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Dr. J. R. B. ALFRED

Director

Zoological Survey of India

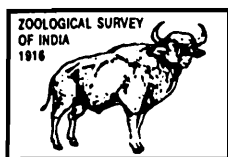
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Dr. J. R. B. ALFRED
Director
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WETLAND FAUNAL RESOURCES OF WEST BENGAL–4. DARJILING AND JALPAIGURI DISTRICTS

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INTRODUCTION

During 1996–97 and 1997–98, two surveys were undertaken to study wetland faunal resources of Darjiling and Jalpaiguri districts, representing the fourth report in the series. The significance of this survey lies with the fact that Darjiling and Jalpaiguri districts represent the hills and the terai-duars regions respectively. The narrow winding gorges of mighty rivers in the majestic Himalayan ranges run down the duars region forming marshy swamps along the valleys and the terai plains. The wetland habitats of duars region particularly of Jaldapara Wildlife Sanctuary of Jalpaiguri district are the abode of wild animals (Spillet, 1967). But, game animal is usually rare in wetland environs of Darjiling district.

Studies on faunal resources of wetlands in West Bengal mostly pertain to Calcutta and its adjoining districts of South Bengal (De *et al.*, 1989; Ghosh, 1990; Nandi *et al.*, 1993, 1999, 2001a, b). Very little is known on wetland fauna of North Bengal except the study on trophic structure and physical characteristics of some lentic habitats by Dasgupta (1995). Largely for this reason the present study was undertaken from Darjiling and Jalpaiguri districts representing the hills and the terai-duars region of North Bengal.

THE STUDY AREA

General : The districts of Darjiling and Jalpaiguri fall under the broad physiographic division, the Himalayan and sub-Himalayan West Bengal. Darjiling district, excluding a major portion of Siliguri subdivision, lies on the Himalayan hill. Jalpaiguri district mostly represents the plains (some 90 m above the sea level) with a belt of forest; the portion lying west of Teesta river is known as the “Terai” and the portion lying east of the river is known as “Duars” This forest belt in the past was very dense and was full of swamps. The duars, criss-crossed with mountain rivers,

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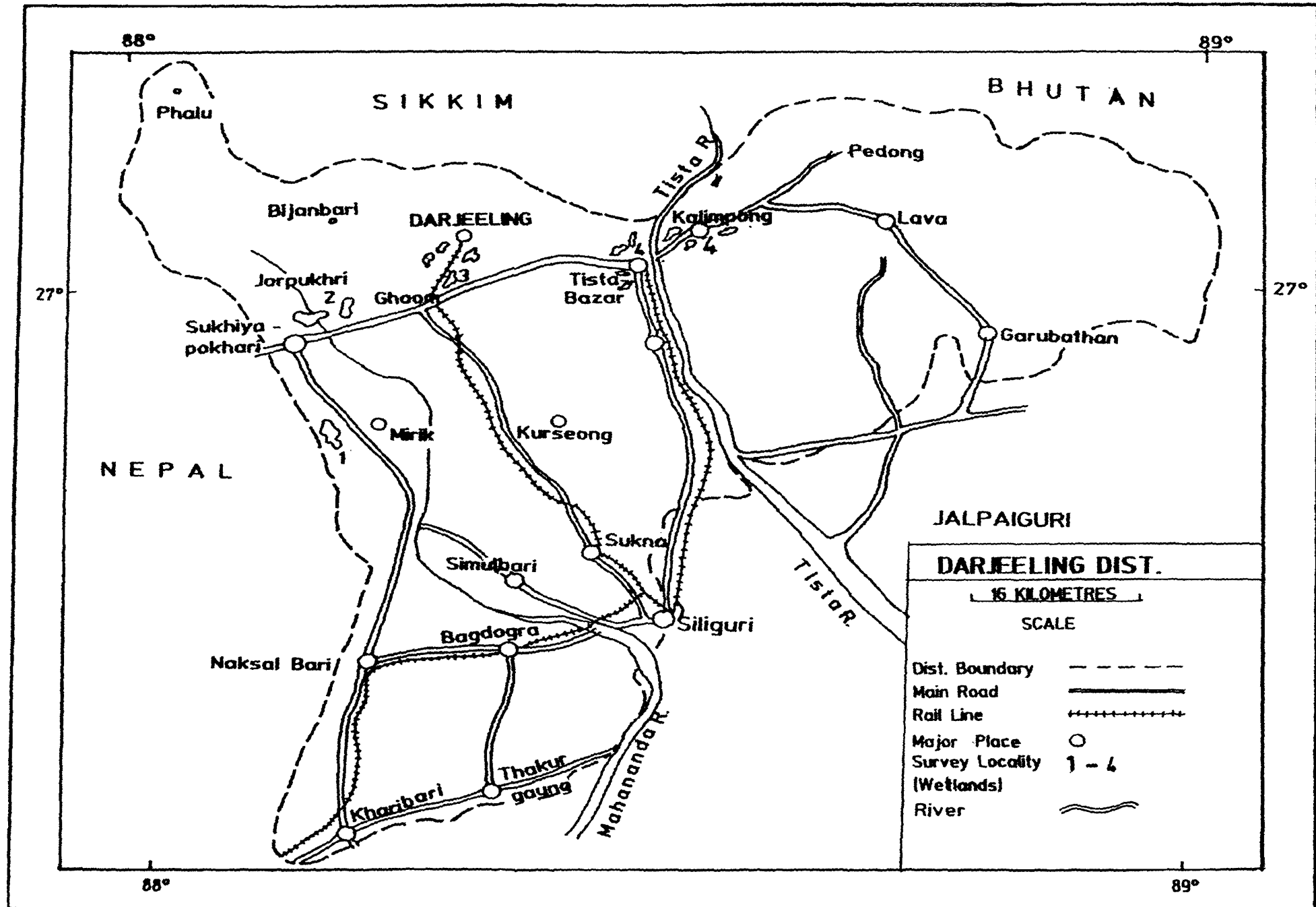


Fig. 1. : Map of Darjeeling district showing the wetlands (1-4) surveyed. 1 = Mirik Lake; 2 = Ponds and ditches of Jorpukhri Salamander Sanctuary; 3 = Ponds and jhoras of Darjeeling-Ghoom areas; 4 = Ponds and jhoras of Teesta-Kalimpong areas.

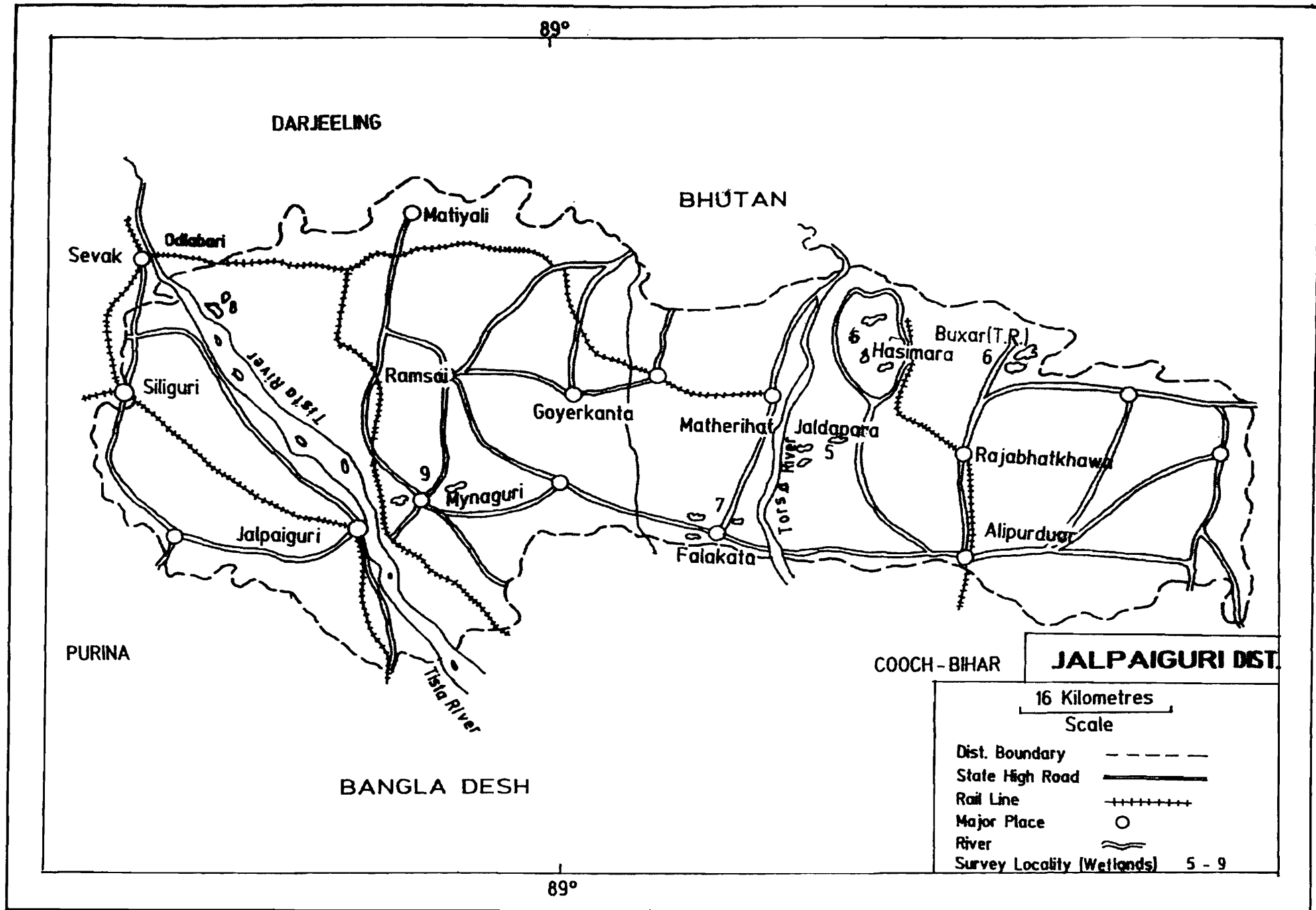


Fig. 2. : Map of Jalpaiguri district showing the wetlands (5-9) surveyed. 5 = Ponds, river and swamp in and around Jaldapara Wild Life Sanctuary; 6 = Ponds and lake in and around Buxa Tiger Reserve; 7 = Ponds and wetlands of Falakata area; 8 = Kathambari beel; 9 = Ponds and fishery of Paharpur-Mainaguri areas.

mostly support swamps of the sub-Himalayan region. Darjiling district lies between 26°27' and 27°13' N latitude; and 27°59' and 88°53' E longitude at the northern part of West Bengal covering a geographical area of 3254 sq. km. The major part of the district is in the Himalayan ranges extending over an elevation of 200 to 3800 m, with temperature reaching below the freezing point in winter (Banerji *et al.*, 1980). The mean maximum and mean minimum temperature during winter are 8.3°C and 1.6°C and the same during the hottest period is 18.9°C and 14.5°C respectively. The mean temperature varies from 10.2–16.7°C, some areas experience temperatures below 0°C every year. Monsoon season extends from June to September with average annual rainfall 2812 mm. The thunderstorms generally occur between March and June. The main rivers are Teesta and Mahananda. The forest is mixed type from riverine to Oak-Hemlock forests. The vegetation cover is 46.2% of which 29.63% dense forest, 11.8% open forest, and the rest plantations.

Jalpaiguri district (26°16'–27°0' N and 88°0'–89°53' E) lies in the moist tropical zone with an area of 6227 sq. km. (Kusari *et al.*, 1981). The total forested area is 23.5% out of which 13.26%, 5.9% and 4.37% are dense, open and plantation forests respectively. The important reserve forests, like Jaldapara, Buxa, Gorumara and Chapramari are located in this district. The average day temperature varies from 15.5–32°C and the average rainfall varies from 4100–5000 mm. Thunder and hailstorms are frequent between April and September. The main rivers are Rydak, Jaldhaka, Torsa, Kaljani, Dhawls. The district is rich in both plant and animal bio-diversity where a large number of species are endemic to the area. The species diversity of mammals is comparatively highest in Buxa Tiger reserve (71 species) among the Tiger reserves in India (Anonymous, 1995).

The physiographic features including population figures of these two districts are given in Table 1.

Table 1. : Physiographical features of Darjiling and Jalpaiguri districts, West Bengal.

Parameters	Darjiling district	Jalpaiguri district
Area (in sq. km.)	3,149	6,227
Altitude	40–3630 m	75–150 m
Latitude	26°31'–27°13' N	26°16'–27°00' N
Longitude	87°59'–88°53' E	88°4'–89°53' E
Population (2001 census)	16,05,900	34,03,204
Population density (sq. km.)	510	547
Temperature (°C)	4.5–18.9	12.2–40
Rainfall	321 cm	390 cm
Humidity	70–90%	80–90%
Landscape type	Himalayan mountains	Terai-Duars plains
Soil type	Mountain soil	New alluvial soil
Vegetation type	Tropical evergree / deciduous	Tropical evergree / deciduous
Forest cover (in sq. km.)	12.46	1456
Water resource (in ha)	4763.51	17073.11

Soil : At the foot of the Himalayas, the soils are mostly sandy, raw humus type, and deep black to grey-black in colour. These represent the rice growing areas of Jalpaiguri district, which get waterlogged during rain. The soil is acidic, the pH ranging from 4.7 to 5.8. In Jalpaiguri district, in general, the soil is alluvium, ranging from pure sand to clay but generally sandy loam. In Darjiling district, the soil of the terai tract is alluvium of light sandy loam in texture. A kind of red soil is found in patches of areas lying in Kalimpong and Gorubathan Police Stations of Darjiling district. A small portion of the hill soil consists of stiff loam of reddish colour. In general, the soils are poor in lime contents (Raychaudhuri *et al.*, 1963).

Vegetation : The common hydrophytes that occur in the wetlands of Jalpaiguri district include species belonging to the genera *Nymphaea*, *Nymphoides*, *Jussiaea*, *Hydrolea*, *Ipomoea*, *Limnophila*, *Hydrilla*, *Ottelia*, *Monochoria*, *Pistia*, *Lemna*, *Sagittaria*, *Alisma*, *Najas*, *Scirpus*, *Marselia*, *Eichhorma*, *Azolla*, etc. (Kusari *et al.*, 1981). In the Mirik Lake of Darjiling district reeds (*Typha*) and sedges (*Cyperus* spp.) have been noted. The riverine habitat of Jaldapara Wildlife Sanctuary of Jalpaiguri district consists primarily of forests with tall, dense grasses and interconnecting waterways. Being flooded each year by the rivers flowing through the sanctuary, much of the grassland or sandy soils is colonized primarily by a relatively short grass, *Saccharum spontaneum*, which is usually less than six feet high. *Phragmites karka* is generally found in clay pockets, as is *Saccharum procerum*. Some other grasses present in the sanctuary are *Erianthus elephantinus*, *Anthistria gianiea*, *Andropogon nardus*, *Arundinella brasiliensis*, *Arundo donax*, *Paspalidium punctatum*, *Saciolepis myosuroides*, etc. (Spillett, 1966).

Water resource : The major rivers of the Darjiling Himalaya are Teesta, Mahananda and Jaldhaka. The major tributaries of the Teesta are Rangit, Rangpo, Rili, Sebak, etc., while that of Mahananda river are Balasan and Mechi rivers. The Darjiling Himalaya region exhibits many beautiful springs and waterfalls besides ponds and jheels. The undulating Terai-Duars plains are traversed by Mechi, Mahananda, Teesta, Jaldhaka, Torsa, Kaljani, Raidhak and Sankosh rivers. The behaviour of these rivers is always unpredictable. They have a tendency to cut new channels during the annual flood season, from May to September and interconnected by a network of “cross-country” watercourses. The frequent changes in the river course result in numerous pools and marshes in the terai-duars region.

MATERIAL AND METHODS

A total of 15 freshwater wetlands, 6 from Darjiling and 9 from Jalpaiguri district, comprising of ponds, beels lakes, fishery system and road-wide nullahs were surveyed twice during the years 1996 and 1997. Both ponds and roadside nullahs (ponds) were clustered herein to show their faunal element, lake/locality-wise for convenience as follows :

- Darjiling District :
1. Mirik Lake
 2. Ponds and ditches of Jorpukhri Salamander Sanctuary
 3. Ponds and jhoras Darjiling-Ghoom areas
 4. Ponds and jhoras Teesta-Kalimpong areas
- Jalpaiguri District :
5. Ponds, river and swamp in and around Jaldapara Wildlife Sanctuary
 6. Ponds and lake in and around Buxa Tiger Reserve
 7. Ponds and wetlands of Falakata area
 8. Kathambari beel
 9. Ponds and fishery of Paharpur-Mainaguri areas.

Both the surveys were conducted during September-October months. The geographical locations of nine-selected wetland areas are shown in Fig. 1 & 2, indicating serial number as above. Field observations as well as some environmental parameters were noted. Faunal samples of zooplankton, macroinvertebrate, fishes and amphibians were collected using plankton net, drag net, cast net, etc. Higher vertebrates and cultivable fishes were observed in the field. Local enquiries were made to ascertain the occurrence of some important vertebrate species in the field. The faunal elements inhabiting the selected wetlands are presented in the following text and Tables 2–8 indicating their occurrence under Darjiling and Jalpaiguri districts in parenthesis as per serial number given above.

FAUNAL RESOURCES

Darjiling and Jalpaiguri districts are rich in faunal diversity in their terrestrial and arboreal habitats. But they are not so rich in wetlands as well as wetland fauna. The faunal elements habitually found to inhabit wetlands include aquatic, wetland dependent and wetland associated species (Nandi *et al.*, 1993). However, mention has also been made about some important dryland vertebrate species either common or occasional but characteristic to the area protected as sanctuary/reserve, viz., Jaldapara Wildlife Sanctuary and Buxa Tiger Reserve harbouring wetlands within these two protected areas.

VERTEBRATES

Mammals : Six species of mammals viz., the Smooth Indian Otter, *Lutra perspicillata*, the Great One-horned Rhinoceros, *Rhinoceros unicornis*, Wild Boar, *Sus scrofa*, Fishing Cat, *Felis viverrina*, Wild Buffalo, *Bubalus bubalis* and Swamp Deer, *Cervus duvauceli* have been associated with wetlands of Jalpaiguri district only. Of these, Smooth Otter and Fishing Cat occur in Kathambari beel, while Fishing Cat and Swamp Deer inhabit wetlands of Buxa Tiger Reserve. The swamp of Jaldapara Wildlife Sanctuary offers suitable living conditions to four wetland dependent mammals

Table 2. : List of avian species recorded in wetlands of Darjiling and Jalpaiguri districts.

Family and species	Occurrence in wetlands of	
	Darjiling district	Jalpaiguri district
A. Resident birds		
Family PODICEPETIDAE		
<i>Podiceps ruficollis</i> (Pallas)	—	7, 8
Family PHALACROCORACIDAE		
<i>Phalacrocorax niger</i> (Vicillot)	—	5, 7–9
<i>Anhinga rufa</i> (Daudin)	—	8
Family ARDEIDAE		
<i>Ardea purpurea</i> Linnaeus	—	5, 6, 8
<i>Ardea alba</i> J. E. Gray	—	5–8
<i>Ardeola grayii</i> (Sykes)	—	5–9
<i>Bubulcus ibis</i> (Boddaert)	—	5–9
<i>Egretta garzetta</i> (Linnaeus)	—	5–9
<i>Ixobrychus cinnamomeus</i> (Gmelin)	—	5, 7, 8
Family CICONIIDAE		
<i>Anastomus oscitans</i> (Boddaert)	—	5, 7, 8
Family RALLIDAE		
<i>Amaurornis phoenicurus</i> (Pennant)	—	5–9
<i>Porphyrio porphyrio</i> (Linnaeus)	—	5–8
<i>Gallinula chloropus</i> (Linnaeus)	—	5–8
Family JACANIDAE		
<i>Hydrophasianus chirurgus</i> (Scopoli)	—	5–9
Family ROSTRATULIDAE		
<i>Rostratula bengalensis</i> (Linnaeus)	—	7, 8
Family CHARADRIIDAE		
<i>Hoplopterus indicus</i> (Boddaert)	—	5–8
Family ALCEDINIDAE		
<i>Ceryle rudis</i> (Linnaeus)	1	5–9
<i>Alcedo atthis</i> (Linnaeus)	1	5–9
<i>Pelargopsis capensis</i> (Linnaeus)	—	5, 6
<i>Halcyon smyrnensis</i> (Linnaeus)	1	5–9

Table 3. : List of reptilian species recorded in wetlands of Darjiling and Jalpaiguri districts.

Family and species	Occurrence in wetlands of	
	<i>Darjiling district</i>	<i>Jalpaiguri district</i>
Family EMYDIDAE <i>Kachuga tecta</i> (Gray) Indian Sawback Turtle	–	7
Family TRIONYNICHIDAE <i>Lissemys punctata</i> (Bonaterre) Indian Flap-shelled Turtle	–	5–9
Family VARANIDAE <i>Varanus bengalensis</i> (Daudin) Bengal Monitor	1, 2	5–9
Family BOIDAE <i>Python molurus</i> (Linnaeus) Indian Rock Python	–	5, 6
Family COLUBRIDAE <i>Enhydris enhydris</i> (Schneider) Smooth Water Snake	–	7–9
<i>Xenochrophis piscator</i> Checkered Keelback	–	7–9

Table 4. : List of amphibian species recorded in wetlands of Darjiling and Jalpaiguri districts.

Family and species	Occurrence in wetlands of	
	<i>Darjiling district</i>	<i>Jalpaiguri district</i>
Family BUFONIDAE <i>Bufo melanostictus</i> Schneider Common Indian Toad	1–4	5–9
<i>Bufo himalayana</i> Gunther	1	–
Family MICROHYLIDAE <i>Microhyla ornata</i> (Dumeril and Bibron) Ornate Frog	1	5, 7
Family RANIDAE <i>Rana cyanophlyctis</i> Schneider Skipping Frog	1, 2	5–9
<i>Rana limnocharis</i> Boie Cricket Frog	1, 2	5–9
<i>Rana tigrina</i> Daudin Indian Bull Frog	1	5–9
Family SALAMANDRIDAE <i>Pleurodeles verrucosus</i> (Anderson) Himalayan Newt	1, 2	–

Table 5. : List of fishes occurring in wetlands of Darjiling and Jalpaiguri districts.

Family and species	Occurrence in wetlands of	
	<i>Darjiling district</i>	<i>Jalpaiguri district</i>
Family NOTOPTERIDAE		
<i>Notopterus notopterus</i> (Pallas)	–	5–9
Family CYPRINIDAE		
<i>Salmostoma bacaila</i> (Hamilton)	–	5, 6, 8
<i>Hypophthalmichthys molitrix</i> (Valenciennes)	1	5, 7, 9
<i>Aspidoparia morar</i> (Hamilton)	–	5, 6
<i>Amblypharyngodon mola</i> (Hamilton)	–	5–9
<i>Barilius bendelisis</i> Hamilton	1, 4	5, 6
<i>Danio aequipinnatus</i> (McClelland)	1, 4	5, 6
<i>Danio devario</i> (Hamilton)	1, 4	5, 6
<i>Danio rerio</i> (Hamilton)	1	5–9
<i>Esomus danrica</i> (Hamilton)	–	5–9
<i>Rasbora daniconius</i> (Hamilton)	–	5–9
<i>Catla catla</i> (Hamilton)	1, 4	5–9
<i>Cirrhinus mrigala</i> (Hamilton)	1, 4	5–9
<i>Cyprinus carpio</i> Linnaeus	1, 4	5–9
<i>Ctenopharyngodon idella</i> (Valenciennes)	1, 4	5–9
<i>Labeo rohita</i> (Hamilton)	1, 4	5–8
<i>Labeo boga</i> (Hamilton)	1	5–8
<i>Labeo gonius</i> (Hamilton)	1	5
<i>Osteobrama cotio</i> (Hamilton)	–	5–8
<i>Puntius chola</i> (Hamilton)	1, 4	5–9
<i>Puntius conchoni</i> (Hamilton)	1	5–9
<i>Puntius phutunio</i> (Hamilton)	–	5–9
<i>Puntius sophore</i> (Hamilton)	–	5–9
<i>Puntius ticto</i> (Hamilton)	1, 4	5, 6
<i>Tor putitora</i> (Hamilton)	–	5, 6
<i>Garra annandalei</i> Hora	1	5, 6
<i>Garra gotyla</i> (Gray)	1, 4	5, 6
Family HOMALOPTERIDAE		
<i>Nemacheilus botia</i> (Hamilton)	1	5, 6
<i>Nemacheilus corica</i> (Hamilton)	1	5, 6
<i>Nemacheilus rupicola</i> (McClelland)	1, 4	5, 6

Table 5. : (Cont'd.).

Family and species	Occurrence in wetlands of	
	Darjiling district	Jalpaiguri district
Family COBITIDAE		
<i>Lepidocephalus guntea</i> (Hamilton)	1	5–9
Family BAGRIDAE		
<i>Batasio batasio</i> (Hamilton)	—	5, 6
<i>Mystus vittatus</i> (Bloch)	—	5–9
<i>Mystus tengara</i> (Hamilton)	—	5, 6
Family SILURIDAE		
<i>Ompak bimaculatus</i> (Bloch)	—	5, 6
<i>Wallago attu</i> (Schneider)	—	5, 6
Family CLARIIDAE		
<i>Clarias batrachus</i> (Linnaeus)	1	5–9
Family HETEROPNEUSTIDAE		
<i>Heteropneustes fossilis</i> (Bloch)	1	5–9
Family CYPRINODONTIDAE		
<i>Aplocheilichthys panchax</i> (Hamilton)	1, 3, 4	5–9
Family CHANNIDAE		
<i>Channa barca</i> (Hamilton)	—	5, 8
<i>Channa striatus</i> (Bloch)	1	5–9
<i>Channa orientalis</i> (Schneider)	—	5–9
<i>Channa punctatus</i> (Bloch)	1	5–9
Family SYMBRANCHIDAE		
<i>Monopterus albus</i> (Hamilton)	1	5–9
Family CHANDIDAE		
<i>Chanda nama</i> Hamilton	1	5–9
<i>Chanda ranga</i> Hamilton	1	5–9
Family NANDIDAE		
<i>Badis badis</i> (Hamilton)	—	5–9
<i>Nandus nandus</i> (Hamilton)	—	5–9
Family CICHLIDAE		
<i>Oreochromis mossambica</i> (Peters)	—	5, 9
Family MASTACEMBELIDAE		
<i>Mastacembelus armatus</i> (Lacepede)	—	5, 7, 8
<i>Mastacembelus pancalus</i> (Hamilton)	—	5–9
Total (= 54 species)	20	54

Table 6. : List of macroinvertebrates recorded in wetlands of Darjiling and Jalpaiguri districts. West Bengal.

Family and species	Occurrence in wetlands of	
	Jalpaiguri district	Darjiling district
A. Macrocrustaccans (Decapoda)		
Family PALAEMONIDAE		
<i>Macrobrachium rude</i> (Heller)	—	5
<i>Macrobrachium rosenbergii</i> (deMan)	—	7–9
<i>Macrobrachium lamarrei</i> (H. M Edwards)	—	6–9
<i>Macrobrachium</i> sp.	—	5, 7, 9
<i>Palaemon styliferus</i> Milne Edwards	—	5–9
Family POTAMONIDAE		
<i>Sartoriana spinigera</i> Wood Masoon	—	5–9
<i>Potamon</i> sp.	1, 3	—
B. Insects		
INSECTA : HEMIPTERA		
Family BELOSTOMIDAE		
<i>Diplonychus rusticum</i> (Fabricius)	1, 2	5–9
<i>Diplonychus annulatus</i> (Fabricius)	1, 2	5–9
<i>Diplonychus molestum</i> (Dufour)	—	5, 7
<i>Diplonychus</i> sp.	—	9
<i>Lethocercus indicus</i> (Lep. & Serv.)	—	7–9
Family NEPIDAE		
<i>Laccotrephes ruber</i> (Linnaeus)	—	6
<i>Laccotrephes griseus</i> (Guerin)	1, 2	5–9
<i>Laccotrephes</i> sp.	—	7
<i>Ranatra sordidula</i> Dohrn	1, 2	6, 7, 9
<i>Ranatra filiformis</i> Faabricius	1, 2	5–9
<i>Ranatra longipes</i> Stal	—	5
<i>Ranatra varipes</i> Stal	—	5
<i>Ranatra</i> sp.	—	7
Family CORIXIDAE		
<i>Corixa</i> sp.	1–4	5–9
<i>Micronecta</i> spp. (3 species)	1, 3, 4	5–9

Table 6. : (Cont'd.).

Family and species	Occurrence in wetlands of	
	Jalpaiguri district	Darjiling district
Family NOTONECTIDAE <i>Anisops</i> spp. (3 species)	1–4	5–9
Family MESOVELIDAE <i>Mesovelis vittigera</i> Horvah	1, 4	5–9
Family HYDROMETRIDAE <i>Hydrometra</i> sp.	1	5–7, 9
Family GERRIDAE <i>Gerris</i> spp. (2 species)	1, 2, 4	5–9
<i>Limnogonus fossarum</i> (Fabricius)	–	5, 7
<i>Limnogonus nitidus</i> (Mayr)	2	7–9
<i>Limnogonus parvulus</i> (Stal)	1, 2	6, 9
<i>Rhagadotarsus kraepelini</i> Breddin	–	5, 8
Family PLEIDAE <i>Plea</i> spp. (2 species)	1	5–9
INSECTA : COLEOPTERA		
Family DYTISCIDAE <i>Guignotus signatellus</i> Klug	–	5
<i>Hydrovatus</i> sp.	–	5, 6, 9
<i>Rhantus taprobanicus</i> Sharp	2, 3	–
<i>Platynectis</i> sp.	3	–
<i>Agabus</i> sp.	2	–
<i>Cybister</i> sp.	–	5, 8
Family HYDROPHILIDAE <i>Regimbartia attenuata</i> F.	1	6–9
<i>Sternolophus rufipes</i> F.	–	6, 7, 9
<i>Berosus indicus</i> Mots.	2	6–8
<i>Helochares</i> sp.	–	7, 8
<i>Amphiops</i> sp.		
INSECTA : ODONATA		
Family LIBELLULIDAE <i>Urothemis</i> sp.	2	6, 8
<i>Brachythemis</i> sp.	1, 2	6, 8
<i>Anax</i> sp.	–	7, 8

Table 6. : (Cont'd.).

Family and species	Occurrence in wetlands of	
	Jalpaiguri district	Darjiling district
Family COENAGRIONIDAE <i>Enallagma</i> sp.	2	5–9
INSECTA : EPHEMEROPTERA		
Family CAENIDAE <i>Caenis</i> sp.	3	6, 7
Family BAETIDAE <i>Cloeon</i> sp.	3, 4	6, 7
INSECTA : DIPTERA		
Family CULICIDAE <i>Culex</i> sp.	1, 2	5–9
<i>Anopheles</i> spp. (2 species)	2	5–9
Family CHIRONOMIDAE Chironomid larvae (2 species)	1	7–9
INSECTA : ORTHOPTERA		
Family GRYLLOTALPIDAE <i>Gryllotalpa africana</i> Beauvois	1	7
C. Arachnids		
Family LYCOSIDAE <i>Lycosa</i> sp.	3	5, 8
<i>Pardosa</i> sp.	2	6, 7, 9
Family TETRAGNATHIDAE <i>Tetragnatha</i> spp. (2 species)	–	6–9
Order ACARINA Water mites	1, 3	6–9
D. Annelids		
Family TUBIFICIDAE <i>Limnodrilus</i> sp.	1	–

Table 6. : (Cont'd.).

Family and species	Occurrence in wetlands of	
	Jalpaiguri district	Darjiling district
Family HAEMADIPSIDAE <i>Haemadipsa</i> sp.	1, 2, 3	–
Family GLOSSIPHONIDAE <i>Glossiphonia</i> sp.	1, 2	7, 8
E. Molluscs		
MOLLUSCA : GASTROPODA		
Family THIARIDAE		
<i>Thiara tuberculata</i> (Muller)	–	5–7
<i>Thiara lineata</i> (Gray)	–	5, 6
<i>Paludomus regulata</i> (Benson)	–	7
<i>Brotia costula</i> (Rafinesquc)	–	6
Family VIVIPARIDAE		
<i>Belamya bengalensis</i> (Lamarck)	–	5–9
Family PILIDAE		
<i>Pila globosa</i> (Swainson)	–	5–9
Family BITHYNIDAE		
<i>Digonistoma pulchella</i> (Benson)	–	5–7, 9
Family PLANORBIDAE		
<i>Indoplanorbis exustus</i> (Deshayes)	–	5–9
<i>Gyraulus convexiusculus</i> (Hutton)	–	5–7, 9
Family LYMNAEIDAE		
<i>Lymnaea acuminata</i> Lamarck	–	5–9
<i>Lymnaea luteola</i> Lamarck	–	7, 9
MOLLUSCA : BIVALVIA		
Family UNIONIDAE		
<i>Lamellidens marginalis</i> (Lamarck)	–	6
Family Amblenidae		
<i>Parreysia</i> sp.	–	6
Total (= 82 species)	43	76

Table 7. : List of zooplankton species recorded in wetlands of Darjiling and Jalpaiguri districts. West Bengal.

Family and species	Occurrence in wetlands of	
	Darjiling district	Jalpaiguri district
CRUSTACEA : COPEPODA		
Family DIPTOMIDAE		
<i>Diaptomus</i> sp.	—	5–7
Family CYCLOPIDAE		
<i>Mesocyclops</i> spp. (2 species)	1–3	5–7
CRUSTACEA : OSTRACODA		
Family CYPRIDIDAE		
<i>Strandesia weberi</i>	—	7
<i>Astenocypris papyracea</i> (Sars)	—	6
Cyprid species	—	5–7
CRUSTACEA : CLADOCERA		
Family SIDIDAE		
<i>Diaphanosoma excisum</i> Sars	1	5–7
<i>Diaphanosoma sarsi</i> Richard	—	6, 7
<i>Latonopsis australis</i> Sars	—	5, 6
<i>Pseudosida bidentata</i> Herrick	—	5
Family DAPHNIIDAE		
<i>Ceriodaphnia cornuta</i> Sars	—	5
<i>Daphnia pulex</i> Leydig	2, 3	—
<i>Scapholeberis kingi</i> Sars	—	5, 6
<i>Simocephalus vetulus</i> (O. F. Muller)	—	5
Family MOINIDAE		
<i>Moinnadaphnia macleayi</i> (King)	—	5
Family MACROTHRICIDAE		
<i>Bosmina longirostris</i> (O. F. Muller)	1, 4	—
<i>Grimaldina brazzai</i> Richard	—	6
<i>Guernella raphalis</i> Richard	—	6
<i>Hyocryptus spinifer</i> Herrick	—	5, 6
<i>Macrothrix laticornis</i> (Jurine)	—	6
<i>Macrothrix spinosa</i> King	—	5–7
<i>Macrothrix triserialis</i> (Brady)	—	6

Table 7. : (Cont'd.).

Family and species	Occurrence in wetlands of	
	Darjiling district	Jalpaiguri district
Family CHYDORIDAE		
<i>Alona costata</i> Sars	1	6, 7
<i>Alona davidi</i> Richard	–	6
<i>Alona guttata</i> Sars	1	–
<i>Alona karua</i> (King)	–	5–7
<i>Alona kwangensis</i> Chiang	–	6
<i>Alona pulchella</i> Sars	1	5–7
<i>Alona monacantha</i> (Stingelin)	–	6
<i>Alona reticulata</i> Sars	–	5–7
<i>Alonella excisa</i> (Fischer)	–	5, 6
<i>Chydorus barroisi</i> (Richard)	–	6–7
<i>Chydorus reticulatus</i> Daday	1	5, 6
<i>Chydorus sphaericus</i> (O. F. Muller)	1	5–7
<i>Dadaya macrops</i> (Daday)	–	6
<i>Dunhevedia crassa</i> King	–	5, 6
<i>Euryalona orientalis</i> (Daday)	–	6
<i>Kurzia longirostris</i> (Daday)	–	6
<i>Notalona globulosa</i> (Daday)	–	6
<i>Oxyurella singalensis</i> (Daday)	–	6
<i>Pleuroxus similis</i> Vavra	–	5
<i>Pseudochydorous globosus</i> (Baird)	2	–
<i>Streblocerus serricaudatus</i> (Fischer)	–	6
CRUSTACEA : CONCHOSTRACA		
Family CYCLESTHERIDAE		
<i>Cyclestheria hislopi</i> Baird	–	5, 6
CRUSTACEA : ROTIFERA		
Family ASPLANCHIDAE		
<i>Asplancha</i> sp.	1, 3	6
Family FILINIDAE		
<i>Filinia</i> sp.	3	–
Total (= 45 species)	12	40

Table 8. : Comparative faunal diversity (major groups) of freshwater wetlands representing coastal plains. Gangetic plains and hills and terai regions, West Bengal.

Major groups	Faunal diversity of				
	Coastal plains	Gangetic plains	Hills and Terai duars	Darjiling hills	Jalpaiguri duars
Mammals	3	1	6	–	6
Birds	67	54	20	3	20
Reptiles	6	6	6	1	6
Amphibians	6	6	7	6	5
Fishes	56	48	54	29	54
Decapod crustaceans	7	7	7	1	6
Hemipterans	20	27	30	19	30
Coleopterans	24	35	11	5	8
Miscellaneous insects	Unknown	Unknown	12	11	12
Arachnids	8	6	6	4	6
Annelids	9	6	3	3	1
Molluscs	12	15	13	–	13
Zooplankton	17	55	45	12	40
Total	235	286	220	94	207
Source :	Nandi <i>et al.</i> (1993)	Nandi <i>et al.</i> (1999)	Nandi <i>et al.</i> , (present report)		

such as One-horned Rhinoceros, Wild Boar, Fishing Cat and Wild Buffalo. However, Jaldapara Wildlife Sanctuary is also known to harbour Indian Elephant, *Elephas maximus*; Pygmy Hog, *Sus salvanius*; Hog Deer, *Axis porcinus*; Bison, *Bos gaurus* and Hispid Hare, *Coprolagus hispidus* (Spillet, 1967; Ghose and Ghosal, 1985). Similarly, these mammalian species are also represented in and around riverine and lacustrine environments of Buxa Tiger Reserve. Besides these wetland associated species, the wetland habitats of these two forest reserves also harbour a number of carnivorous mammals such as Jackal (*Canis aureus*), Common Fox (*Vulpes bengalensis*), Sloth Bear (*Melursus ursinus*), Small Indian Civet (*Viverricula indica*), Palm Civet (*Paradoxurus hermaphroditus*), Jungle Cat (*Felis chaus*), Leopard Cat (*Felis bengalensis*), Leopard (*Panthera pardus*) and Tiger (*Panthera tigris*). In the Jaldapara Wildlife Sanctuary, the Tiger, *Panthera tigris* is more or less associated with swampy habitat like the mangrove swamps of Sanjnakhali Wildlife Sanctuary under Sundarban Biosphere Reserve (Saha *et al.*, 1992). However, Wroughton (1916) reported two species of water shrew, viz., *Nectogale elegans sikkimensis* de Winton & Styan and *Chimmarogale platycephala himalayana* (Grey) from Darjiling district.

Birds : Only 20 species of resident birds belonging to 9 families have been encountered in the wetlands of these two districts (Table 2). Being a hilly area, like wetlands, wetland birds of Darjiling district are poorly represented by three species of kingfishers encountered in Mirik Lake, even though the district contains nearly a quarter of all species of birds found in the Indian subcontinent (Lister, 1954). However, besides Eastern Goosander (*Mergus merganser orientalis*) and Barheaded Goose (*Anser indicus*) a variety of waterbirds viz., Great Whitebilled Heron (*Ardea imperialis*), Eastern Golden Plover (*Pluvialis dominicus fulvus*), Fantail Snipe (*Capella gallinago gallinago*), Pintail Snipe (*Capella stenura*) Wood Snipe (*Nemoricola n. nemoricola*), Painted Snipe (*Rostralia b. bengalensis*) etc., were reported from Terai region as well as Teesta and other rivers basins (Inglis, 1940). Jaldapara Wildlife Sanctuary is known to be inhabited by Pied Kingfisher (*Ceryle* sp.), Fishing Eagle (*Haliaeetus* sp.), Cormorants (*Phalacrocorax* spp.), Cotton Teal (*Nettapus* sp.), Common Teal (*Anas* sp.), Grebe (*Podiceps* sp.) etc. Sanyal (1994) sighted Blacknecked Crane, *Grus nigricollis* Przevalski within the Bhutanghat forest core area of Buxa Tiger Reserve.

Reptiles : Six species of reptiles belonging to five families comprising of two species of turtles, one species of monitor lizard and three species of snakes have been found to occur in the selected wetlands of Darjiling and Jalpaiguri districts (Table 3). Two species of turtles and two species of colubrid snakes are aquatic, while the rest two reptilian species are wetland associated for shelter. Among the wetland associated species the common Indian Monitor, *Varanus bengalensis* is found by the side of nullah, marshes and ponds. The Indian Rock Python, *Python molurus* occurs around pools, marshes and streams. However, some other species of reptiles may be associated with wetlands as 17 species of lizards and 64 species of snakes are reported from these two districts (Ahmed and Dasgupta, 1992).

Amphibians : Seven species of toads, frogs and salamander newt belonging to four families, either aquatic or wetland dependent for their larval development, have been recorded (Table 4). Of these, three ranid frogs and the Himalayan Newt are aquatic species. The bufonid and microhylid are wetland dependent species usually found on moist shady places and also in and around wetlands during breeding season. All the three ranid species are more or less common in these two districts and occur in water on the banks of lakes, ponds and ditches. The Himalayan Newt, *Pleurodeles vrrucosus* inhabits seasonal and perennial pools of Jorpukhri Salamander Sanctuary as well as in the hillside pools/jhoras on the southern bank of Mirik Lake adjacent to Singha Devi Temple. Chanda (1986) described a new species *Rana senchalensis* from Senchal Lake, Darjiling. However, it is mentioned that 32 out of 39 anuran amphibians from West Bengal were recorded from Darjiling and Jalpaiguri districts (Sarkar *et al.*, 1992).

Fishes : Fifty-four taxa belonging to nineteen families have been recorded from various wetlands of Jalpaiguri district, while 33 species are determined from Darjiling district (Table 5).

Of the 19 families, the Family Cyprinidae is represented by 26 species which include major and minor carps belonging to genera *Labeo*, *Catla*, *Cirrhina* as well as Mahaseer (*Tor putitora*) and weed fishes (*Puntius*, *Esomus*, etc.). The various other groups of fishes are represented by catfishes (*Clarias*, *Heteropneustes*, *Wallago*, *Mystus*, *Batasio*, *Ompak*), murrels (*Channa* species) and mud eels (*Mastacembelus* and *Monopterus* species). The species belonging to the genera *Garra* and *Nemacheilus* that are typically inhabiting running waters of the Himalayan hills, have been recorded from both the districts. These fishes possess suctorial disc formed on the lower lip, helping them to cling to the substratum as an adaptation to life in the fast flowing hill streams.

It is, however, mentioned that the species reported herein only represent a fraction of fish faunal diversity of the hills and terai region as Shaw and Shebbeare (1937) gave an account of 131 species belonging to 26 families and 8 orders from northern Bengal covering these two districts. Hora and Gupta (1941) added 2 species from Kalimpong Duars and Siliguri Terai region. Jayaram and Singh (1977) listed 96 species of which previous workers did not report 17 species.

INVERTEBRATES

The aquatic invertebrate elements comprising of macro-invertebrates and zooplankton are reported herein mainly based on the specimens collected from the selected wetlands of these two districts.

Macro-invertebrates : Macroinvertebrates belonging to five major groups comprising of 76 species have been identified from freshwater wetlands of Darjiling and Jalpaiguri districts (Table 6). Of the five groups, namely, macrocrustaceans, insects, arachnids, annelids and molluscs, insects were found to dominate these wetlands.

Macrocrustaceans : Seven species of macrocrustaceans belonging to two families have been recorded from wetlands of Darjiling and Jalpaiguri districts. Of these, only one species of potamonid crabs viz., *Potamon* sp. was recorded from Darjiling district, while the rest six species were collected/observed from wetlands of Jalpaiguri district.

Insects : A total of 53 species of insects belonging to 6 orders and 17 families have been observed/obtained from wetlands of these two districts. Among these, 41 species of aquatic adult insects belong to the orders Hemiptera (30 species) and Coleoptera (11 species), 11 species of aquatic larval forms representing orders Odonata (4 species) and Diptera (5 species), two species of nymphs, just emerged (Order : Ephemeroptera) and a single species of wetland associated gryllotalpid, *Gryllotalpa africana* (Order : Orthoptera) have been identified. Of the six insect orders, Hemiptera represents the highest diversity of 30 species followed by Coleoptera (11 species) and Diptera (5 species).

As per records in the Fauna of West Bengal, it is revealed that Bal and Basu (1994a) reported 14 and 4 species of aquatic and semi-aquatic Hemiptera from Darjiling and Jalpaiguri districts respectively. Bal and Basu (1994b) in another paper recorded 10 species of hemipteran insects from Darjiling district only. In the present paper 15 and 24 species of Hemiptera have been encountered from wetlands of Darjiling and Jalpaiguri districts respectively. Biswas *et al.*, (1995a, b, c) recorded 50 and 1 species of aquatic coleopterans from Darjiling and Jalpaiguri districts respectively. In the present paper only 4 and 8 species of Coleoptera have been reported from wetlands of Darjiling and Jalpaiguri districts respectively. Srivastava and Sinha (1993) found 90 and 43 species of Odonata from Darjiling and Jalpaiguri districts respectively. Srivastava (1993) observed 7 and 13 species of Ephemeroptera from Darjiling and Jalpaiguri districts respectively. Chaudhuri and Chattopadhyay (1997) recorded a number of chironomid species from this region.

Arachnids : Four species of spiders belonging to three genera and two undetermined species of water mites could be collected from wetlands of Darjiling and Jalpaiguri districts. Biswas and Biswas (1992) in their document on spider fauna of West Bengal reported the occurrence of the genus *Lycosa* viz., *L. carmichaeli* Gravely, *L. himalayensis* Gravely and *L. kempfi* Gravely from Darjiling district, the genus *Pardosa* (*P. annandalei*) (Gravely), *P. birmanica* Simon, *P. shyamae* (Tikader), *P. sumatrana* (Thorell) and *P. sutherlandi* (Gravely) from Darjiling and Jalpaiguri districts and the genus *Tetragnatha* (*T. andamanensis* Tikader and *T. mandibulata* Walckenaer) from these two districts. However, Dasgupta (1995) recorded six species of spiders viz., *Leucauge* sp., *Liarimia* sp., *Cyclosa* sp., *Theridion* sp. *Tetragnatha* sp. and *Xyaticus* (= *Xysticus*) sp. from lentic habitats in Darjiling district.

Annelids : Three species of annelids comprising of one species of freshwater oligochaete, *Limnodrilus* sp. and two species of leeches viz., a land leech, *Haemadipsa* sp. and an aquatic leech, *Glossiphonia* sp. have been recorded from wetlands of these two districts.

Molluscs : Thirteen species of gastropod and bivalve molluscs belonging to 8 families have been found to occur in freshwater wetlands of Jalpaiguri district but not a single species could be recorded from Darjiling district. However, a few species of freshwater molluscs viz., *Bellamya bengalensis*, *Thiara tuberculata*, *Thiara lineata*, *Paludommus* spp., *Lamellidens corrianus* and *Parreysia lima* have been recorded in Darjiling district out of 75 species reported from West Bengal by Thakur *et al.* (1992). Among the wetlands, Narathaly Lake of Buxa Tiger Reserve is dominated by a wide variety of gastropod and bivalve species in abundance.

Zooplankton : In all, 45 species of zooplankton belonging to Copepoda, Ostracoda, Cladocera, Conchostraca and Rotifera have been recorded from freshwater wetlands of Darjiling and Jalpaiguri

districts (Table 7). Of these, 38 species (84.4%) are represented by cladocerans, three species by ostracods and two species each of copepods and rotifers, while one species viz., *Cyclestheria hislopi* Baird belongs to Conchostraca. Of the two districts, 12 species of zooplankton are recorded from Darjiling and 40 species from Jalpaiguri districts. Among ostracods, *Astenocypris papyracea* (Sars) constitutes new report from West Bengal (Venkataraman, 2000). Out of 38 species of cladocerans three species viz., *Alona guttata* Sars, *Daphnia pullex* Leydig and *Streblocerus serricaudatus* (Fischer) recorded herein for the first time from West Bengal.

Of the five different groups of zooplankton, cladocerans represent highest diversity of species particularly inhabiting littoral vegetation. Among copepods, *Mesocyclops* occur in the limnetic region of almost all the wetlands surveyed. The ostracod and conchostracan species are recorded from Jalpaiguri district only. In over all, zooplankton diversity is poor in this region of North Bengal (Dasgupta, 1995) than that of South Bengal (Nandi *et al.*, 1999; 2001a, b). However, it may be mentioned that Dasgupta (1995) reported seven species of crustacean zooplankton such as *Cyprinotus gunningi*, *Illyocypris* sp., *Daphnia carinata*, *Chydorus* sp., *Daphniopsis* sp., *Diaphanosoma tibetnus* and *Cyclops* sp. from Darjiling Himalayas and recorded the smaller zooplankton taxa (Family : Cyclopidae and Chydoridae) in high abundance in lentic habitats at lower altitudes during the periods of most heavy rainfall in June-July months.

DISCUSSION

The faunal diversity in the selected freshwater wetlands of Darjiling and Jalpaiguri districts represents a total of 220 species of 13 major groups (Table 8). The freshwater wetlands of North and South 24-Parganas districts representing the coastal plains were inhabited by 235 species, while those of Haora and Hugli districts under the Gangetic plains represented 286 species (Nandi *et al.*, 1993; Nandi *et al.*, 1999). Among the two districts, wetlands of Darjiling hills are inhabited by 94 species only but wetlands of terai-duars region represent 207 species, *i.e.*, more than double the species occurring in the hill region. This may be due to poor representation wetlands and also due climatic condition in the hills.

In general, Darjiling hills and the duars regions are faunistically well explored and rich in terrestrial fauna including a large number of mountain inhabiting species and hill stream fishes (Agarwal *et al.*, 1992; Ahmed and Dasgupta, 1992; Sarkar *et al.*, 1992; Sen, 1992). Dasgupta (1995) studied the trophic structure of some lentic habitats of Darjiling Himalayas and reported 7 species of plankton (Crustaceans), 11 species of nekton (fish and amphibians), 29 species of periphyton (insects and spiders), 5 species of neuston (insects) and 5 species of benthos (single species each of Pisces, Gymnophiona, Crustacea, Diptera and Bivalvia).

There are a number of wildlife sanctuaries in these two districts of northern West Bengal (Saha *et al.*, 1992). These sanctuaries as well as flood plain regions of this part of West Bengal have diverse type of wetlands and wildlife. The hill streams in this region have a tendency to cut new channels including 'cross-country' watercourses forming numerous pools and marshes, which are favourite hunts of rhino. The cutting of reeds and killing of wildlife in wetlands and woodlands are reported from this region. It is, therefore, felt that the wetlands as well as threatened species of wildlife inhabiting wetlands viz., rhino, wild buffalo, salamander etc. protected and included under the Schedules of the Indian Wildlife (Protection) Act (1972) should be thoroughly surveyed and meticulously conserved. Some of these species viz., Hispid Hare, *Caprolagus hispidus* (Pearson), Pygmy Hog, *Sus salvanius* (Hodgson), Great One horned Rhino, *Rhinoceros unicornis* (Linnaeus) and Wild Buffalo, *Bubalus bubalis* (Linnaeus) have now confined to this part of West Bengal. So, the status of these large animals and the rules and regulations prohibiting their exploitation in wetlands and wildlife sanctuaries in this region need to be strictly enforced.

SUMMARY

1. A faunal inventory of 15 freshwater wetlands, 6 from Darjiling district and 9 from Jalpaiguri district dealing with 93 species of vertebrates and 122 species of macroinvertebrates and zooplankton is communicated.
2. The vertebrate elements include 6, 20, 6, 7 and 54 species of mammals, birds, reptiles, amphibians and fishes respectively and invertebrate organisms include 82 species of macroinvertebrates and 45 species of zooplankton.
3. Three species of Cladocera constitute new records from West Bengal.
4. The diversity of fauna is discussed with reference to Gangetic plains and Coastal plains of West Bengal.

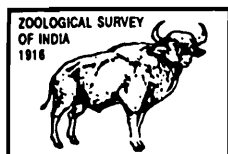
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THE BUTTERFLIES (RHOPALOCERA) OF PANNA NATIONAL PARK (MADHYA PRADESH)

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INTRODUCTION

Panna National Park is one of the 9 National Parks in Madhya Pradesh. The Park falls in two districts Panna and Chhatarpur. It was constituted as a National Park in the year 1981 and a Tiger Reserve in the year 1994. The Park has an area of 543 Sq. Km. and located in the 'Vindhyan Hill Ranges' part of Bundelkhand Region. It lies between 24° 27' to 24° 46' North latitude and 79 ° 45' to 80° 90' East longitude, and is about 20 Km. west of Panna town. It can be approached from Panna either via Madla or via Hinauta side. A large area of the Park covers the catchment area of the River Ken, a tributary of Yamuna river.

Butterfly fauna of Madhya Pradesh has been previously studied by Marshall and de Niceville (1882), de Niceville (1886, 1890), Betham (1890, 1891a & b, 1892), Swinhoe (1886), Witt (1909), Evans (1932), Talbot (1939, 1947), Wynter-Blyth (1957), Singh (1977, 1995), Singh and Koshta (1997), and Chandra *et. al.*, (2000). A perusal of literature reveals that nothing is known about insect fauna of the Park (Tiwari, 1998) *per se*. Hence, to explore the insect fauna especially butterflies, three extensive surveys *i.e.*, from 07.11.2000 to 27.11.2000; 12.3.2001 to 23.3.2001 and 13.3.2002 to 27.3.2002 were undertaken by the Central Regional Station, Zoological Survey of India Jabalpur.

The present work is an attempt to provide a comprehensive account of Rhopalocera from Panna National Park, based on the specimens collected during the above surveys. The study reveals the presence of fifty species under thirty six genera and eight families. All the fifty species dealt with in this account are reported for the first time from Panna National Park. Taxonomical revisions have been cited after Varshney (1993, 1994, and 1997).

ABBREVIATIONS USED

Coll. – Name of the Collector

ex (s) – Number of examples (s)

SYSTEMATIC ACCOUNT

Phylum ARTHROPODA

Class INSECTA

Order LEPIDOPTERA

Suborder RHOPALOCERA

Family 1. PAPILIONIDAE

Subfamily 1. PAPILIONINAE

Genus 1. *Papilio* Linn.17581. *Papilio demoleus demoleus* Linnaeus1758. *Papilio demoleus* Linnaeus, *Syst. Nat.* (ed. 10) : 464.1939. *Papilio demoleus demoleus* Linnaeus : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 189.*Common name* : The Lime Butterfly.

Material examined : 2 exs., Chhiwala Jhiria, 14.ix.2000, Coll. R. K. Singh; 5 exs., Mahlen Seha, 11.xi.2000, Coll. R. K. Singh; 4 exs., Chandra Nagar, 13.xi.2000, Coll. R. K. Singh; 1 ex., Madla, 8.xi.2000, Coll. R. K. Singh; 9 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 4 exs., Judi, 12.xi.2000, Coll. R. K. Singh; 2 exs., Ken river bank, Madla, 15.xi.2000, Coll. R. K. Singh; 4 exs., Jhalar village, 19.xi.2000, Coll. R. K. Singh; 1 ex., Kharra, 22.xi.2000, Coll. R. K. Singh; 2 exs., Khamariya, 24.xi.2000, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria and surrounding, 15.iii.2001, Coll. R. K. Singh; 1 ex., Judi surrounding, 18.iii.2001, Coll. R. K. Singh and Party; 2 exs., Near Mera Sen river, Dutti village 21.iii.2002, Coll. Y N. Gupta; 4 exs., Katari, 22.iii.2002, Coll. Y N. Gupta; 1 ex., Rampur Dam near Baria, 24.iii.2002, Coll. Y N. Gupta; 1 ex., Jhalar Talgaon, 26.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Bihar; Delhi; Orissa; Uttar Pradesh (almost throughout India). *Elsewhere* : Sri Lanka, Pakistan and North Myanmar.

2. *Papilio polytes romulus* Cramer1775. *Papilio romulus* Cramer, *Pap. Exot.*, 1 : 67.1939. *Papilio polytes romulus* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 178.*Common name* : The Common Mormon.

Material examined : 1 ex., Madla, 8.xi.2000, Coll. R. K. Singh; 3 exs., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 5 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1 ex., Mahlen Seha, 11.xi.2000,

Coll. R. K. Singh; 2 exs., Judi, 12.xi.2000, Coll. R. K. Singh; 2 exs., Raipura village, Chandra Nagar, 13.xi.2000, Coll. R. K. Singh; 1 ex., Judi, 16.xi.2000, Coll. R. K. Singh; 2 exs., Jhalar village, 19.xi.2000, Coll. R. K. Singh; 1 ex., Ken river lodge, 20.xi.2000, Coll. R. K. Singh; 1 ex., Hinauta gate, 21.xi.2000, Coll. R. K. Singh; 1 ex., Kharrya, 22.xi.2000, Coll. R. K. Singh; 2 ex., Chhiwala Jhiria Surrounding, 15.iii.2001, Coll. R. K. Singh; 3 exs., Judi surrounding, 18.iii.2001, Coll. R. K. Singh & party; 1 ex., Rampura, 16.iii.2002, Coll. Y N. Gupta; 2 exs., Barer Hinauta, 17.iii.2002, Coll. Y N. Gupta; 1 ex., Pipartola Talgaon, 20.iii.2002, Coll. Y N. Gupta; 2 exs. Bargadi Hinauta, 22.iii.2002, Coll. Y N. Gupta; 1 ex., Rampur Dam area, near Baria, 24.iii.2002. Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Assam; Bihar; Delhi; Goa; Kerala; Lakshadweep; Sikkim; Tamil Nadu and Uttar Pradesh.

Elsewhere : Sri Lanka, Bangladesh and Myanmar.

Genus 2. *Pachliopta* Reakirt, 1865

3. *Pachliopta hector* (Linnaeus)

1758. *Papilio hector* Linnaeus, *Syst. Nat.* (ed. 10) : 459.

1939. *Polydorus hector* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 83.

1993. *Pachliopta hector* : Varshney, *Oriental Ins.* 27 : 354.

Common name : The Crimson Rose.

Material examined : 1 ex., near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh and Party.

Distribution : INDIA : Madhya Pradesh; Andaman; Karnataka; Maharashtra; Tamil Nadu and Peninsular India.

Elsewhere : Sri Lanka.

Genus 3. *Pathysa* Reakirt, 1865

4. *Pathysa nomius nomius* (Esper)

1785-98. *Papilio nomius* Esper, *Ausl. Schmett.*, p. 210, pl. 52, fig. 3.

1939. *Graphium nomius nomius* : Talbot, *The Fauna of British India*, Butterflies, 1 : 207.

1993. *Pathysa nomius* : Varshney, *Oriental Ins.* 27 : 351.

Common name : The Spot Swordtail.

Material examined : 1 ex., Katari, 23.iii.2002, Coll. Y N. Gupta; 1 ex., Judi nala, 25.iii.2002, Coll. Y N. Gupta; 1 ex., Jhalar, Talgaon, 26.iii.20002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; East to North West Himalaya; rest of Eastern, Northern and Southern Peninsula; Sikkim and West Bengal.

Elsewhere : Sri Lanka.

Family 2. PIERIDAE

Subfamily 2. PIERINAE

Genus 4. *Belenois* Huebner, 18195. *Belenois aurota aurota* (Fabricius)

1793. *Papilio aurota* Fabricius, *Syst. Ent.*, **3** : 197.

1939. *Anapheis aurota aurota* : Talbot, *The Fauna of Brit. India*, Butterflies, **1** : 380.

1993. *Belenois aurota* : Varshney, *Oriental Ins.*, **27** : 358.

Common name : The Pioneer.

Material examined : 1 ex., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1 ex., Madla gate, 13.iii.2001, Coll. R. K. Singh and Party.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Delhi; Karnataka; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Pakistan and Sri Lanka.

Genus 5. *Cepora* Billberg, 18206. *Cepora nerissa phryne* (Fabricius)

1775. *Papilio phryne* Fabricius, *Syst. Ent.*, : 473.

1939. *Cepora nerissa phryne* : Talbot, *The Fauna of Brit. India*, Butterflies, **1** : 362.

Common name : The Common Gull.

Material examined : 2 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 2 exs., Jalar village, 19.xi.2000, Coll. R. K. Singh; 3 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 1 ex., Khamariya, 24.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Assam; Bihar; Maharashtra; Sikkim; Tamil Nadu; Uttar Pradesh; and North West Himalayas.

Genus 6. *Delias* Huebner, 18197. *Delias eucharis* (Drury)

1773. *Papilio eucharis* Drury, *Illustr. Nat. Hist.* 2., pl., X, figs. 5, 6.

1939. *Delias eucharis* : Talbot, *The Fauna of Brit. India*, Butterflies, **1** : 352.

Common name : The Common Jazebal.

Material examined : 2 exs., Madla gate, 8.xi.2000, Coll. R. K. Singh; 1 ex., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 1 ex., Jhalar village, 19.xi.2000, Coll. R. K. Singh; 5 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 1 ex., Kharriya, 22.xi.2000, Coll. R. K. Singh; 1 ex., Nararan, 25.xi.2000, Coll. R. K. Singh and Party.

Distribution : INDIA : Madhya Pradesh; Bihar; Uttar Pradesh; Peninsular India extending upto lower slopes of Himalaya.

Elsewhere : Sri Lanka and Myanmar.

Genus 7. *Leptosia* Huebner, 1818

8. *Leptosia nina nina* (Fabricius)

1793. *Papilio nina* Fabricius, *Ent. Syst.* 3(1) : 194.

1997. *Leptosia nina nina* : Ghosh & Chaudhury, *State Fauna Series 3 : Fauna of West Bengal*, Part-7, *Zool. Surv. India* : 709.

Common name : The Psyche.

Material examined : 4 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh and Party; 4 exs., Madla, 8.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Andaman; Uttar Pradesh West Bengal and Peninsular India to Mussooree Hills.

Elsewhere : Myanmar; Indo-China; Thailand; Hainan and South China.

Genus 8. *Pareronia* Bingham, 1907

9. *Pareronia valeria hippia* (Fabricius)

1787. *Papilio hippia* Fabricius, *Montissa Ins.*, 2 : 55.

1939. *Valeria valeria hippia* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 486.

1993. *Pareronia valeria* : Varshney, *Oriental Ins.*, 27 : 362.

Common name : The Common Wanderer.

Material examined : 3 exs., Madla gate, 8.xi.2000, Coll. R. K. Singh; 1ex., Raipura, Chandra Nagar, 13.xi.2000, Coll. R. K. Singh; 3 exs., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 7 exs., near Judi, 16.xi.2000, Coll. R. K. Singh; 3 exs., Badgadi, 18.xi.2000, Coll. R. K. Singh; 3exs., Ken river Lodge, 20.xi.2000, Coll. R. K. Singh; 2 exs., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh & Party; 2 exs., Jhalar Village, 19.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Karnataka; Maharashtra; Sikkim; Tamil Nadu Uttar Pradesh and West Bengal.

Elsewhere : Myanmar and Thailand.

Subfamily 3. COLIADNAE

Genus 9. *Catopsilia* Huebner, 1819

10. *Catopsilia pomona* (Fabricius)

1775. *Papilio pomana*, Fabricius, *Syst. Ent.*, : 479.

1939. *Catopsilia pomona* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 493.

1993. *Catopsilia crocale* : Varshney, *Oriental Ins.*, 27 : 362.

Common name : The Lemon Emigrant.

Material examined : 1 ex., Pipartola, 10.xi.2000, Coll. R. K. Singh; 3 exs., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh; 3 exs., Judi, 16.xi.2000, Coll. R. K. Singh; 1 ex., Jhalar Village, 19.xi.2000, Coll. R. K. Singh; 1 ex., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 3 exs., Kharriya, 22.xi.2000, Coll. R. K. Singh; 1 ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh; 1 ex., Khamariya, 24.xi.2000, Coll. R. K. Singh; 1 ex., Madla gate, 13.iii.2001, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria, 15.iii.2001, Coll. R. K. Singh & Party.

Distribution : INDIA : Madhya Pradesh; Assam; Andaman and Nicobar; Bihar; Delhi; Gujarat; Maharashtra; Tamil Nadu; Uttar Pradesh; West Bengal and North West Himalayas.

Elsewhere : Sri Lanka; Pakistan and Myanmar.

11. *Catopsilia florella gnoma* (Fabricius)

1775. *Papilio gnoma* Fabricius, *Syst. Ent.*, : 828.

1939. *Catopsilia florella gnoma* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 500.

Common name : The African Emigrant.

Material examined : 1 ex., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh; 1 ex., Kharriya, 22.xi.2000, Coll. R. K. Singh; 1 ex., Rampur, 16.iii.2002, Coll. Y N. Gupta; 1 ex. Judi nala, Madla, 25.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Bihar; Delhi; Goa; Himachal Pradesh; Maharashtra; Tamil Nadu; Uttar Pradesh; West Bengal and North West Himalayas.

Elsewhere : Pakistan; Sri Lanka and Myanmar.

12. *Catopsilia pyranthe pyranthe* (Linnaeus)

1775. *Papilio pyranthe* Linnaeus, *Syst. Nat.* (ed. 10) : 469.

1939. *Catopsilia pyranthe pyranthe* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 497.

Common name : The Mottled Emigrant.

Material examined : 1 ex., Madla gate, 8.xi.2000, Coll. R. K. Singh; 2 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1 ex., Judi, 12.xi.2000, Coll. R. K. Singh; 1 ex., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh; 1 ex., Ken river Lodge, 20.xi.2000, Coll. R. K. Singh; 1 ex., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 1 ex., Kharriya, 22.xi.2000, Coll. R. K. Singh; 1 ex., Khamariya, 24.xi.2000, Coll. R. K. Singh; 1 ex., Madla gate, 13.iii.2001, Coll. R. K. Singh & Party; 1 ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Andaman's; Assam; Gujarat; Tamil Nadu; Uttar Pradesh; West Bengal and North West Himalayas.

Elsewhere : Sri Lanka, Pakistan and Myanmar.

Genus 10. *Terias* Swainson, 182113. *Terias brigitta rubella* Wallace

1867. *Terias rubella* Wallace, *Trans. ent. Soc. Lond.*, (3)4 : 323.

1939. *Eurema brigitta rubella* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 515.

1993. *Terias brigitta* : Varshney, *Oriental Ins.*, 27 : 363.

Common name : The Small Grass Yellow.

Material examined : 1 ex., Mahlenseha, 11.xi.2000, Coll. R. K. Singh and party; 1 ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Bihar; Karnataka; Maharashtra; Nicobar; Punjab; Tamil Nadu; Uttar Pradesh; West Bengal and North West Himalayas.

Elsewhere : Sri Lanka and Myanmar.

14. *Terias laeta laeta* Boisduval

1836. *Terias laeta* Boisduval, *Spec. Gen. Lep.*, 1 : 674.

1939. *Eurema laeta laeta* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 517.

1993. *Terias laeta* : Varshney, *Oriental Ins.*, 27 : 363.

Common name : The Small Grass Yellow.

Material examined : 1 ex., Madla gate, 8.xi.2000, Coll. R. K. Singh; 1 ex., Pipartola, 10.xi.2000, Coll. R. K. Singh; 3 exs. Raipura, Chandra Nagar, 13.xi.2000, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 4 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 2 exs., Judi surrounding, 14.iii.2001, Coll. R. K. Singh; 4 exs., Chhiwala Jhiria Surrounding, 15.iii.2001, Coll. R. K. Singh; 6 exs., Mahlenseha, 11.xi.2000, Coll. R. K. Singh; 1 ex., Pandav fall, 18.iii.2002, Coll. Y. N. Gupta; 4 exs., Pipartola, 20.iii.2002, Coll. Y. N. Gupta; 1 ex., Rampur Dam near Baria, 24.iii.2002, Coll. Y. N. Gupta.

Distribution : INDIA : Madhya Pradesh; Bihar; Delhi; Himachal Pradesh; Karnataka; Maharashtra; Punjab; Tamil Nadu; Uttar Pradesh; West Bengal and Peninsular India to North West Himalayas.

Elsewhere : Sri Lanka; Nepal; Pakistan and Myanmar.

15. *Terias hecabe simulata* Moore

1881. *Terias simulata* Moore, *Lep. Ceylon*, 1 : 119.

1939. *Eurema hecabe simulata* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 530.

1993. *Terias hecabe* : Varshney, *Oriental Ins.*, 27 : 363.

Common name : The Common Grass Yellow.

Material examined : 1ex., Chhiwala, Jhiria, 14.xi.2000, Coll. R. K. Singh; 1ex., Judi, 14.iii.2001, Coll. R. K. Singh; 3 exs., Chhiwala, Jhiria, 15.iii.2001, Coll. R. K. Singh; 2 exs., Judi surrounding,

18.iii.2001, Coll. R. K. Singh & Party; 2 exs., Ken river Lodge, Madla, 20.xi.2000, Coll. R. K. Singh; 1 ex., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh; 2 exs., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh; 2 exs., Kharrya, 22.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Bihar; Delhi; Himachal Pradesh; Karnataka; Lakshadweep; Maharashtra; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka and Pakistan

Family 3. DANAIDAE

Subfamily 4. DANAINAE

Genus 11. *Danaus* Kluk, 1780

16. *Danaus chrysippus chrysippus* (Linnaeus)

1758. *Papilio chrysippus* Linnaeus, *Syst. Nat.* (ed. 10)1 : 471.

1947. *Danaus chrysippus chrysippus* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 20.

Common name : The Plain Tiger.

Material examined : 9 exs., Madla gate, 8.xi.2000, Coll. R. K. Singh; 1 ex., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 2 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1 ex., Ken river Lodge, 20.xi.2000, Coll. R. K. Singh; 1 ex., Madla gate, 13.iii.2001, Coll. R. K. Singh; 2 exs., Judi surrounding, 14.iii.2001, Coll. R. K. Singh; 3 exs., Chhiwala Jhiria surrounding, 15.iii.2001, Coll. R. K. Singh & Party; 7 exs., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh; 2 exs., Near Lake, Hinauta, 15.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Assam; Bihar; Delhi; Gujarat; Himachal Pradesh; Maharashtra; Manipur; Orissa; Sikkim; Tamil Nadu and Uttar Pradesh.

Elsewhere : Sri Lanka; Pakistan; Nepal; Myanmar; Indonesia and China.

17. *Danaus genutia* (Cramer)

1779. *Papilio genutia* Cramer, *Pap. Exot.*, 3 : 23.

1947. *Danaus plexippus plexippus* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 25.

1987. *Danaus genutia* : Gupta and Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 17.

Common name : The Common Tiger.

Material examined : 2 exs., Pandav Fall, 9.xi.2000, Coll. R. K. Singh; 4 exs., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh; 4 exs., Ken river Lodge, 20.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Arunachal Pradesh; Assam; Bihar; Himachal Pradesh; Karnataka; Manipur; Mizorum; Nagaland; Orissa; Punjab; Rajasthan; Sikkim; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan; Pakistan; Nepal; Myanmar; Sri Lanka; Thailand and China.

Genus 12. *Tirumala* Moore, 188018. *Tirumala limniace leopardus* (Butler)

1866. *Danaus limniace* var. *leopardus* Butler, *Proc. zool. Soc. Lond.*, : 52.

1947. *Danaus limniace leopardus* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 31.

1991. *Tirumala limniace leopardus* : Mandal & Maulik, *State Fauna Series 3 : Fauna of Orissa, Part-3, Zool. Surv. India* : 235.

Common name : The Blue Tiger.

Material examined : 1ex., Near Ken River, Madla, 15.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Assam; Bihar; Delhi; Himachal Pradesh; Karnataka; Lakshadweep; Manipur; Nagaland; Orissa; Punjab; Sikkim; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka; Pakistan; Nepal; Myanmar; Taiwan; Thailand and China.

Subfamily 5. EUPLOEINAE

Genus 13. *Euploea* Fabricius, 180719. *Euploea core core* (Cramer)

1780. *Papilio core* Cramer, *Pap. Exot.*, 3 : 133.

1947. *Euploea core core* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 67.

Common name : The Common Crow.

Material examined : 1ex., Madla gate, 8.xi.2000, Coll. R. K. Singh; 3 exs., Pandav fall, 9.xi.2000, Coll. R. K. Singh and party; 1 ex., Ken river lodge Madla, 20.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Bihar; Delhi; Karnataka; Lakshadweep; Orissa; Sikkim; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka; Pakistan and Nepal.

Family 4. SATYRIDAE

Subfamily 6. SATYRINAE

Genus 14. *Melanitis* Fabricius, 180720. *Melanitis leda ismene* (Cramer)

1775. *Papilio ismene* Cramer, *Pap. Exot.*, 1 : 40, pl. 26, figs. A, B.

1997. *Melanitis leda ismene* : Bhattacharya, *State Fauna Series, 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 748.

Common name : The Common Evening Brown.

Material examined : 1ex., Madla gate, 8.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Assam; Bihar; Delhi; Himachal Pradesh; Lakshadweep; Orissa; Sikkim; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Pakistan; Nepal; Sri Lanka; Myanmar and China.

Genus 15. *Mycalesis* Huebner, 1818

21. *Mycalesis lepcha lepcha* (Moore)

1880. *Samanta lepcha* Moore, *Trans. ent. Soc. Lond.*, (4) : 167.

1947. *Mycalesis lepcha lepcha* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 160.

Common name : The Lepcha Bushbrown.

Material examined : 1ex., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 1 ex., Mehlen Seha, 11.xi.2000, Coll. R. K. Singh; 2 exs., Ludha nala, Hinauta, 26.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Himachal Pradesh and Uttar Pradesh.

Elsewhere : Nepal.

22. *Mycalesis perseus tabitha* (Fabricius)

1793. *Papilio tabitha* Fabricius, *Syst. Ent.*, 3(1) : 243.

1947. *Mycalesis perseus tabitha* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 131.

Common name : The Common Bushbrown.

Material examined : 3 exs., Ludha nala, Hinauta, 26.xi.2000, Coll. R. K. Singh; 1 ex., Judi, 12.xi.2000, Coll. R. K. Singh; 3 exs., Kharrya, Hinauta, 22.xi.2000, Coll. R. K. Singh; 1ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Kerala; Orissa; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka.

23. *Mycalesis visala visala* Moore

1857. *Mycalesis visala* Moore, *Cat. Lep. Ins. E.I.C.*, 1 : 230.

1997. *Mycalesis visala visala* : Bhattacharya, *State Fauna Series*, 3 : *Fauna of West Bengal, Part-7, Zool. Surv. India* : 733.

Common name : The Long Brand Bushbrown.

Material examined : 2 exs., Ludha nala, Hinauta, 26.xi.2000, Coll. R. K. Singh; 1 ex., Judi, 12.xi.2000, Coll. R. K. Singh; 1 ex., Kharrya, Hinauta, 22.xi.2000, Coll. R. K. Singh; 1ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Assam; Nagaland; Sikkim; Uttar Pradesh and West Bengal.

Elsewhere : Myanmar.

Genus 16. *Ypthima* Huebner, 1818

24. *Ypthima asterope mahratta* Moore

1884. *Ypthima mahratta* Moore, *J. Asiat. Soc. Beng.*, 53(2) : 16.

1947. *Ypthima asterope mahratta* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 325.

Common name : The Common Three-ring.

Material examined : 3 exs., Near Judi, 16.xi.2000, Coll. R. K. Singh; 5 exs., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Assam; Himachal Pradesh; Punjab; Tamil Nadu and Uttar Pradesh.

Elsewhere : Baluchistan.

25. *Ypthima inica* Hewitson

1865. *Ypthima inica* Hewitson, *Trans. ent. Soc. Lond.*, (3)2 : 284.

1997. *Ypthima inica* : Bhattacharya, *State Fauna Series*, 3 : *Fauna of West Bengal, Part-7, Zool. Surv. India* : 745.

Common name : The Lesser Three-ring.

Material examined : 1ex., Madla gate, 13.iii.2001, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Punjab, and West Bengal.

Family 5. NYMPHALIDAE

Subfamily 7. BIBLIDINAE

Genus 17. *Ariadne* Horsfield, 1829

26. *Ariadne merione* (Cramer)

1777. *Papilio merione* Cramer, *Pap. Exot.*, 2 : 76, pl. 144, figs. G, H.

1994. *Ariadne merione* : Varshney, *Oriental Ins.*, 28 : 167.

Common name : The Common Coster.

Material examined : 1ex., Pipartola, 10.xi.2000, Coll. R. K. Singh; 4 exs., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh and party; 4 exs., Ken river lodge, 20.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Delhi; Kashmir; Orissa and Uttar Pradesh.

Elsewhere : Sri Lanka and Myanmar.

Subfamily 8. AGRYNNINAE

Genus 18. *Phalanta* Horsfield, 182927. *Phalanta phalantha phalantha* (Drury)1770. *Papilio phalantha* Drury, *Exot. Inst.*, 1 : 41.1987. *Phalanta phalantha phalantha* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 30.*Common name* : The Common Leopard.

Material examined : 2 exs., Raipura, 13.xi.2000, Coll. R. K. Singh; 1ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 3 exs., Near Judi, 16.xi.2000, Coll. R. K. Singh; 2 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 2 exs., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh and party; 1ex., Khamariya, 24.xi.2000, Coll. R. K. Singh; 1 ex., Ludha nala, Hinauta, 26.xi.2000, Coll. R. K. Singh; 1 ex., Jhalar Tallagaon, 26.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Arunachal Pradesh; Bihar; Delhi; Maharashtra; Nicobar; Orissa; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Pakistan; Sri Lanka and Myanmar.

Subfamily 9. NYMPHALINAE

Genus 19. *Precis* Huebner, 181928. *Precis iphita pluviatilis* Fruhstorfer1900. *Precis pluviatilis* Fruhstorfer, *Berl. ent. Z. Berlin*, 45 : 22.1987. *Precis iphita pluviatilis* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 32.*Common name* : The Chocolate Pansy.

Material examined : 1ex., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 6 exs., Judi, 12.xi.2000, Coll. R. K. Singh; 2 exs., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 2 exs., Near Judi, 16.xi.2000, Coll. R. K. Singh; 1ex., Badgadi, 18.xi.2000, Coll. R. K. Singh; 1ex., Near Ken river, Madla, 20.xi.2000, Coll. R. K. Singh and party; 3 exs., Mehlenseha, 11.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Kashmir; Orissa; South India and Uttar Pradesh.

Elsewhere : Maldives and Sri Lanka.

Genus 20. *Junonia* Huebner, 181929. *Junonia almana almana* (Linnaeus)1758. *Papilio almana* Linnaeus, *Syst. Nat.* (ed. 10); 472.1987. *Precis almana almana* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 35.1994. *Junonia almana almana* : Varshney, *Oriental ins.*, 28 : 176.*Common name* : The Peacock Pansy.

Material examined : 2 exs., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 1 ex., Dhundhua fall, 22.xi.2000, Coll. R. K. Singh; 1ex., Raipura, Chandra Nagar, 13.xi.2000, Coll. R. K. Singh; 1ex., Judi, 12.xi.2000, Coll. R. K. Singh; 1 ex., Near Judi, 16.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Andaman; Bihar; Delhi; Orissa; Uttar Pradesh and West Bengal (widely distributed in India).

Elsewhere : Sri Lanka and Myanmar.

30. *Junonia atlites* (Linnaeus)

1763. *Papilio atites* Linnaeus, *Centur. Ins.*, : 24.

1987. *Precis atlites* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. **106** : 34.

1994. *Junonia atlites* : Varshney, *Oriental Ins.*, **28** : 176.

Common name : The Grey Pansy.

Material examined : 3 exs., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 2 exs., Judi, 16.xi.2000, Coll. R. K. Singh; 2 exs., Jhalar village, 19.xi.2000, Coll. R. K. Singh and party; 1 ex., Judi, 12.xi.2000, Coll. R. K. Singh; 2 exs., Khamariya, 24.xi.2000, Coll. R. K. Singh; 1 ex., Pipartola, Talgaon, 20.iii.2002, Coll. Y N. Gupta; 1 ex., Judi nala, Madla, 25.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Orissa; Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka and Myanmar.

31. *Junonia hierta hierta* (Fabricius)

1798. *Papilio hierta* Fabricius, *Ent. Syst. Suppl.*, **4** : 424.

1987. *Precis hierta hierta* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. **106** : 33.

1994. *Junonia hierta* : Varshney, *Oriental Ins.*, **28** : 176.

Common name : The Yellow Pansy.

Material examined : 2 exs., Pandav fall, 9.xi.2000, Coll. R. K. Singh and Party; 1ex., Rampur dam near Baria, 24.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Bihar; Delhi; Orissa; and Uttar Pradesh.

Elsewhere : Sri Lanka and Pakistan.

32. *Junonia lemonias vaisya* (Fruhstorfer)

1912. *Precis vaisya* Fruhstorfer, in Seitz; *The Micolepidoptera of the World*, **9** : 34.

1987. *Precis lemonias vaisya* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. **106** : 34.

1994. *Junonia lemonias* : Varshney, *Oriental Ins.*, **28** : 176.

Common name : The Lemon Pansy.

Material examined : 1 ex., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 2 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 1 ex., Badgadi, 18.xi.2000, Coll. R. K. Singh; 2 exs., Ken river lodge, 20.xi.2000, Coll. R. K. Singh; 1 ex., Kharrya, 22.xi.2000, Coll. R. K. Singh; 2 exs., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh and party; 1 ex., Madla, 8.xi.2000, Coll. R. K. Singh; 1 ex., Near Judi, 16.xi.2000, Coll. R. K. Singh; 2 exs., Pipartola, Talgaon, 20.iii.2002, Coll. Y N. Gupta; 1 ex., Rampur Dam near Beria, 24.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Bihar; Orissa and South India.

Elsewhere : Sri Lanka.

33. *Junonia orithya swinhoei* Butler

1885. *Junonia swinhoei*, Butler, *Ann. Mag. nat. Hist.*, (5)16 : 309.

1987. *Precis orithya swinhoei*, Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 33.

1994. *Junonia orithya* : Varshney, *Oriental Ins.*, 28 : 176.

Common name : The Blue Pansy.

Material examined : 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 1 ex., Madla gate, 13.iii.2001, Coll. R. K. Singh and party; 2 exs., Madla, 8.xi.2000, Coll. R. K. Singh; 1 ex., Near Lake Hinauta, 15.iii.2002, Coll. Y N. Gupta; 1 ex., Pipartola, Talgaon, 20.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Bihar; Delhi; Himachal Pradesh; Orissa; South India and Uttar Pradesh.

Elsewhere : Pakistan; Sri Lanka and Myanmar.

Genus 21. *Hypolimnias* Huebner, 1819

34. *Hypolimnias bolina* (Linnaeus)

1758. *Papilio bolina* Linnaeus, *Syst. Nat.* (ed. 10) 1 : 479.

1987. *Hypolimnias bolina* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 29.

Common name-The Great Eggfly.

Material examined : 1 ex., Pipartola, 10.xi.2000, Coll. R. K. Singh; 2 exs., Judi, 12.xi.2000, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 1 ex., Near Judi, 16.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Andaman and Nicobar; Arunachal Pradesh; Bihar; Delhi; Meghalaya; Orissa; Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka; Pakistan and Myanmar.

35. *Hypolimnias misippus* (Linnaeus)

1764. *Papilio misippus* Linnaeus, *Mus. Utr.*, : 264.

1987. *Hypolimnias misippus* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. **106** : 28.

Common name : The Danaid Eggfly.

Material examined : 1 ex., Mehlen seha, 11.xi.2000, Coll. R. K. Singh; 1 ex., Judi, 12.xi.2000, Coll. R. K. Singh; 1 ex. Near Judi, 16.xi.2000, Coll. R. K. Singh; 3 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Arunachal Pradesh; Andaman and Nicobar; Bihar; Delhi; Orissa; Sikkim; Tamil Nadu; Uttar Pradesh and West Bengal.

Elsewhere : Pakistan; Sri Lanka and Myanmar.

Subfamily 10. LIMENITIDINAE

Genus 22. *Neptis* Fabricius, 180736. *Neptis hylas astola* Moore

1872. *Neptis astola* Moore, *Proc. zool. Soc. Lond.*, : 560.

1997. *Neptis hylas astola* : Gupta, *State Fauna Series 3 : Fauna of West Bengal*, Part-7. *Zool. Surv. India* : 592.

Common name : The Common Sailer.

Material examined : 4 exs., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 2 exs., Badgadi, 18.xi.2000, Coll. R. K. Singh; 1 ex., Jhalar village, 19.xi.2000, Coll. R. K. Singh; 3 exs., Ludha nala, 26.xi.2000, Coll. R. K. Singh; 1 ex., Judi Surrounding, 18.iii.2001, Coll. R. K. Singh and party; 1 ex., Madla, 8.xi.2000, Coll. R. K. Singh; 4 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Assam; Himachal Pradesh; Kashmir; Maharashtra; Uttar Pradesh and West Bengal.

Elsewhere : Myanmar.

Genus 23. *Symphaedra* Huebner, 181837. *Symphaedra nais* (Forster)

1771. *Papilio nais*, Forster, *Nov. Spec. Ins. Cent.*, **1** : 73.

1987. *Euthalia nais* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. **106** : 38.

1994. *Syphaedra nais* : Varshney, *Oriental Ins.*, **28** : 184.

Common name : The Baronet.

Material examined : 3 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 9 exs., Mehlen seha, 11.xi.2000, Coll. R. K. Singh; 3 exs., Judi, 12.xi.2000, Coll. R. K. Singh; 6 exs., Raipura village, 13.xi.2000, Coll. R. K. Singh; 2 exs., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 3 exs., Near Judi, 16.xi.2000, Coll. R. K. Singh; 1 ex., Kharrya, 22.xi.2000, Coll. R. K. Singh; 1 ex., Nararan, 25.xi.2000, Coll. R. K. Singh; 1 ex., Chhiwala Jhiria, surroundings, 15.iii.2001, Coll. R. K. Singh; 1 ex., Nararan, 16.iii.2001, Coll. R. K. Singh; 1 ex., Budriya nala, 21.iii.2001, Coll. R. K. Singh and party; 3 exs., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh; 1 ex., Khamariya, 24.xi.2000, Coll. R. K. Singh; 1 ex., Bargadi, Hinauta, 22.iii.2002, Coll. Y N. Gupta; 1 ex., Katari, 23.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Bihar; Goa; Gujarat; Sikkim; Uttar Pradesh and South India.

Elsewhere : Sri Lanka.

Genus 24. *Euthalia* Huebner, 1819

38. *Euthalia garuda anagama* Fruhstorfer

1913. *Euthalia anagama* Fruhstorfer, In Seitz; *The Macrolepidoptera of the World*, 9 : 667.

1987. *Euthalia garuda anagama* : Gupta and Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 39.

Common name : The Baron.

Material examined : 1 ex., Nararan, 25.xi.2000, Coll. R. K. Singh and Party.

Distribution : INDIA : Madhya Pradesh; Himachal Pradesh; Maharashtra; Orissa and Uttar Pradesh.

Subfamily 11. CHARAXINAE

Genus 25. *Charaxes* Ochseneimer, 1816

39. *Charaxes fabius* (Fabricius)

1781. *Papilio fabius* Fabricius, *Spec. Ins.* 2 : 12.

1997. *Charaxes fabius fabius* : Gupta, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 548.

Common name : The Black Rajah.

Material examined : 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh; 3 exs., Near Judi, 16.xi.2000, Coll. R. K. Singh; 1 ex., Kharrya, 22.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Bihar; Himachal Pradesh; Karnataka; Maharashtra; Sikkim; South India; Uttar Pradesh and West Bengal.

Subfamily 12. ACRAEINAE

Genus 26. *Acraea* Fabricius, 180740. *Acraea terpsicore* (Linnaeus)

1758. *Papilio terpsicore* Linnaeus, *Syst. Nat.*, (ed. 10) : 466.

1932. *Telchinia violae* : Evans, *The Identification of Indian Butterflies*, : 192.

1947. *Acraea violae* : Talbot : *The Fauna of British India, Including Ceylon and Burma*, Butterflies, 2 : 466.

1994. *Acraea terpsicore* : Varshney, *Oriental Ins.* 28 : 191.

Common name : The Tawny Coster.

Material examined : 8 exs., Madla gate, 8.xi.2000, Coll. R. K. Singh; 1 ex., Pandav fall, 9.xi.2000, Coll. R. K. Singh; 9 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 8 exs., Mehlen Seha, 11.xi.2000, Coll. R. K. Singh; 1ex., Mota Chokhan, Chandra Nagar, 13.xi.2000, Coll. R. K. Singh; 2 exs., Raipura village, Chandra Nagar, 13.xi.2000, Coll. R. K. Singh; 1 ex., Near Judi, 16.xi.2000, Coll. R. K. Singh; 2 exs., Badgadi, 18.xi.2002, Coll. R. K. Singh; 1ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh; 1ex., Madla gate, 13.iii.2001, Coll. R. K. Singh; 2exs., Judi surrounding, 18.iii.2001, Coll. R. K. Singh; 1ex., Kharrya, Hinauta, 24.xi.2000, Coll. R. K. Singh; 4 exs., Near Lake Hinauta, 15.iii.2002, Coll. Y N. Gupta; 1 ex., Barer, Hinauta, 15.iii.2002, Coll. Y N. Gupta; 2 exs., Jhalar, Talgaon, 26.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Bihar;Gujarat; Lakshadweep; Punjab; Sikkim; Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka and Pakistan.

Family 6. RIODINIDAE

Subfamily 13. RIODININAE

Genus 27. *Abisara* Felder & Felder, 196041. *Abisara echerius suffusa* (Moore)

1882. *Abisara suffusa* Moore, *Proc. zool. Soc. Lond.*, : 244.

1997. *Abisara echerius suffusa* : Gupta, *State Fauna Series 3 : Fauna of West Bengal*, Part-7, Zool. Surv. India : 599.

Common name : The Plum Judy.

Material examined : 3 exs., Pandav fall, 9.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Karnataka; Kanara to Western Himalaya and West Bengal.

Family 7. LYCAENIDAE

Subfamily 14. POLYOMMATINAE

Genus 28. *Jamides* Huebner, 181942. *Jamides celeno aelianus* (Fabricius)

1793. *Hesperia aelianus* Fabricius, *Ent. Syst.*, 3(1) : 280, No. 79.

1997. *Jamides celeno aelianus* : Gupta, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 451.

Common name : The Common Cerulean.

Material examined : 1 ex., Judi, 12.xi.2000, Coll. R. K. Singh; 1 ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Assam and West Bengal.

Elsewhere : Pakistan and Myanmar.

Genus 29. *Castalius* Huebner, 181643. *Castalius rosimon rosimon* (Fabricius)

1775. *Papilio rosomon* (Fabricius), *Syst. Ent.*, : 523.

1997. *Castalius rosimon rosimon* : Gupta, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 434.

Common name : The Common Pierrot.

Material examined : 1 ex., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1 ex., Mehlen seha, 11.xi.2000, Coll. R. K. Singh; 1 ex., Raipura village, Chandra Nagar, 13.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh : West Bengal; Widely distributed in India.

Elsewhere : Pakistan; Sri Lanka and Myanmar.

Genus 30. *Tarucus* Moore, 1881.44. *Tarucus nara* (Kollar)

1848. *Lycaena nara* Kollar, *In Huegel's Kaschmir*, 4 : 241.

1907. *Tarucus theophrastus* : Bingham, *The Fauna of British India, Butterflies*, 2 : 417.

1997. *Torucus nara* : Gupta, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 436.

Common name : The Striped Pierrot.

Material examined : 1 ex., Pipartola, 10.xi.2000, Coll. R. K. Singh and party.

Distribution : INDIA : Madhya Pradesh; Sikkim; Southern, Western and Northern India and Uttar Pradesh.

Elsewhere : Sri Lanka.

Subfamily 15. APHNAEINAE

Genus 31. *Spindasis* Wallengren, 1857

45. *Spindasis vulcanus vulcanus* (Fabricius)

1775. *Papilio vulcanus* Fabricius, *Syst. Ent.*, : 519, no. 23.

1997. *Spindasis vulcanus vulcanus* : Gupta, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 467.

Common name : The Common Silverline.

Material examined : 5 exs., Mehlen Seha, 11.xi.2000, Coll. R. K. Singh.; 1ex., Judi, 12.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; West Bengal, Widely distributed in India except Eastern Himalayas and Assam.

Elsewhere : Pakistan.

Subfamily 16. THECLINAE

Genus 32. *Virachola* Moore, 1881

46. *Virachola isocrates* (Fabricius)

1793. *Hesperia isocrates* Fabricius, *Ent. Syst.*, BF 3(1) : 226, no. 29.

1997. *Virachola isocrates* : Gupta, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 478.

Common name : The Common Gauva Blue.

Material examined : 1 ex., Near Judi, 16.xi.2000, Coll. R. K. Singh; 3 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 2 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 1 ex., Pipartola, 20.iii.2002, Coll. Y N. Gupta.

Distribution : INDIA : Madhya Pradesh; Assam; Maharashtra; Meghalaya; Nagaland; Orissa and West Bengal.

Elsewhere : Pakistan and Sri Lanka.

Genus 33. *Rapala* Moore, 1881

47. *Rapala iarbus iarbus* (Fabricius)

1787. *Papilio iarbus* Fabricius, *Mant. Ins.*, 2 : 68, no. 648.

1957. *Rapala melampus* : Wynter Blyth, *The Butterflies of Indian Region* : 362.

1997. *Rapala iarbus iarbus* : Gupta, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 480.

Common name : The Common Red Flash.

Material examined : 1ex., Pipartola, 10.xi.2000, Coll. R. K. Singh; 1ex., Judi, Madla, 12.xi.2000, Coll. R. K. Singh; 5exs., Jardhoba, Hinauta, 21.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Sikkim and West Bengal.

Elsewhere : Nepal and Myanmar.

Family 8. HESPERIDAE

Genus 34. *Udaspes* Moore, 1881

48. *Udaspes folus* (Cramer)

1775. *Papilio folus* Cramer, *Pap. Exot.*, 1 : 118, pl. 74, fig. F.

1997. *Udaspes folus* : Ghosh & Choudhury, *State Fauna Series, Fauna of West Bengal, Part-7, Zool. Surv. India* : 294.

Common name : The Grass Demon.

Material examined : 1 ex., Chhiwala Jhiria, 14.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Assam; Orissa; South India; Sikkim; West Himalaya and West Bengal.

Elsewhere : Palaearctic.

Genus 35. *Telicota* Moore, 1881

49. *Telicota ancilla* Herrich-Schaffer

1869. *Telicota ancilla* Herrich-Schaffer, *Stett. Ent. Ztg.*, p. 79.

1997. *Telicota ancilla* : Ghosh & Chaudhury, *State Fauna Series, Fauna of West Bengal, Part-7, Zool. Surv. India* : 304.

Common name : The Palm darts.

Material examined : 1 ex., Jhalar, 19.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; South India; Sikkim; North West Himalaya and West Bengal.

Elsewhere : Papuan and Australian Region.

Genus 36. *Pelopidas* Walker, 1870

50. *Pelopidas mathias* (Fabricius)

1798. *Hesperia mathias* Fabricius, *Ent. Syst. Suppl.*, p. 438.

1997. *Pelopidas mathias* : Ghosh & Choudhury, *State Fauna Series 3 : Fauna of West Bengal, Part-7, Zool. Surv. India* : 313.

Common name : The Swifts.

Material examined : 1 ex., Madla gate, 8.xi.2000, Coll. R. K. Singh; 4 exs., Near Ken river, Madla, 15.xi.2000, Coll. R. K. Singh; 2 exs., Madla gate, 13.iii.2001, Coll. R. K. Singh; 2 exs., Pipartola, 10.xi.2000, Coll. R. K. Singh; 2 exs., Jardhoba, 21.xi.2000, Coll. R. K. Singh; 1 ex., Dhundhua fall, 23.xi.2000, Coll. R. K. Singh.

Distribution : INDIA : Madhya Pradesh; Assam; Central Nicobars; Jammu and Kashmir; Maharashtra, Rajasthan, Punjab, Sikkim; South India and West Bengal.

Elsewhere : Papuan and Australian Region.

SUMMARY

The paper incorporates the account of fifty species pertaining to thirty-six genera distributed over eight families recorded for the first time from Panna National Park, Madhya Pradesh.

ACKNOWLEDGEMENTS

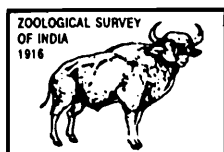
The authors are highly grateful to Dr. J. R. B. Alfred, Director Zoological Survey of India, Kolkata, for assigning the problem and to Dr. K. Chandra, Scientist 'E' and Officer-In-Charge, Central Regional Station, Zoological Survey of India, Jabalpur, for providing materials and other facilities for survey work. We also express sincere thanks to Chief Wildlife Warden, Bhopal and Field Director of Panna Tiger Reserve, for giving permission and providing facilities in the park during our survey work.

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BUTTERFLY–FLOWER INTERACTION IN KEOLADEO NATIONAL PARK, BHARATPUR, RAJASTHAN

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INTRODUCTION

India with an estimated diversity of about 15,000 flowering plants offer a vast potential for studying the role of butterflies and other insects in pollination. But for the contributions made by Subba Reddi *et. al.* (1983), Subba Reddi and Meerabai (1984), Alluri and Subba Reddi (1994), Byragi Reddi and Subba Reddi (1996), the subject has received no significant attention in India. In the present communication, we describe our observations on butterfly-flower interactions made in the Keoladeo National Park, Bharatpur, Rajasthan.

STUDY AREA

The Keoladeo National Park is situated between latitude 27° 7' 6" to 27° 12' 2" N and longitude 77° 29' 5" to 77° 33' 9" E in the Bharatpur district of Rajasthan. The park covers 29 sq. km. of which 12 sq. km. forms a man-made wetland. Water level fluctuates from 0 to 2 m. The park receives water from river Gambhir, a tributary of river Yamuna. Temperature varies from 2°C in winter (November to February) to 49°C in summer (March to June) exposing the park to extreme climatic conditions. The average annual rainfall is 662 mm, mostly received from the southwest monsoon during July to September. Due to varying eco-climatic conditions, the general vegetation of the park is remarkable, comprising of 379 species of plants, which include 96 species of wetland plants (Meena and Sharma, 1996).

METHODOLOGY

While conducting hydrobiological studies in the park from 13–24 April 1999 (Summer Survey) and 1–5 December 1999 (Winter Survey), we made a note of the flowering plants especially attended

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by the butterflies. Each flowering tree was carefully observed with naked eye or through 7×50 binoculars during morning and evening hours, every day, and the butterflies interacting with the flowering plants were counted and their activities observed. While enumerating the butterflies, their highest number at a time was recorded.

RESULTS

A total of 15 species of butterflies belonging to 5 families were recorded, interacting with 7 plant species during the study (Table 1). The family Pieridae was found dominant with 6 species followed by Nymphalidae with 4 species, Lycaenidae and Danaidae with 2 species and one species of Hesperidae. An account of the nectar plants subjected to study and their associated butterfly species observed are given below.

Azadirachta indica A. Juss (Verbenaceae)

Azadirachta indica is a well-known tree of family Verbenaceae, commonly known as neem. The trees bear small, pale yellow flowers, from March to May. It is a common tree around the Keoladeo national park.

During our study in April, we noticed unusually large congregations of butterflies on the flower heads of neem, especially on trees along the road leading from the Park's entry point to the Keoladeo Temple. The Caper White (*Anaphaeis aurota*), Common Gull (*Cepora nerissa*), Lemon Pansy (*Junonia lemonias*), Striped Tiger (*Danaus genutia*) and Common Tiger (*Danaus chrysippus*) were found constantly visiting and feeding nectar from flowers of all the neem trees observed. Of these, Lemon Pansies and Striped tigers were found visiting the flowers in rapid succession and based on the observation, they could be considered as the major butterfly pollinators of neem in the Park. At the same time, swarms of Rock Honey bees (*Apis dorsata*) were also found visiting the flowers along with butterflies.

Interestingly, the neem flowers of Hyderabad (Andhra Pradesh) and Palakkad (Kerala) could never be found entertaining such swarms of butterflies. The role of butterflies on the pollination of neem tree is not known before and the effect of azadirachtin on butterflies can be an interesting subject for study.

Ageratum conyzoides Linnaeus (Asteraceae)

The troublesome annual weed, *Ageratum conyzoides* is known among the plant biologist as 'goat-weed' due to its peculiar odour. The plant can be commonly observed along the bund lines adjacent to the Sampanmori and Vackaliya areas of the park. During the April survey, we observed

Table 1. : Butterfly visitors (in number) on flowers of the plant species studied in Keoladeo National Park, Bharatpur, Rajasthan.

Sl. No.	Butterfly Species	Plant Species						
		1	2	3	4	5	6	7
	Family PIERIDAE							
1.	Caper White <i>Anapheis aurota</i>	40	13	8	8	25	–	20
2.	Small Salmon Arab <i>Colotis amata</i>	–	–	1	–	8	2	10
3.	Plain Orange Tip <i>Colotis eucharis</i>	–	–	–	–	–	4	–
4.	Common Gull <i>Cepora nerissa</i>	6	3	–	–	2	4	–
5.	White Orange Tip <i>Ixias marianne</i>	–	–	–	–	–	4	50
6.	Common Grass Yellow <i>Eurema hecabe</i>	–	–	–	–	–	4	–
	Family NYMPHALIDAE							
7.	Peacock Pansy <i>Junonia almana</i>	–	2	3	1	25	–	–
8.	Blue Pansy <i>Junonia orithya</i>	–	–	–	–	4	–	–
9.	Lemon Pansy <i>Junonia lemonias</i>	3	–	1	–	3	–	–
10.	Grey Pansy <i>Junonia atlites</i>	–	–	–	–	3	–	–
	Family DANAIDAE							
11.	Striped Tiger <i>Danaus genutia</i>	2	–	6	–	–	–	–
12.	Common Tiger <i>Danaus chrysippus</i>	8	12	14	–	30	–	–

Table 1. (Cont'd.).

Sl. No.	Butterfly Species	Plant Species						
		1	2	3	4	5	6	7
	Family LYCAENIDAE							
13.	Gram Blue <i>Euchrysops cnejus</i>	—	—	2	—	—	—	—
14.	Bright Babul Blue <i>Azanus ubaldus</i>	—	—	—	—	—	3	—
	Family HESPERIIDAE							
15.	Bank's Swift <i>Baoris kumara</i>	—	—	—	—	—	2	—

1 *Azadirachta indica*, 2. *Ageratum conyzoides*, 3. *Polygonum glabrum*, 4. *Polygonum barbatum*, 5. *Blumea* sp., 6. *Hygrophila auriculata*, 7 *Albizzia lebbeck*.

up to 12 Plain Tiger (*Danaus chrysippus*), 13 Caper White (*Anaphaeis aurota*), 3 Common Gull (*Cepora nerissa*) and 2 Peacock Pansy (*Junonia almana*) butterflies on a single plant, feeding nectar from its bloom of bluish-white flower heads. Presence of *Apis dorsata* was also noted during the study.

Ageratum conyzoides is a confirmed source of pyrrolizidine alkaloids (Larsen, 1986). These compounds are essential for the synthesis of a pheromone necessary for successful courtship in the life of danine butterflies. Though the Plain tiger is a known associate of the Goat weed plant, the association of Caper white, Common Gull and Peacock Pansy butterflies on *Ageratum* is not known before.

***Polygonum glabrum* Willd. (Polygonaceae)**

An erect herb growing up to 1m heights, *Polygonum glabrum* produces pink flowers in terminal panicle racemes. They are mostly found on the banks of the Ghana canal, especially near the Sampanmori and Mansarovar areas. The nectary inflorescence attracts many butterflies and other insect species. Of the 7 species of butterflies observed, the Plain Tiger, Caper White, Striped Tiger and Peacock Pansy were the more constant and abundant visitors. Small number of Gram Blue (*Euchrysops cnejus*), Lemon Pansy (*Junonia lemonias*) and Small Salmon Arab (*Colotis amata*) were also observed. Honey bees and many species of wasps were also noted during the study.

***Polygonum barbatum* Linnaeus (Polygonaceae)**

An erect herb growing up to 1 m in height, *Polygonum barbatum* is mostly seen towards Keoladeo Temple area within the water edge. The plant is much rarer and localized than *P. glabrum* in the Park. The creamy white flower heads of the plant attract mainly Caper White (*Anaphaeis aurota*) and Peacock Pansy (*Junonia almana*) butterflies. Honey bees have also been observed on the flower heads during the summer season.

***Blumea* sp. (Asteraceae)**

There are 5 species of *Blumea* recorded in the Park (Meena and Sharma, 1996). On 21st April 1999, one small shrubby species of *Blumea* with cream white inflorescence found near Kadamgunj area was observed with an unusually large assemblage of butterflies on its flower heads. 8 species of butterflies were noted attracted to the plant's inflorescence. Among them, as many as 30 Plain Tigers, 25 Caper Whites, 25 Peacock Pansies dominated the scene. The Small Salmon Arab, Common Gull, Blue Pansy, Lemon Pansy and Grey Pansy were found in less numbers ranging from 2 to 8 along with a good number of honey bees (*Apis dorsata*).

***Hygrophila auriculata* Linnaeus (Acanthaceae)**

Hygrophila auriculata is a common spinescent herb observed in full bloom during winter survey in December. The plant is fairly well distributed along the bunds adjoining the marshy area. The nectary purple flowers attract many insects. The 7 species of butterflies observed attending the flowers are, Small Salmon Arab, Plain Orange Tip, Common Gull, White Orange Tip, common Grass Yellow, Bright Babul Blue and Bank's Swift. Large number of wasps, honey bees, damselflies, spiders and ants were also observed on the flower heads. In winter season, this is the only nectar-providing plant species for the butterflies in the park. On 5.12.1999 at Python Point, we made a sweep with an insect net among the *Hygrophila* bushes and it resulted in the collection of diverse group of insects, comprising of 5 species of butterflies, 4 species of Odonata, 2 species of grasshoppers, 2 species of Diptera, 1 species of honey bee and 1 species of Neuroptera. Lizards, Praying Mantis and Crab spiders were seen waiting near the flowers to prey upon the flower-visiting insects.

***Albizzia lebbek* (Linnaeus) (Fabaceae)**

The huge trees of *Albizzia* with large creamy-white flowers line either side of the road leading to Ajan Bund, in the southwestern area of the Park. The fallen flowers attract pierids such as Caper White, Small Salmon Arab and White Orange Tip. We enumerated as many as 50 White Orange Tips, 20 Caper Whites and 10 Small Salmon Arabs. The White Orange Tip butterflies were never seen attending on the flowers during summer season.

Besides the above plants, the flowers of *Lantana camara* and *Capparis* sp. were found attracting many species of butterflies during the study period.

Of the 7 flowering plants observed in our study, the *Blumea* sp., which flowers during April-May, was most preferred by butterflies. *Blumea* attracted a total of 8 species of butterflies, followed by *Polygonum glabrum* and *Hygrophila auriculata*, which attracted 7 species of butterflies each.

Maximum butterfly density was also recorded on *Blumea* sp., which was visited by about 100 specimens of 8 species, at a time, in April. The high density is likely to be due to the numerous flower heads that provide good source of nectar.

We have also observed that, in Keoladeo National Park, the butterfly diversity on flowering plants is higher in summer than during the winter season. This may be due to the need of higher intake of fluids required for the butterflies to cope-up with the summer heat. Vogel (1978) observed a great increase in the number of butterfly-visits to flowers during a drought, driven there by the need for water.

40 species of butterflies have been recorded to occur in the Park (Jafer and Soniya, 2001). The present study is only a preliminary one and an extensive survey is required to gain a comprehensive idea of the relationship of all the butterfly species with the floral components in the Park.

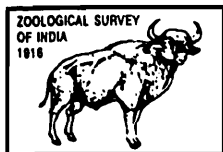
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Rec. zool. Surv. India : 104 (Part 1–2) : 59-69, 2005

STUDIES ON THE ICHTHYOFAUNA OF SACRED GROVES IN KANCHIPURAM DISTRICT, TAMIL NADU

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INTRODUCTION

Sacred groves represent an ancient Indian conservation tradition and they may be forests, scrub jungles or may even be few trees. They are patches of land with trees, scrubs and other kinds of vegetation growing naturally and are dedicated to the local deity. Further the size also may range from few square meters to several hectares. Another tradition was the construction of artificial tanks to conserve water source.

Eventhough lot of information is available on the floristic wealth of the sacred groves, faunistic investigation is almost negligible. With a view to study the fauna of two sacred groves in Kanchipuram district, Tamilnadu investigations were made from Maraimalainagar sacred grove and Tiruvidanthai sacred grove. In this paper studies pertaining to fish fauna of a tank situated inside Tiruvidanthai sacred grove is presented.

TIRUVIDANTHAI SACRED GROVE

This is situated 30 km away from Chennai city near Kovalam town on the Mahabalipuram road. Here the temple is known as Nithyakalyanaperumal temple. The tree covered area is very limited and three tanks are available within the total area of 4.04 ha. One tank is situated on the main road and protection wall of this tank is constructed very recently. Near the entrance of the temple another tank with *Microcystis* bloom is situated. Further one more tank on the backside of the temple with macrophytes is also present. The total area of this tank is nearly 400 m² and the maximum depth noted was 1.5 m. Ichthyological investigations were carried out from this tank.

MATERIAL AND METHODS

Fish samples were collected monthly once from this tank from April 2000 to December 2002. For collection, one net cloth with a size of 6 m × 1 m was operated on the shores. For each sample

the net was operated five times. Also one waternet with 30 cm diameter was also utilised and this net was also operated five times for each collection. For the deeper parts of the tank, one fisherman was engaged for operating castnet with a meshsize of 3 cm for five times. Classification is after Jayaram (1999) and Menon (1999).

RESULTS

SYSTEMATIC LIST OF THE COLLECTED TAXA

Order CYPRINIFORMES

Family CYPRINIDAE

Subfamily DANIONINAE

1. *Amblypharyngodon microlepis* (Blkr.)
2. *Esomus danricus* (Ham.)
3. *Esomus thermoicos* (Val.)
4. *Rasbora caverii* (Jerdon)
5. *Rasbora daniconius* (Ham.)
6. *Chela laubuca* (Ham.)

Subfamily CYPRININAE

7. *Puntius chola* (Ham.)
8. *Puntius conchoni* (Ham.)
9. *Puntius dorsalis* (Jerdon)
10. *Puntius sophore* (Ham.)
11. *Puntius ticto* (Ham.)
12. *Puntius vittatus* Day

Family COBITIDAE

13. *Lepidocephalus thermalis* (Val.)

Order SILURIFORMES

Family BAGRIDAE

14. *Mystus bleekeri* (Day)
15. *Mystus vittatus* (Bloch)

Family HETEROPNEUSTIDAE

16. *Heteropneustes fossilis* (Bloch)

Order BELONIFORMES

Suborder ADRIANICHTHYOIDEI

Family ADRIANICHTHYIDAE

Subfamily ORYZINAE

17. *Oryzias carnaticus* (Jerdon)

Order CYPRINODONTIFORMES

Family POECILIDAE

18. *Gambusia affinis* (Baird & Girard)

Order SYNBRANCHIFORMES

Family MASTACEMBELIDAE

19. *Macrognathus pancalus* Ham.

Order PERCIFORMES

Family CICHLIDAE

20. *Etilapia maculatus* (Bloch)

21. *Oreochromis mossambica* (Peters)

Family GOBIIDAE

22. *Glossogobius giuris* (Ham.)

Family ANABANTIDAE

23. *Anabas testudineus* (Bloch)

Family BELONTIDAE

24. *Polyacanthus lalius* (Ham.)

25. *Pseudosphromenus cupanus* (Val.)

Family CHANNIDAE

26. *Channa punctatus* (Bloch).

DETAILS OF COLLECTIONS

1. *Amblypharyngodon microlepis* (Bleeker)

1853. *Leuciscus microlepis* Bleeker, *Verh. Bat. Gen.* 25, p. 141.

1999. *Amblypharyngodon microlepis* (Bleeker) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 32-33.

Material : 133 exs., 27.ii.02., (size 26–61 mm SL) M.B.R., 4 exs., 17.iv.02., (size 26–61 mm SL) M.B.R., 10 exs., 17.v.02 (size 26–27 mm SL) M.B.R.

Remarks : Size : 10.0 cm. TL.

Distribution : Ponds, slow-moving streams. (Throughout India except the westface of the western ghats).

2. *Esomus danricus* (Hamilton)

1822. *Cyprinus (Danio) danrica* Hamilton, *Fish. Ganges.*, pp. 325, 390, pl. 16. fig. 88.

1999. *Esomus danricus* (Hamilton) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 46-48.

Material : 1 ex., 27.ii.01, (size 27 mm SL) M.B.R., 1 ex., 17.iv.02, (size 18 mm SL) M.B.R., 4 exs., 17.v.02 (size 35–37 mm SL) M.B.R.

Remarks : Size : 12.5 cm. TL.

Distribution : Ponds and irrigation canals (Throughout India).

3. *Esomus thermoicos* (Valenciennes)

1842. *Nuria thermoicos* Valenciennes, *Hist. Nat. Poiss.*, 16 : 238, pl. 472.

1999. *Esomus thermoicos* (Valenciennes) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 49.

Material : 3 exs., 27.iii.01, (size 67–87 mm SL) M.B.R., 5 exs., 18.iv.01., (size 74–78 mm SL) M.B.R., 1 ex., 30.v.01. (size 68 mm SL) M.B.R., 2 exs., 17.xi.01. (size 48–52 mm SL) M.B.R., 6 exs., 27.ii.02. (size 49–50 mm SL) M.B.R., 1 ex., 17.iv.02. (size 81 mm SL). M.B.R., 5 exs., 17.v.02. (size 34–46 mm SL) M.B.R., 1 ex., 17.xii.02. (size 28 mm SL) M.B.R.

Remarks : Size : 12.7 cm. TL, usually 6 to 10 cm.

Distribution : Ponds, canals. (Peninsular India).

4. *Rasbora caverii* (Jerdon)

1849. *Leuciscus caverii* Jerdon, *Madras. J. Lit. Sci.*, 15 : 320.

1999. *Rasbora caverii* (Jerdon) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 52-53.

Material : 2 exs., 18.iv.01. (size 68–70 mm SL) M.B.R., 1 ex., 30.viii.01. (size 70 mm SL) M.B.R., 16 exs., 27.ii.02. (size 32–64 mm SL) M.B.R., 35 exs., 17.iv.02. (size 15–82 mm SL) M.B.R., 10 exs., 17.v.02. (size 26–36 mm SL) M.B.R.

Remarks : Size : 7.0 cm. TL.

Distribution : Forest streams, ponds, mountain streams. (Peninsular India).

5. *Rasbora daniconius* (Hamilton)

1822. *Cyprinus daniconius* Hamilton, Fish. Ganges, p. 327, pl. 15, fig. 89.

1999. *Rasbora daniconius* (Hamilton) Jayaram, *The Freshwater Fishes of The Indian Region* : 82.

Material : 166exs., 27.ii.01. (size 17–43 mm SL) M.B.R., 41 exs., 17.xi.01. (size 24–35 mm SL) M.B.R., 2 exs., 17.xii.01. (size 34 mm SL) M.B.R., 2 exs., 17.i.02. (size 28–32 mm SL) M.B.R., 1 ex. 17.iii.02. (size 32 mm SL) M.B.R., 6 exs., 17.v.02. (size 24–43 mm SL) M.B.R.

Remarks : Size : 10 cm. TL.

Distribution : Slowmoving streams, pools, with sandy substrate. (Throughout India).

6. *Chela laubuca* (Hamilton)

1822. *Cyprinuss (Chela) laubuca* Hamilton, Fish. Ganges. pp. 260, 384.

1999. *Chela laubuca* (Hamilton) Jayaram, *The Freshwater Fishes of The Indian Region* : 73.

Material : 3 exs., 17.xii.01. (size 32–38 mm SL). M.B.R.

Remarks : Size : 5.5 cm. TL.

Distribution : Streams, ponds, canals. (Throughout India).

7. *Puntius chola* (Hamilton)

1822. *Cyprinus chola* Hamilton, Fish. Ganges. pp. 312, 389.

1999. *Puntius chola* (Hamilton) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 88-90.

Material : 1 ex., 18.iv.01. (size 70 mm SL) M.B.R., 2 exs., 30.v.01. (size 35–54 mm SL) M.B.R., 1 ex., 19.vii.01. (size 80 mm SL) M.B.R., 2 exs., 17.xi.01. (size 68–93 mm SL) M.B.R., 6 exs., 17.iv.02. (size 61–93 mm SL) M.B.R.

Remarks : Size : 15 cm. TL, usually 12.0 cm.

Distribution : Rivers, streams, tanks (Throughout India).

8. *Puntius conchoni* (Hamilton)

1822. *Cyprinus (Puntius) conchoni* Hamilton, Fish. Ganges. pp. 317, 318, 389.

1999. *Puntius conchoni* (Hamilton) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 90-91.

Material : 6 exs., 27.ii.01. (size 18–35 mm SL) M.B.R., 1 ex., 17.xii.01. (size 38 mm SL) M.B.R.

Remarks : Size : 12.5 cm. TL.

Distribution : Fast flowing hill streams (Throughout India).

9. *Puntius dorsalis* (Jerdon)

1849. *Systemus dorsalis* Jerdon, *Madras J. Lit. Sci.*, **15** : 314.

1999. *Puntius dorsalis* (Jerdon) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 91-92.

Material : 4 exs., 19.vii.01. (size 76–150 mm SL) M.B.R., 5 exs., 17.xi.01. (size 105–126 mm SL) M.B.R., 1 ex., 17.iv.02. (size 116 mm SL) M.B.R.

Remarks : Size : 25 cm. TL, commonly 12 to 15 cm.

Distribution : Rivers, streams with pebbly substrate (Peninsular India).

10. *Puntius sophore* (Hamilton)

1822. *Cyprinus sophore* Hamilton, *Fish. Ganges*; 310, 389.

1999. *Puntius sophore* (Hamilton) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 101-102.

Material : 6 exs., 27.ii.01, (size 22–32 mm SL) M.B.R., 1 ex., 15.v.02, (size 48 mm SL) M.B.R.,

Remarks : Size : 13 cm. TL.

Distribution : Plains and sub-montane regions (Throughout India).

11. *Puntius ticto* (Hamilton)

1822. *Cyprinus ticto* Hamilton, *Fish. Ganges*. pp. 314, 398, pl. 8, fig. 87.

1999. *Puntius ticto* (Hamilton) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 103-104.

Material : 6 exs., 27.ii.01. (size 18–35 mm SL) M.B.R., 1 ex. 17.xii.01. (size 38 mm SL) M.B.R.

Remarks : Size : 20.0 cm. TL.

Distribution : Rivers, streams, ponds with clear waters (Throughout India except Kerala).

12. *Puntius vittatus* Day

1865. *Puntius vittatus* Day, *Proc. Zool. Soc. Lond.*, p. 303.

1999. *Puntius vittatus* Day Jayaram, *The Freshwater Fishes of The Indian Region* : 114.

Material : 5 exs., 27.ii.01. (size 20–21 mm SL) M.B.R., 4 exs., 17.xi.01. (size 18–30 mm SL) M.B.R., 1 ex., 17.xii.01. (size 23 mm SL) M.B.R., 25 exs., 17.iv.02. (size 28–41 mm SL) M.B.R.

Remarks : Size : 5.0 cm. TL commonly 3.5 cm.

13. *Lepidocephalus thermalis* (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, *Hist. Nat. Poiss.*, **18** : 78.

1999. *Lepidocephalus thermalis* (Valenciennes) Jayaram, *The Freshwater Fishes of The Indian Region* : 217.

Material : 3 exs., 27.ii.02. (size 20–29 mm SL). M.B.R.

Remarks : Size : 8 cm. TL.

Distribution : Peninsular India south of Krishna river system.

14. *Mystus bleekeri* (Day)

1846. *Bagrus keletius* (Valenciennes) Bleeker, *Nat. Gen. Arch. Ned. India*, 3(2) : 135.

1999. *Mystus bleekeri* (Day) Jayaram, *The Freshwater Fishes of The Indian Region* : 235.

Material : 1 ex., 17.v.02. (size 85 mm SL) M.B.R.

Remarks : Size : 13.5 cm. TL.

Distribution : Upper reaches of rivers. Northern India. Southern India upto Mahanadi river.

15. *Mystus vittatus* (Bloch)

1797. *Silurus vittatus* Bloch, *Ichth. Hist. Nat.*, 11 : 40. pl. 371, fig. 2.

1999. *Mystus vittatus* (Bloch) Jayaram, *The Freshwater Fishes of The Indian Region* : 236.

Material : 1 ex., 17.xii.01. (size 75 mm SL) M.B.R.

Remarks : Size : 21.0 cm. TL.

Distribution : Rivers, streams, ponds, lakes (Throughout India).

16. *Heteropneustes fossilis* (Bloch)

1798. *Silurus fossilis* Bloch, *Ichth. Hist. Nat. Poiss.*, 11 36, 370. fig. 2.

1999. *Heteropneustes fossilis* (Bloch) Jayaram, *The Freshwater Fishes of The Indian Region* : 305.

Material : 1 ex., 17.xii.01. (size 95 mm SL) M.B.R.

Remarks : Size : 30.0 cm. TL.

Distribution : Ponds, swamps, marshes, muddy rivers (Throughout India).

17. *Oryzias carnaticus* (Jerdon)

1849. *Aplocheilus carnaticus* Jerdon, *Madras j. lit. Sci.*, 15 : 302-346.

1998. *Oryzias carnaticus* (Jerdon), Tyson Roberts, *Ichthyological Research* : 217-218.

Material : 4 exs., 17.v.02. (size 22–23 mm SL) M.B.R.

Remarks : Size : 4.0 cm. TL.

Distribution : Brackish water, estuaries, shallow lagoons, swamps, mangroves, readily adapt to freshwater conditions and breed in freshwater (Peninsular India).

18. *Gambusia affinis* (Baird & Girard)

1853. *Heterandria patruelis* Baird and Girard, *Proc. Acad. nat. Sc. Philad.* 6, p. 390.

1999. *Gambusia affinis* (Baird & Girard) Jayaram, *The Freshwater Fishes of The Indian Region* : 345.

Material : 47 exs., 27.ii.01. (size 17–36 mm SL) M.B.R., 7 exs., 30.viii.01. (size 11–30 mm SL) M.B.R., 1 ex., 17.xi.01. (size 19 mm SL) M.B.R., 77 exs., 17.xii.01. (size 16–31 mm SL) M.B.R., 112 exs., 17.i.02. (size 13–37 mm SL) M.B.R., 693 exs., 27.ii.02. (size 10–44 mm SL) M.B.R., 912 exs., 17.iii.02. (14–37), 555 exs., 17.iv.02. (size 11–47 mm SL) M.B.R.

Remarks : Introduced for mosquito control and most dominant species in the sacred grove.

Distribution : Throughout India.

19. *Macrogathus pancalus* Hamilton

1822. *Macrogathus pancalus* Hamilton, *Fish. Ganges.*, pp. 30, 364, pl. 22. fig. 7.

1999. *Macrogathus pancalus* Hamilton Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 302-303.

Material : 2 exs., 27.ii.01. (size 55–61 mm SL) M.B.R., 4 exs., 27.iii.01. (size 138–140 mm SL) M.B.R., 1 ex., 18.iv.01. (size 137 mm SL) M.B.R., 2 exs., 30.v.01. (size 106–118 mm SL) M.B.R., 2 exs., 17.iv.02. (size 125–145 mm SL) M.B.R.

Remarks : Size : 18.0 cm. TL.

Distribution : Rivers and estuaries (Throughout India).

20. *Etroplus maculatus* (Bloch)

1785. *Chaetodon maculatus* Bloch, *Syst. Ichth.*, pl. 427, fig. 2.

1999. *Etroplus maculatus* (Bloch) Jayaram, *The Freshwater Fishes of The Indian Region* : 399.

Material : 4 exs., 27.ii.01. (size 31–35 mm SL) M.B.R., 5 exs., 27.iii.01. (size 31–41 mm SL) M.B.R., 22 exs., 18.iv.01. (size 34–51 mm SL) M.B.R., 22 exs., 30.v.01. (size 40–48 mm SL) M.B.R., 19 exs., 30.viii.01. (size 39–58 mm SL) M.B.R., 4 exs., 17.xi.01. (size 30–58 mm SL) M.B.R., 2 exs., 17.xii.01. (size 32–36 mm SL) M.B.R., 19 exs., 27.ii.02. (size 39–58 mm SL) M.B.R., 57 exs., 17.iii.02. (size 11–60 mm SL) M.B.R., 46 exs., 17.iv.02. (size 18–60 mm SL) M.B.R., 4 exs., 17.v.02. (size 30–58 mm SL) M.B.R.

Remarks : Size : 7.5 cm. TL.

Distribution : Coastal freshwater, paddy fields, tanks, backwaters (Peninsular India).

21. *Oreochromis mossambica* (Peters)

1852. *Chromis mossambicus* Peters, *Monatsb. Akad. Wiss. Berlin.*, p. 681.

1999. *Oreochromis mossambica* (Peters) Jayaram, *The Freshwater Fishes of The Indian Region* : 400.

Material : 11 exs., 27.ii.01. (size 25–129 mm SL) M.B.R., 4 exs., 18.iv.01. (size 40–50 mm SL) M.B.R., 5 exs., 19.viii.01. (size 92–166 mm SL) M.B.R., 12 exs., 30.viii.01. (size 16–25 mm SL) M.B.R., 2 exs., 17.xi.01. (size 18–21 mm SL) M.B.R., 4 exs., 17.xii.01. (size 38–47 mm SL) M.B.R., 105 exs., 17.iv.02. (size 63–175 mm SL) M.B.R., 13 exs., 17.v.02. (size 13–36 mm SL) M.B.R.

Remarks : Maximum size recorded was 175 mm in April 2002.

Distribution : Throughout India.

22. *Glossogobius giuris* (Hamilton)

1822. *Gobius giuris* Hamilton, Fish. Ganges, pp. 51, 366, pl. 33, fig. 15.

1999. *Glossogobius giuris* (Hamilton) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 294-295.

Material : 2 exs., 27.iii.01. (size 80–220 mm SL) M.B.R., 4 exs., 18.iv.01. (size 68–96 mm SL) M.B.R., 6 exs., 30.v.01. (size 35–88 mm SL) M.B.R., 1 ex., 30.viii.01. (size 70 mm SL) M.B.R., 1 ex., 17.iii.02. (size 72 mm SL) M.B.R., 20 exs., 17.iv.02. (size 23–128 mm SL) M.B.R.

Remarks : Size : 30 cm. TL, usually 15 cm.

Distribution : Freshwaters, estuaries, (Throughout India).

23. *Anabas testudineus* Bloch

1795. *Anabas testudineus* Bloch, *Nat. Aus. Fish*, 7 : 121, pl. 322.

1999. *Anabas testudineus* Bloch Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 296-297.

Material : 1 ex., 27.ii.01. (size 64 mm SL) M.B.R.

Remarks : Size : 20.0 cm. TL, rarely 25.0 cm.

Distribution : Freshwaters and estuaries (Throughout Indi).

24. *Polyacanthus lalius* (Hamilton)

1822. *Trichopodus lalius* Hamilton, Fish. Ganges, pp. 120, 372.

1999. *Polyacanthus lalius* (Hamilton) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 298-299.

Material : 6 exs., 17.xii.01. (size 24–31 mm SL) M.B.R.

Remarks : Size : 5.0 cm. TL.

Distribution : Slow moving streams, lakes with vegetation (usually Northern India).

25. *Pseudosphromenus cupanus* (Valenciennes)

1831. *Polycanthus cupanus* Cuvier (in C & V), *Hist. Nat. Poiss.*, 7 : 357.

1999. *Pseudosphromenus cupanus* (Valenciennes) Menon, *Rec. zool. Surv. India, Occ. Paper No. 175* : 300.

Material : 1 ex., 27.ii.01. (size 30 mm SL) M.B.R., 3 exs., 17.xii.01. (size 32–33 mm SL) M.B.R.

Remarks : Size : 7.5 cm. TL.

Distribution : Freshwater and brackishwater with vegetation (Peninsular India).

26. *Channa punctatus* (Bloch)

1793. *Ophicephalus punctatus* Bloch, *Natur. Aus. Fische.*, 7 : 139, pl. 358.

1999. *Channa punctatus* (Bloch) Menon, *Rec. zool. Surv. India, Occ. Paper No.* 175 : 276-277.

Material : 3 exs., 27.ii.01. (size 28–72 mm SL) M.B.R., 1 ex., 19.vii.01. (size 160 mm SL) M.B.R., 1 ex., 17.xii.01. (size 76 mm SL) M.B.R., 1 ex., 27.ii.02. (size 25 mm SL) M.B.R.

Remarks : Size : 30.4 cm. TL, only upto 11 cm. in the plains.

Distribution : Tanks, ponds, swamps (Throughout India).

DISCUSSION

During the study period 26 species were recorded from this tank situated in the sacred grove. Eventhough there is no regular fishing, occasionally during the period of collection certain poachers were seen to be engaged in fishing operations. Both gill net and cast net, were used. *Gambusia* sp. occupies the first position with reference to the number of examples (2404 exs.). With reference to the richness in species diversity in a single month, the maximum number (15) was in February 2001. Certain species like *Esomus danricus*, *Mystus bleekeri* (distribution shown upto Mahanadi river) and *Polyacanthus lalius* (distribution shown as northern India) are well established species in Tamilnadu. The former species has been recently reported by the authors (Rema Devi *et al.*, 2001) and the latter by Ranjit Daniels (2002).

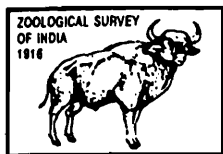
Of the 3436 specimens collected, the bulk was constituted by the exotic species *Gambusia affinis* constituting 70% of the total. About 4–6.5% was comprised by the following four species viz. *Rasbora daniconius*, *Eetroplus maculatus*, *Oreochromis mossambica* and *Amblypharyngodon microlepis* in the order of abundance. All the other species constituted less than 2%. For the months studied it was observed that maximum species abundance occurred during the month of February, and quantitatively also February and March were the peak months. This increase in fish number could be due to the decrease in water level.

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ODONATA (INSECTA) DIVERSITY OF RICE FIELD HABITAT IN PALAKKAD DISTRICT, KERALA

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INTRODUCTION

Our information on the odonata (Insecta) fauna of Kerala state, south India has been confined to the works of Fraser (1933, 1934 & 1936) from Kerala part of the southern Western Ghats, Peters (1981) from the Thiruvananthapuram district, Rao and Lahiri (1982) from the Silent Valley National Park, Mathavan *et. al.* (1989) from the Periyar Tiger Reserve and Emiliyamma and Radhkrishnan (2000) from the Parambikulam Wildlife Sanctuary. There has been no comprehensive study on this insect group from the plains and wetlands of Kerala. In the present study we made an attempt to study the odonata fauna occurring in a paddy field habitat at Palakkad district of Kerala.

Rice fields are excellent habitats for the study of odoantes, as such areas are ideal foraging grounds, with more open environs, providing a large number of insect pests (prey-population) for the odonates to predate upon. Fraser (1933, 1936) mentioned 3 species of odonates from paddy fields of Bangalore. Kumar and Prasad (1977) recorded 10 species from the paddy fields of Dehradun valley. Krishnaswamy *et. al.* (1984) reported 8 species of odonates predaceous on known insect pests of paddy from Assam. Recently Gunathilagaraj *et. al.* (1999) listed 16 species from the rice fields of Coimbatore. Asaithambi and Manikarasagam (2002) recorded *Tholymis tillarga* (Fabricius) from paddy field near Annamalai University area in Tamil Nadu. Talmale and Kulkarni (2003) have reported 19 species of odonata from the paddyfield of Bhandara district of Maharashtra.

STUDY AREA

Palakkad (Palghat) is known as the 'rice bowl' of Kerala. This district, centrally located in the state, with its close proximity to Western Ghats is having extensive paddy fields. The present

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study area Nanniode, a small village, situated at Perumatty Panchayat about 25 kms south-east of Palakkad town is located at a latitude of 10° 42' N. and a longitude of 76° 47' E. Due to the influence of the Western Ghats mountain ranges and the Palakkad Gap, the area experiences a characteristic climate of severe summer with gusty winds during March to May and plenty of rains during June to November received through the both the southwest and northeast monsoons. Traditionally, two yields of crops are taken annually. The lush green paddy fields, interspersed with banana crops, coconut and Palmyra groves, and bordered with herbaceous weeds along the field bunds, contribute good habitats for the foraging odonates.

METHODOLOGY

During the current study, three field surveys spanning 20 days each were carried out in August-September, 1999 (First Harvesting Stage), December-January, 1999–2000 (Second Growing Stage), April-May, 2000 (Second Post Harvesting Stage). Only the adult odonates were collected from the paddy fields, adjoining water bodies and irrigational canals. The observations were categorized according to their abundance, as indicated below :

A = Abundant-More than 30 examples observed.

VC = Very Common 16–30 examples observed.

C = Common 4–15 examples observed.

R = Rare 1–3 examples observed.

RESULTS AND DISCUSSIONS

Altogether 21 species under 18 genera of 5 families were recorded during the study. Of these, 6 species are additions to the odonate fauna of the rice-field habitats of India. 5 species were seen throughout the study. Maximum species richness was seen during the harvesting stage. Diversity and richness of species observed in three different stages of the paddy-crop are summarized in Table 1.

GROWING STAGE

When the plant is two-month old, most of the insect pests were found active, feeding on tender shoots and leaves of the paddy plants. 5 species of damselfly and 8 species of dragonfly dominated at this time. The most common species found were *Ceriagrion coromandelianum*, *Ischnura aurora aurora*, *Orthetrum sabina sabina*, *Brachythemis contaminata*, *Diplacodes trivialis* and *Pantala flavescens*. During this stage, breeding of *Ceriagrion coromandelianum* was observed among the adjoining marsh-vegetation near paddy fields. *Copera marginipes*, *Vestalis gracilis*, *Trithemis*

Table 1. : Showing Odonata diversity in different stages of the Paddy at Palakkad.

Sl. No.	Species	Growing Stage	Harvesting Stage	Post-Harvesting Stage
	Suborder : ZYGOPTERA			
	Family : COENAGRIONIDAE			
1.	<i>Ceriagrion coromandelianum</i> Fabricius	VC	VC	A
2.	<i>Pseudagrion microcephalum</i> (Rambur)	C	–	–
3.	<i>Pseudagrion rubriceps</i> Selys	–	R	R
4.	<i>Aciagrion occidentale</i> Laidlaw	VC	–	–
5.	<i>Ischnura aurora aurora</i> (Brauer)	A	C	R
6.	<i>Agriocnemis pygmaea</i> (Rambur)	C	–	–
	Family : PLATYCNEMIDIDAE			
7.	<i>Copera marginipes</i> (Rambur)	–	R	–
	Family : LESTIDAE			
8.	<i>Lestes elatus</i> Hagen	A	–	–
9.	<i>Lestes malabarica</i> Fraser	A	–	–
	Family : CALOPTERYGIDAE			
10.	<i>Vestalis gracilis gracilis</i> (Rambur)	–	R	–
	Suborder : ANISOPTERA			
	Family : LIBELLULIDAE			
11.	<i>Orthetrum sabina sabina</i> (Drury)	A	VC	C
12.	<i>Potamarcha congener</i> (Rambur)	R	R	–
13.	<i>Brachythemis contaminata</i> (Fabricius)	VC	C	VC
14.	<i>Diplacodes triviallis</i> (Rambur)	A	VC	C
15.	<i>Neurothemis i. intermedia</i> (Rambur)	R	–	–
16.	<i>Trithemis aurora</i> (Burmeister)	R	–	–
17.	<i>Trithemis pallidinervis</i> (Kirby)	–	R	–
18.	<i>Rhyothemis v. variegata</i> (Linnaeus)	R	–	R
19.	<i>Pantala flavescens</i> (Fabricius)	VC	A	–
20.	<i>Tramea limbata similata</i> (Rambur)	–	R	–
21.	<i>Tholymis tillarga</i> (Fabricius)	–	R	–

Abbreviation : A = Abundant, C = Common, VC = Very Common, R = Rare.

pallidinervis, *Tramea limbata* and *Tholymis tillarga* were found in the habitat only during this stage. On many occasions, species such as *Pantala flavescens*, *Tholymis tillarga* and *Diplacodes trivialis* were found attracted to electric light adjacent to the paddy fields. *Pseudagrion rubriceps* and *Copera marginipes* were observed ovipositing on the submerged plants in the irrigation canal along the paddy fields.

HARVESTING STAGE

During this stage, 15 species of odonates were observed which include 7 damselflies and 8 dragonflies. Large swarms of *Pantala flavescens* were observed soaring over the mature paddy plants. Besides *Pantala flavescens*, the species commonly observed were *Ceriagrion coromandelianum*, *Ischnura aurora aurora*, *Aciagrion occidentale*, *Lestes elatus*, *L. malabarica*, *Orthetrum sabina sabina*, *Brachythemis contaminata* and *Diplacodes trivialis*. During this stage *Lestes elatus* and *L. malabarica* were observed only for a brief period of time. *Trithemis aurora*, *Neurothemis intermedia intermedia* were found sparingly, only for a few days. Immediately after the monsoon, the waterlogged fields were found attracting many species of odonates for breeding and foraging. Frequent courtship flights of *Ceriagrion coromandelianum* and *Aciagrion occidentale* could be noticed during this stage.

Paddy fields being temporary wetlands with periodically changing microhabitat characteristics, the odonate community exhibits variation in species diversity, in accordance with the changes. The community variation in odonates between stages of the crop indicates the seasonal fluctuation of the odonates frequenting the entire field. The present study shows that the species richness and abundance of odonates were maximum during the harvesting stage. The rain-fed field conditions and the abundance of prey species could be the reasons for the odonate diversity.

Multivoltine species such as *Ceriagrion coromandelianum*, *Ischnura aurora aurora*, *Brachythemis contaminata*, *Diplacodes trivialis* and *Orthetrum sabina sabina* were recorded throughout during all the stages of the crop. *O. sabina sbaina* was found to be the most voracious feeder of the insect pests as observed by Fraser (1936) and Gunathilagaraj *et. al.* (1999). According to Krishnaswamy *et. al.* (1984), *O. sabina*, *P. flavescens*, *I. aurora*, *A. pygmaea* and *C. coromandelianum* are predaceous odonates of rice-field habitats in Assam.

A perusal of literature and present study reveals that altogether 41 species of odonata occur in rice-field habitats of India (Table 2), which include 6 species recorded during the present study, for first time from a rice-field habitat. The data presented in Table 2 also reveal that the most frequent species of odonates in the rice-field ecosystem of the country are *Ceriagrion coromandelianum*, *Ischnura aurora*, *Agriocnemis pygmaea*, *Orthetrum sabina*, *Brachythemis contaminata*, *Crocothemis servilia* and *Pantala flavescens*.

Table 2. : Comparative biodiversity of odonates studied in rice-fields of various states in India.

Sl. No.	Species	Distributional records in India					
		I	II	III	IV	V	VI
	Family : COENAGRIONIDAE						
1.	<i>Ceriagrion coromandelianum</i> Fabricius	-	-	+	+	+	+
2.	<i>Ceriagrion cerinorubellum</i> (Brauer)	-	-	-	+	-	-
3.	<i>Pseudagrion microcephalum</i> (Rambur)	-	-	-	-	+	-
4.	<i>Pseudagrion rubriceps</i> Selys	-	-	-	-	+	-
5.	<i>Aciagrion occidentale</i> Laidlaw	-	-	-	-	+	-
6.	<i>Aciagrion hisopa hisopa</i> (Selys)	+	-	-	-	-	-
7.	<i>Ischnura aurora aurora</i> (Brauer)	-	-	+	+	+	+
8.	<i>Ischnura rufostigma</i> Selys	-	-	+	-	-	-
9.	<i>Ischnura senegalensis</i> (Rambur)	-	-	+	-	-	-
10.	<i>Agriocnemis pygmaea</i> (Rambur)	-	-	-	-	-	+
11.	<i>Agriocnemis rubescens</i> Selys	-	-	-	+	-	-
12.	<i>Rhodischnura nursei</i> (Morton)	-	+	-	-	-	-
	Family : PLATAYCNEMIDIDAE						
13.	<i>Copera marginipes</i> (Rambur)	-	-	-	-	+	+
	Family : LESTIDAE						
14.	<i>Lestes elatus</i> Hagen	+	-	-	-	+	-
15.	<i>Lestes malabarica</i> Fraser	+	-	-	-	+	-
16.	<i>Lestes viridulus</i> Rambur	-	-	-	+	-	+
17.	<i>Lestes umbrinus</i> Selys	-	-	-	-	-	+
	Family : CALOPTERYGIDAE						
18.	<i>Vestalis gracilis gracilis</i> (Rambur)	-	-	-	-	+	-
	Family : AESHNIDAE						
19.	<i>Gynacantha bayadera</i> Selys	-	-	-	-	-	+
	Family : LIBELLULIDAE						
20.	<i>Orthetrum sabina sabina</i> (Drury)	-	+	+	+	+	+
21.	<i>Orthetrum chrysis</i> (Selys)	-	-	-	+	-	-

Table 2. : (Cont'd.).

Sl. No.	Species	Distributional records in India					
		I	II	III	IV	V	VI
22.	<i>Orthetrum pruinatum neglectum</i> (Rambur)	—	+	—	—	—	—
23.	<i>Orthetrum taeniolatum</i> (Schneider)	—	+	—	—	—	—
24.	<i>Orthetrum triangulare triangulare</i> (Selys)	—	+	—	—	—	—
25.	<i>Orthetrum glaucum</i> (Brauer)	—	+	—	—	—	—
26.	<i>Poamarcha congener</i> (Rambur)	—	—	—	—	+	+
27.	<i>Brachythemis contaminata</i> (Fabricius)	—	+		+	+	+
28.	<i>Crocothemis servilia</i> (Drury)	—	+	+	+		+
29.	<i>Diplacodes trivialis</i> (Rambur)	—	—		+	+	+
30.	<i>Diplacodes nebulosa</i> (Fabricius)	—	—	+	—	—	—
31.	<i>Neurothemis tullia tullia</i> (Drury)	—	—	+	—	—	—
32.	<i>Neurothemis intermedia intermedia</i> (Rambur)	—	—	—	—	+	+
33.	<i>Trithemis aurora</i> (Burmeister)	—	—	—	+	+	+
34.	<i>Trithemis festiva</i> (Rambur)	—	—	—	—	—	+
35.	<i>Trithemis pallidinervis</i> (Kirby)	—	+	—	—	+	—
36.	<i>Rhyothemis variegata variegata</i> (Linnaeus)	—	—	—	—	+	—
37.	<i>Pantala flavescens</i> (Fabricius)	—	+	+	+	+	+
38.	<i>Tramea limbata similata</i> (Rambur)	—	—	—	—	+	
39.	<i>Tramea basilaris burmeisteri</i> Kirby	—	—	—	+	—	+
40.	<i>Tholymis tillarga</i> (Fabricius)	—	—	—	+	+	+
41.	<i>Zyxomma peteolatum</i> Rambur	—	—	—	—	—	+

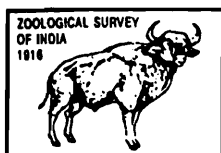
KEY : I – Karnataka (Bangalore), II – Uthanchal (Dehra Dun), III – Assam,
 IV – Tamil Nadu (Coimbatore), V – Kerala (Palakkad), VI – Maharashtra (Bhandara),
 '+' = Present; '—' = Absent.

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Rec. zool. Surv. India : 104 (Part 1–2) : 79-83, 2005

A NEW GENUS AND NEW SPECIES OF GALL MIDGE [CECIDOMYIIDAE : DIPTERA] FROM INDIA

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ABSTRACT : Descriptions of new genus *Kitella* and new species *orientalis* from India together with key to the related genera is given.

KEY WORDS : *Kitella orientalis*, new genus and new species, Diptera : Cecidomyiidae.

INTRODUCTION

While studying the gall midges from Maharashtra [India], these cecidomyiid flies were collected at light by one of us [THS] at Hadgaon, Dist., Nanded, Maharashtra, India in the year 1994. On the closer observations of these flies, a new genus *Kitella* a new species *orientalis* are described.

Kitella gen. nov., is readily distinguished from closely placed genera viz., *Delodiplosis* Tav; *Phyllodiplosis* Kieffer; *Paradiplosis* Felt; *Styradiplosis* Tav; *Plesidiplosis* & *Plemeliella* Seitan in possession of (a) entire sub dorsal plate, (b) kite shaped dorsal plate, (c) terminal clasp segment greatly swollen basally and with a tooth apically.

Key to the related genera

(Modified from Grover 1975 – Couplet no. 156 on words)

1. Subdorsal plate long and linear
Subdorsal plate broad. 2

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2. Subdorsal plate lobed (i) *Delodiplosis* Tav
 (ii) *Phyllodiplosis* Kieffer
 (iii) *Paradiplosis* Felt
 (iv) *Styradiiplosis* Tav.
 (v) *Plesidiplosis* Kieffer
 (vi) *Plemeliella* Seitan.

Subdorsal plate entire *Kitella* gen. nov.,

***Kitella* gen. nov.**

Eyes confluent above. Trophi normal. Palpi quadriarticulate. Antenna : 2 + 12 segments, flagellate segments binodose with long stems, two whorls of long setae, one on each enlargement, three whorls of regular circumfila, one on basal and two on apical enlargements, third and fourth antennal segments confluent; wing hairy, vein R_5 reaching wing margin well beyond its apex and latter interrupted at its union with costa, vein Cu forked, forks obsolete; claws simple on all legs; empodium shorter than the claw. Genitalia : basal clasp segments large, without lobe, terminal clasp segments greatly swollen basally, without lobe, narrowed apically, ending with a pointed tooth; dorsal plate entire, kite shaped, with a pair of short spines medially, lobed apically, subdorsal plate broad, entire, rounded apically; adeagus shorter than subdorsal plate, tip round, sclerotized and pointed apically.

Type species : Kitella orientalis gen. et. sp. nov.

Remarks : On Kitella orientalis sp. nov.

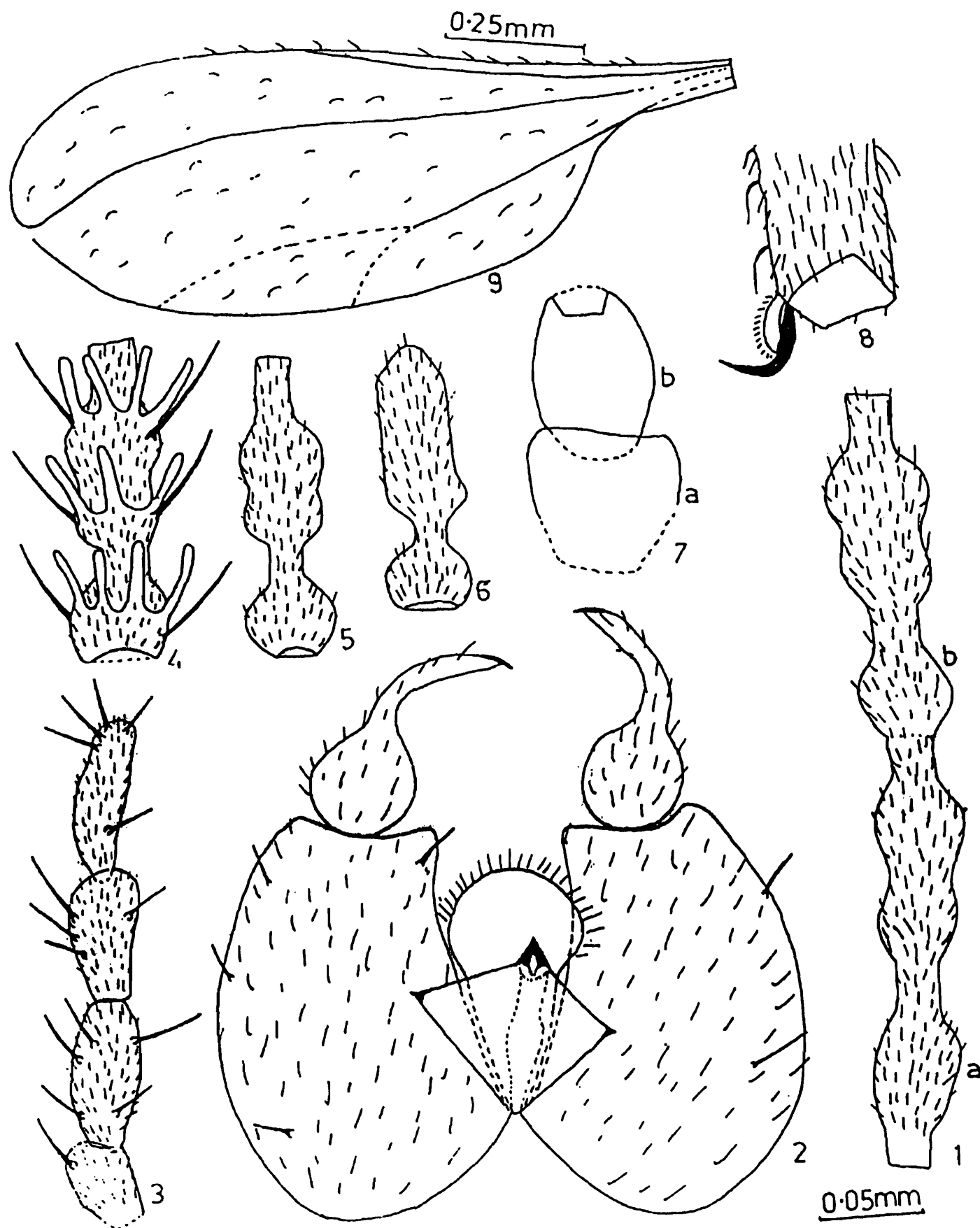
Kitella orientalis is characterised in having :

- i. Subdorsal plate broad and entire, longer than dorsal,
- ii. Dorsal plate kite (quadrate) shaped, lobed apically and with a pair of spine laterally,
- iii. Terminal clasp segment greatly swollen basally and with a tooth terminally.

***Kitella orientalis* sp. nov.**

(Figs. 1-9)

MALE : Body : 0.90 mm long. Palpus quadriarticulate, sparsely setose, first segment [6 : 4] cylindrical, broad apically, length 1.5 X its maximum thickness; second segment [10 : 4] cylindrical, length 1.6 X its maximum thickness; third segment [9 : 4] cylindrical, slightly shorter than second, length 2.25 X its maximum thickness; fourth segment [11 : 3] longest of all, length 3.66 X its



Figs. 1-9. : *Kitella orientalis* sp. nov. ♂ : 1a. Third antennal segment, 1b. Fourth antennal segment; 2. Genitalia; 3. Palpus; 4. Fifth antennal segment; 5. Penultimate antennal segment; 6. Terminal antennal segment; 7a. Scape, 7b. Pedicel; 8. Claw; 9. Wing.

maximum thickness. Antenna : shorter than body, with 2 + 12 segments, segments with binodose enlargements and long stems, stems becoming longer and thinner towards the apex of the antenna, with two whorls of long setae, one on each enlargement, three whorls of regular circumfila, one on the basal and two on apical enlargements; scape cup shaped, narrow at base and broad apically, nearly as long as broad [10 : 11]; Pedicel suboval, longer than scape, length 1.20 X its thickness [12 : 8]; third segment [30] confluent with and longer than fourth, with a small basal prolongation [2 : 2], basal enlargement [8 : 5] 0.26 the length of the segment and 1.60 X its maximum thickness, basal stem [3 : 3] 0.37 the length of the basal enlargement and as long as thick, apical enlargement [13 : 5] 0.43 the length of the segment, 2.40 its maximum thickness, apical stem [4 : 3] shorter than apical enlargement, 1.3 x its maximum thickness; fourth segment [23], basal enlargement [5 : 6] globose, 0.20 the length of the segment and slightly thicker than long, basal stem [3 : 3] shorter than basal enlargement, apical enlargement [10 : 6] twice the length of basal and 1.66 X its maximum thickness, apical stem [5 : 3] shorter than apical enlargement and 1.66 X its maximum thickness; fifth segment [21] slightly shorter than fourth; sixth to eleventh segments slightly shorter and similar to fifth; penultimate segment [20] shorter than ninth; terminal segment [17] shortest of all, basal enlargement [4 : 5] 0.23 the length of the segment, basal stem [2 : 2] as long as thick, apical enlargement [11 : 4] 2.71 X its maximum thickness, apical stem round apically. Wing [37 : 15], hairy, 2.46 X as long as broad, vein R_1 meeting costa nearly at the middle of the wing, vein R_5 reaching wing margin well beyond its apex and interrupting costa at its union, vein Cu forked, forks obsolete distally. Legs : long, densely hairy, metatarsus [17] shorter than terminal tarsal segment, second tarsal segment [89] longest of all and shorter than the following segments combined together [89 : 98]; claws : simple on all legs, evenly curved, empodium shorter than claw [5 : 7]. Genitalia : small, sparsely setose, basal clasp segment [25 : 7] oval, without lobes, 1.47 X as long as thick, terminal clasp segment [16 : 6] greatly swollen basally, curved medially, ending in a pointed tooth, 2.66 X as long as its maximum thickness; dorsal plate [10 : 13] Kite [quadrate] shaped, shorter than subdorsal plate, with a pair of spine medially, broader than long lobed apically, subdorsal plate [15 : 8] entire, narrow basally, broadly rounded apically, 1.87 X its maximum thickness; aedeagus [11 : 3] shorter than subdorsal plate, narrow basally, rounded and sclerotized at tip, 3.66 X its maximum thickness.

FEMALE : Unknown.

Material examined : HOLOTYPE : Male dissected and mounted on slide labelled "at light", Hadgaon, Dist. Nanded, Maharashtra, T. H. Shaikh, Coll. 12.VI.1994.

PARATYPE : One male dissected and mounted on slide, data as in Holotype.

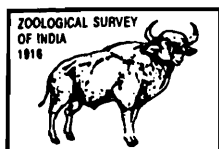
ETYMOLOGY : The generic name pertains to the Kite-shaped [quadrate] dorsal plate. Type material is retained in first author's collection at Nanded for time being.

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Rec. zool. Surv. India : **104** (Part 1–2) : 85-90, 2005

**ON TAXONOMIC STATUS OF *BANDICOTA BENGALENSIS*
LORDI (WROUGHTON) AND *BANDICOTA MAXIMA*
(PRADHAN *ET. AL.*) : (SUBFAMILY : MURINAE;
FAMILY : MURIDAE; ORDER : RODENTIA)**

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INTRODUCTION

Agrawal (2000) recorded certain remarks on the taxonomic status of *Bandicota bengalensis lordi* (Wroughton) and *B. maxima* (Pradhan *et. al.*) in the revisionary studies on Indian Murids and Hystricids. While reporting them, he has completely ignored the results obtained from the biochemical studies of these populations. Though merger of *B. bengalensis lordi* in *B. bengalensis bengalensis* has been supported by Agrawal (2000), he has totally neglected the variant populations occurring in the natural population. Probably very few taxonomists are aware of the observations made by Fergusson (1980) that allelic heterozygosity at any genomic site even in a single specimen, irrespective of age and sex, is a concrete proof of occurrence of polymorphism in the gene pool of the naturally occurring population under study.

RESULTS AND DISCUSSION

It is now established fact that proteins like hemoglobins, eye lens proteins, keratins, certain enzymes like esterases, *etc.* are stable proteins and they are often used worldwide as chemotaxonomic parameters for solving taxonomic problems (Dessauer and Fox, 1964, Selander and Young, 1969, Wright, 1974, Fergusson, 1980 and Gavin *et. al.*, 1999). Eye lens proteins and Keratins (hair proteins) are considered to be extremely stable and can be used for resolving taxonomic problems even at the family level (Fergusson, 1980). Even though aware of these results, Pradhan (1979) remarked that merger of *B. bengalensis lordi* in *B. bengalensis bengalensis* could be more practical irrespective of the differences in the Hindfoot measurements and occurrence of Haemoglobin

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polymorphism in the natural populations. However, he further stated that *B. bengalensis lordi* could not be merged in *B. bengalensis bengalensis* by just overlooking the significant differences. But for these prominent differences, he was also in favour of merger, of the two subspecies.

All the morphological measurements reported in Pradhan (1979) and Pradhan *et. al.* (1989, 1993) were taken meticulously by following Roonwal and Agrawal (1962). Even if, there is an element of error in taking Hindfoot measurements, as stated by Agrawal (2000), the level of difference can not be to the extent of 8–11 mm (Table 1). Hence, in light of these observations, the authors are, now, confident that two distinctly separate populations exist in the region. They are of the opinion that revisionary taxonomic studies of freshly collected *B. bengalensis lordi* and *B. bengalensis bengalensis* populations be carried out with the help of the morphological and osteological studies alongwith the studies based on modern parameters like biochemical, karyological and hair impression pattern studies. The systematic position of these populations can also be resolved by testing these observations on the scales of genetic distances and evolutionary separations (Nei, 1972 and Sneath and Sokol, 1973).

Taxonomic studies of *Bandicota maxima* populations were based on these lines only. All the available parameters were tested meticulously on Genetic and Evolutionary scales (Pradhan, 1989). On the basis of data on Genetic I values and UPGMA method of cluster analysis of Nei (1972) and Sneath and Sokol (1973), it became crystal clear that this population is distinctly separate from *B. indica* and deserves *species novum* status. In all probabilities and possibilities, *B. maxima* cannot be synonymised in *B. indica*. Agrawal (2000) overlooked the results based on the biochem-taxonomical studies reported earlier by Pradhan *et. al.* (1989, 1993). These studies are being widely used in systematics even today (Peppers and Bradley, 2000).

Table 1. : Measurements (In mm) of some key characters of three *Bandicota bengalensis* subspecies.

	<i>Bandicota bengalensis bengalensis</i>	<i>Bandicota bengalensis kok</i>	<i>Bandicota bengalensis lordi</i>
Head and Body Length	132–237 179 ± 21	130–225 165 ± 24	221–261 241 ± 20
Hindfoot Length	29–39 33.7 ± 2.0	27–39 33.5 ± 2.0	41–48 44.5 ± 2.0
Occipitonasal Length	33.3–45.5 39.1 ± 2.6	33.8–45.4 39.2 ± 2.2	43.5–47.9 45.7 ± 2.0
Molar tooth-row Length	5.9–8.0 7.15 ± 0.4	6.3–8.5 7.25 ± 0.4	6.3–7.9 7.65 ± 1.15

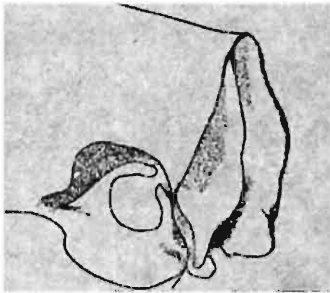
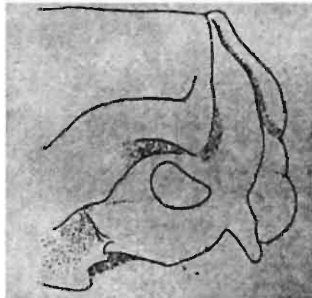
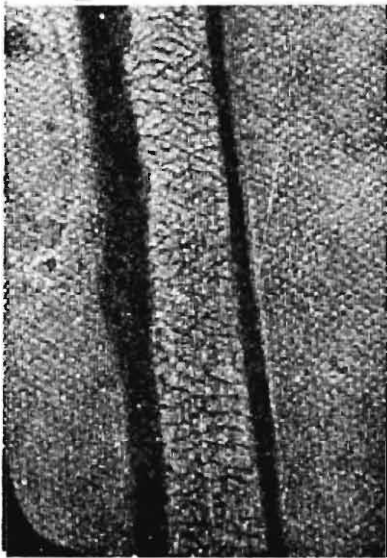
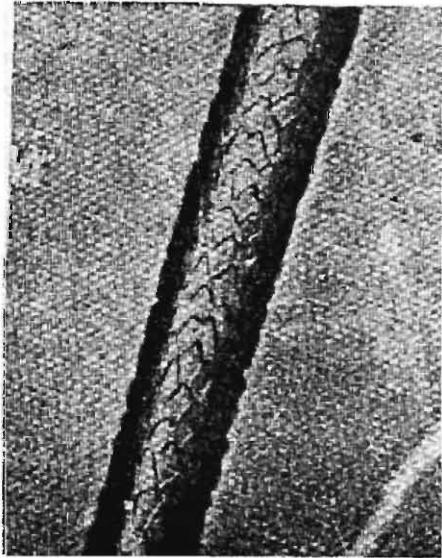
In case of other character like difference in occipitonasal length, which is one of the key characters and not the only character (Pradhan, 1993), it has been observed that occipitonasal length was always equal to or more than and never less than condylobasal length in the juvenile, subadult and adult specimens of *B. maxima* populations studied from different regions (Table 2). The measurements of these specimens were taken as per Roonwal and Agrawal (1962). Osteomorphological measurements reported in Pradhan *et. al.* (1989, 1993) were noted from the freshly collected specimens as well as those registered in Zoological Survey of India and Bombay Natural History Society's collections. Localities of these specimens include Mumbai, Pune, Goa, Kolkata, Pondicherry, some areas of Western Ghats and North India. While noting down the osteological measurements, it was observed that ridges in the flattened occiput region were distinctly pronounced and prominent in *B. indica* specimens of different sex and age groups. However, in *B. maxima* populations the occiput region was clearly inflated and swollen and the ridges were not as sharp, prominent and pronounced as those were in *B. indica* (Table 2). This difference could be noticed even in the juvenile and subadult specimens.

Differences in the hair impression patterns of dorsal guard hairs are distinct (Table 2) and have been used as an additional key character. It is, now, universally accepted fact that basal part of the mammalian guard hair shows definite and uniform hair impression patterns irrespective of sex, age and locality groups (Ryder, 1973 and Koegh, 1985). Similar techniques have been widely used in identification of carnivore species in wildlife studies by Chakraborty *et. al.* (1996) and De *et. al.* (1998). Thus the prominent differences seen in the hair impression patterns (Mozaic pattern in *B. indica* and Chevron in *B. maxima*) can not be overruled so easily.

Finally, on the basis of consolidation of the results derived from all the parameters (including use of Genetic Identity, UPGMA dendrogram and phylogenetic tree studies), Pradhan *et. al.* (1989 and 1993) came to the ultimate conclusion that there exists a third population under Genus *Bandicota*, which cannot be merged in *B. indica* with the help of any circumstantial evidence. Hence, the population has rightly been separated as a new species and named as *B. maxima* on the basis of possession of the combination of key characters like occipitonasal length equal to or more than condylobasal length, inflated occiput region and mozaic hair impression pattern (Table 2). We strongly feel and conclude that *B. maxima* is a valid species which does exist in the natural population and there is no ground for its "tentative" inclusion in *B. indica* as has been done by Agrawal (2000).

Agrawal (2000) in the revisionary studies of Indian Murids merged two subspecies (*pallidior* and *singuri*) of *Millardia meltada* to nominate subspecies *meltada*. Here he has deviated from the basic definition of subspecies given in Mayr (1969). According to Mayr (1969) the subspecies is "a geographically defined aggregate of local populations which differs taxonomically from other such subdivisions of the species."

Table 2. : Distinct differences in some of the key characters of *Bandicota indica* and *B. maxima*.

	<i>Bandicota indica</i>	<i>Bandicota maxima</i>
Occipitonasal Length (In mm.)	48.5–61.2 54.6 ± 4.0	58.5–68.1 62.6 ± 2.71
Condylbasal Length (In mm.)	48.8–63.4 56.1 ± 5.0	57.2–67.9 61.62 ± 2.96
Shape of Occiput Region	FLATTENED 	INFLATED 
Cuticular Hair Impression Pattern (Lower Magnification)	MOZAIC 	CHEVRON 

Ellerman (1961) recognized two subspecies of *Millardia meltada* namely : *Millardia meltada meltada* and *Millardia meltada pallidior* from India. Latter subspecies differs from the former in having more pallid grey dorsum and whitish venter. He has recognized two geographical areas for these two subspecies. Further he has mentioned that the colour difference of these two subspecies is an average and not absolute. What Agrawal (2000) found in Rewa, Gwalior and Darbhanga collections was nothing but mixed characters of *pallidior* and *meltada* due to mixing (interbreeding) of the two subspecies in the demarcated fringes of the two populations.

In case of *Millardia meltada singuri* described by Mandal and Ghosh (1981) the specimens of this subspecies were collected from Singur, Dist. Hugli, West Bengal in 1978 and 1980. They are more darker than *Millardia meltada meltada*. Even after 21–23 years of collection there is no sign of foxing in the coloration of these specimens which have been deposited in the National Zoological Collection of Zoological Survey of India in Kolkata. Over and above, these specimens have been collected from an entirely new geographical area. Thus, we find three subspecies in case of *Millardia meltada* in India viz. : *M. m. meltada*, *M. m. pallidior* and *M. m. singuri* which are present as geographically defined populations, although we came across with some mixing of *meltada* and *pallidior* populations living on borders.

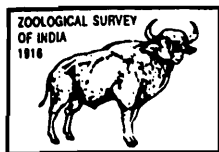
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HISTOLOGICAL STUDIES OF TISSUE DAMAGES ASSOCIATED WITH *CYATHOCEPHALUS TRUNCATUS* (CESTODA : SPATHEBOTRIDEA) INFECTION IN THE RAINBOW TROUT *SALMO GIARDNERI*

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INTRODUCTION

Previous studies have shown that *Cyathocephalus truncatus* infection in salmonid fishes do result in host tissue destruction at the site of the tapeworm's attachment (Wisniewski, 1932; Vik, 1955; Awachie, 1966; Catalini *et al.*, 1978; Okaka 1990). These studies were based only on already established infections in the pyloric caeca of fish collected from the wild and in some cases lacked detailed histological descriptions of damages on the infected tissues.

In the present report, the histopathological changes seen in the pyloric caeca and other tissues infected by the tapeworm were studied in laboratory infected rainbow trout, *Salmo giardneri* over a 2-years period.

KEY WORDS : Tapeworm, *Cyathocephalus truncatus*, rainbow trout *Salmo giardneri*, histopathology.

MATERIALS AND METHODS

Sixteen hatchery-bred *Salmo giardneri* varying between 10 cm and 14 cm in length were put two per tank into eight tanks and maintained in the laboratory by being fed with uninfected amphipods, *Gammarus pulex*. Sixty infected *G. pulex* were later fed in each tank to establish infections in the fish after which they were continuously fed with uninfected gammarids. The infected *G. pulex* were earlier raised and infected in the laboratory as described by Okaka (1989).

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Field infected fish and amphipods from which laboratory infections of amphipods were established, were originally collected at the Southburn Beck tributary of the River Hull at Driffield, England. Two control experiment tanks were set up in which the fish were only fed with non-infected gammarids over the period of study.

The experimental fish were examined 4 times (*i.e.* 4 fishes in 2 tanks at a time) for the state of establishment of infection. The infected tissues studied histologically were those of infected fish examined after one week, one month, one year and two years of infections respectively. 10 mm thick longitudinal and transverse sections of the infected tissues were made using paraffin wax routine histological techniques and employing Ehrlich's Haematoxylin / Eosin and Masson's trichrome staining techniques as stated by Humason (1962). Histological studies were also conducted on the tissues of fish in the control experiment tanks and on transverse sections of the entire infected fish at the pyloric region.

RESULTS

The prevalence of infection was highest (90% and 88.3%) for the fish examined one month after infections and lowest (60% and 58.3%) for the fish examined 2 years after infection as shown in Table 1.

The histological section of the uninfected pyloric caecum (Fig. 1) shows clearly the body wall layers of the *Serosa*, *Muscularia*, *Stratum compactum* of the submucosa and the mucosa as previously described by Weinreb and Bilstad (1955), Kimura (1973) and Ezeasor and Stockoe (1981). In the one-week-old infection, the tapeworms were recovered from the pyloric caeca where they were attached to the mucosa at the distal blind end. The histological section of the one week old infection (Fig. 2a) shows that the villi was already being eroded and inflammation set up at the body wall of the distal end. (Fig 2b). Collagenous fibres which gave green colour stain with Massons technique were being deposited in the *Tunica propria*, *Stratum compactum* and *Stratum granulosum* layers. Detailed studies also showed increase eosinophils and macrophage cells in the sections when compared to similar tissue of the uninfected pyloric caeca.

The histological section of the one-month-old infection (Fig. 3) shows that the tapeworm's attachment at the distal end of the caecum advanced into the *Muscularis* layer of the body wall. The scolex was seen to be surrounded by inflamed tissue reaction. Inflammation of tissues and blood vessels and collagenous fibres deposition were also seen in the *Serosa* layer.

The histological section of the one-year-old infection (Fig. 4) shows the attachment deep into the heavily inflamed tissues at the distal end of the caecum. The original layers of *Muscularis* and *Serosa* have been lost with the entire tissue being filled with collagenous fibres, which were

also noted to be deposited in tissues of other organs in the body cavity that are attached to the mesothelium of the *Serosa*. By tissue reaction, effects of the infection thus spreads to other organs of the body that have any bodily contact with the infected caeca.

The histological sections through the pyloric caeca region of the two year old infection (Fig. 5, 6 and 7) shows that in some cases the scolex was at the *Serosa* end while in others, the worms having completely eroded through the caecal body wall, were now attached to the abdominal musculature, submucosa and skin of the fish. Infection was also seen to have spread to the wall of the duodenum and small intestine, and to tissues of the liver and gonads lying in the body cavity of the fish.

Table 1. : Experimental infection of *Salmo giardneri* with *Cyathocephalus truncatus* using laboratory infected *Gammarus pulex* harbouring the tapeworm proceroid.

Track Number	No. of fish	No. of infected <i>G. pulex</i> fed to fish	Time of examination	No. of tapeworm recovered from fish	Percentage of tapeworm established (%)	Percentage of tapeworm lost (%)
1	2	60	After 1 week	21 } 40 19 }	66.7	33.3
2	2	60	”	17 } 39 22 }	65.0	35.0
3	2	60	After 1 month	28 } 54 26 }	90.0	10.0
4	2	60	”	27 } 53 26 }	88.3	11.7
5	2	60	After 1 year	25 } 48 23 }	80.0	20.0
6	2	60	”	22 } 46 24 }	76.7	23.3
7	2	60	After 2 years	20 } 36 16 }	60.0	40.0
8	2	60	”	21 } 35 14 }	58.3	41.7
9	2	Control	A fish each after 1 week and 1 month	—	—	—
10	2	Control	A fish each after 1 year and 2 years	—	—	—

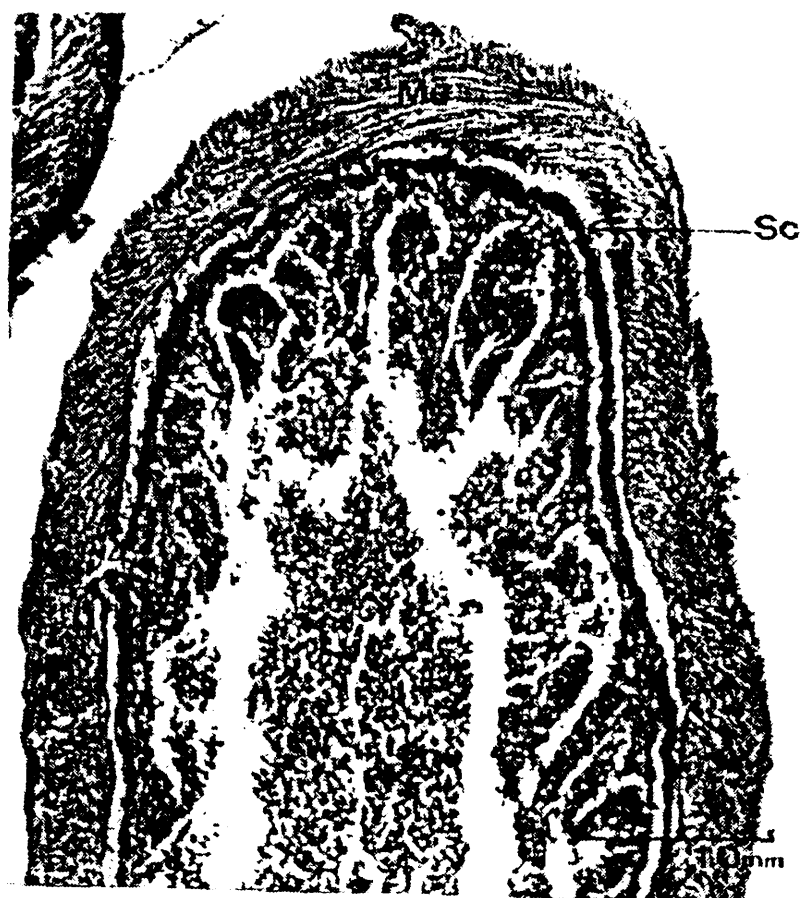


Fig. 1. Longitudinal section of the uninfected pyloric caecum of rainbow trout *Salmo gairdneri*.



Fig. 2(a). Longitudinal section of a one-week old infected pyloric caecum with the tapeworm *C. truncatus* attached to the epithelium of the mucosa.

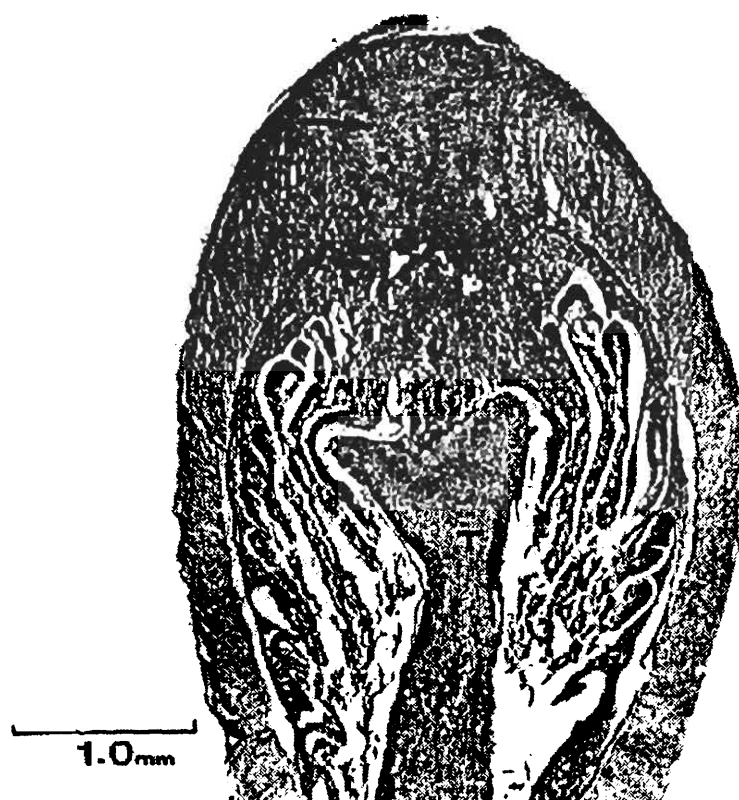


Fig. 2(b). Longitudinal section of a one-week old infected pyloric caecum with the tapeworm *C. truncatus* attached to the epithelium of the mucosa.

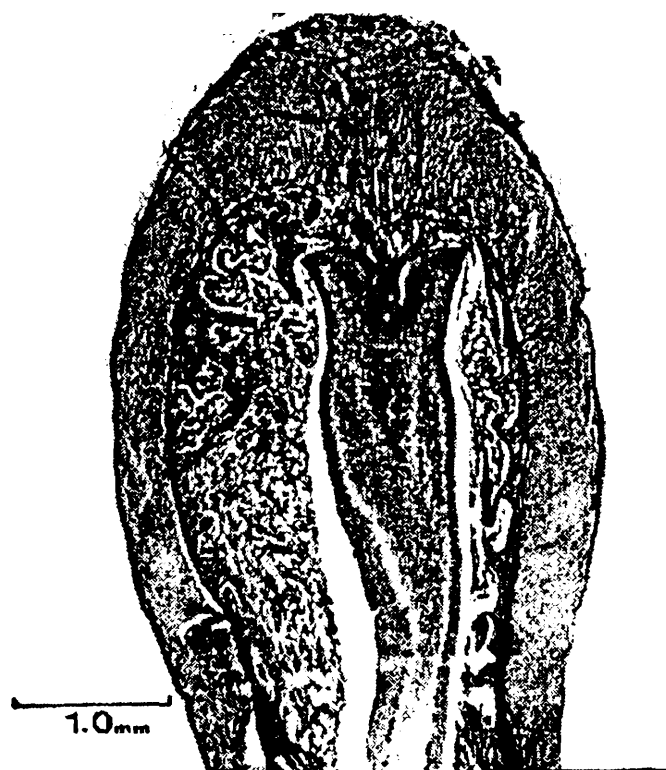


Fig. 3. Longitudinal section of a one-month old infected caecum with *C. truncatus* attached to the muscularis layer of the body wall.



Fig. 4. Longitudinal section of a one-year old infected caecum with *C. truncatus* attached to the inflamed and heavily swollen tissue at the distal tip. Note that the *muscularis* and *serosa* layers are no longer distinguishable at the site of attachment.



Fig. 5. Transverse section of an infected *S. giardneri* at the pyloric region showing the tapeworm *C. truncatus* at the serosa layer and advancing towards the body cavity of the fish. Note another worm is cross section (arrowed) already lodged in the skin of the fish.

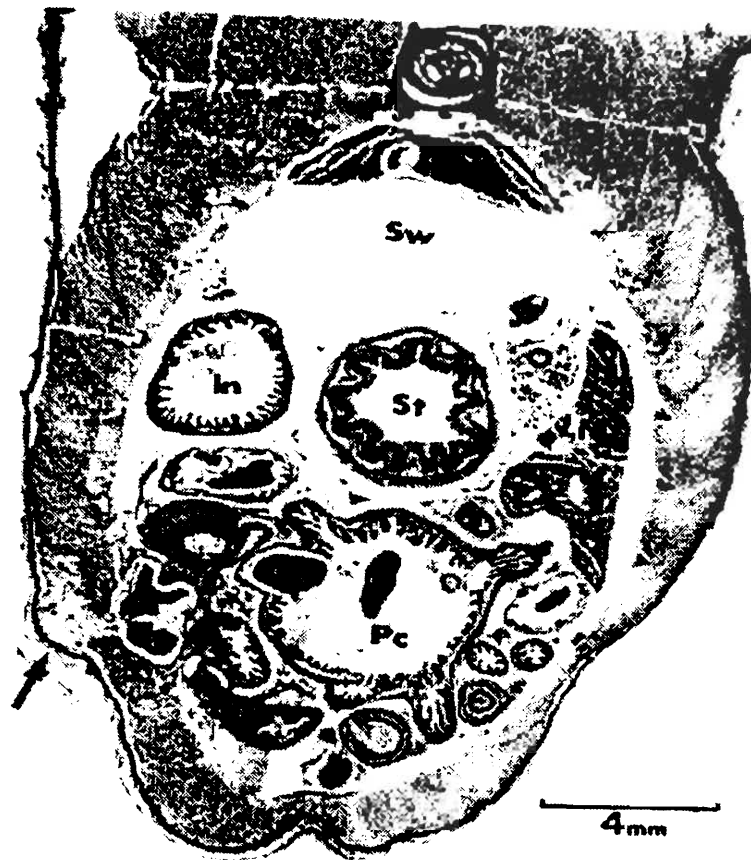


Fig. 6. Transverse section of an infected *S. giardneri* at the pyloric region showing the tapeworm at the body cavity of fish. Note the destruction (arrowed) of the body wall musculature of the fish.



Fig. 7. Transverse section of an infected *S. giardneri* showing the tapeworm (arrowed) in the body cavity of the fish.

DISCUSSION

The results of experimental infection show that a high percentage of worms establish on infection and only few worms are lost. Loosing of tapeworms by this method of infection may be due to inability of the worms to quickly form an attachment to the intestinal body wall but swept out of the gut by peristalsis. Inability to attach at a specific site may also be due to competition for space among the tapeworms (Chappell, 1969), but this may be unlikely for *C. truncatus* because Okaka (1984) reported the occurrence of more than one worm in a single pyloric caecum.

The present work has also shown that once the tapeworm infection is established a strong attachment is already formed one week after infection. The firm attachment elicited tissue reactions, which resulted in infiltration of fibres and inflammation or swellings of the site of attachment in fish. This is similar to the observations of Bullock (1963). McDonough and Gleason (1981) on histopathology of the intestine of fish infected with acanthocephalan parasites. The tapeworm *C. truncatus* in the present study was seen attached to this inflamed tissue for over one year of infection but by the second year the tapeworm was seen to have eroded through this tissue to reach other organs like the liver, gonads, abdominal body wall and even the skin of the fish. This ability of the infections to spread to other organs in long standing infections resulting in impairment of the organs and possibly can result in the death of the fish. Wisniewski (1932) and Vik (1954) have reported high rate of mortality of fish infected with *C. truncatus*.

The tendency of *C. truncatus* to penetrate the host tissue of the pyloric caeca to get into other organs at the abdominal region could support the views of Wisniewski (1932) and Okaka (2000) that the tapeworm in fish possesses neotenic features but attained maturity in the fish at a stage when it should have been a plerocercoid encapsulated in the muscular tissues.

SUMMARY

Histological studies of tissues and organs of rainbow trout (*Salmo giardneri*) infected with the tapeworm *Cyathocephalus truncatus* revealed tissue damages in the pyloric caeca, body wall of small intestine, liver, gonads, lower abdominal body wall and skin. Typical sections of the damaged tissues characteristically showed the followings : a longitudinal or cross-section of the tapeworm, heavy presence of collagen fibres, eosinophils, macrophage cells and general loss of natural texture. Tissue damages were seen to be more severe as infection ages. Two years old infection can lead to impairment of the infected organs and possibly death in heavily infected fish.

LABELS

Amu—Abdominal musculature of fish; In—Intestine of fish; Li—Liver; Lu—Lumen of intestine; Mu—Muscle layers; Muc—Mucosa layer of pyloric caecum; O—Gonads; Pc—Pyloric caeca region;

Sc–*Stratum compactum* layer of submucosa; Sk–Skin of fish; St–Stomach; Sw–Swim bladder; T–Tapeworm *Cyathocephalus truncatus*.

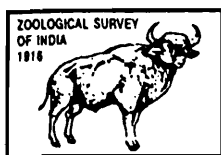
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Rec. zool. Surv. India : 104 (Part 1–2) : 101-104, 2005

EVOLUTIONARY ADAPTATIONS IN MORPHOLOGY AND ECOLOGY OF *THOLYMIS TILLARGA* (FABRICIUS) AND *BRADINOPYGA GEMINATA* (RAMBUR) (INSECTA : ODONATA)

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INTRODUCTION

Morphological and ecological features which have selection value and ensure the survival of the species are known as evolutionary adaptations. Lack (1965) defined evolutionary ecology, concerning those features of a species or population that are evolutionary adaptations (i.e., have survival value) and are not merely the consequences of population dynamics. Similarly evolutionary morphology are those features which are evolutionary adaptations. Evolutionary adaptations, it is presumed, arise usually in Hutchinson's (1957) "fundamental niche"

Primitive insects, like dragonflies, like other animals have undergone several changes since their evolution. As a result Corbet (1962) observed " certain tropical Anisoptera with coloured wings are thought to derive protection from birds on account of their resemblance to large Hymenoptera in flights" It may be considered coevolution. Moreover, odonates have got the highest development of compound eyes; the head is movable and is set on the neck or prothorax. The head can be twisted sideways 180°, backward 70°, forward and downward 40° The width of hind wings, especially in Anisoptera, help them in capturing preys while on wings. Dragonflies can fly backward, move vertically upward, like a helicopter or stop in turn in the midst of the rapid progression, as if they have been rammed into. This could be made possible due to adjustment of the centre of gravity between bases of wings and leaves a sharp contrast with all other living insects. These features, too, have selection value (Mitra, 1999, 2002 & 2003).

In the present paper morphological and ecological features of *Tholymis tillers* (Fabricius) and *Bradinopyga geminata* (Rambur) and their importance in the survival of the species have been discussed.

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MATERIAL AND METHODS

Observations were made both in field and in laboratory. Field observations were carried out in Dum Dum Park, on the eastern fringe of Calcutta and where the author lived (since 1967) and in Jodhpur, Rajasthan, during the period from February to April, 1980, for laboratory observations three examples of each species viz., *Tholymis tillarga* and *Bradinopyga geminata* and five examples of *Brachythemis contaminata* (Fabricius) were collected. For experimental work a black board measuring 30 × 30 cms was used.

OBSERVATIONS

Morphological features having selection value : Tholymis tillarga (Fabricius) : The imago of *Tholymis tillarga* (Fabricius) can be identified in the field with the help of the 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 the base and posterior border of hind-wing : the fascia bordered distally by a broad oval opalescent white spot about four cells deep. During flight over water and viewed from above the opalescent spots on the hind wings are lit by the reflection of the sky and glow with extraordinary intensity, as dusk falls on the tanks. This features help the species to resemble large hymenopterous insects and derive protection from predators.

Bradinopyga geminata (Rambur) : In the field an adult can be identified with the help of its cryptic colour. Prothorax and thorax cinereous or dirty pale yellow, marbled and peppered with black in a very irregular manner (best described as granite in colour). The perostigma further adds to their cryptic colouration. This, in the environment, especially during rest on the old tree trunk, shaded granite, plastered old walls make them practically indistinguishable from surroundings. This features help them to derive protection from the predators.

Experimental observations : Five examples of *Brachythemis contaminata* (Fabricius) were fixed on a white wall in a well illuminated room in the night. By the side of these specimens one example of *Tholymis tillarga* (Fabricius) was also fixed. The House gecko (*Hemidactylus brookii*) moving on the wall attacked the specimens of *Brachythemis contaminata* but not the *Tholymis tillarga*, since the opalescent white spot was glowing. Two examples of *Tholymis tillarga* were fixed on the black board and then the board was fixed on the wall. The room was illuminated. The opalescent white spot was distinct, and the gecko, moving about did not devour the dragonflies. But when the light was made dim, the spot was not very distinctly glowing and the gecko then attacked the dragonflies.

One specimen of *Bradinopyga geminata* was fixed on the dirty portion of the wall and the light of the room was made dim, the gecko could not see the specimen. The last two specimens of *Bradinopyga geminata* were fixed on the black board and the board was fixed on the white wall in

a well illuminated room. The gecko moving on the wall, walked over the board but did not attack the odonata specimen probably due to margin of the body colour of the odonata specimen with the black background.

Ecological features having selection value : Both *Tholymis tillarga* and *Bradinopyga geminata* are crepuscular in habit and show maximum activities from late afternoon of dusk to the early evening. They also come out in the very early morning to prey on smaller insects. At that time when the insects are on the wings neither opalescent white spot on the wing of *Tholymis tillarga* glow nor the body colour of *Bradinopyga geminata* merges with the habitats of their prey, i.e., the leaves of bushes and trees. But as soon the sun rays reach the ground dragonflies take shelter under cover or in the shade. *Tholymis tillarga* goes in the bushes and hang under leaves. In this way they go out of the predators' sight. Thus the species get protection both from heat and the predators as well. *Bradinopyga geminata* rests on the shaded tree trunk, plastered walls or granite walls. The cryptic body colour harmonizes with the environment to such an extent that the specimens become indistinguishable from the environment. In Jodhpur, Rajasthan, the author has noticed that a good number of *Bradinopyga geminata* specimens rest throughout the day on an old plastered wall and used to come out in the early dusk or early evening in search of food.

DISCUSSION

From the above it is thought that in the early morning the body colour of dragonflies do not merges with the environment, i.e., the habitat of their prey. It can, therefore, be conjectured that the lack of merger of body colours with the environment give opportunities to the predators of dragonflies, i.e., birds who are also out of their roots for foods. Hence the death rate of these dragonflies in the morning is higher than the midmorning. According to Mitra (1974) the opalescent white spot on the hind wings *Tholymis tillarga* help the species to mimic hymenopterous insects and they derive protection from the predators. Fraser (1936) considered that the cryptic colour of the body of *Bradinopyga geminata* help the species to derive protection from birds. The habit of taking rest either on the shaded tree trunk, plastered walls or granite walls of *Bradinopyga geminata* to avoid heat also help them to derive protection from the predators. Similarly to avoid the heat *Tholymis tillarga* takes shelter under leaves in the nearby bushes, which, too, help them to get protection from predators (Mitra, 1994).

It is, therefore, conjectured that the aforesaid features increase the survival value of these species and hence can be considered as the evolutionary adaptations.

ABSTRACT

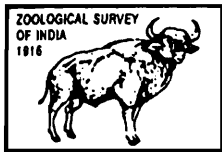
Morphological and ecological features which are evolutionary adaptations of *Tholymis tillarga* (Fabricius) and *Bradinopyga geminata* (Rambur) have been discussed.

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Rec. zool. Surv. India : **104** (Part 1–2) : 105-110, 2005

NOTES ON SOME COLLEMBOLA (APTERYGOTA : INSECTA) FROM RAJASTHAN

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INTRODUCTION

Many workers viz., Baijal (1955), Choudhuri (1963), Carpenter (1924), Hazra (1995), Imms (1912), Mitra (1967, 1973), Prabhoo (1971), Salmon (1957) and Yosii (1966) have studied the Collembolan fauna from different states of India. However, the studies on Collembolan fauna of Rajasthan are very scanty. The present study deals with six species of Collembola namely *Cyphoderus javanus* Börner, 1906, *Cryptopygus thermophilus* (Axelson, 1900), *Isotomodes dagamae* Prabhoo, 1971, *Xenylla obscura* Imms, 1912, *Hypogastrura indovaria* Salmon, 1970 and *Entomobrya* sp. All these species are recorded for the first time from Rajasthan, India.

Present communication is based on a collection of Collembola made in the project of faunal diversity (funded by the Ministry of Environment & Forests, New Delhi) during the last two years from the following three districts of Rajasthan namely — Jodhpur, Sriganganagar and Jalore. It is noteworthy that this contribution is the first consolidated record of this group of insects from the State of Rajasthan.

Order COLLEMBOLA

Suborder ARTHROPLEONA

Key to the Superfamilies of ARTHROPLEONA

First thoracic segment dorsally distinct and with dorsal setae
..... PODUROIDEA, Womersley, 1933

First thoracic segment without dorsal setae and frequently more or less reduced or hidden dorsally by mesothoracic segment ENTOMOBRYOIDEA, Womersley, 1933

Key to the Families of PODUROIDEA

1. Pseudocelli present, at least on antennal base or dorsum of fifth abdominal segment.
..... ONYCHIURIDAE, Gervais, 1841
2. Pseudocelli absent. HYPOGASTRURIDAE, Bourlet, 1839

Key to the Families of ENTOMOBRYOIDEA

1. Hind coxae usually with trochanteral organ. Abdomen IV appreciably longer than abdomen III. Scales present or absent. Furcula well developed.
..... ENTOMOBRYIDAE, Tomosvary, 1882
2. Hind coxae without trochanteral organ. Abdomen III and IV usually subequal; the abdomen III never more than one and half times as long as the abdomen III, the other posterior abdominal segments often fused. Scales usually not present
..... ISOTOMIDAE, Börner, 1913

Key to the Subfamilies of ENTOMOBRYIDAE

1. Dentes dorsally crenulated and curving upwards basally in the line with manubrium
..... ENTOMOBRYINAE, Schaffer, 1896
- Dentes not crenulated, straight and usually forming a basal angle with manubrium 2
2. Serrated or coarsely ciliated dental spine is absent 3
- Serrated or coarsely ciliated dental spine present on the basal portion of the dentes only ..
..... TOMOCERINAE, Schaffer, 1896
3. Eyes and pigment absent; dentes with large dorsal scale without apical lobe
..... CYPHODERINAE, Börner, 1913
- Eyes and pigment present; dentes without dorsal scale and with apical lobe
..... PARONELLINAE Börner, 1913

Family HYPOGASTRURIDAE

This family represented by two genera and two species from Rajasthan.

I. Genus *Xenylla* Tullberg, 1869**1. *Xenylla obscura* Imms, 1912**

1912. *Xenylla obscura* Imms, *Proc. zool. Soc. London*, 80-125.

1970. *Xenylla obscura* Salmon, *Rev. Soc. N. Z. Biol. Sci.*, 12(13) : 145-152.

Material examined : Srivijayanagar, Sriganaganagar dist., 1 ex., 20.ix.2000, A. Bhattacharyya; Bhinmolgarh, Jalore dist., 4 exs., 7.xii.2000, A. Bhattacharyya; Jaliwada, Jodhpur dist., 64 exs.,

18.i.2001, A. Bhattacharyya; Gardali, Jalore dist., 8 exs., 8.xii.2000, A. Bhattacharyya; Ghaseri, Jalore dist., 8 exs., 6.xii.2000, A. Bhattacharyya; Dhanpara, Jalore dist., 2 exs., 8.xii.2000, A. Bhattacharyya; Kapeda, Bilara, Jodhpur dist., 35 exs., 15.i.2001, A. Bhattacharyya; Bhinmal Guest House, Jaore dist., 2 exs., 7.xii.2000, A. Bhattacharyya; Falna, Sanalone, Jalore dist., 8 exs., 7.xii.2000, A. Bhattacharyya.

Diagnostic characters : Body length upto 1.4 mm; elongate in shape. Colour indigo-blue, segmental margins and ventral side pale. Ant. Ratio as 10 : 12 : 12 : 14. P.A.O. absent. Unguis carinate. Without lateral teeth, but 1, 1, 1 inner tooth near the apex. Unguiculus absent. Ventral tube with 4 + 4 setae. Mucro short, obtuse and blunt on apex, with a narrow rounded lamella, which is often very obscure.

Distribution : INDIA : Rajasthan, Manipur, Nagaland, Sikkim, Maharashtra (Mumbai).

Remarks : The occurrence of this species in different parts of Rajasthan showed its wide distributional range in Rajasthan.

II. Genus *Hypogastrura* Bourlet, 1839

2. *Hypogastrura indovaria* Salmon, 1970

1970. *Hypogastrura indovaria* Salmon, *Trans. Biol. Sci.*, 12(13) : 149.

Material examined : Gardali, Jalore dist., 8 exs., 8.xii.2000, A. Bhattacharyya.

Diagnostic characters : Body length upto 0.8 mm. brownish black granular, ocelli on black fields. Sparse to heavy clothing of short and long curved simple setae. Antennae shorter than head. 8 + 8 eye. P.A.O. very irregular consists of 4–12 indistinct disconnected lobes with or without central boss. Abd. VI with two long anal spines on papillae. Tenent hairs never clavate. Claw and unguculus finely granulate; mucrones finely granulate and spoon-shaped with two distinct lamellae.

Distribution : INDIA : Rajasthan, Sikkim.

Remarks : Occurrence of this species in Western India in Rajasthan only after its occurrence in Manipur and Sikkim of North East India, is interesting.

Family ENTOMOBRYIDAE

Subfamily CYPHODERINAE Börner, 1913

III. Genus *Cyphoderus* Nicolet, 1842

3. *Cyphoderus javanus* Börner, 1906

1906. *Cyphoderus javanus* Börner, *Mitt. Nat. Hist. Mus. Hamburg.*, 23 : 180

1966. *Cyphoderus javanus* Yosii, *Kyoto Univ. Expt. Karakoram & Hindukush*, 8 : 381

1971. *Cyphoderus javanus* Prabhoo, *Oriental Ins.*, 5(1) : 38.

Material examined : Paota, Jodhpur dist., 2 exs., 11.xi.2000, A. Bhattacharyya; Bhagwansar, Sriganganagar dist., 2 exs., 11.xi.2001, A. Bhattacharyya; Khandadeol, Jalore dist., 2 exs., 7.xii.2001, A. Bhattacharyya.

Diagnostic characters : White without trace of pigment. Eyes lacking elongated mucro with a well-developed lamellated anteapical tooth. Large fringed scale on dens; unguis and unguiculus both have enlarged wing like teeth.

Distribution : INDIA : Rajasthan, Manipur, Sikkim, West Bengal, Kerala.

Remarks : So far this species was recorded from Northeast India, Sikkim Himalaya, South India, occurrence of this species from the desert of Rajasthan proves its wide distributional range in varied habitat.

Subfamily ENTOMOBRYINAE Schaffer, 1896

IV. Genus *Entomobrya* Rondani, 1861

4. *Entomobrya* sp.

Material examined : AFRI-Nursery, Jodhpur dist., 2 exs., 12.xi.2000, A. Bhattacharyya.

This genus includes scaleless Entomobryinae with 6 + 6 eyes, the fourth abdominal segment 3 or more times as long as the third and greatly enlarged setae on the body. The unguis is quite consistent, having 1 outer, 2 lateral, and 4 inner teeth; the unguiculus is always acuminate and externally smooth or very finely ciliate.

Family ISOTOMIDAE Börner, 1913

Head prognathus, tracheae absent. Antennae inserted in front half of head. P.A.O. usually present; always simple. Mucrones short.

V. Genus *Cryptopygus* Willem, 1901

5. *Cryptopygus thermophilus* (Axelson, 1900)

1947. *Isotoma thermophilus* Stach, *Med. Soc. Fauna Flora Fenn.*, **26** : 113

Material examined : Khandadeol, Jalore dist., 39 exs., 7.xii.2001, A. Bhattacharyya; Bhopalgarh, Jodhpur dist., 4 exs., 20.ix.2000, A. Bhattacharyya; CSF-Nursery Bhagwansar, Sriganganagar dist., 20. exs., 11.ii.2001, A. Bhattacharyya; Godane ki dhani, Bhopalgarh, Jodhpur dist., 8 exs., 20.ix.2000, A. Bhattacharyya.

Diagnostic characters : Generally dark back ground with numerous pale spots. Fourth antennal segment without clearly distinguishable blunt setae. P.A.O. about 3 times as long as the

nearest eye. Eye 8 + 8 or 7 + 7. Unguis without lateral teeth but with a clear inner tooth; unguiculus tooth less. Ventral tube with 2 basal posterior setae and 4 + 4 distal anterior setae. Manubrium 1/2–3/5 as long as dens, with 1 + 1 ventral setae. Dens with numerous dorsal crenulations, 6 + 6 dorsal setae, and about 20 ventral setae. Maximum length 1.2 mm.

Distribution : INDIA : Rajasthan, Manipur; NORTH AMERICA, JAPAN.

Remarks : Recorded for the first time from Rajasthan.

VI. Genus *Isotomodes* Linnaniemi, 1907

6. *Isotomodes dagamae* Prabhoo, 1971

1971. *Isotomodes dagamae* Prabhoo, *Oriental Insects*, 5(1) : 1-46.

Material examined : Khandadeol, Jalore dist., 28 exs., 7.xii.2000, A. Bhattacharyya.

Diagnostic characters : Upto 1.6 mm. long, white, slender species. Clothed with plain setae arranged in transverse rows. Antenna/head as 3/2; antennal ratio as 12 : 20 : 25 : 35; ant. IV with 21 blunt sense rods; ant. III without the usual sense organ. P.A.O. with eight setae posterior to it. Claw without teeth. Unguiculus half as long as the claw. Tenent hair absent. Furcula segments as 25 : 25 : 8; manubrium without seate on the ventral side and dorsally with 9 + 9 setae; mucro with two unequal teeth.

Distribution : INDIA : Kerala, Rajasthan.

Remarks : First recorded from Rajasthan.

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We are grateful to Dr. J. R. B. Alfred, Director, Zoological Survey of India, Kolkata, for providing laboratory facilities. Thanks are also due to Dr. Q. H. Baqri, Additional Director, D.R.S., Jodhpur and the Principal Investigator of the Project entitled "Studies on Faunal Diversity in the Thar Desert of Rajasthan" (funded by the Ministry of Environment & Forests, New Delhi) for placing the collections of Collembola to us.

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CYPSSELURUS NARESII (GUNTHER, 1889) (PISCES : EXOCOETIDAE) : A NEW RECORD IN INDIAN WATERS

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INTRODUCTION

During the course of our studies on the flying fishes of family Exocoetidae the authors came across a specimen hitherto not known from Indian coast. On close examination this specimen is turned out to be *Cypselurus naresii* (Gunther, 1889).

The genus *Cypselurus* Swainson, 1838 is represented by 12 species out of about 60 species under 7 genera of Exocoetid fishes known in the world (Heemstra and Parin, 1986). There are at least 6 species of *Cypselurus* occurring in the Indian Ocean (Parin, 1996). But *C. angusticeps* Nichols and Breder, 1935, *C. hexazona* (Bleeker, 1853) and *C. opisthopus* (Bleeker, 1866) are apparently not recorded from Indian coast. *C. naresii* is known to be widely distributed in tropical Indian Ocean and in the Pacific Ocean (Parin, 1984), but as the above three species it is also not recorded from Indian waters.

C. naresii differs from other known species *i.e.* *C. oligolepis* (Bleeker, 1866) and *C. poecilopterus* (Valenciennes, 1847) of the Indian coast in having its pelvic fin origin about midway between head and caudal fin and, head length approximately equal the distance between dorsal fin origin and origin of upper caudal fin lobe. The pelvic fin origin is much nearer to head than caudal fin and, the head length shorter in these two later cited species. Moreover, *C. poecilopterus* have spotted pectoral fin.

A brief description of *C. naresii* is presented hereunder with the remarks on the species of the genus *Cypselurus* known from the Indian Ocean.

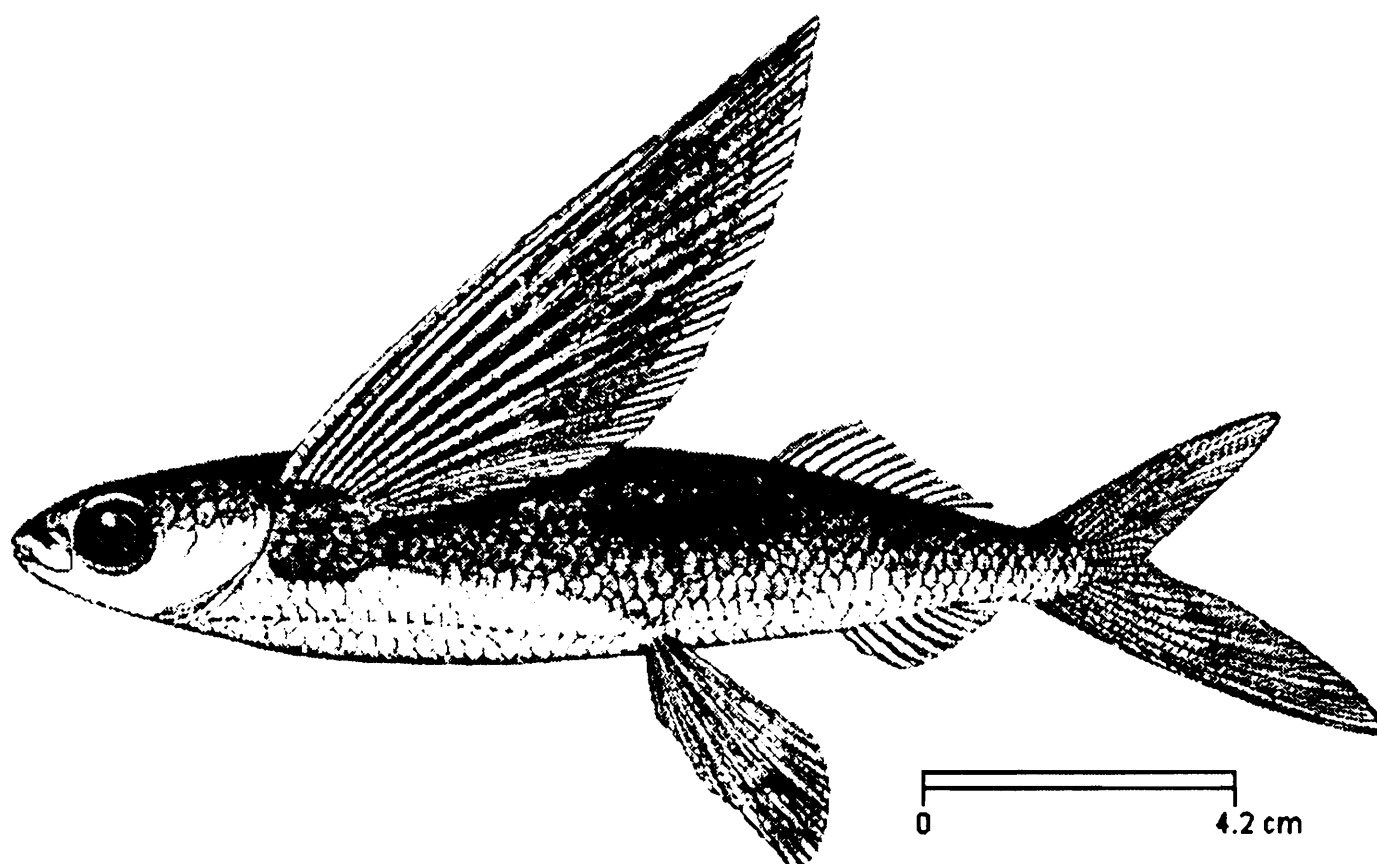
***Cypselurus naresii* (Gunther, 1889)**

1889. *Exocoetus naresii* Gunther, *Zool. Challenger Exp.*, **31** : pt. 78 (Type locality : Cape York, Queensland, Australia).
1922. *Cypsilurus naresii*: Weber and de Beaufort, *Fish. Indo-Aust. Archip.*, **4** : 188.
1984. *Cypselurus naresii* : Parin, *FAO species identification sheets for fishery purposes. Fishing Area 51 (W. Indian Ocean)*, **2** : EXOC Cyp 10.

Material examined : Reg. No. ZSI-F 9678/2, 1 ex., 170 mm SL, Locality : Nagapattinam, Tamil Nadu, Collected by R. P. Barman and party, on 08-07-2003.

Description : D 10; A 7; P i, 14; total GR 22; predorsal scales 32; LL 48. Body depth less than 20%, head length about 26.5% of standard length. Upper jaw not protrusible; lower jaw included beneath the upper; palatine teeth present. Distance between dorsal fin origin and origin of upper caudal fin lobe equals head length. Anal fin originates 5 rays behind origin of dorsal fin. Pectoral fin long, its length about 66% of standard length; reaching to caudal peduncle, beyond anal fin base. Pelvic fin large, reaching to end of anal fin base; its insertion closer to anal fin origin than to pectoral fin base and approximately at midpoint of distance between hind margin of head and origin of lower caudal fin lobe. Caudal fin deeply forked, its lower lobe longer than upper. Scales large, cycloid, and deciduous. Lateral line low on body; pectoral branch of lateral line absent; 9 scale rows above lateral line and origin of dorsal fin base.

Colour : Dark above, pale below; dorsal fin grayish; pectoral fin brownish black, unpigmented below 9th ray; pelvic fins with distal half black between 2nd and 4th ray.



Cypselurus naresii

Distribution : Tropical waters of Indian and Pacific oceans : from Gulf of Aden and East Africa to Southern Japan, Fiji and New South Wales, Australia.

Remarks : The taxonomy of the Indo-Pacific species of flying fishes is ambiguous and some authors included *Cheilopogon* Lowe, 1840 in the genus *Cypselurus* that amounted to confusion (Heemstra and Parin, 1986). Talwar (1984) reported the occurrence of 6 species of *Cypselurus* in our area, of which only 2 species *i.e.*, *C. exsiliens* (Linnaeus, 1771) and *C. oligolepis* are to be placed under this genus in *sensu stricto*. Talwar (1984) has placed *C. poecilopterus* under *Cheilopogon spilopterus* (Valenciennes, 1846), as a synonym (Barman *et. al.*, in press) while *C. spilopterus* is known to occur in the east Indo-Pacific, from Andaman Sea to Samoa and Ryukyu islands. Talwar (1984) followed Chandy (1954) erroneously in recording *C. exsiliens* from Indian waters which definitely refers to *Cheilopogon nigricans* (Bennett, 1840) since *C. exsiliens* is known

Table 1. : Morphometric characters of the specimen studied (*C. naresii*).

No.	Characters	Measurements	% of SL
01.	Standard Length (SL)	170 mm	–
02.	Head Length	45 mm	26.5
03.	Maximum depth at mid-body	33 mm	19.4
04.	Depth at dorsal fin origin	30 mm	17.6
05.	Eye diameter	15 mm	8.8
06.	Pectoral fin length	112 mm	65.9
07.	Pelvic fin length	55 mm	32.4
08.	Length of upper caudal fin lobe	35 mm	20.6
09.	Length of lower caudal fin lobe	55 mm	32.4
10.	Distance from snout tip to dorsal fin origin	125 mm	73.5
11.	Distance from snout tip to pelvic fin origin	105 mm	61.8
12.	Distance of dorsal fin origin to upper caudal fin origin	43 mm	25.3
13.	Distance of anal fin origin to lower caudal fin origin	30 mm	17.6
14.	Distance between dorsal fin origin and anal fin origin	32 mm	18.8
15.	Distance between dorsal fin origin and pelvic fin origin	35 mm	20.6
16.	Distance between pectoral fin origin and anal fin origin	95 mm	55.9
17.	Distance between pelvic fin origin and anal fin origin	35 mm	20.6
18.	Distance between pectoral fin origin and pelvic fin origin	65 mm	38.2

to occur in the Western Atlantic Ocean and so, unlikely to occur in the Indian coast. Similarly, report of *Cypselurus comatus* (Mitchill, 1815), also a Western Atlantic species, from Ceylon by Munro (1955) is erroneous (De Bruin *et. al.*, 1995), which could be *C. naresii*. The identity of *Cypselurus starksi* Abe, 1953 from Andamans (Kyushin *et. al.*, 1977) is uncertain, since it is known only from Southern Japan. There are three other species, viz., *C. angusticeps* Nichols and Breder, 1935, *C. hexazona* (Bleeker, 1853) and *C. opisthopus* (Bleeker, 1866) known to occur in the Indian Ocean but are yet to be recorded from Indian waters.

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FRESHWATER CRABS (POTAMONIDS) IN THE COLLECTION OF THE SOUTHERN REGIONAL STATION, ZOOLOGICAL SURVEY OF INDIA, CHENNAI

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INTRODUCTION

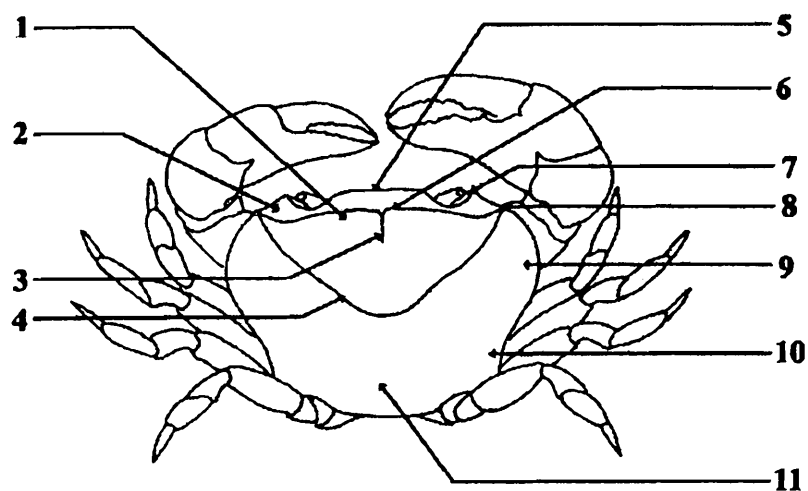
The Freshwater Decapod Brachyuran faunal resources are yet to be properly assessed for enumeration and inventorisation despite the availability of classic literature. The baseline information available to the carcinological worker date back to Wood Mason (1871), Rathbun (1904–06) and Alcock (1910), followed by Chopra (1947), Hora (1934), (1935), Dutta (1989) and a series of worker including Deb (1998) and Ghosh and Ghatak (1999, 2000). The Infraorder Brachyura has colonized a series of habitats from terrestrial, fresh water, brackish water to marine exhibiting a high degree of adaptive tendency morphologically and physiologically.

From among the taxa described under brachyuran (broad carapace crabs) the potamonids enjoy a very restricted distribution in freshwater in different altitudes and ecological conditions. As on date no concurrence of opinion exists and among worker as to the number of species of potamonids available in the Indian territory. The reasonable estimate shall be either 90 species accommodated in 3 genera *i.e.*, *potamon*, *paratelphusa* and *Gecarcinus* accordingly to Alcock, or the same number of the species under more genera as per observation of recent worker Bott (1970). Concerning information about the number of species recorded from Southern India, the tally remains static at 13 species from the time of Alcock (1910).

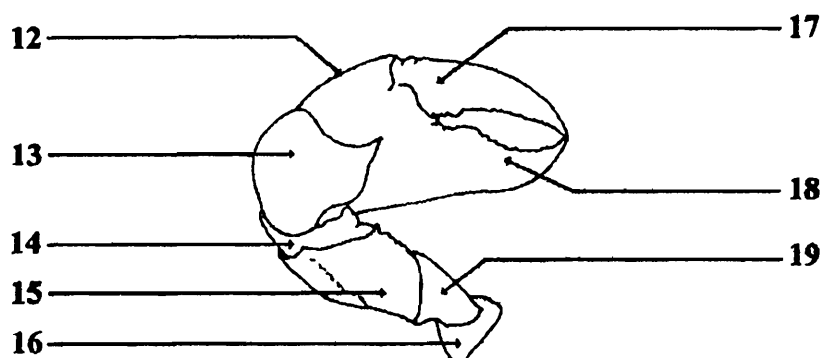
In order to know the current numerical status of species distribution in South India, the programme has been taken to study the holdings of southern regional station, Zoological Survey of India, Chennai and results are reported.

The diagnostic characters and distribution of the species state-wised have been provided. The classification is adopted from Alcock (1910) and revised after Bott (1970).

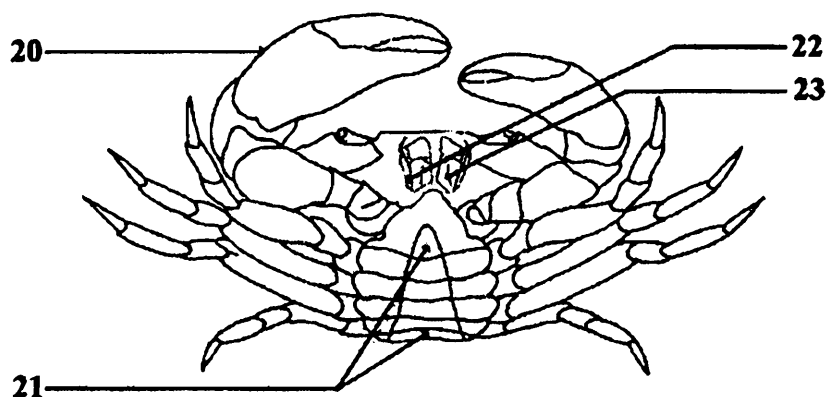
Diagrammatic sketch of a typical potamonid crab is given below :



Dorsal view



Cheliped



Ventral view

- | | | |
|-------------------------------|----------------------------|-------------------------|
| 1. Post-orbital crest | 9. Antero-lateral border | 17. Dactylus |
| 2. External orbital angle | 10. Postero-lateral border | 18. Pollex |
| 3. Mesogastric groove | 11. Carapace | 19. Basis |
| 4. Cervical groove | 12. Palm | 20. Cheliped |
| 5. Front | 13. Carpus | 21. Abdominal segments |
| 6. Epigastric crest | 14. Merus | 22. Exopodite |
| 7. External orbital tooth | 15. Ischium | 23. External maxilliped |
| 8. Lateral Epibranchial tooth | 16. Coxa | |

LIST OF SPECIES

Class CRUSTACEA

Order DECAPODA

Infraorder BRACHYURA

Family POTAMONIDAE Rathbun 1904

1. *Travancoriana schirnerae* Bott 1969,
2. *Barytelphusa (Barytelphusa) guerini* (Milne-Edwards 1853)
3. *Barytelphusa (Barytelphusa) cunicularis* (West Wood 1836)
4. *Oziotelphusa senex senex* (Fabricius 1798)
5. *Spiralothelphusa hydrodroma* (Herbst 1794)

TAXONOMIC ACCOUNT

Family POTAMONIDAE Rathbun, 1904.

1. Genus *Travancoriana* Bott 1969(i) *Travancoriana schirnerae* Bott 1969

Plate I, Fig. 1

1836. *Telphusa cunicularis*, Westwood, *Trans. Entomol. Soc. London.*, 1 : 183, pl. 19, Figs. 1-6.
1905. *Potamon (Potamonantes) cunicularis*, Rathbun, *Nouv. Arch. Du Museum*, (4), 7 : 184, pl. 15, fig. 10.
1910. *Paratelphusa (Barytelphusa) cunicularis*, Alcock, *Cat. Ind. Decap., Ind. Mus.*, 1(2) : 83, pl. 12, fig. 56.
1970. *Travancoriana schirnerae*, Bott *Abh. Senckenb. Natur. Ges* no. 526 : 41.

Material examined : 1 ex., Sarkarpathy, IGWLS, Tamil Nadu, 10.xii.1996, Coll. M. S. Ravichandran; 5 exs., Attingal, Trivandrum, 25.xii.97, Coll. P. T. Cherian; 1 ex., Kodai Dakshnishwar, Tamil Nadu, 9.ix.1998, Coll. M. B. Raghunathan; 1 ex., Kamuthi Koil, IGWLS, Tamil Nadu, 2.ii.1998, Coll. M. S. Ravichandran; 2 exs., Kolar Road, Karnataka, 2.ii.1999, Coll. G. Thirumalai; 25 exs., K. Gudi, Karnataka, 24.ii.1999, Coll. S. Krishnan; 7 exs., Kanakere, Karnataka, 25.ii.1999, Coll. S. Krishnan; 4 exs., Basavanagodu, 3.iv.1999, Coll. G. Thirumalai; 5 exs., Kanakere, Karnataka, 1.iii.1999, Coll. S. Krishnan; 17 exs., Basavangodu, Karnataka, 3.iv.1999, Coll. G. Thirumalai; 1 ex., BRT Hills, Karnataka, 20.ii.2000, Coll. G. Thirumalai; 4 exs., Doddasempige, Karnataka, 2.iii.2000, Coll. G. Thirumalai.

Diagnosis : Carapace broad and more convex, cervical groove not deeply demarcated. The front is slight deflexed. The lateral epibranchial tooth is very minute. Owing to superficial nature of cervical groove, the post-orbital crests are not clear, separated from the lateral epibranchial tooth.

Distribution : INDIA : Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Maharashtra (Poona to Baroda)

Outside India : Not recorded.

Remarks : This is the first record of occurrence from Kerala and Karnataka.

2. Genus *Barytelphusa* Alcock 1909

(ii) *Barytelphusa (Barytelphusa) guerini* (Milne-Edwards 1853)

Plate 1, Fig. 2

1853. *Telphusa guerini*, Milne-Edwards, *Ann. Sci., nat. Zool.*, (3), 20 : 210.

1905. *Potamon (Potamonautes) guerini*, Rathbun, *Nouv. Arch. Du Museum*, (4) 7 : 186, T. 6, pl. 16, fig. 2.

1918. *Paratelphusa (Barytelphusa) guerini*, Bouvier, *Bull. Mus. Hist. Nat.*, 6 : 8.

1970. *Barytelphusa (Barytelphusa) guerini*, Bott, *Abh. Senckenb. Natur, Ges* no. 526 : 33.

Material examined : 3 exs., Sarkarpatty, IGWLS, Tamil Nadu, 10.xii.1996, Coll. M. S. Ravichandran; 1 ex., Kamuthi Koil, IGWLS, Tamil Nadu, 21.ii.1998, Coll. M. S. Ravichandran; 2 exs., Kolar Road, Karnataka, 2.ii.1999, Coll. G. Thirumalai; 3 exs., Honametti Bedaguli, Karnataka, 20.ii.1999, Coll. S. Krishnan; 3 exs., BRT Hills, Karnataka, 1.iii.1999, Coll. S. Krishnan; 2 exs., Basavanagodu, Karnataka, 3.iv.1999, Coll. G. Thirumalai; 2 exs., BRT Hills, Karnataka, 20.ii.2000, Coll. G. Thirumalai.

Diagnosis : Carapace broad, deep and strongly convex, cervical groove broad but not reaching to lateral epibranchial tooth. The epigastric and postorbital crests form one prominent ridge continuous, on either side of mesogastric furrow.

Distribution : INDIA : Assam, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu.

Outside India : Not recorded.

Remarks : This is first record of occurrence from Karnataka State.

(iii) *Barytelphusa (Barytelphusa) cunicularis* (West Wood 1836)

Plate 1, Fig. 3

1905. *Potamon (Potamonautes) jacquemontii*, Rathbun, *Nouv. Arch. Du Museum*, (4) 7 : 185, T. 6, pl. 16, fig. 1, 5.

1910. *Paratelphus (Barytelphusa) jacquemontii*, Alcock, *Cat. Ind. Decap. Crust. Ind. Mus.*, 1(2) : 79, fig. 55.

1910. *Paratelphusa (Barytelphusa) lamellifrons*, Alcock, *Cat. Ind. Decap. Crust. Ind. Mus.*, 1(2) : 82, fig. 18.

1910. *Paratelphusa (Barytelphusa) pulvinata*, Alcock, *Cat. Ind. Decap. Crust. Ind. Mus.*, 1(2) : 86, fig. 21.

1970. *Barytelphusa (Barytelphusa) cunicularis*, Bott, *Abh. Senckenb. Natur, Ges*. No. 526 : 31.

Material examined : 19 exs., Mukurti Road, Silent-Valley, Kerala, 18.i.1979, Coll. R. S. Pillai; 32 exs., South of Kunti, Silent Valley, Kerala, 25.i.1979, Coll. R. S. Pillai; 6 exs., Dust Beri Lake, Pondicherry, 27.iii.1992, Coll. K. R. Rao; 3 exs., IGWLS, Tamil Nadu, 4.xi.1995, Coll. M. S. Ravichandran; 17 exs., Sarkarpathy, IGWLS, Tamil Nadu, 10.xii.1996, Coll. M. S. Ravichandran; 14 exs., Shivaete R. F., D. Kanada, Karnataka, 10.xii.1998, Coll. M. S. Ravichandran; 14 exs., Kamuthi Koil, IGWLS, Tamil Nadu, 21.xii.1998, Coll. G. Thirumalai; 5 exs., Honametti Bedaguli, Karnataka, 20.ii.1999, Coll. S. Krishnan; 14 exs., K. Gudi, Karnataka, 21.ii.1999, Coll. S. Krishnan; 3 exs., Basavanagodu, Karnataka, 20.ii.1999, Coll. S. Krishnan; 2 exs., Kanakere, Karnataka, 1.iii.1999, Coll. S. Krishnan; 4 exs., Basavangodu, Karnataka, 3.iv.1999, Coll. G. Thirumalai; 4 exs., Hosahalli, Mysore, Karnataka, 20.xi.1999, Coll. M. B. Raghunathan; 14 exs., BRT Hills, Karnataka, 22.xi.1999, Coll. M. B. Raghunathan; 6 exs., Ranganathan Koil, Chamraj nagar, Karnataka, 19.ii.2000, Coll. G. Thirumalai; 3 exs., BRT Hills, Karnataka, 20.ii.2000, Coll. G. Thirumalai; 2 exs., Dodasampige, BRT, Karnataka, 20.ii.2000, Coll. G. Thirumalai; 8 exs., K. Gudi, Karnataka, 7.iv.2000, Coll. S. Krishnan.

Diagnosis : Carapace flat; cervical groove very prominent and deep, broadly v-shaped, runs towards lateral epibranchial tooth. Epigastric and post orbital crests form a bold ridge from mesogastric region to the lateral epibranchial tooth. The exopodite of the external maxillipeds is much longer than ischium and carries the hairy flagellum.

Distribution : INDIA : West Bengal (Burger), Andhra Pradesh, Bihar (undivided), Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh (undivided).

Outside India : Sri Lanka (Doflein).

3. Genus *Oziotelphusa* Müller 1887

(iv) *Oziotelphusa senex senex* (Fabricius 1798)

Plate II, Fig. 4

1904. *Potamon (Potamon) bouvieri*, Rathbun, *Nouv. Arch. Du Museum*, (4) 6 : 293, pl. 12, fig. 5.

1910. *Paratelphusa (Oziotelphusa) bouvieri*, Alcock, *Cat. Ind. Decap. Crust. Ind. Mus.*, 7(2) : 100, pl. 13, fig. 61.

1970. *Oziotelphusa senex senex*, Bott, *Abh. Senckenb. Natur. Ges.* No. 526 : 100.

Material examined : 11 exs., K. Peramanoor, Punch, Tamil Nadu, 14.i.1998, Coll. Mary Bai; 5 exs., Anamalai hills, Tamil Nadu, 15.xi.1990, Coll. M. S. Ravichandran; 37 exs., Koilegal Road, Mysore, Karnataka, 24.ii.2000, Coll. G. Thirumalai; 25 exs., Belu, Hasan, Karnataka, 31.iii.2001, Coll. G. Thirumalai.

Diagnosis : The Carapace moderately convex; its antero-lateral borders are slightly convex and the lateral epibranchial teeth are large, very prominent and sharp. The post-orbital crests straight and more transverse which runs towards the lateral epibranchial spine.

Distribution : INDIA : Karnataka, Tamil Nadu.

Outside India : Not recorded.

Remarks : This is the first record of occurrence from Karnataka.

4. Genus *Spiralothelphusa* Bott 1968

(v) *Spiralothelphusa hydrodroma* (Herbst 1794)

Plate II, Fig. 5

1794. *Cancer hydrodromus*, Herbst, *Naturgesch Krabben und Krebse*, 2 : 164, T. 41, F. 2.
 1887. *Telphusa* (*Oziotelphusa*) *hippocastanum*, Müller, *Verh. Nat. Ges. Basel.*, VIII : 482, pl. 5, fig. 7.
 1904. *Potamon* (*Potamon*) *hydrodromus* (Herbst), Senex Fabr. And Wagra Karowensis Rathbun, Rathbun, *Nouv. Arch. Du. Museum*, (4), 6 : 287.
 1910. *Paratelphusa* (*Oziotelphusa*) *hydrodromus*, Alcock, *Cat. Ind. Decap. Crust, Ind. Mus.*, 1(2) : 97, fig. 60.
 1970. *Spiralothelphusa hydrodroma* Bott, *Abh, Senckenh. Natur, Ges.* No. 526 : 97.

Material examined : 1 exs., K. Peramanoor, Punch, Tamil Nadu; 14.i.1998, Coll. Mary Bai; 1 ex., Tiruvalluvar, Pondicherry, 5.iii.1991, Coll. K. R. Rao; 3 exs., Karokkakulam, Pondicherry, 23.iii.1992, Coll. K. R. Rao; 1 ex., Utseri Lake, Pondicherry, 25.iii.1992, Coll. K. R. Rao; 2 exs., Dustberi lake, Pondicherry, 27.iii.1992, Coll. K. R. Rao; 4 exs., Valontariat, Pondicherry, 3.iii.1995, Coll. K. R. Rao; 4 exs., Vallioor R. F., Tirunelveli, Tamil Nadu, 25.xi.1996, Coll. M. S. Ravichandran; 2 exs., Kamuthi Koil, IGWLS, Tamil Nadu, 21.xi.1998, Coll. M. S. Ravichandran; 1 ex., Shivaete R. F., Karnataka, 10.xii.1998, Coll. M. S. Ravichandran; 26 exs., Narasipurkera, Karnataka, 18.xi.1999, Coll. M. S. Ravichandran; 87 exs., Hosahaiti, Mysore, Karnataka, 20.xi.1999, Coll. M. B. Raghunathan; 24 exs., Chikkund, Mysore, Karnataka, 25.xi.1999, Coll. M. B. Raghunathan; 16 exs., Kolegal, Mysore, Karnataka, 26.xi.1999, Coll. M. B. Raghunathan; 5 exs., Chamrajnagar, Karnataka, 21.ii.2000, Coll. G. Thirumalai; 19 exs., Kollegal Road, Mysore, Karnataka, 24.ii.2000, Coll. G. Thirumalai; 1 ex., Attubuthupura, Karnataka, 25.xi.2000, Coll. G. Thirumalai; 2 exs., Belur, Bhomihalla, Karnataka, 31.iii.2001, Coll. G. Thirumalai.

Diagnosis : Carapace strongly convex, cervical groove distinct but appears superficial; it disappears behind the post-orbital crests. Orbit broad. External orbital tooth blunt and not separated by a gap from the lower margin of the orbit. The antero-lateral borders of carapace strongly convex, cristiform and smooth, postero-lateral borders ill defined. Three terminal segments of the male abdomen are slightly narrower in comparison to the basal segment.

Distribution : INDIA : Karnataka, Kerala, Orissa, Pondicherry, Tamil Nadu, Uttar Pradesh, West Bengal.

Outside India : Sri Lanka.

SUMMARY

The present study is based on the available samples of Potamonid crabs collected during various surveys, undertaken for Karnataka, Kerala, Pondicherry and Tamil Nadu. About 550 specimens accounted for identification which comprises 5 species belonging to 4 genera, under 1 family.

The study projects the occurrence of all the 5 species in Tamil Nadu and Karnataka State followed by 4 species in Kerala, Andhra Pradesh and other states of India and 2 species from Pondicherry (Table 1).

Table 1.

Sl. No.	Name of the Species	Name of the Locations						
		1	2	3	4	5	6	7
1.	<i>Travancoriana schirnerae</i> Bott, 1969	+	+	+	-	+	+	Not recorded
2.	<i>Barytelphusa (Barytelphusa) guerini</i> (Milne-Edwards, 1853)	+	+	-	-	-	+	Not recorded
3.	<i>Barytelphusa (Barytelphusa) cunicularis</i> (West Wood, 1836)	+	+	+	+	+	+	Sri Lanka
4.	<i>Oziotelphusa senex senex</i> (Fabricius, 1798)	+	+	+	-	+	-	Sri Lanka
5.	<i>Spiralothelphusa hydrodroma</i> (Herbst, 1794)	+	+	+	+	+	+	Sri Lanka

1. Tamil Nadu

2. Karnataka

3. Kerala

4. Pondicherry

5. Andhra Pradesh

6. Other States of India

7. Outside India

The previous records on the status of distribution show the occurrence of these 5 species in throughout South India where as only 4 species i.e., *T. schirnerae*, *B. (B.) guerini*, *B. (B.) cunicularis* and *S. hydrodroma* are widely distributed throughout India. Among these *B. (B.) cunicularis*, *O. senex senex* and *S. hydrodroma* have so far been recorded from outside India.

The study leads enough scope to examine more specimens in order to know the present status of Potamonids in South India.

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PLATE I



1. *Travancoriana schirnerae* Bott



2. *Barytelphusa (Barytelphusa) guerini* (Milne-Edwards)



2. *Barytelphusa (Barytelphusa) cuneata* (West Wood)

RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA

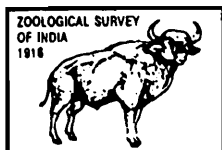
PLATE II



4. *Oziotelpusa senex senex* (Fabricius)



5. *Spiralothelphusa hydrodroma* (Herbst)



Rec. zool. Surv. India : **104** (Part 1–2) : 123-131, 2005

THE LAND SNAILS OF SHARAVATHI WILDLIFE SANCTUARY

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INTRODUCTION

Leaf litter and soil of tropical rain forests have the earth's most diverse and endangered, yet least understood communities (Emberton *et al.*, 1996). Molluscs are an important constituent of this ecosystem, yet majority of them remain undiscovered and under described, partly because of insufficient exploration and partly because of their often minute sizes (Emberton, 1995). In India, especially from the Western Ghats in Karnataka, land snails have been least worked out. The present report is from our collection from the Sharavathi Wildlife Sanctuary (14°N & 74°24' E) with a total area of 431.23 sq. km, which includes the reservoir area (123.63 sq. km.). The sanctuary was declared vide notification No. AFD. 70. FWL-71, in 1972 by the Govt. of Karnataka. The collection includes 22 examples 10 of which have been identified to the species level with the remaining been assigned to their generic name. The system of Classification followed is that given in "A Classification of Living Mollusca" (Vaught, 1989). The study assumes significance because of 10 out of the 23 families of land snails found in the Western Ghats (Madhyastha 2002) are present in this Sanctuary.

Descriptions of ten of them identified at species level have been given below.

Key to the Families

1. Shells with operculum 2
- Shells without operculum 3
2. Shells depressed, widely umbilicate *Cyclophoridae*
- Shells elongate/cylindrical, narrowly umbilicate *Diplommatinidae*

*Author for Correspondence.

3. Shells with dentition in the aperture *Streptaxidae*
 — Shells without dentition in the aperture 4
 4. Shells longer than broad, imperforate *Succineidae*
 — Shells broader than higher, perforate (*Mariaella* has plate like internal shell)
 *Ariophantidae*

SYSTEMATIC ACCOUNT

Order MESOGASTROPODA

Family CYCLOPHORIDAE

Genus *Cyclophorus* Montfort, 1810

Cyclophorus altivagus (Benson, 1854)

1854. *Cyclophorus altivagus* Benson, A. M. N. H. ser. 2, xiv : 411.

1914. *Cyclophorus altivagus* : Gude, *Fauna Brit. India*, Mollusca III : 56.

Shell globose, sturdy, opaque, widely umbilicate, spire short, dark brownish, with distinct chestnut flame like streaks near the sutures, and with distinct spiral lirations criss crossed by transverse striations. Body whorl with an indistinct keel, with 3–5 lirations above the keel prominent. Whorls 5, rapidly increasing, with visible growth lines, sutures distinct. Apex prominent, chestnut coloured with the periostracum generally corroded. Aperture rounded, lips double, inner lip slightly protruded, continuous forming a thick callus on the columellar margin. Outer lip, expanded and reflected, discontinuous at the point of attachment to the penultimate whorl. Operculum concentric, concave, retractable only up to the aperture.

Measurements : H = 32 mm, W = 36 mm.

Material observed : Six examples. Nidagod about 25 kms from Sagar, 29-7-2003 (Coll. Rajendra G. M.).

Distribution : Maharashtra : Mahableshwar, Karnataka : Sharavathi Valley (new record).

Remarks : This species has been reported earlier from Maharashtra only. This report marks the extension of the range of distribution. It measures a bit more than the measurements given in the *Fauna of British India* (Gude, 1921). The absence of any sinus in the columellar lip rules out the possibility of it being *C. indicus*.

Genus *Alycaeus* Gray, 1850

Alycaeus expatriatus (Blanford, 1860)

1860. *Alycaeus expatriatus* Blanford, J. A. S. B. xxix, p. 123;

1914. *Alycaeus expatriatus* : Gude, *Fauna Brit. India*, Mollusca III : 249.

Shell globose, widely umbilicate, uniformly pink coloured, apex reddish, an accessory canal runs along the suture at the body whorl. Shell thin with distinct vertical striations, which are lacking near the aperture. Whorls $3\frac{1}{2}$, body whorl much inflated, just before the constriction, after which it descends considerably towards the aperture forming a vertical keel like swelling. Sutural tube present just before the constriction. Body whorl near the aperture descending and rounded. Lips double, outer expanded, inner lip continuous. Operculum thin, concave, retracts completely up to the constriction.

Measurements : H = 3 mm, W = 4 mm.

Material observed : Six examples, Mundgesara, around 6 kms from Sagar. 29-7-2003 (Coll. Rajendra G. M.)

Distribution : Tamil Nadu : Neddoowutton Ghat, Nilgiris, Annamalai hills, Shevroy hills, Karnataka : South Canara, Sagar.

Remarks : This is an interesting genus, which is widely distributed in the north eastern Himalayas with only two species reported in South India. The keel after the constriction is not so thoroughly marked and also the sutural tube is considerably long which is the opposite in *A. footei*, the other species found in South India.

Family DIPLOMMATINIDAE

Genus *Nicida* Blanford, 1868

Nicida liricincta (Blanford, 1868)

1868. *Diplommata* (*Nicida*) *liricincta* Blanford, *Journ. Conchyl.* xvi : 336, pl. 14, fig. 5.

1914. *Nicida liricincta* : Gude, *Fauna Brit. India*, Mollusca III : 293.

Shell ovate, imperforate, glossy, thin and translucent. Spire elevated, apex obtuse, sutures impressed. Whorls $5\frac{1}{2}$, distinctly sculptured with 2 spiral lirations on third, fourth and 3 on the penultimate whorls, body whorl with 4–5 lirations. The penultimate whorl is the largest, body whorl slightly constricted. Aperture rounded slightly ascending touches nearly half of the penultimate whorl. Lips double, outer lip slightly reflected, Operculum thin, fully retractable much beyond the aperture.

Measurements : H = 3 mm, W = 1.5 mm.

Material observed : Ten examples, Jog about 29 kms from Sagar. 28-7-2003 (Coll. Rajendra G. M.).

Distribution : Maharashtra : Khandalla, Karnataka : Jog Falls (new report).

Remarks : This is a widely distributed genus endemic to Sri Lanka and South India. The present is the first report of the species outside Khandalla.

Genus *Opisthostoma* Blanford, 1861

Opisthostoma fairbanki (Blanford, 1875)

1866. *Opisthostoma fairbanki* Blanford, *Proc. Zool. Soc.* : 448, pl. 38, figs. 14.

1914. *Opisthostoma fairbanki* : Gude, *Fauna Brit. India*, Mollusca III : 298.

Shell cylindrical, narrowly perforate, glossy, thin and translucent. Spire sunken, apex obtuse, sutures impressed. Whorls 5, apical two gradually increasing and sunken, third suddenly increases almost enclosing the former, the penultimate whorl is equal to the third, body whorl constricted and deflected inwards. Whorls sculptured with vertical lirations, which are prominent on the body whorl. Aperture reversed, triangularly rounded, slightly ascending touches nearly half of the penultimate whorl. Lips double, reflected, with a broad channel between them. Operculum thin, fully retractable much beyond the aperture.

Measurements : H = 1.5 mm, W = 1.5 mm.

Material observed : Four examples, about 15 kms from Sagar. 28-7-2003 (Coll. Rajendra G. M.).

Distribution : Maharashtra : Khandalla, Karnataka : Sagar (new record).

Remarks : This remarkable micro gastropod species measures around 1.5 mm. When observed under the microscope it exhibits a distinct sculpture, with its unique contorted aperture. Collection of leaf litter is the only feasible method of collecting this species.

Order STYLOMMATOPHORA

Family ARIOPHANTIDAE

Genus *Ariophanta* Desmoulins, 1829

Ariophanta canarica (Blanford, 1901)

1901. *Ariophanta canarica* Blanford, *Proc. Mal. Soc.* iv : 248, pl. 25, fig. 1.

1908. *Ariophanta canarica* : Blanford & Godwin-Austen, *Fauna Brit. India*, Mollusca I : 32.

Shell sinistral, moderately umbilicate, sturdy, with hay yellow periostracum, underneath white. Spire elevated, apex obtuse, whorls rapidly increasing, and sutures prominent. Whorls 5, surface with coarse transverse striations, with distinct lines of growth, body whorl distinctly angulate, which takes the appearance of a keel in younger forms. Aperture descending sharply just below the keel for a short distance, lunately rounded, lips slightly thickened. Umbilicus moderate, almost covered by the triangularly reflected columellar lip.

Measurements : H = 30 mm, W = 32 mm.

Material observed : Eight examples, Kabdur about 32 kms from Sagar. 28-7-2003 (Coll. Rajendra G. M.).

Distribution : Karnataka : South Canara, Kabdur (Sagar).

Remarks : This species is endemic to Western Ghats and is easily distinguishable from *A. bajadera* and *A. intumescens* by its descending body whorl and also being comparatively more solid and sturdy.

***Ariophanta immerita* (Blanford, 1870)**

1870. *Nanina-Ariophanta* Blanford, *J.A.S.B.* xxxix : 17.

1908. *Ariophanta immerita* : Blanford & Godwin-Austen, *Fauna Brit. India*, Mollusca I : 31.

Shell sinistral, moderately umbilicate, thin, fragile, translucent. Spire moderate, apex obtuse, dark brown above with a whitish band at the periphery after which the colour fades into white nearing the umbilicus, whorls rapidly increasing, and sutures not impressed. Whorls 5, surface with smooth transverse striations, converging with lines of growth, body whorl distinctly angled, rounded nearing the aperture in mature forms; it takes the appearance of a keel in younger forms. Body whorl near the aperture scarcely descending, with nacre just behind the slight pinkish aperture, lips slightly thickened. Upper lip flattened, basal lip inflated and rounded, columellar lip triangularly reflected, but does not cover the comparatively wider umbilicus.

Measurements : H = 32 mm, W = 38 mm.

Material observed : Six examples, about 18 kms from Sagar. 28-7-2003. (Coll. Rajendra G. M.).

Distribution : Karnataka : South Canara, Sagar.

Remarks : This typical species is endemic to Western Ghats. It is quite commonly distributed in Karnataka. It has a marked resemblance to *A. cysis* from which it differs in size, colour pattern and deeper umbilicus. In *A. cysis* the upper lip is rounded whereas in this species it is flattened.

Genus *Cryptozona* Morch, 1872

***Cryptozona solata* (Benson, 1848)**

1848. *Helix* Benson, *A. M. N. H.* (2) ii : 159.

1908. *Ariophanta solata* : Blanford & Godwin-Austen, *Fauna Brit. India*, Mollusca I, p. 31.

Shell dextral, moderately umbilicate and translucent. Spire moderate, apex obtuse, pinkish turning to white as the shell grows. Shell with small specks all over the body whorl; with a chestnut coloured band at the periphery, coinciding with the sutures and another just below it visible only on the body whorl, both the bands end abruptly just behind the aperture. Whorls 5½, rapidly increasing, sutures impressed, surface with smooth transverse striations, body whorl, rounded. Aperture negligibly descending, lips thin, white but just behind, it is hay coloured, inside it has nacre.

Upper lip flattened, basal lip inflated and rounded, columellar lip triangularly reflected, partly covering the umbilicus.

Measurements : H = 16 mm, W = 26 mm.

Material observed : Six examples, about 18 kms from Sagar. 28-7-2003. (Coll. Rajendra G. M.)

Distribution : Tamil Nadu : Nilgiris. Karnataka : Sagar (new report).

Remarks : This genus was earlier grouped with *Ariophanta*; it can be easily distinguished from other members of the genus by its whitish shell and the translucent spots.

Genus *Mariaella* Gray, 1855

Mariaella dussumieri (Gray, 1855)

1855. *Mariaella dussumieri* Gray, *Cat. Pulm. B. M.* : 63.

1908. *Mariaella dussumieri* : Blanford & Godwin-Austen, *Fauna Brit. India*, Mollusca I : 205, fig. 71.

Shell internal, flat, solid in mature forms, with beak like apex, sides sharp, hay yellow in colour, spire indistinct. Animal is a slug; yellowish with dark brown spots present in the hind region in older forms, the spots are not distinct in the younger. Shell is internal, partly visible externally through the pore present on the top of the mantle. Mantle lobes united to form a shield enclosing the various systems, on the surface with two ridges running almost parallel to each other, the right one from the respiratory orifice to the shell aperture the other round the left margin. Posterior portion sharply keeled behind the mantle, ending in the mucus pore. Foot tripartite, edges with short vertical black parallel lines.

Measurements : Animal at full stretch 46 mm.

Material observed : Ten examples, about 32 kms from Sagar. 28-7-2003 (Coll. Rajendra G. M.)

Distribution : Sri Lanka and Western Ghats up to Mahableshwar, Karnataka : Sagar.

Remarks : This endemic slug of Western Ghats and Sri Lanka is an agricultural pest. Farmers cultivating *Vanilla*, the widely used flavouring agent, reported that it is a voracious feeder of the leaves. At full stretch the specimen measured around 46 mm.

Family STREPTAXIDAE

Genus *Streptaxis* Gray, 1837

Streptaxis canaricus (Blanford, 1869)

1869. *Streptaxis canaricus*, Blanford. (Beddome M. S.) *J.A.S.B.*, xxxviii, pt. 2 : 142, pl. 16, fig. 11.

1908. *Streptaxis canaricus* : Blanford & Godwin-Austen, *Fauna Brit. India*, Mollusca I : 15, fig. 9.

Shell dextral, moderately umbilicate, and white in colour, thick and sturdy. Spire short, apex obtuse. Whorls 5½ nearly flat, rapidly increasing, sutures impressed, surface with transverse lirations. Penultimate whorl sharply keeled projecting more than the body whorl, which is slightly diverging from the columellar axis and flattened below. Aperture axe shaped, with indentations present behind the peristome, which is reflected, lips thin. Aperture with a deeply re entering parietal lamella and 6 palatal teeth, two basal, two columellar and two on the right margin. Umbilicus shallow.

Measurements : Shell damaged.

Material observed : A single example at Markuttuka about 36 kms from Sagar, 29-7-2003 (Coll. Rajendra G. M.).

Distribution : Karnataka : South Canara, Sagar (Markuttuka).

Remarks : This remarkable specimen is one of the few-keeled species of *Streptaxis*. It is clearly distinguishable by its beautiful coarse sculpture and numerous indentations present in the aperture. Found very rarely.

Family SUCCINEIDAE

Genus *Succinea* Draparnaud, 1801

Succinea raoi Subba Rao & Mitra

Succinea arboricola Rao, *Rec. Indian Mus.*, **27** : 394, figs 7-11. (Preoccupied by *Succinea arboricola* Connolly).
Succinea raoi Subba Rao & Mitra, *Nautilus*, **90**(3) : 125.

Shell dextral, imperforate, glossy upon cleaning the black deposition on the surface, hay coloured, thin and delicate. Spire short, apex obtuse. Whorls 3, rounded, rapidly increasing, sutures shallow, surface with transverse striations converging with the lines of growth and decussated by faint spiral striations. The body whorl is disproportionately large. Aperture more than double the spire, lips thin, columella chestnut coloured.

Measurements : H = 3 mm, W = 2.5 mm.

Materials observed : Four examples from Kathlekan, about 35 kms from Jog Falls. 29-7-2003 (Coll. Rajendra G. M.).

Distribution : Maharashtra : Khandalla, Pune; Karnataka : Kathlekan (new report).

Remarks : This species though not described in the *Fauna of British India* (Gude, 1914), was identified, by matching the specimens present in the ZSI collections. True to the amphibious nature of the genus, this species has been found in a very threatened micro habitat the Myristica swamps. They were found attached to wild Arecanut trees, with black depositions over the shell camouflaging it.

SUMMARY

This study is the first of its kind on land snails of this picturesque Wildlife Reserve. The land snails of Western Ghats show high endemism; 94% including those common with Sri Lanka (Ramakrishna & Mitra 2002, Mavinkurve *et al.*, 2003). The present study is in tune, with all the species studied being endemic to the Western Ghats and Sri Lanka ranges. Among these, *Mariaella dussumieri* is a serious pest causing damage to the economically important Vanilla plants. It is common in Home Gardens, near water pipes, and wherever there is even slight amount of moisture. *Ariophanta canarica*, *A. immerita* and *Streptaxis canarica* have earlier been reported from South Canara only, this study marks an extension of their range up north. *Succinea arboricola* has been reported way back in 1979 by N. V. Subba Rao and Mitra in their checklist of Molluscs of Pune. It is also found in Sharavathi valley.

The report of *Cyclophorus altivagus* and *Nicida liricincta* marks the southern most range for the species while that of *Alycaeus expatriatus* extends its distribution up north.

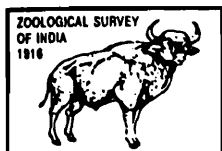
ACKNOWLEDGEMENTS

The authors acknowledge the grant of funds for this study through Ministry of Environment and Forests under the AICOPTAX scheme. The authors are thankful to the research scholars at CES (IISC) Field station Sagar, particularly to Mr. Sameer Ali, who helped a lot during collection. The authors are also grateful to Mr. S. C. Mitra, Officer in charge, Mollusca Section, ZSI, Kolkatta, for his help during identification of the species.

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Rec. zool. Surv. India : **104** (Part 1–2) : 133-140, 2005

ON A COLLECTION OF CHALCIDOIDEA (HYMENOPTERA : INSECTA) FROM THE MANGROVE ECOSYSTEMS OF KERALA, SOUTH INDIA WITH THE DESCRIPTION OF A NEW SPECIES

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INTRODUCTION

Entomofauna associated with the mangroves is poorly known. The order Hymenoptera (Insecta) of the mangrove ecosystem is represented by the pollinator, predator, phytophagous and parasitic species. Among the parasitic Hymenoptera Chalcidoidea represents an economically important group, members of which are mostly parasitic on other insects, thus playing a vital role in the natural regulation of insect population. The present account is based on the study of a small collection of Chalcidoidea from the mangrove and associated vegetations from North Kerala with Zoological Survey of India, Western Ghats Field Research Station, Calicut. Eleven species of Chalcidoidea belonging to 3 families are reported here for the first time from the mangrove ecosystem. The account also includes description of a new chalcid species belonging to the family Eurytomidae viz. *Tetramesa calicutensis* sp. nov. The specimens were identified following Narendran (1989, 1994) and Sureshan 2003. Terminology in this paper follows to that of Boucek (1988). Following abbreviations are also used.

ABBREVIATIONS

- F1–F5 – Funicular segments 1 to 5
- MV – Marginal vein
- OOL – Ocellocular distance
- PMV – Post marginal vein
- POL – Post ocellar distance
- SMV – Submarginal vein
- STV – Stigmal vein
- T1–T6 – Gastral tergites 1 to 6.

SYSTEMATIC ACCOUNT

Order HYMENOPTERA

Suborder APOCRITA (Parasitica)

Superfamily CHALCIDOIDEA

Family CHALCIDIDAE

Subfamily CHALCIDINAE

Tribe BRACHYMERINI

1. *Brachymeria lasus* (Walker)1841. *Chalcis lasus* Walker. *Entomologist*, **1** : 219.1973. *Brachymeria lasus* : Joseph et al., *Zool. Monograph. Calicut. Uni.*, **1** : 29.1989. *Brachymeria lasus* : Narendran, *Zool. Monograph. Calicut. Uni.*, **1** : 29.

Diagnostic characters : Length 5–7 mm. Black, hind femur black with apex yellow; hind tibia yellow with base black; head not wider than thorax, with fine and close punctuation, preorbital carina absent, post orbital carina reaching posterior margin of genotemporal region; hind coxa with a distinct ventromesal tooth; apex of scutellum weakly emarginated; gaster oval, short, T1 smooth.

Material examined : 2 Females, 4 males, INDIA : Kerala : Calicut dist., Kolavipalam, 19.ix.2001, coll. P. M. Sureshan.

Distribution : Cosmopolitan.

Remarks : Common polyphagous species, parasitising several Lepidoptera, helpful in controlling pest species.

Subfamily HALTICHELLINAE

Tribe HALTICHELLINI

2. *Hockeria atra* Masi1929. *Hockeria atra* Masi. *Boll. Lab. Ent. R. Ist. Sup. agr. Bologna*, **2** : 180.

Diagnostic characters : Length 3 mm. Black, forewing with transverse fuscous brown band. Head triangular, face almost flat; antenna with scape about 0.5x flagellum; thorax punctuate; propodeum with median areola narrowly hexagonal; gaster fusiform, shiny; T1 almost 0.5x total length with reticulate sculpture.

Material examined : 1 Female, Kerala : Kannur dist., Melur, 27.ii.2002, coll. P. M. Sureshan.

Distribution : India, Philippines and Java.

Remarks : Common species.

Family PTEROMALIDAE

Subfamily EUNOTINAE

3. *Cephaleta brunneiventris* Motschulsky

1859. *Cephaleta brunneiventris* Motschulsky. *Etud. Ent.*, 8 : 174.

Diagnostic characters : Length 1.5 mm. Head and thorax shiny black, gaster shiny purple violet, antennae brown. Head very slightly wider than thorax; antennae with scape slender, as long as the funicular segments combined; F1 shortest, F3–F5 gradually becoming thicker; thorax delicately reticulate; gaster almost as long as thorax, with a small tuft of white setae at base on either side of petiole.

Material examined : 1 Female. Kerala : Kannur dist., Melur, 27.ii.2002, coll. P. M. Sureshan.

Distribution : India, Sri Lanka, America, China, Philippines and Formosa.

Remarks : A polyphagous species parasitising various coccids.

Subfamily PTEROMALINAE

Tribe PTEROMALINI

4. *Propicroscytus oryzae* (Subba Rao)

1973. *Obtusiclava oryzae* : Subba Rao, *Bull. Ent. Res.*, 62 : 627.

1988. *Propicroscytus oryzae* : Boucek, *Aust. Hym. CAB. Int.*, 410.

Diagnostic characters : Length 2.5–4 mm. Head and thorax metallic green; dorsum with distinct green iridescence in certain lights; gaster yellow with sides and middle with brown streaks longitudinally; antennae with funicular segments elongated; pronotum distinctly at a low level; gaster lanceolate, 1.2x as long as head plus thorax.

Material examined : 2 Females, Kerala : Kannur dist., Melur, 27.ii.2002, coll. M. P. Sureshan.

Distribution : India (Kerala, Orissa, Maharashtra, Andhra Pradesh).

Remarks : Species parasitising gall midges in grass stems, commonly occurring in grass.

5. *Dinarmus maculatus* (Masi)

1924. *Sphaerakis maculatus* Masi. *Ann. Mus. Civ. Stor. Nat. Giacomo Doria*, 51 : 157.

1979. *Dinarmus maculatus* : Boucek et al., *Oriental Ins.*, 12(4) : 442.

Diagnostic characters : Length 2.5–3 mm. Body metallic blue with bronzy patches; antennae yellowish brown; anterior margin of clypeus almost straight; antennae with third anellus as long as first and second combined; propodeum with moderate nucha, plicae strong; forewing with PMV as long as or little longer than MV; gaster cordiform.

Material examined : 2 Females, Kerala : Kannur dist., Melur, 27.ii.2002, coll. P. M. Sureshan.

Distribution : India (Kerala, Maharashtra, West Bengal).

Remarks : Species parasitising bruchid beetles.

6. *Chlorocytus indicus* (Walker)

2000. *Chlorocytus indicus* Sureshan, *Rec. Zool. Sur. India*, **98**(2) : 143.

Diagnostic characters : Length 1.6–2.4 mm. Bright metallic bluish green with golden reflection; antennae brown. Head distinctly and closely punctate; antennae with pedicel plus flagellum 1.2x head width; pronotal collar sharply carinate anteriorly; propodeum with complete median carina; gaster longer than head plus thorax combined.

Material examined : 1 Female, Kerala : Kannur dist., Melur, 27.ii.2002, coll. P. M. Sureshan.

Distribution : India (Kerala).

Remarks : Common species associated with grasses.

7. *Norbanus thekkadiensis* Sureshan

2003. *Norbanus thekkadiensis* Sureshan. *Rec. Zool. Sur. India, Occ. Paper No. 205* : 60.

Diagnostic characters : Length 1.8–2.2 mm. Head and thorax bluish black, gaster golden yellow, antennae testaceous; clypeus radiately striated, anterior margin shallowly emarginated; antennae with scape reaching median ocellus, club with terminal stylus elongate; posterior margin of pronotal collar deeply emarginated; gaster not much pointed towards the tip, as long as head plus thorax combined.

Material examined : 7 Females, 3 males, Kerala : Calicut dist., Kolavipalam, 19.ix.2001, coll. P. M. Sureshan.

Distribution : India (Kerala).

Remarks : Collected by sweeping over *Avicenia marina* plants, probably parasitising wood boring beetles.

Family EURYTOMIDAE

Subfamily EURYTOMINAE

8. *Eurytoma poroensis* Mukerjee

1981. *Eurytoma poroensis* Mukerjee, *Rec. Zool. Sur. India. Misl. publ.*, **25** : 1-87.

Diagnostic characters : Length 1.6–3 mm. Black, antennae dark brown, legs yellowish brown except coxae black; antennal scape distinctly exceeding vertex level, funicular segments

characteristically elongate, oval; propodeum with distinct median groove; hind tibia with three spines or bristles on dorsal margin; gaster distinctly longer than combined length of head and thorax.

Material examined : 2 Females, Kerala : Calicut dist., Kolavipalam, 5.x.2001, coll. P. M. Sureshan.

Distribution : India (Kerala, Karnataka, Tamil Nadu).

Remarks : Common species.

9. *Eurytoma agalica* Narendran

1994. *Eurytoma agalica* Narendran. *Zool. Monograph. Uni. of Calicut*, 239.

Diagnostic characters : Length 2.5 mm. Black, antenna brownish black; antenna with scape just reaching level of front ocellus; propodeum with its median part broadly concave with shallow depression containing microsculptures and some vertical irregular rugae; gaster with petiole as long as broad, distinctly longer than head plus thorax combined.

Material examined : 1 Female, Kerala : Kannur dist., Melur, 27.ii.2002, coll. P. M. Sureshan.

Distribution : India (Kerala, Tamil Nadu).

Remarks : Uncommon species.

10. *Plutarchia marginata* Narendran & Padmasenan.

1990. *Plutarchia marginata* Narendran & Padmasenan. *J. Bombay Nat. Hist. Soc.*, 87 : 114-115.

Diagnostic characters : Length 2.3 mm. Black. Antennae brownish black, face with radiating striae; POL nearly 2X OOL; antennal scape reaching lower level of median ocellus; forewing with MV short and broad; hind tibia with 7 strong backwardly directed spines; gaster with exerted part of ovipositor distinctly shorter than dorsal length of epipygium; T1–T2 very small and fused to T3 dorsally.

Material examined : 1 Female. Kerala : Kannur dist., Melur, 27.ii.2002, coll. P. M. Sureshan.

Distribution : India (Kerala).

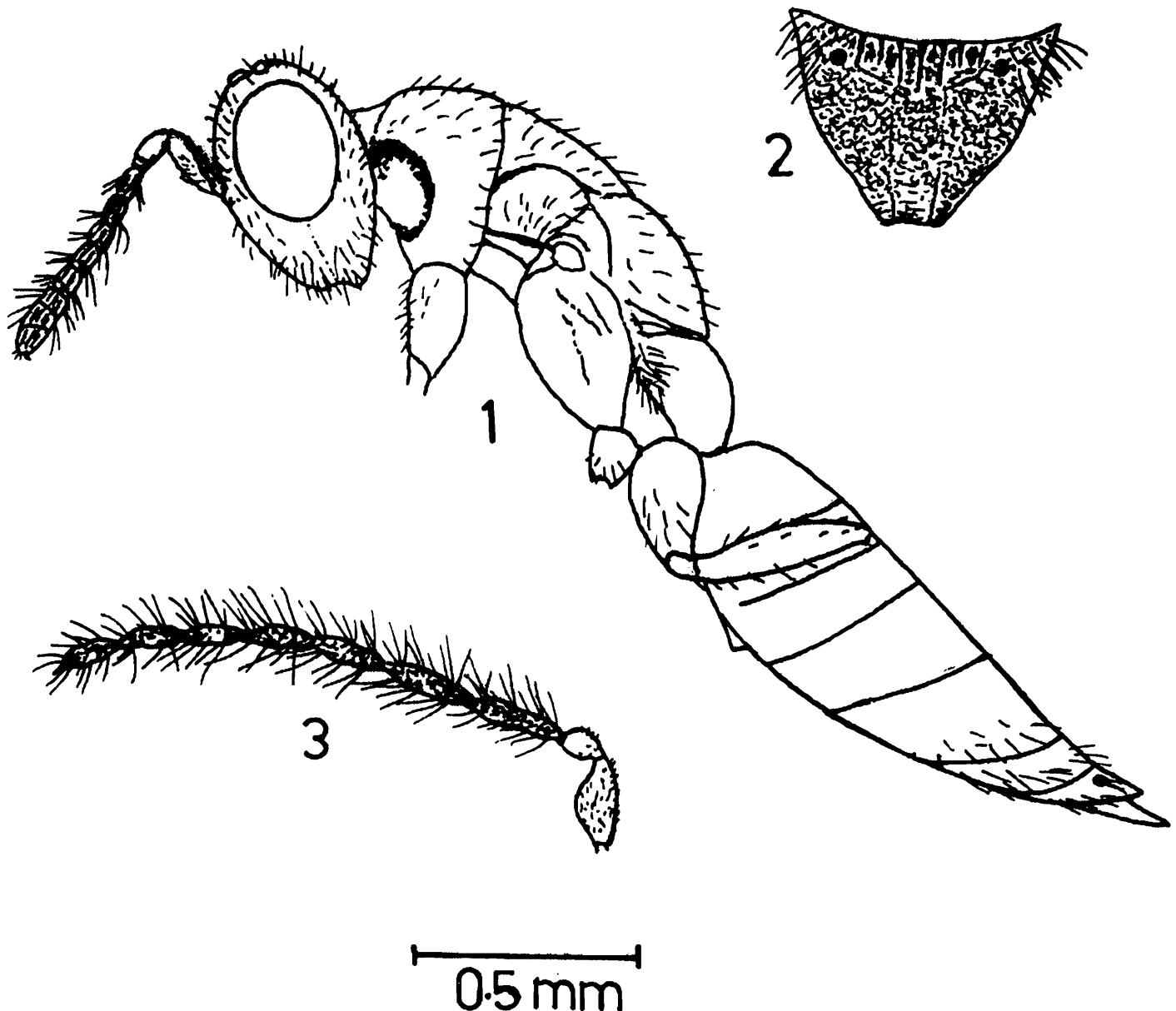
Remarks : Uncommon species.

11. *Tetramesa calicutensis* sp. nov.

(Figs. 1-3)

Diagnostic characters : Length 2.6 mm. Body black, Pubescence white; mandibles brown, lower face yellowish brown; pronotum with a broad yellowish white patch on antero lateral corners; legs brown except tips of tibiae and tarsi testaceous; antennae brown; eyes and ocelli grey; gaster blackish brown, ovipositor sheaths testaceous; tegulae brown, wings hyaline, veins pale yellow.

Head : Uniformly and finely reticulate, meshes very small, with long white hairs; gena almost shiny, malar grooves weakly indicated; clypeal area slightly raised, anterior margin angularly produced. Head in dorsal view 1.6x as wide as long; temple length 0.43x eye length; POL 2x OOL. In front view head width 1.2x height; eye length 1.23x width in profile; malar space 0.46x eye length; scrobe deep, not reaching median ocellus. Antennae (Fig. 1) inserted above lower margin of eyes; scape hardly reaching median ocellus, finely reticulate, length 0.7x eye length; pedicel plus flagellum length as long as head width; antennal formula 11153; pedicel as long as F1 and as wide as F5; F2–F5 equal in length, shorter than F1; funicular segments longer than wide, except F5 almost subquadrate, club as long as 3 preceding segments combined; funicular segments covered with long setae.



Figs. 1-3. : *Tetramesa calicutensis* sp. nov. 1. Female body in profile; 2. Porpodeum dorsal view; 3. Male antenna.

Thorax : 2.3x as long as wide, pronotum almost as long as wide, collar ecarinate, finely reticulate. Mesoscutum medially shorter than pronotum and 1.6x as wide as long, notauli complete, deep and groove like. Scutellum similarly reticulate as on mesoscutum and pronotum, medially little longer than mesoscutum. Propodeum (Fig. 2) lies at 45° to longitudinal line of mesoscutum, convex, uniformly reticulate punctate, meshes small, medially 0.7x as long as scutellum, medially with a shallow fovea, basal part with few short carinulae separated by deep foveae, only upper part of callus covered with white hairs. Prepectus finely reticulate. Mesopleuron with mesepisternum moderately reticulate, mesepimeron transversely striated. Metapleuron similarly reticulate as on propodeum. Forewing length 2.7x width, basal part with less pubescence, speculum open below, PMV short, stigma slightly enlarged. Relative lengths of SMV 33, MV 12, PMV 6, STV 4. Hind coxae finely reticulate, femur finely and longitudinally striated. Relative lengths of hind coxa 12, femur 20, tibia 26, tarsus 24.

Gaster : (Fig. 1) sessile, elongatedly ovate, as long as head plus thorax combined, dorsally collapsing; T1 dorsally as long as T2 and T3 combined; T4 little longer than T3; T5 1.2x longer than T4; exerted part of ovipositor sheath little shorter than T6 dorsally.

Male : Length 2.2 mm. Similar to female but differs in having antennal scape swollen (Fig. 3), funicular segments pedunculate with whorls of long hairs; gaster petiolate, short, only 0.72x as long as head plus thorax combined.

Holotype : Female : INDIA : Kerala : Calicut dist., Kolavipalam, 5.x.2001, coll. P. M. Sureshan.
Paratype : Male : Data same as that of holotype.

Etymology : The species is named after the type locality.

Remarks : Among the species with 5 segmented funicle and pronotum (including column) distinctly longer than mesoscutum, *T. calicutensis* sp. nov. resembles *T. distincta* Narandran and *T. narendrani* Sureshan (Sureshan, 2004) and runs to couplet 5 of the key to Indian species of *Tetramesa* (Narendran, 1994). But it differs from *T. distincta* in having forewing with MV 2x PMV, POL 2x OOL, gaster as long as head plus thorax combined, shorter antennae, and genal area almost smooth with very fine reticulation. (in *distincta* MV 1.65x PMV, POL 1.46x OOL, gaster little longer than head plus thorax combined, longer antennae and genal area distinctly striated). It differs from *T. narendrani* in having smaller size, genal area smooth, POL 2x OOL, antennae with F1 as long as pedicel, pedicel plus flagellum as long as head width, thorax with small meshed reticulation, pronotum almost as long as broad, propodeum with small meshed reticulation and covered with hairs only on upper callus, forewing with MV 2x PMV and gaster as long as head plus thorax combined with T4 little longer than T3. (in *narendrani* body size larger, genal area striate, POL 1.3x OOL, F1 longer than pedicel, pedicel plus flagellum 1.3x as long as head width, thorax with broad meshed reticulation, pronotum width 1.3x median length, MV 1.6x PMV; propodeum with broad meshed reticulation and whole surface covered with white hairs, gaster 1.3x as long as head plus thorax combined with T4 distinctly longer than T3).

DISCUSSION

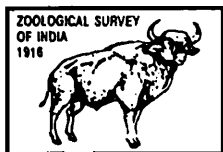
Eleven species of Chalcidoidea (Hymenoptera : Insecta) belonging to 10 genera and 3 families are reported for the first time from the mangrove ecosystems of Kerala, South India. One species belonging to the family Eurytomidae viz. *Tetramesa calicutensis* is described new to science.

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Rec. zool. Surv. India : **104** (Part 1–2) : 141-146, 2005

A NEW SPECIES OF *THECOLAX* WESTWOOD (CHALCIDOIDEA : PTEROMALIDAE) PARASITISING WOOD BORING BEETLES FROM INDIA

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INTRODUCTION

Theocolax Westwood belongs to the subfamily Cerocephalinae of Pteromalidae, members of which are parasites of small beetles associated with stored grains or anobiid beetles attacking dead wood. There are 6 species known under the genus in the world, out of which four occur in the Oriental Region (Noyes, 2001, (Table 1)). From the Indian subcontinent only *Theocolax elegans* (Westwood) is known which is commonly found together with Pteromalid parasites *Anisopteromalus calandrae* (Howard) and *Cerocephala dinoderi* Gahan, attacking small beetle pests infesting stored grains (Boucek *et al.*, 1979, Sureshan & Narendran, 2003). During the faunistic survey of Lonar Crater Wild life sanctuary of Buldhana district, Maharashtra (19°59" N; 76°34" E) by the Zoological Survey of India, Western Regional Station, Pune, one species of *Theocolax* was reared from pieces of dead wood of *Ficus* plant, which was heavily infested with wood boring beetles. The wood was infested with larger and smaller beetle larvae, the presence of which was indicated by numerous smaller and larger holes. On detailed examination it was revealed that the specimens of *Theocolax* emerged from the wood belong to an undescribed species, which is described hereunder. From the dead wood two beetle specimens of the family Cerambycidae viz. *Olenecamptus bilobus* Fabricius also emerged. Since beetles of the family Cerambycidae are not yet reported as hosts for *Theocolax* species, the possibility of the new species parasitising such beetles is excluded. Since the wood is infested with smaller beetles, probably of the family Anobiidae, it is assumed that the new species attack such beetles in dead wood.

The following abbreviations are used in the text : F1-F5–Funicular segments 1 to 5; OOL–Ocellocular distance; POL–Postocellar distance; SMV–Submarginal vein; MV–Marginal vein; PMV–Postmarginal vein; STV–Stigmal vein; T1, T2–Gastral tergites 1 and 2.

Table 1. : *Theocolax* species of the world.

Species	Host	Distribution
<i>Theocolax backeri</i> (Crawford, 1915)	Larval/pupal parasites of Scolytidae.	Philippines (Oriental)
<i>Theocolax elegans</i> (Westwood, 1874) (Brachypterous, macropterous and apterous forms known)	Larval or nymphal parasites of beetles associated with stored grains, common host : <i>Sitophilus oryzae</i> (rice weevil); other hosts : <i>Sitophilus granarius</i> , <i>S. linearis</i> , <i>S. zeamais</i> , <i>Sitotroga cerealella</i> , <i>Stegobium paniceum</i> , <i>Zabrotes subfasciatus</i> , <i>Bruchus analis</i> , <i>Bruchus chinensis</i> , <i>Callosobruchus maculatus</i> , <i>Acanthoscelides obtectus</i> , <i>Stegobium paniceum</i> , <i>Caulophilus latinasus</i> , <i>Caulophilus oryzae</i> , <i>Cryptolestes ferrugineus</i> , <i>Lasioderma serricorne</i> , <i>Prostephanus truncatus</i> , <i>Rhyzopertha dominica</i> , <i>Sphenophorus</i> , Chrysomelidae, Curculionidae, Scolytidae, Bostrichidae, Anobiidae, Gelechiidae	Cosmopolitan
<i>Theocolax formiciformis</i> Westwood, 1832 (Micropterous and Macropterous forms known)	Common parasite of <i>Anobium</i> sp. (Coleoptera) in dead wood. Other hosts : <i>Sitophilus granarius</i> , <i>Trypomyia carpini</i> , <i>Anobium punctatum</i> , <i>Hylesinus fraxini</i> , <i>Lyctus brunneus</i> , <i>Anobium</i> .	Western and Central Europe (Widely distributed), New Zealand, Nearctic, Australasian.
<i>Theocolax fasciata</i> (Ishii, 1956)	Not known	Japan
<i>Theocolax frater</i> (Girault, 1913)	Not known	Australia
<i>Theocolax phloeosini</i> Yang, 1989	Larval/pupal parasite. Recorded hosts : <i>Scolytus seulensis</i> , <i>S. butovitschi</i> , <i>S. schevyrewi</i> , <i>Phloeosinus aubei</i>	China (Oriental)

Theocolax radhakrishnani sp. nov.

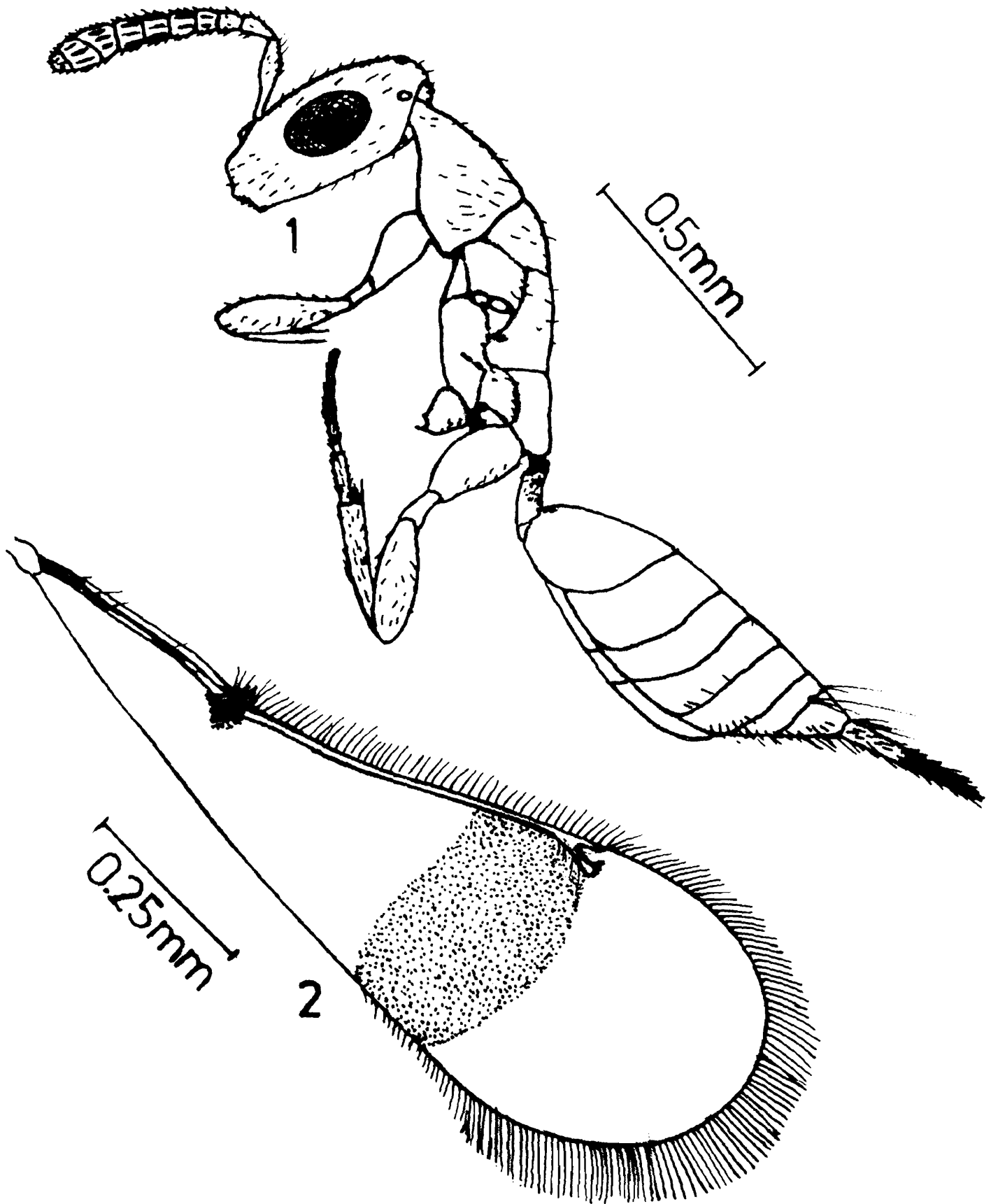
(Figs. 1-2)

Holotype : Female, Length 2 mm (including ovipositor). Dark brown; dorsal part of head, tip of antenna, mesosoma except propodeum, gaster and tip of ovipositor blackish; fore and hind coxae yellowish white; tegulae brown; wings hyaline with a brown transverse infumation below stigma.

Head : (Fig. 1) Almost rectangular in facial view, longer than wide, parallel sided, mostly smooth and polished except with small scattered piliferous punctures; face below level of antennal insertion finely reticulate with denser setae. In front view head 1.23x as long as wide; eyes separated 1.4x by their height; malar space 0.8x as long as eye; eyes 1.6x as long as wide in profile. In dorsal view head 1.8x as wide as long; temple length almost equal to eye length, ocelli small, POL 1.3x OOL, occipital carina fine, but distinct, almost touching posterior ocelli. Antennae inserted well below middle of face, scape as long as eye, maximum width of scape in middle, pedicel plus flagellum 1.3x head width, pedicel longer than F1, funicular segments becoming wider towards tip; F1–F3 equal in length, F4 and F5 equal but a little longer than F3, club a little shorter than three preceding segments combined.

Mesosoma : (Fig. 1) Pronotum bell shaped, 1.25x as long as wide in dorsal view, smooth and polished with scattered sparse white hairs, neck region distinctly but finely reticulate. Mesoscutum 1.3x as wide as long, polished with sparse piliferous punctures, notauli incomplete, in the form of fine groove with minute cross carinulae. Scutellum medially 1.21x as long as mesoscutum, and 1.2x as wide as long, polished, with 3 setae laterally on either side. Dorsellum very narrow. Propodeum uniformly and distinctly reticulate, medially as long as mesoscutum, median area almost flat, no median carina and plicae, callus with very small hairs; spiracles very small. Mesopleuron uniformly and finely reticulate. Metapleuron smooth and shiny. Forewing (Fig. 2) 3.2x as long as wide without discal setae; marginal fringe very long, a tuft of black bristles at parastigma, a broad brown infumation embracing apical half of MV and all of the STV and extending across the wing and a slight brownish infumation below parastigmal bristles. Relative lengths of SMV 14.5, MV 21, PMV 2 and STV 1.5. Relative lengths of hind coxa 9, femur 11, tibia 14 and tarsus 14, fore and hind femora a little swollen, hind tibia with 2 unequal spurs.

Metasoma : (Fig. 1) Distinctly petiolate, petiole long, only a little shorter than hind coxa in profile, gaster (without petiole and with ovipositor) 1.23x as long as head plus mesosoma combined, petiole distinctly reticulate, the first sternite is produced forwards under the elongate petiole and both sclerites are strongly sclerotised. In dorsal view they appear as one petiole which is more wide subapically with two small lateral spines and fine carinae on either sides; exerted part of ovipositor little shorter than half length of gaster (without petiole, including ovipositor),



Figs. 1-2. : *Theocolax radhakrishnani* sp. nov. Female : 1. body in profile; 2. forewing.

cerci long, posterior margin of T1 deeply notched in the middle as in *T. elegans*, posterior margin of T2 slightly emarginated, the remaining tergites almost straight.

Male : Length 1.2 mm. Closely resembles female, but differs in smaller size, shorter gaster and funicular segments of antenna more globular except first and second.

Material examined : HOLOTYPE : Female : INDIA : Maharashtra, Buldhana district, Lonar crater wild life sanctuary, 19.xi.2003, ex. Dead wood infested with wood boring beetles. PARATYPES : 1 Male, 3 Female, other data same as that of holotype. The type specimens are kept in the collections of Western Regional Station, Zoological Survey of India, Pune.

Biology : Not known. Reared from dead wood of *Ficus* plant extensively infested with wood boring beetles.

Etymology : The species is named after Sri. C. Radhakrishnan, Joint Director, Western Ghats Field Research Station, Zoological Survey of India, Calicut.

Remarks : The new species resembles *Cerocephala* species in having the peculiar longer petiole of the gaster and the long ovipositor. But it is placed in *Theocolax* because of the peculiar, elongate and rather long head, which is considered as the main character of the genus (Boucek, 1988). Boucek (1988) opined that *Theocolax frater* (Girault) with a long petiole may prove to belong to *Cerocephala*, but it seems to have a strong median carina and plicae on the propodeum and according to Gahan (1946) *T. frater* differs from *T. elegans* mainly in having the first funicular segment wider than long. Though the new species possesses an elongate petiole, the propodeum is without median carina and plicae and the first funicular segment longer than wide unlike in *T. frater*.

The new species can be readily distinguished from other species in having a long gastral petiole and distinctly elongate ovipositor. However in general morphology it closely resembles *T. elegans* (Westwood), but differs from *T. elegans* in having a long gastral petiole (only little shorter than hind coxa), long ovipositor, occipital carina almost touching the posterior ocelli and longer pronotum in *T. elegans*, the petiole is small, only a little longer than half of hind coxa, ovipositor very short, only 0.2x as long as gaster, posterior ocellus separated from the occipital carina by its diameter and pronotum shorter, almost as long as broad.

SUMMARY

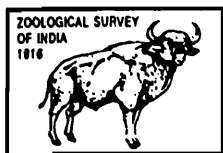
A new species of *Theocolax* Westwood viz. *T. radhakrishnani* is described from India and its affinities with other known species are discussed. The specimens of this species emerged from wood infested with anobiids.

ACKNOWLEDGEMENTS

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Rec. zool. Surv. India : **104** (Part 1–2) : 147-155, 2005

INVENTORY OF THE TRUE FLIES (DIPTERA) OF THE THAR DESERT

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INTRODUCTION

Great Indian Desert or the Thar Desert with its xeric environment is known to harbour an improvised fauna. The members of the order Diptera are commonly known as flies, gnats, midges, mosquitoes, keds, bots, etc. This diversity of names documents the importance of the group to man and reflects the range of organisms in the order. However, it is admittedly true that there is a paucity of knowledge on the account that does not show the Diptera of distinction that are absolutely prone to the arid and semi-arid situations in the desert.

A perusal of literature revealed that Kumar and Kumar (1996) have provided first exhaustive list of dipterans of the Thar Desert enumerating 84 species belonging to 45 genera spread over 22 families. However, recent studies on this group from Thar Desert by Parui and Mitra (2000), Banerjee and Mitra (2002) and Mitra *et al.*, (2002) have further substantially increased our knowledge bringing the tally of the species to 155 belonging to 77 genera spread over 27 families. The systematic list is as follows :

Suborder NEMATOCERA

Family 1. PHLEBOTOMIDAE

1. *Phlebotomus* (*Anaphlebotomus*) *colabaensis* Young & Chalam
2. *Phlebotomus* (*Euphlebotomus*) *argentipes* Annandale & Brunetti
3. *Phlebotomus* (*Paraphlebotomus*) *sergenti* Parrot
4. *Phlebotomus* (*Phlebotomus*) *papatashii* Scopoli
5. *Phlebotomus* (*Phlebotomus*) *salehi* Mesghali

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6. *Sergentomyia (Parrotomyia) babu* (Annandale)
7. *Sergentomyia (Parrotomyia) baghadadis* (Adler & Theodor)
8. *Sergentomyia (Sergentomyia) punjabensis* (Sinton)
9. *Sergentomyia (Sintonius) christophersi* (Sinton)
10. *Sergentomyia (Sintonius) clydei* (Sinton)
11. *Phlebotomus bailyi* (Sinton)

Family 2. CULICIDAE

Subfamily ANOPHELINAE

12. *Anopheles (Anopheles) barbirostris* van der Wulp
13. *Anopheles (Anopheles) nigerrimus* Giles
14. *Anopheles (Cellia) annularis* van der Wulp
15. *Anopheles (Cellia) culicifacies* Giles
16. *Anopheles (Cellia) dthali* Patton
17. *Anopheles (Cellia) fluviatilis* James
18. *Anopheles (Cellia) pallidus* Theobald
19. *Anopheles (Cellia) pulcherrimus* Theobald
20. *Anopheles (Cellia) splendidus* Koidzumi
21. *Anopheles (Cellia) stephensi* Liston
22. *Anopheles (Cellia) subpictus* Grassi
23. *Anopheles (Cellia) tessellatus* Theobald
24. *Anopheles (Cellia) turkhudi* Liston
25. *Anopheles (Cellia) vagus* Donitz

Subfamily CULICINAE

26. *Aedes (Aedimorphus) culicinus* Edwards
27. *Aedes (Aedimorphus) taeniorhynchoides* (Christophers)
28. *Aedes (Finlaya) sintoni* (Barraud)
29. *Aedes (Neomacleya) yusafi* Barraud
30. *Aedes (Stegomyia) aegypti* Linnaeus
31. *Aedes (Stegomyia) vittatus* Bigot
32. *Aedes (Stegomyia) w-albus* Theobald
33. *Coquillettidia (Coquillettidia) crassipes* (van der Wulp)
34. *Culex (Culex) barraudi* Edwards

- 35. *Culex (Culex) perplexus quinquefasciatus* Say
- 36. *Culex (Culex) pseudovishnui* Colless
- 37. *Culex (Culex) bitaeniorhynchus* Giles
- 38. *Culex (Culex) sitiens* Wiedemann
- 39. *Culex (Culex) tritaeniorhynchus* Giles
- 40. *Culex (Culex) univittatus* Theobald
- 41. *Culex (Lutzia) halifaxii* Theobald
- 42. *Culex (Mochthogenes) malayi* (Leicester)

Family 3. CECIDOMYIIDAE

- 43. *Contarinia prosopidis* (Mani)

Suborder BRACHYCERA

Family 4. STRATIOMYIDAE

- 44. *Adoxomyia heminopla* (Wiedemann)

Family 5. TABANIDAE

Subfamily TABANINAE

- 45. *Tabanus (Tabanus) rubidus* Wiedemann
- 46. *Tabanus (Tabanus) striatus* Fabricius

Family 6. ASILIDAE

Tribe LAPHRIINI

- 47. *Laxenecera albibarbis* Macquart
- 48. *Laxenecera flavibarbis* Macquart
- 49. *Nusa elva* (Walker)

Tribe STICHOPOGONINI

- 50. *Stichopogon meridionalis* Oldroyd
- 51. *Stichopogon inaequalis* (Loew)
- 52. *Cophinopoda chinensis* (Fabricius)
- 53. *Michotamia aurata* (Fabricius)
- 54. *Ommatius hradskyi* Joseph & Parui
- 55. *Ommatius ponti* Joseph & Parui
- 56. *Ommatius pseudokempi* Joseph & Parui

Tribe ASILINI

- 57. *Apoclea rajasthanensis* Joseph & Parui
- 58. *Astochia psedoguptai* Joseph & Parui
- 59. *Clephydroneura pulla* Oldroyd
- 60. *Philodicus pruthii* Bromley
- 61. *Philodicus femoralis* Ricardo
- 62. *Philodicus ceylanicus* Schiner
- 63. *Philodicus femoralis* Ricardo
- 64. *Philodicus javanus* (Wiedemann)
- 65. *Philodicus raoi* Joseph & Parui
- 66. *Promachus duvaucelii* (Macquart)
- 67. *Promachus melampyrgus* van der Wulp

Family 7. BOMBYLIIDAE

Subfamily TOXOPHORINAE

- 68. *Toxophora javana* Wiedemann

Subfamily BOMBYLIINAE

- 69. *Bombylius maculatus* (Fabricius)

Subfamily ANTHRACINAE

- 70. *Petrorossia albofulva* (Walker)
- 71. *Petrorossia nigrofemorata* (Brunetti)
- 72. *Anthrax bipunctatus* Fabricius
- 73. *Argyromoeba duvaucelii* (Macquart)

Subfamily EXOPROSOPINAE

- 74. *Thyridanthrax (Exhyalanthrax) absalon* (Wiedemann)
- 75. *Exoprosopa (Exoprosopa) collaris* (Wiedemann)
- 76. *Ligyra aurantiaca* (Guérin-Méneville)
- 77. *Ligyra oenomaus* (Rondani)

Family 8. PIPUNCULIDAE

- 78. *Tomosvaryella limpidipennis* (Brunetti)

Family 9. SYRPHIDAE

- 79. *Asarkina (Asarkina) ericetorum* Fabricius
- 80. *Ischiodon scutellaris* (Fabricius)
- 81. *Scaeva latimaculata* (Brunetti)
- 82. *Baccha (Allobaccha) sapphirina* Wiedemann
- 83. *Baccha (Allobaccha) umbrosa* Brunetti
- 84. *Eristalinus arvorum* (Fabricius)

Suborder CYCLORRHAPHA

Family 10. DIOPSIDAE

- 85. *Sphyracephala hearseiana* (Westwood)

Family 11. TEPHRITIDAE

- 86. *Euphranta (Staurella) crux* (Fabricius)
- 87. *Carpomyia vesuviana* Costa

Family 12. OTITIDAE

- 88. *Chrysomyza* sp.
- 89. *Physiphora aenea* (Fabricius)
- 90. *Physiphora demandata* (Fabricius)

Family 13. SEPSIDAE

- 93. *Sepsis cynipsea* Linnaeus
- 94. *Sepsis nitens* Wiedemann
- 95. *Saltella setigera* Brunetti
- 96. *Australosepsis frontalis* (Walker)

Family 14. AGROMYZIDAE

- 91. *Melanagromyza cuscatae* Hering
- 92. *Liriomyza trifolii* (Burgess)

Family 15. MILICHIIDAE

- 97. *Desmometopa singaporensis* Kertesz

Family 16. CHLOROPIDAE

- 98. *Anatrichus pygmaeus* Lamb
- 99. *Pachylophus rufescens* (de Meijere)

Family 17. EPHYDRIDAE

- 100. *Paralimna hirticornis* de Meijere
- 101. *Paralimna* sp.
- 102. *Brachydeutera longipes* Hendel
- 103. *Ochthera brevitibialis* de Meijere

Family 18. DROSOPHILIDAE

- 104. *Drosophila (Sophophora) ananassae* Doleschall

Family 19. HIPPOBOSCIDAE

- 105. *Hippobosca variegata* Megerle

Family 20. NYCTERIBIIDAE

- 106. *Basilina (Basilina) blainvillii amiculata* (Speiser)
- 107. *Basilina (Paracyclopodia) royliei* Westwood

Family 21. STREBLIDAE

- 108. *Brachyotheca lobulata* (Speiser)
- 109. *Brachytarsina (s.str.) maii* Advani & Vazirani
- 110. *Brachytarsina (s.str.) joblingi* Advani & Vazirani
- 111. *Brachytarsina (s.str.) theodori* Advani & Vazirani
- 112. *Brachytarsina (s.str.) sinhai* Advani & Vazirani
- 113. *Ascodipteron namrui* Maa
- 114. *Ascodipteron rhinopomatos* Jobling
- 115. *Parascodipteron scotophilus* Advani & Vazirani

Family 22. MUSCIDAE

Subfamily MUSCINAE

- 116. *Musca (Musca) domestica* Linnaeus
- 117. *Musca (Byomya) sorbens* Wiedemann

Subfamily PHAONIINAE

- 118. *Atherigona (Acritochaeta) orientalis* Schiner
- 119. *Atherigona (Atherigona) approximata* Malloch
- 120. *Atherigona (Atherigona) falcata* (Thomson)

- 121. *Atherigona (Atherigona) naqvii* Steyskal
- 122. *Atherigona (Atherigona) oryzae* Malloch
- 123. *Atherigona (Atherigona) soccata* Rondani

Subfamily STOMOXIINAE

- 124. *Stomoxys calcitrans* (Linnaeus)

Family 23. CALLIPHORIDAE

- 125. *Bengalia torosa* (Wiedemann)
- 126. *Chrysomya albiceps* (Wiedemann)
- 127. *Chrysomya megacephala* (Fabricius)
- 128. *Chrysomya rufifacies* (Macquart)
- 129. *Rhyncomya catalypsa* Séguy
- 130. *Stomohina discolor* (Fabricius)

Family 24. SARCOPHAGIDAE

Subfamily SARCOPHAGINAE

- 131. *Parasarcophaga (Liopygia) ruficornis* (Fabricius)
- 132. *Parasarcophaga (Liosarcophaga) brevicornis* (Ho)
- 133. *Parasarcophaga (Liosarcophaga) dux* (Thomson)
- 134. *Parasarcophaga (Parasarcophaga) albiceps* (Meigen)
- 135. *Parasarcophaga (Parasarcophaga) hirtipes* (Wiedemann)
- 136. *Parasarcophaga (Parasarcophaga) misera* (Walker)
- 137. *Parasarcophaga (Parasarcophaga) knabi* (Parker)
- 138. *Parasarcophaga (Parasarcophaga) orchidea* (Böettcher)
- 139. *Parasarcophaga (Parasarcophaga) sericea* (Walker)
- 140. *Iranihindia futilis* (Senior-White)

Family 25. TACHINIDAE

Subfamily PHASIINAE

- 141. *Cylindromyia fuscipennis* (Wiedemann)
- 142. *Cylindromyia wiedemanni* Crosskey

Subfamily TACHININAE

- 143. *Hystricovoria bakeri* Townsend
- 144. *Voria ruralis* (Fallén)

Subfamily GONIINAE

- 145. *Peribaea orbata* (Wiedemann)
- 146. *Peribaea suspecta* Malloch
- 147. *Carcelia (Senometopia) illota* (Curran)

Family 26. GASTEROPHILIDAE

- 148. *Gasterophilus intestinalis* (De Geer)
- 149. *Gasterophilus nasalis* (Linnaeus)
- 150. *Gasterophilus pecorum* (Fabricius)

Family 27. OESTRIDAE

- 151. *Hypoderma bovis* (Linnaeus)
- 152. *Hypoderma lineatum* (Villers)
- 153. *Przhevalskiana silenus* (Brauer)
- 154. *Cephalopina titillator* (Clark)
- 155. *Oestrus ovis* Linnaeus

DISCUSSION

The Thar Desert is decidedly arid, being characterized by low rainfall and high temperature. The subterranean water is certainly insufficient to support any but very scanty plant life. However, there is abundant growth of annual vegetation shortly after the commencement of the rainy season but the greenery withers with the withdrawal of the monsoon. All these adverse conditions impose restrictions also on the animal lives that not only interact among themselves but also with various plants, plant predators and plant parasites. Therefore, the desert does not exhibit a flourished fauna that normally occurs in other ecosystems.

The Great Indian Desert or Thar Desert covers part of the four Indian states (Punjab, Haryana, Rajasthan and Gujarat) and two provinces of Pakistan (Sind and Punjab). There are 28 districts of the 4 states coming under the Thar Desert of which major area lying in the states of Rajasthan (13 districts) and Gujarat (8 districts). Besides this, 4 districts of Haryana and 3 districts of Punjab are also fall under the Thar desert of Indian part.

However, among the 27 families so far reported from the Thar Desert major share has taken by the family Culicidae (31 spp.) and Asilidae (21 spp.) followed by Phlebotomidae (11 spp.), Bombyliidae & Sarcophagidae (10 spp.), Muscidae (9 spp.), Streblidae (8 spp.), Syrphidae & Calliphoridae (6 spp.), Oestridae (5 spp.), Sepsidae (4 spp.), Otitidae & Gasterophilidae (3 spp.), Tabanidae, Tephritidae, Agromyzidae, Chloropidae, Nycteribiidae & Tachinidae (2 spp.).

The families like Cecidomyiidae, Stratiomyidae, Pipunculidae, Diopsidae, Milichiidae, Drosophilidae, Hippoboscidae, are represented by single species.

The dipterans in their adult stage are generally terrestrial but some need to go to water for oviposition or so. Indeed, they are in their larval stages more moisture loving and the great majority live in water, in rotting vegetable or animal matter, inside living plant tissues or bodies of other animals or in substrata where necessary moisture for vital process exists. It is true that the scarcity of water in the desert prevents most aquatic Diptera from colonization and the semi-aquatic Diptera that live in soil or in plants and animals have to live either in or decaying matters thus cannot undergo complete development. In fact, the other cause of limitation to many such Diptera in the desert is the physiological draught mostly due to the salinity of soil and water they inhabit.

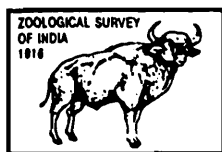
The arid and semi-arid situations of the desert are likely to support high size population of the Asilidae, the Bombyliidae, the Conopidae and the Nemestrinidae in their diversity but the recorded fauna does not depict the true picture except the Asilidae (21 species) and the Bombyliidae (10 species).

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KARYOTYPE CHARACTERISTICS OF FORTY-ONE SPECIES OF ORTHOPTERA AND THEIR EVOLUTIONARY TRENDS AT THE FAMILY LEVEL

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INTRODUCTION

Orthopterans form a large and prominent group in the class Insecta which includes more than 20,000 described species (Yadav and Yadav, 1986). Their abundance and world wide distribution makes them conspicuous in the animal world. Ever since the pioneer work of McClung (1905) at the dawn of the 20th century plethora of information on the karyology of this group has accrued. However, the chromosome biology of the Indian Orthoptera is comparatively less than those from the other parts of the world. It was Asana (1928) who initiated the chromosome study of insects in India. Yadav and Yadav (1986) have presented the chromosome number and sex determining mechanism in thirty species of Orthoptera confining mostly to northwest India. Since there is no separate list of the karyologically analysed species of Orthoptera from south India, present authors present the chromosome number, form and sex determining mechanism of 14 species of acridids, 14 species of tettigonids and 13 species of gryllids and an attempt has been made to discuss the evolutionary trends at the respective family levels. Table 1, 2 and 3 present the chromosome number and the morphology of previously published species in addition to unpublished data of some species.

MATERIALS AND METHODS

All the specimens of all the subgroups of Orthoptera were collected within a radius of 10 Kms of Manasagangotri Campus Mysore (south India). Testes and hepatic caecae were utilized for chromosomal preparations by applying the usual air dry Giemsa method.

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Table 1. : Number and morphology of chromosomes in Acrididae.

Sl. No.	Species	2n ♂	Chromosome morphology
OXYINAE			
1.	<i>Oxya nitidula</i> Walker	23	all acro (l, m, s) XL
CATANTOPINAE			
2.	<i>Brachyxenia</i> sp.	23	all acro (l, m, s) Xm
3.	<i>Catantops pinguis innotabilis</i> Walker		all acro (l, m, s) Xm
ACRIDINAE			
4.	<i>Acrida turrita</i> Linnaeus	23	all acro (l, m, s) XL
OEDIPODINAE			
5.	<i>Aiolopus</i> sp. 1	23	all acro (l, m, s) XL no. 5 pair with a/sm or sm/sm
6.	<i>Aiolopus</i> sp. 2	23	all acro (l, m, s) XL
7.	<i>Heteropternis respondens</i> Walker	23	all acro (l, m, s) XL
8.	<i>Acrotylus humbertianus</i> Saussure	23	all acro (l, m, s) XL
9.	<i>Gastrimargus africanus orientalis</i> Sjost	23	all acro (l, m, s) XL except no. 6, 7 and 9 pairs with variant morphs
10.	<i>Oedaleus abruptus</i> Thunberg	23	all acro (l, m, s) XL
11.	<i>Sphingonotus</i> sp.	23	all acro (l, m, s) XL
HEMIACRIDINAE			
12.	<i>Spathosternum prasiniferum</i> Walker	23	all acro (l, m, s) XL
CALLIPTAMINAE			
13.	<i>Acorypha glaucopsis</i> Walker	23	all acro (l, m, s) XL
COPTACRIDINAE			
14.	<i>Coptarca punctoria</i> Walker	23	all acro (l, m, s) XL (except no. 6, 9 and 10 pairs with variant morphs)

Note : l-long; m-medium; s-small; L-longer.

Publication : no. 9 and 14 published, others unpublished.

In *Gastrimargus africanus orientalis* and *Coptarca punctaria* no individual sample had all acrocentric chromosomes.

In *Aiolopus* sp. 1, 5th pair showed a/sm or sm/sm; a/a condition not observed.

Table 2. : Number and morphology of chromosomes in Tetigoniidae.

Sl. No.	Species	2n ♂	Chromosome morphology
LISTROSCELINAE			
1.	<i>Euhexacentrus annulicornis</i> Stol	12	4p meta, 1p micro meta, X meta Y micro meta
2.	<i>Euhexacentrus</i> sp.	9	4p meta, X acro
CONOCEPHALINAE			
3.	<i>Conocephalus maculatus</i> Le Guillum	21	7p meta, 2p sm, 1p sa, X meta
4.	<i>Euconcocephalus incertus</i> Walker	21	3p meta, 1p sm, 6p acro, X meta
PHANEROPTERINAE			
5.	<i>Elimaea securigera</i> Brunner	27	All acro, X Acro Variant karyotype
6.	<i>Holochlora spectabilis</i> Walker	29	All acro X Acro
7.	<i>Letana nigrosparsa</i> Walker	29	All acro, X Acro, Variant sat. Chro. Pair No. 8 sa
8.	<i>Himerta kinneari</i> Uvarov	31	All acro, X Acro
9.	<i>Himerta</i> sp.	31	All acro, X Acro
MECOPODINAE			
10.	<i>Mecaopoda elongata</i> Linnaeus	29	1p Meta, 7p meta, 5p sa, 1p acro X meta
11.	<i>Mecopoda</i> sp.	27	1p meta, 7p meta, 1p sm 44 sa, X meta
PSEUDOPHYLLINAE			
12.	<i>Sathrophyllia femorata</i> Linnaeus	35	All acro, X Acro
13.	<i>Phyllozelus pectinatus</i> Retd	35	All acro, X Meta
MECONEMATINAE			
14.	<i>Xiphidiopsis</i> sp.	33	1p meta, 2p sm, 3p sa, 10p acro X meta

Note : meta—med metacentric; sm—submetacentric; sa—subacrocentric; acro—acrocentric, Meta—large-metacentric; Acro—large acrocentric.

Publication : no. 1, 2 and 5 to 14 published (see Reference).

Euhexacentrus annulicornis is included under the subgroup INCERTAE SEDIS by Elzbeita Warchalowska-Sliwa (see *Folia biologica* (Krakow) 46 No. 3–4, 143–176, 1998).

Table 3. : Number and morphology of chromosomes in *Grylloidea*.

Sl. No.	Species	2n ♂	Chromosome morphology
Fam GRYLLIDEA			
1.	<i>Gryllopsis maculithorax</i> Chopard	19	1p meta, 8p acro, X meta
2.	<i>Gryllodes sigillatus</i> Walker	21	All auto acro, X Meta
3.	<i>Plebeiogryllus guttiventris</i> Walker	21	All auto acro, X Meta
4.	<i>Velarifictorus maindroni</i> Chopard	21	3p meta, 3p sm, 2p sa, 2p acro, X Meta
5.	<i>Velarifictorus dehradunensis</i> Tandon and Shishodia	25	6p sm, 5p sa, 1p acro, X Meta
6.	<i>Teleogryllus</i> sp.	27	10p meta, 2p sm, 1p acro, X Meta
7.	<i>Gryllus bimaculatus</i> DeGeer	29	3p meta, 4p sm, 3p sa, 4p acro, X Meta
Fam : NEMOBIINAE			
8.	<i>Pteronemobius taprobanesis</i> Walker	15	3p meta, 2p sm, 2p acro, X sm
9.	<i>Pteronembius csikii</i> Boliver	17	4p meta, 4p acro, X meta
Fam OECANTHIDAE			
10.	<i>Oecanthus</i> sp.	18	All auto acro, 1p l, 2p m, 5p s, X meta, Y acro
Fam TRIGONIDIIDAE TRIGONIDIINAE			
11.	<i>Trigonidium cicindelodes</i> Ramber	11	1p l sm, 4p meta, X meta
12.	<i>Trigonidium humbertianum</i> Saussure	11	3p meta, 2p sm, X Meta
13.	<i>Trigonidium</i> sp.	15	3p l. meta, 2p m. meta, 2p sm, X Meta

Note : meta–medium metacentric; sm–submetacentric; acro–acrocentric; l–large, m–medium; s–small.

Oecanthus sp. Neo-XY sex determining mechanism.

Publications : Published No. 1 and 6.

RESULTS AND DISCUSSION

Acrididae

All the acridids of the present study have a diploid number of 23 in males and the length and form of the chromosomes of all the species is tabulated (Table 1). The chromosomes of all the species are acrocentric including the X chromosome except in *Gastrimargus africanus orientalis* and *Coptarca punctaria* in which a few chromosomes are biarmed, keeping the diploid number intact. In *G. a. orientalis* 3 pairs of chromosomes namely 6th, 7th and 9th exhibit variant morphs in different individuals. Of the 3 pairs, the 9th pair is highly dynamic in that one homologue is always metacentric and the other partner is either acrocentric, subacrocentric, submetacentric or metacentric whereas the 7th pair is heteromorphic with acrocentric/subacrocentric. Further, the 6th pair is heteromorphic with meta/acrocentric (Aswathnarayana *et al.*, 1981, Ashwath, 1981). Similarly such structural variation has been encountered in *Coptarca punctaria* involving 6th, 9th and 10th pairs in different individuals. The 9th pair shows homomorphic metacentric, submetacentric and heteromorphic with metacentric/submetacentric chromosomes. The 6th pair is heteromorphic with meta/acrocentric and the 10th pair having meta/acrocentric condition (Umadevi and Aswathanarayana, 1987). In general, in the above mentioned species, no individual sample had all acrocentric chromosomes. These structural changes may be of the floating type or may be established in the karyotype as seen in one homologue of the 9th pair of *G. a. orientalis* as a metacentric. Such a change in the morphology of the chromosomes is attributed to pericentric inversion. With regard to the formation of a bi armed or metacentric chromosome, White (1973) stated that in acridids, although very short pericentric inversions might have been established in a few species, there appeared to be a 'special barrier' operating against longer inversions to establish metacentric morphology' The above examples confirm that only short inversions can give rise to biarmed chromosomes. Though Yadav and Yadav (1986) have analysed 29 species of acridids they did not discover structural variation in autosomes which may be due to geographical conditions.

Tettigonoidea

The tettigonids form a highly diversified group with chromosome number varying from 9 to 35 (Table 2). The diploid number of 9 is found in *Euhexacentrus* sp. (Aswathanarayana, 1998) and $2n = 35$ in species of *Pseudophyllinae* (Aswathanarayana and Ashawath, 1996). In Phaneropterinae subgroup, $2n = 27$ occurs in *Elimaia securigera*, $2n = 29$ in *Holochlora spectabilis* and *Letana nigrosparsa* and $2n = 31$ in *Himerta kinneari* and *Himerta* sp. In these species the chromosomes are all acrocentric including the large X-chromosome (Aswathanarayana and Ashwath, 1996). Rarely a few individuals exhibit variation in the morphology of a few chromosomes of the karyotype (they are called variant karyotypes). For example in *E. securigera* pairs 3, 4, 5 and 7 show structural changes. The pair no. 3 is heteromorphic with acrocentric/subacrocentric whereas pair nos. 4

and 5 are homomorphic with submetacentric and pair no. 7 has homomorphic subacrocentric chromosomes (Aswathanarayana and Srinivasa, 1993). In *L. nigrosparsa* pair no. 2 has satellited chromosomes and pair no. 8 is homomorphic with subacrocentric chromosomes. The structural changes in both the species are due to pericentric inversions. The sat-chromosome formation seem to be a secondary feature (Aswathanarayana, 1996). In Phaneropterinae, the typical karyotype has $2n = 31$ having all acrocentrics (probably has been ancestral) and it is possible that some species with lower numbers (for example $2n = 29$ and 27) must have evolved by tandem fusions (Aswathanarayana and Ashwath, 1996) Mecopodinae shows $2n = 29$ in *M. elongata* which has 8 pairs of metacentrics (one pair is large), 5 pairs of subacrocentrics and one pair of acrocentrics and the X is a large metacentric whereas *Mecopoda* sp. has $2n = 27$ which agrees with the *M. elongata* in all aspects except that it has only one pair of submetacentric and 4 pairs of subacrocentrics (Table 2). If the basic karyotype of the genus *Mecopoda* is assumed to be $2n = 31$ with all acrocentrics, then the karyotypes of both the above 2 species are considered to be derived from such a basic karyotype by centric fusion and pericentric inversion (Aswathanarayana and Ashwath, 1994). Even in Listroscelinae, the basic karyotype must have had $2n = 33$ as in the genus *Hexacentrus* (Aswathanarayana, 1998) with all acrocentrics from which *E. annulicornis* ($2n = 12$) and *Euhexacentrus* sp. ($2n = 9$) might have evolved by centric fusion, tandem fusion and pericentric inversion. Since many structural mechanisms are involved in the process, differentiation must have taken considerable span of time (Aswathanarayana, 1998).

According to White (1973) it may be assumed that $2n = 31$ is the basic (ancestral) chromosome number for most of the subfamilies of Tettigonoidea. But in Pseudophyllinae ($2n = 35$) and Meconematinae ($2n = 33$), the karyotype data are insufficient to draw any conclusion on evolutionary trends.

Grylloidea

Gryllids show a wide range of diploid numbers from 11 to 29. The lowest chromosome number of $2n = 11$ is in the species of *Trigonidium* and the highest of $2n = 29$ in *Gryllus bimaculatus*. In *Grylloides sigillatus* ($2n = 21$) and *Plebeigryllus guttiventris* ($2n = 21$) and *Oecantrus* sp. ($2n = 18$) all the autosomes are acrocentric but the X-chromosomes are metacentric. In all the other species viz., *Gryllopsis maculithorax* ($2n = 19$), *Velarifictorius maindroni* ($2n = 21$) and *V. dehradunensis* ($2n = 25$). *Telegryllus* sp. ($2n = 27$) and *Gryllus bimaculatus* ($2n = 29$) the karyotypes have a combination of acrocentric and biarmed chromosomes. The X chromosome in all the species is a large metacentric except in *Pteronemobius taprobanensis* in which it is a large submetacentric. In this group 21, 19 and 15 are the commonest numbers. So it is difficult to designate the basic number for the whole group. However, it is possible to indicate the generic modal numbers for almost all the genera; for example, in the genus *Gryllus* it is 29. *Grylloides sigillatus*,

Plebeiogryllus guttiventris and *Oecanthus* sp. are considered to be more primitive than the other species of Gryllinae and all species of Nemobiinae and Trigonidiinae. In general, Robertsonian changes must have taken place during the evolution of this group.

Sex chromosomes and Sex determining mechanism

In general, the sex determining mechanism in all the 3 subgroups Acrididae, Tettigonoidae and Grylloidea is XX : XO type except in *Euhexacentrus annulicornis* (Tettigonidae) (Aswathanarayana and Ashwath, 1985) and *Oecanthus* sp. (Glylloidea) (Ashwath, 1981) which have neo-X Y condition. It is known that neo-X Y condition is produced by centric fusion between X (of XX : XO) and an autosome and the homologue of the fused autosome forms a neo-Y

In 14 species of the acridids (Table 1), the X-chromosome is the largest and measures ca. 10 to 15% of the haploid set in different species. No species exhibited neo-X Y condition. But Yadav and Yadav (1986) have recorded neo-X Y condition in 3 species from Kurukshetra (North-West India) and are considered to be of recent origin.

The evolution of the X chromosome in tettigonids is of special interest and importance because it is generally large and in some strikingly large irrespective of its morphology. The length varies from ca. 16 to 30% of the haploid genome in different species. White (1973) stated that the X-chromosome had an independent evolution and its acrocentric condition was considered to be primitive from which other forms seem to have arisen in tettigonids. The largeness of the X-chromosome may not be due to the addition of heterochromatin as evidenced by our preliminary C-banding studies, since the amount of heterochromatin was almost the same or even less than in some of the large autosomes (Aswathanarayana and Ashwath, 1985 and 1994). It is not clear how the X-chromosome attains large size. In gryllids all the 13 species have generally large metacentric X-chromosome except in one species which has large submetacentric morphology. The X-chromosome measures ca. 14 to 23% of the haploid genome in different species.

SUMMARY

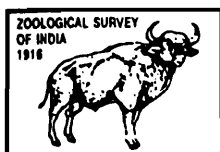
The chromosome number, morphology and sex determining mechanism of 41 species of Orthoptera are described and the trends of karyotype evolution at the family level are discussed.

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SOME OBSERVATIONS ON THE BIOLOGY OF *MICROTERMES UNICOLOR* SNYDER (TERMITIDAE) IN THE INDIAN DESERT

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INTRODUCTION

Four species of *Microtermes* (Termitidae : Macrotermitinae) occurs in Rajasthan, viz. *M. mycophagus* (Desneux), *M. obesi* Holmgren (Syn. *M. anandi*), *M. unicolor* Snyder and *M. bharatpurensis* Rathore (Rathore, 1989). Out of the four species imagoes of first three are known (Chatterjee & Thakur, 1964) and can be separated as follows :

Sl. No.	Description / Species	<i>M. mycophagus</i>	<i>M. obesi</i>	<i>M. unicolor</i>
1.	Total Body length with wings	17.4–21.9 mm	14.1–14.8 mm	17.3–18.7 mm
2.	Total Body length without wings	09.8–12.3 mm	09.4–10.2 mm	09.4–10.8 mm
3.	Colour of head and body	Pale yellow brown	Dark chocolate	Pale yellow brown
4.	Eyes and ocelli distance	Not close	Not close	Very close
5.	Distribution (Vide Roonwal & Bose, 1964, 1969; Ahmad, 1955; Choudhary and Ahmed, 1972)	W. India and Pakistan (An Arid Zone species)	Widespread in India, Pakistan, Bangladesh and Srilanka	Widespread in N. India and Pakistan
6.	Status	Most common	Common	Rare

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All the four species are subterranean in habit (Roonwal, 1976) and they attack old timber as well as agriculture crops. Information on the biology is very scanty. In the present paper, data on swarming, post-swarming behaviour, oviposition, brood care, egg character, hatching and post hatching behaviour of newly formed nymph and predators of *M. unicolor* are described.

MATERIAL AND METHODS

Both field (Swarming) and laboratory observations (breeding in glass petri dishes of diameter 75–100 mm) were taken at Jodhpur during the year 1996. Alates were collected from swarming population, which take place after the two or three monsoon showers. Alates were collected and kept in pairs in petri dishes containing sufficient quantity of moist soil with little humus and one or two pieces of wood as food. A few drops of water were added usually after the interval of 3 to 4 days gap to maintain adequate moisture in the petri-dishes. The outside air temperature (1996) of Jodhpur during June to August was hot, but was somewhat cooler in September. The mean maximum and minimum temperature (°C) were 38.3 and 27.5 in June, 34.9 and 26.2 in July, 31.9 and 24.3 in August and 29.6 and 23.5 in September 1996.

RESULTS AND DISCUSSION

Swarming

Swarming occurs at night (8 PM to 8.30 PM) during a period of about 8 weeks, from end of June to the third week of August (26th June to 20th August), in the Jodhpur district (Jodhpur, Mandor, Banar) in sparse to dense swarms which are attracted to light. Similar swarms were collected by one of us from Jaisalmer district during year 1995.

The weather during swarming is always very calm, sultry and some time cloudy also. On some occasions, simultaneous swarming was recorded at same hour of the same day from different localities of Jodhpur, 1 to 5 km away from each other, suggesting some influence of the prevailing weather, such as rains, temperature and humidity. Each swarming session last about half an hour. The alates fly rapidly and often crowd around streetlights.

Elsewhere in India (Dehra Dun, Uttar Pradesh), swarming has been recorded as occurring, from tiny holes in the ground, in early June 5th, (Mathur and Sen-Sarma, 1960); similarly early swarm was reported by Thakur (1991) from April to August and in Doon Valley at night (1900–2100 hrs) in the month of June, usually after rainfall. In Pakistan (Ahmad, 1955) swarming occurs in July and August in Lahore on 13th July and in Mardan on 18th August.

Post-swarming behaviour

After flying for half an hour or so, sometimes less, the alates descend to the ground and by usual process of turning and twisting the body, casts off their wings. Immediately after this they

start running about in tandem pairs, a male closely following a female and touching her hind end with his fore mouth-parts, specially the antennae. Occasionally both male and female of the tandem couple may still be winged. In the field this tandem couple goes on crawling for period up to 1 hour, after which they disappear underground. In the laboratory, the dealates obtained from swarms were released in petridishes (75 mm to 100 mm diameter) in pairs. They immediately start digging in soil quickly, forming a small brood-chamber, later on extending it into zigzag tunnels. Tandem is strongly marked in this species.

Oviposition, eggs and hatching

Early egg laying by primary reproductives was observed in the laboratory in individual pairs. In 4 separate oviposition by 4 females, 44 eggs were laid by them during the 27–29 days of their lives (after which all the four pair died by infection of fungi). The following are the principal conclusions :

- (i) The first oviposition occurs on 4th day after swarming. This gap has also been observed by Roonwal and Rathore (1974, 1975a, b), Nutting (1969), Rathore (1977, 1994) in other termites in different localities as well as in laboratory. Eggs are laid in clusters of 6–8.
- (ii) Thereafter eggs were laid on 7th day, in the “First spurt” of egg-laying which lasted 1–4 days during this phase 2 successive egg-laying occurred, the number of eggs laid per female being 9–13 (average 11.0). The number of eggs laid per female was highest at the 1st oviposition (average 7.2).
- (iii) The first spurt of egg-laying was followed by a “rest period” of 22 days.
- (iv) There was no second period of egg-laying in all the four pairs till their death (27–29 days).

Brood care and egg-shifting

In single pair breeding, it was observed that while the female laid the cluster of eggs at different places in the brood chamber, then later on all the eggs lightly glued and gathered together in a single mass. For this purpose, the parents lift the egg cluster one by one with the mouthparts. The two parents in the brood chamber sit quietly for hours near the eggs though not necessarily touching them, but some time they pick up the egg mass and deposit it in another place in the tunnel.

Egg-character and size-increase during development (Fig. 2A)

The freshly laid eggs of *M. unicolor* are suboval with rounded ends. The dorsal surface of egg is convex and the ventral slightly concave. It is paler in colour and measures 0.60–0.61 mm in length (L) and 0.30–0.31 mm in maximum width (W), the ratio W/L being 0.50; the egg is thus of the “broad type” as indicated by Roonwal (1973).

There are 10–12 micro-pyles situated on the convex dorsal surface of the egg near its posterior end. The micropylar apparatus is of the “concentrated type” and the canals are arranged in an irregular row with funnel mouth close (Fig. 3 A, B, C).

During development the egg increases in size (presumably by the imbibition of external water, (as happens in many other insects) by 12.5% in length and 12.5% in width and become, more turgid and plump (Fig. 2B & C). The egg-size increase as in Table 1.

A similar size increase has been noted in other termites from the Indian desert, viz. *Anacanthotermes macrocephalus* (Roonwal & Rathore, 1975a), *Angulitermes jodhpurensis* (Roonwal and Rathore, 1974), *Microtermes mycophagus* and *M. obesi* (Roonwal and Rathore, 1975b), *Eremotermes paradoxalis* (Rathore, 1977) and *Microcerotermes raja* (Rathore, 1994), as well as termites from other regions. It is observed that the growth rate of eggs in all the species follows a similar pattern.

Table 1. : Increase in egg size.

Age of egg	Length (mm)	Maximum width (mm)
1 day	0.60–0.61	0.30–0.31
8 days	0.62–0.64	0.32–0.34
17 days	0.66–0.68	0.36–0.38

Incubation period and hatching (Fig. 1)

Thirteen eggs were laid in two sessions from 28th to 31st July 1996. These hatched from 14th to 16th August, 1996. The incubation period was 17–19 days. Data on incubation period of eggs in Isoptera are scanty and are limited to 17 species. In other species it is reported to be 15–90 days depending on air temperature (Roonwal & Rathore, 1974, 1975a, 1975b) (Rathore, 1977, 1994), (Mukherji, 1970; Waston *et al.* 1971).

Eggs were laid in the laboratory during July 1996 and hatching took place in August during a period spread over 3 days (14th to 16th August 1996); 13 eggs hatched during this period. The first egg hatched on 18 days after laying. A day or two before hatching, forwardly directed peristaltic movements on the dorsum of the embryo (covering the hind part of the head thorax and distal part of the abdomen) were noticed. The movements were weak and slow in the beginning but become quicker later on. With the aid of peristalsis and the “hatching spines”, on the head and body, the egg shell was burst at the head region and the head come out first from the egg. The embryo remained in this position for hours. Later on the whole body wriggled out of the egg-shell and thus hatching was completed.

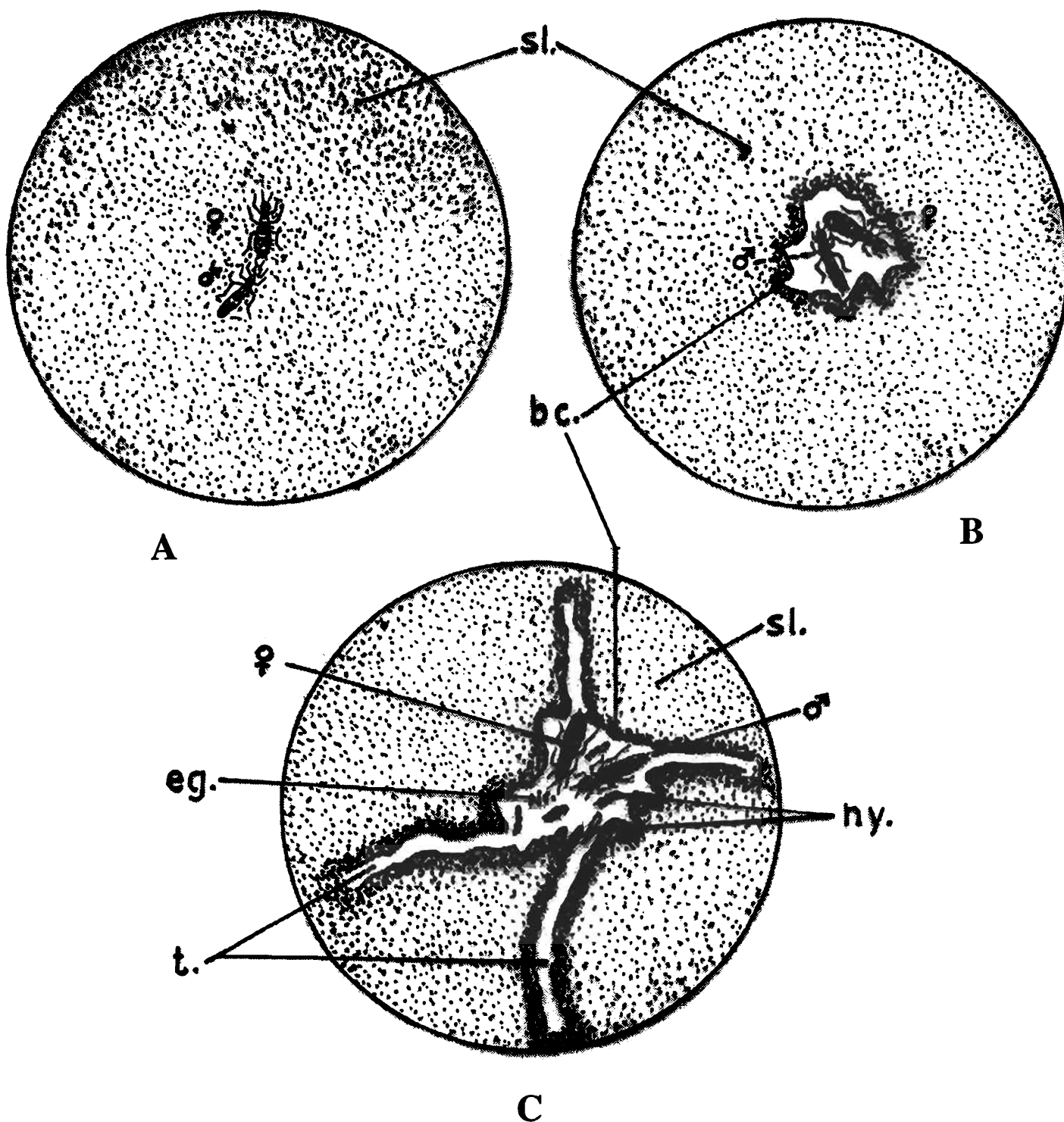


Fig. 1. : *Microtermes unicolor*. Post-swarming activities of dealated imagoes as observed in single-pair breeding (1 male, 1 female) in small petridish diameter 75 mm, with soil. Swarming at Jodhpur at 8 P.M. on 24th July, 1996 at AFRI compound, Jodhpur. Except in Fig. A, Observations made from bottom of dish. (A) 25, July, 96 pair in courtship-tandem just after release in dish. (B) Dealates have made a cavity (brood chamber) in soil 25th July. (C) After 28 days colony with nymphs moving in zig-zag tunnels having direct connection with brood chamber. b.c., brood chamber; eg., eggs, ny., nymphs, sl. soil., t. tunnels.

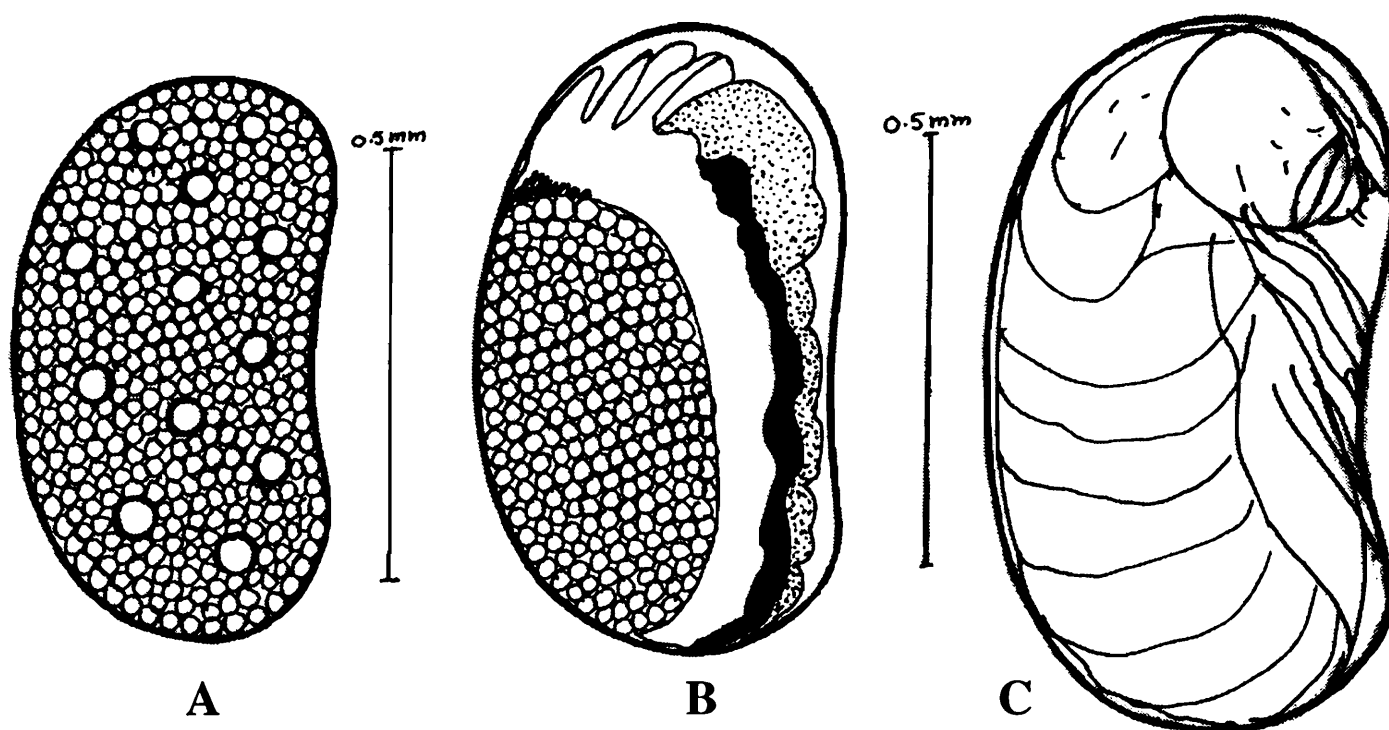


Fig. 2. : *Microtermes unicolor*. Egg from oviposition to near hatching. Breeding in the laboratory at Jodhpur July to August, 1996. (A) Outline of freshly laid egg. (B) Outline of 8 days old egg. (C) Egg one day before hatching, embryo seen through the translucent egg wall.

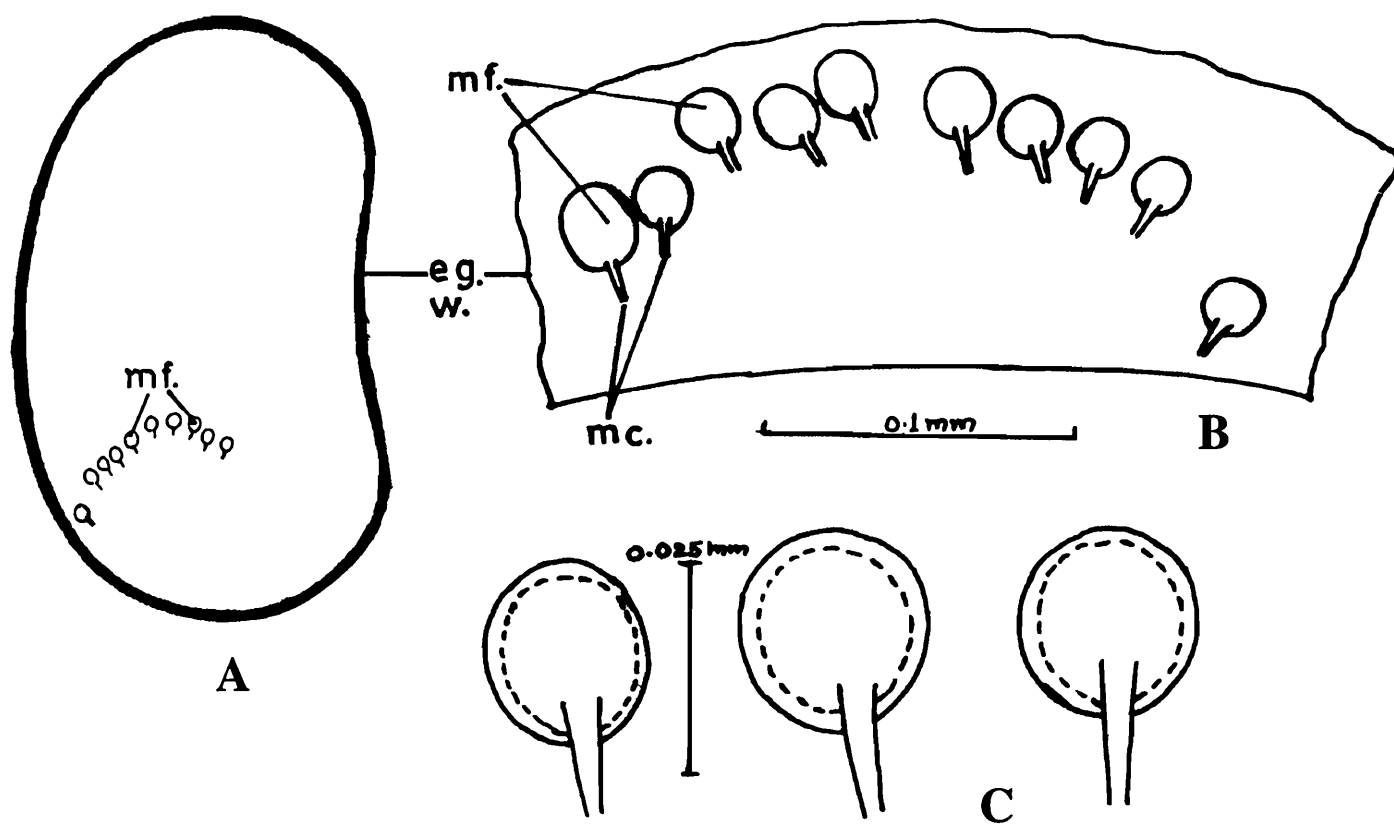


Fig. 3. : *Microtermes unicolor*. (A) Showing relative position of micropyles on dorsal surface. (B) Portion of egg wall showing arrangement of micropyles. (C) Same as 'C' but two micropyles enlarged. eg. w., egg wall, mc., micropylar canal, mf., micropylar funnel.

First stage nymph (Fig. 4 A-G)

A few minutes after hatching and cleaning of the body of the young by the parents, the first stage nymph started moving slowly in the brood chamber. The nymph was milky white in colour and its body was covered with small to medium sized hairs, being longest on the cerci. The antennae had 12 segments, the number in alates being 15, in soldier 14 and 14–15 in worker. The body measurements of the newly hatched nymph are as follows :

(1)	Total body length up to tip of Labrum	1.40–1.50 mm
(2)	Maximum width of Head	0.40–0.42 mm
(3)	Head length	0.44–0.46 mm
(4)	Length of Antennae	0.50 mm
(5)	Max. width of Pronotum	0.25 mm
(6)	Max. width of Abdomen	0.46–0.48 mm
(7)	Max. length of Style	0.08 mm
(8)	Max. width of Style	0.02 mm
(9)	Max. length of Cercus	0.06 mm
(10)	Max. width of Cercus	0.015 mm

Predators

At Jodhpur and other places swarming imagoes both at flight and when they alight on to the ground were seen to be eaten in large number by lizards, bats, toad, ants etc.

SUMMARY

Some aspects of the breeding biology of *Microtermes unicolor* are recorded. Swarming takes place at night during the end of June. Alates emerge from tiny holes in the ground. Egg-laying habits, brood-care hatching and post-hatching developments are recorded for the first time. After swarming and dealation, the dealates show strong tandem behaviour for few hours. They then go under ground and form a small brood-chamber along with some tunnels. Eggs are laid on the 4th day after swarming and again on the 7th day. This spurt of egg-laying activity continues for 1–3 days during which a female lays about 9–13 eggs. This is followed by a long rest period of about 22 days. Eggs increase in size during development, presumably by the imbibition of external water. The incubation period is 17–19 days. The hatching process and newly hatched nymphs are described and its predators are also listed.

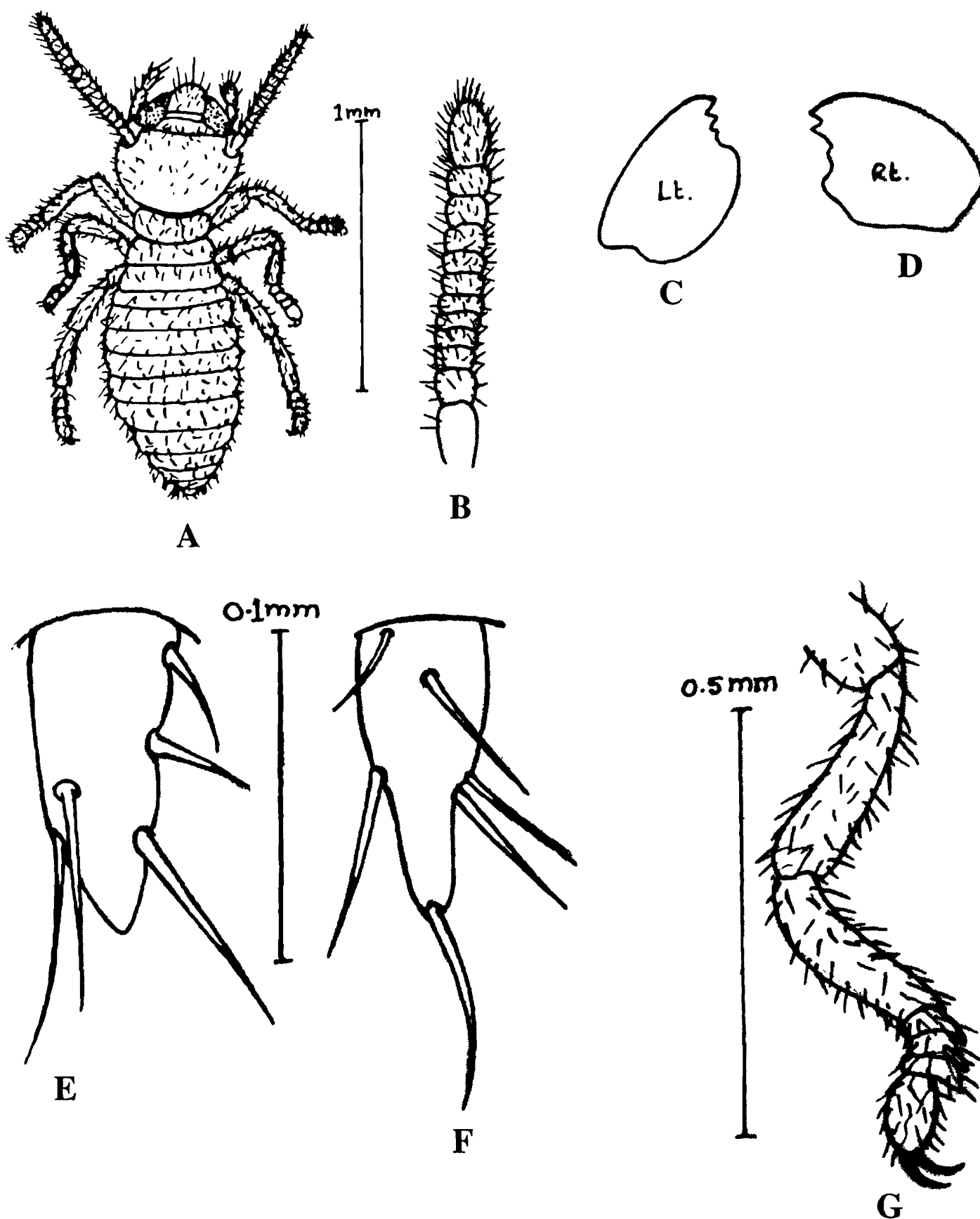


Fig. 4. : *Microtermes unicolor*. Freshly hatched first stage nymph (A) Nymph in dorsal view. (B) Right antenna, enlarged. (C & D) Right and left mandibles, enlarged. (E) Left style, enlarged. (F) Left cercus, enlarged. (G) Distal end of Left hind leg, enlarged.

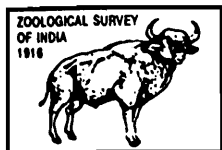
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Rec. zool. Surv. India : **104** (Part 1–2) : 175-178, 2005

Short Communication

ON THE OCCURRENCE OF *REDIGOBIUS RÖMERI* (WEBER) (PISCES : GOBIIDAE) IN THE MAINLAND OF INDIA

INTRODUCTION

Through a recent survey of Dakshin Kannada, Karnataka, six specimens of *Redigobius römeri* (Weber) were collected by Zoological Survey of India parties. Talwar and Jhingran (1991) included six species under the composite genus *Stigmatogobius* with a remark that *römeri* has not been reported from Indian inland waters though recorded from some insular parts of the Indo-west Pacific. This is the first report of this species from the inland waters of the mainland of India. It has been reported earlier from Sulawesi, Mollucas, New Guinea, the Philippines, Fiji, Australia, Java, Andamans, all insular areas, and hence is of Ichthyological significance. The specific identity of the species is discussed.

KEYWORDS : Gobiid fish, *Redigobius römeri*, *neglectus*, India.

***Redigobius römeri* (Weber)**

(Fig. 1)

Gobius römeri Weber, 1911, *Abh. Senckenb. Naturf. Ges.*, **34** p. 39, fig. 8.

Stigmatogobius neglectus Koumans, 1932, *Zool. Meded.*, **15**, p. 5.

Pseudogobiopsis römeri : Koumans, 1935, *Zool. Meded.*, **18**, p. 132.

Stigmatogobius römeri : Koumans, 1953, *Fish. Indo. Australian Arch.*, **10**, p. 113.

Material : 6 exs. 26.5–29.0 mm SL., Reg. No. F.6136 ZSI/SRS., 15.04.1999, Alt. 100 m., Kukki, Subramania, Kallagi, G. Thirumalai & party. 1 ex., 24 mm. SL., Reg. No. F.7363 ZSI/SRS., 27.02.2002, Seedhanadhi, Karnataka, Arunachalam & party.

Description : D. 1. VI; D.2.1.7; A.1.6; L.1. 25–27; L. tr. 6½–7; Predorsal scales 8–9. Body elongate, posteriorly compressed, its depth 6.33 (5.53–7.71) in SL, 7.36 (6.68–8.78) in TL; width of body 7.15 (5.97–8.29) in SL, 2.08 (1.77–2.46) in HL. Head subcylindrical to compressed,



Fig. 1. : Lateral view of *Redigobius romeri*, 26.5 mm. SL, F.6136, ZSI/SR.

its length 3.34 (3.11–3.63) in SL, 4.19 (4.06–4.39) in TL; its depth 1.68 (1.53–1.90) in HL, 5.63 (5.14–6.19) in SL; its width 1.55 (1.43–1.69) in HL, 5.19 (4.91–5.58) in SL. Snout shorter than eye, its length 4.43 (4.21–4.60) in HL; its tip before or below lower margin of eye; interorbital width $1/3$ – $1/2$ eye diameter, 12.45 (7.74–15.5) in HL; maxillary extends to below middle of eye in females its length is 2.57 (2.19–2.92) in HL. Teeth in front in several rows, outer row a little enlarged, no canines. Tongue emarginate to bifid. Two mucous canals longitudinally on cheek, a vertical canal behind preopercular border, another along lower border of cheek extending upto maxilla; a pair of anterior interorbital pores, a median posterior interorbital pore, a pore behind eye, a few pores below lower margin of eye, a pore on posterior end of preopercle, several pores along preopercular border and a few along its lower border; a row of pores run parallel to sensory canal row below cheek and mandible. Head scaled above behind eye; scales of head, nape, breast and belly cycloid; other scales ctenoid.

DISCUSSION

Koumans (1935, 1941) placed *römeri* Weber under the genus *Pseudogobiopsis*, based especially on the prolonged maxillary, narrow interorbital width and emarginate to truncate tongue.

A species similar to *römeri* but without the prolonged maxillary, he (1932) described as *Stigmatogobius neglectus* and remarked (1941) that “it is possible that this species is the female of *Pseudogobiopsis römeri* (Weber). In that case, the male will have a prolonged maxillary, while in the female the maxillary is not prolonged” Subsequently Koumans (1953) treated *neglectus* as a junior synonym of *römeri*.

In a recent work by Kottelat *et. al.* (1993) both the species were kept separate under different genera, *römeri* under *Redigobius* Herre and *neglectus* under the genus *Pseudogobiopsis* Koumans, with a note that this is possibly a synonym of *Redigobius römeri* as communicated to him by H. K. Larson. Of the several generic characters of *Redigobius* given by Koumans (1953), a significant feature is the presence of numerous short canals radiating under the eyes. However, both *römeri* and *neglectus* have only two longitudinal canals on cheeks. The key provided by Kottelat *op. cit.* assigns the species with radiating canals under eye to the genus *Stigmatogobius* and the species with only longitudinal rows under the genus *Redigobius*. This genus is also characterised by paired interorbital pores. (Fig. 280 in Kottelat Figs. A & B are found to be interchanged).

The specimens collected from Karnataka bear some resemblance to the picture captioned as *isognathus* in pl. 70 of Kottelat (*op. cit.*). However the description of both the species given in Koumans (1952) enables the identification of the Karnataka specimens as *römeri* especially by its bilobate tongue and paired interorbital pores whereas in *isognathus* the tongue is rounded and the species lack interorbital pores.

A comparison of the biometric details of the specimens from Karnataka with those of *römeri* Koumans 1953 indicate no significant differences except in body depth, the present specimens being comparatively more slender. On dissection all the 6 specimens were observed to be females. Earlier females of this species have been described as *neglectus* by Koumans (1941).

SUMMARY

Redigobius römeri (Weber) is reported for the first time from the mainland of India. The specific identity of the species is discussed.

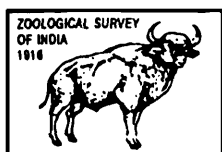
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Short Communication

A SIGHT RECORD OF THE GLOSSY IBIS, *PLEGADIS FALCINELLUS* (LINNAEUS) [THRESKIORNITHIDAE : AVES] FROM CHENNAI, SOUTH INDIA

INTRODUCTION

The avian family Threskiornithidae comprises of 25 species of ibises and 6 species of spoonbills known from the world over (Walters, 1981). Among the ibises, the White Ibis or black headed ibis, *Threskiornis melanocephalus* (Latham), the Indian Black Ibis, *Pseudibis papillosa* (Temminck) and the Glossy Ibis, *Plegadis falcinellus* (Linnaeus) have so far been recorded from India (Ali and Ripley, 1983; Grimmett *et. al.*, 1999). During a field survey conducted on 7th September, 2001, the authors could locate a flock of Glossy Ibises along with a few Median Egrets, *Egretta intermedia* (Wagler) and Black winged Stilt, *Himantopus himantopus* (Linnaeus) foraging in the marsh land at Okkium Thorapakkam, a locality adjoining the Pallikaranai swamp, 22 Kms. South of Chennai, Tamilnadu. The flock (Plate-I) comprised of a non-breeding population of about 70 individuals and could easily be identified as belonging to the Glossy Ibis, *Plegadis falcinellus* by the species characteristics such as brown down curved bill, feathered head, the body with brown and glossy green-blue colour, absence of a white patch near shoulders and wings etc. The plumage colouration, brownish black with a purple and green iridescence, makes the bird appear glossy black from a distance.

In Tamilnadu, The Glossy Ibis has been sighted twice in Vedanthangal Sanctuary, Kancheepuram district (Kannan, 1984; Shiromoney, 1984). However, the present record forms the first report of the species from Chennai Metropolitan area.

The Glossy Ibis is a widely distributed water bird found in temperate and tropical Eurasia to Indonesia and Australia, Africa, Madagascar, West Indies and the Caribbean. Among the Ibis species found in India, Glossy Ibis is the rarest. It is partly resident and nomadic, and partly a winter visitor to southern India. The bird inhabits large lakes, marshes, riverbanks, flooded grasslands, paddy fields, and often-found very locally distributed (Alfred *et. al.*, 2001; Ripley, 1982).

PLATE I



Glossy Ibis, *Plegadis falcinellus* (Linnaeus) observed at Chennai.

They are gregarious, usually found in flocks comprising of 40–50 members, and are colonial nesters. They breed in colonies usually in association with egrets and herons. However, this cosmopolitan bird can be described as having no fixed abode nesting to any regular or foreseeable pattern being unpredictable and even more temperamental than other Ibis species (Hancock, 1984). Ripley (1982) has reported several new sightings of the Glossy Ibis, vagrant to Sri Lanka and Maldives Islands. In south India, the bird has been reported in recent years in Kerala from Kannur, Thrissur and Palakkad districts (Sasikumar *et. al.*, 1991; Ravindran, 1993; Praveen and Kumar, 1996), and in Karnataka only from Dharwad (Desai, 1996). The marshland habitats in the vicinity of the Pallikaranai wetland area near Chennai, appears to be an ideal feeding and foraging ground-like one among a few of such important sites found on the Deccan Plateau – for a wide range of water birds including the rare Glossy Ibis. These observations confirm that in recent years the Glossy Ibises tend to colonise suitable habitats in newer sites. Hancock (1984) while studying the water birds of Indonesia, has observed that a few water birds species including the Glossy Ibis appear to have transferred their activities to the less disturbed island of Pulau Rambat off the coast nearer to Jakarta. The recent new sighting records of the bird in south India can be attributed to the nomadic habit of the bird being a will-o'-the-wisp species. However, it maybe worth investigating whether there is any environmental disturbance-taking place in its former ranges. It may be all the more important to study this aspect in Vedanthangal bird sanctuary in Tamilnadu, which is only 86 kms. away from Chennai particularly in view of the current sighting of the Glossy Ibis in Chennai.

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