrist with a cristiform expansion at outer angle and a stout tooth both at inner and outer angles; upper border of palm with 3-4 bullous tubercles; fingers strong and stout with hooked tips, their cutting margins bearing strong interlocking teeth.

Distribution : Indian Ocean. India : Goa; Orissa; Nicobars.

Remarks : This species of crab occurs in both the coasts of India including the Nicobar Islands. It is endemic to India.

Family ERIPHIIDAE MacLeay, 1838

1838. Eriphidae MacLeay, In : Smith's *Illustr. Zool. S. Afr. (Invert.)* : 59, 60 [corrected to Eriphiidae by Stimpson, 1870 in *Bull. Mus. Comp. Zool. Harvard*, **2** : 141].

2005. Eriphiidae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 469.

Diagnosis : Carapace xanthoid shaped, narrow

and dorsally convex. Antero-lateral margins spinose. Front very broad, half or more the greatest breadth of carapace. Basal antennal joint not meeting the front. Chelipeds unequal and weakly dissimilar, smaller cheliped without noticeably elongated fingers.

Remarks : The family is represented by two subfamilies namely, Oziinae Dana, 1851 and Menippinae Ortmann, 1893.

Key to subfamilies of the family ERIPHIIDAE

- Antero-lateral border of carapace lobate or dentate, fingers of smaller cheliped conspicuously elongated ..... OZIINAE
- Antero-lateral border spinose, fingers of smaller cheliped not noticeably elongated ... . MENIPPINAE

Subfamily MENIPPINAE Ortmann, 1894

1894. Menippinae Ortmann, *Zool. Jb. (Syst.)*, 7(3) : 429.

2005. Menippinae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 469.

Diagnosis : Carapace Xanthoid-shaped or transversely oval; antero-lateral margins usually with lobes, teeth, spine or spinules. Chelipeds weakly dissimilar, smaller chelipeds without markedly elongated fingers.

Key to genera of the subfamily Menippinae

- Orbits completely closed, antennary flagellum excluded from the orbital hiatus .... ***Myomenippe***

  Orbits not closed completely, antennary flagellum in the orbtal hiatus ..... ***Menippe***

Genus ***Menippe*** de Haan, 1833

1833. *Menippe* de Haan, In : Siebold, *Fauna japon. (Crust.)* : 21.

2005. *Menippe*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 470.

Diagnosis : Carapace and chelipeds smooth, regions poorly outlined. First two lobes of antero-lateral border broad, last two dentiform. Front four-lobed.

Remarks : This genus contains a single species.

28. ***Menippe rumphii*** (Fabricius, 1798) (Pl. 3, Fig. 8)

1798. *Cancer rumphii* Fabricius, *Ent. Syst. Suppl.* : 336.

2005. *Menippe rumphii*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 470, pl. 3, fig. 1.

Material examined : 2(M), Vagator, 18.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5495/2; 6 (F), Bogmolo, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5427/2; 1(M), Calangute, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5430/2; 1(F), Vagator, 18.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5492/2.

Measurement :

W = 58.6	F = 10.9	L = 40.55
67.55	13.5	46.55

Diagnosis : Carapace broad, slightly convex longitudinally, rather declivous towards the front and the antero-lateral margins, surface pitted. Only the gastric region distinct and subdivided into three lobes by shallow grooves, a faintly marked arcuate granular line running almost parallel with the curve of antero-lateral border traverse the branchial regions. Front broad, bilobed, each consisting of two obtuse rounded lobes. Antero-lateral borders almost as long as the postero-laterals and cut into four lobes (excluding the outer orbital angle), of which, posterior two lobes dentiform and slightly prominent, anterior two broad but hardly prominent.

Distribution : Indian Ocean. India : Goa; Karnataka; Kerala; West Bengal; Andhra Pradesh; Tamil Nadu; Bay Islands; Lakshwadweep.

Elsewhere : Persian Gulf, Pakistan, Sri Lanka, Tavoy, Mergui Archipelago, Penang and Sumatra.

Remarks : This crab is a new record to Goa. These were collected from rocky habitat.

Genus ***Myomenippe*** Hilgendorf, 1879

1879. *Myomenippe* Hilgendorf, *MB. AK. Berl.* : 795.

1984. *Myomenippe*, Serène, *Faune Tropicale*, **24** : 307.

2005. *Myomenippe*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) 471.

Diagnosis : Carapace and chelipeds roughened with granules, regions conspicuous. First three lobes of antero-lateral borders broad, only the last one dentiform. Front six-lobed.

Remarks : The genus is represented by a single species

29. ***Myomenippe hardwickii*** (Gray, 1831)

1831. *Myomenippe hardwickii* Gray, *Zool. Misc., London* : 39-41 (not seen).

2005. *Myomenippe hardwickii*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 472. pl. 3, fig. 2.

Material examined : 1(M), Station-29, Mormugao Bay, Verem Bay, Goa, August-September, 1916, S. Kemp, Reg. No. C 5935/1.

Measurement :

W = 34.05 F = 7.85 L = 24.45

Diagnosis : Carapace broad, convex, regions distinct and separated from one another by deep grooves, elevated areas of epibranchials covered with large vesiculous granules. Front broad, cut into two lobes each of which consisting of three teeth, median two broadest, squarish and most prominent; second lobe tuberculiform, third one bigger than the second. Antero-lateral teeth four, first three broad with granular margins, separated from one another by deep incisions, fourth tooth directed obliquely outwards and forwards. outer surface of wrist of chelipeds roughened with large vesiculous granules; a line of granules running from distal part of wrist to its proximal part at the inner angle, the granules diminishing in size from front to back.

Distribution : Indian Ocean. India : Goa; Gujarat; Maharashtra; West Bengal; Andhra Pradesh; Tamil Nadu.

Elsewhere : East coast of Africa, Bangladesh, Akyab, Mergui Archipelago, Singapore and Indonesia.

Remarks : This species is recorded for the first time from Goa.

Subfamily OZIINAE Dana, 1851

1851. Oziinae Dana, *Am. J. Sci. Arts*, sér. 2, **12** : 12

1984. Oziinae, Serène, *Faune Tropicale*, **24** : 11, 18, 302 (in addendum).

Diagnosis : Carapace xanthoid-shaped, antero-lateral margins lobate or dentate. Chelipeds very much dissimilar, smaller chelipeds with markedly elongated fingers.

Key to genera of the subfamily OZIINAE

- Dactylus of smaller cheliped as long as the upper border of palm ..... ***Epixanthus***
- Dactylus of smaller cheliped shorter than the upper border of palm ..... ***Lydia***

Genus ***Epixanthus*** Heller, 1861

1861. *Epixanthus* Heller, *Cl. K. Akad. Wiss. Wien.*, **43**(1) : 323.

2000. *Epixanthus*, Dev Roy and Das, *Zool. Surv. India, Occ. Paper No.* **185** : 70.

Diagnosis : Carapace thick or nearly flat with the regions obscurely marked. Antero-lateral margins long, strongly curved and either fissured or dentate. Anterior border of merus of external maxillipeds either not at all or very weakly notched.

30. ***Epixanthus frontalis*** (H. Milne Edwards, 1834)
(Pl. 3, Fig. 6)

1834. *Ozius frontalis* H. Milne Edwards, *Hist. Nat. Crust.*, **1** : 406.

1865. *Epixanthus frontalis*, Heller, *'Novara' Crust.* : 20.

2000. *Epixanthus frontalis*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 72, pl. 4, fig. 2 and pl. 12, figs. 9, 10.

Material examined : 4(M), 16(F), Bogmolo,

01.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5428/2; 1(M), Betul, 25.01.2004, Reg. No. C 5454/2.

Measurement :

W = 22.25	F = 5.7	L = 14.1
26.15	6.75	15.55

Diagnosis : Carapace transversely oval, depressed, surface minutely punctuate if observed under lens, anterior half roughened with short rugae and granules, regions indistinct, only the gastric region somewhat recognizable. Front broad, deflexed, double-edged, about a fourth the greatest breadth of carapace and cut into four subequal blunt lobes. Antero-lateral borders sharp, crest-like and divided into five broad, shallow lobes by very fine, short fissures; an oblique fine granular line extending towards gastric region from the last antero-lateral tooth. Chelipeds smooth, stout and markedly unequal in both sexes; outer surface of arm, wrist and palm smooth; inner corner of wrist bidentate; in larger chela, fingers curved down strongly, those in the smaller chela being very long and slender but not curved; fingers chocolate brown in colour; cutting edge of immobile finger of larger cheliped armed with 2-3 enlarged teeth, dactylus bearing a strong molariform tooth proximally in addition to 5-6 denticles. Leg joints smooth, propodus broad, dactylus longer than broad and thickly fringed with hairs. Abdomen in both sexes consisting of 7 distinct segments.

Distribution : Indo-West Pacific. India : Goa; Maharashtra; Orissa; Andaman and Nicobar Islands.

Elsewhere : East coast of Africa, Red Sea, Persian Gulf, Comoro Island, Madagascar, Mauritius, Seychelles, Sri Lanka, Arakan coast, Mergui Archipelago, Gulf of Thailand, Malay Peninsula, Philippines, Japan, Australia, Tasmania, New Caledonia and Funafuti.

Remarks : In one, out of 21 specimens, both the chelipeds are slender and equal. This crab which is a new record to Goa was collected from rocky areas of the coast.

Genus ***Lydia*** Gistel, 1848

1848. *Lydia* Gistel, *Naturgeschichte des Thierreichs fur höhere Schulen* : IX.

1884. *Eurüppellia* Miers, *H.M.S. 'Alert' Crustacea (Brachyura)* : 534.

2000. *Lydia*, Dev Roy and Das, *Rec. zool. Surv. India, Occ Paper No.* **185** : 74.

Diagnosis : Carapace thick with well demarcated regions. Antero-lateral borders strongly curved and cut into lobes, postero-lateral borders almost as long as the antero-laterals. Anterior border of merus of external maxillipeds deeply notched.

Remarks : The genus consists of two species namely, *L. tenax* (Rüppell, 1830) and *L. annulipes* (H. Milne Edwards, 1834). The former is confined to Zanzibar coast, Red Sea, Persian Gulf and Coetivy while the latter is Indo-West Pacific in distribution.

31. ***Lydia annulipes*** (H. Milne Edwards, 1834) (Pl. 3, Fig. 7)

1834. *Rüppellia annulipes* H. Milne Edwards, *Hist. Nat Crust.*, **1** : 422.

1898. *Ozius (Eurüppellia) annulipes*, Alcock, *J. Asiat Soc Bengal*, **67**(2) : 188.

1984. *Lydia annulipes*, Serène, *Faune Tropicale*, **24** : 309, pl. 46, fig. E.

2000. *Lydia annulipes*, Dev Roy and Das, *Zool. Surv. India, Occ. Paper No.* **185** : 74, pl. 4, fig. 3 and pl. 13, figs 3, 4.

Material examined: 3(M), 1(F), Bogmolo, 01.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5431/2.

Measurement :

W = 34.65	F = 8.2	L = 22.6
33.65	8.1	22.5

Diagnosis : Carapace thick, broad, transversely oval, moderately convex and distinctly divided into regional and subregional lobules by wide grooves. Front broad, deflexed, less than one-fourth the greatest breadth of carapace; free edge followed by a parallel edge and divided into four equal and equidistant teeth. Antero-lateral border cut into five lobules; first three lobes low, broad.

fourth acuminate, fifth lobe shaped like a tubercle. Orbits deep, oval; upper margin entire, separated from the lower one by a shallow groove. Chelipeds stout, unequal; outer surface of arm smooth, that of wrist granular; outer surface of palm roughened with granules and granular ridges; fingers of smaller chelipeds long and narrow, those of the larger chela very much stout; tips pointed; dactylus armed with a large molariform tooth proximally. Upper and lower edges of dactylus of legs covered with velvet up to claw.

Distribution : Indo-West Pacific. India : Goa; Andamans.

Elsewhere : East coast of Africa, Seychelles, Indonesia, Japan, Fiji, Samoa, Tahiti and Hawaiian Islands.

Remarks : The specimens examined differ from earlier studies of the species by the senior author (2000) in the width of front and in the absence of pustulose granules on palm of chelipeds.This crab was collected from rocky areas.This species of crab is reported for the first time from mainland India.

Family GRAPSIDAE MacLeay, 1838

1838. Grapsidae Macleay, In : *Smith's Illustr. Zool. S. Afr. (Invert.)* : 63, 65

2005. Grapsidae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5** : 473.

Diagnosis : Carapace thick or depressed, quadrilateral with lateral margins either straight or slightly convex. Front very broad. Orbits at or very close to the antero-lateral angles. Buccal cavern square cut; a gap often wide and rhomboidal in shape between the external maxillipeds. Chelipeds massive. Legs strong. Male genital openings sternal.

Remarks : The family is divisible into four subfamilies, all but Plagusiinae are represented in the present collection.

Key to subfamilies of the family GRAPSIDAE

1. An oblique hairy ridge on the exposed surface of third maxilliped ..... SESARMINAE

– No oblique hairy ridge on the exposed surface of third maxilliped 2

2. A wide gap left between third maxillipeds, exopod narrow. Infra-orbital margin extending uninterruptedly to buccal cavity. Male abdomen occupying all space between bases of the last ambulatory legs .... GRAPSINAE

   A moderate gap left between third maxillipeds, exopod broad. Infra-orbital margin incomplete, supplemented by a sub-orbital crest. Male abdomen hardly occupying all space between bases of last ambulatory legs ..... VARUNINAE

Subfamily GRAPSINAE MacLeay, 1838

1838. Grapsidae MacLeay, In : *Illustr. Zool. S. Afr. (Invert.)*: 63, 65.

2005. Grapsinae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5** : 473.

Diagnosis : Carapace flat. External maxillipeds not traversed by any oblique hairy crest, their exognath very slender and exposed throughout. Male abdomen filling entire space between the last pair of ambulatory legs.

Key to genera of the subfamily GRAPSINAE

1. Front less than half the greatest breadth of carapace, merus of third maxillipeds longer than broad ..... ***Grapsus***

– Front more than half the greatest breadth of carapace, merus of third maxillipeds broader than long ..... ***Metopograpsus***

Genus ***Grapsus*** Lamarck, 1801

1801. *Grapsus* Lamarck, *Syst. Anim. Sans Vert, (Crust.)* : 150.

1900. *Grapsus*, Alcock, *J. Asiat. Soc. Bengal*, **69**(2) : 390.

2000. *Grapsus*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 82.

Diagnosis : Carapace flat, broader than long, regions faintly indicated, branchial grooves distinct, branchial regions with parallel oblique ridges; gastric region marked by a transverse

squamiform sculpture. Chelipeds subequal, finger tips broad and hollowed.

Remarks : The genus *Grapsus* contains two species from Indian coasts. The present collection is, however, represenred by a single species.

32. ***Grapsus albolineatus*** Lamarck, 1818

1818. *Grapsus albolineatus* Lamarck, *Hist. Nat. Anim.Sans. Vert.*, **5** : 249 (not seen).

1960. *Grapsus albolineatus*, Banerjee, *Temminckia*, **10** : 147, figs. 1c, 2 o, p and 3 a-f.

2005. *Grapsus albolineatus*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series* 5(Part 5) : 475.

Material examined: 1(F), Bogmolo, 01.12. 2002, Dr. M. K. Dev Roy, Reg. No. C 5418/2; 1(F), Chorao Island, 04.11.2002, S. R. Das, Reg. No. C 5379/2; 1(M), Betul, 25.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5458/2; 1(F), Vagator, 18.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5493/2.

Measurement :

W = 23.7	F = 9.75	L = 21.1
30.15	13.35	26.6

Diagnosis : Carapace subcircular, depressed. Lateral borders smooth, strongly arched with a tooth just behind the outer angle. Front deep, vertically deflexed, its free edge nearly straight and not so distinctly crenulated. Inner angle of lower border of orbit with a subacute tooth. Tooth at inner angle of wrist of chelipeds straight, not talon-shaped; upper border of palm about half the length of its dactylus and traversed longitudinally by two lines of 4-5 granules, those of the outer line culminating in a sharp spinule; outer surface of palm roughened with ridges and granules, lower border marked by oblique ridges. Fingers stout, spoon-tipped, their cutting edges strongly dentate. Leg joints broad, compressed; first pair shortest, third pair longest, first and fourth pair subequal in length; upper border of merus crest-like, finely crenulated, terminating in a short spine; outer surface roughened owing to the presence of transverse squamiform sculpture; dactyli thorny, propodi also with thorns and bristles.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Kerala; Maharashtra; Orissa; Andhra Pradesh; Tamil Nadu; Andaman Islands; Lakshadweep; Nicobar Islands.

Elsewhere : East coast of Africa, Red Sea, Baluchistan, Sind coast, Sri Lanka, Arakan and Tenasserim coasts, Mergui Archipelago, Philippines, Japan, Polynesian Islands, Australia and as far as Hawaii.

Remarks : At Dona Paula and Anjuna beaches, though could not be collected, this species of crab was seen in abundance in rocky areas of these beaches. The rocks of lower part of these two beaches are porous with very sharp edges. By the action of waves numerous holes, cavities and enclosures are formed; these are ideal habitats for the adults of this species. With slightest approach, they disappeared among the crevices of these rocks and boulders. At Vagator, 7-8 individuals of this crab was noticed even on a small boulder. This crab has also been collected from mangroves in Chorao Island. The single ovigerous female measured 20.0 mm across its carapace width. This is a widely distributed species of the Indo-Pacific region. This crab is recorded for the first time from Goa.

Genus ***Metopograpsus*** H. Milne Edwards, 1853

1853. *Metopograpsus* H. Milne Edwards, *Annls. Sci nat (Zool.)*, sér. 3, **20** : 164.

2005. *Metopograpsus*, Dev Roy and Bhadra, *Zool Surv India, Fauna of Andhra Pradesh, State Fauna Series* 5(Part 5) : 476.

Diagnosis : Carapace flattish, quadrangular, regions indistinct, a transverse ridge in between orbits and lateral parts of cervical grooves. Chelipeds subequal or unequal, outer surface of arm and wrist scabrous, fingers spoon-tipped.

32. ***Metopograpsus messor*** (Forskål, 1775) (Pl. 4, Fig. 1)

1775. *Cancer messor* Forskål, *Desc. Anim.* : 88.

2005. *Metopograpsus messor*, Dev Roy and Bhadra, *Zool Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 477, pl. 3, fig. 3.

Material examined : 1(M), Zuari River near Agacaim, 26.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5437/2; 8(M), 7(F), Zuari River near Rassaim, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5438/2;1(M), Station-22, Mormugao Bay, August-September, 1916, S. W. Kemp, Reg. No. C 458/2; 1(M), Canacona, 23.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5408/2; 4(M), 1(F), Betul, 25. 01.2004, Dr. M. K. Dev Roy, Reg. No. C 5455/2; 2(M), 1(F), Diwadi Island, 22.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5466/2; 1(M), Canacona, 23. 01.2004, Dr. M. K. Dev Roy, Reg. No. C 5500/2.

Measurement :

W = 27.15	F = 15.6	L = 22.15
15.1	8.85	11.05

Diagnosis : Free edge of front beaded, some fine transverse markings on post-frontal region. Inner angle of sub-orbital border denticulate. In cheliped, dactylus not much longer than upper border of palm.

Distribution: Indo-West Pacific. India : Goa; Gujarat; Karnataka; Maharashtra; Malabar; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu.

Elsewhere : Suez Canal, Red Sea, Aden, Madagascar, Pakistan, Sri Lanka, Bangladesh, Myanmar, Australia and as far as Hawaii.

Remarks : This crab was seen in plenty under boulders on fluviatile muddy bottom of mangroves. These boulders are porous and the smaller individuals immediately disappeared among the crevices of these rocks. Their adults were occasionally found foraging in forest floor among the dense thickets of prop roots and pneumatophores of mangroves which were almost inaccessible. These crabs are very fast in movement. The smallest and largest ovigerous female ranged from 12.1 and 16.7 mm across their carapace width. This crab is recorded for the first time from Goa.

Subfamily VARUNINAE H. Milne Edwards, 1853

1853. Varunacea H. Milne Edwards, *Annls. Sci. nat. (zool.)*, sér. 3, **20** : 175.

2005. Varuninae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 479.

Diagnosis : Carapace flattened. Front moderately or slightly deflexed, often sublaminar. Antennal flagella of good length. Exognath of third maxilliped generally broad. Male abdomen rarely occupy all space between the last pair of ambulatory legs.

Genus ***Varuna*** H. Milne Edwards, 1830

1830. Varuna H. Milne Edwards, *Dict. Hist. Nat.*, **16** : 511.

2005. Varuna, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 479.

Diagnosis : Carapace slightly broader than long with thin sharp edges. Front broad and straight. Antero-lateral borders curved and cut into three teeth. Chelipeds equal, massive in adult males. Middle two pair of legs longest, last one shortest; last three joints of legs compressed, dialated and fringed with hairs, natatory.

33. ***Varuna litterata*** (Fabricius, 1798) (Pl. 4, Fig. 2)

1798. *Cancer litteratus* Fabricius, *Entom. Syst. Suppl.* : 342.

2005. *Varuna litterata*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 480, pl. 3, fig. 4.

Material examined: 6(M), 1(F), Calangute, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5429/ 2; 6(M), Station-12, Mormugao Bay, Panjim River, 20.02.1958, Reg. No. C 420/2; 1(M), Calangute, Goa, 19.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5405/2.

Measurement :

W = 36.15	F = 14.8	L = 33.7
33.0	12.9	30.25

Diagnosis : Carapace with a H-shaped groove at its middle, surface pitted and frosted. Inner border of arm of cheliped denticulate, inner corner of wrist with a large sharp spine, inner surface of palm granular; a fine raised line on the outer surface of fixed finger.

Distribution : Indo-West Pacific. India : Goa; Kerala; Maharashtra; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu.

Elsewhere : East Africa, Bangladesh, Myanmar, Singapore, Philippines, Hong Kong, Japan, New Guinea, Australia and New Zealand.

Remarks : This species was collected from fishermen's net at Calangute beach indicating its occurrence in marine condition.

Subfamily SESARMINAE Dana, 1852

1852. Sesarminae Dana, *U. S. Explor. Exped.*, **13**(1) : 333.

2005. Seaarminae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 480

Diagnosis : Carapace thick or flat. External maxillipeds traversed by an oblique hairy crest across ischium and merus, their exognath slender and partly or almost completely hidden. Male abdomen may or may not be filling entire space between the last pair of ambulatory legs.

Remarks : The subfamily is represented by six genera.

Key to genera of the subfamily SESARMINAE

1. Antennal peduncle excluded from the orbit ..... ***Clistocoeloma***
- Antennal peduncle not excluded from the orbit 2
2. Posterior border of merus of pereopods 4-5 denticulated or serrated ..... ***Nanosesarma***
- Posterior border of merus of pereopods 4-5 entire, not denticulated or serrated 3
3. A large tooth on inner border of arm of chelipeds near its far end, upper surface of movable finger of male milled 4
- No tooth on inner border of arm of cheliped at its far end, upper surface of movable finger of male granular but not milled ..... ***Pseudosesarma***
4. A tooth on the lateral border of carapace behind the orbital angle 5
- No tooth on lateral border of carapace behind the orbital angle ..... ***Parasesarma***
5. Dactylus of male cheliped elegantly milled with 40-60 fine lamellae, large crab ..... ***Episesarma***
- Dactylus of male cheliped milled with 15-20 coarse lamellae, small crab ..... ***Chiromantes***

Genus ***Chiromantes*** Gistel, 1848

1848. *Chiromantes* Gistel, *Naturgeschichte des Thierreichs für höhere Schulen* : X.

2000. *Sesarma (Chiromantes)*, Dev Roy and Das, *Rec. zool Surv. India, Occ. Paper No.* **185** : 89

Diagnosis : Lateral border of carapace without any tooth behind the outer orbital angle.

34. ***Chiromantes bidens*** (de Haan, 1835) (Pl. 4, Fig. 3)

1835. *Grapsus (Pachysoma) bidens* de Haan, In Siebold, *Fauna japon. (Crust.)* : 60, pl. 11, fig. 4 and pl. 16, fig. 4.

1900. *Sesarma bidens*, Alcock, *J. Asiat. Soc. Bengal*, **69**(2) : 415.

2005. *Chiromantes bidens*, Dev Roy and Nandi, *J. Environ & Sociobiol.*, **2**(1&2) : 123.

Material examined : 3(M), 1(F), Durbat, Ferry Point, Ponda, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5421/2; 1(M), Zuari River near Rassaim, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5445/2; 1(F), Diwadi Island, 22.01.2002, Dr. M. K. Dev Roy, Reg. No. C 5447/2; 2(M), Chorao Island, 20.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5464/2.

Measurement :

W = 19.3	F = 11.15	L = 16.25
14.75	8.85	12.3

Diagnosis : Carapace deep, broader than long. Lateral borders almost parallel, slightly divergent anteriorly and cut into a sharp tooth just behind the outer orbital angle. In male chelipeds, outer surface of arm and wrist granular and scabrous; upper border of palm with two comb-like ridges, anterior border of dactylus elegantly milled with 15–20 coarse, transverse lamellae.

Distribution : Indo-West Pacific. India : Goa; West Bengal; Orissa; Andhra Pradesh; Andaman and Nicobar Islands.

Elsewhere : East coast of Africa, Madagascar, Sri Lanka, Mergui Archipelago, Malay Peninsula, Hong kong, Indonesia, Philippines, Korea, New Guinea and Australia.

Remarks : All the present specimens were collected from muddy bottoms of mangroves.

Genus ***Parasesarma*** de Man, 1895

1895. *Parasesarma* de Man, *Zool. Jb. (Syst.)*, **9** : 181.

1976. *Parasesarma*, Sakai, *Crabs of Japan and the Adjacent Seas* : 655.

2001. *Parasesarma*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Godavari Estuary, Estuarine Ecosystem Series*, **4** : 46.

Diagnosis : Resembling very closely to the genus *Sesarma sensu stricto*, differing from it in the lateral border of carapace which is entire and not toothed behind the outer orbital angle.

Remarks : It is represented by a single species.

35. ***Parasesarma plicatum*** (Fabricius, 1798) (Pl. 4, Fig. 4)

1798. *Cancer quadratus* Fabricius, *Ent. Syst. Suppl.* : 341.

1900. *Sesarma quadrata*, Alcock, *J. Asiat. Soc. Bengal*, **69**(2) : 413.

2001. *Sesarma (Parasesarma) plicatum*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Godavari Estuary, Estuarine Ecosystem Series*, **4** : 46.

Material examined : 1(M), Salim Ali Bird Sanctuatary, Chorao, Island, North Goa, 07.11.2002, S. Das, Reg. No. C 5350/2; 20 (M), 9 (F), Diwadi Island, North Goa, 22. 11.2002, Dr. M. K. Dev Roy, Reg. No. C 5422/2; 21(M), 10(F), Zuari River near Agacaim, North Goa, 26.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5420/2; 1(M), Durbat, Ferry Point, Ponda, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5423/2; 1(M), Chorao Island, North Goa, 25.03.2002, S. R. Das, Reg. No. C 5417/2; 1(F), Zuari River near Rassaim, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5439/2; 7(M), 5(F), Chorao Island, 20.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5486/2.

Measurement :

W = 24.0	F = 13.45	L = 19.25
20.7	12.7	16.75

Diagnosis : Carapace thick, convex from front to back in male, flattish in female. Front broad, more than half of the greatest breadth of carapace. Lateral borders devoid of any tooth behind the outer orbital angle. Chelipeds massive in male, less so in female; outer surface of arm, wrist and palm granulate; inner border of arm bearing a large spine at its distal end; upper border of palm with two oblique pectinated crests in male but tuberculate and less developed in female; upper border of male dactylus elegantly milled with 10-20 blunt, coarse transverse lamellae, milling incomplete and much less prominent in female.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Karnataka; Kerala; Maharashtra; West Bengal; Orissa; Andhra Pradesh; Tamil Nadu; Pondicherry; Andaman Islands.

Elsewhere : East coast of Africa, Madagascar, Pakistan, Sri Lanka, Myanmar, Malay Archipelago, China, Korea and Japan.

Remarks : The present specimens were collected from muddy bottoms of mangroves. This is a very common species in the mangroves of this state. The largest and smallest ovigerous females recorded during the present investigation were 21.15 and 16.9 mm respectively across the carapace width.

Genus ***Episesarma*** de Man, 1895

1895. *Episesarma* de Man, *Zool. Jb. (Syst.)*, **9** : 165.

1970. *Neoepisesarma* Serène and Soh, *Treubia*, **27**(4) : 395, 405.

2001. *Neoepisesarma*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Godavari Estuary, Estuarine Ecosystem Series*, **4** : 47.

2005. *Episesarma*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 484.

Diagnosis : Distinguished from the genus *Sesarma* Say by its relatively narrower carapace and front. Antero-lateral tooth behind the outer

orbital angle strongly marked instead of just indicated as in *Sesarma*. Anterior border of arm of male cheliped with a sub-distal triangular dentate process instead of a granular subdistal convexity as found in *Sesarma*. A longitudinal pectinated crest on upper part of palm of male cheliped running parallel to the margin instead of a granulated line not distinct from the margin as in *Sesarma*. Dactylar tubercle on male cheliped conspicuously shaped instead of 7–9 depressed spinules as in *Sesarma*.

Remarks : This genus is represented by a single species in Goa.

37. ***Episesarma taeniolata*** (White, 1847)

1847. *Sesarma taeniolatum* White, *List of the Specimens of Crustacea in the collection of the British Museum*, London : 38.

1957. *Sesarma (Sesarma) taeniolata*, Chhapgar, *J. Bombay nat. Hist. Soc.*, **54(3)** : 521, pl.16, figs. h-j.

2001. *Neoepisesarma (Neoepisesarma) taeniolata*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Godavari Estuary, Estuarine Ecosystem Series*, **4** : 47.

2005. *Episesarma taeniolata*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 485.

Material examined : 1(M), Salim Ali Bird Sanctuatary, Chorao Island, North Goa, 07.11.2002, S. Das, Reg. No. C 5349/2.

Measurement :

W = 34.45 F = 17.05 L = 31.5

Diagnosis : Carapace dorsally flat, deep and squarish; surface covered with tufts of hairs, those of the anterior half longer than the posterior part. In male, pectinated crest of palm of chelipeds extending from its proximal to distal margin and upper border of dactylus elegantly milled with 40-60 fine lamellae.

Distribution: Indo-Pacific. India : Goa; Maharashtra; West Bengal; Andhra Pradesh; Andaman Islands.

Elsewhere : Pakistan, Mergui Archipelago, Malay Peninsula, Singapore, Indonesia, Thailand, China and Japan.

Remarks : This species has been recorded from mangroves of Goa (Dev Roy and Nandi, 2005).

Genus ***Pseudosesarma*** Serène and Soh, 1970

1970. *Pseudosesarma* Serène and Soh, *Treubia*, **27**(4) : 391, 399.

Diagnosis : Carapace slightly shorter than the breadth between outer orbital angle. Gastric and cardiac region well outlined by a groove. Antero-lateral tooth prominent. Anterior margin of front with a shallow but marked median concavity. Anterior border of cheliped with a subdistal triangular process.

Remarks : The genus *Pseudosesarma* contains 7 species (including a subspecies) from the Indo-Pacific region. It is represented by a single species, *Pseudosesarma edwardsi* from India.

38. ***Pseudosesarma edwardsi*** (de Man, 1887) (Pl. 4, Fig. 5)

1887. *Sesarma edwardsi* de Man, *Zool. Jb. (Syst.)*, **2** : 6

1900. *Sesarma edwardsi*, Alcock, *J. Asiat. Soc. Bengal*, **69**(2) : 416.

Materaial examined : 6(M), 3(F), Zuari River near Panchabati, 29.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5491/2.

Measurement :

W = 9.4 F = 5.55 L = 8.05
8.6 5.45 7.4

Diagnosis : Carapace squarish. Front broader than long, post frontal lobes distinct. Lateral borders of carapace with a blunt tooth behind the outer orbital angle. Chelipeds unequal, much stronger in male than in female; upper border of arm not ending to a spine; inner angle of wrist with a broad tooth; upper surface of wrist and palm closely studded with vesiculous granules; palm tumid, without oblique pectinated crest, upper border of dactylus and lower border of fixed finger also bearing smaller and sharper granules; cutting margin of fingers strongly dentate. Male abdomen broad.

Distribution : Indian Ocean. India : Goa; West Bengal; Andamans.

Elsewhere : Sri Lanka, Myanmar.

Remarks : Granulation on palm is not so much

pronounced in female. This crab is reported for the first time from the west coast of India. These specimens were collected from muddy bottom of mangroves.

Genus ***Nanosesarma*** Tweedie, 1950

1950. *Nanosesarma*, Tweedie, *Bull. Raffles Mus.*, **23** : 310.

1970. *Nanosesarma* (*Beanium*) Sérene and Soh, *Treubia*, **27**(4) : 389, 394.

Diagnosis : Antero-lateral tooth not marked. In male cheliped, upper surface of palm bearing at least one oblique pectinated crest, its outer surface smooth and bare and covered by an hairy patch around cutting margins of fingers, upper border of dactylus with a regular row of 10-15 transverse tubercles. Posterior border of merus of pereopods 2-5 armed with with 2-5 denticles. Telson of male abdomen not markedly elongated.

Type species : *Sesarma minutum* de Man, 1887

39. ***Nanosesarma andersoni*** (de Man, 1887) (Pl. 4, Fig. 6)

1887. *Sesarma andersoni* de Man, *Zool. Jb. (Syst.)*, **2** : 657 and 1888, *J. Linn. Soc. Zool.*, **22** : 172, pl. 12, figs. 1-4.

1970. *Nanosesarma (Beanium) andersoni*, Sérene and Soh, *Treubia*, **27**(4) : 394.

2000. *Nanosesarma (Beanium) andersoni*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 93, pl. 6, fig. 5 and pl. 18, figs. 7, 8.

Material examined : 6(M), 5(F), Zuari estuary, Agacaim, 26.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5510/2; 1(M), 2(F), Zuari River near Rassaim, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5512/2; 2(M), 1(F), Zuari River at Panchabati, 27.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5511/2.

Measurement :

W = 8.8	F = 4.95	L = 6.85
9.0	5.0	7.0

Diagnosis : Carapace deepish, convex from front to back, broader than long; surface smooth, glabrous, minutely punctuate if observed under the binocular; regions indistinct, cardiac and intestinal areas hardly recognizable; oblique striations of epibranchial regions sharp and distinct. Lateral borders slightly convergent backwardly, an indistinct tooth just behind the outer orbital angle. Front broad, exceeding half the length of greatest breadth of carapace, vertically deflexed, free edges almost straight and perfectly smooth. Chelipeds markedly unequal, but equal in the same sex; inner border of arm culminating to an acute denticulated lobe; outer surface of wrist finely granular; palm tumid, nearly smooth, minutely rugose towards the upper border close to articulation with wrist and finely pitted near articulation with the mobile finger; several fine oblique ridges run parallel to one another on its upper surface, at least two of them much enlarged and become pectinated; a fine elevated line on its lower outer surface running from the articulation with wrist to the acute tooth of inner margin of index; inner surface finely granular; fingers broad, stout with smooth surfaces, their cutting edges strongly dentate, inner margin of thumb armed at its base with two strong teeth, of which, inner one exceeding the other in size; upper border of dactylus milled with a row of 10-12 transverse ridges, the ridges increasing in size and coarseness from back to front; in female, pectinated ridges either absent or rudimentary, upper margin of thumb also lacking transverse ridges, being somewhat granular at the base. Distal end of posterior border of merus of legs armed with 3-4 strong spines, their size increasing from front to back; anterior border devoid of any subterminal spine; anterior margin of propodus of first to third pair thickly fringed with short hairs; terminal three leg joints also bearing sparsely distributed long hairs, dactylus shorter than propodus.

Distribution : Indian Ocean. India: Goa; Tamil Nadu, Middle Andaman.

Elsewhere : Mergui Archipelago, Malay Peninsula.

Remarks : de Man (1888) reported to have obtained this species at low water in the deep but narrow burrows of dead *Novaculina* sp. (Mollusca: Bivalvia) on the banks of Tenaserrim river at

Minthantoung. The present specimens were, however, collected from burrows in soft muddy bottoms of shaded mangroves regularly inundated by tides.

Alcock (1900) reported no tooth behind the outer orbital angle while de Man (*op. cit.*) recorded 2-3 teeth behind the ex-orbital angle. The present specimens show the trace of a single feebly developed tooth. Post frontal lobes were reported to be little prominent by de Man (*op. cit.*) but these are very much conspicuous in the specimens studied by us. Carapace width of the smallest and largest ovigerous female recorded during this investigation were 7.1 and 7.6 mm respectively. This species is a new record to the state of Goa.

Genus ***Clistocoeloma*** A. Milne Edwards, 1873

1873. *Clistocoeloma* A. Milne Edwards, *Nouv. Archs. Mus. Hist. nat. Paris*, **9** : 310.

2005. *Clistocoeloma*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 10 9.

Diagnosis : Lateral borders of carapace dentate. Reticulation of side walls of carapace made up of hairs only. Antennae excluded from the orbit fully. Merus of external maxillipeds short.

Remarks : The genus contains two species from India, of which, one species occurs in Goa.

40. ***Clistocoeloma merguiense*** de Man, 1888
(Pl. 4, Fig. 7)

1888. *Clistocoeloma merguiense* de Man, *J. Linn. Soc. Zool.*, **22** : 195, pl. 13, fig. 10.

2000. *Clistocoeloma merguiense*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 109, pl. 7. and pl. 20, figs. 7, 8.

Material examined : 4(M), 3(F), Agacaim, Zuari River, 26.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5432/2; 2(F), Diwadi Island, 22. 01. 2002, Dr. M. K. Dev Roy, Reg. No. C 5433/2; 9(M), 9(F),Station 4, Mormugao Bay, August-September, 1916, S. Kemp, Reg. No. C 293/2.

Measurement :

W = 11.75	F = 7.6	L = 10.05
6.8	4.05	6.4

Diagnosis : Entire body and its appendages covered with dark dense adherent fur. Free edge of front emarginated at the middle to form a trenchant horizontal crest. Palm tumid, equal in the same sex; pectinated crest on its upper part much long and extended, dactylus strongly curved.

Distribution : Indo-West Pacific. India : Goa; West Bengal; Andaman and Nicobar Islands.

Elsewhere: Mergui Archipelago, Singapore, Indonesia, Thailand, Korea and Japan.

Remarks: This is the first report of the occurrence of this crab from west coast of India. The smallest and largest ovigerous female were 6.1 and 8.2 mm respectively across the carapace width.

Family OCYPODIDAE Rafinesque, 1815

1815. Ocypodia Rafinesque, *Analyse de la Nature* 96 [corrected to Ocypodidae by MacLeay, 1838 63]

2005. Ocypodidae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 497.

Diagnosis: Carapace deep or flat, subquadrangular, subcubical or subglobose, generally broader than long, regions not well marked. Front narrow, deflexed, usually a mere lobe between the long eye-stalks. Orbits occupying almost the entire anterior border of carapace; eye-stalks slender, often much elongated. Chelipeds markedly unequal either in both sexes or in males only. An orifice or recess thickly fringed with hairs between bases of second and third pair of legs.

Key to subfamilies of the family OCYPODIDAE

1. A hairy-ridged pouch between bases of second and third pair of walking legs 2
- No hairy-ridged pouch between bases of any of the Legs ..... MACROPHTHALMINAE
2. Lateral border of carapace with no tooth or indentation behind the outer orbital angle, orbits deep, chelipeds asymmetrical in male or in both sexes, tympanum absent .... OCYPODINAE

– Lateral border of carapace marked with tooth or indentation behind the outer orbital angle, orbits shallow, merus of thoracic legs, chelipeds and sternum usually bearing a tympanum ..... DOTILLINAE

Subfamily OCYPODINAE Rafinesque, 1815

1815. Ocypodia Rafinesque, *Analyse de la Nature* : 96.

2005. Ocypodidae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 499.

Diagnosis : Carapace deep, subquadrilateral, regions indistinct. An orifice or recess between bases of second and third pair of legs. Chelipeds unequal, remarkably in males.

Key to genera of the subfamily OCYPODINAE

– Antennular flagella rudimentary, concealed under the front fully; antennae small almost rudimentary; eyes very large, occupying the major part of ventral surface of eye-stalks; chelipeds unequal, ambulatories large ..... ***Ocypode***

– Antennular flagella small, not concealed under the front; antennae long; eyes small, terminal on long slender eye-stalks; one of the male chelipeds enormously enlarged, the other being very small; ambulatories short ..... ***Uca***

Genus ***Ocypode*** Weber, 1795

1795. *Ocypode* Weber, *Nomencl. Ent. Syst. Fabr.* : 92.

2005. *Ocypode*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 499.

Diagnosis : Carapace deep, subquadrilateral, slightly broader than long. Lateral borders with or without any tooth behind the outer orbital angle. Eye-stalks prolonged in a horn or style. Chelipeds unequal in both sexes; palm of larger chela high and usually provided with a stridulating ridge of granules or striae for scrapping against a corresponding ridge on the ischium

41. ***Ocypode ceratophthalma*** (Pallas, 1772)

1772. *Cancer ceratophthalmus* Pallas, *Spicilegia Zool.*, **9** : 83, pl. 5, fig. 7.

2005. *Ocypode ceratophthalma*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 500.

Material examined : 1(M). 8(J), Bogmolo beach, 01.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5419/2; 5(J), Canacona, 23.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5424/2; 7(J), Calangute beach, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5425/2; 27(M), 2(F), Colva Beach, 02.12.2002, Reg. No. C 5457/2; 9(M), 1(F), Cavelossim, 27. 01.2004, Dr. M. K. Dev Roy, Reg. No. C 5459/ 2; 20 (M), Calangute, 23.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5487/2; 1(M), Goa, 09.12.1973, Dr. B. S. Lamba, Reg. No. WRS 3/2279; 2(M), Vagator, 18.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5497/2.

Measurement :

W = 34.8 F = 4.7 L = 29.6

Diagnosis : Carapace thick, squarish. Eye-stalks prolonged beyond the carapace as a blunt narrow horn. Stridulatory organ consisting of a few rounded granules on the upper part of inner surface of palm very close to base of fixed finger followed by several rather widely spaced striae and then more very close striae at the lower half. Propodus of first two pair of of walking legs densely hairy on their edges.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Maharashtra; Karnataka; Orissa; Andhra Pradesh; Tamil Nadu; Andamans; Lakshadweep; Nicobars.

Elsewhere : East coast of Africa, Madagascar, Mauritius, Maldives, Sri Lanka, Malay Peninsula, Singapore, Indonesia, China, Japan, Australia, Sandwich Island, Tahiti and Hawaii.

Remark : The dense hair on propodus of first two pair of walking legs has been noted even in juveniles. This species of crab is a new record to Goa.

Genus ***Uca*** Leach, 1814

1814. *Uca* Leach, In : D. Brewster, *The Edinburgh Encyclopedia*, 7(2) : 430.

1817. *Gelasimus* Latreille, *Nouv. Dict. Nat.*, **12** : 517

2005. *Uca*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 505.

Diagnosis : Carapace deep, subquadrilateralor subhexagonal, broader than long. Antero-lateral margins absent or moderately parallel, converging or diverging. Chelipeds remarkably unequal in male, small and equal in female.

Key to species of the genus *Uca*

- Front narrow ..... *U. dussumieri*
- Front wide ..... *U. lactea*

42. ***Uca dussumieri*** (H. Milne Edwards, 1852)

1852. *Gelasimus dussumieri* H. Milne Edwards, *Annls. Sci. nat. (Zool.)*, sér. 3, **18** : 148, pl. 4, fig. 2.

2000. *Uca dussumieri*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 119, pl. 4, fig. 6 and pl. 14, figs. 3, 4.

Material examined : 5(M), 3(F), Diwadi Island, 22.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5484/2.

Measurement :

W = 25.2	F = 2.0	L = 14.5
16.6	2.1	11.0

Diagnosis : Carapace deep, strongly convex from front to back, regions ill-defined. Dorso-lateral margin long, definite extending up to the level of third walking legs, finely beaded but becoming very weak or absent posteriorly. Antero-lateral angle acute and directed forward. Antero-lateral margins short, definite, converging and finely beaded, postero-lateral stria absent. In major cheliped, two distinct long grooves present running most of the length on its outer surface and a similar groove on pollex; fingers very long and strong, crossing each other and curved like a hook at their tips; in male minor cheliped, gape extremely small, evenly serrated with few dense setae dorsally; in female, gape small with a central pair of enlarged teeth in both the chelae.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Maharashtra; West Bengal; Andhra Pradesh; Andaman and Nicobar Islands.

Elsewhere : Madagascar, Mergui Archipelago, Malay Peninsula, Singapore, Indonesia, Thailand, Philippines, Hong Kong, China, Ryu Kyu Island, Palau, Indonesia, New Guinea, Australia, New Caledonia, Solomon and Caroline Islands.

Remarks : These specimens were collected from foreshore part of unshaded mangroves, the substratum consisted of soft and fluviatile muddy bottom. It occurred sympatrically with the congeneric species *U. lactea*. Two types of males were noticed in the population of *U. dussumieri* – some with short chela (brachychelous) and others with large chela (leptochelous). Leptochelous individuals were more in the population about 87% The carapace width of smallest and largest ovigerous were 13.75 and 16.6 mm respectively.

43. ***Uca lactea*** (de Haan, 1835)
(Pl. 4, Fig. 9)

1835. *Ocypode (Gelasimus) lacteus* de Haan, In : Siebold, *Fauna japon. (Crust.)* : 54, pl. 15, fig. 5.

2005. *Uca lactea*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 508, pl. 4, fig. 10.

Material examined : 2(M), Canacona, 23.01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5450/2; 1(M), Zuari River near Agacaim, Dr. M. K. Dev Roy, 26. 01. 2004, Reg. No. C 5449/2; 3(M), Zuari River near Rassaim, 28.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5448/2; 11(M), Chorao Island, 20.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5467/2; 14(M), Diwadi Island, 22.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5465/2; 14 (M), 1(F), Chorao Island, 20.11. 2002, Dr. M. K. Dev Roy, Reg. No. C 5483/2; 1(M), Canacona, 23.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5501/2; 5(M), Near Kadamba Bus Stand, Panaji, 21.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5494/2.

Measurement :

W = 13.1 F = 2.75 L = 7.55

Diagnosis : Carapace subquadrilateral, much broader than long, antero-lateral angles sharp, claw-shaped and diagonally produced outwards;

regions ill-defined. Chelipeds smooth, porcelain white in colour; dactylus hook-like, compressed, pollex slightly curved upwards, truncated at tips due to the presence of an enlarged tooth.

Distribution : Indo-West Pacific. India : Goa; Gujarat; Karnataka; Kerala; Maharashtra; West Bengal; Orissa; Andhra Pradesh; Pondicherry; Tamil Nadu; Andaman and Nicobar Islands.

Elsewhere : South Africa, East coast of Africa, Madagascar, Mauritius, Red Sea, Persian Gulf, Pakistan, Mergui Archipelago, Malay Peninsula, Singapore, Thailand, Indonesia, Philippines, China, Japan, Ryukyu Island, New Guinea, Australia, New Caledonia and as far as Hawaii.

Remarks : This crab was abundant in soft bottom at Betim (near shore line). In the shaded area of the mangrove, *Rhizophora* sp., its population varied from 40-48 m^{-2} whereas it ranged from 32-36 m^{-2} in unshaded area. At Agacaim, this crab was noticed even in firmer subatratum. However, these were difficult to catch in such substratum. This crab is reported for the first time from Goa.

Subfamily DOTILLINAE Stimpson, 1858

1858. Dotillidae Stimpson, *Proc. Acad. nat. Sci. Philad.* : 44.

2005. Dotillinae, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 510.

Diagnosis : Carapace very deep, subglobose or quadrilateral in outline. Chelipeds equal or subequal. Legs slender; a conspicuous membranous area known as "tympana" present on merus of legs and often on chelipeds and sternal segments; no hairy recess between bases of second and third pair of legs.

Remarks : The subfamily is represented by three genera, namely, *Dotilla*, *Scopimera* and *Ilyoplax*.

Key to genera of the subfamily DOTILLINAE

1. Penultimate segment of second maxilliped greatly expanded, last segment attached to it laterally as a narrow strip 2

– Penultimate segment of second maxilliped not expanded, last segment attached terminally ..... ***Ilyoplax***

2. Merus of third maxillipeds larger than ischium, a conspicuous brush of hair indicating the position of accessory branchial orifice between bases of first and second pair of walking legs, fourth segment of abdomen not overlapping the fifth nor with a brush of hair at its distal end, fourth or fifth segment of male abdomen constricted ..... ***Scopimera***

– Ischium of third maxillipeds larger than merus, no brush of hair between bases of walking legs, fourth segment of abdomen overlapping the fifth in both sexes and with a dense brush of hair at its distal end, male abdomen not constricted ..... ***Dotilla***

Genus ***Dotilla*** Stimpson, 1858

1858. *Dotilla* Stimpson, *Proc. Acad. Nat. Sci. Philad.* : 98.

2005. *Dotilla*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 511.

Diagnosis : Carapace very deep, subglobose or quadrilateral in outline.Chelipeds equal or subequal in both sexes. Tympana present on merus of legs and often on chelipeds and sternal segments; no hairy recess between bases of second and third pair of legs.

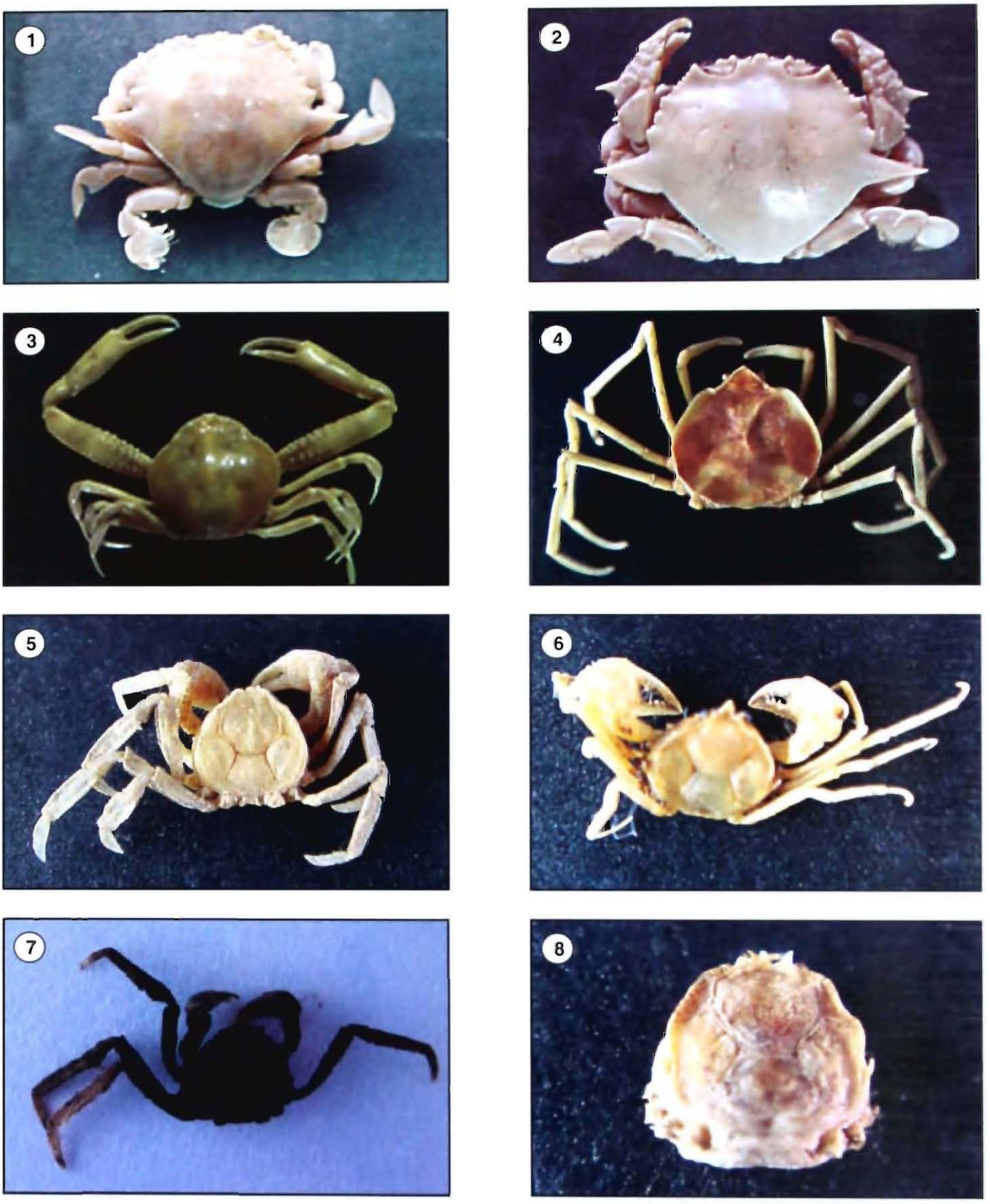
44. ***Dotilla myctiroides*** (H. Milne Edwards, 1852) (Pl. 4, Fig. 10)

1852. *Doto myctiroides*, H. Milne Edwards, *Annls. Sci. nat. (Zool.)*, sér. 3, **18** : 152, pl. 4, fig. 24.

2000. *Dotilla myctiroides*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185** : 128, pl. 5, fig. 2 and pl. 15, figs. 7, 8.

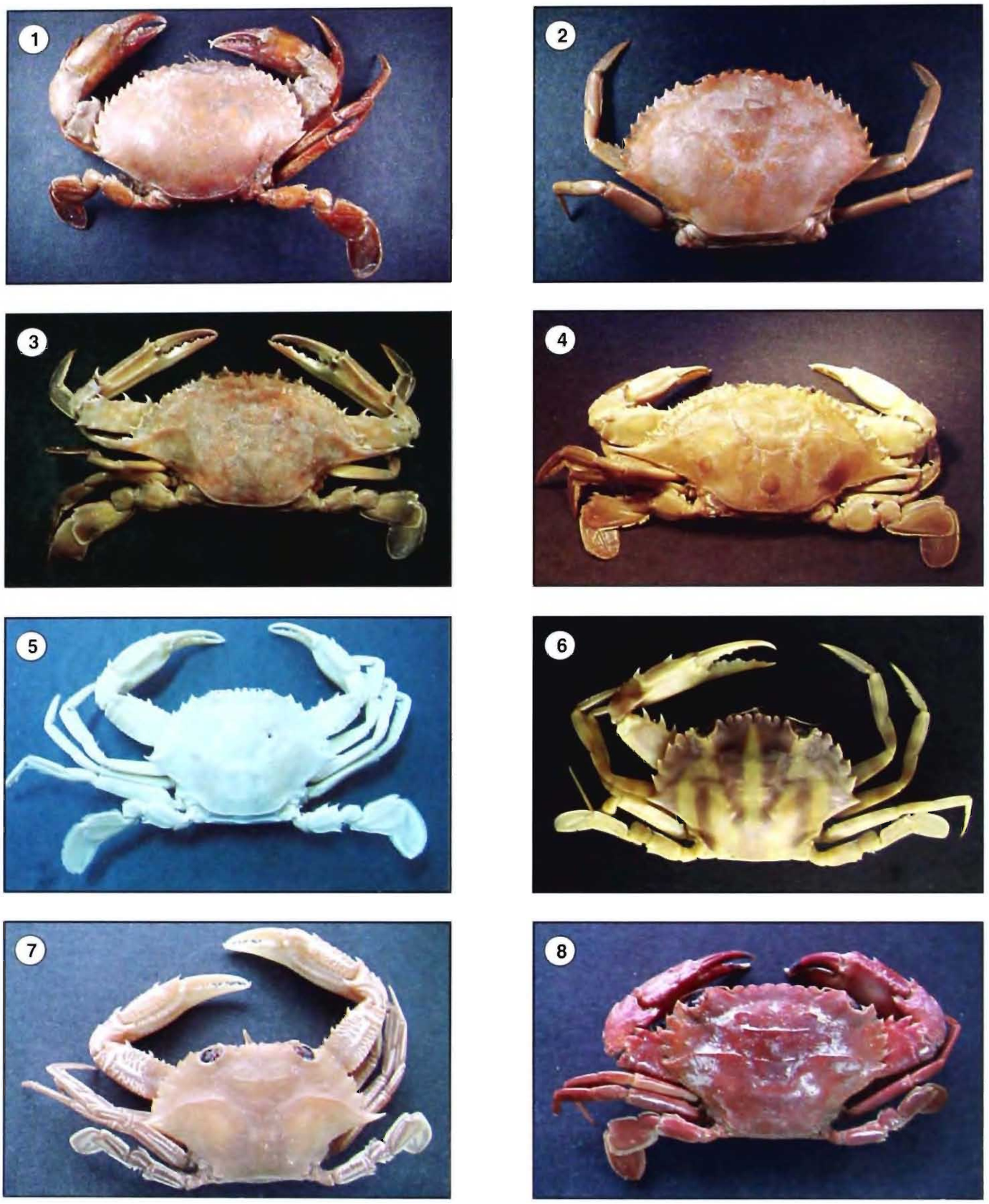
Material examined : 16(M), 1(F), Canacona, 23.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5452/2; 2(M), 3(F), Cavelossim Beach, 27.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5453/2; 8(M), 1(F), Vagator Beach, 18.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5496/2.

PLATE-I



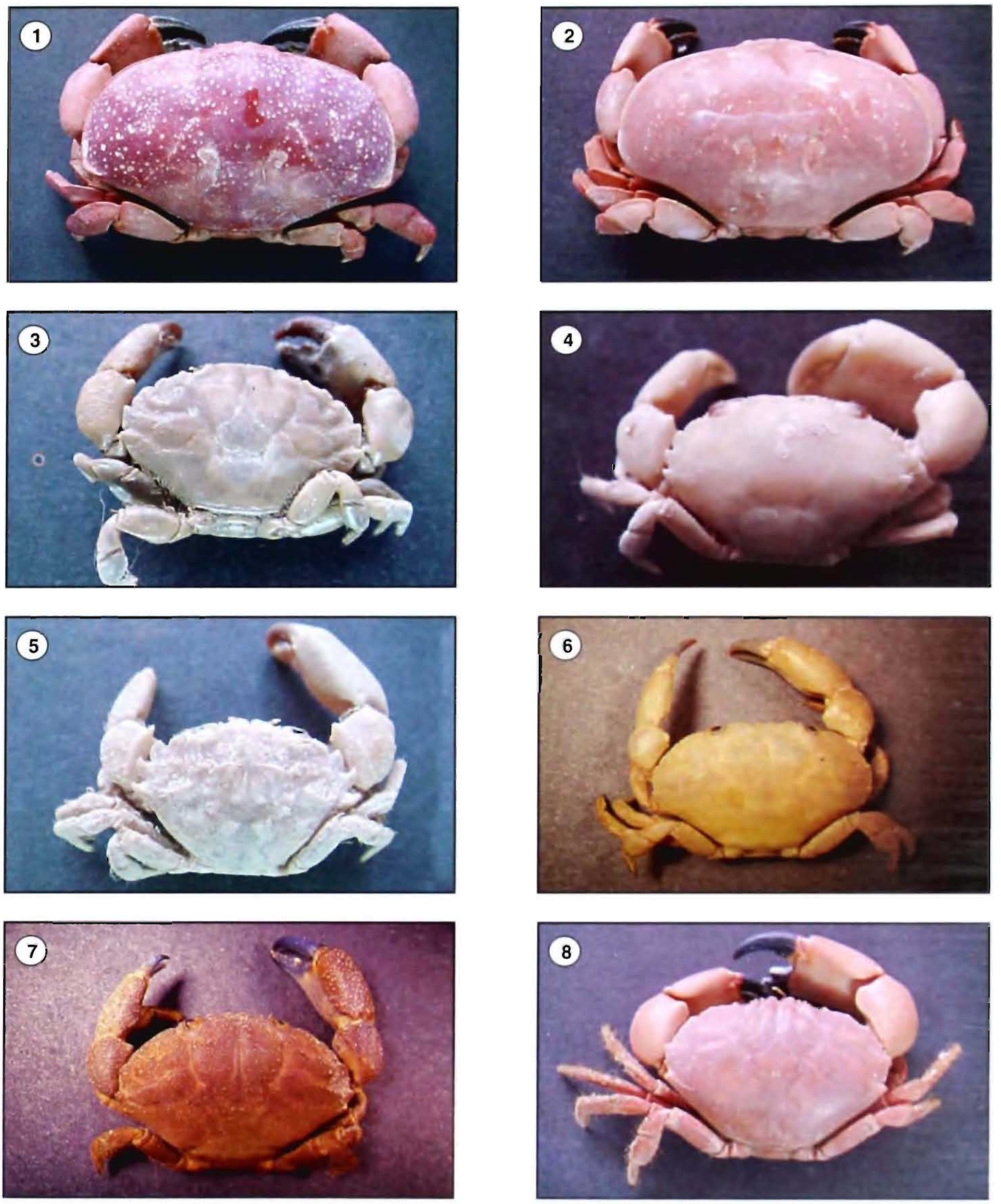
Figs. 1-8. Doral view of Marine & Estuarine Crabs of Goa : **1.** *Ashoret miersi* (Henderson); **2.** *Matuta victor* (Fabricius); **3.** *Philyra scabriuscula* (Fabricius); **4.** *Elamena xavieri* (Kemp); **5.** *Elamenopsis demani* (Kemp); **6.** *Elamenopsis alcocki* (Kemp); **7.** *Elemena truncata* (Stimpson); **8.** *Elamenopsis octagonalis* (Kemp)

PLATE-II



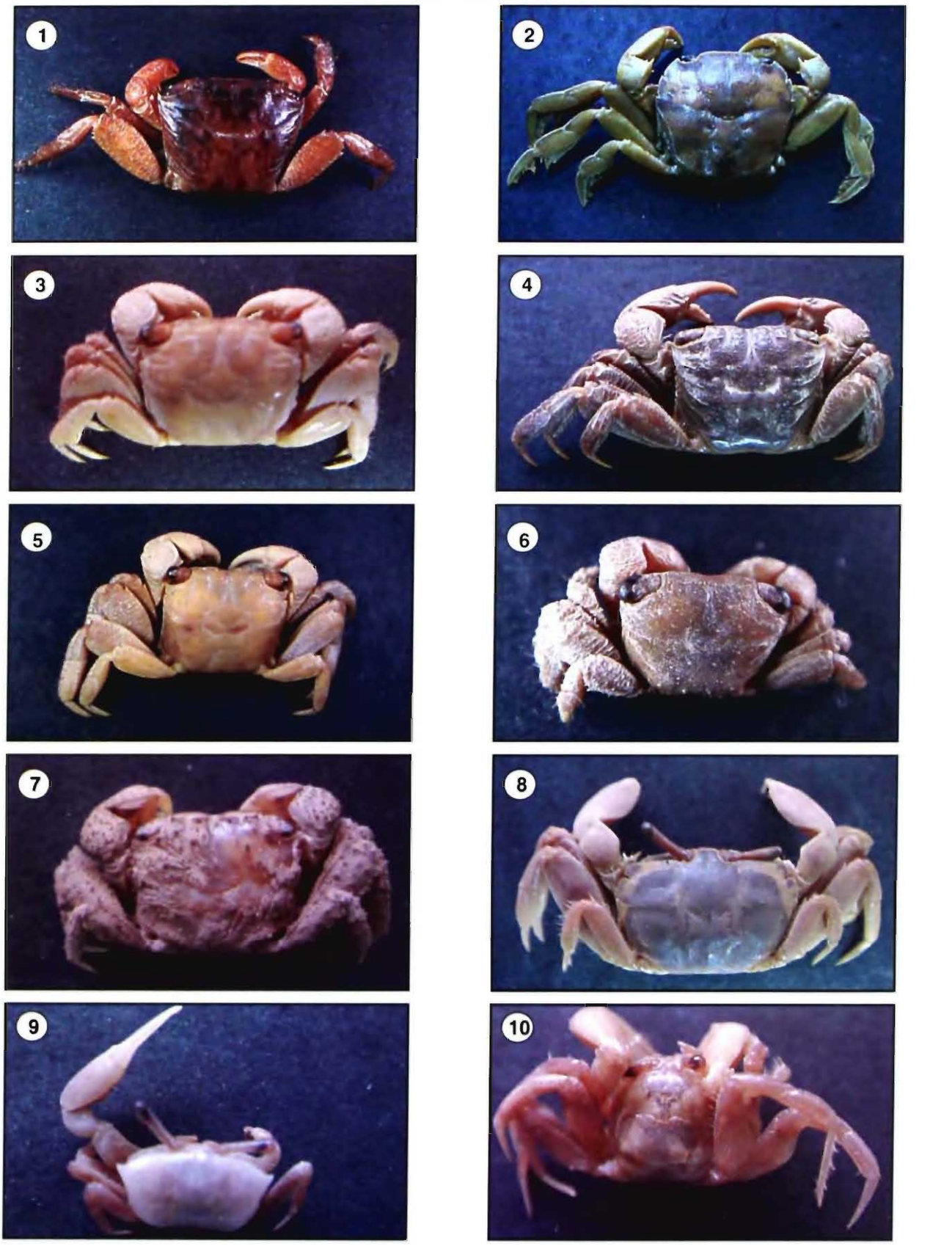
Figs. 1-8. Doral view of Marine & Estuarine Crabs of Goa: **1**. *Scylla tranquebarica* (Fabricius); **2**. *Scylla serrata* (Forskål); **3**. *Portunus pelagicus* (Linnaeus); **4**. *Portunus sanguinolentus* (Herbst); **5**. *Charybdis (Charybdis) callianassa* (Herbst); **6**. *Charbydis charybdis feriatus* (Linnaeus) **7**. *Charybdis (Goniohellenus) hoplites* Wood-Mason; **8**. *Thalamita crenata* (Latreille).

PLATE-III



Figs. 1-8. Doral view of Marine & Estuarine Crabs of Goa: **1**. *Atergatis integerrimus* (Lamarck); **2**. *Atergatis laevigatus* A. Milne Edwards; **3**. *Leptodius exaratus* (H. Milne Edwards); **4**. *Eurycarcinus orientalis* A. Milne Edwards; **5**. *Benthopanope indica* (de Man); **6**. *Epixanthus frontalis* (H. Milne Edwards); **7**. *Lydia annulipes* (H. Milne Edwards); **8**. *Menippe rumphii* (Fabricius)

PLATE-IV



Figs. 1-10. Doral view of Marine & Estuarine Crabs of Goa : **1.** *Metopograpsus messor* (Forskål); **2.** *Varuna litterata* (Fabricius); **3.** *Chiromantes bidens* (de Haan); **4.** *Parasesarma plicatum* (Fabricius); **5.** *Pseudosesarma edwardsi* (de Man); **6.** *Nanosesarma andersoni* (de Man); **7.** *Clistocoeloma merguiense* de Man; **8.** *Macrophthalmus (Mareotis) pacificus* Dana; **9.** *Uca lactea* (de Haan); **10.** *Dotilla myctiroides* (H. Milne Edwards)

Measurement :

W = 7.0	F = 1.3	L = 7.95
5.7	1.05	6.2

Diagnosis : Carapace subcubical, longer than broad. Sidewalls granular and sculptured anteriorly with the grooves resembling "brain convolution" Chelipeds long, slender, unarmed; fingers slender, pointed, longer than palm, deflexed and without any conspicuous tooth in their inner margins. Tympanum present on merii of legs and on either side of last thoracic sterna.

Distribution : Indo-West Pacific. India : Goa; Karnataka; Kerala; Maharashtra; Orissa; Andhra Pradesh; Tamil Nadu; Pondicherry; Andamans.

Elsewhere : Seychelles, Sri Lanka, Tenasserim coast, Mergui Archipelago, Malay Peninsula, Singapore, Indonesia and Phillipines.

Remarks : The sandy mud area of Vagator beach was found to be densely colonized by the population of this species. Its population varied from 24-28 m^{-2}. Their burrows were also noticed at mid-tidal zone at Cavelossim beach and on a narrow sandy patch behind mangroves on the bank of the river Talpona at Canacona However, their population was less, 18-20 m^{-2} in these areas. The length and width of the single ovigerous female measured 6.2 and 5.7 mm respectively.

Genus ***Scopimera*** de Haan, 1833

1833. *Scopimera* de Haan, In: Siebold, *Fauna japon. (Crust.)* : 24.

1900. *Scopimera*, Alcock, *J. Asiat. Soc. Bengal*, **69**(2) : 369.

Diagnosis : Carapace deep, globose, much broader than long, sidewalls without any curious sculpture. External maxillipeds unsculptured, merus shorter than ischium. Male abdomen having a curious wasp-like form owing to the length and narrowness of its fifth segment, female abdomen consisting of seven separate segments.

Remarks : Of the four species of this genus recorded from Indian waters (Dev Roy and Bhadra, in press), only a single species has so far been reported to occur in Goa.

45. ***Scopimera proxima*** Kemp, 1919

1919. *Scopimera proxima* Kemp, *Rec. Indian Mus.*, **16**(5) : 317, pl. 13, fig. 3.

Material examined : 71, exs., Vasco da Gama Boy, Portuguese India, August-September, 1916, S. Kemp, Reg. No. 9812-4/10; 11 exs., Dona Paula Bay, Mormugoa Bay, August-September, 1916, S. Kemp, Reg. No. 9815-6/10; 5 exs., Bay north of Nazareth Point, Mormugao Bay, Reg. No. 9817-18/10.

Diagnosis : Carapace smooth, about one and a half times as broad as long. Chelipeds short; all the three edges of merus sharp and cristate. Male abdomen with an extremely deep constriction at the junction of fourth and fifth segments, anterior end of the former being exceedingly narrow; fifth segment not chanelled, sixth one slightly broader than long with straight little divergent sides; in female abdomen, fifth segment proportionately narrower with the sides triffle concave, seventh segment broader.

Distribution : Indian Ocean. India : Goa; Tamil Nadu.

Remarks : This crab is endemic to India.

Genus ***Ilyoplax*** Stimpson, 1858

1835. *Cliestostoma* (in partim), de Haan, In : Siebold, *Fauna japon. (Crust.)* : 26.

1858. *Ilyoplax* Stimpson, *Proc. Acad. nat. Sci. Philad.*, **10** : 98.

1897. *Tympanomerus* Rathbun, *Proc. biol. Soc. Wash.*, **11** : 164.

1888. *Dioxippe*, de Man, *J. Linn. Soc. Zool.*, **22** : 137.

1976. *Ilyoplax*, Sakai, *Crabs of Japan and the Adjacent Seas* : 622.

Diagnosis : Carapace thick, quadrilateral, broader than long, regions indistinct. Front broad, deflexed, orbits occupying entire anterior border of carapace between the front and antero-lateral angles. Buccal cavity large, slightly narrowed, rounded anteriorly and fully closed by external maxillipeds. Chelipeds stout in both sexes and longer than the legs, fingers slightly deflexed. Legs compressed, middle two pairs slightly longer than

the first and last pair, merus often with ill-defined tympana. Abdomen consisting of seven separate segments in both sexes, male abdomen narrow.

Remarks : The genus consists of 17 species from the Indo-Pacific. Among these, only two species occur in India.

46. ***Ilyoplax gangeticus*** (Kemp, 1919)

1919. *Tympanomerus gangeticus* Kemp, *Rec. Indian Mus.*, **16**(5) : 347, pl. 13, fig. 3.

1980. *Ilyoplax gangeticus*, Chhapgar, *J. Bombay nat. Hist. Soc.*, **82** : 226, fig. 1.

Material examined : 27(M), 4(F), Durbat, Ferry Point, Ponda, 28.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5489/2; 75 (M), 1(F), Zuari River near Panchabati, 29.11.2002, Dr. M. K. Dev Roy, Reg. No. C 5488/2.

Measurement :

W = 7.1	F = 3.5	L = 4.8
7.9	3.7	5.1

Diagnosis : Carapace quadrilateral, broader than long, its length varying from 5/7th to 5/8th of its greatest breadth, convex from front to back, surface smooth excepting 3-4 rows of ciliated lines on the postero-lateral sides, regional outlines feebly indicated. Front broad, deflexing, slightly sinuous at the middle. Lateral borders notched behind the ex-orbital angles, epibranchial tooth hardly discernible, lateral margins slightly divergent posteriorly bearing numerous setae. Orbits transverse, little oblique, eye-stalks stout, as long as orbit, lower margin finely serrated. Buccal cavern broad, merus of external maxilliped as broad as long. Chelipeds asymmetrical, slightly shorter than anterior breadth of carapace; wrist bearing a long stout tooth at its inner corner, its upper surface finely roughened with numerous minute granules antero-externally; palm tumid; fingers slightly longer than upper border of palm and meeting at tips, their inner edges minutely crenulated along their whole length. Merus of leg joints strongly compressed and flattened, their upper and lower margins finely granulated, dactylus shorter than propodus, laterally compressed and acute, carpus and propodus of first two pair thickly coated with short hairs.

Distribution : Indian Ocean. India : Goa; Maharashtra; West Bengal.

Remarks : The present specimens agree well with Kemp (1919a). However, some minor variations have been observed during the course of this study. These are :

1. Kemp (*op. cit.*) observed numerous short setae on the ouer surface of merus of external maxillipeds but no such setae has been observed in the present specimens.
2. The tooth at inner angle of wrist is not so prominent in female specimens.
3. Merus of leg joints and sternal segments bearing tympana.

This species was collected from muddy habitat recently cleared of mangrove vegetation. The width and length of the single ovigerous female were 5.4 and 3.1 mm respectively. This crab is reported for the first time from Goa.

Subfamily MACROPHTHALMINAE Dana, 1851

1851. Macrophthalminae Dana, *Am. J. Sci. Art.*, ser. 2, **12** : 286.

2005. Macrophthalminae, Dev Roy and Bhadra, *Zool. Surv. India State Fauna Series* **5** : *Fauna of Andhra Pradesh* (Part 5) : 514.

Diagnosis : Carapace rectangular, broader than long, flattish but never very deep, regions well marked. Chelipeds subequal. No special recess between bases of legs. Tympanum absent.

Macrophthalmus Latreille, 1829

1829. *Macrophthalmus* Latreille, In : Cuvier's, *Régne Anim.* ed. 2, **4** : 44.

1967. *Macrophthalmus*, Barnes, *Trans. Zool. Soc. Lond.*, **31** : 201.

2005. *Macrophthalmus*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, **5**(Part 5) : 515.

Diagnosis : Carapace flat, quadrilateral, broader than long; regions well defined. Lateral borders cut out in two distinct teeth or lobes. Chelipeds equal or subequal, much enlarged in male, shorter and slenderer in female, fingers of

both sexes curiously deflexed, bent or curved inwards distally. Third pair of leg longest and stoutest, fourth pair shortest and weakest of all.

Remarks : Of the four subgenera recognized under this genus, only one subgenus namely, *Mareotis* is represented in the present collection.

Subgenus *Mareotis* Barnes, 1967

1967. *Mareotis* Barnes, *Trans. Zool. Soc. Lond.*, **31** : 203.

2005. *Mareotis*, Dev Roy and Bhadra, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series*, 5(Part 5) : 517.

Diagnosis : Carapace narrow, with no eminence on its outer surface. Lateral teeth very broad, rectangular. Eye-stalks not projecting beyond the tip of external orbital angle. Longitudinal ridge on palm of larger cheliped absent in male. Male abdomen narrow compared to its length.

Remarks : Only one species of this subgenus has been recorded from Goa.

47. ***Macrophthalmus (Mareotis) pacificus*** Dana, 1851 (Pl. 4, Fig. 8)

1851. *Macrophthalmus pacificus* Dana, *Proc. Acad. nat. Sci. Philad.*, **5** : 248.

1967. *Macrophthalmus (Mareotis) pacificus*, Barnes, *Trans. Zool. Soc. Lond.*, **31** : 202.

1995. *Macrophthalmus pacificus*, Bairagi, *Zool. Surv. India, Hugli Matla Estuary, Estuarine Ecosystem Series*, (Part 2) : 284.

Material examined : 4(M), 1(F), Rachol River, opposite Durbate, 23.09.1916, S. Kemp, Reg. No. C 9869/10; 1(M), 1(F), At the junction of Mapusa and Mandovi River, Nova Goa, 25.09.1916, S. Kemp, Reg No. C 9840/10.

Measurement :

W = 18.3	F = 2.95	L = 12.7
19.0	2.95	13.15

Diagnosis : Carapace smooth, surface very minutely granulated and pitted visible only with the aid of binocular. Lateral borders subparallel. Front narrow, not bilobed. Antero-lateral angle rather a square cut lobe than a tooth. Orbits slightly sinuous and oblique, upper border microscopically beaded, lower border finely and evenly denticulated; eye-syalk not produced beyond antero-lateral angle. Chelipeds markedly unequal but equal in the same sex, massive in male and slenderer in female; in male, dactylus strongly curved, its inner margin bearing a large elongate rectangular lobe with crenulated teeth, occupying proximal third to quarter margin and distally with low scattered triangular tubercles extended upto its tip; a faint longitudinal rim on outer surface of fixed finger in male, cutting edge armed with low, crenulated teeth near the basal half, teeth increasing in size in central half and then diminishing distally; in female, cutting margins of fingers weakly serrated. Anterior margin of merus of last walking leg armed with a spine at its distal end.

Distribution : Indo-Pacific. India : Goa; Gujarat; West Bengal; Nicobar.

Elsewhere : Malay Peninsula, Japan, Upolu, Loo choo Island, Australia and Samoa.

Remarks : This crab occurs in both the coasts of India including the Nicobars. However, there is no report of further collection of the species from this state after 1917.

SUMMARY

A consolidated account of brachyuran fauna dealing with a total of 47 species of marine and estuarine crabs belonging to 33 genera and 9 families has been recorded from the coast of Goa State. Among these, two species namely, *Elamena truncata* and *Lydia annulipes* have been recorded for the first time from mainland India while 28 species for the first time from the state. These include four species viz. *Ashtoret miersi*, *Pseudosesarma edwardsi*, *Nanosesarma andersoni* and *Clistocoeloma merguiense* which have been recorded for the first time from the west coast. Only two species namely, *Elamenopsis demeloi* and *Elamena xavieri* are endemic to the state. Eleven species have been recorded from the mangrove habitats.

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ANOMURAN CRABS
Diogenidae, Porcellanidae, Hippidae (Crustacea : Decapoda)

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INTRODUCTION

The infraorder anomura consists of a heterogeneous assemblage of marine crustaceans, some of which are crab-like in appearance. They are mostly marine although estuarine forms are not uncommon, while a few have invaded land also.

From India, very little systematic works have been done on these groups. The hermit crabs, porcellanid and mole crabs of India have been studied by a handful of workers and most of these studies are pertaining to east coast (Heller, 1865; Henderson, 1893, 1915; Nobili, 1903; Kemp, 1915; Sewell and Annandale, 1922; Sundararaj, 1927; Kamalveni, 1949; Sankarankutty, 1961a, b and 1963a, b; Sarojini and Nagabhushanam, 1968, 1972, 1974; Khan and Natarajjan, 1984; Reddi, 1935; Reddy, 1995a, b; Reddy and Murthy, 1998; Reddy and Dev Roy, in press) while very few attempts have been made from the west coast (Southwell,1909; Sankoli, 1961, 1963, 1965 a, b, 1966; Ramanan dan, 1967; Haig *et al.*, 1986; Nayak and Neelakantan, 1989; Thomas, 1989). However, so far, nothing is known of these groups of crustaceans from the Goa coast. A total of 171 specimens either elected recently from Goa coast or lying in the old unnamed collections of crustacean section were studied. They belong to 9 species of hermit crabs and one species each of porcellanid and mole crabs and all have been recorded for the first time from Goa coast. Among these, two species of hermit crabs namely, *Clibanarius striolatus* and *Diogenes affinis* are new records from the west coast of India.

Haig (1960) has made an important contribution on the porcellanid crabs. Efford (1976) has dealt with worldwide distribution data for the genus *Emerita*. Boyko and Harvey (1999) has provided a key to mole crabs of the Indo-West Pacific region along with a list of species of the family.

LIST OF SPECIES REPORTED

Phylum	CRUSTACEA
Class	MALACOSTRACA
Subclass	EUMALACOSTRACA
Superorder	EUCARIDA
Order	DECAPODA
Suborder	PLEOCYEMATA
Infraorder	ANOMURA
Superfamily	COENOBITOIDEA
Family	DIOGENIDAE

1. *Clibanarius merguiensis* de Man, 1888
2. *Clibanarius infraspinatus* Hilgendorf, 1869
3. *Clibanarius longitarsus* (de Haan, 1849)
4. *Clibanarius padavensis* de Man, 1888
5. *Clibanarius striolatus* Dana, 1852
6. *Diogenes affinis* Henderson, 1893
7. *Diogenes avarus* Heller, 1865

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8. *Diogenes diogenes* (Herbst, 1791)
9. *Diogenes planimanus* Henderson, 1893

Superfamily GALATHEOIDEA

Family PORCELLANIDAE

10. *Petrolisthes lamarckii* (Leach, 1820)

Superfamily HIPPOIDEA

Family HIPPIDAE

11. *Emerita holthusi* Sankolli, 1965

STSTEMATIC ACCOUNT

Family DIOGENIDAE Ortmann, 1892

Diagnosis : External maxillipeds approximated at base. Chelipeds equal or subequal, or the left one vastly larger, right one very rarely slightly and never vastly larger than the left.

Remarks : Forest *et al.* (2000) has recently revised the family while dealing with the marine fauna of New Zealand.

Key to genera of the family DIOGENIDAE

- Fingers of chelipeds opening and closing horizontally, their tips corneous and black and somewhat spoon-like ..... ***Clibanarius***
- Fingers of chelipeds opening and closing vertically, their tips calcareous and white and acuminating or tapering to a point ..... ***Diogenes***

Genus *Clibanarius* Dana, 1852

1852. *Clibanarius* Dana, *Proc. U. S. Explor. Exped. Crust.*, **13**(1) : 461.

1905. *Clibanarius*, Alcock, *Cat. Indian Decapod Crust.*, **2**(1) : 40.

1984. *Clibanarius*, Khan and Natarajan, *Rec. zool. Surv. India, Occ. Paper No.*, **67** : 4.

1992. *Clibanarius*, Rahayu and Forest, *Bull. Mus. natn. d'Hist. Nat., Paris*, Ser. 4, Sec-A, *Zoologie Biologie et Ecologie Animales*, **14** (3-4)1992 : 745–779.

Diagnosis : Rostrum distinct, short. Eye-stalks long and slender, ocular scales well developed. Chelipeds equal or subequal, fingers opening horizontally, fingers tips and thumb corneous and spooned. A biramous appendage on left side of each of abdominal segments 2-5 in both sexes.

Remarks : Members belonging to this genus are essentially shallow-water inter-tidal forms, sometimes ascending into the estuaries. The genus is represented by five species in Goa.

Rahayu and Forest (1992) has recently revised the Indo-Pacific species of the genus and provided the key.

Key to species of the genus *Clibanarius*

1. Dactylus of third pair of thoracic legs (second pair of crawling legs) decidedly longer than propodus 2
- Dactylus of third pair of thoracic legs decidedly shorter than propodus .... *Cl. merguiensis*
2. A strong tooth present at proximal end of inner border of merus of chelipeds .... *Cl. infraspinatus*
- Strong tooth absent at proximal end of inner border of merus of chelipeds 3
3. Second and third pair of thoracic legs with red longitudinal stripes 4
- Second and third pair of thoracic legs with pale blue longitudinal band bordered with red colour ..... *Cl. longitarsus*
4. Eyestalks slender and longer than the anterior border of carapace and as long as the antennular peduncles; eye occupying about one-eleventh of the length of eye-stalk .... *Cl. padavensis*
- Eyestalks stouter and shorter being only as long as the anterior border of carapace; eye occupying about one-seventh to one-eighth of the length of eye-stalk ..... *Cl. striolatus*

1. ***Clibanarius infraspinatus*** Hilgendorf, 1869

1869. *Clibanarius infraspinatus* Hilgendorf, Decken's *Reisen Ost Afr.*, **3**(1) : 97 (footnote).

1905. *Clibanarius infraspinatus*, Alcock, *Cat. Indian Decapod Crust.*, **2**(1) : 44.

1989. *Clibanarius infraspinatus*, Thomas, *J. mar. biol. Ass. India*, **31**(1&2) : 63, pl. 1B.

Material examined : 1ex. (8.7 mm), Opposite to Nova Goa, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5667/2; 3 ex. (10.0–13.3 mm), Opposite to Nova Goa, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5668/2; 1 ex. (11.7 mm), Junction of Mandair and Mapusa Roads, off Nova Goa, Reg. No. C 5669/2.

Diagnosis : Eyestalks shorter than antennular and antennal peduncles and also of the anterior breadth of carapace. Chelipeds equal, merus with a strong tooth at proximal end of lower inner border, distal upper margin serrated; carpus with three strong spines on upper inner margin and with a few scattered spines on the rest of the upper surface.

Distribution : *India* : It is reported on the east coast of India from Hugli-Matla estuarine complex (West Bengal) in the north to Palk Bay and Gulf of Mannar (Tamil Nadu) in the south at different places. On the west coast of India, it is recorded from Beyt Island near Okha and Dwarka (Gujarat) by Southwell (1909).

Elsewhere : Red Sea, Arabian Sea, Bay of Bengal, Singapore, Vietnam, Borneo, Philippines, Taiwan and Australia.

2. ***Clibanarius longitarsus*** (de Haan, 1849)

1849. *Pagurus longitarsus* de Haan, In : Siebold, *Fauna japon. (Crust.)* : 211.

1972. *Clibanarius longitarsus*, Reddy and Ramakrishna, *Rec. zool. Surv. India*, **66**(1-4) : 21.

1984. *Clibanarius longitarsus*, Khan and Natarajan, *Rec. zool. Surv. India, Occ. Paper No.*, **67** : 8, fig. 6.

1989. *Clibanarius longitarsus*, Thomas, *J. mar. biol.Ass. India*, **31** : 65, fig. 1i-k and pl. 1D.

Material examined : 1ex. (7.0 mm), Betul, 25.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5662/2.

Diagnosis : Eye-stalks as long as antennular peduncles and a little longer than anterior border of carapace; ophthalmic scales small with pointed tips. Antennal acicle reaching middle of last segment of antennal peduncle. Chelipeds equal, provided with long setae, palm and wrist with dark tipped spines, fingers bearing 1 or 2 rows of spines. Eyestalks without any longitudinal red stripes. Outer surface of second and thoracic legs with a pale blue band bordered with red.

Distribution : *India* : It is reported on the east coast of India from Chilka Lake in the north to Palk Bay and Gulf of Mannar in the south and also from Andaman and Nicobar Islands. On the west coast of India it is recorded from Quilon, Kerala (Thomas, 1989).

Elsewhere : East coast of Africa and Red Sea throughout Indo-Pacific to Vietnam, Philippines, China and Japan.

3. ***Clibanarius padavensis*** de Man, 1888

1888. *Clibanarius padavensis* de Man, *J. Linn. Soc. Zool.*, **22** : 242.

1984. *Clibanarius padavensis*, Khan and Natarajan, *Rec. zool. Surv. India, Occ. Paper No.*, **67** : 6, fig. 4

1989. *Clibanarius padavensis*, Thomas, *J. mar. biol. Ass. India*, **31** (1&2) : 65.

Material examined : 13 ex. (8.5–16.0 mm), Vareeg Islet, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5670/2; 4 ex. (9.0–10.5 mm), Bay East of Cacara Point, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5671/2; 2 ex. (7–10 mm), Junction of Mandair and Mapusa Roads, off Nova Goa, Mormugao Bay, Reg. No. C 5672/2; 15 ex.(8.0–15.0 mm), Betul, 25. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5523/2; 1 ex. (14.0 mm), Malim, 17. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5524/2.

Diagnosis : Eye-stalks as long as the antennular peduncles and slightly longer than anterior border of carapace. Chelipeds equal and similar, merus with 1 or 2 spinules at distal end of the lower border, carpus with a distinct spine at far end of the inner border, fingers with dark-tipped spinules on their outer surface. Longitudinal red stripes on eyestalks on second and third pairs of legs.

Distribution : *India* It is reported on the east coast from Hugli-Matla estuary in the north to Palk Bay in the south. From the west coast of India it is reported by Shenoy and Sankolli (1977) as they studied the metamorphosis of the species reared in the laboratory.

Elsewhere : East coast of Africa from Delagoa Bay northwards and Madagascar, Bay of Bengal, Singapore and Indonesia to Australia.

4. ***Clibanarius striolatus*** Dana, 1852

1852. *Clibanarius striolatus* Dana, *U. S. Explor. Exped.*, **13**(1) : 463; 1855, pl. 29, fig. 3a-e.

1905. *Clibanarius striolatus*, Alcock, *Cat. Indian Decapod Crust.*, **2**(1) : 46, pl. 4, fig. 7.

1955. *Clibanarius striolatus*, Fize and Serène, *Notes Institut Oceanographique Nhatrang*, **45** : 97–105, fig. 13 (A-C), pl. 3, fig. 4.

1989. *Clibanarius striolatus*, Thomas, *J. mar. biol. Ass. India*, **31** (1&2) : 66, pl.1, fig. e.

Material examined : 1ex. (7.4 mm), Chicolna Bay, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5673/2; 1ex. (11.3 mm), Vareeg Islet, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5674/2.

Diagnosis : Eyestalks as long as the antennular and antennal peduncles and also of the anterior border of carapace. Longitudinal colour bands absent on the eye-stalks. Chelipeds equal, propodi shorter and stouter, they along with carpi rougher and more setose than in *Cl. padavensis*. Upper border of outer surface of propodus of third left leg well defined, dactylus slightly shorter than in *Cl. padavensis*. Red stripes present on legs.

Distribution : *India* : It is reported on the east coast of India from Waltair, Andhra Pradesh (Sarojini and Nagabhushanam, 1972), Andaman and Nicobar Islands (Reddy and Ramakrishna, 1972) and from Minicoy Island (Thomas, 1989). From the west coast of India, it is being reported for the first time.

Elsewhere : South Africa, Seychelles, Red Sea, Arabian Sea, Sri Lanka, Mergui Archipelago, Malaysia, Vietnam, Philippines, China, Japan and Tahiti Island.

5. ***Clibanarius merguiensis*** de Man, 1888

1888. *Clibanarius aequabilis* var. *merguiensis* de Man, *J. Linn. Soc. Zool.*, **22** : 247.

1905. *Clibanarius aequabilis* var. *merguiensis*, Alcock, *Cat. Indian Decapod Crust.*, **2**(1) : 47, pl. 4, fig. 5.

1955. *Clibanarius merguiensis*, Fize and Serène, *Notes Institut Oceanographique Nhatrang*, **45** : 145-150, fig. 22 (A-C).

1989. *Clibanarius merguiensis*, Thomas, *J. mar. biol. Ass. India*, **31**(1&2) : 68, fig.1(l-n).

Material examined : 15 ex. (4.0–8.0 mm), Chicolna Bay, Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5675/2; 2 ex. (3.5–5.0 mm), Mormugao Bay, August-September 1916, S. Kemp, Reg. No. C 5676/2.

Diagnosis : Eyestalks as long as anterior border of carapace, slightly longer than antennular peduncle. Chelipeds subequal, upper surface of carpus, propodus and dactylus more or less studded with conical spinules interspersed with setae. In second and third pairs of legs, dactylus smaller than propodus; outer surface of propodus of third leg remarkably flattened with upper margin well defined; dactyli of both legs compressed.

Distribution : *India* : It is recorded from Palk Bay on the south east coast of India. Nayak (1984) studied the larval forms of this species reared in the laboratory from the west coast of India.

Elsewhere : From Red Sea, Mauritius Island and coastal areas of Sri Lanka, Myanmar, Vietnam, Malaysia and Indonesia.

Genus ***Diogenes*** Dana, 1852

1852. *Diogenes* Dana, *Proc. U. S. Explor. Exped. Crust.*, **13**(1) : 438.

1905. *Diogenes* , Alcock, *Cat. Indian Decapod Crust.*, **2**(1) : 59.

1984. *Diogenes*, Khan and Natarajan, *Rec. zool. Surv. India, Occ. Paper No.* : 12.

Diagnosis : Rostrum absent, replaced by a movable spine-like process. Eye-stalks moderately slender, ocular scales large, pectinated or serrated on anterior margin. Chelipeds unequal, left one much larger, fingers opening in an obliquely-vertical plane, finger tips and thumb pointed and serrated. Abdominal appendages on left side of segments 2-5 uniramous in male, the first three biramous in female.

Remarks : Members belonging to this genus are essentially shallow-water species never descending below 70 fathoms (= 127.4 m). It is represented by four species in Goa, all of which are new records from the concerned state.

Key to species of the genus *Diogenes*

1. Rostrum a narrow lamina, with the free edge spinose 2
- Rostrum a slender, simple (non-serrated) spinule ..... *Diogenes avarus*
2. Antennal acicle bifurcate, outer surface of palm of cheliped with claw-shaped spines .. .. *Diogenes diogenes*
- Antennal acicle obscurely bifurcate, outer surface of palm of cheliped with granules 3
3. Height of hand of left cheliped more than the length ..... *Diogenes affinis*
- Height of hand of left cheliped equal to its length ..... *Diogenes planimanus*

6. *Diogenes diogenes* (Herbst, 1791)

1791. *Cancer diogenes* Herbst, *Krabben* : 17, pl. 22, fig. 5.

1905. *Diogenes diogenes*, Alcock, *Cat. Indian Decapod Crust.*, 2(1) : 62, pl. 15, fig. 3.

1984. *Diogenes diogenes*, Khan and Natarajan, *Rec. zool. Surv. India, Occ. Paper No.*, **67** : 15, fig. 11.

1989. *Diogenes diogenes*, Thomas, *J. mar. biol. Ass. India*, **31** : 71, pl. 2G.

Material examined : 1ex. (14.0 mm), Malim, 17. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5677/2; 7 ex., (16.0 mm–19.0 mm), Calangute, 19. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5528/2; 4 ex. (7.0–12.0 mm), Malim, 17. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C5527/2; 1 ex. (7.5 mm), Bank of Tarir River, Canacona, 23. 01. 2004, Dr. M. K. Dev Roy, Reg. No. C 5659/2.

Diagnosis : Rostrum long reaching nearly one-third the length of eye-stalks, distal half spinose.Antennular peduncle longer than antennal peduncle. Antennal acicle bifurcate, inner edges of fork spinulose, outer branch hardly reaching the base of terminal joint, inner branch reaching about half of penultimate joint of the antennal peduncle. Fingers of small cheliped and dactyli of second and third legs densely setose.

Distribution : *India* : It is reported from Karnataka and Kerala on the west coast and all along the east coast of India. Nayak and Kakati (1978) studied the metamorphosis of this crab reared in the laboratory from the west of India.

Elsewhere : Arabian Sea and Sri Lanka.

7. *Diogenes affinis* Henderson, 1893

1893. *Diogenes affinis* Henderson, *Trans. Linn. Soc. Lond. Zool.*, ser., 2, **5** : 415, pl. 39, figs. 1, 2.

1905. *Diogenes custos* var. *affinis*, Alcock, *cat. Indian Decapod Crust.*, 2(1) : 65, pl. 6, fig. 2.

1995. *Diogenes custos* Reddy, *Zool. Surv. India, Estuarine Ecosystem Series*, Part 2 : *Hugli Matla Estuary* : 207.

Material examined : 5 ex. (14.7–21.1 mm), Vasco-da-Gama Bay, Mormugao Bay, Reg. No. C 5678/2; 7 ex. (6.5–8.7 mm), Caranzalem Beach, Mormugao Bay, Reg. No. C 5690/2; 2 ex. (13.0–14.0 mm), Colva, Margao, 02. 12. 2002, Dr. M. K. Dev Roy, Reg. No. C 5525/2; 3 ex.(15.0–18.0 mm), Colva, Margao, 02. 12. 2002, Dr. M. K. Dev Roy, Reg. No. C 5526/2.

Diagnosis : Rostrum shorter, but slightly longer than ophthalmic scales.Antennular peduncle shorter than antennal peduncle. Antennal acicle indistinctly bifurcate, outer branch not reaching base of terminal joint of peduncle.Antennal flagellum densely setose. Height of palm of left cheliped more than its length.

Distribution : *India* : This species has been reported from the east coast of India from Orissa, Andhra Pradesh and Tamil Nadu. However, from the west coast of India it is a new record

Elsewhere : East Africa, Madagascar, Bay of Bengal, Sri Lanka and south east coast of Australia.

8. *Diogenes planimanus* Henderson, 1893

1893. *Diogenes planimanus* Henderson, *Trans. Linn. Soc. Lond. Zool.*, ser., 2, **5** : 416, pl. 39, figs. 5, 6

1905. *Diogenes custos* var. *planimanus*, Alcock, *Cat. Indian Decapod. Crust.*, **2**(1) : 66, fig. pl. 6, fig. 3.

1969. *Diogenes planimanus*, Thomas, *Bull. Cent. Mar. Fish. Res. Inst.*, **7** : 41.

Material examined : 8 ex. (3.2-10.0), Vasco-da-Gama Bay, Mormugao Bay, Reg. No. C 5679/2; 13 ex. (6–9 mm), 19. 11. 2002, Karmali, Dr. M. K. Dev Roy, Reg. No. C 5660/2.

Diagnosis : Same as in *Cl. affinis* but palm of left cheliped as long as its breadth, lower portion of its outer surface flattened and bounded posteriorly by a short ridge running parallel with the carpal articulation.

Distribution : India : It is reported from Sandheads, mouth of River Hugli in the north to Tamil Nadu in the south on the east coast of India. Nayak (1981) studied the larval forms of this species reared in the laboratory from the west coast of India.

Elsewhere : Malay Peninsula.

9. ***Diogenes avarus*** Heller, 1865

1865. *Diogenes avarus* Heller, *'Novara Crust.'* : 183; pl. 7, fig. 2.

1905. *Diogenes avarus*, Alcock, *Cat. Indian Decapod. Crust.*, **2**(1) : 68, pl. 6, fig. 6.

1984. *Diogenes avarus*, Khan and Natarajan, *Rec. zool. Surv. India, Occ. Paper No.*, **67** : 18, fig. 15.

1989. *Diogenes avarus*, Thomas, *J. mar. biol.Ass. India*, **31** : 74, pl. 2m-o.

Material examined : 4 ex. (4.0–4.5 mm), Vasco-da-Gama Bay, Mormugao Bay, Reg. No. C; 17 ex. (5.5–7.3 mm), opposite Nova Goa, M. B., Reg. No. C 5680/2; 7 ex. (5.5–7.5 mm), Junction of Mandair and Mapusa Roads, off Nova Goa, Mormugao Bay, Reg. No. C; 2 ex. (8–10 mm), 19.11.2002, Karmali, Dr. M.K. Dev Roy, Reg. No. C 5661/2.

Diagnosis : Eye-stalks stout extending up to the middle third of the last segment of antennular peduncle. Antennal peduncles slightly shorter than antennular peduncles. Rostrum slender and spinule-like. Left cheliped stouter, vastly larger than the right and about two and a half times the length of carapace; carpus longer than merus and palm; palm about one and half times as long as broad, its outer surface carinated longitudinally near mid-line up to the finger cleft. Fixed finger deflexed, dactylus less than half the length of palm.

Distribution : *India* : This species has been reported from the entire east coast of India from Hugli estuary in the north to Rameswaram in the south and Nicobar Islands. Sankolli and Shenoy (1977) cultured the species in the laboratory and studied the larval forms from the west coast of India.

Elsewhere : East coast of Africa, Persian Gulf, Arabian Sea, Bay of Bengal, Singapore, Philippines, Torres Strait and Australia.

Family PORCELLANIDAE Haworth, 1825

Diagnosis : Carapace with ill-defined regions, frontal margin somewhat triangularly produced but never rostriform. Abdomen symmetrical.

Remarks : The family is represented by a single genus.

Genus ***Petrolisthes*** Stimpson, 1858

1950. *Petrolisthes*, Barnard, *Ann. S. Afr. Mus.*, **38** : 477.

Diagnosis : Frontal margin subtriangular. First joint of antennule enlarged but not much thick, first joint of antenna very short. Chelipeds compressed, wrist long, not much unequal in male. Legs culminating to a single claw.

10. ***Petrolisthes lamarckii*** (Leach, 1820)

1820. *Pisidia lamarckii*, Leach, *Dict. Sci. Nat.*, **18** : 54.

1950. *Petrolisthes lamarckii*, Barnard, *Ann. S. Afr. Mus.*, **38** : 477, fig. 89a-d.

1968. *Petrolisthes lamarckii*, Sarojini and Nagabhusanam, *J. zool. Soc. India*, **20**(1&2) : 152, pl. 1, fig. 2.

Material examined : 1(F), Bogmolo, Goa, 01.12.2002, Dr. M. K. Dev Roy, Reg. No. C 5664/2; 1(F), Vagator, Goa, 18.01.2004, Dr. M. K. Dev Roy, Reg. No. C 5665/2.

Measurement : W = 9.0 L = 9.0

Diagnosis : Carapace as long as broad, frontal edge broadly triangular, epibranchial spine present, peduncular joint of antenna keeled; palm of

cheliped with rounded lobe on inner apex, surface of both wrist and palm squamose-granulose, upper border of wrist with 4-5 strong serrations, lower border ridged strongly culminating to a very stout spine distally; merus of fourth pereiopod 1¾ times as long as wide.

Distribution : *India* : This species has been recorded from Andhra Pradesh on the east coast and Maharashtra on the west coast besides from Andaman Islands.

Elsewhere : South Africa. Oman, Pakistan, Mergui Archipelago, Malaya, Singapore, Hong Kong, Japan, Java, Sulusea, Australia, Figi, Micronesia and Polynesian Islands.

Family HIPPIDAE Latreille, 1825

Diagnosis : Carapace oval in outline. Third maxilliped sub-operculiform, fourth joint very large, exopod absent. Fourth pair of legs subcylindrical. Telson elongate, lanceolate.

Genus ***Emerita*** Scopoli, 1777

1950. *Emerita*, Barnard, *Ann. S. Afr. Mus.*, **38** : 402.

Diagnosis : Carapace narrowly ovoid, barrel-like, strongly convex. Frontal margin tridentate. Flagellum of antenna 2 large and long. Eye-stalks elongate, slender. Dactyl of first leg ovate, lamellate.

Remarks : The genus *Emerita* contains five species namely, *Emerita austroafricana* Schmidtt, 1937, *E. emereitus* (Linnaeus, 1767), *E. holthusi* Sankolli, 1965, *E. karachiensis* Niazi and Haque, 1974 and *H. adactyla* Fabricius, 1787 from the Indo-West Pacific region (Boyko and Harvey, 1999). Among these, only the second and third species occurs in India. While *E. emereitus* is reported from both the coasts of India, the other species namely, *E. holthusi* is known exclusively from the west coast.

11. ***Emerita holthusi*** Sankolli, 1965

1965. *Emerita holthusi* Sankolli, *Crustaceana*, **8**(1) : 50, figs. 1a-e.

1976. *Emerita holthusi*, Efford,*Crustaceana*, **30**(2) : 177, fig. 6.

1977. *Emerita holthusi*, Tirmizi, *Crustaceana*, *32*(1) : 108, figs. 1-7.

Material examined : 14 ex., Station-15, Mormugao Bay, Portuguese India, Goa, August-September, 1916, S. Kemp, Reg. No. C 5053/1; 14 ex., Goa, 09. 12. 1973, Dr. B. S. Lamba, Reg No. 3/2292 (WRS).

Measurement : W = 7.0 L = 12.0

Diagnosis : Body cylindrical, much longer than broad, frontal lobes short and wide. Outer antero-lateral angle of external margin of merus of third maxilliped rectangular; antero-lateral lobe low, triangular, distally rounded and very much inconspicuous. Width of dactylus of first pereiopod less than half of its length and bearing four distinct spines on the lower margin but no teeth on the upper margin.

Distribution : *India* : This species has earlier been reported from Maharashtra and Kerala on the west coast.

Elsewhere : Red Sea, Yemen, Muscat, Iran and Pakistan.

Remarks : The distributional range of this species extends from the southern Red Sea along the coast to the southern west coast of India (Efford, 1976).

SUMMARY

A systematic study of the anomuran crabs belonging to families Diogenidae, Porcellanidae and Hippidae of the state of Goa is attempted for the first time. The family Diogenidae is represented by nine species and Porcellanidae and Hippidae by one species each. Out of these, two species namely, *Clibanarius striolatus* and *Diogenes affinis* have been recorded for the first time from the west coast of India.

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CRUSTACEA : DECAPODA : PALAEMONIDAE : GECARCINUCIDAE

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INTRODUCTION

Prior to the establishment of Zoological Survey of Indian in 1916 our knowledge on fresh water prawns and crabs of Goa State is still inadequate. Though the prawns and crabs of marine ecosystem of Goa are rich in diversity yet no information is available on the fresh water prawns and crabs till date. Earlier, wood Mason (1871), Alcock,A. (1910), Kemp, W. (1970), Kurian, C.V. & V. O. sebastian (1933), Bott (1970), Holthuis, L. B. (1950) and Jalihal, D. K. *et al.* (1998) initiated the study of Indian fauna of fresh water prawns and crabs. Works of Roy, T. Ghosh, S. K. & Ghatak, S. S. (2003) and Ghosh. H. C. & Ghatak, S. S. (1999), Ghosh, S. K. and Roy, T. (1995) may be mentioned in this context after the said workers. But all the workers mentioned above did not work out on the fauna of Goa State. However, the present work is an attempt to study the systematic of this group with a view to fill up this gap. In this communication an inventory of prawns and crabs of Goa has been based on the collections by two faunistic surveys at different seasons and at different localities of Goa State during the period from 2002-2004.

A total number of 98 examples of fresh water prawns and crabs have been examined. These belong to four species of prawns and one species of crab under two genera including all new records from this state.

The present paper deals with diagnostic characters of each species and a brief description of localities in which collections were made are given in the description of study area. It also furnishes general account of morphology and terminology, key to the species, material and methods, habits and habitats and as well as the distribution of this group. A sincere attempt has been made to provide with the difference between male and female crabs and prawns and their economic value. Synonyms have been reduced to over repetation but include the original and most recent references and the authors are responsible for the major changes in nomenclature.

STUDY AREA

Goa is the 25th state of India. It lies on the Western Coast of India, approximately between 14°49′-15°52′N, 73°40′-74°20′ E. Total length from north to south is 104 kms and East to West is 59 kms. The southern part is characterised with forest clad hills, supporting evergreen forest. The rivers flow from Westernghat and Sajadri hills. The limits of Goa Coastal region and fresh water zones for the present study is approximately 3702 sq. kms. It has a coastal line of 157 kms. Mandovi and Zuari river is specially dominated by mangroves, estuaries, backwater and brackishwater bheres. All of this ecosystem are rich in fauna including Crustaceans and many of which are commercial value. The total length of the forest area is 1424. 38 sq. kms. where 3000 different species flora and fauna are available. The total length of the salem ali Bird Sanctuary is 1.78 kms. More or less climates is tropical and rainfall varies from 57 mm. to 20 mm. Weather is 32.2°C-21.3°C in winter and 33.2°C-24°C in summer.

There are about 36 sea beaches of Goa are rich in golden dust and a few beaches where some parts are rocky in nature. The man made lake is the Mayem Lake which is irregular in shape. It is shallow at the peripheral region with a depth of 4-6 feet only while the maximum depth is more than 20 feet at the central part. This lake is commercially importance for fish cultivation.

MATERIAL AND METHOD

The material dealt with in this present paper was mostly collected in various ecological zones in the Goa State. A tow net is used for collecting fresh water prawns in deep waters. A tow net is made by conical bag of nylon or muslin attached to a circular frame is tied with by three cords. This net may be dragged behind a boat and submerged in water at required depth. Regarding crabs, the material was collected with the help of big forceps, chisels and hammer. Some time the poison like rotenone is applied at the mouth of the hole where crabs inhabits. Prawns and crabs may be killed in 4-5% formaldehyde solution. The killing process is known as narcotization. The narcotized material along with the exact labels containing the date of localities were packed in 5% formalin and transported to the laboratory for study. In the laboratory these material was rinsed in water and transferred to 70-90% ethylalcohol for the purpose of taxonomic studies.

HABITS AND HABITATS OF PRAWNS AND CRABS

The prawns are common is river, ponds, lakes, man made reservoirs and other fresh water ecosystems. It is nocturnal, bottom dweller and lives within under crevices and aquatic vegetations. It takes all kinds of food specially decaying leaves. It is good swimmer but it is also capable of crawling on the source and at the time of danger can jump backwardly. In case of crabs, they are of several types and vary in size, shape and colouration. Its body is adapted for aquatic respiration.

The crabs dig burrow on the bank of ponds, rivers, lakes, jheels and paddy fields. The crabs come out from hole for feeding but with the slightest disturbance very swiftly return to whole. Lateral movement is found on the land with the help of walking legs. Its strong chela help for catching the prey.

DIFFERENCE BETWEEN MALE AND FEMALE

PRAWNS

Male	Female
1. Usually larger in size	1. Small
2. Narrow abdomen	2. Broad abdomen
3. Walking legs are closely set	3. Walking legs are set a part
4. Second walking leg is strong and provided with numerous spines	4. Moderately developed
5. Presence of "appendix masculina" in the second pleopod.	5. "Appendix masculina" absent.

CRABS

Male	Female
1. Usually larger in size	1. Small
2. First and second pleopods are uniranus	2. Pleopods consist of unsegmented propodite. Each carrying two hairy elongated structure called remai.

Male	Female
3. Reproducting opening present in the last leg.	3. Reproducting opening present in the sternum.
4. Two pairs of copulatory stylets are present.	4. Four pairs of abdominal segments form an egg bearing baskets.

ECONOMIC IMPORTANCE

Fresh water prawns and crabs are regarded as delicious food which occur in fresh water ecosystem i.e. ponds, rivers, lakes, jheels etc. They play an important role in aquatic ecosystem to reclycling dead organic matter of state. It is interesting to note that crabs cause serious damage to the paddy field by cutting the stem of the tender paddy plant and digging holes. It is widely true that next to fish the fresh water prawns and crabs form major sources of quality protein to the economically and socially backward casts.

MORPHOLOGY AND TERMINOLOGY

PRAWNS

Altogether there are nineteen pairs of appendages of which thirteen pairs are borne on 1. Cephalothorax and remaining six on 2. Abdomen.

1. **The Cephalothoracic appendages** : There are two groups on Cephalothorax; the anterior five pairs forming A. Cephalic appendages and the posterior eight pairs forming B. Thoracic appendages.

A. **Cephalic appendages** :

i) **Antennules** : Receptor organ, situated at the anterior end of body below the bases of eye stalks. Antennules consist of peduncles and a pair of slender many jointed flagella.

ii) **Antennae** : Receptor organs, situated below and behind the antennules. It is more or less triangular leaf like scale.

iii) **Mandibles** : The appendages are masticatory in function lying one on each side of mouth.

(iv) **Maxillulae** : The maxillulae have a function of passing food to mouth lying behind the lower lip.

(v) **Maxillae** : There have feeding and respiratory functions in which the maxillae lying near the maxillulae.

B. Thoracic appendages :

i) Maxillipeds : First are flatten and leaflike in structure, second is less flattened than first and whip like appearance and third is leg like appearance have a respiratory function.

(ii) **Peraeopods** :First and second pair of walking legs bear chelae, act either as prehension of food or offence and defence. Third to fifth pair of legs are typical in structure use for walking.

2. Abdominal appendages : The six abdominal appendages are known as pleopods or swimmerets. Out of six, the first five help the prawn in a slow forward swimming movement, while the last is uropod together with telson help the prawn in a backward spring. In the female second to fifth abdominal appendages serve to carry eggs in breeding season.

CRABS

1. **Carapace** : Variable in shape, subquadrilateral or even subcircular but commonly broader than long. The surface of the dorsal side may be either well or quite ill defined, but are seldom areolated to any marked extend.

2. **Cervical groove** : Commonly clear and deep in all its extend but time to time interrupted and not unseldom well defined only behind the mesogastric area.

3. **Anterolateral broader of carapace** : Anterolateral broader of carapace is well arched and not longer than the posterolateral broader which are convergent.

4. **Chelipeds** : The Chelipeds are usually more or less unequal in both sexes.

5. **Legs** : Legs are strong and stouter than the chelipeds. Legs are grassorial.

6. **Maxillipeds** : The palp of the external maxillipeds are articulated at or near the angle of the merus.

7. **Front** : In adult always broad, only narrow to narrower than the orbit. Not separated from the inner. supra orbital angles. Generally more or less deflexed.

8. **Pleopod** :Pleopods of the males are long and slender at the tip.

9. **Antennules** : The antennules are usually folded transversly in narrow fossae.

10. **Abdomen of adult male** : Sternum broad, abdomen of the male covering all the space between the last pair of legs.

11. **Epistome** : Epistoms are well defined not eneroached upon by the external maxillipeds.

SYSTEMATIC LIST OF THE FRESH WATER PRAWNS AND CRABS OF GOA STATE

Phylum CRUSTACEA Pennat 1977
Subphylum CRUSTACEA Pennat 1977
Class MALACOSTRACA Latreille 1806
Subclass EUMALACOSTRACA Gorben 1892
Order DECAPODA Laterille 1803
Suborder CARIDEA Dana 1852
Infra-order PALAEMONOIDEA Refinesque 1815
Family PALAEMONIDAE Refinesque 1815

1. *Macrobrachium dayanum* (Henderson, 1893)
2. *Macrobrachium idella* (Hilgendorf, 1898)
3. *Macrobrachium lamarrei* (H.Milne Edwards, 1837)
4. *Macrobrachium malcomsonii* (H. Milne Edwards, 1844)

Infra-order BRACHYURA Latreille 1803
Section BRACHYRHYNCHA Borradaile 1900
Superfamily PARATHELPHUSOIDEA Colost, 1920
Family GECARCINUCIDAE Rathbun 1909

5. *Barytelphusa (Barytelphusa) cunicularis* (West wood 1836)

SYSTEMATIC ACCOUNT

Family PALAEMONIDAE Rafinesque 1815

Diagnosis : The Palaemonidae is characterised by the carpus of second pair of peraeopods entire; no epipods on legs; upper antennular flagellum bifid; third maxilliped normal. The following only one genus of *Macrobrachium*, Bate under this family representing from the State of Goa.

Genus ***Macrobrachium*** Bate, 1868

1868. Macrobrachium Bate, *Proc. Zool. Soc. Lond.* : 363.
Type spceis : Macrobrachium americanum Bate.

Diagnosis : Body compressed; rostrum well developed; serrate and compressed; hairs present between teeth; carapace smooth in young specimens; numerous small tubercles present on carapace in several species of adult specimens, branchiostegal spine absent, antennal and hepatic spines present, dactylus of last three legs simple. The genus is representing four species from this state.

A Key to The identification of species of the genus *Macrobrachium* Bate

1. Distal part of rostrum with dorsal teeth 2
– Distal part of rostrum without dorsal teeth 3
2. Carpus of second leg shorter than chela..... ..... *M. dayanum*
– Carpus of second leg longer than chela..... ..... *M. idella*
3. Fingers of second leg shorter than palm ....*M. lamarrei*
– Fingers of second leg longer than palm .... *M. malcomsonii*

1. ***Macrobrachium dayanum*** (Henderson, 1893)

1893. *Palaemon dayanus* Henderson, *Trans. Linn. Soc. London* (2)**5** : 443, pl. 40. figs. 7-13.

1950. *Macrobrachium dayanum* Holthuis, *Siboga Exped. Monogr.*, **39**a (9) : 197.

1988. *Macrobrachium dayanum Jalihal*, Shenoy & Sankolli, *Rec. zool. Surv. India, Occ. paper No.* **112** : 43.

2000. *Macrobrachium dayanum* Ghosh & Roy, Zool. Surv. India, *Fauna of Tripura, State Fauna Series*, **7**(4) : 270.

Material examined : 1 ex., from chodan, 12 kms. S. W. of Panaji, Goa, M. K. Dev Roy & Party, 20.11.2002.

Diagnosis : Rostrum extends upto apex of antennal scale or exceeds it. Rostral formula 7-11/4-7 with 2 or 3 post orbital teeth. The shape of rostrum straight or up turned distally. Carpus of second leg longer than merus and thickened distally, palm equal or slightly shorter than carpus, fingers shorter than palm with densely pubescent. Cutting edge of fixed finger with one tooth and mobile finger with two teeth. The outer sub-terminal spinules very small, the inner terminal spinules long with a tuft of setae between them two pairs of dorsal spinules situated on the posterior half of the telson.

Distribution : India : Assam, Bihar, Jharkhand, Kerala, Madhya Pradesh, Meghalaya, Orissa, Punjab, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Pakistan.

Type species : *Palaemon dayanus* Henderson, 1893.

Type locality : Northern India.

Remarks : The species is found in plain and at lower altitudes in hills throughout a large part of India and Pakistan. The species is recorded for the first time from this area.

2. ***Macrobrachium idella*** (Hilgendorf)

1898. *Palaemon (Eupalaemon) idae idella* Hilgendorf, *Deutsch. Ost. Africa.* **4** : 29.

1910. *Palaemon idae* Henderson & Mathhai, *Rec. Indian Mus.* **5** : 285.

1950. *Macrobrachium idella* Holthuis, *Siboga Exped Monogr.* **39**a(9) : 146.

1988. *Macrobrachium idella Jalihal*, Shenoy & Sankolli, *Rec. zool. surv. India, Occ. paper No.* **112** 51.

1993. *Macrobrachium idella* Kurian & Sebastian, Prawns and Prawn Fisheries of India : 77.

Material examined : 8 exs., from chodan, 12 kms. S. W. of panaji, Goa, M. K. Dev Roy & Party, 20.11.2002.

Diagnosis : Rostrum extend upto antennal scale. Rostral formula 11-14/4-6 with 2 post-orbital teeth. Second legs equal and smooth. In young ones and females, fingers smooth while in males, entire movable and inner half of fixed fingers covered with pubescence. Cutting edge of movable finger with 2 and fixed finger with 1 or 2 denticles in young ones and females while in adult males, movable finger with 2 and fixed finger with 3 to 5 denticles. Merus longer than is chium and less than carpus, third to fifth legs similar, abdomen and telson smooth in young ones and females while in adult males, entire abdomen and telson with tubercles.

Distribution : India : Kerala, Karnatak, Maharastra, Pondicherry, West Bengal.

Elsewhere : East Africa, West Madagascar.

Type species : *Palaemon (Eupalaemon) idae* var idella hilgendorf, 1898.

Type locality : East Africa.

Remarks : The species is closely related to *Macrobrachium idae*, only difference between two species in the dorsal teeth of rostrum and post-orbital teeth. The species is recorded for the first time from this area.

3. ***Macrobrachium lamarrei*** (H. M. Edwards, 1837)

1837. *Palaemon lamarrei* H. Milne Edwards, *Hist. nat. Crust.*, **2** : 397.

1949. *Palaemon lamarrei* Chopra & Tiwari, *Rec. Indian Mus.*, **45** : 214.

1950. *Macrobrachium lamarrei* Holthuis, *Siboga Exped. Monogr.*, **39**a(9) : 119.

1988. *Macrobrachium lamarrei lamarrei* Jalihal, Shenoy & Sankolli, *Rec. zool. Surv. India, Occ. Paper No.* **112** : 2.

1993. *Macrobrachium lamarrei* Kurian & Schastian, Prawns and Prawn Fisheries of India : 77.

2005. *Macrobrachium lamarrei* Ghosh, Ghatak & Roy, Zool. Surv. India. *Fauna of Andhra Pradesh, State Fauna series*, **5**(5) : 553.

Material examined : 16 exs., from chodan, 12 Kms. S. W. of Panji, Goa, M. K. Dev Roy & Party, 20.11.2002. 5 exs., from Chorao IS, Goa S.R. Das & Party, 7.11.2002.

Diagnosis : Rostrum slightly longer than antennal scale and upturned distally. Rostral formula 5-9 + 0-2 + 1-2/4-8 with 1 or 2 post-orbital teeth. Basal crest of rostrum not much elevated second leg not swollen, carpus of second leg longer than merus and ischium. Absence of sub-apical spine in the exopods of uropods.

Distribution : India : Assam, Andhra Pradesh, Arunachal Pradesh, Bihar, Chatrishgarh, Jharkhand, Kerala, Manipur, Orissa, Maharashtra, Punjab, Tripura, Tamil Nadu, Uttaranchal.

Elsewhere : Bangladesh, Nepal, Pakistan.

Type species : *Palaemon lamarrei* H. M. Edwards, 1837.

Type locality : Karnatak, India.

Remarks : It is one of the oldest and widely distributed *Macrobrachium*. The species is always confused with the sub-species lamarroides, only differs in length of rostrum and number of dorsal teeth. The species is recorded for the first time from this area.

4. ***Macrobrachium malcomsonii*** (H. M. Edwards, 1844)

1844. *Palaemon malcolmsonii* H. Milne Edwards, *Voy. Inde Jacquemont.* **4** : 8.

1910. *Palaemon malcolmsonii* Henderson & Matthai, *Rec. Indian Mus.* **5** : 283.

1915. *Palaemon malcolmsonii* Kemp. *Mem. Indian Mus.* **5** : 266.

1950. *Macrobrachium malcolmsonii* Holthuis, *Siboga Exped, Monogr.* **39**a(9) : 121.

1993. *Macrobrachium malcomsonii* Kurian & Sebastian, *Prawns and prawn fisheries of India*, : 77 & 79.

2005. *Macrobrachium malcomsonii* Ghosh, Ghatak & Roy, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna Series* **5**(5) : 554.

Material examined : 16 exs, from Chodan, 12 kms. S. W. of Panaji, Goa, M. K. Dev Roy & party, 20.11.2002.

Diagnosis : Rostrum slightly upturned distally and extends as far as the end of antennal scale. Proximal portion highly convex and deep while the distal portion more or less straight and much narrower. Proximal portion of upper edge contains 9 to 10 teeth 1 or 2 teeth near the apex and 5 to 7 teeth on lower edge. Rostral formula 9-11 + 1-2/5-7. In the female, second peraeopods about two-thirds the length of the body the palm slightly compressed dorso-ventraly and wider than the distal end of carpus. Mobile finger without pubescent. Carpus of second peraeopods in adult males longer than chela and merus, palm swollen and fingers longer than palm. Tip of telson over-reached by longer posterior spines.

Distribution : India : Andhra Pradesh, Tamil Nadu, Orissa, Bihar, Madhya Pradesh, Gujarat.

Elsewhere : Myanmar, Bangladesh, Pakistan.

Type species : *Palaemon malcolmsonii* H. M. Edwards, 1844.

Type locality : Nagpore, Maharashtra.

Remarks : The species is recorded for the first time from this area and it is fairly good fishery in N.E. coast in moonsoon months.

Family GECARCINUCIDAE Rathbun 1904

Diagnosis : Carapace subquadrilateral in shape but broader than long. Commonly the cervical groove deep and clear. Antero-lateral broader of the carapace well arched and longer than the postero-lateral broaders. Epistome well defined. Sternum broad. Abdomen of the male covering all the space between the last pair of legs. The antennals usually transversely folded in narrow fossae. Palp of the external maxillipeds arearticulated. In both sexes the chelipeds usually unequal. Legs glossorial.

Genus ***Barytelphusa*** Alcock 1909

Diagnosis : Epigastric crests either in unbroken continuity with the post orbital crests on either side of the mesogastric groove, or almost in line with and more or less distinctly separated from them. Exopodites of external maxillipeds a strong plumose flagellum.

5. ***Barytelphusa (Barytelphusa) cunicularis*** (West Wood, 1836)

1836. *Thelphusa cunicularis* West Wood, In. *Sykes and West Wood, Trans Entomol Soc. London.*, 1 : 183. pl. 19, figs. 1-6.

1869. *Thelphusa indica*, A. Milne Edwards, *Nouv. Arch. Mus. Hist. nat. Paris*, **5** : 184.

1898. *Potamon (Potamonates) indicus*, de man. Ann. *Civ. Stor. Nat. Genova* (2)**19** : 423.

1910. *Potamon (Barytelphusa) jacquemontii* Alocock, Brachyura, The Indian fresh water crabs—Potamonidae. Catalouge of the Indian Decapod Crustacea in the collection of the Indian Museum-Calcutta **1**(2) : 79, pl. 12, fig. 55.

1970. *Barytelphusa (Barytelphusa) cunicularis Bott.* Abh. Senckenb. Naturforsch. Ges. Frankfurt, **526** : 31, pl. 2, figs. 18-20 and pl. 26, fig. 13.

2005. *Barytelphusa (Barytelphusa) cunicularis* Ghosh. Ghatak & Roy, *Zool. Surv. India, Fauna of Andhra Pradesh, State Fauna series*, **5**(5) : 556.

Material examined : 3F, from Kulem, Goa. M. K. Dev Roy & party, 22.01.04, 4M & 10F, from Sonal near Valpai, Goa, M. K. Dev Roy & party. 25.11.02, 3M and 4F, from Nagve near Valpai Goa, M. K. Dev Roy & party, 26.11.02, 5M & 2F, from Nanua near concrete bridge, Goa, M. K. Dev Roy & party 26.11.02, 3M & 18F, from veluz river. Nagargoa, Valpai, Goa, M. K. Dev Roy & party, 26.11.02.

Diagnosis : The carapace distinclty broader than long. In both sexes the length of the carapace three-fourth its greatest breadth. The shape of the carapace convex. The antero-lateral margin of the carapace well defined but hardly crest like or the lateral part of the epibranchial regions less rugose. The cervical groove bold, deep and broadly "V" shaped. The surface of the carapace not areolated. The front of the male and female broad deflexed and bilobed. The anterolateral broader of the carapace more convex. The lateral epibranchial tooth smaller and sometimes absent. The shape of the merus of external maxilliped quadrangular and its anterior broader less oblique. Fixed finger of the cheliped broader and none of the teeth except one at the base of the fixed finger enlarged.

The legs long and stouter than the cheliped. In the abdomen of the adult male, the length of the sixth segment equal to its greatest breadth. The pleopods of the male long and slender at the tip.

Distribution : India : Coorg, Parisnath Hill, Barrabhum, Coonoor, Nilgiris, Anamalai Hills, Khandella and Mahabaleswar, Debnaddi, Narbudda basin, Hardwar, Moror, Chotanagpore, Nassik, Upper Godabari, Poona, Shervaroy Hills, Calicut, Hoshangabad, Manbhum, Octacamund, Madathorary, Travancore, Mangalore, Pulicat, Kolleru Lake.

Elsewhere : Not known.

Type species : *Thelphusa cunicularis* (West wood, 1836).

Type locality : Umgebung, Von Bombay, West Ghat, 17°-19°23'N. 73°-75°E (Cunicularissykes) Umgebung Von Poona (jacquemontii Rathbun).

Remasks : This is a very common Gecarcinucid crab of India but it is reported for the first time from Goa State. It is not yet known to occur out side India.

SUMMARY

The present report is based on the collection from the different localities of the Goa state. A total number of 96. specimens belonging to one genus of prawns and crabs have been encountered for the first time from this state. This includes four new records of prawns namely *Macrobrachium dayanum, Macrobrachium idella, Macrobrachium lamarrei* and *Macrobrachium malcomsonii* and one new record of Gecarcinucid crab namely *Barytelphusa (Barytelphusa) cunicularis* from the state of Goa. Brief synonyms and Zoogeographical distribution for all the species have been dealt with. Diagnostic characters are provided for the families as well as genera along with a general account of morphology and terminology, methods of collection and preservation, information of the type species and type localities are also provided.

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Fauna of Goa, State Fauna Series, **16** : 173-194, 2008

INSECTA : ODONATA

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INTRODUCTION

Odonata are the insects known as dragon and damselflies. They are very common in the vicinity of streams, ponds and lakes. Even temporary water bodies during monsoon, attract these insects. Dragonflies are conspicuous and can easily be noticed due to their size and rapid flight over water and shores. The damselflies are thin slender insects, less vigorous in flight.

A total of 499 species of odonata are known to occur in India (Prasad and Varshney, 1995). Comparatively these insects are well studied from different areas in the country. South Andaman (Kailash Chandra and Rajan, 2004), Bihar (Prasad and Varshney, 1988); Central India, Mitra, 1986, 1995; Delhi (Kumar, 1997c); Desert National Park, (Prasad, 2004); Erivakulam National Park (Prasad and Kulkarni 2002); Indravati Tiger Reserve, Madhya Pradesh (Mitra, 1995); Kabar Lake Wetland, Bihar (Ramakrishna, 2002); Manipur (Srivastava and Sinha, 2004); Meghalaya (Lahiri, 1987); Melghat Tiger Reserve, Maharashtra (Kulkarni and Prasad 2005): Nanda Devi Biosphere Reserve, Uttar Pradesh (Kumar, 1997); Nathsagar Wetland, Maharashtra (Kulkarni and Talmale 2005); Nilgiri Biosphere Reserve, (Prasad and Kulkarni, 2001); Orissa (Srivastava and Das, 1987); Pench National Park, Maharashtra (Kulkarni *et al.*, 2004); Rajaji National Park, Uttar Pradesh (Prasad and Singh, 1995); Renuka Wetland, Himachal Pradesh (Kumar, 2000); Saipung Wildlife Sanctuary / Narpur Reserve Forest, Meghalaya (Hatter *et al.* 2004); Sanjay Gandhi National Park, Mumbai (Kulkarni *et al.* 2006); Tadoba Andhari Tiger Reserve, Maharashtra (Kulkarni *et al.* 2006); Tripura (Srivastava and Sinha, 2000); Ujani Wetland, Maharshtra (Kulkarni & Prasad, 2002); West Bengal (Srivastava and Sinha, 1993); Western Himalaya, Uttar Pradesh (Kumar and Prasad, 1981; Kumar, 1997(b)); Pictorial handbook on common dragonflies and damselflies of Kerala (Emiliyamma *et al.*, 2005) is also available.

22 species of Odonata are known from Goa State (Prasad, 1995); The present account contains 39 species, thus 17 species are recorded for the first time from Goa State. Systematic arrangement of the species is in accordance with (Prasad and Varshney, 1995). Keys are provided for the species of Suborder Zygoptera while those couldnot be provided for the species of Suborder Anisosptera as Nymphal characters are necessary for classification (Fraser, 1957; Lahiri, 1987). Species recorded for the first time from Goa State are marked with * in the taxonomic list and the text.

Order ODONATA

Suborder ZYGOPTERA

Superfamily COENAGRIONOIDEA

Family COENAGRIONIDAE

Subfamily PSEUDAGRIONINAE

Genus ***Ceriagrion*** Selys, 1876

1. *Ceriagrion cerinorubellum* (Brauer)
2. *Ceriagrion coromandelianum* (Fabr.)

Genus ***Pseudagrion*** Selys 1876

3. *Pseudagrion indicum* Fraser

4. *Pseudagrion malabaricum* Fraser
5. *Pseudagrion microcephalum* (Rambur)

Subfamily ISCHNURINAE

Genus ***Aciagrion*** Selys, 1891

6. **Aciagrion hisopa* (Selys)
7. *Aciagrion occidentale* Laidlaw
8. *Aciagrion pallidum* Selys

Genus ***Enallagma*** Charp., 1840

9. *Enallagma parvum* (Selys)

Genus ***Ischnura*** Charp., 1840

10. *Ischnura aurora aurora* (Brauer)

Subfamily AGRIOCNEMIDINAE

Genus ***Agriocnemis*** Selys, 1877

11. *Agriocnemis lacteola* Selys
12. *Agriocnemis pieris* Laidlaw
13. *Agriocnemis pygmaea* (Rambur)

Genus ***Mortonagrion*** Fraser, 1920

14. **Mortonagrion varralli* Fraser

Family PLATYCNEMIDIDAE

Subfamily PLATYCNEMIDINAE

Genus ***Copera*** Kirby, 1890

15. **Copera marginipes* (Ramb.)

Family PROTONEURIDAE

Subfamily DISPARONEURINAE

Genus ***Elattoneura*** Cowley, 1935

16. *Elattoneura tetrica* (Laidlaw)

Superfamily LESTOIDEA

Family LESTIDAE

Subfamily LESTINAE

Genus ***Lestes*** Leach, 1815

17. *Lestes elatus* Hagen
18. **Lestes viridulus* Rambur

Superfamily CALOPTERYGOIDEA

Family CALOPTERYGIDAE

Subfamily CALPTERYGINAE

Genus ***Neurobasis*** Selys, 1853

19. **Neurobasis chinensis chinensis* (Lin.)

Genus ***Vestalis*** Selys, 1853

20. **Vestalis apicalis apicalis* Selys
21. *Vestalis gracilis gracilis* (Ramb.)

Family CHLOROCYPHIDAE

Genus ***Rhinocypha*** Rambur, 1842

22. **Rhinocypha (Heliocypha) bisignata* (Selys)

Genus ***Libellago*** Selys, 1840

23. **Libellago lineata indica* (Fraser)

Suborder ANISOPTERA

Superfamily AESHNOIDEA

Family GOMPHIDAE

Subfamily ONYCHOGOMPHINAE

Genus ***Paragomphus*** Cowley, 1934

24. **Paragomphus lineatus* (Selys)

Superfamily LIBELLULOIDEA

Family LIBELLULIDAE

Subfamily LIBELLULINAE

Genus ***Orthetrum*** Newman, 1833

25. **Orthetrum glaucum* (Brauer)
26. *Orthetrum pruinosum neglectum* (Rambur)
27. *Orthetrum sabina sabina* (Drury)
28. **Orthetrum taeniolatum* (Schn.)

Genus ***Potamarcha*** Karsch, 1890

29. *Potamarcha congener* (Rambur)

Subfamily SYMPETRINAE

Genus ***Brachythemis*** Brauer, 1868

30. *Brachythemis contaminata* (Fabr.)

Genus ***Crocothemis*** Brauer, 1868

31. **Crocothemis servilia servilia* (Drury)

Genus ***Diplacodes*** Kirby, 1889

32. *Diplacodes trivialis* (Rambur)

Genus ***Neurothemis*** Brauer, 1867

33. **Neurothemis fulvia* (Drury)
34. **Neurothemis intermedia intermedia* (Rambur)
35. **Neurothemis tullia tullia* (Drury)

Subfamily TRITHEMISTINAE

Genus ***Trithemis*** Brauer, 1868

36. **Trithemis aurora* (Burmeister)

37. **Trithemis festiva* (Rambur)

Subfamily TRAMEINAE

Genus *Pantala* Hagen, 1861

38. *Pantala flavescens* (Fabr.)

Genus *Tholymis* Hagen, 1867

39. *Tholymis tillarga* (Fabr.)

Order ODONATA

Key to the Suborders of Order ODONATA

1. Distance between margins of eyes greater than their own diameter. Wings petiolate, forewings and hindwings more or less similar in shape and venation ..... ZYGOPTERA

– Distance between margins of eyes always less than their own diameter. Wings never petiolate, fore and hindwings dissimilar, hindwings broader; different in venation .... ANISOPTERA

Key to the Superfamilies of Suborder ZYGOPTERA

1. More than 23 antenodal cross viens present; post nodals not coinciding with the viens beneath ..... CALOPTERYGOIDEA

– Only 2 antenodal cross viens present; post nodals in strict alignment with cross viens beneath 2

2. Origin of IR^3 and R^{4+5} generally more near nodus than or even beyond the level of Nodus; males with anterior hamules subquadreate .. .. COENAGRIONOIDEA

– Origin of IR^3 and R^{4+5} generally more near to arc than nodus; males with anterior hamules elongate ..... LESTOIDEA

Key to the families of Superfamily COENAGRIONOIDEA

1. Discoidal cell with costal and inner margins subequal; inner distal angle being obtuse .... PLATYCNEMIDIDAE

– Discoidal cell with costal margin considerably shorter than inner one; inner distal angle acute or subacute ..... COENAGRIONIDAE

Key to the subfamilies of family COENAGRIONIDAE

1. Pterostigma more or less similar in fore and hind wings ..... AGRIOCNEMINAE

– Pterostigma different in shape and size in fore and hind wings 2

2. Vulvar spine present on eighth abdominal segment of female; 10^{th} abdominal segment often raised in to a bifid tubercle..... ..... ISCHNURINAE

– Vulvar spine absent on eighth abdominal segment of female; 10^{th} abdominal segment without tubercle ..... PSEUDAGRIONINAE

Subfamily PSEUDAGRIONINAE

Genus ***Ceriagrion*** Selys, 1876

1. ***Ceriagrion cerinorubellum*** (Brauer)

1865. *Pyrrhosoma cerinorubellum* Brauer, *Verh. Zool - Bot Ges. Wien*, XV, 511.

1866. *Agrion cerinorubellum*, Brauer, *Reise d. 'Novara' (Neur.)* 59.

1876. *Ceriagrion cerinorubellum*, Selys, *Bull Acad Belg* (2) : xlii, 526.

1933. *Ceriagrion cerinorubellum*, Fraser, *The Fauna of British India : Odonata*–1, 326–328.

1995. *Ceriagrion cerinorubellum*, Prasad and Varshney, *Oriental Ins.*, **29** : 388.

Diagnostic characters : Head : Labium whitish; labrum dark olivaceous, bordered broadly and diffusely with ochreous; ante and post clypeous dark greenish olivaceous; base of mandibles, gene and front of frons pale greenish yellow, occiput bright ochreous, sharply defined from dark vertex. Prothorax and thorax green, changing to blue on sides, yellow beneath. Wings hyaline; pterostigma amber tinted, paler around circumference; elongate and diamond shaped, oblique, covering one cell. Abdomen multicoloured, segments 1 & 2 bright brick red, apical half of 3 and 4–6 black on dorsum. Segments 7–10 bright brick red but the

base of 7 sometimes black on dorsum. Legs yellow with short black spines. Anal appendages reddish brown, tipped with black. Females very similar to males in colouration.

Material examined/Source : Prasad, 1995.

Distribution : Throughout India.

Elsewhere : Sri Lanka, Myanmar; Sumatra, Java and Borneo.

2. ***Ceriagrion coromandelianum*** (Fabr.)

1798 *Agrion coromandelianum* Fabr., *Ent. Syst. Suppl.*, : 287

1842 *Agrion cerinum*, Ramb., *Ins. Neurop*, : 279

1933 *Ceriagrion coromandelianum*, Fraser, *Fauna Brit. India, Odon.*, **1** : 315-316

Diagnostic characters : Labium pale yellow; labrum, clypeus, genae, bases of mandibles and frons bright citron yellow. In female face pale olivaceous. Prothorax and thorax uniformly olive green, the posterior lobe of prothorax and the dorsum of thorax often tinted with orcherus. Pterostigma golden yellow, framed in brown nervures. Distinguishing character of this species is, abdomen bright citron-yellow, without markings.

Material examined/Source : Prasad, 1995.

Distribution : Throughout India.

Elsewhere : Sri Lanka, Myanmar, Malaysia and South China.

Remarks : Breeds in weedy ponds and tanks, may be found for the greater part of the year on the banks and breeds in water bodies.

3. ***Pseudagrion indicum*** Fraser

1924. *Pseudagrion indicum* Fraser, *Rec. Ind. Mus.*, xxvi, 428, 495.

1931. *Pseudagrion indicum* Fraser, *ibid* xxxiii, 448, 465.

1933. *Pseudagrion indicum* Fraser, *The Fauna of British India* : Odonata-1 : 303–304.

1995. *Pseudagrion indicum*, Prasad and Varshney, *Oriental Ins.*, **29** : 389.

Diagnostic characters : Head : Labium white, labrum face, and cheeks pale yellowish green, eyes black above, greenish at sides and beneath; vertex and occiput black, marked with large azure blue post ocular spots, Prothorax azure blue marked with fine subdorsal and lateral longitudinal black lines confluent behind, posterior lobe blue, thorax and mid dorsum broadly black. Wings hyaline, pterostigma very narrow and acute at both ends, less than one cell, blackish brown. Abdomen azure blue on segments 1, 2 and basal half of segment 3; 3-7 greenish laterally, 8–10 azure blue, marked with black. Segment 10 broadly black on dorsum. Anal appendages : Superior black shorter than segment 10, unequally bifid at apex. Females differ widely in colour and markings.

Material examined/Source : Prasad, 1995.

Distribution : India : Nilgiris, Coorg, Malabar, Tamil Nadu, Western Ghats.

4. ***Pseudagrion malabaricum*** Fraser

1924. *Pseudagrion malabaricum* Fraser, *Rec. Indian Mus.*, xxvi, 428, 494–495.

1931. *Pseudagrion malabaricum* Fraser *ibid* : xxxiii 448, 465.

1936. *Pseudagrion malabaricum* Fraser, *The Fauna of British India* : *Odonata*-1 : 284–286.

1988. *Pseudagrion malabaricum*, Prasad and Varshney, *Rec. zool. Surv. India*, 110 :

1995. *Pseudagrion malabaricum*, Prasad and Varshney, *Oriental Ins.*, **29** : 389.

2001. *Pseudagrion malabaricum*, Prasad and Kulkarni, *Fauna of Nilgiri Biosphere Reserve, Fauna of Conservation Area Series*, **11** : 74. *Zool. Surv. India*.

Diagnostic characters : Head : Labium white; labrum and epistome azure blue, with three minute points on the epistome and a small central point behind the frons black; vertex blue, traversed by a broad black band from eye to eye; occiput black, marked with two very large blue postocular spots. Prothorax black, with a anterior collar; thorax azure blue, marked with three broad black bands on dorsum; legs blue, femora with black stripe behind. Wings hyaline, pterostigma dark brown. Abdomen blue, marked with black. Anal appendages black, apices curling strongly inward as a robust tooth.

Female : Differs in colouration in labrum and

epistome pale olive green, prothorax with anterior collar broader; thorax peacock blue, paling on lower party of sides and beneath and abdomen dark azure blue with black markings.

Material examined/Source : Prasad, 1995.

Distribution : India : Throughout the Western Ghats in Mountain and sub mountain areas; Bihar; Tamil Nadu.

5. ***Pseudagrion microcephalum*** (Rambur)

1842 *Agrion microcephalum* Rambur, *Ins. Neurop* : 259.

1876 *Pseudagrion microcephalum*, Selys *Bull. Acad. Belg.*, (2) : Xlii, : 504.

1933 *Pseudagrion microcephalum*, Fraser, *The Fauna of Brit. India, Odonata*, 1 : 278–280.

Diagnostic characters : Labium white, bases of mandibles, genae, frons and fore part of vertex azure blue, post clypeus with three small black spots at base; Prothorax blue, anterior lobe and five parallel lines on middle lobe all confluent in front and behind, black. Thorax blue, pale to white below and beneath. Abdomen azure blue marked with black on segment 2 and segments 3 to 7 dorsally with apical narrow rings; 8 with a thick apical dorsal ring & 9th unmarked. Segment 10 with saddle shaped dorsal mark extending from base to apex.

Material examined/Source : Prasad, 1995.

Distribution :Throughout the plains in India.

Elsewhere : Mynamar and SriLanka, extending to Australia.

Remarks : Dwells near permanent and temporary water bodies. Variations in colour markings in males are recorded.

Subfamily ISCHNURINAE

Genus ***Aciagrion*** Selys, 1891

6. ****Aciagrion hisopa hisopa*** (Selys)

1876. *Pseudagrion hisopa* Selys *Bull. Acad. Belg.* (2) : Xlii. 509.

1891. *Aciagrion hisopa*, Selys, *Ann. Mus. Civ. Genova*, (2) : X(xxx), 511–512.

1921. *Aciagrion hisopa* race *krishna*, Fraser, *J. Bombay Nat. Hist. Soc.*, 27 : 543.

1933. *Aciagrion hisopa*, Fraser, *The Fauna of British India : Odonata*-1 : 340–342.

1995. *Aciagrion hisopa hisopa*, Prasad and Varshney, *Oriental Ins.*, 29 : 390.

Diagnostic characters : Head : Labium palest yellow; labrum, bases of mandibles, genae, and anteclypeus and frons broadly pale blue, post clypens black; vertex and occiput black, eyes capped with black above, pale greenish at sides and yellow below. Prothorax black on dorsum sides broadly azure blue. Thorax black on dorsum, with violet antehumaral stripes, violet laterally fading beneath. Legs creamy white, with few short slim black spines, wings hyaline; pterostigma larger in fore wing than in the hind. Abdomen pale blue at sides, marked broadly on dorsum with black, segments 8–10 azure blue, 8th with short black stripe on each side 9 unmarked, 20 with a small cross shaped dorsal marking. Anal appendages black.

Female similar to male in colouring and markings.

Material examined/Source : 1♂, 1♀ Kodal, Sattari, North Goa, 21-01-2002, Coll. P.P. Kulkarni.

Distribution : India : Karnataka, Kerala.

Elsewhere : Myanmar and Sri Lanka.

Remarks : Fraser (1921) regarded *Aciagrion hisopa* race *krishna* but however synonymized the same with *Aciagrion hisopa* (Selys) in 1933. Prasad and Varshney (1995) retained separate identity of *Aciagrion hisopa krishna* Fraser to the sub species level and separated *Aciagrion hisopa hisopa* (Selys) from it. Same nomenclature is followed here.

7. ***Aciagrion occidentale*** Laidlaw.

1919. *Aciagrion hisopa* (Selys) ? race *occidentalis* Laidlaw, *Rec. Ind. Mus.*, 26 : 186.

1922. *Aciagrion paludensis*, Fraser; *J. Bombay nat. Hist Soc.*, 28 : 698–699.

1933. *Aciagrion occidentale* Laidlaw, *The Fauna of British India : Odonata*-1 : 335–337.

1995. *Aciagrion occidentale*, Prasad and Varshney, *Oriental Ins.*, 29 : 390.

Diagnostic characters : Head : Labium white; labrum pale blue, with a medium spot; genae, anteclypeus, and frons azure blue; post clypeus glossy black; rest of the head black. Eyes bottle green above, with a small black cap. Prothorax black on dorsum, azure blue laterally, anterior lobe blue. Thorax pale azure blue, with dorsum black, marked with a narrow greenish-yellow antehumeral stripe on each side, white beneath legs pale blue, femora broadly black on exterior surface. Wings hyaline, narrow, pterostigma almost of the double size in fore wing than that in hind wing; blackish grey. Abdomen extremely slender, long, pale azure blue at sides of segments 1–3; pale yellow from 4–7; blue from 8 – 10, broadly marked with black on 1–8. Anal appendages black; superiors about half the length of segment 10.

Female : Similar to the male, with stouter abdomen.

Material examined/Source : Prasad, 1995.

Distribution : India : South India; Sri Lanka.

8. ***Aciagrion pallidum*** Selys.

1891. *Aciagrion pallidum* Selys. *Ann. Mus. Civ. Genova*, **2** : X(xxx) : 512–513.

1921. *Aciagrion pallidum*, Fraser. *J. Bombay Nat. Hist. Soc.*, **27** : 543.

1931. *Aciagrion pallidium*, Fraser. *Rec. Ind. Mus.*, **33** : 448.

1933. *Aciagrion pallidum*, Fraser. *The Fauna of British India* : Odonata -1 : 344–345.

Diagnostic characters : Head : Labium white, labrum and anteclypeus pale brown; bases of mandibles, genae, post clypeus and frons pale carneous, almost white; vertex occiput pale brown, with large triangular pale blue post ocular spots with median stripe of same colour. Prothorax brown, on dorsum except anterior lobe, which is pale blue. Thorax brown on dorsum as far as posterior lateral suture, with a narrow pale blue antehumeral stripe; white beneath. Legs white, distal ends on anterior two femora striped with black. Wings hyaline, narrow and pointed at apices, pterostigma pale brown covering less than one cell. Abdomen very long slender, dialating somewhat at the anal end. Abdominal colouration as described by (Fraser 1933), Anal appendages carneous; superiors shorter than segment 10, triangular and pointed at apex.

Female closely similar to be male in colouring except few differences in dorsal markings of the abdomen.

Material examined/Source : Prasad, 1995.

Distribution : India : Assam : Bihar, Eastern and Western Himalaya, Orissa, Maharashtra, Uttar Pradesh, Western Ghats; Myanmar.

Genus ***Enallagma*** Charp., 1840

9. ***Enallagma parvum*** Selys

1876. *Enallagma parvum* Selys, *Bull. Acad. Belg.*, (2)**41** : 537.

1933. *Enallagma parvum*, Fraser, *Fauna Brit. India, Odonata*-1 : 376-378.

Diagnostic characters : Head : Labium white, labrum, bases of mandibles, genae and anteclypeus pale sky blue; vertex & occiput black. Prothorax broadly black on dorsum, the sides pale blue, Thorax black on dorsum laterally pale blue; legs white, spines short 4-5 on hind tibiae. Wings, pterostigma small, less than one cell, blackish in adults. Abdomen pale sky blue. In females ground colour of thorax greenish yellow to yellow abdomen with dorsal strips broader. Heterochrome females also recorded (Fraser 1933).

Material examined / Source : Prasad, 1995.

Distribution : Throughout India.

Elsewhere : Nepal, Myanmar and Sri Lanka.

Remarks : It is a small damselfly, smallest within the genus and is found on waters of weedy tanks, almost throughout the year.

Genus ***Ischneura*** Charp., 1840

10. ***Ischneura aurora aurora*** (Brauer)

1858. *Agrion delicatum* Hagen, *Verh. Zool-bot. Ges. Wien.*, **8** : 479.

1865. *Agrion aurora*, Brauer, *Verh. Zool.- bot. Ges. Wein.*, **15** : 510.

1954. *Ischnura aurora*, Lieftinck, *Treubia*, **22** : 74.

1995. *Ischnura aurora aurora*, Prasad and Varshney, *Oriental Ins.*, **29** : 390.

Diagnostic characters : Labium white; Labrum citron yellow; vertex bronzed black; eyes beautifully olive green, with semilunar spot bordering it. Prothorax bronzed black on dorsum, sides and anterior lobe blue. Thorax black on dorsum, Legs pale citron-yellow, wings : pterostigma differs in fore & hind wings, in fore wings kite shaped, broader than long rose red for proximal half; in the hind wing much smaller about half the size. Abdomen citron yellow except segments 8 to 10 which are azure blue.

Material examined/Source : 1 ♀, Stream 10 kms on the way to Phonda, 28-02-2002, Coll. S.G. Patil

Distribution : Throughout India, in Maharashtra Khed, Pune, Buldhana, Aurangabad.

Elsewhere : Australia; Indonesia; Malaysia; Myanmar; Nepal; New Guinea; Papua; Philippines; Sri Lanka and Sondaic Archipelago.

Remarks : Widely distributed, found in grasses & marshy places around water bodies.

Subfamily AGRIOCNEMIDINAE

Genus *Agriocnemis* Selys, 1877

11. ***Agriocnemis lacteola*** Selys

1877. *Agriocnemis lacteola* Selys, *Bull. Acad. Belg.* **2**(43) : 144.

1890. *Agriocnemis lacteola*, Kirby, *Cat. Odon.* : 158.

1933. *Agriocnemis lacteola*, Fraser, *The Fauna of Brit. India : Odonata*, **1** : 381–383.

Diagnostic characters : Head : Labium white; labrum creamy white; anteclypeus and post clypeus, bases of mandibles, genae and the frons, as far as bases of antennae putty coloured; Vertex and occiput black. Prothorax black on dorsum, pale blue at the sides, posterior lobe black and finely margined with white; thorax black on dorsum with two very narrow antehumeral stripes; laterally pale blue. Legs white, spines black; wings hyaline, pterostigma pale blue with hinder three fourths black in hind wings and black in forewings. Abdomen pale blue, almost white on proximal segments, marked with black. Anal appendages pale blue; superiors as long as segment 10, broadly triangular, pointed; ventrally produced into a long hollow curled spine hidden beneath segment 10. Inferiors shorter and concealed.

Female much stouter than male differs in colouration as Head with face blue except the white labrum, post ocular spots azure blue and broader; legs with extensor surface of all femora black, wings with pale yellow pterostigma. Abdomen azure blue with its dorsum broadly black except 10. Anal appendages small, conical, blue, vulvar scales blue.

Material examined/Source : Prasad, 1995.

Distribution : India : Assam, Bihar, Meghalaya, Orissa, Sikkim, South India and West Bengal.

12. ***Agriocnemis pieris*** Laidlaw

1919. *Agriocnemis pieris* Laidlaw, *Rec. Ind. Mus.*, **15** 179–180.

1923. *Agriocnemis pieris*, Fraser, *J. Bombay Nat. Hist. Soc.*, **19** : 747.

1933. *Agriocnemis pieris*, Fraser, *The Fauna of Brit. India : Odonata*, **1** : 384–385.

Diagnostic characters : Head : Labium white; Labrum, bases of mandibles, genae, clypeus and a stripe across the frons pale azure blue; post clypeus narrowly black at base which runs through middle and confluences with the black on vertex. Eyes black, at sides and below pale blue. Prothorax black on dorsum, pale blue at sides. Thorax black on dorsum, marked by pinkish narrow antehumeral stripes; laterally blue with a small black spot. Legs white, broadly marked with black on the extensor surface of all femora. Wings hyaline, pterostigma narrow and elongate distally pale yellow, with centre blackish grey. Abdomen pale yellow, with centre blackish grey. Abdomen pale blue, marked with black, segment two with an anchor shaped dorsal markings, segments 2 to 6 with well defined apical annuals, segments 9 and 10 unmarked. Anal appendages pale blue to pinkish, superiors slightly longer than segment 10.

Female : Robust insect than male with the black markings much more extensive on abdomen. Legs more broadly black on extensor surface of femora. Wings with pterostigma golden yellow. Anal appendages short, conical, blue.

Material examined/Source : Prasad, 1995.

Distribution : India : Western Ghats (South of Bombay), South India.

13. ***Agriocnemis pygmaea*** (Rambur)

1842. *Agrion pygmaeum* Rambur, *Ins,.Neurop.*, : 278.

1882. *Agriocnemis velaris*, Selys, *Ann. Soc. Espan. Hist. Nat.*, **11** : 29.

1913. *Agriocnemis hyacinthus*, Tillyard, *Proc. Linn. Soc. N. S. Wales*, **37** : 457.

1933 *Agriocnemis pygmaea*, Fraser, *Fauna Brit. India, Odon.*, **1** : 398-401.

Diagnostic characters : Labium palest yellow, labrum entirely brilliant, metallic blue; anteclypus, bases of mandibles, genae and the frons narrowly pale apple green; occiput with very small rounded postocular spots. Thorax black on dorsum as far as the anterior-lateral suture, marked with narrow antehumeral apple green stripes, very small black spots on the upper part of the posterio-lateral suture. Wings hyaline, pterostigma pale yellow in the fore wings, black in the hind wing. That of the hind wing slightly shorter than the fore. In female, pterostigma similar in all wings, yellow, framed in darker coloured nervures covering less than one cell. Abdominal segments 1 to 6 with the ground color pale greenish yellow, the terminal segments brick red, marked with bronzed black.

Material examined/Source : 1♀ Goa, 17-xii-1973, B.S. Lamba. 1♂, Polayum, Goa, 25-ii-1993, Coll. P.D. Rane.

Distribution : Throughout India.

Elsewhere : Sri Lanka, Myanmar, Singapore, Java, Philippines, Formosa, China, Australia, Afghanistan, Bangladesh, Hong Kong, Indonesia, Japan, Kampuchia, Malaysia, Nepal, Pakistan, Papua, Seychelles, Taiwan and Thailand.

Genus ***Mortonagrion*** Fraser, 1920

14. **Mortonagrion varralli*** Fraser

1920. *Mortonagrion varralli* Fraser, *J. Bombay Nat. Hist. Soc.*, **27** : 148.

1931. *Mortonagrion varralli*, Fraser, *Rec. Ind. Mus.*, **33** : 448, 464.

1995. *Mortonagrion varralli*, Prasad & Varshney, *Oriental Ins.* **29** : 391.

Diagnostic characters : Head : Labrium straw coloured, labrum, genae, bases of mandibles and clypeus pale sky blue; vertex and occiput reddish brown post ocular oval spot bordering the eye inwardly. Eyes dove grey, capped with reddish brown above. Prothorax reddish-brown, the anterior lobe and the sides pale blue; thorax pale reddish brown on dorsum and sides marked with narrow antehumeral pale blue stripe on each side; sides and beneath pale blue. Legs pale brown, spine blackish. Wings hyaline, pterostigma covering less than a cell; braced, pale golden brown, framed in yellow and thick black nurvures. Abdomen pale reddish brown, sides of segment 1 & 2 pale blue and 3 to 7 with narrow pale blue basal annules, segments 9 and 10 unmarked. Anal appendages; superior as long as segment 10, inferiors slightly longer, very broad at base.

Females : coloured as in males except for segment 8, on which the basal annule is of even width, covering about one third of the segment.

Material examined/Source : 1♀, Nagve, North Goa, 19-01-2002, Coll. P.P. Kulkarni.

Distribution : India : North East India and Western Ghats.

Family PLATYCNEMIDIDAE

Subfamily PLATYCNEMIDINAE

Genus ***Copera*** Kirby, 1890

15. **Copera marginipes*** (Ramb.)

1842. *Platycnemis marginipes* Rambur *Ins. Neurop*, : 240.

1933. *Copera marginipes*, Fraser, *Fauna Brit, India. Odon.*, **1** : 192-197.

Diagnostic characters : Labium pale brownish white, labrum pale greenish yellow, frons and vertex bronzed black, eyes bordered with white stripes. Prothorax and thorax bronzed black on dorsum, legs variably bright orange to dull reddish. Wings hyaline, pterostigma brown. Abdomen bronzed black upto middle of segment 8, from which to the end pale bluish white to creamy white. Superior anal appendages only one fourth the length of inferiors. Fraser (1933) has described Ceylon, Coorg, Westcoast, Deccan, Assam & Bengal forms with variation in colour patterns.

Material examined/Source : 1 ♀, Kaley village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni. 1 ♀, Keri nala, Goa, 11-11-2002, Coll. P.D. Rane.

Distribution : India : (Assam, Bihar, Chandigarh, Madhya Pradesh, Maharashtra (Lone, Pune, Khandala, Hingoli, Wardha, Gondhonkher, Buldhana), Rajasthan, South Andaman Islands, West Bengal, Western Ghats & Western Himalaya).

Elsewhere : Indonesia; Malaysia; Myanmar; Nepal; Sri Lanka and Thailand.

Family PROTONEURIDAE

Subfamily DISPARONEURINAE

Genus ***Elattoneura*** Cowley, 1935

16. ***Elattoneura tetrica*** (Laidlaw)

1917. *Disparoneura tetrica* Laidlaw, *Rec. Ind. Mus.*,**13** : 323, 345, 346.

1923. *Disparoneura tetrica*, Fraser, *J. Bombay Nat. hist. Soc.*, **29** : 743.

1933. *Disparoneura tetrica*, Fraser, *Fauna Brit. India : Odonata*, **1** : 235–236.

1995. *Elattoneura tetrica*, Prasad and Varshney, Oriental Ins., **29** : 394.

Diagnostic characters : Labium brown, labrum dark brown, genae and anteclypeus palest blue; rest of the head velvety black; yes capped with black, pale beneath. Prothorax black, thorax velvety black with creamy white markings on the hinder border and posterio lateral suture, pale yellow beneath; heavily bordered with black. Legs black, the flexor surfaces of all tibiae bright yellow. Wings hyaline, th outer one ifth more or less palely enfumed, pterostigma dark, blakish brown, covering from 1 to 1½ cells. Abdomen black, thinly pruinosed on the basal segment in adult, segments 3–6 or 7 with minute baso-dorsal paired pale bluish spots. Anal appendages black.

Material examined / Source : 1 ♂, Kalay village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni.

Distribution : Western Ghats of India.

Superfamily LESTOIDEA

Family LESTIDAE

Subfamily LESTINAE

Genus ***Lestes*** Leach, 1815

17. ***Lestes elatus*** Hagen

1858. *Lestes elata* Hagen, *Verch. zool. bot; gest Wien*, **8** 478.

1890. *Lestes elatus*, Kirby, *Cat. Odon.*, 162.

1929. *Lestes elata elata*, Fraser, *J. Bombay Nat. Hist. Soc.*, **33** : 845–847.

1933. *Lestes elata*, Fraser, *The Fauna of British India Odonata*; (1) : 37–40.

1995. *Lestes elatus*, Prasad and Varshney, *Oriental Ins.*, **95** : 395.

Diagnostic characters : Head : labium white, labrum, bases of mandibles, cheeks, and anteclypeus blue; post clypeus olivaceous, marked with a small triangle of reddish brown, bordered with black; frons olivaceous green, vertex between the ocelli and bases of antennae black; eyes turquoise blue. Prothorax with mid dorsum olivaceous, with a longitudinal diffuse brown subdorsal stripe on each side. Thorax dark reddish brown to almost black, heavily pruinosed at the sides and white beneath, dorsum marked with a pair of narrow antehumeral metallic green stripe. Legs pale yellow, with a black stripe on the outer side of femora, tarsi black. Wings hyaline, pterostigma black, covering two cells. Abdomen pale yellow to bluish green marked broadly on dorsum with metallic green. Segments 7–8 broadly dark brown to black. Anal appendages creamy

yellow, black with apices tipped with yellow hairs. Inferiors very short about one third the length of superiors, rounded at base, conical.

Female resembles males.

Material examined/Source : 1 ♀, Molem (Goa), 14-12-1973, Coll. B.S. Lamba.

Distribution : India : Karnataka, Orissa and Peninsular India.

18 **Lestes viridulus* Rambur

1842. *Lestes viridula* Rambur, *Hist. Nat. Ins. Neurop.*, 252-253.

1890. *Lestes viridulus*, Kirby. *Cat Odon.*, 163.

1995. *Lestes viridulus*, Prasad and Varshney, *Oriental Ins.*, **29** : 395.

Diagnostic characters : Labium pale yellow, Labrum, clypeus, frons, vertex and occiput pale brown, behind the eyes pale yellow; eyes brown above, golden yellow below, prothorax pale brown uniformly, thorax pale yellow; dorsum of thorax with two very narrow conspicuous metallic green stripes running parallel. Legs pale yellow with black spines. Abdomen pale yellow at sides and almost white beneath. Anal appendages yellow, tipped with black. Females coloured as in males with a longitudinal black stripe on all femora.

Material examined/Source : 1 ♂, Hiware, Sattari, North Goa, 20-01-2002, Coll. P.P. Kulkarni. 1 ♀, Dhapodem Beat range, Kurdi, South Goad, 25-01-2002, Coll. P.P. Kulkarni.

Distribution : Throughout India.

Elsewhere : Thailand.

Remarks : Common in dry season and usually among dry long grasses. Recorded from Maharashtra State, Poona, Khandala, Chenchni, Dist. Satara (Prasad, 1996).

Key to the families of Superfamily CLAOPTERYGOIDEA

1. Two primary antenodal cross veins easily distinguishable from the secondaries; Petiolation of wings ending for proximal to the level of arc..... CHLOROCYPHIDAE

– Two primary antenodal cross viens not distinguishable from the secondaries; 1st lateral suture of synthorax well developed, tracable even beyond spiracle .... CALOPTERYGIDAE

Superfamily CALOPTERYGOIDEA

Family CALOPTERYGIDAE

Subfamily CALOPTERYGINAE

Genus *Neurobasis* Selys, 1853

19. **Neurobasis chinensis chinensis* (Linn.)

1758. *Libellula chinensis* Linnaeus, **1** : 545.

1853. *Neurobasis chinensis*, Selys, *Syst. Cal.*, 18.

1915. *Neurobasis chinensis chinensis*, Ris. *Tijdsch. Ent.* **58** : 6.

1934. *Neurobasis chinensis chinensis*, Fraser, *Fauna of Brit. India*, Odonata, **2** : 121-124

1981. *Neurobasis chinensis chinensis*, Kumar and Prasad, *Rec. zool. Surv. India Occ. Paper*, **20** : 46.

1987. *Neurobasis chinensis chinensis*, Lahiri, *Rec. Zool. Surv. India, Occ. Paper*, **99** : 48–50.

2001. *Neurobasis chinensis chinensis*, Prasad and Kulkarni, *Fauna of Nilgiri Biosphere Reserve, Fauna of conservation Area Series*, **11** : 77. *Zool. Surv. India.*

Diagnostic characters : Head : Labium with middle lobe whitish, lateral lobes metallic green, labium blue, with a large triangular medio basal black spot; cheeks and bases of mandibles pale blue, anteclypeus with a small median yellow spot. Prothorax bronzy green with coppery reflex; thorax brillient metallic green humeral and anterior-lateral stripes blackish-brown; legs very long and slim; femora dark bronze, white on flexor surface, tarsi black. Wings moderately rounded at apices; forewings considerably longer than hind wings, hyaline tinted with pale yellowish green along costa and at apex. Neuration emerald green, node thickened and narrlwly clouded with brown; hind wings opaque. In males forewing partly opaque matellic blue or green. Abdomen narrow and cylindrical, much longer than wings, metallic bronzy green above and at sides, intersegmental joints brighter emerald-green, finely bordered with black, beneath black segments 9 and 10 whitish.

Anal appendages black. Female differs in many respects from male. Head : labium pale yellow, white at base; labrum, cheeks, bases of mandibles, lower two thirds of eyes, two basal segments of antennae greenish yellow; post clypeus metallic green; upper two thirds of eyes brownish black; rest of the head brilliant metallic green. Prothorax and thorax as in male with difference in colours of humeral, lateral, posterio-lateral sutures which are white. Legs as in males. Wings tinted with yellow, palely enfumed with brown, specially at apices, generally deeper in tint throughout hind wings. All wings with an opaque creamy yellow patch at node. Abdomen dull metallic bronzy green with golden reflections on dorsum, black beneath. Anal appendages stout, conical pointed shorter than segment 10.

Material examined/Source : 1♂, Kalay village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni.

Distribution : India : Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Tamil Nadu, Uttar Pradesh, Bengal.

Elsewhere : Indonesia; Malaysia; Myanmar; Sri Lanka.

Genus ***Vestalis*** Selys, 1853

20. ****Vestalis apicalis apicalis*** Selys

1873. *Vestalis apicalis* Selys. *Bull. Acad.Belg.*, (2)**36** : 612.

1921. *Vestalis apicalis* Fraser, *J. Siam. Soc.*, **4** : 164.

1933. *Vestalis apicalis apicalis* Fraser, *Fauna Brit. India* : *Odonata*, **2** : 128–130.

1995. *Vestalis apicalis apicalis* Prasad & Varshney, *Oriental Ins.*, **29** : 397.

Diagnostic characters : Head : Labium, labrum, cheeks, bases of mandibles and basal joints of antennae bright yellow, rest of head metallic emerald green. Posterior lobe of prothorax more conspicuously bordered with yellow. Wings hyaline, apices of all wings broadly tipped with blackish brown for about distal 5 mm. Abdomen as in *Vestalis gracilis gracilis* (Rambur). Anal appendages black. Females closely similar to males, abdomen more coppery and less metallic. Apical markings on the wings usually paler and less sharply defined.

Material examined/Source : 1♀ Kalay village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni.

Distribution : India : Western and Eastern Ghats, West Bengal, Asam.

Elsewhere : Myanmar, Thailand.

Remarks : This species was recorded from Sanjay Gandhi National Park, Borivali, Mumbai Maharashtra State (Kulkarni *et al.*, 2006).

21. ***Vestalis gracilis gracilis*** (Rambur)

1842. *Calopteryx gracilis* Rambur, *Ins. Neorop.*, : 224

1934. *Vestalis gracilis gracilis* Fraser, *Fauna Brit. India. Odon.*, **2** : 126–128.

1988. *Vestalis gracilis gracilis* Prasad and Varshney, *Rec. zool. Surv. India, Occ. Paper*, **110** : 13-14.

Diagnostic characters : Head : labium, labrum, bases of mandibles, cheeks, basal segments of antennae bright yellow. Eyes: upper two thirds portion dark brown, the rest greenish yellow. Thorax brilliant metallic emerald green. Legs pale to dark brown. Wings hyaline, iridescent with colour of mother of pearl or blue in some, light uniformly so. Abdomen metallic green or blue. Anal appendages black. Females exactly similar to males in colour, but abdomen usually more dully metallic and segments 8 to 10 yellow laterally.

Material examined/Source : 7♂♂, 2♀♀ Hiware, Sattari, North Goa, 20-01-2002, Coll. P.P. Kulkarni. 4♂♂, 7♀♀, Nagve, North Goa, 19-01-2002, Coll. P.P. Kulkarni. 1♀, Kotegaon forest area, 28-01-2002, Coll. P.P. Kulkarni. 1♀, Kodal, Sattari, North Goa, 21-01-2002, Coll. P.P. Kulkarni. 2♂♂, 1♀, Kalay Village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni. 2♂♂, 3♀♀, Fanasmal, Sanguem, Goa, 23-01-2002, Coll. P.P. Kulkarni.

Distribution : India : Western and Eastern Ghats, West Bengal.

Elsewhere : Myanmar, Thailand.

Family CHLOROCYPHIDAE

Genus ***Rhinocypha***, Rambur, 1842

22. **Rhinocypha (Heliocypha) bisignata*** (Selys)

1853. *Rhinocypha bisignata* Selys, *Syn. Cal.*, 62.

1890. *Rhinocypha bisignata*, Kirby, *Cat. Odon.*, 113.

1934. *Rhinocypha bisignata*, Fraser, *Fauna of Brit. India* : *Odonata*; **2** : 49–52.

1995. *Rhinocypha (Heliocypha) bisignata*, Prasad and Varshney, *Oriental Ins.*, **29** : 397.

2001. *Rhinocypha (Heliocypha) bisignata*, Prasad and Kulkarni, *Fauna of Nilgiri Biosphere Reserve, Fauna of Conservation Area Series*, **11** : 77. *Zool. Surv. India.*

Diagnostic characters : Head : eyes brown, rest of head velvety black. Prothorax black, with a large yellow spot on each side of middle lobe, a similar spot on outer end of posterior lobe and a large rosepink spot covering dorsum of the same lobe. Thorax black, mesothoracic triangle rose pink, a large spot of same colour lying between humeral suture and mesothoracic triangle; Beneath three pairs of yellow spots, legs black, two posterior pairs of femora pruinoised white on flexar surfaces, wings long and narrow. Fore wings with outer fourth or more opaque, brilliant coppery or with fiery reflex, with its inner border prolonged slightly basally between costa and Ri and running obliquely out towards hind border of the wing. Hind wing with outer third opaque and marked with two series of vitreous spots which glow with coppery reflex. The inner spot with always violateous in colour. Details of colours and extension of spots as described (Fraser 1934). Female with labium bluish green, tipped with black, labrum black with a large oval triangular yellow spot on each side; prothorax black with a large yellow spot on each side, with borders of posterior lobe yellow. Thorax as in male. Legs black, wings entirely hyaline, tinted palely with yellow, apices narrowly enfumed, pterostigma black. Abdomen black, marked with yellow as in male.

Material examined/Source : 1♂, Lolagam–Maxem, Goa, 24-11-1993, Coll. P.D. Rane,. 1♂, 1♀, Hiware, Sattari, North Goa, 20-01-2002, Coll. P.P. Kulkarni.

Distribution : India : Maharashtra, Southern and Peninsular India.

Genus ***Libellago*** Selys, 1840

23. **Libellago lineata indica*** (Fraser)

1919. *Micromerus lineatus* Fraser, *Rec. Ind. Mus.* **15** : 197–198.

1924. *Micromerus lineatus*, Laidlaw, *Spolia Zeylanica* **12** : 354, 355.

1928. *Micromerus lineatus indica*, Fraser, *J. Bombay Nat. Hist. Soc.*, **32** : 686–687.

1934. *Libellago lineata indica*, Fraser, *Fauna of Brit. India* : *Odon.*, (2) : 63–65.

1995. *Libellago lineata indica*, Prasad & Varshney, *Oriental Ins.*, **29** : 398.

Diagnostic characters : Head : labium ochreous, labrum dark brownish yellow, black at base; epistome black, frons and vertex velvety black, with two transverse yellow spots in two pairs, a crown shaped mark on occiput. Prothorax black, marked with citron yellow, a large transversely oval spot on dorsum of posterior lobe. Thorax blacked marked with citron yellow, yellow beneath. Legs black, flexer surfaces of tibiae and anterior pair of femora pruinosed white. Wings as a typical *L. lineata* but apical black spot of forewings distinctly longer. The amber tinting at base usually very marked upto or even beyond node. Abdomen, segment 1 bright golden-yellow with the base narrowly black, 2 to 6 bright citron yellow, dorsum golden green, 6 and 7 with basal sub-dorsal wedge shaped yellow spots, 8 to 10 black. Anal appendages, black, superiors almost twice the length of segment 10 and inferiors only half the length of superiors.

Female : Labium yellow, labrum yellow with a small median basal black point, epistome entirely yellow, frons with two large quadrate citron yellow spots separated by a black median stripe, rest of the markings similar to male but an additional pair of spots situated between ocelli, Eyes brown, Prothorax and thorax similar to male. Legs yellow, femora lined externally with dark brown. Abdomen largely yellow with black markings, segment 10 black with two transversely elongate subdorsal

yellow spots. Wings hyaline, pale with amber tint. Anal appendages blackish brown, pointed.

Material examined/Source : 1♂, 2♀♀, Kalay Village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni.

Distribution : India : Karkataka, Kerala, Maharashtra and Western Ghats.

Suborder ANISOPTERA

Key to the superfamilies of Suborder ANISOPTERA

1. Eyes separated except in family Aeschniidae. Zygopterous ovipositor present except in members of Gomphidae ..... *Aeshnoidea*

– Eyes more or less broadly confluent and occupy major part of globular head. No conspicuous ovipositor. Exophytic oviposition ..... *Libelluloidea*

Superfamily AESHNOIDEA

Family GOMPHIDAE

Subfamily ONYCHOGOMPHINAE

Genus ***Paragomphus***, Cowley, 1934

24. ****Paragomphus lineatus*** (Selys)

1850. *Gomphus lineatus* Selys, *Rev. Odon.*, : 386.

1854. *Onychogomphus lineatus*, Selys, *Bull. Acad. Belg.* **Xxi**(2) : 36

1924. *Mesogomphus lineatus*, Fraser, *Rec. Indian. Mus.*, Xxvi, 427, 477.

1995. *Paragomphus lineatus*, Prasad & Varshney, *Oriental Ins.*, **29** : 402.

Diagnostic characters : Labium, labrum, face & frons sandy yellow, vesicle and occiput yellow, separated by narrow, transverse dark brown streak. Prothorax blackish brown, thorax sandy yellow,legs yellow, marked with black, tarsi black, femora with two rows of spines. Abdomen black marked with yellow, anal appendages yellow. Females closely resemble males, much paler than males.

Material examined/Source : 1♂, Keri Nala, 11-11-2002, Coll. P.D. Rane.

Distribution : India : Bihar, Haryana, Himachal Pradesh, Meghalaya, West Bengal, Dehradun (Uttaranchal), Poona, Khandala, Satara, (Maharashtra), Madras, Palaghat, Trichinopally, Coorg and the Nilgiris.

Elsewhere : Myanmar, Nepal.

Remarks : Breeds both in still and running waters, camoflages with surroundings and a bit difficult to catch. Pale and dark forms are recorded in summer & monsoon.

Superfamily LIBELLULOIDEA

Family LIBELLULIDAE

Subfamily LIBELLULINAE

Genus ***Orthetrum***, Newman, 1833

25. ****Orthetrum glaucum*** (Brauer)

1865. *Libellula glauca* Brauer, *Varh. Zool. bot. Ges. Wien.* **15** : 1012.

1890. *Orthetrum glaucum*, Kirby, *Cat. Odon.*, 39.

1936. *Orthetrum glaucum*, Fraser, *Fauna Brit. India. Odon.* **3** : 307–309.

Diagnostic characters : Medium sized dragonfly with face black, eyes, dark green during life. Prothorax bright yellow to dark brown, marked with yellow; thorax in old adults pruinosed dark dull blue or black. Legs black, wings hyaline, with extreme base tinted with dark amber-yellow upto the cubital nervure and up to anal triangle in hind wing; discoidal cell of hind wing entire. In female abdomen reddish brown with a broad greenish yellow stripe on mid dorsum extending up to segment 7 as against in males, pale dirty blue up to apical end of segment 8 & black for the remainder.

Material examined/Source : 1♂, 1♀, Chorlium, Goa, 9-11-2002, Coll. P.D. Rane. 1♀, Stream 10 kms on the way to Phonda, 28-2-2002, Coll. S.G. Patil.

Distribution : India : West Coast, Western Himalaya, Manipur, Meghalaya, Arunachal Pradesh, Mizoram.

Elsewhere : Sri Lanka, Nepal, Philippines, and Java.

Remarks : This species is found at altitudes up to 4000' and recorded only on West coast in plains. Its occurance in Melghat Tiger Reserve confirms its dwelling in plains.

26. ***Orthetrum pruinosum neglectum*** (Rambur)

1842. *Libellula neglecta*, Rambur, *Ins. Neurop.*, 86.

1936. *Orthetrum pruinosum neglectum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 311–313.

Diagnostic characters : Head, with reddish brown colour progressively dark from labium to frons and up to vesicle & occiput; eyes blue black above, bluish-gray below during life. Prothorax and thorax reddish brown, legs black, wings hyaline with enfumed pale brown towards apices and with a reddish-brown basal marking in hind wing. Abdomen bright vermilion red in sub adults, purplish red in adults. Anal appendages red. Famales differ from males in frons similar to rest of face in colour, eyes yellowish capped with brown. Thorax reddish brown, abdomen dull ocherus with sutures and borders all finely black, anal appendages dark ocherus and basal markings in wings pale and almost obsolete.

Material examined / Source : 1♂, Keri Nala, Goa, 11-11-2002, Coll. P.D. Rane, 1♀, Stream 10 kms on the way to Phonda, 28-02-2002, Coll. S.G. Patil.

Distribution : India : Himachal Pradesh, Bilaspur, Kangra, Kinnaur, Kulu, Srimaur, Solan, Uttar Pradesh Chamoli, Dehradun, Nainital, Pauri and Tehri Garhwal, Uttarkashi; Bihar & Dhanbad.

Elsewhere : Nepal; Myanmar; Sri Lanka; Hong Kong; Thailand and Malaya.

Remarks : Breeds in small tanks; recorded from altitude of 7,250' from Ooty, Nilgiris. Variation in nodal index is recorded in this species Melghat, SGNP, Pench, Tadoba, NBR.

27. ***Orthetrum sabina sabina*** (Drury)

1770. *Libellula sabina* Drury, *Ill. Exot. Int.*, **1** : 114.

1936. *Orthetrum sabina*, Fraser, *Fauna Brit. India, Odon.*, **3** : 300-302.

1995. *Orthetrum sabina sabina*, Prasad and Varshney, *Oriental Ins.*, 409.

Diagnostic characters : Labium yellow, middle lobe brownish to black; labrum face and frons yellowish, variably marked on anterior surface with black; frons very deeply notched so as to form two triangular facets in front. Prothorax bright yellow, thorax greenish yellow, legs black. Abdomen greenish yellow with very broad apical black rings on segments 4 to 5, narrow ring on segments 6; segments 7 to 9 and base of 10 black. Segments 1 and 3 enormously swollen dorso ventrally as well as laterally; 4 to 6 narrow, cylindrical, 7 to 9 dialated but compressed laterally; 10th very small. Anal appendages as long as segment 9. Females exactly like males.

Material examined/Source : 1♀, Cancona, Goa, 27-11-1993, Coll. P.D. Rane, 1♂, Stream 1 km after Chandor village, 02-03-2002, Coll. S.G. Patil. 1♂, Khargel, Paigiam, South Goa, 27-01-2002, Coll. P.P. Kulkarni.1♂, 1♀, Bhagwan Mahavir Sanctuary, Goa, 30-11-1993, Coll. P.D. Rane. 1♀, Chikhalinou, Goa, 4-12-1993, Coll. P.D. Rane. 2♀♀, Cotigaon, Goa, 26-11-1993. Coll. P. D. Rane. 2♀♀, Cancona, Goa, 27-11-1993, Coll. P.D. Rane. 1♀, Molem Forest, Goa, 09-11-2002, Coll. P.D. Rane. 2♂♂, Arvellum, Goa, 10-11-2002, Coll. P.D. Rane.

Distribution : India : Bilaspur, Kangra, Sirmaur, Solan, Una, Dehra Dun, Nainital, Pauri Garhwal and Bihar Singhbhum, Dhanbad.

Elsewhere : Somalia (Somali Land); Iraq; Iran; Nepal; Sri Lanka; Burma; Thailand; Micronesia (Ocenia); Samoa Island (Pacific Ocean) Indonesia (Java, Sumba, Timor); Papua (New Guinea); Australia; Egypt; Angola and most of African continent.

Remarks : Found in all parts of India, up to 7000' (Nilgiri's), most predaceous; canabalism is also recorded and preys on other dragonflies also.

28. **Orthetrum taeniolatum*** (Schn.)

1845. *Libellula taeniolata*, Schneider, *Stett. Ent. Zeit.*, **6** : 111.

1936. *Orthetrum taeniolatum*, Fraser, *Fauna Brit. India, Odon.*, **3** : 296-298.

Diagnostic characters : Head : Labium, labrum, face, frons and vesicle palest brown; occiput dark brown, prothorax & thorax pulverulent blue; legs black, hinder surface yellow, wings hyaline not enfumed, pterostigma orchrous, between thick black nervures covering two and half cells. Abdomen pulverulent blue throughout. Anal appendages black. Female : differs widely from males, never purverulent. Face very pale, nearly white in many specimens. Prothorax dark brown, thorax pale brown. Abdomen olivaceous yellow. Anal appendages brown, shortly conical.

Material examined/Source : 1♂, Zuari river, Goa, 5-12-1993, Coll. P.D. Rane.

Distribution : Throughout India.

Elsewhere : Nepal and countries bordering Mediterranean Sea.

Genus ***Potamarcha,*** Karsch, 1890.

29. ***Potamarcha congener*** (Rambur)

1842. *Libellula obscura* Rambur, *Ins. Neurop* : 64.

1842. *Libellula congener*, Rambur, *Ins. Neurop* : 70.

1890. *Potamarcha obscura*, Karsch,*Berlin Ent. Zeit.* **33** : 371.

1891. *Potamarcha congener*, Selys, *An. Soc. Espan.* **20** : 221.

1936. *Potamarcha obscura*, Fraser, *Fauna Brit. India. Odon.*, **3** : 289-291.

1995. *Potamarcha congener*, Prasad & Varshney, *Oriental Ins.*, **29** : 410.

Diagnostic characters : The only species of the genus. Can be distinguished by arc situated between the first and second antenodal nervures; 2 rows of cells between I R iii and Rspl. and anal field of hind wing rather broad with cells arranged in straight rows. Wings hyaline, with extreme apices tipped with brown. They are dragonflies of moderate size, coloured black brown, marked with yellow but never of metallic colour. Anal appendages black.

Material examined/Source : Prasad, 1995.

Remarks : Common Species in India.

Subfamily SYMPETRINAE

Genus ***Brachythemis*** Brauer, 1868

30. ***Brachythemis contanimata*** (Fabr.)

1793. *Libellula contaminata*, Fabricius, *Ent. Syst.*, **2** : 382.

1936. *Brachythemis contaminata*, Fraser, *Fauna Brit. India. Odon.*, **3** : 365-366.

Diagnostic characters : Head : Labium pale orchreous; labrum reddish; face frons and vesicle olivaceous or pale green yellow, eyes broadly contigious; prothorax with dark reddish brown stripes traversing anterior and posterior borders of middle lobe, thorax with obscure brownish stripes, wings hyaline, reticulation reddish, with a broad bright orange fasica extending from base within 2-3 cells of pterostigma in fore wing and as far as that organ in the hind; pterostigma rust red. Only 6½ to 7½ antenodal nervures in forewings. Abdomen reddish-orchareous, marked with obscure dorsal and sub dorsal brown stripes. Females differ in colour, with hind wings very palely tinted with yellow at extreme base without orange fasica seen in the males, pterostigma bright ocherous. Abdomen pale olivaceous brown, with narrow black stripe on mid dorsal carina from segment 2 to end. Anal appendages yellow.

Material examined/Source : 1♂, Paigin, Goa, 25-11-1993, Coll. P.D. Rane.

Distribution : India : Himachal Pradesh : Bilaspur, Kangra, Sirmaur, Una, Uttar Pradesh: Dehradun, Nainital, Parui, Garhwal; Madhya Pradesh; Bihar: Dhanbad; West Bengal and East Himalaya, Maharashtra: Melghat Tiger Reserve, Amravati, Tadoba Andhari Tiger Reserve, Chandrapur, Osmanabad, Pune (Khandala, Khed and Lonavala).

Elsewhere : China; Indonesia; Malaysia; Myanmar; Nepal; Philippines; Singapore; Sri Lanka Taiwan and Thailand.

Remarks : It is common species in India and found in large numbers. Seen flying over water surface throughout year and recorded to undergo three generations annually.

Genus ***Crocothemis*** Brauer, 1868.

31. ****Crocothemis servilia servilia*** (Drury)

1770. *Libellula servilia*, Drury, *Ill. Ex. Ins.*, **1** : 16.

1936. *Crocothemis servilia servilia*, Fraser, *Fauna Brit. India*, Odon., **3** : 345–347.

Diagnostic characters : Head : Labium ferruginous; labrum blood red, anteclypeus pale red, rest of face and frons bright blood red; eyes during life blood red above, purple laterally. Prothorax and thorax ferruginous, often blood red on dorsum during life, legs ochreous, Wings, hyaline bases of all wings marked with rich amber yellow up to cubital nervure in forewing and to first antenodal neroure nearly to arc; apices of wings lined narrowly with pale brown in old specimens. Abdomen blood red. Anal appendages blood red.

Females differ widely in colouration from the males. Labium pale yellow; labrum, face, frons and vesicle olivaceous; prothorax and thorax olivaceous brown. Wings similar to males but markings paler, abdomen orchreous, segments 8 & 9 blackish along mid dorsal carina. Anal appendages ochreous.

Material examined/Source : 1♂, Arvellem, Goa, 10-11-2002, Coll. P.D. Rane.

Distribution : India : Himachal Pradesh : Kangra, Uttar Pradesh : Chamoli, Dehradun, Nainital, Pauri Garhwal, Madhya Pradesh, Bihar : Singhbhum, Dhanbad, West Bengal; Maharashtra : Buldana (Gondhonkher), Colaba (Matheran), Osmanabad (Upla), Pune (Khed and Lone) Melghat Tiger Reserve, Amravati ,Tadoba Tiger Reserve, Chandrapur, Satara (Lingmal Falls) and Tadoba Tiger reserve, Amravati.

Elsewhere : Iraq; Nepal; Myanmar, Sri Lanka, Philippines; Indonesia (Sumba); Australia, Sundaic Archipelago and Japan.

Remarks : Common species in India. Adults are seen throughout the year on wing. Teneral males and females are similar in colour, pale straw-yellow, differ from mature males, may confuse identity of the species.

Genus ***Diplacodes*** Kirby, 1889

32. ***Diplacodes trivialis*** (Rambur)

1842. *Libellula trivialis*, Rambur, *Ins. Neurop.*; 115.

1936. *Diplacodes trivialis*, Fraser, *Fauna Brit. India, Odon.*, **3** : 336-338.

Diagnostic characters : Head : Labium, labrum and bases of mandibles creamy yellow; face, frons, and vesicle palest azure blue with fine black line at the base of frons. Eyes contiguous over a short space. Prothorax pale brown to black; thorax greenish yellow with sutures finely black; the area between mid dorsal carina and humeral sutures olivaceous brown speckled with minute dots, colouration darkens with age. Legs greenish yellow, marked with black in subadults; wings hyaline with a minute yellow point in cubital space of hind wings, discoidal cell in hind wings entire. Abdomen with segments 1 to 3 greenish yellow; remaining segments black with sub dorsal yellow stripes on segments 4-7. Females : Similar to sub adult males, abdominal markings broader on segments 8 to 10.

Material examined/Source : 1♂, Stream 120 kms on the way to Phonda, 28-02-2002, Coll. S.G. Patil. 3♀♀, Hiware, Sattari, North Goa, 20-01-2002, Coll. P.P. Kulkarni. 1♂, Khotegaon Forest area, 28-01-2002, Coll. P.P. Kulkarni. 1♂, 4♀♀, Kodal, Sattari, North Goa, 21-01-2002, Coll. P.P. Kulkarni. 1♂, Gokarde, Cancona, South Goa, 29-01-2002, Coll. P.P. Kulkarni. 1♀, Vilian Kurdi, Bhati range, South Goa, 25-01-2002, Coll. P.P. Kulkarni. 2♂♂, Maxem aroung, Goa, 245-11-1993, Coll. P.D. Rane. 1♂, 3♀♀ Bhagwan Mahavir Sanctuary, Goa, 30-11-1993, Coll. P. D. Rane. 2♂♂, 1♀, Zuari River and around, 5-12-1993, Coll. P.D. Rane. 3♂♂, 1♀, Catigaon, Goa, 26-11-1993, Coll. P.D. Rane. 1♂, 3♀♀, Patridevi, Goa, 07-12-1993, Coll. P.D. Rane. 2♀♀, Paingin, Goa, 25-11-1999, Coll. P.D. Rane. 2♂♂, 1♀, Bondla Sanctuary, Goa, 29-11-1993, Coll. P.D. Rane.

Distribution : Throughout India.

Elsewhere : Nepal; Myanmar; Sri Lanka; Thailand; W. Malaysia (Malacca) and Indonesia (Sumatra).

Remarks : Common species found throughout the year near water bodies. Also found in grassy vegetation & agricultural fields.

Genus ***Neurothemis*** Brauer, 1867

33. ****Neurothemis fulvia*** (Drury)

1773. *Libellula fulvia* Drury, *Ill. Exot. Ins.*, **2** : 84.

1773. *Libellula sophronia*, Drury, Ill, *Exot. Ins.* **2** : 86.

1889. *Neurothemis fulvia*, Kirby, *Trans. Zool. Soc. Lond.*; **12** : 271.

1935. *Neurothemis fulvia*, Fraser, *Fauna Brit. India* : *Odonata*, **3** : 353–354.

1995. *Neurothemis fulvia*, Prasad and Varshney, *Oriental Ins.* **29** : 411.

Diagnostic characters : Labium creamy yellow; labrum bright ochreous; rest of face, frons, vesicle, occiput reddish brown; eyes dark reddish brown above, golden brown below; Prothorax thorax and abdomen uniform reddish brown. Sutures and borders of abdomen finely black. Legs and anal appendages dark ferruginous. Wings opaque, dark reddish brown from base to about middle of pterostigma, apex of wings also narrowly opaque brown to partly enclose a clear window in each wing at apex. The dark area presenting clear amber tinted areas in costal and basal spaces. Fraser (1936) observed isochromes to heterochromes females, those having paler ground colour of head, thorax and body and various pattern in wing colouration to the extent that apex of forewing completely clear. Wings clear, amber yellow with a dark ray in the accessory genital structures of specimens from Western Himalaya.

Material examined/Source : 1♂, Hiware, Sattari, North Goa, 20-01-2002, Coll. P.P. Kulkarni. 1♀, Bhagwan Mahavir Sanctuary, Goa, 30-11-1993, Coll. P.D. Rane. 3♂♂, Molem Forest, Goa, 9-11-2002, Coll. P.D. Rane.

Distribution : India : Assam, Bihar, Himachal Pradesh, Karkataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Nepal; China; Bangladesh; Myanmar; Malaysia; Indonesia; Thailand; Vietnam.

34. ****Neurothemis intermedia intermedia*** (Rambur)

1842. *Libellula intermedia*, Rambur, *Ins. Neurop* : **91**.

1936. *Neurothemis intermedia intermedia*, Fraser, *Fauna Brit. India, Odon.*, **3** : 357-358.

Diagnostic characters : Labium, bases of mandible, labrum, face, frons pale yellow; occiput and upper surface of eyes reddish-brown; eyes below golden yellow. Thorax with a distinct humeral reddish brown stripe, wings hyaline, palely tinted with yellow and with broad basal amber-yellow marking at the base of all wings. Abdomen bright reddish–orcheous with sutures on segment 2 & 3 finely darker, ventro-lateral brownish strip on segment 3–8. Females resemble males but with more defined ventro-lateral stripe.

Material examined / Source : 1♂, Stream 120 kms on the way to Phonda, 28-02-2002, Coll. S.G. Patil. 3♀♀, Hiware, Sattari, North Goa, 20-01-2002, Coll. P.P. Kulkarni. 1♂, Khotegaon Forest area, 28-01-2002, Coll. P.P. Kulkarni. 1♂, 4♀♀, Kodal, Sattari, North Goa, 21-01-2002, Coll. P.P. Kulkarni. 1♂, Gokarde, Cancona, South Goa, 29-01-2002, Coll. P.P. Kulkarni. 1♀, Vilian Kurdi, Bhati range, South Goa, 25-01-2002, Coll. P.P. Kulkarni. 2♀♀, Maxem aroung, Goa, 245-11-1993, Coll. P.D. Rane. 1♂, 3♀♀, Bhagwan Mahavir Sanctuary, Goa, 30-11-1993, Coll. P. D. Rane. 2♂♂, 1♀, Zuari River and around, 5-12-1993, Coll. P.D. Rane. 3♂♂, 1♀, Catigaon, Goa, 26-11-1993, Coll. P.D. Rane. 1♂, 3♀♀, Patridevi, Goa, 07-12-1993, Coll. P.D. Rane. 2♀♀, Paingin, Goa, 25-11-1999, Coll. P.D. Rane. 2♀♀, 1♂, Bondla Sanctuary, Goa, 29-11-1993, Coll. P.D. Rane.

Remarks: Pattern of marking on wings differentiate this species from all others within the genus. Prasad *et al.* (2000) recorded andromorphic female of this species from central India.

35. ****Neurothemis tullia tullia*** (Drury)

1773. *Libellula tullia*, Drury, *Ill. Exot.Ins.*, **2** 85

1781. *Libellula equestris*, Fabricius, *Spec.Ins.*, **1** 523

1793. *Libellula lineata*, Fabricius, *Ent. Syst.*, **2** : 375.

1936. *Neurothemis tullia tullia*, Fraser, *Fauna Brit. India, Odon.*, **3** : 360-362.

Diagnostic characters : Labium blackish brown, middle lobe and borders of lateral lobes paler brown; labrum, face, frons, vesicle and occiput black; eyes blackish-brown above, violaceous below. Prothorax, thorax and abdomen black, mid dorsal carina of thorax narrowly yellow, Legs black, tibiae yellow on extensor surface. Wings hyaline for apical half, opaque steely blue-black for basal half, the border of this opaque area running in both fore and hind wings from costal border, one cell distal to node in fore wings, two or three cells distal to node in hind wings in a convex curve., a broad opalescent white band bordering the black area in both wings, broad at costal border, tapering to posterior border, but not quite attaining to it.

Female differs from the male both in body colours and markings and in markings of the wings. Broad black apices of wings and sickle shaped stripe on basal half.

Material examined/Source : 1♂, Stream 1 km. from Chandor vill. 02-03-2002, Coll. S.G. Patil. 2♂♂, Canacona, Goa, 27-11-1993, Coll. P.D. Rane. 3♂♂, Polayam, Goa, 25-11-1993, Coll. P.D. Rane. 1♂, Cotigaon, 26-11-1993, Coll. P.D. Rane. 1♂, Patridevi, 8-12-1993, Coll. P.D. Rane.

Remarks : This species occurs in large colonies in swamps or heavily weeded tanks; it keeps close to the shelter of the herbage and has a weak fluttering flight. Prasad *et al.* (2000) recorded andromorphism in one female collected by A.S. Mahabal from Totladoh, Pench national Park, Nagpur, Maharashtra, on 12.10.1996. Later examination of other survey material revealed andromorphism in another specimen also, collected by M.S. Pradhan on 2.3.1999, from the same locality.

Subfamily TRITHEMISTINAE

Genus ***Trithemis*** Brauer, 1868

36. ****Trithemis aurora*** (Burmeister)

1839. *Libellula aurora* Burmeister, *Handb Ent.* **2** : 859.

1936. *Trithemis aurora*, Fraser, *Fauna Brit. India, Odon.*, **3** : 383-385.

Diagnostic characters : Head : Labium dark ochreous, labrum dark brown, face and front of frons ochreous, changing to reddish above; eyes crimson above, brown laterally changing to liliaceous beneath. Prothorax reddish brown; thorax dull purple with obscure superior humeral brown stripe and narrow black stripe on posterio-lateral suture; a short lower black line at the levels of spiracle; beneath olivaceous, marked with a black square with an angular black line crossing it. Legs black; wings hyaline with crimson reticulation and a broad amber-yellow fascia at base of wings with darker brown rays in subcostal and cubital spaces. Abdomen swollen dorso-ventrally at base; then constricted at segment 3 and again dilated fusiformally depressed and broad. Anal appendages red.

Female : Differs from male in colour and shape, with wings often broadly tipped with brown up to pterostigma; reticulation bright yellow to brown, basal markings similar to males. Abdomen subcylindrical & anal appendages black.

Material examined/Source : 1♂, 1♀, Kalay village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni. 2♀♀, Vilian-Kurdi, Bhati range, South Goa, 29-01-2002, Coll. P.P. Kulkarni. 1♂, Gokarde, Canacona, South Goa, 29-01-2002, Coll. P.P. Kulkarni. 1♂, Arvellum Goa, 10-11-2002, Coll. P.D. Rane. 1♂, Keri Nala, 11-11-2002, Coll. P.D. Rane.

Distribution : Throughout India.

Elsewhere : Pakistan; Nepal; Sri Lanka; Myanmar; West Malaysia : (Penang); Indonesia: (Borneo, Sulawesi, Java, Moluccas, Sumba, Sumatra, Timor) and Philippines.

Remarks : It is common species near hill streams, also recorded from plains in Maharashtra (Buldana, Osmanabad, Satara, Melghat Tiger reserve, Amravati, Tadoba-Andhari Tiger Reserve, Chandrapur and Wardha.).

37. ****Trithemis festiva*** (Rambur)

1842. *Libellula festiva*, Rambur, *Ins. Neurop*, 92.

1936. *Trithemis festiva*, Fraser, *Fauna Bri. India. Odon.*, **3** : 387–389.

Diagnostic characters : Head : Labium blackish brown, labrum, dark olivaceous; frons, dark brown in front; metallic violet above; prothorax dark blue; thorax black; legs black; wings hyaline with a dark brown mark at base of hind wings; abdomen black and appendages back. Females differ from adult males in labium face & frons dirty yellow, thorax greenish yellow, wings similar to males but in adults broadly drak reddish brown at apices, abdomen with a narrow mid dorsal stripe.

Material examined/Source : 1♂, Stream on the way to Arjuna dam, 25-2-2002, Coll. S.G. Patil. 2♂♂, Hiware, Sattari, North Goa, 20-01-2002, Coll. P.P. Kulkarni. 1♂, Kalay village near Molem Sanctuary, 24-01-2002, Coll. P.P. Kulkarni. 1♂, Keri Nala, Goa, 11-11-2002, Coll. P.D. Rane.

Distribution : India : Himachal Pradesh: Hamirpur, Kangra, Sirmaur, Solan; Uttar Pradesh: Chamoli, Dehradum, Nainital, Pauri and Tehri Garhwal, Uttar Kashi; West Bengal; Assam; Maharashtra: Khed, Pune, Matheran, Colaba, Poladpur, Lingmal falls, Mahabaleshwar, Bordharan, Tadoba Andhari Tiger Reserve, Chandrapur and Wanarvira Wardha,Rajpur, Gondhonkher, Buldhana and Melghat Tiger Reserve, Amravati.

Elsewhere : Nepal; Sri Lanka; Myanmar; West Malaysia: (Penang); Singapore; Indonesia : (Sulawesi, Java,Lesser Sunda, Sumatra); Philippines: Taiwan and Papua (new Guinea).

Remarks : It is a common species near hill streams. Adults breed in still waters or streams with sluggish current.

Subfamily TRAMEINAE

Genus ***Pantala*** Hagen, 1861

38. ***Pantala flavescens*** (Fabr.)

1798. *Libellula flavescens*, Fabricius, *Ent. Syst. Suppl.*, 285.

1839. *Libellula analis*, Burmeister, *Handb. Ent.*, **2** : 852

1936. *Pantala flavescens*, Fraser, *Fauna Brit. India, Odon.*, **3** : 414–416.

1995. *Pantala flavescens*, Prasad and Varshney, *Oriental Ins.*, **29** : 413.

Diagnostic characters : Rather large sized and robust built dragonfly coloured ochreous or reddish and with uncoloured wings. Head large; eyes broadly contiguous; labium pale brown with borders dark brown, anteclypeus pale brown, post clypeus & frons bright golden yellow; eyes reddish brown above, lilaceous or bluish laterally and beneath; prothorax rich ochreous, bluish laterally a beneath; thorax olivaceous, coated thickly with yellowish downy hairs; legs black, bases & exterior of femora yellowish; wings hyaline, with base of hind wing pale golden yellow upto anal loop and with narrow apical brown spot limited to posterior border of wing. Abdomen bright ochreous, sides of segments 1-4 pale yellow, 8-10 with sharply defined black mid dorsal pyriform spots with narrow end of them at bases of segments. Anal appendages ochreous, changing black towards apex. Females similar to males, with eyes olivaceous brown above; face vivid cream yellow; wings often evenly and deeply enfumed and always without the brown spot. Abdomen more stout and robust.

Material examined/Source : 1♀, Zuari river around, 5-12-1993, Coll. P.D. Rane. 1♀, Patridevi, 8-12-1993, Coll. P.D. Rane.

Distribution : Circumtropical and subtropical in Distribution; Throughout India.

Elsewhere : China, Indonesia, Malaysia, Micronesia, Morocco, Myanmar, Sri Lanka and Thailand).

Remarks : Common species, breeds in marshes in foot hills, streams in agricultural fields. Large number of specimens emerge out and take to swarming from September to November/ December. Kulkarni, *et al.* (1999), reported this species predated by giant wood spider, *Nephila maculata* (Fabr.) at Ranidoh in Pench National Park.

Genus ***Tholymis*** Hagen, 1861

39. ***Tholymis tillarga*** (Fabr.)

1798. *Libellula tillarga*, Fabricius, *Ent. Syst.,Suppl* 285

1805. *Libellula pallida*, Palisot de Beauvais, *Ins. Afr. et Amer.* : 171.

1835. *Libellula bimaculata*, Desjardins, *Ann. Soc. Ent. France*, **4** : 4.

1936. *Tholymis tillarga*, Fraser, *Fauna. Brit. India, Odon.*, **3** : 411–413.

1980. *Tholymis paratillarga*, Singh & Prasad, *Zool. Beitrage*, **26**(1) : 65.

1995. *Tholymis tillarga*, Prasad & Varshney, *Oriental Ins.*, **29** : 413.

Diagnostic characters : Labium, labrum and face oilvaceous or pale yellowish-brown; frons and vesicle ochreous, but often with a chrimson flush; eyes brown capped with reddish, oilvaceous below; occiput dark, ochreous. Prothorax and thorax golden-yellow or olivaceous with a bright reddish suffusion on dorsum. Legs ochreous. Wings hyaline, with a broad fan-shaped, smoky golden-brown fascia extending from node to base of hind wing, very deep in colour at node and somewhat longitudinally striated, paling towards base and posterior border of wing, this fascia bordered distally by a broad oval opalescent white spot about 4 cells deep; pterostigma reddish-brown between dark nervures. Abdomen bright rust red, especially on dorsum, paler at sides of basal segments. Female closely similar to male differing in head and thorax olivaceous and without any reddish ting. Wings without any opalescent spot and the goldenbrown fascia very pale and obscure, abdomen olivaceous brown.

Material examined/Source : Prasad, 1995.

Distribution : Throughout India.

Elsewhere : Sri Lanka; Myanmar; Throughout Southern Asia; Australia; Tropical Africa and Madagascar.

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Zool. Surv. India
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INSECTA : MANTODEA

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INTRODUCTION

The mantid fauna (Insecta : Mantodea) of Goa state has not been studied so far. According to Mukherjee *et al.* (1995), India has a diverse fauna of mantids with about 162 species under 68 genera and 6 families, however, only one species (name not mentioned) is known to occur in Goa state. Here an attempt has been made to investigate the mantid fauna of Goa State based upon the study of the collections made from the area by various survey parties of Zoological Survey of India, Western Regional Station, Pune, during the year 1991–2002. The specimens were identified following Mukherjee *et al.* (1995) and are deposited in the collections of Zoological Survey of India, Western Regional Station, Pune.

Brief diagnosis and known distribution as per Mukherjee et al. (1995). Names of the families and genera, and additional distribution data, are as per the revised nomenclature (Ehrmann, 2002). All the species are being reported for the first time from Goa state. The following abbreviations are used in the text.

BL : Body Length
PN : Pronotum
FW : Forewing
(All Measurements are in mm.)

SYSTEMATIC LIST

Order MANTODEA
Family HYMENOPODIDAE
Subfamily ACROMANTINAE
1. *Ephestiasula pictipes* (Wood-mason)
Subfamily HYMENOPODINAE
2. *Creobroter laevicollis* (Saussure)
Family TARACHODIDAE
Subfamily TARACHODINAE
3. *Didymocorypha lanceolata* (Fabricius)
Family LITURGUSIDAE
Subfamily LITURGUSINAE
4. *Humbertiella ceylonica* Saussure
5. *Humbertiella indica* Saussure
Family MANTIDAE
Subfamily AMELINAE
6. *Elmantis trichomaliae* (Saussure)
Subfamily PARAMANTINAE
7. *Hierodula unimaculata* (Olivier)
8. *Rhombodera tectiformes* Saussure
Subfamily MIOMANTINAE
9. *Deiphobe* sp.

A detailed account of each species is as follows :

SYSTEMATIC ACCOUNT

Order MANTODEA
Family HYMENOPODIDAE
Subfamily ACROMANTINAE

1. ***Ephestiasula pictipes*** (Wood-mason)

1879. *Hestias pictipes* Wood-mason, *Proc. Asiatic Soc. Bengal* : 258.

Diagnosis : Vertex with a small tubercle above ocelli, marked with black spots, lateral lobes

pointed; pronotum dorso-medially black; outer margin of fore coxa with very minute spines; internal spines of fore femora black at tips, inferior internal lobes contain three pale yellow spots encased by black patch; patch present at upper border, tarsi internally black, in fore wings the coastal area opaque, greenish yellow and irregularly reticulate.

Measurements :

BL : 18 PN : 3 FW : 15

Material examined : 2 male, Lolayam-maxem, coll. P.D. Rane, 24.11.1993 (Reg. No. E/5313)

Distribution : India : Madhya Pradesh, Orissa, Uttar Pradesh, Maharashtra.

Elsewhere : Nepal.

Subfamily HYMENOPODINAE

2. ***Creobroter laevicollis*** (Saussure)

1870. *Creobotra laevicollis* Saussure, *Mitt. Schweiz. Entomol. Ges.*, **3** : 242.

1927. *Creobroter laevicollis* : Giglio-Tos, *Das Tierreich*, **50** : 557.

Diagnosis : Vertex with a spine. Prozona of pronotum denticulate. Fore coxae with 5-6 spines. Fore wing with a small yellow spot latero-basally, eye spot a little infront of middle and contains one black dot. Hind wing pink at base and costal area. Smoky patch is in the centre of wing.

Measurement :

BL : 31 PN : 7 FW : 27

Material examined : 1 male, Lolayam-maxem, coll. P.D. Rane, 24.11.1993 (Reg. No. E/5313)

Distribution : India : Andhra Pradesh, Assam, Meghalaya, Sikkim, West Bengal, Maharashtra.

Elsewhere : Indonesia : Java.

Family TARACHODIDAE

Subfamily TARACHODINAE

3. ***Didymocorypha lanceolata*** (Fabricius)

1798. *Mantis lanceolata* Fabricius, *Syst. Entomol. Suppl.*, : 191.

Diagnosis : Left lateral process of the vertex a little longer dorsally than right one, with a median suture along the entire length. Eyes slightly bulging and laterally placed. Frontal sclerite about 1.5x as long as wide in the middle, with two less prominent carinae; pronotum with supra coxal widening, a little broader anteriorly; carina of metazona thin, linear with a row of 4-5 black dots on either side; prosternum with a black middle line and two longitudinal grooves for reception of coxae. All legs with black dots, foreleg with a few black marks; a small longitudinal one on claw groove, one on femoral brush, one on mid-dorsal length of tibia; trochanter with a black dot externally, all spines of foreleg black at apex; tibia with 5 external spines from base to apex, the 2nd longer and the terminal one longest with considerable gaps between 1st, 2nd and 3rd.

Measurements :

BL : 33 PN : 8.9 FW : 30

Material examined : 1 ex., Lolayam-maxem, coll. P.D. Rane, 24.11.1993 (Reg. No.E/5313)

Distribution : India : Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu, Uttar Pradesh, Bihar, West Bengal, Maharashtra.

Elsewhere : Nepal, Sri Lanka.

Family LITURGUSIDAE

Subfamily LITURGUSINAE

4. ***Humbertiella ceylonica*** Saussure

1869. *Humbertiella ceylonica* Saussure, *Mitt. Schweiz. Entomol. Ges.*, **3** : 62.

Diagnosis : Body deep brownish. Frontal sclerite black. Superior margin less arched, light brown; longer internal spines of fore femur black, external spines black at tips only, five in number; fore wing longer than body.

Measurement :

BL : 34 PN : 7 FW : 19

Material examined : 1 female, near fresh water pond, maxem, tal. Cancana, 19.9.93, Coll. M.S. Pradhan (Reg. No.E/2382).

Distribution : India : Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh.

Elsewhere : Myanmar, Nepal, Sri Lanka.

5. ***Humbertiella indica*** Saussure

1869. *Humbertiella indica* Saussure, *Mitt. Schweiz. Entomol, Ges.*, **3** : 62.

Diagnosis : Body pale brown, Frontal sclerite brownish, superior margin straight; tubercles of pronotum more prominent, fore femur externally brown, internally with a black longitudinal line; black patches present on claw groove and inside of 1st external spine, internal spines black at tips only

Measurements :

BL : 26 PN : 4.9 FW : 23.5

Material examined : 1 male., Lolayem-maxem, coll. P.D. Rane, 24.11.1993 (Reg. No. E/5313).

Distribution : India : Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh.

Elsewhere : Myanmar, Nepal, Sri Lanka.

Family MANTIDAE

Subfamily AMELINAE

6. ***Elmantis trincomaliae*** (Saussure)

1869. *Gonypeta trincomaliae* Saussure, *Mitt. Schweiz. Entomol. Ges.*, **3** : 63.

Diagnosis : Body grayish brown. Frontal sclerite blackish, superior border arched; pronotum with a tooth at broadest points of supra-coxal dilation; metazona constricted after more flattened prozona; prosternum with a large oval black patch. In forelegs, femora indistinctly with 3 brown bands; bands more distinct on tibiae; tibiae with 10 external spines.

Measurements :

BL : 20 PN : 3.9 FW : 18

Material examined : 1 male., Baruse village stream, 6.3.2002, coll. S.G. Patil (Reg. No. E/4838), 1 ex., stream near katol village, 4.3.2002, coll. S.G. Patil (Reg. No. E/4837).

Diatribution : India : Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu

Elsewhere : Sri Lanka.

Family MANTIDAE

Subfamily PARAMANTINAE

7. ***Hierodula unimaculata*** (Olivier)

1792. *Mantis unimaculata* Olivier, *Enc. Meth.*, **7** 640

1927. *Hierodula (Hierodula) unimaculata*, Giglio-Tos. Das Tierreich, **50** : 445.

Diagnosis : Frontal sclerite pentagonal, bicarinate; pronotum slender, dilation oval; metazona gradually narrow, prozona about one third of metazona. In forelegs, coxae with 5-6 sharp, small, tubercular, pre-marginal spines. All spines of femora black at tip, internal tips of tarsi black.

Measurements :

BL : 57 PN : 20.5 FW : 45

Material examined : 1 male, near freshwater pond, maxem, tal. Canacona, coll. M.S. Pradhan, 19.9.1993, (Reg. No. E/2380), 1 male, forest rest house around Painginium, M.S. Pradhan, 19.9.1993), E/2381)

Distribution : India : Karnataka, West Bengal, Maharashtra

Elsewhere : China, Myanmar, Indonesia, Vietnam, Java, Sri Lanka

Family MANTIDAE

Subfamily PARAMANTINAE

8. ***Rhombodera tectiformis*** Saussure

1870. *Rhombodera tectiformis* Saussure, *Mitt Schweiz Entomol. Ges.*, **3** : 232.

Diagnosis : Frontal sclerite with spiniform tubercle at superior corner. Pronotum oval, margins denticulate. In forelegs, coxae extending beyond the extremity of prosternum, 10-12 spines and alternate with 4-5 smaller spines; femora without any band on the outer face, larger internal

spines black at tips only and bases with reddish bands; a reddish patch at the claw groove. Discoidal area of forewing irregularly hyaline along costal vein.

Measurements :

BL : 67 PN : 18.5 FW : 54

Material examined : 1 male., Lolayam-maxem, coll. P.D. Rane, 24.11.1993 (Reg. No. E/5313)

Distribution : India : Maharashtra, Bihar, Sikkim, Tamil Nadu, West Bengal.

Family MANTIDAE

Subfamily MIOMANTINAE

9. ***Deiphobe*** sp.

Material examined : 1 nymph, Khotegaon area, 28.1.2002, coll. P.P.Kulkarni, (Reg. No. E/4792)

SUMMARY

The present study records 9 species of mantids belonging to 8 genera and 4 families from Goa state. In addition Dr. H.V. Ghate (Personal communication) has studied two more species from Goa which where collected by Mr. And Mrs. Ranganekar. The species are *Gongylus gongylodes* (Linnaeus) and *Hestiasula brunneriana* Saussure. Thus, a total of 11 species of mantids are now known to occur in Goa state. All the species are reported for the first time from Goa state. Goa has diverse ecosystems and rigorous surveys during different seasons will definitely reveal additional species and thus add to the known distribution of Mantodea of India.

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Zool. Surv. India
Fauna of Goa, State Fauna Series, **16** : 199-210, 2008

INSECTA : LEPIDOPTERA : RHOPALOCERA AND GRYPOCERA

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INTRODUCTION

The butterflies being phytophagous insects with fair degree of food and host plant specificity, their species diversity and richness is indicative of floral diversity of the habitat in which they occur and decline in the diversity of these fascinating insects suggests the habitat degradation. It is estimated that the Indian region harbours 1641 species of butterflies representing roughly 9.50 % of the total world occurrence (Varshney, 2006). Earlier excellent works of Bell (1909-1927) detailing about 250 species from the Western Ghats still remains valid. Another dedicated work on butterflies of Nilgiri Mountains of Southern India covering Tamil Nadu, Kerala & Karnataka by Larsen (1987-88) providing an account of 229 species is noteworthy. Recent authentic study on Butterflies of the Western Ghats including Sri Lanka by Goankar (1996) taking into account 330 species (about 20% of Indian diversity) belonging to 166 genera spread over five families is a classic work.

Out of 330 species recorded by Goankar (1996) from Western Ghats covering Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala, enumerated 251 species of 141 genera from Goa. Of which, 190 species are common, 61 rare and 7 species endemic to Western Ghats found in Goa. Thirteen species fall under different schedules of Indian Wildlife Act. The species (97) marked with asterisk(*) were actually collected by the second author while studying diversity of butterflies from Bondla Wildlife Sanctuary in Goa (Borkar & Komarpant, 2004) and the scientists of Western Regional Station, Zoological Survey of India, Pune during the faunistic surveys of the State both put together. Rangnekar (2007) depicted 90 species in his Photographic guide to Butterflies of Goa and provided a list of 35 probable species likely to occur in the limits of the State. The present compilation is based on Goankar (1996) and follows the classification and nomenclature given therein.

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SYSTEMATIC ACCOUNT OF BUTTERFLIES RECORDED FROM GOA

Sr. No.	Species Name	Common Name	Status
	Family PAPILIONIDAE Subfamily PAPILIONINAE Tribe **Troidini**		
1.	**Troides minos* Cramer	Southern Birdwing	Endemic to Western Ghats Schedule I
2.	*Pachliopta pandiyana* Moore	Malabar or Ceylon Rose	Rare in Goa
3.	**Pachliopta aristolochiae* (Fabricius)	Common Rose	
4.	**Pachliopta hector* (Linn.)	Crimson Rose	Schedule I
	Tribe **Leptocircini**		
5.	**Graphium sarpedon* (Linn.)	Common Bluebottle	
6.	**Graphium doson* C. & R. Felder	Common Jay	
7.	**Graphium agamemnon* (Linn.)	Tailed Jay	
8.	**Graphium nomius* (Esper.)	Spot Swordtail	Rare in Goa
9.	*Graphium antiphates* Cramer	Five-Bar Swordtail	Rare in Goa
	Tribe **Papilionini**		
10.	**Papilio clytia* (Linn.)	Common Mime	
11.	**Papilio demoleus* Linn.	Lime Butterfly	
12.	*Papilio liomedon* Moore	Malabar Banded Swallowtail	Rare in Goa
13.	*Papilio dravidarum* Wood-Mason	Malabar Raven	Rare in Goa. Endemic to Western Ghats
14.	**Papilio helenus* Linn.	Red Helen	
15.	**Papilio polytes* Linn.	Common Mormon	
16.	**Papilio polymnestor* Cramer	Blue Mormon	
17.	*Papilio paris* Linn.	Paris Peacock	Rare in Goa
18.	**Papilio buddha* Westwood	Malabar Banded Peacock	Rare in Goa Endemic to Western Ghats Schedule II
	Family PIERIDAE Subfamily COLIADINAE Tribe **Coliadini**		
19.	**Catopsilia pomona* (Fab.)	Common Emigrant	
20.	**Catopsilia pyranthe* (Linn.)	Mottled Emigrant	
21.	**Eurema brigitta* (Stoll)	Small Grass Yellow	
22.	*Eurema laeta* Boisduval	Spotless Grass Yellow	
23.	**Eurema hecabe* (Linn.)	Common Grass Yellow	

Sr. No.	Species Name	Common Name	Status
24.	*Eurema blanda* (Boisduval)	Three Spot Grass Yellow	
	Tribe **Pierini**		
25.	**Delias eucharis* (Drury)	Common Jezebel	
26.	**Leptosia nina* (Fabricius)	Psyche	
27.	*Prioneris sita* C. & R. Felder	Painted Sawtooth	
28.	**Cepora nerissa* (Fab.)	Common Gull	
29.	**Cepora nadina* (Lucas)	Lesser Gull	
30.	**Anaphaeis aurota* (Fab.)	Pioneer or Caper White	
31.	*Appias indra* (Moore)	Plain Puffin	Rare in Goa
32.	*Appias libythea* Fabricius	Striped Albatross	
33.	**Appias lyncida* Cramer	Chocolate Albatross	Rare in Goa Schedule II
34.	*Appias albina* Boisdual	Common Albatross	Rare in Goa
35.	*Appias wardi* Moore	Lesser Albatross	Rare in Goa
36.	*Colotis amata* (Fab.)	Small Salmon Arab	
37.	*Colotis etrida* (Boisduval)	Small Orange Tip	
38.	*Colotis eucharis* (Fab.)	Plain Branded Tip	
39.	*Colotis danae* (Fabricius)	Crimson Tip	
40.	*Colotis fausta* (Olivier)	Large Salmon Arab	
41.	*Ixias marianne* (Cramer)	White Orange Tip	
42.	*Ixias pyrene* Linn.	Yellow Orange Tip	
43.	**Pareronia valeria* Cramer	Common Wanderer	
44.	**Pareronia ceylanica* C.&R. Felder	Dark Wanderer	Rare in Goa
45.	**Hebomoia glaucippe* Linn.	Great Orange Tip	
	Family NYMPHALIDAE Subfamily MORPHINAE Tribe **Amathusiini**		
46.	*Discophora lepida* Moore	Southern Duffer	Rare in Goa
	Subfamily SATYRINAE Tribe **Melanitini**		
47.	**Melanitis leda* (Linn.)	Common Evening Brown	
48.	*Melanitis zitenius* Herbst.	Great Evening Brown	
49.	*Melanitis phedima* (Stoll)	Dark Evening Brown	
	Tribe **Elymniini**		
50.	* *Elymnias hypermnestra* (Linn.)	Common Palmfly	
51.	**Lethe europa* (Fabricius)	Bamboo Tree Brown	

Sr. No.	Species Name	Common Name	Status
52.	*Lethe drypetis* Hewitson	Tamil Tree Brown	Rare in Goa
53.	**Lethe rohria* (Fabricius)	Common Tree Brown	
54	**Mycalesis pereus* Fabricius	Common Bush Brown	
55	**Mycalesis mineus* (Linn.)	Dark Branded Bush Brown	Rare in Goa
56.	*Mycalesis patina* Eliot	Gladeye Bush Brown	
57.	**Orsotriaena medus* (Fabricius)	Nigger	Rare in Goa
	Tribe **Satyrini**		
58.	**Ypthima asterope* (Klug)	Common Threering	
59.	*Ypthima ceylonica* Hewitson	White or Ceylon Fourring	Rare in Goa
60.	**Ypthima huebneri* Kirby	Common Fourring	
61.	*Ypthima avanta* Moore	Jewel Fourring	Rare in Goa
62.	**Ypthima baldus* Fabricius	Common Fivering	
	Subfamily CHARAXINAE Tribe **Charaxini**		
63.	*Polyura athamas* (Drury)	Common Nawab	
64.	*Polyura agraria* Swinhoe	Anomalous Nawab	
65.	*Polyura schreiber* Godart	Blue Nawab	Rare in Goa
66.	*Charaxes bernardus* Fabricius	Tawny Rajah	
67.	*Charaxes solon* (Fabricius)	Black Rajah	
	Subfamily HELICONIINAE Tribe **Acraeini**		
68.	**Acraea violae* (Fab.)	Tawny Coster	
	Tribe **Heliconiini**		
69.	**Cethosia nietneri* Felder & Felder	Tamil Lacewing	Endemic to Western Ghats
70.	**Vindula erota* Fabricius	Cruiser	Rare in Goa
	Tribe **Argynnini**		
71.	**Cupha erymanthis* Drury	Rustic	
72.	**Phalanta phalantha* (Drury)	Common Leopard	
73.	*Phalanta alcippe* Stoll	Small Leopard	Rare in Goa
74.	**Cirrochroa thais* Fab.	Tamil Yeoman	Endemic to Western Ghats
	Subfamily APATURINAE Tribe **Apaturini**		
75.	*Rohana parisatis* Westwood	Black Prince	
76.	*Euripus consimilis* Westwood	Painted Courtesan	Rare in Goa
	Subfamily LIMENITINAE Tribe **Neptini**		
77.	**Neptis jumbah* Moore	Chestnut- Streaked Sailer	Schedule I

Sr. No.	Species Name	Common Name	Status
78.	**Neptis hylas* (Linn.)	Common Sailer	
79.	*Neptis clinia* Moore		Rare in Goa
80.	*Neptis nata* Moore	Clear Sailer	Rare in Goa
81.	**Pantoporia hordonia* Stoll	Common Lascar	
82.	*Pantoporia sandaka* Butler	Extra Lascar	Rare in Goa
	Tribe **Limenitini**		
83.	**Athyma nefte* Cramer	Colour Sergeant	
84.	*Athyma selenophora* (Kollar)	Staff Sergeant	Rare in Goa
85.	*Athyma perius* (Linn.)	Common Sergeant	
86.	**Limenitis procris* (Cramer)	Commander	
	Tribe **Parthenini**		
87.	**Parthenos sylvia* Cramer	Clipper	Rare in Goa Schedule II
	Tribe **Euthaliini**		
88.	**Tanaecia lepidea* (Butler)	Grey Count	Schedule II
89.	*Euthalia telchinia* Menetries	Blue Baron	Rare in Goa
90.	**Euthalia aconthea* (Moore)	Common Baron	Schedule II
91.	**Euthalia lubentina* Cramer	Gaudy Baron	Rare in Goa
92.	*Euthalia nais* (Forster)	Baronet or Red Baron	
93.	*Dophla evelina* Stoll	Red Spot Duke	
	Tribe **Biblini**		
94.	*Byblia ilithyia* Drury	Joker	
95.	**Ariadne ariadne* (Linn.)	Angled Castor	
96.	**Ariadne merione* (Cramer)	Common Castor	
	Tribe **Marpesiini**		
97.	**Cyrestis thyodamas*	Common Map	
	Subfamily **Libytheinae**		
98.	*Libythea myrrha* Godart	Club Beak	
	Subfamily NYMPHALINAE Tribe **Nymphalini**		
99.	**Junonia hierta* (Fab.)	Yellow Pansy	
100.	**Junonia orithya* (Linn.)	Blue Pansy	
101.	**Junonia lemonias* (Linn.)	Lemon Pansy	
102.	**Junonia almana* (Linn.)	Peacock Pansy	
103.	**Junonia atlites* (Linn.)	Grey Pansy	Rare in Goa
104.	**Junonia iphita* (Cramer)	Chocolate Pansy	
105.	**Cynthia cardui* (Linn.)	Painted Lady	

Sr. No.	Species Name	Common Name	Status
106.	**Hypolimnas bolina* (Linn)	Great Eggfly	
107.	**Hypolimnas misippus* (Linn.)	Danaid Eggfly	Schedule I
108.	*Doleschallia bisaltide* Cramer	Autumn Leaf	Rare in Goa
109.	**Kallima horsfieldi* Kollar	South Indian Blue Oakleaf	Endemic to Western Ghats
	Subfamily DANAINAE		
	Tribe **Danaini**		
110.	**Parantica aglea* (Stoll)	Glassy Tiger	
111.	**Tirumala limniace* (Cramer)	Blue Tiger	
112.	*Tirumala septentrionis* Butler	Dark Blue Tiger	
113.	**Danaus chrysippus* (Linn)	Plain Tiger	
114.	*Danaus genutia* (Cramer)	Striped or Common Tiger	
	Tribe **Euploeini**		
115.	**Euploea core* (Cramer)	Common Indian Crow	
116.	*Euploea sylvester* (Fab.)	Double-Branded Crow	Rare in Goa
117.	**Idea malbarica* Moore	Malabar Tree Nymph	Endemic to Western Ghats
	Family LYCAENIDAE		
	Subfamily RIODININAE		
	Tribe **Riodiniini**		
118..	**Abisara echerius* Stall	Plum Judy	
	Subfamily MILETINAE		
	Tribe **Spalgini**		
119.	*Spalgis epius* Westwood	Apefly	
	Subfamily POLYOMMATINAE		
	Tribe **Polyommatini**		
120.	**Castalius rosimon* (Fab.)	Common Pierrot	Schedule I
121.	**Caleta caleta* (Hewitson)	Angled Pierrot	
122.	*Discolampa ethion* Westwood	Banded Blue Pierrot	
123.	**Tarucus ananda* de Niceville	Dark Pierrot	Schedule IV
124.	*Tarucus callinara* Butler	Spotted Pierrot	Rare in Goa
125.	*Leptotes plinius* (Fabricius)	Zebra Blue	
126.	*Azanus ubaldus* Stoll	Bright Babul Blue	
127.	*Azanus uranus* Butler	Dull Babul Blue	
128.	*Azanus jesous* Guerin-Meneville	African Babul Blue	
129.	*Everes lacturnus* Godart	Indian Cupid	
130.	*Acytolepis puspa* Horsfield	Common Hedge Blue	
131.	*Neopithecops zalmora* Butler	Quaker	
132.	*Megisba malaya* Horsfield	Malayan	

Sr. No.	Species Name	Common Name	Status
133.	**Pseudozizeeria maha* (Kollar)	Pale Grass Blue	
134.	*Zizeeria karsandra* Moore	Dark Grass Blue	
135.	*Zizina otis* Fabricius	Lesser Grass Blue	
136.	*Zizula hylax* Fabricius	Tiny Grass Blue	
137.	*Chilades laius* Stoll	Lime Blue	
138.	*Chilades parrhasius* (Fabricius)	Small Cupid	
139.	**Chilades pandava* (Horsfield)	Plains Cupid	
140.	*Freyeria trochylus* (Freyer)	Grass Jewel	
141.	**Euchrysops cnejus* (Fabricius)	Gram Blue	Schedule II
142.	*Catochrysops strabo* (Fabricius)	Forget-Me-Not	
143.	**Lampides boeticus* (Linn.)	Pea Blue	Schedule II
144.	**Jamides bochus* Stoll	Dark Cerulean	
145.	**Jamides celeno* (Cramer)	Common Cerulean	
146.	*Nacaduba pactolus* Felder	Large 4-Lineblue	
147.	*Nacaduba hermus* Felder	Pale 4-Lineblue	
148.	*Nacaduba kurava* Moore	Transparent 6-Lineblue	
149.	*Nacaduba beroe* Felder & Felder	Opaque 6-Lineblue	
150.	*Prosotas nora* Felder	Common Lineblue	
151.	*Prosotas dubiosa* Semper	Tailess Lineblue	
152.	*Petrelaea dana* de Niceville	Dingy Lineblue	
153.	**Talicada nyseus* Guerin-Meneville	Red Pierrot	
154.	Tribe **Lycaenesthini** *Anthene emolus* Godart	Ciliate Blue	
155.	*Anthene lycaenina* Felder	Pointed Ciliate Blue	
156.	Subfamily THECLINAE Tribe **Aropalini** *Aropala psedocentaurus* (Doubleday)	Western Centaur Oak Blue	
157.	**Aropala amantes* (Hewitson)	Large Oak Blue	
158.	*Aropala alea* (Hewitson)	Rosy or Kanara Oak Blue	Rare in Goa
159.	*Aropala bazaloides* (Hewitson)	Tamil Oak Blue	Rare in Goa
160..	*Thaduca multicaudata* Moore	Many tailed Oak Blue	
161.	**Surendra quercetorum* Moore	Common Acacia Blue	
162.	*Zinaspa todara* (Moore)	Silverstreaked Acacia Blue	
163.	Tribe **Amblypodiini** *Iraota timoleon* (Stoll)	Blue Silver Streak	Rare in Goa

Sr. No.	Species Name	Common Name	Status
164.	*Amblypodia anita* Hewitson	Leaf Blue	
	Tribe **Aphnaeini**		
165.	**Spindasis vulcanus* (Fabricius)	Common Silverline	
166.	*Spindasis schistacea* (Moore)	Plumbeous Silverline	
167.	*Spindasis ictis* Hewitson	Shot Silverline	
168.	*Spindasis elima* (Moore)	Scarce Shot Silverline	
169.	*Spindasis lohita* Horsfield	Long Banded Silverline	
	Tribe **Catapaecilmatini**		
170.	*Catapaecilma major* Druce	Common Tinsel	Rare in Goa
	Tribe **Loxurini**		
171.	**Loxura atymnus* Stoll	Yamfly	
	Tribe **Cheritrini**		
172.	**Cheritra freja* Fabricius	Common Imperial	
	Tribe **Horagini**		
173.	**Rathinda amor* Fabricius	Monkey Puzzle	
174.	*Horaga onyx* Moore	Common Onyx	
175.	*Horaga viola* Moore	Violet / Brown Onyx	Rare in Goa
	Tribe **Zesiini**		
176.	*Zesius chrysomallus*	Red Spot	Rare in Goa
	Tribe **Iolaini**		
177.	*Ancema blanka* de Niceville	Silver Royal	
178.	*Creon cleobis* Godart	Broadtail Royal	Rare in Goa
179.	*Pratapa deva* (Moore)	White Royal	Rare in Goa
180.	*Tajuria cippus* (Fabricius)	Peacock Royal	
181.	*Tajuria jehana* Moore	Plains Blue Royal	
182.	*Tajuria melastigma* de Niceville	Branded Royal	Rare in Goa
183.	*Eliotia jalindra* Horsfield	Banded Royal	Rare in Goa
	Tribe **Hypolycaenini**		
184.	*Hypolacaena othona* Hewitson	Orchid Tit	
185.	**Zeltus amasa* Hewitson	Fluffy Tit	Rare in Goa
	Tribe **Deudorigini**		
186.	*Deudorix epijarbus* (Moore)	Cornelian	
187.	*Deudorix isocrates* (Fabricius)	Common Guava Blue	
188.	*Deudorix perse* Hewitson	Large Guava Blue	
189.	*Bindahara phocides*(Fabricius)	Plane	
190.	*Rapala iarbus* Fabricius	Indian Red Flash	

Sr. No.	Species Name	Common Name	Status
191.	*Rapala manea* Hewitson	Slate Flash	
192.	*Rapala varuna* Horsfield	Indigo Flash	
	Subfamily CURETINAE		
193.	*Curetis thetis* Drury	Indian Sunbeam	
194.	**Curetis acuta* Moore	Toothed Sunbeam	Rare in Goa
195.	*Curetis siva* Evans	Shiva Sunbeam	Rare in Goa
	Family HESPERIIDAE Subfamily COELIADINAE		
196.	*Bibasis jaina* Moore	Orange- Striped Awl	Rare in Goa
197.	*Bibasis gomata* Moore	Pale Green Awlet	Rare in Goa
198.	*Bibasis sena* (Moore)	Orange Tail Awl	Rare in Goa
199.	*Hasora chromus* Cramer	Common Banded Awl	
200.	*Hasora badra* Moore	Common Awl	
201.	*Hasora vitta* Butler	Plain Banded Awl	
202.	**Badamia exclamationis* (Fab.)	Brown Awl	
	Subfamily PYRGINAE		
203.	**Celaenorrhinus leucocera* (Kollar)	Common Spotted Flat	
204.	*Celaenorrhinus ambareesa* (Moore)	Malabar Flat	
205.	*Celaenorrhinus ruficornis* Mabille	Tamil Spotted Flat	
206.	*Tagiades japetus* Stoll	Suffused Snow Flat	
207.	*Tagiades gana* Moore	Large Snow Flat	
208.	*Tagiades litigiosa* Moschler	Water Snow Flat	
209.	*Gerosis bhagava* (Moore)	Common Yellow-breast Flat	Rare in Goa
210.	*Pseudocoladenia dan* (Fab.)	Pied Flat	
211.	**Coladenia indrani* Moore	Tricolour Pied Flat	Rare in Goa
212.	*Sarangesa dasahara* (Moore)	Common Small Flat	
213.	*Sarangesa purendra* (Moore)	Spotted Small Flat	
214.	*Tapena thwaitesi* Moore	Black Angle	
215.	*Odontoptilum angulata* (R. Felder)	Chestnut Angle	
216.	*Odontoptilum ransonnettii* (R. Felder)	Golden Angle	
217.	*Gomalia elma* Trimen	African Marbled Skipper	
218.	**Spialia galba* (Fabricius)	Indian Skipper	
	Subfamily HESPERIINAE		
219.	*Aeromachus pygmaeus* Fab.	Pigmy Scrub Hopper	Rare in Goa
220.	*Ampittia dioscorides* Fab.	Bush Hopper	

Sr. No.	Species Name	Common Name	Status
221.	*Halpe homolea* Hewitson	Indian Ace	
222.	*Sovia hyrtacus* de Niceville	Bicolour Ace	
223.	*Thoressa honorei* de Niceville	Madras Ace	Rare in Goa
224.	*Thoressa astigmata* Swinhoe	Southern Spotted Ace	Rare in Goa
225.	*Iambrix salsala* Moore	Chestnut Bob	
226.	*Notocrypta paralysos* Wood-Mason & de Niceville	Common Banded Demon	Rare in Goa
227.	*Notocrypta curvifascia* R. Felder	Restricted Demon	
228.	**Udaspes folus* (Cramer)	Grass Demon	
229.	*Arnetta vindhiana* Moore	Vindhyan Bob	
230.	*Suastus gremius* (Fabricius)	Indian Palm Bob	
231.	*Baracus vittatus* R.Felder	Hedge Hopper	
232.	*Hyarotis microstictum* Wood-Mason & de Niceville	Brush Flitter	Rare in Goa
233.	*Hyarotis adrastus* Stoll	Tree Flitter	Rare in Goa
234.	*Gangara thyrsis* (Fabricius)	Giant Redeye	
235.	*Matapa aria* (Moore)	Common Redeye	
236.	*Taractrocera maevius* (Fabricius)	Common Grass Dart	
237.	*Taractrocera ceramas* Hewitson	Tamil Grass Dart	
238.	**Potanthus pseudomaesa* Moore	Common Dart	
239.	**Telicota colon* Fabricius	Common Palm Dart	
240.	**Telicota ancilla* Herrich-Schiiffer	Dark Palm Dart	
241.	*Parnara naso* Fabricius	Straight Swift	
242.	**Borbo cinnara* Walker	Rice Swift	
243.	*Borbo bevani* Moore	Bevan's Swift	
244.	*Pelopidas agna* Moore	Obscure Branded Swift	
245.	*Pelopidas subochracea* Moore	Large Branded Swift	Rare in Goa
246.	*Pelopidas mathias* Fabricius	Small Branded Swift	
247.	*Pelopidas conjucta* Herrich-Schiiffer	Conjoined Swift	Rare in Goa
248.	*Baoris farri* Moore	Paintbrush Swift	Rare in Goa
249.	*Caltoris kumara* Moore	Blank Swift	
250.	*Caltoris canaraica* Moore	Kanara Swift	Rare in Goa
251.	*Caltoris philippina* Herrich-Schiiffer	Philippine Swift	

SUMMARY

An account of 251 species belonging to 141 genera of five families occurring in the State of Goa is compiled especially from Goankar (1996) and actual collections made in the State during butterfly diversity studies.

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ARACHNIDA (ORDERS SCORPIONES, UROPYGI, AMBLYPYGI, ARANEAE AND PHALANGIDA)

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INTRODUCTION

The studies on state fauna of Goa state are scarce and limited to certain groups only. No serious attempts were made previously either by naturalists or scientists in the field of taxonomic studies. The studies of state fauna of Goa were under taken by Zoological Survey of India, Western Regional Station, Pune and about 6 faunal surveys were under taken by different survey parties under the guidance of different subject expert scientists from 1992–2002. Mean while Dr. Manoj Borkar and some of his students from graduate Science course in Carmel College for Women, Nuvem, Goa under took the preliminary studies of Scorpions and Spider fauna of Molem National Park and Bhagwan Mahavir Wildlife Sanctuary and Khotigao Sanctuary during 1998–2000. These studies could focus on the species diversity in the region of the respective Sanctuary. Their studies report 6 species of Scorpions, 1 species of Whip – Scorpions, 1 species of Whip Spiders and 16 species of Spiders, which have been duly incorporated in this communication as their initial contribution towards the studies of Arachnid fauna of state Goa. The authentic identification help was extended from the senior author as advisory services. During the 6 faunal surveys 31 specimens of Scorpions, 4 specimens of Amblypygi 2 specimens of Uropygi, and 75 specimens of Spiders were collected, have been reported here. Total 8 species of Scorpions, 1 species of Amblypygi, 1 species of Uropygi, 39 species of Spiders and 1 species of Laniatore Phalangid are reported. The new descriptions and new reports for the state fauna of Goa have been summarized finally. Some of the Spider specimens are not identified up to specific taxa due to the want of literature and adult specimens, are not included in the list of identification.

The modified dichotomous keys for reported Arachnid Orders, Scorpion families, genera and species have been freshly added. The identification keys for reported Spider families, genera and species given by Tikader and others have been used and fresh keys were not necessary hence not included. Diagnostic characters for new description have been discussed.

AN INVENTORY OF SPECIES

Order SCORPIONIDA

Family BUTHIDAE

Subfamily BUTHINAE

Genus ***Mesobuthus*** Vachon

1. *Mesobuthus tamulus concanensis* (Pocock)
2. *Mesobuthus rugiscutis* (Pocock)

Genus ***Lychas*** C. Koch

3. *Lychas* (*Endotrichus*) *tricarinatus* Simon

Genus ***Stenochirus*** Karsch

4. *Stenochirus politus* Pocock

* Biodiversity Research Cell, Carmel College for Women, Nuvem-Goa.

Subfamily CENTRURINAE

Genus ***Isometrus*** Hempr. & Ehranb.

5. *Isometrus (Isometrus) maculatus* De Geer

Subgenus ***Reddyanus*** Vachon

6. *Isometrus (Reddyanus) rigidulus* Pocock

Family SCORPIONIDAE

Genus ***Heterometrus*** Hempr. & Ehranb.

Subgenus ***Heterometrus*** Couzijn

7. *Heterometrus (Heterometrus) keralensis* Tikader & Bastawade

Subgenus ***Chersonesometrus*** Couzijn

8. *Heterometrus (Chersonesometrus) wronghtoni* (Pocock)

Order UROPYGI

Family THELYPHONIDAE

Genus ***Labochirus*** Pocock

9. *Labochirus tauricornis* Pocock

Order AMBLYPYGI

Family PHRYNICHIDAE

Genus ***Phrynichus*** Karsch

10. *Phrynichus phipsoni* Pocock

Order ARANEAE

Family THERAPHOSIDAE

Genus ***Chilobrachys*** Karsch

11. *Chilobrachys fimbriatus* Pocock

Genus ***Thrigmopoeus*** Pocock

12. *Thrigmopoeus insignis* Pocock

Family CTENIDAE

Genus ***Ctenus*** Walckenaer

13. *Ctenus goaensis* Sp. n.

Family HERSILIDAE

Genus ***Hersilia*** Audouin

14. Hersilia savignyi Lucas

Family PHOLCIDAE

Genus ***Smeringopus*** Simon

15. *Smeringopus pallidus* (Blackwall)

Genus ***Artema*** Walckenaer

16. *Artema Atlanta* Walckenaer

Genus ***Pholcus*** Walckenaer

17. *Pholcus phalangioides* (Fusselin)

Family ARANEIDAE

Genus ***Nephila*** Leach

18. *Nephila maculata* (Fabricius)

19. *Nephila malbarensis* (Walckenaer)

Genus ***Argiope*** Savigny

20. *Argiope pulchela* Thorell

21. *Argiope aemula* (Walckenaer)

Genus ***Cyclosa*** Menge

22. *Cyclosa hexatuberculata* Tikader

Genus ***Parawixia*** F. O. P. Cambridge

23. *Parawixia dehaanii* (Doleschall)

Genus ***Leucauge*** White

24. *Leucauge tessellata* (Thorell)

Genus ***Tylorida*** Simon

25. *Tylorida culta* (O. P. Cambridge)

Genus ***Cyrtophora*** Simon

26. *Cyrtophora cicatrosa* (Stoliczka)

27. *Cyrtophora citricola* (Forskal)

28. *Cyrtophora feae* (Thorell)

Genus ***Neoscona*** Simon

29. *Neoscona molemensis* Tikader & Bal

30. *Neoscona mukerjei* Tikader

31. *Neoscona laglaizei* (Simon)

32. *Neoscona bengalensis* Tikader & Bal

Genus ***Gastracantha*** Sundevall

33. *Gastracantha geminata* (Fabricius)

34. *Gastracantha hasseltii* C. L. Koch

Family LYCOSIDAE

Genus ***Hippasa*** Simon

35. *Hippasa ageleonoides* (Simon)

36. *Hippasa olivaceae* (Thorell)

Genus ***Pardosa*** Koch

37. *Pardosa sumatrana* (Thorell)

Genus ***Lycosa*** Latreille

38. *Lycosa phipsoni* Pocock

39. *Lycosa carmichaeli* Gravely

40. *Lycosa mahabaleshwarensis* Tikader & Malhotra

Family GNAPHOSIDAE

Genus ***Herpyllus*** Hentz

41. *Herpyllus goaensis* Tikader

Family SALTICIDAE

Genus ***Myrmarachne*** Simon

42. *Myrmarachne plataleoides* (Cambridge)

Genus ***Rhene*** Thorell

43. *Rhene khandalensis* Tikader

Family THOMISIDAE

Genus ***Camaricus*** Thorell

44. *Camaricus formosus* Thorell

Genus ***Strigoplus*** Simon

45. *Strigoplus netravati* Tikader

Genus ***Platythomisus*** Doleschall

46. *Platythomisus sudeepi* Biswas

Family CLUBIONIDAE

Genus ***Clubiona*** Latreille

47. *Clubiona drassodes* Cambridge

Family TETRAGNATHIDAE

Genus ***Tetragnatha*** Latreille

48. *Tetragnatha mandibulata* Walckenaer

Genus ***Herennia*** Thorell

49. *Herennia ornatissima* (Doleschall)

Order PHALANGIDA (= OPILIONES)

Suborder LANIATORES

Family ASSAMIIDAE

Genus ***Mormuga*** Roewer

50. *Mormuga uncifrons* Roewer

SYSTEMATIC ACCOUNT

Key to the orders of class ARACHNIDA

1. Body ranges from 20 to 170 mm, divided in to Prosoma and Opisthosoma, the latter again sub-divided in to Mesosoma and Metasoma, Metasoma may be 5 segmented with a poison gland at the tip or multi-segmented, thin and long, with out a poison gland at the tip; chelicerae chelate or semi-chelate; pedipalps robust, stout, chelate or semi-chelate with or with out definite dentition and trichobothrial pattern; metatarsi of legs usually ventrally armed with rows of short and stout spines 2

– Body ranges 4–45 mm, divided in to Prosoma and Opisthosoma, the latter not sub-divided in to Mesosoma and metasoma but at the most ending posteriorly in to a short flagellum, pygidium or spinneretes; chelicerae chelate or semi-chelate; pedipalps robust, stout, semi-chelate with out definite dentition and trichobothrial pattern; metatarsi of legs usually ventrally armed with rows of short and stout spines 3

2. Body 20–170 mm, colour yellow to dark bluish-greenish to black,divided in to Prosoma and Opisthosoma, the latter again sub-divided in to 7 segmented Mesosoma and Metasoma, Metasoma 5 segmented with a poison gland at the tip; prosoma almost squarish, with a pair of median and 2–5 pairs of lateral eyes; chelicerae always chelate; pedipalps robust, stout, chelate with definite dentition and trichobothrial pattern; metatarsi of legs usually ventrally armed with rows of short and stout spines, spinules or bristles ..... SCORPIONIDA

– Body 30–50 mm, colour brick brown to brownish black, divided in to Prosoma and Opisthosoma, the latter again sub-divided in to Mesosoma and Metasoma, Metasoma multi-segmented, thin and long, with out a poison gland at the tip; prosoma almost rectangular narrowed in front with a pair of anteriorly placed median eyes and 3 pairs of lateral eyes; chelicerae always semi-chelate; pedipalps robust, stout, semi-chelate with out definite dentition and trichbothrial pattern; metatarsi of legs usually ventrally armed with rows of short and stout spines ..... UROPYGI

3. Body 30–40 mm, colour yellowish brown to blackish brown, divided in to Prosoma and Opisthosoma, the latter not sub-divided in to Mesosoma and metasoma but at the most ending posteriorly in to a short, pygidium; prosoma always wider than long, roundish on lateral margins and a pair of median eyes placed on anterior sub-margin; chelicerae semi-chelate; pedipalps robust, stout, armed distally with larger spines, with out definite dentition and trichbothrial pattern; metatarsi of legs usually ventrally armed with rows of short and stout spines except 1st modified in to long sensory tactile organ..... ..... AMBLYPYGI

– Body ranges from 4 to 45 mm, divided in to Prosoma and Opisthosoma, may or may not divided in to tergites and sternites, the latter not sub-divided in to Mesosoma and metasoma but at the most ending posteriorly in to 2–6 short spinnerets or an anal operculum; prosoma mostly longer than wide, with 2–8 eyes placed on ocularium or ocular quadrangle, on median portion or anterior sub-margin, with or with out scent glands; chelicerae chelate or semi-chelate; pedipalps short, palpus some times stout; modified and armed distally with male gentital organ in males or with larger spines only on interior surface metatarsi of legs usually ventrally armed with minute spines and a single or a pair of claws 4

4. Body 4–45 mm, colour variable from reddish to blackish, divided in to Prosoma and Opisthosoma, not divided in to tergites and sternites, but ending posteriorly in to 2–6 short spinnerets as silk spinning apparatus; prosoma mostly longer than wide, with 2–8 eyes placed on anterior sub-margin in an ocular quadrangle and with out scent gland; chelicerae semi-chelate armed with poison gland; pedipalps short, palpus, some times stout, modified and armed distally with male gentital organ in males; metatarsi of legs usually ventrally armed with minute spines and a single or a pair of claws ..... ARANEAE

– Body 2–7 mm, colour veriable from light yellowish to yellowish brown, divided in to Prosoma and Opisthosoma, latter divided in to 10 tergites and 8 sternites and ending posteriorly in to an anal operculum; prosoma mostly longer than wide, with 2 eyes normally placed on a median ocular tuberculum and with a pair of scent glands; chelicerae 3 segmented, chelate and not armed with poison gland; pedipalps short, palpus and some times stout, armed with spines on interior or mesal portion; metatarsi of legs distally armed with a single or a pair of claws..... ..... OPILIONES

Key to the families of order SCORPIONIDA

1. Body size ranges fr. 20 to 70 mm, colour normally yellowish brown and rarely black, prosoma almost squarish with almost straight or slightly invaginated anterior margin and surface mostly granular with definite keels carinae, mesosomal tergites I–VI mostly granular with 1–3 carinae and if smooth finely punctate; pectines well developed with 12–38 teeth, metasomal segments carinated or smooth, telson with robust vesicle some times with a sub-aculear spine or nodule; chelicerae with 4 minute teeth on dorsal inner margin of movable finger; pedipalps comparatively thin with narrow manus and 'A' type trichobothrial patter; legs with a pair of pedal spur and somes with a tibial spur on 3rd and 4th pairs..... ..... BUTHIDAE

– Body size ranges fr. 40 to 170 mm, colour normally deep bluish green to black and rarely dark brownish yellow; prosoma almost squarish with deeply notched on middle portion of anterior margin and surface mostly finely granular with out definite keels, carinae, mesosomal tergites I–VI mostly smooth with 1 carina and if smooth finely punctate; pectines well developed with 11–19 teeth, metasomal segments always carinated, telson with robust vesicle and never with a sub-aculear spine or nodule; chelicerae with 3 minute teeth on dorsal inner margin of

movable finger; pedipalps always with broad expanded manus and 'C' type trichobothrial patter; legs with only one anterior pedal spur and never with any tibial spur on 3rd and 4th pairs. ..... SCORPIONIDAE

Key for subfamilies of family BUTHIDAE

1. Body size ranges from 20 to 70 mm; surface may be granular or smooth; 3rd and 4th pairs of legs always each with a tibial spur; telson with vesicle may or may be with a sub-aculear spine ..... SUBFAM. BUTHINAE

– Body size ranges from 20 to 50 mm; surface always granular; 3rd and 4th pairs of legs always with out a tibial spur; telson with vesicle always with a sub-aculear spine .... subfamily CENTRURINAE

Key to genera of subfamily BUTHINAE

1. Prosoma mostly granular or carinated, posterior medians may or may not form Lyre-form configuration or smooth, trichobothries *d1,d2* and *d3* form β or γ angle on femur, telson with robust or elongated vesicle with or with out sub-aculear nodule or spine or smooth, punctate and pyriform 2

– Prosoma mostly granular, carinated and posterior medians form Lyre-form configuration, trichobothries *d1, d2* and *d3* form β angle on femur, telson robust vesicle without sub-aculear nodule ..... ***Mesobuthus***

2. Prosoma mostly granular but not carinated and never punctate, trichobothries *d1, d2* and *d3* form β angle on femur, telson with elongated vesicle always with sub-aculear nodule or spine; pedipalp fingers always with non-imbricated rows of teeth ..... ***Lychas***

– Prosoma entirely smooth and minutely punctate, trichobothries *d1,d2* and *d3* form γ angle on femur, telson with pyriform vesicle always with out sub-aculear nodule or spine; pedipalp fingers always with imbricated rows of teeth ..... ***Stenochirus***

Order SCORPIONIDA

Family BUTHIDAE

Subfamily BUTHINAE

Genus ***Mesobuthus*** Vachon

Key to the species of genus *Mesobuthus* Vachon

1. Body colour more yellowish with reddish tinge on last metasomal segment and telson; prosoma with posterior median carinae placed closer to each other and form anarrow Lyre-form configuration, most of the carinae moderately granular; Metasoma comparatively thin, longer and segments II–IV distinctly longer than wide; average length of adult ranges from 45 to 85 mm; pectinal teeth between 26–38 in number..... ..... *tamulus* (*concanensis*)

– Body colour more with reddish tinge on last metasomal segment and telson; prosoma with posterior median carinae placed more distantly to each other and form a wide Lyre form configuration, most of the carinae distinctly granular; Metasoma comparatively broad, wider and segments II IV distinctly wider than long; average length of adult ranges from 35 to 50 mm; pectinal teeth between 20–22 in number..... *rugiscutis*

1. ***Mesobuthus tamulus concanensis*** Pocock

1900. *Buthus tamulus concansis* Pocock, *Fauna Brit. India. Arachn.*, : 25.

1983. *Mesobuthus tamulus sindicus* : Tikader & Bastawade, *Faun. of India, Scorpions*, **3** : 188–194 (erroneous)

Common name : Yellow Scorpion.

Local name : Tambada Vinchu (Marathi), Chol (Karnataka), Bichhi (Bengali).

Diagnostic characters : Medium size body ranges from 45–85 mm in length, body color yellowish to reddish brown, blackish-green on tergites, entire body surface less granular, posterior median carinae on carapace forming lyre-form configuration with central medians median ocular tubercles smooth and black, provided with a pair of median eyes, situated anteriorly in the

ratio 1 : 1.5, male slender with robust pedipalp manus, length of under hand more than half the length of carapace in male and as long as half in female, outer row of movable finger of pedipalp with fifteen teeth in male and fourteen teeth in female, trichobothrial pattern of A type with β configuration on femora, pectines well developed with 34/38 teeth in male and 29/30 in female, last mesosomal sternite with two pairs of smooth carinae, inferior carinae on I, II and III caudal segments smooth, cauda almost five times as long as carapace, telson longer than V caudal segment but vesicle shorter and granular on ventral surface.

Habits and habitat : Normally found under medium to larger stones and boulders, occasionally under bricks and logs, common intruder of houses through coastal areas on Konkan stripe. Reports of bite deaths use to occur before Dr. Bhavalkar's useful treatment in recent years, which has brought death rate from 40% to nil.

Material examined : This species has prevalent distribution up to Sindhudurg district, Maharashtra, the stripe of Konkan and the adjacent northward district of state Goa. It is expected that this species must have distribution in the state Goa, however no authentic reports have been made so far.

Distribution : Sindhudurg, Ratnagiri, Raigad and Thane Dists, Maharashtra.

2. ***Mesobuthus rugiscutis*** (Pocock)

1897. *Buthus rugiscutis* Pocock, *J. Bombay nat. Hist. Soc.*, **11** : 106.

1983. *Mesobuthus rugiscutis* : Tikader and Bastawade, *Fauna of India, Scorpions*, **3** : 229–235.

Common name : Brown Scorpion.

Local name : Tambada Vinchu (Marathi),Chol (Karnataka), Bichhi (Bengali).

Diagnostic characters : Body color yellowish brown with reddish tinge, size medium, males smaller and slender than females, all carinae granular, prosoma almost as long as wide, granular and posterior median carinae form broader Lyre-form configuration with median central carinae; mesosomal tergites granular, each I–VI tergites with a median granular carina; metasoma almost four times as long as prosoma with segment I wider than long, carinae on each segments well developed and granular, telson vesicle as long as IV segment and slightly less than as wide or deep as segment V, globular with granular ventral surface, aculeus more curved, sharply pointed; male with robust manus of pedipalp and movable finger with 13 minute teeth on outer row, trichobothria of 'A' type and β configuration; pectines well developed and with 20–22 teeth.

Habits and habitat : Normally found under stones and rocks on high altitude plateaus of Western Ghats, rarely encountered through late rite rocks. Prefer to feed on smaller insects, arachnids, millipedes and centipedes. Females parturate during pre-monsoon and post-monsoon months of the year and about 20–25 baby scorpions are born at time, all remain on the back of the mother at least for first two molts. No definite reports are available for other biological particulars.

Material examined : 1 ♀ from Eastern part of Gao, adjacent to Karnataka and Maharashtra bordering areas, was collected by an amature naturalist from the late rite rocks.

Distribution : Kolhapur, Sindhudurg, Ratnagiri, Satara, Pune, and Raigad Dists., Maharashtra.

Genus ***Lychas*** C. Koch

3. ***Lychas (Endotrichus) tricarinatus*** Simon

1884. *Lychas tricarinatus* Simon, *Ann. Mus. Civ. Sto. nai. Genova*, **20** : 371.

1892. *Lychas tricarinatus* Pocock, *J. Bombay nat. Hist. Soc.*, **7** : 301.

1983. *Lychas (Endotrichus) tricarinatus* : Tikader & Bastawade., *Fauna of India, Scorpions*, **3** : 73-78.

1997. *Lychas tricarinatus* : Kovarik, *Acta Soc. Zool. Bohem.*, **61** : 311–371.

Common name : Brown Scorpion.

Local name : Rakhat Vinchu (Marathi)

Diagnostic Characters : Body size medium, color yellowish-dark brown to blackish, prosoma

more darker with few yellow spots, mesosomal tergites with 4 darker and 5 yellowish bands, metasoma more darker on last two segments and telson, sting with a sub–aculear spine, carapace with no carinae but sparsely granular throughout, tergites: I–VI also with median carina each, tergites III–VI with a pair of lateral carinae prominent on posterior portion and more granular on lateral portions, metasomal segments carinated and almost all carinae evenly and minutely granular but more granular and crenulate on last two segments, pectinal teeth 20–22 in number, 'A' type trichobothria with β on femur pattern and of *Endotrichus* sub-type.

Habits and habitat: Normally arboreal in habit, hides under loose barks of large to medium size trees at 4–6′ high, some times perverted to lead terrestrial habits under medium to small stones and boulders. Female parturates about 15–20 young ones. Sting toxicity much less and non-fatal.

Material examined : 1♀ Coll. S. Kemp, Mormugao bay, Aug.- Sept 1916, Reg. No. 244 (HQ), Kolkata; 2♂♂, 3♀♀ Coll. M. S. Pradhan, Dabel River near Coligao Sanctuary, Panginium, 21.ix.1993; 1♂ Forested area near Usgaon, Tal. Phonda, 30.ix.1993; 2♀♀ Coll. G. M. Yazdani, Hilly area near Sonal Vill., 9 Kms. NE Valpoi station, 15.iii.1993, 1♀ subadult, Hill slopes in forested area near Pamburpao, Dona Paula, 09.iii.1993.

Distribution : This species occurs fairly common in Gujarat, Madhya Pradesh, Bihar, West Bengal, Orissa, Andhra Pradesh and Nothern Maharashtra (Vidarbh region and rarely in Southern Maharashtra).

Genus ***Stenochirus*** Pocock

4. ***Stenochirus politus*** Pocock

1899. *Stenochirus politus* Pocock, *J. Bombay nat, Hist. Soc.*, **12** : 262.

1983. *Stenochirus politus* : Tikader & Bastawade, *Fauna of Indian, Scorpions*, **3** : 153–158.

Common name : Black Scorpion.

Local name : Kala Vinchu (Marathi).

Diagnostic Characters : Body size medium to small, color dark brown to black with light yellowish-brown spots on prosoma and mesosomal tergite I–VI, pedipalps and legs I–IV infustigated, prosoma entirely smooth and finely punctate, body surface smooth and finely punctate, metasoma smooth carinae obsolete, posterior IV and V segments wider than long with only lobate inferior lateral carinae, sting vesicle pyri-form, twice as long as deep; Pedipalp manus slender 'A' type trichobothria with α pattern on femora. Pectinal teeth count 15/15.

Habits and habitat : Not exactly known. Probably inhabit through loosely fixed rocks and crevices and might be preferring to stay in loose soil between the stones and crevices or in close association of roots and rocks. Recently known, an unusual case of house intrusion at Chennai, was observed by R. Whitekar and Ashok Captain (personal communication).

Material examined : 1♂, 1♀, *Coll. G. M. Yazdani*, Loc. : Hilly area near Sonal Vill., 9 Kms. NE Valpoi Station, 15.iii.1993, Reg. No. I/1974.

Distribution : India : Tamil Nadu {(Chennai) unpublished data}, Karnataka (Kanara) Maharashtra (Amaravati) and Madhya Pradesh (Mandala National Park).

Subfamily CENTRURINAE

Genus ***Isometrus*** Hempr. & Ehranb.

Subgenus ***Isometrus*** Vachon

5. ***Isometrus (Isometrus) maculatus*** De Geer

1778. *Scorpio europaeus* De Geer, *Mem. Hist. Ins.*, **7** 346

1888. *Isometrus europaeus* : Oates, *J. Bombay nat Hist Soc.*, **3** : 250.

1897. *Isometrus maculates* : Lonnbarg, *Ann. Mus. Nat. Hist.*, **7**(1) : 86.

1900. *Isometrus europaeus* : Pocock, *Faun. Brit India, Arachn.*, : 46–47.

1983. *Isometrus (Reddyanus) europaeus* : Tikader & Bastawade, *Fauna of India, Scorpions*, **3** 286–292

2003. *Isometrus (Isometrus) maculatus* : Kovarik, *Euscorpius, Occ. Publ. Scorp.*, **10** : 2-4.

Common name : Scorpion.

Local name : Vinchu (Marathi), Bichhu (Hindi).

Diagnostic Characters : Body size ranges between 60–70 mm in length, male larger, thinner and much elongated, specially on pedipalps. Body colour yellowish brown with six yellowish and four blackish bands on each tergite. Carapace with entire surface weakly and sparsely granular but more granular on anterior portion and without carinae. A pair of median eyes situated anteriorly in the ratio 1 : 2.25. Chelicerae normal as in other *Isometrus* species. Pedipalps thinner but more in male and movable fingers with 7 minute teeth in outer row. Trichobothrial pattern of A type with β configuration on femur and a typical type of sub-genus *Isometrus*. Pectinal teeth 17/18 in number. Mesosomal tergites weakly granular but more granular on posterior portion of each tergite I–VI, VII tergite with a median broad anterior carina and two pairs of granular lateral carinae. Cauda more than eight times longer than carapace, basal segment always longer than wide and with all ten granular carinae, lateral carinae totally absent on segments II–IV, Segment V almost twice as long as carapace, inferior laterals and a inferior carinae weakly crenulate. Telson shorter than segment V but longer than carapace, inferior carina smooth ending in to a sub-aculear nodule armed on inner margin with a pair of minute denticle. Aculeus shorter than vesicular length, less curved and pointed.

Habits and habitat : Normally found in forested areas of Western Ghats including Goa, occasionally intruder in houses, hiding in dark corners and wooden furniture. Feeds on smaller ground dwelling arthropods. Nothing is known about the toxicity and other biological aspects.

Material examined : 1♂, found near the border areas of Goa and Maharashtra at Tillari Dam site in a Forest Rest House.

Distribution : Shows very large distribution all over South East Asia (Kovarik 2003).

Subgenus ***Reddyanus*** Vachon

6. ***Isometrus (Reddyanus) rigidulus*** Pocock

1897. *Isometrus rigidulus* Pocock, *J. Bombay nat. Hist. Soc.*, **11** : 113.

1983. *Isometrus (Raddyanus) rigidulus* : Tikader & Bastawade, *Fauna of India, Scorpions*, **3** : 262–267(sic).

2003. *Isometrus (Reddyanus) rigidulus* : Kovarik, *Euscorpius, Occ. Publ. Scorp.*, **10** : 12-13.

Common name : Scorpion.

Local name : Vinchu (Marathi).

Diagnostic Characters : Body size small, color blackish with yellow stripes on mesosomal tergites, variegated on prosoma and darker on metasomal carinae but paler on pedipalps and legs; carapace entirely granular including ocular tubercles, median eyes situated anteriorly in the ratio 1 : 1.75, with out carinae; mesosomal tergites I–VI granular each with a median granular carina, sternites I–IV smooth, sternite V entirely granular and with two pairs of granular carinae, pectinal count 14–15; metasoma about five times as long as carapace, all segments carinated, dorsals weakly dentiform on II-III, laterals granular on III–IV, segment V slightly longer than carapace, telson shorter than carapace or segment V, vesicle as long as segment IV, smooth, with sub-aculaer nodule with a pair of denticle on inner margin; males with more robust manus and some times granular, 'A' type trichobothria with β pattern on femora. Sting with triangular sub-aculear spine.

Habits and habitat : Normally found under small stones and boulders and rarely under loose barks of large trees of different forest plant species at 5 to 6' height. Nothing known about its toxicity and toxin.

Material examined : Reported by Manoj Borkar from Molem Wildlife Santuary, Molem, Goa.

Distribution : India : Goa and Madya Pradesh (Gwalior).

Family SCORPIONIDAE

Subfamily SCORPIONINAE

Genus ***Herometrus*** Hempr. & Ehranb.

Subgenus ***Heterometrus*** Couzijn

7. ***Heterometrus (Heterometrus) keralensis*** Tikader & Bastawade

1983. *Heterometrus (Heterometrus) keralensis* Tikader & Bastawade, *Fauna of India, Scorpions*, **3** : 528–533.

Common name : Black Scorpion

Local name : Ingali (Marathi), Kakada Bichi (Bangali).

Diagnostic characters : Large body, ranging 105–115 mm in length, almost entirely black in colour, except reddish brown on manus and yellowish brown on telson; weakly granular on lateral portions of carapace and tergites, ocular tubercles smooth, median eyes situated anteriorly in the ratio 1 : 1.25; chelicerae normal with normal dentition; Pedipalps exceptionally long, slender and narrow on manus and carinated only on femur, femur longer than carapace, strongly carinated, carinae with denticulate granules, patellae shorter than femur but longer than carapace, anterior or inner surface weakly elevated and armed with few denticulate granules on proximal portion, Manus exceptionally elongated, narrow and length of underhand shorter than femur or patella but longer than carapace, carinated but only exterior carinae distinct and smooth, fingers also slender and long, movable fingers as long as femur, trichobothrial pattern of C type with 3 ventrals; legs I–IV granular on femur and patella spine formula 4/5 4/5, 4/64/5, 4/64/6 and 4/64/6; pectines well developed, 2and ½ times longer than wide, pectinal teeth 13/13 in number; mesomal tergites I–VI weakly granular on lateral portions and without carinae, sternite VII entirely smooth; cauda slightly longer than 3 and ½ times as long as caapace, segments I–III carinated, dorsal, dorsolateral carinae granular but inferiorlateral and inferiors smooth, segment IV dorsal carinae distinct and serrated, dorsolaterals granular, inferior laterals and inferiors weakly granular and obsolete, segment V shorter than carapace, inferior laterals and a inferior median sparsely serrated; telson shorter than carapace but longer than patella, vesicle longer than segment IV, aculeus more than half the vesicular length and sharply pointed.

Habits and habitat : Almost same to *Heteromerus (Chersonesometrus) phipsoni* (Pocock). It appears that these two species share the same habitat and show most of the habit same including the feeding habits.

Material examined : 1♀, Coll. P. P. Kulkarni, Khotegaon Forest area, 28.i.2002, Reg. No I/3244; 1♀, Dhapodena beat, Kurdi range, South Goa, 25.i.2002, Reg. No I/3239.

Distribution : India : Meenamutty, New Amaranbalan Reserve Forest (Type Locality) Kerala and Ratnagiri, Mumbai and Thane Dists., Maharashtra.

Subgenus ***Chersonesometrus*** Couzijn

8. ***Heterometrus (Chersonesometrus) wronghtoni*** (Pocock)

1899. *Palamnaeus wronghtoni* Pocock, *J. Bombay nat. Hist. Soc.*, **12** : 745.

1900. *Palamnaeus wronghtoni* : Pocock, *Fauna Brit. India. Arachn.*, : 89.

1981. *Heterometrus (Chersonesometrus) wronghtoni* Couzjin, *Zool. Verln.*, **184** : 158.

1983. *Heterometrus (Chersonesometrus) wronghtoni* Tikader & Bastawade, *Fauna of India, Scorpions*, 3 : 593–598.

Common name : Black Scorpion.

Local name : Ingali (Marathi), Kakada Bichi (Bangali).

Diagnostic Characters : Body size large, 90–95 mm in length, colour almost entirely blackish except brownish yellow on legs and telson vesicle. Body surface mostly smooth except weakly granular on lateral portion. Tail segments carinated and carinae mostly crenulate. Median eyes place anteriorly in 1 : 1 ratio. Pedipalp strong and stout, convexed on dordal surface of manus and granular with 3–4 weakly granular carinae. Spine formula on legs I–IV 4/6 4/5, 4/6 4/6, 4/6 4/6, 4/6 4/6. Pectines well developed with 17/17 teeth. Metasoma 3½ times as long as carapace, telson as long as V segment, vesicle equals to segment III and aculeus to segment I.

Habits and habitat : Almost same to *H. (Ch.) phipsoni* (Pocock) and *H. (Ch.) wronghtoni* (Pocock) share the same habitat and show most of the habits same including the feeding. While making collections of this species, at two instances, it was noticed, that the burrows of this

species were shared by tiny Frogs of the Genus *Ramanella* Rao. Such an unusual association is not yet understood.

Material examined : 1♀, 1♀, 2♀♀, subadults, Coll. P. P. kulkarni, Khotegaon Forest area, 28.i.2002, Reg. No. I/3244; 1♀, 3♀♀, subadult, 2 young ones, Dhapodena beat, Kurdi range, South Goa, 25.i.2002,Reg. No. I/3239; 1♀ 4♀♀ subadults, Kharget, Paigien, South Goa, 27.i.2002, Reg. No. I/3241; 2♀♀, subadults, Nagse, North Goa, 19.i.2002, Reg. No.I/3243.

Distribution : India : Belgaum, Karnataka, Gadinglaj, Kolhapur, Maharashtra. and Goa.

Order UROPYGI

Family THELYPHONIDAE

Genus ***Labochirus*** Pocock

9. ***Labochirus tauricornis*** Pocock

1898. *Labochirus vervinus* (*errore*) Pocock, *J. Bombay nat. Hist. Soc.*, **12** : 745.

1900. *Labochirus tauricornis* : Pocock, *Fauna of Brit. India, Arachn.*, : 109–110.

Common name : Whip–Scorpion.

Local name : Chabuk Vinchu (Marathi).

Diagnostic characters : Body size ranges between 28–34 mm in length, colour reddish brown to blackish brown on dorsal and mahogany–red bellow, distal segments of legs light and all tarsi yellow. Abdominal sternites closely, finely and distinctly granular around the impressions and the border. The pedipalp chela differs, tibia with out basal anguliform prominence bellow the apophysis with posterior edge straight, smooth and without curvature to the apex and provided with 1–3 smaller teeth. Female with first abdominal sternum with a shallower impressions, one on either sides and with out ridges. All sternites finely punctate.

Habits and habitat : Normally inhabit through wet forest areas and found near to streams and caves. Rarely notices unusual gathering of more than 10 specimens on the outside rocks of the shallow caves. Seen feeding on Amphibians and smaller reptiles normally the Geckoes and some times on Molluscs. No other biological details are available.

Material examined : 2♀♀, and 2♀♀, Immature sent by Manoj Borkar, and 2 Immature specimens collected by M. S. Pradhan but no details given.

Distribution : India : Kanara Dist., Karnataka and Goa.

Order AMBLYPYGI

Family PHRYNICHIDAE

Genus ***Phrynicus*** Pocock

10. ***Phrynichus phipsoni*** Pocock

1900. *Phrynichus phipsoni* Pocock, *Fauna Brit. India, Arachn.*, : 127.

1986. *Phrynichus phipsoni* : Bastawade, *J. Bombay nat. Hist. Soc.*, **92**(1) : 132–135.

1998. *Phrynichus phipsoni* : Weygoldt, *Zoologica*, **147** : 38–41.

Common Name : Whip spider.

Local Name : Chabuk Koli (Marathi), Kasha Makadi (Hindi).

Diagnostic characters : Body size ranges from 22 to 30 mm in length, colour also ranges from dark brownish to Black more darker on carapace and abdomen, body surface granular on dorsal side while smoother on ventrum. Chelicera vertical, fingers with definite dentition. Pedipalp with 3 dorsal tibial spines and 2 ventral spines, femur with 4 dorsal and 6 ventral spines. Leg I modified in to long flexible whip with tibial, tarsal and metatarsal digits, legs II–IV thin and tibia with 27, 29, 30, trichbothria. Female genitalia with a pair of spherical gonopods, surface covered with many microscopic pores. Male spermatophore unknown.

Habits and habitat : Strictly nocturnal, usually hides through large boulders, crevices in forested area of Western Ghats. Rarely intruder in to human habitations and prefers to be in moist places like bathroom and WCs. Seen feeding on Geckos and Molluscs. Some times noticed to make congregations in 20–25 individuals on large tree

trunks near to streams or water holes. These are inhabitants of natural caves. Female gives birth to 15–20 babies, whitish blue to light greenish in color, which ride on mothers back and tightly cling together but appear to be unlike scorpion babies, no other details are available on their developmental biology.

Material examined : 1 ♀, 2 ♀ ♀, subadults Coll. Manoj Borkar, from local vehicle Garage near Carmel College for Women, Nuvem Goa (specimens donated to ZSI, WRS, Pune).

Distribution : India : Borivali, Mumbai, Raigad, Ratnagiri Dists. Maharashtra and Goa.

Order ARANEAE

Family THERAPHOSIDAE

Genus ***Chilobrachys*** Karcsh

11. ***Chilobrachys fimbriatus*** Pocock

1899. *Chilobrachys fimbriatus* Pocock, *J. Bombay nat. Hist. Soc.*, **12** : 746.

1900. *Chilobrachys fimbriatus* : Pocock, *Fauna Brit. India, Arachn.*, : 195.

1985. *Chilobrachys fimbriatus* : Raven, *Megalomorphae*, : 118.

1976. *Ischnocolus decoratus* : Tikader, *J. Bombay nat. Hist. Soc.*, 74(2) : 311–314.

2000. *Chilobrachys fimbriatus* : Smith, *A field guide for Theraphosid spiders of India and Sri Lanka, particularly the genus Poecilotheria, (Unpublished data).*

Common name : Ornamental spider/Cat-legged spider.

Local name : Koli (Marathi), Mawli (Konkani), Makadi (Hindi).

Diagnostic characters : Large colourful spider, blackish with yellowish hair intermixed with reddish bristles on abdomen and legs, abdomen marked with narrow dark stripes above and dark blackish bellow; body length 30–45 mm, carapace longer than wide, wider on anterior portion and narrowed on posterior, eyes grouped on anterior median portion, ocular quad longer than wide, chelicerae robust with long and strong fang, basal segment with a stridulating organ on outer surface, 3–6 rows of mixed modified setae at basal corner, lower line of tapering medium to long straight setae, mixed with majority of short thorny setae plus prolateral surface of maxillae with 2–3 lines of horizontal bacilliform setae, outer larger setae paddle shaped; abdomen narrowed posteriorly with elongated spinnerets, epigyne much chitinised with twin seminal receptacle spermathecae; male palpal bulb embolus long and stout and tapering with tegular keels.

Habits and habitat : Species found in forests, live in self made burrows, some times hide in larger crevices of forest lands, feed on larger insects and smaller reptiles and mammals, no authentic information available.

Material examined : 1 ♀, Coll. D.B. Bastawade, Loc. Kotigaon Forest area, 28.01.2002, Reg. No. I/3248.

Genus ***Thrigmopoeus*** Pocock

12. ***Thrigmopoeus insignis*** Pocock

1899. *Thrigmopoeus insignis* Pocock, *J. Bombay nat. Hist Soc.*, **12** : 747.

1900. *Thrigmopoeus insignis* : Pocock, *Faun. Brit India, Arachn.*, : 186.

2000. *Thrigmopoeus insignis* : Smith, *A field guide for Theraphosid spiders of India and Sri Lanka, particularly the genus Poecilotheria,* (Unpublished data).

Common name : Ornamental spider/Cat-legged spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size ranges from 50–55 mm colour blackish brown to velvety black on ventral portion, carapace 1/3rd longer than wide, length of carapace equals the length of patella and tibia of 4th leg together, fovea as wide as ocular tubercle and slightly procurved.

Habits and habitat : Species found in forests, live in self made burrows, some times hide in larger crevices of forest lands and litters, feed on larger insects and smaller reptiles and mammals, no authentic information available. No biological details available for other aspects.

Material examined : 1♀, Imm., Coll. D.B. Bastawade, Kotigaon Forest Area, 28.i.2002, Reg. No. I/ 3247.

Distribution : India : Karnataka and Goa.

Family CTENIDAE

Genus ***Ctenus*** Walckenaer

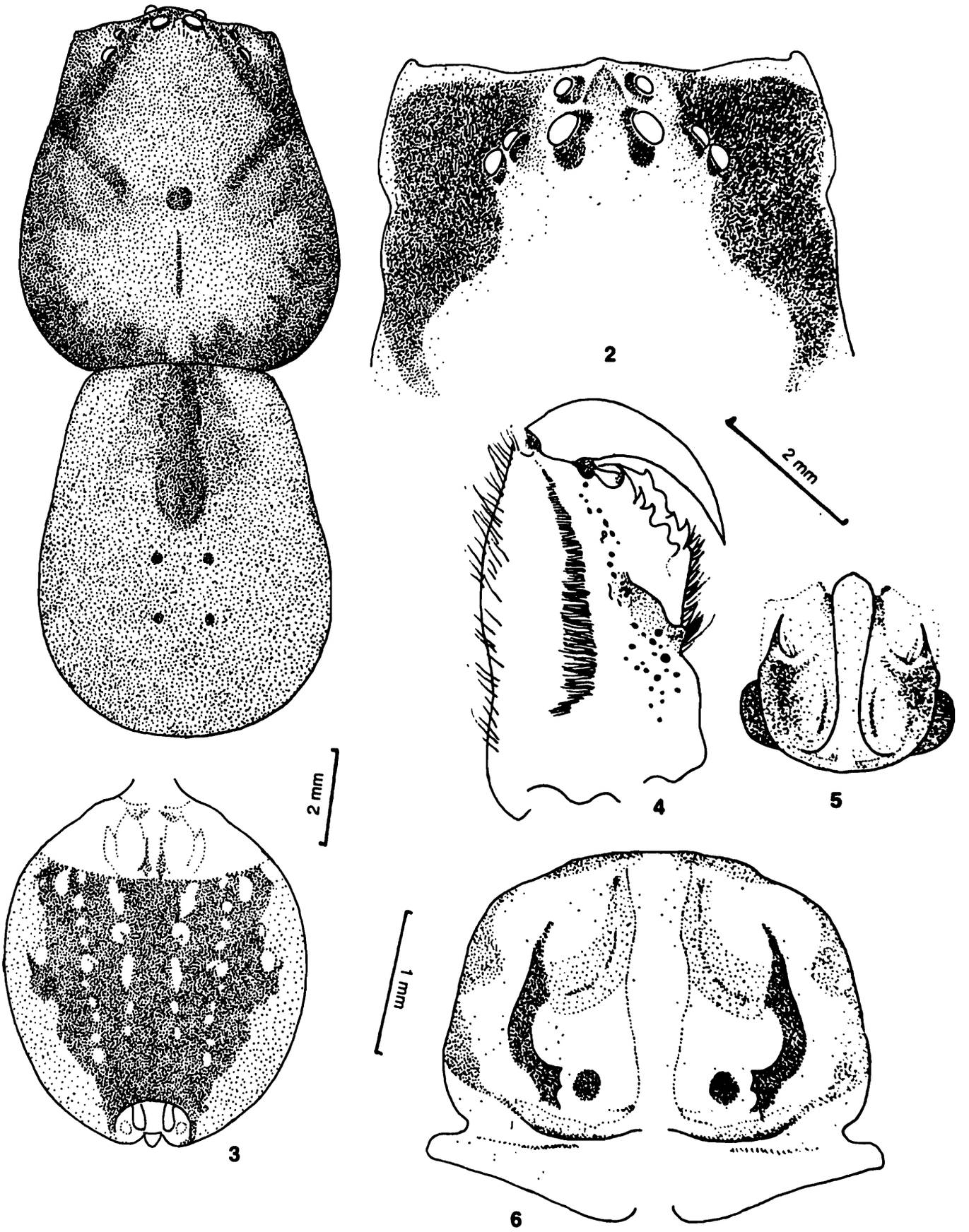
13. ***Ctenus goaensis*** Sp. n.
(Figs. 1–6)

General : Body color dark reddish brown on cephalothorax with a pair of anterior lateral and a pair of posterior sub-median blackish brown patches, anterior being larger and narrowed posterior medially and inner sides (Fig.1). Median area light brown from ocular area to the base. Abdomen dark brown with an anterior median short, elongated yellowish patch.

Measurements (in mm) : Total length 20.00. Cephalothorax 9.60 long, 7.00 wide. Abdomen 10.40 long, 7.30 wide.

Cephalothorax : Longer than wide, slightly narrowing anteriorly, clothed with pubescence and spinulate hair. Posterior median area with a long median, elongated, black fovea. Both the rows of eyes recurved, anterior being strongly recurved, anterior lateral placed in the line of posterior medians thus forming three rows of eyes. Ocular quad longer than wide, slightly wider on posterior portion (Fig. 1 & 2). Sternum slightly longer than wide, narrowed posteriorly and clothed with longer and thinner but spinulate hair. Labium longer than wide, notched laterally on posterior portion just before the end, anterior margin armed with few longer and stiffer hair. Maxillae longer than wide, slightly widened on 1/3rd anterior portion and turned inwardly and thickly scopulate on anterior margin. Chelicerae stout and strong, flatish on inner portion but round, globular on outer basal portion, fang furrow deep with row of 5 teeth on pro-margin while 3 teeth on retro-margin, median being the largest, thickly scopulate along the retro-margin, a moderate, triangular smooth boss present on proximal outer basal portion (Fig. 3). Palps thin, short, leg like, femora narrowed proximally but widened on distal half portion with a median, 2 pairs sub-median spines on dorsal portion; patellae uniformally wide with a long pointed spine on pro-margin. Tibiae slightly longer than patellae and armed with 2 pairs of sub-dorsal, dorso-lateral longer and pointed spines. Tarsi almost as long as tibia armed proximally with 2 pairs of long, dorso-lateral, pointed spines and distally with a claw provided with 3 minute teeth on inner, ventral margin. Legs I–IV elongated but strong and armed with longer and stouter spines. Femur I with 3 dorsal-median and 1 sub-dorsal distal spines. Femora II–IV with 3 dorsal and 2 pairs of sub-dorsal spines and intermitantly colored with whitish smaller patches. Patellae almost half the femoral length, I–II with out spines but III–IV each with a pair of sub-dorsal, pointed little curved spines. Tibiae 1½ times longer than patellae, each armed below with a row of 5 pairs of ventro-lateral spines on I and II and 3 dorsal, 3 sub-dorsal pairs and 3 ventro-lateral pairs strong spines on III–IV. Metatarsi almost as long as tibiae, I–II each armed bellow with 3 ventral pairs, 3 sub-dorsal pairs and 1 distal dorsal pair of shorter spines. Tarsi almost 1/3rd of metatarsi with out spines, thickly scopulate bellow and each armed distally with a pair of strongly bent pointed claws.

Abdomen : Longer than wide and more widened on posterior portion, covered with short and sparsely placed setae, 2 pairs of distinct sigilla placed on mid-dorsal portion (Fig. 1). Ventrum more darker and 4–6 lines of yellowish brown smaller spots and patches appear radiating from spinnerets up to epigastric furrow (Fig. 4). Epigynum with a median elongated and a pair of lateral broad chitinized plates, laterals more thicker on posterior portion (Fig. 5). Internal genitalia with a pair of elongated spermathecae each with a posterior median dark spot and opening posteriorly with short but straight duct (Fig. 6).



Figs. 1-6. *Cteius goaensis* sp. n. 1. Dorsal aspects of female Holotype; 2. Dorsal aspects of cephalothorax enlarged; 3. Lateral aspects of chelicera with fang; 4. Ventral aspects of abdomen; 5. Ventral aspects of epigynum; 6. Dorsal aspects of internal genitalia.

Table 1 : Showing the measurements in mm for Legs I–IV of *Ctenus goaensis* sp. n.

Legs	Trochanter	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.40	7.00	4.00	7.70	5.50	1.90	27.50
II	1.30	6.60	3.50	6.70	5.20	1.50	18.80
III	1.20	5.50	2.80	4.20	4.80	1.80	20.30
IV	1.40	7.20	3.00	6.20	7.20	1.70	26.70

Type Data : Holotype ♀, kept in 70 % Alcohol, gentiatlia dissected and kept in separate micro-vial, both chelicerae removed for studies and kept in separate micro-vial with the specimen.

Type Locality : 1 ♀ Gokarde, Canacona, South Goa, Goa. Coll : D. B. Bastawade, Dt. 29.01.2002, Reg. No. I/3253.

Etymology : The species has been named after the state locality 'Goa' suffixing with ensis as *goaensis*, being the first Ctenus species described from the state.

Discussions : This is the typical *Ctenus* species, compared with known species of this genus, it stands close to *C. narashinhai* Patel & Reddy, differs from it as follows 1. The color pattern on the cephalothorax drastically differs, specially the anterior lateral darker patches more broad and shorter where as these patches more elongated and narrower in *C. narashinhai*. 2. The anterior median patch uniformally light coloured where as it roughly T shaped and darker in *C. narashinhai*. 3. Cheliceral fang with 3 retro-marginal and 5 pro-marginal teeth where as 4 retro-marginal and 3 pro-marginal teeth in *C. narashinhai*. 4. Female epigynum and internal genitalia structurally differ.

Family HERSILLIDAE

Genus ***Hersilia*** Audouin

14. ***Hersilia savignyi*** Lucas

1836. *Hersilia savignyi* Lucas, *Mag. Zool. 6e anee* **60**(8) : 10.

1869. *Hersilia calcuttensis* (?) : Stoliczka, *Jr. Asiatic Soc. Bengal*, **38** : 216.

1900. *Hersilia savignyi* : Pocock, *Fauna Brit. India, Arachn.*, : 241.

Common name : Hunting spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body ranges from 8–12 mm in length, female larger than male, colour pale to dark black with darker spots and transverse band on abdomen, palps and legs banded, carapace narrowed anteriorly, ocular quadrangle placed on anterior median tubercle with larger lateral eyes, abdomen elliptical with lateral pair of spinnerets very long, female genitalia bi-lobed and lobes separated by deep emargination; male palp with a distinct sigmoid curvature and patella produced into a prominent conical hairy structure above.

Habits and habitat : Normally solitary, seen moving on large tree trunks, very fast moving, camouflaging with trunk color, rarely seen to produce smaller and irregular snare, feeds on variety of smaller insects inhabiting the tree trunks.

Material examined : Collected and reported by Manoj Borkar.

Distribution : Through out Indian subcontinent.

Family PHOLCIDAE

Genus ***Smeringopus*** Simon

15. ***Smeringopus pallidus*** (Blackwall)

1858. *Pholcus pallidus* Blackwall, *Ann. Mag. Nat. Hist.*, **1**(3) : 433.

1863. *Smeringopus elongatus* Vinson, *Aran. Réunion, etc.*, : 135, t. iii, fig.5.

1869. *Smerignopus distinctus* : O. P. Cambridge, *J. Linn. Soc. Zool.*, **10** : 380, t. 11, fig.28-30.

1900. *Smeringopus elongatus* : Pocock, *Fauna Brit. India, Arachn.*, : 239.

2003. *Smeringopus pallidus* : Cai, *Acta Arachnol. Sin.*, **12** : 20.

Common name : Long bodied cellar spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 5–7 mm in length, colour grayish yellowish. Carapace with radiating triangular dark patches, legs yellowish brown with pale whitish bands around femora and tibiae, abdomen grayish white ornamented dorsally with double series of black spots and large black patches on lateral portions and with a broad median reddish brown band on ventral portion, divided on posterior portion by a pale stripe.

Habits and habitats : Almost unknown.

Material examined : Few specimens collected and reported by Manoj Borkar.

Distribution : India : Kerala, Tamil Nadu, Pondichery and deccan peninsular area, Goa and Andaman Islands.

Elsewhere : Sri Lanka; Myanmar And Indo-Austro-Malaysia; Tropical Africa.

Genus ***Artema*** Walckenaer

16. ***Artema atlanta*** Walckenaer

1837. *Artema atlanta* Walckenaer., *Ins. Apt.*, **1** : 656.

1857. *Pholcus atlanta* : Doleschall, *Nat. Tijdschr. Nederl Indie*, **13** : 408.

1900. *Artema atlanta* : Pocock, *Fauna of Brit. India, Arachnida*, : 238.

1987. *Artema atlanta* : Tikader, *Handbook of Indian Spiders*, : 170.

Common name : Short bodied cellar spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Body short, about 8–10 mm long, abdomen very high, globular, more than as wide, sternum posteriorly acuminate, chelicerae with two minute teeth, body colour yellowish brown, carapace with median brown patch and clypeus striped brown, legs yellow with brown on patellae, brown rings on femora and tibiae, abdomen grayish yellow, 3 rows of dusty gray spots, genitalia of brown, thickly horny plate and concave on posterior margin. Male and female alike except thick on palps and chelicerae with large serrated crest externally.

Habits and habitat : Almost similar to *Crossoproza lyoni* (Blackwall).

Material examined : 1♀ Collected and reported by Manoj Borkar.

Distribution : India : Kerala, Andhra Pradesh, Maharashtra and Uttar Pradesh.

Elsewhere : Pakistan : Karachi; Myanmar.

Genus ***Pholcus*** Walckenaer

17. ***Pholcus phalangioides*** (Fusselin)

1775. *Pholcus phalangioides* Fusselin, *nebst der Ankdg Ein. Neu. Inst. Werk*, : 9

1987. *Pholcus phalangioides* : Tikader, *Handbook of Indian Spiders*, : 170–171.

Common name : Long bodied cellar spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body elongated, thin delicate and about 8–12 mm in length, grayish green in colour, abdomen smooth, shining, narrow and elongated, legs very long and thin, delicate as compared to body, these spiders prepare smaller, irregular snares and remain at the center in an inverted position and female typically carries the egg sac in its chelicerae. Their webs are used by gall-midges as resting places.

Habits and habitat : Occupies dark corners of remote vacant houses and buildings, hallow tree trunks, medium to smaller size pits through the side cuttings of rocks and out crops, prepares smaller snares, can easily be pointed out by the presence of numerous tiny whitish gall midges, resting on their web threads(Sharma and Bastawade 2002). Spider usually occupies the center of the snare, vigorously vibrates if disturbed, otherwise difficult to notice the occupant.

Material examined : Collected and reported by Manoj Borkar.

Distribution : Almost through out Indian sub-continent.

Elsewhere : Sri Lanka, Myanmar, Bangla Desh And Pakistan.

Family ARANEIDAE

Genus ***Nephila*** Leach

18. ***Nephila maculata*** (Fabr.)

1793. *Aranea maculata* Fabricius, *Ent. Syst.*, **2** : 425.

1900. *Nephila maculata* : Pocock, *Fauna Brit, India, Arachn.*, : 217.

1982. *Nephila maculata* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 97–99.

Common name : Giant Wood Spider.

Local name : Ajastra Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Large spiders, body size range from 35 to 45 mm. Body attractively colourful with a pair of mid-lateral yellowish brown stripes on dorsal portion. Males comparatively smaller in body size and also differ in color pattern and never found to spin webs but hang around the female in variable numbers. Two variants seen in this area and differ in having colors on legs, one variety bears dark black legs where as the other has light to dark brown legs.

Habits and habitat : Inhabiting wooded and forest area of Indian subcontinent, females spin enormously large individual webs of much sticky threads and sit at center of the web, normally head positioned towards ground, spins large sticky webs between adjacent large trees and patiently waits for prey, generally feeds on medium to large bodied insects such as Dragon flies and grass hoppers and sometimes smaller bird caught in to the nests. Many males are always noticed on the periphery of the web, are very small and comparatively light orange-red in colour. Their bite is not fatal but portion remains painful and swollen for 6–8 hrs.

Material examined : 1 ♀, Coll. D.B. Bastawade, Loc. : Khotigaon Forest area, 28.i.2002, Reg. No. I/3247.

Distribution : Forested areas of Uttaranchal, Uttar Pradesh, Madhya Pradesh, Bihar, Chhatisgarh, West Bengal, Sikkim, Entire North Eastern states, Maharashtra, Goa, Karnataka, Tamil Nadu, Kerala and Andaman and Nicobar, India.

Elsewhere : Sri Lanka; Burma; Malaysia; China; Australia; Japan and New Guinea.

19. ***Nephila malabarensis*** (Walckenaer)

1837. *Epeira malabarensis* Walckenaer, *Hist. Nat. Ins. Apt.*, **1** : 103.

1900. *Nephila malabarensis* : Pocock, *Fauna Brit. India, Arachn.*, : 219.

1977. *Metepeira andamanensis* : Tikader, *Rec. zool. Surv. India*, **72** : 181–183.

1982. *Nephila malabarensis* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 95–97.

Common name : Giant spider.

Local name : Motha Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Large spider, body ranges from 20.00 to 25.00 mm in length, dark brown on cephalothorax, grayish yellow with brownish patches laterally on abdomen and brownish yellow with brown patches on legs; cephalothorax longer than wide, slightly narrower in front, cephalic region elevated, thoracic fovea shallow, both rows of eyes recurved but posterior row acutely recurved, ocular quad slightly wider behind than long and narrowed in front, anterior medians larger than posterior medians, laterals separated from each other by 3 times of its diameter size; chelicerae strong and stout with prominent boss; legs short and strong; abdomen oval, longer than wide, overlapping the posterior portion of cephalothorax, dorsum with five pairs of sigilla arranged mid-dorsally, epigynum heavily sclerotised with a distinct median septum beaked anteriorly, internal genitalia with a pair of spherical spermathecae each with short and inwardly bent opening tube.

Habits and habitat : Forest inhabitant, prepares large, radial symmetrical webs between adjacent trees by female and waits for prey. Feed mainly on medium to large insects such as grass hoppers, odonates, butterflies and beetles.

Material examined : Some specimens collected and studied from Carmel College, Molem by Manoj Borkar.

Distribution : India : Tamil Nadu (Ootacamund), Kerala (Trivendrum), Bihar (Purulia and Chota Nagpur), Andaman and Nicobar Islands.

Elsewhere : Burma; Sri Lanka; Thailand; New Guinea And Australia.

Genus ***Argiope*** Audouin

20. ***Argiope pulchela*** Thorell

1881. *Argiope pulchela* Thorell, *Annali. Mus. Civ. Genova,* **18** : 74.

1900. *Argiope pulchela* : Pocock, *Fauna Brit. India, Arachn.,* : 221.

1975. *Argiope pulchela* : Patel, *Vidya. J. Gujarat Univ.,* **18** (1) : 154.

1982. *Argiope pulchela* : Tikader, *Fauna of India, Araneae : Araneidae,* **2**(1) : 129–131.

Common name : Signature spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 10–13 mm in length, body colourful, yellowish white on abdomen while yellowish brown on cephalothorax and legs; cephalothorax slightly longer than wide, narrowing in front, cephalic region less elevated than thoracic region, ocular quad much longer than wide and more wider behind than in front, laterals situated on prominent tubercles, anterior row procurved in front view while posteriors strongly procurved viewed from above; chelicerae with rudimentary boss; abdomen roughly pentagonal, slightly longer than wide, truncated on anterior margin, dorsum white with deep brown transverse patches and stripes, ventral portion dark brown with a pair of chalk white longitudinal band between epigastric groove to spinnerets, epigyne with a pair of weakly bulging lateral lobes and distally narrowing median scape, internal genitalia with a pair of much elongated elliptical spermathecae opening separately on posterior lateral portion.

Habits and habitat : Forest inhabitant, prepares medium, radial symmetrical webs between adjacent shrub twigs or braches. Webs are generally prepared by females with diagonally placed stabelimentum and wait for prey. Feed mainly on medium to large insects such as grass-hoppers, odonates, butterflies and beetles.

Material examined : Some female specimens were collected and photographed by Manoj Borkar.

Distribution : India : Andaman and Laccadive Islands; 24 Pargana, Kalimpong, Darjeeling, West Bengal, Madhya Pradesh; Orissa; Assam; Pune, Raigad and Thane, Maharashtra; Tamil Nadu.

Elsewhere : Myanmar, Malaya Peninsula.

21. ***Argiope aemula*** (Walckenaer)

1841. *Epeira aemula* Walckenaer, *Hirst. Nat. Ins. Apt.,* **2** : 118.

1871. *Argiope magnifica* : L. Koch, *Arachn. Austrat.,* **1**(1) : 27.

1877. *Argiope aemula* : Thorell, *Annoli Mus. Civ. Geneva.* **25** : 164.

1900. *Argiope aemula* : Pocock, *Fauna Brit. India, Arachnida,* : 223.

1982. *Argiope aemula* : Tikader, *Fauna of India, Araneae : Araneidae,* **2**(1) : 119–121.

Common name : Signature spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Medium size body about 20–25 mm in length, general body colour Yellowish gray, yellowish brown on cephalothorax, deep brown on legs and grayish white with blackish stripes and reticulation on abdomen, cephalothorax narrowing in front, anterior and posterior rows of eyes strongly procurved, legs long, spined and femur bearing yellowish patch ventrally, abdomen oval, truncated in front and partly overlapping cephalothorax, pair of ventral longitudinal yellow stripes between gastric furrow and spinnerets, epigyne roughly triangular, narrowing in front with a pair of basal round bulging, internal genitalia with a pair of single pouched spermathecae.

Habits and habitat : Prefer to inhabit through forested areas, prepare medium sized geometrical webs in vertical plane, typically strengthen the web by preparing X shaped stabilimentum due which are known as "Signature Spiders" keeps facing towards ground, feeds on smaller to medium sized insects get in to the nest.

Material examined : Some females were observed, collected and photographed by Manoj Borkar.

Distribution : India : Kerala, Tamil Nadu, Maharashtra, West Bengal, Andaman and Nicobar Islands.

Elsewhere : Sri Lanka; Myanmar; Indo-austro-malaysia.

Genus ***Cyclosa*** Menge

22. ***Cyclosa hexatuberculata*** Tikader

1980. *Cyclosa hexatuberculata* Tikader & Bal, *Fauna of India, Araneae:Araneidae*, **2**(1) : 197–199.

Common name : Orb-weaving spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Body thin and elongated about 7–10 mm in length, cephalothorax yellowish with some blackish patches, legs yellowish, banded with blackish brown colour, abdomen yellowish brown with silvery and blackish patches, cephalothorax elongated narrowed anteriorly, anterior and posterior pair of eyes recurved,. abdomen also elongated with two dorsal humps, two pairs of lateral humps, epigyne with a prominent cone shaped scape with basal bulged portion, internal genitalia with a pair of rounded spermathecae.

Habits and Habitat : Spins smaller delicate, geometrical webs through bushes and shrubs, prefer to sit in the center camouflaging the thickened threads of the web, feeds on smaller and tiny insects caught in to the web.

Material Examined : 1♀, 1♀, subadult, Coll. D.B. Bastawade, Loc. : Mahadai, North Goa, 19.i.2002, Reg. No. I/ 3255.

Distribution : India : BSI garden, Pune, Maharashtra.

Genus ***Parawixia*** F O. P. Cambrdge

23 ***Parawixia dahaanii*** (Doleschall)

1859 *Epeira dahaanii* Doleschall, *Act. Soc. Ind. Neerl.*, 5(5) 33.

1899. *Araneus dahaanii* : simon, *Annls. Soc. ent. Belg.*, **43** : 90.

1951. *Araneus dahaanii* : Sinha, *Rec. Indian Mus.*, **49** : 84.

1982. *Parawixia dahaanii* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 212–214.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 18–22 mm in length, many colour variations noted from grayish to yellowish brown, cephalothorax longer than wide, narrowing in front, surface granular, cephalic region much raised in the middle, ocular quad also situated on raised portion, slightly wider in front than behind, anterior row of eyes procurved in front view, posterior row recurved from above, anterior medians larger than posterior medians, laterals of same size, placed close and on the base of horn like tubercles; chelicerae stout and with moderate boss; legs long, strong and darker on tarsi; abdomen triangular, longer than wide, with two pointed spine like shoulder humps and one pointed tail hump at the posterior end, a chalk like white narrow band extending between shoulder humps; epigynum with single plate drawn posteriorly in to stout beak like scape, bent at right angle to the base, internal genitalia with a pair of comparatively large rounded pouched spermathecae each drawn out on inner portion into a 'S' shaped ducts opening at the base of beaked scape.

Habits and habitat : Species found in forested area and commonly encountered in Sanjay Gandhi National Park, Borivali, Mumbai. About 6–8 colour varients have been noticed on different types of trees, preferably at the tip of thin branch along with its small web, the specimen, mostly the female, was never observed to rest on the web but always selects to rest on a smaller twig utilized for supporting the web. Mostly feeding on medium to larger insects. The web remains more sticky than other araneids.

Material examined : Some female specimens were collected amd photographed by Manoj Borkar.

Distribution : India : Karanataka, Maharashtra, West Bengal, Sikkim.

Elsewhere : Myanmar; Indo-austro-malaysia; Java, Sumatra, Polynesia And Japan.

Genus ***Leucauge*** White

24. ***Leucauge tessellata*** (Thorell)

1887. *Leucauge tessellata* Thorell, *Annali. Mus. Civ. Genova,* **25** : 135.

1900. *Leucauge tessellata* : Pocock, *Fauna Brit. India, Arachn.,* : 216.

1975. *Leucauge tessellata* : Patel, *Vidya J. Gujarat Univ.,* **18**(1) : 156.

1982. *Leucquge tessellata* : Tikader, *Fauna of India, Araneae : Araneidae* **2**(1) : 80-82.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 9–12 mm in length, colour light brown to reddish, legs brownish with yellowish patches, abdomen grayish with silvery white and blackish patches; cephalothorax longer than wide, flat, cephalic region slightly raised, thoracic region with posterior median trifid groove, ocular quad longer than wide and slightly narrowed in front, both the rows of eyes recurved but anterior strongly recurved; chelicerae large and very strong with smaller boss; abdomen longer than wide, elongated, anterior portion with a pair of blunt rounded prominences and also a bunt caudal hump on posterior end, dorsum with silvery white and and chalk white patches and line, ventrum with a pair of elongated silvery patches between epigastric furrow and spinnerets, epigynum plate like with a thin semilunar rim anteriorly, a pair of median round lighter spots and lager and darker inverted comma like structure on posterior portion, internal ganitalia with three pairs of pouches, inner two pairs smaller than outer with incurved tube arising from the junction of inner smaller pouche and opening in the mid-lateral portion.

Habits and habitat : Forest species, commonly seen on medium size webs on bushes and smaller trees, occasionally on Bamboo bunches, feeds on smaller to medium size insects entangled on webs, solitary but seen to prepare webs on adjacent branched in large numbers.

Material examined : 1 ♀ was collected and photographed by Manoj Borkar.

Distribution : India : Kerala, Maharashtra, Gujarat, West Bengal, Sikkim; Bhutan.

Elsewhere : Mayanmar.

Genus ***Tylorida*** Simon

25. ***Tylorida culta*** (O. P. Cambridge)

1869. *Tetragnath culta* O. P. Cambridge, *J. Linn. Soc.*, **10** : 390

1982. *Leucauge culta* : Tikader, *Fauna of India, Araneae Araneidae,* **2(1)** : 87–89.

2005. *Tylorida culta* : Platnick, *World catalogue of Spiders, on line Family : Araneidae.*

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size ranges from 3–5 mm in length, colour yellowish on cephalothorax and legs but pale yellow to grayish with silver white specks and black patches on abdomen; cephalothorax longer than wide, ocular quad wider than long, narrow in front, anterior medians smaller than posterior median while posterior laterals smaller than anterior laterals, both rows recurved,; chelicerae strong with small boss; abdomen elongated oval, moderately overlapping carapace, dorsum with minute silvery white specks, a median black patch at the extreme posterior end and three pairs of sub-median patches just in front of posterior patch; Epigynum plate like with a median recurved semicircular rim like structure; internal genitalia with a pair of elongated madian spermathecae and each with anterior lateral circular pouch with dorsal tube opening posteriorly.

Habits and habitat : No information available.

Material examined : Few specimens collected and reported by Manoj Borkar.

Distribution : India : West Bengal, Karnataka.

Elsewhere : Sri Lanka.

Genus ***Cyrtophora*** Simon

26. ***Cyrtophora cicatrosa*** (Stoliczka)

1869. *Epeira (Nephila) cicatrosa* Stoliczka, *J. Asiat. Soc. Beng.*, **33** : 242.

1900. *Araneus Sicatrosa* : Pocock, *Fauna Brit. India, Arachn.*, : 226.

1921. *Cyrtophora cicatrosa* : Gravely, *Rec. Indian Mus.*, **22**(4) : 413.

1951. *Cyrtophora cicatrosa* : Sinha, *Rec. Indian Mus.*, **49** : 85.

1982. *Cyrtophora cicatrosa* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 178-180.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 6–9 mm in length, colour yellowish to grayish with blackish patches and stripes; cephalothorax longer than wide, narrowing in front, much broad and rounded on posterior portion, a middle and a pair of lateral longitudinal black patches, thoracic area with deep trifid fovea, ocular quad longer than wide, slightly narrowed in front, anterior median larger than posteriors, laterals subequal placed little away from each other on prominent tubercles, both rows of eyes recurved but anterior strongly recurved; chelicerae moderately strong; legs thin and delicate, femora I & II with longitudinal black stripes and rest with numerous black spots; abdomen highly raised on anterior portion, dorsum with two pairs of anterior small black conical tubercles and a blunt posterior caudal tubercle, black and chalk white patches present, ventral portion with a pair of chalk white longitudinal lines and three pairs of chalk white spots present between epigastric furrow and spinnerets. Epigynum covered with a single plate raised on posterior middle portion of operculum, internal genitalia with two pairs of elliptical and round patches placed one above the other, the rounded pouches connected to lateral operculum portion by small duct on each side.

Habits and habitats : Prefer to prepare two tire web, inner median dom shaped and the outer an irregular snare supporting the median dome, the individual spider stays in the center of the dom. Such nets are prepared among the smaller branches of bushes, usually by the female spiders and a chain of 4-6 dirty grayish egg cocoons are normally left hanging on one side of the net. Many female spiders are seen to occupy a single bush constructing their individual web. These spiders feed on smaller to medium size arthropods entangled in the web.

Material examined : 1 ♀ Coll. P. P. Kulkarni, Reg. No. I/3245.

Distribution : India : Tamil Nadu, Karnataka, Maharashtra, Gujarat, West Bengal, Uttar Pradesh, Punjab and Andaman and Nicobar.

Elsewhere : Pakistan; Myanmar; New Guinea And Austro-Maleysia.

27. ***Cyrtophora citricola*** (Foskal)

1775. *Aranea citricola* Forskal, *Descriptions animalium*, : 86.

1900. *Araneus citricola* : Pocock, *Fauna Brit. India, Arachn.*, : 226.

1935. *Cyrtophora citricola* : Dyal, *Bull. Zool. Punjab Univ.*, **1** : 174.

1975. *Cyrtophora citricola* : Patel, *Vidya J. Guj. Univ.*, **18**(1) : 155.

1982. *Cyrtophoira citricola* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 180-182.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 10–13 mm in length, colour highly variable, normally with brownish to grayish and yellow patches, cephalothorax longer than wide, narrowing anteriorly and much broader posteriorly, tri-fid fovea on thoracic region, ocular quad forming trapezium place on an elevation longer than wide and wider in front than behind, both rows of eyes strongly recurved, anterior medians larger than posterior medians, laterals sub-equal, away from each other and placed on prominent tubercles; chelicerae strong, distinctly swollen at the base with prominent boss; legs short and stout; abdomen raised high up anteriorly and strongly overlapping the cephalothorax, dorsum with a pair

of shoulder humps, one pair of lateral humps in the middle and a pair of bifid caudal humps, epigynum with small but much broad scape with prominent rim, internal genitalia with a pair of elliptically pouched spermathecae drawn posteriorly in to narrow duct opening in to lateral portion of scape.

Habits and habitat : Almost same as *Cyrtophora cicatrosa* (Stoliczka) and occupying neighboring areas.

Material examined : 1 ♀ Reg. No. I/3245.

Distribution : India : Tamil Nadu, Karanataka, Maharashtra, Gujarat, West Bengal, Assam, Madhya Pradesh, Rajasthan, Punjab.

Elsewhere : Sri Lanka; Madagascar; Malaysia; Australia; Africa; Egypt And Europe.

28. ***Cyrtophora feae*** (Thorell)

1887. *Araneus feae* Thorell, *Annali. Mus. civ. Genova*, **25** : 173.

1981. *Cyrtophora feae* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 176–178.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size ranges 14–16 mm in length, colour pale yellowish on cephalothorax and legs, greyish with white and black patches on abdomen; cepalothorax longer than wide deeply narrowed anterior 1/3rd thoracic area with a median distinct longitudinal fovea, ocular quad longer than wide but same in width, anterior medians larger than posterior medians, laterals placed close and on prominent tubercles, anterior row strongly recurved but posterior straight; chelicerae weak with moderate boss; abdomen elongated, narrowly overlapping carapace anteriorly and slightly elevated on posterior portion, dorsum decorated with black, white and grayish patches, lines and provided with a pair of anterior sub-lateral conical humps, ventrum grayish brown and a pair of longitudinal white stripes between epigastric furrow and spinnerets; epigynum provided with a distinct median septum broad posteriorly, scape short, roundish and blunt, internal genitalia with a pair of elliptical spermathecae and each with a duct arising from middle portion, running posteriorly to open at the base of scape.

Habits and habitat : Normally encountered in forested areas, seen to prepare radial symmetrical webs at lower heights through bushes, shrubs and grasses. Other biological details wanting. Preferably feeds on smaller to medium sized insects entagled in to the web.

Material examined : 1 ♀ Coll. P. P. Kulkarni, Loc. : Dhapodem Beat, Kurd Range, South Goa, 25.i.2002, Reg. No. I/3150.

Distribution : India : West Bengal, Goa.

Elsewhere : Myanmar.

Genus ***Neoscona*** Simon

29. ***Neoscona molemensis*** Tikader & Bal

1982. *Neoscona molemensis* Tikader & Bal, *Rec. zool. Surv. India, Occ. Pap.*, No., **24** : 22.

1983. *Neoscona molemensis* : Tikader, *Fauna of India. Araneae: Araneidae*, **2**(1) : 257-59.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size 4–7 mm in length, body color yellowish brown to brownish white. Cephalothorax longer than wide, narrowing in front. Cheliceral region slightly high with a deep longitudinal groove, ocular quad nearly as wide as long but more wider in front than behind, anterior median eyes larger than posterior medians, lateral eyes closer, both rows of eyes recurved but anterior row more recurved. Chelicerae strong, dark brown with moderate boss. Legs long and moderately strong, tibiae except III, each provided with cospicuous longitudinal black line. Abdomen Nearly elliptical, longer than wide, dorsum with conspicuous mid-longitudinal chalk white broad band extending from base to end and two pairs of lateral chalk white bands of which one pair placed a little away from the anterior end, and the other starts from the middle of the dorsum, all these bands margined with

reddish brown lines. Two pairs of sigilla present on mid-dorsal portion. Ventrum grayish brown with indistinct white patches, mid-ventral region with broad dark bar guarded with chalk white patches on anterior and posterior portions. Epigynum with triangular scape, with a pair of lateral lobes at the base, internal genitalia with a pair of irregular shaped spermathecae each with a small duct on posterior lateral portion bent laterally to open on lateral portion.

Habits and habitat : Not known.

Material examined : Reported on previous record from Fauna of India, Araneae.

Distibution : India : Molem, Goa.

30. ***Neoscona mukerjei*** Tikader.

1980. *Neoscona mukerjei* Tikader, *Proc. Indian Acad. Sci.*, **89**(3) : 247.

1982. *Neoscona mukerjei* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 248-253.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Small spiders of body size 8–12 mm, carapace longer than wide, narrowed in front, cephalic region with conspicuous 'V' shaped dark brown patch, thoracic with deep longitudinal groove, anterior median eyes slightly larger than posterior medians, lateral eyes placed closer to each other, both rows recurved and ocular quadrangle wider in front; chelicerae strong, yellowish with moderate boss; abdomen sub-triangular, longer than wide, tapering posteriorly, dorsum with a club shaped grayish white patch, arranged longitudinally, 5 pairs of sigilla prominent mid-dorsally, epigynum provided with a moderately long scape with a deep constriction and a pair of indistinct lateral lobes.

Habits and habitat : Mostly observed to spin a thin threaded small sized radial geometric webs through tall grasses and bushes. When disturbed drops down at once to avoid predation. There is tremendous color variation specially the color pattern on dorsal portion of abdomen, almost 18 colour variations have been reported by Tikader (1982).

Material examined : 1♀ reported by Manoj Borkar.

Distribution : Through out Indian subcontinent.

31. ***Neoscona laglazei*** Simon

1977. *Epeira laglaizei* Simon, *Annls. Soc. ent. Fr.* 7(5) : 77.

1900. *Araneus laglaizei* : Pocock, *Fauna Brit. India, Arachn.*, : 224.

1982. *Neoscona laglaizei* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) :263-265.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Body 8-10 mm in length, abdomen tapering and pointed posteriorly with 2 pairs of light coloured bands in middle, body colour yellowish gray, female epigyne with short broad scape directed upwards distally and with a pair of elongated dark spots.

Habits and habitat : Prepares smaller snares along with rolling of small to medium size leaves at centric or eccentric place of the web and hides in rolling of the leaf, web may be at considerable height from ground level. It becomes difficult to notice and collect these spiders from such nest in fields. Preys on smaller insects and other invertebrates entangle in to net. Many times seen along with other species of *Neoscona*.

Material examined : 2♀♀, reported by Manoj Borkar.

Distribution : India : Tamil Nadu (Ootacamund).

Elsewhere : Sri Lanka : Perandeniya, Trincomali, Burma : Tounghnoo. Tharrawaddy, Rangoon, Tenasseri, Java, Indo-Austr–Malayasia Region And China To Philippines, New Guinea.

32. ***Neoscona bengalensis*** Tikader & Bal

1981. *Neoscona bengalensis* Tikader & Bal, *Rec. zool. Surv. India, occ. Pap.*, **24** : 15.

1982. *Neoscona bengalensis* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 246-248.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size ranges from 10–14 mm in length, colour reddish brown on cephalothorax, light brown on legs and dirty brown on abdomen; cephalothorax longer than wide, narrowed in front. Cephalic region raised and thoracic region with a median longitudinal groove. Ocular quad longer than wide and more wider on anterior than on posterior, anterior medians considerably larger than posterior medians, both the rows of eyes recurved. Chelicerae strong. Abdomen sub-triangular, longer than wide and much wider in front, five pairs of sigilla on mid-longitudinal portion and dorsum with minute chalk-white spots and each with deep brown short line, ventrum with a mid-ventral dark brown broad longitudinal patch between epigastric furrow and spinnerets and a pair of chalk white spots present anterior to the spinnerets. Epigynum with long, narrow, thin scape bent at right angle to the base and with a pair of dark spots on the lateral portion of the base, internal genitalia with a pair of elongated kidney shaped spermathecae placed near to the base and inner margin of spermathecae emerging with thin duct running posteriorly to open out just before the posterior margin of scape.

Habits and habitat : No information available.

Material examined : Collected and reported by Dr. Manoj Borkar, from Carmel college campus,

Distribution : India : West Bengal and Goa.

Genus ***Gastracantha*** Sundevall

33. ***Gastracantha geminata*** (Fabr.)

1798. *Aranea geminata* Fabricius, *Suppl. Ent. Syst.*, : 292.

1838. *Gastracantha geminata* : C. L. Koch, *Die Arachniden*, **4** : 16.

1900. *Gastracantha geminata* : Pocock, *Fauna Brit. India, Arachn.*, : 233.

1982. *Gastracantha geminata* : Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 53–55.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 6–9 mm in length, colour dark brown to blackish brown, cephalothorax slightly longer than wide, blunt anteriorly, cephalic region elevated while thoracic region slopping posteriorly ocular quad wider than long and more wider on posterioly,; chelicerae strong and stout with moderate boss; legs also short and stout, femora with transverse yellow bands; abdomen hexagonal, much wider than long, overlapped cephalothorax, dorsum with three yellowish white transverse bands, three pairs of spines, anterior and median of same size while posterior short and smallest, few pairs of sigilla present on dorsum, ventral portion with scattered patches of yellowish white colour and a tubercle present in front of spinnerets, epigynum with short and blunt scape and a pair of median darker spot, internal genitalia provided with a pair of rounded pouched spermathecae with median darker area, each continued posteriorly in to a duct opening posteriorly at the base of median scape.

Habits and habitat : This is a small spider, prepares medium size geometrical, delicate webs between taller and rigid adjacent grass blades at the height of 3–4' from ground level through forested areas, rarely or occasionally also seen to make webs through shrubs and herbs. The spider is seen seating in the central place, a thickly woven, 'the Hub' Feeds on smaller insects entangled in the web threads.

Material examined : 1 ♀, Coll. P. P. Kulkarni, Dhapodem Beat, Kurd Range, South Goa, 25.i.2002, Reg. No. I/3150.

Distribution : India : Tamil Nadu, Karnataka, Raigad, Thane Dists. Maharashtra.

Elsewhere : Sri Lanka.

34. ***Gastracantha hasseltii*** C. L. Koch

1838. *Gastracantha hasseltii* C. L. Koch, *Die Arachniden*, **4** : 29.

1900. *Gastracantha hasseltii* : Pocock, *Fauna Brit. India, Arachn.*, : 233.

1951. *Gastracanth hasseltii* : Sinha, *Rec. Indian Mus.*, **49** : 82.

1982. *Gastracantha hasseltii* Tikader, *Fauna of India, Araneae : Araneidae*, **2**(1) : 63-65.

Common name : Orb-weaving spider.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body 4–6 mm in length, colour dark brown to blackish browm and yellowish on legs; cephalothorax slightly longer than wide and blunt on anterior margin, cephalic region with a median depression and thoracic region slopping down posteriorly, ocular quad wider than long and more wider on posterior portion, medians subequal; chelicerae very strong, stout with moderate boss; legs short and strong; abdomen octagonal, much wider than long, anteriorly overlapping the cephalothorax, dorsum chalk white, blackish brown outer sides and few pairs of conspicuous sigilla, actually spinned with three pairs, median being largest and much pointed; epigynum with rounded short scape, internal genitalia with a pair of narrow tubular and pouched spermathecae, opening on anterior lateral sides.

Habits and habitat : Species found in forested area, spins small delicate webs on shrub and grass blades preferably horizontal to ground, feeds on smaller to medium size insects.

Material examined : 1♀, reported by Manoj Borkar.

Distribution : India : Kerala; Raigad, Thane, Maharashtra; West Bengal; Sikkim; and Assam.

Elsewhere : Myanmar.

Family LYCOSIDAE

Genus ***Hippasa*** Simon

35. ***Hippasa agelenoides*** (Simon)

1884. *Pardosa ageleniodes* Simon, *Ann. Mus. civ. stor. Nat. Geneva*, **20** : 334.

1895. *Hippasa agelenoides* : Thorell, *Spiders of Burma* : 218.

1980. *Hippasa agalenoides* : Tikader & Malhotra, *Fauna of India, Spiders, Lycosidae*, **2**(2) : 293–295.

Common name : Wolf spider.

Local name : Landaga Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size 6–8 mm in length, colour light brown to reddish brown with black spots on abdomen, cephalothorax longer than wide, cephalic region slightly high and abruptly narrowing from the thoracic region, anterior row of eyes slightly procurved with median and lateral of same size, posterior row of eyes larger than others, thoracic area with fine fovea; abdomen longer than wide, variegated with reddish brown patches, black spots and anterior mid-dorsal longitudinal lens shaped brown markings; epigynum smaller, with lateral darker arch shaped short patches and posterior median deep notch, internal genitalia with much smaller roundish spermathecae each continued posteriorly in to a thinner duct curved out laterally and turned in again, bifurcated in to double pouches before opening on posterior portion.

Habits and habitat : Not known.

Material examined : 1♀, Coll. G. M. Yazdani, Loc. : Near Mouth of Mandavi River, Dona Paula, Tal : Tiswadi, 08.iii.1993, Reg. No. I/1982.

Distribution : India : Kerala, Tamil Nadu, Karnataka, Goa, Andhra Pradesh, Maharashtra, Uttatanchal and Uttar Pradesh; Myanmar.

36. ***Hippasa olivaceae*** (Thorell)

1887. *Diponlia olivacea* Thorell, *Ann. Mus. civ. Stor. nat.* Genova, **5(2)** : 297.

1895. *Hippasa olivacea* : Thorell, *Spiders of Burma*, : 217.

1924. *Hippasa olivacea* : Gravely, *Rec. Indian Mus.*, **26** : 593.

1890. *Hippasa olivecea* : Tikader & Malhotra, *Fauna of India, Araneae : Lycosidae*, **1**(2) : 283-285.

Common name : Wolf spider.

Local name : Landaga koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size 10–15 mm long, brownish green in colour, cephalothorax with distinct central fovea with thin but conspicuous brown bands extend for middle to the sides. Chelicerae strong, inner margin of fang with 3 teeth. Abdomen longer, tapering posteriorly with dorsal alternate dark and pale greenish patches.

Epigynum simple with a median plate and lateral cellular loop.

Habits and habitat : Not exactly under stood, specimens collected near to water bodies and streams.

Material examined : 2♀♀, Coll. P. P. Kulkarni, Loc. : Dhapodem Beat, Kurd Range, South Goa, 25.i.2002, Reg. No. I/3250, 2??, Loc. : Fanasmall, Sanguama, Goa, 23.i.2002,Reg. No. I/3254; 2?? Imm., Loc.: Hiware, Sattari, North Goa, 20.i.2002, Reg. No. I/3254.

Distribution : India : Tamil Nadu, Karnataka, Maharashtra, Uttaranchal, West Bengal.

Elsewhere : Myanmar.

Genus ***Pardosa*** Koch

37. ***Pardosa sumatrana*** (Thorell

1890. *Lycosa sumatrana* Thorell, *Ann. Mus. Stor. nat. Genova,* **30** : 136.

1935. *Lycosa arorai* : Dyal, *Bull. Dept. Zool. Punjab Univ.,* **1** : 140.

1951. *Lycosa sumatrana* : Sinha, *Rec. Indian Mus.,* **48**(2) : 33.

1980. *Pardosa sumatrana* : Tikader & Malhotra, *Fauna of India, Araneae : Lycosidae,* **1**(2) : 353–355.

Common name : Wolf spider.

Local name : Landaga Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Smaller body ranging from 6-10 mm in length, brownish in colour, cephalothorax brown with a pale median and two lateral pale bands extending from anterior to posterior margins, a distinct fovea at the center of cephalic region, abdomen longer than wide oval pointed behind, anterior mid dorsal with lens shaped longitudinal marks, rest provided with dark brown and pale patches and black spots, epigyne broder almost hexagonal with a median plate of inverted 'T' shape and a pair of round median spots, internal genitalia with a pair of elongated and elliptical pouched spermathecae and 'S' shaped ductile on inner side.

Habits and habitat : No information available.

Material examined : 1♀, 1♀, Coll. S. G. Patil, Loc. : Colem River near Molem, 26.ii.2002, Reg. No. I/3308; 1♀ 1♀ Immature, Coll. P. P. Kulkarni, Loc. : Hiware, Sattari, North Goa, 20.i.2002, Reg. No. I/3254;

Distribution : India : Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, West Bengal, Meghalaya, Arunachal Pradesh, Bihar, Madhya Pradesh, Gujarat, Rajasthan, Himachal Pradesh and Nicobar Islands.

Elsewhere : Nepal, Bangla Desh, Sumatra and Sri Lanka.

Genus ***Lycosa*** Latreille

38. ***Lycosa phipsoni*** Pocock.

1899. *Lycosa phipsoni* Pocock, *J. Bombay nat. Hist. Soc.,* **12** : 751.

1900. *Lycosa phipsoni* : Pocock, *Fauna of Brit. India, Arachnida,* : 253.

1924. *Lycosa phipsoni* : Gravely, *Rec. Indian Mus.,* **26** 590.

1980. *Lycosa phipsoni* : Tikader & Malhotra, *Fauna of India, Araneae : Lycosidae,* **1**(2) : 398–400.

Common name : Wolf-spider.

Local name : Landaga Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Body large 20–25 mm in length, body colour yellowish to pale brown, darker on cephalic region, centre with conspicuous fovea and brown bands extend laterally from it, abdomen almost oval, broadest just behind of middle, pale with few brown spots present, ventral side black patch between epigastric furrow and spinnerets, epigyne almost triangular with lateral notch and black spots at the base, internal genitalia with obliquely placed minute spermathecae.

Habits and habitat : These are expert ground dwelling hunters, generally found near the streams and aquatic bodies in isolated areas. Females are known to carry their young ones on their abdomen and often sacrifice for young ones for the want of food.

Material examined : 1♀, 1♀, Subadult, Coll. G. M. Yazdani, Loc. : Tributary of Mandavi River, Near Sonal vill., 8 Kms. North East of Valpoi, 15.iii.1993, Reg. No. I/1984,

Distribution : India : Mumbai, Pune, Satara, and Nasik Dists. Maharashtra.

39. ***Lycosa carmichaeli*** Gravely

1924. *Lycosa carmichaeli* Gravely, *Rec. Indian Mus.*, **26** : 604.

1980. *Lycosa carmichaeli* : Tikader & Malhotra, *Fauna of India, Araneae : Lycosidae*, **1**(2) : 407-409.

Common name : Wolf spider.

Local name : Landaga Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Larger spiders, body size ranges from 17-20 mm in length; colour brown to greenish black; cephalothorax longer than wide, convex, provided with conspicuous, chocolate brown, longitudinal broad patch on each side of the distinct fovea extending from the base of third row of eyes to the base of cephalothorax. Anterior row of eyes shorter than the posterior, slightly procurved and medians slightly larger than the laterals. Eyes of the second row largest. Ocular quad wider than long and narrowing in front. Abdomen longer than wide, light brown, broadest behind the middle, anterior mid-dorsum with brown lens shape marking. Ventrum mid-longitudinally with conspicuous broad brown band extending from epigastric furrow to spinnerets. Epigynum with median inverted 'T' disc, darker on posterior lateral and on anterior portions; internal genitalia with same madian plate and a pair of small elliptical spermathecae each with short and coiled duct opening posteriorly at the base of median plate.

Material Examined : 1 ♀, Coll. G. M. Yazdani, Loc. : On the way to Pali Vill., North of Vapoli, Tal.: Sattari, Goa, 18.iii.1993, Reg. No. I/1983.

Distribution : India : Bijnoor, Kansro, Dehra Dun, Kumaon,Uttaranchal; Darjeeling, Sukhawani, West Bengal; Mangal Dai, Assam.

40. ***Lycosa mahabaleshwarensis*** Tikader & Malhotra

1980. *Lycosa mahabaleshwarensis* Tikader & Malhotra, *Fauna of India, Araneae : Lycosidae*, **1(2)** : 429–431.

Common name : Wolf spider.

Local name : Landaga Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size ranges from 25–30 mm in length, colour yellowish brown to dark brown. Cephalothorax longer than wide, narrowing in front, convex, thoracic area with distinct fovea. Anterior row of eyes slightly procurved, less wider than second row and median slightly larger than laterals. Eyes of second row larger than others. Ocular quad wider behind and narrowing in front. A pair of dark brown bands extend the whole sub-lateral length leaving the median and lateral margings reddish yellow. Chelicerae strong and black. Legs long and strong, femora I & II jet black ventrally while III & IV dark brown. Abdomen longer than wide, pointed behind, dorsum with mid-longitudinal broad black band and two reddish yellow broad bands of lateral sides and dark brown patches on sub-lateral sides. Ventrum pale, four stripes of reddish brown spots extend from epigastric furrow to the spinnerets. Epigynum with median plate broader at the base and a pair of lateral broad comma shaped pouched structures, internal genitalia much complicated structure and a pair of coiled spermathecae open posteriorly on the lateral sides of the median plate.

Habits and habitat : Almost unknown.

Material examined : 1♀, Coll. : S. G. Patil, Loc. : Tulsimal Rest House, Keri, 24.ii.2002, Reg. No. I/3312.

Distribution : India : Maharashtra and Goa.

Family GNAPHOSIDAE

Genus ***Herpyllus*** Hentz

41. ***Herpyllus goaensis*** Tikader

1982. *Herpyllus goaensis* Tilader, *Fauna of India, Araneae, Gnaphosidae*, **2**(2) : 460-462.

Common name : Spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size 7–9 mm in length, color reddish brown to gray. Cephalothorax longer than wide, oval, slightly narrowing in front and moderately convex, posterior median with short but conspicuous fovea. Eyes pearly white, widely separated posterior row longer than the anterior, both the rows almost straight,medians almost round, smaller than laterals and closer, ocular quad longer than wide but wider behind than in front. Chelicerae short, fang groove provided with a small tooth on inner margin and three on outer margin. Legs relatively long and strong. Abdomen longer than wide and widest behind the middle portion and darker, lighter on ventrum, epigynum and internal genitalia much complicated structure.

Habits and habitat : Almost not known.

Material examined : Reported on the basis of information available in Fauna of India, Araneae : Gnaphosidae(1982).

Distribution : India : Caranzalem, Goa.

Family SALTICIDAE

Genus ***Myrmarachne*** Mac Leay

42. ***Myrmarachne plataleoides*** (Cambridge)

1869. *Salticus plataleoides* Cambridge, *Ann. Mag. Nat. Hist.*, **3**(4) : 68.

1897. *Myrmarachne plataleoides* : Simon, *Hist. Nat. Araig.*, **2** : 499.

1915. *Myrmarachne plataleoides* : *Rec. Indian Mus.*, **11**(5) : 396.

1973. *Myrmarachne plataleoides* : Tikader, *Proc. Indian Acad. Sci.*, **78**(2) : 60.

Common name : Ant-like spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size ranges from 6–8 mm in length, Cephalothorax almost half of the body length, broadened on cephalic region and separated from thoracic region by a moderate constriction, thoracic region with an additional lateral constriction just posterior to first and narrowed posteriorly. Thoracic region darker brownish with slightly recurved anterior row of eyes, medians being the largest. Posterior row of eyes deeply recurved with posterior laterals larger the medians. Pedicel almost half of the cephalothoracic length. Chelicerae enormously large and robust, almost more tha half of the body length with equally long thin and pointed fang and fang furrow armed with rows of 14 minute but sharply pointed teeth on inner margin and 7 on outer margin. Abdomen small, short with a deep constriction on mid anterior portion and narrowed posteriorly.

Habits and habitat : This species is known to mimic the Ant species *Oecophylla smaragdinea*, and many times this species was seen moving with the line of these ants while shifting the colony from one place to the other. This spider was interestingly found to walk side by side of the row of ants even though some times it falls to the predation of ants (Narayan 1915).

Material examined : 1 ♀, Coll. Manoj Borkar, Loc. : Protected area of Molem Range, Goa (Photographed).

Distribution : India : Tamil Nadu, Goa, Maharashtra, Bihar and West Bengal.

Genus ***Rhene*** Thorell

43. ***Rhene khandalensis*** Tikader

1976. *Rhene khandaalensis* Tikader, *Proc. Indian Acad Sci.*, **85**(5) : 274–275.

Common name : Jumping spider.

Local name : Nil.

Diagnostic characters : Body size ranges from 4–7 mm in length, colour deep to light brown. Cephalothorax wider than long, slightly narrowed on anterior and posterior end but wider on posterior to middle portion. Anterior row of eyes strongly recurved, anterior laterals and posteriors nearly same size, second pair of eyes smaller and situated more nearer to the anterior laterals than to the posteriors. Posterior eyes placed far behind the anterior row of eyes. First pair of legs

conspicuously stout and dorsal side of femur bulging prominently. Tibiae and metatarsi I provided with two pairs of ventral spines. Abdomen short but longer than wide, narrowing behind, dorsum with two pairs of sigilla and posterior half with three light brown transverse bands, the posterior most more darker. Ventrum uniformly lighter and with median longitudinal broad light brown band between epigastric furrow and spinnerets. Epigynum small, a pair of inverted comma shaped plates marked darker on inner margins. Internal genitalia with pair of irregular shaped spermathecae.

Habits and habitats : No information is available.

Material examined : 1♀, Coll. P. P. Kulkarni, Loc. : Nagve, North Goa, 14.i.2002, Reg. No. I/ 3258.

Distribution : India : Goa and Maharashtra.

Family THOMISIDAE

Genus ***Camaricus*** Thorell

44. ***Camaricus formosus*** Thorell

1887. *Camaricus formosus* Thorell, *Ann. Mus. Civ. Stor. Nat. Gen.*, **5(2)** : 261.

1892. *Camaricus formosus* : Workman, *Malaysian Spiders*, **1** : 4.

1980. *Camaricus formosus* : Tikader, *Fauna of India, Araneae : Thomisidae*, **1**(1) : 175 –176.

Common name : Crab spider.

Local name : Kark Koli (Marathi).

Diagnostic characters : Body size ranges from 5-10 mm in length, conspicuously coloured, red to light greenish to dark brown. Cephalothorax high, convex, wider in front and median anterior margin truncated. Eyes in two rows, both recurved, posterior row slightly longer than anterior, ocular quad longer than wide. Legs short and robust, tibiae and metatarsi I & II with three pairs of ventral spines. Chelicerae moderate dark brown. Abdomen longer than wide, widest behind the middle conspicuously decorated, chalk white bands on lateral portion. Ventrum light brown, mid-ventral with longitudinal brown patch between epigastric furrow and spinnerets. Epigynum smaller, club shaped, placed on the posterior portion with a pair of lateral curved whitish patches. Male palp short, stout with thick coiled, pointed duct and provided with a inner strong basal apophysis and a pair of long stout setae on outer portion.

Habits and habita : Usually seen wandering through foliages and soft shoots of Bamboo, feeds by direct attacks on Dipteran flies visiting flowers and foliages. Prepares smaller snares under broad leaves to lay eggs with two openings and sits with eggs to guard up to babies hatch out.

Material examined : 1♀, Coll. P. P. Kulkarni, Loc. :Madai, North Goa, 19.i.2002, Reg. No. I/ 3255.

Distribution : India : Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra and West Bengal.

Elsewhere : Myanmar; Indonesia.

Genus ***Strigoplus*** Simon

45. ***Strigoplus netravati*** Tikader

1963. *Strigoplus netravati* Tikader, *Proc. Indian Acad. Sci.*, Banglore, **58** (3) : 252.

1980. *Strigoplus netravati* : Tikader, *Fauna of India, Araneae : Thomisidae*, **1**(1) : 165–166.

Common name : Crab spider.

Local name : Kark koli (Marathi).

Diagnostic characters : Body size ranges from 3–5 mm in length, colour dark grayish black variegated with whitish and light gray. Cephalothorax slightly wider than long, cephalic region wider behind with clypeus broad, conspicuously projecting, the sides and middle portions of margins concave and provided with one row of clavate hair. Eyes round and black, both the rows recurved, anterior lateral eyes slightly larger than the posterior laterals. Legs I and II much longer than III and IV but II longer than I, dorsal side of femora and the base of the tibiae I and II with conspicuous chalk-white patches, femora III and IV pale white. Abdomen

oval, dorsum spined, slightly overlapping the posterior portion of cephalothorax, dorsum with traseverse, dentate, white bands beautifully coloured with admixture of yellow, dark brown and blue. Ventrum black. Epigynum bark blackish with a pair of anterior, lateral, obliquely placed whitish spots and a median whitish patch narrowed on mid anterior portion and with a pair of sub-median black spots, internal genitalia with a pair of highly bent inside roughly kidney shaped spermathecae, each opening with short duct on posterior margin.

Habits and habitat : Generally found through foliages of wild shrubs in search of prey. Prey usually caught by direct attack, includes smaller dipterans visiting the plant. No other details available.

Material examined : 1 ♀, Coll. S. G. Patil, Loc. : Near stream 1 Km. after Chandor, 02.iii.2002, Reg. No. I/3310.

Distribution : India : Karnataka, Goa and Maharashtra.

Genus ***Platythomisusu*** Doleschall

46. ***Platythomisus sudeepi*** Biswas

1977. *Platythomisus sudeepi* Biswas, *j. Bombay nat. Hist. Soc.*, 74(2) : 332-334.

1980. *Platythomisus sudeepi* : Tikader, *Fauna of India, Araneae : Thomisidae*, 1(1) : 172–174

Common name : Crab spider.

Local name : Kark Koli (Marathi).

Diagnostic characters : Body ranges between 7–11 mm in length, colour yellowish brown with black transverse bands and patches. Cephalothorax high and rounded, little longer than wide, dorso-lateral sides abruptly depressed and anterior portion conical, provided with four roundish black spots and the eyes placed within the anterior black spots, posterior spots larger. Both rows of eyes recurved, anterior laterals larger. Legs I and II brown, longer and subequal. Femora III and IV light yellow. Abdomen longer than wide, broad and conical behind, with three transverse black patches with brown spots and patches. Ventrum black bordered with yellow and spinnerets brown at the base. Epigynum with a broad and short inverted T shape structure with a median blackish round and lateral basal wing shaped structure. Internal genitalia with a pair of elongated spermathecae straight on inner margins but appears bent and convoluted on outer margins, opening posteriorly each with a short duct.

Habits and habitat : No information avialble.

Material examined : 1 ♀, Collected by NGO group Pune, Photographed and reported.

Distribution : India : Karanataka and Goa.

Family CLUBIONIDAE

Genus ***Clubiona*** Latreille

47. ***Clubiona drassodes*** Cambridge

1874. *Clubiona drassodes* Cambridge, *Proc. Zool. Soc London*, : 414.

1931. *Clubiona drassodes* : Gravely, *Rec. Indian Mus.*, 33 262.

1991. *Clubiona drassodes* : Majumder & Tikader, *Rec. zsi. Occ. Pap.*, **102** : 35–37.

Common name : Sac spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size ranges from 8–12 mm in length, colour light yellowish with deep brown ornamentation on abdomen. Cephalothorax longer than wide, narrowed anteriorly and posteriorly but broader on middle portion with a prominent median longitudinal fovea present. Eyes more or less of same size, arranged in two transverse rows, anterior row slightly recurved but posterior procurved and longer than the anterior, the eyes placed at equi-distance. Chelicerae moderately strong, fang groove provided with a pair of similar teeth on inner margin while three dis-similar teeth on outer margin. Leg formula 4 1 2 3, tibiae and metatarsi I & II with 2 and 1 pairs of ventral spines, tarsi long and scopulated, Male palp tibia longer than wide, without apophysis, flat tegulum and with out spur on cymbium. Abdomen elongated, decorated with deep brown spots on posterior

portion. Epigynum with an elongated, curved black central plate, placed on anterior median portion, a pair of conspicuous copulatory opening present on lateral posterior portion. Internal genitalia with smaller pair of spermathacae, the copulatory tubes long and coiled.

Habits and habitat : Species found through forested areas of Western Ghat, seen moving through foliages of shrubs and herbs, feeding on smaller Arthropods in direct attacks. Not seen to spin the web but females prepare sac type, thickly woven, sticky pockets in tall grasses by folding the wider grass blades to lay eggs, mother guards the sac up to the young ones hatch out.

Material examined : 1♀ 1♂; Coll. D. B. Bastawade, Mahadai, North Goa, 19.i.2002, Reg. No. I/3255.

Distribution : India : Karnataka, Goa (New report), Maharashtra, Uttaranchal, Uttar Pradesh, Bihar, West Bengal and Andaman Islands.

Family TETRAGNATHIDAE

Genus ***Tetragnatha*** Latreille

48. ***Tetragnatha mandibulata*** Walckenaer

1837. *Tetragnatha mandibulata* Walckenaer, *Ins. Apt.*, **2** : 211.

1899. *Tetragnatha mandibulata* : Pocock, *Fauna Brit. India, Arachn.*, : 215.

1977. *Tetragnatha mandibulata* : Tikader, *Rec. zool. Surv. India*, **75** : 153–212.

Common name : Long-cylendrical spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic Characters : Body shape narrow more elongated, about 12–15 mm long, yellowish to dark yellowish with greenish tinge and one or two pairs of whitish stripes dorsal surface of abdomen, legs exceptionally long as compared to the body; carapace flat and narrowed anteriorly with truncated margin, eyes in two slightly procurved rows; chelicerae large and exceptionally long with large teeth and longer fangs; male palp with exposed round cymbium, female genitalia simple with tubular epigyne.

Habits and habitat : Normally found in the vicinity of water bodies and streams, prepare radial symmetrical delicate webs, just about 2 to 3 above water surface between available supports, feed on smaller insects visiting the streams or aquatic bodies which entangle in to the webs.

Material examined : 1♀, Coll. G. M. Yazdani, Valvanti River, Near Tulsimala, 15 Kms. NW 'O' Valpoi, 16.iii.1993, Reg. No I/1986; 1♀, 2♀♀, Subadults, 3 youngs, Coll. D. B. Bastawade, Reg. No. I/3245.

Distribution : Almost throughout Indian sub-continent.

Genus ***Herennia*** Thorell

49. ***Herennia ornatissima*** (Doleschall)

1859. *Epeira ornatissima* Doleschall, *Act. Soc. India Neerl.*, **5** : 32.

1900. *Herennia ornatissima* : Pocock, *Faun. Brit. India, Arachn.*, : 219.

1982. *Herennia ornatissima* : Tikader, *Fauna of India, Araneae : Araneidae*, **1**(1) :106–108.

Common name : Orb–weaving spiders.

Local name : Koli (Marathi), Makadi (Hindi).

Diagnostic characters : Body size 11–13 mm in length, color brownish yellow to grayish white. Cephalothorax longr than wide, narrowing on anterior portion, thoracic region with transeverse groove. Ocular quad as long as wide, slightly wider behind, anterior medians larger than posterior medians, laterals sub-equal in size, closer and situated on prominent tubercles, anterior row of eyes recurved where as posterior row straight. Chelicerae strong and stout, light brownish with moderate boss. Legs longer and slender. Abdomen flat, lobate having 4 pairs of lateral lobes, dorsum with numerous grayish specks each with a distinct center, five pairs of distinct sigilla arranged mid – dorsally, ventrum with median broad yellowish patch with a large black spot in the center between epigastric furrow and spinnerets. Epigynum plate like with a median septum, internal genitalia with a pair of pear shaped spermathecae, each darker on lateral portions and the other elongated

elliptical pair just ventral of the first, each opening on posterior median portion with short and bent in duct.

Habits and habitat : Not known.

Material examined : Reported on the basis of previous records by Tikader (1982).

Distribution : India : Trivendrum, Ootacamand, Tamil Nadu; Shillong, Meghalaya; Punda (?), Goa.

Elsewhere : Sri Lnaka. Mayanmar. Austro–Malaysia.

Order PHALAGIDA (= Opiliones)

Suborder LANIATORES

Family ASSAMIIDAE

Subfamily POLYCORIPHINAE

Genus ***Mormuga*** Roewer

50. ***Mormuga uncifrons*** Roewer

1927. *Mormuga uncifrons* Roewer, *W. W. I.* : 277.

Common name : Daddy-long-legs.

Local name : Zad-zankar (Hindi).

Diagnostic characters : Body small, about 3–5 mm long, yellowish to brownish, darker on borders of segments, spined, ocular tuberculum with one pair of small spine, areas I, II and IV of scutum and 1–3 abdomenal tergites without spines and smooth, areas III and IV always with a pair of spines, palpal femur without proximal, distilateral and median spine. Tarsal formula : V > 6, VI > 6 and end segment of tarsus II–3 jointed.

Habits and habitat : Normally found in humid wet climate under stones, through rock crevices, under barks of rotten logs or trees and occasionally under leaves in rainy season. No other biological aspects are known.

Material examined : 1 ♀ ♀ Coll. Dr. V.C. Agarwal, Loc. : Forest area, 12 kms. SE of Molem, Dt. 06.01.1969, Reg. No. G Ar. 13, Loc. : Forest area, 5 kms. NE of Margao, Dt. 20.12.1968, Reg. No G Ar. 6; Coll. Dr. P. P. Kulkarni, Loc. : Khotigaon forest area, Dt. 28.01.2002, Reg. No. I/3249.

Distribution : India : Molem and Margao, Goa and Ratnagiri Dist., Maharashtra.

SUMMARY

This communication on the state fauna of Goa deals with 5 Arachnid orders, 16 families and 33 genera and 50 species, which have been actually collected, recorded and reported from present political boundaries of this state. 2 species of spiders are reported on the basis of previous reports from the state in recent literatures.

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FRESHWATER FISHES

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INTRODUCTION

Goa state, an isolated niche for piscine fauna, is characterized by moist deciduous evergreen forest in the Western Ghats. Goa exhibits xerophytic and isothermic climate. Mountain ranges directly run into the Arabian sea. Goa has eastern portion having succession of gradually ascending hills, domes, plateaus, ramifying spurs, and deep valleys. It has thick forests in Bhagwan Mahaveer and Bondla Sanctuaries on the Western Ghats side. The major rivers of Goa are Mandovi, Zuari, Chapora, Sal, Khandepar, Talpan and Galjibag.

Literature reveals that, ichthyofauna of Goa State is less studied except Tilak (1973) who evaluated 52 species of freshwater and estuarine fishes. Earlier, Tandon *et al.* (1967) studied marine ichthyofauna of Goa. Considering a large gap in research, various survey parties of Zoological Survey of India, W.R.S. Pune, have conducted four state faunal surveys of Goa (one in 1973 and 3 in 1993). The ichthyofauna of Goa State comprises 58 species, out of which 39 were actually collected and 19 are inventorised from literature.

Ichthyofauna of Goa represents 58 species belonging to 31 genera under 20 families spread over 8 piscine orders. They include mostly medium sized food fishes, gamefishes and aquarium fishes.

MATERIAL AND METHODS

Fish material was collected by applying cast net, bag net, water net and blocking smaller streams and shallow water river course, Yazdani (1993). The fish specimens collected were instantly fixed in 4-5% formaldehyde solution and subsequently after 3-4 hours of fixation and washing with water transferred to rectified spirit. The large sized fishes were injected with 10% formaldehyde and given incision in belly, in the field itself.The specimens wetre identified on the basis of shape of the snout, presence or absence of barbels, position of eyes, dorsal fin rays, number of scales in lateral line, transverse lines, anal fin rays, predorsal scales etc. Day (1875-78, 1889), Jayaram (1981, 1991), Menon (1987, 1992, 1999), Talwar and Jhingran (1991) were referred for identification of fish species.

The present paper reports valid scientific names of the freshwater fishes, systematic account, type locality, diagnosis, material examined, distribution, remarks, range in mm (Standard length) and status of the fish on the basis of visual observation and literature. Menon (2004), Yazdani (1990, 1991) and Yadav (2003, 2004, 2005). Species marked with asterices were actually collected from Goa state.

FISHES OF GOA

(Asterisk indicates species actually collected)

Class OSTEICHTHYES
Subclass ACTINOPTERYGII
Infraclass TELEOSTEI
Order ANGUILLIFORMES
Family ANGUILLIDAE

1. *Anguilla bengalensis* (Gray)

Order OSTEOGLOSSIFORNMES

Family NOTOPTERIDAE

2. *Notopterus notopterus* (Pallas)

Family CYPRINIDAE

Subfamily Cultrinae

3. **Chela cachius* (Ham–Buch)
4. *Chela dadiburjori* (Menon)
5. **Salmostoma boopis* (Day)
6. **Danio aequipinnatus* (McClelland)
7. **Rasbora daniconius* (Ham–Buch)
8. *Rasbora rasbora* (Ham–Buch)
9. **Rasbora caverii* (Jerdon)

Subfamily CYPRININAE

10. **Puntius crescentus* Yazdani and Singh
11. **Puntius fasciatus pradhani* Tilak
12. *Puntius fasciatus fasciatus* (Jerdon)
13. *Puntius filamantosus* (Valenciennes)
14. **Puntius setnai* Chhapgar and Sane
15. **Puntius narayani* (Hora)
16. *Puntius sarana subnasutus* (Valenciennes)
17. *Puntius vittatus* Day
18. **Puntius jerdoni* (Day)
19. **Puntius amphibious* (Valenciennes)
20. **Puntius ticto* (Ham-Buch)
21. **Cirrhinus cirrhosus* (Bloch)
22. *Labeo dussumieri* (Valenciennes)

Subfamily GARRINAE

23. **Garra g. gotyla* (Gray)
24. **Garra mullya* (Sykes)
25. **Garra g. sternorhynchus* (Jerdon)

Family COBITIDAE

Subfamily COBITINAE

26. **Lepidocephalus guntea* (Ham–Buch)
27. **Lepidocephalus thermalis* (Valenciennes)
28. *Pangio goaensis* (Tilak)

Family HOMALOPTERIDAE

Subfamily NEMACHEILINAE

29. **Noemacheilus evezardi* Day
30. **Noemachilus botia* (Ham–Buch.)
31. **Noemachilus elongatus* (Hora)

Order SILURIFORMES

Family BAGRIDAE

32. **Rita kuturnee* (Sykes)
33. **Rita pavimentata* (Valenciennes)
34. **Mystus malabaricus* (Jerdon)
35. **Mystus oculatus* (Valenciennes)
36. **Mystus gulio* (Ham-Buch)
37. **Mystus keletius* (Valenciennes)

Family SILURIDAE

38. **Ompok bimaculatus* (Bloch)
39. *Ompok malabaricus* (Valenciennes)

Family SCHILBEIDAE

40. *Pseudeutropius mitchelli* (Gunther)
41. *Clarias d. dussumieri* Valenciennes

Order ATHERINIFORMES

Family BELONIDAE

42. *Xenentodon cancila* (Ham–Buch.)

Family CYPRINODONTIDAE

43. *Aplocheilus blocki* (Arnold)
44. **Aplopcheilus lineatus* (Valenciennes)
45. **Aplocheilus panchax* (Ham-Buch)

Family POECILIDAE

46. **Gambusia affinis* (Baird & Girard)
47. **Poecila reticulata* Peters

Order CHANNIFORMES

Family CHANNIDAE

48. **Channa orientalis* Bloch & Schneider
49. *Channa punctatus* (Bloch)

Order PERCIFORMES

Family AMBASSIDAE

50. **Chanda nama* (Ham.–Buch.)
51. *Parambassis thomassi* (Day)

Family CICHLIDAE

52. *Etroplus maculates* (Bloch)
53. **Etroplus suratensis* (Bloch)

Family GOBIIDAE

54. **Glossogobius giuris* (Ham–Buch)

55. *Anabas testudineus* (Bloch)

Family BELONTIDAE

56. **Pseudosphromenus cupanus* (Valenciennes)

Family MUGILIDAE

57. **Sisamugil cascasia* (Ham–Buch.)

Order MASTACEMBELIFORMES

Family MASTACEMBELIDAE

58. **Masatacembelus armatus* (Lacepede)

39 species actually collected.

19 species incorporated from the literature.

SYSTEMATIC ACCOUNT

Class PISCES

Subclass TELEOSTOMI

Skeleton bony. Gills covered by bony operculum and having only one externeal opening on each side. Skin normally covered with overlapping scales which in some families may be obsolete and in others modified by calcification into a hard covering, ossified dermal plates or a complete bony casing. Caudal fins almost symmetrical.

Key to the orders of subclass TELEOSTOMI

1a. Body more less cylindrical elongated and eel–shaped. Pelvic girdle and fin absent. ....MASTACEMBELIFORMES

1b. Body not cylindrical elongated and eel shaped but fusiform and laterlally compressed, pelvic girdle and fin present. 2

2a. Head like snakehead, Dorsal and anal fins far from caudal fin. Gill openings wide, membranes of two sides connected beneath isthmus. Scales moderately large..... ..... CHANNIFORMES

2b. Dorsal and anal fins confluent with caudal fin.....3

3a. Gill openings situated near the base of pectoral fin. Scales small embedded in the skin. .... ANGUILLIFORMES

3b. Skin with or without scales, either smooth or covered with osseous plates. 4

4a. Skin without scales. Pectoral fin with osseous spine or thick ray, barbels long, dorsal adipose fin present. ..... SILURIFORMES

4b. Skin scaled, pectoral fins without modifications dorsal adipose fin absent 5

5a. Abdominal edge keeled with double serrations ..... OSTEOGLOSSIFORMES

5b. Abdominal edge smooth, rounded 6

6a. Pelvic fins inserted in the abdominal region and with spines. Dorsal and anal fins with spines. Mostly dorsal fin in two parts, continuous or separate one spiny, another with soft rays. ..... PERCIFORMES

6b. Pelvic fins inserted in the abdominal region without spines. Dorsal and anal fins without spines. Mostly with a single dorsal fin.....7

7a. Scales on head and body. Teeth present on jaws. ..... ATHERINIFORMES

7b. No scales on head. No teeth on Jaws. ....CYPRINIFORMES

Order ANGUILLIFORMES (Eels)
Freshwater eels

Eel like fishes with minute, embedded scales. Gill opening vertical slits near base of pectoral fins. Lateral line present. Only one species is recorded from Goa.

1. *Anguilla bengalensis* (Gray)

1831. *Mauraena bengalensis* Gray, *Ind. Zool.* III pl 95, fig. 5 (Type locality : The Ganges)

1999. *Anguilla bengalensis* Menon, *Rec. zool. Surv. India Occ. Paper No.*, **175** : 5-6. (Checklist)

Diagnosis : Elongated cylindrical body, gill openings nearer the base of pectoral fins. Dorsal fin at mid way between gill opening and origin of anal fin with 220-305 rays, caudal continued round the end of tail, scales rudimentary embedded in the skin.

Distribution : India.

Elsewhere : Pakistan, Sri Lanka, Myanmar.

Remarks : Inhabits streams, pools and reservoirs, mud substrates, tanks and deep rocky pools of rivers. Descending to estuaries and to sea to spawn.

Status : Common.

Order OSTEOGLOSSIFORMES

Body and head strongly compressed with ornamental scales. Caudal region very long and tapering Maxillares well toothed. Maxilla and premaxilla firmly bound together. Abdomen non-keeled. Pelvic fins abdominal. Barbels absent. Anal fin long united with caudal. Caudal skeleton reduced.

Family NOTOPTERIDAE
Feather backs or knife fishes

Body broad elongated and compressed; scales present on head. Abdomen serrated before pelvic fins. Dorsal fin small, inserted middle of body with 8 to 10 rays. Anal fin with 100 to 110 rays, confluent with caudal fin. Pelvic fin very small with 3 to 6 rays. Lateral line arched with 120–180 scales.

Out of two species occurring in India, only one species is recorded from Goa.

2. ***Notopterus notopterus*** (Pallas)

1769. *Gymnotus notopterus* Pallas, *Spicil Zool.*, **7** : 40, pl 6, Fig. 2 (Type locality : Ponds and rivers of Bengal.)

1999. *Notopterus notopterus* Menon, *Rec. zool. Surv. India Occ. Paper No.*, **175** : 9-10. (Checklist).

Diagnosis : Teeth present on jaws, scales on head, preorbital serrated, gape of mouth does not extend hind part of orbit. Dorsal profile curved but not humped.

Distribution : India.

Elsewhere : Nepal, Pakistan, Bangladesh, Myanmar, Malaya, Thailand, Indonesia.

Remarks : Inhabits rivers, canals, swamp and estuaries.

Status : Common.

Order CYPRINIFORMES

The body is generally with scales. Head scaleless. Mouth protractile and toothless. Barbels often present. A single dorsal fin, no adipose dorsal fin. Lateral line present. Swimbladder free or closed in bony capsule. Weberian apparatus connects the swim bladder with internal ear.

Key to the families

1a. Head and body depressed, flattened below. ..... HOMALOPTERIDAE

1b. Head and body compressed, not flattened below 2

2a. 2 to 4 barbels or barbels absent. Swim blader divided into anterior and posterior part not surrounded by a bony capsule ....CYPRINIDAE

2b. 6 to 8 barbels. Swim bladder entirely or partially enclosed by a bony capsule, its posterior part small or vestigial..... ..... COBITIDAE

Family CYPRINIDAE
Carps

Body with scales and laterally compressed. Abdomen rounded or cutting. Mouth with or without sucker, sometimes with a symphysial knob. Lips sometimes absent from one of the jaws or closely infesting both jaws or reflected from one of the other. A continuous or interrupted labial fold present. Same to either side of the lips or both. Barbels 1, 2 pairs or none. Last undivided dorsal fin ray osseous, serrated or articulated. Lateral line complete, incomplete or absent.

A very large and most common group of freshwater fishes.

Key to the Subfamilies

1a. Abdomen partly keeled, scales extend upto inter-orbital space, barbels absent. .... CULTRINAE

1b. Abdomen partly keeled, scales extend upto inter-orbital space, barbels 2 pairs, 1pairs or absent.....2

2a. Upper lip continuous with the skin of the snout, Mouth inferior. Lower lip with a adhesive disc. ..... GARRINAE

2b. Upper lip separate from the skin of rostrum by a deep groove. Mouth anterior, inferior or subinferior. Lower lip without an adhesive disk. 3

3a. Lower jaw with a symphysial knob. Lateral line with an abrupt downward curvature anteriorly, running in lower half of caudal peduncle. Dorsal fin without any osseous, simple ray. ..... RASBORINAE

3b. Lower jaw without symphysial knob. Lateral line complete or incomplete running along the middle of caudal peduncle. Dorsal fin with or without osseous simple ray. ..CYPRININAE

Subfamily CULTRINAE

A symphysial knob on lower jaw present or absent. A part or whole of abdominal edge cutting. Mouth directed upwards. Dorsal fin without osseous ray, inserted in posterior half of the body. Lateral line concave, barbels absent.

Key to the Genera

1a. lower jaw with a symphysial knob. Predorsal scales extend to the inter-orbital space. Pelvic fin with outer ray generally not elongated. ..... ***Salmostoma***

1b. Lower jaw without a symphysial knob. Predorsal scales do not extend to the inter-orbital space. Pelvic fin with outer ray elongated. ..... ***Chela***

Genus ***Chela*** Hamilton–Buchanan, 1822

Body oblong, compressed with a cutting abdominal edge. Mouth directed obliquely upward cleft extending to below anterior border of the orbit. Lower jaw without a symphysial knob. Dorsal fin with 9 to 11 rays elvic fins with outer ray elongated. Anal fin with 17 to 25 rays lateral line with 34–68 scales. Predorsal scales do not extend to inter-orbital space.

Key to the species

1a. Lateral line scales 51 to 56. Pectoral fin not reaching anal fin. Pelvic fin with an elongated ray, extending to middle or even end of anal fin base. ..... ***C. cachius***

1b. Lateral line incomplete or absent pelvic fin without an elongated ray, not extending to anal fin. ..... ***C. dadiburjori***

3. ***Chela cachius*** (Ham–Buch)

1822. *Cyprinus cachinus* Hamilton, Fish Ganges. 258. 384. (Type locality : River Ganges, above the commencement of the delta.)

1981. *Chela cachius* Jayaram, *H.B.F.W. Fish India*. 72.

1999. *Chela cachius* Menon. *Rec. zool. Surv. India Occ Paper No.*, **175** : 35-36.

Diagnosis : Lateral line complete with 51 to 68 scales. Body depth 4 to 4.25 in TL.

Materail examined : 1ex. Tributary of Mandovi river, Valpoi, Tal Satari; G.M. Yazdani, 15.3.93.

Distribution : Throughout India.

Elsewhere : Pakistan, Bangladesh, Burma.

Remarks : Numerous scales present on body. Inhabits ponds, ditches and rivers in plains and sub-montane regions.

Range : 38 mm.

Status : Uncommon.

4. ***Chela dadiburjori*** (Menon)

1952. *Laubuca dadiburjori* Menon. *Rec. Indian Mus.*, **49** : 1 (Type locality Kerala).

1981. *Chela dadiburjori*, Jayaram, *H.B.F.W. Fish India*. 72

1991. *Chela dadiburjori*, Talwar and Jhingran, *Inland Fish*. **1** : 314.

1999. *Chela dadiburjori*, Menon, *Rec. zool. Surv. India Occ. Paper No.*, **175** : 37.

Diagnosis : Lateral line incomplete or absent. (A broad moniliform dark stripe interrupted in 3–5 places extend from opercle to caudal base).

Distribution : India : West coast : Nagercoil to Goa.

Remarks : Inhabits clear ponds and streams.

Status : Uncommon.

Genus ***Salmostoma*** Swainson 1839

Body elongated and compressed. Abdomen keeled from pectoral fin to anus. Lower jaw longer with symphysial knob. Dorsal fin short, inserted mostly opposite to anal fin. (ahead in *S. boopis*) with 9 to 10 rays (7 or 8 branched). Anal fin short with 13 to 22 rays. Caudal fin deeply forked. Lateral line with 38 to 112 scales.

Only one species, *S. boopis* (Day) is recorded from Goa state.

5. ***Salmostoma boopis*** (Day)

1873. *Chela boopis* Day, *Proc. Zool. Soc. London*, **708**. (Type locality : South Kanara).

1999. Salmostoma boopis, Menon, *Rec. zool. Surv. India Occ. Paper No.*, **175** : 26.

Diagnosis : Anal fin with 12–14 branched rays. Lateral line with 39–42 scales. Dorsal fin inserted in advance of anal fin.

Material examined : 1 ex, Zuari river, P.D. Rane, 5.12.1993.

Distribution : Peninsular India : Western Ghats; Karnataka, south Kanara, and Maharashtra.

Remarks : It inhabits upper reaches of rivers.

Range : 63 mm.

Status : Common.

Subfamily RASBORINAE

Body oblong or elongated and compressed. Abdomen not trenchant, somewhat rounded. Mouth terminal, obliquely ascending; lower jaw usually projecting, generally provided with a symphysial knob. Dorsal fin without an osseous ray. Lateral line abruptly bending downwards, running along lower half of caudal peduncle.

Key to the Genera

1a. Lower jaw with three promineances. Anal fin with 8–9 rays. ..... ***Rasbora***

1b. lower jaw with a single symphysial knob. Anal fin with 11–20 rays. ..... ***Danio***

Genus ***Danio*** Hamilton-Buchanan 1822

Mouth small directed obliquely upwards. Lower jaw prominent with symphysial knob. Eyes provided with backwardly directed preorbital spinous process at the anterior rim of orbit. Barbels 2 pairs, one pair or absent. Dorsal fin with 16 to 17 branched rays, anal with 11–20. Lateral line concave, complete, incomplete or absent, with 32 to 65 scales. Only one, species *Danio aequipinnatus* (McCleland) from Goa state is recorded.

6 ****Danio aequipinnatus*** (McCleland)

1839. *Perilampus aequipinnatus* McCleland, *Asiat. Res.* **19**(2) : 393, pl. 60, fig. 1. (Type locality : Assam)

1981. *Danio aequipinnatus*, Menon, *Rec. zool Surv. India, Occ. Paper No.*, **175** : 39–40.

Diagnosis : No spines along anterior margin of orbit. Barbels present, well marked and uniform lateral colour bands present. Lateral line scales 34–36.

Material examined : 1 ex., Goa, B.S. Lamba, 17.12.1973; 7 exs, Molem, B.M. Sanctuary, G. M. Yazdani, 13.3.1993; 2 exs, Khandepar river near Dudh Sagar falls, B.M. Sancturary, M.S. Pradhan, 17.9.1993., Galjibag river, Painginium, tal. Cancona, M.S. Pradhan, 26.9.1993., 38 exs., Palayam Nalla, P. D.Rane, 25, 11.1993, 13 exs, Pernem Goam, B. S. Lamba, 8.12.1973; 1 ex. Mandovi river, M.S. Pradhan, 30.3.1993.

Distribution : Throughout India.

Elsewhere : Nepal, Bangladesh, Myanmar and Thailand.

Remarks : Clear stream inhabitant at foothills.

Range : 28–75 mm.

Status : Common.

Genus ***Rasbora*** Bleeker, 1860

Body elongated and compressed with rounded abdomen. Lower jaw conspicuous with three

internal prominances. Barbels 1 pair or absent. Dorsal fin inserted opposite interspace between pelvic and anal fin, with 9–10 soft rays and no spine. Anal fin with 8–9 rays (5 or 6 branched rays). Caudal fin emarginated or forked. Lateral line concave, complete with 26 to 44 scales.

Key to the species

1a. Distance from anterior base of dorsal fin to end of hypural plate when carried forward falling behind the posterior border of orbit ..... *R. caverii*

1b. Distance from anterior base of dorsal fin to end of hypural plate when carried forward falling before the posterior border or orbit.. 2

2a. Lateral line scales 32 to 34. A black lateral longitudinal band present. .... *R. daniconious*

2b. Lateral line scales 28–31. Caudal fin with well defined blackish hind border. .... *R. rasbora*

7. ****Rasbora daniconius*** (Ham-Buch.)

1822. *Cyprinus daniconius* Hamilton, *Fish Ganges* : **327**, pl. 15, Fig 89. (Type locality : Rivers of Southern Bengal)

1972. *Rasbora daniconius daniconius*, Tilak, *Rec. zool. Surv. India*, **101**.

1981. *Rasbora daniconius*, Jayaram. *HBFW Fish India* : 84–85, fig. 43.

Diagnosis : Barbels absent, lower lip simple, fins without fleshy sheaths, dorsal hypural distance when carried forward falling before the posterior margin of the eye. Lateral line with 32–34 scales. A black lateral stripe present along centre of body.

Material examined : 1ex., Nanodi river, Kudal Village; 15 km NE of Valpoi, tal. Sateri, G.M. Yazdani, 17.3.1993; 4 exs, Sacorda, Goa, B.S. Lamba, 17.12.1973; 25 exs, Galjibag river, Painginium, tal. Cancona, M.S. Pradhan, 26.9.1993.,20exs. Mandovi river, P.D. Rane, 3.12.1993; 20 exs., Dudhsagar falls, B.M. Sancturary P.D. Rane, 25. 11.1993, 7 exs., Palayam Nalla, P. D. Rane, 25, 11.1993; 26 exs, Noveband Sal River, Conolim, Margaon M.S. Pradhan, 28.9.1993; 19 exs, Pernem Goa, B.S. Lamba, 8.12.1973; 5 ex. Mandovi river, M.S. Pradhan, 30.3.1993.

Distribution : Throughout India.

Elsewhere : Sri Lanka, Pakistan, Nepal and Bangladesh, Burma and Thailand.

Remarks : It is a clear water inhabitant.

Range : 18-22 mm.

Status : Common.

8. ***Rasbora rasbora*** (Ham–Buch.)

1822. *Cyprinus rasbora* Hamilton. *Fish Ganges* : 329, 391, pl 2, fig 90. (Type locality : Ponds of Bengal).

1981. *Rasbora rasbora*, Jayaram *HBFW. Fish India* : 84–85.

1999. *Rasbora rasbora*, Menon. *Rec. Zool Survey India, Occ. Paper No.*, **175** : 53–54.

Diagnosis : Barbels absent, pores in lateral line more than 21, dorsal hypural distance when carried forward falling before the posterior margin of eye, lateral line scales 28–31, caudal fin with well defined blackish hind border.

Distribution : India : West Bengal and Assam, Pakistan, Bangladesh, Burma and Thailand.

Remarks : Inhabits clear streams and ponds in the plains.

Status : Common.

9 ****Rasbora caverii*** (Jerdon)

1849. *Leuciscus caverii* Jerdon, Madras *J. Lit. Sci.*, **15** 320 (Type locality : Cauvery river southern India)

1981. *Rasbora caverii*, Jayaram, *HBFW Fish India*, 84-85

1999. *Rasbora caverii*, Menon, *Rec. zool Survey India, Occ. Paper No.*, **175** : 52–53.

Diagnosis : No barbels, pores in lateral line more than 21, lips simple, fins without fleshy sheaths, dorsal hypural distance when carried forward falling behind the posterior margin of orbit.

Material examined : 20 exs, Dudhsagar falls, B.M. Sancturary, P. D.Rane, 1.12.1993; 1 ex. Zuari river, P. D. Rane. 5.12.1993.

Distribution : Peninsular India: Karnataka, Tamil Nadu (Cauvery drainage) and Tambraparni.

Elsewhere : Sri Lanka.

Remarks : It is a first record from Goa.

Status : Rare.

Subfamily CYPRININAE

Abdominal edge rounded. Barbels either present or absent. Dorsal fin with or without an osseous simple ray. Generally a symphysial knob on lower jaw absent, sometimes present. Lateral line complete or incomplete, usually straight in the middle of lateral sides.

Key to Genera

1a. A knob or horny tubercle present at the symphysis of lower jaw. Rostral barbels generally present. ..... ***Cirrhinus***

1b. No such symphysial knob present. Rostral barbels present or absent. 2

2a. Small to medium sized, deep bodied boat shaped fish, snout simple. A horny covering on the lips absent. Lower jaw covered by lip. Lower lip attached to lower jaw along the entire mouth ..... ***Puntius***

2b. Medium sized slender fishes lower lip with or without groove, a horny covering on the inner side of lips present. Lips distinct. ..... ***Labeo***

Genus ***Puntius*** Hamilton 1822

Body short, moderately elongate to deep, compressed. Abdomen rounded. Head short, snout obtuse, conical, or pointed. Mouth arched, anterior or inferior without inner folds, upper jaw more or less protractile. Eyes moderate to large, without adipose lids, dorso lateral. Lips thin, covering the jaws. Dorsal fin short, may be with scaly sheath. Lateral line complete or incomplete with 20 to 47 scales.

Key to the species and subspecies of *Puntius*

1a. Barbels present. 2

1b. Barbels absent 10

2a. 2 pairs of barbels. 3

2b. only one pair of barbels 7

3a. lateral line scales above 25 4

3b. lateral line scales below 25 5

4a. Lateral line scales 28–31, last unbranched, dorsal ray osseous, strong serrated. ..... *P. sarana subnasutus*

4b. Lateral line scales 27–32, dorsal spine weakly ossified. ..... *P. jerdoni*

5a. Body with dark vertical bands 6

5b. Body without dark vertical bands 7

6a. Body with 2 to 3 vertical bands ..... *P. fasciatus fasciatus*

6b. Body with 5 vertical bands ... *P. f. pradhani*

7a. Body with distinct black markings on either dorsal fin or on caudal peduncle, lateral line scales less than 25 8

7b. Blotch present on caudal peduncle only. Lateral line scales 21 to 28. (Normally 24–25.) 9

8a. Body with dark crescentic mark on dorsal fin and a blotch on caudal peduncle. ..... *P. crescentus*

8b. Body with finger like marking on caudal peduncle ..... *P. filamentosus*

9a. A deep bodied elongated fish dorsal fin ray non-serrated ..... *P. amphibius*

9b. Deep bodied, medium sized fishes, barbels absent. Lateral line scales less than 25 ... 10

10a. Body without black blotches, dorsal fin ray serrated or not ..... *P. vittatus*

10b. Body with black blotches or bands 11

11a. Body with two black blotches, one on operculum and the other on lateral line scales 16-18., last unbranched, dorsal fin ray serrated ..... *P. ticto*

11b. Body with vertical bands. 12

12a. Body with 3 vertical bands, dorsal fin ray serrated. Lateral line scales 20. ..... *P. narayani*

12b. Body with 3 vertical bands, dorsal fin ray serrated. Lateral line scales 20 ..... *P. setnai*

10. ***Puntius crescentus***, Yazdani and Singh

1994. *Puntius crescentus*, Yazdani and Singh, *J. Bombay nat. Hist. Soc.* **91** : 107–109. (Type Locality : Kali Nadi, Sunkeri, Karwar, Karnataka)

1997. *Puntius crescentus*, Yadav, *Studies syst. & zoogeography Fishes of Western Ghats with Observations on status of endemic species, PhD. Thesis, Pune University;* 168.

Diagnosis : One pair of barbels present. Last undivided ray of dorsal fin not serrate, serrated, lateral line incomplete with 22–23 scales. Lateral black spot at the base of caudal fin. Horizontal dark line along the body, a black crescentic band on dorsal fin present.

Material examined : 10 exs. Nalla nr. Chikhali, Vasco-da-Gama, Marmugoa, G.M. Yazdani, 17.3.1993; 20 exs. Galjibaug river, Painginium, tal. Cancona, M.S. Pradhan, 26.9.1993; 10 exs. Mandovi river, Goa, P. D.Rane, 3.12.1993; 12 exs, Fresh water pond near Maxem, Painginium, M.S. Pradhan, 19.9.1993; 27 exs. Pernem, B.S. Lamba, 8.12.1973.

Distribution : India : Karwar, Karnataka.

Remarks : It is the new record from Goa.

Range : 15–25 mm.

Status : Common.

11. ***Puntius fasciatus pradhani*** Tilak

1973. *Puntius malanampyx pradhani* Tilak, *Rec. zool. Surv. India*, **67**(1-4) : 97, fig 2,3 and 4 (Type locality : Molem, Goa.)

1991. *Puntius fasciatus pradhani* Jayaram, *Rec. zool Survey India, Occ. Paper No.*, **135** : 139–141

1997. *Puntius fasciatus pradhani* Yadav, *Studies syst. & zoogeography Fishes of Western Ghats with Observations on status of endemic species, PhD. Thesis, Pune University* : 176.

Diagnosis : A deep bodied fish with five coloured bands on body, with 4 barbels, dorsal spine weak and articulated and complete lateral line having 19–20 scales.

Material examined : 1 ex. Bhagwan Mahavir sanctuary, Molem, Goa, Dr. G.M. Yazdani, 13.3.1993.

Distribution : India : Goa, South Kanara.

Remarks : This species occurs in west flowing rivers of Western Ghats.

Range : 29–52 mm.

Status : Common.

12. ***Puntius fasciatus fasciatus*** (Jerdon)

1849. *Cirrhinus fascoatus* Jerdon, *Madras J. Lit. & Sci* **15**, 305 (Type locality Malabar.

1991. Puntius fasciatus Jayaram, *Rec. zool Survey India, Occ. Paper No.*, **135** : 135–139.

1997. *Puntius fasciatus fasciatus*, Yadav, *Studies syst. & zoogeography Fishes of Western Ghats with Observations on status of endemic species, PhD Thesis, Pune University;* 174.

Diagnosis : A deep bodied fish with 2 or 3 vertical bands on body, 4 barbels, dorsal ray weak, non osseous, and complete lateral line with 18–20 scales.

Material examined : 11 exs, tributary of Mandovi river, 8 km NE of Valpoi, G. M. Yazdani, 15.3.1993, 1 ex; Goa, B.S. Lamba, 17.12.1973.

Distribuition : Peninsular India, Cauvery, South Kanara, Malabar, Travancore hills.

Remarks : It is a colourful fish endemic to southern part of Western Ghats.

Range : 10–20 mm.

Status : Common.

13. ***Puntius filamentosus*** (Valenciennes)

1844. *Leusiscus filamentosus* Valenciennes *Hist. nat. Poiss* **17** : 96, pl. 492. (Type locality : P Alleppey, Kerala)

1973. *Puntius filamentosus*, Tilak, *Rec. zool Surv. India*, **67** : 87–120.

1991. *Puntius filamentosus*, Jayaram, *Rec. zool Surv. India, Occ. Paper No.*, **135** : 77–83

1991. *Puntius filamentosus*, Talwar & Zingran., *Inland Fish* **1**. 270-271, fig 92.

1999. *Puntius filamentosus*, Menon, *Rec. Zool Survey India, Occ. Paper*, **175** : 92–93.

Diagnosis. : Spindle shaped elongated body, D, I8, large hexagonal scales, oblong finger like dark blotch above anal fin; L.l.20-24.

Distribution : India : Goa, Southern India.

Elsewhere : Sri Lanka, Myanmar, Thailand.

Remarks : This species is abundant in the westerly drainage. Black marking present on the tips of caudal fin rays.

Status : common.

14. **Puntius setnai* Chhapgar & Sane

1992. *Puntius setnai* Chhapgar & Sane, *J. Bombay nat. Hist. Soc.*, **89** : 357–359. (Type locality : Sangem, Goa)

1993. Puntius setnai, Yazdani & Ghate, *J. Bombay nat. Hist. Soc.*, **91** : 464–465.

1997. *Puntius setnai*, Yadav, *Studies syst. & zoogeography Fishes of Western Ghats with Observations on the status of endemic species, PhD. Thesis, Pune University*: 196.

Diagnosis : Barbels absent, 3 vertical blackish colour bands present on body, last undivided ray of dorsal fin serrated, L.l.20.

Material examined : 2 exs, rivulet, ponda Goa, B. S. Lamba. 13.12.1973; 1 ex. B. M. Sanctuary, Dudhsagar waterfalls, P. D. Rane, 1.12.1993.

Distribution : India : Goa, Karnataka,

Remarks : It is mostly occurring in the west flowing rivers. It is a good aquarium fish. In breeding season male acquires golden yellow colour. Fins become transparent, except dorsal which becomes reddish. Range 30–45 mm.

Status : Rare.

15. **Puntius narayani* (Hora)

1937. *Barbus narayani* Hora, *Rec.. Indian Mus.* **39**(1) : 24, fig. 10. (Type locality : Cauvery river, Coorg, Karnataka)

1981. *Puntius narayani*, Jayaram, *Rec. zool Survey India, Occ. Paper No.*, **175** : 139–141

1991. *Puntius narayani*, Talwar and Jhingran, *Inland Fish*, **1** : 275–276.

1999 *Puntius narayani* Menon, *Rec. Zool Survey India, Occ. Paper*, **175** : 97–98.

Diagnosis : A deep bodied fish with 3 vertical colour bands on body, no barbels, dorsal ray weak and articulated, lateral line complete with 22-23 scales.

Material examined : 4 exs. Namodi, Kudal, 15 km NE of Valpoi, Goa, G.M. Yazdani, 13-3-1993.

Distribution : India : Peninsular India : Coorg (Cauvery river system) and Kadur (Tungbhadra river system.

Remarks : It is a good aquarium fish.

Range : 30–40 mm.

Status : Uncommon.

16. *Puntius sarana subnasutus* (Valenciennes)

1853. *Barbus subnasutus* Valenciennes, (in C. & V.), *Hist, nat. Poiss.*, **16** : 154 (Type locality : Pondicherry).

1973. *Puntius sarana subnasutus*, Tilak, *Rec. zool. Surv. India.*, **67** : 96.

1991. *Puntius sarana subnasutus*, Jayaram, *Rec. zool. Surv. India, Occ. Paper No.*, **135** : 120–123.

1991. *Puntius sarana subnasutus*, Talwar and Jhingran, *Inland Fish*, **1** : 285

Diagnosis : A larger sized fish with lateral line scales 28–31, PDS. 8–10, Pre pelvic scales : 7 or 8.

Distribuition : Krishna river system and south of it, Goa.

Elsewhere : Sri Lanka.

Remarks : Menon (1999) considers this species under the genus *Barbodes.*

Status : Uncommon.

17. *Puntius vittatus* Day

1865. *Puntius vittatus* Day, *Proc. Zool. Soc London* : 303 (Type locality : Madras)

1973. *Puntius vittatus* Tilak, *Rec. zool. Surv. India*, **67** : 95.

1991. *Puntius vittatus* Jayaram, *Rec. zool. Surv. India, Occ. Paper No.*, **135** : 86–88.

Diagnosis : An elongated fish with body compressed behind dorsal fin. No barbels, dorsal ray weak and articulated. Lateral line incomplete with 20–22. scales. A black streak across dorsal fin and a small dot on caudal base.

Distribution : Peninsular India : Goa, Kutch, Karnataka, Kerala, Tamil Nadu.

Elsewhere : Sri Lanka.

Remarks : The colour is light brown above lateral line and yellowish below.

Status : Uncommon.

18. **Puntius jerdoni* (Day)

1870. *Barbus jerdoni*, Day *Proc. Zool. Soc. Lond.*, : 372. (Type locality : Mangalore, South Kanara)

1991. *Puntius jerdoni*, Jayaram, *Rec. zool. Surv. India, Occ Paper No.*, **351** : 46–48.

1999. *Hypselobarbus jerdoni*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 78.

Diagnosis : .. A moderately deep bodied fish without any bands and spots on body, four barbels, dorsal ray weak, articulated and lateral line complete with 26–32 scales.

Material examined : 1 ex. Galjibag river, Painginium, tal. Cancona, M. S. Pradhan, 26-9-1993.

Distribution : South Kanara.

Remarks : It is the first record form Goa State.

Range : 100 mm.

Status : Endangered.

19. *Puntius amphibius* (Valenciennes)

1842. *Capota amphibians* Valenciennes (in C &V), **16** : 282, pl 478. (Type locality : Bombay)

1991. *Puntius amphibius* Jayaram, *Rec. zool. Surv. India, Occ. Paper No.*, **135** : 61–64.

1999. *Puntius amphibius* Menon *Rec. zool. Surv. India, Occ. Paper No.*, **175** : 85–86.

Diagnosis : An elongated fish with a pair of thin barbels, dorsal ray feebly osseous, lateral line complete with 21–28 scales, (normally 24–25). A conspicuous dark spot at base of caudal fin present.

Material examined : 5 exs, B. M Sanctuary, Dudhsagar, P. D. Rane, 1-12-1993; 2 exs, Palayam nalla, P. D. Rane, 25-11-1993; 13 exs, Mandovi river Goa, P. D. Rane, 3-12-1993; 1 exs. Saquilim, Valvanti river, Tulshimala, Vill, 15 km NW of Valpoi, G. M. Yazdani, 16.3.93; 37 exs. Naveband Sal River, Conolim, Margaon, M. S. Pradhan, 28-9-1993; 22 exs Galjibag river, M. S. Pradhan, 26-9-1993; 10 exs.; Zuari river, P.D. Rane, 5-12-1993.

Distribution : Peninsular India.

Elsewhere : Sri Lanka.

Remarks : It inhabits streams and ponds in the plains.

Range : 35–75 mm.

Status : Common.

20. **Puntius ticto* (Ham–Buch.)

1822. *Cyprinus ticto* Hamilton, *Fish Ganges*, **314**, 398 Pl. 8 figs 87 (Type locality : Southern east part of Bengal)

1991. *Puntius ticto*, Jayaram, *Rec. zool. Surv. India, Occ. Paper No.*, **135** : 22–26.

1999. *Puntius ticto*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 103–104.

Diagnosis : A deep bodied small fish with no barbels, dorsal fin ray short, osseous, serrated, lateral line complete or incomplete. A black blotch on 3rd, 4th or 5th lateral line scales and another on 16th to 20th scales present.

Material examined : 40 exs, B.S. Lamba, Pernem, Goa, 8.12.1973.

Distribution : India : Except Kerala and south Tamil Nadu.

Elsewhere : Nepal, Pakistan Bangladesh.

Remarks : Clear water inhabitant.

Range : 20–28 mm.

Status : Common.

Genus *Cirrhinus* Oken 1817

Body elongated and compressed with rounded abdomen. Mouth transverse. Upper lip fringed or entire, not continuous with lower. Lower jaw sharp with a small tubercle at the symphysis. Barbels 2 pairs, 1 pair or absent. Dorsal fin with 10 to 19 soft rays and no spine. Anal fin with 7–8 rays. Caudal fin forked. Lateral line scale 35 to 45.

21. **Cirrhinus cirrhosus* (Bloch)

1792. *Cyprinus cirrhosus* Bloch, *Naturges ausland Fish;* **9** : 52, fig, 411 (Type locality Cauvery river)

1991. *Cirrhinus cirrhosus* Talwar and Jhingran, *Inland Fish*; **1** : 170.

1999. *Cirrhinus cirrhosus* Menon *Rec. zool. Surv. India, Occ. Paper No.*, **175** : 120–121.

Diagnosis : Dorsal fin with 11 or more than 11 branched rays, four barbels present.

Material examined : 1 ex, Khandepar river, Khandepar village, Ponda, M.S. Pradhan, 15.9.93.

Distribution : Peninsular India.

Remarks : Dorsal and caudal fins tipped black. It inhabits fast running streams.

Range : 68 mm.

Status : Endangered.

Genus *Labeo*, Cuvier, 1817

Body moderately elongated with rounded abdomen. Mouth mostly inferior, transverse and semi-oval. Lips thick covering the jaws, continuous at the angle of the mouth and one or both having an inner transverse fold. A soft and movable horny covering, with a sharp margin on inner side of one or both lips. Barbels, 1 pair, 2 pairs or absent. Dorsal fin inserted before pelvic fin with 11–26 rays and no spine. Anal fin with 7 to 8 rays. Caudal fin forked. Lateral line complete with 26–85 scales.

22. *Labeo dussumieri* (Valenciennes)

1842. *Rohita dussumieri* Valenciennes (in C & V), *Hist. Nat.* Poiss., **16** : 258 pl. 475. (Type locality : Allepy, Kerala state.)

2000. *Labeo dussumieri* Jayaram and Dhas, *Rec. zool. Surv. India, Occ. Paper No.*, **183** : 22–24.

Diagnosis : A Labeo with 50–55 lateral line scales, dorsal fin with 15–16 rays; prepelvic scales 14–16.

Distribution : India : Western Ghats and North Kanara.

Elsewhere : Sri Lanka.

Remarks : It occurs in tidal reaches.

Status : Vulnerable.

Subfamily GARRINAE

Mouth inferior. A suctorial disc on ventral surface of head present or absent. Pectoral fin laterally inserted. Upper and lower lip may or may not be connected.

Genus *Garra* Hamilton–Buchanan, 1822

Body elongated, subcylindrical, compressed and with a rounded abdomen. A proboscis may be present. A suctorial disc of semicartilaginous pad present on the chin, formed on the lower lip. Jaws sub-equal. Barbels one or two pairs. Dorsal fin inserted slightly before pelvic fins, with 9–12 rays and no spine. Anal fin with 6–8 rays. Paired fins horizontal, not plaited. Lateral line complete with 32–40 scales. Caudal fin forked.

Key to the species of *Garra*

1a. Proboscis present, well developed with well defined lateral tubercular area. 2

1b. Proboscis absent snout without tubercles.... 3

2a. Body depth less than five times in standard length. ..... *G. gotyla gotyla*

2b. Body depth about 5 times or more in standard length. ..... *G. gotyla sternorhynchus*

3. Lateral line scales 34. Distance of vent from base of anal fin less than 4 times in that between anterior origin of anal and pelvic fins. ..... *G. mullya*

23. **Garra gotyla gotyla* (Gray)

1832. *Cyprinus gotyla* (Gray) *Indi. Zool*, **1** : 88, fig 3, 3a (Type locality : Northern India).

1991. *Garra gotyla gotyla*, Menon, *Rec. zool. Surv. India Occ. Paper No.*, **175** : 143-144.

Diagnosis : Spiny tubercles on snout, head and cheeks. Upper lip bears 3 markings, scales present on chest and belly. Lateral line scales 32–35. distance between vent and anal fin 4.7 times in distance between pelvic fin origin and anal fin.

Material examined : 2 exs, Goa, B.S. Lamba., 17.12.1973; 1 ex, Marmu Goa, Nanodi river, Kudal vill., 15 km NE of Valpoi, G.M. Yazdani, 17.3.1993. 1 ex, Rivulet in Ponda, Sacorda, Goa, B.S. Lamba, 17.12.1973; 1 ex., Saqulim, Valvanti river, Tulshimala 15 km NW of Valpoi, G. M. Yazdani, 16.3.1993, 1 ex, pernem, Goa,; B. S. Lamba, 8.12.1973.

Distribution : India: Assam, Himalayas, Chota Nagpur Plateau,Vindhya Satpura mountains.

Elsewhere : Myanmar, Pakistan.

Remarks : It inhabits mountain streams.

Range : 40–45 mm.

Status : Common.

24. **Garra mullya* (Sykes)

1841. *Chondrostoma mullya* Sykes, *Trans. Zool. Lond.* **2** : 359, pl. 2. fig. 3 (Type locality : Bhima river, Daund, Pune Dist.)

1999. *Garra mullya*, Menon, *Rec. zool. Surv. India, Occa. Paper No.*, **175** : 148-150.

Diagnosis : Four barbels,snout rounded with transverse groove, lateral line scales 34, dark spot behind angle of operculum, distance of vent from anal fin base less than 4 times in distance between pelvic fin origin and anal fin base.

Material examined : 1 ex., Mayem lake, Bicholim, M.S. Pradhan, 24-9-1993 , 2 exs, Zuari river near Margaon, M.S. Pradhan, 23-9-1993, 5 exs, Mandovi river, M.S. Pradhan, 30-9-1993.

Distribution : Throughout India except Assam and Himalaya.

Remarks : Colour blackish grey, it inhabits mountain streams.

Range : 40 mm–95 mm.

Status : Common.

25. **Garra gotyla stenorhynchus* (Jerdon)

1849. *Gonorhynchus stenorhynchus* Jerdon, Madras *J. Lit. & Sci.*; **15** : 310 (Type Locality : Bhavani river, Nilgiris).

1997. *Garra gotyla stenorhynchus*, Yadav, *Studies syst. & zoogeography Fishes of Western Ghats with Observations on status of endemic species, Ph.D. Thesis, Pune University*, 223-224.

1999. *Garra gotyla stenorhynchus*, Menon, *Rec. zool. Surv. India Occ. Paper No.*, **175** : 144-145.

Diagnosis : Transverse groove on snout with 7–8 horny spines. Distance of vent to anal fin 3–6 times in distance between p[elvic fin and anal fin.

Material excamined : 1 ex, Nanodi river Kudal, 15 km NE of Valpoi, G. M. Yazdani, 17.3.1993.

Distribution : Western Ghats : Cauvery, Krishna drainages, Madhya Pradesh, Bihar.

Remarks: It prepares nest by collecting smaller stones in torrential streams.

Range : 93. mm.

Status : Uncommon.

Family COBITIDAE Loaches

Body worm like to fusiform. Mouth subterminal. Lips thick, fleshy and papillated. One row of pharyngeal teeth. Jaws and palate edentate. Barbels present. An erectile spine near the orbit present. Vertical fins spineless. Lateral line either absent or complete or incomplete. Body with small cycloid scales. Scales absent on head. Gill membranes free from each other. Swim bladder entirely or partially enclosed in a bony capsule.

Subfamily COBITINAE

Body oblong conical. A spine under or before the orbit. Anterior nostrils tubular or simple. No ridge on upper part of caudal peduncle. Dorsal fin long with 8–30 rays.

Genus *Lepidocephalus* Bleeker 1858.

Body elongated or moderately compressed. Mouth inferior and narrow. Eyes small, superior, continuous at angle of mouth; lower lip interrupted in the middle. Jaws and palate without teeth. Barbels 3 pairs, one pair rostral, one or two maxillary, two pairs of barbel–like mental lobes. A large erectile bifid spine below or in the front of the orbit. Dorsal fin inserted slightly ahead of

pelvic fins, with 8–9 soft rays and ossified as a flat osseous vertical plate like structure. Anal fin with 7–8 rays. Caudal fin truncate or slightly emarginated. Scales small. Lateral line absent.

Key to Genera

1a. Dorsal and pelvic fins inserted in first half of body. Scales on sides of head present. ..... ***Lepidocephalus***

1b. Dorsal fin inserted in posterior half of body. Well behind pelvic fin base head scaleless. ..... ***Pangio***

Key to the species of *Lepidocephalus*

1a. 25 to 30 rows of scales between anal fin base and back. Body depth 5.75 to 7.00 in total length. ..... *L. guntea*

1b. 30 to 40 rows of scales between anal fin base and back. Body depth 7.00 to 9.00 in total length. ..... *L. thermalis*

26. ***Lepidocephalus guntea*** (Ham–Buch)

1822 *Cobitis guntea* Hamilton, *Fish Ganges*, : 353, 394. (Type locality : Ponds and rivers of Bengal)

1922. *Lepidocephalus guntea*, Menon, *Rec. zool. Surv. India, Occ. Paper No.*, **17** : 160–163.

Diagnosis : Head length 6–6.75. Body depth 5.75 to 6.80 in total length.

Material examined : 1 ex. Small ditch, 10 km NE of Painguim, P. D. Rane.

Distribution : India : Bramhaputra, Ganges, Indus Drainages, Himalayas, Satpura–Vindhyas.

Elsewhere : Bangladesh, Nepal and Pakistan.

Remarks : It inhabits shallow clear streams with sandy bottom.

Range : 35 mm.

Status : Common.

27. ***Lepidocephalus thermalis*** (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, (in C & V), *Hist., Nat. Poiss.* **18** : 78 (Type locality : hot springs of Kanniya, E. P., Sri Lanka)

1992. *Lepidocephalus thermalis*, Menon, *Fauna India Pisces*, **4**(2) : 60 pl V figs 1–8, pl 8, figs 3–5.

1999. *Lepidocephalus thermalis* Menon, *Rec. Zool. Surv. India Occ. Paper*, **175** : 164.

Diagnosis : Head length 5. 75 to 6, body depth 8.17 to 9.71 in total length.

Distribution : Peninsular India.

Elsewhere : Sri Lanka.

Remarks : This species is restricted to southern part of India.

Status : Common.

28. ***Pangio goensis*** (Tilak)

1973. *Acanthopthalmus goansis* Tilak, *J. Inland Fish. Soc. India*, **4** : 62, figs. 1–4 (Type locality : colem river, Goa).

1991. *Pangio goaensis*, Talwar & Jhingran, *Inland Fish.* **I** : 530–531.

Diagnosis : Elongated compressed body, pelvic fin with five rays; length of head 6.2 in SL lower lip with a pair of leaf like lobes.

Distribution : Colem river, Goa.

Remarks : It is endemic to Goa state. A dark band from snout to base of caudal fin present, which terminates into a blotch.

Status : Uncommon.

Family HOMALOPTERIDAE

Head and body depressed, flattened below. Body covered with small cycloid scales. Head and part of whole of ventral surface without scales. Jaws and palate edentate. Gill openings united with the isthmus. Paired fins inserted horizontally and 2 rays of pectoral fins simple. (subfamily : NOEMACHEILINAE).

Subfamily NOEMACHEILINAE

Body generally cylindrical or compressed. No spine under or before the orbit. Anterior nostril simple or tubular. Upper part of caudal peduncle may be with an adipose keel. Dorsal fin moderately long with 7 to 20 rays.

Genus ***Noemacheilus*** van Hasselt, 1823

Body elongated and almost cylindrical or compressed. No preorbital spine on head. Barbels 2, 3 or 4 pairs. Dorsal fin inserted opposite to pelvic fins, with 8 to 20 soft rays and without any spine. Anal fin with 6–8 soft rays. Caudal fin emarginated, truncate or lunate. Scales minute. Lateral line complete or incomplete.

Key to the species

1a. Barbels 4 pairs. ..... *N. evezardi.*

1b. A round dark spot on upper part of caudal base, barbels 3 pairs, lateral line complete. 12 to 16 blackish cross bars on body. .... *N. botia*

2. From behind origin of dorsal fin body marked with number of broad black rings alternating with narrow yellowish bands. .. *N. elongatus*

29. ***Noemacheilus evezardi*** Day 1878

1878. *Noemacheilus evezardi* Day *Fish India,* : 613, pl 153, fig 11 (Type locality : Poona)

1987. *Noemacheilus evezardi* Menon, *Fauna India, Pisces* 4(1) : 191–193.

Diagnosis : Well developed nasal barbels, caudal fin rounded, L. l. short, dorsal fin with 7 branched rays. Number of dark vertical blotches presnt on body.

Material examined : 3 exs, Rivulet in Ponda, Sacorda, Goa, B. S. Lamba, 17.12.1973.

Distribution : India : Western Ghats: Krishna and Godavari Basins, Satpura Range, Panchmarhi hills.

Remarks : Black vertical stripes on body wider, regular, V or Y shaped, Black spots present on head.

Range : 18–20 mm.

Status : Uncommon.

30. ***Noemachilus botia*** (Ham–Buch.)

1822. *Cobitis botia* Hamilton, *Fish Ganges,* pp. 350, 394. (Type locality : Rivers of North-eastern part of Bengal.)

1987. *Noemochilus botia,* Menon, *Fauna India , Pisces* 4(1) : 141, fig 1, pl 13; fig 5., 1 : 2,3 pl 15.

1999. *Noemochilus botia* Menon., *Rec. zool. Surv. India, Occ Paper No.,* **175** : 180–181.

Diagnosis : An *Acanthocobitis* with 9–11 dorsal fin rays, L. l. complete, 12–16 cross bars broken up and scattered irregularly. A round dark spot present on upper part of caudal base.

Material examined : 19 exs, Noveband Sal river, Conolim, Margaon, M.S. Pradhan, 28.9.1993.

Distribution : Northern India (Bramhaputra, Ganges and Indus Basin.

Remarks : Males possess suborbital flap.

Range : 40–60 mm.

Status : Common.

31. ***Noemacheilus elongatus*** (Hora)

1921. *Aborichthys elongatus* Hora, *Rec. Indian Mus.* **22** 735, fig. (Type locality : Base of Darjeeling, Himalayas)

1987. *Noemachilus elongatus,* Menon, *Fauna India, Pisces.* **4(1)** : 184, pl 7, fig 6.

1997. *Noemacheilus elongatus,* Menon., *Rec. zool. Surv. India, Occ Paper No.,* **175** : 187.

Diagnosis : An ***Aborichthys*** with vent situated nearer base of caudal than tip of snout. Body marked with black rings with narrower yellowish bands in between (from behind the origin of dorsal fin.)

Material examined : 2 exs. Upper reaches of Mandovi river, Bondla, G.M. Yazdani, 12-31993.

Distribution : India : Darjeeling, Himalayas

Remarks : It is the new record from Goa.

Range : 28–30 mm.

Status : Uncommon.

Order SILURIFORMES

Body without true scales, naked or covered with bony plates. Adipose fin usually present. Spines often present at the front of the dorsal and pectoral fins, if present, only single in each fin.

The second, third and fourth vertebrae of the weberian apparatus are fused to a single ossification called a complex vertebra. 1–4 pairs of whisker like sensory barbels on the upper and lower jaw. Caudal skeleton of catfishes is variably developed, the number of principal rays differing considerably. Principal caudal rays 18 or fewer (most with 17). Swimbladder, when well-developed, is divided into an anterior and posterior segments by a partition not a constriction as in most characoids and cyprionoids.

Key to the families

1a. Adipose dorsal fin absent. 2

1b. Adipose dorsal fin present as a smooth, short or long high or low. 3

2a. Nasal barbels absent. Accessory respiratory organs present or absent. ..... SILURIDAE

2b. Nasal barbels present. Dorsal fin long. Accessory organs present on gills. .... CLARIIDAE

3a. Anal fin short with less than 20 rays. Paired fins horizontally inserted. ..... BAGRIDAE

3b. Anal fin long with more than 20 rays. Paired fins inserted laterally. ..... SCHILBEIDAE

Family BAGRIDAE

Rayed dorsal fin short with 6–8 rays and variable spine. Adipose dorsal fin present and highly variable in size, it is not confluent with either rayed dorsal or with caudal fin. Nostrils widely separated, above angle of mouth, anterior tubular on tip of snout, posterior nearer to the orbit than to snout tip and with nasal barbels. Barbels 6 or 8, generally well developed. Paired fins inserted horizontally. Pectoral fins with strong spine, usually serrated. Anal fin short or moderately long with 8–16 rays, not confluent with caudal fin. Caudal fin forked.

Key to the genera

1a. Barbels 3 pairs. Lateral line with developed scutes along anterior quarters. ..... ***Rita***

1b. Barbels 4 pairs. Lateral line simple without any scutes. 2

2. Interneural shield absent. ..... ***Mystus***

Genus ***Rita*** Bleeker 1859

Head large and depressed. Mouth sub-terminal, transverse and wide. Eyes subcutaneous and dorsolateral. Teeth villiform, 3 pairs of barbels, the nasal, the maxillary and the mandibular. Nasal barbels minute or small with a valve like base. Rayed dorsal fin origin above half of pectoral fin, with 6–7 rays and a spine. Adipose dorsal fin low and short. Pectoral fins with 7–10 rays and a spine serrated along both the edges. Pelvic fin with 7–8 rays. Anal fin short with 8–13 rays. Lateral line with well developed scutes along anterior quarters, rather uniformly distinguishable. Caudal fin forked.

Key to species

1a. Teeth on palate in one patch. Teeth on prevomar mixed with molariform and villiform. ..... *R. pavimentata*

1b. Teeth on palate in two pear shaped patches. ..... *R. kuturnee*

32. ****Rita kuturnee*** (Sykes)

1839. *Phractocephalus* kuturnee *Sykes, Proc. Z. Lond.*, 164 (Type locality : River Bhima, Pairgaon.)

1981. *Rita kuturnee*, Jayaram, *HBFW fish India* : 190.

Diagnosis : Three pairs of barbels, one pair each of maxillary, nasal and one of mandibular, pectoral fin with 7–10 rays and serrated at both the edges. Teeth on palate with two pear shaped patches.

Material examined : 70 exs. Airvao, Goa, G. M. Yazdani, 17.12.1975.

Distribution : Peninsular India : Deccan rivers upto Krishna system.

Remarks : It inhabits large rivers in freshwaters.

Status : Common.

33. **Rita pavimentata* (Valenciennes)

1832. *Arius pavimentata* (Valenciennes.) *Jacg. Voy. Ind. Ori. Atl. Poiss.* : 2, pl 17, fig 2 (Type locality : India)

1981. *Rita pavimentata*, Talwar and Jhingran, *Inland Fish.* **2** : 577.

1991. *Rita pavimentata* Menon *Rec. zool. Surv. India, Occ Paper No.*, **175** : 197.

Diagnosis : Teeth on palate in one patch, teeth on prevomar mixed with molariform and villiform. Premaxillary tooth band 3.5 to 4 times long as broad.

Material examined : 1 ex, khandepur river, Ponda, M.S. Pradhan, 15.9.1993.

Distribution : Rivers of Deccan up to Krishna river system.

Remarks : This catfish attains length of 26 cm, is common in Andhra Pradesh.

Range : 13 mm.

Status : Common.

Genus *Mystus* Scopoli 1777

Mouth terminal transverse and moderately wide. 4 pairs of barbels, one each of maxillary nasal and two of mandibular; maxillary barbels extend beyond dorsal fin. Rayed dorsal fin low of varying length. Pectoral fin with 6–10 rays and spine serrated along inner edge with antrose teeth. Pelvic fin with 6 rays. Anal fin short, with 9–16 rays. Caudal fin forked. Lateral line simple, complete. Interneural shield in between basal bone of dorsal fin and occipital process absent.

Key to species

1a. Occipital process not reaching basal bone of dorsal fin. Median longitudinal groove on head not reaching base of occipital process. 2

1b. Occipital process reaching basal bone of dorsal fin, median longitudinal groove reaching base of occipital process. ..... *M. oculatus*

2a. A dark spot present at the base of caudal fin. ..... *M. malabaricus*

2b. No dark spot present at the base of caudal fin. 3

3a. A light band above and below lateral line present. ..... *M. keletius*

3b. Body plain without any colour bands. .... *M. gulio*

34. **Mystus malabaricus* (Jerdon)

1849. *Bagrus malabaricus* Jerdon. *Madras J. Lit. Sci.*; **15** : 338 (Type locality : Mountain streams in Malabar)

1981. *Mystus malabaricus*. Jayaram, *HBFW Fish India*, : 203.

1999. *Mystus malabaricus*. Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 203.

Diagnosis : Median longitudinal groove on head not reaching base of occipital process. Occipetal process short, 1 to 2 times longer than wide at base. Body depth 4.5 to 6 times in SL. A dark band along lateral line ending with a dark blotch at base of caudal fin.

Distribution : Peninsular India : Western Ghats of Kerala and Maharashtra.

Remarks : Males provided with urinogenital papilla and females have slit like aperture.

Status : Common.

35. **Mystus oculatus* (Valenciennes)

1839. *Bagrus oculatus* Valenciennes (in C & V) *Hist. Nat Poiss.*, **14** : 424 (Type locality : Malabar)

1981. *Mystus oculatus*. Jayaram, HBFW *Fish India*, 197

Mystus oculatus Menon, *Rec. zool. Surv. India, Occ Paper No.*, 175 : 205 206.

Diagnosis : Adipose dorsal fin commencing after an interspace between rayed dorsal fin. Its base longer than anal fin base. Median longitudinal groove short reaching the base of occipital process.

Material examined : 1 ex., 5 km near Devils Canyon, Molem, M.S. Pradhan, 14.9.93, 1 ex. Noveband Sal river, Concolim, Margaon, M.S. Pradhan, 28.9.1993.

Distribution : Kerala and Tamil Nadu (Coimbatore district).

Remarks : It is a new record from Goa.

Range : 50–120 mm.

Status : Common.

36. **Mystus gulio* (Ham–Buch)

1822. *Pimelodus gulio* Hamilton, *Fish Ganges*, : 201, 379, Pl. 23, figs 86 (Type locality : Higher part of Gangetic estuaries).

1981. *Mystus gulio*, Jayaram, *HBFW Fish India*, : 200.

1999. *Mystus gulio* Menon., *Rec. zool. Surv. India, Occ Paper No.*, **175** : 201–202.

Diagnosis : Body plain, occipital crest rugose No blotch at base of caudal fin. Adipose dorsal fin base shorter than or equal to anal fin base. Median longitudinal groove short extending slightly beyond posterior border of orbit.

Material examined : 1 ex. Vadachi Kutali, river Tivim, Goa G. M. Yazdani, 4 exs. Britona on the bank of Nanodi river, 7.3.1993.

Distribution : Estuaries tidal rivers, lakes ascending to freshwater and entering the sea.

Remarks : It is a gregarious cat fish, attains length of 40 cm.

Range : 65 to 75 mm.

Status : Common.

37. **Mystus keletius* (Valenciennes)

1839. *Bagrus keletius* Valenciennes *Hist. Nat. Poiss.*, **14** : 411 (Type locality : Pondicherry South India.)

1981. *Mystus keletius* Jayaram, *HBFW Fish India*, : 202.

1999. *Mystus keletius* Menon, *Rec. zool. Surv. India, Occ Paper*, **175** : 202.

Diagnosis : Occipital process long, 5 times longer than the base. Body depth about 4 times SL. A light band above and below lateral line.

Material examined : 1 ex. Mandovi river, Goa, P. D. Rane, 3-12-1993.

Distribution : Peninsular India : Tamil Nadu, Karnataka.

Elsewhere : Sri Lanka.

Remarks : In life colour is silvery with yellowish tinge on dorsal surface, a light band along lateral line present.

Range : 85 mm.

Status : Common.

Family SILURIDAE

Body elongated and compressed. Skin scaleless either smooth or covered with osseous plates or scattered tubercles. Rayed dorsal fin short with 4–5 soft rays not preceded by spine. Adipose fin absent. Paired fins laterally inserted. Pectoral fin with a strong spine. Occasionally serrated. Anal fin very long, extending from just posterior to anal opening to caudal fin or confluent with it. Pelvic fin small. Caudal fin deeply forked, lobes rounded or pointed or cutsquare. Lateral line straight and complete.

Genus ***Ompok*** Lacepede 1803

Body elongated and compressed. Abdomen rounded. Mouth superior, cleft oblique, not extending to the anterior margin of orbit. Barbels two pairs, one pair each of maxillary and mandibular. Dorsal fin origin above the last half of pectoral fin, with 4–5 soft rays and without any spine. Adipose dorsal fin absent. Pectoral fin with 11–14 rays and weak spine, serrated or smooth. Pelvic fin with 7–10 rays. Anal fin long with 52–75 rays, extending close to caudal fin, caudal fin forked. Lateral line complete.

Key to species

1a. Maxillary barbels longer than head, extending upto or beyond anal fin. Gape of mouth not reaching below eyes. ..... *O. bimaculatus*

1b. Maxillary barbels short, do not extend up to anal fin, gape of mouth reaching to below eyes. ..... *O. malabaricus*

38. **Ompok bimaculatus* (Bloch)

1797. *Silurus bimaculatus* Bloch, *Hist., Nat. Poiss.* **18** : 78 (Type locality : Malabar)

1981. *Ompok bimaculatus* Jayaram, *HBFW Fish India*, : 209.

1999. *Ompok bimaculatus* Menon *Rec. zool. Surv. India, Occ Paper No.*, : 216–217.

Diagnosis : Maxillary barbels longer than head.extending upto or beyond anal fin.

Material examined : 2 exs. M. S. Pradhan, 26.9.93.

Distribution : Throughout India.

Elsewhere : Pakistan, Nepal, Bangladesh, Sri Lanka, Burma, Thailand, Java, Sumatra, Borneo, China (Yunnan).

Remarks : It is a tasty fish, attains length of 40 cm.

Range : 55-95 mm.

Status : Common.

39. **Ompok malabaricus* (Valenciennes)

1839. *Silurus malabaricus* Valenciennes, *Hist., Nat. Poiss.* **14** : 353 (Type locality : Malabar)

1973. *Silurus goae*, Tilak, *Rec. zool. Surv. India*, **67** : 87-120.

1997. *Silurus goae*, Yadav, *Studies Syst. Zoogeogr. Fishes W. Ghats with Obs. status of Endemic Spp. Phd. Thesis, Pune Univ, 296.*

1999. *Ompok malabaricus*, Menon *Rec. zool. Surv. India, Occ Paper No.*, **175** : 217–218.

Diagnosis : Gape of mouth reaching to below eyes. Eyes small above level of angle of mouth, not visible from below. Teeth on upper jaw in two separate, mesially separated broad bands.

Distribution : Goa to Kerala.

Remarks : The colour in life deep grayish with purple, becoming paler below. A black spot behind gill opening.

Status : Uncommon.

Family SCHILBEIDAE

Body elongated and compressed. Nostrils widely separated. Barbels 2–4 pairs, fairly well developed. Dorsal fin present with a short base of 5–7 soft rays and a spine. Adipose dorsal fin usually vestigial. Paired fins inserted laterally. Pectoral fin with a strong spine, usually serrated. Anal fin very long with 40–46 rays and not confluent with caudal fin. Caudal fin forked. Lateral line simple, complete.

Genus *Pseudeutropius* Bleeker, 1862

Body elongated and compressed. Part of abdomen somewhat keeled. Teeth small villiform with narrow bands on jaws and palate. Eyes large, ventrolateral, partly below and behind level of cleft of mouth, with broad circular adipose lids. Barbels 4 pairs, one each of maxillary, nasal and two of mandibular. Rayed dorsal fin inserted above half of pectoral fin, with 5–6 soft rays and a spine. Adipose fin short, pectoral fin with 7–9 soft rays and a spine serrated along both margins. Pelvic fin with 6 soft rays. Anal fin with 33–46 rays, not confluent with caudal. Caudal fin forked. Lateral line simple, complete.

40. *Pseudeutropius mitchelli* (Gunther)

1864. *Pseudeutropius mitchelli* (Gunther) *Cat. Fish Brit Mus.*, **5** : 59. (Type locality Madras.

1981. *Pseudeutropius mitchelli*, Jayaram, *IIBFW Fish India.* : 217.

1999. *Pseudeutropius mitchelli* Menon, *Rec. zool. Surv India, Occ Paper No.*, **175** : 228

Diagnosis : Eye diameter 4–5 in HL. Nape slightly elevated. Maxillary barbels reach pectoral or middle of pelvics. Teeth on palate in two small oval patches.

Distribution : Western Ghats, Goa, Kerala.

Remarks : This species attains length of 90 cm.

Status : Uncommon.

Family CLARIIDAE
Air breathing cat fish

Body elongated and compressed. Barbels 4 pairs, well developed. Dorsal fin base very long, usually with more than 30 rays, not preceded by a spine, separated or continuous with caudal fin. Adipose dorsal fin absent. Paired fins inserted horizontally. Pectoral fins with a strong spine, may be serrated. Anal fin long, not confluent with caudal fin. Caudal fin rounded. Lateral line complete. Air breathing labyrinthic organ arising from gill arches.

Genus *Clarias* Scopoli, 1777

Body elongated, compressed with rounded abdomen. Head generally depressed, covered with

osseous plates dorsally and laterally forming cask covering a diverticulum of the gill cavity. Barbels 4 pairs, one pair each of maxillary, nasal and two of mandibular. An accessory respiratory dendritic branchial organ attached to 2nd and 4th branchial arches present. Dorsal fin very long, with 62 to 77 soft rays and no spine originating from near occiput and extending to and not continuous with caudal fin. Adipose dorsal fin absent. Pectoral fin with 7–11 soft rays and a strong serrated spine, covered by skin. Pelvic fin with 6 rays. Anal fin long with 45–63 rays. Caudal fin rounded. Lateral line simple, complete.

41. *Clarias dussumieri* Valenciennes

1840. *Clarias d. dussumieri* Valenciennes (in C & V) *Hist. Nat. Poiss.* **15** : 382 (Type locality : Pondicherry, Malabar).

1981. *Clarias d. dussumieri*, Jayaram, *HBFW Fish India*, : 217.

1999. *Clarias d. dussumieri*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 261.

Diagnosis : Dorsal fin with 66–70 rays. Pectoral spine strongly serrated externally. Snout broad, nasal barbels not more than two times in head length measured from tip of snout to base of occipital process.

Distribution : India : Western Ghats from South Kanara to Kerala.

Remarks : Colour dark above, lighter ventrally. This species attains a length of 25 cm.

Status : Uncommon.

Order ATHERINIFORMES

Branchiostegal rays 4–15. Margin of upper jaw formed solely by premaxillaries. Upper jaw protractile in many species. Teeth in both jaws, also in superior and inferior pharyngeal bones. Upper and lower pharyngeal bone well developed. Fin spines present or absent. A single spineless dorsal fin. Pelvic fins abdominal, subabdominal or thoracic caudal skeleton with two large triangular hypural plates, never more than four. Swimbladder physoclistic. Lateral line may be absent. Head and body with scales. Ctenoid scales in relatively few species.

Key to the families

1a. Jaws produced into long and pointed beak like structure ..... BELONIDAE

1b. Jaws not produced into beak like structure 2

2a. Caudal peduncle longer than head. Lateral line present, complete ..... POECILIDAE

2b. Caudal peduncle shorter than head, lateral line absent. ..... CYPRINODONTIDAE

Family BELONIDAE
Garfishes, Needle fishes

Body elongated, rather slender with both upper and lower jaws extended into a long beak. Teeth on jaws and palate edentate in Indian species. Head and body with small cycloid scales. Gill openings wide. Branchiostegal rays 12–15. Dorsal and anal fins posterior in position. No spines in fins. Dorsal fin usually with 10–26 soft rays and anal fin usually with 14–23 soft rays. Lateral line low down.

Genus *Xenentodon* Regan 1911

Body elongated subcylindrical or compressed with rounded abdomen. Snout sharply pointed. Both jaws prolonged into a beak, the upper formed by premaxillaries, with fine rugosities. Dorsal fin generally inserted above anal fin, with 15–18 soft rays and without any spine. Anterior dorsal rays vary in elevation, sometimes forming a lobe to the fin and no finlets. Anal fin with 15–19 soft rays. Caudal fin truncate. Lateral line double.

42. *Xenontodon cancila* (Ham–Buch.)

1822. *Esox cancila* Hamilton, *Fish Ganges*, : 213, 215, 380, pl. 27, fig 70. (Type locality : Ponds and smaller rivers of Gangetic provinces).

1981. *Xenontodon cancila*, Jayaram, *HBFW Fish India*, : 292.

1999. *Xenontodon cancila*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 267.

Diagnosis : Body elongated sub-cylindrical,

compressed, snout sharply pointed, eyes in anterior part of head, dorsal fin inserted above anal fin, with 15–18 rays, no spine, anal fin with 15–19 rays. Caudal fin truncate. Scales small. Lateral line on posterior half of the body.

Distribution : Pakistan, throughout India.

Elsewhere : Sri Lanka, Bangladesh, Burma, Malay Peninsula, Thailand.

Remarks : It inhabits slow moving streams in rivers and ponds with rocky or sandy substrate. Found basking just near the surface.

Status : Common.

Family CYPRINODONTIDAE
Killifishes

Body moderately elongated and compressed, small fishes. Head and body with scales. Margin of the upper jaw formed solely by the premaxillaries. Barbels absent. A single soft rayed spineless dorsal fin inserted in the posterior half of body. Pelvic fin bases relatively far apart. Lateral line absent. Typical members of the family have a flattened head. Mouth opens upward, an adaptation for feeding at the surface.

Genus *Aplocheilus* McCleland 1839

Fishes with more or less elongated compressed body. Abdomen rounded. Upper surface of head and nape broad and depressed. Upper jaw protractile. Barbels absent. Dorsal fin origin above or behind posterior end of anal fin, with 7–11 soft rays and no spine. Pelvic fin relatively far apart. Anal fin with 15–18 soft rays. Caudal fin rounded. Scales cycloid, 27–34 in lateral series. Lateral line absent.

Key to the species

1a. Pelvic fin without a prolonged ray. Body plain without black bands.....2

1b. Pelvic fin with a prolonged ray. 8–10 vertical bands present on body .....*A. lineatus*

2a. Eye diameter equal to inter orbital width; 30-34 scales in longitudinal series..... .....*A. panchax*

2b. Eye diameter half inter orbital width, 26-29 scales in longitudinal series .....*A. blocki*

43 ***Aplocheilus blocki*** (Arnold)

1911. *Haplocheilus pachax* var. blocki Arnold, Wochenschr Aquarien and Terrainkude. **8** : 672 (Type locality : Cochin, Kerala).

1973. *Aplocheilus blocki*, Tilak, Malabar) *Rec. zool. Surv. India*, **67** :107.

1999. *Aplocheilus blocki*, Menon, Menon, *Rec. zool. Surv India, Occ Paper No.*, **175** : 267.

Diagnosis : Pelvic fin without prolonged ray. Eye diameter about half interorbital width; 26 to 29 scales in longitudinal series.

Distribution : Peninsular India : West coast from Kutch to Kerala.

Remarks : It inhabits coastal, fresh and brackish water.

Status : Uncommon.

44 ****Aplocheilus lineatus*** (Valenciennes)

1846. *Panchax lineatus* Valenciennes (in C&V) *Hist. Nat Poiss.* **18** : 381.

1981. *Aplocheilus lineatus*, Jayaram, *HBFW Fish India*, 295.

1999. *Aplocheilus lineatus*, Menon, *Rec. zool Surv India, Occ Paper No.*, **175** : 268.

Diagnosis : Pelvic fin rays prolonged. Anal fin with 15 to 17 rays, a golden green spot in the centre of each scale. Eight to 10 vertical black bands along sides.

Material examined : 1 ex, 5 km. S. nr. Devil's Canyon, Molem, M. S. Pradhan, 14.9.93; 1 ex Nanodi river, Kudal Village, 15 km NE of Valpoi, G. M. Yazdani, 17.3.93; 3 exs Middle channel of Mandovi river, G. M. Yazdani, 7.3.93; 6 exs, Galjibag river, Painginium, tal Cancona, M. S. Pradhan, 26.9.93; 1 ex nalla near Chikhali, Vasco-da-Gama, MarmuGoa, G. M. Yazdani, 7 exs Tributory of Mandovi river, G. M. Yazdani, 9.3.93; 4 exs, Saqulim, Valvanti river, Tulshimala, 15 km NW of Valpoi, G. M. Yazdani, 16.3.93; 14 exs, Freshwater Pond near Maxem, Painginium, M. S. Pradhan, 19.9.93; 3 exs; Noveband, sal river,

Conolim, Margaon, M. S. Pradhan, 28.9.93; 26 exs., Pernem, Goa, B.S. Lamba 8.12.73.

Distribution : Widely distributed in Peninsular India.

Remarks : It inhabits freshwater tanks, ponds small streams and tidal waters.

Range : 22–47 mm.

Status : Common.

45. ****Aplocheilus panchax*** (Ham.–Buch.)

1822. *Esox panchax* Hamilton, *Fish Ganges*, 211, 380, pl.3, fig., 69. (Type locality : Bengal)

1981. *Aplocheilus panchax*, Jayaram, *HBFW Fish India*, 295.

1999. *Aplocheilus panchax*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 269.

Diagnosis : Pelvic fin without any prolonged ray. Flanks plain, without vertical bands.

Material examined : 2 exs., Freshwater pond near Maxem, Painginium, M. S. Pradhan, 19.9.93.

Distribution : India : Orissa, W. Bengal, Andamans.

Elsewhere : Bangladesh, Pakistan Burma, Thailand to Malaya Archipelago, Sri Lanka.

Remarks : The blue panchax is a larvivorous fish. It is prolific perennial breeder. Breeds at 8 cm.

Range : 12–20 mm.

Status : Common.

Family POCILIIDAE
Live bearers

Body short, cylindrical, laterally compressed. Head and body with scales. Mouth oblique, small, cleft not extending to anterior margin of the orbit. Premaxillaries slightly protractile, mandible prominent. A single dorsal fin, without any spine. Anal fin with first three rays unbranched. Male specimen with elongated anterior anal fin rays (gonopdium, primarily formed from 3rd 4th and 5th rays) with internal fertilization.

Key to genera

1a. Teeth conical and fixed. ..... ***Gambusia***

1b. Teeth spatuliform and movable..... ***Poecilia***

Genus ***Gambusia*** Poey, 1854

Body cylindrical, compressed with rounded abdomen. Lower jaw slightly upturned, upper jaw shorter than lower. Dorsal fin inserted in the middle of body in males and midway between anterior border of the orbit and caudal fin tip in females, with 6–12 soft rays and without any spine. Anal fin with 8–10 rays. Anal fin of male is modified to form an intromittant organ for introducing sperm in to the female. Caudal fin rounded. Lateral line complete, with 28 to 32 scales.

46. ****Gambusia affinis*** (Baird and Girard.)

1853. *Heterandria affinis* Baird and Girard, *Proc. Acad. Nt. Sci. Phld.* **6** : 390. (Type locality : San Antonio river drainage, Texas.)

1991. *Gambusia affinis*, Talwar and Jhingran, *Inland Fish.*, **2** : 756-757,

Diagnosis : Dorsal fin inserted behind anal fin origin. Zone of melanophores present on dorsal and caudal fins.

Material examined : 60 exs., small ditch, 10 km E of Painginium, P. D. Rane, 23.11.1993.

Distribution : South eastern USA, introduced in India.

Remarks : It is destructive in new habitat as larvicidal.

Range : 22–28 mm.

Status : Exotic species.

Genus ***Poecilia*** Bloch and Schneider 1801

Lower jaw projecting. Dorsal and anal fins short, of about equal length; dorsal fin origin in advance of anal fin. No distinctive markings on dorsal and caudal fin.

47. ***Poecila reticulata*** Peters

1859. *Poecilia reticulata* Peters. *K. Preussischen Akad Wiss., Berlin*, 412. (Type locality : Venezuela).

1977. *Lebistes reticulatus*, Menon, 1977. *Sci & cult*, **43**(3) : 113.

1991. *Poecilia reticulate*, Talwar and Jhingran, Inland Fish; **2** : 758.

Diagnosis : Dorsal fin inserted in front of anal fin, no distinctive markings on dorsal and caudal fins. Dorsal fin rays 7.

Material examined : 40 exs, small ditch, 10 km NE of Painginium, P. D. Rane, 23.11.1993.

Distribution : The Netherlands Antilles, the venezualan islands, Trinidad and British Guiana; introduced in India.

Remarks : Males are distinguished from females by orange red and black dots all over the body.

Range : 18–28 mm.

Status : Exotic species.

Order CHANNIFORMES

Body elongated with cycloid scales. Head with plate like scales. Branchiostegal rays 5. Suprabranchial accessory respiratory organ well developed, enabling these fishes to breathe for a long time out of water. A single long dorsal fin and a similar long anal fin present, without spine. Pelvic fin thoracic. Lateral line abruptly curved or almost interrupted. Swimbladder very long. Physoclistic fishes.

Family CHANNIDAE
Murrels

Body elongated with cycloid scales. Head with plate like scales. Cephalic pits present. Suprabranchial organ for air breathing present. Lower jaw protruding beyond the upper jaw. A single long dorsal and similar anal fin present, both spineless and free from caudal fin. Dorsal fin with 29–55 rays. Pelvic fin usually present, with 6 rays. Lateral line abruptly curved or almost interrupted with 37–110 scales. Caudal fin rounded.

Genus *Channa* Scopoli, 1777
Snake headed fishes

Genus characters are same as those of family.

Key to the species

1a. 5–6 rows of scales between the orbit and angle of preopercle. 12–13 predorsal scales. 2

2a. Pelvic fin less than half the length of pectoral fin. Pectroral fin spotted..... *C. orientalis*

2b. Pelvic fin more than half length of pectoral fin. Pectoral fins plain ..... *C. punctatus*

48. **Channa orientalis* Bloch and Schneider

1801. *Channa orientalis* Bloch and Schneider, *Syst. Ichth.*, : 496, pl 90 fig 2. (Type locality : India).

1981. *Channa orientalis*, Jayaram, *HBFW Fish India*, : 305.

1999. *Channa orientalis* Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 274.

Diagnosis : Pectoral fins with bluish vertical bands; dorsal finrays 32–37. length of pelvic fin less than 50% of pectoral fin length.

Material examined : 1 ex; stream near. B. M. Sanctualry 3 km from Molem, G. M. Yazdani, 13.3.93; 1 ex. Sacorda, Goa, B. S. Lamba, 17.12. 73; 2 exs; saqulim, valvanti river, Tulshimala vill. 15 km NW of Valpoi, G. M. Yazdani, 16.3.93.

Distribution : India.

Elsewhere : Afghanistan, Iran, Pakistan, Nepal, Sri Lanka, Bangladesh, Myanmar and East Indies.

Remarks : It is widely distributed in Oriental Region.

Range : 22–64 mm.

Status : Common.

49. **Channa punctatus* (Bloch).

1793. *Ophiocephalus punctatus* Bloch, *Naturges ausland* Fische. (7) : 139, pl. 358 (Type locality Coromandel Coast.)

1999. *Channa punctatus*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 275.

Diagnosis : Pectoral fins plain, no vertical bands; dorsal fin rays 28–32. Length of pelvic fin more than 50% of pectoral fin length.

Distribution : India.

Elsewhere : Afghanistan, Pakistan, Sri Lanka, Nepal, Bangladesh, Burma and Ynnan (China).

Remarks : Inhabits large freshwater pond, tank, prolific breeder forms net of weeds, mature in first year.

Status : Common.

Order PERCIMORMES

Body rarely elongated, with scales commonly ctenoid. Fins usually with spines. Dorsal fins two in number, the first one being spiny. Pectoral fins inserted on the sides. Pelvic fins thoracic or jugular, with one spine and five soft rays, sometimes fewer. Caudal fin never with more than 17 principal rays, often fewer. Head and cheek with muciferous canals, pores. Weberian apparatus absent and the first vertebra free. Fishes of this order are physoclists. Lateral–line when present continuous (exception *Chanda* Hamilton). Bones of head usually with pungent spines.

Key to the Families

1a. Pelvic fins united with a membrane or frenum across their base, forming a sucking disc.... ..... GOBIIDAE

1b. Pelvic fins may be close, but not united as above, may be apart. 2

2a. An accessory respiratory organ in the form of a cavity above the 3rd or upper portion of 1st branchial arch present 3

2b. No such accessory organ present 4

3a. First ray of pelvic fin produced into a long filament, pelvic fin inserted behind pectoral fin base ..... BELONTIDAE

3b. First ray pelvic fin not produced into a long filament. Pelvic fin inserted below the base of pectoral fin ..... ANABANTIDAE

4a. Spinous and soft portion of dorsal fin well separated ..... MUGILLIDAE

4b. Spinous and soft portion of dorsal fin continuous 5

5a. A forwardly directed recumbent spine ahead of dorsal fin present ..... AMBASSIDAE

5b. No recumbent spine ahead of dorsal fin present ..... CICHLIDAE

Family AMBASSIDAE
Glass fishes

Body oblong and compressed. Head bones variously serrate or not; opercle ending in a membranous flap. Mouth moderate to large, shightly protrusible; maxilla naked; no supramaxilla. Jaw teeth generally villiform; tongue often dentate. Dorsal fin deeply divided before last spine, with 7–8 spines and 8–12 soft rays; anal fin with 3 spines and 8–17 soft rays. Pectoral fins rounded; pelvic fin with one spine and 5 soft rays. Caudal fin forked, with 15 branched rays. Scales with thin and cycloid, rather deciduous; lateral line complete or interrupted. Dorsal and anal fins naked, but with low scaly sheath.

Genus ***Chanda*** Hamilton–Buchanan, 1822

Body short, compressed somewhat diaphanous. Abdomen rounded. Lower limit of preopercle provided with double serrated edge, operculum without a prominent spine. Two dorsal fin continuous, the first dorsal fin with 7 spines and the second dorsal fin with one spine and 9–17 soft rays. A forwardly directed recumbent spine in front of the dorsal fin base. Anal fin with 3 spines and 9–17 soft rays. Caudal fin forked. Lateral line complete, incomplete, interrupted or absent. Scales cycloid small or moderate frequently deciduous.

50. ****Chanda nama*** Ham.–Buch

1822. *Chanda nama* Hamilton, *Fish Ganges* : 109, 371, pl 39, fig 37 (Type locality : N. E. Bengal.)

1991. *Chanda nama*, Talwar & Jhingran, *Inland Fish.* **2** : 799.

1999. *Chanda nama* Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 283–284.

Diagnosis : Canine teeth on lower jaw; scales minute, 100–107 in longitudinal series, mouth particularly large with very prominent lower jaw. A patch of black dots present on shoulder, upper half of first dorsal fin deep black.

Material examined : 1 ex. Nalla near Chikhali, Vasco-da-Gama, MarmuGoa, G.M. Yazdani, 9.3.1993.

Distribution : Throughout India.

Elsewhere : Pakistan, Nepal, Bangladesh and Burma.

Remarks : It inhabits brackish and freshwater in both standing and running waters.

Range : 35 mm.

Status : Common.

Genus ***Parambassis*** Bleeker, 1874

Body elongate and compressed. Supraorbital ridge usually smooth, with one or two spines posteriorly; preorbit dentate; pre-opercular ridge with several serrae on lower limb, its vertical margin generally smooth; interoperculum smooth. Mouth moderate; lateral line complete, with 30–43 pored scales; cheeks with 4–6 transverse scale rows.

51. ***Parambassis thomassi*** (Day)

1870. *Ambassis Thomassi* Day, *Proc. zool. Soc. Lond.*, 369 (Type locality : Calicut and Mangalore.)

1973. *Chanda thomassi*, Tilak, *Rec. zool. Surv. India*, **67** : 90.

1999. *Parambassis thomassi*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 287

Diagnosis : Cheek with 4 transverse scale rows, snout with a pronounced elevated tip, lateral line scales 35–43.

Distribution : India : Western Coast, S. Kanara to Kerala.

Remarks : This species attains a length of 12 cm.

Status : Uncommon.

Family CICHLIDAE

Body moderate, deep and compressed. Head and body with slightly ctenoid scales. One nostril on each side of head. Dorsal fin single with a spinous and a soft portion united. Generally, 7–25 spines and 5–30 soft rays in the dorsal fin. Anal fin with 3 (in majority of species) to 15 spine, and 4–15 soft rays. Lateral line interrupted. Generally 20–50 scales in lateral line but the number may exceed 100.

Genus ***Etroplus*** Cuvier, 1830

Body elevated compressed with rounded abdomen. Snout spot like. Dorsal fin inserted above base of pectoral fin, with 17–22 spines and 8–15 rays. Spinous fin part longer than soft part. Scales very slightly ctenoid, of moderate size and extending to base of soft dorsal and anal fin. Anal fin with 12–15 spines and 6–11 soft rays. Caudal fin lunate or emarginated. Lateral line interrupted or abruptly ceasing with 30–40 scales. Body with circular spots or vertical bands.

Key to the species

1a. Body with 1–3 dark circular blotches along sides. Dorsal fin with 8–10 soft rays and anal fin with 8–9 soft rays..... *E. maculates*

1b. Body with vertical bands. Dorsal fin with 14–15 soft rays and anal fin with 11–12 soft rays. ..... *E. suratensis*

52. ***Etroplus maculatus*** (Bloch)

1785. *Chaetodon maculates* Bloch, *Syst. Ichthy. Pl* 427, fig. 2 (Type locality : India)

1973. *Etroplus maculates*, Tilak, *Rec. zool. Surv. India*, **67** : 111.

1999. *Etroplus maculates*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 291–292.

2007. *Etroplus maculatus*, Jadhav & Yadav, *Bionotes*, **9**(1) : 26.

Diagnosis : Body with three dark blotches along flank, dorsal fin with 17 to 20 spines and 8 to 10 soft rays, anal fin with 12–15 spines and 8–9 soft rays.

Distribution : Peninsular India.

Elsewhere : Sri Lanka.

Remarks : It is an aquarium fish.

Status : Uncommon.

53. ****Etroplus suratensis*** (Bloch)

1785. *Chaetodon suratensis* Bloch, *Syst. Ichthy.*, 217, fig 2 (Type locality : Surat.)

1999. *Etroplus suratensis*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 292.

Diagnosis : Body with about 8 vertical bands. Dorsal fin with 18 to 19 spines and 14 to 15 soft rays, anal fin with 12–13 spines and 11–12 soft rays.

Material examined : 1 ex. Galjibag river, Painginium, Cancona, M. S. Pradhan, 26.9.1993.

Distribution : Peninsular India.

Elsewhere : Sri Lanka.

Remarks : Female guards the fertilized eggs. The fish attains sexual maturity at 2nd year.

Range : 100 mm.

Status : Uncommon.

Family GOBIIDAE
Gobies

Branchiostegal rays 5. body varying from oblong to elongated, eel like in some genera. Head usually with mucous canals and open pores. Two dorsal fins united with each other or separated narrowly by a notch or well separated, with 2–8 soft flexible spines and /or soft rays. First dorsal fin may be absent. The second dorsal fin (soft rayed) and the anal fin mirror each other, pelvic fins forming an adhesive or sucking disc, with which they hold on to the bottom. Anal fin short or long. Lateral line absent, exposed pit organs present. Scales cycloid or ctenoid.

Genus ***Glossogobius*** Gill, 1860.

Body generally elongated, anteriorly cylindrical, compressed. Head depressed, pointed, scales above behind the orbits. Tongue bilobate. Gill openings continued far forward below isthmus narrow. Two dorsal fins, separated by a short interspace, first dorsal fin with one spine and 6–10 soft rays, not elongated. Pelvic fins united, forming a sucking disc. Anal fin with one spine and 8–9 soft rays. Caudal fin oblong to rounded. Scales ctenoid on body and cycloid on head, 28–36 scales along lateral series.

54. ****Glossogobius giuris*** (Ham–Buch)

1822. *Gobius giuris*, Hamilton, *Fish Ganges*, **51** : 366, pl. 33, Fig. 15 (Type locality : Gangetic Provinces).

1991 *Glossogobius giuris*, Talwar and Jhingran, *Inland fish.* **2** : 936.

1999. *Glossogobius giuris* Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 294–295.

Diagnosis : Body elongate, compressed, iris without process in pupil, pelvic fins form disc like structure.

Material examined : 2 exs, Goa, B. S. Lamba 17.12.1973. 1 ex. Talpan river, Canacona, Painginium, M.S. Pradhan, 28.9.1993, 4 exs, Vadachi Kutuli river, Tivim, Goa, G. M. Yazdani, 16.3.1993. 1 ex., Britona on the bank of Nanodi river, G. M. Yazdani, 7.3.1993; 3 exs, Khandepur river, Khande par Village; M.S. Pradhan, 15.3.93.

Distribution : Indo-West Pacific.

Remarks : Five dark patches present on flank, dorsal, pectoral and caudal fins mottled with dark spots.

Range : 70–92 mm.

Status : Uncommon.

Family ANABANTIDAE

55. ****Anabas testudineus*** (Bloch)

1795. *Anabas tesudineus* Bloch, *Nat. Aus. Fish*, **7** : 121, pl. 322 (Type locality : Mentioned as Japan, but it does not occur in Japan).

1991. *Anabas testudineus*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 296-297.

Diagnosis : Depth of body 3 to 3.5 times in SL, snout length 13–17.5 times in SL.

Material examined : 4 exs., Nalla near Chikhali, Vasco-da-gama, Marmu Goa, G.M. Yazdani, 9.3.1993.

Distribution : India.

Elsewhere : Pakistan, Bangladesh, Sri Lanka, Myanmar, Malay Archipelago, Singapore and Philippines.

Remarks : Inhabits fresh and brackish waters. It is called as jumping perch.

Range : 25–30 mm.

Status : Uncommon.

Family BELONTIDAE

56. * ***Pseudosphromenus cupanus*** (Valenciennes)

1831. *Polycanthus cupanus* Valenciennes (in C & V). *Hist. nat. Poiss.* **7** : 357, pl. 492. (Type locality : Arian Coupam river, Pondicherry).

1991. *Macropodus cupanus*, Talwar and Jhingran, *Inland Fish*, **2** : 1002.

1999. *Pseudosphromenus cupanus*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 300.

Diagnosis : Anal fin with 14 to 20 spines; dorsal fin more forwardly placed, its origin in advance of or above spinous portion of anal fin. Dorsal fin with 13–17 spines.

Material examined : 1 ex, Mayem lake, Bicholim, M.S. Pradhan, 24.9.1993.

Distribution : Peninsular India : Kerala, Tamil Nadu, Karnataka, Pondicherry.

Elsewhere : Sri Lanka.

Remarks : It is a good aquarium fish, it inhabits fresh and brackish waters, usually in lentic condition with thick vegetation and floating plants.

Range : 35 mm.

Status : Uncommon.

Family MUGILIDAE

57. ***Sicamugil cascasia*** (Ham–Buch.)

1822. *Mugil cascasia*. Hamilton, *Fish Ganges*, **217** : 380. (Type locality : Upper waters of Ganges.)

1991. *Sicamugil cascasia*, Talwar and Jhingran, **2** : 899.

1999. *Sicamugil cascasia*, Menon, *Rec. zool. Surv. India, Occ Paper No.*, **175** : 293.

Diagnosis : Dorsal fin inserted conspicuously nearer tip of snout than to caudal fin base, anal fin origin opposite to second dorsal fin origin.

Material examined : 2 exs, Khandepar river, Khandepar vill., Ponda, M. S. Pradhan, 15.9.1993.

Distribution : Himalayan rivers, introduced in Cauvery.

Elsewhere : Pakistan Indus system, Bangladesh.

Remarks : It is a purely freshwater species.

Range : 60–70 mm.

Status : Uncommon.

Order MASTACEMBELIFORMES

Family MASTACEMBELIDAE

58. ***Mastacembelus armatus*** (Lacepede)

1800. *Macrognathus armatus* Lacepede, *Hist. nat. Poiss.*; **2** : 280. (Not Known).

1990. *Mastacembelus armatus*, Yazdani, *Rec. Zool. Surv. India, Occ Paper*, 124 : 1–36.

Diagnosis : Spines present on preopercle, occasionally hidden beneath the skin. Spines and soft rays in the dorsal fin exceeding 100. Gape of mouth 14–22% of total length. Gape of mouth extending to below posterior nostrils or beyond.

Material examined : 1 ex., Goa, B. S. Lamba, 17.12.1993; 5 exs, Galjibag river Painginium, tal. Cancona, M.S. Pradhan, 26.9.1993; 1 ex, saqulim, valvanti river, tulshimala vill., 15 km NW of Valpoi, G. M. Yazdani, 5 exs, Pernem, Goa, B.S. Lamba, 8.12.1973.

Distribution : Throughout India.

Elsewhere : Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, Thailand, Vietnam, Tonkin, Hainan Islands, China, Malaya, Sumatra, Java.

Remarks : Median and lateral bands present on body. The later, break into spots or crossbars.

Range : 60–90 mm.

Status : Common.

RESULTS AND DISCUSSION

In India there are about 650 species of fishes Menon (2004) evaluated about 60 fish species as threatened while Karmakar and Das (2005) recorded 225 species endemic to Indian Waters. Goa is one of the beautiful niches in Western Ghats, one of the 25 hotspots in the world. Here more or less fragile and isolated ecosystems harbour marvellous piscine fauna. Yazdani (1992) evaluated 8 spp. threatened and endemic of fishes from Western Ghats. Yadav (1997, 200a) studied 11 species from Goa State. The fish fauna

particularly from short west flowing rivers is very interesting.

Tilak (1973) recorded 52 estuarine and freshwater fish species from Goa. He originally described one subspecies *Puntius malampyx pradhani (Cyprinidae)*. Later it was considered as *Puntius fasciatus pradhani*. Haig (1950) described a new species *Silurus goae* but later Menon (1999) considered it as *Ompok malabaricus* (Bloch) *(Siluriformes, Siluridae)*. Tilak (1973) recorded two endemic species from Goa namely *Puntius f. Pradhani* and *Pangio goaensis* (Family Cobitidae). The present paper reports *Puntius crescentus* which was originally described by Yazdani and Singh (1994) from Kalinadi, Sunkeri and Karwar. It is found abundantly in Goa. It is a new record.

Present paper deals with 58 species of freshwater fishes of Goa, comprising 31 genera in 18 families under 9 orders. Order Cypriniformes form major bulk of 29 species, order Siluriformes contains 10 species of catfishes while order Perciformes represents 9 perches. Other orders represent 10 fish species. Out of 58 species, 32 are common whereas 19 species are uncommon. Two species of fishes *Rasbora caverii* (Jerdon) and *P. setnai* Chhapar and Sane are rare, while *Puntius jerdoni* (Day) and *Cirrhinus cirrhosus* (Bloch) are endangered and *Labeo dussumieri* (Valenciennes) is vulnerable freshwater Menon (2004) while two species are exotic.

Species diversity of small boat shaped *Puntius* spp. is high in Goa (11 species). Similar observations were made in other parts of Western Ghats by Yadav 1997, 2000, 2003). However species of other genera like *Currhinus* and *Labeo* could not be collected in more numbers.

Total fish catch is reducing in number. Estuarine fish species mentioned by Tilak (1973) could not be collected. These are about 20 species (e.g. Families *Ophichthidae, clupeidae, Exocoetidae, Belonidae, Scatophagidae, Scianidae, Lutjanidae, Mugilidae, Blennidae* etc.) Thus Goa exhibits a rich piscine fauna of about 78 species but at present their collection number is reduced both, specieswise and specimenwise.

In order to protect the ichthyofauna of Goa, conservation strategies (Yadav 2000b) should be applied by giving protection to young ones, broods, fry and fingerlings, ban on mass killing, observing close period in the breeding season and other scientific methods, like forming buffer zone, fish ladder etc.

SUMMARY

Goa state represents 58 species of freshwater fishes pertaining to 31 genera of 18 families grouped under 9 orders. Out of this, 32 species are common, 19 are uncommon, one is vulnerable, 2 are rare, while 2 are endangered. The fish catch is reducing in number and essential conservative steps must be taken to protect ichthyofauna of Goa.

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AMPHIBIAN

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INTRODUCTION

The amphibian fauna of Goa is characteristic part of the amphibians of the Western Ghats. Boulenger, 1920; Rao, 1937; Daniel 1963(a), 1963(b),1979,1989; Abdulali, 1988; Inger and Dutta, 1986; Sekar, 1991,1992; Bhatta, 1997; Bhatt and Desai, 1998; Dutta, 1997; Das & Whitaker, 1997, 1998; Chanda, 2002; Sarkar & Ray, 2004; Gururaj and Ramchandra 2004, altogether have reported about 26 species of amphibians from Goa state and Bhatta & Prashant, 2004, have described a new species of *Gegeneophis* from Bondla wildlife sanctuary and Das and Kunte have described a new species of the genus *Nyctibatrachus* making the list of 28 amphibians from Goa. The present study is based on the the collections made by several survey parties of Zoological Survey of India, Western Regional Station, Pune and the species reported by various authors.

MATERIALS AND METHOD

Amphibians were collected with water nets, cast nets and picked by hand. The speciemens were fixed in 5% formaldehyde solution for 24 hours. Abdomens of larger specimens were slit to allow proper fixation of the viscera. The fixed collections were transferred to 80% Rectified spirit and carried to the laboratory for analysis.

SYSTEMATIC LIST

(Asterisk indicates the specimens actually collected)

Phylum CHORDATA

Class AMPHIBIA

Order ANURA

Family BUFONIDAE

1. **Bufo melanostictus* Schn.
2. **Bufo stomaticus* Lutken
3. *Pedostibes tuberculosus* Gunther

Family MICROHYLIDAE

4. **Microhyla ornata* Dumeril & Bibr.
5. *Microhyla rubra* (Jerdon, 1854)
6. *Ramanella montana* (Jerdon, 1854)
7. *Ramanella mormorata* Rao, 1937.
8. *Uperodon globulosus* (Gunther, 1864)

Family RANIDAE

9. *Nyctibatrachus petraeus* Das and Kunte 2005.
10. **Euphlyctis cyanophlyctis* (Schn.)
11. *Euphlyctis hexadactylus* Lesson, 1834
12. **Fejervarya limnocharis* (Gravenhorst.)
13. **Fejervarya syhadrensis* Annandale
14. **Hoplobatrachus tigerinus* (Daudin)
15. *Indirana beddomii* (Gunther, 1875)
16. **Limnonectes brevipalmatus* (Peters, 1871)

17. *Limnonectes keralensis* Dubois, 1980.
18. *Micrixalus fuscus* (Boulenger 1882)
19. *Micrixalus opisthorhodus* (Gunther 1868)
20. **Sphaerotheca breviceps* (Schn.)
21. *Sphaerotheca rufescens* (Jerdon, 1854)

Family RHACHOPHORIDAE

22. **Philautus bombayensis* (Annandale, 1919)
23. *Philautus leucorrhinus* (Lichtenstein and Martens, 1856)
24. **Polypedates maculates* (Gray, 1832)
25. *Rhacophorus malabaricus* Jerdon, 1870
26. *Rhacophorus pleurostictus* (Gunther, 1864)

Order GYMNOPHONIA

Family CAECILIDAE

27. *Gegeneophis ramaswami* Taylor, 1964
28. *Gegeneophis nadkarnii* Bhatta & Prashanth, 2004

SYSTEMATIC ACCOUNT

Family BUFONIDAE

1. *Bufo melanostictus* Schn.
Common Indian Toad

Material examined : Ponda, Goa, Dr. B.S. Lamba, 9.12.73. 3 exs.; Devil's Canyon around Molem, Dr. M.S. Pradhan, 14.9.93, 3 exs.; Panjim forest rest house, Dr. P.P. Kulkarni, 28.1.2002, 1 ex.

Diagnostic Characters : Snout to vent length between 60 to 75mm. Head, upper lip, tips of fingers, toes and metatarsal tubercles with prominent bony ridges. Tympanum 2/3 diameter of the eye. First finger usually longer than the second. Skin with spine tipped warts. Colour of the dorsal side varying from grayish to brownish. Venter whitish with black striplings on the chin. Toes about ½ webbed with small subarticular tubercles. Inner metatarsal tubercle large and elliptical, outer metatarsal tubercle small.

Distribution : Throughout the Indian subcontinent and Malaysia.

2. *Bufo stomaticus* Lutken
Marbled toad

Material examined : Fonda, Dr. B.S. Lamba, 13.12.73, 1 ex.; Bondla, Dr. M.S. Pradhan, 25.9.93, 2 ex.; Hivare Sattari, North Goa, Dr. P.P. Kulkarni, 20.1.2002, 2 exs.

Diagnostic Characters : Size medium, snout to vent length about 55 mm. Dorsal surface of the body is tuberculated. Ventral surface is granulated except for the chin and throat which are smooth. Tympanum 2/3 diameter of the eye. Fingers free, first finger always longer than the second. Tibio-tarsal articulation reaches between the shoulder and eye. Toes 2/3rd webbed. Inner and outer metatarsal tubercles equal and with sharp edges. Dorsal surface grayish, venter white.

Distribution : Assam, Bihar, Himachal Pradesh, Karnataka, Jammu and Kashmir, Maharashtra, Orissa, and West Bengal.

3. *Pedostibes tuberculosus* Gunther
Malabar tree toad

Material examined : None only from records.

Diagnostic Characters : Snout to vent length 35 mm. colour brownish above whitish below. Dorsal surface tuberculated, parotid glands distinct. Fingers webbed partially, toes webbed completely. Tips of fingers and toes dilated into discs.

Distribution : Kerala, Goa.

Family MICROHYLIDAE

4. *Microhyla ornata* Dumeril & Bibr.
Ornate Microhylid

Material examined : Fonda Dr. B.S. Lamba, 13.12.73, 1ex; East Mahavir sanctuary, Goa Dr. P.D. Rane, 1.12.93, 4 ex.; Valpoi Rest house 19.1 2002, Dr. P.P. Kulkarni, 2 ex.

Diagnostic Characters : Size small, snout to vent length about 25 mm. Dorsal surface reddish brown with a characteristic marking on the back giving it an ornate look. Throat and chest whitish. Tympanum is not visible. Toes webbed feebly. Subarticular tubercles small and distinct. Tibio-

tarsal articulation reaches between the shoulder and the eye. Inner and outer metatarsal tubercles are small and round.

Distribution : Throughout Southeast Asia.

5. ***Microhyla rubra*** (Jerdon, 1854)
Densely spotted Microhylid

Material examined : None only from records.

Diagnostic Characters : Small sized frog about 26 mm length. Dorsally reddish brown, ventrally white. Throat region mottled with brown. Fingers free, with rounded tips. Tibiotarsal articulation reaches the eye. Toes half webbed. Outer metatarsal tubercle shovel shaped and semicircular. Inner metarsal tubercle crescentic.

Distribution : Assam, Karnataka, Kerala, Maharashtra, Tamil Nadu, Andhra Pradesh and Shri Lanka.

6. ***Ramanella montana*** (Jerdon, 1854)
Malabar Hill frog

Material examined : None only from records.

Diagnostic Characters : Size small, snout to vent length 35 mm. Dorsal surface brown with darker markings. Ventral surface brown with whitish markings. Skin smooth both dorsally and ventrally. Fingers moderately long with prominent discs. Toes ½ webbed, tips of toes swollen. Inner metatarsal tubercle oval shaped, outer metatarsal tubercle blunt.

Distribution : Kerala, Maharashtra.

7. ***Ramanella mormorata*** Rao

Material examined : None only from records.

Diagnostic Characters : Size zmall, snout to vent length 25 mm. Dorsum in male bright reddish brown with limbs showing dark bands upto fingers. Female similar with olive green colouration. Skin dorsally warty, ventrally smooth. Tibio-tarsal articulation reaching the shoulder. Finger tips with triangular discs. Toes obtusely pointed and feebly webbed. Inner metatarsal tubercle strong and shovel shaped. Outer metatarsal tubercle conical.

Distribution : Kerala, Maharashtra, Goa.

8. ***Uperodon globulosus*** (Gunther, 1864)
Balloon Frog

Material examined : None only from records.

Diagnostic Characters : Medium to large sized frogs snout to vent length about 60 mm. Head small, body robust and globular. Dorsal surface brown and ventrally white. Skin smooth on the dorsal side, ventrally wrinkled with granular anal region. Tympanum indistinct. Hindlimbs short, tibiotarsal articulation not reaching the shoulder when the limb is held to the side of the body. Toes feebly webbed. Inner and outer metatarsal tubercles large and shovel shaped. Inner metatarsal tubercle bigger than the outer.

Distribution : Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, West Bengal.

Family RANIDAE

9. ***Nyctibatrachus petraeus*** Das and Kunte 2005

Material examined : None only from records.

Diagnostic Characters : Size small about 35–40 mm. Colour Dark brown above venter white, hind limbs with dark vertical bands. Tympanum indistinct. Fingers without web, Toes webbed completely. Tips of the digits dialated into small discs with circum-marginal grooves.

Distribution : Karnataka, Goa.

10. ***Euphlyctis cyanophlyctis*** (Schn.)
Skipper Frog

Material examined : Parneri, Goa, Dr. B.S. Lamba, 8.12.73, 10 exs.; Molem, Dr. B.S. Lamba, 11.12. 73, 6 ex.; Sacorda Dr. B.S. Lamba, 17.12.73, 9 exs.; Valpoi, Sattari, Dr. G.M.Yazdani, 15.3.93. 2 ex.; Freshwater pond Maxim Painjinim Dr. M.S. Pradhan, 19.9.93, 15 exs.; Mandovi river, Dr. P.D. Rane, 3.12.93, 15 ex.; Stream near Baruse village, Dr. S.G. Patil, 6.3.2002, 5 exs.; Stream near Kalol village Dr. S.G. Patil, 4.3.2002, 9 exs.; Gagangiri, Dr. S.G. Patil, 5.3.2002, 11 exs.; Arjuna

dam. Dr. S.G. Patil, 25.2.2002, 5 ex.; Stream about 10 km from Molem on Fonda road, Dr. S.G. Patil, 28.2.2002, 6 exs.

Diagnostic Characters : Medium sized frogs of 45 to 55 mm snout to vent length. First and second fingers equal. Tympanum about two-thirds the diameter of the eye. Tibiotarsal articulation reaches between the eye and the nostril. Toe tips swollen and rounded, toes fully webbed, a line of porous warts on the flanks. Inner metatarsal tubercle finger like, outer metatarsal tubercle absent. Skin warty dorsally, a 'U' shaped line of warts around anus, ventrally smooth. Colour olive green above with darker marblings, ventrally white. Some specimens show dark marblings on the underside.

Distribution : Throughout India, Shri Lanka and Nepal.

11. ***Euphlyctis hexadactylus*** Lesson, 1834
Indian green frog

Material examined : None only from records.

Diagnostic Characters : Size about 70 mm. dorsally green with a yellowish stripe along the spine. Ventrally pale yellow. Tympanum 2/3 diameter of the eye. Fingers free. Tibiotarsal articulation reaches eye. Toes pointed and completely webbed. A small finger like inner metatarsal present.

Distribution : Punjab, Karnataka, Tamil Nadu, Maharashtra, West Bengal, Andhra Pradesh and Shri Lanka.

12. ***Fejervarya limnocharis*** (Gravenhorst.)
Indian Cricket Frog

Material examined : Parneri, Goa, Dr. B.S. Lamba, 8.12.73, 4 exs.; Tulsi Maal, Valvanti river Bicholim, Dr. G.M.Yazdani, 16.3.93, 2 exs.; Forest Rest House Painjinim, Dr. M.S. Pradhan, 19.9.93, 3 exs.; Sal river near Kunkolim, Madgao. Dr. M.S. Pradhan, 23.9.93, 2 exs; Hivere sattari, North Goa, Dr. P.P. Kulkarni, 20.1.2002, 3 exs. Tulsi Maal, near Keri Dr. S.G. Patil, 24.2.2002, 3 exs.; Kolem river, Molem, Dr. S.G. Patil, 26.2.2002, 3 exs.

Diagnostic Characters : Small to medium sized frogs. Toes are only half webbed. First finger longer than the second. Tympanum distinct and nearly half the diameter of the eye. Tibiotarsal articulation reaches the nostril when the legs are held alongside of the body. Subarticular tubercles small, both inner and outer metatarsal tubercles present. Skin warty above, grayish or brownish coloured with darker markings and a dorsal vertebral band, the vertebral band is much broader in some specimens.

Distribution : Throughout the Indian Union.

13. ***Fejervarya syhadrensis*** Annandale
Small circket frog

Material examined : Chinchani village on Madgaon-Kankona road, Dr. R.M. Sharma, 6.12.90, 1ex.; River near Ujem village, Dr. S.G. Patil, 3.3.2002, 3 ex.

Diagnostic Characters : Size about 35 mm. Dorsal surface grayish brown with a series of dark spots. Ventral surface yellowish white. Skin with warts and tubercles dorsally ventrally smooth, posterior parts of belly and inner thighs granular. Tympanum half the diameter of the eye. Tibiotarsal articulation reaches eye. Fingers free, toes half webbed. Subarticular tubercles small. Inner metatarsal tubercle oval, outer metatarsal tubercle small and indistinct.

Distribution : Orissa, Maharashtra.

Elsewhere : Nepal.

14. ***Hoplobatrachus tigerinus*** (Daudin)
Indian bull frog

Material examined : Parneri, Goa, Dr. B.S. Lamba, 8.12.73, 1 ex.; Molem, Dr. B.S. Lamba, 16.12.73, 2 exs.; Valpoi, Dr. M.S. Pradhan, 26.2.93, 2 exs.; Forest near Usgaon Fonda, Dr. M.S. Pradhan, 30. 9.93, 2 exs.; Kotigao, Dr. P.D. Rane, 26.11.93. 1 ex.; Rest House at Keri, Dr. S.G. Patil, 24.2.2002, 2 exs.

Diagnostic Characters : Large sized amphibians, snout to vent length 120 mm. Skin with longitudinal folds dorsally, ventrally smooth.

Tympanum equal to the eye in diameter. Fingers moderately long and obtusely pointed. Heels overlap strongly when the hindlimbs are folded. Toes fully webbed and with swollen tips. Inner metatarsal tubercle obtusely pointed, no outer metarsal tubercle. Colour olive green above with a vertebral streak in some specimens, limbs spotted, ventrally white.

Distribution : Throughout the Indian union except Meghalaya

Elsewhere : Nepal, Pakistan and Bangladesh.

15. ***Indirana beddomii*** (Gunther, 1875)
Beddome's frog

Material examined : None only from records.

Diagnostic Characters : Small sized frogs about 40 mm in length. Colour light brown to gray dorsally, ventrally white. Skin smooth dorsally with small warts. Ventral surface smooth with granulations on the hinder part of thighs. Tympanum 2/3 diameter of the eye. Tips fo fingers dialated into smaller discs. Tibiotarsal articulation reaching beyond the tip of snout. Toes 2/3 webbed, tips of toes dialated into smaller discs. Subarticular tubercles small, an inner, elliptical metatarsal tubercle present.

Distribution : Karnataka, Kerala, Maharashtra, Tamil Nadu and Goa.

16. ***Limnonectes brevipalmatus*** (Peters, 1871)
Peter's frog

Material examined : Molem, Dr. B.S. Lamba, 11.12. 73, 3 ex.; Hivere sattari, North Goa, Dr. P.P. Kulkarni, 20.1.2002, 1 exs.

Diagnostic Characters : Medium sized frogs, of abot 50 mm length. Dorsal surface dark brown in colour with a yellow vertebral streak. Ventral surface white. Skin warty above with some longitudinal folds. Ventrally smooth. Tympanum about ¾ diameter of the eye. Tibiotarsal articulation reaching the tip of the snout. Toes pointed and 1/3 webbed. A large, oval, inner metatarsal tubercle present.

Distribution : Karnataka and Goa.

17. ***Limnonectes keralensis*** Dubois, 1980)
Dubois's Hill frog

Material examined : None only from records.

Diagnostic Characters : Medium sized frogs 60 to 65 mm length. Dorsal surface grayish brown with black spots. Skin with warts dorsally, ventrally smooth and thighs granular. Tympanum prominent and nearly equal to the diameter of the eye. First finger longer than second, subarticular tubercles of fingers large. Toes fully webbed, inner metatarsal tubercle oval.

Distribution : West Bengal, Orissa, Gujarat, Kerala, Tamil Nadu and Goa.

18. ***Micrixalus fuscus*** (Boulenger 1882)
Brown Tropical Frog

Material examined : None only from records.

Diagnostic Characters : Small sized frogs of 30 to 32 mm length. Dorsally brick red coloured, ventrally yellowish brown. Tympanum small and indistinct. Fingers free and tips dialated into discs. Tibiotarsal articulation reaches beyond eye. Toes three fourth to fully webbed. Tips of toes dialated into small discs. Inner metatarsal tubercle small and indistinct.

Distribution : Kerala and Goa.

19. ***Micrixalus opisthorhodus*** (Gunther 1868)
Black Banded frog

Material examined : None only from records.

Diagnostic Characters : Small sized frogs of about 35 mm length. Dorsally brownish, ventrally yellow with mottled with brown. Tympanum small and hidden. Fingers free, tips of fingers with discs. Tibiotarsal articulation reaching beyond eye. Inner metatarsal tubercle small.

Distribution : Kerala and Goa.

20. ***Sphaerotheca breviceps*** (Schnieder)
Indian Burrowing Frog

Material examined : Parneri, Goa, Dr. B.S. Lamba, 8.12.73, 1 ex.; Molem, Dr. B.S. Lamba, 11.12. 73, 3 ex.; Nanadi river, Kudal, Sattari, Dr.

G.M.Yazdani, 17.3.93. 1 ex.; Bondla sanctuary Dr. M.S. Pradhan, 25.9.93 2 exs.; Devils canyon around Molem Dr. M.S. Pradhan, 14.9.93, 1 exs.

Diagnostic Characters : Medium sized Frogs. Snout short and rounded. Tympanum is 3/5 the diameter of the eye. First finger is longer than the second finger. Tibiotarsal articulation reaching the shoulder when the leg is held by the side of the body. Toes are ¾ webbed. Inner metatarsal tubercle strong, large, crescent shaped and equal in length to the inner toe. Skin smooth or finely granular on the back, coarsely granular on the belly and thighs. Colour grayish above with white marblings. Thighs marbled with yellow ventrally, throat sometimes brownish, rest of the venter white.

Distribution : Throughout the Indian Peninsula, Nepal, Mynmar, Shri Lanka.

21. ***Sphaerotheca rufescens*** (Jerdon, 1854)
Red Burrowing frog

Material examined : None only from records.

Diagnostic Characters : Medium sized frogs of 42 to 46 mm length. Dorsally brownish with darker spots. Skin warty above smooth below, thighs granular. Tympanum ½ diameter of the eye. Tibiotarsal articulation reaching the tympanum. Fingers free, toes feebly webbed. Inner metatarsal tubercle large and crescentic; outer metatarsal tubercle small.

Distribution : Maharashtra, Kerala, Goa.

Family RHACHOPHORIDAE

22. ***Philautus bombayensis*** (Annandale, 1919)
Castle Rock bush frog

Material examined : Bhagwan mahavir sanctuary, Molem, Dr. M.S. Pradhan, 16.9 93. 1 ex.

Diagnostic Characters : Small sized frog of 25 to 30 mm. Dorsally brown coloured with black spots. Ventral surface greenish yellow. Skin with warts and granules dorsally and belly granulated. Tympanum small and indistinct. Fingers without web, toes 1/3rd webbed. Tips of fingers with small discs.

Distribution : Maharashtra, Kerala, Goa.

23. ***Philautus leucorrhinus*** (Lichtenstein and Martens, 1856)

Material examined : None only from records.

Diagnostic Characters : Small sized frogs of 30 mm length. Colour dorsally brown ventrally white. Limbs with dark cross markings. Skin smooth above with a few granules. Abdomen and inner thighs granulated. Fingers with minute webbing. Toes 1/3rd webbed.

Distribution : Kerala, Goa.

Elsewhere : Shri Lanka.

24. ****Polypedates maculatus*** (Gray.)
Common Tree Frog

Material examined : Devils canyon around Molem, radhan 14.9.93, 2 exs.; Bondla sanctuary, Dr. M.S. Pradhan, 27.9.93. 4 exs.; Bondla sanctuary Rest House, Dr. G.M. Yazdani 1 ex.

Diagnostic Characters : Slender frog of a medium size of about 35 to 45 mm. Vomerine teeth are present in two equal rows. Tympanum is 3/4th the diameter of the eye. First finger equal to the second. Toes are 3/4th webbed. Tips of the fingertips and toes with discs inner metatarsal tubercle oval and prominent. Skin smooth above and granular on belly and thighs. Colour yellowish white above with darker spots, ventrally dull white. Lanka.

Distribution : Throughout India, Except Haryana, Punjab and Rajasthan

25. ***Rhacophorus malabaricus*** Jerdon, 1870.
Malabar Gliding frog

Material examined : None only from records.

Diagnostic Characters : Size large about 75 to 80mm. Dorsally green coloured with balck spots, venter yellow, webs between fingers and toes reddish. Skin smooth dorsally ventrally lightly granulated. Tympanum prominent and half the diameter the eye. Figners fully webbed with large

discs. Tibiotarsal articulation reaches anterior corner of the eye. Toes fully webbed and with large discs. Inner metatarsal tubercle present.

Distribution : Kerala, Mysore and Goa.

26. ***Rhacophorus pleurostictus*** (Gunther, 1864)

Material examined : None only from records.

Diagnostic Characters : Medium sized frogs of about 50mm length. Dorsally green with black spots, sides of thighs purple-brown with yellow spots, limbs with dark cross markings, ventrally grey coloured. Skin smooth above and coarsely granular on thighs and belly. Tympanum indistinct and ½ diameter of the eye. Fingers webbed at base, toes completely webbed. Tips of fingers and toes with large discs. Tibio-tarsal articulation reaches the eye.

Distribution : Tamil Nadu, Kerala and Goa.

Order GYMNOPHONIA

Family CAECILIDAE

27. ***Gegeneophis ramaswami*** Taylor, 1964

Material examined : None only from records.

Diagnostic Characters : Length 340 mm. Colour grayish blue above grey below. Eyes indistinct, tentacles located behind and lower to nostrils, nearer to the mouth. Tongue thick and fleshy with two lateral bead like narial plugs. Collars are prominent, first collar narrower than the second. There are 99 primary and 11 secondary grooves behind the collar. Vent is transverse.

Distribution : Kerala, Goa.

28. ***Gegeneophis nadkarnii*** Bhatta & Prashanth, 2004

Material examined : None only from records.

Diagnostic Characters : Length 289 mm. colour of the body is dark slaty-grey on the dorsum and light grey on the venter. Eyes are indistinct. Tentacles are close to the margin of upper lip than that of head. Tongue rounded and with a pair of narial plugs. Two Collars are prominent and marked with 3 white nuchal grooves. First collar is narrower than the second. There are 114 primary grooves and 86 secondary grooves.

Distribution : Goa.

SUMMARY

There are altogether 28 species of Amphibians belonging to two orders, five families and 17 genera found in the state of Goa. Family bufonidae is represented by 2 genera, family microhylidae by 3 genera, family ranidae by 8 genera, family rhachophoridae by 3 genera and family caecilidae by 1 genus.

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REPTILIA

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INTRODUCTION

State of Goa is more famous, nationally as well as internationally, for tourism rather than for its rich faunal components surviving in the varied ecosystems ranging from marine to mountainous habitats. However, scientists, naturalists and amateurs were keen in studying the reptilian fauna of this region since long time. Because the small sized-state exhibits varied habitat diversity ranging from marine ecosystem on west coast side to heavily forested mountainous tracts of Central Western Ghats on eastern side. Such habitat diversity in a smaller area has resulted in expression of spectacular faunal diversity.

Earlier scientists and naturalists have recorded reptilian species in their isolated reports based on the intensive surveys carried out in this region by them over a period of time (Smith, 1931, 1935, 1943; Daniel, 1983; Murthy, 1985; Tikader and Sharma, 1985, 1992, Sharma, 1976, 1998, 2002, 2003; Das, 1995; Pradhan, 1997a; Nalawade, 1998 ;Whitaker and Captain, 2004 and many others). Sharma published taxonomic account on lizards (2002) and snakes (2003) of India which includes his studies on the reptilian material collected from Goa State by various scientists and deposited in ZSI, WRS, Pune. He has also published a separate account on reptiles of Goa in 1976 based on the faunistic survey conducted by him in 1969. Present article is based on the valuable information contributed in past by these dedicated workers.

State of Goa has been very well surveyed in past by number of scientists from Zoological Survey of India and Bombay Natural History Society. Further, the state falls within the jurisdiction of Western Regional Station, Pune, since its inception in 1960. Number of survey parties have visited and surveyed the state from faunal point of view. However, unfortunately, no consolidated account on the reptilian diversity from State of Goa is available. Hence, an attempt has been made in the present article to report updated information on the reptilian species and subspecies from the entire State of Goa. Present account is based on the material collected during the project period as well as in the past by various scientists, species sighted during the project period and also on the account based on bibliographic records. In addition to the above list of references, Ahmed and Dasgupta (1992), Gayen (1999) and many others were also consulted which have been mentioned at relevant places.

SYSTEMATIC LIST OF REPTILIAN SPECIES REPORTED FROM STATE OF GOA

*(*Asteriks indicates species actually collected and/or sighted during the project period)*

Phylum CHORDATA

Class REPTILIA

Order LORICATA (CROCODLLIA)

Family CROCODLLIDAE

1. Indian or Marsh Crocodile, Mugger : *Crocodylus palustris* Lesson

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Order TESTUDINES (CHELONIA)

Suborder CRYPTODIRA

Family CHELONIIDAE

2. Loggerhead Sea Turtle : *Caretta caretta* (Linnaeus)
3. Green Sea Turtle : *Chelonia mydas* (Linnaeus)
4. Hawksbill Sea Turtle or Tortoise Shell Turtle : *Eretmochelys imbricata* (Linnaeus)
5. Olive Ridley Turtle : *Lepidochelys olivacea* (Linnaeus)

Family DERMOCHELYIDAE

6. Leatherback Sea Turtle : *Dermochelys coriacea* (Linnaeus)

Family EMYDIDAE (BATAGURIDAE)

*7. Indian Snail–Eating Turtle : *Melanochelys trijuga* (Schweigger)

Family TESTUDINIDAE

8. Star Tortoise or Indian Starred Tortoise : *Geochelone elegans* (Schoepff)

Family TRIONYCHIDAE

*9. Southern Flap-shelled Turtle : *Lissemys punctata granosa* (Lacepede)
10. Peninsular Soft-Shelled or Leith's Softshelled Turtle : *Trionyx leithi* Gray = *Aspideretes leithii* (Gray)

Order SQUAMATA

Suborder SAURIA (LACERTILIA)

Family GEKKONIDAE

11. South Indian Rock Gecko : *Cyratodactylus collegallensis* (Beddome)
12. North Malabar Rock Gecko : *Cyratodactylus dekkanensis* (Gunther)
*13. South Malabar Rock Gecko : *Cyratodactylus albofasciatus* (Boulenger)
14. North Kanara Hill Palli : *Cnemaspis kandiana* (Kelaart)
*15. Goa Forest Palli : *Cnemaspis goaensis* Sharma
16. Dark Spotted Giant Gecko : *Hemidactylus maculatus* (Dum. & Bibr.)
17. Blotched Gecko : *Hemidactylus triedrus* (Daudin)
*18. Spotted House Gecko : *Hemidactylus brooki* Gray
*19. Prashad Brown Gecko : *Hemidactylus prashadi* Smith
20. Reticulated Gecko : *Hemidactylus reticulatus* Beddome
*21. Ticticky House Gecko : *Hemidactylus frenatus* Schlegel
22. Common Bark Gecko : *Hemidactylus leschenaulti* Dum. & Bibr.
*23. Yellow –Bellied House Gecko : *Hemidactylus flaviviridis* Ruppell

Family AGAMIDAE

*24. South Indian Flying Dragon or Flying Lizard : *Draco dussumieri* Dum. & Bibr.
*25. India Fan-Throated Lizard : *Sitana ponticeriana* Cuvier
*26. Indian Garden Lizard : *Calotes versicolor* (Daudin)
*27. Matheran Olive-Brown Calotes : *Calotes rouxi* Dum. & Bibr.
28. Olive Brown Rock Lizard : *Psammophilus dorsalis* (Gray)

Family CHAMAELEONIDAE

*29. Indian Chamaeleon : *Chamaeleo zeylanicus* Laurenti

Family SCINCIDAE

*30. Allapalli Forest Skink : *Mabuya allapallensis* Schmidt
*31. Bornzy Grass Skink : *Mabuya macularia* (Blyth)
*32. Common Indian Skink : *Mabuya carinata* (Schneider)
33. Beddom's South Indian Skink : *Mabuya beddomii* (Jerdon)
*34. Five Striped Skink : *Mabuya trivittata* (Hardwicke & Gray)
*35. Dotted Garden Skink : *Riopa punctata* (Linnaeus)
*36. Malabar Dotted Skink : *Riopa guentheri* (Peters)

37. Golden-Brown Four-toed Skink : *Riopa lineata* (Gray)

*38. Goanese Bronze Skink : *Riopa goaensis* Sharma

Family LACERTIDAE

* 39. Beddom's Snake-Eyed Lacerta : *Ophisops beddomii* (Jerdon)

Family VARANIDAE

*40. Common Indian Monitor Lizard : *Varanus bengalensis* (Daudin)

Suborder SERPENTES (Ophidia)

Family TYPHLOPIDAE

*41. Common Worm or Blind Snake : *Ramphotyphlops braminus* (Daudin) = *Typhlops braminus* (Daudin)

42. Slender Worm Snake : *Typhlops porrectus* Stoliczka

*43. Beaked Worm or Blind Snake : *Typhlops acutus* (Dum. & Bibr.) = *Grypotyphlops acutus* (Dum. & Bibr.)

Family UROPELTIDAE

44. Travancore Melanophidium or Pied-belly Shieldtail Snake : *Melanophidium punctatum* Beddome

45. Elliot's Uropeltis or Shieldtail Snake : *Uropeltis ellioti* (Gray)

46. Peter's Uropeltis or Mahrrata roughtail Snake : *Uropeltis macrolepis* (Peters)

47. Cuvier's Uropeltis or Kerala Shieldtail Snake : *Uropeltis ceylanicus* Cuvier

48. Bombay Hills Uropeltis or Phipsoni roughtail Snake : *Uropeltis phipsoni* (Mason)

49. Myhendra Mountain Uropeltis or Barred shieldtail Snake : *Uropeltis myhendrae* (Beddome)

Family BOIDAE

*50. Indian Python or Rock Python : *Python molurus* (Linnaeus)

*51. Common or Russel's Sand Boa : *Eryx conicus* (Schneider) = *Gongylophis conicus* (Schneider)

52. Indian or Red Sand or John's Sand Boa : *Eryx johni johni* (Russell)

53. Whitaker's Boa : *Eryx whitakeri* I. Das

Family ACROCHORDIDAE

*54. Elephant Trunk or Indian Wart or File Snake : *Chersydrus granulatus* (Scneider) = *Acrochordus granulatus* (Scneider)

Family COLUBRIDAE

Subfamily COLUBRINAE

*55. Common Trinket Snake : *Elaphe helena* (Daudin) = *Coelognathus helena* (Daudin)

*56. Indian Rat Snake or Dhaman : *Ptyas mucosus* (Linnaeus)

57. Banded Racer : *Argyrogena fasciolatus* (Shaw)

*58. Russell's Kukri Snake : *Oligodon taeniolatus* (Jerdon)

*59. Common Kukri Snake : *Oligodon arnensis* (Shaw)

*60. Painted Bronzeback Tree snake : *Dendrelaphis pictus* (Gmelin) = *Ahaetulla ahaetulla* (Linnaeus)

*61. Nilgiri Olive-Brown Black-Blotched or Large-eyed Bronzeback Tree snake : *Dendrelaphis grandoculis* (Boulenger) = *Ahaetulla grandoculis* (Boulenger)

62. Common Bronze-Back Tree Snake : *Dendrelaphis tristis* (Daudin)

*63. Golden Tree or Ornate Flying Snake : *Chrysopelea ornata* (Shaw)

64. Travancore Wolf Snake : *Lycodon travancoricus* (Beddome)

65. Northern or Barred Wolf Snake : *Lycodon striatus* (Shaw)

*66. Common Wolf Snake : *Lycodon aulicus* (Linnaeus)

67. Light Brown or Dumeril's Black-headed Snake : *Sibynophis subpunctatus* (Dum. & Bibr.)

*68. Striped Keelback : *Amphiesma stolata* (Linnaeus) = *Natrix stolata* (Linnaeus)

*69. Beddom's Olive-Brown Keelback : *Amphiesma beddomei* (Gunther) = *Natrix beddomei* (Gunther)

70. Green or Hill Keelback : *Amphiesma monticola* (Jerdon)

*71. Checkered Keelback : *Xenochrophis piscator* (Schneider) = *Natrix piscator* (Schneider)

*72. Green Keelback : *Macropisthodon plumbicolor* (Cantor)

*73. Indian Gamma or Common Cat Snake : *Boiga trigonata* (Schneider)

74. Ceylon Cat Snake : *Boiga ceylonensis* (Gunther)

75. Reddish Peninsular Cat Snake : *Boiga forsteni* (Dum. & Bibr.)

*76. Common Green Whip or Vine Snake : *Ahaetulla nasutus* Lacep.

*77. Brown Whip or Vine Snake : *Ahaetulla pulverulentus* (Dum. & Bibr.)

Subfamily HOMALOPSINAE

78. Glossy Marsh Snake : *Gerardia prevostiana* (Eydoux and Gervais)

79. Siebold's Smooth-scaled Water Snake : *Enhydris sieboldi* (Schlegel)

80. Dog-faced Water Snake : *Cerberus rhynchops* (Schneider).

Family ELAPIDAE

*81. Common Indian Krait : *Bungarus caeruleus* (Schneider)

82. Slender Coral Snake : *Callophis melanurus* (Shaw)

83. Striped Coral Snake : *Callophis nigrescens* (Gunther)

*84. Spectacled Indian Cobra : *Naja naja naja* (Linnaeus)

85. King Cobra or Hamadryad : *Ophiophagus hannah* (Cantor)

Family HYDROPHIIDAE

*86. Hook-nosed Sea Snake : *Enhydrina schistosa* (Daudin)

87. Yellow Sea Snake : *Hydrophis spiralis* (Shaw)

88. Annulated Sea Snake : *Hydrophis cyanocinctus* (Daudin)

89. Pale-Grayish or Cochin Banded Sea Snake : *Hydrophis ornatus* (Gray)

*90. Many Toothed or Malacca Sea Snake : *Hydrophis caerulescens* (Shaw)

91. Bombay Sea Snake : *Hydrophis mamillaris* (Daudin)

92. Grayish-Black White-Bellied Sea Snake : *Hydrophis fasciatus* (Schneider)

*93. Short Sea Snake : *Lapemis curtus* (Shaw)

94. Common Small Headed Sea Snake : *Microcephalophis gracilis* (Shaw)

95. Pelagic or Black & Yellow Sea Snake : *Pelamis platurus* (Linnaeus)

Family VIPERIDAE

Subfamily VIPERINAE

*96. Russell's Viper or Daboia : *Vipera russelli* (Shaw) = *Daboia russelii* (Shaw)

*97. Saw-scaled Viper or Phoorsa : *Echis carinatus* (Schneider)

Subfamily CROTALINAE

98. Hump-nosed Pit Viper : *Hypnale (Agkistrodon) hypnale* (Merrem)

*99. Bamboo Pit Viper : *Trimeresurus gramineus* (Shaw)

100. Greenish Malabar Pit Viper : *Trimeresurus malabaricus* (Jerdon)

SPECIES-WISE SYSTEMATIC ACCOUNT OF REPTILES OF GOA STATE

Phylum CHORDATA

Class REPTILIA

Class Reptilia is represented in Goa State by following three out of four orders of living reptiles.

1. Loricata (Crocodylia) : Includes Crocodiles, Gharials, Alligators etc.
2. Testudines : Includes Turtles, Tortoises and Terrapins
3. Squamata : Includes Lizards and Snakes

Order LORICATA (CROCODYLIA)

Order Loricata (Crocodylia) contains a single family, Crocodylidae.

Family CROCODYLIDAE

Family Crocodylidae is represented by a single species under Genus *Crocodylus* in Goa State.

1. ***Crocodylus palustris*** Lesson

1763. *Crocodilus palustris* Lesson, in *Belong. Voy. Ind. or., zool.*, : 305.

Common name : English : Marsh Crocodile, Indian Crocodile.

Diagnostic Characters : Crocodiles are the largest modern living reptiles. They are closely related with dinosaurs. Crocodiles are characterized by lizard like characters viz. long body and tail with short limbs. The back is covered with thick rectangular horny, partially ossified plates known as scutes or scales. They are sharply raised and arranged in 16-17 transverse and 4 6 longitudinal rows. Ventral plates are smooth and smaller in size. The broad snout is elongated with number of teeth inside. Fourth tooth of the lower jaw is laid into a notch in the upper jaw. The area is open at the sides so that the fourth tooth of the lower jaw is visible when the snout is closed. The skin over the snout is firmly fused to the skull. The valved nostrils are placed on the upper surface of the snout. Crocodiles are the exceptional reptiles for possessing flapped external ears. Tongue is entirely attached to the floor of the mouth and can barely be moved. Eyes with third transparent eyelid, (Nictitating membrane) permitting limited underwater vision. The pupil is vertical. Tail is compressed with two series of flattened vertical scales merging and continuing as a single row to the tip. There are four distinct post-orbital plates just behind the head. Forelegs with five fingers and hindlegs with four webbed toes. Body rarely reaches upto 5 m in length and 1.6 m. in girth. Crocodiles are dorsally olive with specklingsc of black in colour which is more evident in young ones. They are white or yellowish white below.

Locality : There are unaunthetic reports of crocodile sighting in Goa and adjoinging areas of Maharashtra State.

Distribution : Practically throughout India.

Habitat : Crocodiles are true amphibious in behaviour and show structural adaptations for a successful aqauatic life. They are excellent swimmers and they inhabit rivers, lakes and other large water bodies on plains and upto 600 m altitude in Indian subcontinent. They are now well spread in the Indian river systems. They are true carnivorous in feeding habits. They are oviparous and lay oval and hard shelled eggs buried in the soil for incubation.

Status : IUCN : Vulnerable (CAMP Report, 1998), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : I Part : II; CITES Appendix : I, Red Data Book on Indian Animals (Annonymous, 1994) : Endangered.

Remarks : The species is known to be hunted for trade for skin and body parts in domestic as well as international markets (Pradhan, 1997). Sometimes even the live specimens are traded illegally.

Order TESTUDINES (CHELONIA)

Order Testudines (Chelonia) includes turtles (marine and fresh-water, both), tortoises and terrapins. It is represented in Goa State by a single suborder Cryptodira.

Suborder CRYPTODIRA

Subroder Cryptodira is represented by five families in Goa State.

Key to the families of the suborder CRYPTODIRA

1. Digits elongated, flattened and bound together, limbs paddle-shaped 2
– Digits neither elongated nor flattened or bound together. Limbs not paddle-shaped but with distinct toes 3
2. Limbs clawless, feet scaleless and carapace

covered with smooth skin and plastron with seven prominent longitudinal keels .... DERMOCHELYIDAE

– Limbs with one or two claws, feet with scales and carapace covered with epidermal horny shields ..... CHELONIIDAE

3. Forelimbs semi-paddle-shaped and carapace covered with smooth skin. Edge of the carapace flexible ..... TRIONYCHIDAE

– Forelimbs paddle-shaped and carapace covered with horny shields. Edge of the carapace not flexible 4

4. Limbs paddle-shaped but more or less flattened. Digits webbed. With 4-5 claws and carapace covered with horny shields or its skin bears many projections giving it a rough appearance. Top of head covered with smooth skin or with its posterior part divided into shields ..... EMYDIDAE (Bataguridae)

– Limbs more or less cylindrical. The hindlimbs club-shaped or elephantine. Digits not webbed but free. Upper part of head shielded. Plastron with 12 shields. Pectoral shield forming front part of bridge ..... TESTUDINIDAE

Family CHELONIIDAE

Family Cheloniidae contains marine turtles and it is represented by four species under four genera in Goa State.

Key to the species and genera of the family CHELONIIDAE

1. Horny scutes on carapace non-overlapping, coastal shields 4 on each side, one pair of prefrontal scutes between the eyes, jaws not hooked, upper jaw blunt, single claw present on each flipper, carapace greenish with violet marking, skin on neck yellow or creamish.. ..... *Chelonia mydas*

– Coastal shields 4-9 on each side, two pairs of prefrontal scutes between the eyes, horny edge of lower jaw smooth or feebly dentate, bony alveolar surface of upper jaw smooth or with a sharp crested ridge 2

2. Coastal shields 4 on each side, imbricated horny scutes, two pairs of prefrontal scutes between the eyes, nuchal not in contact with the first coastal on each side, snout elongated and narrow, bony alveolar surface of upper jaw with a single sharp crested ridge, jaws are hooked, premaxilla not toothed, 2 claws are present on each flipper, carapace brown with deep brown markings, neck light orange in colour ..... *Eretmochelys imbricata*

– Coastal shields 5 or more on each side, horny scutes not imbricate, nuchal in contact with the first coastal on each side, snout comparatively short and broad, bony alveolar surface of upper jaw smotth or with a rounded ridge, premaxilla toothed 3

3. Coastal shields 5-9 (generally 6-7) on each side, plastron with 4 pairs of inframarginals on bridge, each inframarginal provided with pores on hinder margin, maxilla separated by vomer, single claw present on each flipper. Dorsal colour grey, while plastron yellow in colour ..... *Lepedochelys olivacea*

– Coastal shields 5 on each side, plastron with 3 pairs of inframarginals on bridge, no pores on hinder margin of inframarginals, maxillae in contact with each other, Dorsal colour brown or reddish brown. Carapace brownish red with light spots, while plastron yellow withorange spots ..... *Caretta caretta*

2. *Caretta caretta* (Linnaeus)

1758. *Testudo caretta* Linnaeus, *Systema Nature*, Ed. **10** T. **I** : 197.

Common name : English : Loggerhead Sea Turtle.

Diagnostic Characters : Loggerhead Sea Turtle is a large cosmopolitan species with elongated carapace, somewhat serrated and tapering posteriorly. The species gets the name from its big head, which may reach upto 30 cms in length in adult specimens. It is one of the largest amongst the marine turtle species. The species may attain the length of 2.7 metres and weight of 385 kilograms. Length of carapace upto 1.14 m. The

turtle has a pronounced beak and large brown eyes. Coastal scutes are generally five on each side. Coastal 1 touching the nuchal. Central scutes are also five in a row. Number of coastal and neural shields may vary. Plastron consists of paired gular, humeral, pectoral, abdominal, femoral and anal shields. Inframarginals are in 3 pairs, enlarged and devoid of pores on hinder margin. Marginal shields 27 in number. Two claws are present on each flipper. Tail extremely short. General colouration is brown or red brown; carapace is brownish-red with light spots, eyes are brown and the flippers are grey brown.

Locality : Loggerhead Sea Turtle is found in all the temperate and sub-tropical oceans of the world. It is circumglobal in distribution. These turtles have been recorded from the waters of Indian coast (Sharma, 1998, Annonymous, 1994).

Distribution Elsewhere : All the temperate and sub-tropical oceans of the world.

Habitat : Nesting is seasonal (Varying between May to January at different coasts) and generally the nests are constructed at night. Slow stride movements by flippers in four-legged manner of these turtles on shores are magnificent. Clutch size of eggs varies between 60-200. Incubation in sand takes 55-66 days. Female can remigrate to the same beach for laying eggs at 2-3 year intervals. Loggerheads are fully carnivorous feeding mainly on benthic invertebrates such as mollusks, crustaceans, sponges, jelly-fish, fish seaurchins and starfish..

Status : IUCN : Lower risk-Near threatened (CAMP Report, 1998), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : I Part : II; CITES Appendix : I, Red Data Book on Indian Animals (Annonymous, 1994) : Endangered.

Remarks : The eggs of Loogerhead Turtle are much sought after and relished, while carapaces are used in the preparation of crude ornaments. The turtle is exploited for meat, eggs and for making local articles in many countries including India (Annonymous, 1994).

3. *Chelonia mydas* (Linnaeus)

1758. *Testudo mydas* Linnaeus, *Systema Nature*, Ed. 10th T. I : 197.

Common name : English : Green Sea Turtle.

Diagnostic Characters : The Green Sea Turtle is one of the largest of the hard-shelled species of marine turtles possessing marked variations in size, weight and carapace shape in its various populations spread over the globe. The species gets the name from the colour of its green fatty tissues. It possesses flat, smooth, heart shaped streamlined body. Head small and round as compared to body. The species may attain carapace length upto 155cm (Range 100-155cm) and weight of 135-175 kilograms. Carapace never completely ossified. It is arched in adults. It may be occassionally feebly keeled on lateral sides. Snout short and jaws not hooked. Dorsal shields juxtaposed. Coastal scutes four on each side, central scute five, while marginal shields 25. Plastron consists of six pairs of shields with a single intergular and a series of intermarginal shields. Head covered with symmetrical shields and one pair of prefrontal shields. Neither the head nor legs can be pulled under the shell. The flippers are long and each is provided with a single claw. Tail short as compared to the body. The carapace is dark blue black in hatchlings, while green, olive, brown or buff in adults. The flippers are grey-green. Edges of the head scales pale in most cases. Older shells look brownish. Semi-adult tutles look attractive and are called sunrays because of the beautiful brown and yellow shades on the dorsal shield. Limbs yellow with dark patch on each limb. Ventrum yellowish.

Locality : The Green Sea Turtle is circumtropical in distribution and is found to nest in all the tropicaland sub-tropical oceans of the world. Nearest record, as reported by Das (1995), is from Mumbai coast.

Distribution Elsewhere : All the tropical and sub-tropical oceans of the world.

Habitat : The Green Sea turtle is common around oceanic islands and coasts with wide sandy beaches. It is unique amongst all the marine turtles

in being mainly herbivorous, highly migratory with well-developed homing abilities. It may frequent inshore estuarine, coastal and reef-system habitats with less than 25 metres depth. Remote islands are favoured for selecting nesting sites, though it may use mainland beaches as well. Nesting is seasonal and takes place at night (Varying between May to July at different coasts). Females congregate in large numbers on these beaches between June and November to lay eggs. Each breeding female is known to lay 350-600 eggs annually. Average clutch size is 110. Incubation in sand takes 40-91 days. Adult Green Sea Turtle feeds mainly submerged marine algae, sea weeds and grasses, while hatchling is adapted to deal with wider range of food organisms including molluscs, crustaceans, jelly fish, fishes and even the plant material.

Status : IUCN : Endangered (CAMP Report, 1998), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : I Part : II; CITES Appendix : I, Red Data Book on Indian Animals (Annonymous, 1994) : Endangered.

Remarks : Human predation on Green Sea Turtle is very heavy. It is a most valued reptile of commercial importance for its palatable protein rich meat. Its flesh is also considered to be source of famous "Turtle soup" The flesh and eggs of Green Sea Turtle form a part of staple diet for the natives in several parts of the world (Annonymous, 1994).

4. ***Eretmochelys imbricata*** (Linnaeus)

1766. *Testudo imbricata* Linnaeus, *Systema Nature*, Ed. 12th T. I. : 350.

Common name : English : Hawksbill Sea Turtle or Tortoise Shell Turtle.

Diagnostic Characters : The Hawksbill Sea Turtle is one of the small-sized but most colourful marine turtle. Beautiful yellow motteling on rich brown background distinguishes the species from other marine turtle species. Head narrow with distinct scales on it and snout tappers to a point. Its powerful ridged jaws resembling hawks bill help in breaking open molluscs, crabs and other hard animals. The jaws also help in pulling out such animals from crevices of rocks and coral reefs. Premaxilla deeply excavated and not toothed terminally. Jaws strongly hooked. Carapace is narrowly heart-shaped, elongated with keel on the last four vertebrals. It is strongly serrated behind. Scutes on its shell thicker and strongly overlapping in the young but later the edges come to lie side by side.Dorsal scute horny and strongly imbricated. However, they are juxtaposed in the very advanced stage of age. The species may attain length upto 100 cm (Average 60-65 cm, Range 60-100 cm) and maximum weight of 140 Kg. (Range 60-120 Kg). Coastal scutes are four on each side, central scutes five, while marginal shields 25. Coastal I not in contact with nuchal. Vertebrals wider than long. Plastron consists of six pairs of shields with a single intergular and a series of intermarginal shields. Head covered with symmetrical shields and two pairs of prefrontal shields. Neither the head nor legs can be pulled under the shell. The flippers are long and each is provided with two claws. Tail short as compared to the body. Juveniles black above, while blackish below. The carapace may be amber-coloured or greenish with violet markings or dark brown to black with yellow mottlings, and in all cases with radiating brown or black streaks on the scutes. Flippers dark brown, while plastron yellow, orange or reddish brown in colour. Neck is yellow or creamish. Shields of head and limbs are dark brown with yellow borders.

Locality : The Hawksbill Sea Turtle is circumtropical in distribution and is found to nest on the beaches of tropical and sub-tropical zones of Pacific, Atlantic and Indian oceans. Nearest isolated record, as reported by Das (1995), is from off Elephanta Caves, Mumbai.

Distribution Elsewhere : Tropical and sub-tropical zones of Pacific, Atlantic and Indian oceans.

Habitat : The Hawksbill Sea Turtle is common in warm seas around oceanic islands and coasts with wide sandy nesting beaches. Nesting is sporadic and takes place at night. It frequents

rocky coastal embankments and coral reefs with shallow vegetated bottoms as well as bays and lagoons with muddy bottms lacking widespread submerged vegetation. It is a non-migratory species covering only short distances in search of food. Long distance migration is undertaken by the species very scantily. The hind flippers are primarily used for steering and for excavation of the nest. Breeding season is correlated with the onset of northwest monsoon and it starts from latter part of August and lasts till end of February (Peak from October to January). Each breeding female is known to lay 96-182 eggs per clutch at nest depth of 12-20 cm during daytime. Clutch size varies from population to population. Generally 2-4 clutches are laid in one season with a re-nesting interval of around 15-19 days. Adult Hawksbill Sea Turtle is entirely omnivorous. Food mainly consists of a great variety of items such as sponges, ascidians, echinoderms, coelenterates, ectoprocts, bryozoans, gastropods, bivalve mollusks, burnacles, crustaceans, soft corals and fishes. Vegeteranian diet includes seaweeds, marine angiosperms and fruits of mangrove plants. (Annonymous, 1994).

Status : IUCN : Endangered (CAMP Report, 1998), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : I Part : II (As *Eretmochelys imbricate unbriscata*); CITES Appendix : I, Red Data Book on Indian Animals (Annonymous, 1994) : Endangered.

Remarks : Indiscriminate exploitation of Hawksbill Sea Turtle for the horny shields or keratin layer of its shell for making attractive articles such as jewellery, curios and even furnitures is on extremely large scale. Another major threat to the survival of the species is due to increasing tourist trade. Killing of hatchlings and young ones for making beautiful curios for the tourists has created a devastating and direct effect on the various populations within the distributional range. Habitat destructions and loss of nesting grounds on beaches is also an additional threat to the survival of the species in some countries (Annonymous, 1994).

5. ***Lepidochelys olivacea*** (Linnaeus)

1829. *Chelonia olivacea* Eschscholtz, *Zool. Atlas*, **1** 3.

Common name : English : Olive Ridley Turtle.

Diagnostic Characters : The Olive Ridley Turtle is a small marine turtle with a broad fairly raised but flat top carapace. Carapace length varies between 56.5 and 75 cm and it is devoid of any keels. Its posterior margin is serrated. Head large and triangular in shape with large orbits. Head is covered with symmetrical shields with two pairs of prefrontal. Coastal scutes are 5-9 on either side. Central scutes 8-9, while marginal shields 27-29 with mid marginals much wider. Plastron consists of six pairs of shields with variable intergular (Single, double or even absent). Four pairs of inframarginal scutes present. Distinct pores present on the inframarginals. Upper jaw hooked but without a ridge. The species may attain length upto 100cm (Average 60-65 cm, Range 60-100 cm) and maximum weight of 140Kg. (Range 60-120 Kg)., Coastal 1 in contact with broad nuchal. Vertebrals I and V wider than long, while II, III and IV longer than broad. The flippers are long and each is provided with a single claw. The carapace is olive grey, head grey brown, shields yellow white, plastron creamy yellow and flipper edges light yellow brown in colour.

Locality : The Olive Ridley Turtle is wide in distribution and is found to nest on the beaches of tropical and sub-tropical zones of Pacific, South Atlantic and Indian oceans. Minor nesting ground of Olive Ridley Turtle has been reported from Goa coast (Annonymous, 1994, Das, 1995).

Distribution : Indian oceans.

Elsewhere : Tropical coastal waters of Pacific, South Atlantic.

Habitat : The Olive Ridley Turtle is common and widely distributed in tropical waters. The typical nesting occurs mainly on the mainland beaches all over the world. Nesting takes place at night. It is capable of foraging at relatively great depth (upto 150 metres or even more) in neritic waters. It undertakes long journeys in search of feeding grounds. General breeding season starts

from September and lasts till March. Each breeding female is known to lay 96-182 eggs per clutch at nest depth of 12-20 cm during daytime. Clutch size varies from region to region. It varies between 79 and 201 in India. Incubation period ranges between 46-63 days. Hatching success of eggs and survival of hatchlings are very poor due to large-scale predation by birds, mammals reptiles and other organisms such as ghost crabs, dipteran flies, fugi and bacteria. Olive Ridley Turtle feeds mainly on benthic crustaceans, larger planktonic organisms and marine algae. It also cherishes variety of items such as sessile and pelagic tunicates, jellyfishes, small invertebrates and fishes. (Annonymous, 1994).

Status : IUCN : Endangered (CAMP Report, 1998), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : I Part : II; CITES Appendix : I, Red Data Book on Indian Animals (Annonymous, 1994) : Endangered.

Remarks : Indiscriminate exploitation of Olive Ridley Turtle eggs from mass nesting beaches and also due to poaching of nesting females and predation of juveniles is a matter of serious concern from conservation point of view. It is creating a devastating and direct effect on the various populations within the distributional range.(Annonymous, 1994). Habitat destructions and loss of nesting grounds on beaches is also an additional threat to the survival of the species. Das and Kar (1990 : As cited in Annonymous, 1994) have carried out some pioneering research on different aspects of biology of Olive Ridley Turtle in Orissa.

Family DERMOCHELYIDAE

Family Dermochelyidae is represented by a single species, *Dermochelys coriacea* (Linnaeus), under Genus *Dermochelys* in Goa State.

6. ***Dermochelys coriacea*** (Linnaeus)

1766. *Testudo coriacea* Linnaeus, *Syst. Nat.*, **12** : 350.

Common name : English : Leatherback Sea Turtle.

Diagnostic Characters : The Leatherback Sea Turtle is the largest and heaviest of all the living turtles and tortoises of the world. It's body shape is somewhat triangular with elongated carapace which is devoid of any hornified epidermal structures. However, hatchlings and young ones possess body and limbs covered with small irregular polygonal shields. The top and sides of the young ones covered with symmetrical plates. The carapace in adults tappers to a point posteriorly and is covered with ridged, smooth rubber-like leathery skin. There are in all seven strong, nodular and longitudinal ridges. Carapace length varies between 140-200 cm. Jaws are sharp edged but without any flattened horny plates. Head large and neck massive. Limbs are paddle shaped but clawless. Front flippers extremely long and powerful. Hind flippers are broad and connected to the tail by a fold of thick skin.Tail short. The species may attain maximum weight of 725 Kg. (Range 400-725 Kg)., The carapace is slaty black with white spots, plastron a mixture of pink, white and black. Adult females with crown of head provided with a pink spot. Tail Black in colour.

Locality : The Leatherback sea Turtle is wide in distribution and is found to nest on the beaches of the tropical seas of Pacific, Atlantic and Indian oceans. Minor nesting ground of Leatherback sea Turtle has been reported from Goa coast (Annonymous, 1994, Das, 1995).

Distribution Elsewhere : Leatherback sea Turtle is circumglobal in distribution and is known to inhabit tropical waters of Pacific, Atlantic and Indian oceans.

Habitat : The Leatherback sea Turtle is truly a pelagic species and comes to shore only for nesting. It is believed to dive upto 1200 m below the surface. Counter current circulatory system in the limbs enables the species to wander in the freezing waters. It is a powerful swimmer with a strong instinct for migration and prefers to live in open sea. It prefers to nest on the mainland beaches rather than on island beaches. Nesting takes place at night. It migrates from tropical waters for foraging widely in the northern

temperate waters for its primary food, jelly fish (*Physalia utricus*). Its diet also includes tunicates, fish, mollusc, shrimp, crab and some other marine animals. Nesting season is between March and February. It breeds 3-4 times in a year, but the peak is during May to July. Re-migration takes place at the interval of 2-3 years. Each breeding female is known to lay 80-85 eggs per clutch. Several clutches are laid during the year. Incubation period ranges between 56-70 days. Hatching success of eggs and survival rate of hatchlings vary between 63-70% due to predation by birds, mammals, reptiles (Monitor Lizard) and other organisms such as ghost crabs. Sharks devour adults. (Annonymous, 1994).

Status : IUCN : Endangered (CAMP Report, 1998), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : I Part : II; CITES Appendix : I, Red Data Book on Indian Animals (Annonymous, 1994) : Endangered.

Remarks : Indiscriminate killing and consumption of Leatherback sea Turtle eggs and adults are matter of serious concern from conservation point of view. Flesh and eggs are extensively used for extraction of oil and also as shark bait. It is creating a devastating and direct effect on the various populations within the distributional range (Annonymous, 1994). Habitat destructions and disturbance near nesting grounds on beaches are also responsible for the decline in population densities.

Family EMYDIDAE (BATAGURIDAE)

Family Emydidae (Bataguridae) is represented by a single subspecies/species, *Melanochelys trijuga trijuga* (Schweigger), under Genus *Melanochelys* in Goa State.

*7. *Melanochelys trijuga trijuga* (Schweigger)

1814. *Emys. trijuga* Schweigger, *Prodr. Mong. Chel.* 41.

Common name : English : Indian snail eating turtle.

Diagnostic Characters : Turtles and tortoises are easily recognised from all other animals by their characteristic bony shell consisting of two parts : the carapace above and the plastron below. A suture along the flanks between the fore and hindlimbs joins both. The shell has regularly arranged horny shields above, while bony plates on inner side. Indian snail eating turtle is moderate in size (23 cm +). Head is somewhat small, snout shorter than the orbit. It is covered with smooth skin, which is divided into large shields on top, while carapace covered with horny shields. Vertebral shields hexagonal and short sided posteriorly. Upper jaw feebly notched in the middle. Snout slightly projecting beyond the lower jaw. Carapace is moderately depressed, tricarinate with lateral margins slightly reverted. Digits of the fingers completely webbed, limbs paddle-shaped but with more or less flattened 4-5 claws. Tail very short. Dorsum light brown in juveniles, while dark brown to blackish in colour in adults. Plastron has a yellow margin, which reduces in width at the advancement of the age. Head is greyish or olivaceous with yellow or pink reticulations which are more prominent on sides. The markings become obscure in later age.

Locality : R.C. Sharma has collected four specimens from Nagae River, Goa (Sharma, 1976).

Distribution : Tikader and Sharma (1985) and Sharma (2000) have recorded the distribution of the subspecies from Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu. It inhabits central part of Indian peninsula.

Habitat : Indian snail eating turtle is mainly aquatic and vegetarian in habit. It is a commonest widely distributed terrapin preferring to live in slow flowing or sedentary water. Young ones are more thoroughly aquatic than the adults. They are seen basking on rocks and logs. Several individuals may live together in a safe hideout under rocks or in holes near banks. They are also seen in the trunks of submerged trees. They swim in a manner in which each limb paddles independently.

Status : The subspecies is endemic within Indian limits. Sharma (2000) reports its status as Indeterminate or possibly vulnerable, while CAMP

Report (1998) records its status as Lower risk-least concern.

Remarks : Though Gayen (1999) has reported the species under Family *Bataguridae*, *Melanochelys trijuga trijuga* (Schweigger) has been retained in Family *Emydidae* following Sharma (2000). Sharma (2000) reports that main threat to the survival of the subspecies is due to large scale exploitation of eggs and adults for food and habitat destruction.

Family TESTUDINIDAE

Family Testudinidae is represented by a single species, *Geochelone elegans* (Schoepff), under Genus *Geochelone* in Goa State.

8. ***Geochelone elegans*** (Schoepff)

1792. *Testudo elegans* Schoepff, *Hist. Tes.* p. 111 pl. xxv.

Common name : English : Star Tortoise or Indian starred Tortoise, Land Tortoise.

Diagnostic Characters : It is a small tortoise in which the length of a largest female reaches upto 25 cm. Carapace length reaches 280 mm. Males are much smaller. Carapace is elongated and highly dome-shaped and possesses conspicuous hump. Head with small irregular shields. Nuchal shield absent. Vertebral shields five in number. First vertebral longer than broad. Four coastals. Plastron is large truncated or notched anteriorly. Hind limbs cylindrical and club-shaped possessing five claws. Tail moderately long and ends in spur like scute. Shell is black above. Colour pattern is distinctive. Each vertebral shield has a yellow coloured central areola with yellow streaks radiating over from areola giving a *star-like* appearance. The plastron has black rays on a yellow background. However the markings become obscure in later age. Head and limbs yellowish with darker markings.

Locality : Tikader and Sharma (1985) and Sharma (2000) have reported the distribution of starred tortoise from Peninsular India including Goa State.

Distribution : Das (1995) has reported the distribution of starred tortoise from Indian subcontinent including India.

Elsewhere : Pakistan and Sri Lanka.

Habitat : The species, a land tortoise, prefers to live in varied habitats ranging from sandy tracts to rocky and grassy areas with plenty of vegetations. It is also found along coastal scrublands and desert tracts of India. The species is largely crepuscular in habit, spending rest of the time under cover. It remains dormant during cold season, while its activity is at its peak during monsoon season. Though omnivorous in habit, but also inclined to be vegetarian.

Status : Daniel (1983) reported the status of starred tortoise as not uncommon species in its distributional range, while Sharma (2000) considers its status as indeterminate. CAMP Report (1998) has recorded its status as Vulnerable; Indian Wildlife (Protection) Act (1972, as amended upto2002). Schedule : Schedule : IV; CITES Appendix : Appendix II.

Remarks : Sharma (2000) reports that the threat to the survival of the species can be due to habitat loss.

Family TRIONYCHIDAE

Family Trionychidae contains soft-shelled turtles and it is represented by two species under two separate genera in Goa State.

Key to the species and genera of the family TRIONYCHIDAE

1. Carapace covered with skin, horny mandibles concealed under fleshy lips, three claws on each limb, cutaneous femoral flaps present on plastron. Prominent patches of wart-like structures on anterior part of carapace absent ..... *Lissemys punctata granosa*

– Carapace covered with skin, horny mandibles exposed with no fleshy lips, 4-5 claws on each limb, cutaneous femoral flaps absent on plastron. Prominent patches of wart-like structures on anterior part of carapace present ..... *Trionyx leithi* = *Aspideretes leithii*

*9. ***Lissemys punctata granosa*** (Schoepff)

1792. *Testudo granosa* Schoepff, *Hist. Tes.* p. 127, pl. xxx A & B.

Common name : English : Southern flap-shelled turtle.

Diagnostic Characters : Family Trionychidae comprises soft-shelled freshwater or mud turtles in which entire head and neck region is retractile. Though carapace and plastron are devoid of any epidermal shields, a continuous layer of soft skin covers them. The sides of hinder portion of the carapace are flexible. Neck exceedingly long but flexible. Forelimbs fully webbed and semi paddle shaped with only three claws on each foot. Elongated phalanges, plastron with soft, semicircular flaps which enable the turtle to conceal completely the retracted hind feet. Marginal bones present. First marginal bone smaller than second. Carapace without any definite pattern, yellow spots absent. Snout comparatively short. Carapace brown or blackish, head with black longitudinal lines, which are more prominent in juveniles. Size of carapace can grow upto 230 mm in length and 170 mm. in breadth. Ectoplastral callosity on plastron is very large in the adult individuals and in certain specimens it is in contact with the hyo-hypo-plastral callosities.

Locality : R.C. Sharma has collected one juvenile specimen for the first time from Canacona-Ponda Road, Goa (Sharma, 1976).

External Distribution : Peninsular India south of Ganges.

Habitat : The southern flap-shelled turtle prefers to live in ponds and tanks with muddy bottoms and embankments. They may or may not be connected with any river system. The species is carnivorous in habit and likes to feed on fish, frogs, snails etc. It is very ferocious in nature and can bite instantly even on gentle handling.

Status : Daniel (1983) reports status of southern flap-shelled turtle as common, while Sharma (2000) states that its status is suspected to be threatened on account of large scale killing for flesh and eggs and also due to habitat distructions. Indian Wildlife (Protection) Act, 1972 (as amended upto 2002), Schedule : Schedule : I Part II (*Lissemys punctata*).

Remarks : Sharma (2000) suspects threat to the survival of the species due to urbanisation on nesting sites. Though Das (1995) and Annonymous (1994) have considered *L. punctata punctata* (Lacep.) as a subspecies from southern peninsular India, the southern Indian flap-shelled turtle has been retained here as *L. punctata granosa* (Schoepff) as per Tikader and Sharma (1985) and Sharma (1976, 1998 and 2000).

10. ***Trionyx leithi*** Gray

1872. *Trionyx leithi*, Gray, Ann. *Mag. Nat. Hist.*, (4)X : 334

Common name : English : Peninsular or Deccan Soft-shelled turtle or Leith's Softshell Turtle.

Diagnostic Characters : A large sized soft-shelled turtle reaching slightly above 50 cm. in length. This species is quite similar to *Trionyx gangeticus* except that *Trionyx leithi* possesses a bony snout longer than the orbit diameter, flat alveolar surface of upper jaw, flat mandibular symphysis etc. Carapace olive-green in colour with lighter vermiculations. Head greenish. Black longitudinal streaks from between eyes to nape with side streaks often present. They may be entire or broken up. The young ones possess four eye-spots or ocelli on the disc. Ventrum whitish.

Locality : Das (1995) and Sharma (1998) report that Leith's Softshell Turtle is restricted to peninsular India only in distribution. Nearest isolated known records, as reported by Das (1995), are from Satara in Maharashtra State and Sharavati Wildlife Sanctuary in Karnataka State.

Distribution : Sharma (2000) has reported the distribution of the species from Ganga and all other river systems of peninsular India upto Chennai. He has also recorded the species from southeastern districts of Gujarat.

Habitat : A perfectly aquatic species which can also be seen basking on sandy banks or resting in shallow water with its head projecting out of water surface. It inhabits deep turbid rivers, canals,

marshes, ponds and lakes. The species is a scavenger and also omnivorous in behaviour.

Status : The species is endemic within Indian limits. Sharma (2000) suspects the status of *Trionyx leithi* as endangered on account of excessive killings of adult specimens for flesh and eggs for food. Indian Wildlife (Protection) Act, 1972 (As amended upto 2002). Schedule : Schedule : IV, IUCN Category as per CAMP Report (1998) : Vulnerable (for *Aspderetes leithii* = *Trionyx leithii).*

Remarks : Though Das (1995) and Gayen (1999) have reported merger of *Trionyx* in Genus *Aspideretes*, Genus *Trionyx* has been retained in the present communication following Tikader and Sharma (1985) and Sharma (1998, 2000).

Order SQUAMATA

Order Squamata includes diversified range of reptilian species comprising gecko, lizard, chameleon, skink, monitor lizard, blind snakes and snake species. It is represented by two suborders in Goa State (1) Sauria (Lacertilia) & (2) Serpentes (Ophidia).

Key to the suborders of Order SQUAMATA

1. Limbs, external ear openings and eyelids present. The two halves of the lower jaw fused and cannot move independently ....SAURIA (LACERTILIA) (Ex : Gecko, lizard, chameleon, skink and monitor lizards)
2. Limbs, external ear openings and eyelids absent. The two halves of the lower jaw are not fused but are united by ligaments only and hence can move independently. .... SERPENTES (OPHIDIA) (Ex : Blind snake, python, boa and venomous and non-venomous snakes)

Suborder SAURIA (LACERTILIA)

Subroder Sauria (Lacertilia) is represented by six families in Goa State.

Key to the families of the suborder Sauria (Lacertilia)

1. Body dorsoventrally flat covered with granule-like imbricate scales, no symmetrical shields on the top of head. The digits are with adhesive pads. Eyes are devoid of movable lids. Transperant membrane on eyeball. Teeth emerging from the side of jaws (Pleurodont). Tounge is fleshy, short, broad, nicked anteriorly, with villose papillae and protrusible. Skull is devoid of temporal and postorbital arcades. Vertebrae amphicoelous. ..... GEKKONIDAE
2. Body dorsoventrally or laterally compressed, covered with imbricate scales, no symmetrical shields on the top of head. The digits are without any adhesive pads. Eyes are with movable lids. Teeth emerging from the side of jaws (Pleurodont) and situated on the summit of the jaws (Acrodont). They are differentiated into incisors, cannines and molars. Tounge is short, broad, smoothor covered with villose papillae and not protrusible. Skull is with temporal and postorbital arcades Vertebrae amphicoelous. ..... AGAMIDAE
3. Body laterally compressed, covered with flat, rounded granular scales or tubercles. The digits are without any adhesive pads. Eyes are large and move independently. Upper and lower eyelids are joined forming a complete ring around the eye with a small aperture at the centre. The feet possess the digits permanently opposed in groups of two or three and are modified to form a clasping organs. Teeth are small, triangular and situated on the summit of the jaws (Acrodont). Tounge is club shaped, sticky at the tip and extensible upto the distance of 15 cm for catching insects. Skull is with temporal and postorbital arcades. Ear devoid of tympanum..... ..... CHAMAELEONIDAE
4. Body is circular in cross section, covered with cycloid overlapping scales. Osteoderms are present under the scales of head and body.

Symmetrical shields present on the top of head. Legs short or may be absent in many species. Lower eyelid with transperant disc. Teeth emerging from the side of jaws (Pleurodont). Tounge is short, feebly nicked in front. It is covered with scale like papillae. Skull is with temporal arcade only ..... SCINCIDAE

5. Body is dorsoventrally flat, covered with scales. Scales on the head with osteoderms fused with the top of the skull. No osteoderm plates on the body. Legs are very well developed. Teeth emerging from the side of jaws (Pleurodont). Tounge is long and forked anteriorly. It is covered with scale like papillae. Skull is with, both, temporal and postorbital arcades ..... LACERTIDAE

6. Body stout dorsoventrally compressed, covered with small scales generally without osteoderms. Head is typically long. Tail is also very long and laterally compressed.Legs are very well developed. Teeth large, pointed and emerging from the side of jaws (Pleurodont). Tounge is very long, smooth, retractile and forked anteriorly. Skull is with complete temporal and incomplete postorbital arcades ..... VARANIDAE

Family GEKKONIDAE

Family Gekkonidae includes gecko species and it is represented by three genera in Goa State.

Key to the genera of the Family GEKKONIDAE

I. Digits feebly dilate 2

2. Digits angularly bent. Pupil vertical ..... ***Cyrtodactylus***

– Digits angularly bent. Pupil round ..... ***Cnemaspis***

II. Digits strongly dilated ..... ***Hemidactylus***

Genus *Certodactylus*

Genus *Certodactylus* is represented by three species in Goa State.

Key to the species of Genus *Certodactylus*

I. Dorsal scales smaller than the ventral scales ..... *Cyrtodactylus collegalensis*

II. Dorsal scales larger than the ventral scales 2

2. Dorsum is reddish-brown with white transverse bands ..... *Cyrtodactylus dekkanensis*

– Dorsum is brown with deep yellow cross bars ..... *Cyrtodactylus albofasciatus*

11. ***Cyrtodactylus collegalensis*** (Beddome)

1870. *Gymnodactylus collegalensis* Beddome. *Madras Month. J. Med. Sci.* ii : 173

Common name : English : South Indian Rock Gecko.

Diagnostic Characters : Suborder *Sauria* (lizards) under order *Sqamata* can be defined as the reptiles with well developed limbs and girdles. Some species might have lost their limbs and acquired long bodies, but they possess vestiges of pectoral and pelvic girdles. Majority of them are covered with horny epidermal scales and possess eyes with movable eyelids. Pupils of the eyes vertical. The species under family *Gekkonidae* are characterized by possession of dialated pentadactyle digits (adhesive digital pads). The pads help in increase in efficiency of climbing and/or resting on vertical surfaces. Head and body depressed, rostral broad with a cleft above. In *Cyrtodactylus* dorsum is devoid of enlarged rounded tubercles. Dorsal scales smaller than the ventral scales. Digits feebly dilated, clawed and cylindrical. Two or three distal phalanges strongly compressed laterally and form a strong dorsoventral curve (bend) between last and next to last phalanx. Underside of the digits is with a row of distinct transverse plates. Tail not tapering abruptly behind the vent. Pupil vertical. *Cyrtodactylus collegalensis* possesses two main colour forms. (i) Dorsum with four dark brown, black-margined cross bands. One across the nape reaching upto the eyes. One just behind the shoulder. One at the middle of the back. Fourth

one is at the base of the tail. Dorsal part of the head, lips and throat profusely spotted with brown. Belly is light brown. The bands are broader that the interspaces between them. (ii) Dorsum is light brown to grey, with series of large, rounded black-margined spots arranged in pairs. In some specimens smaller-sized irregularly arranged brown spots may be present on dorsal side of back and tail. Head and body length : 46-52 mm, Tail length : 42-46 mm.

Locality : Hilly districts of Southern India South of Lat. 13°N. including Goa State

Distribution : Hilly districts of Southern India.

Elsewhere : Sri Lanka.

Habitat : *Cyrtodactylus collegalensis* is a gecko species of the forest. It is an arboreal and insectivorous species found under the tree barks. It is available at lower elevations also.

Status :. Sharma (2002) reports status of the species as vulnerable on account of habitat destruction particularly at lower elevations where forests are being cut indiscriminately; IUCN Category as per CAMP Report (1998) : Data Deficient (As *Geckoella collegalensis*).

Remarks : Nil.

12. ***Cyrtodactylus dekkanensis*** (Gunther)

1864. *Gymnodactylus dekkanensis* Gunther, *Rept. Brit. Ind.* : 115, pl. 12 Fig. E.

Common name : English : North Malabar Rock Gecko.

Diagnostic Characters : Suborder Sauria (lizards) under order Sqamata can be defined as the reptiles with well developed limbs and girdles. The species under family Gekkonidae are characterized by possession of dialated pentadactyle digits (adhesive digital pads). However, in *Cyrtodactylus* pentadactyle digits are feebly dilated. Pupils of the eyes vertical. Dorsum is devoid of tubercles. Digits clawed and cylindrical. Two or three distal phalanges strongly compressed laterally and form a strong dorsoventral curve (bend) between last and next to last phalanx. Underside of the digits is with a row of distinct transverse plates. *Cyrtodactylus dekkanensis* is a moderately large gecko. It is reddish-brown in colour above with narrow white brown-edged transverse bars on the back and tail. Curved black streak starts from the nape and reaches upto eyes. Ventrum white in colour. Head is large in comparison to the body with a prominent snout covered above with small rounded scales. Body is depressed, flattened dorsoventrally with no lateral folds. Dorsum with larger somewhat quadrangular, juxtaposed scales forming regular transverse series. Belly scales much larger than the dorsal scales.Hind limbs reach the axilla. Tail feebly swollen at the base and tapers to a point. It is covered above with small juxtaposed scales and rows of enlarged tubercles. Males without any preanal or femoral pores. Head and body length : 47-85 mm, Tail length : 34-80 mm.

Locality : Hilly districts of Western Ghats including Goa State. Nearest collection locality as reported by Sharma (2002) is Helvak, Koyana Valley in Maharashtra State.

Distribution : Western Ghats in India.

Habitat : *Cyrtodactylus dekkanensis is* a gecko species of hilly forest. It is a terrestrial, insectivorous and nocturnal species.

Status : Sharma (2002) reports status of the species as rare; IUCN Category as per CAMP Report (1998) : Vulnerable (As *Geckoella dekkanensis*).

Remarks : Nil.

*13. ***Cyrtodactylus albofasciatus*** (Boulenger)

1885. *Gymnodactylus albofasciatus* Boulenger, *Cat. Liz. Brit. Mus. i* : 37, pl. 4, Fig. 3.

Common name : English : South Malabar Rock Gecko.

Diagnostic Characters : The *Cyrtodactylus* species under family Gekkonidae possess feebly dilated pentadactyle digits. *Cyrtodactylus albofasciatus is* a moderately large gecko. It has a brilliant coloration with alternate black and deep yellow tranverse bars all the dorsum when alive. A curved black streak emerges from the nape and

reaches upto eyes. Pupils of the eyes vertical. Ventrum white in colour. Head is slightly larger in comparison to the body with a prominent acute snout covered above with small rounded intermixed with large scales at the nape. Body is depressed, flattened dorsoventrally with no lateral folds. Dorsum with less uniform scales. It is a mixture of small irregular scales with number of large and rounded subtrihedral tubercles. Belly with feebly keeled scales. Hind limbs reach the axilla. Tail slightly swollen at the base and tapers to a point. It is covered above with small-juxtaposed scales and rows of enlarged tubercles. Males without any preanal or femoral pores. Head and body length : 49-63 mm, Tail length : 38-57 mm.

Locality : R.C. Sharma has collected one specimen from Molem, Goa State (Sharma, 1976, Identified as *Gymnodactylus albofasciatus* Boulenger).

Distribution : Western Ghats in Goa and Karnataka States in India. Appears to be Western Ghat endemic species.

Habitat : *Cyrtodactylus albofasciatus is* a gecko species of the forest. It is a terrestrial, nocturnal and a most secretive species of the forests. Hides under stones and logs during day time. Makes croaking sound when disturbed.

Status : Sharma (2002) reports status of the species as rare; IUCN Category as per CAMP Report (1998) : Not Listed.

Remarks : First collection record from Goa State reported by Sharma (1976).

Genus ***Cnemaspis***

Genus *Cnemaspis* is represented by two species in Goa State.

Key to the species of Genus *Cnemaspis*

1. Sides provided with small spinose projecting tubercles. Ventral neck scales keeled; 2-4 preanal pores; 3-6 femoral pores on each side ..... *Cnemaspis kandiana*

– Sides provided with small spinose projecting tubercles. Ventral neck scales feebly keeled; 2 or 3 preanal pores; 2-4 femoral pores on each side ..... *Cnemaspis goaensis*

14. ***Cnemaspis kandiana*** (Kelaart)

1852. *Gymnodactylus kandianus* Kelaart, *Prod. Fauna Zeyl.* : 186.

Common name : English : North Kanara Hill Palli.

Diagnostic Characters : Suborder Sauria (lizards) under order Sqamata can be defined as the reptiles with well developed limbs and girdles. Majority of them are covered with horny epidermal scales and possess eyes with movable eyelids. The *Cnemaspis* species under family Gekkonidae possess feebly dilated pentadactyle digits. Pupils of the eyes round. *Cnemaspis kandiana* is a small brown gecko with transversely arranged variegations and a faint vertebral stripes or spots. Throat dark brown, while ventrum light brown. Tubercles on the flanks are white. Head is covered above with minute keeled scales, which are largest on the snout. Dorsal surface is with small granular, slightly keeled scales intermixed with larger rounded tubercles. Digits feebly dilated, clawed and cylindrical. Flanks with small, widely separated, spine-like tubercles. Scales under neck are large and keeled, while those on the belly are smooth and rarely keeled. Hind limbs reach the axilla or slightly beyond. Digits elongated and clawed. Subdigital lamellae large. The plates beneath the basal phalanges are 3-5 in number, usually large. Tail slightly longer that Head and Body, cylindrical covered dorsally with small keeled scales and clusters of large tubercles. Males with 2-4 preanal on each side and 3-5 femoral pores. Head and Body length : 36-40 mm, Tail length : 40-44 mm.,

Locality : Hilly districts of Southern Western ghats in India including Goa State. Nearest collection localities as reported by Sharma (2002) are Mahabaleshwar in Maharashtra State and Kanara and Jog Falls in Karnataka State.

Distribution : Hilly districts of Southern India, Andaman Islands.

Elsewhere : Sri Lanka and Sumatra (Sharma, 2002).

Habitat : *Cnemaspis kandiana* is a gecko species of the forest. However it may enter in houses also. It is available at lower elevations also.

Status : Sharma (2002) reports status of the species as common throughout its range; IUCN Category as per CAMP Report (1998) : Lower Risk- Least Concern.

Remarks : Nil.

*15. ***Cnemaspis goaensis*** Sharma

1976. *Cnemaspis goaensis* Sharma, *Rec. zool. Surv. India*, **71** : 152.

Common name : English : Goa Forest Palli.

Diagnostic Characters : Suborder Sauria (lizards) under order Sqamata can be defined as the reptiles with well developed limbs and girdles. Majority of them are covered with horny epidermal scales and possess eyes with movable eyelids. The *Cnemaspis* species under family Gekkonidae possess feebly dilated pentadactyle digits. *Cnemaspis goaensis* is a small brown gecko with W-shaped dark brown marks on the back (Two on neck, six on the space between the forelimbs and hind limbs). Tail with light and dark narrow annuli above. Head, limbs and flanks variegated with lighter and darker markings. Head and throat densly spotted with black on ventral side. Flanks with small, widely separated, spine-shaped tubercles. Ventral scales imbricate and those under the neck are feebly keeled, while those on the belly are smooth. Snout obtuse. A few dark lines emerging from eyes and extending to the cheeks. Head is covered above with small and granular keeled scales, which are intermixed with a few larger tubercles. Digits feebly dilated, clawed and cylindrical. They are with conspicuous dark bars. Hind limbs reach the axilla. Digits elongated and clawed. Subdigital lamellae large. The plates beneath the basal phalanges are 2-5 in number, usually large. Tail longer that Head and Body, cylindrical covered above with small keeled scales and a series of six large, pointed white tubercles.Ventrally tail possess large, imbricate feebly keeled scales. Males with 2-3 preanal and 2-4 femoral pores on each side. Measurements of Holotype Head and Body length : 30.00 mm, Tail length : 41.00 mm.

Locality : R.C. Sharma has collected six specimens from Canacona (Poinguinim), Goa State (Sharma, 1976)

Distribution : Not known so far (Sharma, 2002).

Habitat : *Cnemaspis goaensis* is a nocturnal and insectivorous gecko species. It was collected from under stones (Sharma, 2002).

Status : An Indian Endemic species. Sharma (2002) reports status of the species as rare and indeterminate; IUCN Category as per CAMP Report (1998) : Critically Endnagered.

Remarks : *Cnemaspis goaensis* is a new species (*sp. nova*) described by Sharma (1976).

Genus ***Hemidactylus***

Genus *Hemidactylus* is represented by eight species in Goa State.

Key to the species of Genus *Hemidactylus*

I. Back with large number of strongly keeled tubercles, arranged in longitudinal series. Free distal phalanx of inner digit is half as long as the dilated portion.

1. Lamellae under the digits are in a transverse series. 11-13 Lamellae under the fourth toe. Males with 19-25 femoral pores on each side ..... *Hemidactylus maculatus*

2. Lamellae under the digits are in oblique series. 7-16 lamellae under the fourth toe. Males with preano-femoral pores only.

a) Back with very large tubercle like scales; digits free, 7-10 lamellae under the fourth toe; back with a pattern of strongly defined large brown saddles; males with 6-14 preanofemoral pores ..... *Hemidactylus triedrus*

b) Back with large tubercles; digits free, 8-10 lamellae under the fourth toe; dorsum is with

small dark spots or blotches; males with 7-16 preanofemoral pores. ... *Hemidactylus brooki*

c)Back with moderately large tubercles; digits webbed at the base, 10 oblique lamellae under the fourth toe; dorsum brownish-grey with faint narrow white cross bars; males with 17-20 preanofemoral pores ..... *Hemidactylus prashadi*

3. Lamellae under the digits are in a semi-transverse series; 8-10 lamellae under the fourth toe. Males with preanal pores only. Free distal phalanx of inner digit not even half as long as the dilated portion.

Back with granular scales mixed with erect conical tubercles; digits free, 8-10 lamellae under the fourth toe; dorsum is with dark reticulations; males with 6-12 preanal pores. ..... *Hemidactylus reticulatus*

II. Back with smaller number of rounded, smooth or feebly keeled, irregularly arranged tubercles. Tail without lateral dentition.

1. Inner toe less than half of length of second toe; Males with a continuous series of 23-33 preano-femoral pores ..... *Hemidactylus frenatus*

2. Inner toe more than half of lengtrh of second toe; Males with 10-20 femoral pores on each side. 9-12 lamellae under the fourth toe; Tail with enlarged tubercles above, swollen at the base ..... *Hemidactylus leschenaulti.*

3. Inner toe more than half of length of second toe; Males with 5-7 femoral pores on each side. 11-15 lamellae under the fourth toe; Tail with enlarged tubercles above, swollen at the base ..... *Hemidactylus flaviviridis*

16. ***Hemidactylus maculatus*** Dumeril & Bibron

1836. *Hemidactylus maculatus* Dumeril & Bibron *Erp. Gen.* iii : 358.

Common name : English : Rock Gecko or Dark spotted Giant Gecko.

Diagnostic Characters : Easily distinguishing gecko by its large size and colouration patterns. Dorsum brown with dark-brown spots, undulating with transverse bars and streaks. Tail banded alternately with dark and white bands. Belly dirty white. Sub-adults brilliantly coloured. Head large and prominent with a bulging on the tip of the snout. Eyes moderately large with vertical pupil. Small ear opening. Head covered with small granular scales intermixed with large conical tubercles. Upper labials 10-12, while lower labials 9-10 in number Hind limbs just reach axilla. Digits are free and moderately dilated. Digital transverse lamellae straight and smooth; 9-10 under first toe, while 10-13 under the fourth toe. Tail clearly longer than head and body, slightly depressed and verticillate. Male with 19-25 femoral pores on each side. Head and Body length : 83-122 mm, Tail length : 90-130 mm.

Locality : Western Ghats including Goa State (Pradhan, 1997 and Sharma, 2002). Nearest collection localities as reported by Sharma (2002) are Panchgani in Maharashtra State and Malabar Coast in Kerala State.

Distribution : Western Ghats and parts of Tinnevelly Hills, Ramnad and Salem districts in Tamil Nadu. (Sharma, 2002).

Habitat : Usually inhabits the crevices, caves and other such structures in rocks. Occasionally seen on the rough outer walls of the buildings and on trees. A carnivorous species feeding on variety of arthropods, small lizards including juveniles of its own and other species of geckkos, worm snakes and earthworms. Breeds during March to July.

Status : Endemic species within Indian limits. Sharma (2000) reports status of *Hemidactylus maculatus as* common in the distribution range. IUCN category as per CAMP report (1998) : Lower-risk least concern.

Remarks : *Hemidactylus maculatus* is a most pugnacious species and bites savagely on rough handling.

17. ***Hemidactylus triedrus*** Daudin

1802. *Gecko triedrus* Daudin, *Hist. Nat. Rept.*, 4 155

Common name : English : Blotched Gecko.

Diagnostic characters : This is a large and colourful gecko. Dorsum is somewhat yellowish with brownish or pinkish or greenish tinge and with numerous scattered white tubercles all over. Back with four large rich-brown or olive green white edged saddle shaped cross bars or bands between the head and hind limbs. Supra-occular region is greenish. Head is with one or two yellow stripes behind the eye and a yellow streak across the nape. Ventral side is light pink in the young ones, while it turns white or yellow with a reddish tinge in adults. The dorsum becomes faint with advancement of age in very old specimens. Tail possesses alternate dark-brown and white bands or bars throughout the life. Head is large and prominent with a bulging on the tip of the snout. Eyes are moderately large with vertical pupils. Head is covered with minute granular scales intermixed with larger keeled tubercles. Dorsum is covered with small, irregular scales and very large trihedral tubercles arranged in 16-18 regular longitudinal rows. Ventrum is with large smooth rounded subimhbricate scales. Mentle shield is large subtriangular and two times longer than the adjoining labials. Upper labials 8-10, while lower labials 7-8 in number. Hind limbs just reach the axilla. Digits are free and moderately dilated with slightly oblique lamellae. 6-7 under the first toe, while 7-8 under the fourth toe. Tail is longer than head and body, slightly depressed but oval in cross section. Tail is covered above with small, irregular, pinted scales and series of 4 or 6 large, keeled pinted tubercles. Male with 6-14 preanofemoral pores on each side briefly interrupted mesially generally with a single scale only. Standard length : 65-80 mm, Tail length : 63-90 mm.

Locality : Western Ghats including Goa State. Nearest collection locality as reported by Sharma (2002) is Satara district in Maharashtra State.

Distribution : Peninsular and Western India.

Elsewhere : Sri Lanka and West Pakistan (Sharma, 2002).

Habitat : The blotched gecko is nocturnal, docile and insectivorous preferring to live in semi-arid rocky as well as flat sandy but moderately moist area with plentiful of scrubby vegetation. Suitable abodes are rodent and lizard burrows, crevies in trees, rocks dam walls etc. It emerges out from its hide out at dusk. The species feeds on variety of arthropods such as beetles, moths, bugs, spiders, termites, crickets etc. The species has been recorded upto 400 metres altitude. Breeding season is from May to July.

Status : Sharma (2000) reports status of *Hemidactylus triedrus as* common in the distribution range. IUCN category as per CAMP report (1998) : Lower-risk least concern.

Remarks : In Pakistan *Hemidactylus triedrus was found* to be feeding on its young ones. When provoked, it exhibits a defensive attitude (Sharma, 2002).

*18. ***Hemidactylus brooki*** Gray

1845. *Hemidactylus brooki* Gray, *Cat. Liz. Brit. Mus.*, 153.

Common name : English : Spotted House Gecko.

Diagnostic Characters : All lizards under Sub-order Sauria can be defined as the reptiles with well developed limbs and girdles. Majority of them are covered with horny epidermal scales and possess eyes with movable eyelids. The species under family Gekkonidae are characterized by possession of strongly dialated pentadactyle digits (adhesive digital pads). Body is dorsoventrally flat, covered with large number of strongly keeled tubercles or granule like imbricate scales with no symmetrical shields on top of the head. Dorsum with small granular scales mixed with conical, keeled tubercles which are arranged in 16-20 longitudinal rows. Ventrum scales are smooth, rounded and imbricate. Tongue is broad, fleshy, short, and protrusible with villose papillae. Eyes are moderately large with vertical pupils. Hindlimbs not reaching upto the axilla. Head large ovate and prominent, eyes moderately large with a vertical pupil. Head is covered with small granular and larger scales. Upper labials 8-12, while lower labials with 7-9 scales. Male with 6-16 preanal -femoral pores on each side. Digits

are free, moderately dialated with 5-6 oblique lamellae under the first and 6 -10 under the fourth toe. Depressed and verticillate tail, which is swollen at the base, is much longer than head and body in length. Dorsum with small dark and light brown spots or blotches. Ground colour brown or grey above, while dirty whitie below. Sometimes there is a dark streak along the sides of the head. Head and body length : 14-60 mm, Tail length : 17-75 mm.

Locality : Specimens have been collected from Margoa, Valpoi, Molem, Panjim, Ponda and many other localities in Goa by Sharma (2002) and by different ZSI parties in past.

Distribution : Widely distributed in whole of India.

Elsewhere : Other parts of the world.

Habitat : *H. brooki* is the common house gecko preferring to live under the stones, beneath the wooden logs, also seen in rocky areas in dense forest and even in buildings in urban areas. Mostly insectivorous in habit but can grab gastropods, isopods and even seeds of some wild plants.

Status : Sharma (2000) reports status of the species as very common in its wide range of distribution; IUCN Category as per CAMP Report (1998) : Lower-risk-least concern.

Remarks : Sharma (1976) reported first collection record of this species from Goa State.

*19. ***Hemidactylus prashadi*** Smith

1935. *Hemidactylus prashadi* Smith, *Fauna Brit. Ind.*, **2** : 92.

Common name : Prasad Brown Gecko.

Diagnostic Characters : The species under family Gekkonidae are characterized by possession of strongly dialated pentadactyle digits (adhesive digital pads). Body is dorsoventrally flat. Dorsum is covered with small granular scales intermixed with quite larger subtrihedral tubercles which are arranged in regular longitudinal rows. Ventrum scales are smooth, rounded and sub-imbricate. Gular region is with small granular scales. There is a distinct laterl fold in this large sized gecko species.There are 35-40 scales are present across mid-body between the lateral folds. The gecko is grayish-brown in colour with a faint white band on the complete dorsum including tail. Young ones are more prominently coloured with 7-8 whitish cross bars/spots with darker margins. Hindlimbs are hardly reaching to the axilla. Head is slightly large with circular ear opening and prominent, eyes moderately large with a vertical pupil. Head is covered with small granular scales and larger convex scales are present on the occiput region. Here they are intermixed with larger and rounded tubercles. Eyes are moderately large with vertical pupil. Upper labials 11-12, while lower labials with 9-11 scales. Mentle shield is large, subtriangular and twice in size than the adjoining labials in length. Male with 17-20 preano-femoral pores on each side separated mesially by three scales. Digits are distinctly webbed at the base and moderately dialated with 8 oblique lamellae under the first and 10 under the fourth toe. Depressed and verticillate tail which is swollen at the base is much longer than head and body in length. It is round in cross section. Dorsum with small dark and light brown spots or blotches. Ground colour brown or grey above, while dirty whitie below. Sometimes there is a dark streak along the sides of the head. Head and body length : 51-95 mm, Tail length : 71-123 mm.

Locality : Specimens have been collected from Canacona, Nayawada village, Kandal rubber plantation etc. in Goa by Sharma (2002).

Distribution : Karwar and Jog falls in India.

Habitat : *H. prasadi* specimens were collected from the crevies in the walls of old deserted buildings. The abode of this species was observed to be shared by wolf snake and pit-viper (Sharma, 2002). It is an insectivorous and nocturnal species in habit, while docile and gentle in disposition.

Status : Sharma (2000) reports status of the species as Indeterminate; IUCN Category as per CAMP Report (1998) : Endangered. Endemic to Western Ghats.

Remarks : Sharma (1976) reported first record of this species from Goa State. Giri and Bauer

(2006) have reported further extension of range of distribution of this species northwards upto Ratnagiri in Maharashtra State.

20. ***Hemidactylus reticulatus*** Beddome

1870. *Hemidactylus reticulatus* Beddome, *Madras Month. J. Med. Sci.* i : 33.

Common name : English : Reticulated Gecko.

Diagnostic Characters : Reticulated Gecko is a brown gecko possessing a network of brownish-blue lines on its dorsum. *Hemidactylus reticulatus* possesses all the characters mentioned earlier for the Family *Gekkonidae*. However, most of the dorsal tubercles in *H. reticulatus* are white, while throat possesses brown markings and ventrum white. Head small and bulged, while snout rounded with small and sub-circular ear-openings. Upper labials 9-10, while lower 7-8 in number. Dorsum with small-keeled scales mixed with large, sharply pointed keeled tubercles. Ventrum with smooth and round imbricate scales. The hind limbs just reach the axilla, digits short, free and moderately dilated. Free distal phalange of innermost digit quite short. Lamellae under digits are in semi-transverse series. 4-6 lamellae under the first and 8-10 lamellae under the fourth toe. Tail verticillate and slightly longer than Head and Body in length. Male with an angular series of 6-12 pre-anal pores. Head and Body length : 21-60 mm; Tail : 30-65 mm.

Locality : Southern India including Goa State. Nearest collection locality as reported by Sharma (2002) is Chickmanglur in Karnataka State.

Distribution : Andhra Pradesh, Karnataka and further southwards in South India.

Habitat : Not much is known about the habitat of *H. reticulatus* except that they are found under stones in rocky areas or from in rocky crevices. The species is nocturnal and insectivorous.

Status : Endemic species within Indian limits. Tikader and Sharma (1992) report status of *H. reticulatus* as indeterminate in the distribution range; IUCN category as per CAMP report (1998) : Lower risk-near threatened.

Remarks : Nil.

*21. ***Hemidactylus frenatus*** Schlegel

1836. *Hemidactylus frenatus Schlegel, Erp. Gen.*, **3** : 366.

Common name : English : Ticticky House Gecko.

Diagnostic Characters : A small gecko possessing different shades of brown with grey colour on dorsal side. Some may possess very faint brown longitudinal stripes on dorsum. A dark streak emerges generally from near the eyes and extends down upto the groin. Belly whitish or light yellow, while tail may be reddish in colour. Head quite large covered above with small granular scales, which become large on snout. Ear-opening sub-circular. Upper labials 10-12 and lower labials 8-10 in number. Mental shield large and with two pairs of post mental shields of equal size. Dorsum with small granular scales usually intermixed with scattered, rounded faintly keeled tubercles. Ventrum with smooth rounded imbricate scales. Hindlimbs not reaching the axilla. Digits free and moderately dilated. First digit smallest. Oblique lamellae under the first toe 4-5 and 9-10 under fourth toe. Tail slightly longer than Head and Body, feebly depressed, verticillate, covered above with small scales and series of six enlarged pointed tubercles. Under side of the tail with a median series of transversely enlarged scales with continuous series of 26-36 preanofemoral pores. Head and body length : 40-60 mm, Tail length : 39-65 mm.

Locality : Six specimens have been collected from Canacona, Valpoi and Dhavan village in Goa by Sharma (2002). Smith (1935) and Tikader and Sharma (1992) reported the extent of distribution of this species throughout peninsular India.

Distribution : Peninsular India, West Bengal, Andaman and Nicobar Islands.

Habitat : The species is terrestrial, insectivorous and nocturnal preferring to live in the crevices of tree trunks, deserted houses, gardens and many other various types of habitats.

Status : Ahmed and Dasgupta (1992) and Tikader and Sharma (1992) reported the status of *H. frenatus* as abundant and widely distributed

species; IUCN category as per CAMP report (1998) : Lower risk-least concern.

Remarks : Nil.

22. ***Hemidactylus leschenaulti*** Dumeril & Bibron

1836. *Hemidactylus leschenaulti* Dumeril & Bibron *Erp. Gen.*, iii : 364.

Common name : English : Common Bark Gecko.

Diagnostic Characters : A large ashy grey coloured gecko with undulating crossbars or rhomboidal spots on the dorsal side. A black stripe emerges from behind the eye and extends upto the flanks. Belly whitish in colour. Head large with a broad snout. Head covered with small granular scales, which becomes quite large near the snout. Ear opening subcircular. Upper labials 10-10 in number. Mental shield quite large and subtriangular in shape. Two pairs of post-mantles, inner pair larger than the outer pairs. Nostril is situated between rostrals. Dorsum is covered with small granular scales intermixed with few larger, rounded and feebly keeled tubercles. Ventrum covered with smooth, round and subimbricate scales. Hindlimbs hardly reach the axilla. Digits are free moderately dilated with slightly oblique or more transverse lamellae. 6-7 lamellae under the first toe, while 9-11 under the fourth toe. Tail almost equal to Head and Body, but strongly depressed and swollen at the base in adults. It is verticillate and flat beneath. It is covered above with small scales and series of 6 enlarged pointed tubercles. Male with 10-17 femoral pores on each side. Head and Body length : 32-83 mm; Tail length : 31-83 mm.

Locality : Smith (1935), Tikader and Sharma (1992) and Ahmed and Dasgupta (1992) reported the extent of the distribution of this species throughout peninsular India.

Distribution : Peninsular India and West Bengal in Eastern India.

Habitat : The species is arboreal, nocturnal and insectivorous. Its favourable abodes includes under barks of large trees of banyan, tamarind, mango etc. During daytime they hide under the bark and crevices of these trees.

Status : Abundant (Tikader and Sharma, 1992), Common (Daniel, 1983); IUCN Category as per CAMP Report (1998) : Lower risk-least concern.

Remarks : Daniel (1983) reports that the dark grey colour of this gecko with wary bands on the back merges with the colour of the tree bark and hence becomes difficult to locate it.

* 23. ***Hemidactylus flaviviridis*** Ruppell

1835. *Hemidactylus flaviviridis* Ruppell, *Neue Wirb. Faun. Abyss.* : 18 pl. vi fig. 2.

Common name : English : Yellow bellied house Gecko.

Diagnostic characters : A large sized and robust gecko with a pale-grey or greenish-grey to olive coloured dorsum. There are wavy and dark cross bands on the dorsal side. Belly yellowish. Head is large with a broad snout. Ear-opening subcircular. There are minute granules on the head, but they are more prominent and large on the snout. Upper labials 12-15 and lower labials 10-12. Mental shield large and subtriangular. Rostral broad. Dorsum covered with small granular scales intermixed with very few large, round and feebly keeled tubercles. Ventrum with smooth imbricate scales. Hindlimbs just reach the axilla. Digits are free and moderately dilated with oblique lamellae. 7-10 lamellae under the first toe (This character separates *H. flaviviridis* from the remaining *Hemidactylus* species). 11-14 lamellae under the fourth toe. Tail length is almost equal to the head and body length. Tail strongly depressed and swollen at the base, flat beneath and verticillate. Male with 5-7 femoral pores on each side. Head and Body length : 42-90 mm, Tail length : 38-90 mm.

Locality : ZSI Survey parties sighted live specimens in Molem, Bondala and Valpoi Rest Houses during the project period.

Distribution : Whole of India.

Habitat : A commensal species usually seen on the inside walls of houses and buildings. Most

agile, pugnacious, excellent climber and normally a nocturnal and an insectivorous species. Makes voice like a chirp of a small bird.

Status : Most common (Tikader and Sharma, 1992), IUCN category as per CAMP report (1998) : Lower-risk-least concern.

Remarks : Widely distributed in North India above 20° N.

Family AGAMIDAE

Family Agamidae is represented five species under four genera in Goa State.

Key to the genera of the Family AGAMIDAE

I. A wing-like expansion is present on the much extended ribs ..... ***Draco***

II. Wing-like expansion absent and ribs normal 2

2. Body not depressed. Dorsal crest present 3

– Body is depressed and dorsal crest absent. 4

3. i) Only four toes are present ..... ***Sitana***

ii) Five toes present ..... ***Calotes***

4. Body is depressed and dosal crest absent..... ..... ***Psammophilus***

Genus *Draco*

Genus *Draco* is represented by a single species in Goa State.

*24. ***Draco dussumieri*** Dum. & Bibr.

1837. *Draco dussumieri* Dum. & Bibr. *Erp. Gen.*, **4** : 456.

Common name : English : South Indian Flying Dragon or Lizard.

Diagnostic characters : Body with a large, lateral, wing-like membrane or patagia is supported by six ribs which are very much extended. Wings are expanded when the lizard is gliding from tree to tree. When the lizard is at rest or climbing on a tree in search of food, the wings are folded back along the sides of the body and are hardly distinguishable from the body. A gular appendage and a lateral flap on either side of the throat are present. Gular pouch is usually much larger in males than in females. Head is moderately large with a broad snout. Dorsal scales on the head are unequal and strongly keeled. Presence of a conical scale at the posterior part of the orbit is also a characteristic feature. Nostrils directed vertically upwards. Tympanum is necked. Colouration is grayish brown, ashy-brown to brownish black. Back is provided with darker circular spots. Ventrum is grayish with a series of large black-magined spots. Throat is light blue with numerous black spots. Upper labials 10-12. Dorsum is covered with unequal smooth to feebly keeled scales Ventrum with strongly keeled scales. Forelimbs are longer and can be stretched slightly beyond the snout. Hindlimbs reach the axilla. Tail is longer than head and body in length. Head and Body length : 95 mm, Tail length : 135 mm.

Locality : Specimens have been collected from Molem sanctuary region. in Goa by ZSI Survey parties in past and also during the project period.

Distribution : Peninsular India.

Habitat : Specimens have been seen in coconut, betel, arcnut and even teak plantations in thick forests up to the elevation of 1500 m. The species is absolutely arboreal, most agile and gliding lizard. Insectivorous species. Pre-mating combats are common in males.

Status : Indeterminate (Tikader and Sharma, 1992), IUCN category as per CAMP report (1998) : Lower-risk- Near Threatened.

Remarks : Nil.

Genus ***Sitatna***

Genus *Sitana is* represented by a single species in Goa State.

* 25. ***Sitana ponticeriana*** Cuvier

1844. *Sitana ponticeriana* Cuvier. *Guerin. Icon. Reg. Anim. Rept.* : pl. x fig. 2.

Common name : English : Indian fan throated lizard.

Diagnostic characters : All members of the family Agamidae are characterised by possession of digits of the feet without any adhesive pads, eyes with movable eyelids, body dorsoventrally or laterally compressed and covered with imbricate scales. Tongue broad and short but not protrusible. Skull with temporal and postorbital arcades. Genus *Sitana* under family Agamidae is recognized by possession of four toes only, by absence of femoral pores, ribs normal and not extended and finally body normal and not depressed. Four toes on each foot seperates *Sitana* from all other agamid lizard species possessing five toes on each foot. *Sitana ponticeriana* is a small agamid lizard, brown above with a series of dark brown black margined, rhomboidal, vertebral spots on the back. The throat fan in male is brilliantly coloured in red, blue and black. Belly whitish. Body compressed with no dorsal crest. Head scales unequal in size. Scales strongly keeled. Limbs long with strongly keeled scales. Fourth toe longest, while fifth toe absent. Tail is extremely longer than the head and body. Males with a low nuchal crest and a large folding gular appendage. Head and Body length : 40-80 mm, tail length : 60-170 mm.

Locality : ZSI Survey parties have sighted live specimens in Molem, Bondala and Valpoi sanctuary areas in Goa state during the project period.

Distribution : Whole of India excluding region east of Ganges in Eastern India.

Habitat : Fan throated lizard inhabits practically all biotopes except perhaps the heavy rainfall forests and the deserts. Preferred habitat is scrub and sandy country. Terrestrial, ground dwelling and diurnal agamid lizard feeding mainly on ants and small insects. A fast and graceful runner.

Status : Very common (Daniel, 1983 and Tikader and Sharma, 1992); IUCN category as per CAMP report (1998) : Lower risk-least concern.

Remarks : Nil.

Genus ***Calotes***

Genus *Calotes* is represented by two species under a single genus in Goa State.

Key to the species of the Genus *Calotes*

I. No fold or pit in front of the shoulder .... *Calotes versicolor*

II. A long fold is present in front of the shoulder whichextends across the throat .... *Calotes rouxi*

26. *Calotes versicolor (Daudin)

1802. *Agama versicolor* Daudin, *Hist. Nat. Rept.* iii : 395 pl. xliv.

Common name : English : Indian garden lizard.

Diagnostic characters : These agamid lizards are with compressed body, five toes, exposed tympanum, and equal-sized dorsal scales, which are arranged regularly. Dorsal crest present. Tail comparatively long and slender, in males swollen at the base. Femoral and preanal pores are absent. No fold or pit in front of the shoulder. Two erect and separated spines above the tympanum. Long snot. Dorsal colour lightly brown greyish, transverse spots on back and sides. Dark streak from eyes. Males with gular sac. Limbs long and well developed. Digits long, slender and strongly clawed. 10-13 upper labials, while 11-14 lower labials. Body scales keeled and imbricate with pointed tips. Scales in 37-47 rows at mid-body. Head and Body length : 86-129 mm; tail length : 300-350 mm.

Locality : Number of specimens have been collected from different areas such as Fatorpa, Dudhsagar waterfalls, Cortalim, Margoan, Molem, Durgini Hills, Asavana Village, Dhavan Village, Canacona etc. during various surveys conducted at different times by ZSI Survey parties (Sharma, 1976).

Distribution : Practically whole of India.

Habitat : Arboreal species in true sense. Diurnal and insectivorous lizard of the gardens, hedges, scrub land and forests. Most plentiful in

the vicinity of streams, riversides, desert oases etc. These lizards are excellent climbers. Their prehensile toes and long tail help them in balancing the body for such arboreal life.

Status : Most common species throughout its range (Daniel, 1983, Sharma, 2000), IUCN category as per CAMP report (1998) : Lower risk-Near Threatened in Central India. (For *Calotes versicolor versicolor* (Daudin).

Remarks : Nil.

* 27. ***Calotes rouxi*** Dum. & Bibr.

1837. *Calotes rouxi* Dumeril and Bibron, *Erp. Gen.*, **iv** : 407.

Common name : *English* : Forest Calotes or Matheran olive-Brown calotes.

Diagnostic characters : The body of the forest calotes species is comparatively smaller than *versicolor*. *C. rouxi* can be distinguished by the presence of a distinct dark fold across the neck in front of the shoulder and by presence of two slender spines on each side of the back of the head. Normally brown in colour with patterns on the back. It is easily confused with young *versicolor*. Head, nape and gular pouch red. Side of head and neck banded with brown. Dark brown lines radiate from the eye. During the breeding season the head and a narrow strip along the mid back of the male turn bright brick red contrasting distinctly with that of the rest of the body. Head scales unequal in size and strongly keeled. 9-10 labials on both the sides. Limbs are moderately developed, slender in size with fourth toe longer than the third toe. Hind limbs reach the temple. Tail slender but long and slightly compressed. Dorsal body scales keeled, the upper rows pointing upwards and backwards, while the lower rows pointing backwards and downwards. Ventral scales strongly keeled. 50-60 rows of scales in the middle of the body. Head and Body length : 29-77 mm; Tail length : 49-170 mm.

Locality : Number of specimens have been collected and, or sighted from different areas such as Dudhsagar waterfalls, Cortalim, Margoan, Molem, Ponda, Dhavan Village, Canacona etc. during various surveys conducted at different times by ZSI Survey parties (Sharma, 1976).

Distribution : Peninsular India (Daniel, 1983).

Habitat : Forest dwelling arboreal species. Insectivorous and diurnal in habit.

Status : Though widely distributed, the species is vulnerable on account of habitat destruction (Sharma, 2000). The species is, however, endemic within Indian limits. IUCN category as per CAMP report (1998) : Lower risk-Near threatened.

Remarks : Nil.

28. ***Psammophilus dorsalis*** (Gray)

1831. *Agama dorsalis* Gray, in *Griffith Anim. King.* 9, Syn. : 56.

Common name : *English* : Olive Brown rock lizard.

Diagnostic characters : Body of the olive brown rock agamid lizard is feebly depressed with tympanum exposed and throat with a deep transverse fold. Cheeks swollen in the adult males. Head is very large, elongated and flat. Limbs are very strong and covered with uniform keeled scales. Preanal scales are absent in males. Gular sac absent. Nuchal and dorsal crest are indicated by a ridge of the enlarged scales. Head scales unequal, smooth or sometimes obtusely keeled. Body covered with uniform comparatively small and feebly keeled scales in adults (Strongly keeled in juveniles). Scales in the middle of the body 115-150. All scales pointing upwards and backwards. Labials 10-13. *P. dorsalis* is olive-brown or pale-brownish in dorsal colouration in young ones and females, while pale-brownish in adult males. Series of white elongated spots on sides and back present. Lips yellowish brown. Ventrum yellowish. Throat speckled with gray. Hind-limb reaches the ear or orbit. Tail long, slender and slightly compressed. Dorsal scales on the tail are larger than the ventral scales. Tail swollen at the base in males. Head and Body length : 100 mm; Tail length : 200 mm.

Locality : Smith (1935), Tikader and Sharma (1992) and Sharma (2002) reported the extent of

the distribution of this species south of 16°N in peninsular India including Goa State. Nearest collection locality as reported by Sharma (2002) is Malabar Coast in Karnataka State.

Distribution : Karnataka, Nilgiri and Nallamalai Hills, South Arcot, Bangalore.

Habitat : Absolutely rock dwelling, living in the crevices and holes in rocks upto 700 metres. Agile, insectivorous and diurnal lizard.

Status : In abundance (Tikader and Sharma, 1992). IUCN category as per CAMP report (1998) : Lower risk-Near threatened.

Remarks : Nil

Family CHAMAELEONIDAE

Family Chamaeleonidae is represented by a single species in Goa State.

* 29. *Chamaeleo zeylanicus* Laurenti

1768. *Chamaeleo zeylanicus* Laurenti, *Syn. Rept.* : 46.

Common name : *English* : Indian chameleon.

Diagnostic characters : Chamaeleon family includes highly specialized arboreal, insectivorous and diurnal lizards. The body is laterally compressed. There is a caque on top of the head. Anterodorsal crest is most prominent, which bends slightly on posterior side. Dorsal crest low serrated. The skin is granular suitable for quick and extensive changes in colour. Teeth compressed, small, triangular, tricuspid, uniform and acrodont. The tongue is club shaped, sticky at the tip and can quickly extend to a distance upto 15-20 cms. for catching insect preys. The feet are with digits permanently opposed in groups of two and three for grasping. Claws simple. The tail is long and prehensile. Eyes are large and move independently. Both the eyelids are fused and form a complete ring around the eye leaving a small opening at the centre. Ears devoid of tympanum and tympanic cavity. Basic colour is green but can change rapidly and camouflage with the surrounding. Male with a spur like process. Head and Body length : 175 mm; Tail length : 200 mm.

Locality : Sighted two live specimens in Bhagwan Mahawir Sanctuary, Molem, and Bondla sanctuary by ZSI survey parties during the project period.

Distribution : Peninsular India.

Habitat : Strictly arboreal, diurnal and insectivorous. Perfectly adapted for an arboral existence and also for its feeding habits. Its movements are deliberate and slow. Chamaeleon prefers thick-forested areas but is uncommon in very heavy rainfall regions. In semi-desert regions it is found in hedges and shrubs.

Status : Endangered in India on account of habitat loss (Sharma, 2000), Wildlife (Protection) Act 1972 (as amended upto 2002) Schedule : Schedule : II (*Chameleo calauratus*);* IUCN category as per CAMP Report (1998) : Vulnerable, CITES Appendix : Appendix II.

Remarks : The chameleon can increase its striking range by supporting itself on its hindlimbs and tail independently and reaching out with the body. On the ground its walk is slow and stilted, each leg being waved in a curious action before being set on the ground. The whole effort looks like a walk of sick patient. * *Chameleo calcaratus* has been synonomised with *Chamaeleo zeylanicus* Laurenti (Smith, 1933).

Family SCINCIDAE

Family Scincidae is represented by two genera in Goa State.

Key to the genera of the Family SCINCIDAE

I. Limbs well developed and strong. Pterygoid bones are not touching one another ..... ***Mabuya***

II. Limbs short, weak and vestigial or even absent. Pterygoid bones in contact with one another ..... ***Riopa***

Genus *Mabuya*

Genus *Mabuya* is represented by five species in Goa State.

Key to the species of the Genus *Mabuya*

1. 28-30 scales around the middle of the body; dorsal scales with 5-9 strong keels; 12-17 lamellae under the fourth toe. .... *M. macularia*
2. 26-30 scales around the middle of the body; dorsal scales with 3-7 strong keels; 15-18 lamellae under the fourth toe .... *M. allapallensis*
3. 30-34 scales around the middle of the body; dorsal scales with 5-7 moderate keels; 14-18 lamellae under the fourth toe. .. *M. carinata*
4. 30-32 scales around the middle of the body; dorsal scales with 3-5 feeble keels; 12-15 strongly keeled lamellae under the fourth toe. Back with 4 dark longitudinal stripes .... *M. beddomii*
5. 34-36 scales around the middle of the body; dorsal scales with 5-7 moderate keels; 13-14 lamellae under the fourth toe. Back with 5 broad, black edged yellowish-white longitudinal stripes..... *M. trivittata*

* 30. ***Mabuya allapallensis*** Schmidt

1926. *Mabuya allapallensis* Schmidt, *Pub. Field. Mus. Nat. Hist. (Zool), Chicago,* **12** : 170.

Common name : English : Allapalli forest skink.

Diagnostic characters : Species under family *Scincidae* posess subcylindrical and almost circular elongated body, which is covered with cycloid overlapping scales. There is no marked distinction between the head and body. They are continuous without any evidence of neck. Body, limbs and tail are protected with osteoderms. 26-30 scales round the middle of the body. Dorsal and lateral scales are almost equal, each with 3-7 distinct strongly marked keels. Ventrum with very feeble keel-like markings. Union of palatine bones takes place at the midline of the palate, while pterygoid bones are not touching one another. Supranasals present and widely separated. Limbs short but strongly developed. The complete [illegible] of this skink is very dark brown with black spots between neck and base of the tail. There is a white line from the upper lip to the shoulders. Belly is greenish white. Prefrontals markedly separated. Post-frontals absent. Ear opening almost circular. Digits moderately long and with 15-18 obtusely keeled lamellae beneath the fourth toe. Hindlimb not reaching the elbow. Standard Head and Body length 24-50 mm; Tail length : 32-64 mm.

Locality : Number of specimens have been collected from Canacona, Molem, Asavana Village, Kandal rubber plantations and Ponda regions in Goa state by the ZSI survey parties in past (Sharma, 1976).

Distribution : Andhra Pradesh, Bihar, Karnataka and Madhya Pradesh in India.

Habitat : Terrestrial, diurnal and insectivourous generally seen in rocky open areas in deciduous forests.

Status : *Mabuya allapallensis* is an endemic species in India. Indeterminate (Tikader and Sharma, 1992). IUCN category as per CAMP report (1998) : Endangered.

Remarks : Nil.

* 31. ***Mabuya macularia*** (Blyth)

1853. *Euprepes macularius* Blyth, *J. Asiat. Soc. Beng.*, **xxii** : 652.

Common name : English : Little skink, Bronzy Grass skink.

Diagnostic characters : Little skink possesses all the characters mentioned for the family *Scincidae* and Genus *Mabuya*. In addition, it possesses scaly lower eyelids. There are 28-30 scales round the middle of the body. Dorsal scales with 5-9 strong keels. 12-17 lamellae under the fourth toe. Snout to vent length not exceeding 75 mm. The colour pattern of this widely distributed species varies greatly. However, the general body colour is brown with or without longitudinally arranged spots. Sometimes the skink is brown olive or bronzy in colour. Light dorsolateral stripe is always present. Standard Head and Body length : 60-75 mm. Tail length : 110-140 mm.

Locality : Sharma (1976) reported collection of this species from Ponda region. This is a first collection record from Goa State.

Distribution : Peninsular India.

Habitat : Forested areas of India. Basically terrestrial, diurnal, insectivorous and oviparous skink.

Status : Very common (Daniel, 1983, and Sharma, 2002), IUCN category as per CAMP Report (1998) : Lower risk-least concern (As *Mabuya macularius*).

Remarks : Nil.

* 32. ***Mabuya carinata*** (Schneider)

1801. *Scincus carinatus* Schneider, *Hist. Amphib* ii : 183.

Common name : English : Common Indian skink, Common skink, and Brahminy skink.

Diagnostic characters : Common skink possesses all the characters of Family Scincidae and genus *Mabuya*. In addition it possesses scaly lower eyelids. Dorsal scales moderately keeled with only 5-7 keels on each scale. 30-34 scales round the middle of the body. 14-18 lamellae under the toe. Common skink is olivacious brown or shining bronze in colour dorsally. Back and anterodorsal portion of the tail is with dark-brown to black spots or longitudinal lines along the lateral margin of the scales. Laterally the skink is dark brown. Two somewhat lighter dorsolateral stripes present. Limbs very well developed. Supranasal shields on the head just touching or separated from one another. Frontonasal broader than long. Prefrontals in contact with each other. Ear opening circular. Standard Head and Body length : 125 mm, Tail length : 165 mm.

Locality : Number of specimens have been collected and/or sighted from areas such as Margaon, Molem, Valpoi, Nayavada Village, Ponda, Bondla, Mormugoa etc. in Goa State by ZSI survey parties in past and also during the project period.

Distribution : Peninsular India.

Habitat : Terrestrial, diurnal, insectivorous and oviparous. One of the commensal species. Almost at home in semi-urban and forest areas. Primarily ground dweller. Actively searches through ground litter for prey. It is more often heard than seen.

Status : Very common (Daniel, 1983, Tikader and Sharma, 1992 and Sharma, 2002), IUCN category as per CAMP Report (1998) : Lower risk-near threatened.

Remarks : Nil.

33. ***Mabuya beddomii*** (Jerdon)

1870. *Euprepes beddomii*, Jerdon, *P. Asiat. Soc. Beng* 73

Common name : English : Beddom's South Indian skink, Common skink, and Brahminy skink.

Diagnostic characters : Beddom's South Indian Skink possesses characters of the Family Scincidae and genus *Mabuya*. In addition it possesses scaly lower eyelids. Further, it has 30-32 scales round the middle of the body, dorsal scales with 3-5 feeble keels, 12-15 strongly keeled lamellae under the fourth toe and back with 4 dark brown longitudinal stripes running all along the body length upto the base of the tail. A broad stripe is present on the lateral side of the head. Belly whitish. Supranasals and prefrontals are in contact with each other. Ear opening circular. Digits moderately long. Hind limbs can reach upto the wrist. Standard Head and Body length : 55 mm. Tail length : 115 mm.

Locality : Smith (1933) and Tikader and Sharma (1992) have reported occurrence of this species in Penninsular India including Goa State. The nearest collection localities reported by Sharma (2002) are Hills of Malabar coast and Karnataka State.

Distribution : Peninsular India.

Habitat : Terrestrial, diurnal and insectivorous. Not much is known about its habit and habitat.

Status : Rare due to habitat loss (Tikader and Sharma, 1992), IUCN category as per CAMP Report (1998) : Lower risk-least concern.

Remarks : Nil.

*34. ***Mabuya trivittata*** (Hardwicke & Gray)

1827. *Tiliqua trivittata* Hardwicke & Gray, *Zool.l Jour.* iii : 227..

Common name : English : Five striped skink.

Diagnostic Characters : Five striped skink possesses all the characters of Family Scincidae and Genus *Mabuya* mentioned earlier. In addition it possesses scaly lower eyelids. 34-36 scales round middle of the body. Dorsal scales with 5-7 moderate keels. 13-14 lamelle under the fourth toe. Back with five broad black edged yellowish white longitudinal stripes. The stripes extend the whole length of the body upto the base of the tail. Vertebral and dorso-lateral stripes most prominent. Supranasals and prefrontals in contact with one another. Ear opening is almost circular. The hind limbs reach to the wrist. Standard Head and Body length : 80 mm; Tail length : 80 mm.

Locality : Smith (1933) and Tikader and Sharma (1992) reported wide occurrence of this species from Central and South India and consider it as endemic to these region only. ZSI survey parties sighted the species in Molem and Dudhsagar regions of Goa State during the project period.

Distribution : Central and Southern peninsular India.

Habitat : Terrestrial, ground dwelling reported from forested as well as urban areas. Insectivorous and diurnal species.

Status : Endemic to Central and Southern India, Indeterminate (Tikader and Sharma, 1992), IUCN category as per CAMP Report (1998) : Lower risk-least concern.

Remarks : Nil.

Genus ***Riopa***

Genus *Riopa* is represented by four species in Goa State.

Key to the species of the Genus *Riopa*

I. Lower eyelid is scaly ..... *R. goaensis*

II. Lower eyelid is with a semi-transparent disc. ..... A

A. With five fingers and five toes ..... 1.

1. 24-28 scales around the middle of the body; 62-76 rows of scales down middle of back between parietals and hind-limbs. *R. punctata*

2. 24-26 scales around the middle of the body; 87-100 rows of scales down middle of back between parietals and hind-limbs. .... *R. guentheri*

B. With five fingers and four toes ... *R. lineata*

* 35. ***Riopa punctata*** (Linnaeus)

1799. *Lacerta punctata* Linnaeus, *Syst. Nat.*, : 369.

Common name : English : Dotted Garden skink, Snake skink.

Diagnostic characters : Dotted Garden skink or snake skink possesses all the characters of family Scincidae mentioned earlier. However, in Genus *Riopa* the palatine bones are united in the middle of the palate, pterygoid bones in contact, limbs short and weak and body snake like. Lower eyelid with semitransparent disc. *R. punctata* possesses five fingers and five toes; 24-28 scales round the body, 62-76 rows of scales down middle of back between the parietals and hindlimbs. The dorsum is brown with each scale having dark basal spot forming longitudinal series. In Juveniles and subadults the spots are confluent into 4-6 lines down the back. A yellow dorsolateral stripe start from the snout. Tail in subadults red in colour. Snout obtusely pointed. Small ear openings. 7 upper labials, body scales smooth and digits long with fourth toe longer than the third. 11-14 keeled lamellae under the fourth toe. Tail swollen at the base and slightly longer than head and body. Standard Head and Body length : 86 mm.; and Tail length : 92 mm.

Locality : One specimen has been collected from Canacona-Ponda road in Goa State by R. C. Sharma (Sharma, 1976) in past.

Distribution : Almost whole of India.

Habitat : Generally ground dwelling, insectivorous and oviparous. It lives in damp soil and under fallen leaves or logs.

Status : Most common (Sharma, 2000) IUCN category as per CAMP Report (1998) : Lower risk least concern. (*Lygosoma punctatus* (Gmelin) = *Riopa punctatus* (Linnaeus).

Remarks : Though Gayen (1999) and some others have considered to keep dark spotted garden skink in *Lygosoma punctata* (Gmelin), it has been retained here in *Riopa punctata* (Linnaeus) only following keys and observations reported by Smith (1935), Daniel (1983), Tikader and Sharma (1992), Ahmed and Dasgupta (1992) and Sharma (2000).

*36. ***Riopa guentheri*** (Peters)

1831. *Eumeces guentheri* Peters, *Sistz. Ges. Nat. Berlin* : 36.

Common name : English : Malabar dotted skink.

Diagnostic characters : Malabar dotted skink possesses all the characgters mentioned earlier for family Scincidae and genus *Riopa*. Most of the characters of *Riopa punctata* are seen in *Riopa guentheri* except that there are 87- 100 rows of scales down middle of back between the parietals and hindlimbs and body more elongated. Frontal length is equal to the combined length of fronto-parietals and interparietal. Digits shorter with fourth toe slightly longer than the third. Standard length : 110 mm.

Locality : One specimen has been collected from Canacona area in Goa State by R. C. Sharma (Sharma, 1976) in past. This is the first collection record from Goa State reported by Sharma (1976).

Distribution : Western and Central India.

Habitat : Terrestrial, ground dwelling, subterrenian diurnal, insectivorous and oviparous. Generally seen in dry and moist deciduous as well as evergreen forests.

Status : Endemic species. Not common (Tikader and Sharma, 1992), IUCN category as per CAMP Report (1998) : Lower risk near threatened (*Lygosoma guentheri* (Peters) = *Riopa guentheri* (Peters).

Remarks : Some authors have considered to treat this species as *Lygosoma guentheri* (Peters) (CAMP REPORT, 1998), However, malabar dotted skink has been treated here as *Riopa guntheri* (Peters) based on keys and observations reported for the Genus *Riopa* by Smith (1935), Daniel (1983), Tikader and Sharma (1992) and Sharma (2000). The species appears to be endemic to Western and Central India.

37. ***Riopa lineata*** (Gray)

1839. *Chiamela lineata* Gray, *Ann.Mag. Nat. Hist.*, **2** : 333.

Common name : English : Golden-Brown four-toed skink.

Diagnostic characters : Golden-Brown four-toed skink possesses all the characgters mentioned earlier for family Scincidae and genus *Riopa*. Most of the characters of *Ruiopa punctata* are seen in *Riopa lineata* except that lineata possesses four toes insteade of five toes. There are 22 scales round the middle of the body and 104-110 rows of scales down middle of back between the parietals and hindlimbs. Limbs are very weak. Body is much elongated but size is smaller. Lower eyelids are with an undivided semi-transparent disc. Supranasal is entire. Frontal is smaller than the single fronto-parietal. The dorsum is golden brown with dark brown dots forming distinct longitudinal lines. Standard length : 53 mm.

Locality : Smith (1935), Tikader and Sharma (1992) and Sharma (2002) reported the distribution of this species south of Bombay upto North Kanara in Western India including Goa State. Nearest collection locality as reported by Sharma (2002) is North Kanara in Karnataka State.

Distribution : Northern Western India including Maharashtra to Karnataka states (CAMP Report, 1998).

Habitat : Terrestrial, ground dwelling, subterrenian diurnal, insectivorous and oviparous. Generally seen in dry deciduous forests, scrub-jungle as well as in semi-evergreen forests.

Status : Endemic species. Not common, Rare and Indeterminate (Tikader and Sharma, 1992), IUCN category as per CAMP Report (1998) : Lower risk near threatened (*Lygosoma lineata* (Gray) = *Riopa lineata* (Gray).

Remarks : Some authors have considered to treat this species as *Lygosoma lineata* (Gray) (CAMP REPORT, 1998), However, malabar dotted skink has been treated here as *Riopa lineata* (Gray) based on keys and observations reported for the Genus *Riopa* by Smith (1935), Daniel (1983), Tikader and Sharma (1992) and Sharma (2000). The species is endemic to Western India.

*38. ***Riopa goaensis*** Sharma

1976. *Riopa goaensis* Sharma, *Rec. zool. Surv. India*, **71** : 157.

Common name : English : Goanese Bronze skink.

Diagnostic characters : Goanese Bronze skink possesses all the characgters mentioned earlier for family Scincidae and genus *Riopa*. Most distinctive character of *Riopa goaensis* is the possession of scaly lower eyelids with a large semi-transparent scale in the center. There are 30 scales round the middle of the body and 64 rows of scales down middle of back between the parietals and hindlimbs. Head is small with obtuse snout. Body is much elongated but size is smaller. Lower eyelids are with an undivided semi-transparent disc. Supranasal is entire in contact with one another behind the rostral. Frontal is larger than the fronto-parietal and interparietals together. Digits long. Fourth toe longer than the third. 13 lamellae under the fourth toe. Tail thick at the base and smaller than the head and body. The dorsum is dark brown to blackish with a black dorso-lateral streak beginning from canthus rostralis to the almost end of the tail. Lower surface light brown. Back and sides densely spotted with brown. Standard length : 53 mm, Tail length 49 mm.

Locality : One specimen has been collected from Molem area in Goa State by R. C. Sharma (Sharma, 1976) in past. This is a new species record reported from Goa State by Sharma (1976).

Distribution : Known only from the type locality (Sharma, 1976).

Habitat : Terrestrial, diurnal, insectivorous and oviparous.

Status : Endemic species. Rare (Tikader and Sharma, 1992), IUCN category as per CAMP Report (1998) : Data Deficient (*Lygosoma goaensis* (Sharma) = *Riopa goaensis* (Sharma).

Remarks : Some authors have considered to treat this species as *Lygosoma goaensis* (Sharma) (CAMP REPORT, 1998), However, the Goa bronze skink has been treated here as *Riopa goaensis* (Sharma) based on keys and observations reported for the Genus Riopa by Tikader and Sharma (1992) and Sharma (2000). The species is endemic to Western India.

Family LACERTIDAE

Family *Lacertidae* is represented by a single species in Goa State.

* 39. ***Ophisops beddomei*** (Jerdon)

1870. *Ophiops jerdoni* Blyth. *J. Asiat. Soc. Beng.*, **xxii** : 653.

Common name : English : Beddom's snake eyed lacerta.

Diagnostic characters : Body dorsoventrally flat covered with scales. There are osteoderms on the head. They are fused with top of the skull. Legs very well developed. Teeth are pleurodont. Tongue long and forked anteriorly covered with scales like papilla. Temporal and post-orbital arcades present. Dorsal scales are pointed, strongly keeled and overlapping. No distinct collar is present. A fold is present in front of the shoulder. Lower eyelid with a large semitransparent disc completely fused with the upper eyelid (which is extremely small or vestigial). This species resembles with *O. jerdoni* in many respects including scalation, colouration etc. but differs in following aspects. Upper lateral light-brown stripe is missing, two or three fronto-nasals are in transverse series, one or two shields etc generally separate prefrontals from one another. Upper head-shields are keeled and striated. 26-32 scales round the middle of the body. Dorsum is olive-brown, golden or grayish. Belly yellowish white. Digits with sharply keeled scales beneath. Hind limb reaches the anthumeral fold or in males between the fold and ear. 8-13 femoral pores on each side.

Head and Body length : 34 mm; Tail length : 60 mm.

Locality : One specimen has been collected from Molem area of Goa State by Sharma in 1976. This is a first collection record from Goa State.

Distribution : Endemic to Western Ghats in India.

Habitat : Terrestrial diurnal and insectivorous species. Prefers grassy patches. Also found in deciduous, moist-deciduous and evergreen forests.

Status : Indeterminate but not endangered (Tikader and Sharma, 1992), IUCN Category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

Family VARANIDAE

*40. ***Varanus bengalensis*** (Daudin)

1802. *Tupinambis bengalensis* Daudin, *Hist. nat. Rept.*, **3** : 67.

Common name : English : Common Indian monitor, Monitor lizard, and Indian monitor.

Diagnostic Characters : Monitor lizards are distinguished by their long and flattened body, long and laterally compressed tail, long neck and extremely elongated, slender and forked tongue. Tongue smooth and retractile like that of a snake. All monitors show uniformity in structure, which is not seen in other orders of lizards. Body stout, covered with small scales and without osteoderms. Teeth large, pointed, acute, recurved and pleurodont. Ventral scales arranged in regular rows. Limbs well developed and digits armed with very strong claws. The colour of the Indian monitor is dark brown. The young ones possess pale ring spots and blackish cross bars. Crown scales characteristically large. The snout is convex terminally, nostrils are placed as oblique slits midway between the eyes and the end of the muzzle. Preanal pores present. Head and Body length : 72-75 cms. and Tail length : 90-100 cms.

Locality : Three specimens have been collected from Dhavan Village, Valpoi and Canacona areas in Goa State by ZSI survey parties in past. One specimen was sighted in Bondla area during the project period.

Distribution : Whole of India.

Habitat : The Indian monitor is widely distributed and lives in all biotopes from evergreen forests to the fringes of desert. It is terrestrial and ground dwelling. Diurnal and fussorial in habit. It occupies burrows, dense clump of vegetation, hollows of trees, cracks and crevices. Graceful in movement, good climber and swimmer.

Status : The population is alarmingly dwindling throughout the country due to excessive exploitation of the adults for meat and skin (Tikader and Sharma, 1992). Indian Wildlife (Protection) Act 1972 (as amended upto 1991) : Schedule II Part II, CITES : Appendix I, Red Data Book (1994) : Endangered, IUCN category as per CAMP Report (1998) : Vulnerable.

Remarks : As per Central Zoo Authority records live specimens of this species are present in 26 Indian zoos. The species is involved in illegal trade at national as well as international level (Pradhan, 1997).

Suborder SERPENTES (Ophidia)

Subroder *Serpentes* (Ophidia) is represented by seven families in Goa State.

Key to the families of the suborder Serpentes (Ophidia)

I. Eyes vestigial covered over by shields. Body worm-like, covered with uniform scales. Very short tail. (Blind Snakes) .. TYPHLOPIDAE

II. Eyes exposed and well developed. Serpentine body. Median row of ventral scales more or less distinctly enlarged, usually forming tranverse shields. Tail not very short. (Python, Boa, and other snakes) 1

1. Vestiges of hind-limbs present in the form of claw-like spurs, situated usually on each side of the vent. Body overall bulky. (Python and Boa) ..... BOIDAE

Vestiges of hind-limbs totally absent. Overall

body not bulky but slender, round and snake-like 2

2. No poison fangs in front of the mouth. (Non-Venomous snakes) 3

   A pair of poison fangs present in front of the mouth. (Venomous Snakes) 4

3. Ventral scales scarcely broader than the adjacent scales. Tail extremely short and blunt ending obtusely covered with thick modified, rough file like shield scales. (Rough Shieldtail snakes; Non-Venomous) ..... UROPELTIDAE

- Ventral shields are distinct. Ventral scales nearly or quite as broad as those on body.Tail cylindrical, long and pointed. Premaxillary teeth absent. (Non-Venomous colubrine snakes) ..... COLUBRIDAE

- No Ventral shields present. Complete body is covered with small granular or tuberculate juxtaposed scales ..... ACROCHORDIDAE

4. Maxillary bone with teeth behind the poison fangs. Tail cylindrical. Pupil round. Ventrals nearly or quite as broad as the body. (Krait and Cobra) ..... ELAPIDAE

   Maxillary bone with teeth behind the poison fangs. Tail vertically compressed, puddle shaped.. Pupil round.(Marine snakes) ..... HYDROPHIIDAE

   Maxillary bone very short bearing only poison fang. Tail cylindrical. Pupil vertical. Ventrals nearly or quite as broad as the body. (Vipers) ..... VIPERIDAE

Family TYPHLOPIDAE

Family Typhlopidae contains blind or worm snakes and it is represented by two genera in Goa State.

Key to the genera of the family TYPHLOPIDAE from Goa State

1. Maximum length upto 200 mm only. Scales round the body are 20. 290-320 transverse row of scales along the body length. Total length of the snake is between 30-45 times of the diameter of its body ..... ***Rhamphotyphlops***

- Maximum length not less than 200 mm. Scales round the body are 18-34. 400-500 transverse row of scales along the body length. Total length of the snake is between 40-60 times of the diameter of its body ..... ***Typhlops***

Genus *Rhamphotyphlops*

Genus *Ramphotyphlops* is represented by a single species in Goa State.

*41. *Ramphotyphlops braminus* (Daudin)

1803. *Eryx braminus* Daudin, *Hist. nat. Rept.*, 7 : 279.

Common name : English : Common Blind snake, Worm snake.

Diagnostic characters : Order Squamata has two Suborders, Serpentes (Ophidia) or Snakes and Sauria (Lacertilia) or lizards. Snakes can easily be distinguished from lizards by a combination of characters. Absence of limbs and girdles, eyelids and external ear openings are some of these characters. Body elongated and snake like. There is an absence of fusion between the two halves of lower jaw but are united by ligaments only. They can move independently. The body is covered with ungranulated cycloid scales. Nictitating membrane and a transparent spectacle are well developed over the eyes. Tongue retractile and acts as an olfactory organ. Teeth are pointed, sharp and recurved. Most of the skull bones except those in palatal region are flexible. Left lung is either rudimentary or absent. Locomotion is effected by lateral undulation of dorsal musculature. Vestiges of pelvis are present in family Typhlopidae. Prefrontal and nasal bones are in articulation in the family. Coronoid bone present. Maxillary bones loosely attached and bear teeth. Typhlopid snakes are worm like cylindrical bodied snakes covered uniformly with cycloid scales. Eyes minute but distinct, covered by enlarged ocular shield like scales. Mouth small and ventrally situated. Mandibles (lower jaws) devoid of teeth. *Ramphotyphlops* is an annelid

worm like burrowing snake whose head is not differentiated from the tubular body. Tail quite short and bears terminal spinous hook which helps in locomotion. Nasal bones not in contact with each other behind the rostral. Nostrils are in lateral position. 20 scales round the body. 290-320 transverse row of scales along the body length. Total length of the snake is between 30-45 times of the diameter of its body. Dorsal colouration varies from brown to black. While ventrum is light brown. Snout, anal portion and tail tips are somewhite whitish. Standard total length 100-138 mm and never more than 200 mm.

Locality : Five specimens have been collected by the ZSI survey party in past (Sharma, 1976). This is the first collection record from Goa State.

Distribution : Whole of India.

Habitat : Usually leads solitary life, but occasionally seen in aggregations in rotting wood. Prefers to live beneath soil, stones, debris, and barks of rotten wood. An active burrower but slow mover above the ground. Often seen inside houses. Preyed upon by other snake spp.

Status : Fairly common in the distributional range (Sharma, 2003). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

Genus *Typhlops*

Genus Typhlops is represented by a two species in Goa State.

Key to the species of the Genus *Typhlops* from Goa State

1. Maximum length upto 290 mm only rarely exceeds in length. Scales round the body are 18. 400-440 transverse row of scales along the body length. Total length of the snake is between 50-60 times of the diameter of its body ..... *Typhlops porrectus*

– Largest species amongst the worm snakes. Maximum length reaches upto 600 mm. Scales round the body are 28-34. 450-500 transverse row of scales along the body length. Total length of the snake is between 40-60 times of the diameter of its body ..... *Typhlops acutus*

42. ***Typhlops porrectus*** Stoliczka

1871. *Typhlops porrectus* Stoliczka, J. A. S. Beng., **40** 426 pl. 25, figs. 1-4.

Common name : English : Slender Worm snake.

Diagnostic characters : Serpentes (Ophidia) or snakes can easily be distinguished by a combination of characters such as total absence of limbs and girdles, eyelids and external ear openings etc. Body always elongated and snake like. The body is covered with ungranulated cycloid scales. Nictitating membrane and a transparent spectacle are well developed over the eyes. Teeth are pointed, sharp and recurved. Most of the skull bones except those in palatal region are flexible. Vestiges of pelvis are present in Family *Typhlopidae*. Prefrontal and nasal bones are in articulation in the family. Coronoid bone present. Maxillary bones loosely attached and bear teeth. Typhlopid snakes are worm like cylindrical bodied snakes covered uniformly with cycloid scales. Eyes minute but distinct, covered by enlarged ocular shield like scales. Mouth small and ventrally situated. Mandibles (lower jaws) devoid of teeth. *Typhlops* is an annelid worm like burrowing snake. Tail quite short and bears terminal spinous hook which helps in locomotion. Nasal bones not in contact with each other behind the rostral. Nostrils are in lateral position. 18 scales round the body. 400-440 transverse row of scales along the body length. Total length of the snake is between 50-60 times of the diameter of its body. Dorsal colouration varies from brown to blackish. While ventrum is light brown or still paler. Snout, chin and anal portion are generally whitish. Standard total length upto 290 mm and never more.

Locality : Sharma (2000) and 2003) reported the distribution of this species throughout India including Goa State.

Distribution : Whole of India.

Habitat : Usually leads solitary subterraenean life. Prefers to hide under stones, debris, and barks of rotten wood. Lives in association with various small insects like earwigs, silverfish and spiders (Sharma, 2003).

Status : Fairly common in the distributional range (Sharma, 2003). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

*43. ***Typhlops acutus*** (Dum. & Bibr.)

1844. *Onychocephalus acutus* Dumeril & Bibron, *Erp. Gen.*, **6** : 333.

Common name : English : Beaked Blind snake.

Diagnostic characters : Beaked blind snake possesses all the characters of family Typhlopidae and Genus *Typhlops*. However beaked blind snake has nasal bones in contact with one another behind rostral, which is very large covering large part of the head. Moreover snout is strongly pointed, hooked and projecting strongly with sharp horizontal edge. Nostrils inferior. 26-28 scales round the body. Tail ending in a small spine. Colouration brown above while pale below. This is the largest of all the blind snakes. Total length between 450 mm to 600 mm.

Locality : One specimen has been collected from Ponda by the ZSI survey party in past (Sharma, 1976). Smith (1943), Daniel (1983) and Ahmed and Dasgupta (1992) have reported wide occurrence of this species in the region south of Ganges in peninsular India above 16° Latitude. The species is endemic to the peninsular Indian region. This is the first collection record from Goa State.

Distribution : Endemic to peninsular India from Gangetic plains to 16° Latitude.

Habitat : Habit and habitat similar to that of *Rhamphotyphlops braminus*. However, beaked blind snake is believed to feed on worms also.

Status : Uncommon in its range of distribution (Sharma, 2003), Indian Wildlife (Protection) Act 1972 (as amended upto 1991) Schedule : Schedule : IV.

Remarks : The species appears to be rare south of Latitude 16° N. Whitaker and Captain (2004) have considered treating this species as *Grypotyphlops acutus*. However, the Beaked worm snake has been treated here as *Typhlops acutus* (Dum. and Bibr.) based on keys and observations reported for the species by Smith (1935) and Sharma (1976, 2000 and 2003). The species is endemic to Western India.

Family UROPELTIDAE

Family Uropeltidae contains Rough tailed or shieldtail uropeltid snakes and it is represented by two genera in Goa State.

Key to the genera of the family UROPELTIDAE from Goa State

1. A mentle groove present. ..... ***Melanophidium***
– Mentle groove absent ..... ***Uropeltis***

Genus ***Melanophidium***

Genus *Melanophidium is* represented by a single species in Goa State.

44. ***Melanophidium punctatum*** Beddome

1871. *Melanophidium punctatum* Beddome, *Madras Monthly J. Med. Sci.*, : 401.

Common name : English : rough tailed snake or Pied-belly shieldtail snake or Travancore Melanophidium snake.

Diagnostic characters : Serpentes (Ophidia) or snakes can easily be distinguished by a combination of characters such as total absence of limbs and girdles, eyelids and external ear openings etc. Head is not distinct from neck in family Uropeltidae. Snout is obtusely pointed. The body is short, cylindrical and is covered with smooth scales. Ventral scales are slightly larger than dorsal scales. Tail is quite short with its

terminal end portion transformed into a large, file like naked shield, a characteristic feature of the family. Tail tip bears a scute with a lateral or superior ridges. Most of the skull bones except those in palatal region are flexible. Vestiges of pelvis may be present in family Uropeltidae. Presence of a mentle groove is a characteristic feature of the genus *Melanophidium*. Eyes minute but distinct, covered by enlarged ocular shield like scales. Mouth small and ventrally situated. Suture between the ocular and frontal shields is less than 1/3rd the length of the frontal shield. Ventrals and outer 2-3 body scale rows are white and bear a central black spot on each scale. 15 scales round the body. Dorsal colouration is black, while ventrum is white. Standard total length upto 560 mm. Diameter of the body of fully grown adult is between 14-16 mm. Ventral shields are 180-198 in number and almost two times broader than the adjacent scales. Subcaudal scales between 11-18.

Locality : Sharma (2003) and Whitaker and Captain (2004) reported the distribution of this species in Goa State (Locality : Telewady).

Distribution : Maharashtra, Kerala and Tamil Nadu (Annamalai Hills) in Western Ghats. The species is endemic to Western Ghats.

Habitat : The species is generally seen at higher altitude between 1200-1500 m. Usually leads subterraenean life in hard clay mixed soil (CAMP Report, 1998). Generally lives in semi-evergreen forests and tea plantations in southern states. Feeds on earthworms (Whitaker and Captain, 2004).

Status : Available in sufficient number (Sharma, 2003) and rare (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Vulnerable.

Remarks : Locality Telewady mentioned erranously in Goa State by Sharma (2003) and Whitaker and Captain (2004) is perhaps actually Talewadi on Goa-Karnataka Border in Karnataka State as rightly mentioned by Murthy (1985).

Genus *Uropeltis*

Genus *Uropeltis* is represented by six species in Goa State.

Key to the species of the Genus *Uropeltis* from Goa State

1. Truncated oblique upper part of tail small, convex (Not flat) and is covered with thickened, multicarinate scales..... ..... *Uropeltis ellioti*

   Truncated oblique upper part of tail large, flat and concave and is covered with thickened bi-, tri- or multicarinate scales 2

2. Scales in 15 rows. ..... *Uropeltis macrolepis*

   Scales in 17 rows I

I. Visible rostral portion not or not much longer than its distance from the front shield..... ..... *Uropeltis ceylanicus*

   Visible rostral portion is distinctly longer than its distance from the front shield. i

i. A yellow line along each lateral aspect of the front portion of the body. Ventral shields : 138-157..... *Uropeltis phipsoni*

   Ventrum is yellowish with dark spots or cross Bars. Ventral shields : 138-157..... ..... *Uropeltis myhendrae*

45. ***Uropeltis ellioti*** (Gray)

1858. *Uropeltis ellioti* Gray, *Proc. Zool. Soc.*, 5 262

Common name : English : Elliot's Uropeltis or Elliot's Shieldtail Snake

Diagnostic characters : Uropeltid or shieldtailed snakes can be distinguished by a combination of characters such as total absence of limbs, eyelids and external ear openings etc. Head is not distinct from neck in the family Uropeltidae. Snout is obtusely and sharply pointed. The body is short, cylindrical and is covered with smooth scales. Ventral scales are slightly larger than the dorsal scales. Tail is quite short with its terminal end portion transformed into a large, file like naked shield, a characteristic feature of the

family. Truncated oblique upper part of the tail large, flat and concave and is covered with thickened bi-, tri- or multicarinate scales. Tail tip bears a scute with a lateral or superior ridges. Vestiges of pelvis may be present. Mentle groove is absent in genus *Uropeltis*. Eyes distinct with round pupil. Mouth small and ventrally situated. Rostral is separating the nasals for most of their length. 17 scales round the body. Dorsal colouration is glossy dark brown black with or without small yellow spots scattered all over the body with larger ones on the ventral side. There is a distinct yellow line along sides of the neck and a broad yellow stripe on each side of the tail. The stripes join by a cross bar at the anal region. Standard total length upto 260 mm. Ventral shields are 144-176 scales. Subcaudal scales are between 5-11, paired.

Locality : Sharma (2000, 2003) and Whitaker and Captain (2004) reported the distribution of this species in Goa State. The Nearest collection locality recorded by Whitaker and Captain (2004) appears to be close to Goa State border.

Distribution : Gujrat, Maharashtra, Kerala and Tamil Nadu in Western Ghats, while Andhra Pradesh and Tamil Nadu in Eastern Ghats (Sharma, 2003). Appears to be Western and Eastern Ghats endemic species.

Habitat : Usually leads fossorial life. (CAMP Report, 1998). Generally lives in wet evergreen, semi-evergreen and dry deciduous forests. Feeds mainly on earthworms. Mostly nocturnal, agile and insectivorous species hiding under loose sand, mud, dead wooden log and in decaying forest leaf litter. Females bear live young ones. Predators include raptors, wild boar and other snake species(Whitaker and Captain, 2004).

Status : Indian endemic species. Rare (Sharma, 2003) and common (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

46. ***Uropeltis macrolepis*** (Peters)

1861. *Uropeltis macrolepis* Peters, *Serp. Fam. Uropelt.*, : 904.

Common name : English : Peter's Uropeltis or Large scaled Shieldtail or Mahrrata roughtail Snake.

Diagnostic Characters : Uropeltid or shieldtail snakes can be distinguished by a combination of characters such as total absence of limbs, eyelids and external ear openings etc. Head is not distinct from neck in the family Uropeltidae. Snout is rounded. The body is short, cylindrical and is covered with smooth scales. Loreal scale absent. Tail is very short and appears to be cut at a slant ending in two small points that are side by side. Truncated oblique upper part of the tail large, flat and concave and is covered with thickened bi-, tri- or multicarinate scales. Upper scales on tail rough and keeled. Vestiges of pelvis may be present. Mentle groove is absent in genus *Uropeltis*. Eyes distinct with round pupil. 15 scales round the body. This is a moderately large-sized uropeltid snake. Dorsal colouration is glossy dark blackish brown or dark purpleish brown with each scale with a light margin. A short and broad yellow or orange stripe on lips and sides of neck that later breaks up and continues as large spots on either side of the forebody. Belly scales usually unmarked. There is a broad yellow stripe on each side of the tail. The stripes join by a cross bar at the anal region. Standard total length upto 300 mm. Ventral shields with 125-140 scales. Subcaudal scales are between 7-10, paired.

Locality : Sharma (2000, 2003) and Whitaker and Captain (2004) reported the distribution of this species in Goa State. The Nearest collection locality recorded by Whitaker and Captain (2004) is Amboli in Western Ghats close to Goa State border.

Distribution : Western Ghats (Sharma, 2003 and Whitaker and Captain, 2004). Western Ghats endemic species.

Habitat : Usually leads fossorial life (CAMP Report, 1998) Inoffensive burrower. Generally

lives in secondary, semi-evergreen, and deciduous forests. Feeds mainly on earthworms. Mostly nocturnal, agile and insectivorous species hiding under stones and dead wooden logs. Predators include wild boar and other snake species (Whitaker and Captain, 2004).

Status : Western Ghats endemic species. Quite common particularly in rainy season (Sharma, 2003) and common (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Vulnerable.

Remarks : Nil.

47. ***Uropeltis ceylanicus*** Cuvier

1829. *Uropeltis ceylanicus* Cuvier, *Reg. Anim.*, 2nd Ed. : 76.

Common name : English : Cuvier's Uropeltis or Kerala Shieldtail Snake

Diagnostic characters : Uropeltid or shieldtail snakes can be distinguished by a combination of characters such as total absence of limbs, eyelids, external ear openings etc and by characteristic presence of thickened, flat, rough, multicarinate file like scales on the dorsal side of the end portion of the tail. Head is not distinct from neck and vestiges of pelvis may be present in family Uropeltidae. Mentle groove is absent in genus *Uropeltis*. The moderately large sized snake possesses obtusely pointed snout. The body is short, cylindrical and is covered with smooth scales. Tail is very short and appears to be cut at a slant ending in two small points that are side by side. Truncated oblique upper part of the tail large, flat and concave and is covered with thickened bi-, tri- or multicarinate scales forming a distinct disc. 17 scales round the body. Dorsal colouration is uniformly blackish or brownish. Some individual may possess transversely arranged spots. A yellow lateral stripe is also present in few individuals. Belly scales may be yellowish with or without dark brown or black spots or entirely brown or black. There is a broad yellow stripe on each side of the tail. Standard total length upto 455 mm with diameter of the body 15 mm. Ventral shields 119-146 scales. Subcaudal scales are between 8-12, paired.

Locality : Smith (1935) and Sharma (2000, 2003) reported the distribution of this species in Goa State (Castle Rock).

Distribution : Western Ghats (Smith, 1935 and Sharma, 2003). Western Ghats endemic species.

Habitat : Usually leads fossorial life (CAMP Report, 1998). Generally lives in secondary vegetation (Plantation) and evergreen forests. Mostly nocturnal, agile and insectivorous species hiding under stones and dead wooden logs.

Status : Western Ghats endemic species. Most common in its distributional range(Sharma, 2003). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-least concern.

Remarks : Nil.

48. ***Uropeltis phipsoni*** (Mason)

1864. *Silybura phipsonii* Mason, *Ann. Mag. Nat. Hist.*, (6)i : 184.

Common name : English : Bombay Hills Uropeltis or Phipsoni roughtail Snake.

Diagnostic Characters : Uropeltid or shieldtail snakes can be distinguished by a combination of characters such as total absence of limbs, eyelids and external ear openings etc. and by characteristic presence of thickened, flat, rough, multicarinate file like scales on the dorsal side of the end portion of the tail. Head is not distinct from neck but is narrower than neck. Vestiges of pelvis may be present. Mentle groove is absent in genus *Uropeltis*. Snout is obtusely pointed. The body is short, cylindrical and is covered with smooth scales. Loreal scale absent. Visible rostral portion is distinctly longer than its distance from the front shield. Tail is very short and appears to be cut at a slant ending in two small points that are side by side. Truncated oblique upper part of the tail large, flat and concave and is covered with thickened bi-, tri- or multicarinate scales. 17 scales round the body. This is a moderate-sized uropeltid snake. Dorsal colouration is glossy brown or purplish brown with or without yellow molting or dots.

Lip scales partly yellow. A short and thin yellow line from behind mouth runs along sides of neck and forebody that later breaks up and continues as spots further back. Belly scales coloured like back sometimes with a few very small, faint yellow spots. There is a broad yellow stripe on each side of the tail. The stripes join by a cross bar at the anal region. Standard total length upto 280 mm with a diameter of the body 9mm. Ventral shields with 138-157 scales. Subcaudal scales are between 7-12, paired.

Locality : Sharma (2000, 2003) and Whitaker and Captain (2004) reported the distribution of this species in Western Ghats including Goa State. The Nearest collection locality recorded by Whitaker and Captain (2004) is Belgaon close to Goa State border.

Distribution : Western Ghats (Sharma, 2003 and Whitaker and Captain, 2004). Western Ghats endemic species.

Habitat : Usually leads fossorial life(CAMP Report, 1998). A docile snake. Generally lives in evergreen, semi-evergreen deciduous and secondary forests. Feeds mainly on earthworms. Active above ground after heavy rains. Predators include birds and wild boar (Whitaker and Captain, 2004).

Status : Western Ghats endemic species. Rare (Sharma, 2003) and common (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

49. ***Uropeltis myhendrae*** (Beddome)

1886. *Silybura myhendrae* Mason, *Ann. Mag. Nat. Hist.*, (5)**xvii** : 15.

Common name : English : Myhendra Mountain Uropeltis or Barred shieldtail Snake.

Diagnostic characters : Uropeltid or shieldtail snakes can be distinguished by a combination of characters such as total absence of limbs, eyelids and external ear openings etc. and by characteristic presence of thickened, flat, rough, multicarinate file like scales on the dorsal side of the end portion of the tail. Head is not distinct from neck but is narrower than neck and vestiges of pelvis may be present in the family. Mentle groove is absent in genus *Uropeltis*. Snout is obtusely pointed. The body is short, cylindrical and is covered with smooth scales. Loreal scale absent. Visible rostral portion is distinctly longer than its distance from the front shield. Tail is very short and appears to be cut at a slant ending in two small points that are side by side. Truncated oblique upper part of the tail large, flat and concave and is covered with thickened bi-, tri- or multicarinate scales. 17 scales round the body. This is a fairly large-sized uropeltid snake. In morphology and scale characteristics it is quite similar to *U. phipsonii* but differs in size (540 mm), diameter (17 mm) and colouration. Dorsal colouration is purplish brown. Each scale bears a yellowish posterior border forming more or less distinct tranverse cross bars, particularly on the anterior part of the body. Ventrum is yellowish and thickly spotted or barred with brown or black. In exceptional cases some individuals may possess darker annulations of same colour as that of the back. Standard total length upto 540 mm with a diameter of the body 17 mm. Ventral shields with 139-156 scales. Subcaudal scales are between 6-8, paired.

Locality : Smith (1935), Sharma (2000, 2003) and CAMP Report (1998) reported the distribution of this species in Western Ghats including Goa State.

Distribution : Western Ghats (Sharma, 2003 and CAMP Report, 1998). Western Ghats South of Goa. Western Ghat endemic species.

Habitat : Usually leads fossorial life (CAMP Report, 1998). Nothing much is known about the habit and habitat of this species.

Status : Western Ghats endemic species. Undeterminate (Sharma, 2003). Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Data Deficient.

Remarks : Nil.

Family BOIDAE

Family Boidae contains Pythons and Boas and is represented by two genera in Goa State.

Key to the genera of the family BOIDAE from Goa State

1. Supraorbital bone is present; teeth present on the premaxilla; head is with large symmetrical shields and labial scales are pitted ... ***Python***

– Supraorbital bone is absent; No teeth present on premaxilla; head is covered with small scale-like shields and labial scales are not pitted ..... ***Eryx***

Genus *Python*

Genus *Python* is represented by a single species in Goa State.

*50. *Python molurus* (Linnaeus)

1758. Coluber molurus *Linnaeus*, Syst. Nat. ***10th Ed.*** : *225.*

Common name : English : Indian rock python.

Diagnostic Characters : Indian rock python possesses all the characters mentioned earlier for the Suborder Serpentes. All snakes in the Family *Boidae* possess teeth in both the jaws, prominent eyes and vestiges of hindlimbs. This family comprises the largest living snakes, the pythons and boas. Some of them reach to a length of about 10 metres. The snake species of this family are easy to identify due their large size and presence of typical colouration pattern. The sensory pits on the rostral and first two labials distinguish python from all other Indian snakes. Its maximum length is 7 m. and weight 85 kg. The head is quite distinct from the neck and possesses symmetrical shields on top. Coastals are smooth and arranged in 60-75 rows, centrals (Large transversely enlarged plates) 245-270 and caudals in 60-72 pairs. Comparatively small eyes with vertical pupils. The body is covered with small, smooth scales. The skull is with ectopterygoid, supratemporal and other palatal bones. Supratemporal articulates with the cranium like a scale. Quadrate bones fully suspending. Ground colour greyish, whitish or yellowish in adults. A dark streak from eye to nostril found in young one may be retained in adult forms. On the back of the head and the nape is a large lance-shaped mark with a pale centre. The body with a series of large, roughly quadrate patches from neck to tail dorsally. The patches are centrally of the same colour as the general body colour and are broadly outlined with black. Two smaller rows of markings occur to the side of the median row. In freshly moulded specimen the dorsal patches are highly iridescent giving bluish and amenthystine hues in certain lights.

Locality : ZSI survey party during project period sighted one live specimen in the thick forest of Bhagawan Mahaveer Sanctuary, Molem.

Distribution : Peninsular India.

Habitat : Normally a forest dweller occurring in dense as well as in open forests with rock outcrops. Python is a terrestrial, arboreal and carnivorous snake. Feeds on mammals, bird and reptilian species. Coiling and constrictions by python resulting in suffocation kills sometimes animals of larger size.

Status : Vulnerable Sharma (2000) and not uncommon (Daniel, 1983). IUCN category as per CAMP Report (1998) : Lower risk-Near threatened, Indian Wildlife (Protection) Act (1972 as amended upto 2002) Schedule : Schedule : I Part : II, CITES : Appendix : I, Red Date Book (1994) : Endangered.

Remarks : The survival of the species is in danger due to illegal trade for skin, body parts and live animals at national and international level (Pradhan, 1997).

Genus *Eryx*

Genus *Eryx is* represented by three species in Goa State.

Key to the species of the Genus *Eryx* from Goa State

1. Scales on head and tail strongly keeled. Tail pointed ..... *Eryx conicus*

- Scales on head and tail weakly keeled and smooth Tail blunt and round .....2.

2. Mentle groove present. Body colour, though variable, uniform without any distinct blotches. ..... *Eryx johnii*

- Mentle groove absent. Body colour brown with darker brown coloured blotches .... *Eryx whitakeri*

*51. ***Eryx conicus*** (Schneider)

1801. *Boa conica* Schneider, *Hist. Amphibia*, ii : 268

Common name : English : Common or Russell's sand Boa, Russell's Earth Boa.

Diagnostic Characters : Rusell's sand/Earth Boa possesses all the characters mentioned for suborder : Serpentes, family Boidae and genus *Eryx*. However, mental groove is absent and tail end is pointed in Russell's sand/Earth Bao. Moreover, Head is slightly distinct from neck. Rostral about two times broader than head. All scales except nasals and internasals on head are small. A markedly stout snake. Body short and heavy. Scales on head and tail strongly keeled. Tail short and tapering so rapidly that it is conical in shape. Total length not exceeding 950 mm. Body scales are 40-55 in number, ventral scales 161-196 and subcaudals 16-24. Anal is small and undivided. Hemipenis is not forked. Dorsal colouration is yellowish, brownish or grayish mixed with a dorsal series of dark brown black-edged spots. Flanks molted brown varying in shades. Just above vent on each side is a small curved claw-like process directed backwards in the female, which indicates the termination of the rudimentary hindlimb. It is well developed in males. The skin is rough on the back owing to the keeled scales.

Locality : ZSI survey party has sighted one live specimen in Bondla wildlife sanctuary during the project period.

Distribution : Whole of India.

Habitat : Terrestrial and arboreal. Generally considered as a snake of arid areas, but is also found in multiparous habitats. It is marginally commensal as well. *Eryx conicus* is a dull creature but with uncertain temperament. It is also speedy burrower. However, its life is not fully subterranean. Feeds on small rodents, birds and frogs. It kills its victim by constriction.

Status : Common in the distributional range (Daniel, 1983; Sharma, 2003 and Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972 as amended upto 2002) Schedule : Schedule : IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : The species is traded illegally for body parts and live individuals at domestic level (Pradhan, 1997). As per CAMP Workshop Report (1998) there is a threat to the survival of the species due to loss of habitat, human interference and illegal trade. Whitaker and Captain (2004) have kept this species under Genus *Gongylophis*. However, it has been retained here as *Eryx conicus* only following Sharma (2000, 2003) and CAMP report (1998).

52. ***Eryx johnii*** **(Russell)**

1801. *Boa johnii* Russell, *Ind. Serp.*, ii : 18 & 20.

Common name : English : Indian Sand Boa, John's sand Boa, Red Sand Boa, Black Earth boa, Stump- tailed Sand Boa.

Diagnostic Characters : Indian sand Boa or John's sand Boa possesses all the characters mentioned earlier for the family Boidae. However, supraorbital bone is absent, teeth are absent on premaxillary bone, head covered with small scale-like shields and labial scales are normal and not with pits in John's sand Boa. The body of the snake is cylindrical and robust which suddenly tappers immediately after vent. Scales on head and tail weakly keeled and smooth. Tail ends abruptly into blunt shield. Head not distinct from neck. Snout broad, nostrils opening like a slit. Eyes distinct, small and with vertically elliptical pupil. Ventral scales do not cover the whole width of the ventrum. Subcaudals not divided. Mental groove present. Adults uniform light brown, or dark olivaceous brown in colour with or without fine dark reticulations arranged to form crossbars.

Markings when present conspicuous posteriorly only. Ventral side lighter. Young ones are brick red or sandy red in colour. Back with dark blotches or ruddy-brown crossbars. Adults approximately 1 metre in length (Males : 980 mm, Females : 1080 mm). Scales rows on middle of the body 51-67 (Scales feebly keeled), ventrals in males 193-212 and in females 198-215; anal shield is small and undivided, caudals in males 28-40 and in females 29-34.

Locality : Daniel (1983), Das (1991), Sharma (2003) and Whitaker and Captain (2004) have reported wide occurrence of this species in the Indian subcontinent.

Distribution : Whole of India.

Habitat : Burrowing snakes preferring to live in and around croplands, scrublands and different types of forests. The snake possesses gentler temperament with inoffensive behavior. It is a speedy burrower. Feeds mainly on small rodents killing them by constriction.

Status : Common in distributional range (Daniel, 1983, Sharma 2003 and Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972 as amended upto 2002) : Schedule : Schedule : IV, IUCN category as per CAMP Workshop(1998) : Lower risk-least concern.

Remarks : Sometimes live snake is used in street-shows by snake charmers (Pradhan, 1997).

53. ***Eryx whitakeri*** I. Das

1991. *Eryx whitakeri*, Das. I., *J. Bombay nat. Hist. Soc.*, **88** : 92-97.

Common name : English : Whitaker's Boa.

Diagnostic characters : Whitaker's Boa, a recently described new species by Das (1991) possesses all the characters mentioned earlier for the family Boidae. However, supraorbital bone is absent, teeth are absent on premaxillary bone, head covered with small scale like shields and labial scales are normal and not with pits. The body of this medium sized snake is cylindrical and robust which suddenly tappers immediately after vent. Scales on head and tail weakly keeled and smooth. Tail ends abruptly into blurt shield. Head not distinct from neck. Snout broad, nostrils opening like a slit. Eyes distinct small and with vertical pupil. Ventral scales do not cover the whole width of the ventrum. Subcaudals entire. Mental groove absent. Adults brown blotched with darker brown in colour. Similar to common sand Boa except that Whitaker's Boa possesses abruptly ending blunt, rounded and smooth scaled tail. Ventral side lighter. Overall appearance of Whitaker's Boa is smooth, while that of Common sand Boa is rough. Adults approximately 790 cm -1 metre in length Scales rows on middle of the body 50-54 (Scales feebly keeled), ventrals scales : 201-213; caudals 18-25, entire.

Locality : Das (1991) and Whitaker and Captain (2004) have reported wide occurrence of this species in theWestern Ghats including Goa State. Western Ghat endemic species.

Distribution : Western Ghats in India.

Habitat : Poorly known snake species. Appears to be nocturnal and occasionally arboreal preferring to live in scrubland, deciduous, west coast forests. The snake has been found in areas of heavy rainfall. Feeds on small rodents and Brook's Geckos in captivity.

Status : Common in distributional range (Das, 1991 and Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972 as amended upto 2002) : Schedule : Schedule : IV IUCN category as per CAMP Workshop(1998) : Vulnerable.

Remarks : Whitaker's Boa has not been listed in Sharma (2003).

Family ACROCHORDIDAE

Family Acrochordidae is represented by a single species under the genus *Chersydrus*. Though Sharma (1976), CAMP Report (1998) and Whitaker and Captain (2004) have maintained the generic name *Acrochordus*, the name *Chersydrus* has been retained here following the systematic arrangement given in Murthy (1985), Sharma (2000) and Sharma (2003).

Genus ***Chersydrus*** (= ***Acrochordus***)

Genus *Acrochordus* is represented by a single species in Goa State.

*54. ***Chersydrus granulatus*** (Scneider) = ***Acrochordus granulatus*** (Scneider)

1799. *Hydrus granulatus*, Schneider. *Hist. Amphib.*, **1** : 243.

Common name : English : Elephant Trunk or Indian Wart or File Snake.

Diagnostic characters : Indian Wart or File Snake possesses scales, which are small, juxtaposed or subimbricate and generally granular. Ventral scales are slightly larger than the dorsal scales. Body is slightly flattened on lateral aspects. Head is distinctly broader than the neck. The body of this fairly large-sized snake is cylindrical stout and robust covered with loose skin. Tail is short and prehensile. Eyes moderately large with vertically elliptical pupils and absolutely lateral in position. Head is covered with small granular scales. Upwardly pointed nostrils with valves are quite close and enclosed in nasal shields. They are situated on the upper surface of the snout. Ventral shields are not present. General body colouration is dark grey or some what blackish with whitish annulation all over the body. The white rings are quite distinct in juveniles, but as the age increases the colour fades. The annulations are more prominent on dorsal side. Dorsal side of the head is dark grey with lighter spots. A fold of loose skin is available along the middle of the belly which is covered with small spine bearing scales. Posterior portion of the body and tail strongly compressed. Hemipenis is forked for more than half the length. Adults approximately 1100 mm in length. Tail Length 66 mm. Scales on middle of the body 100; 8-11 scales on a line between the eyes. 14-22 supralabials.

Locality : One specimen has been collected from Panjim sea beach area of Goa State by Sharma in 1976.

Distribution : Shallow coastal and estuarine waters of India.

Habitat : Extremely sluggish snakes inhabiting mainly estuarine and shallow coastal waters throughout the range. Feeds mainly on fishes. A docile snake and do not make any attempt to bite. Viviparous species giving birth to 6-12 young ones at a time.

Status : Fairly common in distributional range (Sharma, 2000, 2003) and uncommon (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972 as amended upto 2002) : Schedule : Schedule : IV, IUCN category as per CAMP Workshop (1998) : Lower risk-Near threatened (For *Acrochordus granulatus*).

Remarks : Skin of this snake is traded in the local market (CAMP Report, 1998).

Family COLUBRIDAE

Family Colubridae is represented by two subfamilies in Goa State.

Key to the Subfamilies of the Family COLUBRIDAE

1. Maxillary teeth solid (Aglypha). Anterior part with solid teeth, but 2 or 3 posterior teeth are grooved. Nostrils not valvular, usually lateral. Scales imbricate ..... COLUBRINAE

– Last 2 or 3 maxillary teeth enlarged and grooved (Ophlathoglypha). Nostrils valvular, situated on the upper surface of the snout. Scales may be smooth, striated or strongly keeled. Ventrals narrow .... HOMALOPSINAE

Subfamily COLUBRINAE

Subfamily Colubrinae *is* represented by twelve genera in Goa State.

Key to the Genera of the Subfamily COLUBRINAE

(I) All the teeth solid and not grooved (Aglypha)

(A) Hypapophyses not developed on the posterior dorsal vertebrae

(i) Posterior maxillary teeth are longest but not grooved

1. Maxillary teeth 19 or less, last 2 or 3 are generally largest and separated from the other by a distinct diastema; subocular one or more; scales in 19-23 rows, smooth, head shields entire; head distinct from the neck. ..... ***Argyrogena***

2. Maxillary teeth 28 or less, enlarge gradually and form a continuous series; scales in 15-17 rows, slightly keeled, head shields entire; head distinct from the neck; body scales smooth or keeled on the median rows ..... ***Ptyas***

3. Maxillary teeth 16 or less, posterior strongly enlarged and compressed; scales in 13-21 rows, smooth, head shields normal; or reduced in number head may not be or scarcely distinct from the neck; rostral large, extend well on the upper surface of the snout ..... ***Oligodon***

(ii) Maxillary teeth are subequal. Pupil round or horizontal.

1. Scales in 19-27 rows, with apical pits. Pupil round ..... ***Elaphe = Coelognathus***

2. Scales in 13 or 15 rows, smooth. Pupil round. ..... ***Dendrelaphis***

3. Scales in 13 or 15 rows, oblique. Vertebrals are enlarged; ventrals and caudals with a suture like lateral keel and notch on each side. Pupil horizontal ..... ***Ahaetulla***

(iii) Some of the anterior maxillary teeth are enlarged and fang like. Pupil vertically elliptical. Scales in 15-19 rows.

1. Maxillary bone strongly arched. Scales in 15-17 rows, smooth or feebly keeled. Subcaudals divided ..... ***Lycodon***

(B) Hypapophyses developed throughout the vertebral column and represented on the posterior dorsal vertebrae by a more or less developed crest or tubercle projecting below the centrum.

(i) Dentary bone has got a loose attachment to the apex of the articular and freely movable on it; 30-50 teeth equal in size; scales in 17 rows ..... ***Sibynophis***

(ii) Dentary bone either not having a loose attachment or having a slight attachment to the apex of the articular and as such slightly movable on it; generally less than 30 teeth.

1. Posterior maxillary teeth longest; maxillary teeth 11-18 followed by a pair of very large fangs;two internasals; pupil round; scales are strongly keeled, in 25-27 rows ..... ***Macropisthodon***

2. Maxillary teeth are unequal; maxillary teeth 19-35 in number; head distinct from the neck; nostrils lateral; scales keeled, in 19 rows; hemipenis and sulci spematicus simple ..... ***Amphiesma***

3. Maxillary teeth are equal; 20-25 in number; head quite distinct from the neck; nostril is in the nasal pointing upward; scales strongly keeled, in 19 rows; hemipenis and sulci spematicus forked ..... ***Xenochrophis***

(II) Last two or three maxillary teeth are grooved.

(i) Pupil round. Maxillary teeth are 18-20 in number; scales in 17 rows ..... ***Chrysopelea***

(ii) Pupil vertical. Maxillary teeth are 10-14 in number; scales in 19-29 rows ..... ***Boiga***

Genus *Elaphe (= Coelognathus)*

Though Whitaker and Captain (2004) have maintained the generic name *Coelognathus*, the name *Elaphe* has been retained here following the systematic arrangement given in Murthy (1985), Sharma (2000) and Sharma (2003) Genus *Elaphe* is represented by a single species in Goa State.

*55. *Elaphe helena* (Daudin) = *Coelognathus helena* (Daudin)

1803. *Coluber helena* Daudin, *Hist. nat. Rept.* iv : 277

Common name : English : Trinket Snake, Common Trinket Snake.

Diagnostic Characters : Since trinket snake is a snake, it possesses all the characters mentioned earlier for suborder Serpentes. Presence of prominent eyes, normal teeth in both the jaws,

maxillary teeth and absence of poisonous fang are typical characters of family Colubridae. This is a large family comprising roughly more than 2500 species and subspecies of arboreal, burrowing, terrestrial and aquatic snakes belonging to 250 genera. They exhibit extreme diversity in size, shape and colour. Nostrils not valvular, usually lateral. Scales imbricate. A mental groove present. Ventral shields distinct. All teeth solid and not grooved. Hypapophyses absent on the posterior dorsal vertebrae. Posterior maxillary teeth not longest and all submaxillary teeth subequal. Pupil round. Scales in 19 to 27 rows with apical pits. *Elaphe helena* is with elongated and cylindrical body and also with head quite distinct from the neck. Dorsal colour brown of varying degree of intensity. An oblique streak from eye to lip. Forebody for some length ornamented with ocellated crossbars of a pattern peculiar to this snake. The patterns gradually disappear at distal end. There is usually a 'V' shaped conspicuous mark on nape. Finally broad dark coloured stripes on sides replaces crossbars on the body and extend upto tip of the tail. Total length never exceeds 1700 mm in length. Tail length around 181 mm. Posterior body scales keeled. Ventrals 217-265, subcaudals 73-100 paired and anal single.

Locality : Sharma (1976) collected one live specimen from Valpoi in 1969, while ZSI Survey party near Madgaon sighted another specimen during project period. This is the first collection record reported from Goa State.

Distribution : Throughout India.

Habitat : Usually found in or at the periphery of forest. Sometimes seen in human habitats also. It is a snake, which becomes aggressive when disturbed. Prefers diet of mammalian, lizard and even snake species when hungry. Though the snake coils round the prey, it does not constrict.

Status : Fairly Common in its area of occurrence (Daniel, 1983 and Sharma, 2003). Indian Wildlife (Protection) Act (1972 as amended upto 2002) Schedule : Schedule : IV, IUCN category as per CAMP Report (1998) : Lower risk- near threatened.

Remarks : Trinket snake has been collected from the urban areas also (WRS, ZSI, Collection).

Genus *Ptyas*

Genus *Ptyas* is represented by a single species in Goa State.

*56. ***Ptyas mucosus*** (Linnaeus)

1758. *Coluber mucosus* Linnaeus, *Mus. Ad. Frid.*, **1** : 37

Common name : English : Indian rat Snake, Dhaman.

Diagnostic Characters : Rat snake or Dhaman, being a snake possesses all the key characters mentioned for the suborder Serpentes and family Colubridae. However, the characteristic feature of genus *Ptyas* is there is no marked development of hypophyses on the posterior dorsal vertebrae. Posterior maxillary teeth longest and not grooved. Maxillary teeth 28 or less. They enlarge gradually and form a continuous series. Dorsal scales in 15-17 rows and slightly keeled. Head shields entire. Head distinct from the neck. Genus *Ptyas* includes long, cylinderical and slender snakes with most agile body. Eyes large with round pupil. Snout obtusely pointed. Dorsal colouration is olivaceous brown, sometimes as dark as sepia or light mustard yellow. Scales on the posterior part are irregularly margined with black colour forming reticulate pattern. There is a tendency of formation of black crossbars. Lip scales margined with black. Belly greyish white or dirty white or yellowish in colour.

Locality : ZSI survey parties have reported sighting of live specimens from Molem, Bondla and Valpoi areas of Goa State during the project period. Sharma (1976) collected five specimens from Canacona region in 1969, which is the first collection record reported from Goa State.

Distribution : Whole of India and Andaman Istalds.

Habitat : Terrestrial, semi-arboreal, semi-aquatic snake essentially seen on plains but recorded upto the altitude of 1800 m. Diurnal in habit, living in variety of habitats. Eclectic in diet.

Rat is not a staple diet of the snake as suggested by its popular name. It's preferred diet includes frogs, toads, lizards, birds and small vertebrates including rats and mice.

Status : Though common in its range of distribution, the rat snake is subjected to the commercial exploitation on account of its large-scale killing for skin and meat (Daniel, 1983, Pradhan, 1997, Sharma, 2000). Indian Wildlife (Protection) Act (1972 as emended upto 2002) Schedule : Schedule II (Part II), CITES Appendix : Appendix II, IUCN category as per CAMP report (1998) : Lower risk-Near threatened.

Remarks : Killing of rat snakes on large scales for its skin is a real threat to the survival of the sub-species. Rat snake skin is involved in illegal local, domestic and international trade (Pradhan, 1997). Some communities in different parts of the country eat the snake. There is a persistent erranous belief amongst illiterates that rat snake is the male of a Cobra. An unusual behavior seen in rat snake is a "Combat Dance" between the two males which twine around each other on the ground as well as when half erect. The "act" appears to be a part of mating behavior.

Genus *Argyrogena*

Genus *Argyrogena* is represented by a single species in Goa State.

57. *Argyrogena fasciolatus* (Shaw)

1802. *Coluber fasciolatus* Shaw, (based on Russell, 1796 p. 26, pl. 21).

Common name : English : Banded racer, Fasciolated rat snake.

Diagnostic Characters : Banded racer or fasciolated rat snake possesses all the characters mentioned for the family Colubridae. However, hypapophyses not developed on the posterior dorsal vertebrae. Posterior maxillary teeth long but not grooved. Maxillary teeth 19 or less. Subocular one or more. Scales in 19-23 rows smooth and with apical pits. Head shields entire. Head distinct from the neck. Ventral shields enlarged and rounded or obtusely angulate laterally, 185-234 in number. The snakes of this genus are elongated and cylindrical. Eyes large with round pupil. Many specimens with a lateral keel. Tail moderately long. Banded racer is a diurnal snake reaching to a length of 1350 mm. Anal shield divided. Hemipenis is devoid of spines. Dorsal colouration brown, cinnamon to greyish brown. Posterior part of the body with faint crossbars or spots, which gradually disappears towards the tail. Head is beautifully coloured with light and dark olive and two white spots on parietal shields on either side of the interparietal suture. Ventrum is whitish or yellowish.

Locality : Daniel (1983), Das (1991), Sharma (2003) and Whitaker and Captain (2004) have reported wide occurrence of this species in the Indian subcontinent including Goa State.

Distribution : Peninsular India, north to Himalaya and east to West Bengal.

Habitat : Terrestrial, preferring to live in scrub jungle, arid grassland, open forest tracts and urban areas. Diurnal. Found in rodent burrows, rock piles and heavy bushes. A plucky and aggressive snake when disturbed. Becomes tame in captivity. Feeds on small mammals and amphibians.

Status : Common in the range of distribution (Daniel, 1983 and Sharma, 2003), Uncommon (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972 as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report 1998 : Lower risk-Near threatened.

Remarks : When disturbed, it raises its body and tries to flatten the neck like a cobra.

Genus *Oligodon*

Genus Oligodon is represented by two species in Goa State.

Key to the species of the Genus *Oligodon* from Goa State

1. Scales in 13-15 rows at mid-body. Head with typical markings modified by confluence. ... . *Oligodon taeniolatus*

2. Scales in 17 rows at mid-body. Head with three chevarons, separate from one another. ..... *Oligodon arnensis*

*58. ***Oligodon taeniolatus*** (Jerdon)

1853. *Coronella taeniolata*, Jerdon, *J.A.S. Bengal*, **xxii** : 528.

Common name : English : Streaked kukri snake, Russell's or variegated kukri snake.

Diagnostic Characters : Streaked kukri snake possesses all the characters mentioned for the suborder Serpentes and family Colubridae. However, in genus *Oligodon* all teeth are solid and not grooved, hypapophyses on posterior dorsal vertebrae not developed. Kukri snakes are short bodied but stout snakes with cylindrical shape. Head not distinguished from neck. Snout short, blunt and obtusely rounded with much enlarged rostral. Eye distinct with round pupil. Maxillary teeth 6-7. Body scale smooth and devoid of any pits. Ventral shields round. Length of the body never exceeds 650 mm. Diameter uniform from neck to vent. Scales at mid-body in 15 rows. Ventral shields 158-218, subcaudal 29-56 and anal shield divided. Hemipenis forked and spinose extending upto 11th caudal plate. Dorsal colour variable from light brown to blackish-brown to buff with narrow cross bars or transverse spots, which may be round or elongate. Ventrum yellowish or grayish. A dark band across the head at the level of eyes is present. Nape with W-shaped dark collar. Variegation, if present, confined to flanks. Name kukri has been suggested due to presence of broad blade-like and peculiar shaped posterior maxillary teeth. Variegated kukri snake is the only snake species found on plains of Indian peninsular which has 15 scales rows throughout the length of the body and which possesses divided anal shield.

Locality : Sharma (1976) collected three specimens from Canacona region in 1969, which is the first collection record reported from Goa State.

Distribution : Whole of India.

Habitat : Though the species is a hill form, it is not uncommon near human habitation. Largely diurnal snake of variety of forests. Fond of basking in sun, on rock or grass. Feeds mainly on eggs of other reptiles and frogs spawn. Generally quite docile, but will flatten body and strike sideways when provoked (Whitaker and Captain, 2004).

Status : Fairly Common snake species Sharma, 2003 and uncommon (Whitaker and Captain, 2004)); Indian Wildlife (Protection) Act (1972 as amended upto 2002) Schedule : Schedule IV, IUCN Category as per CAMP Report (1998) : Lower risk-Near threatened (for *Oligodon taeniolatus fasciatus* (Gunther) which has been merged in *Oligodon taeniolatus*).

Remarks : As per CAMP Workshop Report (1998) there is a threat to the survival of the species due to loss of habitat and human interference.

*59. ***Oligodon arnensis*** (Shaw)

1802. *Coluber arnensis*, Shaw, *Gen. Zool.* **iii** : 526.

Common name : English : Russel's kukri snake, common kukri snake.

Diagnostic Characters : Common Kukri snake possesses all the characters mentioned for Family Colubridae and genus *Oligodon*. Like variegated Kukri Snake, common kukri snake never exceeds 650 mm in total length including tail length. Hemipenis is not forked but spinose and extends upto the 8th caudal plate only. Maxillary teeth in the range of 8-11 in number. Snout short and blunt. Nostril present in elongated nasal partly separating internasal. Rostral large. Scales in 17 : 17 : 15 rows. Head depressed. 4-5 infralabials. Body short, smooth and cylindrical. Colour reddish or greyish brown with series of black bands. Ventrum whitish, sometimes with faint spots. Head with chevron shaped mark. Common kukri snake differs from other kukri snakes by presence of divided anal shield, presence of loreal, 7 supralabials and more than 40 caudals. Back with black bars narrow but distinctly outlined with whitish or pale yellow colouration. Black bands breaks on the flanks into streaks. Number of bands varying.

Locality : Sharma (1976) reported collection of one specimen from Ponda region in 1969, which is the first collection record reported from Goa State.

Distribution : Peninsular India.

Habitat : Chiefly snake of plains however may be seen upto altitude of 1620 m. Terrestrial and diurnal in behavior preferring to live in variety of forests. Generally seen in rainy season. Not uncommon in the vicinity of human habitation, where it is seen in masonry of the old walls of the building. Found in termite mounds, caves, crevices, tree holes and old houses. It can easily climb. It possesses sharp, flattened, and curved teeth. Feeds chiefly on reptile eggs but also likes mice and other small mammalian species.

Status : Fairly common (Sharma, 2003 and Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-least concern.

Remarks : When alarmed, it inflates its body to a remarkable degree and some specimens also flatten the posterior part of the head making the head broader than usual.

Genus *Dendrelaphis*

Genus *Dendrelaphis* is represented by three species in Goa State.

Key to the species of the Genus *Dendrelaphis* from Goa State

1. Eye very large, as long as its distance from the rostral shield; no black temporal stripe; no lateral stripes on the body; tail with 3 black lines ..... *Dendrelaphis grandoculis*
2. Eye as long as its distance between it and nostrils; a more or less distinct temporal stripe; a light lateral band on the body... i

i. Vertebral row of scales starting directly behind the distal end of the parietal suture and thence gradually enlarged; posterior maxillary teeth usually shorter than the others; the 5th and 6th supralabials touching the eye .... *Dendrelaphis tristis*

ii. Vertebral row of single enlarged scales starting much behind the posterior border of the parietal suture and abruptly enlarged, seemingly by the fusion of two nutchal scales enlarged; posterior maxillary teeth longer than the others; 4th supralabial slightly touching the eye, while 5th and 6th touching the eye ..... *Dendrelaphis pictus*

*60. ***Dendrelaphis pictus*** (Gmelin) (= ***Ahaetulla ahaetulla*** (Linnaeus))

1789. *Coluber pictus*, Gmelin, *Syst. Nat.*, i : 1116.

Common name : Painted Bronzeback Bronzeback Tree snake.

Diagnostic Characters : Painted Bronze –Back Tree Snake possesses all the characters mentioned for family colubridae. Painted Bronze Back is a long, slender and smooth-scaled snake with its head distinctly broader than the neck. Snout bluntly rounded. Eyes large with round pupil. Tail very long thin wire-like. Dorsal colouration is bronze-brown or purplish brown. Ventrum is creamy white, greenish, yellowish or bluish. A yellow or cream-coloured, black bordered stripe on the flank along scale rows 1 and 2. Head is with a black temporal stripe wich extends to the neck where it generally breaks up into oblique bars. Upper lip and lower jaw is yellow or white. In certain cases the markings are reduced, the yellow flank stripe is absent or merely indicated and the black stripe is reduced to spots edging the scales. Ventral and tail sacles have outer edges keeled. Vertebral scales are distinctly enlarged than the outer scales. Painted Bronze-Back Tree snake reaches to a maximum length upto 1100 mm. with tail length of 365 mm in males, while 1220 mm and 400mm respectively in females. Body scales are in 15 : 15 : 11 or 9 rows. Ventral shields with 163-211, subcaudals 112-174. Anal shield is divided. Hemipenis is quite long and undivided. Maxillary teeth 23-28 in number with the last one being largest.

Locality : Sharma (1976) reported collection of three specimens from Molem and Canacona regions in 1969, which is the first collection record

reported from Goa State. However, he has determined them as *Ahaetulla ahaetulla* (Linnaeus) which has been synonymised in *Dendrelaphis pictus* (Gmelin) (Smith, 1943). Same view has been followed, later, by Sharma (2000 & 2003).

Distribution : Southern India.

Habitat : Terrestrial, diurnal and arboreal in behavior preferring to live in low bushes and trees in scrub to moist-deciduous forests. It is a very agile, extremely fast, and strong climber species. Can leap from branch to branch. It descends to the ground only to capture food which consists of frogs, toads, small lizards, small snakes birds and their eggs and even insects.

Status : Fairly Common (Sharma, 2003, Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Not Evaluated.

Remarks : The southern Indian population has been considered as *Dendrelaphis pictus pictus* (Gmelin).

*61. ***Dendrelaphis grandoculis*** (Boulenger) (= ***Ahaetulla grandoculis*** (Boulenger))

1890. *Dendrophis grandoculis*, Boulenger, *F.B.I.* : 337.

Common name : Nilgiri Olive-Brown Black-Blotched or Large-eyed Bronzeback Tree snake.

Diagnostic characters : Large-eyed Bronzeback Tree Snake possesses all the characters mentioned for family Colubridae and genus *Dendrelaphis*. This is also a long, slender and smooth-scaled snake with its head distinctly broader than the neck and slightly flattened body. Snout bluntly rounded. Eyes very large with round pupil as long as its distance from the rostral shield. Black temporal stripe and lateral stripes on the body totally absent though tail possesses 3 black lines. Tail very long thin wire-like. Dorsal colouration is olive brown with small black irregularly placed blotches. Vertebral scale feebly enlarged. Ventrum is pale brown in front and darker behind, sometimes with small black small spots on the sides. Ventral and tail sacles have outer edges sharply keeled. Large-eyed Bronzeback Tree Snake reaches to a maximum length upto 1280 mm. with tail length of 350mm. Body scales are in 15 : 15 : 11 or 9 oblique rows. Ventral shields are 167-189, with subcaudals 117-124, paired. Anal shield is divided. Maxillary teeth 31-33 in number with the last one being largest.

Locality : Sharma (1976) reported collection of two specimens from Valpoi region in 1969, which is the first collection record reported from Goa State. However, he has determined them as *Ahaetulla grandoculis* (Boulenger) which has been synonymised in *Dendrelaphis grandoculis* (Boulenger) (Smith, 1943). Same view has been followed, later, by Sharma (2000 & 2003).

Distribution : Southern Western Ghats in India. This is an Indian Endemic species. Further, collection of *D. grandoculis* from Goa State as reported by Sharma (1976) shows the exention of range of distribution in Western Ghats upto Goa State.

Habitat : Diurnal and arboreal in behavior preferring to live in low bushes and trees in scrub to moist-deciduous forests. It is comparatively a slower moving snake species but a good climber. Can leap from branch to branch. It descends to the ground only to capture food, which consists of frogs, toads, small lizards, small snakes birds and their eggs and even insects.

Status : Rare (Sharma, 2003) and Uncommon (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Vulnerable.

Remarks : Nil.

62. ***Dendrelaphis tristis*** (Daudin)

1803. *Coluber tristis*, Daudin, *Hist. Nat. Rept.*, **6** : 430.

Common name : Common Bronze-Back Tree Snake.

Diagnostic Characters : Bornze–Back Tree Snake possesses all the characters mentioned for

Family Colubridae. Bronze Back is a long, slender and smooth-scaled snake with its head distinctly broader than the neck. Snout bluntly rounded. Eyes large with round pupil. Tail very long thin wire-like. Dorsal colouration is bronzy, brownish or purplish brown. Ventrum is greenish, yellowish or grayish. Lateral aspect is with a buff or yellowish band, covering the two outer scale rows. Head is with a feeble black temporal stripe wich extends to the neck where it generally breaks up into verticle bars. Upper lip is yellow. Vertebral scales are feebly enlarged, slightly narrower than the outer scales. Bronze-Back Tree snake reaches to a maximum length of 1700 mm. Females are larger than the males. Body scales are in 15 : 15 : 11 or 9 rows. Ventral shields with 163-205, subcaudals 105-150. Anal shield is divided. Hemipenis extends up to the 8th caudal plate, undivided Maxillary teeth 17-22 in number.

Locality : Daniel (1983), Das (1991), Sharma (2003) and Whitaker and Captain (2004) have reported wide occurrence of this species in the peninsular Indian region including Goa State.

Distribution : Peninsular India, north to Gujrat and east to West Bengal.

Habitat : The species is seen from sea level to the altitude of 2000 m. Terrestrial, diurnal and arboreal in behavior preferring to live in bushes and trees in scrub to moist-deciduous forests. It is very agile, strong climber, shy, timid species. Can leap from branch to branch. It descends to the ground only to capture food which consists of frogs, toads, small lizards,birds and their eggs and even insects. Generally seen in rainy season.

Status : Vulnerable on account of habitat destruction (Sharma, 2003) and Common (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-least concern.

Remarks : Nil.

Genus ***Chrysopelea***

Genus *Chrysopelea* is represented by a single species in Goa State.

***63.** ***Chrysopelea ornata* (Shaw)**

1802. *Coluber ornatus*, Shaw, *Gen. Zool.*, iii : 477.

Common name : English : Golden Tree snake, Ornate Flying snake.

Diagnostic Characters : Golden Tree or Ornate Flying snake possesses all the characters mentioned for family Colubridae. It is a long and slender snake. It possesses last two or three maxillary teeth grooved. Head elongate, snout squarish with large eyes. Pupil round. The maximum length reaches upto 1100 mm including a very long tail. Hemipenis is undivided but composed of many folds and extends upto the 34th caudal plate. Maxillary teeth in the range of 18-20 in number. Scales in 17 rows in middle. Scales in 15 : 17 : 14 rows. Ventral shields with 207-230 subcaudals 118-138 and divided anal shield. Dorsal colouration most variable but generally with red or orange spots or markings. There is a longitudinal series of oval or flower shaped vertebral flecks which are, in some individuals, separated from one another by a pair of black crossbars. Black head has yellow crossbars and spots. Lateral aspects are greenish. Each scale is with a black marginal tinge and with a black median streak. Subcaudals shields are generally with black flecks. They may unite in some individuals to form two longitudinal lines. Body scales are feebly keeled.

Locality : Sharma (1976) collected two specimens from Valpoi and Canancona regions in 1969, which is the first collection record reported from Goa State.

Distribution : Western Ghats and Eastern India from Uttar Pradesh, Bihar and Orissa onwards.

Habitat : Golden Tree Snake is a most agile, bold, diurnal, arboreal and forest dwelling snake with tremendous climbing and gliding power. It prefers to live in bushy to moist-deciduous and evergreen forests. Glides in the air by extending ribs and pulling in underside. It virtually swims through the air. It covers the distance of 4 feet in the air. It has also been reported from close to human habitations (Sharma, 2003). Feeds on

lizards, mammals, birds, snakes and insects.

Status : Vulnerable due to habitat loss (Sharma, 2003) and uncommon (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near theatened.

Remarks : Nil.

Genus *Lycodon*

Genus *Lycodon is* represented by three species in Goa State.

Key to the species of the Genus *Lycodon* from Goa State

1. Anal undivided. Back with light crossbars which are never pure white .... *Lycodon travancoricus*

   Anal divided. Back with crossbars which include white colouration 2

2. Supralabials 9; annals 1or 2; loreal usually in broad contact with the internasals. .... *Lycodon aulicus*

   Supralabials 8; annals 2; loreal usually just in touch with the internasals .... *Lycodon striatus*

64. *Lycodon travancoricus* (Beddome)

1870. *Cercaspis travancoricus* Beddome, *Madras Month. J. Med. Sci.*, ii : 169.

Common name : English : Travancore Wolf snake.

Diagnostic Characters : Travancore Wolf snake possesses all the characters mentioned for the family Colubridae. The snake species under Genus *Lycodon* are small to medium in size with elongated body and flat head which is slightly broader than neck. Nostrils situated between two nasals. All the teeth are solid and not grooved. Some of the anterior maxillary teeth are enlarged and fang like. Eyes are entirely black. Subcaudals (64-76) divided but some may be entire. Loreal 1 not touching internasal. Wolf snake is slender bodied smooth-scaled snake. Total length is about 600-625 mm including tail (Length 120-125 mm). Snout broad and projects beyond the lower jaw. Dorsal body scale smooth and they are in 17 : 17 : 15 rows. Ventral shields 176-206, angulated laterally. Anal shield undivided. Hemipenis extends upto 12th subcaudal plate, forked at the tip. Narrower part of the hemipenis is spinous. Dorsal colouration is purplish brown or black with yellow cross bars forked on sides and as such enclosing triangular dark spots. Ventrum uniformly white.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have recorded Western Ghats including Goa State as the locality for this species. Nearest collection locality is Khanapur in Karnataka State (CAMP Report, 1998). Indian endemic species.

Distribution : Western Ghats as far north as Matheran in Maharashtra State. Also recorded from Tamil Nadu, Andhra Pradesh, Orissa and Madhya Pradesh in India.

Habitat : Nocturnal species, usually found in the hills. They are often met with in the houses and hide in masonry or beneath stones or any convenient hide out. Feeds on skinks, geckos and frogs. A gentle snake usually does not bite while handling.

Status : Common (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

65. *Lycodon striatus* (Shaw)

1802. *Coluber striatus* Shaw, *Genl. Zool.* **iii** : 527.

Common name : English : Shaw's wolf snake, Northern Wolf snake, and Barred wolf snake.

Diagnostic characters : Barred or Shaw's wolf snake possesses all the characters mentioned earlier for the family Colubridae and genus *Lycodon*. *Lycodon striatus* resembles very closely the common wolf snake in body characters and

habits. It is a small snake (430 mm. in length) and is distinguished from *L. aulicus* by the presence of 8 supralabials and less number of ventral shields (172-214) and caudals (35-58). Ventral shields are strongly angulated laterally. Subcaudal shields are 57-80; anal is divided. Rostral much broader than high. Colour dark brown or black above with 11-18 white or yellowish crossbars on body, which divide on sides to enclose triangular spots of ground colour on body. Belly and upper lip white. Hemipenis extends upto 10th subcaudal plate, forked at the tip. Most of the organ has longitudinal folds, which possess less distinct spines.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have recorded whole of India as the distribution for this species.

Distribution : Whole of India excluding Northeast India.

Habitat : The habit and habitat are similar like those of common wolf snake or rather any wolf snake. However, it is a timid snake, which hides its head beneath its coil, if disturbed.

Status : Not common (Sharma, 2003) and Common (Whitaker and Captain, 2004) Indian Wildlife (Protection) Act (1972 as amended upto 2002) Schedule : Schedule : IV; IUCN Category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

*66. ***Lycodon aulicus*** (Linn.)

1754. *Coluber aulicus* Linnaeus, Mus. *Adolph. Frider.*, **1** : 29 Pl. 12. Fig. 2.

Common name : English : Common wolf snake.

Diagnostic characters : Common Wolf snake possesses all the characters mentioned earlier for family Colubridae and genus *Lycodon*. Common wolf snake, *Lycodon aulicus* possesses 17 scale rows at mid body, loreal touching internasal, nasal touching 1st and 2nd labial. Nine supralabials. Body scales are smooth and in 17 : 17 : 15 rows with strongly angulated ventral shields, which are 172-224 in number. Subcaudals 56-80 in number. Total length does not exceed 950 mm. The snout spatulate and well beyond lower jaw. Anal shield mostly divided rarely single. Hemipenis extends upto 10th caudal plate. Dorsal ground colouration brown or grayish with white or yellow crossbars, ventrum whitish and upper lip white with or without brown spots. Colouration and markings in wolf snakes, in general, variable. There is usually a collar or two blotches of white or yellow colour on occiput. Sometimes specimens without any markings and uniform brown colour may also occur.

Locality : Sharma (1976) collected five specimens from Valpoi and Nayawada regions in 1969, which is the first collection record reported from Goa State.

Distribution : Whole of India.

Habitat : The species prefers to live in and around human habitations and is strictly nocturnal. Generally found in caves, wells, stone piles, hollow trees etc. They are also excellent climbers capable of going up almost smooth vertical surface. Common wolf snake prefers lizards of Gecko family but can consume small animals including mice and skinks also.

Status : Most common snake throughout its range (Daniel, 1983, Sharma, 2003 and Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report : Lower risk-least concern.

Remarks : A lively snake, ready to strike instantly when provoked. But is can soon get accustomed to being handled in captivity. The readiness with which it bites and its habit of living in houses make this snake responsible for a large number of snake bite cases.

Genus ***Sibynophis***

Genus *Sibynophis* is represented by a single species in Goa State.

67. ***Sibynophis subpunctatus*** (Dum. & Bibr.)

1854. *Oligodon subpunctatus* Dum. & Bibr. *Erp. Gen.*, **7** : 58.

Common name : Light Brown or Dumeril's Black-headed Snake.

Diagnostic Characters : Dumeril's Black-headed snake possesses all the characters mentioned earlier for family Colubridae. In genus *Sibynophis* all the teeth are solid and not grooved. Hypophyses developed throughout the vertebral column represented on the posterior dorsal vertebrae by a more or less developed crest or tubercle projecting below the centrum. 30-50 teeth closely set and equal in size. Head slightly differentiated from the neck. Eyes large with round pupil. Dumeril's Black-headed snake, *Sibynophis subpunctatus* possesses 17 scale rows at mid body. Nine supralabials. Body scales are smooth and in 17 : 17 : 17 rows with round ventral shields, which are 151-215 in number. Subcaudals 42-76 in number and are paired. Total length does not exceed 460 mm. Tail long and gradually tapering. Anal shield divided. Hemipenis extends upto 8th or 9th subcaudal plate. Dorsal colouration is light brown with dorso-median series of tiny black spots. Sides of body often grey. Ventrum greenish yellow. Ventral scales with black dots on each side. Head and nape are dark brown to black in colour. Lips are yellowish. A yellow transverse bar is present between the eyes. Two broad yellow bars form a border to the dark area of the nape.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have recorded peninsular India as the distribution for this species including Goa State (CAMP Report, 1998). The Type locality Malabar is not very far from the state border in south.

Distribution : Peninsular India.

Habitat : This is a terrestrial, rock dwelling, diurnal snake feeding on small lizards, skinks and smaller snakes. May also be seen under leaf litter, stones or dead wood (logs) in dry or moist-deciduous forests.

Status : Vulnerable (Sharma, 2003) and Uncommon (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report : Lower risk-Near threatened.

Remarks : Sharma (2003) reports vulnerable status for this species due loss of habitat.

Genus ***Amphiesma***

Genus *Amphiesma* is represented by three species in Goa State.

Key to the species of the Genus *Amphiesma* from Goa State

1. Two light horizontal stripes down the back till the tip of the tail. .... *Amphiesma stolata=Amphiesma stolatum=Natrix stolata* (Linnaeus)

– No light horizontal stripes down the back... .....2.

2. Coastal scales with bidentate tips. Labials yellow with black margins. An oblique black-edged streak from the eye to the gape .... *Amphiesma beddomei* = *Natrix beddomei* (Gunther)

– Coastal scales with rounded margins. Lip scales below the eye without stripes. A white or yellow transverse line across the back to head. A white dot on each side of the frontal ..... *Amphiesma monticola*

*68. ***Amphiesma stolata*** (Linnaeus) = ***Natrix stolata*** (Linnaeus)

1758. *Coluber stolatus* Linnaeus, *Syst. Nat.*, : 219.

Common name : English : Striped keelback, buff stripped keelback snake.

Diagnostic Characters : Striped keelback snake is a slender bodied, elongated snake with head quite distinct from the neck. It possesses all the Characters mentioned for the family Colubridae. Hypapophyses developed throughout the vertebral column and represented on the posterior dorsal vertebrae by a more or less developed crest or tubercle projecting below the centrum. Maxillary teeth are unequal 21-24 in number with last two enlarged. Nostrils lateral, scales in 19 rows. Striped keelback is also distinguished by the nasals not touching the 2nd supralabial, rostral touching 6 shields and single anterior temporal. The buff

stripes along the sides are also distinct. Eyes large with round pupil flecked with gold. Tounge, dull orange, black tipped. The striped keelback reaches to a length of about 550 mm. Ventral shields in the range of 118-161; while subcaudals in 48 89 shields, paired. Anal shield divided. Hemipenis simple and extends upto the 8th caudal plate, forked at the anterior tip. Spines present on the complete organ except the basal part. Dorsal colouration is olivaceous or olive brown or somewhat greenish with a pair of pale yellow stripes, which sometimes break up into spots in the anterior region of the body. Belly white with some scattered black spots. There is a black V shaped mark on the neck. Black streaks present in front of and below the eye.

Locality : Sharma (1976) reported collection of three specimens (Determined as *Nastrix stolata*, which has been synonymised with *Amphiesma stolata* (Sharma, 2003) from Molem and Canacona regions of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Throughout India.

Habitat : Terrestrial and semi-aquatic preferring to live in fields, grassy and cultivated areas of open country during the rains. Its choice of habitat is directly related with its food. Often hides in holes in the ground or in masonry of drains and culverts. Essentially diurnal. It feeds mainly on frogs and toads, but also can take small lizards and rodents

Status : Most common snake in its range. (Sharma 2003 and Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN Category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Two distinct colour varieties occur in India. The typical form occurs throughout India (Daniel, 1983).

*69. ***Amphiesma beddomei*** (Gunther)
= ***Natrix beddomei*** (Gunther)

1864. *Tropidontus beddomei*, Gunther, *Rep. Brit. Ind.*, : 269.

Common name : English : Beddom's Keelback or Beddom's Olive-Brown Keelback snake

Diagnostic characters : Beddom's keelback snake is a slender bodied, elongated snake with head quite broader than the neck. It possesses all the Characters mentioned for the family Colubridae. Hypapophyses developed throughout the vertebral column and represented on the posterior dorsal vertebrae by a more or less developed crest or tubercle projecting below the centrum. Maxillary teeth are unequal in number with last two enlarged. Nostrils lateral, body scales in 19 rows at midbody. The dorsal scales are distinctly keeled. Beddome's keelback is characterized by the absence of the buff stripes along the sides. Eyes large with round pupil flecked with gold. The Beddome's keelback reaches to a length of about 525 mm with tail length of 140mm in males, while females are longer in length than the males. (Total length : 690 mm with tail length : 210 mm). Ventral shields in the range of 140-150; while subcaudals in 62-82 shields, paired. Coastal scales with bidentate tips. Anal shield divided. Hemipenis simple and extends upto the 12th caudal plate, forked at the anterior tip. Dorsal colouration is olivaceous or olive brown. With a series of yellow spots each one between the two black spots or short transverse bars along each side of the back. Belly whitish with with or without closely dotted spots. Labials are yellow, the sutures are edged with black. There is a distinct obliquely placed yellow, black-edged streak from the eye to the gape.

Locality : Sharma (1976) reported collection of one specimen (Determined as *Nastrix beddomei*, which has been synonymised with *Amphiesma beddomei* (Sharma, 2003) from Canacona region of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Western Ghats from Maharashtra to South Kerala. Western Ghats endemic species.

Habitat : A forest species semi-aquatic preferring to live at the altitudinal range from 3000-7000 Ft. Found near sream sides of high rainfall areas. Mostly diurnal. It feeds mainly on frogs and small toads.

Status : Fairly Common snake in its range. (Sharma 2003 and Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN Category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Nil.

70. ***Amphiesma monticola*** (Jerdon)
= ***Natrix monticola*** (Jerdon)

1864. *Tropidonius monticolus*, Jerdon, *J.A.S. Bengal* : **xxii** : 530.

Common name : English : Green or Hill Keelback snake.

Diagnostic characters : Green or Hill Keelback snake is a slender bodied, elongated snake with head quite broader than the neck. It possesses all the Characters mentioned for the family Colubridae and the genus *Amphiesma*. Hypapophyses developed throughout the vertebral column and represented on the posterior dorsal vertebrae by a more or less developed crest or tubercle projecting below the centrum. Maxillary teeth are unequal in number with last two enlarged. Nostrils lateral, body scales in 19 rows at midbody. The dorsal scales are distinctly keeled. The Hill keelback snake is characterized by the absence of the buff stripes along the sides. Eyes large with round pupil flecked. The Hill Keelback reaches to a length of about 380 mm with tail length of 118 mm in males, while females are longer in length than the males. (Total length : 475 mm with tail length : 150 mm). Ventral shields in the range of 132-145; while subcaudals in 78-92 shields, paired. Coastal scales with rounded margins. Anal shield divided. Hemipenis simple and extends upto the 9th caudal plate, forked at the anterior tip. Dorsal colouration is olive brown or greenish with broad black cross-bands or big squarish spots. Top of the head is reddish-brown. Scales around the eyes whitish or yellow Belly whitish with with or without closely dotted spots. Lip scales below the eye without any stripes. A white or yellow transverse line across the back to head. There is a white dot on each side of the frontal.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have recorded Western Ghats as the distributional range for this species from Goa State to South Kerala. The nearest collection locality is Talewadi in Belgaon Dist. Karnataka.

Distribution : Western Ghats from Goa to South Kerala. Western Ghats endemic species.

Habitat : A forest species. Diurnal. Found near stream sides of high rainfall areas. It feeds mainly on frogs and small toads.

Status : Rare (Sharma 2003) and uncommon (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN Category as per CAMP Report (1998) : Vulnerable.

Remarks : *Natrix monticola* (Jerdon) reported by Smith (1943) has been synonimised in *Amphiesma monticola* (Jerdon) (Sharma, 2003).

Genus ***Xenochrophis***

Genus *Xenochrophis is* represented by a single species in Goa State.

*71. ***Xenochrophis piscator*** (Schneider)

1799. *Hydrus piscator* Schneider, *Hist. Amph.*, : 247.

Common name : English : Checkered Keelback snake.

Diagnostic characters : Checkered Keelback snake possesses all the characters mentioned for suborder Serpentes and family Colubridae. Keelback snake belonging to genus *Xenochrophis* comprises fresh water snakes with cylindrical body, head quite distinct from the neck, snout long and eyes moderately large with round pupil. Nostril dorsolateral and pierced into a single nasal, which is directed outwardly upward. Hypapophyses developed throughout the vertebral column and represented on the posterior dorsal vertebrae by a more or less developed crest or tubercle projecting below the centrum. *X. piscator* is distinguished by a combination of characters like scale round the body at midway in 19 rows.

Scales somewhat round but strongly keeled, 4th or 5th supralabials touching eye, presence of a pair of internasals and undivided anal shield. Tail one-third to one fourth of total length. Ventrals 122-158 and subcaudals 60-97. Hemipenis and sulci spermaticus are forked. The colour of the dorsum is much variable, and may be yellowish, olive, light green and grey brown with reddish tinge with five rows of small light black spots, bars which are generally narrower than the interspaces. The arrangement of spots/bars looks lika a checkerboard pattern, hence the name, checkered keelback. Head olive brown above with two oblique black streaks, one above and one behind the eye. Ventrum white or yellowish.

Locality : Sharma (1976) reported collection of ten specimens (Determined as *Nastrix piscator*, which has been synonymised with *Xenochrophis piscator* (Sharma, 2003) from Molem, Durgini Hills, Vasco-de-Gama, Margaon and Canacona regions of Goa State in 1969. This is the first collection record reported from Goa State. ZSI survey party sighted one live specimen in Bondla sanctuary during the project period.

Distribution : Throughout India.

Habitat : Semi-aquatic preferring to live in the vicinity of fresh water bodies. Frequents tanks, paddy fields, pools and rivers. Active by day as well as night. Aggressive in nature when threatened or cornered. When exited, may mimick the posture of a cobra.

Status : Commonest snake of India (Sharma, 2003 and Whitaker and Captain, 2004)). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule II Part II, CITES : Appendix II, IUCN category as per CAMP Report (1998) : Lower risk-Least concern.

Remarks : Most active and vicious amongst Indian snakes. Strikes rapidly and with great determination holding on tenaciously. However, its temperament varies depending upon the situations. The secretion of the large parotid glands is fatal to small mammals, birds, lizards and frogs, but has no effect on man and large mammals.

Genus *Macropisthodon*

Genus *Macropisthodon* is represented by a single species in Goa State.

*72. *Macropisthodon plumbicolor* (Cantor)

1839. *Tropidonotus plumbicolour* Cantor, *Proc. Zool. Soc. London* : 54.

Common name : English : Green Keelback snake.

Diagnostic characters : Green Keelback snake possesses all the characters mentioned earlier for the suborder Serpentes and family Colubridae. It is a stout bodied snake reaching to a maximum length of 580 mm in males and 775 mm in females. Head distinct from the neck. Eye moderately large with round pupil. Tail short. Frontal shield in contact with six surrounding shields. The shields on the head distinguish it immediately from the green pit viper and presence of round pupil from green whip snakes. Body scales in 21-27 rows strongly keeled. Ventral shields 144-162, subcaudal shields divided in males (34-48 in number). Anal shield divided. Hemipenis reaches upto the 15th caudal plate. Dorsal colouration greenish with yellow tinge or olive green with faint irregular black crosses lines. Dorsal aspect of head is with two black inverted V-shaped marks. Ventrum is whitish gray or dark gray with black spots. Juveniles may have very well defined black chevron on the nape with its angle pointed forward. Following the chevron is a broad gorget of bright yellow or orange. A black streak from eye to gape present.

Locality : Sharma (1976) reported collection of three specimens from Dhavan village region of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Throughout India except Ganges Valley.

Habitat : A hill species frequenting grass and low vegetation. Nocturnal and crepuscular. Found in green as well as open deciduous forest. Terrestrial, diurnal and carnivorous in habit. A singularly gentle and inoffensive snake. Feeds

more or less exclusively on the common toad but occasionally take other amphibians and lizards. Secretion of large parotid glands is toxic to frogs and toad.

Status : Common throughout its range (Sharma, 2003), and Uncommon (Whitaker and Captain, 2004) Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : When provoked, it erects its forebody and flattens its neck like a cobra, hence it is called as "green cobra" in Tamil.

Genus ***Boiga***

Genus *Boiga is* represented by three species in Goa State.

Key to the species of the Genus *Boiga* from Goa State

I. Preocular single, not reaching the upper surface of the head ..... *Boiga trigonata*

II. Preocular 1-3, the upper one reaching the dorsal surface of the head. 1

1. Nape with a dark blotch or transverse bar, sometimes broken up; scales in 19-21 (23) rows ..... *Boiga ceylonensis*

   Nape with three longitudinal stripes, the middle one extending forward on the top of the head upto frontal. Scales in 25-29 rows ..... *Boiga forsteni*

*73. ***Boiga trigonata*** (Schneider)

1802. *Coluber trigonatus* Schneider, *Bechst. transl. Lacep* iv : 256 *pl.* XI fig. 1.

Common name : English : Indian Gamma or cat snake.

Diagnostic characters : Indian Gamma snake possesses all the characters mentioned for suborder Serpentes and family Colubridae. Hypapophyses present on the posterior dorsal vertebrae. Maxillary teeth solid, subequal and 8-10 in number. Last two-three maxillary teeth large and grooved. Teeth present on the palatine bone. They are strongly enlarged. Body scales smooth and arranged in oblique fashion. Genus *Boiga* includes large distinctly triangular headed snakes with laterally compressed body, large eyes with vertical pupils and duplex retina. Tail moderately long, anal shield undivided. Pits and tubercles present on head trunk scales. Scales with apical pits and in 21 : 21 : 15 oblique rows, smooth. Preocular single, not reaching the upper surface of the head. Subcaudal shields paired. Ventrals 206-256, Subcaudals 75-96, paired. Anal entire. Hemipenis divided but not forked and reaches upto 10, 11, 12th caudal shields. Cat snake reaches to length of about 1000 mm in males and 1200 mm in females. Dorsal colouration grayish brown with two alternating series of large rounded or oval dark brown light edged spots. There are two other series of much smaller spots on lateral sides of the body. Dorsal side of head is with two broad dark brown or black longitudinal stripes diverging posteriorly. Nape with longitudinal mark. Stripe emerging from the eye reaches the angle of the mouth. Ventrum whitish spotted with brown.

Locality : Sharma (1976) reported collection of four specimens from Dhavan village, Ponda and Canacoa regions of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Peninsular India.

Habitat : Essentially arboreal frequenting bushes, scrubs or trees. Usually close to the ground. Also seen in different types of forests, plantations and rural human settlements. Nocturnal in behaviour. Feeds on almost anything it can capture with preference for garden and other lizards. Killing done by constriction.

Status : Common throughout its range (Sharma, 2003, Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : IV, IUCN Category as per CAMP Report (1998) : Lower risk-least concern.

Remarks : Cat snakes are always ready to act offensively on the least provocation. Its striking

poisture is characteristic. Head and forebody are erected well off the ground with remaining body forming a loop of eight. Head poised in the middle. Prior to striking, the erected part is swayed forward and backward. The colour and markings of cat snakes bear close resemblance to those of *Echis carinatus*. But two species can be easily separated by the absence of head shields in viper. The secretion of the parotid gland of cat snake is lethal to lizards and highly toxic to mice.

74. ***Boiga ceylonensis*** (Gunther)

1858. *Dipsadomorphus ceylonensis* Gunther, *Cat. Col. Sn.* Brit. Mus., iv : 176.

Common name : English : Ceylon Cat Snake.

Diagnostic characters : Ceylon Cat snake possesses all the characters mentioned for family Colubridae and genus *Boiga*. Hypapophyses present on the posterior dorsal vertebrae. Maxillary teeth solid, subequal and 12-13+2 in number. Last two-three maxillary teeth are large and grooved. Body scales smooth and arranged in oblique fashion. Genus *Boiga* includes large distinctly triangular headed snakes with laterally compressed body, large eyes with vertical pupils and duplex retina. Tail long, anal shield undivided. Body scales in 19 or 21 or 23 : 19 : 15 or 13 oblique rows, smooth. Preocular 1-3, the upper one reaching the dorsal surface of the head. Vertebral scales distinctly enlarged and hexagonal. Subcaudal shields paired. Ventrals 209-267, Subcaudals 90-133, paired. Anal entire. Hemipenis divided but not forked and reaches upto 10-12th caudal shields. Cat snake reaches the length of about 1020 mm in males with tail length 240mm and 1315 mm and 255mm respectively in females. Dorsal colouration pale grayish or yellowish brown on the back with a series of dark brown or black spots on the vertebral column. Sometimes there may be short, oblique backward pointing streaks originating from the spots. Dorsal side of head is with two broad dark brown or black longitudinal stripes diverging posteriorly. Nape with a dark blotch or transverse bar, sometimes broken up. Ventrum white or yellow usually with dark brown or black spots.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have recorded Western Ghats including Goa State as the distributional range for this species from Maharashtra State to Kerala. Whitaker and Captain (2004) reported collection of a specimen from Goa State.

Distribution : Western and Eastern Ghats and Andaman Islands in India.

Elsewhere : Sri Lanka.

Habitat : Essentially arboreal frequenting bushes, scrubs or trees. Usually close to the ground. Also seen in different types of forests, plantations and rural human settlements. Nocturnal in behaviour. Feeds on almost anything it can capture with preference for garden and other lizards. Killing done by constriction. Mild venom can paralyze small preys.

Status : Common throughout its range (Sharma, 2003, Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : IV, IUCN Category as per CAMP Report (1998) : Data Defficient (For *Boiga beddomei* (Wall, 1909) which has actually been synonymised in *Boiga ceylonensis* (Gunther, 1858) by Smith, (1945), Murthy, (1985) and Sharma (2000, 2003).

Remarks : Cat snakes are always ready to act offensively on the least provocation. Its striking poisture is characteristic. Head and forebody are erected well off the ground with remaining body forming a loop of eight. Head poised in the middle. Prior to striking, the erected part is swayed forward and backward. Smith (1985), Murthy, (1985) and Sharma, (2000 & 2003) have synonimysed *Boiga beddomei* (Wall, 1909) in *Boiga ceylonensis* (Gunther, 1858). Same view has been adopted here as well.

75. ***Boiga forsteni*** (Dum. & Bibr.)

1854. *Triglyphodon forsteni*, Dum. & Bibr., *Erp. Gen.*, 7 : 1077.

Common name : English : Reddish Peninsular Cat Snake; Forsten's Cat Snake.

Diagnostic characters : Reddish Peninsular Cat snake possesses all the characters mentioned for family Colubridae and genus *Boiga*. Hypapophyses present on the posterior dorsal vertebrae. Maxillary teeth solid, subequal and 9-12 in number. Last one maxillary tooth is the large and grooved. Body scales smooth and arranged in oblique fashion. Genus *Boiga* includes large distinctly triangular headed snakes with laterally compressed body, large eyes with vertical pupils and duplex retina. Tail long, anal shield undivided. Body scales in 25 or 27 : 27 or 29 or 31 : 15 or 17 oblique rows, smooth. Preocular 1-3, the upper one reaching the dorsal surface of the head. Vertebral scales feebly or strongly enlarged and hexagonal. Subcaudal shields paired. Ventrals 254-272 with distinct lateral keel; Subcaudals 102-119, paired. Anal entire. Hemipenis reaches upto 12th caudal shields. Cat snake reaches the length of about 2150 mm in males and 2312 mm in females. Dorsal colouration uniformly brown or reddish-brown with regular angular black spots or cross bars and white spots in between them on the back. This type of colour pattern is more distinct on the anterior part of the body. Posteriorly it may be replaced by the chequred pattern. Black stripes present on the head emerging from the frontal shield and reaches upto the nape. Two more stripes are present on the sides of the nape. A dark black-coloured stripe starts from eye and reaches the angle of the mouth. The darker specimens may have their labials marked with distinct black spots on the sutures. Specimens with another colour form have also been noticed. They possess nearly uniform reddish-brown back with dull yellow markings. Plain or light coloured forms possess spotless whitish underside, while the darker forms possess belly scales heavily spotted with brown or black.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have recorded Western Ghats including Goa State as the distribution for this species from Gujrat to Kerala.

Distribution : Western Ghats and other parts in northern, western and eastern in India.

Elsewhere : Sri Lanka.

Habitat : Essentially arboreal frequenting bushes, scrubs or trees. Usually close to the ground. Also seen in different types of forests, plantations and rural human settlements. Nocturnal in behaviour. Feeds on almost anything it can capture with preference for garden and other lizards. Killing done by constriction.

Status : Common throughout its range (Sharma, 2003, Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : IV, IUCN Category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Similar as those mentioned in previous Cat Snake species.

Genus *Ahaetulla*

Genus *Ahaetulla is* represented by two species in Goa State.

Key to the species of the Genus *Ahaetulla* from Goa State.

1. Dermal appendage without any median groove. It is formed by the rostral shield covered above by number of small scales ... . *Ahaetulla pulverulentus*

– Dermal appendage with a median groove above. It is formed almost entirely by the rostral shield sometimes with small scales at the base ..... *Ahaetulla nasutus*

*76. ***Ahaetulla nasutus*** Lacepede

1789. *Coluber nasutus* Lacepede, *Hist. Nat. Serp.*, i : 100 and ii 277 pl. 4, fig. 2.

Common name : English : Common green whip snake, Common vine snake.

Diagnostic Characters : Common green whip snake or common vine snake possesses all the characters mentioned for the family Colubridae. Genus *Ahaetulla* possesses subequal maxillary teeth, horizontal pupil, obliquely placed scales in 13-15 rows and enlarged vertebrals. The snake is very long with compressed body measuring to a length of almost 1855 mm in males, while 2660

mm in females. Head is elongated and distinct from neck. Canthus rostrials quite long. A dermal appendage with a median groove above is formed almost entirely by the enlarged rostral shield sometimes with small scales at the base. Concave loreals, quite large eyes and log tail. Snout long acuminate terminating in a dermal beak shaped appendage. Body scales smooth in 15 : 15 : 11 rows. Vertebral rows larger then other dorsal rows. Ventral shields 166-207, laterally notched, while sub-caudal shields 156-180 in males and 135-152 in females. Anal shield divided. Dorsal colouration verdant green, while ventral side is pale with greenish tinge. A thin white or yellow line separating upper body scales from ventrals is present. The interstitial skin is black and white in colour forming oblique lines, which are most distinct on the anterior of half of the body. Many individuals exhibit remarkable colour variations, as they may be coloured in yellow, brown or buff dorsally. Whip snake reaches 1855 mm. length in males, while 2600 mm in females. Hemipenis is short and not forked.

Locality : Sharma (1976) reported collection of 11 specimens from Nayawada village, Durgini Hills, Ponda and Canacoa regions of Goa State in 1969. This is the first collection record reported from Goa State. The specimens were identified as *Dryophis nasutus* (Lacep.) by him. However, they have been redesignated, later, as *Ahaetulla nasutus* (Lacep.) by him (Sharma, 2000 & 2003). ZSI Survey party sighted one live specimen in Bondla Wildlife Sanctuary during the project period.

Distribution : Peninsular India.

Habitat : Common green whip snake prefers to live in scrub jungle, dry deciduous, mixed deciduous and evergreen forest also. The snake is arboreal and diurnal in habit. One escapes its sight due to its camouflaging colouration. An elegant snake with wonderful speedy movements. Though gentle in behavior, it could be fierce when caught. When alarmed, it rears its head and forebody and the dilation of the forebody brings into prominence the black and white chequering skin. Feeds on small mammals, birds, lizards and occasionally other snakes and frogs.

Status : Common in the range of distribution (Daniel, 1983 and Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : IV, IUCN category as per CAMP Report, 1998 : Lower risk-Near threatened.

Remarks : Common Vine Snake, *Dryophis nasutus* (Lacep.), of Smith (1943) and Sharma (1976) has been synonymised in *Ahaetulla nasutus* (Lacep.) (Murthy, 1985, Sharma, 2000 & 2003 and Whitaker and Captain, 2004). Sharma (2003) feels that the status of the species is vulnerable due to habitat loss. The whip snake is mildly poisonous. The symptoms are like that of Cobra bite. Even though there is no effect of poison in man, it may occasionally cause swelling and numbness around the bitten area. Common green whip snake closely resembles green or bamboo pit viper in colouration.

***77. *Ahaetulla pulverulentus* (Dum. & Bibr.)**

1854. *Dryinus pulverulentus*, Dum.& Bibr., *Erp. Gen.* vii : 812.

Common name : English : Brown Whip or Vine Snake

Diagnostic characters : Brown Whip snake or brown vine snake possesses all the characters mentioned for the family Colubridae and genus *Ahaetulla*. Brown Whip Snake also possesses horizontal pupil, obliquely placed scales in 13-15 rows and enlarged vertebrals. The snake is very long with compressed body measuring to a length of almost 1600 mm in males, while 2450 mm in females. Head is elongated and distinct from neck. Canthus rostrials quite long. The species is quite similar to *A. nasutus* in number of respects. However, there is a fairly long dermal appendage without any median formed almost entirely by the enlarged rostral shield covered above on the tip with several small scales. Concave loreals, quite large eyes and long tail. Snout long acuminate terminating in a swollen tip. Body scales smooth in 15 : 15 : 13 oblique rows. Ventral shields 182-203, laterally notched, while sub-caudal shields 169-208 paired. Anal shield divided.

Dorsal colouration is grayish or brownish, powdered with brown and with black transverse or oblique spots above. A dark brown rhomboidal spot is present on top of the head and a brown stripe on either side passes through the eye. Hemipenis is short and not forked.

Locality : Sharma (1976) reported collection of 3 specimens from Dhavan village and Canacoa regions of Goa State in 1969. This is the first collection record reported from Goa State. The specimens were identified as *Dryophis pulverulentus* (Dum. & Bibr.) by him. However, they have been redesignated, later, as *Ahaetulla pulverulentus* (Dum. & Bibr.) by him (Sharma, 2000 & 2003). Same name has been retained by Whitaker and Captain (2004).

Distribution : Gujarat and further south in Western Ghats in India.

Elsewhere : Sri Lanka.

Habitat : Brown whip snake prefers to live in plains as well as in the hills. The snake is mainly arboreal and diurnal in habit. An elegant snake with wonderful speedy movements. Though gentle in behavior, it could be fierce when caught. Feeds on small mammals, birds, lizards and occasionally other snakes and frogs.

Status : Vulnerable (Sharma, 2003). Uncommon in the distributional range (Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : IV, IUCN category as per CAMP Report, 1998 : Lower risk-Near threatened.

Remarks : Brown Vine Snake, *Dryophis pulverulentus* (Dum. & Bibr.) of Smith (1943) and Sharma (1976) has been synonymised in *Ahaetulla pulverulentus* (Dum. & Bibr.) (Murthy, 1985, Sharma, 2000 & 2003 and Whitaker and Captain, 2004). Sharma (2003) feel that the status of the species is vulnerable due to habitat loss. The whip snake is mildly poisonous. The symptoms are like that of Cobra bite. Even though there is no effect of poison in man, it may occasionally cause swelling and numbness around the bitten area.

Subfamily HOMALOPSINAE

Subfamily Homalopsinae is represented by three genera in Goa State.

Key to the Genera of the Subfamily HOMALOPSINAE

I. Nasal shields in contact with one another 1

1. Parietals well developed; scales smooth .... ***Enhydris***

2. Parietals more or less broken; scales keeled .... ***Cerberus***

II. Nasal shields separated by internasals ....***Gerardia***

Genus *Gerardia*

Genus *Gerardia* is represented by a single species in Goa State.

78. *Gerardia prevostiana* (Eydoux and Gervais)

1832-1837. *Coluber(Homalophis) prevostianus*. Eydoux & Gervais. *Guer.Mag. Zool.*, : CL3 : 5.

Common name : Glossy Marsh Snake.

Diagnostic characters : Glossy Marsh snake possesses all the characters mentioned earlier for family Colubridae and subfamily Homalopsinae. In genus *Gerardia* ventrals are well developed and not keeled. A single internasal shield separates well-developed nasal shields. Head slightly broader than the neck and it is covered with large shields. Eyes small with vertical pupil and situated high on the head. Glossy marsh snake is stout bodied aquatic snake with moderately long tail, dentition well developed with maxillary bone extending beyond the palatine with 11-13 teeth. Hypapophysis are present throughout the vertebral column. It possesses 17 : 17 : 15 (Rarely 13) scale rows with smooth scales. Seven supralabials. Ventral shields are 144-157 in number. Subcaudals 29-36 in number and are paired. Total length does not exceed 587 mm. Tailis quite short. Anal shield divided. Single loreal present. Dorsal colouration

is uniform gray, brown or olive back with a distinct ivory white or pale yellow lateral stripe from lip scales to tip of the tail. Ventrum whitish with dark margins. In many individuals it may be entirely gray.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2003) have recorded coastal and tidal river parts of India including Goa State as the distributional range for this species.

Distribution : Coastal and tidal river of India and adjacent countries.

Habitat : This is an aquatic nocturnal snake, excellent swimmer and moves rapidly in mud. Found in mudflats, estuaries and mangrove swamps. Often lives in mud lobster holes and/or under rocks near the shoreline. Feeds on freshly moulted crabs, frogs and toads. Viviparous species (Whitaker and Captain, 2004).

Status : Common (Sharma, 2003) and uncommon (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto2002) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Mildly venomous (Whitaker and Captain, 2004).

Genus *Enhydris*

Genus *Enhydris* is represented by a single species in Goa State.

79. *Enhydris sieboldi* (Schlegel)

1837. *Homalopsis sieboldii* Schlegel. *Phys. Serp.*, ii : 349.

Common name : Siebold's Smooth-scaled Water Snake.

Diagnostic characters : Siebold's Smooth-scaled water snake possesses all the characters mentioned earlier for family Colubridae and subfamily Homalopsinae. Species under Subfamily Homalposinae possess last 2 or 3 maxillary teeth enlarged and grooved. Nostrils valvular, situated on the upper surface of the snout. Siebold's Smooth-scaled water snake is a stout bodied, smooth-scaled snake with head slightly broader than neck, depressed scarcely distinct from the latter. In genus *Enhydris* ventrals are well developed and not keeled. Parietals are also well developed and not fragmented. Head slightly differentiated from the neck. Eyes small with vertically elliptical pupil. The nasal cleft extending from the nostrils to the first supralabial. Loreal present. Siebold's Smooth-scaled Water Snake possesses 27 or 29 (rarely 33 rows) scale rows at mid body. 7-8 supralabials. Body scales are smooth and ventral shields are 143-158 in number. Subcaudals 43-56 in number and are paired. Internasals two. Total length does not exceed 780 mm. Tail long and gradually tapering with its length upto 110mm. Anal shield divided. Dorsal colouration is Pale brown or off-white with very broad, closely spaced dark brown or dull olive green, squarish, black edged marks that are much broader than the pale cross lines. A series of roundish spots on each side alternating with the dorsal spots. Top of head has three bold, dark brown stripes that converge or join between the eyes. Underside white with black checks or pale brown mottled with dark green.

Locality : Smith (1943) and Sharma (2003) have recorded many parts of northern, eastern and western India including Goa State under the distribution for this species (CAMP Report, 1998).

Distribution : Many parts of northern, eastern, central and western India in India.

Habitat : This is an aquatic diurnal snake active during morning hours and generally found in or close to rivers or water bodies. Burrows deep into mud. Feeds on frogs, toads and fishes.

Status : Uncommon (Sharma, 2003) and rare (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV, IUCN category as per CAMP Report : Lower risk-Near threatened.

Remarks : Mildly venomous (Whitaker and Captain, 2004). Old records of distribution of this species from western India need confirmation from the present status.

Genus *Cerberus*

Genus *Cerberus* is represented by a single species in Goa State.

80. ***Cerberus rhynchops*** (Schneider)

1799. *Hydrus rhynchops* Schneider. *Hist. Amphib.*, **1** : 246.

Common name : Dog-faced Water Snake.

Diagnostic characters : Dog-faced water snake possesses all the characters mentioned earlier for family Colubridae and subfamily Homalopsinae. In genus *Cerberus* ventrals are well developed and not keeled. Parietal are also well developed but fragmented. Head with broken up shields slightly differentiated from the neck. Eyes small with elliptical pupil. Dog-faced snake is stout bodied aquatic snake with moderately long tail, well developed dentition (Maxillary teeth 12-17), nostrils situated on the upper surface of the snout and hypapophysis present throughout the vertebral column. Dog-faced water Snake possesses 23 or 25 (rarely 21 or 27 rows) scale rows at mid body. The body scales strongly keeled. 9-10 supralabials. Ventral shields are 143-158 in number. Subcaudals 49-72 in number and are paired. Internasals two. Total length does not exceed 850 mm in males and 1180 mm in females. Tail long and gradually tapering. Anal shield divided. Dorsal colouration is slaty-gray, brown or olive with a darker pattern of cross bars or spots, sometimes faint pattern, on the back. A black streak passes through the eye on to the neck. Belly white or yellow withblack checks or it may be plain dark gray. The outer side of belly with three scale rows generally yellow in colour.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2003) have recorded coastal and tidal river parts of India including Goa State under the distribution for this species.

Distribution : Coastal and tidal river parts of India and adjacent countries.

Habitat : This is an aquatic nocturnal snake, excellent swimmer and moves rapidly in mud. Found in mudflats, estuaries, mangrove swamps and even in paddy fields several Kms. Often lives in crab holes and/or under rocks near the shoreline. Feeds on frogs, toads and fishes.

Status : Fairly common (Sharma, 2003 and Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule II (Part II), IUCN category as per CAMP Report : Lower risk-Near threatened.

Remarks : Mildly venomous (Whitaker and Captain, 2004)

Family ELAPIDAE

Family Elapidae (Proteroglypha : Grooved fang after two solid teeth in the upper jaw) is represented by four genera in Goa State.

Key to the Genera of the Family ELAPIDAE

Scales disposed obliquely, particularly on the neck, which has more scale-rows than the mid-body and is distensible into a hood. 3rd supralabial touch the eye & the posterior nasal. 1

Scales not obliquely disposed, particularly on the neck, which is normal. Number of scale rows remains same throughout the body starting from the neck 2

1. Scales in 19 – 27 rows at mid-body. Occipital shields absent ..... ***Naja***

   Scales in 15 rows at mid-body. A Pair of large occipital shields present ..... ***Ophiophagus***

2. Subcaudals all or most of them are single. Vertebral row of scales strongly enlarged. 3rd supralabial not touching the posterior nasal. ..... ***Bungarus***

   Subcaudals are paired. Vertebral row of scales normal and not enlarged. 3rd supralabial touching the nasal or/and nasal suture ..... ***Callophis***

Genus ***Bungarus***

Genus *Bungarus* is represented by a single species in Goa State.

81. *Bungarus caeruleus (Schneider)

1801. *Pseudoboa caerulea*, Schneider, *Hist. Amphib.*, ii : 284.

Common name : English : Common Indian Krait.

Diagnostic characters : Common Krait possesses all the characters of suborder Serpentes. However, snake species under family Elapidae are venomous in nature. Anterior most maxillary teeth enlarged, recurved and grooved or tubercular. These teeth act as fangs to inject poisonous secretion of modified parotid glands into victim's body. Poison fangs are present in front of the mouth. Maxillary bone is with teeth behind the fangs. Tail cylindrical, loreal absent, pupil round, and ventrals almost as broad as the width of the body. Elapidae is a family of terrestrial and arboreal deadly poisonous snakes. The family includes kraits, cobras and coral snakes. Kraits are long and slender bodied snakes with cylindrical body. Tail is not long but cylindrical and tapering to a point. Head not quite distinct from the neck. Eye small with round pupil. Poison fangs are fixed and followed after a wide gap by 2-3 small teeth. Scales round the body are in 15-17 rows. Ventral shields 194-234 and subcaudals entire and 42-52 in number. Vertebral row of scales enlarged into hexagonal shape. Hemipenis extends upto 6-9th caudal plate. Dorsal colouration is shining jet black to dark brown with a series of 3-9 vertebral spots on neck and anterior most part of the body followed by 38-56 narrow transverse bands or spots, generally in pairs. Upper labials are yellowish or whitish. Ventrum whitish.

Locality : Sharma (1976) reported collection of 3 specimens from Ponda and Canacoa regions of Goa State in 1969. This is the first collection record reported from Goa State. ZSI survey party sighted one specimen in Bondla region during the project period.

Distribution : Peninsular India.

Habitat : Kraits inhabits a wide range of biotopes in its range of distribution. It inhabits fields, low scrub jungles and open forest. They are even seen in human habitation seeking shelter in houses. Nocturnal in behaviour placid in temperament. They are also frequently found near or in water. Krait feeds mainly on snakes including other kraits. Young ones feed more or less exclusively on blind snakes. Frogs, lizards and small mammals are also preferred;

Status : Common in the range (Daniel, 1983 and Whitaker and Captain, 2004). Becoming rare on account of habitat loss (Sharma, 2000) and illegal trade of its skin (Pradhan, 1997). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule Schedule IV, IUCN category as per CAMP Report (1998) Lower risk-Near threatened.

Remarks : One of the deadliest among the poisonous snakes of the world and it can kill adult human being in minutes. The lethal dose for man is considered to be equivalent of 1 mgm of dried poison. Poison is neurotoxic. Basically, shy in nature. It bites only when provoked. Harvest, human interference and trade are some of the threats to the survival of the species. Kraits are killed for skins for illegal trade (Pradhan, 1997).

Genus *Callophis*

Genus *Callophis* is represented by two species in Goa State.

Key to the species of the Genus *Callophis* from Goa State.

1. Supralabials six ..... *Callophis melanurus*
– Supralabials seven..... *Callophis nigrescens*

82. *Callophis melanurus* (Shaw)

1802. *Coluber melanurus*, Shaw, *Gen. Zool.*, iii 552.

Common name : English : Slender Coral snake.

Diagnostic characters : Slender Coral snake possesses all the characters of suborder Serpentes and family Elapidae. All snake species under genus *Callophis* are poisonous and are popularly known as coral snakes. They possess cylindrical and elongated body with almost same diameter from head to anus. Head not distinct from neck. Head shields normal. Eyes small with round pupil. This

85. *Ophiophagus hannah* (Cantor)

1831. *Hamadryas hannah*, Cantor. *Asiat. Res.*, **Xix** : 187.

Common name : English : King Cobra or Hamadryad.

Diagnostic characters : King Cobra possesses all the characters mentioned for suborder Serpentes and family Elapidae. Genus *Ophiophagus*, King cobra, includes deadly poisonous snakes with anterior ribs elongated in the neck region. Neck can be expanded into a hood; a three minute but solid teeth are present on maxilla behind the fangs. The monotypic genus comprises the largest of the poisonous snakes reaching to a length of 4620 mm, popularly known as King Cobra or Hamadryad. A pair of large occipital shields is in contact with each other behind parietals. Nostrils are large bordered by two nasals and a internasal. Body scales oval, smooth and arranged in an oblique fashion, particularly in the anterior half of the body. Seven supralabials present. Subcaudal shields are divided. Head is broader than neck. Hood longer and narrower than that of other cobras. Eyes moderately large with round pupil. Scales in 17 to 19 : 15 : 15 rows and are smooth. Loreal absent. Ventral shields 215-270, while subcaudals are 80-120 in number. Hemipenis is very long and deeply forked extending upto 30th caudal plate or even beyond. Dorsal colourationgray, black, dark olive green or yellowish-brown, usually with white or yellowish cross-bands. Bands on head, if present, are L shaped. Young ones are black with narrow white or yellow bands that encircle the body and tail. Head scales, in paler forms, are often edged with black. Throat is generally with light-yellow or cream coloured.

Locality : Smith (1943), Daniel, (1983) and Sharma (2003) have reported the distribution of this species from Western Ghats including Goa State, eastern and northeastern India (Whitaker and Captain (2004). Even the forest Dept. authorities have reported its occurrence in Molem region of Goa State.

Distribution : Western Ghats including Goa State, eastern and north-eastern India (Whitaker and Captain (2004).

Habitat : The snake is diurnal, very pugnacious and aggressive inhabiting the rocky, bushy areas, grasslands in dense forest of heavy rainfall. Estuarine mangrove swamps are also preferred. Can climb on a tree with remarkable agility. Eclectic habit. Frequently found near water, strong swimmer. When alarmed, it adopts popular pose with erect forebody and flat hood. It can raise its 1/3rd body. Makes hissing sound. Sometimes the poison is ejected as a spray for quite a long distance by a forceful thrust (Spitting by Cobra). The King Cobra feeds on other poisonous snakes such as cobras, kraits and its own kind. It can also devour other larger non-poisonous snakes and monitor lizards. It is the only snake species in which females construct nests of leaves and twigs for breeding purpose.

Status : The population has been reduced drastically on account of habitat destructions and is now extremely vulnerable (Daniel, 1983 and Sharma, 2003). Whitaker and Captain (2004) have also reported rare status for King cobra. Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule II Part II, CITES Appendix : II; IUCN Category as per CAMP Report(1998) : Lower risk-Near threatened.

Remarks : King Cobra venom is much less toxic than other cobras. However, it can inject huge quantities at a time (upto 7 ml.). The Cobra bite is not fatal at all times. The effect depends on the quantity of venom injected, natural resistance of victim and various other factors.

Family HYDROPHIIDAE

Family Hydrophiidae ((Proteroglypha : 1-4 solid teeth before enlarged fangs in the upper jaw), which includes marine snake species, is represented by five genera in Goa State.

Key to the Genera of the Family HYDROPHIIDAE

I. Ventrals are generally entire and distinct throughout ..... A

II. Ventral shields are generally divided by a medial longitudinal fissure (Except quite anteriorly) or are vestigial (Smaller than adjoining dorsal scales or absolutely missing). ..... B

A. Mental shield is elongate; partly concealed in a groove in the symphysis; ventral shields are uniform in size; 3-5 maxillary teeth present. ..... ***Enhydrina***

Mental shield is normal; ventral shields are uniform in size; 1-8 maxillary teeth present. ..... ***Hydrophis***

B. Ventral shields are quite distinct in anterior part, but are smaller or even missing in the posterior portion. Poison fangs are followed after an interval by 3 to 6 solid teeth; 33-43 juxtaposed, hexagonal or squarish scales round the thickest part of the body; lower 3-4 rows are larger than the others ..... ***Lapemis***

Ventral shields are entire in the anterior part, but are divided by a medial longitudinal fissure in the posterior part; maxillary bone extends forward as far as or little further than the palatine bone. Poison fangs are followed after an interval by 5 or 6 solid teeth; 30-36 juxtaposed or hexagonal scales round the thickest part of the body. All dorsal scales are normal in size ..... ***Microcephalophis***

Ventral shields are very small divided by a median longitudinal furrow in the posterior part; maxillary bone never extend beyond the palatine bone. Poison fangs are followed after an interval by 7 or 11 solid teeth; 49-67 scales juxtaposed, squarish or hexagonal round the thickest part of the body. All dorsal scales are normal in size ..... ***Pelamis***

Genus *Enhydrina*

Genus *Enhydrina* is represented by a single species in Goa State.

*86. *Enhydrina schistosa* (Daudin)

1803. *Hydrophis schistosus*, Daudin. *Hist. Nat. Rept.*. **7** : 386.

Common name : English : Hook-nosed Sea Snake.

Diagnostic characters : Hook-nosed sea snake possesses all the characters mentioned for Suborder *Serpentes* and Family *Hydrophiidae*. In fact all the species under *Hydrophiidae* are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Enhydrina*, Hook-nosed sea snake, includes deadly poisonous snakes with elongated compressed body. Ventral shields are generally entire and distinct throughout. Head shields regular and entire. Mental shield is narrow and elongate; partly concealed in a groove. Scale at tip of the snout extends downwards and looks like a beak or " Hook-Nose" 3-5 maxillary teeth present. Maxillary bone never extends beyond the palatine bone. Nostrils are superior; nasal shield in contact with one another. Body scales are imbricate or subimbricate with short central keels on them. Males with 40-52 scale rows on neck and 49-60 on body, while females with 42-55 scale rows on neck and 51-66 around thickest part of the body. Hemipenis is forked for about half its length. The monotypic genus reaches to a maximum length of 1580 mm (Range : 1100-1200 mm), Eyes moderately large. Ventral shields are 239-354 in number, distinct throughout, slightly broader than the adjoining scales. Preanal shields are feebly enlarged. Dorsal colouration is gray or grayish with bluish tinge with dark gray or black annulation, which are broadest on the dorsum. Upper surface of head pale gray unbanded or faintly banded. Ventrum whitish or yellowish white.

Locality : Sharma (1976) reported collection of one specimen from Panjim sea beach region of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Coastal waters of India.

Elsewhere : Pakistan, Sri Lanka and Bangladesh (Whitaker and Captain (2004).

Habitat : The most common of sea snake species. Exllent swimmer. Acive by day and night. Usually found in shallow coastal and estuarine

waters. Capable of staying underwater for longer periods. Feeds chiefly on fishes and crustaceans. Activity is generally guided by tides. Aviods strong tides.

Status : Fairly common (Daniel, 1983, Sharma, 2003 and Whitaker and Captain (2004). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV; IUCN Category as per CAMP Report (1998) : Data Deficient.

Remarks : Venom of Hook-Nosed Sea Snake is 4 to 10 times more potent than cobra venom. However, the bites are rare.

Genus ***Hydrophis***

Genus *Hydrophis is* represented by six species in Goa State.

Key to the species of the Genus *Hydrophis* from Goa State

1. Parietals not touching the postoculars; 14-18 maxillary teeth behind the poison fangs. .... *Hydrophis caerulescens*

– Parietals touching the postoculars; maxillary teeth behind the poison fangs always less than 14 in number 2

2. Coastals with short bi- or tri dentate keels; small, wedge-shaped scales (cuneates) present on the oral border between the infralabials after the 2nd or 3rd .... *Hydrophis cyanocinctus*

– Coastals with a round central tubercle or a short median keels, sometimes smooth or feebly keeled. Cuneates either absent or only 1 or 2 present ..... A

A. Posterior pair of sublinguals ill developed, separated by scales. ..... *Hydrophis ornatus*

– Both the pairs of sublinguals well-developed. The posterior ones are in contact with each other or separated by scales. ..... a

a. Scales on the thickest part of the body with rounded or bluntly pointed tips distinctly or feebly imbricate ..... *Hydrophis spiralis*

– Scales on the thickest part of the body are hexagonal, sub-quadrangular in shape, juxtaposed or feebly imbricate i

i. Normally one anterior temporal. 5-6 maxillary teeth behind poison fangs. Body with lateral spots or cross bars ..... *Hydrophis fasciatus*

– 2 or 3 anterior temporals. 8-10 maxillary teeth behind poison fangs. Body with 44-55 broad black bands on the body .... *Hydrophis mamillaris*

87. ***Hydrophis spiralis*** (Shaw)

1802. *Hydrus spiralis*, Shaw. *Genl. Zool.*, **iii** : 564.

Common name : English : Yellow Sea Snake.

Diagnostic characters : Yellow sea snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. In fact all the species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Hydrophis*, Yellow sea snake, includes deadly poisonous snakes with elongated compressed body. In *Hydrophis spiralis* ventrals are generally entire, distinct throughout and uniform in size. Mental shield is normal. 1-8 maxillary teeth present behind the poison fangs. Parietals touching the postoculars. Coastals with a round central tubercle or a short median keels, sometimes smooth or feebly keeled. Cuneates either absent or only 1 or 2 present. Both the pairs of sublinguals well developed. The posterior ones are in contact with each other or separated by scales. Scales on the thickest part of the body with rounded or bluntly pointed tips distinctly or feebly imbricate. Dorsal colouration is yellowish or yellowish-green or golden-yellow. Dorsal scales with narrow black margins. Flanks and ventral surface are pinkish white. There are about 44-48 black annulation on the whole body, which are widest on the vertebral region and become narrow on the flanks and ventrum. The annuli are narrower than the interspaces and contain several light coloured scales. Tail is with 4-7 bands. Head is moderately large and is yellow in adults. Chin and throat are

white to pale gold. The thickest posterior part is almost two times or more than the diameter of the neck. Eyes are quite small. 25-31 scale rows on the neck, while 33-46 on the thickest part of the body. Ventral shields are 295-362 in number, distinct throughout and twice as broad as the adjacent scales. Scales are feebly imbricate or smooth or with central tubercles or short keels. Preanal shields are enlarged. Hemipenis is forked near the tip. Total length generally reaches upto 1760mm in males, while 1950 mm in females.

Locality : Smith (1943), Daniel, (1983) and Sharma (2003) have reported the distribution of this species from coastal waters of India including Goa State.

Distribution : Coastal waters of India, (Sharma, 2003).

Habitat : The snake is most pugnacious and bites readily without provocation. It is mainly a fish eater.

Status : Fairly common (Daniel, 1983 and Sharma, 2003). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV; IUCN Category as per CAMP Report (1998) : Data Deficient (For Leicocephalophis spiralis (Shaw).

Remarks : *Hydrophis spiralis* (Shaw) (=*Leicocephalophis spiralis* (Shaw) has been retained here following Sharma (2003).

88. ***Hydrophis cyanocinctus*** (Daudin)

1803. *Hydrophis cyanocinctus*, Daudin. *Hist. Nat. Rept.*, vii : 383.

Common name : English : Annulated Sea Snake.

Diagnostic characters : Annulated sea snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. In fact all the species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Hydrophis* includes deadly poisonous snakes with elongated compressed body. Mental shield is normal. 5–6 maxillary teeth present behind the poison fangs. Parietals touching the postoculars. In *Hydrophis cyanocinctus* ventrals are generally small but distinct throughout and uniform in size. Coastals with short bi- or tri dentate keels; small, wedge-shaped scales (cuneates) present on the oral border between the infralabials after the 2nd or 3rd. Scales on the thickest part of the body imbricate throughout with a central keel, which may brake up in series of 2-3 tubercles. Body is not slender anteriorly, compressed posteriorly. The thickest posterior part is almost 2-2½ times more than the diameter of the neck. Eyes are quite small. 25-35 scale rows on the neck, while 37-47 on the thickest part of the body Ventral shields are 290-390 in number, distinct throughout and anteriorly twice as broad as the adjacent dorsal scales, while little less posteriorly. Dorsal colouration is dirty white, pale greenish or yellow. Dorsal scales with narrow black margins. Flanks and ventral surface are pale yellow. There are about 50-75 sooty black cross-bands (Narrower on the sides) on the whole body, which are widest on the vertebral region and become narrow on the flanks and ventrum. Bands may form complete rings. Tail is darker than the colour of the body and is with 6-9 bands. Head is moderately large and is black, dark or pale olive-brown in adults. Preanal shields are much enlarged. Hemipenis is forked near the tip. Total length generally reaches upto 1630 mm in males, while 2020 mm in females.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have reported the distribution of this species from coastal waters of India including Goa State.

Distribution : Coastal waters of India and adjacent countries (Sharma, 2003 and Whitaker and Captain, 2004).

Habitat : Generally found in shallow mangrove swamps or washed ashore, but has also been recorded swimming 12-20 miles off the coast. Able to crawl slowly on the land. Adult can lift its head above the ground. Piscivorous in habit. Most dangerous species and bites readily without provocation. Bites have been proved fatal.

Status : Fairly common (Sharma, 2003) and uncommon (Whitaker and Captain, 2004) Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV; IUCN Category as per CAMP Report (1998) : Data Deficient (For *Leicocephalophis cyanocincta* (Daudin).

Remarks : *Hydrophis cyanocinctus* (Daudin) (= *Leicocephalophis cyanocincta* (Daudin) has been retained here following Sharma (2003) and Whitaker and Captain (2004).

89. ***Hydrophis ornatus*** (Gray)

1842. *Aturia ornata*, Gray. *Zool Misc.* : 61.

Common Name : English : Pale-Grayish or Cochin Banded Sea Snake.

Diagnostic characters : Cochin Banded sea snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. Species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Hydrophis* includes deadly poisonous snakes with elongated compressed body. Mental shield is normal. 10 13 maxillary teeth present behind the poison fangs. Parietals touching the postoculars. In *Hydrophis ornatus* coastals with a round central tubercle or a short median keels, sometimes smooth or feebly keeled. Cuneates either absent or only 1 or 2 present. Posterior pair of sublinguals ill developed, separated by scales. In *Hydrophis ornatus* ventrals distinct from adjacent scales throughout and uniform in size. Scales sub-imbricate or juxtaposed, with a central tubercle or short keel. Body is robust and markedly elongated with its diameter greatest posteriorly. Eyes large with round pupils. Scales in 33-45 rows on the body in males and 39-55 in females, decreasing by 4 to 12 rows on neck. Ventral shields are 209-260 in males, 236-312 in females distinct throughout. Dorsal colouration is pale grayish or olivaceous or almost white above, with broad dark bars or rhomboidal spots separated by narrow interspaces. Cross bands may end abruptly on sides of the body. Ventral surface is yellowish or whitish. Head is moderately large and is blackish or olive with yellowish-white markings on snout and sides. Hemipenis is forked near the tip. Total length generally reaches upto 1065 mm in males, while 940 mm in females.

Locality : Smith (1943), Sharma (2003) and Whitaker and Captain (2004) have reported the distribution of this species from the coastal waters of India including Goa State.

Distribution : Coastal waters of India and adjacent countries (Sharma, 2003 and Whitaker and Captain, 2004).

Habitat : Active at night. Prefers shallow waters. Swims very well, but helpless on land. Sometimes stranded on beaches in stormy weather. Piscivorous in habit. Venom most toxic and bites readily without provocation. Bites have been proved fatal.

Status : Fairly common (Sharma, 2003) and rare (Whitaker and Captain, 2004) Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV.

Remarks : IUCN status of *Hydrophis ornatus* (Gray) has not been assessed during the CAMP Workshop (1998).

*90. ***Hydrophis caerulescens*** (Shaw)

1802. *Hydrus caerulescens*, Shaw. *Genl. Zool..*, **iii** : 561.

Common Name : English : Many Toothed or Malacca Sea Snake.

Diagnostic characters : Malacca sea snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. Species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Hydrophis* includes deadly poisonous snakes with elongated compressed body. Mental shield is normal. In *Hydrophis caerulescens* parietals not touching the postoculars. 14-18 maxillary teeth behind the poison fangs. The body is not much slender anteriorly, but compressed posteriorly. Its greatest

diameter being 2-3 times that of the neck. Head is moderately small. Eyes moderately large and entirely black. Scales sub-imbricate or juxtaposed, with a central tubercle or short keel. Body is robust and markedly elongated with its diameter greatest posteriorly. Scales in 31-43 rows on the neck and 38-54 on the body. The posterior scales are subimbricate and with the truncated tips. Scales strongly keeled. Ventral shields are 253-334 in number and are distinct throughout. Dorsal colouration is bluish gray with 40-60 broad bands, almost two times broader than the interspaces between them at the anterior portion of the snake. These bands taper towards the ventral portion where they may be complete or incomplete on the thicker part of the body. Ventral surface is yellowish or whitish. Head is small and is black or dark gray, sometimes with yellowish-whitish mark behind the eye. Hemipenis is forked near the tip. Total length generally reaches upto 920 mm in males, while slightly more than 800 mm in females.

Locality : Sharma (1976) reported collection of twelve specimens from Panjim sea beach region of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Coastal waters between Mumbai and Karwar and from Chennai northwards to the mouth of the Ganges on the east coast of India and adjacent countries (Sharma, 2003 and Whitaker and Captain, 2004).

Habitat : Active at night. Prefers shallow waters. Swims very well, but helpless on land. Found in estuarine areas and mangroves. Piscivorous in habit. Inoffensive but will bite on provocation. Venom toxic. Bites have been proved fatal.

Status : Fairly common (Daniel, 1983 and Sharma, 2003) and uncommon (Whitaker and Captain, 2004) Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV. IUCN Category as per CAMP Report (1998) : Data Deficient.

Remarks : Nil.

91. ***Hydrophis mamillaris*** (Daudin)

1803. *Anguis mamillaris*, Daudin. *Hist. Nat. Rept.*, **7** : 34.

Common Name : English : Bombay Sea Snake.

Diagnostic Characters : Bombay sea snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. All the species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Hydrophis* includes deadly poisonous snakes with elongated compressed body. Mental shield is normal. Parietals touching the postoculars. Coastals with a round central tubercle or a short median keels, sometimes smooth or feebly keeled. Cuneates either absent or only 1 or 2 present. Both the pairs of sublinguals well developed. The posterior ones are in contact with each other or separated by scales. Scales on the thickest part of the body are hexagonal, subquadrangular in shape, juxtaposed or feebly imbricate. In *Hydrophis mamillaris* there are 2 or 3 anterior temporals and 8-10 maxillary teeth behind poison fangs. Body with 44-55 broad black bands on the body. Head is small. The body is slender anteriorly, but compressed posteriorly. Its greatest diameter being 3-4 times that of the neck. Eyes moderately large and entirely black. In *Hydrophis mamillaris* ventrals distinct from adjacent scales throughout and uniform in size. Body is robust and markedly elongated with its diameter greatest posteriorly. Ventral shields are 302-390 in number, distinct throughout and bicarinate. Dorsal colouration is yellowish or grayish with 44-55 broad black bands on the body, almost two times broader than the interspaces between them. These bands expand dorsally and in most individuals they are connected along the ventral line. Ventral surface is yellowish or whitish. Head is small and is black or sometimes with yellow streak on the temporal region. Hemipenis is forked near the tip. Total length generally reaches upto 870 mm in males, while slightly more than 895 mm in females.

Locality : Smith (1943) and Sharma (2003) have reported the distribution of this species from the coastal waters of India including Goa State.

Distribution : Coastal waters of India and adjacent countries (Sharma, 2003).

Habitat : Found in shallow sandy tidal pools with rocky substratum. Also found in mangrove creeks. Piscivorous in habit. Venom toxic. Bites have been proved fatal.

Status : Rare (Sharma, 2003), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV.

Remarks : Nil.

92. ***Hydrophis fasciatus*** (Schneider)

1799. *Hydrus fasciatus*, Schneider. *Hist. Amphib.*, i : 240.

Common Name : English : Grayish-Black White-Bellied Sea Snake.

Diagnostic characters : Grayish-Black White-Bellied Sea Snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. Species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Hydrophis* includes deadly poisonous snakes with elongated compressed body. Mental shield is normal. Coastals with a round central tubercle or a short median keels, sometimes smooth or feebly keeled. Cuneates either absent or only 1 or 2 present. Both the pairs of sublinguals well developed. The posterior ones are in contact with each other or separated by scales. Scales on the thickest part of the body are hexagonal, subquadrangular in shape, juxtaposed or feebly imbricate. Parietals touching the postoculars. In *Hydrophis fasciatus* there is only one anterior temporal and 5-6 maxillary teeth behind poison fangs. In this species head, neck and anterior part of the body are black to dark olive, with pale yellowish oval spots on the sides or connected as dorsal bars. Posteriorly grayish above, whitish below, with dark rhomboidal spots which may extend down the sides of the body and form complete annuli in the young. Ventrals are distinct from adjacent scales throughout and uniform in size, bicarinate. Hemipenis is forked near the tip. Total length generally reaches upto 1110 mm with tail 100 mm in males, while slightly more than 990 mm with tail 75 mm in females.

Locality : Smith (1943) and Sharma (2003) have reported the distribution of this species from the coastal waters of India including Goa State.

Distribution : Coastal waters of India and adjacent countries (Sharma, 2003).

Habitat : Found in shallow sandy tidal pools with rocky substratum. Also found in mangrove creeks. Piscivorous in habit. Venom toxic. Bites have been proved fatal.

Status : Common throughout its range (Sharma, 2003), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV.

Remarks : Nil.

Genus ***Lapemis***

Genus *Lapemis* is represented by a single species in Goa State.

*93. ***Lapemis curtus*** (Shaw)

1802. *Hydrus curtus*, Shaw. *Genl. Zool.*, iii : 562.

Common Name : English : Short Sea Snake.

Diagnostic characters : Short Sea Snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. In fact species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Genus *Lapemis* includes deadly poisonous snakes with short but compressed body. Mental shield is normal. Ventral shields are quite distinct in anterior part, but are smaller or even missing in the posterior portion. Poison fangs are followed after an interval by 3 to 6 solid maxillary teeth. 33-43 juxtaposed, hexagonal or squarish scales round the thickest part of the body. Lower 3-4 rows of scales are larger than the others. Its greatest diameter is being 2 times that of the neck. Head is moderately large and blunt, but is not broader than the neck. Head shields are entire, but parietals are broken up into irregular small scales. Nostrils are in superior

position. Nasal shields are in contact with each other. Scales sub-imbricate with a central tubercle or short 1 or 2 keels on scales of lower rows (They may be strongly spinous in adult males). Body is robust and stout with its diameter greatest posteriorly. 28-31 scale rows on the neck in males and 31-35 in the females, while 33-39 scales on the body of the males and 36-43 in females. Ventral shields are 154-168 in number. Dorsal colouration is greenish brown or gray above with 35-50 narrow, darker gray or black, ill-defined cross bands that tapper to a point on each side of the body near belly. At times some of these bands form complete bands around the body. Dark gray head is, sometimes, with a curved yellow mark. Ventral surface is whitish. Hemipenis is forked near the tip. Total length generally reaches upto 950 mm.

Locality : Sharma (1976) reported collection of five specimens from Kolva and Canacona sea beach regions of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Coastal waters of India and adjacent countries (Sharma, 2003 and Whitaker and Captain, 2004).

Habitat : Active at night. Prefers shallow rocky coastal waters and estuaries. Swims well, but can crawl slowly on land. Often caught in fishing nets. Piscivorous in habit. Inoffensive but will bite on provocation. Venom toxic. Bites have been proved fatal.

Status : Quite common (Sharma, 2003) and uncommon (Whitaker and Captain, 2004) Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV.

Remarks : Nil.

Genus *Microcephalophis*

Genus *Microcephalophis is* represented by a single species in Goa State.

94. *Microcephalophis gracilis* (Shaw)

1802. *Hydrus gracilis*, Shaw.*Genl. Zool.*, iii : 560.

Common Name : English : Common Small Headed Sea Snake.

Diagnostic characters : Common Small Headed Sea Snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. In fact species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Microcephalophis* includes deadly poisonous snakes with elongated compressed body. Ventral shields are entire in the anterior part, but are divided by a medial longitudinal fissure in the posterior part. Maxillary bone extends forward as far as or a little beyond the palatine bone. Poison fangs are followed after an interval by 5 or 6 solid teeth. Head shields are entire, nostrils are superior, nasals are in contact with each other and 30-36 juxtaposed or hexagonal scales round the thickest part of the body. 1st and 2nd supralabials touching the nasals. Prefrontal is not touching the 3rd supralabial. All dorsal scales are normal in size Ventrals 212-360 in number. They are entire on the anterior part of the body and broader than the adjoining dorsal scales. But in the posterior region these are completely divided by a median furrow. The two halves being opposed to one another and alternating. The body is very long and most slender anteriorly and extremely compressed posteriorly. Its greatest diameter is between 4-5 times than the diameter of the neck. Snout distinctly projects out beyond the lower jaw. Eyes moderately large. Head is very small in comparison to the body, which is somewhat elongated. Dorsal colouration of young is blackish with a series of whitish dorsal bands or oval spots on lateral sides on the slender portion of the body. Posterior part is completely covered with 40-60 bands. In adults these markings become dull and the whole dorsum looks grayish. Ventrum is paler. Head is olivacious or yellowish. 17-23 scale rows are present on the neck, 29-43 on the body (Increase by 12-16). The posterior body scales are hexagonal, juxtaposed, and broader than long, with 2-3 very small tubercles, one behind another. The lower most rows of the scales a little larger than the others and bear very prominent tubercles or dental keels in adults. Hemipenis is forked near the tip. Total length generally reaches upto 1050

mm in males, while slightly more, 1120mm, in females.

Locality : Smith (1943) and Sharma (2000, 2003) have reported the distribution of this species from the coastal waters of India including Goa State.

Distribution : Coastal waters of India and adjacent countries (Sharma, 2000, 2003).

Habitat : Marine snakes most agile in water but helpless on ground. Generally found in mangrove swamps. Piscivorous in habit. Viviparous. Venom toxic. Bites have been proved fatal.

Status : Fairly Common (Sharma, 2000, 2003), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV. IUCN Category as per CAMP Report (1998) : Data Deficient.

Remarks : Nil.

Genus ***Pelamis***

Genus *Pelamis* is represented by a single species in Goa State.

95. ***Pelamis platurus*** (Linnaeus)

1766. *Anguish platurus*, Linnaeus. *Syst. Nat.* Ed. **12** : 391.

Common Name : English : Pelagic or Black & Yellow Sea Snake or Yellow-Bellied Sea Snake.

Diagnostic characters : Black & Yellow Sea Snake possesses all the characters mentioned for suborder Serpentes and family Hydrophiidae. In fact all the species under Hydrophiidae are marine and possess maxillary bone with teeth behind the poison fangs. Tail vertically compressed and puddle shaped. Pupil round. Genus *Pelamis* includes deadly poisonous snakes with elongated compressed body. Ventral shields are very small divided by a median longitudinal furrow in the posterior part. Maxillary bone never extends beyond the palatine bone. Poison fangs are followed after an interval by 7 or 11 solid teeth. 49-67 scales juxtaposed, squarish or hexagonal round the thickest part of the body. All dorsal scales are normal in size. Head shields are entire, nostrils are superior, and nasals are in contact with each other, body is short but very stout covered with rows of 49-67 juxtaposed or hexagonal or squarish scales round the thickest part of the body. All dorsal scales are normal in size. Ventrals 264-406 in number. The body is not very long but is much compressed. Its greatest diameter is more than two times than that of the neck. Eyes moderately large and entirely black. Head is narrow and snout is elongated. Head and body is black or blue black above, "canary yellow" on sides and underside. Edge between the two colours mostly straight, but becomes wavy on hinder part of the body. Tail white with large black spots. Marks on the upper edge of the tail alternate with those on the lower edge. However there are number of colour variations reported such as black above brown or yellow with yellow stripes etc. Yellow may appear brown at the time of moulting. The lowermost rows of the scales a little larger than the others and bear very prominent 2-3 tubercles or dental keels in adults. Hemipenis is forked near the tip. Total length generally reaches upto 800 mm in males, while slightly more, 970 mm, in females.

Locality : Smith (1943), Sharma (2000, 2003) and Whitaker and Captain (2004) have reported the distribution of this species from the coastal waters of India including Goa State.

Distribution : Coastal waters of India and adjacent countries (Sharma, 2000, 2003).

Habitat : Pelagic snakes most docile and swift swimmers in water. Drifts like a stick. Helpless on land. Surface feeder. Piscivorous in habit. Viviparous. Venom toxic. Bites have been proved fatal.

Status : Fairly Common (Sharma, 2000, 2003) and uncommon (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule IV.

Remarks : Nil.

Family VIPERIDAE

Family Viperidae (Solenoglyapha : No solid teeth in front of the fangs. All solid teeth behind

the fangs in upper jaw) is represented by two subfamilies in Goa State.

Key to the Subfamilies of the Family VIPERIDAE

1. Without any deep depression; the loreal pit is between the eye and the nostril; maxillary bone not hollowed out..... ..... VIPERINAE (True Vipers)

– With a deep depression between the eye and the nostril, the loreal pit, on each side of the snout formed by the hollowing out of the maxillary bone ... CROTALINAE(Pit-Vipers)

Subfamily VIPERINAE

Subfamily *Viperinae* is represented by two genera in Goa State.

Key to the Genera of the Subfamily VIPERINAE

1. Subcaudals single. Keels of lateral scales strongly serrated. Size small ..... ***Echis***

2. Subcaudals paired. Keels of lateral scales without any serration. Size large ..... ***Vipera***

Genus ***Vipera***

Genus *Vipera* is represented by a single species in Goa State.

*96. ***Vipera russelli*** (Shaw)
= ***Daboia russelii*** (Shaw)

1797. *Coluber russelli* Shaw, *Nat. Misc.*, viii : 291.

Common Name : English : Russell's viper or Daboia.

Diagnostic characters : Viper species under family Viperidae possess all the characters mentioned for the suborder Serpentes. However, coronoid bone is absent, poison fangs are present in upper jaw, maxillary bone is quite short bearing fangs only, pupil elliptically vertical and ventrals almost as broad as the body in family Viperidae. Poison fangs are large, erectile and tube like. Anterior skull bones flexible. Head is quite distinct from the neck and covered with small scales. Eyes not in contact with the labials. There is no pit between eye and nostril, which is lateral in position in Genus *Vipera*. Dorsal body scales strongly keeled but not serrated in Russell's viper. Subcaudals divided, tail short. Head rather long and wider than neck. Snout bluntly pointed. Rostral about twice as high as wide. Body stout dorsoventrally flattened. Scales in 25-29 : 27-33 : 21-23 rows, ventral shields 153-180, subcaudals 41 in males and 64 in females. Dorsal ground colour brown of varying shades with three series of large ovate spots, one vertebral and two costal. Spots brown in the centre surrounded successively by black and white or buff. Smaller spots may occur between the dorsal and side spots. Head with distinct dark patch behind. A dark stripe from eye to lip. A copnspicuous white, buff or pink line from gape converges to form a V above snout. Belly white, whitish or yellowish with a few dark half moon marks on the margins of the anterior ventral. Maximum length of Russell's viper reaches upto 1500 mm.

Locality : Sharma (1976) reported collection of one specimen from Phonda region of Goa State in 1969. This is the first collection record reported from Goa State. ZSI survey party sighted one live specimen in Valpoi region of Goa State during the project period.

Distrbution : Whole of India (Sharma, 2000, 2003 and Whitaker and Captain, 2004 for *Daboia russelii*).

Habitat : Widely distributed but prefers open country. Russell's viper has been recorded upto 2100 m. in other parts of the country. Normally sluggish and does not strike readily unless irritated. It bites with great malice. The fangs are movable and can be erected when the mouth is open. Viper's poison apparatus is also called as "Nature's hypodermic syringe" All viper species are viviparous. The poison acts as a depressor of the vasomotor centre and a destroyer of the blood targeting R.B.C. The lethal dose is about 42 mgm for an adult human being.

Status : The species is abundant in some areas.

uncommon or rare or even missing in other areas (Daniel, 1983 and Sharma, 2000, 2003). Indian Wildlife (Protection) Act (1972 as amended upto 1991) Schedule : Schedule II, Part II; IUCN Category as per CAMP Report (1998) : Lower risk-Near threatened (for *Daboia russelii*).

Remarks : Nocturnal in behaviour. Feeds mainly on rodents, but diet also include small mammals, birds, lizards, amphibians etc. The young are often cannibalistic. CAMP Report (1998), Gayen (1999) and Whitaker and Captain (2004) consider Russell's viper as a species under another genus *Daboia* (*Daboia russelii*). However, the species has been treated here as *Vipera russelii* (Shaw) following Smith (1945) Sharma (2000 and 2003). Russell's viper is being killed indescriminately on a very large scale for their skins for illegal trade in local, domestic and international market (Pradhan, 1997).

Genus ***Echis***

Genus *Echis* is represented by a single species in Goa State.

*97. ***Echis carinatus*** (Schneider)

1801. *Pseudoboa carinata* Schneider, *Hist. Amphibia*, ii : 285.

Common Name : English : Saw-scaled viper or Phoorsa.

Diagnostic characters : Saw-scaled viper possesses all characters mentioned earlier for suborder Serpentes and family Viperidae. Saw-scaled viper is distinguished from other Indian snakes by the absence of shields on head, broad ventrals covering the whole belly and possession of undivided subcaudals. Body cylindrical, short and stout. Nostrils small and dorsolateral in position directing upwards. Head very distinct from neck. Eyes moderately large with vertical pupil. Maximum length of phoorsa snake is about 760 mm. Scales are small elongated and strongly keeled. Mostly the keels are serrated on the flanks. They are arranged in 25-29 : 27-37 : 21-27 rows. Two outermost rows are largest. Ventral shields 132-185, while subcaudals 23-39 in number. Hemipenis is deeply forked and bears spines all over. Colour and pattern varies considerably. Pale brown, buff or tawny with dark brown or even blackish markings in the form of dark edged spots in a vertebral series connected to a light coloured inverted 'U' or 'V' shaped flank marks enclosing a dark area connected to each other forming a wavy line. Dorsum is with 28 36 spots. There is a cruciform or trident shaped mark on the head. Whitish below, uniform or spotted with brown. Poison fangs of saw-scaled viper are remarkably large for its size. The almond shaped poison glands are placed behind the eyes.

Locality : Sharma (1976) reported collection of forty specimens from Valpoi, Canacona, Dhavan Village, and Ponda regions of Goa State in 1969. This is the first collection record reported from Goa State. One specimen was collected from Bondla Wildlife Sanctuary region by ZSI Survey party during the project period.

Distribution : Widely distributed in India except in Bengal and North East India (Sharma, 2000, 2003 and Whitaker and Captain, 2004).

Habitat : Terrestrial mainly inhabits arid and open broken scrub country. Fairly common along west coast area. An alert little snake. It is diurnal in habit and a good climber. It readily bites with smallest provocation. The striking posture is characteristic, a double coil in the form of a loop of figure '8' with its head in the centre. The hissing noise is produced due to friction of serrated scales on the flanks. Feeds largely on centipedes, scorpions, larger insects, mice, skinks, geckos and frogs.

Status : Common throughout its range (Daniel, 1983, Sharma, 2003 and Whitaker and Captain, 2004)), Indian Wildlife (Protection) Act (1972 as amended upto 1991) Schedule : Schedule IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : Poison of saw-scaled viper is supposed to be five times toxic as cobra venom and 16 times toxic of Russell's viper's venom. The lethal dose for man is believed to be 5 mgm. The poison destroys blood cells and lining of blood

vessels. Saw-scaled vipers are killed indescriminately on a very large scale for illegal trade of their skins (Pradhan, 1997).

Subfamily CROTALINAE

Subfamily Crotalinae is represented by two genera in Goa State.

Key to the Genera of the Subfamily CROTALINAE

I. Top of head is with large symmetrical shields paired (Agkistrodon) ..... ***Hypnale***

Head covered completely with small scales ..... ***Trimeresurus***

Genus ***Hypnale*** (Agkistrodon)

Genus *Hypnale (Agkistrodon)* is represented by a single species in Goa State.

98. ***Hypnale (Agkistrodon) hypnale*** (Merrem)

1820. *Cophias hypnale* Merrem, Syst. Amph. : 155.

Common Name : English : Hump-nosed Pit Viper.

Diagnostic characters : Hump-nosed Pit Viper possesses all the characters mentioned earlier for family Viperidae. Presence of deep pits between the preoculars and the loreal formed due to hollowing out of the maxillary bone on lateral sides of the face is the characteristic feature of all the pit viper species and separates them from all other groups of snakes. Top of the head is with large symmetrical shields. Snout acutely pointed and turned up at the end. A frontal is bounded on each side by a supraocular and followed by internasals. Prefrontals many a times are paired. Eyes are moderately large with vertical pupil. Triangular head is distinctly flattened and appears unduly broad owing to constricted neck. Body stout. Tail short tapering and prehensile. The length of Hump-nosed Pit Viper reaches upto 385 mm. in males and 545 mm in females. Scales of the body are in 17 : 17 : 17 or 15 rows and they are smooth or feebly keeled on postrior side. Scales on head are small, subequal, subimbricate and smooth. Ventral shields 138-157. Subcaudals 32-46 paired or some of them may be single. Hemipenis forked extended upto 15th caudal plate. Dorsal colouration is grayish or brownish of various shades and moultings. A series of ovate dark coastal spots always present. Tip of the tial often yellowish or reddish. Underside is gray, yellow or brown with darker spots.

Locality : Smith (1943), Daniel (1983), Sharma (2000, 2003) and Whitaker and Captain (2004) have reported occurrence of this species in Western Ghats upto Lat. 16°N. Nearest locality is Castle Rock on Goa-Karnataka border (Whitaker and Captain, 2004).

Distribution : Western Ghats in India.

Elsewhere : Sri Lanka.

Habitat : Terrestrial, arboreal, nocturnal ascending low bushes. It's a snake of hill forests of evergreen, moist deciduous and dry deciduous types. Also found in plantation areas. Feeds mainly on small mammals, birds, lizards and frogs. It's venom action is quite toxic and painful. No information is available on human fatalities due to its bites.

Status : Common (Sharma, 2000, 2003 Whitaker and Captain, 2004), Indian Wildlife (Protection) Act (1972, as amended upto 1991) Schedule : Schedule : IV, IUCN category as per CAMP Report : Lower risk-Near threatened.

Remarks : The threat to the survival of species is due to habitat loss for urbanisation.

Genus ***Trimeresurus***

Genus *Trimeresurus is* represented by two species in Goa State.

Key to the species of the Genus *Trimeresurus* from Goa State.

I. Supraocular (Scale above eye) divided into 2 or 3 pieces by transverse sutures or their margins indented by the adjacent scales. .... *Trimeresurus malabaricus*

– Supraocular not divided .... *Trimeresurus gramineus*

*99. ***Trimeresurus gramineus*** (Shaw)

1802. *Coluber gramineus* Shaw, *Genl. Zool.*, **iii** : 420.

Common Name : English : Bamboo Pit viper.

Diagnostic characters : Bamboo pit viper possesses all the characters mentioned earlier for family Viperidae. Presence of deep pits between the preoculars and the loreal on lateral sides of the face is the characteristic feature of all the pit viper species and separates them from all other groups of snakes. The head is flattened and appears unduly broad owing to constricted neck. Body stout. Tail short tapering and prehensile. The length of bamboo pit viper reaches upto 745 mm. in males and 935 in females. Snout two times as long as the diameter of the eye, which is moderately large with vertical pupil. Iris golden. Scales of the body are in 21 : 21 : 15 rows and they are smooth or feebly keeled on postrior side. Scales on head are small, subequal, subimbricate and smooth. Supraocular not divided. Ventral shields 145-175 in males and 164-177 in females. Subcaudals 55 -71 in males and 57-62 in females. Hemipenis forked extended upto 11th to 12th caudal plate. Dorsal colouration grassy green and uniform or sometimes with small dark brown spots. Ventral side glossy white, yellow or greenish extending upto throat, chin and upper lip. A well-defined white, bluish or yellowish line on flank usually present. Black or blackish markings on the head.

Locality : Sharma (1976) reported collection of one specimen from Molem region of Goa State in 1969. This is the first collection record reported from Goa State.

Distribution : Peninsular India, South of Lat. 22° N. Indian endemic species.

Habitat : Terrestrial, arboreal and nocturnal. It's a snake of hill forests. Frequents low vegetation showing marked preference for bamboo. When provoked, it anchors itself firmly by its tail and hind body to a branch and takes shape of 'S' with rest of the body. Feeds mainly on small mammals, birds and lizards. Its venom action is feeble but painful. No information is available on lethal dose.

Status : Not uncommon in its range of distribution (Sharma, 2003) and Common (Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto 1991) Schedule : Schedule : IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : The threat to the survival of species is due to habitat loss for urbanisation.

100. ***Trimeresurus malabaricus*** (Jerdon)

1854. *Trigonocephalus (Cophias) malabaricus* Jerdon, *J. A. S. Bengal*, **xxii** : 523.

Common Name : English : Greenish Malabar Pit Viper

Diagnostic Characters : Malabar Pit Viper possesses all the characters mentioned earlier for family Viperidae. Presence of deep pits between the preoculars and the loreal on lateral sides of the face is the characteristic feature of all the pit viper species and separates them from all other groups of snakes. The head is flattened and appears unduly broad owing to constricted neck. Body stout. Tail short tapering and prehensile. The length of Malabar Pit Viper reaches upto 550 mm. and tail upto 100mm in males and 790 mm and 130 mm respectively in females. Eyes are moderately large with vertical pupil. Iris golden. Scales of the body are in 21 or 23 : 21 (Rarely 19) : 15 or 17 rows and they are smooth or feebly keeled on postrior side. Scales on head are small, subequal, subimbricate and smooth. Supraocular (Scale above eye) divided into 2 or 3 pieces by transverse sutures or their margins indented by the adjacent scales. Ventral shields 143-158 in males and 136-159 in females. Subcaudals 50-63 in males and 44-54 in females all divided. Anal entire. Hemipenis forked extended 12th caudal plate. Colouration pattern variable changing with the season and with faint markings. Typically green, olive, brown or reddish brown dorsal side with prominent brown/black spots that may join to form zigzag pattern. Flanks coarsely dappled with buff. There may be scattered yellow spots on sides. Ventral side greenish or yellowish or even grayish white.

Locality : Smith (1943), Daniel (1983) and Sharma (2000, 2003) have reported occurrence of this species from Western Ghats including Goa State. Nearest sighting locality is Castle Rock near Goa–Karnataka border (Whitaker and Captain, 2004).

Distribution : Western Ghats endemic species.

Habitat : Terrestrial, arboreal and nocturnal. Generally found at the altitudes between 2000 to 7000 Ft. It's a snake of hill forests. Frequents low vegetation and trees or on rocks- seen often near stream edges and pools. It is capable of fast strike. Feeds mainly on small mammals, birds and lizards. Its venom action is feeble but painful. No information is available on lethal dose.

Status : Common in its range of distribution (Sharma, 2003 and Whitaker and Captain, 2004). Indian Wildlife (Protection) Act (1972, as amended upto 1991) Schedule : Schedule : IV, IUCN category as per CAMP Report (1998) : Lower risk-Near threatened.

Remarks : The threat to the survival of species is due to habitat loss for urbanisation.

DISCUSSION

Systematic list of reptilian species given above reports occurrence of 100 reptilian species/ subspecies in the entire region of Goa State. Half of these (50) have been collected and/or sighted by ZSI survey parties which visited Goa State during project period between 1991–1996 and even by those which have visited Goa State before the project period, while remaining half (50) have been included in the list on the basis of the literature consulted. Sharma (1976) has enumerated a first comprehensive account of 46 reptilian species reported from Goa State on the basis of the considerable collections made by ZSI survey parties during 1966-1969, which has formed the base of the present updation.

The list includes systematic account on the every species of one crocodyle family (One species), five turtle/tortoise families (Includes Two Marine Turtle families. (Total 9 species), six lizard families (Includes 30 species) and eight snake families (Includes one family of marine snake species (Total 10 species) and one family of venomous snakes (10 species). Total 60 snake species) have been reported from Goa State. The list clearly indicates excellent herpetofaunal diversity in such a small but ecosystem diversified state. Serpentine species diversity is quite noteworthy.

The present account reports a total of 100 species belonging to 57 genera under 20 families of 4 suborders in three reptilian orders. The present updated systematic account includes about 38 species, which have been recorded from the state for the first time by Sharma (1976). The reptilian endemicity in India and Western Ghats is equally worth mentioning. About 24 Indian endemic reptilian species, which includes 12 Western Ghats endemics, have been reported from Goa State in the present account. Thus about 24% of the reptilian fauna of Goa State is endemic to India and half of the Indian endemics reported from the state are the Western Ghats endemics. Two turtle, eleven lizard and eleven snakes species represent the endemic species. Five species of Genus *Uropeltis* are either Indian or Western Ghats endemic.

The Indian Endemic including Western Ghats endemic reptilian species are :

Order TESTUDINES (Chekibua)

Family EMYDIDAE (Bataguridae

1. Indian Snail –Eating Turtle : *Melanochelys trijuga* (Schweigger)

Family TRIONYCHIDAE

2. Peninsular Soft-Shelled or Leith's Softshelled Turtle : *Trionyx leithi* Gray = *Aspideretes leithii* (Gray).

Order SQUAMATA

Suborder SAURIA (Lacertilia)

Family GEKKONIDAE

3. Goa Forest Palli : *Cnemaspis goaensis* Sharma.
4. Dark Spotted Giant Gecko : *Hemidactylus maculatus* (Dum. & Bibr.)

*5. Prashad Brown Gecko : *Hemidactylus prashadi* Smith.

6. Reticulated Gecko : *Hemidactylus reticulatus* Beddome.

Family AGAMIDAE

7. Matheran Olive-Brown Calotes : *Calotes rouxi* Dum. & Bibr.

Family SCINCIDAE

8. Allapalli Forest Skink : *Mabuya allapallensis* Schmidt.

9. Five Striped Skink : *Mabuya trivittata* (Hardwicke & Gray)

10. Malabar Dotted Skink : *Riopa guentheri* (Peters).

11. Golden-Brown Four-toed Skink : *Riopa lineata* (Gray).

*12. Goanese Bronze Skink : *Riopa goaensis* Sharma.

Family LACERTIDAE

*13. Beddom's Snake-Eyed Lacerta : *Ophisops beddomii* (Jerdon)

Suborder SERPENTES (Ophidia)

Family UROPELTIDAE

*14. Travancore Melanophidium or Pied-belly Shieldtail Snake : *Melanophidium punctatum* Beddome.

15. Elliot's Uropeltis or Shieldtail Snake : *Uropeltis ellioti* (Gray).

*16. Peter's Uropeltis or Mahrrata roughtail Snake : *Uropeltis macrolepis* (Peters).

*17. Cuvier's Uropeltis or Kerala Shieldtail Snake : *Uropeltis ceylanicus* Cuvier

*18. Bombay Hills Uropeltis or Phipsoni roughtail Snake : *Uropeltis phipsoni* (Mason).

*19. Myhendra Mountain Uropeltis or Barred shieldtail Snake : *Uropeltis myhendrae* (Beddome)

Family BOIDAE

*20. Whitaker's Boa : *Eryx whitakeri* I. Das

Family COLUBRIDAE

Subfamily COLUBRINAE

*21. Beddom's Olive-Brown Keelback : *Amphiesma beddomei* (Gunther) = *Natrix beddomei* (Gunther)

*22. Green or Hill Keelback : *Amphiesma monticola* (Jerdon).

Family ELAPIDAE

23. Striped Coral Snake : *Callophis nigrescens* (Gunther).

Family VIPERIDAE

Subfamily CROTALINAE

*24. Greenish Malabar Pit Viper : *Trimeresurus malabaricus* (Jerdon)

Species marked with astericks * above are Western Ghats endemic species.

Following lizard species from Goa State have been described as new to the science (Sharma, 1976) :

1. *Cnemaspis goaensis* Sharma and

2. *Riopa goaensis* Sharma

Further, Sharma (1976) has confirmed the species validity of *Mabuya allapallensis* reported from this region.

When conservation status of the reptilian species under Indian Wildlife (Protection) Act (1972)(as amended upto 2002) was studied, it was seen that 60 species/subspecies out of 100 (60%) have been included in some or other schedules of Indian Wildlife (Protection) Act. Eight species (One Marsh crocodile, six marine turtle and one snake species) have been included in Schedule I. Two lizard and six snake species have been listed in Schedule II Part II, while two turtle and 45 snake species find their place in Schedule IV. All snake families, which include these 45 species, have been listed in Schedule IV. Seven reptilian species fall under the threatened categories of IUCN, while four are Vulnerable and the rest are either Lower risk-Near Threatened, Lower risk-Least Concern or Data Deficient species. Under

CITES Regulations, seven reptilian species figure in Appendix I while six species find their place in Appendix II.

Finally following conclusions can be drawn :

1. State of Goa can boast of excellent reptilian species diversity (100 species belonging to 57 genera under 20 families of 4 suborders in three reptilian orders).
2. It can also boast of a fairly good representation of Indian/Western Ghats endemic reptilian species (24 species).
3. Two lizard species described as new to the science by Sharma (1976) were collected by him from this state.
4. Fairly large number of reptilian species (60 species) have been included under some or other Wildlife (Protection) Act (1972, as amended upto 2002) Schedules.

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AVES

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INTRODUCTION

Goa is a famous tourist place not only known in India but almost throughout the world. Besides the tourists many scientists, amateurs, visitors are very much interested in studying the bird life of Goa since longtime. In nineteenth century, Davidson and Wendon (1878) have contributed to the avifauna of the Deccan. Thereafter in adjoining parts of Goa Vidal (1880) listed out the birds of the South Konkan (i.e. north of Goa), Butler (1881) prepared a catalogue of the birds of Deccan and South Mahratta country. Davidson (1898) contributed to the birds of North Kanara (i.e. south of Goa). In twentieth century, Ali (1942-43) made survey of birds of Mysore (i.e. Karnataka State) and Koelz (1942) prepared notes on birds of the Londa neighborhood. There are many more miscellaneous notes published by various workers on birds occurring in the bordering area of Goa and on West Coast of India.

Ali and Ripley (1968-1974) in their ten volumes of handbook of birds of India have given emphasis on birds occurring in Goa. Thereafter, a number of workers have published the sight records of certain bird species as well as short list of birds from Goa such as Abdul Ali (1980); Price (1980); Ripley (1981); Saha and Mukherjee (1981); Rane (1982 and 1984); Lainer (1990,1991 and in Press); Beevers (2000); Frost and Lainer (2002); Holt and Heil (2003); and Holt (in Press). But seriously birds of Goa have been studied by Grubh and Ali (1976) who listed a total of 154 bird species of which 89 species have been collected and rest of the 65 species were sight records. Further Grubh and Ali (1977) made a correction in a single species to their earlier work on birds of Goa. Thereafter, Rane (1983) added 33 species to the 'Birds of Goa by Robert Grubh and Salim Ali-JBNHS 73(1)'. Again, Saha and Dasgupta (1992) conducted ornithological survey of Goa between 1968 and 1978, and collected a number of specimens for taxonomic study purpose. They reported a total of 208 species of birds of which 25 were additional bird species to the earlier work by Grubh and Ali (1976) and Rane (1983). Shyama and Gowthaman (1995) reported 43 bird species from Goa University campus.

Thereafter, Lainer (1999 a&b) made systematic observations on bird life of Goa and published a comprehensive list of 382 species. Santharam (2003) conducted a brief survey in three wildlife sanctuaries (Bondla, Cotigao and Bhagawan Mahavir) during November-December 1995 and added 14 species to the list of Lainer (1999 a & b). Again, Lainer (2004 a) added some bird species to his earlier communication on 'The Birds of Goa' (Lainer,1999 a & b). Very recently based on earlier work by various workers and his own study, Lainer (2004 b) published a reference book on 'Birds of Goa' with detailed information on their first records in Goa, sightings, residential status, population, breeding season, seasonal status of migratory birds, habitat, etc of 420 bird species that have been reliably recorded in Goa, and further added about 40 unconfirmed records in the appendix. Besides this, in this book he has given a list of number of unpublished reports,

records, and notes on birds by various authors on their visit to Goa.

In this paper, the inventory of birds of Goa comprises of 458 species (including some offshore pelagic birds) of which about 87 species have been mainly observed by first author (AM) during the faunistic survey of this state (November 2002), whereas the rest of the species have been compiled on the basis of published and unpublished literature. Birds were observed with the help of 7 x 50 pair of binoculars. The identification of birds and its account such as residential status, food habits, breeding season, locality, distribution, specimens deposited with Zoological Survey of India, Kolkata and Pune, etc in tabular form (Table-1) is based on Ali and Ripley (1968-1974 and 1995), Saha and Dasgupta (1992), Daniels (1997), Grimett *et. al.* (2000), Pande, *et al*, (2003), Lainer (2004 b) and records available in Z.S.I., W.R.S., Akurdi, Pune.

Further, in the systematic list of birds in tabular form (Table-1) the scientific names, common names and their family sequence have been followed as per standardised common and scientific names of the birds by Manakadan and Pittie (2001).

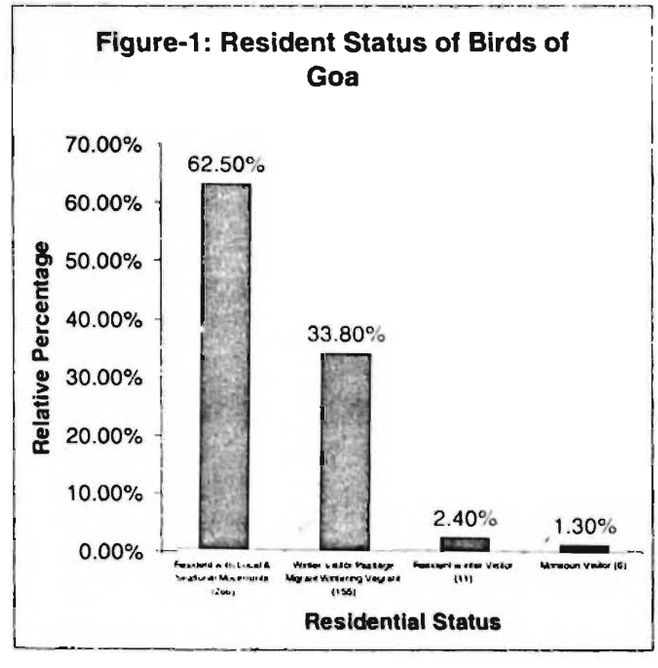
OBSERVATIONS AND RESULTS

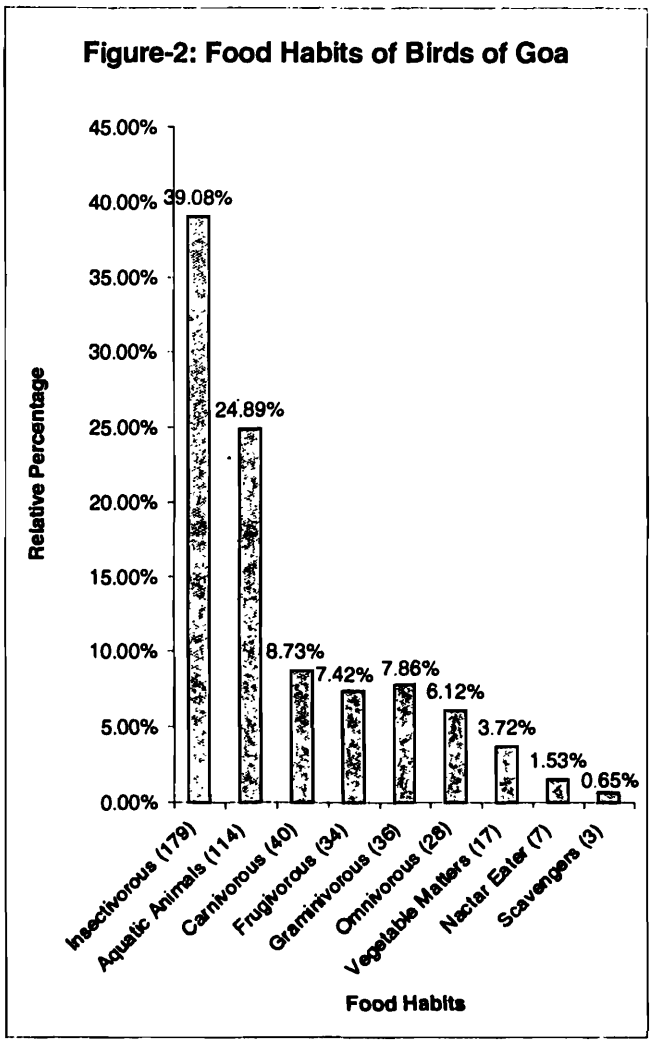
The inventory (annotated list) of birds of Goa State comprises of 458 species (Table-1), which can be further classified into various categories as shown in Table-2. It shows that these species belong to 238 genera under 71 families are grouped into 20 avian orders. This clearly indicates that this state possess a fairly good bird diversity as compared to the avian diversity of Indian subcontinent. Further, it can be pointed out that at generic and species level, orders like Ciconiiformes, Falconiformes, Charadriiformes, Coraciiformes and Passeriformes are well represented in the state of Goa.

The state of Goa is a part of southwestern India and as it possess a substantial portion of Western Ghat, the occurrence of endemic birds in the state is fairly good. The 12 endemic bird species belonging to 7 different families have been represented in Table-3. This list of bird species is based on Ali and Ripley (1968-1974), Jhunjhunwala *et al.* (2001) and Dasgupta *et al.* (2002). The table also includes the Important Bird Areas of Goa such as Bhagawan Mahavir Wildlife Sanctuary, Carambolim Wetlands, Cotigao Wildlife Sanctuary and Mhadei Wildlife Sanctuary (Jhunjhunwala *et al.* 2001 and Islam and Rahmani, 2004).

Residential Status of Birds of Goa has been plotted in Fig. 1. It shows that 62.5% bird species are resident showing some local and or seasonal movements (depending upon availability of food, ripening of fruits, water conditions, heavy rainfall, breeding season, seasonal migration in hilly areas, erratic movements during winter and monsoon season, etc). About 33.8% bird species are winter visitors and or passage migrants or wintering in the state during September-October to March whereas 2.4% bird species are having dual residential status-some population as resident and some as winter visitor. The remaining species (1.3%) are monsoon visitor or vagrant in monsoon.

In order of food preference histogram has been plotted for birds of Goa (Fig. 2). The figure indicates that about 39.08% bird species are insectivorous followed by 24.89% aquatic animal eaters. The percentage of carnivorous, frugivorous





and graminivorous is more or less between 7.0% and 9.0%. Nectar eater and scavenger bird species are very less in the state of Goa. This study (Fig.1 and 2) is mainly based on the account given in Table-1.

CONSERVATION STATUS

The conservation status of birds of Goa is considered, then out of 458 bird species the 17 species are included in Schedule I, Part III (Birds) and Schedule II, Part II (Birds) of Indian Wildlife (Protection) Act, 1972-as amended up to 2002 (Table-4). The table also indicates that some of the birds of Goa are included in Appendix of CITES (2005) : (Convention on International Trade in Endangered Species of Wild Fauna and Flora) along with the Threat Categories of BirdLife International (2005) and IUCN (2002) (Islam and Rahmani, 2002; and Kumar and Khanna 2003). Further, the bird species such as *Gyps bengalensis* (Gmelin) and *Gyps indicus* (Scopoli) are included in Critically Endangered category hence a full protection is required on top priority for these species in future.

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Table 1 : Annotated list of Birds of Goa

	Hand-book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
		Class AVES Order PODICIPEDIFORMES Family PODICIPEDIDAE							
1	5*	*Tachybaptus ruficollis* (Pallas)	Little Grebe	R/LM	Aq A, I	December to February	Terakol River	Throughout the Indian Subcontinent	—
2	13a	Order PROCELLARIIFORMES Family PROCELLARIIDAE *Bulweria fallax* Jounanin	Jounanin's Petrel	Autumn visitor/PM	Squid, Fish	–	Off Anjuna coast	West coast waters	Pelagic sea bird
3	9	*Puffinus pacificus* (Gmelin)	Wedge-tailed Shearwater	–do–	–do–	Extralimital	–do–	Warmer parts of Indian Ocean	–do–
4	12	*Puffinus persicus* Hume	Persian Shearwater	–do–	–do–	–do–	–do–	West coast Arabian Sea	Offshore pelagic bird
5	14	Family HYDROBATIDAE *Oceanites oceanicus* (Kuhl)	Wilson's Storm Petrel	Monsoon visitor/PM	Zooplankton	–do–	–do–	–do–	Pelagic bird
6	23	Family SULIDAE *Sula dactylatra* Lesson	Masked Booby	–do– vagrant	Squids/ fishes	–do–	–do–	–do–	–do–
7	25	*Sula leucogaster* (Boddaert)	Brown Booby	–do–	–do–	–do–	–do–	–do–	–do–
8	28*	Order PELECANIFORMES Family PHALACROCORACIDAE *Phalacrocorax niger* (Vieillot)	Little Cormorant	R/LM	Aq A (Fish)	November to February	HCGL Compound, Corlim (Tiswadi), Arwal	–Do–	—
9	27	*Phalacrocorax fuscicollis* Stephens	Indian Shag	R/LM	Aq A (Fish)	–do–	–do–	–do–	—
10	26	*Phalacrocorax carbo* (Linnaeus)	Great Cormorant	R/LM	Aq A (Fish)	September to February	–do–	Gangetic Plain to eastern Assam south through the Peninsula	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
11	29	Family ANHINGIDAE *Anhinga melanogaster* Pennant	Darter	R/LM	Aq A (Fish)	November to February	–do–	Throughout the Indian Subcontinent	—
12	31	Family FREGATIDAE *Fregata minor* (Gmelin)	Great Frigatebird	Monsoon straggler	Fish/squid	Extralimital	Off Anjuna	West coast	Pelagic bird
13	32	*Fregata ariel* (G.R. Gray)	Lesser Frigatebird	–do–	–do–	–do–	–do–	–do–	–do–
14	49*	Order CICONIIFORMES Family ARDEIDAE *Egretta garzetta* (Linnaeus)	Little Egret	R/LM	Aq A	–do–	–do–	–do–	—
15	50	*Egretta gularis* (Bosc)	Western Reef Egret	R/LM (Nomadic)	Aq A	Local migration during season	Oyster Rock off Karwar 12 Kms south of Goa	Shores of Arabian Sea, Western India	—
16	36*	*Ardea cinerea* Linnaeus	Grey Heron	R/LM	Aq A, I	November to March	Coastal belt of Goa, Tiswadi	All over India	—
17	37	*Ardea purpurea* Linnaeus	Purple Heron	R/LM	Aq A	–do–	HCGL Compound, Corlim (Tiswadi)	Throughout the plains of India	—
18	46*	*Casmerodius albus* (Linnaeus)	Large Egret	R/LM (Nomadic)	Aq A	November to February	–do–, Arwal nalla	Throughout the Indian Subcontinent	—
19	47& 48*	*Mesophoyx intermedia* (Wagler)	Median Egret	R/LM (Nomadic)	Aq A	–do–	–do–, Keri, Bol Kondi nalla	–do–	—
20	44*	*Bubulcus ibis* (Linnaeus)	Cattle Egret	R/LM	I	–do–	Carambolim, Valpoi, Keri	–do–	—
21	42*	*Ardeola grayii* (Sykes)	Indian Pond Heron	R/LM	Aq A	–do–	Offshore Islands, Madgaon, Ponda, Molem, Canacoa, Arwal nalla	–do–	1 ♂, 2 ♀ (ZSI. HQ, Kolkata)
22	38	*Butorides striatus* (Linnaeus)	Little Green Heron	R	Aq A	March to September	Offshore Islands & rocky sea-shore, Panaji	–do–	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
23	52	*Nycticorax nycticorax* (Linnaeus)	Black-crowned Night-Heron	R/LM	Aq A	December to February	St. George's Island (Marmagoa)	–do–	—
24	53	*Gorsachius melanolophus* (Raffles)	Malayan Night-Heron	R	Aq A	May to August	BMWS	Heavy rainfall areas of southern Western Ghat, Belgaum to Kerala; Assam & Manipur	
25	57	*Ixobrychus sinensis* (Gmelin)	Yellow Bittern	R/LM	Aq A, I	June to September	Saline marsh along the Baga Creek	Throughout the Indian Subcontinent	—
26	56	*Ixobrychus cinnamomeus* (Gmelin)	Chestnut Bittern	R/LM	Aq A	–do–	–do–	–do–	—
27	60	Family CICONIIDAE *Mycteria leucocephala* (Pennant)	Painted Stork	R/LM	Aq A, I	November to March	HCGL Compound, Corlim (Tiswadi), Ponda	Throughout the plains of India	—
28	61	*Anastomus oscitans* (Boddaert)	Asian Openbill-Stork	R/ LM	Aq A (Molluscs)	–do–	–do–	–do–	—
29	65	*Ciconia nigra* (Linnaeus)	Black Stork	WV	Aq A, CR	Extralimital	–do–	Northern India, Deccan south to 18°N Lat.	—
30	62	*Ciconia episcopus* (Boddaert)	White-necked Stork	R	Aq A, I	December to March	–do–, Mollem	Sparsely distributed throughout the well watered parts of India	—
31	63	*Ciconia ciconia* (Linnaeus)	European White-Stork	WV	Aq A, CR	Extralimital	–do–, BMWS, Dudhsagar	Northwestern India, south to Karnataka	

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
32	68	*Leptoptilos javanicus* (Horsfield)	Lesser Adjutant -Stork	R/LM (Nomadic)	Aq A, I	November to January	Wetlands between Zuari & Mandovi rivers	Throughout India but less in Continental part	—
33	71	Family THRESKIORNITHIDAE *Plegadis falcinellus* (Linnaeus)	Glossy Ibis	R/WV (partly Nomadic)	Aq A,I	May to July/ Extralimital	HCGL Compound, Corlim (Tiswadi)	Northern, Central, NE India & Deccan	—
34	69	*Threskiornis melanocephalus* (Latham)	Oriental White Ibis	R/LM	OM	November to March	–do–	All over India	—
35	70	*Pseudibis papillosa* (Temminck)	Black Ibis	R	OM	March to October	Mollem	South of Gangetic Plains to Karnataka	per. com. SP & NS
36	72	*Platalea leucorodia* Linnaeus	Eurasian Spoonbill	WV/R (Partly Nomadic)	Aq A & Vg M	Extralimital / November to January	–do–	–do–	—
37	73	Order PHOENICOPTERIFORMES Family PHOENICOPTERIDAE *Phoenicopterus ruber* Linnaeus	Greater Flamingo	R(Nomadic)	Aq A	September to April	Divar-Navelim, Inland estuary of Mandovi	Throughout the Indian Union	—
38	89	Order ANSERIFORMES Family ANATIDAE *Dendrocygna bicolor* (Vieillot)	Large Whistling Duck	R/LM Vagrant	Vg M, AqA	Junt to October	Carambolim Lake	Scattered throughout India	Haris, 1996 Lynes, 1999 (Lainer, 2004-b)
39	88	*Dendrocygna javanica* (Horsfield)	Lesser Whistling-Duck	R/LM (Partly Migrant)	Vg M & Aq A	June to October	HCGL Compounds Corlim (Tiswadi) & Carambolim Lake	–do–	—
40	82	*Anser indicus* (Latham)	Bar-headed Goose	WV	Vg M	Extralimital	Chapora estuary	All India but less in Peninsula	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
41	90	*Tadorna ferruginea* (Pallas)	Brahminy Shelduck	WV	OM	–do–	HCGL Compounds Corlim (Tiswadi) & Carambolim Lake	Throughout the Indian Union	—
42	115	*Sarkidiornis melanotos* (Pennant)	Comb Duck	R/LM	Vg M	July to September	Carambolim Lake	All over India	—
43	114	*Nettpus coromandelianus* (Gmelin)	Cotton Teal	R	Vg M	June to September	–do–, Marmagoa, Benaulim Pond	–do–	—
44	101	*Anas strepera* Linnaeus	Gadwall	WV	Vg M	Extralimital	Inland estuary of Mandovi river & Carambolim Lake	–do–	—
45	103	*Anas penelope* Linnaeus	Eurasian Wigeon	WV	Vg M	–do–	Carambolim Lake & Tidal mudflats of the Mandovi river	Northern India, Less common in Peninsula	—
46	100	*Anas platyrhynchos* Linnaeus	Mallard	WV	OM	—do—	Carambolim Lake & Mandovi river	North India upto Maharashtra exceptional in South India	—
47	97	*Anas poecilorhyncha* J. R. Forester	Spot-billed Duck	R/LM (Nomadic)	Vg M	November to December	Inland estuary of Mandovi river & Carambolim Lake	Throughout the Indian Subcontinent	—
48	105	*Anas clypeata* Linnaeus	Northern Shoveller	WV	Aq A & Vg M	Extralimital	—do—	All over India	—
49	93	*Anas acuta* Linnaeus	Northern Pintail	WV	Vg M	—do—	—do—	All over India	—
50	104	*Anas querquedula* Linnaeus	Garganey	WV	Vg M & Aq A	—do—	—do—	—do—	—
51	94	*Anas crecca* Linnaeus	Common Teal	WV	Vg M	—do—	—do—	—do—	—
52	108	*Aythya ferina* (Linnaeus)	Common Pochard	WV	Vg M & Aq A	—do—	Carambolim Lake & Tidal mudflats of the Mandovi river	NW India (Decreasingly southward in the Peninsula)	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
53	109	*Aythya nyroca* (Guldenstadt)	Ferruginous Pochard	WV	Vg M & Aq A	—do—	Chapora estuary, Carambolim Lake	All India decreasingly in Deccan to South Karnataka	—
54	111	*Aythya fuligula* (Linnaeus)	Tufted Pochard	WV	OM	—do—	Carambolim Lake, Santa Cruz Creek	—do—	—
		Order FALCONIFORMES Family ACCIPITRIDAE							
55	127	*Aviceda leuphotes* (Dumont)	Black Baza	R	CR	February to July	BMWS, Cotigao WS	Western Ghat N. Karnataka to Kerala & NE India	—
56	130	*Pernis ptilorhyncus* (Temminck)	Oriental Honey-Buzzard	R/LM	CR	February to June	BMWS, Bardez, Canacona, Marmagoa, Ponda	All over India	—
57	124*	*Elanus caeruleus* (Desfontaines)	Black-shouldered Kite	R	I & CR	Entire Year	—do—, Mollem, Valpoi, Santrem, Canacona	All over India	
58	133*	*Milvus migrans* (Boddaert)	Black Kite	R	OM	September to April	Goa Meat Complex, ZAC Reservoir, Keri	—do—	—
59	135	*Haliastur indus* (Boddaert)	Brahminy Kite	R/LM/SM	CR (Fish) & I	December to April	ZAC Reservoir, Mayem, Bondla WS, Cotigao WS	—do—	—
60	173	*Haliaeetus leucogaster* (Gmelin)	White-bellied Sea-Eagle	R	CR (sea Snakes)	October to January	Cotigao WS, Selaulim Lake, Panaji	Sea Board, Offshore islands from Mumbai down to West Coast to Kerala	—
61	175	*Ichthyophaga ichthyaetus* (Horsfield)	Greater Grey-headed Fish-Eagle	R	CR (Fish)	November to January	ZAC Reservoir, Sancoale Lake (Marmagoa)	All over India	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
62	187	*Neophron percnopterus* (Linnaeus)	Egyptian Vulture	R	SC	February to May	Goa Meat Complex, Dudhsagar	—do—	—
63	185*	*Gyps bengalensis* (Gmelin)	Indian White-backed Vulture	R	SC	October to March	—do—, Panaji, Canacona, Keri	—do—	—
64	182	*Gyps indicus* (Scopoli)	Long-billed Vulture	R	SC	November to March	—do—, Bondla WS, Carambolim	Western Peninsular India south of Gangetic Plain	—
65	195	*Circaetus gallicus* (Gmelin)	Short-toed Snake-Eagle	R	CR	December to March	Carambolim Lake, Dona Paula, Baga Creek, Aguada & Nagoa hill	Throughout the Indian Union	—
66	197*	*Spilornis cheela* (Latham)	Crested Serpent-Eagle	R	CR	December to March	Bondla WS, Bardez, Canacona, Marmagoa, Mollem, Tiswadi, Keri	Peninsular India south of Ganges & Gujarat to Bengal	—
67	193	*Circus aeruginosus* (Linnaeus)	Western Marsh-Harrier	WV	CR, I	Extralimital	Anjuna, Cotigao WS, Bondla WS, Dabolim	Throughout the Indian Union	—
68	190	*Circus macrourus* (S. G. Gmelin)	Pallid Harrier	WV	CR	—do—	Carambolim Lake, Dona Paula, Velim Lake, Divar	—do—	—
69	192	*Circus melanoleucos* (Pennant)	Pied Harrier	WV	CR	—do—	Divar-Piedade, Bardez	All India (Sparingly in South India)	—
70	191	*Circus pygargus* (Linnaeus)	Montagu's Harrier	WV	CR	—do—	Anjuna, BMWS, ZAC Reservoir, Neura Wetland, Carambolim Lake	Throughout the Indian Subcontinent	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
71	145	*Accipiter trivirgatus* (Temminck)	Crested Goshawk	R	CR	March to May	BMWS, Bondla WS, Cotigao WS, Mollem	SW India (Goa to Kerala)	1♀ (ZSI, HQ, Kolkata)
72	138*	*Accipiter badius* (Gmelin)	Shikra	R	CR	March to June	Mollem, Valpoi, Poinguinim, Keri	All India (Except Kerala & Assam)	5♂, 1♀ (ZSI, HQ, Kolkata)
73	151	*Accipiter virgatus* (Temminck)	Besra Sparrowhawk	R	CR	March to May	BMWS, Bondla WS, Cotigao WS, Nagoa	Western Ghat strip of S. India	—
74	147	*Accipiter nisus* (Linnaeus)	Eurasian Sparrowhawk	WV	CR	Extralimital	—do—, Baga, Mollem, Collem	All over India	—
75	157*	*Butastur teesa* (Franklin)	White-eyed Buzzard	R	CR	February to May	—do—, Arpora, Baga, Valpoi Canacona	—do—	2♀ (ZSI, HQ, Kolkata)
76	156	*Buteo buteo* Linnaeus	Common Buzzard	WV	CR	Extralimital	Aguda, Bondla WS, Candolim pastures	All over India (Irregular)	—
77	153	*Buteo rufinus* (Cretzschmar)	Long-legged Buzzard	WV	CR	—do— (In Himalayas March to May)	Verla-Canca	N. India south to the Deccan	—
78	172	*Ictinaetus malayensis* (Temminck)	Black Eagle	R	CR, I	November to March	Anjuna hill, Baga BMWS, Bondla WS, Cotigao WS Canacona	All over India	—
79	171	*Aquila pomarina* Brehm	Lesser Spotted Eagle	R	CR	April to July	Baga Area, Carambolim, Neura Wetlands, Santa Cruz Creek	Throughout the Peninsular India	—
80	170	*Aquila clanga* Pallas	Greater Spotted Eagle	R	CR	April to June	—do—	N. India down to Karnataka	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
81	168	*Aquila rapax* (Temminck)	Tawny Eagle	R	CR	November to April	Paddy fields of Santa Cruz, Mollem, Bondla WLS	Entire Indian Union	P. Doherty, 1999 (Lainer, 2004b) and per. com. SP & NS
82	169	*Aquila nipalensis* Hodgson	Steppe Eagle	WV	CR	Extralimital	Bondla WS, Chorao-Tikanem & Curtorim	N. India south to the Deccan	—
83	163	*Hieraaetus fasciatus* (Vieillot)	Bonelli's Eagle	R	CR	Mainly December to January	Baga Area, Carambolim, Neura Wetlands	All over India	—
84	164	*Hieraaetus pennatus* (Gmelin)	Booted Eagle	WV (Partly Resident)	CR	Extralimital	Bondla WS, Cotigao WS, Bardez, Marmagoa	All over India	—
85	165	*Hieraaetus kienerii* (E. Geoffroy)	Rufous-bellied Eagle	R	CR	December to March	Devil's Canyon Trail, BMWS, Dudhsagar	Western Ghat strip from Goa to Kerala; NE India	—
86	161	*Spizaetus cirrhatus* (Gmelin)	Changeable Hawk-Eagle	R	CR	November to April	Baga, BMWS, Bondla WS, Cotigao WS, Mayem lake, Nagoa	Throughout the Peninsular India	—
87	203	Family PANDIONIDAE *Pandion haliaetus* (Linnaeus)	Osprey	WV	CR (Fish)	Extralimital & also along Himalayas	Bondla WS, Canacona, Marmagoa, Terakol	Throughout the Indian Subcontinent	—
88	222 & 224	Family FALCONIDAE *Falco tinnunculus* Linnaeus	Common Kestrel	WV, R (Breeding)	CR, I	January to March (W. Ghats)	Cotigao WS, Canacona, Mollem, Vaghera hills, Valpoi	Wintering all India. Breeds in the W. Ghat Complex	1♂, 1♀ (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
89	220	*Falco amurensis* Radde	Amur Falcon	PM	I	Extralimital	Pernem, Bardez, Tiswadi	NE India & Peninsular India	—
90	209 and 211	*Falco peregrinus* Tunstall	Peregrine Falcon	WV and R	CR	—do— and in Himalayas March to May	Baga Area, Carambolim, Chapora estuary, Mollem, Cotigao WS	Throughout the Indian Subcontinent	—
91	250	Order GALLIFORMES Family PHASIANIDAE *Coturnix coturnix* (Linnaeus)	Common Quail	R/WV	GR	March & April	Baga Creek, Terakol Fort, Valpoi	North India to south up to Goa	—
92	252	*Coturnix coromandelica* (Gmelin)	Rain Quail	R (Nomadic)	GR	March to October	Divar-Navelim to Divar-Old Goa ferry	All over India	—
93	257	*Perdicula asiatica* (Latham)	Jungle Bush-Quail	R	GR	July to February	Carambolim Lake, Baga Hill, Terakol Dona Paula, Mayem	Malabar Coast from Ratnagiri (in S. Konkan) south through Kerala	—
94	260	*Perdicula argoondah* (Sykes)	Rock Bush-Quail	R	GR	March to November	Terakol, Baga Carambolim, Mollem	Peninsular India	Holt, 1998 Sykes, 1999 Vermeulen, 2000 (Lainer 2004b) and per. com. SP & NS
95	275	*Galloperdix spadicea* (Gmelin)	Red Spurfowl	R	GR	January to June	–do–, Anjuna, BMWS, Bondla WS, Cotigao WS	Throughout the Peninsular India	—
96.	278	*Galloperdix lunulata* (Valenciennes)	Painted Spurfowl	R	OM	–do–	Mollem, Bondla	Peninsular India south of Gangetic Plain	per. com. SP & NS

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
97	301*	*Gallus sonneratii* Temminck	Grey Junglefowl	R	GR	February to May	Mollem, Valpoi, BMWS, Sattari Bondla WS, Cotigao WS, Mollem Road	Peculiar to the Peninsular India almost to the extreme south	1♂, 2♀ (Subadult) (ZSI, HQ, Kolkata)
98	311*	*Pavo cristatus* Linnaeus	Indian Peafowl	R	OM	April to May	–do–, Terakol	Throughout the Indian Subcontinent	—
99	313	Order GRUIFORMES Family TURNICIDAE *Turnix sylvatica* (Desfontaines)	Small Buttonquail	R(Nomadic)	GR	June to September	Arpora, Parra & Verla-Canca villages	All over India	—
100	318	*Turnix suscitator* (Gmelin)	Common Buttonquail	R	Vg M	June to October	Bardez, BMWS, Cotigao WS, Tiswadi	Entire Continental & Peninsular India	—
101	323	Family GRUIDAE *Grus antigone* (Linnaeus)	Saras Crane	R/LM Vagrant	OM	July to December	Carambolim lake and grassland	Northern part of subcontinent, Gangetic plain south to Godavari delta	Hill, 1998 (Lainer 2004b)
102	329	Family RALLIDAE *Gallirallus striatus* Linnaeus	Blue-breasted Rail	R/LM	OM	Mid-June to October	Arpora, Bardez,	All over India	—
103	342	*Amaurornis akool* (Sykes)	Brown Crake	R/LM	OM	March to August	Arpora-Baga, Bondla	Gangetic Plain south to Karnataka	Prasad, 1996 Marsh, 1998 (Lainer, 2004b)
104	344*	*Amaurornis phoenicurus* (Pennant)	White-breasted Waterhen	R	OM	April to October	Bolkondi nalla, Canacona, Mollem	Peninsular India south of boundary along 20° N Latitude	1♀ (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
105.	335 & 336	*Porzana parva* (Scopoli)	Little Crake	WV, Uncertain	I (Aquatic)	Extralimital	Paddy field of Arpora-Baga	W. India doubtless, Mumbai	Prasad, 1995 (Lainer, 2004b)
106	337	*Porzana pusilla* (Pallas)	Baillon's Crake	R/WV (Wintering)	Aq A, Vg M	May to August	Anjuna Beach, Baga, Carambolim	Winters from Kashmir to rest of India	—
107	338	*Porzana porzana* (Linnaeus)	Spotted Crake	WV	–do–	Extralimital	Coastal marshes Arpora-Baga	Southern Peninsula up to Belgaum	Holt, 1996 (Lainer, 2004b)
108	340	*Porzana fusca* (Linnaeus)	Ruddy-breasted Crake	R/SM	Aq A, Vg M	June to September	Baga Creek, Carambolim Lake, Mandovi river	Western Ghat strip northward to Mumbai	—
109	346	*Gallicrex cinerea* (Gmelin)	Watercock	R	Aq A, Vg M	–do–	Baga, Carambolim Lake, Candolim Marsh, HCGL, Santa-Cruz	All over India	—
110	349	*Porphyrio porphyrio* (Linnaeus)	Purple Moorhen	R/LM	Aq A, Vg M	June to September	–do–	NE & South throughout the Peninsular India	—
111	347	*Gallinula chloropus* (Linnaeus)	Common Moorhen	R/ WV (Partly)	OM	July to September	Carambolim Lake, Baga, Bardez, Calangute, Tiswadi	All over India	—
112	350*	*Fulica atra* Linnaeus	Common Coot	R/ WV (Partly)	Vg M, I	November to December	–do– & Anjuna pond, North Goa,	—do—	—
		Order CHARADRIIFORMES Family JACANIDAE							
113	358	*Hydrophasianus chirurgus* (Scopoli)	Pheasant-tailed Jacana	R/LM	Aq A, Vg M	June to September	Bardez, Carambolim Lake, Marmagoa, Pernem	—do—	—
114	359	*Metopidius indicus* (Latham)	Bronze-winged Jacana	R	Vg M, I	—do—	—do—	All over India (Except West Punjab & West Rajsthan)	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
115	429	Family ROSTRATULIDAE *Rostratula benghalensis* (Linnaeus)	Greater Painted-Snipe	R	Aq A, Vg M	July to September	Bardez, Carambolim Lake, Parxem-Agarwaddo Marshes	Throughout the Indian Union	—
116	360	Family HAEMATOPODIDAE *Haematopus ostralegus* Linnaeus	Eurasian Oystercatcher	WV	Aq A (Marine Molluscs)	Extralimital	Velsao beach, Anjuna Coast, Chapora estuary	W & E Coasts & offshore Islands of India	—
117	373	Family CHARADRIIDAE *Pluvialis fulva* (Gmelin)	Pacific Golden-Plover	WV	Aq A, I	Extralimital	Parxem-Agarwaddo Marshes	NE, West Bengal, Bihar southward to Peninsula	—
118	371	*Pluvialis squatarola* (Linnaeus)	Grey Plover	WV	Aq A	Extralimital	–do– & Bardez, Ponda, Tiswadi, Velsao beach, Terakol estuary	Kutch to western side of the Peninsula & Eastern coast	—
119	378	*Charadrius hiaticula* Linnaeus	Common Ringed Plover	WV	Aq A, I	Extralimital	ZAC Reservoir, Bardez, Tiswadi	Very rare in India	—
120	380	*Charadrius dubius* Scopoli	Little Ringed Plover	R	Aq A, I	December to June	Anjuna beach, Baga Saltpans, Chapora estuary, Collem	All over India	—
121	382	*Charadrius alexandrinus* Linnaeus	Kentish Plover	R	Aq A, I	April to August	Colva beach, Carambolim Grasslands, Mandovi estuary, Margao, Miramar	Southern Peninsular India	2♀ (ZSI, HQ, Kolkata)
122	384	*Charadrius mongolus* Pallas	Lesser Sand Plover	WV	Aq A	Extralimital	Agarwaddo, Morjim beach, Chapora estuary	Seaboards of the Peninsular states (Gujarat to Kerala to West Bengal)	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
123	374	*Charadrius leschenaultii* Lesson	Greater Sand Plover	WV	Aq A	—do—	—do—, Panjim, Velsao beach	—do—	—
124	376	*Charadrius asiaticus* Pallas	Caspian Plover	Vagrant (Wintering)	Aq A	—do—	Mandovi Inland Estuary, Divar Island	West Coast of Maharashtra & Goa (in some areas)	—
125	370*	*Vanellus malabaricus* (Boddaert)	Yellow-wattled Lapwing	R/LM	I	March to July	Anjuna, Marmagoa, Ponda, Siolim-Marna Paddies, Cotigao WS	N. India to West Bengal,southward throughout the Peninsula	—
126	365	*Vanellus cinereus* (Linnaeus)	Grey-headed Lapwing	WV	I	Extralimital	Baga Marsh	North India & Western Ghats	Lainer (1991) 1 Unsexed, (ZSI, HQ, Kolkata)
127	366*	*Vanellus indicus* (Boddaert)	Red-wattled Lapwing	R	Vg M, I	March to September	Arwal nalla, Bondla WS, Canacona, Mollem, Margao	All over India	1♀(Juv), 2♀ (ZSI, HQ, Kolkata)
128	362	*Vanellus leucurus* (Lichtenstein)	White-tailed Lapwing	WV	Aq A	Extralimital	Carambolim & Baga paddies, Merces	NW India to W Bengal, south to Mumbai & may further also, rare in Coastal belts	—
129	406	Family SCOLOPACIDAE *Gallinago stenura* (Bonaparte)	Pintail Snipe	WV	Aq A	—do—	Carambolim, Cotigao WS, Marmagoa	All over India	4♀ (ZSI, HQ, Kolkata)
130	409	*Gallinago gallinago* (Linnaeus)	Common Snipe	WV	Aq A	—do—	Carambolim, Arpora-Baga Marsh, Ponda	Throughout the Indian Subcontinent	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
131	410	*Lymnocryptes minimus* (Brunnich)	Jack Snipe	WV	Aq A, I	—do—	BMWS, Baga, Tambdi-Surla, Dudhsagar	Irregularly throughout the Indian Union	—
132	389	*Limosa limosa* (Linnaeus)	Black-tailed Godwit	WV	Aq A	—do—	Baga, Chapora estuary, Divar-Navelim, Carambolim, Neura Wetlands	N India, W Bengal, decreasingly southward through the Peninsula	—
133	391	*Limosa lapponica* (Linnaeus)	Bar-tailed Godwit	WV	Aq A	—do—	–do–, Panaji, Salestuarg	Seaboards of W India, straggling further south India & eastern coastal states	—
134	385	*Numenius phaeopus* (Linnaeus)	Whimbrel	WV	Aq A	—do—	Velsao Beach	W India along the entire sea-board south to Kerala Ganges Delta	—
135	387	*Numenius arquata* (Linnaeus)	Eurasian Curlew	WV	Aq A,I	—do—	Chapora estuary	NW India to entire South India	—
136	392	*Tringa erythropus* (Pallas)	Spotted Redshank	WV	Aq A	—do—	Bardez, Carambolim, Pernem, Tiswadi	All over India	—
137	394	*Tringa totanus* (Linnaeus)	Common Redshank	WV	Aq A	—do—	Terakol estuary	—do—	—
138	395	*Tringa stagnatilis* (Bechstein)	Marsh Sandpiper	WV	Aq A	—do—	Baga, Pernem, Ponda, Salcete	—do—	—
139	396	*Tringa nebularia* (Gunner)	Common Greenshank	WV	Aq A	—do—	Arpora-Baga, Ponda, Sanguem	—do—	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
140	397	*Tringa ochropus* Linnaeus	Green Sandpiper	WV	Aq A	—do—	Aravali hills near Valpoi, BMWS, Mayem lake, Mollem, Cotigao WS	—do—	1♂, 1♀ (ZSI, HQ, Kolkata)
141	398	*Tringa glareola* Linnaeus	Wood Sandpiper	WV	Aq A	—do—	Velsao, Collem, Carambolim, Surla, Shiroda, Santa Cruz	—do—	—
142	400	*Xenus cinereus* (Guldenstadt)	Terek Sandpiper	WV	Aq A	—do—	Bardez, Marmagoa Terakol estuary, Tiswadi, Velsao beach	Entire Seaboard of Western India to tip of Peninsula & East coast states	—
143	401	*Actitis hypoleucos* Linnaeus	Common Sandpiper	WV	Aq A	—do—	Mollem	All over India	1 Unsexed, (ZSI, HQ, Kolkata)
144	402	*Arenaria interpres* (Linnaeus)	Ruddy Turnstone	WV	Aq A	—do—	Morjim beach, Calangute-Candolim beach, Marmagoa, Dona Paula, Canacona	Entire Seaboard of India	—
145	413	*Calidris tenuirostris* (Horsfield)	Great Knot	WV	Aq A	—do—	—do—	Assam, Kolkata, Chennai and Coastal W India	—
146	412	*Calidris canutus* (Linnaeus)	Red Knot	Vagrant in Winter	AqA	—do—	Morjim beach	—	—
147	414	*Calidris alba* (Pallas)	Sanderling	WV	Aq A	—do—	—do—	Entire Seaboard of Western & Eastern India	—
148	416	*Calidris minuta* (Leisler)	Little Stint	WV	Aq A	—do—	Carambolim Lake, Velsao beach, Baga	Entire Coastal areas of India	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
149	415	*Calidris ruficollis* (Pallas)	Rufous-necked Stint	WV	Aq A	—do—	Divar-Navelim, Shiroda	Andaman-Nicobar Islands & Rameswaram (Chennai)	First five sightings in Goa by Lainer (2004b)
150	417	*Calidris temminckii* (Leisler)	Temminck's Stint	WV	Aq A	—do—	Baga, Cortalim, Parxem-Agarwaddo, Santa Cruz	Throughout the Indian Subcontinent	—
151	418	*Calidris subminuta* (Middendorff)	Long-toed Stint	WV	Aq A	—do—	Carambolim Lake, Panaji, Santa Cruz, Shiroda, Ribandar	Assam, Bihar, W. Bengal, E. coast	Reports from 1997-2000 & also from Lainer (2004b)
152	420 & 421	*Calidris alpina* (Linnaeus)	Dunlin	WV/PM	Aq A	—do—	Bardez, Marmagoa, Morjim beach, Terakol estuary, Ponda	Throughout Northern & Peninsular India from Kashmir to Kerala	—
153	422	*Calidris ferruginea* (Pontoppidan)	Curlew Sandpiper	WV	Aq A	—do—	Parxem-Agarwaddo Marshes, Morjim beach	Entire Seaboard of India	—
154	425a	*Tryngites subruficollis* (Vieillot)	Buff-breasted Sandpiper	Accidental Vagrant	Aq A	—do—	Santacruz, Tiswadi Taluka	—	Recorded by Holt & Heil (2003)
155	424	*Limicola falcinellus* (Pontoppidan)	Broad-billed Sandpiper	WV	Aq A	—do—	Sinquerim, Bardez, Tiswadi	—do—	—
156	426	*Philomachus pugnax* (Linnaeus)	Ruff	WV	Aq A and Vg M	—do—	Parxem-Agarwaddo, Carambolim, ZAC Reservoir, Old Goa Marsh, Ponda	All over India	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
157	430	FamilyRECURVIROSTRIDAE *Himantopus himantopus* (Linnaeus)	Black-winged Stilt	R/WV	Aq A and Vg M	April to August & Extralimital	Kalay paddies & Carambolim	Throughout the Indian Union	—
158	434	Family DROMADIDAE *Dromas ardeola* (Paykull)	Crab-plover	WV	Aq A (Crabs)	Extralimital	Anjuna Coast, Chapora estuary, Morjim	Seacoasts of the Peninsular India, Andaman and Nicobar	—
159	436	Family BURHINIDAE *Burhinus oedicnemus* (Linnaeus)	Stone-Curlew	R/LM	OM	February to August	Arpora, Bardez, Nerla-Canca, Parra plateau	All over India	—
160	437	*Esacus recurvirostris* (Cuvier)	Great Stone-Plover	R/LM	Aq A (Crabs)	February to June	Mandovi river inland estuary, Santa Cruz, Divar-Piedade, Chorao-Madel	—do—	—
161	442	Family GLAREOLIDAE *Glareola pratincola* (Linnaeus)	Collared Pratincole	Wintering (Straggler)	I	Extralimital	Carambolim Grasslands, Divar-Navelim	—do—	—
162	443	*Glareola maldivarum* (J. R. Forster)	Oriental Pratincole	R/LM, (Nomadic),	I	April to June	Morjim beach, Chapora estuary, Divar-Navelim	—do—	—
163	444	*Glareola lactea* Temminck	Small Pratincole	R/LM (Nomadic)	I	February to April	Morjim beach, Marmagoa, Canacona	—do—	—
164	447	Family STERCORARIIDAE *Stercorarius pomarinus* (Temminck)	Pomarine Jaeger	Vagrant/PM	Fish	Extralimital	Off Chapora	Arabian Sea	Pelagic bird Willongh, 1993. (Lainer, 2004 b) and per. com. SP & NS

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
165	448	*Stercorarius parasiticus* (Linnaeus)	Parasitic Jaeger	—do—	—do—	—do—	Off Baga	—do—	Pelagic bird Wieler, 1998. (Lainer 2004 b) per. com. SP & NS
166	New	Family LARIDAE *Larus canus* Linnaeus	Mew Gull	Vagrant	AqA	—	Morjim	—	Holt, 1996 Dennis, 1999 (Lainer 2004 b) per. com. SP & NS
167	450	*Larus heuglini* Bree	Heuglin's Gull	WV	Aq A (Fish)	Extralimital	Morjim beach, Chapora estuary, Divar	N Indian Ocean Coasts to South along coasts of W India upto Kerala	—
168	453	*Larus ichthyaetus* Pallas	Pallas's Gull	WV	Aq A (Fish)	—do—	Colva & Morjim beach, Margaon, Terakol and Chapora estuaries	Sea Coasts of India	1♀(Juv), (ZSI, HQ, Kolkata)
169	454	*Larus brunnicephalus* Jerdon	Brown-headed Gull	WV	Aq A, I	—do—	—do—	—do—	1♀ (Subadult), (ZSI, HQ, Kolkata)
170	455	*Larus ridibundus* Linnaeus	Black-headed Gull	WV	Aq A, I	—do—	—do—	—do—	1♀ (Subadult), (ZSI, HQ, Kolkata)
171	456	*Larus genei* Breme	Slender-billed Gull	WV	Aq A (Fish)	—do—	Aguada, Santa Cruz, Terakol and Chapora estuaries	West coast of India down	In Nineties as regular WV to coast of N. Goa (Lainer, 2004b)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
172	460	*Gelochelidon nilotica* (Gmelin)	Gull-billed Tern	WV/PM	Aq A	—do—	Chapora estuary, Navelim, North Goa,	Throughout the Indian Union	—
173	462	*Sterna caspia* Pallas	Caspian Tern	WV/PM	Aq A (Fish)	—do—	Terakol and Chapora estuaries	Throughout the Indian Subcontinent	—
174	463	*Sterna aurantia* J. E. Gray	River Tern	R	Aq A	March to May	Chapora river & estuary, Zuari river, Chorao	Throughout the Indian Union	Erratic annual visitor to coastal belt
175	479	*Sterna bengalensis* Lesson	Lesser Crested Tern	R (?)	Aq A (Fish & Prawn)	May and June	Carambolim, Velim Tank	Western and Eastern Seaboards of India	—
176	478	*Sterna bergii* Lichtenstein	Large Crested Tern	R	Aq A (Fish & Prawn)	April to June	Aguada, Anjuna, Chapora estuary & Morjim beach	Indian West Coast (South of Ratnagiri) and West Bengal	Breeds on Vengurla rocks south of Ratnagiri
177	480	*Sterna sandvicensis* Latham	Sandwich Tern	WV	Aq A (Fish & Prawn)	Extralimital	Velsao beach, estuaries of Chapora,Mandovi, Terakol & Zauri, rivers	Saurashtra (Gujarat)	First record in July 1981 & year round visitor to entire coastline of Goa (Lainer 2004 b)
178	466	*Sterna dougallii* Montagu	Roseate Tern	R/SM/PM	Aq A	April to June	Anjuna, Chapora estuary, Morjim beach	Andamans, off the South-eastern & West coasts of India	Breeds on Vengurla rocks south of Ratnagiri
179	465	*Sterna hirundo* Linnaeus	Common Tern	WV	Aq A (Fish)	Extralimital	—do—	Indian Union, less in Peninsula	—
180	475	*Sterna albifrons* Pallas	Little Tern	R/LM	Aq A	May and June	—do– & Santa Cruz, Velsao beach	All over India	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
181	467	*Sterna repressa* Hartert	White-cheeked Tern	R/SM/PM	Aq A	—do—	—do—	Maharashtra & Tamil Nadu coasts	Breeds on Vengurla rocks south of Ratnagiri
182	470	*Sterna acuticauda* J. E. Gray	Black-bellied Tern	R/ Vagrant	Aq A (Fish)	March and April	ZAC Reservoir	Throughout the Indian Union	—
183	473	*Sterna anaethetus* Scopoli	Bridled Tern	R/PM	Aq A (Fish)	June/July to September	Chapora Fort	Vengurla rocks off the west coast of the Peninsula	Breeds on Vengurla rocks south of Ratnagiri
184	474	*Sterna fuscata* Linnaeus	Sooty Tern	R/PM	Aq A (Fish & Squids)	April to August/ September	Chapora Coast	—do—	—do—
185	458	*Chlidonias hybridus* (Pallas)	Whiskered Tern	WV	I & Aq A	June to August (in North India)	Chapora estuary, ZAC, Carambolim Lake, HCGL	Throughout the Indian Union	—
186	459	*Chlidonias leucopterus* (Temminck)	White-winged Black Tern	WV	I & Aq A	Extralimital	Mandovi, Carambolim Lake, coastal belt of North Goa	Western side of India, Assam, W. Bengal, Madhya Pradesh	—
187	459a	*Chlidonias niger* (Linnaeus)	Black Tern	Vagrant	I & Aq A	—do—	Chapora & Mandovi rivers, Divar-Navelim	Sight recorded near Delhi	Recorded in Goa by Lainer, 2004 b in (October, 1999)
188	484	Family RYNCHOPIDAE *Rynchops albicollis* Swainson	Indian Skimmer	R/ Nomadic	Aq A (Fish only)	Mid February to mid April	Chapora estuary	N India east to Assam, southward upto 16°N in the Peninsula	Recorded in Goa by Lainer, (2004 b) in 1999

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
189	517*	Order COLUMBIFORMES Family COLUMBIDAE *Columba livia* Gmelin	Blue Rock Pigeon	R	GR	All year (mainly May to July)	Canacona, Mollem Terakol, Anjunem, Valpoi, Keri	Throughout the Indian Union	1♂ (ZSI, HQ, Kolkata)
190	521	*Columba elphinstonii* (Sykes)	Nilgiri Wood-Pigeon	R/LM	FR	April to June	BMWS, Bondla WS, Cotigao WS, Mollem, Canacona	Western Ghats Complex from Kerala northward to 19°N Latitude	1♂ (ZSI, HQ, Kolkata)
191	531	*Streptopelia orientalis* (Latham)	Oriental Turtle-Dove	SM (Wintering)	GR	May to July	—do—	Northern & Peninsular India, chiefly on the western side south to Mysore	—
192	541*	*Streptopelia senegalensis* (Linnaeus)	Little Brown Dove	R	GR	All year	Canacona, Baga, Calangute	All over India	—
193	537*	*Streptopelia chinensis* (Scopoli)	Spotted Dove	R/LM	GR	—do—	Canacona, Mayem lake, Mollem, Bondla Poinguinim	—do—	1♂, 1♀ (ZSI, HQ, Kolkata)
194	535	*Streptopelia tranquebarica* (Hermann)	Red Collared-Dove	R/LM	GR	—do—	Baga, Morjim, Tambdi Surla	N & Peninsular India to Tamil Nadu & Karnataka	—
195	534*	*Streptopelia decaocto* (Frivaldszky)	Eurasian Collared-Dove	R/SM	GR	—do—	Cotigao WS, Bondla, Keri Carambolim Lake, Anjuna, Poinguinim	Throughout the Indian Union	1♀ (ZSI, HQ, Kolkata)
196	542	*Chalcophaps indica* (Linnaeus)	Emerald Dove	R	GR	—do—	Mollem, Baga, Bondla WS, BMWS, Cotigao WS, Valpoi	All over India	1♂ (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
197	501	*Treron bicincta* (Jerdon)	Orange-breasted Green-Pigeon	R/SM/LM	FR	March to September	Cotigao WS, Mayem lake, BMWS	North India, Western Ghat from Kerala to Belgaum	1♂ (ZSI, HQ, Kolkata)
198	496	*Treron pompadora* (Gmelin)	Pompadour Green-Pigeon	R/LM	FR	December to March	BMWS, Baga, Sinquerim Mollem, Canacona	W & SW India the W. Ghats Complex from 20°N latitude up to Kerala	2♂, 1♀ (ZSI, HQ, Kolkata)
199	504	*Treron phoenicoptera* (Latham)	Yellow-legged Green-Pigeon	R/LM	FR	March to June	Bondla WS	All Peninsular India, south of Gangetic Plain	Rane (1983)
200	507	*Ducula aenea* (Linnaeus)	Green Imperial-Pigeon	R/LM	FR	February to June	Bondla WS, Cotigao WS, BMWS, Mollem	Peninsular India north to 20°N latitude; W & E Ghats	—
201	511	*Ducula badia* (Raffles)	Mountain Imperial-Pigeon	R/SM/LM	FR	January to May	Cotigao WS, Bondla WS, BMWS, Coduol, Nagoa Valley, Valpoi	Western Ghat Complex, Kerala north to about Belgaum & Goa (16°N latitude)	1♀ (ZSI, HQ, Kolkata)
202	566 & 567	Order PSITTACIFORMES Family PSITTACIDAE *Loriculus vernalis* (Sparrman)	Indian Hanging-Parrot	R/LM	FR, N	January to April	Canacona, Valpoi	NE & W. India coastal strip & W Ghats to Kerala & E Ghats to Orissa	First reported by Grubh & Ali (1976) in Goa; 1 Unsexed, (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
203	546	*Psittacula eupatria* (Linnaeus)	Alexandrine Parakeet	R/LM (Nomadic)	FR	November to April	Anjuna, North Goa Coast, Valpoi	Throughout the Peninsular India (South of 18°N latitude)	—
204	550*	*Psittacula krameri* (Scopoli)	Rose-ringed Parakeet	R	FR	January to May	Terakol, Keri	All Peninsular India south of latitude 20°N	—
205	558*	*Psittacula cyanocephala* (Linnaeus)	Plum-headed Parakeet	R/LM	FR, N	December to April	Cotigao WS, Keri, Mollem Canacona	—do—	6♂, 4♀ (ZSI, HQ, Kolkata)
206	564	*Psittacula columboides* (Vigors)	Blue-winged Parakeet	R (Nomadic)	FR & GR	January to March	BMWS, Bondla WS, Cotigao WS, Mollem, Canacona	W Ghats Complex from Kerala north to Thane District, upto 19°N latitude	1♂, (ZSI, HQ, Kolkata)
		Order CUCULIFORMES Family CUCULIDAE							
207	571	*Clamator jacobinus* (Boddaert)	Pied Crested Cuckoo	MV	I	June to September (Brood Parasitic)	Terakol, Nagoa valley, Baga, BMWS, Cotigao WS, Calangute	Peninsular India from 15°N latitude upto Kerala	—
208	572	*Hierococcyx sparverioides* (Vigors)	Large Wawk-Cuckoo	Wintering	I	June-July parasitic in Himalayas	Cumburjua canal, Backwood camps, Mayem lake	Peninsular India from Madhya Pradesh to Kerala base of Western Ghats	Arnold, 1997 Woolley, 1999 Lassey, 2000 (Lainer 2004b)
209	573*	*Hierococcyx varius* (Vahl)	Brainfever Bird	R/LM (Nomadic)	I	March to June (Brood Parasitic)	Cotigao WS, Keri, Mollem, Mayem, Bondla WS	Throughout the Indian Subcontinent	1 juvenile ♀ (ZSI, HQ, Kolkata)
210	576	*Cuculus micropterus* Gould	Indian Cuckoo	R/SM (Nomadic)	I	Brood Parasitic	Bondla WS, Carambolim, Mollem, Cotigao WS, Canacona	All over India (Except Rajsthan & Gujarat)	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
211	578*	*Cuculus canorus* Linnaeus	Common Cuckoo	R/SM/LM	I	March to August (Brood Parasitic)	Bondla WS, Keri, Calangute, Saligao, ZAC Reservoir	All over India	—
212	581	*Cuculus poliocephalus* Latham	Lesser Cuckoo	Wintering/ PM	I	May to July (in Himalayas) (Brood Parasitic)	Mollem, Bondla WS	Himalayas, NE & Peninsular India	1♀ (ZSI, HQ, Kolkata)
213	582	*Cacomantis sonneratii* (Latham)	Banded Bay Cuckoo	R/SM/LM	I	February to August (Brood Parasitic)	Baga hill, Bondla WS, Nagoa valley, BMWS, Mollem	Throughout India	—
214	584*	*Cacomantis passerinus* (Vahl)	Indian Plaintive Cuckoo	R/LM/ (Nomadic)	I	June to September (Brood Parasitic)	Arwal nalla, Mollem, BMWS, Terakol, Nagoa valley	Throughout the Indian Subcontinent	—
215	588	*Surniculus lugubris* (Horsfield)	Drongo Cuckoo	R/LM/ (Nomadic)	I	March to October (Brood Parasitic)	Bondla WS, BMWS, Nagoa valley, Mollem	Throughout the Peninsula	—
216	590*	*Eudynamys scolopacea* (Linnaeus)	Asian Koel	R/LM/ (Nomadic)	FR	March to August (Brood Parasitic)	Arwal nalla, Mollem, Valpoi, Ponda, Margao, Canacona	Throughout the Subcontinent excepting Assam	4♂, 6♀ (ZSI, HQ, Kolkata)
217	595	*Phaenicophaeus viridirostris* (Jerdon)	Small Green-billed Malkoha	R	I	All the year (March to May) (Non-parasitic)	Cotigao WS, Bondla WS, Nagoa Valley, Vagheri Hill	Peninsular India (South to 20°N latitude)	1♀, (ZSI, HQ, Kolkata)
218	602	*Centropus sinensis* (Stephens)	Greater Coucal	R	CR & I	All the year (November to May)	Canacona, Mollem, Poinguinim	Peninsular India south of the Gangetic plain to Kerala	3♂, 1♀ (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
219	605*	*Centropus bengalensis* (Gmelin)	Lesser Coucal	R	CR & I	May to September	BMWS	—do—	—
220	606	Order STRIGIFORMES Family TYTONIDAE *Tyto alba* (Scopoli)	Barn Owl	R	CR	Practically entire year	Agassaim	All over India	—
221	617	Family STRIGIDAE *Otus sunia* (Hodgson)	Oriental Scops-Owl	R	I & CR	February to May	Bondla WS, BMWS	Peninsular India south of 21°N lat upto Kerala including W Ghats	—
222	623	*Otus bakkamoena* Pennant	Collared Scops-Owl	R	I & CR	January and February	Bondla WS, Mollem	Peninsular India south upto Kerala	1 Unsexed, (ZSI, HQ, Kolkata)
223	627	*Bubo bubo (bengalensis)* (Linnaeus)	Eurasian Eagle-Owl (Rock Eagle-Owl)	R	CR	October to May	8 Km south of Goa border Bondla	Throughout subcontinent	Davidson, 1898 (Lainer, 2004 b) per. com. SP & NS.
224	628	*Bubo nipalensis* Hodgson	Forest Eagle-Owl	R	CR	December & January	Devil's Canyon, Cotigao WS	All over India	—
225	630	*Bubo coromandus* (Latham)	Dusky Horned-Owl	R/ Uncertain	CR	November April	Terakol, Nagoa valley	—do—	—
226	631	*Ketupa zeylonensis* (Gmelin)	Brown Fish-Owl	R	Aq A & CR	December to March	BMWS, Bondla WS, Cotigao WS	Entire Indian Union	—
227	657	*Strix ocellata* (Lesson)	Mottled Wood-Owl	R	CR & I	November to April	BMWS, Bondla WS	Peninsular India from Madhya Pradesh to Kerala	Smithson, 1996 (Lainer, 2004 b) per. com. SP & NS

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
228	659	*Strix leptogrammica* Temminck	Brown Wood-Owl	R	CR	January to March	Bondla WS	Western & Eastern Ghats, Peninsular India south of 18°N lat	—
229	637	*Glaucidium radiatum* (Tickell)	Jungle Owlet	R	I, CR	March to May	Bondla WS, BMWS, Cotigao WS, Mayem Lake, Mollem, Valpoi, Poinguinim	Malabar Coastal Strip from south Konkan 16°N lat upto Kerala through Goa	3♂, 2♀ (ZSI, HQ, Kolkata)
230	652*	*Athene brama* (Temminck)	Spotted Owlet	R	I, CR	November to March	Anjuna, Carambolim, Keri	Peninsular India south of 20°N lat	—
231	644	*Ninox scutulata* (Raffles)	Brown Hawk-Owl	R	I, CR	January to May	Bondla WS, Cotigao WS	Southern India from 19°N lat to Kerala through Goa	—
232	664	*Asio flammeus* (Pontoppidan)	Short-eared Owl	WV	CR, I	Extralimital	Arpora-Baga, Fort Aguada	Entire Indian Union	—
233	666	Order CAPRIMULGIFORMES Family PODARGIDAE *Batrachostomus moniliger* Blyth	Ceylon Frogmouth	R (Unclear)	I	January to April	Bondla WS	Western Ghats from 15°N lat to Kerala	First reported by Holt in 1996 & others between 1996-2000 by voice record; (Lainer, 2004b)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
234	669	Family CAPRIMULGIDAE *Eurostopodus macrotis* (Vigors)	Great Eared-Nightjar	R/LM/WV (Unclear)	I	February to March	Valpoi, Bondla WS, Tambdi Surla, Canacona	Kerala only	First reported by Grubh & Ali (1976) & between 1985-2000 by others by voice record (Lainer, 2004b)
235	671	*Caprimulgus indicus* Latham	Indian Jungle-Nightjar	R/LM	I	March and April	Bondla WS, Tambdi Surla, Cotigao WS, Mayem lake, Siolim, Mollem, Valpoi	All over India	1♂, 1♀ (ZSI, HQ, Kolkata)
236	676	*Caprimulgus atripennis* Jerdon	Jerdon's Nightjar	R/WV (Unclear)	I	March to July	—do—, Canacona	Peninsular India south of 18°N lat to Kerala	—
237	680	*Caprimulgus asiaticus* Latham	Common Indian Nightjar	R/SM	I	February to September	Arpora-Baga, Tambdi-Surla	Entire India Union	Wielen, 1998 Dennis & Whalim,1999 (Lainer 2004b)
238	682	*Caprimulgus affinis* Horsfield	Franklin's Nightjar	R (Unclear)	I	March to August	Bondla WS, Poinguinim, Nagoa valley, Canacona	All over India	1♂, (ZSI, HQ, Kolkata)
239	685	Order APODIFORMES Family APODIDAE *Collocalia unicolor* (Jerdon)	Indian Edible-nest Swiftlet	R	I	March to June	Bondla WS, BMWS, Mollem Cotigao WS	The coastal and Western Ghats strip south of 16°N lat (Ratnagiri) to Kerala	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
240	692	*Zoonavena sylvatica* (Tickell)	White-rumped Needletail-Swift	R	I	February to May	—do—	All over India	Reported by Grubh & Ali (1976)
241	691	*Hirundapus giganteus* (Temminck)	Brown-backed Needletail-Swift	R/LM (Unclear)	I	February to April	—do—	NE India, Western Ghat strip from 15°N lat, Goa to Kerala	—
242	707	*Cypsiurus balasiensis* (J. E. Gray)	Asian Palm-Swift	R	I	All over the year	Panaji, Mollem, Mapusa	Throughout India	—
243	694	*Tachymarptis melba* (Linnaeus)	Alpine Swift	R/LM/SM	I	December to February	Cotigao WS, Bondla WS	Northern and Peninsular India	—
244	696	*Apus apus* (Linnaeus)	Common Swift	Wintering	I	Extralimital Kashmir Himalayas in May-June	Mandovi river Baga, Bondla	Throughout India	Welland, 1995, Holt, 1998 (Lainer 2004 b)
245	697	*Apus pallidus* (Shelley)	Pallid Swift	Vagrant	I	Extralimital	Calangute, Morjin	—do—	Wilson & Johnson, 1997 (Lainer, 2004b)
246	700	*Apus pacificus* (Latham)	Pacific Swift	R (Uncertain)	I	April to July	—do—	Himalayas, NE India wandering from Saurashtra to N Kanara	—
247	703*	*Apus affinis* (J. E. Gray)	House Swift	R/LM	I	All year except November to February	Dudhsagar, Mollem, Panaji	All over India	—
248	709*	Family HEMIPROCNIDAE *Hemiprocne coronata* (Tickell)	CrestedTree-Swift	R/SM/LM	I	December to July	Bondla WS, Cotigao WS, BMWS, Ponda, Mollem, Canacona Poinguinim	Throughout the Indian Union	2♂, 2♀ (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
249	711	Order TROGONIFORMES Family TROGONIDAE *Harpactes fasciatus* (Pennant)	Malabar Trogon	R	I	February to May	—do—	Peninsular India in Western Ghats Complex south of 20°N Lat through Goa to Kerala	4♂, 1♀ (ZSI, HQ, Kolkata); 2♂ (ZSI, WRS, Pune)
250	724*	Order CORACIIFORMES Family ALCEDINIDAE *Alcedo atthis* (Linnaeus)	Small Blue Kingfisher	R	Aq A	February to September	Canacona, Keri, Mollem, Poinguinim	Peninsular India south of 20°N latitude	2♂, 3♀ (ZSI, HQ, Kolkata)
251	725	*Alcedo meninting* Horsfield	Blue-eared Kingfisher		Aq A	May to June	Bondla WS, Cotigao WS, BMWS, Mollem, Canacona	NE India & Western Ghats Complex from Goa to Kerala	—
252	727	*Ceyx erithacus* (Linnaeus)	Oriental Dwarf Kingfisher	R/MV (for Breeding)	Aq A	July to September	Collem, Mollem, BMWS & Bondla WS	NE India, Western Ghat strip from North of Mumbai to Kerala through Goa	—
253	730*	*Halcyon capensis* (Linnaeus)	Stork-billed Kingfisher	R	Aq A	February to May	Poinguinim	All over India	1♂, Subadult (ZSI, HQ, Kolkata)
254	736*	*Halcyon smyrnensis* (Linnaeus)	White-breasted Kingfisher	R/LM	OM	January to August	Dudhsagar, Margao Mollem, Canacona	—do—	4♂, 4♀ (ZSI, HQ, Kolkata)
255	739	*Halcyon pileata* (Boddaert)	Black-capped Kingfisher	R/LM	Aq A, I	May to June	Marmagoa, Velsao, Collem, Carambolim Lake, Cotigao WS, Baga Creek, Dudhsagar falls	Western Seaboard from Mumbai southward & Eastern coast of the Peninsula to W Bengal	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
256	740	*Todiramphus chloris* (Boddaert)	Collared Kingfisher	R	Aq A	March to August	Chapora river, Zuari-Mandovi Basin	West coast in Ratnagiri district (Maharashtra) to Kerala	—
257	719*	*Ceryle rudis* (Linnaeus)	Lesser Pied Kingfisher	R	Aq A (Fish)	Entire year	Anjuna	Throughout the Indian Union	—
258	753	Family MEROPIDAE *Nyctyornis athertoni* (Jardine & Selby)	Blue-beared Bee-eater	R	I	February to August	Mollem, Bondla WS, BMWS	Almost all over India	1♀, (ZSI, HQ, Kolkata)
259	750*	*Merops orientalis* Latham	Small Bee-eater	R/SM/LM	I	February to June	Colva beach, Baga hill, Mollem, Bondla WS, Canacona, Keri, Poinguinim, Valpoi	Throughout the Indian Subregion	4♂, 9♀, (ZSI, HQ, Kolkata)
260	748	*Merops philippinus* Linnaeus	Blue-tailed Bee-eater	R/LM	I	March to June	Mayem lake, Bicholim, Canacona, Poinguinim	Northern India & patchily through-out the Peninsula	1♂, 1♀ (ZSI, HQ, Kolkata)
261	744	*Merops leschenaulti* Vieillot	Chestnut-headed Bee-eater	R/SM	I	February to June	Bondla WS, Cotigao WS, BMWS, Mollem, Mayem lake, Collem, Dudhsa-gar Rly. Stn.	Himalayan foot-hills, east to W Bengal; Western Ghats Complex from Goa to Kerala	1♀, (ZSI, HQ, Kolkata)
262	754	Family CORACIIDAE *Coracias garrulus* Linnaeus	European Roller	PM	I	Extralimital	Anjuna, Baga, Aguda fort, Carambolim, Mollem-Collem, Canacona	Northern India & Southwest India to Karnataka	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
263	756*	*Coracias benghalensis* (Linnaeus)	Indian Roller	R/LM	I	January to April	Cotigao WS, Canacona, Mollem, Arvalli falls, Keri	Peninsular India south of 20°N lat	2♂, 1♀ (ZSI, HQ, Kolkata)
264	759	*Eurystomus orientalis* (Linnaeus)	Oriental Broad-billed Roller	R	I	March & April	—do—	Kerala north to western Tamil Nadu & Karnataka	—
265	765	Family UPUPIDAE *Upupa epops* Linnaeus	Common Hoopoe	R/WV	I	January to April & Extralimital	Canacona, Dudhsagar, Chapora, Cotigao WS, BMWS, Baga, Collem, Mollem	Almost all over India	1♂, 1♀ (ZSI, HQ, Kolkata)
266	768*	Family BUCEROTIDAE *Ocyceros griseus* (Latham)	Malabar Grey Hornbill	R	FR	January to March	–do–, Bolkondi nalla, Sattari, Terakol, Cotigao WS, Bondla WS, BMWS, Surla	Heavy rainfall areas of Western Ghats Complex from Mumbai to Kerala	5♂, 6♀ (ZSI, HQ, Kolkata)
267	767	*Ocyceros birostris* (Scopoli)	Indian Grey Hornbill	R/LM	OM	March-June	Mollem	Entire India	per. com. SP & NS
268	775	*Anthracoceros coronatus* (Boddaert)	Malabar Pied Hornbill	R/LM	FR, CR	March & April	–do–; Anjuna, Mollem, Collem, Mayem, Nagoa valley	Central India & Western Side of the Peninsula upto Kerala	—
269	776	*Buceros bicornis* Linnaeus	Great Pied Hornbill	R/LM	FR	February to April	–do–; Dudhsagar trek, Canacona	Western Ghats from Khandala 18°N lat south through Goa upto Kerala& NE India	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
270	781*	Order PICIFORMES Family CAPITONIDAE *Megalaima zeylanica* (Gmelin)	Brown-headed Barbet	R	FR	March to May	–do–; Bolkondi nalla, Sanguem, Ponda, Poinguinim, Valpoi	Western Ghats from Godavari river south through Goa to Coorg district	2♂, 2♀ (ZSI, HQ, Kolkata)
271	785*	*Megalaima viridis* (Boddaert)	White-cheeked Barbet	R	FR	December to March	Mollem, Keri, Baga Creek, Nagoa valley	Western Ghats Complex from Kerala north to Narmada river & SW Tamil Nadu	1♂, 4♀, 1 Unsexed, (ZSI, HQ, Kolkata)
272	790	*Megalaima rubricapilla* (Gmelin)	Crimson-throated Barbet	R	FR	January to March	Cotigao WS, Bondla WS, BMWS, Collem, Mollem, Ponda, Canacona	Western Ghats Complex from Goa, 16°N lat south to Kerala	1♂, 1♀ (ZSI, HQ, Kolkata)
273	792*	*Megalaima haemacephala* (P. L. S. Müller)	Coppersmith Barbet	R	FR	November to June	–do–; Keri	Throughout the Indian Union	3♂, 1♀ (ZSI, HQ, Kolkata)
274	796	Family PICIDAE *Jynx torquilla* Linaeus	Eurasian Wryneck	WV	I	Extralimital	Nagoa valley, Baga, Mobor, Bardez	Northern & Western Central India, south to Kerala	—
275	799	*Picumnus innominatus* Burton	Speckled Piculet	R	I	January to March	Bondla WS, Cotigao WS, Backwood Camp, BMWS	Western Ghats Complex from Goa to Kerala, Eastern Ghat, NE India	—
276	852	*Dendrocopos nanus* (Vigors)	Brown-capped Pygmy Wood-pecker	R	I	February to July	Bondla WS, Cotigao WS, BMWS, Mollem, Collem, Valpoi, Ponda, Canacona	All the Peninsular India	1♂, 1♀ (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
277	847*	*Dendrocopos mahrattensis* (Latham)	Yellow-fronted Pied Woodpecker	R	I	February to May	–do–; Baga Nagoa valley, Mayem lake	From the base of Himalayas southward throughout the Peninsula	1♀, (ZSI, HQ, Kolkata)
278	804	*Celeus brachyurus* (Vieillot)	Rufous Woodpecker	R	I	February to April	Canacona, Cotigao WS, Mollem, Ponda, Sanguem	Tapi river 20°N lat in Gujarat through Western Maharashtra to Tamil Nadu & Kerala	4♂, 1♀ (ZSI, HQ, Kolkata)
279	830*	*Dryocopus javensis* (Horsfield)	Great Black Woodpecker	R	I	January to March	–do– Cotigao WS, BMWS, Keri	–do–	—
280	816	*Picus chlorolophus* Vieillot	Small Yellow-naped Woodpecker	R	I	January to May	Bondla WS, BMWS, Surla, Dudhsagar falls	Western Ghats Complex from Narmada river to Kerala & Eastern Ghats Complex, Orissa	—
281	825	*Dinopium javanense* (Ljungh)	Common Golden-backed Woodpecker	R	I	—do—	Bondla WS, Cotigao WS, BMWS, Canacona Mollem	SW India 16°N lat, from Goa To Kerala & Western Tamil Nadu	—
282	821*	*Dinopium benghalense* (Linnaeus)	Lesser Golden-backed Woodpecker	R	I	February-March & July-August	–do–; Canacona, Ponda, Valpoi, Cotigaon	–do–	6♂, 2♀ (ZSI, HQ, Kolkata); 1♂ (ZSI,WRS, Pune)
283	862	*Chrysocolaptes lucidus* (Scopoli)	Greater Golden-backed Woodpecker	R	I	December to March	–do–; Dudhsagar falls, Surla, Valpoi, Collem	Western Ghats Complex from Tapi river through Goa to Kerala	2♂, 1♀ (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
284	858	*Chrysocolaptes festivus* (Boddaert)	Black-shouldered Woodpecker	R	I	November to March	Mayem lake, Anjunem dam	Peninsular India	Verneulen, 2000 (Lainer 2004b)
285	856	*Hemicircus canente* (Lesson)	Heart-Spotted Woodpecker	R	I	November to April	—do—	—do—	2♂, 1♀ (ZSI, HQ, Kolkata)
286	867	Order PASSERIFORMES Family PITTIDAE *Pitta brachyura* (Linnaeus)	Indian Pitta	R/SM/WV	I	May-August	—do—	Entire Subcontinent	—
287	872	Family ALAUDIDAE *Mirafra cantillans* Blyth	Singing Bush-Lark	R	GR	March to September	ZAC Reservoir at Sancoale	All over India	—
288	878*	*Eremopterix grisea* (Scopoli)	Ashy-crowned Sparrow-Lark	R/LM	GR	February to September	Dabolim,Anjuna, Terakol, Baga, Dona-Paula, Canacona, Divar-Navelim, Neura Wetlands	—do—	—
299	882	*Ammomanes phoenicurus* (Franklin)	Rufous-tailed Finch-Lark	R/SM	GR	February to May	Carambolim, Neaura & Shiroda Wetlands, Divar-Navelim	Kutch, Ajmer, Delhi to W Bengal & south upto 15°N latitude	—
290	886	*Calandrella brachydactyla* (Leisler)	Greater Short-toed Lark	WV	GR, I	Extralimital	Anjuna, Baga, Canacona, Collem, Marmagoa, Mollem	Base of the Himalayas to Kerala	—
291	901	*Galerida malabarica* (Scopoli)	Malabar Crested Lark	R/SM/LM	GR	All the year	Canacona, Mollem, Vasco	Western Peninsular India from 23°N lat in Gujarat up to Kerala	2♂, 1♀, 3 (Unsexed) (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
292	902	*Galerida deva* (Sykes)	Sykes's Crested Lark	R/SM	GR, I	March to September	Candolim, Carambolim Grasslands	Rajsthan, Gujarat, Gangetic Plain to south Peninsula up to Karnataka	—
293	907	*Alauda gulgula* Franklin	Eastern Skylark	R/SM	GR	March to August	Divar-navelim, Neura wetland, ZAC reservoir, Mollem-Collem	Peninsular India south of 20°N Lat to Madhya Pradesh, W Bengal, Orissa, Tamil Nadu	—
294	911	Family HIRUNDINIDAE *Riparia riparia* (Linnaeus)	Sand Martin	Wintering	I	October to March	Baga, Mollem, Neura wetland, Cotigao WS, Aguada fort, ZAC reservoir	NE India, West Bengal	First recorded by Holt in 1996 & others in Goa (Lainer, 2004b)
295	910	*Riparia diluta* (Sharpe & Wyatt)	Pale Martin	Wintering	I	November to May (In N India)	Baga	Northern India, Bihar, W Bengal	–do–
296	912	*Riparia paludicola* (Vieillot)	Plain Martin	Wintering	I	October to February (In N India)	Anjuna, Baga, BMWS, Mayem lake	Northern India, Bihar, W Bengal & south to 18°N latitude	First reported by Claydon in 1993 (Lainer, 2004b)
297	913	*Hirundo rupestris* Scopoli	Eurasian Crag-Martin	WV	I	Extralimital& in Himalayas	Valpoi, Surla, Dudhsagar falls, Aguada, BMWS, Baga	Hilly portion of Indian Subregion south to Tamil Nadu, Kerala	—
298	914	*Hirundo concolor* Sykes	Dusky Crag-Martin	R	I	February to August	—do— Panaji	Entire Peninsula up to Kerala	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
299	917*	*Hirundo rustica* Linnaeus	Common Swallow	Wintering	I	Extralimital& in Himalayas	Keri, Panaji	NE India & Peninsula to southern tip	—
300	919	*Hirundo tahitica* Gmelin	House Swallow	R	I	March to May	Candolim	Hills of Southwest India	—
301	921*	*Hirundo smithii* Leach	Wire-tailed Swallow	R/LM	I	March to September	Canacona, Keri, Panaji, Mayem	Himalayas & Peninsula south to Kerala	1♂, 1♀ (ZSI, HQ, Kolkata)
302	927	*Hirundo daurica* Linnaeus	Red-rumped Swallow	R/SM	I	April to August	Mollem & all over Goa	Throughout the Subcontinent	—
303	922	*Hirundo fluvicola* Blyth	Streak-throated Swallow	Wintering	I	All year	Anjuna, Baga, Carambolim, Cotigao WS, Mollem, Shiroda, Velsao	NW India, Gangetic Plain southward to 11° latitude	—
304	930	*Delichon urbica* (Linnaeus)	Northern House Martin	WV	I	Extralimital& in Kashmir, Ladakh	BMWS, Cotigao WS, Keri, Mayem lake, Mollem, Surla	North India & Western Peninsula up to Kerala	—
305	1874*	Family MOTACILLIDAE *Dendronanthus indicus* (Gmelin)	Forest wagtail	WV	I	Extralimital	BMWS, Bondla WS, Cotigao WS, Dudhsagar falls, Mollem road, Keri	All over India & also in Western Ghats	2 (Unsexed) (ZSI, HQ, Kolkata)
306	1885	*Motacilla alba* Linnaeus	White Wagtail	WV	I	—do—	–do–; Collem, Dona Paula, Carambolim lake	Entire Peninsular India & Western Ghats	—
307	1891*	*Motacilla maderaspatensis* Gmelin	Large Pied Wagtail	R	I	December to June	Mapusa, Mollem Road, Siolim	—do—	—
308	1881	*Motacilla citreola* Pallas	Citrine Wagtail	WV	I	Extralimital	Baga, Carambolim, Collem, Mollem, Vaingonn paddy-fields	—do—	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
309	1875	*Motacilla flava* Linnaeus	Yellow Wagtail	WV	I	–do–	Baga fields & -do-	—do—	—
310	1884	*Motacilla cinerea* Tunstall	Grey Wagtail	WV	I	–do–	Mollem, Morjim, Ponda, Valpoi	—do—	1♂, 2♀, 1 (Unsexed), (ZSI, HQ, Kolkata)
311	1857	*Anthus richardi* Vieillot	Richard's Pipit	WV	I	—do—	Baga, Bardez, Carambolim, Divar-Navelim, Dona-Paula, Mollem	—do—	—
312	1859	*Anthus rufulus* Vieillot	Paddy-field Pipit	R/LM	I	November to June	Paddy fields of Goa	From Narmada river south to Tamil Nadu	—
313	1861	*Anthus campestris* (Linnaeus)	Tawny Pipit	WV	I	Extralimital	Aguada, Baga, Carambolim, Divar-Navelim, Dona-Paula, Ponda, ZAC Reservoir	Entire Indian Peninsula & Western Ghats	—
314	1863	*Anthus godlewskii* (Taczanowski)	Blyth's Pipit	WV	I	—do—	–do– & BMWS	—do—	—
315	1854	*Anthus trivialis* (Linnaeus)	Eurasian Tree Pipit	WV	I	—do—	–do– & Canacona, Mollem	—do—	—
316	1852	*Anthus hodgsoni* Richmond	Oriental Tree Pipit	WV	I	—do—	Cotigao WS, Mollem, Canacona	—do—	1♂, (ZSI, HQ, Kolkata)
317	1864	*Anthus cervinus* (Pallas)	Red-Throated Pipit	WV	I	—do—	Baga hills, Candolim	—do—	—
		Family CAMPEPHAGIDAE							
318	1072*	*Coracina macei* (Lesson)	Large Cuckoo-Shrike	R/LM	I	January to October	Anjuna, BMWS, Bondla WS, Cotigao WS, Keri, Mollem, Nagoa valley, Ponda, Valpoi, Canacona	Peninsular India from Kutch to W Bengal & south up to Kerala	2♂, (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
319	1077	*Coracina melaschistos* (Hodgson)	Black-winged Cuckoo-Shrike	Wintering	I	May & June (In Himalayas)	Bondla WS, Carambolim Lake, Nagoa valley	Peninsular India as far south as Karnataka	—
320	1079	*Coracina melanoptera* (Rüppell)	Black-headed Cuckoo-Shrike	R/SM	I	April & May	Baga, Collem, Mayem lake, Mollem & all Wildlife Sanctuaries	Whole of Indian Peninsula	4♂, 3♀, 1 (Unsexed) (ZSI, HQ, Kolkata)
321	1089	*Pericrocotus roseus* (Vieillot)	Rosy Minivet	Wintering	I	May & June (In Himalayas)	Bondla WS, Canacona, Cotigao WS	—do—	—
322	1089a	*Pericrocatus divaricatus* (Raffles)	Ashy Minivet	Winter Vagrant	I	Extralimital	Aguada Fort, Backwood camps	Andaman Is. Mumbai	Holt, 1997 Dennis 1999 (Lainer 2004b)
323	1094	*Pericrocotus cinnamomeus* (Linnaeus)	Small Minivet	R	I	March to October	–do– & Collem, Mollem, Valpoi	From Kerala north up to Goa	4♂, (ZSI, HQ, Kolkata)
324	1081*	*Pericrocotus flammeus* (Forster)	Scarlet Minivet	R	I	July & August	Canacona, Gao Dongrem, Mayem lake, Mollem, Valpoi, Poinguinim	Peninsular India from Gujarat to Kerala, W Ghats	2♂, 2♀, (ZSI, HQ, Kolkata)
325	1065	*Hemipus picatus* (Sykes)	Pied flycatcher-Shrike	R	I	March to May	Baga,Canacona, Nagoa valley, Surla & all Wild-life Sanctuaries	Central & Peninsular India	—
326	1068	*Tephrodornis gularis* (Raffles)	Large Woodshrike	R	I	December to June	—do—	Gujarat to Kerala (Confined to western part)	2♂, (ZSI, HQ, Kolkata)
327	1070	*Tephrodornis pondicerianus* (Gmelin)	Common Woodshrike	R	I	February to July	–do– & Canacona, Mayem lake, Mollem	NE, Central & Peninsular India	1♂, 1♀, (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
328	1114	Family PYCNONOTIDAE *Pycnonotus priocephalus* (Jerdon)	Grey-headed Bulbul	R	FR	March to July	—do—	SW India from Belgaum & Goa to Kerala	—
329	1116	*Pycnonotus melanicterus* (Gmelin)	Black-crested Bulbul (Rubythroated yellow Bulbul)	R	FR, I	January to August	Canacona, Mollem, Poinguinim, Valpoi	—do—	2♂, 2♀, (ZSI, HQ, Kolkata) A State Bird of Goa
330	1120*	*Pycnonotus jocosus* (Linnaeus)	Red-whiskered Bulbul	R	FR	December to June	Arwal nalla, Keri, Canacona, Mayem Mollem, Ponda, Sanguem, Valpoi	Western India from Tapi river to Kerala	7♂, 5♀, (ZSI, HQ, Kolkata)
331	1128*	*Pycnonotus cafer* (Linnaeus)	Red-vented Bulbul	R	FR	February to November	–do–, Keri, Nanaz	Southern Indian Peninsula	10♂, 3♀, (ZSI, HQ, Kolkata)
332	1138	*Pycnonotus luteolus* (Lesson)	White-browed Bulbul	R	FR	January to November	—do—	Peninsular India south of 23°N lat to Kerala & W Ghats	7♂, 5♀, (ZSI, HQ, Kolkata)
333	1144*	*Iole indica* (Jerdon)	Yellow-browed Bulbul	R	FR	February to May	Keri, Mollem, Sanguem, Valpoi & all Wildlife Sanctuaries	W Ghats south of Belgaum & Goa to W Karnataka	2♂, 3 Unsexed, (ZSI, HQ, Kolkata)
334	1149	*Hypsipetes leucocephalus* (P. L. S. Muller)	Black Bulbul	R/LM	FR	March to June	Canacona, Cotigao WS, BMWS, Mollem, Surla	W Ghats from Matheran south to Kerala	—
335	1100	Family IRENIDAE *Aegithina tiphia* (Linnaeus)	Common Iora	R	I	January to August	Canacona, Mollem, Poinguinim, Ponda, Vasco	Peninsular India south of 20°N lat up to Kerala	2♂, 5♀, (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
336	1107	*Chloropsis cochinchinensis* (Gmelin)	Jerdon's Chloropsis	R	I	November to May	—do—, Valpoi	Gangetic Plains & Peninsular India up to Kerala	3♂, (ZSI, HQ, Kolkata)
337	1104*	*Chloropsis aurifrons* (Temminck)	Gold-fronted Chloropsis	R	I, FR	February to August	Bolkondi, Canacona, Collem, Mayem lake, Mollem, Nagoa valley, Ponda, Valpoi & all Wildlife Sanctuaries	W Ghats from Southern Gujarat to Kerala & E Ghats in Tamil Nadu, Andhra Pradesh	1♂, 2♀, (ZSI, HQ, Kolkata)
338	1109 & 1110	*Irena puella* (Latham)	Asian Fairy- Bluebird	R/SM	FR	January to June	—do—	SW India from Ratnagiri district to western Kerala & Tamil Nadu	2♂, 2♀, (ZSI, HQ, Kolkata)
339	943	Family LANIIDAE *Lanius isabellinus* Hemprich & Ehrenberg	Rufous-tailed Shrike	WV/PM	I, CR	Extralimital	Arpora-Parna hills, Baga fields, Divar-Navelim, Santa-Cruz creek	Central & Peninsular India up to Maharashtra	(Various reports in Goa from 1996 onwards) (Lainer, 2004b)
340	949	*Lanius cristatus* Linnaeus	Brown Shrike	WV	I	—do—	Bondla WS, BMWS, Baga, Cotigao WS, Margao, Mollem	All over India	1♀, (ZSI, HQ, Kolkata)
341	940*	*Lanius vittatus* Valenciennes	Bay-backed Shrike	R/SM	I, CR	February to April	Baga, Carambolim, Keri	—do—	—
342	947*	*Lanius schach* Linnaeus	Rufous-backed Shrike	R/SM	OM	March to June	Canacona, Keri, Mollem Poinguinim, Valpoi	Peninsular India & Western Ghats	4♂, 3♀, 2 (Unsexed) (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
		Family MUSCICAPIDAE Subfamily TURDINAE							
343	1723	*Monticola cinclorhynchus* (Vigors)	Blue-headed Rock-Thrush	Wintering	OM	May to July (In Himalayas)	Bondla WS, BMWS, Canacona Cotigao WS, Mayem lake, Mollem, Nagoa valley	Wintering in W. Ghats from Dang district south to Kerala & Western Tamil Nadu	—
344	1726	*Monticola solitarius* (Linnaeus)	Blue Rock-Thrush	Wintering	I	April to July (In Himalayas)	—do— & Baga, Collem, Dudh-sagar Rly Stn., Mollem, Terakol	All over India	1♀, (ZSI, HQ, Kolkata)
345	1728	*Myiophonus horsfieldii* (Vigors)	Malabar Whistling-Thrush	R	OM	May to September	Bondla WS, BMWS, Cotigao WS, Mollem	Western Gujarat, Surat Dangs, Satpura Range, Western Ghats Complex up to Kerala	—
346	1734	*Zoothera citrina* (Latham)	Orange-headed Thrush	R/LM	I	June to August	Canacona, Mayem lake, Mollem, Ponda, Surla, Valpoi & all Wildlife Sanctuaries	Peninsular India from Gujarat to Bihar & south-wards to Kerala	8♂, 1♀, (ZSI, HQ, Kolkata)
347	1748	*Turdus unicolor* Tickell	Tickell's Thrush	WV	I	Extralimital & in Himalayas	—do—	Northern, Eastern & Peninsular India south to Nilgiris	1♂, (ZSI, HQ, Kolkata)
348	1753	*Turdus merula* Linnaeus	Eurasian Blackbird	R/SM (Migrant)	I	June to August	—do—	Satpura Range, Gujarat, Rajsthan to south Western Ghats	3♂, 1♀, (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
349	1645	*Luscinia svecica* (Linnaeus)	Bluethroat	WV	I	Extralimital	Anjuna, Baga creek, Neura, Candolim, Ponda, Marmagoa	Western Peninsula up to Mumbai	First record in Goa in 1985 (Lainer, 2004b)
350	1650 & 1651	*Luscinia brunnea* (Hodgson)	Indian Blue Robin	WV	I	—do—	Bondla WS, Dudhsagar falls, Mollem	SW India from Londa to Kerala & Himalayas	First reported in Goa in 1994 (Lainer, 2004b)
351	1661*	*Copsychus saularis* (Linnaeus)	Oriental Magpie-Robin	R	I	March to June	Keri, Valpoi & Mollem, Bicholim Canacona	Northern, Eastern & Southern Peninsular India	7♂, 6♀, (ZSI, HQ, Kolkata)
352	1665	*Copsychus malabaricus* (Scopoli)	White-rumped Shama	R	I	April to June	Baga, Bondla WS, BMWS, Canacona Cotigao WS, Mollem, Nagoa valley	Western Indian Peninsula from Dangs to Kerala	2♂, (ZSI, HQ, Kolkata)
353	1720*	*Saxicoloides fulicata* (Linnaeus)	Indian Robin	R	I	February to July	Canacona, Keri, Panaji, Ponda	South of Krishna river & Southern India	1♀, (ZSI, HQ, Kolkata)
354	1672	*Phoenicurus ochruros* (Gmelin)	Black Redstart	Wintering	I	May to August; Breeds in Himalayas	–do– & all Wild-life Sanctuaries	NE, Central to South India up to Tamil Nadu	—
355	1697	*Saxicola torquata* (Linnaeus)	Common Stonechat	Wintering	I	Extralimital & in Himalayas	Usgao, Valpoi	North, Central India, South Peninsula to Karnataka	1♀, (ZSI, HQ, Kolkata)
356	1700 & 1701	*Saxicola caprata* (Linnaeus)	Pied Bushchat	R/SM	I	March to August	Cotigao WS, Mayem, Panaji	North, West & South India	—
357	1707	*Oenanthe xanthoprymna* (Hemprich & Ehrenberg)	Rufous-tailed Wheatear	WV/ Vagrant	I	Extralimital	Goa Meat Complex	NW India in arid areas	Willoughby, 1997 (Lainer, 2004b)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
358	1710	*Oenanthe deserti* (Temminck)	Deaser Wheatear	WV/ Vagrant	I	—do—	Chapora, Candolim	North India, south to Maharashtra and north Andhra Pradesh	Smithson, 1996, Whalin 1999 (Lainer, 2004b) and per. com. SP & NS
359	1706	*Oenanthe isabellina* (Temminck)	Isabelline Wheatear	WV	I	Extralimital	Candolim beach, ZAC Reservoir	Plains of North-western India south up to Ahmednagar & Pune	First reported in Goa by Lainer (2004 b)
360	1287	Subfamily TIMALIINAE *Garrulax delesserti* (Jerdon)	Wynaad Laughingthrush	R	I	July to September	BMWS	Southwest India	—
361	1309	*Garrulax jardoni* (Blyth)	Grey-breasted Laughingthrush	R	I	December to June	Dudhsagar Rly. Stn.	South of Goa in Western Ghats, Brahmagiri hills	Rane, 1983 & 1984. Doubtful by Lainer (2004b)
362	1154	*Pellorneum ruficeps* Swainson	Spotted Babbler	R	I	April to September	BMWS, Canacona Mollem	Indian Peninsula, Eastern & Western Ghats	1♂, 1♀, (ZSI, HQ, Kolkata)
363	1173*	*Pomatorhinus horsfieldii* Sykes	Indian Scimitar-Babbler	R	I	February to May	–do–, Bondla WS, Bolkonda nalla, Dudhsagar, Surla	W Ghats Complex to Goa & N Karnataka	—
364	1221	*Dumetia hyperythra* (Franklin)	Rufous-bellied Babbler	R	I	June to October	Aguda, Baga ridge, Betul, Mayem, Nagoa valley, Terakol	Southern India south of Krishna river & Mahabaleshwar	—
365	1224	*Rhopocichla atriceps* (Jerdon)	Black-headed Babbler	R	I	March to July	Bondla WS, BMWS, Canacona Cotigao WS, Mollem, Sattari, Surla	W Ghats Complex from Belgaum to Palghat Gap	2♂, (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
366	1231*	*Chrysomma sinense* (Gmelin)	Yellow-eyed Babbler	R	I	June to November	Dona-Paula, Keri, Terakol	Whole of South India & east of a line Nasik-Indore-Sagar-Gorakhpur & NE India	—
367	1259	*Turdoides subrufus* (Jerdon)	Indian Rufous Babbler	R	I	February to November	BMWS, Dudhsagar falls, Mollem, Surla	W Ghats Complex from Mahabaleshwar south to Nilgiris & north of Tamil Nadu	—
368	1263*	*Turdoides striatus* (Dumont)	Jungle Babbler	R	I	March to October	Canacona, Mollem, Nagoa valley & all Wild-life Sanctuaries	SE Gujarat, Maharashtra from Tapi river to Western Ghat up to Goa	5♂, 8♀, 3 Unsexed (ZSI, HQ, Kolkata)
369	1390	*Alcippe poioicephala* (Jerdon)	Quaker Tit-Babbler	R	I	January to May	—do—, Ponda, Sanguem, Canacona, Valpoi	Hills of Indian Peninsula	5♂, 5♀, 2 (Unsexed) (ZSI, HQ, Kolkata)
370	1498	Subfamily SYLVIINAE *Cisticola juncidis* (Rafinesque)	Streaked Fantail-Warbler	R/LM	I	May to October	Baga, Bardez, Carambolim, Divar, Neura Wetland	All over India	—
371	1496	*Cisticola exilis* (Vigors & Horsfield)	Golden-headed Fantail-Warbler	R	I	Unrecorded	BMWS, Bondla	Hills of southern India	per. com. SP & NS
372	1503	*Prinia hodgsonii* Blyth	Franklin's Prinia	R	I	June to October	Bardez, Canacona	Indian Peninsula	—
373	1521	*Prinia sylvatica* Jerdon	Jungle Prinia	R, Uncertain	I	June to September	Nagoa valley	Peninsular India Maharashtra south to Kanya Kumari	Recorded by Lainer in 1998 (Lainer, 2004b)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
374	1517*	*Prinia socialis* Sykes	Ashy Prinia	R	I	March to November	Bolkonda nalla, Mayem lake, Velsao	—do—	—
375	1511*	*Prinia inornata* Sykes	Plain Prinia	R	I	June to October	Anjuna, Baga, Bardez, Dona-Paula, Keri, Neura Wetlands	Central India South to Tamil Nadu	—
376	1545	*Locustella naevia* (Boddaert)	Pale Grasshopper-Warbler	WV	I	Extralimital	Tambdi Surla, Tivim Wetland	Indian Subcontinent	—
377	1543	*Locustella certhiola* (Pallas)	Rusty-rumped Grasshopper-Warbler	WV	I	—do—	Tikanem	Central India, Assam, West Bengal, Kerala	—
378	1557	*Acrocephalus agricola* (Jerdon)	Paddyfield Warbler	WV	I	—do—	Baga, Bardez, Cotigao WS, Ponda, Velsao	All over the Indian Peninsula	—
379	1556	*Acrocephalus dumetorum* Blyth	Blyth's Reed-Warbler	WV	I	—do—	—do— & Poinguinim Mollem, Canacona	—do—	2♂, 2♀, (ZSI, HQ, Kolkata)
380	1550	*Acrocephalus stentoreus* (Hemprich & Ehrenberg)	Indian Great Reed-Warbler	WV/PM	I	—do—	Salim Ali Bird Sanctuary, Carambolim lake, Panaji, Ponda, Tiswadi, Velsao	Northern India & Western Ghats Complex	—
381	1549	*Acrocephalus aedon* (Pallas)	Thick-billed Warbler	WV	I	—do—	Baga, BMWS, Bondla WS, Carambolim lake, Cotigao WS, Mollem	Assam, Bengal & W Ghats Complex from SW Maharashtra, Goa to Kerala	1♂, (ZSI, HQ, Kolkata)
382	1562	*Hippolais caligata* (Lichtenstein)	Booted Warbler	WV	I	—do—	Nagoa valley & —do—	All over India	—
383	1535*	*Orthotomus sutorius* (Pennant)	Common Tailorbird	R	I	March to December	Canacona, Keri, Mollem	Indian Peninsula	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
384	1575	*Phylloscopus collybita* (Vieillot)	Common Chiffchaff	WV	I	Extralimital	BMWS, Cotigao WS, Nagao, Bondla, Mollem, Baga.	Himalayas to North Canara, coastal belt and base of Western Ghats	Lainer, 2004b and per. com. SP & NS
385	1579	*Phylloscopus affinis* (Tickell)	Tickell's Warbler	WV	I	—do—	Chorao, Dudhsagar waterfalls, Mollem, Bondla.	Entire India	Wielen, 1998. Lassey, 2000 (Lainer 2004b) and per. com. SP & NS
386	1581	*Phylloscopus griseolus* Blyth	Olivaceous Leaf-Warbler	WV	I	—do—	BMWS, Bondla WS, Canacona, Cotigao WS, Mollem, Surla	N Peninsula south to Maharashtra & Andhra Pradesh	—
387	1592	*Phylloscopus inornatus* (Blyth)	Yellow-browed Warbler	WV/Vagrant	I	—do—	Bondla WS, Sinquerim	Entire India. Vagrant to south India	Pitt, 1995, Holt, 1997 (Lainer, 2004 b)
388	1590	*Phylloscopus humei* (Brooks)	Hume's Warbler	WV	I	—do—	Bondla WS, Tambdi-Surla, Mollem, Baga	India south to Belgaum	Several authors (Lainer 2004 b) and per. com. SP & NS
389	1602*	*Phylloscopus trochiloides* (Sundevall)	Greenish Leaf Warbler	WV	I	—do—	Canacona, Keri, Poinguinim	—do—	1♀, (ZSI, HQ, Kolkata)
390	1578	*Phlloscopus tytleri* Brooks	Tytlers Leaf-Warbler	Wintering/ Uncertain	I	Breeds in Kashmir, Himalayas	Bondla WS, BMWS, Mollem, Canacona	Khandala to Londha to Nilgiri	Grubh & Ali, 1976. Several authors (Lainer, 2004 b)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
391	1601	*Phylloscopus magnirostris* Blyth	Large-billed Leaf Warbler	WV	I	—do—	Collem, Mollem, Dudhsagar falls Mayem lake & all Wildlife Sanctuaries	South India	—
392	1606	*Phylloscopus occipitalis* (Blyth)	Western Crowned Warbler	WV	I	—do—	Canacona & —do—	Central India, Southwestern Peninsula, Eastern Ghats	—
393	1567	*Sylvia curruca* (Linnaeus)	Common Lesser Whitethroat	WV/PM	I	—do—	—do—, Bondla	All over India	—
394	1407	Subfamily MUSCICAPINAE *Muscicapa daurica* Pallas	Asian Brown Flycatcher	Wintering	I	Coorg to Cardamon Hills, NW Himalaya, Vindhya	Anjuna, Baga, BMWS, Bondla WS, Cotigao WS, Mayem lake, Mollem, Surla	Most of the Peninsula, Western & Eastern Ghats	1 Unsexed, (ZSI, HQ, Kolkata)
395	1409	*Muscicapa ruficauda* Swainson	Rusty-tailed Flycatcher	Wintering/ PM	I	NW Himalayas	Nagoa valley & all Wildlife Sanctuaries	Southwestern India	—
396	1408	*Muscicapa muttui* (Layard)	Brown-breasted Flycatcher	Wintering	I	In Assam, Garo & Mizo Hills	–do–; Canacona, Mollem	Southwestern India from Londa to Kerala	—
397	1411	*Ficedula parva* (Bechstein)	Red-throated Flycatcher	WV/PM	I	Extralimital	Canacona, Collem, Mollem	Western southern India	1♂, (ZSI, HQ, Kolkata)
398	1421	*Ficedula superciliaris* (Jerdon)	Ultramarine Flycatcher	Wintering	I	In Western Himalayas to Kumao	BMWS, Mollem	Central & South India	—

Table 1. *Contd*:

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
399	1445	*Eumyias thalassina* (Swainson)	Verditer Flycatcher	Wintering	I	In Western & Eastern Himalayas	Canacona, Mollem, Nagoa valley, Surla, Valpoi & all Wildlife Sanctuaries	Whole of the Indian Peninsula	—
400	1446	*Eumyias albicaudata* (Jerdon)	Nilgiri Flycatcher	R	I	February to June	Nagoa valley	Southern section of Western Ghats up to Kerala	—
401	1435	*Cyornis pallipes* (Jerdon)	White-bellied Blue Flycatcher	R	I	February to September	Mayem lake, Mollem, Sanguem, Surla & all Wild-life Sanctuaries	SW India & Western Ghats	1♂, 3♀, (ZSI, HQ, Kolkata)
402	1440	*Cyornis rubeculoides* (Vigors)	Blue-throated Flycatcher	Wintering	I	April to August in Himalayas	Nagoa valley, Valpoi & all Wild-life Sanctuaries	NE, Southern India & Eastern Ghats	1♀, (ZSI, HQ, Kolkata)
403	1442	*Cyornis tickelliae* Blyth	Tickell's Blue Flycatcher	R/LM	I	April to August	Canacona, Mollem, Poinguinim, Valpoi	Indian Peninsula	2 ♂, (ZSI, HQ, Kolkata)
404	1449	*Culicicapa ceylonensis* (Swainson)	Grey-headed Flycatcher	R/SM	I	March to June	All Wildlife Sanctuaries	Southwestern India	—
405	1461*	Subfamily MONARCHINAE *Terpsiphone paradisi* (Linnaeus)	Asian Paradise Flycatcher	R	I	March to August	Keri, Mollem Canacona	Indian Peninsula	5♂, 4♀, (ZSI, HQ, Kolkata)
406	1465	*Hypothymis azurea* (Boddaert)	Black-naped Monarch-Flycatcher	R/LM	I	—do—	Baga, Mollem, Nagoa valley, Surla, Valpoi & all Wildlife Sanctuaries	East of a line from Gulf of Kutch to Gorakhpur; down to southern India up to Kerala & NE India	4♂, 3♀, (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
407	1458	Subfamily RHIPIDURINAE *Rhipidura albicollis* (Vieillot)	White-throated Fantail Flycatcher	R/LM	I	March to July	—do—; Mayem	Indian Peninsula	1♂, 1♀, (ZSI, HQ, Kolkata)
408	1452	*Rhipidura aureola* Lesson	White-throated Fantail Flycatcher	R/LM Wintering Uncertain	I	January to July	Baga Hills, Bondla WS, Tambdi-Surla, Sinquerim	Southern India	Dennis, 1999 Lassey, 2000 Lainer, 2004b)
409	1794	Family PARIDAE *Parus major* Linnaeus	Great Tit	R/LM	I	February to August	Anjuna, Bondla WS	Peninsular India from Rajasthan to Madhya Pradesh, south to Tamil Nadu & Kerala	—
410	1811	*Parus xanthogenys* Vigors	Black-lored Yellow-Tit	R	I	June to October	Anjuna, Baga, Bondla WS, Mollem, Morjim	South Western Ghats from Maharashtra to Karnataka & Kerala	—
411	1830	Family SITTIDAE *Sitta castanea* Lesson	Chestnut-bellied Nuthatch	R	I	April to September	BMWS, Mollem	All over India	—
412	1838	*Sitta frontalis* Swainson	Velvet-fronted Nuthatch	R	I	January to May	Bondla, Mollem, Surla & all Wild-life Sanctuaries	All over Hilly regions of India	—
413	1892*	Family DICAEIDAE *Dicaeum agile* (Tickell)	Thick-billed Flowerpecker	R	FR	January to June	—do—; Valpoi, Keri	Indian Peninsula	—
414	1899	*Dicaeum erythrorhynchos* (Latham)	Tickell's Flowerpecker	R	FR	February to May & August-September	Arpora	Himalayan Foothills, Indian Peninsula from Jabalpur to Kanyakumari	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
415	1902	*Dicaeum concolor* Jerdon	Plain Flowerpecker	R	FR	January to April & May-June	Canacona, Mollem, Poinguinim	Southwestern India from Mahabaleshwar to Kerala	1♂, (ZSI, HQ, Kolkata)
416	1907*	Family NECTARINIIDAE *Nectarinia zeylonica* (Linnaeus)	Purple-rumped Sunbird	R	N	February to April	—do—; Keri	Peninsular India south of line from Nasik, Jabalpur, Bihar & Bengal	1♂, 1♀, (ZSI, HQ, Kolkata)
417	1909*	*Nectarinia minima* (Sykes)	Small Sunbird	R	N	September to April	BMWS, Keri, Mollem, Valpoi	Western Ghats Complex from Mumbai to hills of Kerala	—
418	1917	*Nectarinia asiatica* (Latham)	Purple Sunbird	R/LM	N	February to June	Canacona, Mollem, Nanaz, Ponda, Valpoi	All over India	3♂, 1♀, (ZSI, HQ, Kolkata)
419	1911	*Nectarinia lotenia* (Linnaeus)	Loten's Sunbird	R	N	March to May	Canacona, Mayem lake, Mollem, Surla & all Wild-life Sanctuaries	Southern Indian Peninsula	—
420	1929	*Aethopyga siparaja* (Raffles)	Crimson Sunbird	R	N	June to September	Aguada, Anjuna, Baga, Bondla, Mayem, Angoa valley, Velsao	Western Ghats Complex from Narmada river to Kerala	—
421	1931	*Arachnothera longirostra* (Latham)	Little Spiderhunter	R	N	December to August	Canacona, Mayem lake, Mollem, Poinguinim, Surla & all Wildlife Sanctuaries	Western Ghats Complex of SW India from N Canara to Kerala; NE India	Reported by Saha & Dasgupta (1992) 2 ♂, (ZSI, HQ, Kolkata)
422	1933	Family ZOSTEROPIDAE *Zosterops palpebrosus* (Temminck)	Oriental White-eye	R/LM	OM	April to September	Baga, Bondla WS, Sinquerim	All over India	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
423	2050	Family EMBERIZIDAE Subfamily EMBERIZINAE *Emberiza buchanani* Blyth	Grey-necked Bunting	WV	GR	Extralimital	Baga fields, Candolim, Chapora, Surla	Western & Central India south up to Karnataka	—
424	2046	*Emberiza aureola* Pallas	Yellow-brested Bunting	WV/ Vagrant	GR	—do—	Fields of Baga	NE India and west to Ambala	K. Mullarney 1997, (Lainer 2004b)
425	2043	*Emberiza melanocephala* Scopoli	Black-headed Bunting	WV	GR	—do—	Baga area Bondla WS, Carambolim, Mollem, Surla	—do—	—
426	2044	*Emberiza bruniceps* Brandt	Red-headed Bunting	WV	GR	—do—	—do—	Most of the Indian Peninsula up to western Tamil Nadu	—
427	2013	Family FRINGILIIDAE *Carpodacus erythrinus* (Pallas)	Common Rosefinch	WV	GR	—do—	Baga, Bondla WS, BMWS, Candolim Cotigao WS, Nagoa valley	Indian Peninsula	—
428	1964	Family ESTRILDIDAE *Amandava amandava* (Linnaeus)	Red Munia	R/Vagrant	GR	July to October	Sinquerim marsh, Mollem	Entire India	Smithson, 1996 (Lainer, 2004 b) and per. com. SP & NS
429	1965	*Amandava formosa* (Latham)	Green Munia	R/Vagrant	GR	May and January	Stream at Tambdi-Surla	Central India south to Maharashtra	Lassey, 1999 (Lainer, 2004 b)
430	1966	*Lonchura malabarica* (Linnaeus)	White-throated Munia	R/Uncertain	GR	July to May	Baga, Candolim, Fort Aguada	Throughout India	Several authors, 1996-2000. (Lainer, 2004b)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
431	1968	*Lonchura striata* (Linnaeus)	White-rumped Munia	R/LM	GR	March to November	–do–; Canacona, Mollem, Ponda Valpoi	Southern Indian Peninsula from S. Bihar, Madhya Pradesh to Kerala	4♂, 7(Unsexed) (ZSI, HQ, Kolkata)
432	1971 & 1972	*Lonchura kelaarti* (Jerdon)	Black-throated Munia	R/LM	GR	April to August	Braganza hill, BMWS, Cotigao WS	Southwestern India from Coorg to Kerala	First report in Goa by (Lainer, 2004b)
433	1974*	*Lonchura punctulata* (Linnaeus)	Spotted Munia	R	GR	May to September	Caranzol, Cotigao WS, Keri, Mollem, Nagoa valley	All over India	—
434	1978	*Lonchura malacca* (Linnaeus)	Black-headed Munia	R/LM	GR	June to December	Baga, Bondla, Collem, Divar-Navelim, Mayem lake, Mollem, Valpoi	Indian Peninsula from Raipur south to Kanyakumari	1♂, (ZSI, HQ, Kolkata)
435	1938*	Family PASSERIDAE Subfamily PASSERINAE *Passer domesticus* (Linnaeus)	House Sparrow	R	GR	Throughout the year	Anywhere (Panaji)	All over India	1♂, (ZSI, HQ, Kolkata)
436	1949	*Petronia xanthocollis* (Burton)	Yellow-throated Sparrow	R/LM	GR	February to May	Canacona, Collem, Mollem, Poinguinim, Santrem, Valpoi, Vasco	The whole of Indian Peninsula	6♂, 5♀, (ZSI, HQ, Kolkata)
437	1957 & 1958*	Subfamily PLOCEINAE *Ploceus philippinus* (Linnaeus)	Baya Weaver	R/SM	GR	May to September	Baga paddies, Bolkonda nalla, Candolim, Mollem	Southwestern India from Goa to Kerala	—

Table 1: *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
438	987	Family STURNIDAE *Sturnus malabaricus* (Gmelin)	Grey-headed Starling	R/SM/LM	OM	April to July	Bondla WS, Mayem Chiplem, Cotigao WS, Mollem, Panaji, Sankarda, Poinguinim	Throughout the Indian Union	3♂, 1♀, (ZSI, HQ, Kolkata); 1♀ (ZSI,WRS, Pune)
439	994*	*Sturnus pagodarum* (Gmelin)	Brahminy Starling	R/SM	FR, I	February to September	Anjuna, Baga, Dona-Paula, Keri, Nagoa, Sancordem	All over India	1♂, (ZSI, HQ, Kolkata)
440	996	*Sturnus roseus* (Linnaeus)	Rosy Starling	WV	OM	Extralimital	Aguda, Collem, Cotigao WS, Dona-Paula, Santa-Cruz	Indian Peninsula	—
441	1006*	*Acridotheres tristis* (Linnaeus)	Common Myna	R	OM	March to September	Canacona, Collem, Keri, Mollem	Indian Subcontinent	—
442	1008	*Acridotheres ginginianus* (Latham)	Bank Myna	R/SM/LM	OM	March to August	Calangute, Dudhsagar, Velsao, ZAC	N & Central India southwards up to Mumbai to W Bengal	First reported by Lainer in 1984 (Lainer 2004b)
443	1010*	*Acridotheres fuscus* (Wagler)	Jungle Myna	R/SM/LM	OM	February to May	BMWS, Bondla WS, Canacona, Cotigao WS, Mollem, Sancordem	Western Peninsula up to Kerala	1♂, 3 Unsexed, (ZSI, HQ, Kolkata)
444	1016	*Gracula indica* (Cuvier)	Southern Hill-Myna	R/SM/LM	OM	—do—	BMWS, Bondla WS, Collem, Cotigao WS, Dudhsagar	SW Peninsula in Western Ghats 17°N Lat south to Kerala	—
445	953*	Family ORIOLIDAE *Oriolus oriolus* (Linnaeus)	Eurasian Golden Oriole	R/PM (Wintering)	FR	April to August	Bolkonda nalla, Canacona, Keri, Margaon, Nagoa valley, Ponda, Valpoi, Mollem	Indian Peninsula south up to Kerala	5♂, 9♀, 1 (Unsexed) (ZSI, HQ, Kolkata)

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
446	954*	*Oriolus chinensis* Linnaeus	Black-naped Oriole	WV	FR	Extralimital	BMWS, Bondla WS, Collem, Cotigao WS, Keri, Mollem	South India, Andhra Pradesh to Assam	—
447	959	*Oriolus xanthornus* Linnaeus	Black-headed Oriole	R/LM	FR	March to July	Canacona, Collem, Mollem, Sankarda, Valpoi	Peninsular India south of Gangetic Plain to Western Ghats (Sparingly)	6♂, 1♀, (ZSI, HQ, Kolkata); 1♂ (ZSI, WRS, Pune)
448	963*	Family DICRURIDAE *Dicrurus macrocercus* Vieillot	Black Drongo	R/SM	I	—do—	—do—; Bondla WS, Chorao Carambolim, Keri, Mollem	Peninsular India south of Kutch & Madhya Pradesh	4♂, 5♀, (ZSI, HQ, Kolkata); 1♂ (ZSI,WRS, Pune)
449	965*	*Dicrurus leucophaeus* Vieillot	Ashy Drongo	WV	I	Extralimital (also in Himalayas)	—do—; Keri	Northern Peninsular India to Kerala	—
450	967	*Dicrurus caerulescens* (Linnaeus)	White-bellied Drongo	R/SM/LM	I	March to June	Baga, Bondla WS, BMWS,Canacona, Collem, Cotigao WS, Mollem, Ponda,Sankarda, Terakol, Valpoi	All over India	1♂, 4♀, 1 (Unsexed) (ZSI, HQ, Kolkata); 1♂ (ZSI,WRS, Pune)
451	971	*Dicrurus aeneus* Vieillot	Bronzed Drongo	R/LM (in Winter)	I	—do—	Canacona, Valpoi	Eastern & Western Ghats Complex, Orisa & NE India	2♂, (ZSI, HQ, Kolkata)
452	973	*Dicrurus hottentottus* (Linnaeus)	Spangled Drongo	R/SM	N, I	March to April	Bondla WS, BMWS, Canacona, Valpoi	—do—	—

Table 1. *Contd.*

Sl. No.	Hand-Book No.	Taxa	Common Name	Residential Status	Food Habits	Breeding Season	Locality	Distribution	Remarks
453	977	*Dicrurus paradiseus* (Linnaeus)	Greater Racket-tailed Drongo	R	I	February to May	Cotigao WS, Poinguinim, Mollem	Northern & NE India, Southern Peninsular India	5♂, 1♀, 4 (Unsexed) (ZSI, HQ, Kolkata)
		Family ARTAMIDAE							
454	982	*Artamus fuscus* Vieillot	Ashy Wood Swallow	R/SM/LM	I	March to June	Anjuna, Bondla WS, BMWS, Collem, Cotigao WS, Mollem, Poinguinim, Valpoi	Throughout the Peninsular India, south to Kerala	2♂, 1♀, (ZSI, HQ, Kolkata)
		Family CORVIDAE							
455	1031*	*Dendrocitta vagabunda* (Latham)	Indian Treepie	R	OM	March to July	Canacona, Keri, Mayem lake, Mollem, Ponda	Western India	2♂, 2♀, 1 (Unsexed) (ZSI, HQ, Kolkata); 1 ex. (ZSI, WRS, Pune)
456	1036	*Dendrocitta leucogastra* Gould	White-bellied Treepie	R	OM	February to April	Caranzol Rly. Stn. Dudhsagar Waterfalls	Western Ghats Complex south of 16°N Lat to Tamil Nadu & Kerala	—
457	1049*	*Corvus splendens* Vieillot	House Crow	R	OM	March to August	Canacona, Keri, Mollem, Panaji	All India (except Kerala)	—
458	1057*	*Corvus macrorhynchos* Wagler	Jungle Crow	R	OM	February to June	Keri, Valpoi & in many city, town areas	Gangetic Plain, Peninsular India south to Kanyakumari	1♂, (ZSI, HQ, Kolkata)

Abbreviations used in the Table-1

Residential Status :

R/LM/SM– Resident and or Local and or Seasonal Movements (depending upon availability of food, ripening of fruits, seasonal migration in hills, water conditions, heavy rainfall, breeding season, erratic movements during winter and monsoon period, etc.)

WV–Winter Visitors, PM–Passage Migrant, MV–Monsoon Visitor or Vagrant in Monsoon.

Food Habits :

I–Insectivorous, Aq A – Aquatic Animals, Vg M–Vegetable Matters, GR–Graminivorous, FR – Frugivorous, CR–Carnivorous, OM–Omnivorous, SC–Scavenger, N–Nectar eater.

Other :

Hand Book No.–As per Ali and Ripley (1968-1974)

WS–Wildlife Sanctuary, BMWS – Bhagawan Mahavir Wildlife Sanctuary

Note :

÷ Birds observed by first author (AM);

– also per. com. SP & NS :– personal communication by Satish Pande (Pune) and Niranjan Sant (Belgaum)

The cognisence of specimen collections was recorded from :

ZSI, HQ, Kolkata–In the collections of Zoological Survey of India, Head Quarters at Kolkata (Saha and Dasgupta, 1992)

ZSI, WRS, Pune–In the collections of Zoological Survey of India, Western Regional Station, Akurdi, Pune

The annotated list is mainly compiled on the basis of Ali & Ripley (1968-1974), Grubh and Ali (1976), Rane (1983), Saha and Dasgupta (1992), Shyma and Gowthaman (1995), Daniels (1997), Grimmett *et al* (2000), Pande *et al* (2003), and Lainer (2004 b).

The following bird species seem to be doubtful in their occurrence hence are not included in the list :

Pycnonotus leucogenys (Gray) White-cheeked Bulbul (now Himalayan Bulbul), *Selaeornis* sp. Wren-Babbler (Shama and Gowthaman, 1995); *Sturnus erthropygius* (Blyth) White-headed Myna (now Starling) (Rane, 1983); *Phalaropus* sp. Phalarope *Larus fuscus* (Linnaeus) Lesser Black-backed Gull and *Calandrella acutorostris* Hume Hume's Short-toed Lark (Lainer 2004 b).

Table 2 : Avian Diversity in Goa State

Orders	Families	Subfamilies	Genera	Species
1. PODICIPEDIFORMES	1	--	1	1
2. PROCELLARIIFORMES	2	–	3	4
3. PELECANIFORMES	4	–	4	8
4. CICONIIFORMES	3	–	18	23
5. PHOENICOPTERIFORMES	1	–	1	1
6. ANSERIFORMES	1	–	7	17
7. FALCONIFORMES	3	–	21	36
8. GALLIFORMES	1	–	5	8
9. GRUIFORMES	3	–	9	14
10. CHARDRIIFORMES	12	–	30	76
11. COLUMBIFORMES	1	–	5	13
12. PSITTACIFORMES	1	–	2	5
13. CUCULIFORMES	1	–	8	13
14. STRIGIFORMES	2	–	9	13
15. CAPRIMULGIFORMES	2	–	3	6
16. APODIFORMES	2	–	7	10
17. TROGONIFORMES	1	–	1	1
18. CORACIIFORMES	5	–	13	20
19. PICIFORMES	2	–	10	16
20. PASSERIFORMES	23	9	80	173
Total 20 Orders (21)	71 **(88)**	9 **(11)**	238 **(432)**	458 **(1342)**

*Bird diversity in Indian Subcontinent is given in parenthesis

Table 3 : Endemic Bird Species and Important Bird Areas of Goa

(a) Endemic Bird Species

Sl. No.	Species Name	Common name
	Family COLUMBIDAE	
1	*Columba elphinstonii* (Sykes)	Nilgiri Wood Pigeon
	Family PSITTACIDAE	
2	*Psittacula columboides* (Vigors)	Blue-winged Parakeet
	Family BUCEROTIDAE	
3	*Ocyceros griseus* (Latham)	Malabar Grey Hornbill
	Family PYCNONOTIDAE	
4	*Pycnonotus priocephalus* (Jerdon)	Grey-headed Bulbul
5	*Iole indica* (Jerdon)	Yellow-browed Bulbul
	Family MUSCICAPIDAE Subfamily MUSCICAPINAE	
6	*Eumyias albicaudata* (Jerdon)	Nilgiri Flycatcher
7	*Cyornis pallipes* (Jerdon)	White-bellied Blue Flycatcher
	Subfamily TIMALIINAE	
8	*Garrulax delesserti* (Jerdon)	Wynaad Laughingthrush
9	*Rhopocichla atriceps* (Jerdon)	Black-headed Babbler
10	*Turdoides subrufus* (Jerdon)	Indian Rufous Babbler
	Family NECTARINIIDAE	
11	*Nectarinia minima* (Sykes)	Small Sunbird
	Family CORVIDAE	
12	*Dendrocitta leucogastra* Gould	White-bellied Treepie

(b) Important Bird Areas of Goa

IBA Site Name	IBA Site Code	IBA Criteria
1. Bhagawan Mahavir Wildlife Sanctuary	IN-GA-01	A1, A2, A3
2. Carambolim Wetlands	IN-GA-02	A1, A4i, A4iii
3. Cotagao Wildlife Sanctuary	IN-GA-03	A1, A2, A3
4. Mhadei Wildlife Sanctuary	IN-GA-04	A1, A2, A3

Table 4 : Conservation Status of Birds of Goa

Sl. No.	Species Name	Common Name	CITES (2005)	Bird Life International (2005)	IUCN (2002)	IW(P) Act, 1972 (as amended upto 2002)
	Family PROCELLARIIDAE					
1.	*Puffinus puffinus* Hume	Persian Shearwater	–	–	LR/nt	–
	Family ANHINGIDAE					
2.	*Anhinga melanogaster* Pennant	Oriental Darter	–	NT	LR/nt	–
	Family CICONIIDAE					
3.	*Mycteria leucocephala* (Penant)	Painted Stork	–	NT	LR/nt	–
4.	*Ciconia nigra* (Linnaeus)	Black Stork	Appendix-II	–	–	–
5.	*Anastomus oscitans* (Boddaert)	Asian Openbill-Stork	–	–	NT	–
6.	*Leptoptilos javanicus* (Horsfield)	Lesser Adjutant-Stork	–	VU	GT/VU	–
	Family THRESKIORNITHIDAE					
7.	*Threskiornis melanocephalus* (Latham)	Oriental White Ibis	–	NT	LR/nt	–
8.	*Platalea leucorodia* Linnaeus	Eurasian Spoonbill	Appendix-II	–	–	Schedule-I, Part III (Birds)
	Family ANATIDAE					
9.	*Sarkidiornis melanotos* (Pennant)	Comb Duck	Appendix-II	–	–	–
10.	*Aythya nyroca* (Guldenstadt)	Ferruginous Pochard	–	NT	NT	–
	Family ACCIPITRIDAE					
11.	*Aviceda leuphotes* (Dumont)	Black Baza	–	–	–	Schedule-I, Part-III (Birds)
12.	*Haliaeetus leucogaster* (Gmelin)	White-bellied Sea-Eagle	–	–	–	—do—
13.	*Ichthyophaga ichthyaetus* (Horsfield)	Greater Grey-headed Fish-Eagle	–	NT	LR/nt	—do—
14.	*Gyps bengalensis* (Gmelin)	Indian White-backed Vulture	–	CR	CR	—do—
15.	*Gyps indicus* (Scopoli)	Long-billed Vulture	–	CR	CR	—do—
16.	*Circus macrourus* (S. G. Gmelin)	Pallied Harrier	–	NT	LR/nt	—do—
17.	*Aquila clanga* Pallas	Greater Spotted Eagle	–	VU	GT/VU	—do—
18.	All remaining Hawk species	–	–	–	–	—do—
	Family PANDIONIDAE					
19.	*Pandion haliaetus* (Linnaeus)	Osprey	–	–	–	—do—
	Family FALCONIDAE					
20.	*Falco peregrinus* Tunstall	Peregrine Falcon	Appendix-I	–	–	—do—

Table 4. *Contd.*

Sl. No.	Species Name	Common Name	CITES (2005)	Bird Life International (2005)	IUCN (2002)	I W(P) Act, 1972 (as amended upto 2002)
	Family PHASIANIDAE					
21.	*Gallus sonneratii* Temminck	Grey Jungle Fowl	–	–	–	Schedule-II, Part-II (Birds)
22.	*Pavo cristatus* Linnaeus	Indian Peafowl	–	–	–	Schedule-I, Part-III (Birds).
23.	Family LARIDAF *Sterna acuticauda* J. E. Gray	Black-bellied Tern	–	NT	GT/NT	–
	Family RYNCHOPIDAE					
24.	*Rynchops albicollis* Swainson	Indian Skimmer	–	VU	GT/VU	–
	Family PODARGIDAE					
25.	*Batrachostomus monilinger* Blyth	Ceylon Frogmouth	–	–	–	Schedule-I, Part-III (Birds)
26.	Family APODIDAE *Collocalia unicolor* (Jerdon)	Indian Edible-nest Swiftlet	–	–	–	—do—
27.	Family CORACIIDAE *Coracias garrulus* Linnaeus	European Roller	–	NT	–	–
	Family BUCEROTIDAE					
28.	*Anthracoceros coronatus* (Boddaert)	Malabar Pied Hornbill	–	NT	–	Schedule-I, Part-III (Birds)
29.	*Buceros bicornis* Linnaeus	Great Pied Hornbill	–	NT	–	—do—
30.	Family MUSCICAPIDAE Subfamily SYLVIINAE *Phylloscopus tytleri* Brooks	Tytler's Leaf-Warbler	–	NT	–	–
31.	Subfamily MUSCICAPINAE *Eumyias albicaudata* (Jerdon)	Nilgiri Flycatcher	–	NT	–	–
32.	Family ESTRILDIDAE *Amandava formosa* (Latham)	Green Munia	–	VU	–	–
33.	Family STURNIDAE *Gracula indica* (Cuvier)	Southern Hill-Myna	–	–	–	Schedule-I, Part-III (Birds)

Abbreviations :

GT : Globally Threatened, NT : Near Threatened, CR : Critically Endangered, LR/nt : Lower Risk/near threatened, VU : Vulnerable

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (See also website:http://www.cites.org).

IUCN: International Union for the Conservation of Nature and Natural Resources.

IW(P)Act : Indian Wildlife (Protection) Act, 1972-as amended up to 2002.

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MAMMALIA

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INTRODUCTION

State of Goa was under Portugese rule during the period of British regime over rest of the Indian subcontinent. Later, it was a union territory for some years after independence. Finally, it has acquired a status of independent state of India.

Goa is a famous tourist place not only known in India but almost throughout the world. Besides scientists many tourists and amateurs are very much keen in studying the mammals of this region since long time. Though a small state in size as compared to the other Indian states, it exhibits varied habitat diversity ranging from marine ecosystem on western side to heavily forested mountainous tracts of Western Ghats on eastern side. The state is a part of central Western Ghats. Such habitat diversity in a smaller area has resulted in expression of spectacular faunal diversity.

Previous studies have shown that this region is qualitatively rich in the faunal components. Earlier scientists and naturalists have recorded mammal species in their isolated reports based on the intensive surveys carried out in this region by them over a period of time (Wroughton, 1912-1921, Tiwari *et al.* 1971, Agrawal 1972, Bates *et al.* 1994, Nalawade, 1998 and many others).

Zoological Survey of India (ZSI) has conducted number of intensive surveys in past to document the faunal elements from this part of the Western Ghats. However, there is no consolidated systematic account on the mammalian fauna available from this region. Therefore an attempt has been made, here, to present updated information on the mammal species and subspecies from the entire State of Goa.

Present chapter is based on the collections made by various ZSI survey parties, on the sighting observations and also on the records available from the literature (Ellerman and Morrison-Scott, 1951; Ellerman, 1961; Tiwari *et al.*, 1971; Agrawal, 1972; Prater 1980; Agrawal *et al.*, 1992; Corbet and Hill, 1992; Roberts, 1997; Wilson and Reeder, 1993; CAMP Reports 1998, 2002, 2003 and 2005; Nalawade, 1998; Kumaran, 2000; Alfred *et al.* 2002, 2006 and many more, a mention of which has been made in the appropriate places in the species-wise account). It gives a systematic account of 83 mammalian species and subspecies including six marine mammal species with the added information on their past and recent records along with the comments on their current conservation status. Attempts have also been made to give keys wherever possible. There are number of changes in the taxonomic placements as indicated in Wilson and Reeder (1993) and Alfred *et al.* (2002) which have been accepted by most of the workers. Hence, the systematic order reported by these authors has been followed here.

SYSTEMATIC LIST OF THE MAMMAL SPECIES RECORDED FROM GOA STATE

*(*Asteriks indicate species actually collected and/or sighted during project period)*

Class MAMMALIA

Order SCANDENTIA

Family TUPAIIDAE

Subfamily TUPAIINAE

1. Madras Tree Shrew : *Anathana ellioti ellioti* (Waterhouse)

Order INSECTIVORA

Family SORICIDAE

Subfamily CROCIDURINAE

*2. Common House Shrew : *Suncus murinus murinus* (Lin.)

3. Savi's Pigmy Shrew : *Suncus etruscus* (Savi)

Order CHIROPTERA

Suborder MEGACHIROPTERA

Family PTEROPODIDAE

Subfamily PTEROPODINAE

*4. Rousettes or Indian fulvus fruit bat : *Rousettus l. leschenaulti* (Desmarest)

*5. Indian flying fox : *Pteropus giganteus giganteus* (Brunnich)

*6. Short-nosed fruit bat : *Cynopterus sphinx sphinx* (Vahl)

*7. Lesser Dog-faced fruit bat : *Cynopterus brachyotis ceylonensis* (Gray)

Suborder MICROCHIROPTERA

Family EMBALLONURIDAE

8. Pouch-bearing tomb bat : *Saccolaimus saccolaimus* (Temminck)

9. Long winged tomb bat : *Taphozous l. longimanus* Hardwicke

*10. Black-bearded tomb bat : *Taphozous m. melanopogon* Temminck

11. Theobald's tomb bat : *Taphozous theobaldi secatus* Thomas

Family MEGADERMATIDAE

12. Lesser False vampire bat : *Megaderma spasma horsfieldii* Blyth

*13. Greater False vampire bat : *Megaderma (Lyroderma) l. lyra* Geoffroy

Family RHINOLOPHIDAE

Subfamily RHINOLOPHINAE

14. Blyth's Horse-shoe bat : *Rhinolophus lepidus lepidus* (Blyth)

15. Rufous Horse-shoe bat : *Rhinolophus rouxii rouxii* Temminck

Subfamily HIPPOSIDERINAE

16. Fulvus leaf-nosed bat : *Hipposideros fulvus fulvus* Gray

17. Kelaart's leaf-nosed bat : *Hipposideros lankadiva indus* (Andersen)

18. Schneider's leaf-nosed bat : *Hipposideros speoris speoris* (Schneider)

Family VESPERTILIONIDAE

Subfamily KERIVOULINAE

19. Painted Bat : *Kerivoula picta picta* (Pallas)

Subfamily VESPERTILIONINAE

20. Tickell's Bat : *Hesperoptenus tickelli* (Blyth)

21. Horsfield's Bat : *Myotis horsfieldii* Temminck

22. Kelaart's Pipistrelle : *Pipistrellus ceylonicus indicus* (Dobson)

23. Indian Pipistrelle : *Pipistrellus coromandra coromandra* (Gray)

24. Indian Pipistrelle : *Pipistrellus d. dormeri* (Dobson)

25. Indian Pigmy Pipistrelle : *Pipistrellus tenuis mimus* Wroughton

26. Asiatic greater yellow house bat : *Scotophilus heathii heathii* (Horsfield)

27. Asiatic lesser yellow house bat : *Scotophilus kuhlii kuhlii* Leach

Family MINIOPTERINAE

28. Long-winged Bat or Schreiber's Bat : *Miniopterus schreibersi fuliginosus* (Hodgson)

Family MOLOSSIDAE

29. Egyptian Free-tailed bat : *Tadarida aegyptiaca thomasi* Wroughton

Order PRIMATES

Family LORIDAE

30. Slender Loris: *Loris tardigradus* (Linnaeus)

Family CERCOPITHECIDAE

Subfamily CERCOPITHECINAE

*31. Bonnet Macaque : *Macaca radiata* (Geoffroy)

Subfamily COLOBINAE

*32. Hanuman Langur : *Semnopithecus entellus* (Dufresne)

Order PHOLIDOTA

Family MANIDAE

*33. Indian Pangolin: *Manis crassicaudata* Gray

Order CARNIVORA

Family CANIDAE

*34. Indian Jackal : *Canis aureus* Linn.

*35. Indian Wild Dog : *Cuon alpinus* (Pallas)

*36. Bengal Fox : *Vulpes bengalensis* (Shaw)

Family URSIDAE

Subfamily URSINAE

*37. Sloth Bear : *Melursus ursinus* (Shaw)

Family MUSTELIDAE

Subfamily LUTRINAE

38. Smooth-Coated Indian Otter : *Lutragale perspicillata* (Geoffroy)

Family VIVERRIDAE

Subfamily VIVERRINAE

*39. Small Indian Civet : *Viverricula indica indica* (Desmarest)

Subfamily PARADOXURINAE

*40. Palm Civet or Toddy Cat : *Paradoxurus h. hermaphroditus* (Pallas)

Family HERPESTIDAE

Subfamily HERPESTINAE

*41. Indian Gray Mongoose : *Herpestes edwardsii edwardsii* (Geoffroy)

42. Ruddy Mongoose : *Herpestes smithii smithii* Gray

Family HYAENIDAE

Subfamily HYAENINAE

*43. Striped Hyaena : *Hyaena hyaena hyaena* (Linn.)

Family FELIDAE

Subfamily FELINAE

*44. Jungle Cat : *Felis chaus kelaarti* Pocock

45. Leopard Cat : *Prionailurus bengalensis* (Kerr).

46. Rusty Spotted Cat : *Prionailurus rubiginosus* (Geoffroy)

Subfamily PANTHERINAE

*47. Leopard/Panther : *Panthera pardus fusca* (Meyer)

*48. Striped Tiger : *Panthera tigris tigris* (Linn.)

Order PROBOSCIDEA

Family ELEPHANTIDAE

*49. Indian Elephant : *Elephus maximus* (Linn.)

Order ARTIODACTYLA

Family SUIDAE

Subfamily SUINAE

*50. Indian Wild Boar : *Sus scrofa* (Linn.)

Family TRAGULIDAE

*51. Indian Mouse Deer or Chevrotain : *Moschiola meminna* (Erxleben)

Family CERVIDAE

Subfamily CERVINAE

*52. Indian Spotted Deer or Chital : *Axis axis* (Erxleben)

*53. Sambar : *Cervus unicolor* Kerr

Subfamily MUNTIACINAE

*54. Barking Deer : *Muntiacus muntjak* (Zimmerman)

Family BOVIDAE

Subfamily BOVINAE

*55. Gaur : *Bos gaurus* Smith

56. Chousinga, Four Horned Antilope : *Tetracerus quadricornis* (Blainville)

Order RODENTIA

Suborder SCIUROGNATHI

Family SCIURIDAE

Subfamily SCIURINAE

*57. Indian Giant Squirrel : *Ratufa indica indica* (Erxleben)

*58. Indian Giant Squirrel : *Ratufa indica bengalensis* (Blanford)

*59. Three striped jungle squirrel : *Funambulus tristriatus* (Waterhouse)

*60. Indian Five striped northern palm squirrel : *Funambulus pennanti* (Wroughton)

Subfamily PETAURISTINAE

*61. Common Giant Flying Squirrel : *Petaurista philippensis* (Elliot)

Family MURIDAE

Subfamily GERBILLINAE

*62. Indian Gerbil or Antelope Rat : *Tatera indica* (Hardwicke)

Subfamily MURINAE

63. Long tailed tree Mouse : *Vandeleuria oleracea* (Bennett)

64. Metad Rat : *Millardia meltada* (Gray)

*65. Blanford Rat : *Cremnomys blanfordi* (Thomas)

*66. House Rat or Roof Rat : *Rattus rattus rufescens* (Gray)

*67. White Bellied Rat : *Rattus rattus wroughtoni* (Hinton)

* 68. Norvey Rat : *Rattus norvegicus* (Berkenhout)

69. Indian Bush Rat : *Golunda ellioti* Gray

*70. Common House Mouse : *Mus musculus castaneus* Waterhouse

*71. Little Indian Field Mouse : *Mus booduga booduga* (Gray)

*72. Lesser Bandicoot Rat : *Bandicota bengalensis bengalensis* (Gray)

*73. Large Bandicoot Rat : *Bandicota indica malabarica* (Shaw)

*74. Large Bandicoot Rat : *Bandicota indica indica* (Bechstein)

*75. Large Bandicoot Rat : *Bandicota maxima* (Pradhan *et. al.*)

Suborder HYSTRICOGNATHI

Family HYSTRICIDAE

*76. Indian Crested Porcupine : *Hystrix indica* Kerr

Order LAGOMORPHA

Family LEPORIDAE

*77. Indian Black-naped Hare : *Lepus nigricollis nigricollis* Cuvier

Order CETACEA

Suborder ODONTOCETI

Family DELPHINIDAE

78. Indopacific Humpback Dolphin : *Sousa chinensis* (Osbeck)

79. Common Dolphin : *Delphinus delphis* Linnaeus

80. Spinner Dolphin : *Stenella longirostris* (Gray)

Family PHOCOENIDAE

81. Back Finless Porpoise : *Neophocaena phocaenoides* (Cuvier)

Suborder MYSTICETI

Family BALAENOPTRIDAE

82. Fin Whale : *Balaenoptera physalus* (Linnaeus)

Order SIRENIA

Family DUGONGIDAE

*83. Dugong : *Dugong dugon* (Mueller)

SYSTEMATIC ACCOUNT

Class MAMMALIA

Order SCANDENTIA

Animals with long snout like a shrew without whiskers, long bushy distichous tail like a squirrel and appearance like a small mongoose when running. Functional digits on fore and hind limbs 5/5 in number. $I^2 = I^1$ and C_1 = adjacent teeth in size.

The order contains a single family.

Family TUPAIIDAE

Family Tupaiidae is represented by only one genus *Anathana* with a single species *A. ellioti* within Indian limits.

Genus ***Anathana***

Out of the three subspecies of *A. ellioti*, only one occurs in Goa State.

1. ***Anathana ellioti ellioti*** (Waterhouse)

1850. *Tupaia ellioti* Waterhouse. *Proceedings zool. soc. Lond.*, : 106-108.

Common Name : Madras Tree-shrew.

Diagnostic Characters : Dorsal colour reddish brown, ventral side light yellow, tail bushy and darker than the back.

Locality : Goa State.

Habitat : Lives in a scrubby jungle and dry, moist deciduous forests. Terrestrial, arboreal diurnal and omnivorous in habit feeding on both fruits and invertebrates.

External Distribution : Peninsular India.

Status : IUCN criteria proposed as per CAMP Report (2005) : Near threatened.

Source : Ellerman and Morrison-Scott (1951), Prater (1980) and Corbet and Hill (1992), Wilson and Reader (1993) and Alfred *et al.* (2002).

Order INSECTIVORA

Usually small in size with pointed snout projecting far beyond the lower jaw; snout with whiskers; ears and eyes small; limbs short and five toed. Body covered with short, close-set fur; zygomatic arches may or may not be present.

Only one insectivore genus under single family, *Soricidae*, has been recorded from Goa State.

Family SORICIDAE

Genus *Suncus*

Though only two species out of the eight Indian species under Genus *Suncus* have been reported here, there is a possibility of occurrence of one more *Suncus* species (*Suncus stoliczkanus*) in Goa State. Hence, key to these three species is given here before the detailed systematic account of *Suncus murinus* and *Suncus etruscus*.

Key to the species of genus *Suncus*

Head and body length more than 100 mm. Greatest skull length 27-37 mm and Upper tooth-row 12.4–16.0 mm ..... *Suncus murinus*

Head and body length between 60-80 mm. Greatest skull length 20-23 mm. and Upper tooth-row 8.7-10.1 mm ..... *Suncus stoliczkanus*

Head and body length between 35-55 mm. Greatest skull length 13.7-14.7 mm and Upper tooth-row 5.3-6.4 mm ..... *Suncus etruscus*

Only one subspecies has been recorded under *Suncus murinus*.

*2. ***Suncus murinus murinus*** (Lin.)

1766. *Sorex murinus* Linnaeus, *Systema naturae*, 12th ed : 74.

Common Name : House shrew.

Diagnostic Characters : Largest of the Indian house shrews; Fur short, less than 5 mm in length. Tail thick at the base with sparsely distributed long hairs.

Locality : Margoa (Agrawal, 1972) and Panjim (ZSI, WRS, Pune, Coll. Reg. No. M/559). Sighted three live specimens in the garden by ZSI survey party in Bhagwan Mahaveer WL Sanctuary (BMWL or Molem Sanctuary) during project period.

Habitat : Terrestrial, fossorial, occasionally seen in all sorts of habitats particularly near human dwellings, crop fields and in forests.

External Distribution : Throughout India; *Status* : Common, IUCN criteria proposed as per CAMP Report (2005) : Least concern; *Source* : Lindsay (1929), Ellerman and Morrison-Scott (1951), Prater (1980) and Corbet and Hill (1992) and Wilson and Reeder (1993).

Remarks : Agrawal (1972) and Alfred *et al.* (2002) recognized *S. murinus caerulescens* (Shaw) as a separate subspecies. However, Corbet and Hill (1992) rightly justified merger of *S. murinus caeruleus/caerulescens* in *S. murinus murinus*.

3. ***Suncus etruscus*** (Savi)

1822. *Sorex etruscus* Savi, *Nuovo Giorn. de Letterati, Pisa* 1 : 60.

Common Name : Savi's Pygmy Shrew.

Diagnostic Characters : Head and Body length less than 55 mm. Hindfeet in the range between

7.0-9.5 mm. Fur very short, vibrissae on tail present, 18 teeth present in upper jaw, zygomatic arches absent, bullae imperfect, dorsum medium to dark brown in colour.

Locality : Goa State.

Material Examined/Sightings : None.

Distribution : Throughout India.

Habitat : Fossorial in habit preferring to live in multiparous habitats on plains and high altitudes.

Status : Uncommon locally.

Conservation Status : IUCN: Least Concern (CAMP Report, 2005).

Source : Lindsay (1929), Ellerman and Morrison-Scott (1951), Prater (1980) and Corbet and Hill (1992) and Wilson and Reeder (1993).

Remarks : Perhaps the smallest of all the terrestrial mammals in size.

Order CHIROPTERA

Presence of membranous wings between elongated digits 2-5 of forelimb and hind leg help in sustained flight. This order is represented in Goa State by 24 species under 13 genera of six Chiropteran families. Chiroptera is second largest mammalian order next to Rodentia. It is divided into two suborders (1) *Megachiroptera* or fruit eating bats and (2) *Microchiroptera*, the predominantly insect-eating bats. Suborder *Megachiroptera* is represented by a single family *Pteropodidae* (Old World fruit bats) in Goa State.

Ear margins uninterrupted forming a complete ring, Tragus and Noseleaf absent, 2nd digit usually with a claw, Tail short and Molars simple, flat-crowned or with simple cusps, Fruit eating bats ..... *Megachiroptera*

Ear margins interrupted and does not form a complete ring, Either Tragus or Noseleaf or both present, 2nd digit without a claw, Tail usually well developed and Molars complex with regular pattern of cusps and ridges forming definite "W" or "N" surface outline, Insect eating bats ..... *Microchiroptera*

Suborder MEGACHIROPTERA

Family PTEROPODIDAE

Pteropodidae in Goa State is represented by one subfamily : Pteropodinae.

Subfamily PTEROPODINAE

Four species under three genera of the subfamily *Pteropodinae* have been recorded from the State of Goa.

1. Upper part of one colour throughout; medium sized bats (Forearm Length 55.0–90.0 mm) 2

– Hind neck and shoulders paler than back; large sized bats (Forearm Length 110–209 mm).. ..... *Pteropus giganteus giganteus*

2. Four upper and five lower cheek teeth 3

– Five upper and six lower cheek teeth .... *Rousettus leschenaulti leschenaulti*

3. Forearm length less than 67.0 mm, Condylobasal length less than 29.5 mm, Ears with poorly developed pale margin .... *Cynopterus brachyotis ceylonensis*

– Forearm length more than 67.0 mm, Condylobasal length between 29.5–35 mm. Ears with well developed pale margin .... *Cynopterus sphinx sphinx*

Genus ***Rousettus***

Rousettus is represented by a single species, subspecies in Goa State.

*4. ***Rousettus leschenaulti leschenualti***

(Desmarest)

1820. *Pteropus leschenaulti* (Desmarest) *Encyl. Meth. Mammal*, II : 110.

Common Name : Rousettes or Indian fulvous fruit bat.

Diagnostic Characters : A medium sized fruit

bat with forearm around 80mm. It has a long muzzle and large eyes, tail reduced and rod like, dorsal colour light brown with a rufescent tinge, while ventral side is lighter in colour, back of the neck and shoulders sparsely haired.

Locality : Margao and Poinguinim (Agrawal, 1972) Poinguinim, Bondla and Molem (ZSI, WRS, Pune, Coll. Reg. No. M/563, M/564 and M/567).

Habitat : Terrestrial, arboreal, forming gregarious noisy roosts, preferring to live in caves and man-made constructions. Colonies can be recognized from those of insectivorous bats by the large brilliant eyes.

External Distribution : Peninsular India.

Status : Many roosting sites have been reported from number of localities; IUCN Criteria proposed as per CAMP report (2002): Least Concern; Indian Wildlife (Protection) Act (1972) (as amended upto 1991) : Schedule V (Vermin).

Source : Ellerman and Morrison-Scott (1951), Brosset (1962a), Agrawal (1972),Corbet and Hill (1992), Wilson and Reeder (1993), Bates *et al.* (1994) and Bates and Harrison (1997).

Genus ***Pteropus***

Genus *Pteropus* is represented by a single species/subspecies in Goa State.

*5. ***Pteropus giganteus giganteus*** (Brunnich)

1782. *Vespertilio gigantea* Brunnich, Dyrenes Historie 1 : 45.

Common Name : Indian flying fox.

Diagnostic Characters: Largest sized fruit bat in India; rufous-brown around head and neck; a conspicuous orange or honey-coloured band across upper back; lower back blackish brown; ventral parts dark chestnut brown; naked skin of wings; uropatagium, ears and muzzle jet black; no external tail.

Locality : Collection from Molem by Agrawal (1972). Sighting of a colony near Bondla Wildlife Sanctuary by ZSI survey party during project period.

Habitat : Found in all habitats, leading arboreal life with roosting in hundreds on large fruit bearing trees. Possesses strong memory and can fly away from roosting place for large distances in search of food.

External Distribution : Throughout India.

Status : Roosting sites are seen generally in isolated places, IUCN criteria proposed as per CAMP Report (2002) : Least Concern; Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule V (Vermin); CITES : Appendix II.

Source : Ellerman and Morrison– Scott (1951), Brosset (1962a), Agrawal (1972) Corbet and Hill (1992) Wilson and Reeder (1993), Bates *et al.* (1994) and Bates and Harrison (1997).

Remarks : The species is involved in domestic illegal trade (Pradhan, 1997).

Genus ***Cynopterus***

Genus *Cynopterus* is represented by two species/subspecies in Goa State.

*6. ***Cynopterus sphinx sphinx*** (Vahl)

1797. *Vespertilio sphinx* (Vahl) *Skr. Nat. Selsk* Copenhagen 4(1) : 123.

Common Name : Short-nosed Fruit Bat.

Diagnostic Characters : Medium sized fruit bat with white margined ears, forearm around 70 mm. with metacarpals and phalanges whitish, nostrils divergent with deep inter-narial groove, naked skin of wings and muzzle, tail reduced and rod like, condylobasal length more than 30 mm.

Locality : Poinguinim, Molem and Keri; ZSI, WRS, Pune, Coll. Reg. No. M/566 and M/673).

Habitat : Terrestrial and arboreal species preferring to live in small colonies on fruit bearing trees close to forests.

External Distribution : Indian sub-continent.

Status : IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern; Indian

Wildlife (Protection) Act (1972, as amended up to 2002) Schedule: Schedule V (Vermin).

Source : Ellerman and Morrison-Scott (1951), Brosset (1962a), Agrawal (1972), Corbet and Hill (1992) and Wilson and Reeder (1993), Bates *et al.* (1994) and Bates and Harrison (1997).

*7. ***Cynopterus brachyotis ceylonensis*** (Gray)

1871. *Cynopterus marginatus* var. *ceylonensis* Gray, *Catalogue of monkeys, lemurs and fruit-eating bats in the collection of the British Museum*, London, British Museum, **viii** : 122.

Common Name : Lesser dog-faced fruit bat.

Diagnostic Characters : Medium sized fruit bat with forearm shorter (less than 67 mm) and ears with no white margin, skin of wings and muzzle naked, nostrils divergent, condylobasal length less than 30 mm. Other characters similar to the previous sub-species.

Locality : Poinguinim (Agrawal, 1972) and Molem (ZSI, WRS, Pune, Coll. Reg. No. M/560); *Habitat*: Same as that of *Cynopterus sphinx sphinx* (Vahl), both the species reported to have shared a common roost (Pradhan and Kulkarni, 1997).

Distribution : Western Ghats.

Elsewhere : Sri Lanka.

Status : Pradhan and Kulkarni (1997) report extension of distributional range of *C. b. ceylonensis* upto Khandala in Pune Dist. in Northern Western Ghats. IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (For *Cynopterus brachyotis*) Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule: Schedule V (Vermin).

Source : Ellerman and Morrison-Scott (1951), Das (1986), Corbet and Hill (1992), Wilson and Reeder (1993) Pradhan and Kulkarni (1997) and Bates and Harrison (1997).

Suborder MICROCHIROPTERA

Five families represent sub-order Microchiroptera in Goa State.

Key to the families of the sub-order MICROCHIROPTERA

1. Both noseleaf and tragus present..... ..... **MEGADERMATIDAE**

   Either noseleaf or tragus present, not both.. 2

2. A noseleaf but no tragus present..... ..... RHINOLOPHIDAE

   No noseleaf but tragus present 3

3. Tail entirely enclosed in inter-femoral membrane ..... VESPERTILIONIDAE

   Distal portion of the tail free from inter-femoral membrane 4

4. Tail emerging from the upper surface of the inter-femoral membrane ....EMBALLONURIDAE

   Tail emerging from the end of the inter-femoral membrane ..... MOLOSSIDAE

Family EMBALLONURIDAE

Family Emballonuridae is represented by two genera *Saccolaimus* and *Taphozous,* in Goa State.

Key to the genera of EMBALLONURID

Radio-metacarpal pouch absent, lower lip with a deep median groove, anterior upper premolar large, tympanic bullae complete and postero-ventral face of basisphonoid in contact with tympanic bulla.....***Saccolaimus***

Radio-metacarpal pouch present, lower lip not or scarcely grooved, Anterior upper premolar normal, tympanic bullae not complete and posteroventral face of basisphenoid not in contact with tympanic bulla ..... ***Taphozous***

Genus *Saccolaimus*

Genus *Saccolaimus* is represented by only nominate species in Goa State.

8. ***Saccolaimus saccolaimus*** (Temminck)

1838. *T. saccolaimus* Temminck, *Tijdschrift Natuurl. of Gesch. Physiol.*, **5** : 3–34, 1 pl.

Common Name : Pouch-bearing Tomb Bat.

Diagnostic Characters : A large brown coloured *Saccolaimus* sp. with lower lip divided by a deep, narrow groove; legs and feet naked; interfemoral membrane naked except near the point of origin of tail; gular sac present, larger in males; radio metacarpal pouch absent; ear margin smooth; Tympanic bullae complete. Anterior upper premolar large, covering ½ crown area of posterior premolar.

Locality : Reported from Southern Sahyadri including Goa by Nalavade (1998) and nearby areas like Sirsi and Gersoppa in Karnataka by Bates and Harrison (1997).

Habitat : Though not much information is available about its habit and habitat, the species is reported to inhabit the caves, ruins of tunnels, mine, temples etc.

External Distribution : Throughout India.

Status : Though not rare, it is rather difficult to collect, IUCN criteria proposed as per CAMP Report 2002: Least Concern (For *Taphozous saccolaimus*); Source : Brossett (1962a), Corbet and Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997), Nalawade (1998) and Alfred *et al.* (2002).

Genus *Taphozous*

Genus *Taphozous* is represented by three species/subspecies in Goa State.

Key to the species of Genus *Taphozous*

1. Gular pouch well developed in male, while rudimentary in females. Forearm length in the range between 55.5-65 mm..... ..... *Taphozous l. longimanus*
2. Gular pouch in male not developed or absent in both sexes. Forearm length in the range between 60-68 mm. Ears smaller below 21 mm..... *Taphozous m. melanopogon*
3. Gular pouch absent in both sexes. Forearm length above 70 mm on average and Ears larger, above 21 mm..... .....*Taphozous theobaldi secatus*

9. *Taphozous longimanus longimanus* Hardwicke

1825. *Taphozous longimanus* Hardwicke. *Trans Lin. Soc. Lond.*, **14** : 525.

Common Name : Long-winged tomb bat.

Diagnostic Characters : A brown coloured medium sized insect eating bat with broad tragus. Gular sac well developed in males, while it is represented by a rudimentary fold of naked skin in females. Inner margin of ear smooth, lower lip scarcely grooved.

Locality : Reported from Southern Sahyadri including Goa State by Nalawade (1998) and also from nearby areas like Sirsi and Sagar in Karnataka State (Bates and Harrison, 1997).

Habitat : A colonial species inhabiting old ruins, caves, tree holes etc.

External Distribution : Throughout India.

Status : General field study reports number of locations in isolated places (CAMP, 1998); IUCN criteria proposed as per CAMP Report (2002): Least Concern.

Source : Brosset (1962a), Corbet and Hill (1992), Wilson and Reeder (1993); Bates *et al.* (1994) and Bates and Harrison (1997), Nalawade (1998) and Alfred *et al.* (2002).

*10. *Taphozous melanopogon melanopogon* Temminck

1841a. *Taphozous melanopogon* Temminck, *Monographies de mammalogie* tome 2. Leiden & Paris. 392, Pl xxvi–lxx.

Common Name : Black bearded tomb bat.

Diagnostic Characters : Medium sized insect eating brown coloured bat with tail emerging from the upper surface of the inter-femoral membrane. Gular sac rudimentary or absent in males and absent in females. Forearm less than 70 mm, anterior upper margin of zygoma flat and inferior ante-orbital process well developed.

Locality : Old Goa (ZSI, WRS, Pune, Coll. Reg. No. M/336) and Colva (Bates and Harrison,

1997).

Habitat : A colonial species inhabiting the caves, old mines, tunnels, temples etc.

External Distribution : Throughout India.

Status : General field study reports number of locations in isolated places (CAMP, 1998); IUCN criteria proposed as per CAMP Report (2002): Least Concern.

Source : Brosset (1962a), Corbet and Hill (1992), Wilson and Reeder (1993); Bates *et al.* (1994) and Bates and Harrison (1997).

11. ***Taphozous theobaldi secatus*** Thomas

1915. *Taphozous theobaldi secatus* Thomas, *J. Bombay nat. Hist. Soc.*, **24** : 60.

Common Name : Theobald's tomb bat.

Diagnostic Characters : Medium sized insect eating brown coloured bat with tail emerging from the upper surface of the inter-femoral membrane. Gular sac rudimentary or absent in males and absent in females. Forearm always more than 70 mm. Body hairy, while wings and interfemoral membrane naked. Ears large.

Locality : Reported from Southern Sahyadri including Goa State by Nalawade (1998) and also from nearby areas like Krishnapur in Karnataka State (Bates and Harrison, 1997).

Habitat : A colonial species inhabiting the caves, old mines, tunnels, temples, ruins near forest or dry scrubland etc.

External Distribution : India.

Status : IUCN criteria proposed as per CAMP Report (2002): Vulnerable.

Source : Brosset (1962a), Corbet and Hill (1992), Wilson and Reeder (1993); Bates *et al.* (1994), Bates and Harrison (1997), Nalawade (1998) and Alfred *et al.* (2002).

Family MEGADERMATIDAE

Family *Megadermatidae* is represented by two species under the only Genus *Megaderma* in Goa State (Alfred *et al.* 2002).

Genus ***Megaderma***

Genus *Megaderma* is represented by two species/subspecies in Goa State.

Key to the species of the Genus *Megaderma*

1. Forearm small (52–63 mm), intermediate nose-leaf broad and posterior termination of the nose-leaf rounded .... *Megaderma spasma horsfieldi*
2. Forearm large (60-71 mm), intermediate nose-leaf narrow and posterior termination of the nose-leaf truncated..... *Megaderma lyra lyra*

12. ***Megaderma spasma horsfieldi*** Blyth

1863 *Megaderma horsfieldi* Blyth *Cat. Mammal. Mus. Asiat. Soc. Bengal*, : 23 (India)

Common Name : Lesser False Vampire bat.

Diagnostic Characters : A medium sized bat, with large ears, nose-leaf and tragus, but without externally visible tail; dorsal colour bluish slaty, ventral parts paler; forearm 52–63 cm; posterior termination of nose-leaf rounded.

Locality : Valpoi (Agrawal,1972).

Habitat : The species is colonial in habit inhabiting old ruins, houses, temples wells etc.

External Distribution : Throughout India.

Status : The distribution of the species is rather patchy and occurrence rare. IUCN Criteria proposed as per CAMP Report (2002) : Least Concern.

Source : Brosset (1962b), Agrawal (1972), Corbet and Hill (1992), Wilson and Reeder (1993), Bates *et al.* (1994), Bates and Harrison (1997) and Alfred *et. al.* (2002).

*13. ***Megaderma (Lyroderma) lyra lyra*** Geoffroy

1810. *Megaderma lyra* E. Geoffroy. *Ann. Mag. Hist. Nat. Paris*, **15** : 190.

Common Name : Greater false vampire bat.

Diagnostic Characters : Similar to *Megaderma*

spasma but larger in size, forearm 60–70 mm, posterior termination of nose-leaf truncated, dorsal colour slaty grey.

Locality : The species has been sighted in Bondla Wildlife Sanctuary by ZSI Survey party in 2001.

Habitat: Similar to that of *Megaderma spasma.*

External Distribution : Throughout India.

Status : Fairly distributed and common bat species. IUCN Criteria proposed as per CAMP Report (2002) : Least Concern.

Source : Brosset (1962b), Corbet and Hill (1992), Wilson and Reeder (1993), Bates *et al.* (1994), Bates and Harrison (1997) and Alfred *et. al.* (2002).

Family RHINOLOPHIDAE

Family *Rhinolophidae* is represented by two subfamilies in Goa State: (1) *Rhinolophinae* and (2) *Hipposiderinae*. Old family *Hipposideridae* has been included in the family *Rhinolophidae* following Koopman's comments in Wilson and Reeder (1993).

Key to the subfamilies of the Family RHINOLOPHIDAE

1. Digits of the hindfoot with two joints; noseleaf square in outline, posterior portion takes the shape of a thin flattened disc. Noseleaf without sella and posterior lancet. Two premolars in lower jaw ..... HIPPOSIDERINAE
2. Except for the first, remaining digits of the hindfoot have three joints; noseleaf circular or horse-shoe shaped, posterior portion narrows into a thin pointed appendage, lancet. Noseleaf with sella and lancet. Three premolars in lower jaw ..... RHINOLOPHINAE

Subfamily RHINOLOPHINAE

Subfamily *Rhinolophinae* consists of one modern genus *Rhinolophus* with approximately 60 species throughout the tropics, subtropics and temperate zones of the old world rhinolophid range. These are small to moderate sized bats with forearm ranging in between 30–75 mm and are characterized by a complex nose-leaf. They are insectivorous, catching their prey in flight, and occur in wide variety of habitats from forests to open areas. Some are solitary while others live in moderate groups. Genus *Rhinolophus* is represented by two species in Goa State. Nalawade (1998) reports occurrence of *Rhinolophus luctus beddomei* from Southern Sahyadri range (Mahabaleshwar to Goa). However, it has not been included in the systematic account by Bates and Harrison (1997) Alfred *et al.* (2002) also do not include Goa State in the distributional range of this species.

Genus ***Rhinolophus***

Genus *Rhinolophus* is represented by two species in Goa State.

Key to the species of Genus *Rhinolophus*

1. Connecting process triangular and pointed and higher than top of sella forming deep notch between them. Forearm length less than 42 mm ..... *Rhinolophus lepidus*
2. Connecting process not triangular and pointed and is at the level with top of sella forming a shallow notch between them. Forearm length in the range between 44–54 mm ..... *Rhinolophus rouxi*

14. ***Rhinolophus lepidus lepidus*** Blyth

1844. *Rhinolophus lepidus* Blyth, *J. Asiat. Soc. Bengal.* 13 : 486.

Common Name : Blyth's horse-shoe bat.

Diagnostic Characters : Smaller horse-shoe bat with forearm less than 42 mm., but with relatively larger ears and nose-leaf, connecting process higher than top of sella forming a deep notch between them.

Locality : Reported from Southern Sahyadri region including Goa State by Nalwade (1998) and also from nearby areas like Jog Falls in

Karnataka State (Bates and Harrison, 1997).

Habitat : Large caves in forested areas, rocky outcrops, semi-evergreen forests. It can lead a solitary to colonial life.

External Distribution : Throughout India.

Status : Field survey studies report number of locations in isolated places (CAMP Report, 1998); IUCN Criteria proposed as per CAMP Report (2002) : Least Concern.

Source : Brosset (1962b), Corbet and Hill (1992), Agrawal *et al.* (1992), Wilson and Reeder (1993), Bates *et al.* (1994) and Bates and Harrison (1997) and Nalawade (1998).

15. ***Rhinolophus rouxi rouxi*** Temminck

1834. *Rhinolophus rouxi* Temminck, *Monogr. Mammal*; **2** : 306.

Common Name : Rufous horse-shoe bat.

Diagnostic Characters : Smaller bat with forearm length in the range between 44–54 mm., base of sella straight but not expanded, connecting process is at the level with top of the sella; colour varies from brown to orange–yellow.

Locality : Poinguinam (Agrawal, 1972), Canacona, Colva and Anmode (Bates and Harrison, 1997).

Habitat : Large caves, rocky outcrops in semi-evergreen forests. It can lead a solitary to colonial life.

External Distribution : Throughout India.

Status : Field survey studies report number of locations in isolated places (CAMP Report, 1998); IUCN Criteria proposed as per CAMP Report (2002): Near Threatened.

Source : Brosset (1962b), Agrawal (1972), Wilson and Reeder (1993), Bates *et al.* (1994) and Bates and Harrison (1997).

Subfamily HIPPOSIDERINAE

A subfamily of 9 recent genera with 63 species throughout the tropics and subtropics of the Old World from Africa and S. Asia to Philippines, N. Australia and Vanuatu. However, the subfamily in Goa State is represented by the three species under one genus only viz. *Hipposideros*. All hipposiderids possess complex noseleaf with its anterior part does not have a median notch. Some species possess lateral supplementary leaflets. The central portion of the nose-leaf is a cushion-like structure.

Subfamily *Hipposiderinae* is represented by only one Genus, *Hipposideros*, in Goa State.

Genus ***Hipposideros***

Genus *Hipposideros* is represented by a three subspecies/species in Goa State.

Key to the species of Genus *Hipposideros*

1. Forearm in the range of 75–89 mm..... .....*Hipposideros lankadiva indus*

– Forearm in the range of 40–54 mm.....2

2. Forearm in the range of 45–54 mm. Ears small, not rounded but pointed. 5th metacarpal significantly shorter than 3rd. Three supplementary leaflets ....*Hipposideros speoris speoris*

– Forearm in the range of 38–44 mm. Ears very large (19-26 mm) rounded and broadly triangular but not pointed. 3rd metacarpal shorter than 5th. Supplementary leaflets absent .....*Hipposideros fulvus fulvus*

16. ***Hipposideros fulvus fulvus*** Gray

1838. *Hipposideros fulvus* Gray, *Mag. Zool. Bot.*, **2** : 492.

Common Name : Fulvous Leaf-nosed bat.

Diagnostic Characters : Ears large, rounded, longer than head, upper part of posterior margin slightly flattened, forearms shorter (less than 45 mm.), internarial septum narrow and broadened at the base.

Locality : Reported from Southern Sahyadri region including Goa State by Nalawade (1998) and also from nearby areas like Ratnagiri (Maharashtra State), Dharwad, Gadag and

Honawar (Karnataka State) (Bates and Harrison, 1997).

Habitat : Colonial in habit living in ruins of caves, temples, buildings in and near forested areas.

External Distribution : Throughout India excluding Jammu and Kashmir.

Status : It has been reported from many localities in India, IUCN Criteria proposed as per CAMP Report (2002) : Least Concern (National & Global).

Source : Brosset (1962a), Agrawal *et al.* (1992), Corbet and Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997) and Nalawade (1998).

17. ***Hipposideros lankadiva indus*** (Andersen)

1918. *Hipposideros indus* Andersen, *Annals. Mag. Nat. Hist.*, **2** : 382.

1997. *Hipposideros lankadiva indus* (Andersen), Bates & Harrison, *Bats of The Indian Subcontinent* : 99-100.

Common Name : Kelaart's Leaf-nosed bat.

Diagnostic Characters : Large sized hipposiderid with Forearm length in the range of 75-89 mm.

Locality: Reported from Southern Sahyadri region including Goa State by Nalawade (1998) and also from nearby areas like Gersoppa, Talewadi and Vijaynagar (Karnataka State) (Bates and Harrison, 1997 and CAMP Report, 2002).

Material Examine/Sightings : None.

Distribution : Peninsular and NE India.

Elsewhere : Sri Lanka (Bates and Harrison, 1997 and CAMP Report, 2002).

Status : Bates and Harrison (1997) have listed number of collection localities in India; IUCN Criteria proposed as per CAMP Report (2002) : Least Concern (CAMP Report, 2002).

Remarks : *Hipposideros lankadiva indus* is a high flyer and may be seen in the early evening in the company of *Pipistrellus* spp. It is also known to share the roost with *Taphozous melanopogon* and *Megaderma lyra* (Khajuria and Ghosal, 1981).

18. ***Hipposideros speoris speoris*** (Schneider)

1800. *Vespertilia speoris* Schneider, In Schreber, J.C.D. *Die sangethiere in Abbildungen nach der Natur Frlangen* Supplement : 1112 with 347 pls.

Common Name : Schneider's leaf-nosed bat.

Diagnostic Characters : Forearm larger (45–57 mm), rostrum flattened, prominent supraorbital ridge present, ears triangular moderately or acutely pointed.

Locality : Reported from Southern Sahyadri region including Goa State by Nalawade (1998) and also from nearby areas like Gersoppa, Gadag, Belgaum and Vijaynagar (Karnataka State) (Bates and Harrison, 1997 and CAMP Report, 2002).

Habitat : Same as *Hipposideros fulvus*.

External Distribution : Throughout the Peninsular India.

Status : The species has been reported from many localities in Peninsular India and Sri Lanka; IUCN Criteria proposed as per CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962b), Corbet and Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997) and Nalawade (1998).

Remarks : *Hipposideros speoris speoris* (Schneider) is a low flyer close to ground with skilled slow flights. It is also known to share the roost with *H. fulvus* and *Megaderma lyra* (Bates and Harrison, 1997).

Family VESPERTILIONIDAE

Vespertilionid bats possess tragus but no nose-leaf, the tail is approximately as long as the forearm and is enclosed entirely in the interfemoral membrane.

Two subfamilies have been recorded from the State of Goa.

Key to subfamilies of the family VESPERTILIONIDAE

Ears large and funnel shaped ..... KERIVOULINAE

– Ears normal and not funnel shaped.....2

2. Second phalanx of third finger very much elongated, nearly three times as long as first ..... MINIOPTERINAE

– Second phalanx of third finger normal and not elongated ..... VESPERTILIONINAE

Subfamily KERIVOULINAE

Subfamily Kerivoulinae is represented by a single species and subspecies under the Genus *Kerivoula* from Goa State.

Genus ***Kerivoula***

19. ***Kerivoula picta picta*** (Pallas)

1842. *Vespertilio picta* Pallas, *Spicil. Zool.*, **3** : 7.

Common Name : Painted bat.

Diagnostic Characters : A medium sized bat with forearm around 35 mm. possessing characteristic colour patterns. Ears large, bluntly pointed with bright orange in colour, wing membrane orange coloured with prominent black markings between fingers. Tragus long and slender, interfemoral membrane with prominent fringe on the posterior margin.

Locality : Goa (No exact Locality) (Agrawal, 1972).

Habitat : Though the species leads solitary life it also, sometimes, prefers to stay in small groups, the specimens are generally found among plantations near human habitations.

External Distribution : Throughout India.

Status : The species has been reported from many localities in India, IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (National and Global).

Source : Agrawal (1972), Corbet and Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997) and Alfred *et al.* (2002).

Subfamily VESPERTILIONINAE

Four genera have been reported from Goa State.

Key to the genera of the Subfamily VESPERTILIONINAE

1. Cheek-teeth six on each side of upper and lower jaw ..... ***Myotis***

– Cheek-teeth less than six on each side of upper and lower jaw 2

2. Upper premolars 2–2 ..... ***Pipistrellus***

– Upper premolars 1–1 3

3. Upper incisors 2–2 ..... ***Hesperoptenus***

– Upper incisors 1–1 ..... ***Scotophilus***

Genus ***Hesperoptenus***

Genus *Hesperoptenus* is represented by a single species, *Hesperoptenus tickelli* (Blyth) in Goa State.

20. ***Hesperoptenus tickelli*** (Blyth)

1851a. *Nycticejus tickelli* Blyth, *J. Asiat. Soc. Bengal*, **20** : 157.

Common Name : Tickell's Bat.

Diagnostic Characters : A rather large-sized (Forearm about 55.0 mm with a range of 50.0–60.4 mm) vespertilionid bat; colour in the shades varying from light grayish yellow to bright golden brown with rufous tinge, head grayish; ears oval; wing membrane blackish; wings from base of the toes; small pad under thumb; second upper incisor small and located at the base of first; muzzle broad and blunt, swollen on sides; crescent-shaped tragus is about half the length of pinna.

Locality : Molem (Bates and Harrison, 1997).

Habitat : Essentially a sub-montane species which may migrate to the plains in suitable season; live singly or in small parties concealing very well amongst the foliage, a known high flyer bat species.

External Distribution : Throughout India.

Status : The species has been reported from many localities in India, IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (National and Global).

Source : Agrawal *et al.* (1992), Corbet and

Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997) and Alfred *et al.* (2002).

Genus *Myotis*

Genus *Myotis* is represented by a single species, *Myotis horsfieldii* (Temminck) in Goa State.

21. ***Myotis horsfieldii*** (Temminck)

1840. *Vespertilio horsfieldi* Temminck, *Monogr. Mamm.*, 2 : 226.

Common Name : Horsfield's Bat.

Diagnostic Characters : A rather medium-sized (Forearm about 38.5 mm with a range of 36.5-41.5 mm) vespertilionid bat. Ears naked and dark with rounded tips. Anterior border of ear is evenly convex, while posterior border concave above and convex below. Crescent-shaped tragus is short and about half the length of pinna. Feet are enlarged and exceed half the length of tibiae. Dorsal colour is dark brown almost black. Ventral surface deep brown with grayish tint. Wing membrane deep chocolate brown; wings are attached to the outer metatarsal of each foot.

Locality : Molem (Bates and Harrison, 1997).

Habitat : Essentially a species of wooded area with local supply of fresh water. It appears to favour tunnels, caves, bridges and abandoned houses for its diurnal roosting sites; live-singly or in small groups of 2-3 individuals.

External Distribution : Throughout India.

Status : The species has been reported from number of localities in India, IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern.

Source : Agrawal *et al.* (1992), Corbet and Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997) and Alfred *et al.* (2002).

Genus *Pipstrellus*

The genus *Pipistrellus* is represented by four species/subspecies in Goa State.

Key to the species and subspecies of the Genus *Pipistrellus*

1. Outer upper incisor (I^3) extend distinctly beyond cingulum of I^2 ; Crown area of PM^2 = I^2; PM^2 intruded in tooth row 2

– I^3 absent or minute, when present, not extending beyond cingulum of inner incisor (I^2); Crown area of PM^2 greater than ½ I^2; PM^2 intruded in tooth row .... *Pipistrellus dormeri* (Dobson)

2. Size large (forearm 38 mm or more) .... *Pipistrellus ceylonicus indicus* (Dobson)

– Size smaller (forearm less than 38 mm) ... 3

3. Condylobasal length between 11.2 to 12.5 mm and M^3–M^3 5.0–6.0 mm ..... *Pipistrellus coromandra coromandra* (Gray)

– Condylobasal length between 10.1–11.6 mm. and M^3–M^3 4.7–5.4 mm .... *Pipistrellus tenuis mimus* Wroughton

22. ***Pipistrellus ceylonicus indicus*** (Dobson)

1878. *Vesperugo indicus* Dobson. *Cat. Chiroptera Br. Mus.*, : 222.

Common Name : Kelaart's Pipsiterelle.

Diagnostic Characters : One of the larger pipistrelle with forearm reaching 40.00 mm. ear short and triangular with outer margin straight. tragus with straight inner end. wings from base of toes, post calcarial lobe semicircular. extreme tip of the tail free from membrane. The subspecies can be easily distinguished externally by the deep brown colour of the body.

Locality : Molem (Bates and Harrison, 1997).

Habitat : Colonial in habit living in crevices in wood, building, old ruins, bridges etc. Electic species with colony size ranging from single individual to 200. They do not hang but cling to the surface with the help of feet and wing claws. Most common species.

External Distribution : Widely distributed in India.

Status : It has been reported from many localities in India; IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962c), Corbet and Hill (1992), Agrawal *et al.* (1992), Wilson and Reeder (1993), Bates *et al.* (1994) and Bates and Harrison (1997).

23. ***Pipistrellus coromandra coromandra*** (Gray)

1838. *Scotophilus coromandra* Gray, *Mag. Zool. Bot.*, **2** : 498.

Common Name : Indian Pipistrelle.

Diagnostic Characters : Small-sized pipistrelle but with forearm around 31 mm, dorsal fur blackish brown, hair tips slightly rufescent, belly paler brown, tragus curved forward and bluntly rounded, small calcarial lobe present.

Locality : Molem (Bates and Harrison, 1997), and also reported from Southern Sahyadri region including Goa State by Nalawade (1998).

Habitat : Colonial in habit living in crevices of buildings, ruins and bark of trees.

External Distribution : Widely distributed in Peninsular India.

Status : It has been reported from many Indian localities; IUCN Criteria proposed as per CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962c), Corbet and Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997) and Nalawade (1998).

24 ***Pipistrellus dormeri*** (Dobson)

1875. *Scotozous dormeri* Dobson, *Proc. Zool. Soc. Lond.*, **1875** : 373.

Common Name : Dormer's Bat.

Diagnostic Characters : Medium-sized pipistrelle with forearm around 34 mm (32.7-36.3 mm), tail considerably shorter than head and body. Dorsal fur grayish brown with hair tips almost silvery, belly contrastingly paler brown or lemon yellow in live or freshly killed specimens. Second incisor (I^3) absent or very small when present not extending beyond cingulum of first incisor (I^2).

Locality : Margoa (Agrawal, 1972) and also reported from Southern Sahyadri region including Goa State by Nalawade (1998).

Habitat : A gregarious species. Colonial in habit with colony size ranging from 2 to 24. It is generally found in the close vicinity or in the midst of human habitations. Roost sites include holes and crevices of buildings, ruins and bark of large trees.

External Distribution : Widely distributed in Peninsular India.

Status : It has been reported from many Indian localities; IUCN Criteria proposed as per CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962c), Agrawal (1972), Corbet and Hill (1992), Wilson and Reeder (1993), Bates and Harrison (1997) and Nalawade (1998).

25. ***Pipistrellus tenuis mimus*** Wroughton

1899. *Pipistrellus mimus* Wroughton *J. Bombay nat. Hist. Soc.*, **12** : 722.

Common Name : Indian Pygmy Pipistrelle.

Diagnostic Characters : Small sized pipistrelle bat with forearm between 25.0 to 32.00 mm; fur dense and short; dorsal coloration bistre brown, ventral parts lighter, ears small and scarcely triangular, tragus short and curved forward, wings from base of toes; Condylobasal length between 10.1–11.6 mm and $M^3 - M^3$ 4.7–5.4 mm.

Locality : Reported from Southern Sahyadri region including Goa State by Nalawade (1998) and also from near by areas like Ratnagiri, Dharwar, Bellary etc. (Bates and Harrison, 1997).

Habitat : Both, solitary and colonial in habit preferring to live in crevices of buildings and rocks.

External Distribution Widely distributed throughout India.

Status: It has been reported from many localities in India, IUCN Criteria proposed as per CAMP Report (2002): Least Concern (National and Global).

Source : Brosset (1962c), Corbet and Hill (1992), Wilson and Reeder (1993), Bates *et al.* (1994), Bates and Harrison (1997) and Nalawade (1998).

Remarks : The name *P. t. mimus* has been retained following remarks of Bates and Harrison (1997) and Sinha (1980, as cited in Bates and Harrison,1997).

Genus *Scotophilus*

Genus *Scotophilus* is represented by two species/subspecies in Goa State.

Key to the species and subspecies of the Genus *Scotophilus*

1. Size larger, forearm, on average, more than 55.0 mm ..... *Scotophilus heathii heathii*
- Size smaller, forearm, on average, less than 55.0 mm ..... *Scotophilus kuhlii kuhlii*

26. *Scotophilus heathii heathii* Horsfield

1831. *Scotophilus heathii*, Horesfield, *Proc. Zool. Soc. Lond.*, : 113.

Common Name : Asiatic greater yellow house bat.

Diagnostic Characters : A robust bat with small transversely ridged ears, rounded at tips, tragus semi-lunar, markedly convex on posterior border, larger in size with forearm more than 55.0 mm. Long tail embodied in interfemoral membrane with terminal end of 2-3mm free. Pelage on back dark to chestnut brown. Ventral parts lemon-yellow to orange-yellow in colour.

Locality : Reported from Southern Sahyadri region including Goa State by Nalavade (1998) and also from near by areas like Hubli, Sirsi, Kolar etc. (Bates and Harrison, 1997).

Habitat : Colonial in habit living in old buildings, ruins and trees, Agrawal *et al.* (1992) reported the roosting of this species alongwith *Megaderma lyra lyra* in an old mosque in Malda Dist of West Bengal.

External Distribution : Widely distributed in India.

Status : The species has been reported from many localities in India; IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962c), Corbet and Hill (1992), Wilson and Reeder (1993), Bates *et al.* (1994) and Bates and Harrison (1997) and Nalawade (1998).

27. *Scotophilus kuhlii kuhlii* Leach

Scotophilus kuhlii Leach. *Trans. Linn. Soc. Lond.*, **13** : 723

Common Name : Asiatic lesser yellow house bat.

Diagnostic Characters : Ears small, rounded at tips, tragus semi-lunar, markedly convex on posterior border. Very much similar to the Asiatic greater yellow house bat but smaller in size with forearm less than 55.0 mm. Tip of tail free, fur short and dense, dorsal colour olive-brown, while ventral colour creamy white with tinge of red.

Locality : Reported from Southern Sahyadri region including Goa State by Nalavade (1998) and also from near by areas like Hubli, Sirsi, Kolar etc. (Bates and Harrison, 1997).

Habitat : Specimens of this species can lead solitary and or colonial life in the crevices of old buildings and ruins. They also prefer arboreal life.

External Distribution : Throughout India.

Status : It has been reported from many localities in India; IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962c), Corbet and Hill (1992), Wilson and Reeder (1993); Bates and Harrison (1997) and Nalawade (1998).

Subfamily MINIOPTERINAE

Subfamily Miniopterinae is represented by a single species and subspecies under the Genus *Miniopterus* from Goa State.

Genus ***Miniopterus***

28. ***Miniopterus schreibersi fuliginosus*** (Hodgson)

1835. *Vespertilio fuligenosa* Hodgson *J. Asiat. Soc. Beng.*, **4**. : 700.

Common Name : Schreiber's Long-fingered bat.

Diagnostic Characters : This is a medium sized vespertilionid bat of the subcontinent with average forearm length of 47.0 mm (Range : 44.7–49.6mm). Ears are small, tragus is tall, slender and slightly curved forward at the tip. It is half the height of pinna. The tail, interfemoral membrane and hind limbs are considerably longer. Each wing is characterised by a highly developed second phalanx of the third finger. The third finger (Mean : 38.1 mm, Range: 36.0–40.1 mm) is approximately three times the length of first phalanx. Fur is soft, silky and dark. Dorsal surface is in various shades of brown, while ventral side is slightly paler. Cheeks are naked below the eyes. The body is usually infected with numerous ecto-parasites, especially Nycteribiids. The skull with condylo-canine length with an average of 14.1 mm (13.6–14.8 mm) is marked by the inflation of the braincase anteriorly. The rostrum is low and flattened. The second upper incisor (I^3) is flattened. Its cingulum forming a minute postero-external cusp. Upper canine is tall and slender exceeding the second upper premolar in height. The palate is slightly concave.

Locality : Reported from Southern Sahyadri region including Goa State by Nalawade (1998) and also from near by areas like Mahabaleshwar, Panchgani, Satara etc. (Bates and Harrison, 1997).

Habitat : The species is known to occur in hilly and forested country. The colonies are large and situated in caves, caverns and crevices in rocks (Brosset, 1962c). Colony includes thousands of individuals. Brosset (1962c) suggested that there are two types of colonies. However, there only few large colonies in India.

External Distribution : Throughout India (Corbet and Hill, 1992).

Status : Bates and Harrison (1997) have reported the species as a common species throughout its extensive range; IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962c), Corbet and Hill (1992), Agrawal *et. al.* (1992), Wilson and Reeder (1993); Bates and Harrison (1997) and Nalawade (1998).

Remarks : The individuals of this species are strong and fast flyers and leave their roosts soon after sunset. They do not stay near the roosts but fly directly away in different directions.

Family MOLOSSIDAE

Family Molossidae is represented by a single species and subspecies under the Genus *Tadarida* from Goa State.

29. ***Tadarida aegyptiaca thomasi*** Wroughton

1919. *Tadarida thomasi* Wroughton *J. Bombay nat. Hist. Soc.*, **26** : 732.

Common name : English : Egyptian Free tailed bat.

Diagnostic Characters : This is a small-sized molossid bat with average forearm length of 48.2 mm (46.0–52.3 mm.). Tail stout projecting conspicuously beyond the narrow interfemoral membrane. Muzzle broad and thick. Upper lip is often wrinkled. Ears large, thick rounded and separated on the forehead. Tragus is small, while antitragus is usually large and well developed. Tuft of hairs present on the dorsal side of the feet. Fur is soft, dense and short. The dorsal surface is dark buffy brown to clove brown, while the ventral parts are paler. The skull with an average condylo-canine length of 17.9mm.(17.1–18.8 mm.) is marked by the presence of the unfused premaxillae leaving a larger palatal emargination extending posteriorly beyond incisor roots. Two pairs of lower incisors present.

Locality : Reported from Southern Sahyadri region including Goa State by Nalawade (1998) and also from near by areas like Dharwad, Malabar, Kolar etc. (Bates and Harrison, 1997).

Habitat : The species has been reported to roost in the crevices/cracks in caves, cliff faces, rocks, boulders, walls and deserted stone buildings etc. A colonial species with size of the colonies varying between single individual to more than thousand individuals (Bates and Harrison (1997).

External Distribution: Throughout India (Corbet and Hill, 1992).

Status : Bates and Harrison (1997) have reported the distribution of the species as world-wide with number of colonies in India. As per these authors the Status of the species is common and widespread; IUCN Criteria proposed as per the CAMP Report (2002) : Least Concern (National and Global).

Source : Brosset (1962c), Corbet and Hill (1992), Agrawal *et al.* (1992), Wilson and Reeder (1993); Bates and Harrison (1997) and Nalawade (1998).

Remarks : The individuals of this species are strong, swift and high flyers. They fly with their ears facing downwards. They emerge out of their roosts about half an hour after the sunset. They hunt far away from the roosting sites at the height of 31 meters to 77 meters (Bates and Harrison, 1997).

Order PRIMATES

Order Primates is represented by only three arboreal species in Goa State. It is characterized by presence of rather primitive limbs with plantigrade (Five) digits, reduced nasal region and small facial region with large forward-facing eyes. Hands and feet prehensile. Thumbs of hind feet opposable. Clavicles well developed. Brain large and complex.

Two families in Goa State represent order Primates.

Key to the families of the Order Primates

1. Claws on 2nd (C2) and/or 3rd (C3) digits of hind feet, otherwise all digits with nails, lower incisors and canine narrow, Tail absent .... LORIDAE

– No claws at all on any digits, all digits with nails, lower incisors and canine normal, Tail present ..... CERCOPITHECIDAE

Family LORIDAE

Single species under one genus (*Loris*) in Goa State represent the primate family Loridae.

30. *Loris tardigradus* (Linnaeus)

1758. *Lemur tardigradus* Linnaeus, *Syst. Nat.*, 10th ed., 1 : 29.

Common Name: Slender Loris.

Diagnostic Characters : Slender Loris is a small and slender bodied primate of the size of kitten. It has an elongated snout, long and slender limbs, large, round ears and closely set eyes encircled with brown rim. It has a well-developed index finger. Claws on second and third digits of the hind feet present. External tail absent. Body well furred dark gray to reddish brown in colour with silver tinge on the back. Underparts white or buff.

Locality : Forest Dept. authorities have reported occurrence of Slender Loris in the moist evergreen forests in Dudhsagar region of Bhagwan Mahavir Sanctuary (Molem Sanctuary). However, report needs authentication.

Habitat: Slender Loris lives alone or with mate in the tropical forest, swampy coastal forest and crop land near forest.

External Distribution: Parts of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu in South India.

Status : Doubtful in Goa State (Nalavade, 1998).

Conservation Status : IUCN: Near Threatened (National) and Vulnerable (Global) (CAMP Report, 2003), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : I Part : I *CITES*: Appendix: II.

Source : Corbet and Hill (1992), Agrawal *et. al.* (1992), Wilson and Reeder (1993); and Nalawade (1998).

Remarks : The species is involved in domestic as well as international trade for medicinal and experimental purposes.

Family CERCOPITHECIDAE

Two subfamilies in Goa State represent the primate family *Cercopithecidae.*

Key to the subfamilies of Family CERCOPITHECIDAE

1. Cheek-pouches present, tail in general smaller than head and body, stomach simple, neonatal coat brown in colour .... CERCOPITHECINAE
2. Cheek-pouches absent, tail distinctly longer than head and body, stomach complex, neonatal coat clearly black, gray or golden in colour ..... COLOBINAE

Subfamily CERCOPITHECINAE

Subfamily *Cercopithecinae* is represented by a single genus, namely *Macaca*, in India, while in Goa State *Macaca* is represented by a single species viz. *Macaca radiata.*

*31. ***Macaca radiata*** (Geoffroy)

1812. *Cercocebus radiatus*, Geoffroy, E. *Tableau desdquadrumanes Annales Mus. Hist. nat., Paris* : **15** : 157–198.

Common Name : Bonnet macaque.

Diagnostic Characters : The macaques with presence of cheek pouches, tail normal and without tuft and comparatively longer (95 to 140% head and body) than other macaque species in north India, scalp hairs radial in direction.

Locality : The species has been sighted in Dudhsagar, Molem, Bondla, and Canacona regions of Goa State by ZSI survey parties during project period.

Habitat : The species is semi-arboreal living in forested, urban, semi-urban, rural etc. areas of south India.

External Distribution : Southern peninsular India upto 21° N.

Status : The species has been reported from number of localities in South India, The species is endemic to south India, IUCN Criteria proposed as per the CAMP Report (2003) : Least Concern, Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : II Part I, CITES : Appendix II.

Source : Ellerman and Morrison–Scott (1951), Roonwal and Mohnot (1977), Parter (1980), Fooden *et. al.* (1981), Corbet and Hill (1992) and Wilson and Reeder (1993).

Remarks : The species is involved in domestic as well as international trade (Pradhan, 1997).

Subfamily COLOBINE

Subfamily *Colobinae* is represented by a single species under a genus *Semnopithecus* in Goa State.

*32. ***Semnopithecus entellus*** (Dufresne)

1707. *Simia entellus* Dufresne, *Bull. Soc. Philom.*, Paris : **1**(7) : 49.

Common Name : Hanuman langur.

Diagnostic Characters : A large black faced, gray bodied langur with long limbs, tail longer than head and body, whiskers short partly covering the ears. Crown of head little paler than nape and shoulders. Hands and feet black or brown in colour strongly contrasting with that of arms and legs.

Locality : Sighted number of troops at different places and times in the study area by ZSI Survey parties during the project period.

Habitat : Arboreal and colonial in habit living in troops, in forested, urban, semi-urban and rural areas near human habitations.

External Distribution : Throughout India.

Status : The species has been reported from number of localities in India; IUCN criteria proposed as per CAMP Report (2003) : Least Concern (For *Semnopithecus entellus achates* (Pocock) reported from Goa State), Indian wildlife (Protection) Act (1972, as amended upto 2002) : Schedule II Part I; CITES : Appendix I.

Source : Agrawal (1972), Roonwal and Mohnot (1977), Parter (1980), Corbet and Hill (1992), Agrawal *et al.* (1992) and Wilson and Reeder (1993).

Remarks : The species is involved in domestic as well as international trade. The species is also known to be worshipped by Hindus. Napier (1985) reviewed the taxonomy of the species under Subfamily Colobinae and separated previously known *Presbytis entellus* as *Semnopithecus entellus* on the basis Head and Body and Tail length and colour of Neonatal coat. As per Agrawal (1972) and Brandon-Jones *et al.* (2002) (cited in CAMP Report, 2003) the Goan population of langurs belongs to subspecies, *Semnopithecus entellus achates* (Pocock) which needs further taxonomic confirmation. Specimen collected from Goa by Agrawal (1972) is a juvenile specimen.

Order PHOLIDOTA

Order *Pholidota* is represented by the animals with upper part of body covered with large, overlapping scales or scutes. Undersurface clothed with coarse bristle like hairs. Snout long and narrow with long sticky tongue.

The order contains a single family.

Family MANIDAE

Family *Manidae* is represented by only one genus *Manis* with a single species *M. crassicaudata* Gray within Goan limits.

*33. *Manis crassicaudata* Gray

1827. *Manis crassicaudata* Gray, in *Griffith's Cuvier Animal. Kingd.*, **5** : 282.

Common Name : Indian Pangolin.

Diagnostic Characters : Hump-backed body, tapering tail without glandular naked area at the tip. Muzzle tapering to a narrow, downwardly curving trunk like snout. External pinna like a shallow, crescent-shaped vertical folds. Body covered with 11-13 rows of overlapping light yellowish brown, pointed scales or scutes.

Locality : Molem in Bhagavan Mahavir Sanctuary.

Material Examined/Sightings : One specimen collected earlier by ZSI survey party from Molem has been displayed in Museum of ZSI WRS, Pune.

External Distribution : Peninsular India (Corbet and Hill, 1992 and Chakraborty *et al.*, 2002).

Status : Agrawal *et al.* (1992) have reported the Status of the species as rare in peninsular India. IUCN criteria proposed as per CAMP Report (2003) : Lower risk-Near threatened (National) and Data Deficient (Global) (CAMP Report, 1998), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : I Part : I, CITES : Appendix : II, Red Data Book (National, 1994) : Vulnerable.

Source : Prater (1980), Corbet and Hill (1992), Agrawal (1972), Agrawal *et al.* (1992),Wilson and Reeder (1993) and Chakraborty *et al.* (2002).

Remarks : Recent status survey study of *Manis crassicaudata* was carried out by Chakraborty *et. al.* (2002). The species is known to be hunted for domestic trade of body parts for medicinal and other usage (Pradhan, 1997).

Order CARNIVORA

All hairy animals possessing limbs with sharp and flat claws and six small, equal-sized incisors, a pair of large, conical canines, and last upper premolar and first lower molar having sharp-edged lobes for shearing the flesh belong to the order *Carnivora*.

Seven families of Order *Carnivora* occur in Goa State.

Key to the families of Order CARNIVORA

1. Ethmo-turbinals very large, covering greater part of nasal chambers, extending anteriorly to the anterior orifice; auditory bulla composed of two bones; Cowper's gland absent 2

– Ethmo-trubinals excluded from the anterior orifice of nasal chamber by a large maxillo-turbinals, auditory bulla composed of a single bone; Cowper's gland present 5

2. Posterior palatal foramina set far back on the maxillo-palatine suture; teeth highly sectorial and reduced in number; dental formula 3, 1, 3 or 2, 1/3, 1,2, 1; inter-ramal tuft of vibrissae absent ..... FELIDAE

– Posterior palatal foramina located in front of the maxillo-palatine suture; teeth not so specialized or reduced in number; dental formula 3,1,4 or 2,1/3, 1,4 or 3,2 or 1; inter-ramal tuft of vibrissae present 3

3. Four toes in fore and hind feet, dog-like in structure; ears lacking any marginal bursa; auditory bulla without oblique groove; massive jaws and teeth, hind quarters week .... HYAENIDAE

– Four or five toes in fore and hind feet; not dog-like in structure; ears having bursa on the margin; auditory bulla distinctly grooved; jaws and teeth not powerful and hind quarters normal and proportionate 4

4. Ears moderate in size, with well-developed bursa and simple supratragus, but devoid of a valvular flap over it; feet compact with short claws; anus not enclosed in a glandular sac; no bony tube to auditory orifice..... ..... VIVERRIDAE

– Ears small and rounded with vestigeal bursa, valvular supratragus and a valvular flap over it; feet with free digits and fossorial claws; anus enclosed in a glandular pouch; a well-developed bony tube to the auditory orifice ..... HERPESTIDAE

5. Legs long, slender and digitigrade; fourth digit of forefoot raised above the planter pad; hind-foot with only 4 toes; baculum deeply channeled below ..... CANIDAE

– Legs relatively short and thick, plantigrade or semi-plantigrade; first digit of the forefoot present close to second; and not raised above the plantar pad; baculum not deeply channeled below 6

6. Large-sized animals with a short tail; pads of digits forming a weak curved line; planter pads very wide; three lower molars on each side ..... URSIDAE

– Small sized animals with a moderately long tail; pads of digits forming a strongly curved line; two lower molars present on each side ..... MUSTELIDAE

Family CANIDAE

Family Canidae is represented by three species under three genera in Goa State.

Key to the genera and species of the family CANIDAE

1. A frontal sinus present; post-orbital process smooth and convex above; tail less than half the length of head and body 2

– Frontal sinus absent; post-oribital process concave above; tail clearly more than half the length of head and body .... *Vulpes bengalensis*

2. Seven teeth in lower molar series and dorsal colour a mixture of black and white, comparatively larger in appearance .... *Canis aureus*

– Six teeth in lower molar series and dorsum more reddish in colour, comparatively smaller in appearance .....*Cuon alpinus*

Genus *Canis*

Only one species, *Canis aureus*, is known to occur in Goa State.

*34. *Canis aureus* Linnaeus

1758. *Canis aureus* Linnaeus, *Systema naturae* vol. 1, 10th edition : 40.

Common Name : Indian Jackal.

Diagnostic Characters : Smaller than the wolf and lacks the arching brows and elevated forehead. Upper molars with well defined cingulum; Dorsal colour typically a mixture of black and white, washed with buff above the shoulders, ears and legs; tail straight and not curled like dog.

Locality : Sighted in Molem Sanctuary region by ZSI Survey party and forest officials during project period.

Habitat : Terrestrial in habit living in all types of forests close to urban and semi-urban environs.

External Distribution : Throughout India.

Status : The species has been reported from number of localities in India; IUCN Criteria proposed as per the CAMP Report (1998): Lower risk-least concern (National), Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) : Schedule II Part II; CITES : Appendix III (India).

Source : Prater (1980), Corbet and Hill (1992), Agrawal *et al.* (1992), Wilson and Reeder (1993) and Menon (2003).

Remarks : The species is known to be hunted for domestic trade of body parts for medicinal and other usages and also in the international trade of body fur (Pradhan, 1997).

Genus *Cuon*

Only one species, *Cuon alpinus*, is known to occur in Goa State.

*35. *Cuon alpinus* (Pallas)

1811. *Canis alpinus* Pallas, *zoogr. Ross. Asiat.*, **1** : 34.

Common Name : Indian Wild Dog, Dhole.

Diagnostic Characters : Wild Dog is a typical carnivore belonging to the family Canidae. A medium sized canid with Head and Body length ± 90cm and height at shoulder in the range of 43 –55 cm. Appearance almost like a domestic dog except that wild dog possesses a straight tail and its dorsum is reddish in colour. Short in legs and muzzle. Ears rounded and tail tip bushy. First upper molar with a prominent outer cingulum. Six molar teeth. Body size is definitely smaller than wolf and lacks arching brows and elevated forehead.

Locality : Sighted a small pack of wild dogs in Molem Sanctuary region by ZSI Survey party and forest officials during project period.

Habitat : Wild dog is basically a terrestrial animal preferring to live in different types of dense forests interspersed with open land, prey species and water (Johnsingh and Yoganand, 2000). They have also been found at an altitude of around 12000 Ft. However larger populations live in the lowlands. Wild dogs are more social animals and they live and hunt in packs. They prey upon animals like sheep, sambar, wild boar, gaur, buffalo etc.

External Distribution: Practically whole of India (Menon, 2003).

Status : CAMP Report (1998) has stated that though number of wild dog populations have been reported from many localities, there is a general decline in its actual population in the country due to threat from declining population of prey species and loss of Habitats; IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-near threatened, Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule : II Part : I *CITES* : Appendix : II.

Source : Prater (1980), Corbet and Hill (1992), Agrawal *et al.* (1992), Wilson and Reeder (1993) and Menon (2003).

Remarks : Nil.

Genus *Vulpes*

Only one species of the genus *Vulpes* occurs in Goa State.

*36. *Vulpes bengalensis* (Shaw)

1800. *Canis bengalensis Shaw; Genl. Zool.*, **1, 2** : 300.

Common Name : Bengal Fox.

Diagnostic Characters : A grey coloured fox, having slender limbs with head and body length in the range of 40–65 cm; back of ears sandy brown and tail tip black in colour.

Locality : Sighted in borderline areas of Molem and Bondla sanctuaries by ZSI Survey party and forest officials during project period.

Habitat : Terrestrial, sometimes fossorial living in upper country, open fields etc., adjacent to the human habitations.

External Distribution : Throughout India.

Status : The species has been reported from number of localities in India, however the populations are fragmented; IUCN Criteria proposed as per the CAMP Report(1998) : Lower risk-near threatened (National), Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended up to 2002) : Schedule II Part II, CITES: Appendix III (India).

Source : Prater (1980), Corbet and Hill (1992), Agrawal *et al.* (1992),Wilson and Reeder (1993) and Menon (2003).

Remarks : The species is known to be hunted for illegal domestic trade of body parts for black magic purposes and other usages and also in the international trade of body fur (Pradhan, 1997).

Family URSIDAE

Animals under this family are larger in size heavily built with a short tail, plantigrade feet with planter pads and three lower molars on each side of the jaws.

Subfamily URSINAE

Family *Ursidae* is represented by a single species under one genus, *Ursus*, of Subfamily, *Ursinae*, in Goa state.

*37. ***Melursus ursinus*** (Shaw)

1791. *Bradypus ursinus* Shaw, *Nat. Misc.*, **2** (unpaged), pls. 58–59.

Common Name : Sloth bear.

Diagnostic Characters : A large-sized bear, 140–170 cm. in head and body length, having ivory white claws; coat rough and black with or without white crescent on chest.

Locality : Sighted in Molem sanctuary region by ZSI Survey party and forest officials during project period.

Habitat : Terrestrial and arboreal preferring to live in forests, grasslands etc.

External Distribution : Throughout India.

Status : The species has been reported from many localities in India, however, the populations are fragmented; IUCN Criteria proposed as per the CAMP Report (1998) : Vulnerable (National) and Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule I Part I, CITES : Appendix : I.

Source : Prater (1980), Corbet and Hill (1992), Agrawal *et. al.* (1992), Wilson and Reeder (1993) and Menon (2003) and Alfred *et al.* (2002, 2005).

Remarks : For generic taxonomic Status see remarks of Corbet and Hill (1992) under Family Ursidae. Illegal wildlife trade of the body parts like gall bladder, claws etc. (Pradhan, 1997) is a recent and serious threat in addition to the threat due to loss of habitat and fragmentary populations.

Family MUSTELIDAE

Small to medium sized carnivores with a moderately long, stout and thick tail and two lower molars present on each side of the jaws. The family, in general, is diversified in appearance and most of the species have been placed in four subfamilies. However, only one subfamily *Lutrinae*, has been reported from Goa state.

Subfamily LUTRINAE

Genus ***Lutrogale***

Family Mustelidae is represented by a single species under one genus, *Lutrogale*, of Subfamily: *Lutrinae*, in Goa state.

38. ***Lutrogale perspicillata*** (Geoffroy)

1826 *Lutra perspicillata* I. Geoffroy, *Dict. class Hist. Nat.*, **7** : 519.

Common Name : Smooth coated Indian otter.

Diagnostic Characters : Sides of frontal bones behind post-orbital processes more or less parallel upto constriction in front of brain case, fur short and depressed, hind foot short, feet fully webbed, throat creamy in colour.

Locality : Reported to occur in Goa state (Nalawade, 1998).

Habitat : Aquatic, preferring to live in and near reservoirs, large rivers, tanks at lower altitudes.

External Distribution : Throughout peninsular India; including Eastern and North-Eastern regions.

Status : The species has been reported from number of localities in peninsular, eastern and north eastern India (Agrawal *et al.* 1992), however populations are fragmented; IUCN Criteria proposed as per the CAMP Report (1998) : Not Evaluated (National), Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule II Part II, CITES : Appendix : II.

Source : Prater (1980), Agrawal *et al.* (1992), Corbet and Hill (1992), Wilson and Reeder (1993), and Nalawade (1998).

Remarks : Not much information on its latest distribution, locations, populations etc. is available.

Family VIVERRIDAE

Viverrids, are medium sized carnivores, many of them are arboreal with rather unspecialized dentition and omnivorous diet. Most species have a prominent perineal scent gland situated in front of the anus. Family Viverridae is represented by two species under two genera in Goa state.

Family *Viverridae* is represented by two subfamilies, *Viverrinae* and *Paradoxurinae*, in Goa state.

Key to the Subfamilies of Family VIVERRIDAE

Feet ordinary and digitigrade, carpal pad single, metatarsal pads absent, a definite pattern of dorsal spots present, tail with dark and pale alternate bands ..... VIVERRINAE

Feet scansorial and semi-plantigrade, semi arboreal, carpal and metatarsal pads double, a pattern of dorsal stripes and lateral spots present at least in new coat. Tail without any bands and uniformly dark in colour ..... PARADOXURINAE

Subfamily VIVERRINAE

Subfamily *Viverrinae* is represented by a single species *Viverricula indica indica* (Desmarest) under Genus *Viverricula* in Goa state.

Genus *Viverricula*

*39. *Viverricula indica indica* (Desmarest)

1817. *Viverra indica* Desmarest, *Nouv. Dict. Hist. Nat.*, Paris, 7 : 170.

Common Name : Small Indian civet.

Diagnostic Characters : A Small Indian civet is a carnivore with six small, equal-sized incisors and a pair of comparatively large and conical canines. A civet is long in body and short in limbs. Body length ±90 cm. It has an elongated head and pointed but short and weak muzzle. A tawny grey or grayish brown animal, lined and streaked on back. Body pattern consists of small spots on the fore quarters, larger spots tending to run into longitudinal lines on the flanks and form six to eight stripes down the back. There are usually some transverse white and black bands on the neck and throat region. Tail with alternate dark and pale bands. Cowper's gland absent. Feet compact with short claws unprotected by sheaths of skins. Feet terrestrial and digitigrade with single carpal pad and no metatarsal pads. Four or five toes in fore and hind feet and not dog-like in structure. The first digit on the fore- and hindfoot, set well above the other toes, is functionless. Teeth not specialized like cats or reduced in number; Anus not enclosed in a glandular sac. Scent gland present in both sexes, in males between scrotum and prepuce, while in females it's behind or encircling vulva. Scent glands open into highly specialized pouches. Soles of feet not entirely covered with hairs.

Locality : Small Indian civet was collected from Molem region by Agrawal (1972) and was sighted in Bondla sanctuary region by the ZSI Survey parties during the project period. Earlier, one specimen (Reg. No. M/270) collected by B. S. Lamba from Molem on 17.xii.1973 has been displayed in ZSI, WRS, museum at Pune.

Habitat : Terrestrial, semi-arboreal and nocturnal. Prefers to live in all types of forests and also close to human dwellings. They take shelter in holes, treeholes, under rocks, under bushes or in tall grasses etc. Some may find refuge in drains and outhouses. They prefer to hunt in night. They prey on the ground, preying on rats, squirrels, small birds, lizards, insects, fruits, roots, and other vegetable matters. Given opportunity, they can prey upon poultry as well. They can readily adapt to the changed conditions.

External Distribution : Throughout India excluding deserts.

Status : Though the distribution is wide and the populations are many, they are fragmented. Once very common in distribution, now its population is declining due to the destruction of its habitat, hunting for medicine and local illegal trade for body parts (Pradhan, 1997); IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-Near threatened (National) Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule II Part II, CITES : Appendix : III (India). *Source* : Agrawal (1972), Prater (1980), Agrawal *et al.* (1992), Corbet and Hill (1992) and Wilson and Reeder (1993).

Remarks : The care of the young ones is left entirely to the mother. The civets can easily be tamed. Some are kept under domestication for the regular extraction of the secretion from the scent glands.

Subfamily PARADOXURINAE

Subfamily *Paradoxurinae* is represented by a single subspecies *Paradoxurus hermaphroditus hermaphroditus* (Pallas) under Genus *Paradoxurus* in Goa state.

*40. ***Paradoxurus h. hermaphroditus*** (Pallas)

1777. *Viverra hermaphrodita* Pallas, *In* Schreber, *Die Saugethiere*, 3 : 426.

Common Name : Common Palm civet or Toddy cat.

Diagnostic Characters : A Common Palm civet or Toddy cat is a carnivore with six small, equal-sized incisors and a pair of comparatively large and conical canines. A civet is long in body and short in limbs. Body length ± 60 cm. It has an elongated head and pointed but short and weak muzzle. A black and blackish-brown civet with long coarse hair. Underwool, when present, whitish or buff or sometimes even yellow hidden in heavy winter coat. The new coat shows a definite pattern of dorsal stripes and lateral spots. Pattern of longitudinal stripes on the back and spots on the flanks, shoulders and thighs is present in the new coat. The limbs are always black or dark brown. Facial markings variable, the most common pattern is white patch or spot below the eye. Some times one spot above the eye and one on each side of the nose are also present. Tail uniformly dark in colour and without any alternate dark and pale bands. Feet compact with short claws unprotected by sheaths of skins. Soles of feet not entirely covered with hairs. Feet scansorial and semiplantigrade with double carpal and metatarsal pads. Four or five toes in fore and hind feet and not dog-like in structure. The first digit on the fore and hindfoot, set well above the other toes, is functionless. Teeth not specialized like cats or reduced in number. Anus not enclosed in a glandular sac. Scent gland present in both sexes, in males between scrotum and prepuce, while in females it's behind or encircling vulva. The scent glands open in less specialized pouches. Interramal tuft of vibrissae present.

Locality : Common Palm civet or Toddy cat was sighted in Molem, Bondla Poinguinim and Keri regions of Goa State by the ZSI Survey parties during the project period. ZSI, WRS, Pune, has one specimen in its collection (Reg. No. M/269), collected from Molem by Dr. B.S. Lamba 18.xii.1973.

Habitat : Terrestrial, more arboreal and nocturnal. Prefers to live in all types of forests and also close to human dwellings. They live much on trees lying curled up by day among the branches. But many have adapted themselves to a

life in human settlements, even in the heart of the crowded cities, selecting a roof, an outhouse, or even drain as a place of hiding. They take shelter in holes, treeholes, under rocks, under bushes or in tall grasses etc. They prefer to hunt in night. Though they are arboreal/semi-arboreal, they prey on the ground, preying on rats, squirrels, small birds, lizards, insects, fruits, roots, and other vegetable matters. Given opportunity, they can prey upon poultry as well. They can readily adapt to the changed conditions.

External Distribution : Throughout India excluding deserts.

Status : Though the distribution is wide and the populations are many, they are fragmented. Further, though they are fairly common in distribution, now its population is declining due to the destruction of its habitat, hunting for medicine and local illegal trade for body parts (Pradhan, 1997); IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-Least concern (National) and Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule II Part II, CITES : Nil.

Source : Prater (1980), Corbet and Hill (1992), Agrawal *et al.* (1992), Wilson and Reeder (1993) and Menon (2003).

Remarks : The young ones are born in all seasons and are usually offered shelter in tree holes or under a rock. The civets can easily be tamed. Some are kept under domestication for the regular extraction of the secretion from the scent glands. The species is involved in illegal Wildlife trade due to belief in superstitions (Pradhan, 1997). All the civet species are under threat of illegal trade for this reason. Hence they should be included in one of the CITES appendices.

Family HERPESTIDAE

Family Herpestidae is represented by two species under one Genus, *Herpestes*, in Goa State.

Genus *Herpestes*

Key to the two species of *Herpestes*

Dorsal pelage with shorter hairs (length 20-30 mm), grey in colour, many banded and coarse in nature, colour of legs same as that of dorsum, tail tip normal and never black, bulla normal and not inflated posteriorly .... *Herpestes edwardsii*

Dorsal pelage with longer hairs (length 30-40 mm), grayish in colour, legs darker than dorsum, tail tip black, bulla with posterior chambers greatly inflated .... *Herpestes smithii*

*41. ***Herpestes edwardsii*** (Geoffroy)

1818. *Ichneumon edwardsii* GeoffTroy, E., *Description de l'Egypt Description des mammiferes*, **2**, Paris : 139.

Common Name : Indian grey mongoose.

Diagnostic Characters : The grey coloured Indian mongoose possesses long body with short limbs and a bushy tail. The longer contour hairs almost form a cape along the flanks and over hind quarters. The hairs at the base of the tail are fairly long. The fur is rather stiff and coarse, individual hairs being annulated with creamy white and black long hairs which may have as many as eight to ten alternate bands of colours. Underfur is wooly and reddish-buff in colour. Tip of the tail never black in colour.

Locality : Indian grey mongoose was sighted in Molem, Bondla, Valpoi and Madgaon regions of Goa State by the ZSI Survey parties during the project period.

Habitat : Terrestrial, diurnal/nocturnal, fossorial, living in open scrubs, cultivation, rocky patches, forest edges, near human habitations etc.

External Distribution : Throughout India.

Status : Fairly common, reported from many localities; IUCN Criteria proposed as per the CAMP Report (1998): Lower risk-least concern (National), Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule II Part II; CITES : Appendix III.

Source Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Roberts (1997) and Nalawade (1998).

Remarks : The mongoose can easily be tamed. Threat to its population due to hunting for medicine, trophies and food and also for local illegal trade for body parts for making articles like brushes etc. cannot be ruled out (Pradhan, 1997).

42. ***Herpestes smithii smithii*** Gray

1837a. *Herpestes smithii*, Gray J.E., *Magazine nat. Hist.*, **1** : 578.

Common Name : Ruddy Mongoose.

Diagnostic Characters : Dorsal pelage of ruddy mongoose possesses large hairs, tail tip always black, legs darker than dorsum and bulla with posterior chamber greatly inflated, rest of the characters mostly similar to that of the previous species.

Locality : Reported to occur in many localities of peninsular India including Goa state (CAMP Report, 1998, Nalawade, 1998).

Habitat : Terrestrial diurnal/nocturnal, fossorial preferring to live in dry and moist forests of Central and Southern India.

External Distribution : Peninsular India.

Status : Though seen less commonly in this region, the species has been reported from number of ofther Indian localities; IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-least concern (National), Data Deficient (Global), CITES : Appendix III, Indian Wildlife (Protection) Act (1972) as amended upto 2002) Schedule : Schedule II Part II.

Source : Prater (1980), Corbet and Hill (1992),Wilson and Reeder (1997) and Nalawade (1998).

Remarks : Threat to the populations of ruddy mongoose due to hunting for medicine, trophies and food and also for local illegal trade for body parts for making articles like brushes etc. cannot be ruled out (Pradhan, 1997).

Family HYAENIDAE

Medium-sized, dog like carnivore with pointed ears, weak hind quarter, forefeet with four digits and a sac-like scent gland above the anus. Hyaena also possesses very strong jaws.

Family *Hyaenidae* is represented by a single species under Indian Genus *Hyaena* in Goa state.

*43. ***Hyaena hyaena*** (Lin.)

1758. *Canis hyaena* Linnaeus, *Syst. Nat.*, 10th ed; **1** : 40.

Common Name : Striped hyaena.

Diagnostic Characters : Hyaena possesses vertical dark stripes on the body and transverse bars on the upper portion of the legs with ground colour of body varying between cream and dirty white. A crest of mane extending from the head to root of the tail present. Dog like built with massive head and fore-body but with weak hind quarters.

Locality : Striped hyaena was sighted in Cotigao sanctuary near Painginim in Goa State by the ZSI Survey party during the project period.

Habitat : Terrestrial, nocturnal, rare in forested areas but found in open countries, scrub lands and semi urban areas, found also in thorny semi-arid regions. Prefers to live in low hilly areas and ravines which offer convenient holes and caves for shelter, mainly scavenger in habit but can also hunt preys of its size like sheep, goat, dog etc. Hyaenas are also known to dig open graves in search of food.

External Distribution : Throughout India.

Status : The species has been reported from number of localities in India, IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-near threatened (National) and Data Deficient (Global); Indian Wildlife (Protection) Act 1972 (as amended upto 2002) : Schedule : III.

Source : Prater (1980), Corbet and Hill (1992), Agrawal *et. al.* (1992), Roberts (1997), Wilson and Reeder (1993) and Menon (2003).

Remarks : The population is under threat due to faiths in wrong beliefs and also due to illegal

wildlife trade of its fur in domestic as well as international markets (Pradhan, 1997).

Family FELIDAE

Felids (cats) possess short muzzle (1/5th of total skull length), tooth row of lower jaw with conspicuous gap behind canines, only 3-4 teeth behind the canines in each jaw, no scent glands above anus.

Family Felidae is represented by two subfamilies, *Felinae* and *Pantherinae* in Goa State.

Key to the Subfamilies of Family FELIDAE

Small cats with head-body length in the range 40-75 cm; hairs on nape normal and pupil vertical ..... FELINAE

Large cats with head-body length in the range 107-200 cm; hairs on nape reversed and pupil round ..... PANTHERINAE

Subfamily FELINAE

Subfamily *Felinae* is represented by two Genera, *Felis* and *Prionailurus* in Goa State.

Key to the genera

1. Ears without white patch on the backside, hairs on throat normal and post orbital bar usually incomplete ..... ***Felis***

– Ears with white patch on the backside, hairs on throat reversed and post orbital bar complete ..... ***Prionailurus***

Genus ***Felis***

Genus *Felis* is represented by a single subspecies under the species, *Felis chaus* in Goa State.

*44. ***Felis chaus kelaarti*** Pocock

1776. *Felis chaus* Guldenstaedt, *Novi Comment. Acad. Sci. Impetropol.*, **20** : 483–500 pls. 14, 15.

Common Name : Jungle Cat.

Diagnostic Characters : A medium-sized cat with long legs and comparatively short tail, head and body length varying between 64–72 cm, belly faintly spotted, tail and legs banded, sometimes winter coat large and luxuriant.

Locality : Agrawal (1972) collected one specimen from Molem region of Goa State. Jungle cat has been sighted in Keri region by ZSI Survey party during project period.

Habitat : Terrestrial, nocturnal, inhabiting drier and open parts of the country, keeping more to grassland, scrub, dry deciduous and evergreen forests, reedy banks of rivers and marshes.

External Distribution : India.

Status : The species has been reported from number of localities, IUCN Criteria proposed as per CAMP Report (1998) : Lower risk-near threatened (National) and Data Deficient (Global); CITES : Appendix II, Indian Wildlife (Protection) Act 1972 (as amended upto 2002) : Schedule : Schedule II Part II.

Source : Agrawal (1972), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993) and Alfred *et al.* (2002).

Remarks : The population is under threat due to illicit wildlife trade in domestic as well as International markets (Pradhan, 1997).

Genus ***Prionailurus***

Genus *Prionailurus* is represented by two species in Goa State.

Key to the two species of *Prionailurus*

1. Pelage spotted all over. Tail spotted only on dorsal side. Back of ears black with a pale or whitish spot in the centre. Upper molar series 4 on each side ..... ***Prionailurus bengalensis***

2. Pelage spotted all over. However tail unspotted. Back of ears brown with a large pale spot in the centre. Upper molar series 3 on each side ..... ***Prionailurus rubigenosus***

45. ***Prionailurus bengalensis*** (Kerr)

1792. *Felis bengalensis* Kerr, *Anim. Kingd.*, : 151.

Common Name : English : Leopard Cat.

Diagnostic Characters: Leopard cat is a carnivore with six small, equal-sized incisors and a pair of comparatively short and conical canines with normal post-canine space. Being member of the cat family which contains beasts of preys, leopard cat shows all typical characters of the order *Carnivora* and family *Felidae*. Leopard cat is a relatively small cat with long limbs; head and body length 61-66 cm; tail more than half of head and body length (Approx. 60%) and pelage with beautifully ornamented leopard like blackish brown spots. In colour and markings the leopard cat looks like a panther in miniature. The colour of the body is yellowish above and white below. Back of the ears black with round whitish spot in centre. Among other markings, there are four more or less distinct black bands running from the crown over the neck and break up into short bars and elongated spots on the shoulders. There is a pair of horizontal cheek stripes, the lower one joining the black bar across the throat. There are two black bars on the inside of the forearm. The spots on the tail form cross bars towards its end. Hairs on nape normal while reversed on throat. Contracted pupil vertical. Teeth sectorial and reduced in number and are specialized in nature suited to the diet of meat.

Locality : Reported to occur in central part of Western Ghats including Goa state (Nalawade, 1998).

Habitat : Largely terrestrial, semi-arboreal and nocturnal in habit and, hence, seldom seen; Prefers to live chiefly in thick dry/moist deciduous and evergreen forests, grasslands, scrubs etc. The prey species mostly include small animals and birds.

External Distribution : Throughout India.

Status : Rare atleast in Goa State; IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-Near threatened (National) and Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule I Part I, CITES: Appendix : I; Red Data Book (National, 1994): Vulnerable.

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993) Nalawade (1998), Chakraborty and Agrawal (2000) and Alfred *et al.* (2002).

Remarks : Leopard cat is also killed for fur and body parts for local and domestic trade. Some tribal kill them for preparation of trophies. These beautiful cats are also trapped live for commercial trade (Pradhan, 1997). Earlier *Prionailurus* was synonymised in Genus *Felis*. However most of the taxonomists have chosen to emphasize their distinctiveness by placing them in monotypic genus.

46. ***Prionailurus rubiginosus rubiginosus*** (Geoffroy)

1831. *Prionailurus rubiginosa* Geoffroy, *Belanger, Voy. Ind. Orient. Zool.*, 140.

Common Name : Rusty spotted cat.

Diagnostic Characters : Small sized cat with head & body length varying between 40–50 cm. Dorsal pelage rufescent grey patterned with brown bars and spots. Ground colour grey-brown. Ears with white patch on the backside, hairs on throat reversed. Pair of cheek stripe and four dark lines present over the head. Belly and inner side of legs white with large dark spots. Tail unspotted and uniformly coloured.

Locality: Reported to occur in Western Ghats including Goa State. However, its present occurrence Status south of Mahabalshwar in Western Ghats appears to be doubtful (Nalawade, 1998).

Habitat : Terrestrial and to some extent arboreal, nocturnal, frequenting grassland, scrub, dry and open forests and tolerant to man-made habitats like plantations.

External Distribution : Peninsular India.

Status : Though very rare, the species has a very wide range of distribution, IUCN Criteria proposed as per CAMP Report (1998) : Lower risk-near threatened (National) and Data Deficient (Global), Indian Wildlife (Protection) Act 1972 (as amended upto 2002) : Schedule I Part I, CITES

: Appendix I, Red Data Book (1994) : Insufficiently known.

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993) Nalawade (1998), Chakraborty and Agrawal (2000) and Alfred *et. al.* (2002).

Subfamily PANTHERINAE

Subfamily *Pantherinae* is represented by a single Genus, *Panthera* in Goa State.

Genus *Panthera*

Two species of Genus *Panthera* are known to occur in Goa State.

Key to the two species of *Panthera*

Large sized cats with body length including tail over 260 cm. Colour pattern consisting of vertical black stripes on rich reddish yellow to orange rufous coat .... *Panthera tigris tigris* (Lin.)

Smaller sized cats with body length including tail Less than 215 cm. Colour pattern consisting of black spots irregularly arranged in rosettes. Tail relatively slim .... *Panthera pardus fusca* (Meyer)

*47. ***Panthera pardus fusca*** (Meyer)

1794. *Felis fusca* Meyer, *Zool. Ann.*, : 1 : 394.

Common Name : Panther/Leopard.

Diagnostic Characters : Leopard/panther is a relatively large cat with long limbs; total length including tail 170-215 cm with height at shoulder 60 cm; tail more than half of head and body length (Approx. 60%) and pelage with beautifully ornamented close-set black spots arranged in rosettes on the short haired coat. The ground colour of the body is yellow above and white below with black rosettes all around. Dorsal ground colour may vary from pale yellow to warm grey, rich tawny to rufous fawn. The tail is also covered with spots except at the tip, which is ringed. Hairs on nape and throat reversed. Ears not tufted. Contracted pupils round. Teeth sectorial and reduced in number and are specialized in nature suited to the diet of meat. Claws retractile and especially adapted to strike and hold the struggling prey and teeth specially designed to bite into, cut up and tear flesh.

Locality : Atleast Two flat skins of leopard seized from the poachers by the Maharashtra State Forest Dept. authorities on the border of Maharashtra and Goa States were brought to ZSI, WRS, Pune, for identification studies during project period. Further, Forest Dept. authorities of Goa State reported to have sighted Leopards in Molem, Cotigao and Bondla sanctuaries.

Habitat : Terrestrial, nocturnal, semi-arboreal, inhabiting forests, scrub jungles, open country etc. They are able to thrive almost anywhere. A resident species not restricted to forests and heavy covers like tiger. Being bold in nature this predator species comes more frequently in contact with man than the tiger.

External Distribution : Throughout India.

Status : The species has been reported from number of localities, IUCN Criteria proposed as per CAMP Report (1998) : Vulnerable (National) and Data Deficient (Global), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule I Part I, CITES : Appendix I, Red Data Book (1994): Vulnerable.

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et. al.* (2002) and Menon (2003).

Remarks : Largest number of leopard skins in the cat skin trade are involved in the illegal trade. The populations are under threat due to illicit wildlife trade of its fur and body parts in domestic and international markets (Pradhan, 1997).

*48. ***Panthera tigris tigris*** (Linn.)

1758. *Felis tigris* Linnaeus, *Syst. Nat.*, 10th Ed. : 41.

Common Name : Royal Bengal Tiger/Tiger.

Diagnostic Characters : Tiger, being member of a cat family which contains beasts of preys, shows all typical characters of order *Carnivora*

and family *Felidae*. Tiger is a large cat with graceful built and long limbs; total length including tail 260-290 cm with black ringed tail more than half of head and body length (Approx. 60%); pelage with beautifully ornamented black coloured stripes on the short haired coat. The ground colour of the body varies from reddish yellow to orange rufous above and white below with black prominent stripes all over the body. Hairs on nape and throat reversed. Ears not tufted but are black on the outer side with a prominent white spot in the middle. Contracted pupils round. Teeth sectorial and reduced in number and are specialized in nature suited to the diet of meat. Claws retractile and especially adapted to strike and hold struggling prey and teeth specially designed to bite into, cut up and tear flesh.

Locality : Though tiger was not actually sighted by ZSI Survey parties during the project period, it is quite likely that there is a movement of tiger in areas such as Molem, Cotigao and Valpoi regions close to Western Ghats in Goa State. Because there are confirmed reports of tiger movement in the bordering districts of Maharashtra (Sindhudurg Dist.) and Karnataka States (Belgaon Dist.). Further the Chief Wildlife Warden of Goa State has also confirmed tiger movement in these areas, especially in Molem region.

Habitat : Largely terrestrial and nocturnal in habit and, hence, seldom seen; It can live in variety of habitats like the hills, plains, thick dry/ moist deciduous and evergreen forests, grasslands, scrubs, mangroves swamps etc. Comparatively tiger is a shy animal in behavior. Tiger is a very good swimmer and enormously powerful animal which can easily kill animals larger in size than its own size like bull, cow, bullock etc. In forests it thrives on deer, sambar, nilgai, pig, antelope, hare, monkey, peafowl and other small birds. The prey species also include poultry, goat, sheep, dog and even human being on the village border. Tiger hunts between sunset and dawn and covers long distances in the course of night in search of food. Like any large cat it also shows territorial behavior.

External Distribution : Throughout India except North-Western region.

Status : Possibly not a resident species in Goa State; IUCN Criteria proposed as per the CAMP Report (1998) : Endangered (National) and Data Deficient (Global); Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule I Part I, CITES: Appendix : I; Red Data Book (National, 1994) : Vulnerable.

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et. al.* (2002) and Menon (2003).

Remarks : Large number of tiger skins in the cat skin trade is involved in the illegal trade. Tiger is also killed for fur and body such as bones in domestic as well as international market for various reasons. These beautiful cats are also trapped live for commercial trade (Pradhan, 1997).

Order PROBOSCIDEA

Order *Proboscidea* is represented by the animals with massively built body, possessing long flexible proboscis. Males generally possess large tusks *i.e.* enlarged incisors. Molars large and transversely ridged.

The order contains a single family *Elephantidae*.

Family ELEPHANTIDAE

In India Family *Elephantidae* is represented by a single subspecies, *Elephas maximus indicus* Cuvier under a species *Elephas maximus* of Genus *Elephas*.

*49. ***Elephas maximus indicus*** Cuvier

1997. *Elephas indicus* Cuvier, *Tabl. Elem. Hist. Nat.* : 148 (India).

Common Name : Indian Elephant.

Diagnostic Characters : Elephant possess massively built body with a long flexible proboscis. Proboscis ends in a single lip. Males generally possess large tusks i.e. enlarged incisors. Molars large and transversely ridged. Height at shoulder upto 335 cm. Body blackish grey throughout. Four nails on each hindfoot. Ears large but not enormous like african elephant.

Locality : Elephant appears to be a visitor from Karnataka State. During March 2002 survey, ZSI survey team collected authentic information from Forest Dept. authorities and local residents of neighboring Khalapur Taluka in Belgaon Dist. about elephant attack on trespassers resulting in deaths of some individuals. A small herd of 3-4 elephants was moving in the densely forested region on Karnataka-Goa boundary at that time.

Habitat : Terrestrial, preferring to live in tropical dry and moist deciduous forests including savannah grasslands. Can undertake long distance migration in search of food, shelter and water. Possesses excellent sense of smell and memory. Extremely adaptable. Very social and lives in herds of varying sizes.

External Distribution : Southern Western Ghats, Eastern Ghats, parts of Central, northern, eastern and north-eastern India.

Status : The species has been reported from number of fragmented localities, IUCN Criteria proposed as per CAMP Report (1998) : Vulnerable (National) and Data Deficient (Global), Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule : Schedule I Part I, CITES : Appendix I, Red Data Book (1994): Vulnerable.

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et. al.* (2002) and Menon (2003).

Remarks : Elephants are involved in large scale illegal trade at domestic as well as international level, mostly for ivory and other body parts (Pradhan, 1997). The populations are under threat due to illicit wildlife trade, fragmentation of populations, loss of natural habitat, corridors etc. These result in elephant encroachments in cultivation, house hold properties and elephant-human conflicts (Agrawal *et al.* 1992).

Order ARTIODACTYLA

Even-toed ungulates, axis of the foot between third and fourth toes; toes enclosed in horny hooves of roughly same size giving appearance of single hoof. Four families in Goa State represent order *Artiodactyla.*

Key to the families of the Order ARTIODACTYLA

1. Upper incisors present; animals devoid of horns and antlers; stomach with two chambers. ..... SUIDAE
– Upper incisors absent; horns or antlers present atleast in males; stomach with 3–4 chambers 2
2. Metacarpals of 2nd and 5th digits complete; pre-orbital glands absent, I_1 not angular and wider than I_2, C_1, modified into tusks, stomach with three chambers ..... TRAGULIDAE
– Metacarpals of 2nd and 5th digits rudimentary; pre-orbital gland may or may not be present, I_1 angular and much wider than I_2 C_1 may or may not be modified into tusks, stomach with four chambers 3
3. Permanent horns, atleast in males, present; C_1 absent; post-oribtal gland may or may not be present ..... BOVIDAE
– Deciduous antlers present in males; C_1 present in normal shape; post orbital gland present ..... CERVIDAE

Family SUIDAE

Family suidae is represented by a single species, *Sus scrofa*, under a genus, *Sus*, in Goa State.

*50. *Sus scrofa* Linn.

1758. *Sus scrofa* Linnaeus, *Systema naturae* Vol. 1, 10th Ed. *Holmia.*, : 824.

Common Name : Wild Boar.

Diagnostic Characters : Greatly elongated muzzle terminating in a flattened naked nasal disc adapted for rooting up subterranean parts of plants, upper incisors present, stomach with two chambers only, crest of black bristles present from nape to the back.

Locality : Reported from most of the protected areas of Goa State such as Molem, Bondla, Cotigao etc. sanctuaries. Sighted smaller groups in Molem, Bondla, Paingirim regions by ZSI survey parties during project period.

Habitat : Terrestrial, wild boar lives in grassy or scanty bushy jungle, forest, most commonly seen in agriculture crops also.

External Distribution : Throughout India.

Status : Reported from many localities, human-wild boar conflict occurs due to crop damages, Indian Wildlife (Protection) Act 1972 (as amended upto 2002), Schedule : Schedule III; IUCN Criteria proposed as per CAMP Report (1998) : Lower risk-least concern (National), Data Deficient (Global).

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993) and Menon (2003).

Remarks : Wild Boar causes extensive damage to the standing crops.

Family TRAGULIDAE

The cloven hoofed deers are smallest of the ungulates possessing, like musk deer, enlarged upper canines in males. Mouse deers are included in this family because they do not possess upper incisors, antlers or horns and preorbital glands. But they do possess three chambered stomach. Family Tragulidae is represented by a single species under the genus *Moschiola* viz. *Moschiola meminna* Erxleben in Goa State.

*51. ***Moschiola meminna*** Erxleben

1777. *Moschus meminna* Erxleben, J.C.P., *Mammalia Lipsia* : **Xlviii** : 322.

Common Name : Indian chevrotain or Mouse Deer.

Diagnostic Characters : Same as mentioned for the family, these deers have four well developed toes on each foot. A tiny little deer with high hindquarters. Its coat is olive-brown minutely speckled with yellow. The flanks are marked with characteristic rows of buff or white spots, which elongate and pass into longitudinal bands. Ventral side is always white.

Locality : One specimen has been collected, in past, from Molem by B. S. Lamba on 17. xii. 1973 (Reg. No. M/268). It is also reported to occur in the mountainous forest tracts of Western Ghats in Goa State (Nalawade, 1998).

Habitat : Terrestrial, small sized shy creature preferring to live in thick forest.

External Distribution : Peninsular India.

Status : Reported from many localities in Peninsular India, IUCN Criteria as per the CAMP Report (1998) : Lower risk-near threatened (National), Data Deficient (Global), Indian Wildlife (Protection) Act (1972) as amended upto 2002), Schedule : Schedule I Part I.

Source: Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Alfred *et al.* (2002) and Menon (2003).

Family CERVIDAE

Medium sized deers possessing deciduous antlers in males, post-orbital gland and four chambered stomach. No incisors in upper jaw. Family *Cervidae* is represented by Subfamilies *Cervinae* and *Muntiacinae* in Goa region.

Key to the subfamilies of Family CERVIDAE

Upper canines tusk-like, in males; antlers short, consisting of a short brow-tine and an unbranched beam ..... MUNTIACINAE

Upper canines when present, not tusk-like; antlers long and branched ..... CERVINAE

Subfamily CERVINAE

Two genera represent Subfamily *Cervinae* in Goa region.

Key to the genera of Subfamily CERVINAE

Body distinctly spotted; brow-tine set at right angles to the beam of antlers ..... ***Axis***

Body unspotted; brow-tine form an acute angle with the beam of antlers ..... ***Cervus***

Genus ***Axis***

Species *Axis axis* (Erxleben) represents Genus *Axis* in Goa State.

*52. *Axis axis* (Erxleben)

1777. *Crevus axis* Erxleben,, *Syst. Regn. Anim.* : 312.

Common Name : Chital, Spotted Deer.

Diagnostic Characteristic : Coat bright rufous-fawn, profusely spotted with white, at all ages and seasons, antlers with three tines, a long brow-tine set nearly at right angles to the beam; latter divides into two branches.

Locality : Sighted small herds of spotted deers in Molem and Bondla sanctuaries by ZSI survey party during project period.

Habitat : Terrestrial, diurnal, prefers to stay in grassy forest glades and shaded streams, generally seen in herds of 10–30 with one or two stags.

External Distribution : Throughout India.

Status : Abundant populations reported from number of localities, Indian Wildlife (Protection) Act, 1972 (as amended upto 2002) : Schedule IV; IUCN Criteria proposed as per CAMP Report (1998) : Lower risk-least concern (National), Data Deficient (Global).

Source : Prater (1980), Agrawal *et al.* (1992), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Alfred *et al.* (2002) and Menon (2003).

Remarks : Wilson and Reeder (1993) have included Genera *Axis* and *Cervus* in subfamily *Cervinae* under family *Cervidae* on the basis of the revisionary studies carried out by Whitehead (1972) and Groves and Grub (1987) (Cited in Wilson and Reeder, 1993). Spotted deers are involved in large scale illegal trade, hunting and poaching at domestic as well as international level, mostly for skin and other body parts and also for antlers for making trophies, (Pradhan, 1997).

Genus *Cervus*

Only One species of Genus *Cervus* occurs in Goa State.

*53. *Cervus unicolor* Kerr

1792. *Cervus axis unicolor* Kerr *The animal kingdom Class Mammalia, London*, Murrey : 400.

Common Name : Sambar.

Diagnostic Characters : Largest of the Indian deer, height at shoulder about 159 cm., coat coarse and shaggy, mane present in stags, covering neck and throat, each antlers with 3 tines, brow antler forming an acute angle, colour brown dorsally with yellowish or grayish tinge, ventral side paler.

Locality : Sighted in Molem and Cotigao sanctuaries of Goa State.

Habitat : Terrestrial, preferring to live in thickly wooded forest, diurnal in habit.

External Distribution : Throughout India; *Status* : Many populations have been reported from number of localities, Indian Wildlife (Protection) Act, 1972 (as amended upto 2002) Schedule: Schedule : III, IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-least concern (National) and Data Deficient (Global).

Source : Prater (1980), Agrawal *et al.* (1992), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Alfred *et al.* (2002) and Menon (2003).

Remarks : Same as those mentioned in *Axis axis*.

Subfamily MUNTIACINAE

Subfamily *Muntiacinae* is represented in Goa State by a single Genus *Muntiacus*.

Genus *Muntiacus*

Genus *Muntiacus* is represented in Goa State by a single species, *Muntiacus muntjack*.

*54. *Muntiacus muntjack* (Zimmerman)

1780. *Cervus muntjack* Zimmerman, *Geogr. Gesch. Mensch. Vierf. Thiere*, 2 : 131.

Common Name : Indian muntjak, Barking deer, Rib-faced deer.

Diagnostic Characters : Upper canines tusk like in males; antlers short and unspotted coat slightly darker in colour. Dorsum reddish chestnut, while venter white in colour. Heavy bodied deer

with short dainty legs. Body fur soft and glossy. Male with a pair of short antlers arising from two skin covered bony pedicles which extend down on either side of the face as bony ridges.

Locality : Sighting in Molem sanctuary has been reported by one of the ZSI survey parties during the project period.

Habitat : Terrestrial, any thickly wooded forest including moist mixed deciduous, diurnal in habit.

External Distribution : Almost throughout the country excluding Jammu and Kashmir.

Status : Fragmented populations reported from selected localities; Indian Wildlife (Protection) Act, 1972 (as amended upto 2002) : Schedule III; IUCN Criteria proposed as per CAMP Report (1998) : Lower risk-least concern (National), Data Deficient (Global).

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Alfred *et al.* (2002) and Menon (2003).

Remarks : Wilson and Reeder (1993) have reported number of subfamilies under the Family *Cervidae* on the basis of the revisionary work carried out by Whitehead (1972) and Groves and Grab (1987) (Both cited in Wilson and Reeder, 1993), Genus *Muntiacus* has been included in subfamily *Muntiacinae*. Barking deers are also involved in illegal trade, hunting and poaching at domestic level, mostly for skin and other body parts such as meat and also for antlers for making trophies, (Pradhan, 1997).

Family BOVIDAE

The bovid species possess permanent horns, usually in both sexes, consisting of bone cores with sheaths of horn, no incisors or canines in upper jaw, stomach with four chambers. Family *Bovidae* is represented by a single subfamily *Bovinae* in Goa State.

Subfamily BOVINAE

Only two genera under Subfamily *Bovinae* have been recorded from the State of Goa.

Key to the genera of Subfamily BOVINAE

1. Two pairs of short horns in males. Small-sized antelope with height at shoulder about 65 cm ..... ***Tetracerus***

– Only one pair of strong horns in both sexes. Large-sized heavily built–up animals with height at shoulder more than 100 cm ... ***Bos***

Genus *Bos*

Only one species under genus *Bos* has been reported from Goa State.

*55. *Bos gaurus* Smith

1827. *Bos gaurus* H. Smith, *Griffith's Cuvier Anim. Kingd.* **4**.: pl. Opposite : 399.

Common Name : Indian Gaur.

Diagnostic Characters : Gaur is a robust animal with height at shoulders, in males, in the range of 175-196 cm, and possessing permanent horns in both the sexes. Gaur horn bases are wide apart and cross section of the horn is always round or oval. The horn consists of unbranched bone core with a sheath. Gaur possesses huge head, deep massive body and sturdy limbs. Ears large and broad. A prominent muscular dorsal ridge present on the shoulders, which slopes down to the middle of the back where it ends in an abrupt dip. Being a member of the bovid family upper incisors absent, and diastema between incisors and cheek-teeth long. Tail with terminal tuft of hairs. The general body colour coffee or reddish brown or jet black in older bulls and ashy forehead with yellowish or whitish stockings. Calves always lighter in colour, while adult female blackish brown in colour. Stomach complex and divided into four chambers. In hot weather much of the hair is shed.

Locality: Herds of gaur have been sighted in Molem and Bondla sanctuaries in Goa State by ZSI survey parties and Forests Dept. authorities during the project period.

Habitat : A typical thickly wooded hills are the favourite haunts of Gaur in India. Largely terrestrial preferring to live in all types of forests

and jungles. They can go even beyond the altitude of 6000 Ft. They are fairly diurnal in habit. They are seen generally in herds. They keep to more or less thick jungle and come out to graze in open or outskirts of the forest. Gaur is by nature shy and timid animal.

External Distribution : Peninsular India.

Status : Fragmented populations are reported from isolated localities. Not very common in the state; Indian Wildlife (Protection) Act (1972, as amended unto 2002) Schedule : Schedule I Part I, IUCN Criteria proposed as per the CAMP Report (1998) : Vulnerable (National)and Data Deficient (Global), Red Data Book, National (1994): Vulnerable, CITES Appendix: I.

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Alfred *et al.* (2002) and Menon (2003).

Remarks : Peter Grubb in Wilson and Reeder (1993) has included *Bos gaurus* in *Bos frontalis*. However *Bos gaurus* has been retained here based on the comments given in Corbet and Hill (1992). Gaur is hunted for its meat for food and body parts for various purposes including making trophies. Threats to the survival of the species are also due to habitat destructions, human interference and domestic as well as international commercial trade. (Pradhan, 1997).

Genus *Tetracerus*

Only one species under genus *Tetracerus* has been reported from Goa State.

56. *Tetracerus quadricornis* (Blainville)

1816. *Cerophorus (Cervicapra) quadricornis* Blainville, *Bulletin Sci. Soc. philmon.* Paris : 73–82.

Common Name : Four-horned antelope, chousingha.

Diagnostic Characters : Presence of four horns (second pair on the forehead is comparatively much smaller), absence of rings on the horns, which are keeled in front, and presence of a pair of well-developed glands between the false hooves of the hind legs in both the sexes are the characteristic features of the species. Coat colour dull red-brown dorsally and white ventrally with dark stripe down the front of each leg.

Locality : Reported to occur in the forest tracts of Western Ghats in Goa State (Nalawade, 1998); *Habitat* : Terrestrial, well wooded and watered undulating terrain with dry deciduous forests, also found in transition zone between scrub and the forests, diurnal in habit.

External Distribution : Throughout India excluding northeast region.

Status : Fragmented populations reported from isolated localities; Indian Wildlife (Protection) Act 1972 (as amended upto 2002) : Schedule : Schedule I Part I; Red Data Book (1994) (National) : Vulnerable; Red Data Book (1996) (International) : Vulnerable, IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-near threatened (National) and Data Deficient (Global).

Source : Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Alfred *et. al.* (2002) and Menon (2003).

Remarks : Wilson and Reeder (1993) has divided family Bovidae into number of subfamilies without giving any keys. According to them *Tetracerus* falls under subfamily *Bovinae*.

Order RODENTIA

Order *Rodentia* is characterized by presence of a pair of ever growing chisel-shaped incisors in each jaw and a distinct diastema (Open space) between incisors and cheek teeth (Molars).

Order *Rodentia* is represented by two suborders in Goa State.

Key to the suborders of RODENTIA

1. Fur modified into quills or long stiff hairs; cheek teeth 4/4 in number .... HYSTRICOGNATHI
2. Fur normal and not modified into quills or long stiff hairs; cheek teeth never 4/4 in number except in Genus *Ratufa* .... SCIUROGNATHI

Suborder SCIUROGNATHI

Suborder *Sciurognathi* is represented by two families in Goa State.

Key to the Families of SCIUROGNATHI

1. Skull with distinct post-orbital process; Infraorbital foramen scarcely open for muscle transmission; cheek teeth, except in Genus Ratufa, 5/4 in number ..... SCIURIDAE
2. Skull without any post-orbital process; Infraorbital foramen clearly open for muscle transmission; cheek teeth, 3/3 in number .... MURIDAE

Family SCIURIDAE

Family *Sciuridae* is represented by two subfamilies in Goa State. All types of squirrels belong to the Family *Sciuridae.*

Key to the Subfamilies of SCIURIDAE

1. Flying membrane present on both side of the body ..... PETAURISTINAE
2. Flying membrane totally absent .... SCIURINAE

Subfamily SCIURINAE

Subfamily *Sciurinae* (Non-flying squirrels) is represented by two Genera in Goa State.

Key to the Genera of Sciurinae

1. Large-sized squirrel, head and body length over 280mm; dorsum without any stripe on the body ..... ***Ratufa***
2. Small-sized squirrel, head and body length always below 280mm; dorsal surface of the body with stripes ..... ***Funambulus***

Genus *Ratufa*

One species of the genus *Ratufa* occurs in Goa State.

Species *Ratufa indica*

Indian Giant squirrel, *Ratufa indica,* is represented in Goa State by two subspecies with considerable amount of over-lapping in distribution and intergradations. Many a times they share same ecological zone. Even overlapping in coloration pattern can mislead to wrong identification of the subspecies in the field.

Key to the Subspecies of *Ratufa indica*

1. Half of the forelimbs and distal almost half portion of the tail creamish white coloured; Cream colour on the forelimb does not extend up to neck ..... *Ratufa indica indica*
2. More than half portion of the forelimbs and only terminal portion of the tail creamish white coloured; Cream colour on the forelimb extends up to neck .... *Ratufa indica bengalensis*

*57. ***Ratufa indica indica*** (Erxleben)

1777. *Sciurus indica* Erxleben, *Syst. Regn. Anim.*, **1** : 420.

Common Name : Indian Giant squirrel.

Diagnostic Characters : Indian giant squirrel has been included in the largest mammalian order *Rodentia*, since it possesses a pair of chisel-shaped ever growing incisors in each jaw, a distinct diastema between incisors and cheek teeth (Molars) and the clawed digits. Sqirrels, marmots, rats, mice, porcupines and their close relatives are grouped under Rodentia, the rodents or gnawing mammals. Body size large over 280 mm in head and body length (Max. 470 mm), molars four in number and tail usually long and bushy (Around 600 mm). Infraorbital foramen scarcely open for muscle transmission. Dorsum deep red, while venter light buff or yellowish in colour. Tail dark proximally. However, almost half the distal part of the tail paler in colour. Ears red with small tuft of hairs. Forelegs blackish red in colour.

Locality : Thick forested areas of Western Ghats in Goa State. Sighted one pair by ZSI survey party in the thick forest of Molem sanctuary during project period.

Habitat : Giant squirrels live only in thick forests of different types and, hence, is considered

as indicator species. It is an arboreal and diurnal species. They keep to the canopies and seldom come on the ground. They move from tree top to tree top taking amazing leaps with limbs outspread, covering as much as twenty feet in a single flight. They are in habit of constructing number of nests on the tree tops. They are shy and wary animals and not so easy to locate. Despite its brilliant colouring they are sooner heard than seen.

External Distribution : Thick forested areas of northern Western Ghats.

Status : IUCN Criteria proposed as per the CAMP Report (2005) : Vulnerable, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule II, Part II, CITES Appendix : II.

Source : Ellerman (1961), Agrawal (1972), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et al.* (2002) and Menon (2003).

Remarks : Hoffman Robert S., Anderson C. G., Thorington, R. W. And Heaney, L. R. in Wilson and Reeder (1993) have placed Genus *Ratufa* in the Subfamily *Scuirinae*. However it has been kept under *Ratufinae* here following the comments given in Corbet and Hill (1992). Indian giant squirrel is hunted for its meat for food and skin and body parts for various purposes including making trophies (Pradhan, 1997). Threats to the survival of the species are also due to habitat destructions, habitat isolation restricting to few individuals near sacred springs and riverine forests, human interference and domestic as well as international commercial trade.

* 58. ***Ratufa indica bengalensis*** (Blanford)

1897. *Sciurus indica bengalensis* Blanford, *J. Bom. Nat Hist. Soc.*, **11** : 303.

Common Name : Indian Giant squirrel.

Diagnostic Characters : *R. indica bengalensis* is similar in almost all respect to the earlier subspecies except for a few minor colour variations. Dorsum deep red, while venter light buff or yellowish in colour. Tail dark proximally. However, only terminal tip of the tail paler in colour. Ears red with small tuft of hairs. Forelegs blackish red in colour. However, more than half of the forelimbs creamish in colour. The paler colour extends up to neck.

Locality: Thick forested areas of Western Ghats in Goa State. Dr. B. S. Lamba has collected two specimens from Molem in 1973.

Habitat : Same as that of the previous subspecies.

External Distribution : Thick forested areas of adjoining areas of Western Ghats in Karnataka State.

Status : Not sighted during project period. However, ZSI WRS Pune has collection record from Goa State; IUCN Criteria proposed as per the CAMP Report (2005): Vulnerable, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule: Schedule II Part II, CITES Appendix: II.

Source : Ellerman (1961), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993) and Alfred *et. al.* (2002).

Remarks : Same as that of the previous subspecies.

Genus ***Funambulus***

Two species of the Genus *Funambulus* occur in Goa State.

Key to the species of *Funambulus*

Striped squirrel with three distinct pale and bold stripes on dorsal surface of the body; inguinal region and mid-ventral line of the tail always red in colour ..... ***Funambulus tristriatus***

Striped squirrel with five distinct pale and bold stripes on dorsal surface of the body; scrotal region and mid-ventral line of the tail always white and never red in colour ..... ***Funambulus pennanti***

*59. ***Funambulus tristriatus*** Waterhouse

1837. *Funambulus tristriatus* Waterhouse, *Mag. Nat. Hist. (Charlesworth's)*, **1** : 499.

Common Name : Jungle striped squirrel.

Diagnostic Characters: Indian jungle striped squirrel has been, by far, placed in the largest mammalian order *Rodentia*, which includes all types of squirrels, marmots, rats, mice, porcupines and their close relatives. Head and Body length never over 200 mm, molars four in number and tail always long and bushy (Range 140-155 mm). Infraorbital foramen scarcely open for muscle transmission. There are three pale buff to brownish stripes between the intermediate dark brown to black bands on the dorsal surface with underparts usually white or whitish or buff coloured. The inguinal region, testis and mid-ventral line of the tail is red or from cadmium orange to saturn red in colour. The stripes are long and mid-dorsal stripe light but prominent.

Locality : Small groups of jungle striped squirrels were sighted at number of places such as Molem, Bondla, Cotigao, Poinguinim, Valpoi regions during the project period by ZSI survey parties.

Habitat : Arboreal and diurnal preferring to live in semi-dense forests close to human habitations. Though mostly arboreal, they come quite often on the ground. They are in habit of constructing nests in tree holes. They are basically shy in nature.

External Distribution : Western Ghats.

Status: Not very uncommon in the region ; IUCN Criteria proposed as per the CAMP Report (2005) : Near Threatened.

Source : Ellerman (1961), Agrawal (1972), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et al.* (2002) and Menon (2003).

Remarks : Corbet and Hill (1992) has retained Subfamily *Funambulinae* without any comments on the key characters. However Subfamily *Sciurinae* is retained here following the comments of Hoffman Robert S., Anderson C. G., Thorington, R. W. And Heaney, L. R. in Wilson and Reeder (1993). Indian striped squirrel species are hunted for meat for food and skin and body parts for various purposes including making trophies (Pradhan, 1997). Threats to the survival of the species are also due to habitat destructions and isolation, human interference and domestic commercial trade.

*60. ***Funambulus pennanti*** Wroughton

1905. *Funambulus pennanti* Wroughton, *J. Bombay N. H. Soc.*, **16** : 411.

Common Name : Indian five striped northern palm squirrel.

Diagnostic Characters : Indian five striped squirrel has been, by far, placed in the largest mammalian order *Rodentia*, which includes all types of squirrels, marmots, rats, mice, porcupines and their close relatives. Head and Body length never over 200 mm, molars four in number and tail always long and bushy (Range 130-180 mm). Infraorbital foramen scarcely open for muscle transmission. The back has five bold light coloured stripes on the dorsal surface with underparts usually white or whitish or buff coloured. There are three median pale stripes and one pale stripe on the flanks on each side. Underside of the tail without red or reddish line running down the centre. Dorsum brownish or grayish. The stripes are long and mid-dorsal stripe light but prominent. Baculum simple and not bifurcated. Two pairs of mammary teats present.

Locality : Small groups were sighted in number of places such as Molem, Bondla, Cotigao, Poinguinim, Valpoi, Dona Paula, Madgaon etc. during the project period.

Habitat : Arboreal and diurnal preferring to live close to the human habitations. Five striped squirrel is more commensal species than the three striped species. Five striped squirrel is more common in North India. Though arboreal, they come more frequently on the ground. They are in habit of constructing nests in tree holes.

External Distribution : North, North-East and Central India and also in Western Ghats.

Status : Not very uncommon in the region; IUCN Criteria proposed as per the CAMP Report (2005) : Least concern (India and Pakistan) and Near Threatened (Nepal and Bangladesh), Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule: Schedule : IV.

Source : Ellerman (1961), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Alfred *et. al.* (2002) and Menon (2003).

Remarks : Number of subspecies have been described on the basis of pelage colour variations seen in the species by some authors. However, *Funambulus pennanti* Wroughton has been described here as a single species on the basis of Ellerman (1961), Corbet and Hill (1992) and Agrawal *et al.* (1992). Indian squirrel is hunted for its meat for food and skin and body parts for various purposes including making small trophies and some other articles like brushes etc. (Pradhan, 1997). Threats to the survival of the species are also due to habitat destructions and isolation, human interference and domestic commercial trade.

Subfamily PETAURISTINAE

Subfamily *Petauristinae* (Flying squirrel) is represented by a single species under Genus *Petaurista* in Goa State.

*61. ***Petaurista philippensis*** (Elliot)

1839. *Pteromys philippensis* Elliot, *Madras J. Litt. Sci.*, **10** : 217.

Common Name : Common giant flying squirrel.

Diagnostic Characters : Common giant flying squirrel has been, by far, placed in the largest mammalian order *Rodentia*, which includes all types of squirrels, marmots, rats, mice, porcupines and their close relatives. Flying squirrel is distinctive in possessing gliding membrane on each flank from wrist to ankle. Possession of gliding membrane is the characteristic feature of the subfamily *Petauristinae* amongst all rodents. Head and Body length of adult specimen in the range between 350-470 mm, tail always longer than Head & Body (Range 400-530mm) and bushy, Hind feet moderately long (60-80 mm) and molars four in number. Infraorbital foramen scarcely open for muscle transmission. Dorsally the giant flying squirrel, as a rule, is dark brownish grey or tending to be more grey but without any reddish tinge and with underparts usually whitish grey or buff coloured. Greater part of the tail black. Two pairs of mammary teats present.

Locality : Common giant flying squirrel was sighted in core area of Molem sanctuary by ZSI survey party during the project period.

Habitat : Totally arboreal and nocturnal in habit preferring to live in tropical and temperate forests on plains to those on high altitudes. Contrary to the Common Name, the flying squirrel does not fly but glides from treetop to treetop in the air. When the animal leaps into the air the outspread limbs expands the gliding membrane between the limbs to the fullest extent. Supported by the membrane the squirrel glides smoothly and swiftly downwards. Flying squirrel can easily be tamed but they are delicate animals and do not live long in confinements.

External Distribution : Peninsular India south of Himalaya.

Status : Uncommon in the region; IUCN Criteria proposed as per the CAMP Report (2005) : Near threatened (India) and Endangered (Sri Lanka), Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule : II Part II.

Source : Ellerman (1961), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et al.* (2002) and Menon (2003).

Remarks : *Petaurista philippensis* was earlier considered to be a subspecies of *Petaurista petaurista*. However *Petaurista philippensis* has been considered as a valid species by Corbet and Hill (1992) and upheld by Hoffman *et al* in Wilson and Reeder (1993). The flying squirrel is hunted

for its meat for food. Threats to the survival of the species are also due to habitat destructions, fragmentation, human interference and domestic trade.

Family MURIDAE

Family *Muridae* is represented by only two subfamilies out of six Indian subfamilies in Goa State. All types of rats, bandicoots, mice and gerbils belong to the Family *Muridae.*

Key to the Subfamilies of MURIDAE

1. Upper incisors grooved; molar cusps arranged in two longitudinal rows; Bulla inflated; Tail long with terminal hair tuft .... GERBILLINAE
2. Upper incisors not grooved except in Golunda; molar cusps arranged in three longitudinal rows; Bulla not inflated; Tail long and normal without any terminal hair tuft.... MURINAE

Subfamily GERBILLINAE

Subfamily *Gerbillinae* (Gerbil Rats) is represented by a single species under Genus *Tatera* in Goa State.

*62. ***Tatera indica*** (Hardwicke)

1807. *Dipus indicus* Hardwicke, *Trans Linn. Soc. Lond.*, **8** : 279.

Common Name : Indian Gerbil/Antelope Rat.

Diagnostic Characters : Indian Gerbil Rat has been included in the mammalian order *Rodentia*, the gnawing mammals, which is by far the largest mammalian order. Rats, mice, bandicoots, gerbils and their close relatives have been grouped under Family *Muridae*. However, Indian murid genera *Gerbillus* and *Tatera* have been included in the subfamily: *Gerbillinae*. Further, *Tatera* is known to occur throughout India, while *Gerbillus* is restricted to Rajasthan and Gujarat States only. Genus *Tatera* is characterized by possession of clawed hallux, opisthodont yellow and distinctly grooved upper incisors, long anterior palatal foramina, more than 15.0 mm, extending between the tooth row and molars three in number. Tail longer than Head and Body length and ends in terminal tuft of hairs. Large and soft-furred antelope rat species with Head and Body more than 120 mm (range between 145-203 mm) The terminally tufted haired Tail (157-218 mm) always more than Head and Body length. Hindfoot long and in the range between 40-47 mm. Soles naked up to heel. Nasals unusually long and more than 40% of the occipitonasal length. Upper molar tooth row characteristic with biserially arranged longitudinal cusps. Upper incisors distinctly grooved and usually yellow in colour. Dorsum sandy brown to reddish brown, while underparts white in colour. Tail dark above and below and pale on the sides. Hindfeet white in colour. 4 pairs of mammary glands present.

Locality : Agrawal (1972) collected five specimens from Nova Goa, Poinguinim and Molem.

Habitat : Terrestrial, fossorial and nocturnal rodent species found throughout India. The species is basically a field rat and generally lives in cultivated plains, gardens, orchards pastureland, crop fields, waste lands and forests. Amongst the Indian gerbils, this species appears to be the most adapted ecologically. It makes complex burrows with number of openings covering large areas for the purpose of living, hoarding the food stuff, reproduction and family care. A single burrow system may have separate living chamber, storing chamber, chamber for female and young one etc.

External Distribution : Throughout India.

Status : common; IUCN Criteria proposed as per the CAMP Report (2005): Least concern, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule: Schedule : V (Vermins).

Source : Ellerman (1961), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993) and Alfred *et al.* (2002).

Remarks : Agrawal (1972) identified the specimens collected from Goa as *Tatera indica hardwickei* (Gray) which has, later, been synonymized in *Tatera indica* sp. (Alfred *et al.*

2002). *Tatera indica* is considered to be an agricultural pest or, rather, 'enemy' pest of highest order, since it causes damage on large scale not only to the stored foodgrains in the field but also to the standing crops. The species is a prolific breeder. The species is also known to be a natural vector for number of diseases including the dreaded disease like plague.

Subfamily MURINAE

Subfamily Murinae is represented by seven Genera in Goa State.

Key to the Genera of Subfamily MURINAE

1. Hallux opposable; hallux and fifth toe having a flat nail ..... ***Vandeleuria***
- Hallux not opposable; hallux and fifth toe possess claws 2
2. Upper incisors grooved on the front surface ..... ***Golunda***
- Upper incisors normal and not grooved on the front surface 3
3. Condylobasal length exceeds or equals to the occipitonasal length; upper incisors pro-odont ..... ***Bandicota***
- Condylobasal length always less than occipitonasal length; upper incisors opisthodont or orthodont 4
4. First upper molar more than half the length of upper molar row, and its antero-internal cusp distorted inwards to reach the level of second lamina; third molar extremely reduced ..... ***Mus***
- First upper molar less than half the length of the cheektooth row, and its antero-internal cusp not distorted inwards to reach the second lamina; third molar normal and not extremely reduced 5
5. Palate and anterior palatal foramina long, more than one-half and one fifth of occipitonasal length respectively ..... ***Millardia***
- Never combining the characters of long palate and palatal foramina 6
6. Palate short, less than one-half of the occipitonasal length and anterior palatal foramina long, more than one-fifth of the occipitonsal length ..... ***Cremnomys***
- Palate long more than one-fifth of the occipitonasal length; bullae long, more than 15% of occipitonasal length ..... ***Rattus***

Genus ***Vandeleuria***

Only one species of the Genus *Vandeleuria* occurs in Goa State.

63. ***Vandeleuria oleracea*** (Bennett)

1832. *Mus oleracea* Bennett, *Proc. Zool. Soc. Lond.*, : 121.

Common Name : Indian Long-tailed Tree Mouse.

Diagnostic Characters : Indian Long-tailed Tree Mouse has been included in the mammalian order *Rodentia*, the gnawing mammals, since it possesses a pair of chisel-shaped ever growing incisors in each jaw, a distinct diastema between incisors and cheek teeth (Molars) and the clawed digits. Genus *Vandeleuria* is characterized by the possession of clawless hallux, 5th finger and toe. A beautiful soft furred field mouse possessing Head and Body length in the range of 60-95 mm, molars three in number and the tail, as name suggests, long, poorly haired, unicoloured and dark. Tail length in the range of 95-130mm (about 117%-178% of Head and Body length). It is always longer than Head and Body length. Hindfeet smaller and in the range between 14-20 mm. Occipitonasal length in the range of 19-24 mm. Skull with relatively narrow frontals. Upper molar row less than 4 mm. Postero-internal cusp of the first and second upper molar retained throughout the life. Diastema long. Upper incisors narrow, yellow and plain. Fur always soft and smooth. Dorsum in various shades of brown with reddish tinge, while underparts perfectly white in colour. Hindfeet whitish or paler. Four pairs of mammary glands present.

Locality : Nalawade (1998), Agrawal (2000) and Sanjay Molur, *et al.* (In CAMP REPORT,

2005) reported occurrence of the species in the adjoining areas of Goa State.

Habitat : Terrestrial, arboreal and nocturnal in habit. Trees and shrubs in forest are its natural haunt. Females build globular large nests just a few feet above the ground in the tree hollows, bamboo thickets, thatched roofs of village houses, Baya nests or even in the empty junction boxes fixed on the electric poles. The species is a basically an outdoor species.

External Distribution : Throughout peninsular India; *Status*: Not very common in the region; IUCN Criteria proposed as per CAMP Report (2005) : Least concern, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule: Schedule : V (Vermins).

Source : Ellerman (1961), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Agrawal (2000) and Alfred *et. al.* (2002).

Remarks : Some chromosome studies have been carried out in this species from India (Agrawal, 2000).

Genus *Millardia*

Only one species of the Genus *Millardia* occurs in Goa State.

64. *Millardia meltada* (Gray)

1837. *Golunda meltada* Gray, *Mag. Nat. Hist.*, **1** : 586.

Common Name : Soft-furred Metad.

Diagnostic Characters : Indian soft furred-metad has been included in the mammalian order *Rodentia*, the gnawing mammals, since it possesses a pair of chisel-shaped ever growing incisors in each jaw, a distinct diastema between incisors and cheek teeth (Molars) and the clawed digits. Genus *Millardia* is characterized by possession of tail shorter than Head and Body length, ears rounded and shorter than hindfeet length. Five planter pads on each foot. A rather small and a beautiful soft furred field mouse possessing Head and Body length in the range of 97-156 mm, molars three in number and the tail poorly haired but clearly bicoloured. Tail length in the range of 92-145mm. Hindfeet smaller and in the range between 14-20 mm. Occipitonasal length in the range of 21-29 mm. Skull with well-developed supraorbital ridges and long palate, more than one-half of occipitonasal length. Anterior palatal foramina quite long (more than one-fifth of or more than 22% of the occipitonasal length). Nasals long and tend to be narrower behind. Upper molar row always more than 4 mm and less than 6.5 mm (5.0-6.2 mm). Upper incisors narrow, yellow and plain. M^1 having 8 cusps, M^2 with 7 cusps (t3 very small) and M^3 with 6 cusps and small. Postero-internal cusps of the first and second upper molar retained through out the life. Dorsum in various shades of brown with reddish tinge, while underparts perfectly white in colour. Hindfeet whitish or paler. Four pairs of mammary glands present.

Locality : Nalawade (1998), Agrawal (2000) and Sanjay Molur, *et al.* (In CAMP REPORT, 2005) reported occurrence of the species in the adjoining areas of Goa State.

Habitat : Terrestrial, fossorial and nocturnal in habit preferring to live near cultivations. However they may also be found in the heavy shrubs surrounded by forest, or living among rocks and in the tumbled down walls of the deserted houses. They live in pairs or in small colonies. The species is essentially an outdoor species.

External Distribution : Throughout peninsular India.

Status : Not uncommon in the region; IUCN Criteria proposed as per the CAMP Report (2005): Least concern, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule : V (Vermins).

Source : Ellerman (1961), Prater (1980), Corbet and Hill (1992), Wilson and Reeder (1993), Nalawade (1998), Agrawal (2000) and Alfred *et al.* (2002).

Remarks : Earlier Ellerman (1961) considered *Millardia* as a subgenus of *Rattus*. However latter revisionary taxonomic studies confirmed its generic *Status* Corbet and Hill (1992) and Alfred

et al. (2002) accepted same view. The species is a prolific breeder and considered to be an agricultural pest species since it causes damage to the standing crops.

Genus *Cremnomys*

Only one species of the Genus *Crymnomys* occurs in Goa State.

*65. *Cremnomys blanfordi* (Thomas)

1881. *Mus blanfordi* Thomas, *Ann. Mag. nat. Hist.*, (5)7 : 24.

Common Name : Blanford's Rat.

Diagnostic Characters : Blanford's rat has been included in the mammalian order *Rodentia*, the gnawing mammals, since it possesses a pair of chisel-shaped ever growing incisors in each jaw, a distinct diastema between incisors and cheek teeth (Molars) and the clawed digits. The genus *Cremnomys* is characterized by possession of bicoloured tail longer than Head and Body length, fifth hind toe rather long and not very short of central three toes and six planter pads on each foot. A comparatively large sized *Cremnomys* species with Head and Body length in the range of 150-195 mm, molars three in number and the tail well-haired & bicoloured. The tail is characteristically wholly dark proximally, while wholly white distally. Tail length in the range of 185-208mm. Hindfeet large and In the range between 32-37 mm. Occipitonasal length in the range of 21-29 mm. Skull with well-developed supraorbital ridges and long palate, more than one-half of occipitonasal length. Anterior palatal foramina quite long (more than one-fifth of or more than 22% of the occipitonasal length). Nasals long and tend to be narrower behind. Upper molar row always more than 4 mm and less than 6.5 mm (5.0-6.2 mm). Upper incisors narrow, yellow and plain. M^1 having 8 cusps, M^2 with 7 cusps (t3 very small) and M^3 with 6 cusps and small. Postero-internal cusps of the first and second upper molar retained through out the life. Diastema long. Fur always soft and smooth. Dorsum in various shades of brown with reddish tinge, while underparts white in colour. Hindfeet whitish or paler. Three pairs of mammary glands present.

Locality : One specimen from Valpoi was collected by Agrawal (1972), while another one was collected from Dudhsagar Falls area, Molem, by M. S Pradhan in Sept. 1993.

Habitat : Terrestrial, fossorial and nocturnal in habit preferring to live in all types of forests including dry deciduous forest, jungle etc. They live among rocks and boulders and even in the burrows made in the soft soils. They live in pairs or in small colonies. The species is essentially an outdoor species.

External Distribution : Throughout peninsular India.

Status : Not uncommon in the region; IUCN Criteria proposed as per the CAMP Report (2005) : Least Concern, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule : V (Vermins).

Source : Ellerman (1961), Corbet and Hill (1992), Wilson and Reeder (1993), Agrawal (2000) and Alfred *et al.* (2002).

Remarks : *Cremnomys blanfordi* was originally placed under *Mus*, subsequently in *Rattus* and finally in *Cremnomys* (Corbet and Hill, 1992 and Agrawal, 2000). These rats can also live in open scrub jungles and/or on bare hillsides. In forest it can change its habit from fossorial to arboreal. It makes untidy and large nests in a hole, crevices or in trees.

Genus *Rattus*

Two species of the genus *Rattus* occur in Goa State.

Key to the species of the genus *Rattus*

1. Large size (200-250 mm), occipitonasal on an average between 35–55 mm. in length, tail shortened about 80-90% of head and body, tail obscurely bicolored ..... *R. norvegicus*
2. Medium size (140–200 mm), occipitonasal on an average between 37–47 mm in length, tail unicoloured and long more than 120% of head and body length ..... *Rattus rattus*

Species *Rattus rattus*

Common roof/house rat, *Rattus rattus*, is represented in Goa State by two subspecies.

Key to the Subspecies of *Rattus rattus*

1. Ventral surface purely white; Out-door subspecies Mostly arboreal in behaviour; .... *Rattus rattus wroughtoni*
2. Ventral surface in different shades of grey but never white; In-door commensal subspecies; May live on roofs of houses but never on treetops ..... *Rattus rattus rufescens*

*66. ***Rattus rattus rufescens*** (Gray)

1837. *Mus. rufescens* Gray. *Ann. Mag. nat. Hist.* **1** : 35.

Common Name : House Rat, Roof Rat.

Diagnostic Characters : A medium sized house rat with long tail, dorsum rufuous brown and venter slaty grey or in various shades of grey but never white in colour, tail uniformly dark in colour. Genus *Rattus* is the largest mammalian genus with more than sixty valid species in Asia and Australia alone and well over five hundred named forms. It is characterized by possession of clawed hallux and long tail (more than 120% of the Head and Body length). Head and Body length in the range between 140-200 mm. *Rattus* species also possess elongated anterior palatal foramina (more than 7.0 mm in length) extending between maxillary tooth row. Upper molar tooth row normal and more than 5.0 mm (5.5-6.6mm), palate long and more than one-half of the occipitonasal. Molars three in number. Tail is always longer than Head and Body length. Hindfeet moderate and in the range between 26-36 mm. Occipitonasal length in the range of 36-46.5 mm. Postero-internal cusp of the first and second upper molar retained through out the life. Upper incisors narrow, yellow and plain. Dorsum dark and rufous brown, while underparts dull in colour. Fur with some broad and flat spines in the dorsal pelage. Hindfeet usually dark in colour. Five pairs of mammary glands present.

Locality : The subspecies is known to occur in all the regions of Goa State. Agrawal (1972) collected eight specimens from Molem and Valpoi region, while M.S. Pradhan collected three specimens from Molem region in Sept. 1993;

Habitat : Terrestrial, and a most common commensal form, found in houses, godowns, shops, residential complexes, also in scrubby and secondary forests.

External Distribution : Throughout India.

Status : Many populations have been reported from number of localities, IUCN Category proposed as per CAMP Report (2005). Least concern, Indian Wildlife (Protection) Act (1972) (As amended up to 2002) Schedule : Schedule V (Vermin).

Source : Ellerman (1961), Agrawal (1972 and 2000), Agrawal *et al.* (1992), Corbet and Hill (1992) and Wilson and Reeder (1993).

Remark : A pest species causing extensive damages to the household as well as public properties. The species is also a carrier of vectors for number of diseases. Taxonomically Tiwari *et al.* (1971), proposed to allot this population a specific status on the basis of morphological studies.

*67. ***Rattus rattus wroughtoni*** Hinton

1919. *Rattus rattus wroughtoni* Hinton, *J. Bombay Nat. Hist. Soc.*, **26** : 384.

Common Name : White-bellied House Rat.

Diagnostic Characters : White-bellied House Rat is characterized by possession of clawed hallux and a very long tail (170-210 mm: mostly more than 130% of the Head and Body length). Head and Body length in the range between 144-210 mm. *Rattus* species also possess elongated anterior palatal foramina (6.6-7.7 mm in length) extending between maxillary tooth row. Upper molar tooth row normal and more than 5.5 mm (5.6-6.6 mm), Tail is always longer than Head and Body length. Hindfeet moderate and in the range between 30-33 mm. Occipitonasal length in the range of 36.9-41.3 mm. Upper incisors

narrow, yellow and plain. Dorsum dark and rufous brown, while underpart white in colour sometimes mixed with sulphur yellow colour. Tail unicoloured and dark. Five pairs of mammary glands present.

Locality : Agrawal (1972) collected one specimen from Poinguinim, while another two live specimens were sighted on coconut trees in plantation near Madgaon by ZSI survey party during project period.

Habitat : Mostly arboreal. Very rarely comes on the ground. Generally seen in coconut and other plantations. Terrestrial and nocturnal in habit.

External Distribution : Coastal areas of Western Ghats in India.

Status : Not very uncommon; IUCN Criteria proposed as per the CAMP Report (2005): Not Evaluated in South Asia; Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule : V (Vermins).

Source : Ellerman and Morrison-Scott (1951), Ellerman (1961), Agrawal (1972), Raman and Sharma (1977), Agrawal *et al.* (1992), Corbet and Hill (1992), Wilson and Reeder(1993) and Molur *et al.* (2005).

Remarks : The subspecies is a prolific breeder. Musser and Carleton in Wilson and Reeder (1993) opine that the subspecies should be attributed to *Rattus tanezumi* (Temminck) based on chromosomal and certain biochemical parameters. However, It has been observed that even these parameters are unstable. The chromosomal number is also variable in *Rattus rattus* subspecies (Raman and Sharma, 1977). Hence, *Status quo* has been proposed by Molur *et al.* (2005) and Corbet and Hill (1992). Similar view has been accepted here. A pest species causing extensive damages to the coconut plantations in the Western Ghats.

*68. ***Rattus norvegicus*** (Berkenhout)

1769. *Mus. norvegicus* Berkenhout, *Outlines N.H. Gt. Britain and Ireland*, 1 : 5.

Common Name : Norvey Rat, Drain Rat, Brown Rat.

Diagnostic Characters : Brown rat is a larger and more robust-looking rat than the black rat or common house rat. It can be recognized by shorter tail, shorter than head and body length, dorsum brown or light brown, while venter slaty grey in colour, tail obscurely bicolored. Basically *R. norvegicus* is an introduced species through transportation by human agencies and has initially established itself in the sea port cities of Asia.

Locality : Sighted two dead specimen in putrefied condition near Dona Paula and Vasco regions by ZSI survey parties during project period.

Habitat : Terrestrial and fossorial, an introduced species from temperate lands, has now established itself in number of sea-port cities of Asia. In India it is a commensal rodent species competing with common house rat (*R. r. rufescens*) and field rat (*B. bengalensis*) particularly in metropolis. In metropolitan cities like Mumbai, Kolkata and Chennai this rat has been collected from drains and sewers (Hence the name Drain Rat).

External Distribution : Port cities and interior towns accessible by navigations in India.

Status : Many populations have been reported from number of navigable localities. IUCN Criteria proposed as per CAMP Report (2005) : Not Evaluated in South Asia, Indian Wildlife (Protection) Act (1972) (as amended upto 2002) Schedule : Schedule V (Vermin).

Source : Ellerman and Morrison-Scott (1951), Ellerman (1961), Prater (1980), Agrawal et al. (1992), Pradhan (1976), Corbet and Hill (1992) and Wilson and Reeder (1993).

Remarks : A pest species causing extensive damage to the household as well as public properties. The species is also a carrier of vectors for number of diseases.

Genus ***Golunda***

Genus *Golunda* is reported to be represented by a single species in Goa State.

69. *Golunda ellioti* Gray

1837. *Golunda ellioti* Gray, *Charlesworth's Mag. nat. Hist.*, 1 : 586.

Common Name : Indian Bush Rat.

Diagnostic Characters : Medium sized rat (Head and Body length 100 mm) with rather hairy tail, upper incisors grooved in front, heavily cuspidated upper molar teeth, tall and discrete cusps retain its original shape even after considerable wear and tear; dorsal coat is yellowish brown, while the ventral side is lighter in colour. Genus *Golunda* is characterized by possession of highly unusual dentition, bicoloured tail shorter than Head and Body length and outer digit of hindfoot and 5th finger shortened. A medium-sized bush rat with Head and Body length in the range of 102-170 mm, molars three in number and a distinctly bicoloured tail with short, thick and coarse hairs. The tail is characteristically dark brown to black above, while pale below. Tail length in the range of 86-131 mm. Hindfeet medium and in the range between 22-28 mm. Occipitonasal length in the range of 28-35.4 mm. Skull with well-developed supraorbital ridges and long palate, more than one-half of occipitonasal length. Anterior palatal foramina long but less than one-fifth of or less than 22% of the occipitonasal length. Molars heavily cuspidate. Upper molar row always more than 4 mm but less than 7.0 mm (5.8-6.8 mm). Cusps of upper molars abnormally enlarged (grape shaped), particularly in the middle and inner rows; third upper molar large, lacks the outer row of the cusps and with wear tends to look like the largest tooth in the row. M^1 having 8 cusps, M^2 with 7 cusps (t2 & t7 absent) and M^3 with 4 functional cusps. Lower molars (Maxillary teeth) biserially cuspidate. Antero-internal cusps in M^1 not distorted inwards. Fur always thick, long and soft, sometimes with growing age tends to become spiny. Dorsum varying in the range between grayish brown to blackish, while underparts in the range between white to bluish grey in colour. Hindfeet whitish or paler. Four pairs of mammary glands present.

Locality : Nalawade (1998), Agrawal (2000) and Sanjay Molur, *et al.* (In CAMP REPORT, 2005) reported occurrence of the species in the adjoining areas of Goa State.

Habitat : Terrestrial. It is essentially a rat of jungle and forest, but may venture in adjoining cultivated fields, a favourable Habitat for this rat is bush and scrub jungle, many prefer to live in woven nests built in bushes. It builds a densely woven nest of stalks, grass and fibers in bushes. It's a small moving creature. They live in pairs or in small colonies. The species is essentially an outdoor species.

External Distribution : Throughout India; *Status* : Many populations have been recorded from number of localities, IUCN Criteria proposed as per CAMP Report (2005) : Least concern; Indian Wildlife (Protection) Act (1972)(as amended up to 2002) Schedule : Schedule V,

Source : Ellerman and Morrison-Scott (1951), Prater (1980), Agrawal *et al.* (1992, 2000), Corbet and Hill (1992),Wilson and Reeder (1993) and Nalawade (1998).

Remarks : The species is a prolific breeder and considered to be an agricultural pest species since it causes damage to the plantations. Earlier it was causing extensive damage to the coffee plantation in Sri Lanka.

Genus *Mus*

Genus *Mus* is represented in Goa State by two species.

Key to the species of the Genus *Mus*

1. A commonly found commensal rodent species with tail unicolored and greater than head and body length, greatest length of the skull more than 20 mm. House mouse .... *Mus musculus castaneus*
2. A small sized field mouse found in crop fields, tail bicoloured, greatest length of the skull less than 20 mm. Field mouse ....*Mus booduga booduga*

*70. ***Mus musculus castaneus*** Waterhouse

1843. *Mus castaneus* Waterhouse, *Ann. Mag. nat. Hist.*, **12** : 134.

Common Name : House Mouse.

Diagnostic Characters : House mouse has been included in the mammalian order *Rodentia*, or the gnawing mammals, which is by far the largest mammalian order. Mice, rats, bandicoots and their close relatives have been grouped under Family *Muridae*. A small house mouse with Head and Body length in the range of 55-80 mm, molars three in number and tail always long and short haired (Range 68-88 mm). It may be mostly longer than Head and Body. Infraorbital foramen large and open for muscle transmission. Upper molar row less than 4 mm but highly specialized. First upper molar over half the length of the entire molar tooth-row, while third molar extremely reduced. Anterointernal cusp of the first molar heavily distorted on the inner side. Palatal foramina long extending posteriorly between the toothrow and more than 20% of the occipitonasal length. Anterior of zygomatic plate strongly convex. Dorsum generally dark brown, while venter always dark grey or ochraceous brown, but never white, and hindfoot brown in colour. Tail uniform in colour. Five pairs of mammary glands present.

Locality : Sighting in the rest houses at Molem, Valpoi, Keri, Panjim etc. during the project period.

Habitat : Terrestrial, fossorial and found in all Habitats since it is a commensal species. A common house mouse causing extensive damage to the properties. The species is considered to be the indoor species and rarely seen outdoor.

External Distribution : Throughout India.

Status : Common in residential premises; IUCN Criteria proposed as per the CAMP Report (2005) : Least concern, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule : V (Vermins).

Source : Marshall (1977), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et al.* (2002) and Agrawal (2000).

Remarks : The species is a prolific breeder and considered to be a pest species since it causes damage to the foodgrains stored in godowns. It is also responsible to cause extensive damage to the public as well as private properties and articles of merchandise due to its habit of gnawing by its ever-growing chisel-shaped incisors.

*71. ***Mus booduga booduga*** (Gray)

1837. *Leggada booduga* Gray, *Charlesworth's Mag. Nat. Hist.*, 1 : 586.

Common Name : Little Indian Field Mouse.

Diagnostic Characters : *M. b. booduga* has been included in the mammalian order *Rodentia*, the gnawing mammals, which is by far the largest mammalian order. Mice, rats, bandicoots and their close relatives are grouped under Family *Muridae*. A commonly seen small field mouse possessing Head and Body length in the range of 50-88 mm, molars three in number and tail short haired and bicoloured (Pale below). Tail length in the range of 50-72 mm. It may or may not be equal to Head and Body length. Hindfoot smaller and in the range between 14-16 mm. Infraorbital foramen large and open for muscle transmission. Upper molar row less than 4 mm but highly specialized. First upper molar bears anterior accessory cusp extending over half the length of molar tooth-row, while third molar extremely reduced. Anterointernal cusp of the first molar heavily distorted on the inner side. Anterior palatal foramina long extending posteriorly between the toothrow and more than 20% of the occipitonasal length. Upper incisors opisthodont or orthodont. Fur smooth. Dorsum varies from light to dark reddish or rusty brown and underparts perfectly white, whitish, grey or, sometimes even dull grey in colour. But apparently both, white and grey bellied forms, occur together in many localities and it is very difficult to divide this species into subspecies on the basis of the colour of the underparts (Agrawal, 2000). Hindfoot whitish or paler. Five pairs of mammary glands present.

Locality : Sighted one live specimen in the agricultural fields near Poinguinim by ZSI survey party during project period. Agrawal (1972) collected one specimen from Molem region.

Habitat : Terrestrial, fossorial and nocturnal in habit and generally found in agricultural crop field areas. Inhabits burrows in the field or on the edges of the cultivations. A common field mouse causing extensive damage to the crops. The species is an outdoor species.

External Distribution : Throughout India; *Status*: common in the fields; IUCN Criteria proposed as per the CAMP Report (2005) : Least concern, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule : Schedule : V (Vermins); Agrawal (1972), Marshall (1977), Corbet and Hill (1992), Wilson and Reeder (1993), Alfred *et al.* (2002) and Agrawal (2000).

Remarks : Marshall (1977), Corbet and Hill (1992) and Agrawal *et al.* (1992) separated *Mus booduga, Mus terricolor* and *Mus dunni* on the basis of variations in the underpart colour and also in the chromosomal studies conducted by Sen & Sharma (1983). However recently Agrawal (2000) has pointed out number of anomalies in the taxonomy of *booduga* complex. He rightly concluded that till the confusions were removed, *Mus dunni* and *Mus terricolor* should be treated as synonyms of *Mus booduga* as was done earlier by Ellerman (1961) due to lack of proper demarcation between the populations under study. The species is a prolific breeder and considered to be a pest species since it causes damage to the crops. It is also responsible to cause extensive damage to the public as well as private properties due to its habit of gnawing by its ever-growing chisel-shaped incisors.

Genus ***Bandicota***

Genus *Bandicota* is recognized by its condylobasal length exceeding or equals to occipitonasal length, upper incisors proodont and tail short and scaly. Genus *Bandicota* is represented by three species in Goa State.

Key to the species of Genus *Bandicota*

1. Occipitonasal length, in Indian species, less than 45 mm; zygomatic width more than 57% and bullae more than 20% of occipitonasal length, nasals less than one third of occipitonasal length .. *Bandicota bengalensis*

– Occipitonasal length clearly more than 45 mm; zygomatic width less than 57%, bullae leas than 20% and nasals more than one third of occipito-nasals length 2

2. Occipitonasal length always less than condylosal length;occiput region flat and ridges prominent; sculpture pattern of dorsal guard hairs at base mozaic at lower magnification ..... *B. indica*

– Occipitonasal length equal to or more than condylobasal length; occiput region inflated and ridges less prominent; sculpture pattern of dorsal guard hairs at base chevron at lower magnification ..... *B. maxima*

*72. ***Bandicota bengalensis bengalensis*** (Gray)

1831. *Arvicola bengalensis* Gray Ill. *Indian zool.*, **2** : pl. 21.

Common Name : Lesser bandicoot rat.

Diagnostic Characters : The bandicoots are mole rat superficially look like the European brown rat, *Rattus norvegicus*, in external appearance. It is a medium sized robustly built rat with a semi-naked scaly tail which is slightly shorter than head and body. The body fur is rather coarse and harsh. The head is triangular with rounded ears, short and broad muzzle. These rats have a habit of erecting its pile of long hairs and grunting when excited. Head and Body length in the range between 140-220 mm. Tail (99.0-202.0 mm) always shorter than Head and Body. Occipitonasal length which is clearly less than condylobasal length never exceeds 48 mm; zygomatic width is always more than 57% of the occipitonasal length. Occipitonasal length in the range between 34-48 mm. Nasals short and less than one third of the occipitonasal length. Palate long and more than 60% of the occipitonasal length. Upper molar tooth row normal and more than 5.0 mm (5.9-8.0mm). Molars with 9 cusps (t7 present). Hindfeet moderate and in the range

between 26-36 mm. Upper incisors broad and orange to lemon yellow in colour. Dorsum grayish brown to blackish occasionally with reddish tinge, while underparts light to dark grey in colour. Fur with some broad and flat spines mixed with some short and harsh hairs in the dorsal pelage. Tail unicoloured and dark. 6 to 9 pairs of mammary glands present (Total number variable).

Locality : Sighted typical bandicoot burrow openings in crop fields near Sanguim and Keri by ZSI survey party during project period. Some of them apparently looked like live burrows.

Habitat : Terrestrial, fossorial and nocturnal rodent species found throughout India. The species is basically a field rat and generally lives in cultivated plains, gardens, pasture land, crop fields, waste lands, forests. However, sometimes in cities like Mumbai, Kolkata and Chennai, it enters houses also. Its presence is always made known by a pile of fresh soil resembling mole hill, hence name 'Mole Rat' It makes complex burrows with number of openings covering large areas.

External Distribution : Throughout India.

Status : common but pest species; IUCN Criteria proposed as per the CAMP Report (2005): Least concern, Indian Wildlife (Protection) Act (1972, as amended upto2002) Schedule : Schedule : V (Vermins).

Source : Ellerman and Morrison- Scott (1951), Ellerman (1961), Agrawal *et al.*(1992), Corbet and Hill (1992) and Pradhan *et al.* (1993).

Remarks : *B. bengalensis* is considered to be an agricultural pest No. 1, since it causes damage on large scale not only to the foodgrains stored in godowns but also to the standing crops. Its habit of making complex burrow systems for not only living but also for hoarding the food stuff make it a nuisance for the human life. It is responsible to cause extensive damage to the public as well as private properties and articles of merchandise due to these habits. The species is a prolific breeder. The species is also known to be a vector for number of diseases, including rat bite fever, plague, leptospirosis etc. However, Chakraborty (1985) (as cited in Agrawal *et al.* (1992) has reported it to be playing an important role in biological control of several pestiferous species of molluscs and crabs in West Bengal.

Species ***Bandicota indica***

Bandicota indica is represented by two subspecies in Goa State.

Key to the subspecies of *B. indica*

1. Occipitonasal length in adult specimens more than 56 mm. Nasals and diastema exceeds 40% and 33% of occipitonasal length respectively, size medium to large ....*Bandicota indica malabarica*
2. Occipitonasal length in adult specimens more than 56 mm. Nasals and diastema less than 40% and 33% of occipitonasal length respectively, size small to medium..... ..... *Bandicota indica indica*

73. ***Bandicota indica malabarica*** (Shaw)

1800. *Mus malabarica* Shaw, G. *General Zoology Vol. II* part 1, Mammalia, London, : 54.

Common Name : Large bandicoot rat.

Diagnostic Characters : Large sized bandicoot rat with head and body ranging between 250 mm to 310 mm in adult specimens, hindfeet in the range of 53 mm to 61 mm; Occipitonasal length in the range of 56 to 61 mm; dorsal colour varying in the shades of blackish to slaty grey, fur coarse with bristles on hind quarter long Tail unicoloured and dark. Hindfoot dark in colour. 6 pairs of mammae present. Sculpture pattern of dorsal guard hairs at base mozaic at lower magnification.

Locality : Ellerman (1961) and Tiwari *et al.* (1971) reported occurrence of the species in the adjoining areas of Goa State in Western Ghats.

Habitat : Terrestrial, fossorial, known to invade cultivated fields, gardens, forest fringes, swampy areas etc; However, specimens were collected from areas close to human habitations also.

External Distribution : Western Ghats.

Status : Pest species reported to be causing damages to the private and public properties, many populations have been reported from number of localities; Indian Wildlife (Protection) Act (1972 as amended up to 2002) Schedule : Schedule : V (Vermin).

Source : Ellerman Morrison-Scott (1951), Ellerman (1961), Tiwari *et al.* (1971), Agrawal (1972, 2000) Pradhan (1979, 1982) and Pradhan *et al.* (1993, 2005).

Remarks : Though Agrawal (1972, 2000), Corbet and Hill (1992) and Alfred *et al.* (2002) synonymised *malabarica* population in *B. indica indica*, in light of detailed morphological and biochemical studies carried out by Pradhan (1979, 1982), Pradhan *et al.* (1989, 1993 and 2005) *B. indica malabarica* has been retained here as a separate subspecies. The subspecies is reported to be causing extensive damages to public and private properties. It is also known to be a vector for some diseases.

*74. ***Bandicota indica indica*** (Bechstein)

1800. *Mus. indicus* Bechstein, J.M. *Thomas Pennant's allgemeine uebersicht der vierfussiger Thiere* as quoted in Corbet and Hill (1993).

Common Name : Larger bandicoot rat.

Diagnostic Characters : Medium to large sized robost bandicoot rat with head and body length ranging between 200 mm and 300 mm and hind feet in the range between 45–57 mm. Tail (245-315 mm) may be equal to or more than Head and Body length. Occipitionasal length in the range between 48–56 mm; while zygomatic width in the range between 26–31 mm. Occipitonasal length always less than condylobasal length in the species. It possesses more or less sqarish head, round ear and longish muzzle. Nasals short and less than one third of the occipitonasal length. Palate long but less than 60% of the occipitonasal length. Upper molar tooth row normal and more than 7.0 mm (7.8–11.4 mm). Molars with 9 cusps (t7 present). Upper incisors thick and powerful and usually brown or yellow but rarely white in colour. Dorsum blackish brown to black occasionally intermixed with whitish hairs, while underparts light to dark grey in colour. Some colour variant forms with white patch on thorasic and/or inguinal regions and part of the tail wholly white at the terminal end have been reported from other Indian localities. Fur with some broad, long and flat spines mixed with some short and harsh hairs in the dorsal pelage. Many long hairs may be present on the back. Tail unicoloured and dark. Hindfoot dark in colour. 6 pairs of mammary glands present. Sculpture pattern of dorsal guard hairs at base mozaic at lower magnification.

Locality : Agrawal (1972) collected four specimens from Margoa.

Habitat : Terrestrial and fossorial, known to invade cultivated fields, swampy areas and also forest fringes, godowns, open and closed drainage systems in urban areas.

External Distribution : Throughout the peninsular India.

Status : Pest species. Many populations have been reported from number of localities; Indian Wildlife (Protection) Act (1972 as amended upto 2002) Schedule : Schedule : V (Vermin); IUCN Criteria proposed as per the CAMP Report (2005) :Least Concern.

Source : Ellerman and Morrison–Scott (1951), Ellerman (1961), Agrawal (1972), Pradhan (1979, 1982), Corbet and Hill (1992) and Pradhan *et al.* (1993).

Remarks : The species is considered to be an agricultural pest causing extensive damage to the standing crops, foodgrain godowns, public, and private properties etc. The species is a prolific breeder and is also known to be a vector for number of diseases. Taxonomic *Remarks* same as previous subspecies.

*75. ***Bandicota maxima*** Pradhan *et al.*

1993. *Bandicota maxima*, Pradhan, M.S., Mondal, A.K., Bhagwat, A.M. and Agrawal V.C., *Rec. zool. Surv. India*, **93**(1-2) : 175–200.

Common Name : Large bandicoot rat.

Diagnostic Characters : A very large sized bandicoot rat, with triangular head, rounded snout,

tail shorter than head and body, body covered with coarse fur, dorsum varies from dark slaty grey to light brown in colour, skull more or less similar to that of *B. indica* except that *B. maxima* possess swollen occiput, occipitonasal length equal to or more than condylobasal length. Hair impression pattern of *Bandicota maxima* exhibits distinct cheveron patterns as against irregularly waved mosaic hair sculpture pattern of *B. indica* under lower magnification.

Locality : M.S. Pradhan collected two specimens from Molem Rest House premises in Sept. 1993.

Habitat : Terrestrial, fossorial and nocturnal living close to human settlements and leading epizootic life.

External Distribution : Peninsular India.

Status : Populations have been recorded from different localities in Western Ghats, Pondicherry, Kolkata, U.P. etc., Indian Wildlife (Protection) Act (1972 as amended up to 2002) Schedule : Schedule : V (Vermin), IUCN Criteria proposed as per the CAMP Report (2005) : Least Concern.

Source : Pradhan *et al.* (1989, 1993, 2005).

Remarks : The species is considered to be a pest species since it causes damages to the foodgrains and public properties.

Suborder HYSTRICOGNATHI

Suborder *Hystricognathi* is represented by a single family in Goa State.

Family HYSTRICIDAE

Family *Hystricidae* is represented by a single species under Genus *Hystrix* in Goa State.

*76. ***Hystrix indica*** Kerr

1792. *Hystrix cristata* var *indica* Kerr, *Anim. Kingd.*, : 213.

Common Name : Indian crested porcupine.

Diagnostic Characters : Indian crested porcupine has been included in Family *Hystricidae* which is characterized by the fur being modified into true quills or spines, angular process of mandible strongly distorted outwards, infraorbital foramen large and cheek teeth 4/4 in number and flat crowned. All porcupines are grouped under this family. Genus *Hystrix* is characterized by possession of short tail, less than one-fourth of Head and Body length, possessing hollow quills at its tip. Molars hypsodont and rootless. A prominent crest present on crown and neck. Quills bear more than one brown bands. Head and Body more than 400 mm and in the range between 400-900 mm. Tail length always less than 20% of Head and Body length. Forelimbs and Hindfeet broad and bear 5/5 fingers. Hallux clawed and well-developed. Skull large with occipitonasal length in the range of 139-163 mm. Nasals though long and more than 50% of the occipitonasal length, yet shorter allied species *Hystrix cristata*. Palate long. Upper incisors thick and usually yellow in colour. Anterior half of the body including head dark brown, posterior part more white due to exposure of white tip of the quills. Each quill is ornamented with deep brown or black and white bands. The white quills on tail are large and well open. A narrow band of white-tipped spines form a collar. Undersurface of same colour as back. 3 pairs of mammary glands present.

Locality : One specimen of Indian crested porcupine was collected by B. S. Lamba in Dec. 1973, while some live specimens were sighted in Bondla and Molem sanctuaries during the project period.

Habitat : Terrestrial, fossorial and nocturnal rodent species found throughout India. The species is an out door species and generally lives in large pits and /or burrows dug in the cultivated plains, gardens, orchards pasture land, crop fields waste lands and forests. This species appears to be the most ecologically.adapted species.

External Distribution : Throughout India; *Status*: common; IUCN Criteria proposed as per the CAMP Report (2005): Least concern, Indian Wildlife (Protection) Act (1972, as amended up to 2002) Schedule: Schedule : IV.

Source : Ellerman (1961), Prater (1980), Corbet and Hill (1992), Agrawal (2000) and Alfred *et al.* (2002).

Remarks : *Hystrix indica* is considered to be an agricultural pest or, rather, 'enemy' pest of highest order, since it causes damage on large scale to the standing crops. Its gnawing habit to keep the ever-growing incisors in shape makes it a nuisance for the human life. It has a curious habit of gnawing bones, horns and antlers (Agrawal, 2000). The species is a prolific breeder. Agrawal (2000) concludes that there are no subspecies in *Hystrix indica.*

Order LAGOMORPHA

Order *Lagomorpha* is characterized by presence of two pairs of upper incisors placed one behind the other in each jaw and a distinct diastema (Open space) between incisors and cheek teeth (Molars) which are adopted for grinding. Three pairs of upper and two pairs of lower premolars. Tail very short.

Order *Lagomorpha* is represented by a single family *Leporidae* in Goa State.

Family LEPORIDAE

Family *Leporidae* is represented by a single species under Genus *Lepus* in Goa State.

*77. ***Lepus nigricollis nigricollis*** Cuvier

1823b. *Lepus nigricollis* Cuvier, F. *Dictionnaire des sciences naturelle*, Strasbourg & Paris : **26** : 299-316.

Common Name : Indian black-napped hare or Indian Hare.

Diagnostic Characters : Rabbits, hares and pikas have been included in the mammalian order *Lagomorpha.* Distinguishing features of the order *Lagomorpha* are clawed digits, soft and smooth pelage, very short and bushy tail (0-15% of Head and Body length), long diastema in front of cheek-teeth, canines absent, four incisors in the upper jaw and functional digits on fore/hind limbs 5/4. Rabbits and hares have been grouped under Family *Leporidae*. Genus *Lepus* is characterized by its hind legs much longer than fore legs, hindfeet more than 60 mm (85-115 mm) and ears elongate and more than 30mm (80-120 mm). Pelage always smooth and soft but never harsh. Ears long, plain and not black-tipped. Head and Body length in the range 330-530 mm. Greatest skull length 80-100mm. 'Y'-shaped groove on I^1. The blacknaped Hare is distinctive in having a dark grayish black or black patch on the back of its neck from the ears to the shoulder. Tail black above, while white on sides and undersurface.

Locality : Indian blacknaped hare was sighted in Molem, Bondla, Cotigao sanctuary areas of Goa State during the project period. Earlier Agrawal (1972) collected two specimens from Valpoi.

Habitat : Terrestrial, fossorial and nocturnal species. The species is an out door species and generally lives in all types of habitats except at very high altitudes. Where the habitat is suitable for living, hares are numerous. This species appears to be the most adapted ecologically.

External Distribution : Throughout India.

Status : Common; IUCN Criteria proposed as per the CAMP Report (2005) : Least concern; Indian Wildlife (Protection) Act (1972, as amended upto 2002) Schedule: Schedule : IV.

Source : Prater (1980), Corbet and Hill (1992), Agrawal (2000), Alfred *et al.* (2002) and Menon (2003).

Remarks : *Lepus nigricollis* is considered to be causing damage to the agricultural fields, orchards etc. The species is a prolific breeder.

Order CETACEA

The species under order CETACEA are highly specialized and wholly adapted to an aquatic existence, with reproduction and feeding taking place in water. The animals of this order have developed smooth, spindle shaped and hairless bodies with fore limbs flattened into paddle shaped flippers. Hind limbs are absent, while tail tip expanded into lateral, horizontal flukes. Teeth absent or when present simple or conical.

Order *Cetacea* is represented by two suborders in Goa State.

Key to the two suborders of CETACEA

1. Teeth present, blowhole single and horny 'baleen' plates absent ..... ODONTOCETI
2. Teeth and blowhole absent while horny 'baleen' plates present ..... MYSTICETI

Suborder ODONTOCETI

Out of six known families described under this suborder only two families have been reported from Goa State.

Key to the two families of ODONTOCETI

1. Maximum length in the region 10 meters, dorsal fin usually high and pointed and teeth large or moderate and conical .... DELPHINIDAE
2. Maximum length in the region 1.8 meters, dorsal fin totally absent, teeth flat crowned ..... PHOCOENIDAE

Family DELPHINIDAE

Family DELPHINIDAE is represented by three genera in Goa State.

Key to the Genera of DELPHINIDAE

1. Broad hump below dorsal fin present; 30–38 teeth present on each side of the jaw .... *Sousa*

– Broad hump below dorsal fin absent; 40–65 teeth present on each side of the jaw 2

2. No stripe between eyes and flippers and eyes and anus; palate with deep groove on each side; 40–50 teeth present on each side of the jaw ..... *Delphinus*

– A stripe present from eyes to flippers or from eyes to anus; palate devoid of any groove on each side; 35-65 teeth present on each side of the jaw ..... *Stenella*

Genus ***Sousa***

Genus *Sousa* is represented by a single species, *Sousa chinensis*, in Goa State.

78. ***Sousa chinensis*** (Osbeck)

1765. *Delphinus chinensis* Osbeck, P. *Reise nach Ostindien und china*. Rostock xxiv : 552, 13 pls.

Common Name : Indopacific Humpback Dolphin.

Diagnostic Characters : Medium sized dolphin with maximum length reaching up to 3 m, the beak is slender and sharply defined from forehead, characteristic broad hump below dorsal fin present, teeth in each row less than 35 in number.

Locality : Stranding report of Indo-Pacific Humpback Dolphin specimens along coastal areas adjacent to Goa coast line has been recorded by Kumaran (2000).

Habitat : Aquatic, marine, coastal, estuaries, confluence of rivers with seas etc. They have also been reported from the lower reaches up to 250 km of the Chinese rivers.

External Distribution : Indo-Pacific region.

Status : Many sightings have been reported from number of localities along Indian coastline; Indian Wildlife (Protection) Act(1972 as amended up to 2002), Schedule : Schedule : II Part I; IUCN Criteria proposed as per CAMP Report (1998) : Endangered (National), Data Deficient (Global); CITES : Appendix : I.

Source : Ellerman and Morrison-Scott (1951), Corbet and Hill (1992), Roberts (1997), Agrawal & Alfred (1999) and Kumaran (2000).

Remarks : The species is reported to be declining in the extent of population, occurrence, area of occupancy and quality of Habitat. Survival threat to the population is due to number of accidental death in fishing nets while catching fishes.

Genus ***Delphinus***

Only one species of Genus *Delphinus* occurs in Goa State.

79. ***Delphinus delphis*** Linn.

1758. *Delphinus delphis* Linnaeus, C. *Systema naturae* Vol 1, 10th Ed. : 77.

Common Name : Common Dolphin.

Diagnostic Characters : The snout is prolonged into a long narrow beak separated by a groove from the forehead. Both jaws contain conical teeth exceeding 35 in numbers in each row. Body slender, blowhole single, dorsal and pectoral fins falcate. Dorsum black or dark grey and underparts whitish, while sides with bands of fulvous or ochreous in colour.

Locality : Kumaran (2000) has recorded a report by De Siva (1987) of catch of six males and four females of dolphins in 1983 (?) off Calangute, Goa.

Habitat : Dolphins are aquatic in nature and seen in schools in coastal waters, one of the fastest marine animal attaining the speed up to 30 knots.

External Distribution : Circumtropical, Indian, Pacific and Atlantic Oceans.

Status : Many sightings have been reported from number of localities along Indian coastline, Indian Wildlife (Protection) Act (1972 as amended up to 2002), Schedule : Schedule II, Part I, IUCN Criteria proposed as per CAMP Report (1998) : Lower risk-Near threatened (National), Data Deficient (Global), CITES : Appendix II.

Source : Prater (1980), Corbet and Hill (1992), Agrawal and Alfred (1999), Kumaran (2000) and Alfred *et al.* (2006).

Remarks : Dolphin is known from very ancient times and has figured in myths and legends of early Mediterranean civilization. Now it is being kept in dolphinarium all over the world.

Genus ***Stenella***

Genus *Stenella* is represented by a single species, *Stenella longirostris*, in Goa State.

80. ***Stenella longirostris*** (Gray)

1828. *Delphinus longirostris* Gray, *Specil. Zool.*, **1** : 1.

Common Name : Spinner dolphin.

Diagnostic Characters : Medium sized streamlined bodied dolphin with maximum length reaching up to 2.5 meters, the beak is slender, long and sharply defined from forehead, teeth in each row in the range between 45-65 in number. Body colour pattern variable. However, it is, in general, grey above, white below with paler sides. A grey stripe runs from eye to flipper or from eye to anus. Adults without spots on the back. Subtriangular dorsal fin located in the middle of the back. Tip blunt and backwardly directed. Tail fluke with strongly keeled base and notched in the middle.

Locality : Stranding report of Spinner Dolphin specimens along coastal areas adjacent to Goa coast line (Malabar Coast) has been recorded by Kumaran (2000).

Habitat : Oceanic pelagic form of circumtropical waters. The spinner dolphins are seen in large schools (200 to 1000) in offshore and deep waters. Feeds mainly on fishes and squids.

External Distribution : Indo-Pacific region.

Status : Many sightings have been reported from number of localities along Indian coastline; Indian Wildlife (Protection) Act(1972 as amended up to 2002), Schedule : Schedule : II Part I; IUCN Criteria proposed as per CAMP Report (1998) : Lower risk–Near threatened (National), Data Deficient (Global); CITES : Appendix : II.

Source : Ellerman and Morrison-Scott (1951), Corbet and Hill (1992), Roberts (1997), Agrawal & Alfred (1999), Kumaran (2000) and Alfred *et al.* (2006).

Remarks : Survival threat to the population is due to human interference, trade, pollution, number of accidental deaths in fishing nets while catching fishes and excessive tourism in dolphin habitats.

Family PHOCOENIDAE

Family PHOCOENIDAE is represented by a single species under the Genus *Neophocaena* in Goa State.

81. ***Neophocaena phocaenoides*** (Cuvier)

1829. *Delphinus phocaenoides*, Cuvier, G., *Le regne animale* 2nd ed. Paris, xxxviii, : 584.

Common Name : Black finless porpoise.

Diagnostic Characters : Absence of dorsal fin is the characteristic feature, length not more than 2 meters, teeth flat crowned and not more than 15–20 in each row. Little finless porpoise is one of the smallest cetaceans. Head blunt rounded without any beak. Eyes rather well developed. Blowhole crescentric in shape. Flippers small and elliptical. There are small, hard and horny tubercles in the mid region of the back extending up to caudal peduncle. Tail compressed horizontally with a notch in the middle. Body colour dark slaty grey with purplish white patches on throat and lips.

Locality : Catching report of finless porpoise specimens near the mouth of Zuari river off Vasco-de-Gama Port in 1980 has been recorded by Kumaran (2000).

Habitat : The finless porpoise is aquatic preferably marine as well as estuarine, both, in habit. Prefers to live in coastal, river mouth, and estuarine waters. It has been reported to reach lower reaches up to 65 kms. from the mouth of Indus river in Pakistan and over 1000 kms. from the mouth of Yangtze river in China.

External Distribution : Circumtropical (Indian Ocean and Pacific Ocean).

Status : Reported to have been occasionally caught in gill nets from number of localities along the Indian coast line, Indian Wildlife (Protection) Act (1972)(as amended up to 2002) Schedule I Part I, IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-near threatened (National) and Data Deficient (Global), CITES : Appendix I; Red Data Book (National)(1994) : Insufficiently known.

Source : Ellerman and Morrison-Scott (1951), Prater (1980), Corbet and Hill (1992), Ghosh (1994), Agrawal and Alfred (1999), Kumaran (2000) and Alfred *et al.* (2006).

Remark : Survival of the species in the region is threatened due to pollution, accidental death due to trapping in gill nets, collisions with motor boats, fishing vessels etc.

Suborder MYSTICETI

Only one family has been reported from Goa State.

Family BALAENOPTERIDAE

Family BALAENOPTERIDAE is represented by a single species under Genus *Balaenoptera* in Goa State.

82. ***Balaenoptera physalus*** (Linnaeus)

1758. *Balaena physalus*, Linnaeus, *Syst. Nat.* 10th ed. 1 75.

Common Name : Fin Whale.

Diagnostic Characters : Fin Whale is a second large-sized whale species next to Blue Whale. Fin whale possesses "V" shaped head with a prominent central ridge over it. 56-100 ventral furrows extending up to naval present. Back ridged from dorsal fin to tail fluke. Dorsal fin small but distinct. Baleen plates 230-370 in number on each side with size of 42 × 24 cm. Plates are stripped with alternate yellow and blue bands. Body dark grey to blackish above with no mottling, white underneath. colour of head asymmetrical. Lower lip and palate white in colour. Maximum length recorded up to 24 meters.

Locality : Catching report of fin whale at Candolim north of Panaji in April, 1970 has been recorded by Kumaran (2000).

Habitat : Oceanic and pelagic inhabitant. Also involved in seasonal long distance migrations. Lives in a group of 3-10 or even 20 individuals. Feeds mainly on krills, squids and copepods. Its main predator is killer whale.

External Distribution : Circumtropical (Indian Ocean and Pacific Ocean); *Status* : Indian Wildlife (Protection) Act (1972) (as amended up to 2002) Schedule II Part I, IUCN Criteria proposed as per the CAMP Report (1998) : Lower risk-near threatened (National) and Data Deficient (Global), CITES : Appendix I.

Source : Ellerman and Morrison-Scott (1951), Prater (1980), Corbet and Hill (1992), Agrawal and Alfred (1999), Kumaran (2000) and Alfred *et. al.* (2006).

Remark : Survival of the species in the region is threatened due to heavy hunting for international commercial trade, pollution, accidental death due to trapping in gill nets, collisions with motor boats, fishing vessels etc.

Order SIRENIA

Order Serenia is known by the massive spindle-shaped marine animals with no external trace of dorsal fin or hind limbs, tail-tip expanded and horizontally flattened and cheek teeth flat-crowned. Head rounded and truncated. Order SIRENIA is represented by a single family *Dugongidae* in Goa State.

Family DUGONGIDAE

Family DUGONGIDAE is represented by a single species, *Dugong dugon* under the Genus *Dugong* in Goa State.

Genus ***Dugong***

*83. ***Dugong dugon*** (Mueller)

17776. *Trichecus dugon* Mueller, P.L. S., *Des Ritters c. von. Linne Vollstandiges Natursystem, Supplement* Nurnberg.

Common Name : Dugong or sea cow.

Diagnostic Characters : Body is streamlined with belly more or less flat while the back and sides are rounded. Neck absent, head massive somewhat truncate anteriorly. Fleshy pad-like upper lip, projecting over the lower lip and provided with fine stiff bristles around the muzzle; Nostrils situated on top of the head, eyes small and deeply sunk. Clawed, flipper – like forelimbs, hind limbs absent. Incisors in adult males tusk like. Nostrils are situated on top of the head.

Locality : Reported from adjacent coastal areas such as Konkan and Malabar coasts (Agrawal amd Alfred, 1999).

Habitat : *Dugong* is restricted to coastal, shallow and marine habitat feeding mainly upon sea-grasses of the families *Potamogetonaceae* and *Hydrocharitaceae*. Sea cows are totally aquatic herbivores.

External Distribution : Coastal waters of Asia, Africa and Australia.

Status : Many sightings have been reported from number of localities along Indian Coastline, Indian Wildlife (Protection) Act (1972 as amended up to 2002) Schedule : Schedule I Part I, Red Data Book (1994) (National): Vulnerable, IUCN Criteria proposed as per CAMP Report (1998) : Critically Endangered (National), Data Deficient (Global), CITES : Appendix : I.

Source : Ellerman and Morrison-Scott (1951), Prater (1980), Corbet and Hill (1992), Ghosh (1994), Agrawal and Alfred (1999), Kumaran (2000) and Alfred *et al.* (2006).

Remarks : Sea cow populations along Indian coastline are reported to be under threat due to decline in area of occupancy, extent of occurrence and also due to hunting for its flesh, hide, fat, bones and tusks.

RESULTS AND DISCUSSION

The systematic list of mammalian species given above reports occurrence of 83 mammal species/ subspecies in Goa State. Out of these, 46 species (55%) were actually collected and/or sighted by ZSI survey parties which visited Goa State during project period between 1991–1996 and even by those which visited Goa State before the project period, while 37 species (45%) were included in the list on the basis of the literature consulted (Fig. 1).

If the species/subspecies are sorted out in various categories given in Table 1, it will be seen that 83 species/subspecies of 57 genera belonging to 31 families grouped in twelve mammalian orders have been reported from this region. The table further shows a broad spectral diversity at all the levels at every stage. It has been expressed very well particularly in orders

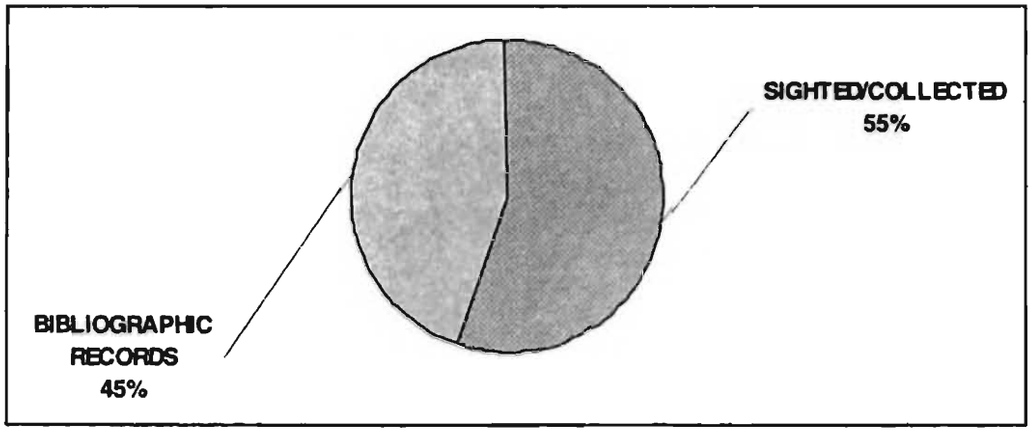


Fig. 1. Mammal Species/Subspecies collected, sighted & recorded from Goa State

Table 1. Mammalian Diversity in Goa State

S. No.	Orders	Suborders	Families	Subfamilies	Genera	Species/ Subspecies
1.	INSECTIVORA		1	1	1	2
2.	SCANDENTIA	-	1	1	1	1
3.	CHIROPTERA	2	6	6	15	26
4.	PRIMATES		2	2	3	3
5.	PHOLIDATA	-	1		1	1
6.	CARNIVORA		7	7	9	15
7.	PROBOSCIDEA		1		1	1
8.	ARTIODACTYLA		4	4	7	7
9.	RODENTIA	2	3	4	12	20
10.	LAGOMORPHA		1	-	1	1
11.	CETACEA		3		5	5
12.	SIRENIA		1		1	1
TOTAL	**Twelve Orders**	**4**	**31**	**25**	**57**	**83**

like *Chiroptera, Carnivora, Artiodactyla* and *Rodentia*. Even marine mammal order, *Cetacea*, has shown remarkable representation in this region.

Fig. 2 shows order-wise representation of mammalian species. Class *Mammalia* is represented by twelve orders with predominance of *Chiroptera, Carnivora* and *Rodentia* followed by *Artiodactyla* (Fig. 2 & 3). It will be seen that more than 75% mammalian species belong to the orders *Chiroptera, Carnivora* and *Rodentia*. Incidentally Chiropteran representation is very well in the region (Total 26 spp.).

Some of the most interesting species reported from the state are : ***Anathana ellioti ellioti, Rhinopoma hardwickei, Scotophillus spp., Tadarida sp., Hipposideros spp., Manis crasicaudata, Cuon alpinus, Panthera pardus fusca, Panthera tigris tigris, Lutragale perspicillata, Viverricula indica, Elephus maximus, Bos gaurus, Tetracerus quadricornis, Ratufa indica, Petaurista philippensis, Cremnomys blanfordi, Hystrix indica, Delphinus delphis, Balaenoptera physalus, Dugong dugon etc.***

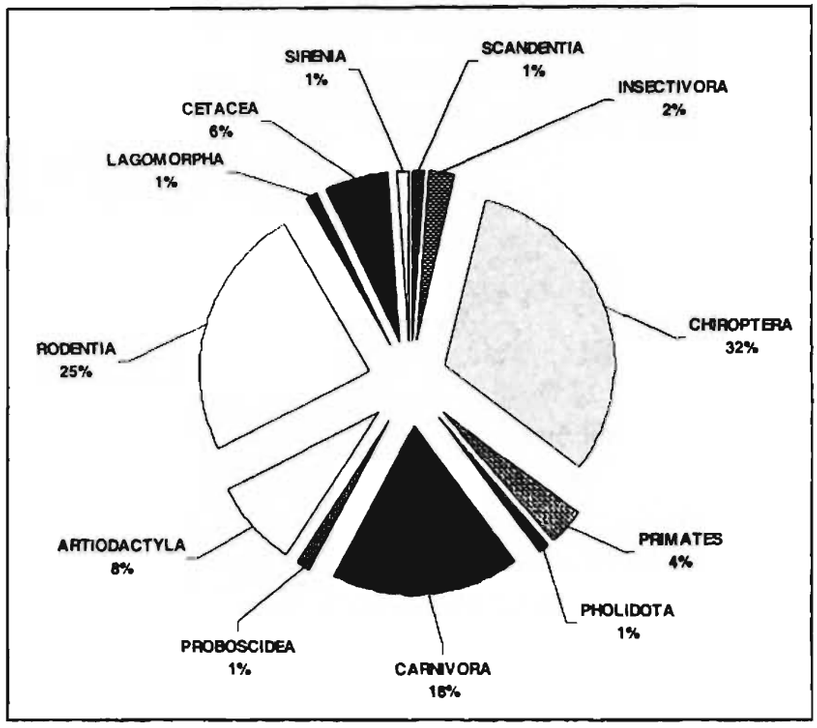


Fig. 2. Mammal Species /Subspecies from Goa State

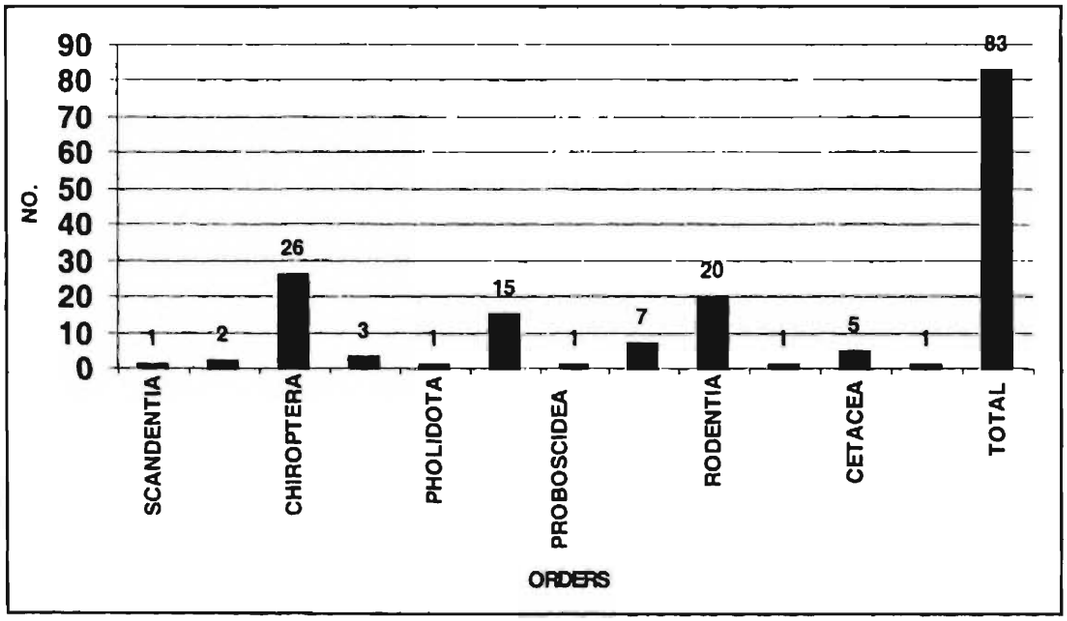


Fig. 3. Order-wise Mammal species/subspecies

When the endemic *Status* of the mammalian species/subspecies reported from Goa State was studied (Fig. 4), it was surprisingly noticed that there were only 4 endemic species (5% of total 83 mammalian species) belonging to orders *Scandentia* (1) and *Rodentia* (3). Therefore, though mammalian species diversity is rich, the endemicity in this region is, however, poor. Interestingly, however, the rodent subspecies are endemic to Western Ghats only.

Order SCANDENTIA

1. *Ananthana ellioti ellioti* (Waterhouse)

Order RODENTIA

1. *Ratufa indica indica* (Erxleben)
2. *Ratufa indica bengalensis* (Blanford)
3. *Funambulus tristriatus* Waterhouse

Conservation *Status* of the mammalian species under Indian Wildlife (Protection) Act 1972 (1991)

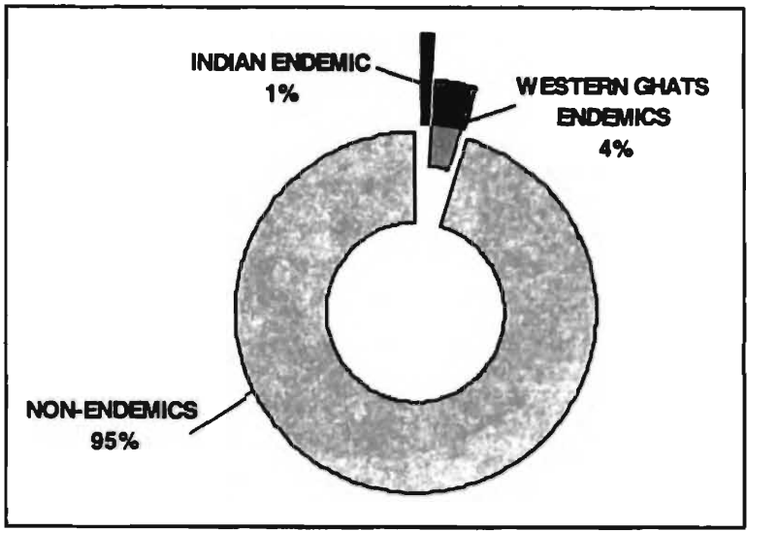


Fig. 4. Endemism in Mammals reported from Goa State

was also studied. It was found that 57 out of 83 mammalian species have been included in all the five schedules of the Act (Fig. 5). Further, of these 83 species 31 species (37%) are under higher conservation *Status* (Indian Wildlife Act Schedule I and II, CITES Appendix I & II and IUCN Categories from Endangered to Vulnerable) (Fig. 6). However, on the other hand, there are about 26 mammalian species, mostly microchiropteran bat species, which have not been listed under any of the wildlife Act schedules (Fig. 5).

Table 2 summarizes order-wise IUCN categories of threats assigned to the mammalian species/subspecies as per CAMP Reports for Mammalia (1998), Chiroptera (2002), Primates (2003) and Small Non-Volant mammals (2005). According to these reports, there is one species under critically Endangered category, 2 in Endangered and 7 in Vulnerable categories, while there are atleast 50 species listed under Least Concern category. These belong mostly to *Rodentia and Chiropta* orders. Lastly, there is one Carnivore and three rodent species listed as Not Evaluated, because of their unstable taxonomic placement for quite sometime. They are *Lutragale perspicilata* (Taxonomic uncertainty), *Bandicota indica malabarica* (Taxonomic uncertainty), *Rattus rattus wroughtoni* (Taxonomic uncertainty) and *Rattus norvegicus* (Introduced species). Incidently Sea cow (Dugong dugon) is a critically Endangered species as per CAMP Report (1998).

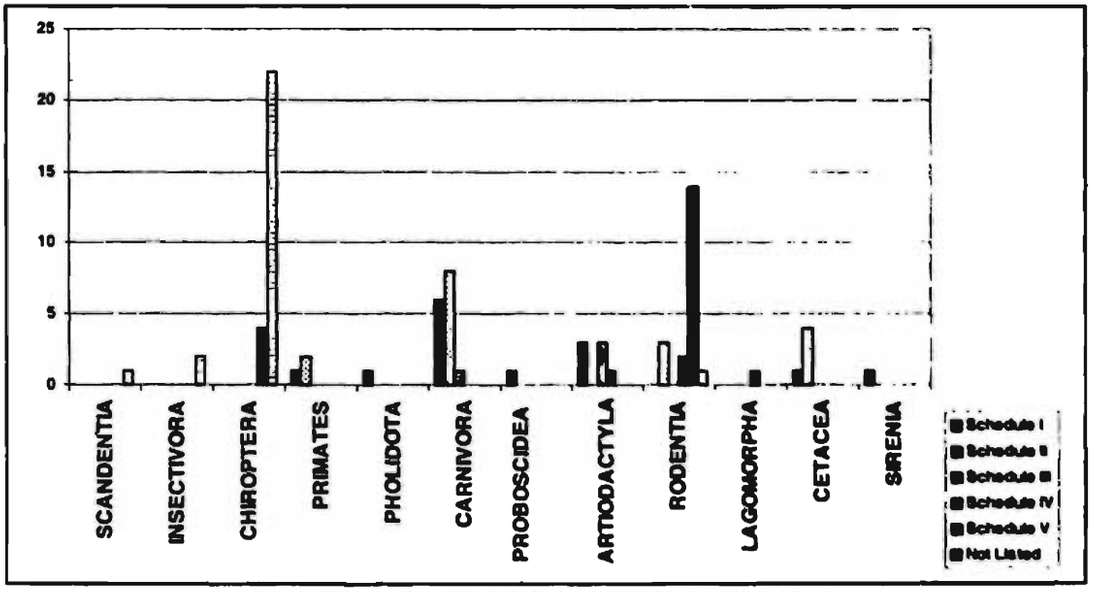


Fig. 5. Goa Mammal orders in Indian Wildlife Act Schedules

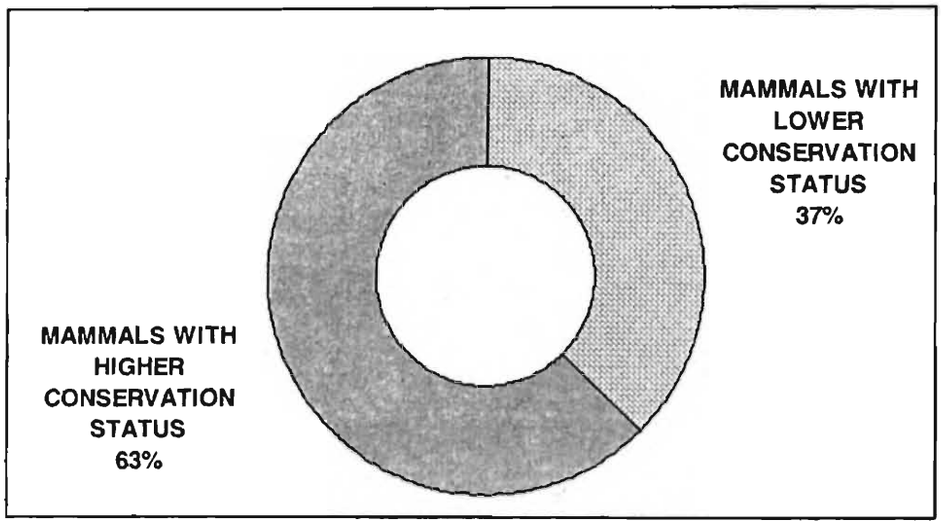


Fig. 6. Goa Mammals with Conservation Status

Table 2. Conservation Status (IUCN categories (National) as per CAMP Reports) of Mammal Species/ Subspecies from Goa State

Sl. No.	Orders	Critically Endangered	Endangered	Vulnerable	Lower Risk Near Threatened /Near Threatened	Lower Risk Least Concern /Least Concern	Data Deficient/ Not Evaluated	Total
1.	SCANDENTIA	*	*	*	1	*	*	1
2.	INSECTIVORA	*	*	*	*	2	*	2
3.	CHIROPTERA	*	*	1	1	24	*	26
4.	PRIMATES	*	*	*	1	2	*	3
5.	PHOLIDOTA	*	*	*	1	*	*	1
6.	CARNIVORA	*	1	2	7	4	1	15
7.	PROBOSCIDEA	*	*	1	*	*	*	1
8.	ARTIODACTYLA	*	*	1	2	4	*	7
9.	RODENTIA	*	*	2	2	13	3	20
10.	LAGOMORPHA	*	*	*	*	1	*	1
11.	CETACEA	*	1	*	4	*	*	5
12.	SIRENIA	1	*	*	*	*	*	1
	TOTAL	**1**	**2**	**7**	**19**	**50**	**4**	**83**

Finally, following conclusions can be drawn on the basis of above observations :

1. Goa State, though a very small state in area can boast of rich mammalian species diversity, quantitatively as well as qualitatively. However, endemic representation of the mammalian species in the state is remarkably poor.

2. Some of the most interesting mammalian species other than *Panthera tigris tigris* and *Panthera pardus fusca* which can attract attention are *Anathana ellioti ellioti, Lutragale perspicillata, Ratufa indica, Petaurista philippensis, Bos gaurus, Elephas maximus etc.* There is also record of movement of marine mammal species such as sea cow along Goa coastline.

3. Fairly large number of mammalian species (31: 37%) with higher conservation Status of Schedule I and Schedule II of Indian Wildlife (Protection) Act, 1972 (2002), CITES Appendix I & II and IUCN categories from Endangered to Vulnerable could be recorded, while about 33% of the total mammal species dominated by microchiropteran bats with no *Status* under Wildlife (Protection) Act have also been reported from this region.

4. Thus, State of Goa can be considered as internationally famous not only for its beautiful beaches but also for its most attractive diversified habitats and its rich and varied faunal elements.

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WETLAND FAUNAL RESOURCES OF GOA

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INTRODUCTION

Wetlands that occupy 6% of the earth's land surface are areas of land and water where water level remains near or above the surface of ground for most part of the year. Man's association with wetland is very ancient. In fact, the first sign of civilization originated in wetland habitats such as the flood plains of the Indus, the Nile Delta and the Fertile Crescent of the Tigris and Euphrates rivers. Wetlands, namely marshy swamps, lagoons, bogs, fens and mangroves, are the most productive ecosystems and the home to some of the richest, most diverse, specialized and fragile elements of natural plant and animal resources.

Although a good deal of information is available on estuarine fauna from different parts of our country including Goa (Dwivedi *et al.*, 1975; Dhawan *et al* , 1976; Nair, 1982; Ansari *et al.*, 1986a, b; Parulakar and Dwidevi, 1974, 1975; Parulakar *et al.*, 1980; Goswami 1982, 1997; Modassir, 1990; Goswami and Devasssy, 1991; Goswami and Gwswami, 1993; 1994; Dev Roy and Nandi 2005), both from mainland as well as islands, very little is known on freshwater wetland fauna from the state of Goa. Das *et al.* (2005), however, recently published on the zooplankton diversity of wetland ecosystems of Goa. In the present paper faunal resources of both freshwater and brackishwater wetlands of Goa have been communicated based on our collection during the years 2000-2005 and partly from published literature.

PHYSIOGRAPHIC FEATURES

Goa is a narrow strip of land located on the West Coast of India, which attains statehood in 1987. It is divided into two districts *viz.*, North Goa (1736 sq. km) and South Goa (1966 sq. km) with its capital at Panjim. This State has an area of 3702 sq. kms and is situated at an altitude of 1022 m from the sea level (Bhatt, 1998). In physical features this state resembles to the neighbouring regions of Karnataka and Maharashtra. There are three main physical divisions: the Sahyadris mountains in the east, the plateaus in the middle and the low-lying coastal plains. The coastal region is relatively rich in wetlands and estuaries and can be subdivided into the coastal region proper and the floodplain region (Wagle, 1982). The physiographic features which usually influence the general ecology and hydrology of wetlands and watersheds are briefly depicted hereunder (Table 1).

Climate : In general, the climate is moderate, although humidity is high. Summer (February-May) temperature 24°C-32°C, monsoon (June-August) 22.6°C-32.5°C and winter (September-January) 21.6°C-32.2°C. The rainfall mainly occurs during monsoon and ranges annually between 213 cm and 368 cm during 1992 to 2001 (Fig. 1). The heavy rainfall (June-September) varies from 3200 mm–3500 mm, which enriches the lash green dazzling variety of flora and fauna.

Soil : The soil of Goa, in general, is of lateritic soils. The laterite soil type is extensive over most

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of the terrain, mountains, plateaus or plains. The agricultural lowlands near the coastal tract are, however, of alluvial soils. There are also sandy coastal soils in some areas of the Arabian coast, saline soils along the estuarine tract and marhy soils at Salcete and Quepem talukas along the Sal river basin.

Table 1. Physiographical features of Goa State

Parameters	Values
Area	3702 sq km
Population (as per 1991 census)	1343998 (2001 Census)
Population density (per sq km)	363 (2001 Census)
Total number of villages	383
Number of submerged villages	6
Altitude	Sea level to 1022 m
Latitude	14°49′ and 15°52′ N
Longitude	73°38′ and 74°24′ E
Coastline	87 km
Climatic condition	Moderate
Temperature (Summer)	24°C-32.7°C
Temperature (Winter)	21°C-32.2°C
Rainfall	3200 mm
Humidity	High
Landscape type	Coastal plains, plateaus and mountains
Forest cover (ha)	125473
Protected Area (ha)	75491
Water resources (ha)	2575

Vegetation : Estuarine wetland areas are fringed with mangrove vegetation (Fig. 2), while brackshwater wetlands / fishery areas have isolated or scattered mangrove trees on the embankments. The mangrove fringing the estuaries / islands are mostly comprised of *Avicennia*, *Rhizophora*,

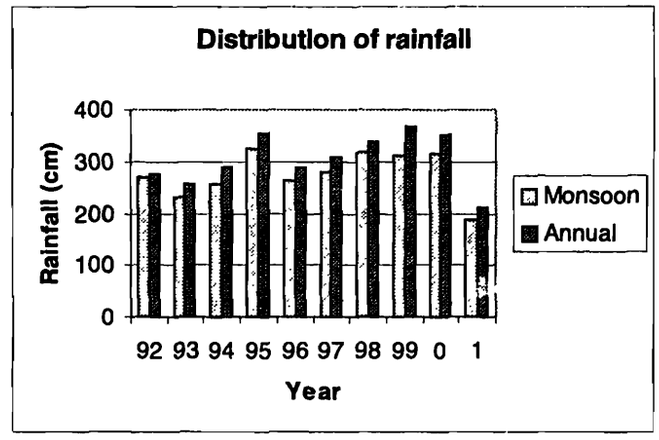


Fig. 1. Year-wise distribution of annual and monsoonal rainfall during 1992–2001.

Excoecaria and *Sonneratia* species. The forest crown density is above 40%. The mangroves of Dr. Salim Ali Bird Sanctuary, Chorao, are classified as CRZ-I and recommended as one of the sub-centres for 'Mangrove Germplasm Preservation Centres' by the International Expert Committee under the ITTO / M. S. Swaminathan Foundation (Alvares, 2002). The freshwater lakes and waterbodies in Goa have diverse macrophytal communities as well as algae. The lake vegetation often exhibits luxuriant growth of submerged and rooted floating hydrophytes, comprising *of Hydrilla verticellata*, *Utricularia aurea*, *Nymphaea stellata*, *Nymphoides* sp., *Nelumbium* sp., *Pistia* sp., *Marselia* sp., *Ceratophyllum* sp., *Wolffia* sp., *Lemna* sp., *Polygonum glabrum* and wild paddy, *Oryza rufipogon* etc. Besides these macrophytes, a total of 26 phytoplanktonic species were identified from Carambolim Lake of which *Oscillatoria formosa* was most dominant. However, the most serious threat of weed infestation in Carambolim Lake and other freshwater lakes comes from tremendous growth of *Salvinia* species, creating ecological interference of the freshwater ecosystem.

Rivers and tributaries : Goa State has nine major rivers and 42 tributaries. The main rivers from north to south are Tiracol, Chapora, Mandovi, Zuari, Sal, Canacona, Talpona and Galgibaga. These rivers, covering about 250 km of inland waterways, are part and parcel of coastal and floodplain ecosystem, river basin geomorphology and wetland ecology of mountain

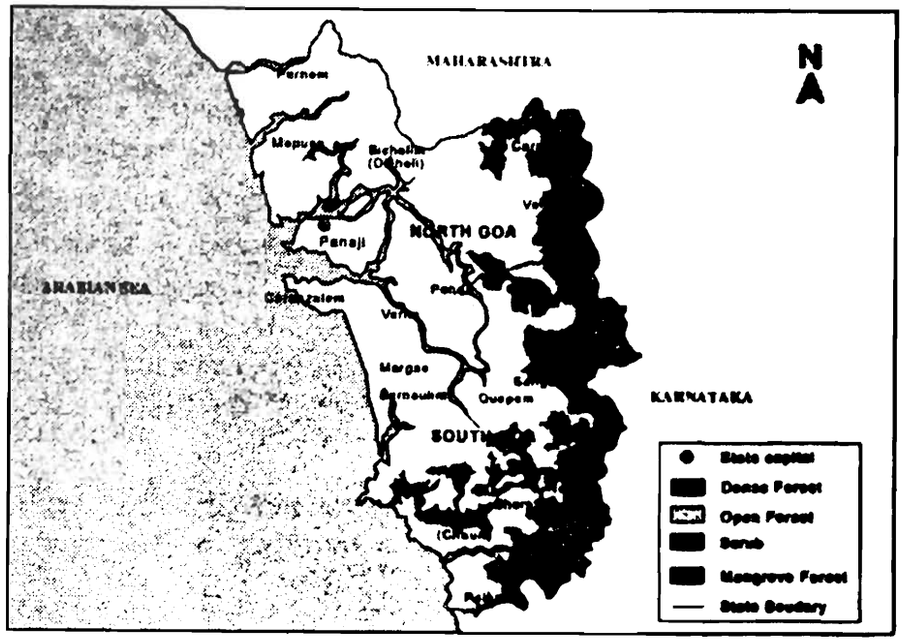


Fig. 2. Estuarine and mangrove areas of Goa.

region of the Sahyadris, plateaus and the coastal plains of Goa.

Tide : The tidal amplitude varies from 0.01-2.44 m with a Mean Sea Level (MSL) of 1.3 m. However, during monsoon tidal height may even reach up to 5.0 m. The high tide inundate the mangrove swamps of the Diwadi Island, Dr. Salim Ali Bird Sanctuary, etc., as well as the estuarine or brackishwater wetlands of Goa.

MATERIALS AND METHODS

Data and information for the present report were based on materials collected during 2000-2005 by two different parties at Headquarters, Zoological Survey of India, Kolkata as well as a number of surveys made by Western Regional Station, Zoological Survey of India, Pune. Naturally, the localities were highly heterogeneous and variable, for which data were presented mostly categorizing freshwater and brackishwater wetlands representing important lakes, fisheries and intertidal areas of estuaries or islands concerned. However, the collection and observations on wetland fauna made from selected localities during the course of survey works are incorporated.

For the present study two freshwater wetlands, namely, Carambolim Lake and Mayem Lake and three brackishwater wetlands *viz.* Chorao Island, Ela Dhauji and Diwadi Island were selected and surveyed (Fig. 3). General Ecology, wetland profiles, etc. were recorded (Table 2-5). Water quality parameters of these wetlands were measured following standard methods. Besides these, a number of freshwater ponds, marshylands, mangrove habitats, estuaries and littoral coastal stretches were brought under general faunistic survey. Field observation and collection of specimens were made using a drag net and plankton net as well as hand picking. Most of the vertebrates and some macroinvertebrates were observed in the field. Their presence (+) and absence (–) from the selected wetlands are indicated in Tables 6 and 9-17. In all, eighty zooplankton samples both qualitative and quantitative were collected from littoral and limnetic zones of freshwater and brackishwater habitats. The zooplankton samples were collected using 80 μm mesh size plankton nets with a circular mouth of 45 cm in diameter. The plankton samples were preserved in 5% formalin with glycerol.

STUDY AREAS

In general, the coastal plains of Goa consist of an intricate system of wetlands, tidal marshy area and cultivated paddy fields, all intersected by



Fig. 3. Map of Goa showing specific wetlands surveyed (●)

canals, inland dykes, bays, lagoons and creeks. All the rivers and extensive backwaters in the hinterland are governed by regular tides, which may go up to 25 km upstream thereby rendering a status of estuaries to these water bodies. The prominent low lands found adjacent to most of the rivers, locally known as "Khazan lands", were also brought under some survey works. The ecology and morphometric features of important lakes and or wetland habitats surveyed along with physico-chemical characteristics (Tables 2 and 3) are communicated. The brief descriptions of the selected wetlands (Figs. 4-11) are also included hereunder :

Carambolim Lake : This Lake is situated at Old Goa about 16 km northwest of Panaji near hill slopes. It is close to Karmali Railway Station. The lake is 1.5-3.0 m deep and has an area of about 100 ha. It receives water during rainy season from the surrounding hill slopes through east and southeast main inlets and retains rainwater for irrigation during winter. About 75% of total area are used for paddy cultivation and 25% for pulses. At present surrounding lake area has been changed with the laying of railway line, spacious roads, construction work as well as cashew nut plantation and other activities covering an area of 4500 sq. m. comprising of 150 plots. The two-third part of littoral region on southeast side of this lake is completely filled with aquatic weeds/grass and *Salvinia* sp. The rest part on northwest side of the lake is covered either with aquatic weed/grass or *Nymphaea* spp., and is visited by many resident and local migratory birds.

Mayem Lake : It is almost an amoeboid-shaped stream-fed natural lake located about 8 km north-west from Bicholim town and situated on the lap of surrounding hills with mixed forest. The total area of the lake is about 450 sq. m. and usual depth in summer 18-21 m and monsoon 21-36 m. This reservoir also receives rainwater during monsoon and is used for irrigation through inter lock culvert system on the northeast part of the lake. The lake is mainly used for recreation. It

has several species of macrophytes, both emergent floating, *Nymphaea* and *Nymphoides* spp. and submerged *Ceratophyllum* sp., and is visited by resident birds like cormorant, egrets, etc.

Ela-Dhauji Fishery : This is mainly man-made fish farm and generally used for experimental pisiculture/fishery and training purpose. In all, there are six tanks in which two almost freshwater and four brackishwater, covering an area of 3500 sq. m. Most of the tanks are devoid of any macrophytes excepting some marginal weeds and grass.

Chorao Island (Fishery) : This fishery system in the Chorao Island is located at latitude 15°31 N and longitude 73°52′ E with an area of about 260 ha. Salim Ali Bird Sanctuary is a protected patch of fragile mangrove ecosystem, located at Chorao Island along side of Mandovi River. This is a small sanctuary which was notified in 1988 with an area of 1.78 sq km. Mangroves dominated by *Rhizophora*, *Sonneratia* and *Avicennia*, cover most part of the sanctuary area and the muddy foreshore of the estuary is embanked by boulders. The mangrove community consists of 12 species of mangrove vegetation besides 8 mangrove of associated species. The entire area including the sanctuary area has a wide range of brackishwater habitats, which attracts local as well as migratory

Table 2. Ecology and morphometric features of some wetlands of Goa

Salient features	Freshwater Wetlands		Brackishwater Wetlands		
	Carambolim Lake	**Mayem Lake**	**Ela-Dhauji Fisheries**	**Chorao Island / Fisheries**	**Diwadi Island**
Category	Natural (almost unmanaged)	Natural (semi-managed)	Manmade (managed)	Natural / manmade (managed)	Natural
Water area	50 ha	75 ha	15 ha	30 ha	50 ha
Depth	2-7 m	20-30 m	1.3-1.8 m	1.9 m	2-3 m
Bottom	Clayey silt	Detritus mud	Muddy clay	Sandy clay	Sandy clay
Catchment area	Hilly	Mountainous	Estuarine	Estuarine	Estuarine
Drainage outlet	Door-locking culvert	Door-locking culvert	Sluice gate	Sluice gate	Open type
Water aeration	Nil	Paddle boat	Netting	Electric wheel	Tidal action
Water use	Agriculture	Recreation	Pisciculture	Prawn culture	Mangrove
Surrounding vegetation	Cultivated vegetation	Wild plants	Mangrove	Mangrove	Mangrove
Macrophytes cover	Dense	Sparse	Sparse	Dense	Dense
Marginal plants	Reeds, Sedge, weeds, etc.	Reeds, Sedge, grass, etc.	Sedge, grass, etc.	Mangrove	Mangrove
Floating plants	*Eichhornia*, *Salvinia*, etc.	–	–	–	–
Emergent plants	*Nymphaea*, *Nymphoides*	*Nymphaea*, *Nymphoides*	–	–	–
Submerged plants	*Ceratophylum*, *Hydrilla*	*Ceratophylum*, *Hydrilla*	–	–	–

Table 3. Physico-chemical characteristics of some wetlands of Goa

Parameters	Freshwater Wetlands		Brackishwater Wetlands		
	Carambolim Lake	Mayem Lake	Ela-Dhauji Fisheries	Chorao Island / Fisheries	Diwadi Island
Air temp. (°C)	27-29	27-29	26.5-28.5	26.5-28.5	26.4-28.6
Water temp. (°C)	26.2-27.6	26.5-27.6	26.2-27.5	26.7-27.5	26.6-27.6
Water pH	7.5-7.8	7.5-8.2	8.0-8.3	7.5-8.5	7.5-8.5
Soil pH	5.5-6.3	5.4-6.5	5.6-7.3	6.5-7.2	6.5-7.2
Water salinity (ppt)	1.2-3.4	0.5-1.5	11.2-25.0	9.5-24.5	10.1-25.4
Soil salinity (ppt)	N. A.	N. A.	5.5-6.8	4.5-5.5	4.5-5.6
D. O. (mg/l)	4.8-5.5	5.1-6.1	6.5-7.2	6.5-7.5	6.4-7.6
Alkalinity (mg/l)	1.5-2.5	1.9-2.8	1.4-2.1	1.5-2.8	1.3-2.6
Transparency (cm)	64-83	248-423	73-77	74-76	74-77
T. D. S. (ppm)	130-265	150-274	480-570	510-530	512-527

birds from different parts of world. The Chorao fishery consists of seven tanks with an area of 260 ha and usually maintained 1.5 m depth of water. It is mainly used for prawn culture by way of leasing to private parties by the Department of Fisheries, Goa. During high tide estuarine water of Mandovi River is taken in using nylon net and filtering river water. The tank water is exchanged through controlling the outlet gate at ebb tide. Each tank has mechanized aeration system.

Diwadi Island : This island is adjacent to Chorao Island and is having almost identical composition of mangrove flora. The foreshore areas are similar to that of Chorao Island. The collection of some macroinvertebrates was mainly made from this island.

LAND USE AND WETLAND PROFILE

Goa is transversely divided into North Goa and South Goa districts. The land use patterns of these two districts that may have some impact on the wetlands are obtained from the Directorate of Settlement and Land Records, Government of Goa. Although, the selected wetlands are located in North Goa district, the wetland profiles of both the districts are presented taluka-wise in Table 4. The area of wetlands in the state of Goa is presented in Table 5. The Salcete taluka has the greatest area of wetlands in comparison to other talukas.

FAUNAL DIVERSITY

Vertebrate Diversity

Mammals : Three species of mammals *viz.*, the Common Otter, *Lutra lutra* and the Smooth Indian Otter, *Lutra perspicillata* and the Fishing Cat (*Felis viverina*) are known to occur in and around wetlands and mangroves of Goa. But these wetland dependent species could not be observed duing the course of survey works though otters were recorded from Chorao Island earlier (Untawale, 1986; Anonymous, 1989).

Birds : A total of 140 avian species belonging to 22 families under 8 orders (Table 6), comprising of water birds, marsh birds, and fish eating wetland dependent birds as well as reed dwelling wetland associated birds were recorded from freshwater and estuarine wetlands of Goa. These birds are listed from two selected freshwater wetlands *viz.*, Carambolim Lake, Mayem Lake and one estuarine wetlands of Dr. Salim Ali Bird

Table 4. Land use pattern and wetland profiles of Goa

Talukas	Net cultivable area	Forest area	Settlement area	Water bodies	Road & Railways	Salt pans	Grand Total
Pernem	14039.19	1387.35	178.69	985.55	153.66	9.61	2411.73
Bardez	13441.45	3.68	767.12	1238.33	442.06	82.35	23843.72
Bicholim	12390.84	205.65	247.18	829.75	195.44	-	23271.11
Satari	21909.94	20245.66	154.31	997.37	241.36		4951.91
Tiswadi	10699.19	0.51	584.07	649.26	290.00	181.13	15041.48
Ponda	14304.19	3976.20	457.00	398.79	213.78	5.50	28074.48
Salcete	18310.27	0.93	849.27	680.79	254.98	59.54	27482.44
Sanguem	22312.74	44913.20	610.64	1174.16	529.99		86371.85
Canacona	14211.28	12694.55	88.68	615.0	122.24		34693.67
Quepem	12736.76	7837.47	181.90	390.49	202.76		31783.10
Murmugao	3050.84	0.33	946.70	69.40	85.85		6341.84
Total	157406.69	91265.53	5065.56	8029.59	2732.12	338.13	350470.33

Source : Directorate of Settlement & Land Records, Government of Goa.

Table 5. Area of wetlands of Goa state

Taluka	Area (in sq. km.)
Pernem	2.70
Bardez	5.22
Bicholim	0.25
Sattari	0.10
Tiswadi	3.97
Ponda	3.25
Mormugao	2.20
Salcete	6.70
Quepem	0.97
Sanguem	0.32
Canacona	0.07

Sanctuary as well as from several not so well known freshwater marshylands and also from estuarine creek/ coastal wetlands. In overall, 95 avian species occur in freshwater wetlands and 83 species inhabit brackishwatwater wetlands. The water birds and marsh birds exhibit highest diversity of 66 species at Carambolim Lake, while the coastal stretch/ wetlands of Goa are rich with gulls, terns and shorebirds, particularly large flocks can be seen at Baga and Chapora estuaries. In Goa State, Mandovi estuary serves as an important staging and wintering area for migratory ducks and shorebirds. According to report of Midwinter Asian Waterfowl survey of van der Ven (1987), *Anas acuta* occurred in large numbers, e.g., over 30,000 were present in January 1987 in this estuarine system along with other species like *Egretta alba*, *Egretta garzetta*, *Egretta gularis*, *Tringa nebularia*, *Tringa totanus* and *Actitis hypoleucos*. In freshwater ecosystem, the total population of avian species was estimated at 11,623 birds in 1996 and 26,117 birds in 1997 (Table 7) from Carambolim Lake (Alvares, 2002). These estimates suggest its recognition as Ramsar site for harbouring more than 20,000 birds in the lake. The Salim Ali Bird Sanctuary at Chorao is also known as Red Shank Sanctuary for greater abundance of Common Redshank, *Tringa totanus* in the sanctuary and surrounding fishery areas. In fact, this sanctuary is a wader's paradise as a wide variety of waders can be seen feeding at low tide.

Besides Redshank, quite a large number of migratory birds use this habitat as an important 'staging' ground due to lack of human interference in the area. The percentage distribution of avian species from three wetlands of Goa, *viz.*, Pilar Lake, Carambolim Lake and Santa Monica Lake (Table 8) in relation to habitat, habit and food habit during 1996 and 1997 was also documented (Alvares, 2002). However, further mid winter waterfowl survey is required for suggesting inclusion of Carambolim Lake and Mandovi estuary as Ramsar sites.

Table 6. List of avian species recorded in wetlands of Goa

Family and species	Common name	Freshwater wetlands			Brackishwater/ estuarine wetlands	
		CL	ML	MR	SABS	EC
Order PODICIPEDIFORMES Family PODICIPEDIDAE						
Trachybaptus ruficollis (Pallas)	Little Grebe	+	+	+		
Order PELECANIFORMES Family PHALACROCORACIDAE						
Phalacrocorax carbo (Linnaeus)	Great Cormorant	+				
Phalacrocorax fuscicollis Stephens	Indian Shag	+		+		
Phalacrocorax niger (Vieillot)	Little Cormorant	+		+		
Family ANHINGIDAE						
Anhinga melanogaster Pennant	Oriental Darter	+				
Order CICONIIFORMES Family ARDEIDAE						
Ardea cinerea Linnaeus	Grey Heron				+	+
Ardea purpurea Linnaeus	Purple Heron			+		
Ardeola grayii (Sykes)	Indian Pied Heron				+	+
Butorides striatus (Linnaeus)	Little Green Heron					+
Bubulcus ibis (Linnaeus)	Cattle Egret				+	+
Casmerodius albus (Linnaeus)	Large Egret	+		+	+	
Egretta garzetta (Linnaeus)	Little Egret	+	+	+	+	+
Egretta gularis (Bosc)	Western Reef Egret					+
Ixobrychus cinnamomeus (Gmelin)	Chestnut Bittern					+
Ixobrychus sinensis (Gmelin)	Yellow Bittern					+
Mesophoyx intermedia (Wagler)	Median Egret	+	+	+	+	
Family CICONIIDAE						
Anastomus oscitans (Boddaert)	Asian Openbill-Stork			+	+	
Ciconia ciconia (Linnaeus)	European White-Stork			+		
Ciconia episcopus (Boddaert)	Whitenecked Stork			+		
Ciconia nigra (Linnaeus)	Black Stork			+		
Leptoptilos javanicus (Horsefield)	Lesser Adjutant			+		+

Table 6. *Contd.*

Family and species	Common name	Freshwater wetlands			Brackishwater/ estuarine wetlands	
		CL	ML	MR	SABS	EC
Mycteria leucocephala (Pennant)	Painted Stork			+	+	
Family THRESKIORNITHIDAE						
Platalea leucorodia Linnaeus	Eurasian Spoonbill	+		+		
Plegadis falcinellus (Linnaeus)	Glossy Ibis	+		+		
Pseudibis papillosa (Temminck)	Black Ibis			+		
Threskiornis melanocephalus (Latham)	Oriental White Ibis			+		
Family PHOENICOPTERIDAE						
Phoenicopterus ruber Linnaeus	Greater Flamingo	-				+
Order ANSERIFORMES Family ANATIDAE						
Anas acuta Linnaeus	Northern Pintail	+	+	+		
Anas clypeata Linnaeus	Northern Shoveler	+				
Anas crecca Linnaeus	Commom Teal	+	+			
Anas penelope Linnaeus	Eurasian Wigeon	+				
Anas platyrhynchus J.R. Forester	Mallard	+	+	+		
Anas poecilorhyncha J. R. Forester	Spot-billed Duck	+	+	+		
Anas querquedula Linnaeus	Garganey	+	+	+		
Anas strepera Linnaeus	Gadwall	+		+		+
Anser indicus (Latham)	Bar-headed Goose	+				
Aythia ferina (Linnaeus)	Common Pochard	+				+
Aythia fuligula (Linnaeus)	Tufted Pochard	+				+
Aythia nyroca (Guldenstadt)	Ferruginous Pochard	+				+
Dendrocygna bicolor (Vieillot)	Large Whistling Duck	+	+	+		
Dendrocygna javanica (Horsefield)	Lesser Whistling Duck	+	+	+		
Nettapus coromandelicus (Gmelin)	Cotton Teal	+	+	+		
Tadorna ferruginea (Latham)	Brahminy Shelduck	+	+	+		
Sarkidiornis melanostos (Pennant)	Comb Duck	+		+		
Order FALCONIFORMES Family ACCIPITRIDAE						
Circus aeruginosus (Linnaeus)	Western Marsh–Harrier	+				
Elanus caeruleus (Destontaines)	Black-shouldered Kite			+		+
Haliastur indus (Boddaert)	Brahminy Kite	+	+	+	+	+

Table 6. *Contd.*

Family and species	Common name	Freshwater wetlands			Brackishwater/ estuarine wetlands	
		CL	ML	MR	SABS	EC
Order GRUIFORMES Family GRUIDAE						
Grus antigone (Linnaeus)	Saras Crane	+		+		
Family RALLIDAE						
Amaurornis akool (Sykes)	Brown Crake			+		
Amaurornis phoenicurus (Pennant)	Whitebreasted Waterhen			+		
Fulica atra Linnaeus	Common Coot	+	+	+		
Gallicrex cinerea (Gmelin)	Watercock	+		+		
Gallinula chloropus (Linnaeus)	Common Moorhen	+		+		
Gallirallus striatus Linnaeus	Bluebreasted Rail			+		
Porphyrio poliocephalus (Latham)	Greyheaded Swamphen	+				
Porzana fusca (Linnaeus)	Ruddybreasted Crake	+	+	+		–
Porzana parva (Scopoli)	Little Crake			+		
Porzana porzana (Linnaeus)	Spotted Crake				+	+
Porzana pusilla (Pallas)	Baillon's Crake			+		
Order CHARADRIIFORMES Family JACANIDAE						
Hydrophasianus chirurgus (Scopoli)	Pheasant-tailed Jacana	+		+	+	
Metopidius indicus (Latham)	Bronzewinged Jacana	+		+	+	
Family ROSTRATULIDAE						
Rostratula benghalensis (Linnaeus)	Greater Painted Snipe	+		+	+	
Famly HAEMATOPODIDAE						
Haematopus ostralegus Linnaeus	Eurasian Oystercatcher				+	+
Family CHARADRIIDAE						
Charadrius alexandrius Linnaeus	Kentish Plover	+		+	+	+
Charadrius asiaticus Pallas	Caspian Plover				+	+
Charadrius dubius Scopoli	Little Ringed Plover			+	+	+
Charadrius hiaticula Linnaeus	Common Ringed Plover			+		
Charadrius leschenaultii Lesson	Greater Sand Plover					+
Charadrius mongolus Pallas	Lesser Sand Plover					+
Pluvialis fulva (Gmelin)	Pacific Golden Plover			+	+	+
Pluvialis squatarola (Linnaeus)	Grey Plover			+	+	+
Vanellus indicus indicus (Boddaert)	Redwattled Lapwing	+		+	+	
Vanellus leucurus (Lichtenstein)	White-tailed Lapwing	+				
Vanellus malabaricus (Boddaert)	Yellow Wattled Lapwing	+		+	+	

Table 6. *Contd.*

Family and species	Common name	Freshwater wetlands			Brackishwater/ estuarine wetlands	
		CL	ML	MR	SABS	EC
Family SCOLOPLACIDAE						
Actitis hypoleucos Linnaeus	Common Sandpiper	+	+	+	+	
Arenaria interpres (Linnaeus)	Ruddy Turnstone	-			+	+
Calidris alba (Pallas)	Sanderling	-				+
Calidris alpina (Linnaeus)	Dunlin					+
Calidris canutus (Linnaus)	Red Knot	-		-		+
Calidris ferrruginea (Pontoppidan)	Curlew Sandpiper	-			+	+
Calidris minuta (Leisler)	Little Stint	+			+	
Calidris ruficollis (Pallas)	Rufous-necked Stint	-			+	+
Calidris subminuta (Middendorff)	Long-toed Stint	+	-		+	+
Calidris temminckii (Leisler)	Temminck's Stint	+			+	+
Gallinago gallinago (Linnaeus)	Common Snipe	+		+	+	
Gallinago stenura (Bonaparte)	Pintail Snipe	+	+	-	+	
Limicola falcinellus (Pontoppidan)	Broad-billed Sandpiper	-	-		+	+
Limosa limosa (Linnaeus)	Black-tailed Godwit	+		+	+	+
Limosa lapponica (Linnaus)	Bar-tailed Godwit	+		+	+	+
Lymnocryptes minimus (Brunnich)	Jack Snipe	-		+		+
Numenius arquata (Linnaus)	Eurasian Curlew	-			+	+
Numenius phaeopus (Linnaeus)	Whimbrel				+	+
Philomachus pugnax (Linnaeus)	Ruff	+	+	+		
Tringa erythropus (Pallas)	Spotted Redshank	+		+	+	
Tringa glareola Linnaeus	Wood Sandpiper	+		+	+	
Tringa nebularia (Gunner)	Common Greenshank			+	+	
Tringa ochropus Linnaeus	Green Sandpiper		+			
Tringa stagnatilis (Bechstein)	Marsh Sandpiper	-	-	+	+	
Tringa totanus (Linnaeus)	Common Redshank			-	+	+
Xenus cinereus (Guldenstadt)	Terek Sandpiper				+	+
Family RECURVIROSTRIDAE						
Himanotopus himanotopus (Linnaeus)	Black-winged Stilt	+	+	+	+	
Family DROMADIDAE						
Dromas ardeola (Paykull)	Crab-plover			-		+
Family BURHINIDAE						
Burhinus oedicnemus (Linnaeus)	Stone-Curlew		-			+
Esacus recurvirostris (Cuvier)	Great Stone-Plover	-	-	-		+

Table 6. *Contd.*

Family and species	Common name	Freshwater wetlands			Brackishwater/ estuarine wetlands	
		CL	ML	MR	SABS	EC
Family LARIDAE						
Chlidonias hybridus (Pallas)	Whiskered Tern	+		+		
Chlidonias leucopterus (Temminck)	White-winged Black Tern	+				+
Gelochelidon nilotica (Gmelin)	Gull-billed Tern	+				+
Larus brunnicephalus Jerdon	Brownheaded Gull				+	
Larus canus Linnaeus	Mew Gull					+
Larus genei Breme	Slender-billed Gull					+
Larus heuglini Bree	Heuglin's Gull					+
Larus ridibundus Linnaeus	Blackheaded Gull					+
Sterna acuticauda J. E. Gray	Black-billed Tern					+
Sterna albifrons Pallas	Little Tern					+
Sterna anaethetus Scopoli	Bridled Tern					+
Sterna aurantia J. E. Gray	River Tern				+	+
Sterna bengalensis Lesson	Lesser Crested Tern	+	+	+	+	
Sterna bergii Lichtenstein	Large Crested Tern					+
Sterna caspia Pallas	Caspian Tern				+	+
Sterna dougallii Montagu	Roseate Tern					+
Sterna fuscata Linnaeus	Sooty Tern					+
Sterna hirundo Linnaeus	Common Tern					+
Sterna hybridus (Pallas)	Whiskered Tern	+			+	+
Sterna leucopterus (Temminck)	White-winged Black Tern	+				+
Sterna repressa Hartert	White-cheeked Tern					+
Sterna sandvicensis Latham	Sandwich Tern					+
Order CORACIIFORMES Family ALCEDINIDAE						
Alcedo atthis (Linnaeus)	Pied Kingfisher	+				
Alcedo meninting Horsfield	Blue-eared Kingfisher		+			
Ceryle rudis (Linnaeus)	Lesser Pied Kingfisher	+	+	+	+	
Ceyx erythacus (Linnaeus)	Oriental Dwarf Kingfisher		+	+		
Halcyon capensis (Linnaeus)	Stork-billed Kingfisher	+		+		
Halcyon pileata (Boddaert)	Black-capped Kingfisher			+		
Halcyon smyrnensis (Linnaeus)	White-breasted Kingfisher	+	+	+	+	
Todiramphus chloris (Boddaert)	Collared Kingfisher			+		

Table 6. *Contd.*

Family and species	Common name	Freshwater wetlands			Brackishwater/ estuarine wetlands	
		CL	ML	MR	SABS	EC
Order PASSERIFORMES Family MOTACILLIDAE						
Dendronanthus indicus (Gmelin)	Forest Wagtail		+	+		
Motacilla alba Linnaeus	White Wagtail	+	+	+		
Motacilla cinerea Tunstall	Grey Wagtail	+	-	+		
Motacilla citreola allas	Citrine Wagtail			+		
Motacilla flava Linnaeus	Yellow Wagtail	+		+		
Motacilla maderaspatensis Gmelin	Large Pied Wagtail	+		+		

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/Riverine wetlands; SABS = Chorao Island; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Chapora, Mandovi, Terakol and Zuari Rivers.

Table 7. Avifaunal population distribution during 1996 and 1997 at Carambolim Lake

Avifauna (Cumulative Total)	1996	1997	% Change
Total (22)	11,623	26,117	+225
Waterfowl (8)	11,318	25,590	+126
Water Visitors			
Pintail	3,449	15,187	+340
Lesser Whistling Teal	2,736	4,957	+81
Coots	718	347	-52

Note : Figures in paranthesis represent the number of additional species of birds newly sighted during the year (*Source* : Alvares, 2002).

Table 8. Distribution of different categories of birds at Pilar (PL), Carambolim (CL) and Santa Monica (SML) Lakes from Jan 1996 to Dec 1997

Bird Community	Lakes of Goa	Percentage distribution of birds in wetlands of Goa		
		PL	CL	SML
Habitat	Terrestrial	6.43%(36)	1.51%(54)	6.43(93)
	Aquatic	94.38%(31)	98.50%(38)	93.56%(48)
Habit	Waders	15.25%(19)	22.23%(20)	39.77%(32)
	Swimmers/Divers	83.34%(8)	77.68%(9)	59.83%(7)
	Skimmers	0.89%(4)	0.07%(6)	0.39%(9)
Food habit	Insectivores	9.64%	8.67%(4)	33.71%(11)
	Herbivores	83.75%(10)	84.37%(12)	12.04%(4)
	Piscivores	6.18%(8)	6.76%(11)	51.98%(17)
	Carnivores	0.16%(1)	0.19%(4)	2.25%(12)

Note : Figures in parantheses represent total number of species (*Source* : Alvares, 2002)

Reptilia : Eight species of reptiles belonging to five families were encountered from various wetlands of Goa (Table 9). Of these, one species of colubrid snake, *Xenochrophis piscator* (Schneider) was quite common in ponds, lakes, fishery systems, marshy and muddy areas and found to occur in both freshwater as well as brackishwater wetlands, while two species of snakes *viz.*, Dog-faced water snake, *Cerberus rhynchops* and Hook-nosed sea snake, *Enhydrina schistosa* exclusively occurred in estuarine/ coastal wetlands. It is mentioned that the Estuarine Crocodiles, *Crocodilus porosus* were observed in the backwaters of Mandovi estuary (Untawale, 1986; Anonymous, 1989). Crocodiles were also reported to occur in the Carambolim Lake as informed by the local knowledgeable people. Indian Rock Python, *Python molurus* is reported to occur in the rocky regions near lakes and hill streams, but not included in the list for not being closely associated with wetlands.

Table 9. List of reptilian fauna recorded in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Order TESTUDINES Family TRIONYCHIDAE					
Lissemys punctata granosa (Schoepff)	+	_	+	-	-
Trionyx leithi Gray	+		+		
Order SAURIA Family VARANIDAE					
Varanus bengalensis (Daudin)	+	+	+	+	+
Order SERPENTES					
Family COLUBRIDAE					
Xenochrophis piscator (Schneider)	+	+	+	+	
Cerberus rhynchops Schneider				+	+
Family HYDROPHIDAE					
Enhydrina schistosa Daudin					+
Hydrophis cynocinctus Daudin					+
Order CROCODILIA Family CROCODILIDAE					
Crocodilus porosus Schneider	+		+	+	+

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands; SABS = Chorao Island & SABS; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers.

Amphibia : Six species of frogs and toads under two families have been recorded from wetlands of Goa (Table 10). Of these, two species viz., *Rana cyanophlyctis* and *Rana limnocharis* were found to be common in occurrence in freshwater ponds and marshes of Goa.

Fishes : A total of 76 species belonging to 29 families have been recorded from different wetlands of Goa State (Table 11). Of these, 57 species were encountered in freshwater wetlands and 23 species were recorded from brackishwater wetlands including estuaries. It may be mentioned

Table 10. List of amphibian fauna inhabiting in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Order ANURA Family RANIDAE					
Rana cyanophlyctis Schneider (=*Euphlyctus eyanophlyctis* (Schneider))	+	+	+	+	
Rana hexadactyla Lesson (= *Euphlyctis hexadactylus* (Lessor))	+	+	+	-	
Rana limnocharis Boie (= *Fejervarua limnocharis* (Gravenhorst)	+	+	+	+	
Rana malabarica Tochudi (= *Hydrophylax malabaricus* (Tschudi))	+		+	-	
Rana tigerina Lesson (= *Hoplobatrachus tigerineus* (Dandin))	+	+	+	-	-
Family BUFONIDAE					
Bufo melanostictus Schneider (= *Duttaphrynus melanostictus* (Schneider)	+	-	+	-	

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands SABS = Chorao Island & SABS; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers.

that many more species occur in estuarine ecosystem of Goa and several species occur both freshwater and brackishwater wetlands. Of these, five species *viz.*, *Etroplus suratensis*, *Lates calcarifer*, *Mugil cephalus*, *M. parsia* and *Chanos chanos* are commonly cultivated species in the brackishwater systems of Goa. During lowtide, juveniles of these species could be collected in large mumbers for pond culture. The Mandovi-Zuari estuarine complex of Goa is endowed with mangrove swamps of varying intensities, characterized by ambient water temperature, salinity, dissolved oxygen and pH, which facilitate to serve as nursery ground for several finfish and shellfish species (Goswami and Goswami, 1994). Beside these species, Doiphode and Naik (1975) recorded a giant rock-cod *Epinephalus malabaricus* (Bloch and Schneider) measuring 210 cm in total length caught in stake net in the Mandovi estuary, Goa.

Table 11. List of fish fauna occurring in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Order ANGUILIFORMES Family ANGUILLIDAE					
Anguilla bengalensis (Gray)			+		
Order OSTEOGLOSSIFORMES Family NOTOPTERIDAE					
Notopterus notopterus (Pallas)	+		+		

Table 11. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Order GONORNCHIFORMES Family CHANIDAE					
Chanos chanos (Forskål)				+	+
Order ELOPIFORMES Family MEGALOPIDAE					
Megalops cyprinoides (Broussonet)			+	+	+
Order CLUPEIFORMES Family ENGRAULIDIDAE					
Thryssa malabarica (Bloch)				+	+
Stolephorus sp.				+	+
Order CYPRINIFORMES Family CYPRINIDAE					
Chela cachius (Ham – Buch)			+		-
Chela dadiburjori (Menon)			+		
Cirrhinus cirrhosus (Bloch)	+		+		
Danio aequipinnatus (Mc Clelland)	+		+		
Garra gotyla gotyla (Gray)			+		
Garra gotyla sternorhynchus (Jerdon)			+		
Garra mullya (Sykes)		+	+		
Labeo dussumieri (Valenciennes)	+	+	+		
Puntius amphibius (Valenciennes)	+	+	+		
Puntius crescentus Yazdani and Singh	+		+		
Puntius fasciatus pradhani Tilak			+		
Puntius fasciatus fasciatus (Jerdon)			+		
Puntius filamantosus (Valenciennes)	+	+	+		
Puntius jerdoni (Day)	+	+	+		
Puntius narayani (Hora)	+		+		
Puntius sarana subnasutus (Valenciennes)			+		
Puntius setnia Chhapgar and Sane			+		
Puntius vittatus Day			+		
Puntius ticto (Ham–Buch)	+	+	+		
Rasbora cavertì (jerdon)	+	+	+		
Rasbora daniconius (Ham–Buch)	+	+	+		
Rasbora rasbora (Ham–Buch)			+		
Salmostoma boopis (Day)			+		

Table 11. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Family COBITIDAE					
Lepidocephalus guntea (Hum – Buch)	+		+		
Lepidocephalus thermalis (Valenciennes)	+	+	+		
Pangio goaensis (Tilak)	+		+		
Family HOMALOPTERIDAE					
Noemacheilus botia (Ham-Buch)			+		
Noemacheilus elongatus (Hora)	-		+		
Noemacheilus evezardi Day			+	-	
Order SILURIFORMES Family BAGRIDAE					
Aorichthys seenghala (Sykes)	+		+		
Mystus gulio (Ham Buch)			+	+	+
Mystus keletius (Valenciennes)					+
Mystus malabaricus (Jerdon			+	+	+
Mystus oculatus (Valenciennes)			+	-	+
Rita kuturnee (Sykes)			+	-	
Rita pavimentata (Valeciennes)	-	-	+		
Family SILURIDAE					
Ompak bimaculatus (Bloch)			+		
Ompak malabaricus (Valenciennes)			+		
Family HETEROPNEUSTIDAE					
Heteropneustes fossilis (Bloch)			+		
Family SCHILBEIDAE					
Clarias dussumieri dussumieri Valenciennes	+		+		
Pseudeutropius mitchelli (Gunther)			+		
Order ATHERINIFORMES Family BELONIDAE					
Xenentodon cancila (Ham-Buch)			+	+	+
Family ATHERINIDAE					
Atherinomorus sp.	-		-		+
Family CYPRINODONTIDAE					
Aplocheilus blockii (Arnold)	+		+		
Aplocheilus lineatus (Valenciennes)			+		
Aplocheilus panchax (Ham–Buch)	+	+	+		

Table 11. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Family POECILIDAE					
Gambusia affinis (Baird & Girard)			+		
Poecila reticulata Peters			+		
Order GASTEROTEIFORMES Family SYNGNATHIDAE					
Microphis cuncalus (Ham-Buch)			+	+	
Order CHANNIFORMES Family CHANNIDAE					
Channa orientalis Bloch & Schneider	+		+		
Channa punctatus (Bloch)	+		+		
Order PERCIFORMES Family AMBASSIDAE					
Ambassis miops Gunther					+
Chanda nama (Ham-Buch)	+	+	+		
Parambassis thomassi (Day)	+		+		
Family ANABANTIDAE					
Anabas testudineus (Bloch)	+		+		
Family CICHLIDAE					
Etroplus maculatus (Bloch)				+	+
Etroplus suratensis (Bloch)				+	+
Oreochromis mossambica (Peters)			+		
Family TERAPONIIDAE					
Terapon jarbua (Forskål)				+	+
Family MUGULIDAE					
Liza parsia (Ham-Buch)				+	+
Sicamugil cascasia (Ham-Buch)				+	+
Family CENTROPOMIDAE					
Lates calcarifer (Block)				+	+
Family GERREIDAE					
Gerres limbatus Cuvier				+	+
Gerres lucidus Cuvier				+	+
Family POLYNEMIDAE					
Eleutheronema tetradactylum (Shaw)				+	+
Polynemus tetradactylus (Bloch)				+	+

Table 11. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Family GOBIIDAE					
Glossogobius giuris (Ham-Buch)		-	+	-	-
Periopthalmus sp.	-	-	-	+	+
Family BELONTIDAE					
Pseudosphromenus cupanus (Valenciennes)	-		-	-	+
Order MASTACEMBELIFORMES Family MASTACEMBELIDAE					
Mastacembelus armatus (Lacepede)	+	-	+	-	

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands SABS = Chorao Island & SABS; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers.

Invertebrate Diversity

Macrocrustaceans : In all 47 species comprising of 17 species of prawns and shrimps, 23 species of crabs, 4 species of hermit crabs, one species of isopod and two species of stomatopod groups have been recorded from wetlands of Goa (Table 12). Among these, 10 species occur in freshwater wetlands and 20 species in brackishwater wetlands. Achuthankutty *et al.* (1976) studied the abundance and distribution of larvae of four species of penaeid prawns, *viz.*, *Metapenaeus dobsoni* (Miers), *M. monoceros* (Fabricius), *Penaeus merguiensis* de Man and *Parapenaeus stylifera* (Milne Edwards) in Mandovi and Zuari estuaries of Goa and found that their larvae were more abundant in the mouth regions than in the upper reaches. George and Goswami (1977) reported five species of prawns, which includes *Metapenaeus affinis* in addition to above four species, in the inshore coastal waters of Goa. Goswami (1992) studied the zooplankton community structure, diversity and species succession in the estuaries of Goa and observed an intimate link to the salinity cycle of the estuarine systems. It was also observed that crustacean groups such as copepods, cladocerans, mysids, sergestids, decapod larvae, prawn larvae and juveniles constitute the bulk of zooplankton. Among the crustaceans, copepods comprise the single largest taxon represented by 55 species. The non-crustacean taxa present were polychaete larvae, ctenophores, veligers, chaetognaths, fish eggs and larvae.

Table 12. List of macrocrustaceans occurring in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	ED	CI/DI	EC
Order STOMATOPODA Family SQUILLIDAE						
Cloridopsis sp.				-	+	+
Order DECAPODA Infraorder MACRURA Family PENAEIDAE						
Metapenaeus affinis (H. Milne Edwards)			+		+	+

Table 12. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	ED	CI/DI	EC
Metapenaeus dobsoni (Miers)					+	+
Metapenaeus moyebi (Kishinouye)					+	
Metapenaeus monoceros (Fabricius)				+	+	+
Parapenaeopsis stylifera (Milne Edwards)					+	
Penaeus canaliculatus Edwards					+	
Penaeus indicus Edwards				+	+	+
Penaeus merguiensis de Man				+	+	
Penaeus monodon (Fabricius)				+	+	+
Family SERGESTIDAE						
Lucifer hanseni Nobili					+	
Acetes indicus Milne Edwards				+	+	+
Acetes sibogae Hansen					+	
Family ATYIDAE						
Caridina sp.	+	+	+			
Family PALAEMONIDAE						
Macrobrachium idae (Heller)					+	+
Macrobrachium lamarrei (H. Milne Edwards)			+			
Macrobrachium rosenbergii (de Man)			+		+	
Macrobrachium sp.	+	+	+	+	+	+
Infraorder ANOMURA Family DIOGENIDAE						
Clibanarus padavensis de Man				+	+	+
Diogenes affinis Henderson					+	
Diogenes avarus Heller				+		
Diogenes diogenes (Herbst)				+	+	
Infraorder BRACHYURA Family HYMENOSOMATIDAE						
Elamenopsis alcocki (Kemp)					+	
Elamenopsis demeloi (Kemp)		-			+	
Elamenopsis octagonalis (Kemp)					+	
Elamena truncata (Stimpson)					+	
Elamena xavieri Kemp	-	-	-	-	+	-
Family PORTUNIDAE						
Portunus pelagicus (Linnaeus)						+

Table 12. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	ED	CI/DI	EC
Scylla serrata (Forskål)				+	+	+
Scylla tranquebarica (Fabricius)				+	+	+
Family PILUMNIDAE						
Eurycarcinus orientalis A. Milne Edwards				+	+	+
Benthopanope indica (de Man)					+	
Parapanope hextii (Alcock)					+	
Family GRAPSIDAE						
Grapsus albolineatus Lamarck				+	+	+
Metopograpsus messor (Forskål)				+	+	+
Varuna litterata (Fabricius)			+	+	+	+
Chiromantes bidens (de Haan)				+	+	+
Episesarma taeniolata (White)				+	+	+
Parasesarma plicatum (Fabricius)				+	+	+
Nanosesarma andersoni (de Man)				+	+	+
Pseudosesarma edwardsi (de Man)			+	+	-	+
Clistocoeloma merguiense de Man	-	-	-	+	+	+
Family OCYPODIDAE						
Uca lactea (de Haan)				+	+	+
Ilyoplax gangeticus (Kemp)					+	
Macrophthlmus (Mareotis) pacificus Dana					+	
Order ISOPODA Family LIGIDAE						
Ligia exotica Roux				+	+	
Family SPHAEROMATIDAE						
Sphaeroma walkeri Stebbing				+	+	+

Note : CL = Carambolim Lake; ML = Mayem Lake; MR + Marshylands/ Riverine wetlands ; ED = Ela Dhauji; CI/ DI = Chorao Island (SABS)/ Diwadi Island; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers.

Insects : Insects comprise one of the dominant invertebrate groups in freshwater ecosystem of Goa especially in Carambolim Lake, which was fully covered with different types of macrophytes. So far, 40 species of insects comprising of 11 species of Hemiptera, 15 species of Coleoptera, 6 species of Odonata and 8 species of Diptera have been reported from wetland environs of Goa (Table 13). Most of these insect species were recorded from freshwater ecosystems. Out of 40 insect species, 28 species were recorded from Carambolim Lake.

Table 13. List of insect species occurring in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Class INSECTA Order HEMIPTERA Family GERRIDAE					
Gerres sp.	+	+	+		
Limnogonus sp.	+		+		
Family BELOSTOMATIDAE					
Diplonychus indicus Venk. & Rao	+	+	+		
Diplonychus sp.	+	+	+		
Family NEPIDAE					
Ranatra longipes Stal	+		+		
Ranatra sp.	+	+	+		
Cercotmetus pilipes (Dall)	+				
Family HYDROMETRIDAE					
Hydrometra greeni Krikaldy	+		+		
Family NOTONECTIDAE					
Anisops breddini Krikaldy.	+		+		
Anisops sp.	+	+	+		-
Enithares sp.		+		-	
Order COLEOPTERA Family DYSTISCIDAE					
Canthydrus laetabilis (Walker)	+	+	+		-
Canthydrus morsbachi (Wehncke)	+		+		
Canthydrus sp.	+	+	+		
Clypeodytes severini Reg.			+		
Cybister cognatus Sharp			+		
Cybister limbatus (Fabricius)			+		
Cybister sp.	+		+		
Dytiscus sp.	+		+		
Guignotus flammulatus Sharp	+		+		
Guignotus sp.	+	+	+		
Hydrovatus sp.	+		+		
Laccophilus sp.		+	+		

Table 13. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands	
	CL	ML	MR	SABS	EC
Family HYDROPHILIDAE					
Helochares sp.	-	-	+		
Amphiops sp.	+	-	+	-	-
Family GYRINIDAE					
Dineutus sp.		+			
Order ODONATA Family COENAGRIONIDAE					
Ceriagrion sp.	+	+	+	-	
Neurothemis sp.	+	+	+		
Orthetrum sp.	+	-	+		
Pantala sp.	+	+	+	-	
Indophaca sp.	+		+	-	
Vestalis sp.	+		+	-	
Order Diptera Family CULICIDAE					
Anopheles (Cellia) subpictus Grassi				+	
Anopheles sp.	+	+	+		
Culex (Culex) sitiens Weidmann		-	-	+	
Culex sp.	+		+	+	
Ochlerotatus (Rhinoskusea) wardi (Reinert)	-			+	
Uranotaenia (Pseudoficalbia) atra Theobald	-	-		+	
Verrallina (Verrallina) lugubris (Barrand)	-			+	
Family CHIRONOMIDAE					
Chironomus sp.	+		+		

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands SABS = Chorao Island & SABS; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers.

Polychaeta : Seven species of polychaetes from 5 families have been reported to occur in the intertidal areas of estuarine ecosystems (Table 14). While working on the spatial and temporal changes in benthic macrofauna from Mandovi and Zuari estuaries, Ansari *et al.* (1986a) recorded 69 species of macrobenthos and observed that polychaetes were dominant taxa in both the estuaries folllowed by Crustacea and Mollusca. A quantitatively enhanced polychaete population was recorded by Ansari *et al.* (1986b) at an estuarine site receiving domestic sewage and waste from fish landing jetty due to organic enrichment that stimulated benthic polychaete productivity.

Table 14. List of polychaetes inhabiting in brackishwater wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	SABS	EC	DI
Family NEREIDIDAE						
Nereis sp.				+	+	+
Perinereis sp.				+	+	+
Family EUNICIDAE						
Eunice antennata Savigny				+	+	
Eunice tentaculata Quatrefages				+	+	+
Family OPHELIIDAE						
Ophelia sp.					+	
Family ONEPHIDAE						
Dioptera neopolitana Delle Chiaje					+	+
Family GLYCERIDAE						
Glycera alba Rahke					+	+

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands SABS = Chorao Island & SABS; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers: DI = Diwadi Island

Mollusca : A total of 40 species of molluscs comprising of 25 species of gastropod and 15 species of bivalve molluscs belonging to 21 families have been found to occur in freshwater and brackishwater wetlands and estuaries of Goa (Table 15). Of these, 21 species occur in freshwater wetlands and 22 species from brackishwater and estuaries. It may be mentioned that the mangrove clam *Polymesoda (Geloina) erosa* (Solander, 1786) as a new record from the West coast was recorded by Ingole *et al.* (1994, 2002) for the first time from Goa.

Table 15. List of molluscan fauna occurring in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	SABS	EC	DI
Class GASTROPODA Family VIVIPARIDAE						
Bellamya bengalensis (Lamarck)	+	+	+			
Bellamya dissimilis (Mueller)	+	+	+			-
Family PILIDAE						
Pila globosa (Swainson)	+		+			
Pila virens (Lamarck)	+		+			
Turbinicola saxea (Reeve)		+	+			
Family THIARIDAE						
Thiara (Melanoides) tuberculata (Mueller)	+	+	+	+	+	
Thiara (Sermtyla) riqueti (Grateloup)			+		+	

Table 15. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	SABS	EC	DI
Thiara (Thiara) scabra (Mueller)	-	+	+			
Thiara (Tarebia) lineata (Gray)	+	+	+			
Family LYMNAEIDAE						
Lymnaea (Pseudosuccinia) acuminata Lamarck	+	+	+			
Lymnaea (Pseudosuccinea) luteola Lamarck	+	+	+			
Family PLANORBIDAE						
Gyraulus convexiusculus (Hutton)	+	+	+			
Indoplanorbis exustus (Deshayes)	+	+	+	+		
Segmenina (Polypylis) trochoidea (Benson)	+	-	+			
Family NERITIDAE						
Neritina (Dostia) violacea (Gmelin)		-	+	+	+	+
Nerita polita Linnaeus					+	
Family TROCHIDAE						
Trochus (Infundibulum) radiatus Gmelin					+	
Family LITTORINIDAE						
Littoraria (Littoraria) undulata (Gray)				+	+	+
Family PETALLIDAE						
Cellana radiata radiata (Born)	-		-		+	
Family TURRITETHIDAE						
Turritella duplicata (Linnaeus)				+	+	
Family ELLOBIIDAE						
Cassidula nucleus (Gmelin)		-		+		+
Family POTAMIDIDAE						
Telescopium telescopium (Linnaeus)			-	+	+	+
Terebraia palustris (Bruguiere)				+	+	+
Family CERITHIDAE						
Cerithidea (Cerithideopsilla) cingulata (Gmelin)		-		+	+	+
(Syn = *Cerithidea fluviatilis*)	-	-	-	-	+	+
Family ONCHIDAE						
Onchidium sp.	-			+	+	+
Class BIVALVIA Family VENERIDAE						
Meretrix meretrix (Linnaeus)				+	+	+
Meretrix casta (Chemntiz)				+	+	
Family MYTILIDAE						
Perna viridis (Linnaeus)				+	+	

Table 15. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	SABS	EC	DI
Modiola undulata (Dunker)				+	+	+
Family UNIONIDAE						
Lamellidens consobrinus (Lea)			+	-		
Lamellidens corrianus (Lea)	+		+			
Lamellidens marginalis (Lamarck)	+		+			
Family AMBLEMIDAE						
Parreysia (Parrreysia) corrugata (Muller)			+			
Parreysia (Parreysia) favidens (Benson)			+	-		
Family CORBICULIDAE						
Corbicula strietella Deshayes			+			
Polymesoda (Geloina) erosa (Solander)			-	+	+	+
Family TEREDINIDAE						
Bactronophorus thoracites (Gould)				+		+
Dicyathifer manni (Wright)				+		+
Nausitora hedleyi Schepmann				-		+
Family PHOLADIDAE						
Martesia striata (Linnaeus)				-	+	

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands SABS = Chorao Island & SABS; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers: DI = Diwadi Island

Zooplankton Diversity

Crustacean Zooplankton : List of crustacean zooplankton recorded from various wetlands of Goa include 27 species of Cladocera, 16 species of Copepoda and 2 species of Ostracoda besides nauplius larvae of crustacean species (Table 16). Das *et al.* (2005) reported that among four selected wetlands, Carambolim Lake represents highest diversity of zooplankton including rotifers (36 species), presumably because of greater diversity and density of macrophytes offering suitable habitat ecology and water quality, and inversely related with anthropogenic/ pisiculture activities as encountered in wetlands of Indian Botanical Garden (Nandi *et al.*, 2001).

Table 16 List of crustacean zooplankton recorded in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater wetlands		
	CL	ML	MR	EF	CF	EC
Order CLADOCERA Family SIDIDAE						
Diphanosoma excisum Sars	+	+	+		-	-
Diphanosoma sarsi Richard	+		+		+	-
Diphanosoma sp.	+	+	+	+		-

Table 16. *Contd.*

Family and species	Freshwater wetlands			Brackishwater wetlands		
	CL	ML	MR	SABS	EC	DI
Latonopsis australis (Sars)	+	-	+	-	-	-
Family DAPHNIDAE						
Ceriodaphnia cornuta Sars	+	+	+	+	+	-
Ceriodaphnia reticulata (Jurine)	-	+	+	+	+	-
Daphnia lumholtzi Sars	+	+	+	+		-
Scapholeberis kingi Sars	+	-	-	-	-	-
Simocephalus vetulus (O. F. Muller)	+	+	-		+	-
Simocephalus serratus (Koch)	+	-	-	-	-	-
Family MOINIDAE						
Moina micrura Kurz	+	+	+	+	+	-
Moina macrocopa (Straus)	+	+	+	-		-
Moina brachiata (Jurine)	+	-	-	-	+	-
Moinodaphnia macleayi (King)	+	-	-	-	-	-
Family BOSMINIDAE						
Bosmina sp.		-	+	-	-	-
Family MACROTHRICIDAE						
Macrothrix spinosa King	-	+	-	+		-
Family CHYDORIDAE						
Alona quadriangularis (O. F. Muller)	+	-	-	-	-	-
Alona rectangula Sars	-	+	-	+	+	-
Biapertura karua King	+	-	-	+		-
Chydorus barroisi (Richard)	+	+	+			-
Chydorus sphaericus (O. F. Muller)	+	+	+		+	-
Chydorus reticulatus Daday	+	+	+			-
Indolona sp.	+			-		-
Pleuroxus aduncbus (Jurine)	+	+	+		+	-
Pleuroxus denticulatus (Birge)	+	-	+	+		-
Family PODONIDAE						
Evadne tergestina Claus	-	-	-		+	+
Penilia avirostris Dana	-	-	-		+	+
Subclass COPEPODA Order CALANOIDEA Family ACARTIIDAE						
Acartia bowmani Abraham	-	-				+
Acartia pacifica Steuer		-			+	+

Table 16. *Contd.*

Family and species	Freshwater wetlands			Brackishwater wetlands		
	CL	ML	MR	SABS	EC	DI
Acartia tropica Ueda and Hiromi						+
Family PSEUDODIAPTOMIDAE						
Pseudodiaptomus bowmani Walter			+			+
Pseudodiaptomus sewelli Walter				+	+	+
Pseudodiaptomus jonesi Pillai	-	-	-	-	-	+
Heleodiaptomus viduus Gurney	+	+	+	+	+	
Diaptomus sp.	+	+	+	+		
Family PONTELLIDAE						
Calanopia elliptica (Dana)						+
Calanopia herdmani Scott						+
Calanopia minor A. Scott					+	+
Family ARIETELLIDAE						
Metacalanus aurivilli Cleve						+
Family DIOSACCIDAE						
Stenhelia longifurca (Sewell)						+
Family MONSTRILLIDAE						
Monstrilla sp.						+
Order CYCLOPOIDA Family CYCLOPIDAE						
Macrocyclops distinctus Richard		+				
Mesocyclops hyalinus Rehberg	+	+	+	+	+	
Subclass OSTRACODA Order PODOCOPA Family CYPRIDINIDAE						
Cypris subglobosa Sowerby	+		+			
Stenocypris sp.	+		+			

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands; EF = Ela Dhauji fishery; CF = Charao fishery; EC = Estuaries / Creeks / Coastal wetlands; DI = Diwadi Island.

Noncrustacean zooplankton **:** Nineteen species of rotifers belonging to 8 families and 7 species of chaetognaths have been recorded from freshwater and brackishwater wetlands of Goa (Table 17). These rotifer species were recorded from both freshwater and brackishwater environment, while chaetognaths were reported from brackish water ecosystems. Nair and Selvakumar (1979) recorded six species of chaetognaths and studied the incidence, seasonal fluctuation and breeding of chaetognaths in the Mandovi Zuari estuarine system as immigrant fauna from the sea. *Sagitta bedoti*, which breeds throughout the year with three peak periods of

PLATE-I



Fig. 4. Carambolim Lake infested with aquatic weeds.



Fig. 5. Collection of plankton samples from different sites of Carambolim Lake using boat.

PLATE-II



Fig. 6. Mayem Lake with surrounding hills and forests.



Fig. 7. A view of Mayem Lake.

PLATE-III



Fig. 8. A view of Salim Ali Bird Sanctuary beside Mandovi river.



Fig. 9. Mangrove mudflat of Chorao Island

PLATE-IV



Fig. 10. A view of Diwadi Island.



Fig. 11. Women selling crabs and molluscs collected from estuarine and brackishwater wetlands of Goa.

heavy spawning, was considered as a true inhabitant of this estuarine system. *Sagitta enflata* was observed during the period of relatively high salinity. Salinity was reported to be the major factor controlling their distribution in the estuarine system as the chaetognaths were absent in the upper reaches during the monsoon period.

Table 17. List of noncrustacean zooplankton inhabiting in wetlands of Goa

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	EF	CF	EC
Phylum ROTIFERA Class MONOGONONIA Order PLOIMIDA Family BRACHIONIDAE						
Brachionus angularis Gosse	+	+	+	+	+	+
Brachionus calyciflorus Wierzejski	+		+	+		
Brachionus caudatus Barrois & Daday	+	+	+		+	+
Brachionus falcatus Zacharias	+		+		+	+
Brachionus quadridentatus Hermann	+	+	+			
Brachionus urceolaris O. F. Muller	+	+	+	+	+	+
Brachionus rubens Ehrb.	+	+	+			
Keratella cocheteais Gosse		+		-	+	
Keratella tropica Apstein	+					
Family EPIPHANIDAE						
Epiphanes macrourus Hermann	+	+	+	+	+	+
Family EUCHLANIDAE						
Euchlanis dilatata Ehrenberg	+	+	+	+	+	+
Family LECANIDAE						
Lecane (Lecane) bidentata (Muller)	+		+			
Lecane (M.) bulla Gosse	+	+	+	+	+	+
Lecane (M.) closterocera Schnarda	+		+			
Family TRICHOCERCIDAE						
Trichicerca cylindrica (Inhoff)	+	+	+		+	+
Trichicerca sp.	+	+	+	+	+	+
Family ASPLANCHNIDAE						
Asplanchna intermedia Hudson	+		+			
Order GNESIOTROCHA Family FILLINIDAE						
Filinia longiseta Ehrenberg	+	+	+	+	+	+
Order BDELELLOIDEA Family PHILODINIDAE						
Rotaria rotatoria (Pallas)	+					

Table 17. *Contd.*

Family and species	Freshwater wetlands			Brackishwater/ estuarine wetlands		
	CL	ML	MR	EF	CF	EC
Phylum CHAETOGNATHA						
Sagitta bedoti Beraneck					+	+
Sagitta enflata Gnassi					+	+
Sagitta ferox (Doncaster)						+
Sagitta pulchra Doncaster						+
Sagitta robusta Doncaster						+
Sagitta sp.					+	
Pterosagitta draco (Krohn)						+

Note : CL = Carambolim Lake; ML = Mayem Lake; MR = Marshylands/ Riverine wetlands; EF = Ela Dhauji Fishery; CF = Chorao Fishery & SABS; EC = Estuaries/ Creeks/ Coastal wetlands particularly of Mandovi and Zuari Rivers.

Distribution of zooplankton groups (No./50 litre) from two freshwater lakes and two brackishwater fisheries of Goa is presented in Table 18. Quantitative samplings (No. of organisms/ 50 litres of water) have revealed higher population densities of zooplankton in freshwater wetlands than that in brackishwater fishery systems and among the two freshwater lakes. Carambolim Lakes showed higher abundance of different groups (Table 18).

Table 18. Distribution of zooplankton selected wetlands of Goa (Source Das *et al.*, 2005)

Groups (Number/50 litres)	Freshwater Lakes		Brackishwater Fisheries	
	Carambolim	Mayem	Ela-Dhauji	Chorao
Cladocera	69-123	37-87	18-25	15-62
Copepoda	79-202	85-145	59-91	52-87
Conchostraca	3-19	6-20		
Rotifera	11-22	12-17	5-9	4-9
Nauplius larvae	13-48	14-35	10-13	7-11
Decapod larvae	0-10	0-8	15-52	—15
Others				0-23
Total	**186-342**	**165-284**	**124-171**	**86-181**

It has also been observed that premonsoon population is higher than postmonsoon population in freshwater wetlands, while post monsoon population is higher than premonsoon population in brackishwater wetlands (Table 19). Goswami (1992) observed that zooplankton community structure and diversity were intimately linked to the salinity cycle in the estuaries of Goa and the maximum and minimum species diversity values were recorded during dry premonsoon and monsoon when salinity was high and low respectively. In terms of abundance, copepods were dominant (54.9-70.6%), while other common groups were cirripede larvae, hydromedusae,

polychaete larvae, decapod larvae, cladocerans, sergestids, veligers, chaetognaths, fish eggs and larvae. Zooplankton biomass and total counts in estuarine ecosystems of Goa varied in relation to seasons and estuaries concerned as higher population densities were recorded in Mandovi (24780 m^3) compared to Zuari estuary (10215 m^3). Numerical abundance of copepod species was recorded more in Zuari estuary, the bulk of which was comprised of species belonging to the families Paracalanidae, Pseudodiaptomidae and Acartiidae. Vijaylakshmi *et al.* (1983) earlier studied the zooplankton variability of various groups of zooplankton and reported that copepods, decapods and chaetognaths in the Zuari estuary, Goa were most common in occurrence, while ctenophores, polychaetes, gastropods and cladocerans occasionally appeared in patches. Selvakumar *et al.* (1980) studied the secondary production of the estuarine system of Goa and recorded mean rates were 16.9, 35.9 and 32.4 mg C/m^2 from Mandovi, Zuari and Cambarjua canal respectively.

Table 19. Seasonal distribution of zooplankton from selected wetlands of Goa (*Source* : Das *et al.*, 2005)

Groups (Number / 50 litres)	Freshwater wetlands				Brackishwater wetlands			
	Carambolim Lake		Mayem Lake		Ela-Dhauji fishery		Chorao fishery	
Season	PRM	POM	PRM	POM	PRM	POM	PRM	POM
Cladocera	69-105	84-123	37-42	58-87	18-25	25-28	15-22	58-62
Copepoda	165-202	79-98	134-145	85—92	59-68	88-91	52-61	74-87
Conchostraca	3-8	6-19	17-20	6-9				
Rotifera	12-17	11-22	12-15	12-17	6-9	6-7	5-6	4-9
Nauplius larvae	25-48	13-18	25-35	14-23	11-13	10-13	7-8	9-11
Decapod larvae		0-10	-	4-8	15-20	39-52		10-15
Others		12-14			4-5	3-9	17-23	
Total	**297-360**	**225-284**	**205-237**	**199-206**	**123-130**	**181-190**	**90-110**	**165-174**

Note : PRM = Premonsoon; POM = Postmonsoon

Other invertebrate diversity

In addition to above major groups of macroinvertebrates comprising of arthropods, annelids and molluscs, a few species of poriferans and sea anemones were recorded from estuarine wetlands of Goa. These include *Cliona celata* Grant, 1826 and *Cliona vestifaca* Hancock, 1849 from Mandovi and Zuari estuaries (Thomas, 1975). So far six species of sea anemones *viz.*, *Edwardsia tinctrix* Annandale, 1915, *Metapeachia tropica* (Panikkar, 1939), *Pelocoetes exul* (Annandale, 1907), *Phytocoetes gangeticus* Annandale, 1915, *Cribrinopsis robertir* Parulekar, 1971 and *Anemonia indicus* Parulekar, 1968 were recorded from the Mandovi-Zuari estuary of Goa by Parulekar *et al.*, (1980). Aquatic oligochaetes, leeches and cirripedes were also available/ observed in wetland ecosystems of Goa, but could not be determined.

THREATS AND CONSERVATION

India is gifted with wetland ecosystems distributed in different geographical regions. Most of the wetlands in India are directly or indirectly linked with major river systems. There are 27,403 wetlands in India, of which, 24,344 are inland and 3,959 coastal wetlands. As per the Directory of Asian wetlands (1989), they occupy

18.4% of the country's area (excluding rivers), of which, 70% are under paddy cultivation. It is estimated that coastal wetlands occupy an area of 6750 sq km, which is dominated largely by mangroves as present along the estuarine ecosystem of Goa.

A number of mangrove habitats, coastal wetlands and lakes in Goa though offer suitable sites for a large number of resident and migratory birds and provide multifarious benefits to human, these bird habitats suffer from various threats. Lakes and freshwater wetlands in Goa mainly suffer from weed infestation, siltation, pollution and human interference. Among the estuarine ecosystem of Goa, particularly Mandovi and Cambarjua estuaries are severely affected by massive inputs of mining rejects, which have caused increasing environmental stress and irreversible ecosystem instability (Modassir, 1990; De Sousa, 1999). It has been reported that reduced oxygen concentration, high suspended solids and blanketing of bottom deposits by mining rejects, resulted in more than 70% reduction in clam production. This has also resulted in near extinction of resident fauna and the appearance of a low diversity of bottom fauna, comprising of tolerant and vagrant species (Parulekar *et al.*, 1985). Ansari *et al.* (1986) studied the macrobenthic fauna of Mandovi and Zuari estuaries and observed maximum density of 2425 m^2 during pre- and post-monsoon and minimum (650 m^2) during monsoon season, and noted about 40% reduction in species composition as compared with earlier study of 1971-73.

Lakes are mostly highly infested with *Salvinia* weed, which encroaches greater portion of waterbodies like a suffocating blanket affecting ecology, survival of existing biota and normal functioning of lake environment. This is particularly pronounced in the case of Carambolim Lake where surface run off, cattle washing and defaecation on catchment areas facilitate luxuriant growth of weeds. This lake and many other freshwater lakes in Goa face serious problem due to lack of management from the owners as well as lack of care and maintenance from local communities. During survey work it has been seen that the entire Carambolim Lake was choked with macrophytes including water lilies in large numbers at the central portion of the lake, leaving no open space for free movement of visiting migratory ducks. But it is worth mentioning that the Forest Department and the local panchayat had recently taken initiative to clean the lake. It is mentioned that three truckloads of weed were removed on the Republic Day in 2001 with the help of voluntary organization and school children (Alvares, 2002). Like all other wetlands in India, lakes in Goa are subjected to accumulation of excessive silt generated from surface runoff. Though desilting was undertaken in Santa Monica Lake, it was not so far carried out in Carambolim and other lakes. Encroachment, pollution and human interference are other problems affecting the health of the urban lake ecosystems of Goa. Thus, there is need to formulate long term conservation and management measures to clean up the weeds and to strengthen the restoration and revival of the lakes, particularly those that attract lake lovers, bird watchers and tourists so that these lakes can potentially act as prime ecotourism sites.

SUMMARY

Faunal elements of freshwater and brackishwater wetlands of Goa have been surveyed from two freshwater lakes *viz.*, Carambolim Lake and Mayem Lake, two brackishwater fishery systems viz., Ela Dhauji fishery and Chorao fishery and two island ecosystems *viz.*, Chorao Island and Diwadi Island in addition to various ponds and marshes as well as Mandovi and Zuari estuaries. The diversity of wetland fauna is represented by vertebrate and invertbrate groups as follows :

1. A total of 447 species of wetland fauna belonging to 233 species of vertebrates and 214 species of macroinvertebrates including zooplankton is communicated.
2. The vertebrate fauna comprises of 3, 140, 8, 6 and 76 species of mammals, birds, reptiles, amphibians and fishes respectively.

3. The invertebrate elements include 135 species of macroinvertebrates (macrocrustaceans-47 species, insects–40 species, polychaetes–7 species and molluscs–40 species), 45 species of crustacean zooplankton, 26 species of non-crustacean zooplankton (rotifers and chaetognaths) and 8 species of other invertebrates.
4. Mid winter waterfowl population of Carambolim Lake and Mandovi estuary should be resurveyed for suggesting their inclusion under Ramsar category.
5. The diversity of wetland fauna is discussed with special reference to zooplankton composition, density and productivity.

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