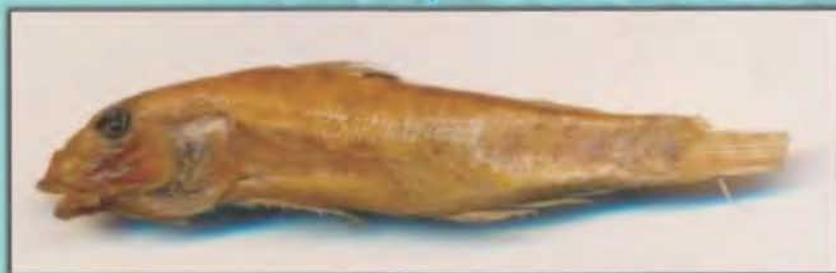


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FEASIBILITY STUDY REGARDING RE-INTRODUCTION OF PYGMY HOG (*PORCULA SALVANIA* HODGSON, 1847) AT GORUMARA NATIONAL PARK, JALPAIGURI, WEST BENGAL

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INTRODUCTION

Captive breeding and subsequent re-introduction of a threatened species is an important and in some cases very successful tool for species conservation. Now-a-days re-introductions using captive-bred individuals are not uncommon than the translocations of wild species.

In the year 1998, International Union for Conservation of Nature & Natural Resources (IUCN) provides the following definition "Re-introduction is an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct". It can also be defined as "The release of captive-bred or wild-caught animals into areas they no longer inhabit or in which their numbers have been seriously depleted within their historical range" [Laidlaw, 2001].

However, re-introduction is always a very lengthy, complex and expensive process and requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. They may include persons from governmental organizations; natural resource management agencies; non-governmental organizations; funding bodies; universities; veterinary institutions and zoos (and or private animal breeders), with a full range of suitable expertise [IUCN, 1998].

The Pygmy Hog (*Porcula salvania* Hodgson, 1847) has long been categorized by IUCN as

Critically Endangered [Red List Category C2a(ii)] – is among the most threatened of all mammals. It is listed on Appendix-I of CITES and Schedule-I Part-I of the Indian Wildlife (Protection) Act, 1972 [Anonymous, 2007b; CITES, 1983]. However, it was formerly presumed to occur across a narrow strip of early successional tall grassland plains along the Himalayan foothills, extending from south Nepal to Sikkim, northern part of West Bengal, through parts of Bhutan and north-western Assam. By the early or mid 1980's the species was reduced to a single, fragmented population in the Manas Tiger Reserve, and all of other smaller populations were confirmed or feared extinct [Oliver, 1980 & 1981; Oliver & Deb Roy, 1993; Narayan *et al.*, 2008a]. Pygmy Hog Conservation Program (PHCP) was formally launched in 1995 for conservation of the Pygmy Hogs and alongwith other endangered species of tall grasslands of the region through field research, captive breeding and re-introduction of the hog after adequate restoration of degraded former habitats [Narayan *et al.*, 2010]. Under this programme, 16 captive bred Pygmy Hogs (7 male and 9 female) were re-introduced in Sonai Rupai Wildlife Sanctuary of Assam (in May, 2008). Again in May 2009, nine hogs (4 male and 5 female) were released in the same Protected Area [Narayan *et al.*, 1999; Narayan, 2001, 2004 & 2006; Narayan & Deka, 2002; Narayan *et al.*, 2008b]. It is always very difficult to monitor these released animals in the absence of any direct sightings. However, it is clear from the secondary evidences

(i.e. nests, forage marks, hoof marks and pellets/scats) that these re-introduced animals are thriving well in wild [Deka *et al.*, 2009].

Therefore, it is high time to re-introduce these captive born Pygmy Hogs to other Protected Areas (where they have been extirpated or became locally extinct) which falls under its known historic distribution.

HISTORICAL REVIEW

Distribution

Due to its long absence and no available data from wild, zoologists thought that the species might have been extinct. Even, E. P. Gee (1964) wrote in his literature that this interesting and unusual member of the pig family is feared to be extinct. Fortunately, Pygmy Hog reappeared dramatically in March, 1971. A twenty four hour long wood fire in north western Assam (Barnadi Reserve Forest, a buffer zone of Manas Tiger Reserve) forced the Pygmy Hogs to migrate and take shelter in the tea garden alongwith another closely associated species Hispid Hare (*Caprolagus hispidus*) [Mallinson, 1971 & 1977; Tessier-Yandell, 1971a & 1971b; Oliver, 1978 & 1980]. It created great impetus among interested zoologists. They ventured to study the breeding and population biology of this animal. Though their works are mainly concentrated on captive animals, yet the results have great role to play in determining the status of this the tiniest pig in the world [Ghosh, 1988]. After several attempts the animals were found in the core area of the Manas Tiger Reserve [Oliver, 1991].

The former known distribution of the species is not clearly known, as most of the records are dependent on occasional chance observation, mainly 'shikari' accounts. However, this species has been reliably recorded from typical lowland savannah possibly indicating poor migratory ability [Oliver, 1978].

The species was formerly widely, but possibly discontinuously, distributed among the Himalayan foothills from north-west Assam, through parts of Bhutan, northern part of West Bengal and Sikkim to South Nepal. This species

has never been recorded as far west as Uttar Pradesh. In Assam, the distribution of Pygmy Hog is limited eastwards by the disappearance of the thatchlands in the region of North Lakhimpur with an increasing abundance of evergreen forest and heavier rainfall [Oliver, 1985 & 1989]. The width of this belt is approximately 5-15 miles [Mallinson, 1971] [Figure 1]. However, loss and degradation of forest habitat due to the expansion of human settlement and agricultural encroachment, uncontrolled dry season grass burning, injudicious high land during flood and replacement of these grasslands with commercial tree plantations make this Pygmy Hog to become shrunken to a small and last viable wild population only at Manas Tiger Reserve. Unfortunately this area is also threatened by political instability and also has been included on the IUCN List of Threatened Protected Areas [Bezbarua *et al.*, 2005].

In West Bengal very little informations is available regarding its distribution. In December, 1989 some dome-shaped nests made up of grass and other vegetation was observed in the 'low alluvial savannah woodland' of Gorumara Wildlife Sanctuary. This was thought to be that of Pygmy Hogs and was reported first time from the Sanctuary [Sanyal, 1995]. Later, Deuti, 2006 and Sanyal and De, 2008 published reports on general habit, habitat and distribution of Pygmy Hog in the state. However, no further records of this animal are available from Gorumara National Park till date.

PURPOSE OF THE STUDY

The principle aims and objectives of any re-introduction is to establish a viable, free-ranging population in the wild, of a species, subspecies or race (to enhance the long-term survival); to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness; or a combination of these [IUCN, 1998].

For a successful re-introduction, feasibility study and background research has to be done prior to the release of animals [Kleiman, 1989 and

IUCN, 1998]. For this, an assessment on taxonomic status of the species to be re-introduced and detailed studies regarding the status and biology of wild populations (if they exist) is to be done to determine the species' critical needs. Special emphasis is to be given on habitat preferences, intra-specific variation and adaptations to local ecological conditions, social behaviour, group composition, home range, shelter, food requirements, foraging and feeding behaviour, predators and diseases. Then, choice of release site and its evaluation is also needed. Re-introduction can only be done within its known historic range and where the habitat and landscape requirements of the species are satisfied. Before re-introduction, it is to be confirmed that there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes. The previous causes of decline (which may include diseases; over-hunting or other human activities; over-collection; pollution; poisoning; predation pressure; habitat loss; intra or inter-specific competition, etc.) has to be addressed before re-introduction in the same habitat. However, there is no universal format for a feasibility study. Feasibility studies can be adapted and shaped to meet the specific needs of any given situation.

The main objective of the project is to study the habitat (general overview, vegetation type, geo-topographical features, etc.), food availability, predator pressure and resource partitioning for the Pygmy Hog at Gorumara National Park and other anthropogenic pressure before introduction in the Park.

According to Project Proposal (submitted to the Directorate of Forests, Govt. of West Bengal), the assessment of habitats were done at four basic levels:

1. Study of vegetation pattern of the survey sites with special emphasis on variance of tree species, tree height, abundance and density of grasslands, shrubs and herbs. Availability of foods *viz.* fungi, roots, tubers, bulbs, green vegetation, grains, nuts, invertebrates, small vertebrates and

carrion are also to be studied.

2. An examination of the level of human induced disturbances of the area. Ecological conditions *viz.* rainfall, temperature, source of water etc., will also be taken into consideration.
3. To locate possible re-introduction sites.
4. To monitor the introduced specimens (if, re-introduction takes place).

Surveys were conducted to Manas Tiger Reserve, Assam (where last known wild population of Pygmy Hog is surviving) and Sonai-Rupai Wildlife Sanctuary, Assam to get basic idea about Pygmy Hog's habitats. To study the behaviour of this animal in captivity, one survey was also conducted to Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Assam (where large numbers of captive born Pygmy Hogs are kept).

DESCRIPTION OF STUDY AREA

The main surveys were conducted at Gorumara National Park located in the Malbazar Sub-Division of Jalpaiguri district, in the state of West Bengal in India. Other surveys were conducted at Manas Tiger Reserve, Assam (last surviving population of Pygmy Hog in wild); Sonai-Rupai Wildlife Sanctuary, Assam (where, captive-bred Pygmy Hogs were successfully re-introduced) and Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Assam (where large number of captive bred Pygmy Hog's are kept for last 15 years).

Gorumara National Park

Gorumara National Park is situated between latitude 26°47'12.5" N to 26°43'25.6" N and longitude 88°52'4.2" E to 88°47'7.3" E. The total area of the National Park is 79.84 sq. km [Figure 5]. Gorumara National Park belongs to the bio-geographical zone 7B-Lower Gangetic Plain [Rodgers & Panwar, 1988]. As because, this Park is located towards the foothills of Eastern Himalayas, therefore, the area boast a rich biological diversity. The terrain of Gorumara National Park is differentiated into a distinct

plateau and a plain area. The soil profile of the area is of alluvial and bhabar formations. The river system of the National Park comprises three main rivers - Murti, Indong and Garati River. These rivers intermingle and meet the Jaldhaka River that forms the boundary of the National Park in the eastern side. *Hatidoba*, *Shealdoba*, *Gairadoba*, *Bandiabil*, *Chukchukie Lake* are other perennial source of water that flow through Gorumara National Park. There are few rivulets and streams passing through Gorumara National Park which are seasonal in nature, carrying water only during rainy season and remain dry rest of the times. Some of them are *Bamni jhora*, *Saraswati jhora*, *Mukaddam nala*, *Neora jhora*, *Amba khola* and *Chang khola*. South-west monsoon is the main source of rainfall. Maximum precipitation occurs from mid June to September, with a peak in July and August. The average annual rainfall is about 382 cm. Maximum recorded temperature is 37°C (in summer) and a minimum of 4°C (in winter).

The entire forest cover of Gorumara National Park comes under the North Indian Moist Tropical Forest [Champion & Seth, 1968]. On the basis of the composition of the vegetation, the forest can be classified into four distinct types, Riverine forests - North Dry Deciduous Seral Sal Khair Sissoo Association (Tondou - 1,2,3,4a,4b and Selkapara - 1b), Sal forests - Eastern Bhabar Sal and Eastern Terai Sal (Gorumara, South Indong 1,2,3 and Bhogolmardi), Wet Mixed forests - Sub-Himalayan Secondary Wet Mixed Forests (Barahati - 1,3, Central - 1, Medlajhora - 1, Dhupjhora - 1b, 2 and Kakurjhora - 2) and Savannah Forests & Lower Alluvial Savannah - Sal Savannah (Jaldhaka - 1b and Dhupjhora - 1a,1b,1c) [Anonymous, 2007a]. Gorumara National Park has only 10% (18.41 sq. km) of its total area covered by grassland. Gorumara National Park has a total of 326 identified plant species (tree species - 158, herbs - 35, shrubs - 77, grasses - 32, climbers - 15 and orchids - 9). Also, sizeable area is covered with bamboo brakes [Anonymous, 2007a]. The species which are commonly found within the forest and having importance from the economical and ecological standpoint is *Sal* (*Shorea robusta*). This species

occurs with its usual associates, namely *Chilauni* (*Schima wallichii*), *Chikrasi* (*Chukrassia tabularis*), *Champ* (*Michelia champaka*) and *Bahera* (*Terminalia belerica*). The other important tree species which are also commonly seen are *Sidha* (*Lagerstroemia parviflora*), *Panisaj* (*Terminalia myriocarpa*), *Lampati* (*Duabanga sonneretoides*), *Lali* (*Amoora wallichii*), *Lahasune* (*Amoora rohitaka*), *Kainjal* (*Bischofia javanica*), *Simul* (*Bombax ceiba*), *Khair* (*Acacia catechu*), *Sissoo* (*Dalbergia sissoo*) and *Siris* (*Albizia* spp.).

Gorumara National Park has approximately 48 species of mammals (carnivores and herbivores), approximately 193 species of birds, 22 species of reptiles including 7 species of turtles, 40 species of fishes and other macro and micro fauna [Anonymous, 2007a]. This Protected Area is famous for one of the last small pockets in Eastern India, that harbours natural population of Greater One-horned Rhinoceros (*Rhinoceros unicornis*), alongwith other mega-herbivores like Asian Elephant (*Elephas maximus*), Gaur (*Bos gaurus*) and other Deer species.

A total of 23 villages lying in the fringe areas of the National Park, of those, Uttar Dhupjhora, Dakshin Dhupjhora, Hazipara, Dangapara, Vellordanga, Chorai Mahal, Kalipur Forest Village and Murti Forest Village are present around the park boundary. A total of six numbers of tea gardens namely Baradighi, Batabari, Jadavpur, Bamandanga, Tondou and Sunrise are there in the peripheral zone of the Gorumara National Park.

Manas Tiger Reserve

Manas Tiger Reserve in Assam is situated in the northern bank of the river Brahmaputra. The Reserve runs along the Indo-Bhutan international border, with contiguous wildlife habitats in Bhutan. The river Manas flows from the gorges of Bhutan and splits into two major streams as it enters India. In India, the Reserve area falls in six districts namely Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamrup and Darrang. Barnadi Wildlife Sanctuary is located in the buffer of the Reserve. There are numerous rivers criss-crossing the Reserve, namely, Sankosh, Saralbangha, Hel,

Tanali, Courang, Sidli (Bhor) Aio, Manas, Beki, Pathimari, Kaladia, Tihunala, Morapagaldia, Braalia, Pbornodi and Dhansiri.

The core zone, the Manas National Park, is a pristine wildlife habitat; the rest of the Reserve is a collection of eighteen Reserve Forests intertwined with revenue villages [Figure 6]. While traversing the Reserve from west to east, one comes across sal forests (both virgin and degraded), moist deciduous forests, grasslands of both savannah and terai types, and miscellaneous forests. Manas habitat provides an excellent abode to the Tiger as well as prey species: Hog Deer (*Axis porcinus*), Sambar (*Cervus unicolor*), Swamp Deer (*Cervus duvaucelii*), Asiatic Wild Buffalo (*Bubalus arnee*) and Gaur (*Bos gaurus*). These species migrate freely across the international border. Tiger population was estimated to be 89 during the 1997 Tiger census.

Recorded major forest types are Sub-Himalayan High Alluvial Semi-Evergreen Forests, Eastern Valoor Type of Forests, East Himalayan Moist Mixed Deciduous Forests, Low Alluvial Savannah Woodland and Assam Valley Semi-Evergreen Alluvial Grasslands. A total of 374 species of dicots and 139 species of monocots are recorded from the Park. Grass species like *Imperata Cylindrica*, *Narenga porphyrocoma*, *Panicum spp.*, *Saccharum arundinaceum*, *Thysanolaena maxima*, etc. are common. There are 21 recorded endangered species of mammals.

There is only one forest village, Agrang, in the core of the Tiger Reserve. However, there are 57 villages surrounding the Tiger Reserve. The population beyond these fringe villages is also heavily dependent on the Reserve for income and energy resources.

Sonai-Rupai Wildlife Sanctuary

Sonai-Rupai Wildlife Sanctuary spreads all the way along the foothills of the Great Himalayan range, is situated on the river bank of Gabharu, in Sonitpur district of Assam. The total area of the sanctuary is 220 sq. km, however, according to reliable sources the area has been reduced to 120 sq. km due to continuous pressure of encroachment by local people. Sonai-Rupai

Wildlife Sanctuary has sufficient grasslands to house Asian Elephants (*Elephas maximus*), Greater One-horned Rhinoceros (*Rhinoceros unicornis*), Leopards (*Panthera pardus*), different small cats and other animals also. Moreover, the unique climatic condition of the area helps in the growth of valuable wood and medicinal plants. A considerable area is covered by grasses. Problems of encroachment and poaching are common in the Sonai-Rupai Wildlife Sanctuary, especially in the remote Assam-Arunachal Pradesh border.

Pygmy Hog Conservation (Breeding) Centre (PHCC)

The Pygmy Hog Conservation Programme (PHCP) was launched collaboratively by Durrell Wildlife Conservation Trust, IUCN Pig Specialist Group, Government of Assam and Government of India, for the protection of Pygmy Hog and its habitat. It is administered in Assam by EcoSystems-India. One of its main activities is conservation breeding of Pygmy Hogs. In connection with the above mentioned project, the Pygmy Hog Conservation (Breeding) Centre (PHCC) was established in March, 1996 at Basistha, on the outskirts of Assam State capitol Dispur, in Guwahati City, with a stock population of six (2 males and 4 females) wild hogs, that were captured from Manas National Park and were transferred to Basistha. Generally two types of enclosures are there, inner and outer. Outer enclosures were planted with tall grasses brought from known former hog habitats. This type of enclosures are not very big, more or less triangular-shaped, brick-walls up to a height of 3 ft, then iron-net fencing upto a height of 8 ft and the roof of the enclosures are also enclosed with iron rope, to nullify the attacks of crows, raptors, etc. predator birds on piglets. Every open-air outer enclosure is leading to a room [Figure 7]. Within the enclosures some clusters of live grasses mainly 'ikra' or 'barenga' are plotted, but no 'kher' or 'thatch' grasses. However, Pygmy Hogs built nests throughout the year, for that thatching grasses are supplied from outside. Artificial food items are supplied daily inside the inner enclosure. The present population of Pygmy Hog in the Pygmy Hog Conservation (Breeding) Centre (PHCC) is

male – 16, female – 14 and young – 19 (as on 14.06.2010).

MATERIALS AND METHODS

Field Surveys

The field surveys were conducted in Gorumara National Park from June 2009 to January 2011. Three camps namely Bamni (North Range), Garati and Medla (South Range) were primarily selected as base camps, from where the entire survey was conducted. These camps are located in the transition zones between high forests and grasslands.

The forest trails/fire-lines/observatory lines in different representative habitats were used as fixed transects for survey of the grasslands and adjacent areas. Random surveys were also conducted in different grassland habitats to assess habitat density. The entire survey was conducted on elephant and/or on foot (when departmental elephants were not available) for six hours per day, 06:00 hrs to 12:00 hrs.

Geographically, the area of Gorumara National Park falls under tropical monsoon climate, with four distinct seasons – summer (April-May), monsoon (June-September), a short autumn (October-November) and winter (December-March). Therefore, a total of six surveys were conducted considering all the major seasons. Special emphasize were given on monsoon time, to see the water-logging condition of the grassland areas.

The results obtained from various surveys conducted at Gorumara National Park, have to be compared with the data available (habitat, food items availability etc.) and obtained from Manas Tiger Reserve, Assam (the last remaining home of endangered Pygmy Hogs) and Sonai-Rupai Wildlife Sanctuary, Assam (where captive bred Pygmy Hogs were successfully re-introduced), before declaring suitability of any habitat at Gorumara National Park for re-introduction and survival of Pygmy Hog. Therefore, **two surveys** were conducted to Manas Tiger Reserve (from 7-10 June 2010 and 13-15 January 2011 respectively) and **one survey** from 11-12 June 2010 at Sonai-

Rupai Wildlife Sanctuary. As Pygmy Hogs are small in size and secretive animal, it is hard to locate a single hog in its natural habitat. Therefore for its generalized habit, behaviour, food preferences it is necessary to rely heavily on observation of the behaviour of captive animals. In this context, **one survey** to Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Guwahati, Assam (from 13-14 June 2010) was also conducted.

Collection of Data

Grassland, shrubland, and water are the sources of food and cover. These cover types, in relation to the limitations of altitude; determine whether a place is a primary, secondary, or non-suitable habitat type. As per the Project Proposal (submitted to the Directorate of Forests, Govt. of West Bengal) surveys were carried out in different habitats of the Protected Area, with special emphasize on grassland areas. Data were collected regarding the following parameters -

To Survey Vegetation Status: Random survey was made in different areas. Sample of botanical specimens were collected from the field and herbariums were prepared [Jain & Rao, 1977]. These were sent to Botanical Survey of India, Shibpur, Howrah, West Bengal for systematic identification. The reports of the same had already been obtained. Soil samples were collected and preserved accordingly for analysis of presence of micro-organisms. For calculating vegetation density, frequency and basal area, data were collected through randomly placed quadrates: 10m×10m quadrates for trees, 3m×3m quadrates for shrubs and 1m×1m quadrates for tree seedlings and herbs.

To Survey Faunal Status: Animal data were collected by considering both direct sighting (primary data) and indirect evidences (secondary data, such as call, pellets or droppings, pugmark or hoof-mark, scratch-mark, killed or dead animal, etc.).

To Survey Availability of Food Source: Surveys were conducted to find out the availability of preferred food items of Pygmy Hog

like roots, tubers, bulbs, green vegetation, grains, nuts, annelids, small vertebrates, carrion, etc.

To Survey Availability of Sources of Water:

Regular surveys were conducted regarding availability of water sources (rivers, rivulets, lake/bill/doba and other perennial sources) in different seasons. As because, this animals are primarily grassland species, thus, data were also collected on how long this areas remain submerged under water during peak monsoon period.

To Survey Human-induced Disturbances:

An examination of the level of human induced disturbances of the area and other anthropogenic pressures were also taken into consideration during the survey period.

Co-ordinates: GPS (Garmin eTrex Vista) was used to obtain the latitude, longitude and altitude of the surveyed/respective areas.

RESULTS AND DISCUSSION

Gorumara National Park has only 10% (18.41 sq. km) of its total area covered by grassland, majority of which is distributed along the river banks of Jaldhaka and Murti River (very small area) (Table 1). Some natural grassland is there in blocks like Jaldhaka – 1a, 1b and Dhupjhora – 1b. To study the entire grasslands in Gorumara National Park the field surveys were conducted from three camps namely Tondou (North Range), Garati and Medla (South Range) and the findings are described under three headings for better comparison [Table 1].

CONCLUSION

As per the Guidelines for Re-introductions prepared by the IUCN/SSC Re-introduction Specialist Group (1995) the choice of release site can be chosen depending on the following factors –

- Selected site is to be located within the known historic range (former natural habitat) of the species concerned.
- For a successful re-introduction, it is to be verified that no remnant population exists, to prevent disease spread, social disruption and introduction of alien genes.

- The re-introduction area should have assured long-term protection.
- Re-introduction should only take place where the habitat and landscape requirements of the species are satisfied (keeping in consideration of species' critical needs).
- The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run. Long term post-release monitoring of all (or sample of) individuals required.
- Before the final re-introduction - identification and elimination or reduction to a sufficient level of previous causes of decline should be addressed (diseases, over-hunting, poisoning, habitat-loss, competition with domestic livestock, etc.). Also capacity building of the departmental staffs and continuous public relation activities (such as awareness campaigning among villagers from adjacent localities, to prevent escaping of any re-introduced animal) are required for conservation of Pygmy Hog.

Identifying Suitable Release Sites

For successful re-introduction of Pygmy Hogs in the wild, first the captive born animals have to be pre-conditioned by keeping them in larger enclosures, the so called 'pre-release' enclosure. The facility must include grasses and vegetation from their known natural habitats. This pre-conditioning of the animals are for maintaining them in integrated social groups, to encourage natural foraging (in simulated natural habitats), nest-building and other behaviours and also to minimize human contact to mitigate tameness and other behavioural characteristics which are common in captive management. This pre-conditioning of the animals may lasts for 5-6 months. Then the animals are to be transferred into temporary 'soft-release' enclosures constructed in the selected site for re-introduction. The site must have easy access to the

TABLE 1: Major flora associated with grassland in the Gorumara National Park.

	Scientific Name	Local Name	Family
1	<i>Urena lobata</i> L.	Okra	Malvaceae
2	<i>Melastoma malabathricum</i> L.		Melastomataceae
3	<i>Pueraria phaseoloides</i> (Roxb.) Benth.		Fabaceae
4	<i>Lantana camara</i> L. var. <i>aculeata</i> (L.) Moldenke	Putus	Verbenaceae
5	<i>Aristida</i> spp.		Poaceae
6	<i>Fimbristylis</i> spp.		Cyperaceae
7	<i>Eupatorium odoratum</i> L.		Asteraceae
8	<i>Ageratum conyzoides</i> L.		Asteraceae
9	<i>Polygonum capitatum</i> Buch.-Ham. ex D. Don		Polygonaceae
10	<i>Spermacoce hispida</i> L.		Rubiaceae
11	<i>Diplazium esculentum</i> (Retz.) Swartz.		Athyriaceae
12	<i>Cajanus scarabacoides</i> (L.) du Petit-Thou.		Fabaceae
13	<i>Mimosa pudica</i> L.		Mimosaceae
14	<i>Ziziphus mauritiana</i> Lam.	Kul	Rhamnaceae
15	<i>Ziziphus xylopyrus</i> (Retz.) Willd.	Kul	Rhamnaceae
16	<i>Lippia geminata</i> H. B. & K.		Verbenaceae
17	<i>Stephania japonica</i> (Thunb.) Miers		Menispermaceae
18	<i>Merremia umbellata</i> (L.) Hall. F.		Convolvulaceae
19	<i>Mikania micrantha</i> Kunth.	Assamlata	Asteraceae
20	<i>Paspalum scrobiculatum</i> L.		Poaceae
21	<i>Digitaria</i> spp.		Poaceae
22	<i>Panicum</i> spp.		Poaceae
23	<i>Isachne</i> spp.		Poaceae
24	<i>Phragmites karka</i> (Retz.) Trin. ex. Steud.	Khagra	Poaceae
25	<i>Arthraxon</i> spp.		Poaceae
26	<i>Commelina diffusa</i> Burm. F.	Kanchira	Commelinaceae
27	<i>Desmodium heterocarpon</i> (L.) DC.		Fabaceae
28	<i>Alpinia nigra</i> (Gaertner) B.L.Burtt	Purundi	Zingiberaceae
29	<i>Arundinella bengalensis</i> (Sprengel) Druce	Chhoto Jharu	Poaceae
30	<i>Arundo donax</i> L.	Nol	Poaceae
31	<i>Imperata cylindrica</i> (L.) Rusch.	Thatch, Kush	Poaceae
32	<i>Saccharum arundinaceum</i> Retzius	Madhua	Poaceae
33	<i>Saccharum narenga</i> (Nees ex Steudel) Hackel	Dhadda	Poaceae
34	<i>Saccharum spontaneum</i> L.	Kasia, Kash	Poaceae
35	<i>Themeda arundinacea</i> (Roxburgh) Ridley	Baro Chepti	Poaceae
36	<i>Acacia catechu</i> (L.f.) Willdenow	Khair	Mimosaceae
37	<i>Cynodon dactylon</i> (L.) Persoon	Durba	Poaceae
38	<i>Dalbergia sissoo</i> DC.	Sissoo	Papilionaceae
39	<i>Bombax ceiba</i> L.	Simul	Bombacaceae
40	<i>Clerodendron viscosum</i> Vent.	Bhant	Rubiaceae
41	<i>Colocasia esculenta</i> (L.) Schott	Kochu	Araceae
42	<i>Dioscorea</i> spp.	Banalua	Dioscoreaceae
43	<i>Leea</i> spp.		Leeaceae

TABLE 2: Comparative Accounts of the three main grassland areas.

	Tondu Area (Figures 8, 9)	Garati Area (Figures 10, 11, 12)	Medla Area (Figure 13)
Landscape (overall altitude)	River plains (120-130 m above MSL)	River plains (110-120 m above MSL)	River plains (105-110 m above MSL)
Forest types	Majority <i>Sal</i> forest and also mixed forests of <i>Simul-Siris</i> and <i>Khair-Sissu</i> association.	Mostly riverine forests of <i>Simul-Siris</i> type. Also mature <i>Sal</i> forests and dry-mixed forests are recorded.	Mostly riverine forests of <i>Simul-Siris</i> type. Large patch of mature <i>Sal</i> is also there.
Grassland	Some riverine natural grassland of <i>Kasia</i> , <i>Thatch</i> , <i>Nol</i> and <i>Khagra</i> . Small part converted into fodder plantation, dominates species <i>Dhadda</i> .	Highest accumulation of natural grassland of <i>Kasia</i> , <i>Thatch</i> , <i>Nol</i> and <i>Khagra</i> . In recent times major part has been converted into fodder plantation of <i>Dhadda</i> , <i>Chepti</i> and <i>Madhua</i> .	Second highest accumulation of the natural grassland of <i>Kasia</i> , <i>Thatch</i> , <i>Nol</i> and <i>Khagra</i> . Major part has been converted into fodder plantation of <i>Dhadda</i> , <i>Chepti</i> and <i>Madhua</i> . In lowland areas <i>Purundi</i> is the dominant species.
Water sources	• River Jaldhaka • Mukaddam nala • Sealdoba	• River Jaldhaka • River Garati • Garati Lake • Madhuadoba • Gandardoba (or Gairadoba) • Two man-made wallow pools	• River Jaldhaka • River Murti • Bandibil • Two man-made wallow pools
Water-logging situation during monsoon	Heavy shower may cause prolonged inundation in natural grassland. Fodder plantation area well-drained.	In lowland area heavy rainfall may cause water-logging situation, but not for prolonged duration. Mostly fodder plantation areas are well-drained.	Some portion of the grassland is well drained, but, heavy rainfall may cause water logging situation in certain areas.
Distance from grassland to high forest	0.05-0.5 km	0.05-2.0 km	0.1-2.0 km
Food source availability	Roots, tubers, bulbs, green vegetation, annelids, small rodents, lizards, etc. moderately present.	Roots, tubers, bulbs, green vegetation, annelids, small rodents, lizards, etc. are in plenty.	Roots, tubers, bulbs, green vegetation, annelids, small rodents, lizards, etc. are in plenty.
Presence of herbivores/carnivores	Leopard, Greater One-horned Rhinoceros, Gaur, Sambar, Spotted Deer, Barking Deer are common. Wild Pig population is less than other part of the forest.	Leopard, Greater One-horned Rhinoceros, Gaur, Sambar, Spotted Deer, Barking Deer are very common. Wild Pig population is also very high.	Leopard, Greater One-horned Rhinoceros, Gaur, Sambar, Spotted Deer, Barking Deer are very common. Wild Pig population is also very high.
Nearest human habitation/villages/tea-gardens	• Hazipara (3.5 km) • Dangapara (4.0 km)	Nil	• Kalipur Forest Village (0.5 km) • Ramsai (2.0 km)
Domestic cattle grazing	Part of block Tondu 2 and 3 are badly affected.	Not affected	Part of block Mdelaajhora 1 and 2 are affected.
Anthropogenic pressure	Except monsoon, villagers regularly enter into the fringe areas for collection of fuel woods and NTFPs.	Almost none	Except monsoon, villagers regularly enter into the fringe areas for collection of fuel woods and NTFPs.
Visitor pressure	Nil	Nil	Yes, visitors enter into the Park by riding elephant. Medla Watch Tower is also there for day visitors.

natural habitat. These enclosures have to be well protected (by electric fencing or by any other means) and under continual surveillance (24 hour) as a precaution against potential predators and attack of wild elephants. The animals can be maintained for a further two to four weeks in these enclosures before final release.

Taking into consideration of all the above mentioned facts detailed studies on the species' critical needs both in wild and captive conditions were made, these include habitat preference (biotic and abiotic habitat requirements), social behaviour, reproductive biology, home range, group size, dispersal, shelter and food requirements, foraging and feeding behaviour, predators and diseases. Almost two years of thorough field surveys in all the areas in Gorumara National Park especially Tondou, Garati and Medla areas [Table 2], one area (situated between latitude 26°46'48.02" N to 26°47'12.42" N and longitude 88°51'21.93" E to 88°51'54.88" E; total area - 0.4 sq. km; average altitude - 111-115 m above MSL) is primarily selected for re-introduction (construction of 'soft-release' enclosure) of Pygmy Hog (*Porcula salvania*) at Gorumara National Park, West Bengal, through proper management's procedure [Figure 15]. This area is very close to the Garati Camp (Gorumara National Park - South Range). This area is preferred as because; it has suitable habitats for the survival of this tiny Suids in the wild, alongwith availability of adequate food base and water sources. This area is flat, well drained, thinly forested and has high forest land adjacent to the grassland. No tourist is allowed in this area and is not affected by domestic cattle grazing and other anthropogenic disturbances. If, everything goes right and re-introduction takes place then, the re-introduced animals can easily be monitored from the Garati Camp (due to its geographic position). Also this area is well protected, two nearby patrolling camps (Zero Bundh and Tondou) are within 2 km radius of this site.

Constraints

- However, certain difficulties are there. First of all, total coverage of the

grassland in Gorumara National Park is only 10% of the total area, which is considerably less than the total grass cover area of Manas Tiger Reserve, Assam (39% of the total area) (Baruah *et al.*, 2003). Majority of the existing grassland is under fodder plantation [Dhadda (*Saccharum longisetosum*) is the dominant species, Chepti (*Themeda arundinacea*), Madhua (*Saccharum arundinaceum*) and Purundi (*Alpinia* spp.) are also there] and rest is natural grassland [grass species like Kasia (*Saccharum spontaneum*), Thatch (*Imperata cylindrica*), Nol (*Arundo donax*), Khagra (*Phragmites karka*) etc.]. This natural grassland is concentrated on the riverbanks thus subject to destruction during monsoon, where flash floods are not uncommon.

- The degraded tall grass community has been gradually converted into community of short grass species. Some non-grass species/weeds namely *Leea* spp., *Eupatorium* spp., *Lantana camara* and *Bombax ceiba* have been found growing extensively in the grassland.
- Although, the grassland of Gorumara National Park is not subjected to annual burning for regeneration of tender grasses, for new fodder plantation and to control weeds, but, burning is followed/ practiced by Forest Department once in every three or five years.
- Due to successful management practices in this National Park, the population of large herbivores like Asian Elephant, Greater One-horned Rhinoceros, Gaur and Deer species is increasing day-by-day, causing more straying out of this animals into locality (leads to man-animal conflict) and may also cause food scarcity (the grass cover is not increasing). It is a big challenge for the Park managers to maintain these animals within the boundary of this Protected Area.

- The population of Leopard (*Panthera pardus*) in Gorumara National Park is also high. The park is home for other carnivores like Fishing Cat (*Prionailurus viverrinus*), Leopard Cat (*Prionailurus bengalensis*), Jungle Cat (*Felis chaus*), Jackal (*Canis aureus*) and Indian Fox (*Vulpes bengalensis*). As because Leopard and other carnivores may or may not be a direct predator of Pygmy Hog, thus, the effect on the re-introduced species cannot be ascertained.
- Pygmy Hogs are successfully re-introduced in the Sonai-Rupai Wildlife Sanctuary in Assam and a viable population has been established. For Gorumara National Park the same model may be adopted to build up the released population considering various sets of condition, like number of animals to be released, age group, sex ratio etc.

If these problems can be addressed, then Gorumara National Park may be considered as suitable for final re-introduction of Pygmy Hog (*Porcula salvania* Hodgson).

SUMMARY

The Pygmy Hog, *Porcula salvania* was first described by B.H. Hodgson in 1847 and he placed it in a new genus of Family Suidae under Order Artiodactyla. This hog was formerly presumed to occur along the foothills of Himalayas, extending from south Nepal to Sikkim, northern part of West Bengal, through parts of Bhutan and north-west Assam. But in the early or mid 1980, this tiny suid is confined to Manas Tiger Reserve due to its habitat destruction, habitat fragmentation and other anthropogenic activities.

First re-introduction of captive bred Pygmy Hog was successfully done by a team of workers under the guidance of Dr. Gautam Narayana and his team, in Sonai-Rupai wildlife Sanctuary, Assam during 2008 and 2009. These re-introduced hogs are thriving well in the wild.

The Forest Directorate, Government of West Bengal has taken up one project to re-introduce

this tiny suid in their earlier habitat i.e. at Gorumara National Park, Jalpaiguri, West Bengal, where it has been extirpated or become locally extinct. Accordingly, the Forest Directorate, West Bengal assigned Zoological Survey of India to make feasibility study for re-introduction of Pygmy Hog at Gorumara National Park, Jalpaiguri and necessary funds were provided to the Z.S.I.

After making several extensive surveys at Gorumara National Park for the last two years, it can be concluded that part of Jaldhaka 1B Block (near Garati Camp) within the Park may be suitable for re-introduction of the Pygmy Hogs. Before re-introduction, it is recommended to set up one pre-release camp for maintaining them in integrated social groups, to encourage natural foraging, nest buildings and other behaviours for about five to six months. Then the animals can be maintained for a further two to four weeks in temporarily build soft-release enclosure in the selected habitat before final release.

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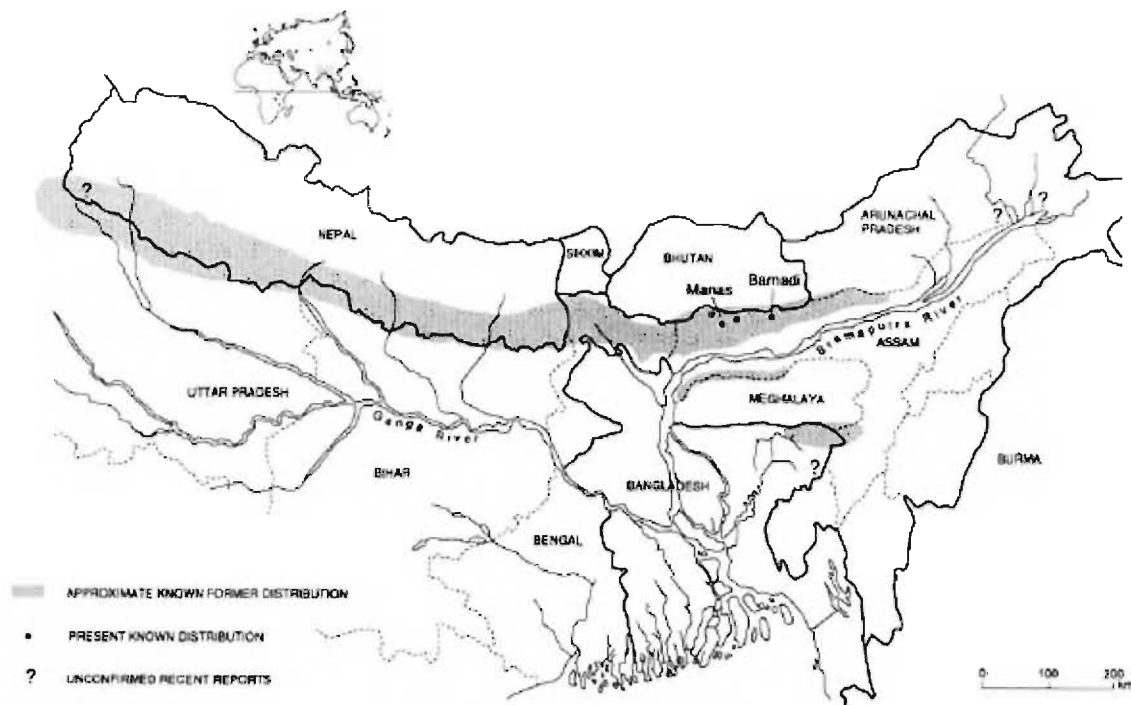


FIGURE 1: Map showing distribution of Pygmy Hog (Courtesy: IUCN/SSC PPHSG)



FIGURE 2: Female Pygmy Hog with piglets
(Courtesy : Pygmy Hog Conservation (Breeding) Centre (PHCC), Baistha, Assam)



FIGURE 3: Solitary male Pygmy Hog
(Courtesy : Pygmy Hog Conservation (Breeding) Centre (PHCC), Baistha, Assam)



FIGURE 4: Nest of Pygmy Hog
(Courtesy : Pygmy Hog Conservation (Breeding) Centre (PHCC), Baistha, Assam)

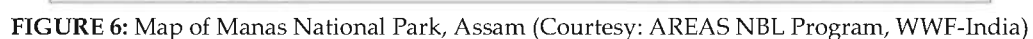
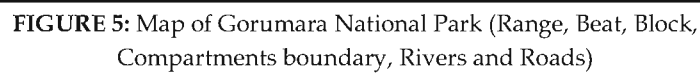




FIGURE 7: Aerial view of the Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Assam



FIGURE 8: Aerial view of the grassland and forested areas near Tondur Camp (Map courtesy: Google Earth)

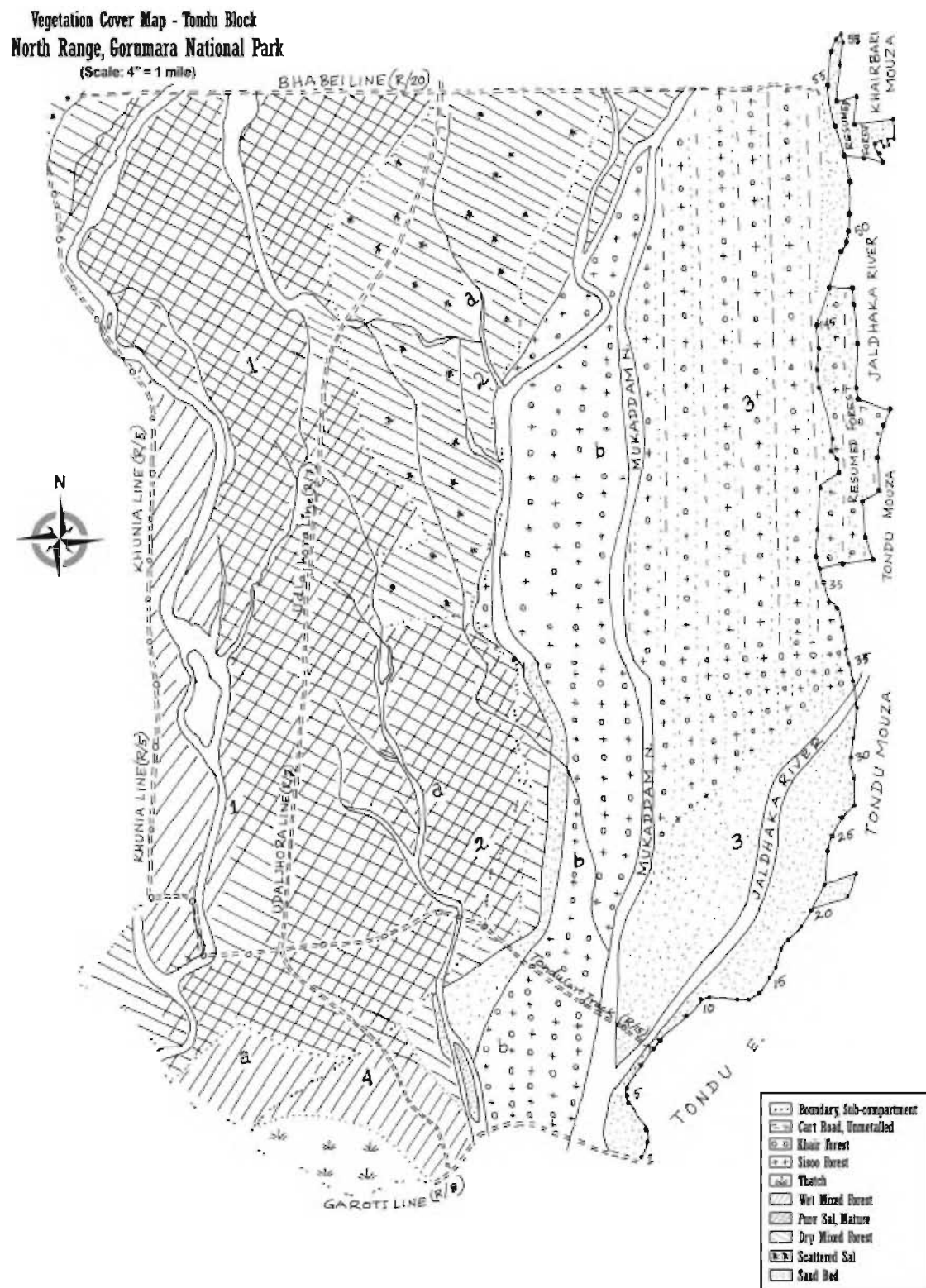


FIGURE 9: Vegetation cover map of Tondou Block (Gorumara National Park)



FIGURE 10: Aerial view of the grassland and forested areas near Garati Camp
(Map courtesy: Google Earth)

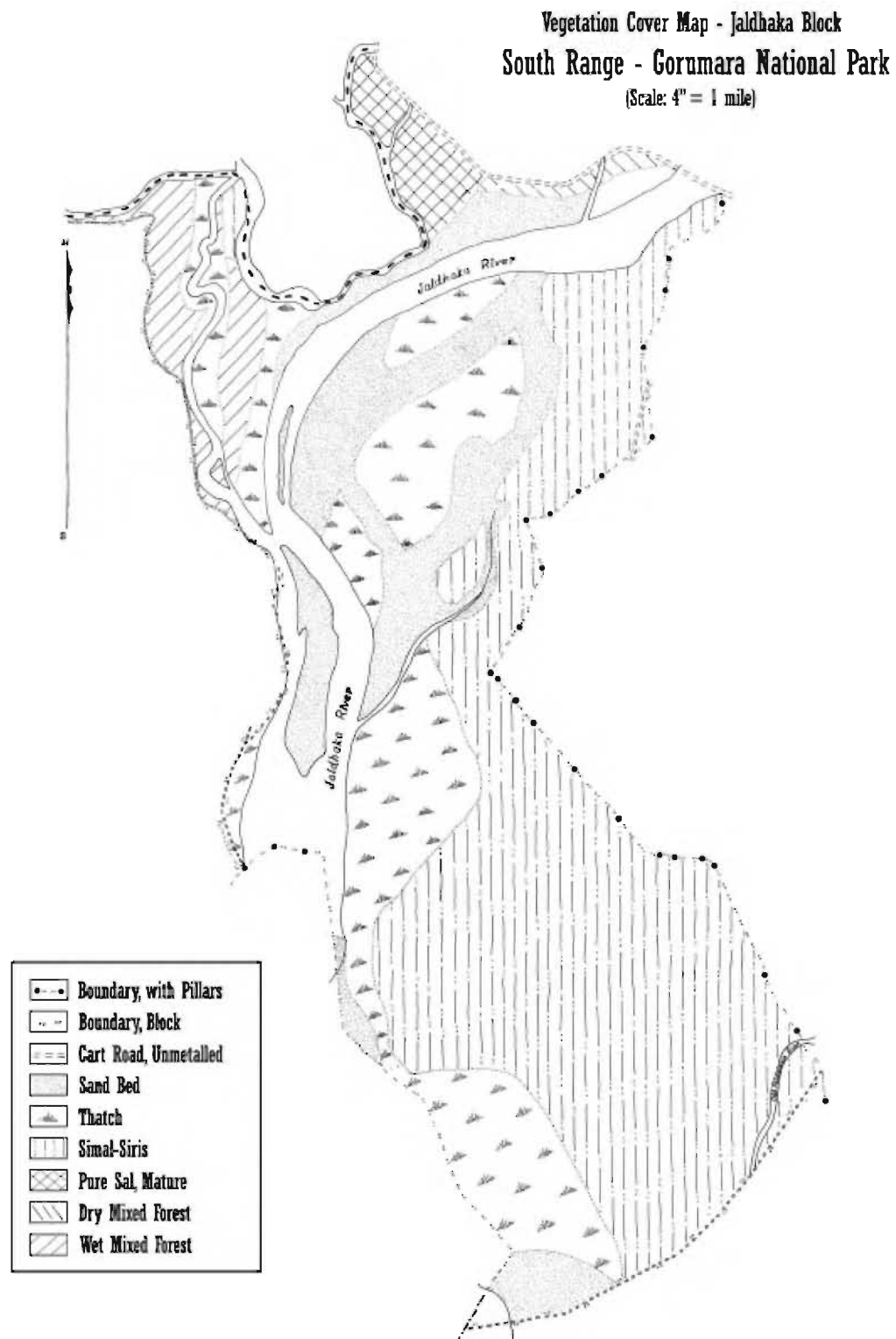


FIGURE 11: Vegetation cover map (old) of Jaldhaka Block (Gorumara National Park)

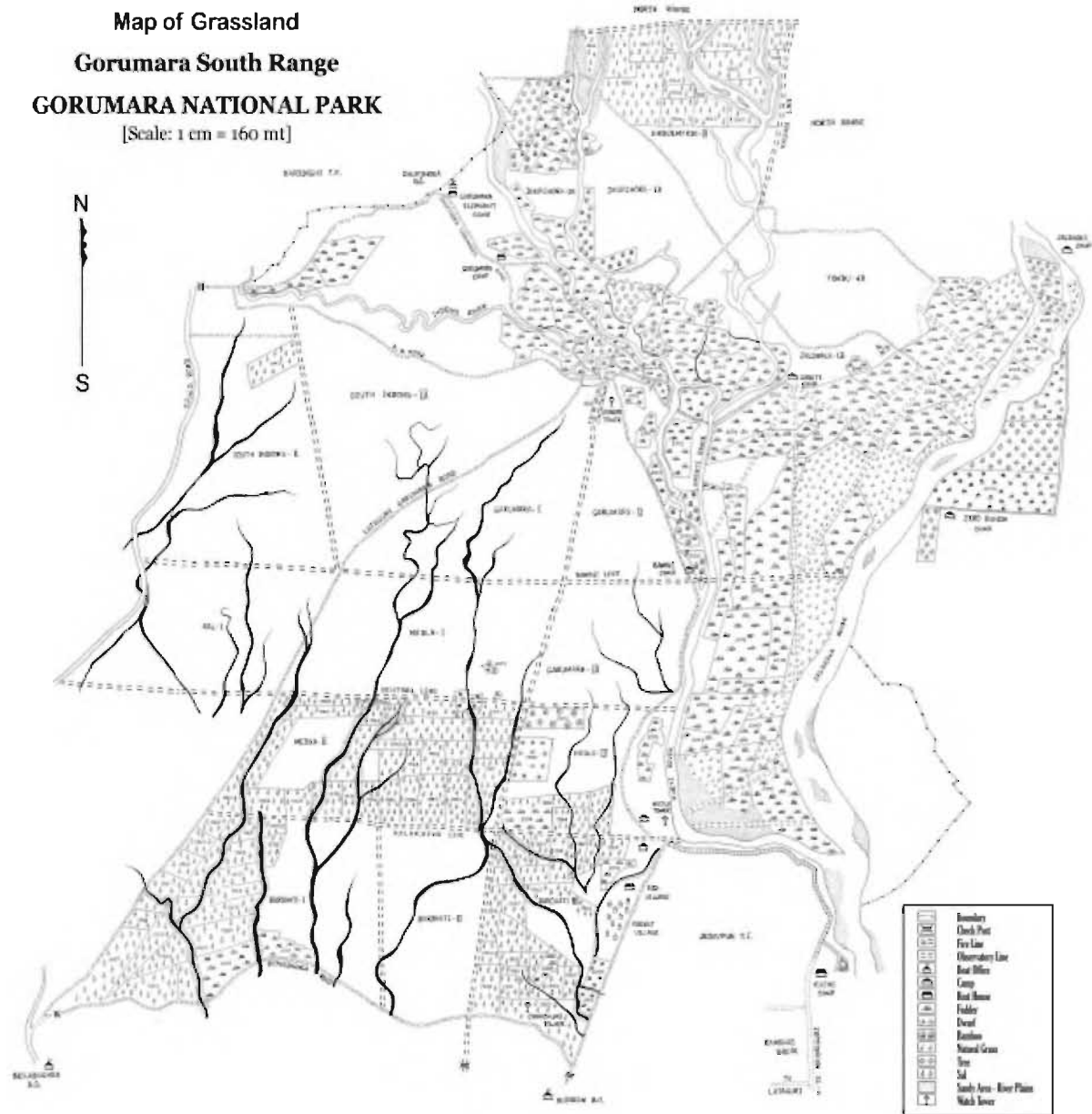


FIGURE 12: Vegetation cover map of South Range, Gorumara National Park



FIGURE 13: Aerial view of the grassland and forested areas near Medla Camp (Map courtesy: Google Earth.



FIGURE 14: Aerial view of the grassland and forested areas near Kanjol Tower (Map courtesy: Google Earth)



FIGURE 15: Aerial view of the area which is preferred for primary re-introduction (Map courtesy: Google Earth)



STUDIES ON THE CADDIS FLY LARVAE (INSECTA TRICHOPTERA) OF GREAT NICOBAR BIOSPHERE RESERVE, NICOBAR ISLANDS, INDIA

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INTRODUCTION

Trichoptera are holometabolous insects with aquatic immature stages. They are moth-like insects with wings covered by hairs, not scales as in Lepidoptera. Trichoptera are grouped among the most useful and important aquatic insects, which are diverse in terms of the micro habitats and the richness of the trophics they occupy. Trichopterans in conjunction with other aquatic insect orders like Ephemeroptera, Plecoptera, Odonata, Coleoptera, Diptera and Lepidoptera serve as very good bioindicators to assess aquatic biodiversity, habitat diversity in which they live (Hannaford and Resh, 1995, and deMoor, 2002, Jehamalar *et al.*, 2008, Anbalagan and Dinakaran, 2006; Subramanian and Sivaramakrishnan, 2005; Anbalagan *et al.*, 2004). Trichoptera larvae are probably best known for the transportable cases and fixed shelters, though not all species construct. Trichopteran larvae possess specializations that permit life in flowing water, including attachment devices such as claws and anal prolegs. Anthropogenic disturbances are rapidly altering the global environment (Vitousek *et al.*, 1997), resulting in a loss of diversity at an unprecedented rate (Pimm *et al.*, 1995 and Chapin *et al.*, 1997). Jehamalar *et al.*, (2010) studied the bioindicator potential of Trichoptera larvae of Southern Western Ghats. In India the study of Trichoptera started a little before the middle of the 19th century (Ghosh, 1991). Subsequently, Indian authors like Ghosh, 1991., Ghosh and Chaudhury

1987, 1992, 1995, 1998, 2000, Majumdar, 2003, 2004., Hafiz, 1937., Pandher and Saini, 2011., Saini *et al.*, (2001, 2010, 2011), Saini and Parey, 2011, Sharma and Chandra (2009) and Saini and Kaur (2012) worked on Trichoptera of Indian subcontinent. However, the Trichoptera of Andaman and Nicobar Islands was studied by Starmühlner (1978) and Malicky (1979, 1984). Malicky (1997, 2005) described two species of Trichoptera namely *Chimarra ariadne* Malicky, 1997 and *Oecetis philoktetes* Malicky, 2005 from Great Nicobar Islands. According to Starmühlner (1986), 19 species of Trichoptera have been recorded as endemic from Andaman Islands. Chandra (1999) has reported 20 species of Trichoptera belonging to 12 genera and 7 families from Andaman and Nicobar Islands. The present study was carried out on the Trichoptera of the head water streams of Great Nicobar Biosphere Reserve. These larvae were collected and identified up to genus level.

Based on the taxa's tolerance to organic pollution the tolerance values were developed by aquatic biologists. Tolerance values are mostly used in the calculation of the Hilsenhoff species-level Biotic Index and the Family Biotic Index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes. In the present study the tolerance values for the Trichoptera were taken from Wiggins *et al.*, 1994.

MATERIALS AND METHODS

Study area

Great Nicobar Island is the southern-most island of the Andaman and Nicobar Islands which is only about 80 nautical miles from Sumatra. The total forests cover of Andaman and Nicobar islands is more than 92% out of which about 84% is the reserved and protected forest. The total forest cover of Nicobar islands is 1,364 km² (very dense forest accounts for 787 km², Moderate dense forest accounts for 461 km² and open forest accounts for 116 km²).

Collection, Preservation and identification

Trichoptera larvae were collected by hand picking directly from stones by using fine tipped forceps and also by D-frame aquatic net. Larvae were preserved in 75 % alcohol. Identification was made by using the keys suggested by Wiggins *et al.*, (1994). Trichoptera larvae were identified up to genus level and confirmed by Dr. John C. Morse, Emeritus Professor and Emeritus Director, Clemson University Arthropod Collection, South Carolina, USA.

RESULTS

The Trichoptera larvae collected from GNBR and its tolerance values are presented in Table - 1. In the present study five genera viz., *Anisocentropus*, *Cheumatopsyche*, *Hydropsyche*, *Lepidostoma* and *Leptocerus* of Trichoptera larvae from four families namely Calamoceratidae, Hydropsychidae, Lepidostomatidae and Leptoceridae belongs to 3 suborders namely

Annulipalpia, Integripalpia and Spicipalpia were observed. Hydropsychidae contributes maximum i.e., two genera with 10 individuals out of the total 15 individuals collected from GNBR and all other families with only one genus in the present survey. The genus *Leptocerus* was the least in the survey. *Anisocentropus*, *cheumatopsyche*, and *Lepidostoma* were collected uniformly from the habitats.

DISCUSSION

Altogether 27 species belonging to 17 genera and 12 families were recorded from Andaman and Nicobar Islands. All these species were described by Malicky (1984, 1997, 2005). Malicky (1984) associated the larvae, pupae and adults of few species of trichopterans. Although several authors have attempted to study caddisfly larvae, progress has been hindered by the lack of knowledge on larval taxonomy and the difficulty in associating larvae with adults (Thamsenanupap *et al.*, 2003). Morse (2012) has provided information about the Trichoptera of Andaman and Nicobar Islands. Of the total 17 genera recorded from the Andaman and Nicobar Islands, the present study records only 5 genera from the Great Nicobar Biosphere Reserve. The genus *Anisocentropus* of the family Calamoceratidae is new record to Andaman and Nicobar Islands. Based on their resistance to pollution, tolerance values were fixed to Trichoptera by the ecologists. Tolerance values for some species of Trichoptera were not yet fixed. Increase in the tolerance value of the trichopteran

Table -1 : Number of examples of Trichoptera larvae and their tolerance value recorded from Great Nicobar Biosphere Reserve

S. No.	Family	Genera	Tolerance value	No. of exs collected
1.	Calamoceratidae	<i>Anisocentropus</i> sp.	0.8	2
2.	Hydropsychidae	<i>Cheumatopsyche</i> sp.	6.6	2
3.	Hydropsychidae	<i>Hydropsyche</i> sp.	0.0 - 8.1	8
4.	Lepidostomatidae	<i>Lepidostoma</i> sp.	1.0	2
5.	Leptoceridae	<i>Leptocerus</i> sp.	-	1
			Total	15



Anisocentropus sp.



Cheumatopsyche sp.



Hydropsyche sp.



Lepidostoma sp.



Leptocerus sp.

larvae increases the resistance to pollution. Of the taxa collected from GBNR, *Lepidostoma* sp. having tolerance value (1.0) and *Hydropsyche* sp. tolerance value ranges from 0.0 to 8.1, so the taxa were found both in unpolluted and polluted sites. In the present study the *Hydropsyche* sp. were collected from a 3rd order stream devoid of human influences. *Cheumatopsyche* sp. having high tolerance value (6.6), as its tolerance value, the taxa was collected from lentic water body with anthropogenic activity. The presence of *Cheumatopsyche* and *Hydropsyche* (Hydropsychidae) in large numbers is probably due to the fact that these retreat-makers are able to colonize a variety of substrates found in flowing waters. Wiggins (1977) mentioned that the families Leptoceridae and Hydropsychidae are widely distributed and having the species adapted to cool lotic and warm lentic habitats. In addition they are able to subsist on many different nutrient resources including diatoms and other algae, invertebrates, and

detritus, utilizing them in differing proportions, depending on the season (Wiggins, 1977 and 1984). According to the census 2001 the population of Andaman and Nicobar Islands is 0.37 million. Of these 88% inhabits Andaman Islands and only the remaining 12% inhabits the Nicobar Islands. So the influence of anthropogenic activities on GBNR water bodies is scarce.

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A NEW SPECIES OF *GASTRACANTHUS* WESTWOOD FROM NAMDAPHA NATIONAL PARK, ARUNACHAL PRADESH, INDIA (HYMENOPTERA : CHALCIDOIDEA : PTEROMALIDAE)

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INTRODUCTION

The pteromalid genus *Gastracanthus* Westwood (Hymenoptera: Chalcidoidea: Pteromalidae) belongs to the tribe trigonoderini, which is presently placed in the subfamily Pteromalinae (Boucek, 1988). In the cladistic analysis of the world genera of Trigonoderini, Heydon (1997) revised the genus *Gastracanthus* and also described a new species from the Oriental region (Taiwan). The genus contains four palearctic species viz. *G. acutus* (Kamijo), *G. japonicus* Kamijo, *G. nigrescens* Kamijo and *G. pulcherrimus* Westwood, one Nearctic species *G. conicus* (Girault) and one Oriental species *G. atrobaculus* Heydon. Species of *Gastracanthus* are mainly forest dwellers and the host organisms of the genus remain practically unknown (Heydon, 1997, Noyes, 2003). Graham (1969) reported an unconfirmed record of *G. pulcherrimus* Westwood on an imago of *Byrrhus fasciatus* (Forster) (Coleoptera : Byrrhidae) found under stones.

During the faunal exploration surveys conducted in the Namdapha National Park, Arunachal Pradesh (27° 23' to 27° 39' N latitude and 96° 15' and 96° 58' E longitudes), one of the important conservation areas in India, one specimen of *Gastracanthus* was collected by sweeping over ground litter from a patch of evergreen forest. The specimen was identified as

an undescribed species which is described hereunder. *Gastracanthus* species are widely distributed in Europe and the distribution extends up to Taiwan. By the present description, the distribution of the genus has been extended further south up to the north east tip of India.

The genus *Gastracanthus* can be recognized by the following combination of characters: Anterior margin of clypeus shortly and broadly truncate (occasionally broadly convex) (Fig. 4), anterior tentorial pits deep; female antennae with terminal or subterminal ovate patch of micropilosity; pronotum with distinct horizontal collar (Fig. 2), length more than half of its width; prepectus flat, uniformly reticulate; frenal sulcus distinct; mesosternum with raised shield-shaped region behind fore coxae; gaster distinctly petiolate, petiole length about 1/3 width, gaster mostly elongate with hind margin of T1 mostly produced, sometimes emarginate or broadly and roundly produced.

Terminology in this account mainly follows that of Bouček (1988) and the terms mesosoma and metasoma are used for thorax and gaster respectively and the following abbreviations are used in the text: F1-F6: funicular segments 1 to 6; MV- marginal vein; OOL-ocellocular distance; PMV- post marginal vein; POL- post-ocellar distance; SMV- submarginal vein; STV- stigmal vein; T1-T7-gastral tergites 1-7. The type

Keywords: Hymenoptera, Chalcidoidea, Pteromalidae, *Gastracanthus*, New species, Namdapha National Park, Arunachal Pradesh, India.

specimen is deposited in Zoological Survey of India, Western Ghat Regional Centre, Calicut, Kerala, India (ZSIK).

Gastracanthus indicus sp. nov.
(Figures. 1-5)

Female: Length 3.5 mm. Colour: Head and mesosoma dark metallic blue with bronzy metallic reflection. Antennae with scape testaceous, remainder brown. Legs with fore coxae brown, mid coxae yellow, hind coxae with basal half concolorous with mesosoma, remainder of legs and distal half of hind coxae yellow. Gaster including petiole brown with metallic blue reflection dorso basally and laterally. Eyes pale chocolate brown; ocelli silvery white except left lateral ocellus brown. Tegulae brownish yellow. Wings hyaline, veins pale brown; pubescence brown.

Scutlpture : Head coarsely reticulate punctate except area just above clypeus shiny, genae coriaceous. Mesosoma coarsely reticulate punctate except dorsellum, callus and metapleuron coriaceous. Mesopleuron except upper mesepisternum almost shiny; axillulae longitudinally striate reticulate. Gastral petiole smooth; T1 and T2 smooth; T3-T7 coriaceous.

Head : Tentorial pits deep, connected by narrow but distinct groove; area of antennal insertion raised, inter antennal crest distinct, reaching half length of scrobe; scrobe deep, not reaching median ocellus; anterior margin of clypeus subtruncate. Eyes separated by their individual height at the level of toruli. Head in front view 1.23x as broad as high and in dorsal view 2x as broad as long. Malar grooves distinct, malar space 0.3x eye length (in profile); eye length 1.24x width in profile, temple round, 0.41x eye length; POL 1.3xOOL. Antennae (Fig. 1) inserted below middle of face, toruli separated by a distance 1.2x their individual diameter, distance between lower margin of toruli to anterior margin of clypeus and upper margin of head is in the ratio 18 : 29. Scape just reaching front ocellus, 0.7x as long as eye, pedicellus plus flagellum 1.5x as long as head width; sensillae long and white, arranged in two rows on each funicular segment, pedicel

1.8x as broad as long; F1 0.9x as long as F2 which is as long as pedicel and anelli combined, F3-F5 almost equal and as long as F1, F6 shortest, clava 2.6x as long as broad, slightly shorter than two preceding segments combined and with area of micropilosity at tip.

Mesosoma : (Fig. 2, 5) 1.95 x as long as broad. Pronotum 1.1x as long as broad in dorsal view, neck distinct, differently coloured. Mesoscutum 1.6x as broad as long, notauli complete, broad. Scutellum medially as long as mesoscutum and as long as broad, frenal area raised, frenal groove deep, prepectus broad. Dorsellum almost rhomboidal. Propodeum 1.8x as broad as long and 0.65x as long as scutellum with sharp complete median carina, median panels bordered posteriorly and laterally by 'W' shaped lamellate carina, plicae not distinct, indicated posteriorly; spiracles elongate ovate, separated by slightly more than their own diameter from hind margin of metanotum (5.5 : 5); post spiracular sulcus deep, callus with long white pubescence. Forewing length 2.4x width, speculum closed behind, basal cell almost empty with 2-3 hairs basally and distally, basal vein with single layer of setae and cuticular border. Relative lengths of SMV, MV, PMV and STV as 39, 22.5, 26.5 and 11.

Metasoma : (Fig. 3, 5) as long as head plus mesosoma combined, sunken dorsally, posterior margin of T1 slightly roundly produced, T2-T4 almost straight, T5 distinctly concave, petiole smooth, exposed part length 0.5x width in dorsal view, hypopygium reaching upto middle of T4.

Material examined : Holotype female, INDIA: Arunachal Pradesh, Namdapha National Park, Firm base camp, way to Daphabum, N 27° 30' 46.9" E 96° 31' 17.4", altitude 534 metres, 9.xi.2009, coll. P. M. Sureshan Reg. No. ZSI/WGRS/IR/INV/2113.

Host : Unknown. Believed to be parasitoids of beetles dwelling in the forest floor.

Etymology : The species is named after the country from where the specimen was collected.

Remarks : This species very closely resembles *G. japonicus* Kamijo in general morphology especially in having a short gaster, similar wings

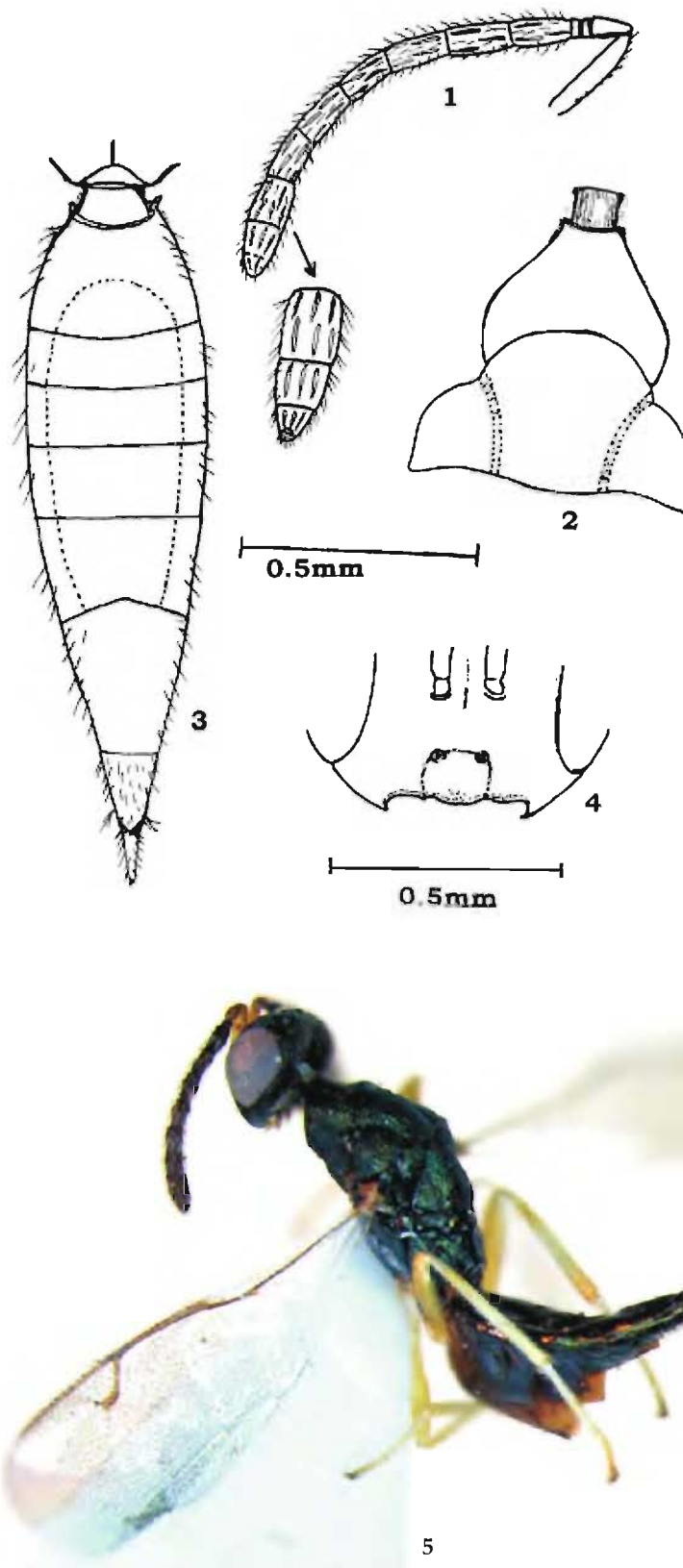


Fig. : 1-5. *Gastracanthus indicus* sp. nov. Female: 1. antenna; 2. pronotum and mesoscutum dorsal view; 3. gaster dorsal view; 4. head anterior margin; 5. female body in profile.

and in general morphology but differs from it in having a different antenna with area of micropilosity restricted to the tip only, sensillae regularly arranged in two rows on each segment, scutellar frenalum without a longitudinal median furrow, pronotum narrow, only 1.1x as long as wide and smaller body size (3.5 mm). In *japonicus* antennal clava with area of micropilosity extending to the base of third segment, sensillae rather sparse and irregularly arranged in three rows on each funicular segment and scutellar frenalum with a deep longitudinal median furrow and pronotum wider, 1.5x as long as wide and larger body size, 4.95.4 mm. The Oriental species *G. atrobaculus* Heydon differs from this new species in having a long gaster (length 2.7x combined length of head and mesosoma) with hind margin of T1 emarginate, forewing with basal cell completely setose, MV longer, 1.2x PMV and 3x STV, antenna with more rows of sensillae and larger body size (5.6mm). In *indicus* sp. nov. gaster short, (length as long as head and mesosoma combined) with hind margin of T1 broadly rounded, forewing with basal cell sparsely setose with MV shorter, 0.9x PMV and 2.1x STV and antennae with two rows of sensillae and smaller size (3.5 mm).

The species *G. nigrescens* Kamijo possesses similar antennal clava with micropilosity band restricted to the tip as in the new species but *nigrescens* distinctly differs from the new species in having a roundly produced clypeus

(uncommon genus character), much elongated gaster, wider head and mesosoma and other morphological features. *G. indicus* sp. nov. also differs from the species *G. acutus* Kamijo, *G. conicus* Kamijo and *G. pulcherrimus* Westwood in having shorter gaster with different hind margin of basal tergites and non maculate wing and other morphological features.

SUMMARY

A new species of *Gastracanthus* Westwood, viz. *G. indicus* (Hymenoptera: Chalcidoidea: Pteromalidae) is described from the Namdapha National Park, Arunachal Pradesh, India and its taxonomic affinities discussed.

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A NEW SUBSPECIES OF THE GENUS *GALUMNA* HEYDEN 1826 (ACARINA: ORIBATIDA: GALUMNIDAE) FROM MAHARASHTRA, INDIA

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INTRODUCTION

von Heyden (1826) established the genus *Galumna* with *Notaspis alata* Hermann, 1804 from Germany as the type under the family Galumnidae Jacot, 1925. The super family Galumnoidea Jacot, 1925 is one of the superfamilies under suborder Cryptostigmata of the order Acarina. These mites are commonly known as galumnid mites. The "characteristically- shaped" galumnid mites possess two wing-like "pteromorphae" at both sides of notogaster giving them a conspicuous look. Most of these mites are highly pigmented and heavily sclerotized.

They are inhabiting in all types of soil but predominantly found in soil, litter, humus and compost heaps. Galumnids have a worldwide distribution including Antarctica. The total number of species stands at 169 and 9 subspecies are there under this genus *Galumna* Heyden, 1826 (Subias, 2009).

In India, a total of 16 species of *Galumna* are known till date. Of these, six species have been described from India as new to science (Pearce, 1906; Ewing, 1910; Deb and Raychaudhuri, 1975; Haq and Adolph, 1980). The present report is based on the material collected from Maharashtra, Nagzira Wildlife Sanctuary collected during the educational trip in the area.

The measurements of the specimens have been given in micron (μm). The type specimens on which the description of new taxa is based, is

deposited in the National Zoological Collection, Zoological Survey of India, Kolkata (Regd. No. 4245/17).

DESCRIPTION OF SUBSPECIES

Galumna (G.) crenata indica ssp. nov.
(Figs. 1-3)

Colour: Reddish brown. Hysterosoma with fine punctuation and granulated areas of weak chitinization.

Measurements: Length of the body: 376; width of the body: 282; length of sensillus: 55.5; length of genital plate: 48; length of anal plate: 74; width of genital plate: 59; width of anal plate: 85; distance between aggenital setae: 56.

Prodorsum: Prodorsum finely punctated. Lamellar setae originate in between *L* and *S* lines. Lamellar setae very short. Rostral setae not visible and rostral setal pit could not be identified even. Interlamellar setae very short but positions of interlamellar setae clearly observed. Sensillus directed outwards, head club- shaped with dense and short bristles. *hy* comparatively small, oval in shape.

Notogaster: Dorsosejugal suture absent. Pteromorphae with strongly developed median and radiating ridges. Pteromorphae with granulation which are comparatively larger and different from the fine punctuation of the dorsal side. Notogaster with 4 pairs of area porosae. *Aa* largest and bean-shaped. *A3* almost round in

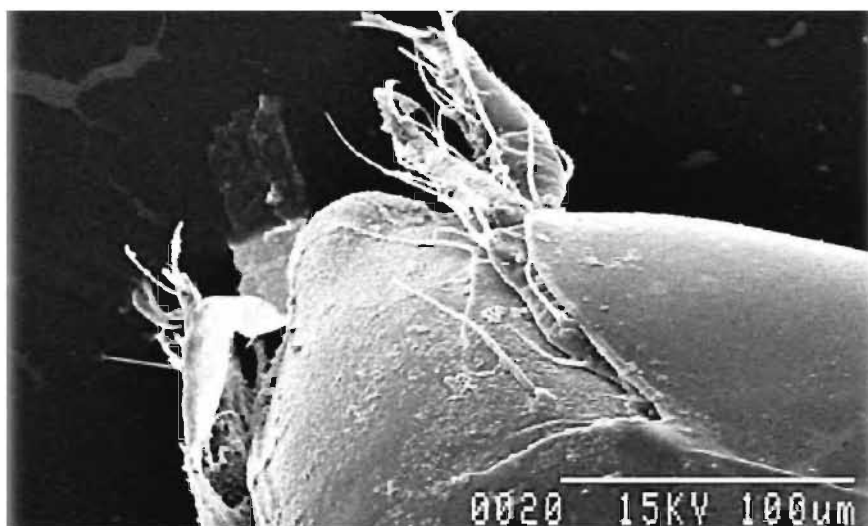


Fig. 1 : SEM photographic view of the prodorsum of *Galumna (G.) crenata indica* ssp. nov. showing the granulation.

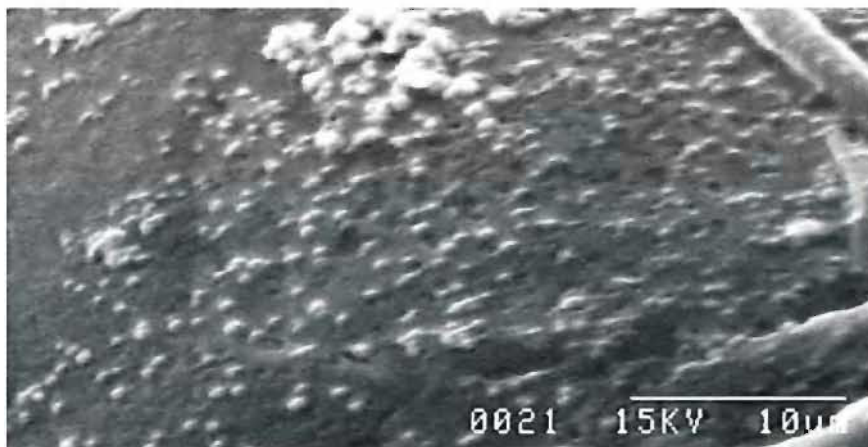


Fig. 2 : A close view of the granulation on dorsal side of the *Galumna (G.) crenata indica* ssp. nov.

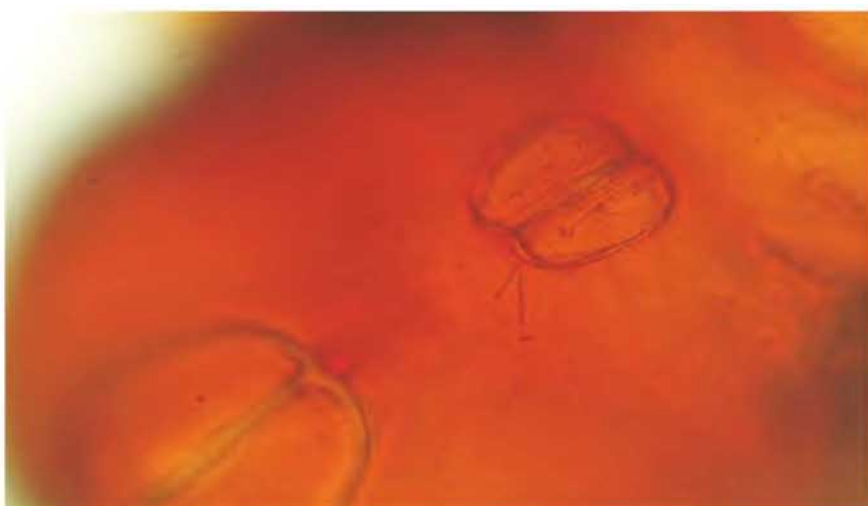


Fig. 3 : Ventral plate showing the genital plate with longitudinal lines and the fine punctuation around the genital plate of the *Galumna (G.) crenata indica* ssp. nov.

shape. According to size, the three pairs of area porosae as follows: $A1 > A2 > A3$. 10 pairs of notogastral setae present.

Ventral side: A crenate line present across the hypostome. All ventral setae smooth. Genital plate with 6 pairs of simple genital setae. Anterior two genital setae closely situated. The first set of anterior genital setae exceptionally long. Aggenital setae placed almost equidistant position from genital and anal plates. Anal plates narrow anteriorly and having 2 pairs of simple setae. *iad* very much close to lateral margin of anal plates. *ad2* closer to *ad1*. *ad3* in front of *iad*.

Material examined: HOLOTYPE: Adult female, India: Maharashtra, Nagzira forest, 13.i.2009, from soil and leaf litter, coll: S. Sarkar. PARATYPE: 1 adult female, data same as for Holotype.

Distribution: Maharashtra (Nagzira Wildlife Sanctuary), India.

Remarks: The present new species comes close to *Galumna (Galumna) crenata* Deb and Raychaudhuri, 1975 and *Galumna (Galumna) crenata uttarkashii* Sarkar, Sanyal and Chakrabarti, 2007 in general body shape, indistinct rostral setae, and a clear crenate line which passes across the hypostome, absence of dorso sejugal suture and similar sensillus. It also differs from *Galumna*

(*Galumna*) *crenata uttarkashii* Sarkar, Sanyal and Chakrabarti, 2007 by the structure of sensillus, the punctuation on dorsal side, and the shape of notogastral area porosae. Hence, the new subspecies, differs from *Galumna (Galumna) crenata* and *Galumna (Galumna) crenata uttarkashii* by the dense granulation on the pteromorphae and fine punctuation on dorsal side, the small, rounded A_3 , short but well observed lamellar setae and inter lamellar setae and exceptionally long first pair of anterior genital setae.

SUMMARY

The new subspecies *Galumna (G.) crenata indica* ssp. nov. from Nagzira Wildlife Sanctuary, Maharashtra, India is described and illustrated along with affinities with *Galumna (G.) crenata* Deb and Raychaudhuri, 1975. The new subspecies differs from *crenata* by the dense granulation on the pteromorphae and fine punctuation on dorsal side, the small, rounded A_3 , short but well observed lamellar setae and interlamellar setae.

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CURRENT STATUS OF SUSU (*PLATANISTA GANGETICA GANGETICA* ROXBURGH, 1801) IN RIVER GANDAK, A MAJOR TRIBUTARY OF THE HOLY RIVER GANGA IN BIHAR, INDIA

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INTRODUCTION

The Gangetic Dolphin, *Platanista gangetica gangetica* commonly known as Susu or Soons in local parlance is distributed in Ganga-Brahmaputra- Meghna and Karnaphuli-Sangu river system of India Nepal and Bangladesh. It is found from the foothills of the Himalayas to some of the tidal zone in India, Bangladesh, Nepal and Bhutan. It belongs to Order Cetacea, Sub Order Odontoceti (Toothed whales). The Cetaceans are aquatic mammals and include whales, dolphins and porpoises. The Gangetic Dolphin is the only cetacean available in Ganga and Brahmaputra river systems in India. Recently the river dolphin has been reported from River Sutlej in Punjab in January 2008. (Behera, WWF India, 2008). The cetaceans are having fusiform body, a pair of pectoral flipper and a horizontal compressed tail fluke with or without a notch in middle. They are lung breathers and their nostrils are placed much above the extremity of snout (melon). These animals come above water surface for breathing (Anderson, 1879; Kasuya and Haque, 1972); Mohan *et al.*, 1997; Smith *et al.*, 1998; Sinha *et al.*, 2000 and Alfred *et al.*, 2006; Sinha *et al.*, 2010, Sharma 2010)

Ganges river dolphin is a solitary animal, has a stocky body with long beak (beak in female larger than male) that thickens at the end. The dorsal fin is very small while flippers are large. The skin colour is usually light gray- brown and pale at the belly, often with tinge of pink. The eyes

are very small and the forehead known as melon rises steeply. The eyes lack crystalline lens; as a result, the animal is unable to detect light and dark vision. Developed echolocation helps in detection of food and navigation. Occasionally individual swims with one flipper laterally.

The dolphin makes a sound while breathing a reason to be called it soons. Due to solitary nature the animals is sighted frequently alone or in small groups of 2-3 (Jones, 1982; Smith, 1993). Sighting in pairs are generally mother and juvenile/calf and male and female during mating (Kasuya and Haque, 1972; Jones, 1982). During dry seasons i.e. from October to April many dolphins leave tributaries of Ganga and Brahmaputra river systems and congregate in the main channel and return to the tributaries in rainy season-June to September (Reeves and Brownell 1989). But resident dolphin population in major tributaries of Ganga and Brahmaputra river systems do not migrate to the big rivers. Migration is due to dispersal of fishes, which are their main food (Kasuya and Haque, 1972).

Globally, there are three recognized obligate species of river dolphin, which inhabit river and estuaries in Asia and South America, and all are among the most endangered cetaceans on earth. Recently one species, the baiji or Chinese river dolphin, was declared functionally extinct in 2006 (Turvey *et al.*, 2007). The other species are Amazon River dolphin (*Inia geoffrensis*), the Ganges river dolphin (*Platanista gangetica gangetica*) and Indus

River dolphin (*Platanista gangetica minor*). The last one is found in Indus River system of India and Pakistan (Behra *et. al.*, 2008). The Gangetic dolphin was historically distributed throughout the Ganges, Meghana, Bramhaputra and Karnaphulli river system of India and Bangladesh (Ghosh, 1991; Gupta, 1986; Jones, 1882; Reeves and Brownell, 1989; Shreshtha, 1989; Agrawal and Alfred, 1999; Alfred *et. al.*, 2006). But the water development projects like construction of Dams and Barrages threatened the dolphin population in the main channel of the major rivers. Pollution in their habitat, accidental or intentional/direct killing for trade, prey depletion are major threats for the dolphins population (Reeves and Leatherwood, 1995; Alfred *et. al.*, 2006).

SYSTEMATIC ACCOUNTS :

Kingdom	: Animalia
Phylum	: CHORDATA
Class	: MAMMALIA
Sub Class	: EUTHERIA
Order	: CETACEA
Sub-order	: ODONTOCETI
Super family	: PLATANIOSTOIDEA
Family	: PLATANISTIDAE
Genus	: <i>Platanista</i>
Species	: <i>P. gangetica</i> , Roxburgh, 1801
Subspecies	: <i>P. g. gangetica</i> .

CONSERVATION STATUS

IUCN (International Union for Conservation of Nature and Natural resources) has declared Gangetic dolphin (Susu) as endangered, while other agencies have also categorized the species as follows:

- Endangered as per IUCN (2003)
- Schedule -I of Indian Wild life (Protection) Act 1972
- Appendix -I of CITES (Perrin and Brownell, 1889)
- Appendix -II of Convention of Migratory Species (CMS)

OBJECTIVE OF THE PRESENT STUDY

Since no documentary evidences were available about the accurate number of river dolphin in river Gandak which originates from Nepal, the main objective of the present study was to assess the current status of the Susu (*Platanista gangetica gangetica*) in the entire stretch of Gandak river from Triveni Barrage at Valmiki Nagar in West Champaran to the mouth of Gandak river meeting Ganga river near Patna in the state of Bihar - a stretch of approximately 320km.

The present study was undertaken by the Gangetic Plains Regional Centre, as a part of the approved annual research plan of work 2008-2010 of the Zoological Survey of India, Ministry of Environment and Forests, Government of India.

Gandak River in India and Kali Gandaki in Nepal

The Gandaki River (also, known as the Kali Gandaki, the Narayani in Nepal and the Gandak in India) is one of the major rivers of Nepal and a left bank tributary of the River Ganga in India. The headwaters of the river are formed at an altitude of 3,900 m (12,795 ft) in the Mustang region of Nepal border; Tibet. The river is notable for the deep gorge through which it flows and also for a large hydroelectric facility in Nepal.

STUDY AREA : RIVER COURSE

The Gandak crosses the outermost foothills of the Himalayas, Sivalik Hills, into the Terai plains of Nepal and from confluence with Trisuli, the river flows southwest and is known as Narayani down to Trivenighat near the India and Nepal boarder. The river later curves back towards the southeast as it enters in India.

Gandak flows southeast across the Gangetic Plains of Bihar state, eventually merging with the Ganga near Patna. The entry point of the river at the Indo-Nepal border is also the confluence of Gandak, known as Triveni, with rivers Pachnad and Sonha also descending into India from Nepal. After the river enters India at Triveni, it travels for a length of 320 km before it joins Ganga river, just downstream of Hajipur at Sonapur (also known as Hariharkshetra), near Mahatma Gandhi Setu at



Fig. 1 : Map of River Gandak in Bihar, India, Showing Survey Area

Patna. Before joining river Ganga near Patna, it flows through East and West Champaran, Gopalganj, Bagha, Saran, Muzaffarpur and Vaishali districts of Bihar (Fig.1). The total length of the river is >600 km both in India and Nepal.

The Gandak plains, called the Gandak Megafan comprise Eastern Uttar Pradesh and North Western Bihar and lies in the Middle Gangetic Plains. The total catchments area of the basin up to its outfall into Ganga is 40,553 Sq. Km of which 4,188 Sq. Km lie in Bihar, 895 Sq Km lie in UP while the rest 35,470 Sq. Km lie in Nepal (2nd Bihar Irrigation Commission Report 1994). The river has very steep slope in the mountain but after it debouches into the plains, the slope gradually becomes flatter. Like other rivers of North Bihar, it also brings enormous quantity of sediment load along with its flow during the monsoon period. The silt load so carried gets deposited on its bed as the river flows through plains. This results in aggradations in bet and tendency to spill its banks and in course of the time to shift its course. Any breach in the embankment, therefore, result in catastrophe in the area.

After Anderson (1879) more than 130 years ago not much more has been studied on *Platanista gangetica gangetica* (Susu) by any other scientists in India except by the team of Patna University which carried out studies only in a part of Gandak river.

MATERIAL AND METHODS : SURVEY METHODOLOGY

Survey team consisted of party leader and three officials from ZSI, GPRC, Patna and one researcher from Zoology Department, Patna University. Surveys were conducted by the team using motor launch (navigable in optimum current) following the recommendation of a panel of experts (Perrin and Brownell, 1989). Direct count survey method was used to estimate susu abundance. When susus were sighted, survey team remained in the area for approximately 15-30 minutes before recording the actual count. Usually more number of susu is found near confluences of two rivers and downstream of

bridge pilings and diaras/sandbars. At such site the boat was anchored at least for one hour observation in order to reduce the chances of counting a single animal more than once or of undercounting when more than one animal were present. In the present study both downstream and upstream of River Gandak from Patna to Balwaghat upstream Bagaha and back were surveyed using the Global Position System (GPS) coordinates for susu sightings.

Distinctive physical characteristics in identification of individual animals were recorded (e.g. scarring, length of rostrum relative to height of melon, and body size). During the continuous survey between Patna to upstream Bagaha near Valmiki National park in West Champaran in Dec. 2008, Apr. 2009 Feb. & Apl. 2010, a total 290 km out of 320 km of the river stretch were surveyed.

Best high and low estimates of the susu populations in the group were recorded. The high and low estimates were used to reflect confidence in the accuracy of best estimate. The low estimate was considered to be an absolute minimum count and the high estimate an absolute maximum count. We used identical best, high and low estimate to indicate a high level of confidence in our best estimate.

Besides the dolphin census the surface water samples, zooplankton and macro-invertebrates fauna as well as sediment samples were also collected for further analysis.

RESULTS AND DISCUSSION

Susu the freshwater dolphin is found up to the Triveni Barrage near India Nepal boarder (persl. commn. : Samir K. Sinha, Asstt. Manager under Wildlife Trust of India, New Delhi working at Valmiki Tiger Reserve). The details of locations, Global positioning system coordinates and number of dolphins and their GPS locations have been recorded and shown in Table 1.

The best congregation of the dolphins was sighted near the counter eddy current where the right/left banks of the river were eroded due to high flood and developed a big poundage area. In

Table-1: Sighting Records of *Platanista gangetica gangetica* (Roxburgh, 1801) In The River Gandak, Bihar From Patna to up Stream Bagaha, West Champaran, During 2008-2010

Sighting Number	Time	Observer	Number of Dolphin			Number in each Group Size			Name of Area	GPS Position
			Best	High	Low	Adult	S.A	Calves		
1st Day										
1.	11:26	P	2	2	2	2	-	-	U/s Ganga confluence	25°38'14"N 85°11'43"E
2.	11:36	P	3	3	3	2	1	-	U/s above location	25°38'42"N 85°11'20"E
3.	11:51	P	3	3	3	1	2	-	Konharaghat	25°41'05"N 85°11'27"E
4.	13:10	P	2	2	2	-	1	1	Hariharkshetra ghat	25°40'38"N 85°11'29"E
5.	13:23	P	1	1	1	-	1	-	U/s Rly bridge	25°41'05"N 85°11'27"E
6.	13:43	P	1	1	1	-	1	-	U/s above location	25°41'35"N 85°11'25"E
7.	14:26	P	2	2	2	1	1	-	U/s above location	25°42'57"N 85°11'15"E
8.	14:32 14:40	P	6	8	6	4	1	1	U/s above location	25°43'19"N 85°11'20"E
9.	14:43	P	2	2	2	1	-	1	U/s above location	25°43'21"N 85°11'18"E
10.	14:57	R	1	1	1	1	-	-	U/s above location	25°43'43"N 85°10'48"E
11.	15:00	P	1	1	1	-	1	-	U/s above location	25°43'34"N 85°10'42"E
12.	15:03	P	4	5	4	2	1	1	U/s above location	25°44'05"N 85°10'40"E
13.	15:49	P	1	1	1	1	-	-	U/s above location	25°45'24"N 85°10'20"E
14.	16:08 16:48	P	3	3	3	1	1	1	Barua Ghat, Hajipur	25°46'10"N 85°10'14"E
2nd Day										
15.	08:55	P	2	2	2	1	1	-	U/s above location	25°47'30"N 85°10'08"E
16.	09:17	P	2	2	2	2	-	-	U/s above location	25°48'26"N 85°10'09"E
17.	09:26	P	1	2	1	1	-	-	U/s above location	25°49'36"N 85°10'03"E
18.	09:57	P	2	2	2	1	1	-	U/s above location	25°50'26"N 85°09'29"E
19.	11:09	P	3	3	3	2	1	-	U/s above location	25°52'53"N 85°06'59"E
20.	11:15	P	1	1	1	1	-	-	U/s above location	25°53'08"N 85°06'37"E

Sighting Number	Time	Observer	Number of Dolphin			Number in each Group Size			Name of Area	GPS Position
			Best	High	Low	Adult	S.A	Calves		
21.	12:16	P	4	4	4	2	2	-	U/s above location	25°55'20"N 85°04'51"E
22.	12:25	P	1	1	1	1	-	-	U/s above location	25°55'44"N 85°04'34"E
23.	12:30	P	1	1	1	1	-	-	U/s above location	25°55'52"N 85°04'32"E
24.	12:41 13:41	P	4	5	4	2	1	1	U/s above location	25°56'16"N 85°04'38"E
25.	14:25	R	2	2	2	2	-	-	U/s Rewaghat	25°59'15"N 85°02'31"E
26.	14:24	P	2	2	2	1	1	-	U/s above location	26°00'04"N 85°01'35"E
27.	14:30	P	1	1	1	1	-	-	U/s above location	26°00'14"N 85°01'19"E
28.	15:35	P	1	1	1	-	1	-	U/s above location	26°01'18"N 84°58'10"E
29.	15:47	P	1	1	1	1	-	-	U/s above location	26°01'56"N 84°58'12"E
30.	16:30	P	1	1	1	1	-	-	Fatehabad Ghat	26°04'07"N 84°58'02"E
3rd Day										
31.	07:15	P	2	2	2	1	1	-	U/s Fatehabad	26°04'23"N 84°58'02"E
32.	08:34	P	1	1	1	1	-	-	U/s above location	26°06'10"N 84°57'38"E
33.	08:41 09:13	P	3	4	3	2	-	1	U/s above location	26°06'12"N 84°57'23"E
34.	10:55	P	1	1	1	-	1	-	U/s above location	26°09'55"N 84°53'38"E
35.	11:21	P	1	1	1	1	-	-	U/s above location	26°11'05"N 84°53'59"E
36.	11:30	P	1	1	1	-	1	-	U/s above location	26°11'29"N 84°54'11"E
37.	11:35	P	2	2	2	1	1	-	U/s above location	26°11'39"N 84°54'23"E
38.	11:40	P	1	1	1	1	-	-	U/s above location	26°11'52"N 84°54'38"E
39.	12:39	P	1	1	1	1	-	-	Near Paharpur	26°13'55"N 84°54'36"E
40.	12:45	P	2	2	2	1	-	1	U/s above location	26°13'55"N 84°54'21"E
41.	13:26	P	2	2	2	1	1	-	U/s above location	26°13'54"N 84°52'02"E
42.	13:40	R	1	1	1	1	-	-	U/s above location	26°13'56"N 84°51'09"E

Sighting Number	Time	Observer	Number of Dolphin			Number in each Group Size			Name of Area	GPS Position
			Best	High	Low	Adult	S.A	Calves		
43.	13:45	P	2	2	2	-	1	1	U/s above location	26°14'04"N 84°50'53"E
44.	13:48	P	3	3	3	2	-	1	U/s above location	26°14'09"N 84°50'39"E
45.	13:47	P	2	2	2	1	1	-	U/s above location	26°14'26"N 84°50'21"E
46.	14:25	P	3	3	3	1	1	1	U/s above location	26°15'44"N 84°50'28"E
47.	15:10	P	1	1	1	-	1	-	U/s Sinha ghat	26°17'41"N 84°49'38"E
48.	15:51	P	1	1	1	-	1	-	U/s above location	26°19'04"N 84°48'07"E
49.	15:58	P	3	3	3	-	2	1	U/s above location	26°19'13"N 84°47'16"E
50.	16:07	P	3	3	3	1	1	1	U/s above location	26°19'26"N 84°47'17"E
51.	16:44	R	1	1	1	-	1	-	U/s above location	26°20'53"N 84°45'52"E
52.	16:49	P	3	3	3	2	1	-	U/s above location	26°21'01"N 84°45'35"E
53.	16:52	P	2	2	2	1	1	-	U/s above location	26°21'07"N 84°45'27"E
54.	16:59	P	1	1	1	1	-	-	Dumari Bridge	26°21'24"N 84°45'05"E
4 th Day										
55.	08:15	P	1	1	1	1	-	-	U/s Dumri Bridge	26°22'06"N 84°44'29"E
56.	09:49	P	1	1	1	-	1	-	U/s above location	26°23'40"N 84°44'02"E
57.	09:42 09:49	P	2	2	2	-	2	-	U/s above location	26°25'34"N 84°43'05"E
58.	10:00	P	4	4	4	2	2	-	U/s above location	26°25'25"N 84°42'11"E
59.	10:17	P	3	4	3	2	1	-	U/s above location	26°25'25"N 84°41'30"E
60.	10:25	P	3	3	3	2	1	-	U/s above location	26°25'50"N 84°41'25"E
61.	11:33	P	3	3	3	3	-	-	U/s above location	26°28'05"N 84°41'16"E
62.	12:12	P	1	1	1	-	1	-	U/s above location	26°28'20"N 84°40'00"E
63.	12:52	P	1	1	1	-	1	-	U/s above location	26°28'21"N 84°37'23"E
64.	13:24	P	1	1	1	1	-	-	U/s above location	26°29'00"N 84°36'42"E

Sighting Number	Time	Observer	Number of Dolphin			Number in each Group Size			Name of Area	GPS Position
			Best	High	Low	Adult	S.A	Calves		
65.	13:56	P	4	4	3	3	1	-	U/s above location	26°30'40"N 84°32'46"E
66.	14:30	P	1	1	1	1	-	-	U/s above location	26°29'58"N 84°34'48"E
67.	15:30	P	1	1	1	-	1	-	U/s above location	26°30'22"N 84°32'48"E
68.	15:59	P	1	1	1	1	-	-	U/s above location	26°28'21"N 84°37'23"E
69.	16:41	P	1	1	1	-	1	-	U/s above location	26°31'07"N 84°33'21"E
70.	17:15	P	1	2	1	-	1	-	U/s above location	26°30'56"N 84°33'21"E
71.	17:49	P	2	2	2	1	1	-	U/s above location	26°30'34"N 84°31'11"E
72.	18:52	P	1	1	1	1	-	-	Jadavpur Ghat	26°31'13"N 84°30'07"E
5 th Day										
73.	08:00	P	1	1	1	-	1	-	U/s above location	26°32'12"N 84°29'25"E
74.	09:03 09:23	P	5	5	4	3	2	-	U/s above location	26°32'22"N 84°28'02"E
75.	10:12	P	1	1	1	1	-	-	U/s above location	26°32'58"N 84°27'09"E
76.	11:40	P	1	1	1	1	-	-	U/s above location	26°34'03"N 84°27'07"E
77.	12:33	P	2	2	2	-	1	1	U/s above location	26°35'13"N 84°27'17"E
78.	13:42	P	1	1	1	1	-	-	U/s above location	26°36'08"N 84°27'17"E
79.	14:59	P	3	3	3	1	1	1	U/s above location	26°37'21"N 84°26'54"E
80.	14:50	P	2	3	2	1	1	-	U/s above location	26°37'53"N 84°25'55"E
81.	15:14	P	2	2	2	1	1	-	U/s above location	26°38'47"N 84°26'34"E
82.	15:50	P	1	1	1	1	-	-	U/s above location	26°39'50"N 84°26'38"E
83.	16:49 17:06	P	3	3	3	1	1	1	U/s above location	26°40'55"N 84°26'15"E
84.	17:40	P	1	1	1	1	-	-	U/s above location	26°41'48"N 84°25'25"E
85.	18:20	P	1	1	1	1	-	-	Sirajpur Ghat	26°42'51"N 84°25'08"E

Sighting Number	Time	Observer	Number of Dolphin			Number in each Group Size			Name of Area	GPS Position
			Best	High	Low	Adult	S.A	Calves		
6 th Day										
86.	8:30	P	1	1	1	1	-	-	U/s above location	26°43'35"N 84°25'10"E
87.	9:30	P	2	2	2	1	1	-	U/s above location	26°44'28"N 84°23'25"E
88.	10:12	P	2	2	2	1	1	-	U/s above location	26°45'30"N 84°22'51"E
89.	11:00	P	1	1	1	-	1	-	U/s above location	26°45'54"N 84°21'49"E
90.	11:56	R	1	1	1	1	-	-	U/s above location	26°45'35"N 84°20'45"E
91.	12:30	P	1	2	1	1	-	-	U/s above location	26°46'27"N 84°19'57"E
92.	13:12	P	1	1	1	1	-	-	U/s above location	26°47'20"N 84°19'18"E
93.	14:36	P	1	1	1	-	1	-	U/s above location	26°47'20"N 84°19'18"E
94.	15:14	P	1	1	1	1	-	-	U/s above location	26°48'39"N 84°17'32"E
95.	15:22	P	1	1	1	1	-	-	U/s above location	26°48'58"N 84°16' 41"E
96.	15:27	P	2	2	2	1	1	-	U/s above location	26°48'42"N 84°15' 43"E
97.	15:43	P	2	2	2	1	1	-	U/s above location	26°49'32"N 84°15' 14"E
98.	15:49	P	1	1	1	-	-	1	U/s above location	26°49'45"N 84°14' 02"E
99.	15:55	P	1	1	1	1		-	U/s above location	26°49'43"N 84°14' 02"E
100.	16:01	P	1	1	1	-	1	-	U/s above location	26°51'40"N 84°13' 00"E
101.	16:11 16:20	P	5	6	5	3	2	-	U/s above location	26°52'18"N 84°12'13"E
102.	16:25	P	1	1	1	1	-	-	U/s above location	26°53'03"N 84°11'36"E
103.	16:41	P	1	1	1	1	-	-	U/s above location	26°53'46"N 84°10'48"E
104.	17:04	P	1	1	1	1	-	-	U/s above location	26°54'44"N 84°10'49"E
105.	17:21	P	2	2	2	-	2	-	U/s above location	26°55'14"N 84°11'45"E
106.	17:59	P	1	1	1	1	-	-	U/s above location	26°56'02"N 84°12'28"E
107.	18:12 18:32	P	3	3	3	1	1	1	Near Sakma ghat	26°57'03"N 84°11'33"E

Sighting Number	Time	Observer	Number of Dolphin			Number in each Group Size			Name of Area	GPS Position
			Best	High	Low	Adult	S.A	Calves		
7 th Day										
108.	06:30	P	1	1	1	1	-	-	U/s above location	26°57'25"N 84°10'27"E
109.	06:36	P	1	1	1	1	-	-	U/s above location	26°57'23"N 84°09'16"E
110.	06:52	R	1	1	1	1	-	-	U/s above location	26°57'52"N 84°08'28"E
111.	07:20	P	2	2	2	1	1	-	U/s above location	26°59'50"N 84°08'44"E
112.	07:41	P	1	1	1	1	-	-	U/s above location	27°00'27"N 84°07'57"E
113.	07:56	P	1	1	1	1	-	-	U/s above location	27°00'49"N 84°06'47"E
114.	08:13	P	1	1	1	1	-	-	U/s above location	27°00'22"N 84°05'56"E
115.	08:38	P	1	1	1	1	-	-	U/s above location	27°01'16"N 84°08'22"E
116.	08:49	P	2	2	2	-	1	1	U/s above location	26°00'19"N 84°04'20"E
117.	09:10	P	2	2	2	1	1	-	U/s above location	27°01'17"N 84°04'06"E
118.	09:35	P	1	1	1	1	-	-	U/s above location	27°02'22"N 84°03'56"E
119.	09:52	P	1	1	1	1	-	-	U/s above location	27°03'29"N 84°04'07"E
120.	10:10	P	1	1	1	1	-	-	U/s above location	27°04'07"N 84°03'28"E
121.	10:15	R	1	1	1	1	-	-	U/s above location	27°04'11"N 84°02'07"E
122.	10:31	P	3	3	3	2	-	1	U/s above location	27°04'49"N 84°00'36"E
123.	10:39	P	1	1	1	-	1	-	U/s above location	27°04'42"N 84°00'29"E
124.	10:50	P	3	3	2	2	1	-	U/s above location	27°05'39"N 84°00'18"E
125.	11:10	P	1	1	1	1	-	-	Near Bagha	27°06'63"N 83°59'56"E
126.	11:52 11:58	P	3	3	3	2	1	-	U/s above location	27°08'27"N 83°59'19"E
127.	12:16	P	6	7	6	3	3	-	U/s above location	27°09'48"N 83°58'80"E
128.	13:00	P	1	1	1	-	1	-	U/s above location	27°11'02"N 83°57'58"E

Sighting Number	Time	Observer	Number of Dolphin			Number in each Group Size			Name of Area	GPS Position
			Best	High	Low	Adult	S.A	Calves		
129.	13:22 13:44	P	3	3	3	1	2	-	U/s above location	27°11'37"N 83°57'04"E
130.	13:49	P	3	3	3	2	1	-	U/s above location	27°12'43"N 83°56'26"E
131.	13:56	P	1	1	1	1	-	-	U/s above location	27°12'59"N 83°55'24"E
132.	14:20	P	1	1	1	-	1	-	U/s above location	27°13'33"N 83°54'32"E
133.	14:43	P	1	1	1	1	-	-	U/s above location	27°14'00"N 83°52'24"E
134.	14:49	P	2	2	2	1	1	-	U/s above location	27°14'06"N 83°52'21"E
135.	14:59 15:06	P	5	6	5	2	2	1	U/s above location	27°14'11"N 83°51'27"E
136.	15:11	P	1	2	1	1	-	-	U/s above location	27°15'14"N 83°51'02"E
137.	15:19	P	1	2	1	1	-	-	U/s above location	27°15'57"N 83°50'44"E
138.	15:28	P	1	1	1	-	1	-	U/s above location	27°16'55"N 83°50'04"E
139.	15:35	P	3	3	3	1	1	1	U/s above location	27°17'50"N 83°49'47"E
140.	15:29	P	2	2	2	1	1	-	U/s above location	27°18'17"N 83°51'39"E
141.	15:52	R	1	1	1	1	-	-	U/s above location	27°19'49"N 83°50'28"E
142.	15:58	P	2	3	2	1	-	1	U/s above location	27°20'51"N 84°51'21"E
143.	16:12	P	2	2	2	1	1	-	U/s above location	27°20'56"N 84°51'23"E
144.	16:57	P	1	1	1	-	1	-	U/s above location	27°23'42"N 83°51'42"E
145.	17:21	P	1	1	1	1	-	-	U/s above location	27°24'06"N 83°51'13"E
Total no. of Dolphin			259	275	256	145	91	23		

P = "Primary observers" three researchers are sitting in the front of the boat

R = "Rear observer" who is pointing out the left sighting by "P" observer of the dolphin from rear side.

SA = "Sub Adult"

U/S = Upstream

D/S = Downstream

TABLE-2: Summary of river dolphin *Platanista gangetica gangetica* (Roxburgh, 1801) in the River Gandak between Patna and Barwa Wildlife Sanctuary near Bagaha, West Champaran, Bihar during 2008-2010

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	Patna to Baruaghat	Baruaghat to Fatehabad	Fatehabad to U/s Dumari Bridge	U/s Dumari Bridge to Jadavpurghat	Jadavpurghat to Sirajpurghat	Sirajpurghat to Sakma ghat	Sakma ghat to Barva WLS.
Total Survey Time (Hrs.)	4.7hrs	7.32hrs	9.1hrs	7.82hrs	5.53hrs	6.98hrs	9.17hrs
Total Survey Distance (Km.)	23.4km	42km	49.1km	43.2km	42km	38.3km	52.0km
Average Survey Speed (Km./hr.)	5.0 km/hr	5.74km/hr	5.40km/hr	5.52km/hr	7.59km/hr	5.49km/hr	5.67km/hr
Number of sighting of Dolphin & groups seen by primary observers	14	16	24	18	13	22	37
Number of sighting of Dolphin & groups seen by the Rear Observer	1	2	2	-	-	1	3
Sum of best high and low estimate of Dolphin group size:							
Best (B).....	32	29	43	32	24	33	66
High (H).....	35	31	44	34	25	35	69
Low (L).....	32	29	43	31	23	33	65
Mean group size based on best estimate:							
Mean.....	1.437	1.047	0.833	1.114	1.214	0.964	1.178
S.D.....	2.286	1.813	1.792	1.778	1.846	1.428	1.737
Range.....	1-6	1-4	1-3	1-4	1-5	1-5	1-6
Percentage error based on groups sightings.....	7.14	12.53	8.33	0.0	0.0	4.54	8.11
Percentage error based on best estimation.....	3.12	6.89	4.76	0.0	0.0	3.03	4.54

Rec. zool. Surv. India

Dolphin encounter rate based on best estimate - (dolphin / Km.).....	1.37	0.69	0.86	0.74	0.57	0.86	1.23
- (Dolphin / hr.).....	6.4	3.97	4.73	4.09	4.34	4.73	7.20
Number of adult, sub adult, calf/ Neonate and unclassified dolphin							
Adult.....	16	20	20	18	13	19	39
Sub adult.....	11	08	16	14	8	12	22
Neonate/Calf.....	05	01	07	0	3	2	5
SD=Standard Deviation							

this area depth was also very high (app. 30-35 feet in post-monsoon season). The second best habitat was observed near the meanders at many sites in the entire stretch of the river. High density of dolphins was also encountered near the confluence where a small water current joining with Gandak River in upper most stretches near Bagaha.

The presence of young and neonate dolphin in the entire stretch of river shows the good recruitment rate in the river.

The density of dolphin was highest (1.37 dolphins/km) in between Patna to Baruaaghat in Vaishali district may be due many complexities in this stretch. The moderate dolphin density (0.86 dolphins/km) was observed in between Fatehabad to Upstream Dumaribridge in Muzaffarpur District due to many sandbars and good water volume with availability of prey species. Dolphin feeds mostly on smaller fishes like *Punctuis* spp. and *Mustacembalus* spp. and these fishes are available in plenty in the entire stretch of the river. Sometimes dolphins were seen to chase the bigger fishes like *Wallago attu* and other carp fishes near the shallow zone of the river. The density of adult dolphin was maximum from Sakmaghat to Barwa wildlife sanctuary near Bagaha.

During the survey between Dumari Bridge on River Gandak (National Highway) and Sattarghat ferry service ghat were recorded. 5 big size turtles (*Aspideretes gangeticus*) swimming in the river current were also recorded. Some turtles were also observed during u/s survey near the river bank and on the small newly immersed diara/sandbars. Total 7 nos. (5 adults & 2 juvenile) of Gharial (*Gavialis gangeticus*) were also sighted during the survey. The density of dolphins were found to be high in the upper reaches of River Gandak. It may be due to availability of very small fishes for the dolphins and also of many meanderings, the preferred habitat of the dolphin. No big motorized boats were seen for local ferry service in the entire surveyed stretch.

Total 259 nos. of dolphins as the best count was recorded along the stretch of the river

Gandak during the survey period of 10 days. Only one up stream survey data (but encounter of dolphins) as shown in the table : 1. Susus were usually inhabited in region between 5-20 mtrs from the shore. Susus were seen in 1-6 groups with 145 sightings near sandbars/bathing ghats, behind the fishing boats in the fishing habitat and sometimes, following our survey boat in the river. Sometimes susu went up to 2-3 mtrs ranges from the shore, most probably due to availability of the food (prey fishes) near the bank. Only oar ferry crossing were observed at some places near the ghats.

Summary of the dolphin count in different subsection between confluences at Patna to Barwa Wildlife Sanctuary at Bagaha are depicted in Table 2.

Between Patna to Baruaaghat in Vaishali district (a segment of 23.4 km river stretch) 32 dolphins were sighted (best estimate 32; group size: 1 to 6; mean Group size 1.437; SD=2.286 and percentage error based on group sighting 7.14, dolphin encounter rate 1.37 dolphin/km and 6.4 dolphin/hr). Total 14 nos. of sightings of dolphin and groups were recorded. From Baruaaghat to Fatehabad (a segment of 42km river stretch) 29 dolphins were sighted (best estimate 29; Group size: 1 to 4; mean group size 1.047; SD=1.813 and percentage error based on group sighting 12.53, dolphin encounter rate 0.69 dolphin/km and 3.97dolphin/hr). Total 16 nos. of sightings of dolphin and groups were recorded. From Fatehabad to u/s Dumari bridge (a segment of 49.1km river stretch) 43 dolphins were recorded (best estimate 43; Group size: 1 to 3; mean group size 0.833; SD=1.792 and percentage error based on group sighting 8.33, dolphin encounter rate 0.86 dolphin/km and 4.73 dolphin / hr). Total 24 nos. of sightings of dolphin and groups were recorded. In between u/s Dumari bridge to Jadavpurghat (a segment of 43.2km river stretch) 32 dolphins were sighted (best estimate 32; Group size: 1 to 4; mean group size 1.114; SD= 1.778 and percentage error based on group sighting 8.33, dolphin encounter rate 0.74 dolphin/ km and 4.09 dolphin/hr) were studied. Total 18 nos. of sightings of dolphin and groups were recorded.

From Jadavpurgat to Sirajpur ghat (a segment of 42km river stretch) 24 dolphins were observed (best estimate 24; Group size 1 to 5; mean group size 1.214; SD=1.846 and percentage error based on groups sighting 0.0 dolphin encounter rate 0.57 dolphin/km and 4.34 dolphin/hr). Total 13 nos. of sightings of dolphin and groups were recorded. Between Sirajpurgat to Sakmaghat (a segment of 38.3 km river stretch) 33 dolphins were sighted (best estimate 33; Group size min. 1, max. 5, mean group size 0.964, SD=1.428 and percentage error based on groups sighting 4.54, dolphin encounter rate 0.86 dolphin/km and 4.73 dolphin/hr). Total 22 nos. of sightings of dolphin and groups were observed and in the 7th segments from Sakmaghat to Barwa Wildlife Sanctuary (a segment of 52 km river stretch) 66 dolphins were sighted (best estimate 66; Group Size 1 to 6; mean group size 1.178, SD=1.737, percentage error based on groups sighting 8.11, dolphin encounter rate 1.23 dolphin/km and 7.2 dolphin/hr). Total 37 nos. of sightings of dolphin and groups were recorded in this segment.

The Gangetic dolphin is usually associated with meandering of the river channel, confluence of two currents and behind the mid channel island (Hua et al., 1989; Smith, 1993; Smith et al., 1997, 1998). In the present study dolphins were recorded mainly in the main current at the meandering of the river or behind the mid channel island (small emerged diara). Sometimes susus were observed foraging or chasing the prey fish in the very shallow zone, depth appx. 2-3 feet. The observation in Nepal show that they move in and out of the tributaries of the Gandaki, Koshi and Karnali systems during high water season, probably spending low-water season in deep pools of the tributaries. In the main rivers, a decrease in abundance during the summer would confirm a seasonal pattern of migration (Shreshtha, 1989).

Susu population is depleting throughout their former range due to habitat destruction including pollution, commercial exploitation and incidental catch in fishing nets.

Local fishermen of Gandak river informed us

about very few accidental catches during fishing in monofilament gill net, they do not confirm the intentional killing.

RECOMMENDATIONS

The monofilament gillnets (Currenty jal) and Mosquito net (Kapda jal) should be strictly banned in the entire stretch of river Gandak. The human pressure and use of chemical fertilizers and pesticides in the flood plains should be reduced. The erosion of the bank of River Gandak should also minimize especially in the dolphin habitat. A continuous mass awareness campaign is needed in the remote area to educate the local fisherman.

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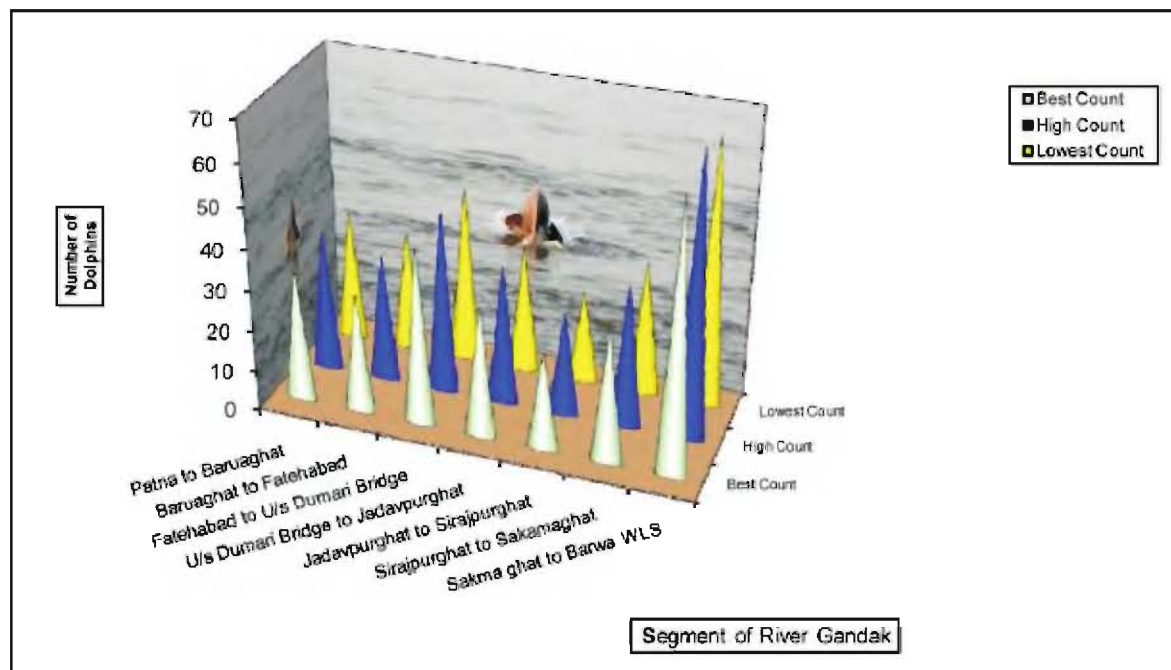


Fig. 2 : Best, Highest and Lowest count of dolphin along River Gandak in Bihar.

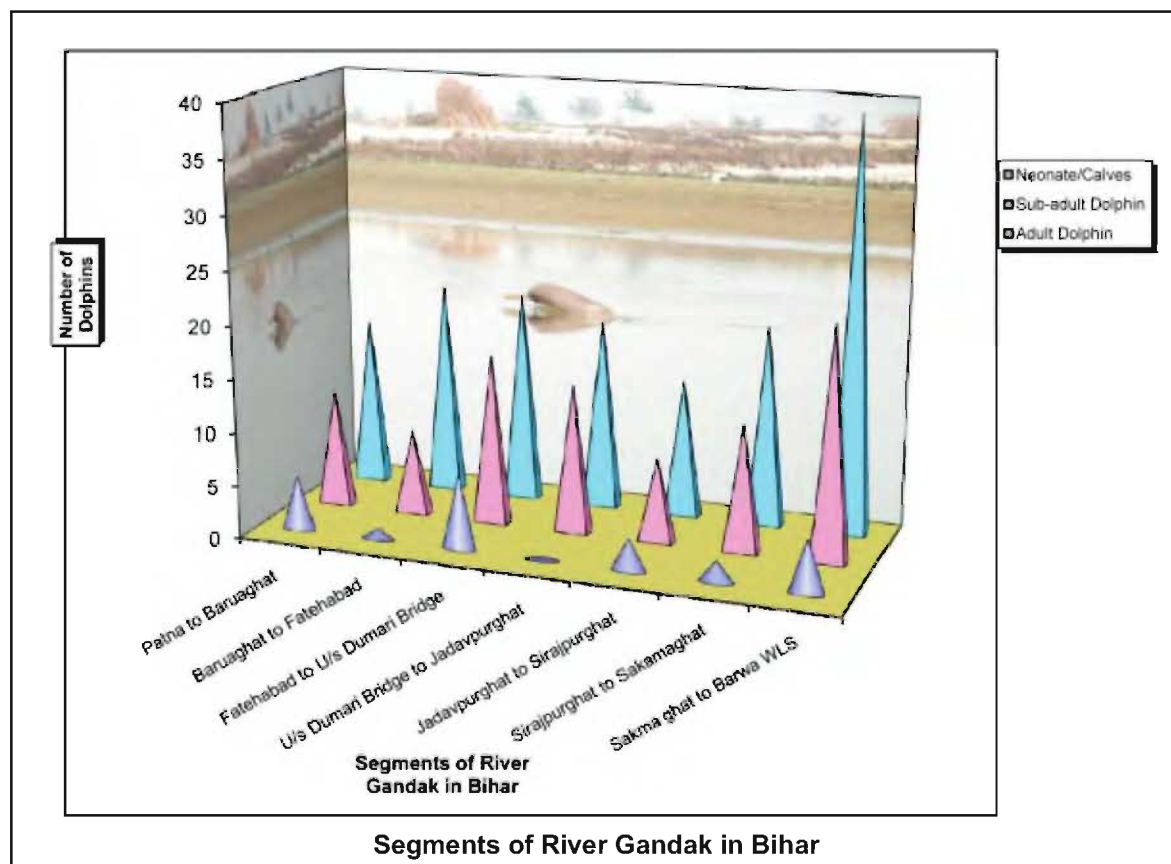


Fig. 3 : Population structure with age classes of dolphin along River Gandak in Bihar.

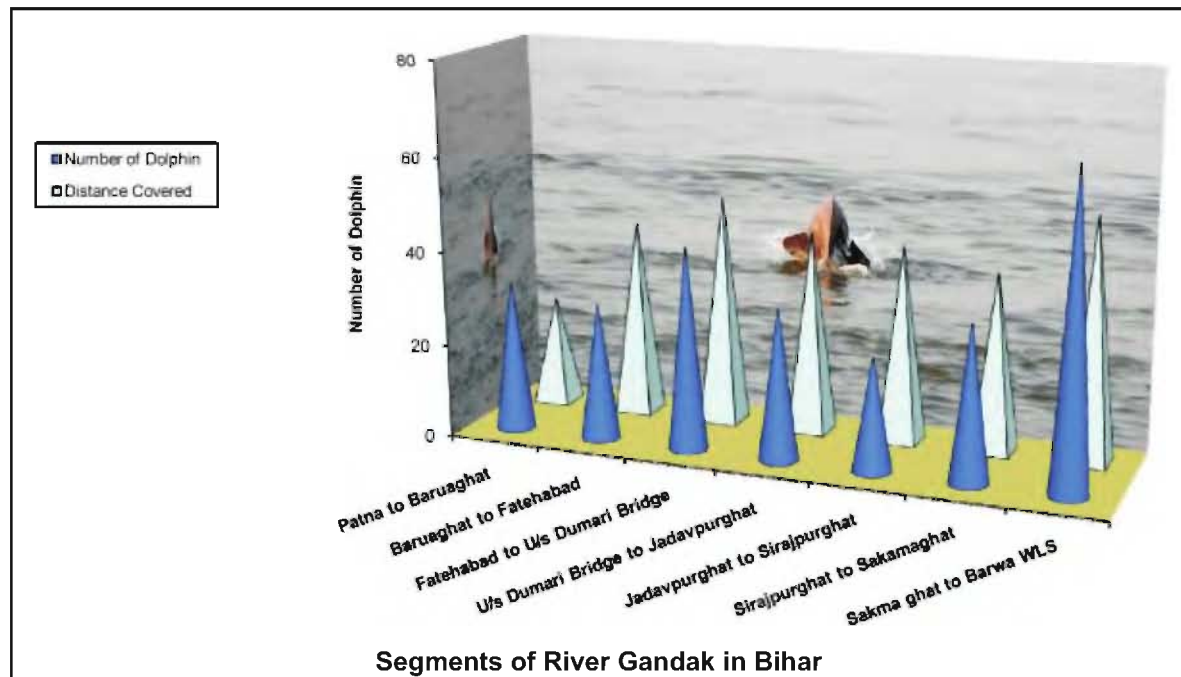


Fig. 4: Graph showing the distribution of dolphin in the different segments of River Gandak in Bihar

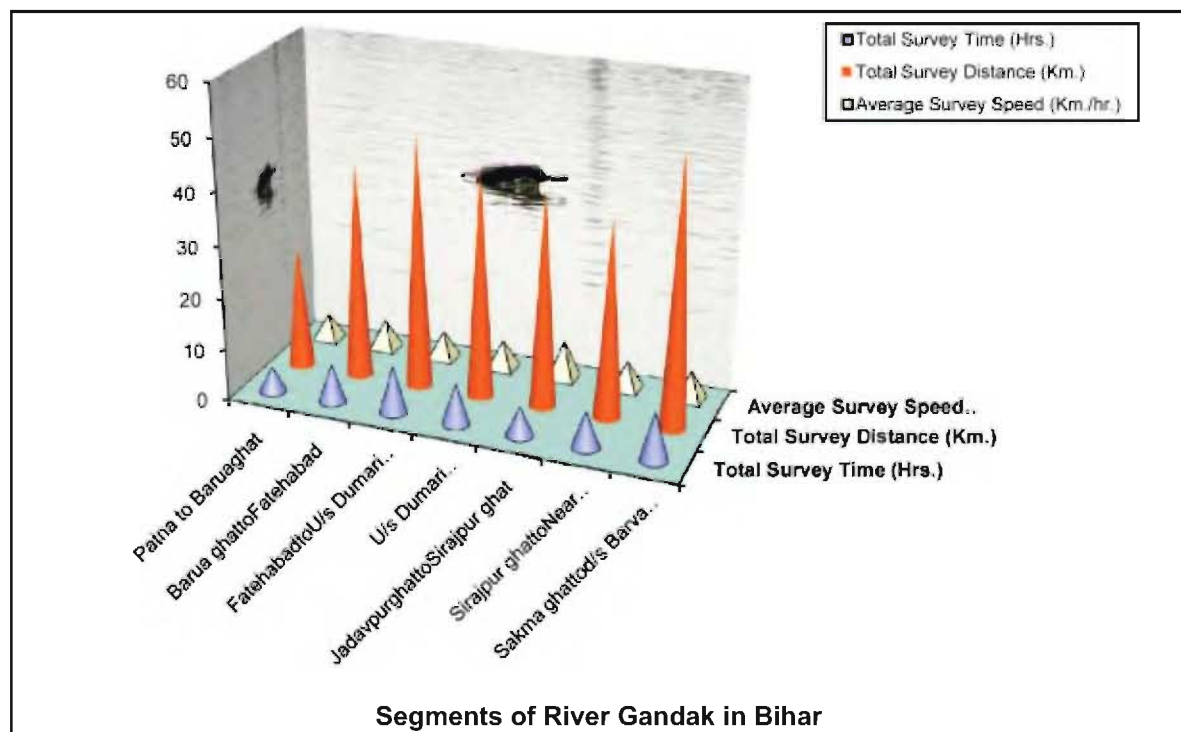


Fig. 5: Survey Time, Survey Distance and Average Survey Speed of the Boat in the River Gandak, Bihar

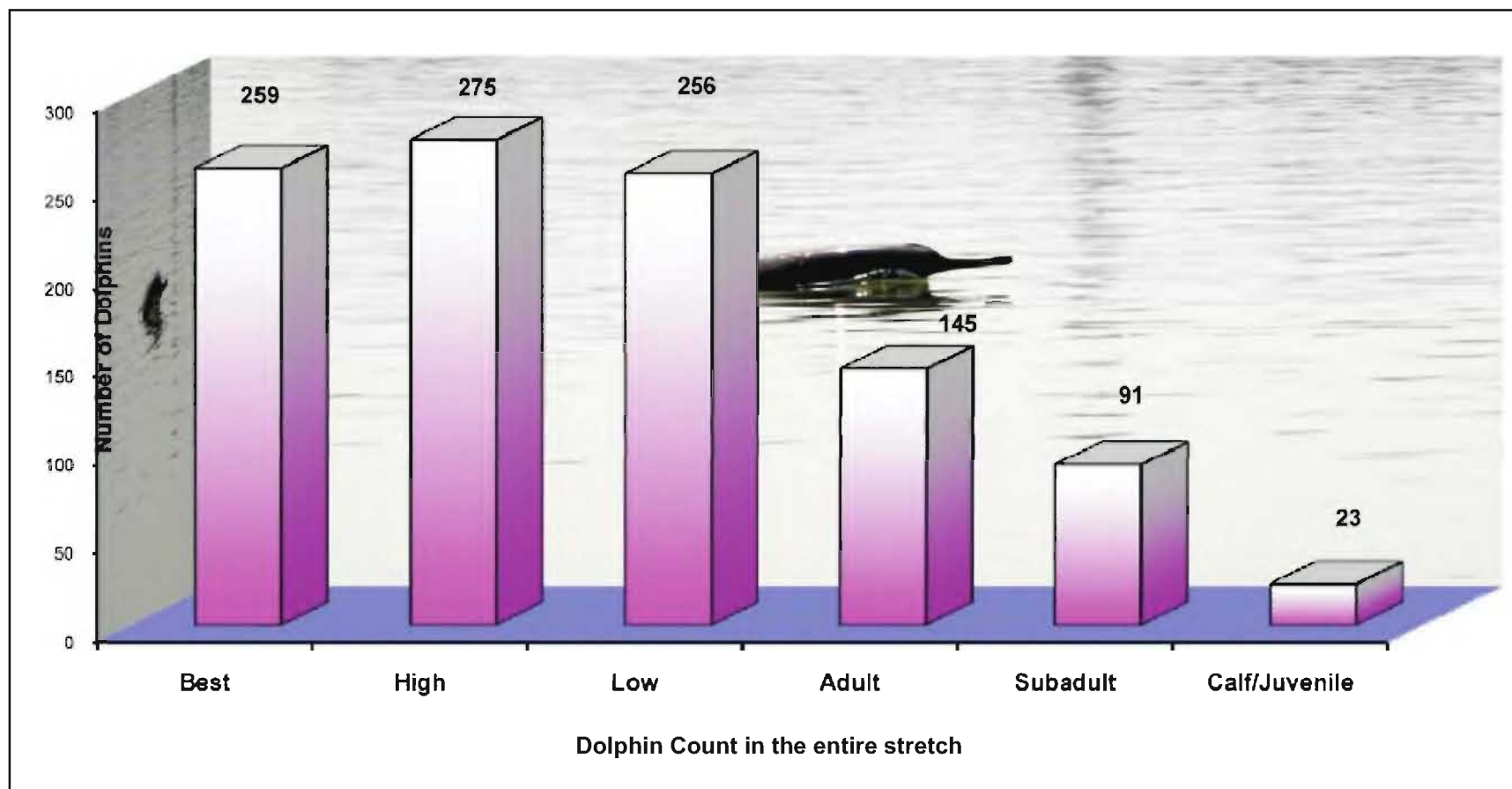


Fig. 6: Dolphin distribution in the entire stretch of River Gandak, Bihar



Gharial *Gavialis gangeticus*
(Gmelin, 1789) eating fish



Perching of Black Kite
Milvus migrans, (Boddaert, 1783)



Surfacing of Dolphin in river, Gandak



Turtle (*Aspideretes gangeticus*)
on the bank of river Gandak



Dolphin (Whol view)



TAXONOMIC STUDIES ON JUNGLE PALM SQUIRREL *FUNAMBULUS TRISTRIATUS* (WATERHOUSE) FROM NORTHERN WESTERN GHATS

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INTRODUCTION :

In India, genus *Funambulus* is represented by five species. Jungle Palm squirrel, *Funambulus tristriatus* (Waterhouse, 1837) is a largest species of the genus classified under the family Scuridae of the order Rodentia. It shows distinct three light longitudinal stripes on the dorsal surface (Photo-1A). Underparts light or whitish. Face, forehead, back and haunches tinged with rusty red. Tail most often shorter than the Head and Body. The inguinal region, testis and mid-ventral line of the

tail cadmium orange to Saturn red in colour (Photo-1B). Occipitonasal length of the skull exceeds 40 mm. Palate usually more than half of the occipitonasal length.

Funambulus tristriatus (Waterhouse), an endemic species to Western Ghats of India, is

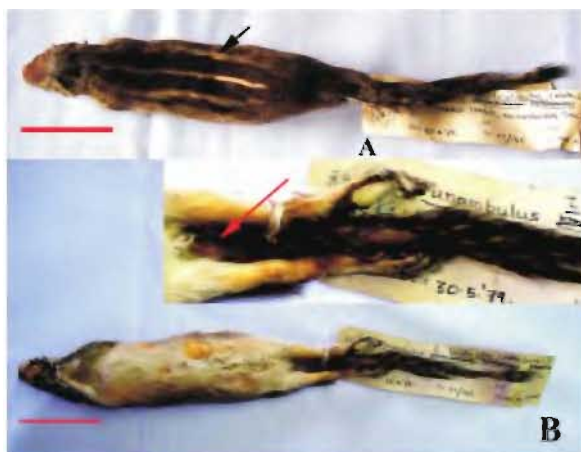


Photo-1 : *Funambulus tristriatus tristriatus* (Waterhouse) Female (ZSI.WRS. M/ 146) (Scale bar = 50 mm). A. Longitudinal three pale buff to brownish stripes (Marked by arrow) between the intermediate dark brown to black bands on the dorsal surface. B. Underparts whitish. Inguinal region & mid-ventral line of the tail cadmium orange to Saturn red in colour (Marked by arrow, Inset)



Map 1 : Distribution of *Funambulus tristriatus tristriatus* (Waterhouse) in Maharashtra State. Records from Maharashtra State includes Kolhapur Dist. : Radhanagari Wildlife Sanctuary [1]; Mumbai Dist. : Ghatkopar [2]; Mumbai Suburban Dist. : SGNP, Borivali [3]; Nandurbar Dist. : Amlibari, Tal. Akkalkua [4], Kondanbari, near Visarwadi [5] (Extended Distribution); Nashik Dist. : Nashik [6]; Pune Dist. : Khandala [7], Karla [8], Bhimashankar [9], Pune [10]; Ratnagiri Dist. : Shirgaum [11], Khed [12]; Sangli Dist. : Chandoli Wildlife Sanctuary [13]; Satara Dist. : Helwak [14], Ghatmatha [15]; Thane Dist. : Thane [16], Jawhar [17], Dehri, Murbad [18].

found upto Bombay in north and occurs in Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu in south (Agrawal, 1973; Corbet & Hill, 1992; Molur *et al.*, 2005). It is diurnal and semi-arboreal and occurs in Tropical Evergreen Forest, Moist Deciduous Forest and plantations like tea, cardamom and coffee (Molur *et al.*, 2005). They feed on paddy grains, male flowers of coconut, mucilage of cacao beans, fruits and other plant parts and insects like termites, black ants, beetles, insect larvae etc. (Bhat and Mathew, 1985). Present paper reports its occurrence in Nandurbar district of Maharashtra State in north (Map 1) which extends the range of earlier distribution. The article also offers comments on its subspecific status in northern part of Western Ghats.

MATERIAL AND METHODS

Present study is a part of the thesis submitted by the author to the University of Pune for the award of Ph.D. degree, 2007. It includes morphometric examination of voucher specimens collected from northern part of Western Ghats available in Zoological Survey of India, Kolkata (ZSI, Kolkata), Zoological Survey of India, Western Regional Centre, Pune (ZSI, WRC) and National Institute of Virology, Pune (NIV). External, Cranial and Dental measurements of each voucher specimen were taken by a vernier caliper with a dial graduation reading up to 0.1 mm. All measurements were taken in millimeter (mm).

Abbreviations used for measurements:

Length of Head and Body (HB), Length of tail (TI), Length of Hind-foot (HF), Length of Ear (E), Occipitonasal length (onl), Condylbasal length (cbl), Greatest zygomatic width (zw), Frontal width (fro), Length of tympanic bulla (bl), Nasal length (nas), Length of maxillary tooththrow (mtr), Length of diastema (dia), Length of palate (pal), Length of the orbit (orb), Nasal width (nw), Mandibular length (ml).

Material Examined : Maharashtra : Mumbai Suburban Dist. : 1 ♀, Ghatkopar, Salsette, 24.iv.1914, Coll. S. H. Prater, (ZSI, Kolkata, 14957), 1 ♂, Ghatkopar, Salsette, 27.iv.1914, Coll. S. H.

Prater, (ZSI, Kolkata, 14954); Nandurbar Dist. : 1 ♀, Amlibari Tal. Akkalkua, 24.xi.1985, Coll. M. S. Pradhan ZSI, WRC, M/462), 1 ♀, Kondaibari Ghat near Visarwadi, 19.xi.1985, Coll. M.S. Pradhan, ZSI, WRC, M/453); Pune Dist. : 2 unsexed, Katkarwadi, Pune, 04.ii.1955, Coll. B. S. Lamba (NIV, W183, 189, skin only), 1 unsexed, Katarwadi, Pune, 08.ii.1955, Coll. B. S. Lamba, (NIV, W18, skin only), 1 ♂, Vithhalwadi, Pune, 13.vi.1963, Coll. S. Paradkar, (NIV, KRPS 24), 1 ♂, Vithhalwadi, Pune, 07.i.1966, Coll. S. Paradkar, (NIV, KRPS 2224), 1 ♂, 1 ♀, Karla village and around, 08.vi.1984, Coll. M. S. Pradhan, (ZSI, WRC, M/520, 521); 1 ♀, Karla, Pune-Bombay Road, 11.v.1988, Coll. M. S. Pradhan, (ZSI, WRC, M/510); 1 ♀, Hanuman Temple, Bhimashankar, 30.v.1979, Coll. A. S. Mahabal, (ZSI, WRC, M/146); Ratnagiri Dist. : 1 ♂, Khia (Khed), 24.xii.1914, Coll. S. H. Prater, (ZSI, Kolkata,

Table-1: External, cranial and dental measurements (mm) of *Funambulus tristriatus tristriatus* (Waterhouse) studied from Maharashtra State. SD: Standard Deviation; N: Sample size

	Mean	Range	SD	N
HB	162.4	138.0 – 185.0	±15.81	15
TI	138.07	118.0 – 157.0	±12.08	13
HF	37.21	32.0 – 40.4	±2.27	17
E	13.21	8.7 – 16.0	±2.05	14
onl	40.73	39.5 – 42.5	±1.01	15
cbl	37.50	36.0 – 39.0	±0.83	15
nas	12.36	10.1 – 13.2	±0.89	14
pal	20.73	20.0 – 21.7	±0.54	14
*mtr	7.62	7.2 – 8.0	±0.25	14
fro	13.79	12.0 – 15.2	±0.94	15
orb	12.00	11.1 – 13.0	±0.45	14
dia	9.86	9.3 – 11.1	±0.55	14
bl	7.35	6.7 – 8.0	±0.41	13
zw	22.97	21.3 – 24.1	±0.86	14
nw	5.2	4.7 – 5.4	±0.22	12
ml	23.2	22.2 – 24.1	±0.65	13

* Upper tooththrow includes premolars and molars.

Table-2: Comparison of external, cranial and dental measurements (mm) of different races under *Funambulus tristriatus tristriatus* (Waterhouse) specimens studied by Ellerman (1961) and Agrawal and Chakraborty (1979b) with those of the specimens under present study. SD : Standard Deviation; N: Sample size.

		Ellerman, 1961 (Maharashtra specimens only)		Agrawal and Chakraborty (1979b)	Present study	
		<i>Funambulus tristriatus tristriatus (numarius)</i>	<i>Funambulus tristriatus tristriatus (thomasi)</i>	<i>Funambulus tristriatus tristriatus</i>	<i>Funambulus t. tristriatus</i> from Satara and Ratnagiri Dist. (Range of 'numarius')	<i>Funambulus t. tristriatus</i> from Pune, Mumbai, Thane, Nandurbar Dist. (Range of 'thomasi')
HB	Range	140 – 155	140 – 147	97.0 – 187.0	150 – 158	127 – 185
	Mean with SD	148.90 ± 4.57	143.5 ± 3.10	148.9 ± 23.99	154 ± 5.65	161.07 ± 18.72
	N	11	4	20	2	14
TI	Range	124 – 157	120 – 148	108.0 – 161.0	118 – 123	122 – 157
	Mean with SD	137.72 ± 11.19	137 ± 14.46	137.1 ± 16.80	120.5 ± 3.53	139.66 ± 11.08
	N	11	4	20	2	12
HF	Range	26.0 – 36.0	35.0 – 38.0	32.0 – 45.0	32.0 – 36.0	33.4 – 40.4
	Mean with SD	31.36 ± 2.90	37.0 ± 1.41	36.57 ± 2.84	34.0 ± 2.82	37.27 ± 2.29
	N	11	4	20	2	15
E	Range	15.0 – 18.0	13.0 – 15.0	13.5 – 20.0	15.0 – 15.0	8.7 – 16.0
	Mean with SD	15.90 ± 1.13	13.75 ± 0.95	16.25 ± 1.5	15.0	12.91 ± 2.07
	N	11	4	20	2	12
onl	Range	39.6 – 41.6	40.2 – 41.5	37.6 – 44.5	40.4 – 42.5	39.1 – 42.5
	Mean with SD	40.92 ± 0.63	40.85 ± 0.91	41.44 ± 2.17	41.36 ± 1.05	40.57 ± 0.98
	N	9	2	14	3	12
cbl	Range	--	--	--	36.6 – 37.7	36.0 – 39.0
	Mean with SD	--	--	--	37.15 ± 0.77	37.56 ± 0.86
	N	--	--	--	2	12

Contd...

nas	Range	11.4 – 13.1	11.8 – 13.1	10.8 – 14.2	10.1 – 12.8	11.3 – 13.7
	Mean with SD	12.41 ± 0.47	12.45 ± 0.91	12.71 ± 1.02	11.73 ± 1.43	12.53 ± 0.69
	N	9	2	14	3	11
pal	Range	20.0 – 21.2	20.4 – 20.9	18.4 – 23.5	20.4 – 20.7	20.0 – 21.7
	Mean with SD	20.74 ± 0.41	20.65 ± 0.35	21.19 ± 1.51	20.55 ± 0.21	20.76 ± 0.58
	N	9	2	14	2	12
mtr	Range	7.4 – 8.0	7.7 – 7.9	7.3 – 8.8	7.5 – 8.0	7.2 – 8.0
	Mean with SD	7.7 ± 0.19	7.8 ± 0.14	8.02 ± 0.49	7.75 ± 0.35	7.6 ± 0.24
	N	8	2	13	2	12
fro	Range	10.9 – 12.4	12.1 – 12.2	11.2 – 13.8	13.0 – 14.1	12.0 – 15.2
	Mean with SD	11.81 ± 0.44	12.15 ± 0.07	12.65 ± 0.79	13.53 ± 0.55	13.85 ± 1.03
	N	9	2	14	3	12
orb	Range	11.4 – 12.1	12.0 – 12.1	11.7 – 13.4	11.6 – 12.1	11.1 – 12.3
	Mean with SD	11.75 ± 0.26	12.05 ± 0.07	12.41 ± 0.52	11.85 ± 0.35	11.90 ± 0.35
	N	9	2	13	2	12
dia	Range	--	--	--	10.0 – 10.2	9.3 – 11.1
	Mean with SD	--	--	--	10.1 ± 0.14	9.85 ± 0.56
	N	--	--	--	2	12
bl	Range	--	--	--	7.0 – 7.3	6.7 – 8.0
	Mean with SD	--	--	--	7.15 ± 0.21	7.39 ± 0.43
	N	--	--	--	2	11
apf	Range	--	--	--	1.1 – 1.2	1.0 – 2.1
	Mean with SD	--	--	--	1.15 ± 0.07	1.36 ± 0.41
	N	--	--	--	2	11
zw	Range	--	--	--	22.5 – 24.1	21.3 – 24.1
	Mean with SD	--	--	--	23.2 ± 0.81	22.90 ± 0.90
	N	--	--	--	3	11
ml	Range	--	--	--	22.6 – 24.0	22.2 – 24.1
	Mean with SD	--	--	--	23.3 ± 0.98	23.18 ± 0.64
	N	--	--	--	2	11

14955); Satara Dist. : 1 ♂, 1 ♀, Helwak, 09.xii.1914, Coll. S. H. Prater, (ZSI, Kolkata, 14958 (skull only), 14956); Thane Dist. : 1 ♀, Dehari, Murbad, 17.iii.1984, Coll. M. S. Pradhan, (ZSI, WRC, M/391).

Material examined other than study area :

Goa : 1 ♂, 1 Km. N. of Poinguinim, Canacona, 24.xii.1968, Coll. V. C. Agrawal, (ZSI, Kolkata, 18743); **Kerala :** 1 ♀, Valley, Travancore, South India, 30.viii.1915, Coll. S. N. Pillay, (ZSI, Kolkata, 14962); **Tamil Nadu :** 1 ♂, Sengartheri, Kalkkad Mundanthurai Reserve Forest, 19.vii.1997, Coll. D. Mudappa, (ZSI, WRC, M/840, Donated).

RESULT AND DISCUSSION

Wroughton (1916) described *Funambulus tristriatus numarius* from Helwak, Satara Dist. as a local race which is smaller in size than *F. tristriatus*. Later Wroughton and Davidson (1919) described *Funambulus thomasi* from Khandala, Pune Dist. However, both the taxa were synonymised in *F. t. tristriatus* by Ellerman (1961) due to overlapping of characters within these races. Agrawal and Chakraborty (1979a) also supported Ellerman's view. Later, Moore and Tate (1965) maintained *numarius* (including *thomasi*) as a distinct subspecies of *F. tristriatus*. Corbet and Hill (1992) and Thorington and Hoffman in Wilson and Reeder (2005) also followed the same view. Pradhan and Talmale (2009) retained it tentatively and also recommended detailed taxonomic studies of *numarius* for its validity. However, Alfred *et al.* (2002), Srinivasulu *et al.* (2004) accepted views of Ellerman (1961) and synonymised both *numarius* and *thomasi* under the nominate subspecies *F. t. tristriatus*. Specimens collected from localities of *thomasi*, *numarius* and nominate subspecies of *F. tristriatus* were compared and studied in the present work. It will be seen from the comparative account that there is a considerable amount of overlapping in the morphological and osteological measurements (Table- 1 & 2 (marked bold) and also in colour forms of these subspecies. Moore and Tate (1965) recognized *numarius* but commented that " Shortridge obtained 35

specimens in Dharwar and Kanara which are clearly intermediates between [*numarius*] and *tristriatus*...". Therefore, it is strongly opined to accept the views of Ellerman (1961) and keep *numarius* and *thomasi* in *F. t. tristriatus*.

The specimen studied from Tamil Nadu (ZSI, WRC, M/840) having larger size with HB : 190mm, onl : 44.1 mm, pl : 23.6 mm and mtr : 9.5 mm, matches with the measurements of *F. tristriatus wroughtoni* Ryley given by Ellerman (1961), which has been synonymised under *F. tristriatus tristriatus* by Corbet and Hill (1992) and Thorington and Hoffman in Wilson and Reeder (2005).

As per collection and literature record the species has been reported from different localities from Maharashtra State in the Western Ghats (Map 1). Collection record from Nandurbar District, Maharashtra (Map 1) indicates extension of range of distribution of this species beyond Mumbai and the northern Western Ghats.

As per IUCN CAMP, 2005 this species has been categorized under Near Threatened category (Molur *et al.*, 2005), recent IUCN status shows Least Concern (Molur and Nameer, 2008) on the basis of its wide distribution, tolerance of a degree of habitat modification, presumed large population.

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ADDITIONAL NOTES ON THE GENUS *ANCYLOTROPUS* CAMERON (HYMENOPTERA: EUCHARITIDAE) FROM INDIAN SUBCONTINENT

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INTRODUCTION

The genus *Ancyлотropus* was erected by Cameron (1909) based on the male specimen of the type species *Ancyлотropus cariniscutis* Cameron. This genus was treated briefly by Narendran & Sheela (1995) and Bouček (1988) and in detail by Heraty (2002). They are distributed in Palaeotropical Region through the Malagasy subregion to western Malaysia. Six species are known from all over the world of which 4 species were reported from Oriental Region including 2 species from Indian subcontinent. These 6 species are *A. cariniscutis* Cameron from Oriental Region, *A. ivondroi* (Risbec) from Malagasy Region, *A. keralensis* Girish Kumar & Narendran from Oriental Region (Indian subcontinent), *A. manipurensis* (Clausen) from Oriental Region (Indian subcontinent), *A. montanus* (Girault) from Oriental Region and *A. seyrigi* (Risbec) from Malagasy Region (Heraty, 2002; Noyes, 2003; Girish Kumar, 2004; Girish Kumar & Narendran, 2008). In this paper we are providing some additional information to the present knowledge about the species of the genus *Ancyлотropus* Cameron from Indian subcontinent. The female of the species *A. keralensis* Girish Kumar & Narendran is described here for the first time. A

redescription of the male of *A. manipurensis* (Clausen) is provided and a modified key to separate the species of the Indian subcontinent is also provided. All the specimens studied are added to the "National Zoological Collections" of the Zoological Survey of India, Kolkata (NZC).

Abbreviations used for the Museums: NZC = 'National Zoological Collections' of Zoological Survey of India, Kolkata, India; USNM = United State National Museum of Natural History, Washington D. C., U. S. A.

Abbreviations used for the terms used in the text: F1-F8 = Funicular segments 1-8; MV = Marginal vein; OOL = Ocellocular line; PMV = Postmarginal vein; POL = Postocellar line; SMV = Submarginal vein; SSS = Scutoscuteellar sulcus; STV = Stigmal vein; Gt1 = First gastral tergite.

Genus *Ancyлотropus* Cameron

Ancyлотropus Cameron, 1909, *Entomologist*, 47: 229. Type species: *Ancyлотropus cariniscutis* Cameron by monotypy.

Diagnosis: Antenna 11 or 12 segmented in females and 12 segmented in males; notauli distinct and complete; spiracle situated at the anterior face of the pronotal-prepectal complex under a shelf-like expansion of the lateral lobe of

the mesoscutum; usually have a distinct, vertical, anterior prepectal carina that terminates dorsally just below or posterior to the mesothoracic spiracle, rarely the carina is indistinct from the surrounding sculpture or the anterior margin is abrupt without any carina; posterodorsal margin of prepectus apically truncate or rounded, not reaching to tegula; apex of scutellum rounded or prolonged in to a truncate or emarginate projection; propodeal spiracle circular or at most with a very small ventral emargination; basal gastral tergite triquetrous or bivalved.

Hosts: Based on their phylogenetic position, they are probably parasites of Ponerinae in the tribe Ectatommini (Heraty, 2002).

Distribution: Palaetropical region through the Malagasy subregion to western Malaysia (Heraty, 2002).

**Key to species of the genus *Ancylotropus*
Cameron from Indian subcontinent**

1. Basal gastral tergite triquetrous (three sided) (Image 7); eyes bare; scutellar horn almost at the same plane of scutellum and not tilted upwards; scutellum with posterior horn almost rounded or at least slightly incised (Image 3).....
..... *keralensis* Girish Kumar & Narendran
- Basal gastral tergite bivalved (two sided) (Image 15); eyes with minute sparse hairs; scutellar horn tilted upwards about 30° on horizontal axis of scutellum; scutellum with posterior horn usually deeply incised at apex, rarely truncated or slightly rounded (Images 11, 16, 17 & 18).....
..... *manipurensis* (Clausen)

Ancylotropus keralensis Girish Kumar and
Narendran
(Images 1-8)

Ancylotropus keralensis Girish Kumar and Narendran, 2008: 92-95, Holotype Male, Muthanga (Kerala, India) (NZC).

Plesiotype Female: Length 3.34 mm. Head, mesosoma and petiole black with metallic green refringence, metallic green reflections on head and petiole very slight; antenna pale brown except scape and pedicel yellow; mandibles pale brownish yellow with tip of teeth brown; eyes black with silvery white reflections; ocelli

reflecting pale yellow to brown; legs pale brownish yellow except coxae brownish black; claws brown; wings hyaline without any infumation around stigma, veins brown; gaster blackish brown.

Head: Transverse subtriangular (Image 2), 1.18x as broad as high excluding mandibles; OOL as long as POL; vertex smooth with a few striations; frons also with a few strong transverse striations; gena and sides of lower frons with minute scattered pits; labrum 9 digitate; clypeal and supraclypeal area smooth; tentorial pit deep; vertex and frons with sparse hairs; eyes bare, eye separated by 1.75x their height. Antenna (Image 4) 11 segmented; scape cylindrical, not reaching front ocellus; relative proportions of length and width of antennal segments: scape: 43:13; pedicel: 20:14; F1: 36:15; F2: 36:15; F3: 36:15; F4: 34:15; F5: 32:16; F6: 27:16; F7: 27:16; F8: 23:16; clava: 40:17.

Mesosoma: Mesoscutum and scutellum including posteriorly projecting horn with close rugoso-alveolate sculpture, and moderately pubescent, interstices carinate; SSS transversely carinate; scutellum with a single horn directed straight posteriorly, almost rounded at apex (Image 3); callus and propodeal disc with felt like pilosity; mesepimeron with sparse pilosity; median length of scutellum up to apical tip of scutellar horn in dorsal view 1.31x basal width (excluding axillae) of scutellum; scutellar horn almost at the same plane of scutellum and not tilted upwards; propodeum sculptured as in image 5; mesepisternum with a large smooth area, upper and lower mesepimeron almost fully sculptured with small smooth areas; coxae sparsely pubescent; femora moderately pubescent; pubescence on tibiae and tarsi denser than those on femora. Fore wing (Image 6) 2.58x as long as broad; fore wing densely pubescent except basal cell sparsely pubescent; SMV 1.38x MV; MV 2.46x PMV; PMV 2.07x STV; hamuli 4 in number.

Metasoma (Image 7): Petiole 0.43x as long as gaster, with longitudinal striations; Gt₁ bivalved, smooth and shiny; ovipositor exerted.

Male (Image 8): See Girish Kumar & Narendran, 2008.

Hosts and Biology: Unknown.

Material examined: Holotype ♂, INDIA: Kerala, Wayanad district, Muthanga Wildlife Sanctuary, 07.v.2000, Coll. T. C. Narendran & Party, NZC Regd. No. 9991/H3. Paratypes, 2 ♂, same data of holotype, 06.v.2000 & 07.v.2000, NZC Regd. Nos. 9992/H3 & 9992/H3. Other materials. INDIA: Kerala, Palakkad district, Silent Valley National Park, 1 ♂, 30.xii.1988, Coll. M. Hayat, NZC Regd. No. 13792/H3; Silent Valley National Park, Sirendri, 2 ♀ & 1 ♂, 04.xii.2007, Coll. K. Rajmohana & Party, NZC Regd. Nos. 13793/H3 to 13795/H3; Kunthipuzha riverside, 1 ♀ & 3 ♂, 05.xii.2007, Coll. K. Rajmohana & Party, NZC Regd. Nos. 13796/H3 to 13799/H3; Aringapara, 1 ♀ & 4 ♂, 06.xii.2007, Coll. K. Rajmohana & Party, NZC Regd. Nos. 13800/H3 to 13804/H3.

Variation: Labrum with 8-9 digitate; scutellar process almost rounded to slightly incised.

Distribution: India: Kerala.

***Ancylotropus manipurensis* (Clausen)**
(Images 9-18)

Schizaspidia manipurensis Clausen, 1928: 85-86, Male, Female. Type Male, Imphal (Manipur, India) (USNM).

Stilbula manipurensis: Gahan, 1940: 436. Description of both sexes. Change of combination. Additional citation: Hedqvist, 1978, 247 (catalogue).

Ancylotropus manipurensis: Bouček, 1988: 534. Change of Combination. Additional citations: Narendran & Sheela, 1995: 46-47. Description of both sexes; partly based on type studied by Narendran, partly based on the figures supplied by Heraty and partly based on original description; Heraty, 2002: 79-80 (key; species catalogue).

Plesiotype Male: Length 4.74 mm. Head, mesosoma and petiole black with metallic refringence; antenna pale yellowish brown except scape and pedicel yellow; mandible pale

brownish yellow with margins brown; eyes black with silvery white reflections; ocelli reflecting brown; legs yellow except mid and hind coxae brownish black, fore coxa blackish brown; claws brown; wings hyaline with a very slight infumation around the surface of stigma, veins brown; gaster blackish brown.

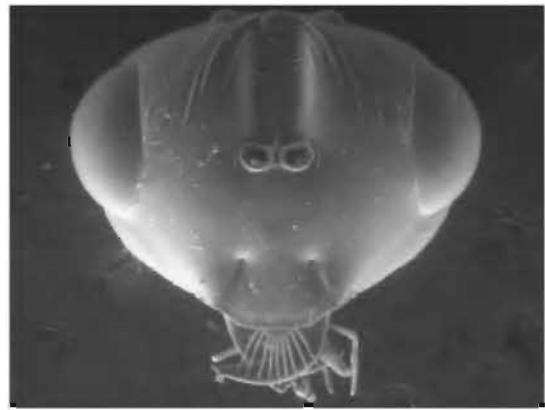
Head: Transverse subtriangular (Image 10), 1.51x as broad as high excluding mandibles; OOL 0.62x POL; vertex with a few striations; frons with a few strong transverse striations; gena and sides of lower frons with minute scattered pits; labrum 8 digitate; clypeal and supraclypeal area smooth with hairs; tentorial pit deep; vertex and frons with sparse hairs; eyes with minute sparse hairs, eye separated by 2.32x their height. Antenna (Image 12) 12 segmented; scape cylindrical, not reaching front ocellus; flagellar segments filiform; relative measurements of length of antennal segments: scape: 16; pedicel: 9; F1: 38; F2: 31; F3: 31; F4: 30; F5: 29.5; F6: 26.5; F7: 26.5; F8: 25; F9: 22; F10: 24.

Mesosoma: Mesoscutum and scutellum including posteriorly projecting horn with close rugoso-alveolate sculpture and moderately pubescent, interstices carinate; SSS transversely carinate; scutellum with a single horn directed straight posteriorly, Y-shaped fork at apex (Image 11); callus and propodeal disc with felt like pilosity; lateral part of pronotum, prepectus and mesepimeron laterally with felt like pilosity (Image 14); median length of scutellum up to apical tip of scutellar horn in dorsal view 1.44x basal width (excluding axillae) of scutellum; scutellar horn tilted upwards about 30° on horizontal axis of scutellum; propodeum rugulose; mesopleuron almost fully sculptured; coxae with felt like pubescence; femora moderately pubescent; pubescence on tibiae and tarsi denser than those on femora. Fore wing (Image 13) 2.86x as long as broad; fore wing densely pubescent except basal cell sparsely pubescent; SMV 1.57x MV; MV 1.64x PMV; PMV 4.76x STV; hamuli 3 in number.

Metasoma (Image 15): Petiole 0.86x length of gaster, with longitudinal striations; Gt₁ triquetrous, smooth and shiny.



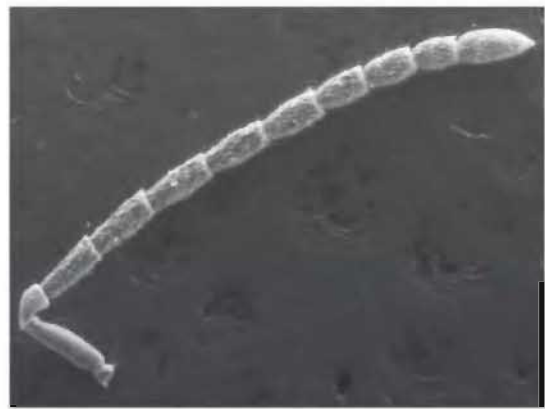
1



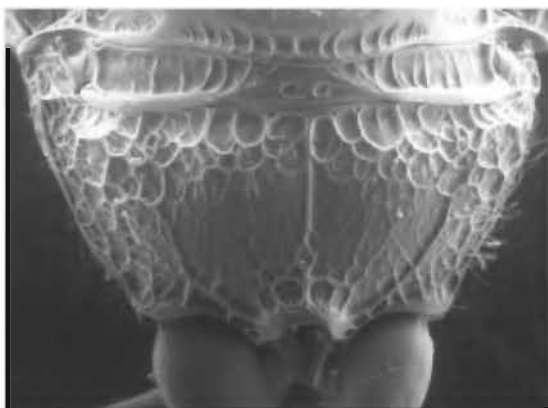
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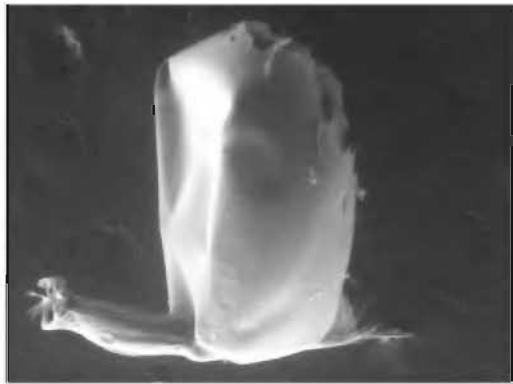


5



6

Images 1-6 : *Ancyлотropus keralensis* Girish Kumar & Narendran Female. 1. Body Profile; 2. Head front view; 3. Head and Mesosoma dorsal view; 4. Antenna; 5. Propodeum; Forewing.



7



8



9



10



11



12

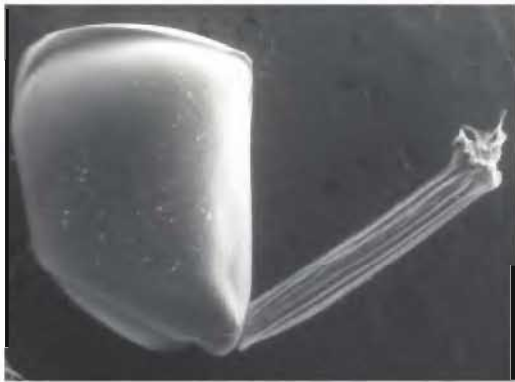
Images 7-8. *Ancylotropus keralensis* Girish Kumar & Narendran Female. 7. Mesosoma lateral view Female; 8. Body profile Male. **Images 9-12.** *Ancylotropus manipurensis* (Clausen) 9. Body profile; 10. Head front view; 11. Head and Mesosoma dorsal view; 12. Antenna.



13



14



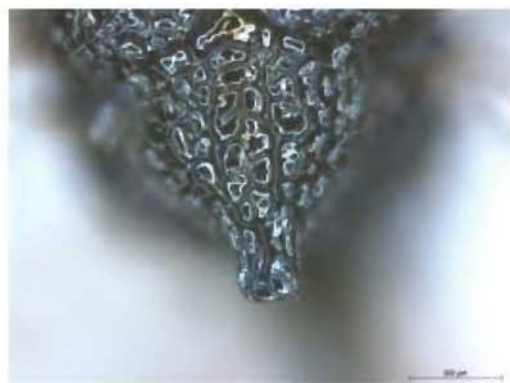
15



16



17



18

Images 13-18 : *Ancylostropus manipurens* (Clausen) Male. 13. Forewing;
14. Measoma lateral view; 15. Metasoma lateral view; 16, 17 & 18.
Scutellar horns in different specimens.

Female: See Clausen (1928), Gahan (1940) and Narendran & Sheela (1995).

Hosts and Biology: Oviposition habits and description of egg and first instar larva are reported in Clausen (1928, 1940).

Material examined: INDIA: Arunachal Pradesh, East Siang district, Mebo, 1 ♂, 19.x.1966, Coll. S. K. Tandon & Party, NZC Regd. No. 13836/H3; Dibang Valley district, Roing, 1 ♂, 08.xi.1985, Coll. G. K. Srivastava & Party, NZC Regd. No. 13811/H3; Changlang district, Namdapha National Park, Deban, 12 ♂, 14.xi.2009, Coll. P. M. Sureshan, NZC Regd. Nos. 13812/H3 to 13823/H3. Tripura, South Tripura district, Chandrapur, 3 ♂, 07.x.1977, Coll. N. Muraleedharan & Party, NZC Regd. Nos. 13837/H3 to 13839/H3; South Tripura district, Paratia East, 1 ♂, 09.x.1977, Coll. N. Muraleedharan & Party, NZC Regd. No. 13840/H3; South Tripura district, Paratia West, 5 ♂, 10.x.1977, Coll. N. Muraleedharan & Party, NZC Regd. Nos. 13841/H3 & 13845/H3; Gumati district, Amarpur, 1 ♂, 15.x.1977, Coll. N. Muraleedharan & Party, NZC Regd. No. 13846/H3; West Tripura district, Teliamura, 2 ♂, 23.x.1977, Coll. N. Muraleedharan & Party, NZC Regd. Nos. 13847/H3 & 13848/H3; Gumati district, Udaipur, 1 ♂, 14.v.1978, Coll. J. K. Jonathan & Party, NZC Regd. No. 13807/H3; West Tripura district, Teliamura, 3 ♂, 18.v.1978, Coll. J. K. Jonathan & Party, NZC Regd. Nos. 13808/H3, 13808/H3 & 13849/H3; West Tripura district, Agartala, 1 ♂, 24.xii.1991, Coll. M. Dutta & Party, NZC Regd. No. 13810/H3.

Variation: The apex of scutellar projection is highly varying in their shape and size. Usually it is forked (usually Y-shaped, rarely U-shaped) rarely truncated or slightly rounded dorsally (Images 11, 16, 17 & 18).

Distribution: India: Arunachal Pradesh (new record), Manipur, Tripura (new record).

SUMMARY

The species of the genus *Ancylotropus* Cameron from Indian subcontinent is reviewed. The female of the species *A. keralensis* Girish Kumar & Narendran is described here for the first time. A redescription of the male of *A. manipurensis* (Clausen) is provided and a modified key to separate the Indian subcontinent species is also provided.

ACKNOWLEDGEMENTS

We are grateful to Dr. K. Venkataraman, Director, Zoological Survey of India Kolkata for providing facilities and encouragements. PGK is also grateful to Dr. Kailash Chandra, Additional Director & Officer-in-Charge of Entomology Division (A), Zoological Survey of India, Kolkata and Dr. Gaurav Sharma, Officer-in-Charge, Hymenoptera Section, Zoological Survey of India, Kolkata for providing facilities and encouragements. TCN is also grateful to the Ministry of Environment & Forests, Government of India, New Delhi for financial assistance for his research under All India Coordinated Project on Taxonomy & Capacity Building (AICOPTAX).

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A TAXONOMIC REVISION OF ORIENTAL *DIPARA* WALKER (HYMENOPTERA: CHALCIDOIDEA: PTEROMALIDAE) WITH DESCRIPTIONS OF SIX NEW SPECIES FROM INDIA

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INTRODUCTION

The genus *Dipara* Walker belongs to the subfamily Diparinae of Pteromalidae (Hymenoptera: Chalcidoidea) and is known for 42 described species throughout the world with eleven species known from the Oriental Region (Noyes, 2003). Desjardins (2007) attempted the phylogenetics and reclassification of world Diparinae in which he synonymised ten genera under *Dipara* based on phylogenetic analysis. Taxonomic studies on *Dipara* from the Oriental region were attempted by Narendran et al, 2000, Narendran & Mini, 2000, Narendran & Sureshan, 2001, Sureshan & Narendran 2004, 2005, Xiao & Huang, 1999 and Huang & Xiao, 2005. The *Dipara* species currently known from the Oriental Region are *D.keralensis* (Narendran 2000), *D.malabarensis* (Narendran & Mini, 2000), *D.eukeralensis* Özdikmen 2011, *D.miniae* Narendran & Sureshan 2001, *D.mohanae* Narendran & Sureshan, 2001, *D.gastra* (Sureshan & Narendran, 2004), *Dipara intermedia* Sureshan & Narendran 2005, *D.sringericus* (Narendran, 2006), *D.bouceki* (Narendran, 2006), *D.dictyodroma* (Xiao & Huang) and *D.hyalinipennis* (Girault) (Noyes, 2003, Desjardins, 2007).

During the faunal exploration surveys undertaken in the different parts of the country, several specimens of *Dipara* were collected mainly from Namdapha National Park, Arunachal Pradesh, Uttarakhand and Kerala which included some interesting species. On detailed

examination the specimens were proved to belong to six undescribed species which are described hereunder. Affinities of these species with other known species are discussed. Systematic account of the other species of *Dipara* known from the Oriental Region and a key to separate them is also provided.

MATERIALS AND METHODS

The specimens of the present study were collected by sweeping with an insect net in all cases except for the specimen of *D.hayati* sp.nov. collected in the malaise trap. They were studied in the laboratory using Leica M 205 A and Leica MZ 16 model stereo zoom microscopes. The images were taken using the inbuilt camera DFC 500 model of M 205 model microscope and the line drawings were made using the inbuilt drawing tube attachment of Leica MZ 16 microscope. The type specimens are deposited in Western Ghat Regional Centre, Zoological Survey of India Calicut, Kerala, India (ZSIK).

The terminology used in the paper generally follows Gibson (1997). The following abbreviations are used in the text: F: Female, M: Male; DZCU: Department of Zoology University of Calicut, Kerala, India; F1-F7: funicular segments 1 to 7; ICZN.- International code of Zoological Nomenclature; IZAS- Chinese Academy of Sciences, Institute of Zoology, Beijing, China; MV marginal vein; NZSI- National Zoological Collections of Zoological Survey of India, Kolkata; OOL-ocellocular distance; PMV-

postmarginal vein; POL- post-ocellar distance; SMV- submarginal vein; QM- Queensland Museum, Brisbane, Australia; STV- stigmal vein; UCDC: Bohart Museum of Entomology, University of California, Davis, USA; ZSIK: Zoological Survey of India, Western Ghat Regional Centre, Calicut, Kerala, India.

Dipara Walker

Dipara Walker 1833: *Ent. Mon.Mag.* 1: 371,373. Type species: *D. petiolata* Walker (by monotypy).

Tricoryphus Forster 1856. Type species: *Tricoryphus fasciatus* Thomson (by subsequent monotypy (Thomson, 1876). Syn. by Domenichini, 1953.

Apterolelaps Ashmead 1901. Type species: *Apterolelaps nigriceps* Ashmead (original designation and by monotypy). Syn. by Graham, 1969.

Alloterra Kieffer & Marshall, 1904: 46-47. Type species: *Alloterra claviger* Kieffer & Marshall (by monotypy). Syn. by Desjardins, 2007.

Trimicrops Kieffer 1906. Type species: *Trimicrops claviger* Kieffer (by monotypy). Syn. by Desjardins, 2007.

Parurios Girault 1913: 318. Type species: *Parurios australiana* Girault (by monotypy). Syn. by Desjardins, 2007.

Epilelaps Girault 1915: 344. Type species: *Epilelaps hyalinipennis* Girault (original designation). Syn. by Boucek, 1988.

Pseudipara Girault 1915: 345. Type species: *Pseudipara albiclava* Girault (original designation and by monotypy). Syn. by Boucek, 1988.

Uriolelaps Girault 1915: 201. Type species: *Uriolelaps argenticoxae* Girault (original designation). Syn. by Desjardins, 2007.

Hispanolelaps Mercet 1927: Syn. by Domenichini, 1953.

Pseudiparella Girault 1927: 334-335. Type species: *Pseudiparella emersoni* Girault (by monotypy). Syn. by Boucek, 1988.

Emersonia Girault 1933. Type species: *Emersonia atriscutum* Girault (by monotypy). Syn. by Desjardins, 2007.

Grahamisia Delucchi 1962. 379-380 Type species: *Grahamisia saetosa* Delucchi (Original designation and by monotypy). Syn. by Desjardins, 2007.

Afrolelaps Hedqvist 1963. 47. Type species: *Afrolelaps maculata* Hedqvist (Original designation). Syn. by Desjardins, 2007.

Pondia Hedqvist 1969. 197. Type species: *Pondia punctulata* Hedqvist (Original designation) . Syn. by Desjardins, 2007.

Diparomorpha Hedqvist 1971. 57-58. Type species: *Diparomorpha machadoi* Hedqvist (Original designation and by monotypy). Syn. by Desjardins, 2007.

Diagnosis: *Dipara* females can be identified by the following combination of characters: Gastral petiole distinct, with at least one pair of setae or bristles on the lateral margins; mesoscutum with two pairs of long bristles; scutellum with at most 2 pairs of bristles, frenum distinctly separated; propodeum with distinct nucha; antennae with anellus broader than long; clypeus without tooth.

Remarks: Desjardins (2007) provided detailed discussion on the phylogenetic relationships of *Dipara* with other closely related genera of Diparinae.

Distribution: *Dipara* species are cosmopolitan in distribution mainly known from Palearctic, Nearctic, Australian, Oriental and Ethiopian regions.

Hosts: Not known except for an undescribed Indian species (under *Parurios*) reared from a curculionid beetle feeding on the roots of *Cyperus* (Boucek, 1988).

Key to the Oriental species of *Dipara* Walker (excluding species from Oriental China) (Based on females, modified from Sureshan and Narendran, 2005)

1. Wings reduced (Brachypterous) 2
- Wings fully developed (Macropterous).....8
2. Mesoscutum with notauli meeting in the posterior end; scapulae with distinct black patch in the posterior half either uniformly in the posterior part or on the posterior half of scapulae only.....3
- Mesoscutum with notauli not meeting in the posterior end and without black patch.....5
3. Mesoscutum with distinct black patch covering almost posterior 2/3 portion (Fig. 3); pronotum with a distinct transverse carina; forewing stump with one short and one long bristle.....*D. thirumalaii* sp. nov.

- Mesoscutum with black patch on the posterior half of scapulae only; pronotum with or without transverse carina; forewing stump with 3 or 4 setae.....4
- 4. Propodeum without a median carina; plicae united in the form of a 'V' in front of nucha; F6 partly whitish yellow as on clava; forewing stump with 4 setae; gaster swollen with T3-T6 not very short, colour yellowish brown with a distinct yellow band overlapping T1 and T2. Size 1.8-1.9mm.....
..... *D. gastra* (Sureshan & Narendran)
- Propodeum with a weak median carina, not quite reaching basal margin, plicae not united in front of nucha to form a 'V' shaped structure; antennae with F6 completely brown; forewing stump with 3 setae; gaster narrow and compressed with T3-T6 short, colour almost brown with epipygium and ventral part paler. Size 1.45-1.6mm.....
..... *D. malabarensis* (Narendran & Mini)
- 5. Forewing stump broad, 4.3x as long as broad, reaching beyond tip of petiole, petiole stout, micro reticulate, 1.6x as long as broad (Fig.22); propodeum with characteristic median carina plicae and costulae as in figure.12
..... *D. venkati* sp. nov.
- Forewing stump very short and narrow not reaching or just touching base of petiole, petiole slender, longitudinally carinate, more than 1.6x as long as broad, propodeum with or without median carina, plicae and costula not as above.....6
- 6. Propodeum with baso-medial area between plicae conically elevated up to middle; surface not shiny, with longitudinal and transverse carinae and striae; wing stump extending well beyond the hind margin of scutellum, touching base of petiole and with 5 or 6 bristles.....7
- Propodeum with baso-medial area between plicae not conically elevated up to middle; surface almost shiny with very weak striations, wing stumps short not reaching much beyond hind margin of scutellum and with only 2 setae *D. intermedia* Sureshan & Narendran
- 7. Upper face and vertex distinctly reticulate, size 2.6mm. POL equal to OOL; antenna with F6 and F7 whitish yellow as on clava; F2-F5 dark brown, wing stump with 5 bristles; hind coxae reticulate..... *D. eukeralensis* Özdikmen
- Upper face and vertex almost shiny, only weakly reticulate, size 1.5 mm. POL little shorter than OOL (0.83x); only F7 whitish yellow as on clava; F3-F6 brown; wing stump with 6 bristles; hind coxae striate reticulate.....
..... *D. mohanae* Narendran & Sureshan
- 8. Mesoscutal bristles in the centre or little above the centre; pronotum without separate long and stout bristles near posterior margin; notauli not meeting each other in the sub apical margin.....9
- Mesoscutal bristles below the centre in the distal one third portion; pronotum with a row of long and stout bristles near posterior margin in addition to shorter uniform pubescence; notauli meeting each other in the sub apical margin.....11
- 9. Mesoscutum posteriorly with a distinct black patch in the lower half of scapulae, notauli closely converging posteriorly; antennae slender with funicular segments long; gaster (including petiole) long 1.5x as long as head plus mesosoma combined (Figs. 5, 6, 15, 16); size 3.3 mm..... *D. debanensis* sp. nov.
- Mesoscutum with a broad black patch covering all the three lobes in the posterior 1/3 portion or without any black patch; notauli not closely converging; antennae not slender, funicular segments shorter; gaster 1.2x as long as head plus mesosoma combined size 1.9 mm. 10
- 10. Mesoscutum without any black patch or band bristles little above centre, reticulation of the body fine; antennae with F4-F6 brown (F4 partly).....*D. miniae* Narendran & Sureshan
- Mesoscutum with a broad black patch covering all the three lobes in the posterior 1/3 portion, bristles in the centre; reticulation of the body coarse; antennae with F4-F7 brown (Figs. 1, 2, 23) *D. nigriscuta* sp. nov.
- 11. Scrobe long, separated from front ocellus by a distance as long as the diameter of front ocellus, exceeding well over middle length of eye from toruli, clava as long as combined length of three preceding segments.....12
- Scrobe shorter than above, at the most reaching mid level of eyes from toruli, clava distinctly shorter than combined length of three preceding segments.....14

12. Gastral petiole smooth and shiny without longitudinal carina, short, its maximum posterior width 1.13 x dorsal length; scutellum distinctly shorter than mesoscutum; frenal area shorter than scutellar area in front, body large, length 4.5 mm.....*D. sringericus* (Narendran)
- Gastral petiole with distinct longitudinal carina or reticulation, long, its maximum posterior width only 0.7-0.9 x dorsal length; scutellum slightly shorter than mesoscutum; frenal area almost as long as scutellar area in front, body small, length 2.3-2.7 mm.....13
13. Gastral petiole long, 1.7 xs as long as broad in dorsal view, almost half length of hind coxa, dorsally mostly reticulate and with carinae only in the hind part, petiolar setae not near the base, sub basal; T1 1.6x as long as broad (Figs. 13,14,26); forewing with PMV long, 2x STV, frenum with only median longitudinal carinae distinct, the others less distinct, face without metallic blue reflection. size. 2.7 mm. *D. nigra* sp. nov.
- Gastral petiole short, 1.2x as long as broad in dorsal view, distinctly less than half length of hind coxa, dorsally without reticulation, only longitudinally carinate, petiolar setae almost near the base (Figs. 9,10,20); T1 1.23x as long as broad; forewing with PMV short, 1.7x STV, frenum with all longitudinal carinae distinct, face with distinct metallic blue reflection. Size. 2.3 mm.....*D. hayati* sp. nov.
14. Forewing with 3 infumate patches; petiole a little longer than half length of hind coxa, axillae and pronotum pink; head mostly brownish pink with vertex and occiput darker.....
D. bouckei (Narendran)
- Forewing without infumations, hyaline; petiole one-third as long as hind coxa; axillae, pronotum and head black.....*D. keralensis* (Narendran)

SPECIES DESCRIPTIONS

Dipara nigriscuta sp. nov. (Figs. 1, 2, 23, 24)

Holotype: Female: Length 1.9 mm. Body honey brown except eyes black, posterior one third part of mesoscutum black, mesopleuron and propodeum blackish brown, gaster blackish brown with a sub apical yellowish brown band, fore and hind coxae and base of hind femora

yellowish white, rest of legs brownish yellow, antenna with scape silvery white except base and tip brown, pedicel brown, F1-F4 brownish yellow, F5-F7 brown, clava yellow, eyes black, ocelli and ocellar triangle black.

Head: (Figs. 1, 2) In dorsal view width 2.2x length, POL 1.3x OOL; in front view head 1.2x as broad as long; toruli little above lower margin of eyes; separated by their individual diameter; malar space 0.34x as long as eye (in profile); eye 1.3x as long as broad; clypeus 1.3x as broad as long, raised from the general surface, anterior margin truncate. Antennae (Fig. 23) with scape 0.82x eye length, pedicel plus flagellum 1.3x head width, funicular segments with one row of sensillae, clava 1.6x as long as 2 preceding segments combined.

Mesosoma: (Fig. 24) Pronotum with collar narrow, carinate in the middle. Mesoscutum 1.7x as broad as long, with a black patch, almost complete in posterior 1/3 portion covering all the three lobes, notauli meeting closer to hind margin but not reaching transscutal line; mesoscutal bristles little above middle; scutellum with frenal line below middle. Propodeum with median carina, anterior median triangular area not clearly marked from the rest area, propodeum medially 2x as broad as long, spiracles small, oval. Fore wing 3.3x as long as broad, marginal fringe long, three transverse infumations, one at parastigma, one at base of MV and other broad one below PMV and STV reaching upto basal margin. Relative lengths SMV 20.5 MV 28 PMV 9 and STV 4.5.

Metasoma: Petiole with longitudinal carinae, one setae anteriorly on either side. Gaster with posterior margin of all tergites straight, in dorsal view gaster 2.6x as long as broad (without petiole), hypopygium reaching tip of T4.

Male: Not known

Material examined: Holotype, Female, Arunachal Pradesh, Namdapha National Park, Deban, Miao road, N 27° 29' 30" E 96° 22' 32.4" Alt. 410 metre, 14.xi.2009, coll. P.M. Sureshan, Reg. No.ZSI/WGRS/IR/INV/2076.

Etymology: This species name is derived from the characteristic black patch on the mesoscutum.

Remarks: This species resembles *D. miniae* Narendran & Sureshan in the nature of propodeum, gaster, forewing and general morphology but can be easily distinguished by the nature of mesoscutum which possess a blackish band in the posterior 1/3 portion and with bristles in the centre, (in *miniae* the mesoscutal bristles are little above the middle and mesoscutum without any black band or patch).

Dipara thirumalaii sp. nov.
(Figs. 3, 4, 17, 18)

Holotype: Female: Length 2 mm. Body yellowish brown; gaster dark brown, dorsally with yellowish brown transverse band in the middle of T1 and yellowish brown ventrally and on the tip; antennae with scape, pedicel, F1-F3 testaceous, remainder brown. Wing stumps pale brown.

Head: (Fig. 3, 4) Moderately reticulate, with fine pubescence, reticulation finer on lower face and gena; in dorsal view head width 2x length; POL almost as long as OOL; ocellar area black; occiput longitudinally reticulate, vertex with 3 pairs of bristles; scrobe broad and deep, not reaching median ocellus, clypeus anteriorly subtruncate; malar grooves distinct; malar space 0.4x as long as eye in profile; antennae (Fig. 17) with scape reaching median ocellus, as long as eye, with long hairs, pedicel plus flagellum 1.3x as long as head width, pedicel longer than F1, little shorter than F1+F2; funicular segments widening towards tip, anellus transverse; clava as long as 3.5 preceding segments combined. Relative lengths of pedicel 13.5, F1 7.5, F2 6.5; F3 6.5, F4 7, F5 7, F6 7, F7 7, clava 25.5.

Mesosoma: (Fig. 18) Pronotum transversely ridged reticulate with a distinct transverse carina, lateral panel striate reticulate. Mesoscutum 1.6x as broad as long, moderately raised reticulate, posterior part of scapulae transversely reticulate; notauli meeting in the posterior end; mesoscutal bristles almost in the centre, posterior 2/3 portion of mesoscutum shining black. Scutellum 1.4x as

broad as long, with 2 pairs of setae. Propodeum (Fig. 18) medially 1.4x as long as scutellum and 1.8x as broad as long., with an irregular median carina connected to several irregular transverse carinae, plicae not present in the anterior half, posteriorly with distinct longitudinal carinae, spiracles round, separated from posterior margin of metanotum by 4x its diameter (Fig. 18); callus with few hairs. Mesopleuron with mesepisternum narrow, separated from mesepimeron by a longitudinal carina, mesopleuron uniformly with transverse oblique carinae. Forewing stump reaching up to propodeal spiracle, with one small and one long bristle in the middle. Hind coxae transversely carinate, hind tibia with two unequal spurs; mid and fore coxae with fine transverse carinae.

Metasoma: (Fig. 18) 2.5x as long as broad in dorsal view, and 1.4x as long as had plus mesosoma combined, ovipositor strongly protruded out (Fig. 3).

Male: Not known.

Material examined: Holotype Female, India: Uttarakand, Dehradun district, Chakarata, 17.vii.2009, coll. Sudhir Singh. Reg. No. ZSI/WGRS/IR/INV/ 2226.

Etymology: The species is named after Dr. G. Thirumalai (late), Scientist-F., Zoological Survey of India, Chennai for his valuable contributions to the taxonomy of Indian insects (Aquatic hemiptera).

Remarks: This species resembles *D. albomaculata* (Hedqvist) in having a distinct transverse carina on pronotum, characteristic black patch on mesoscutum and arrangements of bristles on head and short forewing stump reaching up to propodeal spiracle but differs from it in having scutellum without black patch on anterior part, mesoscutal bristles almost in the middle, forewing stump with two bristles, the basal one half as long as that of the distal and different body colour. (in *albomaculata* scutellum with distinct bluish black patch in the anterior part, mesoscutum with a scaly sculpture, bristles near the front margin; forewing stump with a long bristle at the apex and different body colour).

Among the Oriental species, this species is unique in having a bunch of 5 pairs of setae on the petiole basally (Fig. 18).

Dipara debanensis sp. nov.
(Figs. 5-7, 15, 16)

Holotype: Female: Length 3.3 mm. Body Honey brown, face with three transverse brown bands, one at lower margin of face, the second level with toruli and the third on the upper face; antennae with scape, pedicel, anelli, F1, F2, F3 (partly) testaceous, F4-F7 brownish black, clava yellowish white; eyes and ocelli silvery, ocellar area with black patch; legs with fore and hind coxae silvery white except base brown, mid coxae concolorous with body, basal half of mid and hind femora and base of hind tarsi yellowish white, rest of legs testaceous; side lobes of mesoscutum with broad greenish black patch; gaster brown except T1 dorsally, epipygium completely and ventral part mostly yellowish; forewing with three transverse brown infumations, one at parastigma, one at basal part of MV and the other covering almost distal 1/3 part of wing; bristles of the body and wings brownish black.

Head: (Fig. 5, 6) Moderately and closely punctuate with small white pubescence; clypeus raised, convex, anterior margin sub-truncate; malar grooves distinct, temple narrow, almost absent, eyes 1.5x as long as broad (in profile), parascrobal area little raised; head in front view 1.3x as wide as long and 2.7x as broad as long in dorsal view; scrobe broad, not reaching median ocellus; toruli closer, separated by their individual diameter, malar space almost 0.5x eye length (in profile); POL 1.5x OOL, vertex very narrow abruptly declivous, with 3 pairs of black setae. Antennae (Fig. 15) inserted below middle of face, almost level with lower margin of eyes, formula 11173, scape as long as eye, with a strong bristle on the tip, pedicel plus flagellum 1.6x width of head in dorsal view, all funicular segments with one row of long sensillae. Relative lengths of pedicel 17.5, F1 15, F2 14, F3 12.5, F4 12.5, F5 12.5, F6 11, F7 11, clava 27.

Mesosoma: (Fig. 5, 6, 16) Pronotal collar moderately reticulate, anteriorly with a strong

carina in the middle, lateral panel transversely ridged. Mesoscutum 1.5x as broad as long, moderately reticulate punctuate, side lobes with a distinct broad greenish black patch, 2 pairs of black bristles on in the mid lobe little above middle and other in the side lobes in the lower part, notauli strongly converging towards posterior end, not meeting together. Scutellum medially 0.7x as long as mesoscutum with two pairs of setae, 1st pair in the anterior part and second pair on the frenal line, front part raised reticulate, frenal area longitudinally carinate, 0.8x as long as rest of area. Dorsellum shiny, in the form of a shelf over the median area of propodeum. Propodeum (Fig. 6, 16) medially 0.7x as long as mesoscutum, polished without median carina, with a 'V' shaped, raised median area reaching beyond middle bordered by the ends of transverse carinae; several small oblique carinulae and a sharp transverse carina on either side, plicae absent anteriorly, posteriorly sharp, spiracles small, oval, separated from posterior margin of metanotum by 2.7x of its diameter. Prepectus smooth. Mesopleuron distinctly and transversely striate except on sub-alar area polished; mesepimeron distinctly convex; metapleuron smooth. Forewing reaching up to middle of epipygium, 3.6x as long as broad, SMV with three long bristles, parastigma with two bristles and MV with 2 rows of bristles; marginal fringe absent, discal pubescence moderate, speculum narrow, closed below, basal hairline represented by 4-5 rows of hairs, basal cell not setate. Relative lengths SMV 55, MV 8, PMV 28, STV 8. Hind coxae transversely carinate dorsolaterally, 2.4x as long as broad.

Metasoma: (Fig. 7, 16) brown except T1 and posterior half of epipygium yellow, petiole longitudinally carinate-reticulate with a pair of white setae laterally, petiole 2x as long as wide in dorsal view, 0.2x as long as rest of gaster; gaster 3.1x as long as broad in dorsal view (without petiole), posterior margin of T1 straight, T2 broadly angulate, rest of tergites straight, cerci long, hypopygium reaching up to tip of T4.

Male: not known.

Material examined: Holotype Female, INDIA: Arunachal Pradesh, Namdapha National Park, Deban, way to Miao, N 27° 29' 30" E 96° 22' 32.4". Alt. 410 meter, 14.xi.2009, coll. P.M. Sureshan, Reg. No. ZSI/ WGRS/IR/ INV/2075.

Etymology: The species name is after the type locality, Deban of Namdapha National Park, Arunachal Pradesh.

Remarks: Among the Oriental species of *Dipara* with black patch on mesoscutum this species resembles *D. gastra* (Sureshan & Narendran) in general morphology but differs from it in having large body size (3.3. mm), gaster 3.1x as long as broad dorsally, antenna long and slender, inserted almost level with lower margin of eyes, pedicel distinctly shorter than F1 and F2 combined, funicular segments long and slender and wings fully developed (in *D. gastra* body small 1.8-1.9 mm, gaster short 2.1x as long as broad in dorsal view, antennae short, inserted above lower margin of eyes, pedicel slightly shorter than F1 and F2 combined, funicular segments widened towards tip, wings reduced). In having a black patch on mesoscutum and in the nature of propodeum, this species resembles *D. maculata* (Hedqvist), but differs from it in having fully developed wings and pronotum with distinct transverse carina (in *D. maculata* wings reduced and pronotum without transverse carina).

Dipara hayati sp. nov.
(Figs. 8-10, 19, 20)

Holotype: Female: Length 2.3 mm. Head bluish black anteriorly, rest brownish black except the following: pronotum laterally pinkish brown, gaster laterally blackish brown; scape testaceous, remainder of antenna brown except clava whitish yellow; eyes chocolate brown, ocelli pale brown; legs yellowish brown except posterior half of hind coxa, all tibiae and tarsi yellowish, tegulae brown, wings hyaline with slight pale brown infumation uniformly, veins brown.

Head: (Figs. 8, 9) in front view width 1.21x length, in dorsal view width 2.3x length; POL 1.2xOOL; occipital carina far below posterior

ocelli. Head uniformly raised reticulate, reticulation finer on lower face; gena partly shiny, not carinate posteriorly; malar grooves distinct, malar space 0.42 x eye length (in profile); eye length 1.9x width in profile; clypeus delimited, convex, anterior margin arcuate, clypeus and paraclypeal area shiny. Antennae (Fig. 19) inserted at level of lower margin of eye, scape 0.9x as long as eye, just reaching front ocellus, pedicellus plus flagellum 1.4x as long as head width; anelli narrow, pedicel 2.2x as long as broad, 1.1x as long as F1; F2 slightly shorter than F1. Relative lengths of F1 9.5, F2 9, F3 8, F4 8, F5 7.5, F6 7, F7 5.5, clava 17.

Mesosoma: (Fig. 9, 10) Pronotum moderately reticulate, collar more finely with a row of four stout setae near posterior margin and with short hairs uniformly, collar not carinate anteriorly. Mesoscutum (Fig. 9) moderately reticulate with dense brown pubescence, with a pair of stout setae located below middle, reticulation finer towards posterior margin, notauli meeting together subapically, joined by a transverse groove; scapulae with a stout seta near posterior distal margin. Mesoscutum 2x as broad as long. Scutellum medially little shorter than mesoscutum (0.9x) with a pair of stout setae near trans-scutellar suture and another pair on frenal line, area anterior to frenum reticulate, frenal area 0.7x as long as area anterior to it, frenum longitudinally carinate. Propodeum (Fig. 10) with distinct median carina, connected to an anterior V shaped carina, costula strong, spiracles oval, separated from hind margin of metanotum by 1.8x its diameter, nucha distinct, callus almost shiny, less pubescent. Prepectus shiny, longer than tegula. Hind coxae with strong cross carina dorsally, hind tibia with two unequal spurs. Mesopleuron with mesepisternum cross carinate, upper mesepimeron transversely striate, lower mesepimeron and metapleuron shiny. Forewing length 3x width; speculum narrow, closed below, basal vein hairy, basal cell sparsely hairy, marginal fringe small. Relative lengths of SMV 31, MV 30, PMV 19, STV 11.

Metasoma: (Figs. 8, 20) including petiole 1.2x as long as head plus mesosoma combined, petiole

(Fig. 10) 0.3x as long as dorsal length of T1, 1.1x as long as broad in dorsal view, 0.41x as long as half length of hind coxa laterally, posteriorly little wider, distinctly carinate and with a pair of white setae very near to base directed backwards.

Male: Not known.

Material examined: Holotype Female, India: Kerala, Palakkad district, Chittur (Malaise trap collection from paddy field), coll. Kumar, 10.iv.2011. Reg. No. ZSI/WGRS/IR/INV/ 2227.

Etymology: The species is named after Dr. Mohammad Hayat, Professor (Retd.), Aligarh Muslim University, India for his valuable contributions to the taxonomy of Indian Encyrtidae (Chalcidoidea).

Remarks: This species closely resembles *D. nigra* sp. nov. but differs from it in having short petiole 0.3x as long as dorsal length of T1 and distinctly less than half length of hind coxa, almost shiny except for the distinct longitudinal carina dorsally and laterally; antennae with clava 0.8x as long as three preceding segments combined; frenum with all longitudinal carinae distinct; mesopleuron and metapleuron with few transverse carina in the upper part of former and middle of latter; forewing with less pubescence in the basal part beyond speculum and PMV shorter, 1.7x as long as STV (in *D. nigra* petiole long 0.41x as long as dorsal length of T1, almost as long as half length of hind coxa laterally and distinctly reticulate dorsally and carinate laterally and on hind part dorsally, clava as long as three preceding segments combined, frenum with only median carina distinct, mesopleuron and metapleuron shiny, forewing pubescence distinct and PMV longer 2x as long as STV).

Dipara venkati sp. nov.
(Figs. 11, 12, 21, 22)

Holotype: Female: Length 2.8 mm. Body brownish black except for the following: pronotum completely, a broad band on distal half of T1 dorsally and ventro-laterally, mesopleuron and pronotum completely honey brown. Legs brownish yellow except base of hind coxae, tips of mid and hind femora, middle of tibiae blackish

brown, all tarsi testaceous, eyes grey, ocelli black. Antennae with scape except base and tips yellowish white, remainder dark brown except major part of clava yellowish white. Tegulae brown. Wings uniformly dark brown, bristles of the body black.

Head: (Fig. 11) in dorsal view width 2x length; POL 1.5 x OOL; head in front view 1.12x as broad as high, clypeus smooth, trapezoidal, anterior margin truncate; area below toruli finely reticulate, a fine transverse and convex ridge just below toruli; scrobe deep, broad, transversely and raised reticulate; malar groove distinct in the form of a raised ridge, malar space 0.32x eye length (in profile); eye 1.63x as long as broad (in profile); antennae (Fig. 21) with pedicel plus flagellum 1.31x width of head, scape 0.8x eye length and 2.8x pedicel, anelli strongly transverse, pedicel 1.2x F1, clava little longer than 2.5 preceding segments combined and 2.4x as long as broad, funicular segments longer than broad, each with one row of long sensillae.

Mesosoma: (Fig. 12) pronotum transversely striate reticulate, lateral panel obliquely and transversely ridged, mesoscutum mostly and anterior part of scutellum aciculate, almost shiny on posterior margin medially, frenum smooth and shiny. Pronotum, Mesoscutum and scutellum dorsally covered with brown setae. Pronotum dorsally 1.9x as broad as long. Mesoscutum 1.9x as broad as long in dorsal view and medially 1.23x as long as pronotum, with a pair of long bristles, placed anteriorly above centre, notauli converging posteriorly. Scutellum 1.6x as broad as long in dorsal view and 0.6x mesoscutum medially with two pairs of bristles, anterior pair small and difficult to locate among body bristles, posterior pair very long. Propodeum medially 1.53x as long as scutellum, smooth with distinct median carina not reaching hind margin, anteriorly forked into a V shaped carina, oblique costula joins at the lower junction of V, plicae not distinct anteriorly, spiracles elongate ovate. Prepectus smooth, 1.4 x as long as tegula. Mesopleuron and metapleuron smooth. Forewing reduced, 4.3x as long as broad with 8

long bristles on the total length of vein, disc uniformly dark brown except for a small smooth area in the distal one third part, no marginal fringe.

Metasoma : (Fig. 22) petiole finely reticulate, 1.6x as long as broad with one pair of backwardly directed setae, gaster including petiole 1.2x as long as head plus mesosoma combined, T1 largest covering most of the gaster.

Male: Not known.

Material examined: Holotype: Female. India: Arunachal Pradesh, Namdapha National Park, Bulbulia, N 27° 31' 50.8" E 96° 25' 9.7" , Alt. 585 mtrs. 05. Xi.2009, (Reg. No. ZSI/ WGRS/ IR/ INV/ 2225.

Etymology: The species is named in honour of Dr. K. Venkataraman, Director, Zoological Survey of India for his valuable contributions to animal taxonomy and the constant encouragement and support for my work.

Remarks: Among the Oriental species with reduced wings and without black patch on mesoscutum, the new species is distinct and easily separable with its characteristic propodeum, gastral petiole and nature of wing. However it resembles *D. nigrita* Hedqvist in general morphology and color but differs from it in the nature of gaster which is short and broad (1.8x as long as broad in profile, wings reach beyond tip of petiole, nucha long and malar space less than half width of an eye (in *D. nigrita* gaster long and slender 3.15x as long as broad (in profile), wings reach base of petiole, nucha short, and malar space more than half width of an eye). It also resembles *D. nigrofasciata* Hedqvist in the nature of gaster and antennae but differs in having colour brownish black, antennae inserted level with the lower margin of eyes, malar space less than half width of an eye, wings reach beyond tip of petiole and clypeus wider than long. (in *D. nigrofasciata* colour predominant yellowish brown, antennae inserted above lower level of eyes, malar space half width of an eye, wings reach base of petiole and clypeus as long as wide).

***Dipara nigra* sp. nov.**
(Figs. 13, 14, 25, 26)

Holotype: Female: Length 2.7 mm. Body brownish black except the following: pronotum uniformly, mesoscutum with anterior part of mid lobe, axillae and axillulae pinkish brown. Legs yellowish brown except coxae and femora dark brown. Tegulae brown, veins pale brown; eyes and ocelli silvery white. Antennae with scape except tips and clava whitish yellow, remainder brown; wings hyaline, with pale brown uniform infumation; veins pale brown, pubescence brown.

Head: (Fig. 13) in front view width 1.21x length, in dorsal view width 2.1x length; POL 1.25x OOL; occipital carina far below posterior ocelli, vertex with three pairs of strong setae directed forwards. Head uniformly raised reticulate, reticulation finer on lower face; gena partly shiny, not carinate posteriorly, but hind margin sharp; malar grooves distinct, malar space 0.42x eye length (in profile); eye length 1.41x width in profile; scrobe and adjacent areas cross striate, scrobe separated from front ocellus by a distance equal to its diameter, inter antennal ridge reaching half length of scrobe; clypeus delimited, convex, anterior margin distinctly convex, clypeus and para clypeal area shiny. Antennae (Fig. 25) inserted at level of lower margin of eye, scape almost as long as eye, just reaching front ocellus, pedicellus plus flagellum 1.4x as long as head width; anelli very narrow, pedicel 3x as long as broad, 1.13x as long as F1; F2 slightly shorter than F1. Relative lengths of F1 10, F2 8, F3 8, F4 7.5, F5 7.5, F6 7.5, F7 7, clava 22, funicular segments with a single row of long white sensillae.

Mesosoma: (Fig. 14) Pronotum moderately reticulate, collar more finely with a row of four stout setae near posterior margin and with short hairs uniformly, collar not carinate anteriorly, lateral panel almost shiny with transverse carinae. Mesoscutum (Fig. 14) moderately reticulate with dense brown pubescence, with a pair of stout setae located below middle, reticulation finer towards posterior margin with cross reticulation, notauli meeting together subapically, joined by a transverse groove; scapulae with a stout seta near

posterior distal margin. Mesoscutum 2x as broad as long. Scutellum medially little shorter than mesoscutum (0.9x) with a pair of stout setae near trans-scutellar suture and another pair on frenal line, area anterior to frenum reticulate, frenal area almost as long as area anterior to it, frenum longitudinally carinate, median carina distinct, others less distinct. Propodeum with distinct median carina, connected to an anterior V shaped carina, costula strong, paramedian area with strong transverse carinae connected to costula; spiracles oval, separated from hind margin of metanotum by more than its diameter, nucha distinct, callus almost shiny, less pubescent. Prepectus transversely rugose reticulate, longer than tegula. Hind coxae with strong cross carina dorsally, hind tibia with two unequal spurs. Mesopleuron with mesepisternum cross carinate, mesepimeron and metapleuron shiny. Forewing length 2.6x width; speculum narrow, closed below, basal vein hairy, basal cell partly hairy, marginal fringe small, STV slender. Relative lengths SMV 29, MV 27.5, PMV 18.5, STV 9.

Metasoma: (Fig. 26) including petiole 1.3x as long as head plus mesosoma combined, petiole 0.41x as long as dorsal length of T1, 1.7x as long as broad in dorsal view, almost as long as half length of hind coxa laterally, posteriorly little wider, distinctly reticulate dorsally and carinate laterally and on hind part dorsally, petiole with a pair of white setae directed backwards, hypopygium reaching hind margin of T3, ovipositor distinctly protruded, T1 largest.

Male: Length 1.8 mm. Resembles female but differs from it as follows. Colour uniformly black except pronotal collar laterally honey brown, legs uniformly yellowish brown; antennae brown except scape and pedicel testaceous, funicular segments long and slender with 2 rows of long sensillae, gaster short, petiole long, almost completely reticulate, 0.7x as long as gaster.

Variation: In the female paratype colour mostly blackish brown, black colour restricted to most of mesoscutum and anterior part of scutellum beyond frenum, petiole almost with complete longitudinal carinae dorsally.

Material examined: Holotype Female: Namdapha National Park, Haldibari, N27° 31' 26.5" E96° 23' 57.9", Alt. 634 mtr. 6.xi.2009, coll. P.M. Sureshan. Reg. No. ZSI/WGRS/IR/INV/2228. Paratypes: 1 Female (head lost), 1 Male same data as that of holotype, Reg. No. ZSI/WGRS/IR/INV/2229.

Etymology: The species name is after the black colour of the body.

Remarks: This species closely resembles *D. hayati* sp. nov. but differs from it as given in the key. It also resembles *D. sringericus* Narendran in general morphology, but differs from it in having petiole distinctly reticulate striate, with posterior most width 0.72x as long as its dorsal length and almost as long as half length of hind coxa, frenal area as long as scutellar area anterior to it, propodeal spiracle separated from metanotum by 2x of its diameter and small body size, 2.7mm (in *D. sringericus* petiole without any longitudinal carinae on dorsal side, almost smooth and shiny, its posterior most width a little more than its dorsal length and shorter than half length of hind coxa, and larger body size, 4.5 mm).

Dipara keralensis (Narendran, 2000)

Parurios keralensis Narendran, in Narendran *et al.*, 2000. *Bull. Pure and Appl. Sci.* **19A** (2): 137. India: Kerala. M. (ZSIK)

Parurios keralensis: Narendran *et al.*, 2006. *J. Bio. Sci.* **14**: 21-22. F, India: Kerala (ZSIC).

Dipara keralensis: Ozdikmen, 2011. *Mun. Ent. Zool.* **6**(2): 843. Senior homonym

Diagnosis: Length 3.2 mm. Black, antenna dark brown with clava pale brownish yellow and scape brown; wings hyaline with brown tinge; scrobe reaching mid level of eye, maximum length of eye in profile 2x its width; POL 1.5x OOL; Pronotum with three pairs of stout setae near posterior margin; notauli approaching on posterior part; scutellum distinctly shorter than mesoscutum; frenum with strong longitudinal carinae; propodeum with an anterior median areola followed by a

median longitudinal carina; costula weak; petiole a little shorter than one third length of T1 in dorsal view with weak longitudinal lines on dorsal side, its posterior width a little shorter than its dorsal length.

Distribution: India: Kerala, Uttar Pradesh.

Remarks: Desjardins (2007) not mentioned the species *D. keralensis* Narendran (= *P. keralensis* Narendran) (might be not aware of the species) instead mentioned the name *keralensis* as *D. keralensis* Narendran & Sureshan, 2001. Noyes (2003) treated *P. keralensis* Narendran 2000 under *Dipara* (*D. keralensis*) following the synonymy of *Dipara* by Desjardins.

Dipara eukeralensis Ozdikmen, 2011

Dipara keralensis Narendran & Sureshan, 2001., *Zoo'sprint journal*, **16**(4): 452. F India: Kerala (ZSIK) (examined). Junior sec. homonym (Noyes, 2012)

Dipara eukeralensis Ozdikmen, 2011. Replacement name. *Munis Ent. Zool.*, **6**(2): 843.

Diagnosis: Length 2.47 mm. Head blackish brown, mesosoma honey brown, gaster brownish black with epipygium mostly pale yellow. Antennae with scape yellowish brown, pedicel, anellus and F1 pale brownish yellow, F2-F5 blackish brown, F6, F7 and clava whitish yellow. Wings reduced, forewing stump reaching base of petiole, with 5 bristles; POL equal to OOL; propodeum with basomedial area between plicae conically elevated up to middle with distinct median carina and rest of area with several transverse and longitudinal carinae; petiole 1.2x as long as broad in dorsal view; gaster length 1.9x as long as mesosoma.

Distribution: India: Kerala.

Remarks: The species name *keralensis* was preoccupied in the genus and renamed by Ozdikmen (2011) (see remarks under *D. keralensis* (Narendran)). This species closely resembles *D. mohanae* Narendran & Sureshan but differs from it as given in the key.

Dipara miniae Narendran & Sureshan, 2001

Dipara miniae Narendran & Sureshan, 2001. *Zoo'sprint journal*, **16**(4): 453. F India: Kerala (ZSIK) (examined).

Dipara miniae: Desjardins, 2007. *Zootaxa*, 1647: 53.

Diagnosis: Length 1.9 mm. Head and

mesosoma honey brown; antennae pale yellow with apex of F4, F5 and F6 darker; wings hyaline with three dark infumations; gaster petiole pale yellow with base honey brown, remainder of gaster honey brown with pale colour on sides of T1 and epipygium; POL 2x OOL; scutellum with area behind frenum mostly smooth with faint longitudinal striae; propodeum without median carina and with a polished elevated median triangular area, costula distinct; gaster with petiole a little more than 1.5x as long as is width, longitudinally carinate and reticulate; T1 largest, as long as combined length of T4 to distal margin of epipygium.

Distribution: India: Kerala

Remarks: This species closely resembles *D. nigriscuta* sp.nov. but differs from it in having mesoscutum without any black patch or band with bristles little above centre, reticulation of body fine and antennae with F4-F6 brown (in *D. nigriscuta* mesoscutum with a broad black patch covering all the three lobes in the posterior 1/3 portion, bristles in the centre, reticulation of the body coarse and antennae with F4-F7 brown).

Dipara malabarensis (Narendran & Mini)

Grahamisia malabarensis Narendran & Mini, 2000. *Zoo'sprint journal* XV (2): 371. F, India: Kerala (ZSIK) (examined).

Dipara malabarensis : Transferred by Desjardins , 2007. *Zootaxa*, 1647: 53.

Diagnosis: Length 1.45-1.6 mm. Head brownish yellow with two dark brown bands on lower face, mesosoma pale brownish yellow with two large black spots on scapulae; gaster dark brown with middle part of T1 and ventrally paler. Antenna blackish brown with middle part of scape, ring segment, F7 and clava pale white or pale yellow. Propodeum with median carina not quite reaching basal margin, median area conically little elevated. Forewing reduced, hardly reaching base of petiole. Gaster length (including petiole) 2x that of mesosoma.

Distribution: India: Kerala

Remarks: This species closely resembles *D.*

gastra (Sureshan & Narendran) but differs from it in the nature of gaster which is narrow and compressed with T3-T6 short, colour almost brown with epipygium and ventral part paler, propodeum with a weak median carina, not quite reaching basal margin, plicae not united in front of nucha to form a V shaped structure, antenna with F6 completely brown, forewing stump with 3 setae. (in *D. gastra* gaster swollen with T3-T6 not very short, colour yellowish brown with a distinct yellow band overlapping T1 and T2, propodeum without a median carina, plicae united in the form of V in front of nucha, antenna with F6 partly yellowish as on clava and forewing stump with 4 setae).

***Dipara mohanae* Narendran & Sureshan**

Dipara mohanae Narendran & Sureshan, 2001. *Zoo' sprint journal*, **16**(4): 455. F India: Kerala (ZSIK) (examined).

Dipara mohanae : Desjardins, 2007. *Zootaxa* 1647:53

Diagnosis: Length 1.5 mm. Head and mesosoma yellowish brown; scape, pedicel anelli and F1 pale brownish yellow; F2-F3 light brown, F4-F6 dark brown; F7 and clava whitish yellow. Upper face and vertex almost shiny, weakly reticulate; POL little shorter than OOL; wing stump not reaching base of petiole, with six bristles; propodeum with baso-medial area between plicae conically elevated, basal carina distinct reaching upto middle; petiole 1.25x as long as wide in dorsal view, longitudinally carinate and reticulate with 3 pairs of setae, gaster a little more than 1.6x length of mesosoma.

Distribution: India: Kerala.

Remarks: This species closely resembles *D. eukeralensis* Ozdikmen but differs from it in having forewing stump with 6 bristles, upper face and vertex almost shiny, only weakly reticulate, POL little shorter than OOL (0.83x), antenna with F7 and clava whitish yellow, F3-F6 brown, hind coxae striate reticulate (in *D. eukeralensis* forewing stump with 5 bristles, upper face and vertex distinctly reticulate, POL equal to OOL, antenna with F6 and 7 whitish yellow as on clava, F2-F5 dark brown and hind coxae reticulate)

***Dipara sringericus* (Narendran)**

Parurios sringericus Narendran, in Narendran et al. 2006. *J. bio. sci.* **14**: 20. F India: Karnataka: Sringeri (ZSIK), examined. Comb. nov.

Diagnosis: Length 4.5 mm. Scrobe long, separated from front ocellus by a distance as long as diameter of front ocellus, exceeding well over middle of eye from toruli; clava as long as preceding 3 segments combined; propodeum with an anterior median areola followed by a median longitudinal carina, costula strong; gastral petiole smooth and shiny without longitudinal carinae, maximum width 1.13x its dorsal length.

Distribution: India: Karnataka

Remarks: Though *Parurios* was synonymised under *Dipara*, the species *sringericus* was not treated by Desjardins, 2007 and Noyes 2003 treated this species under *Dipara*. It is hereby transferred to *Dipara* hereunder. This species closely resembles *D. hayati* sp. nov. but differs from it in having a different petiole, scutellum and propodeum

***Dipara bouceki* (Narendran, 2006)**

Parurios bouceki Narendran, in Narendran et al., 2006. *J. bio-sci.* **14**: 20. F India: Kerala:

Wayanad (ZSIK) examined. Comb. nov.

Diagnosis: Length 2.73 mm. Head pale brownish pink, antennae blackish brown except clava, pedicel and scape pale brownish yellow; wings hyaline with three infumate patches. POL 1.83x OOL; Pronotum reticulate with a row of six stout setae near posterior margin and with several short pubescence; mesoscutum with notauli arched and approaching each other on posterior part; frenal area of scutellum little shorter than remaining anterior part; propodeum with an anterior median areola followed by a median longitudinal carina, costula present; petiole about one third as long as T1 in dorsal view and with several longitudinal carinae.

Distribution: India: Karnataka

Remarks: Though *Parurios* was synonymised under *Dipara*, the species *bouceki* Narendran was

not treated by Desjardins, 2007. Noyes, 2003 treated this species under *Dipara*. It is transferred hereunder to *Dipara*. This species closely resembles *D. keralensis* (Narendran) but differs from it in having a different petiole, scutellum and propodeum

Dipara gastra (Sureshan & Narendran)

Grahamisia gastra Sureshan & Narendran, 2000. *Zoo's Print Journal*, **19** (9): 1616. F (UCDC) (examined).

Dipara gastra (Sureshan & Narendran). Transferred by Desjardins, 2007. *Zootaxa*, 1647: 52.

Diagnosis : Size. 1.8-1.9 mm. antennal scape whitish yellow, pedicel and F1-F5 and base of F6 pale brown, upper half of F6, F7 and clava whitish yellow; gaster yellowish brown with an yellow transverse band covering hind part of T1 and base of T2; notauli meet in the middle, scapula with a black punctured patch; propodeum without median carina, plicae on either side unite above base of nucha to form a 'V' shaped structure; brachypterous, forewing stump just short of reaching base of petiole with 4 strong brown setae; gaster 2.1x as long as wide and 1.5 x as long as head plus mesosoma combined; petiole with a pair of backwardly directed white setae.

Distribution: Sri Lanka.

Remarks: This species closely resembles *D. malabarensis* (Narendran & Mini) but differs from it as given under remarks of *D. malabarensis*

Dipara intermedia Sureshan & Narendran

Dipara intermedia Sureshan & Narendran, 2005. *Rec. Zool. Surv. India*: 105(1-2): 105-109. F. Sri Lanka (UCDC) (examined).

Dipara intermedia Sureshan & Narendran. Desjardins, 2007. *Zootaxa*, 1647: 52.

Diagnosis: Length 2.5 mm. Yellowish brown, antenna brownish yellow, F5 completely brown, tip of F4 and base of F6 slightly brown, clava whitish yellow; propodeum with baso-medial area between plicae not elevated, surface almost shiny, plicae reaching only up to one third length, median carina weakly indicated upto $\frac{3}{4}$ length; forewing stump very short, with 2 long setae;

gaster elongate 2x as long as mesosoma, petiole basally with two fine backwardly directed hairs on each side, length 1.2x width dorsal view, longitudinally striate and minutely reticulate.

Distribution: Sri Lanka.

Remarks: This species shows an intermediate set of characters between *D. mohanae* Narendran & Sureshan and *Dipara eukeralensis* Ozdikmen. It differs from both the species in having propodeum with basomedial area between the plicae not elevated, surface almost shiny with very weak striations; wing stumps short, not reaching much beyond hind margin of scutellum and with only 2 setae. (in *D. mohanae* and *D. eukeralensis* propodeum with basomedial area between the plicae conically elevated up to middle, surface with longitudinal striations, not shiny, wing stump long, exceeding well beyond the hind margin of scutellum, touching base of petiole and with 5 or 6 bristles).

Dipara dictyodroma (Xiao & Huang)

Grahamisia dictyodroma Xiao & Huang, 1999. *Oriental Insects*, **33**: 333-336. F. China: Hubei, Province (IZAS) (not examined).

Dipara dictyodroma (Xiao & Huang). Transferred by Desjardins, 2007. *Zootaxa*, 1647: 52.

Diagnosis: Length. 2.5 mm. Colour yellowish brown, scape, pedicel, F1-F4 yellowish, F5-F7 and clava brown, legs yellowish. Antennae filiform, scape not reaching median ocellus, pedicel much longer than F1, funicular segments longer than broad, except last three segments slightly transverse, clava as long as three preceding segments combined. Pronotal collar margined in the middle, notauli Y shaped, meeting in the middle of mesoscutum, bristles below middle, frenum with longitudinal striation. Propodeum with irregular longitudinal striation, nucha distinct, Forewing reduced, not reaching beyond propodeum. Petiole with three hairs in the middle on each side, reticulation, longer than broad, gaster 2.5x as long as broad shallow.

Distribution: China: Hubei : Hefeng

Remarks: I have not examined any specimen of this species and the diagnosis provided here is

based on the original description and the species is not included in the key due to the same reason. This species resembles *D. striata* Hedqvist in having propodeum with longitudinal striation, petiole swollen and with hairs laterally in the middle but differs from it in having antenna with F1-F4 yellowish, petiole longer than broad and head with regular reticulation (in *D. striata* all funicular segments brown, petiole as long as broad and head with rugose reticulation).

***Dipara hyalinipennis* (Girault)**

Epilelaps hyalinipennis Girault, 1915. *Mem. Queensland Museum*, 3: 344. F. Australia, Queensland (QM) (not examined).

Dipara hyalinipennis (Girault). Transferred by Boucek, 1988: 335.

Dipara hyalinipennis (Girault): Huang & Xiao, 2005: 267.

Dipara hyalinipennis, (Girault): Desjardins, 2007. *Zootaxa* 1647: 52

Diagnosis: Length 1.75 mm. Colour black, propodeal nucha and ventral part of gaster yellowish brown, legs and antenna except clava yellow, clava black. Antennae with funicular segments sub quadrate. Wings developed in various grades from short stumps to almost full size. Mesoscutal bristles in the lower half, frenum shorter than area in front, longitudinally striated. Propodeum with a Y shaped median carina, costula strong; gastral petiole little longer than broad, with longitudinal carina. Male antenna with long pedunculate segments and whorls of long hairs.

Distribution: Australia, China: Hubei, Yunnan.

Remarks: I have not examined any specimen of the species and the diagnosis provided here is based on the original description and details provided by Boucek (1988), the species is not included in the key due to the same reason. Huang & Xiao, 2005 reported this species from the Hubei province of China.

SUMMARY

A taxonomic revision of the Oriental species of *Dipara* Walker (Hymenoptera: Chalcidoidea: Pteromalidae) is provided. Six new species viz. *D. nigriscuta* sp. nov., *D. thirumalaii* sp. nov., *D. debanensis* sp. nov., *D. hayati* sp. nov., *D. venkati* sp. nov., and *D. nigra* sp. nov. are described from India based on the collections made mainly from the Namdapha National Park, Arunachal Pradesh (04 species), Uttarakhand (1 species), and Kerala (1 species). Systematic accounts on the 11 species of *Dipara* already known from the Oriental region are provided based on the study of primary type material and original descriptions. The affinities of the new species with the other known species are discussed. A key to separate the Oriental species of *Dipara* excluding the species *D. dictyoderma* (Xiao & Huang) and *D. hyalinipennis* (Girault) which are described/reported from Oriental China is also provided.

ACKNOWLEDGEMENTS

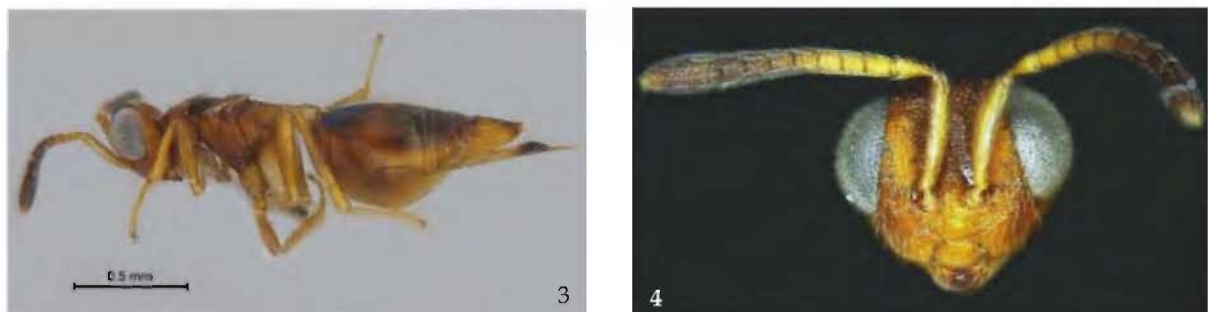
I am grateful to Dr. K. Venkataraman, Director, Zoological Survey of India, for providing the facilities for the work and constant encouragement. I am also thankful to Dr. J. K. De, Scientist D, (Retd.) Zoological Survey of India, Kolkata and Dr. G. Maheswaran, Scientist C and the then Officer in charge, Zoological Survey of India, Arunachal Pradesh, Itanagar for giving me an opportunity to participate in the Namdapha expedition and Dr. Sudhir Singh, Forest Research Institute, Dehradun, for providing his collections of Pteromalidae for my studies. My thanks are also due to Mr. C. Bijoy, and Miss. Dhanya Balan, Senior Research Fellows, Zoological Survey of India, Calicut for helping to take photographs of the specimens and other supports. Thanks are also due the Wildlife warden and other forest officials of Namdapha National Park, Arunachal Pradesh, for permitting to visit the various localities in the area and providing necessary facilities.

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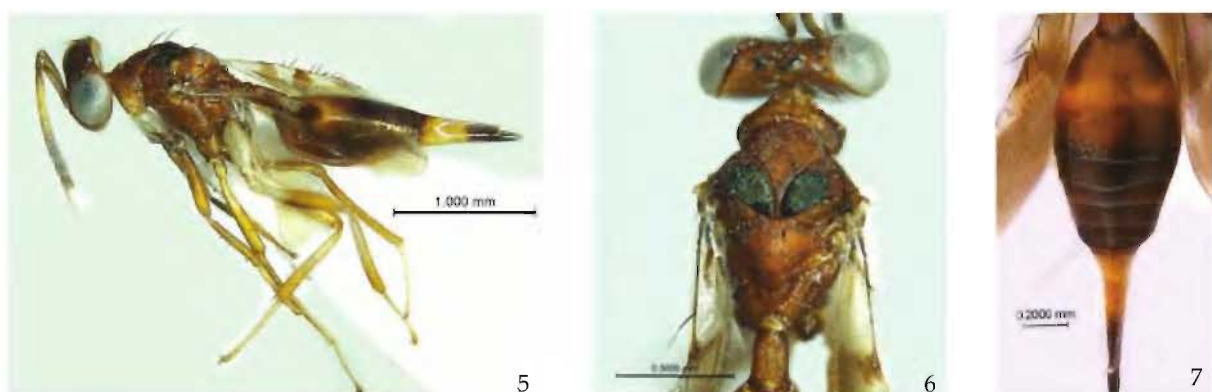
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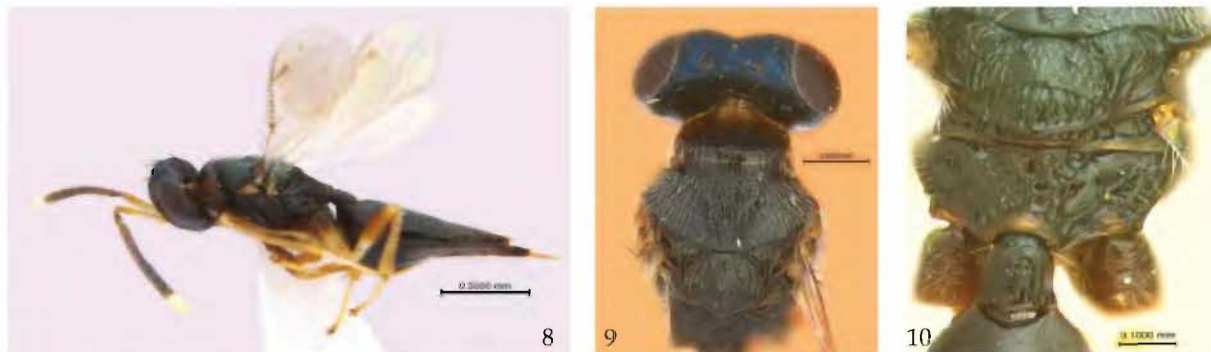
Figs. : 1 - 2. *Dipara nigriscuta* sp. nov. Female: 1, body in dorsal view; 2, body in profile



Figs. : 3 - 4. *Dipara thirumalaii* sp. nov. Female: 3, body in profile; 4, head front view



Figs. : 5 - 7. *Dipara debanensis* sp. nov. Female: 5, body in profile; 6, head and mesosoma dorsal view; 7, gaster dorsal view.



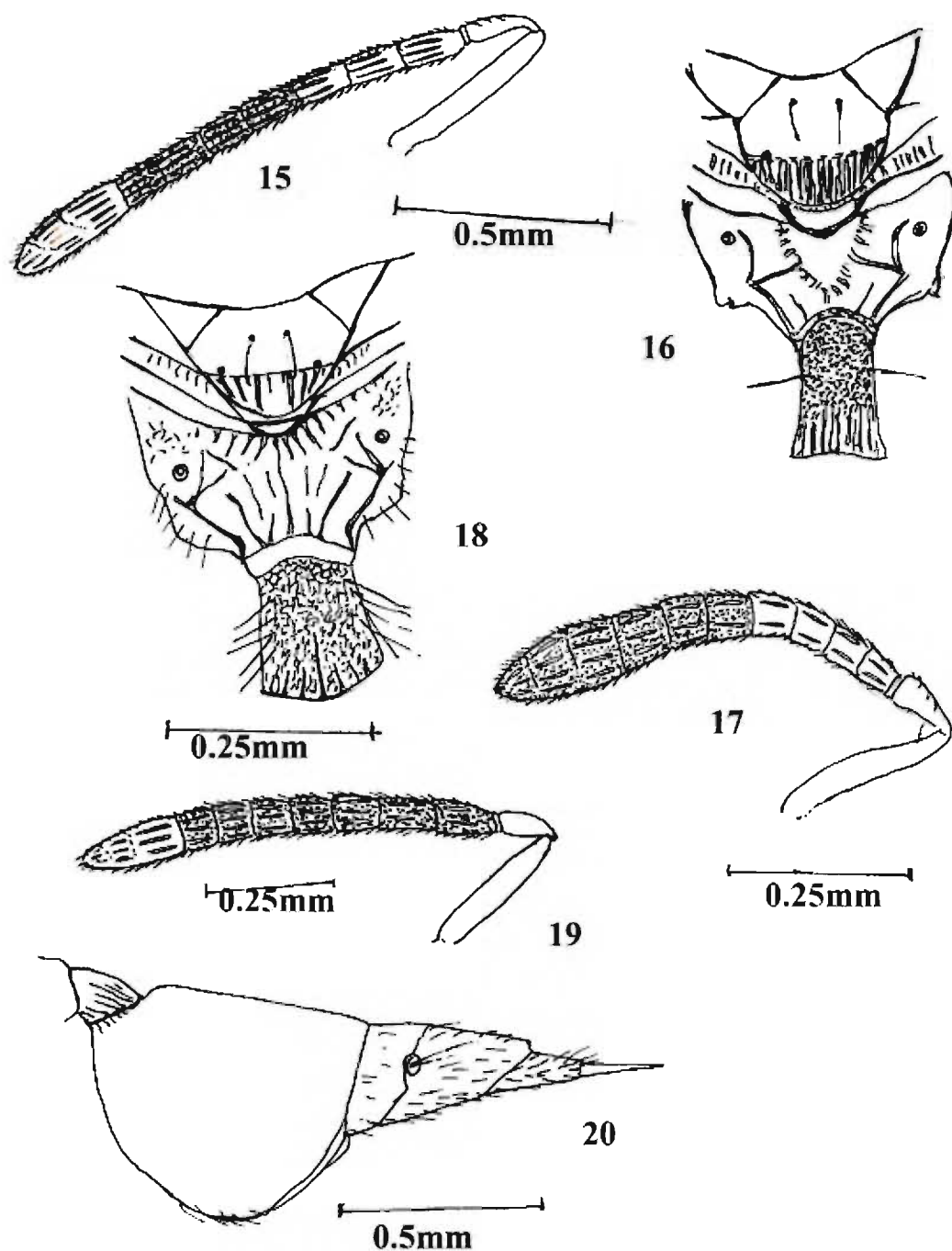
Figs. : 8 -10. *Dipara hayati* sp. nov. Female: 8. body in profile; 9. head and mesosoma in dorsal view; 10. scutellum and propodeum dorsal view.



Figs. : 11-12. *Dipara venkati* sp. nov. Female: 11. body in profile; 12. mesosoma and gaster (part) in dorsal view.



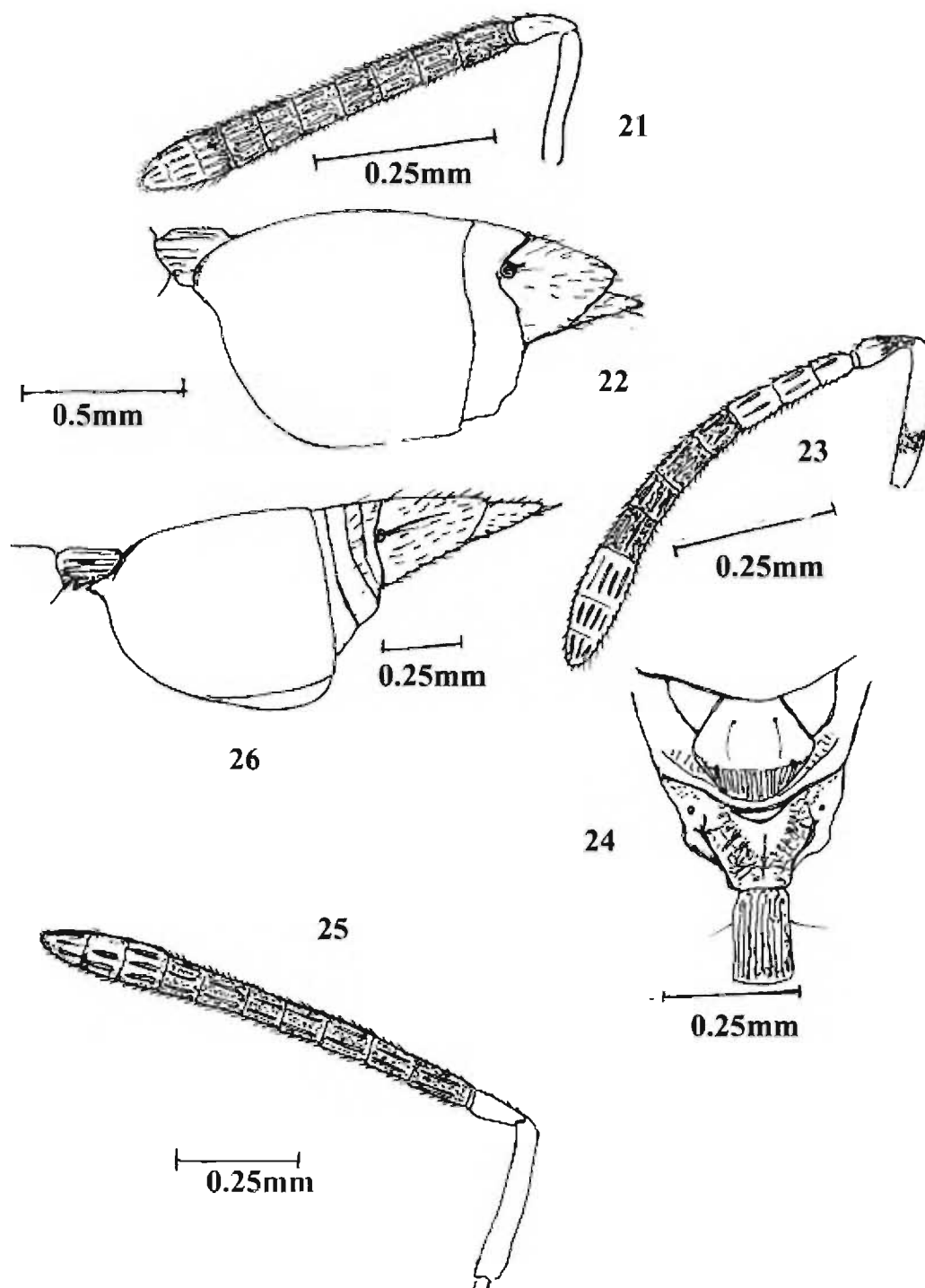
Figs. : 13-14. *Dipara nigra* sp. nov. Female: 13 body in profile; 14. mesosoma and petiole in dorsal view.



Figs. : 15-16. *Dipara debanensis* sp. nov. Female: 15, antenna; 16, scutellum, propodeum and petiole dorsal view.

Figs. : 17 -18. *Dipara thirumalaii* sp. nov. Female: 17, antenna; 18, scutellum, propodeum and petiole dorsal view.

Figs. : 19 -20. *Dipara hayati* sp. nov. Female: 19, antenna; 20, gaster in profile.



Figs. : 21 -22. *Dipara venkati* sp. nov. Female: 21, antenna; 22, gaster in profile.

Figs. : 23 -24. *Dipara nigriscuta* sp. nov. Female: 23, antenna; 24, scutellum, propodeum and petiole dorsal view.

Figs. : 25-26. *Dipara nigra* sp. nov. Female: 25, antenna; 26, gaster in profile.



ON A COLLECTION OF SHALLOW-WATER ECHINODERMS OF GULF OF MANNAR BIOSPHERE RESERVE, SOUTHERN INDIA

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INTRODUCTION

Echinoderms are exclusively marine and are widely distributed in benthic habitats from the intertidal zone to the deep sea. They are fascinating and enigmatic marine creatures and they include spiny skinned animals like starfishes, sea urchins and sea cucumbers. They live among corals and occur from supra-littoral to the hadal zone. They inhabit the rocky, sandy, muddy and mangrove areas. About 6000 living species of echinoderms have been described, of which more than 1000 have been listed for the Indo-West Pacific (Guille *et al.*, 1986). In

particular, the shallow- water echinoderm fauna of the Indo-West Pacific is generally considered to be very rich (Clark and Rowe 1971). India has 649 species recorded so far and about 428 species are known from Andaman and Nicobar Islands Sastry (2005, 2007).

The Gulf of Mannar is a favourable and suitable habitat for echinoderms. The echinoderm fauna of Gulf of Mannar was reported by James (1988) and Venkataraman *et al.*, (2002). The present study reports an account of the echinoderms collected over a period of three years (April 2008- March 2011).



Gulf of Mannar Biosphere Reserve

STUDY AREA

Gulf of Mannar Marine Biosphere Reserve

Gulf of Mannar Biosphere Reserve extends from Rameswaram island to Tuticorin and lies between 8° 45'N - 9° 25'N and 78° 5' E - 79° 30'E, extends to a distance of 140 km. There are 21 islands running almost parallel to the coastline of Mannar. These islands lie between 8° 47' N - 9° 15'N and 78° 12'E - 79° 14' E. These islands are situated at an average distance of about 8km from the coastline of Gulf of Mannar. It is bounded by Palk Bay, Rameshwaram island in the north side; by Ramanathapuram district in the northwest and west Tuticorin district in the south and by Bay of Bengal in the east. It is endowed with three distinct ecosystems namely corals, sea grass and mangroves.

MATERIALS AND METHODS

This study was conducted from April 2008 to March 2011. Extensive collections of echinoderms were made at major fish landing centre and collections from the intertidal region during the low tide. Mask and snorkel were used on the coral reefs to collect and study the habitats of the echinoderm. Small boats were used to visit all the 19 islands. Scuba diving was used throughout the study, and underwater photographs were taken with a Nikon RS underwater camera. The living posture and substratum recorded for the echinoderms were observed and photo-recorded in situ.

Except for some species of crinoids and brittle-stars, most species were identified on the basis of their morphological features, colors, habitat, and postures, the characters commonly used by field researchers. Some specimens were collected by placing them in sealable plastic bags, and they were preserved in 70% ethanol. These specimens are cataloged and deposited at the Marine Biology Regional Centre, Zoological Survey of India, Chennai. The identification of echinoderm species followed by Clark and Rowe (1971), James (2008, 2011).

RESULTS

Table 1 is the checklist of the echinoderm species found in the shallow waters in Gulf of Mannar Biosphere Reserve. The various bottom strata of the coral reef shelter a diversified fauna of 38 species of echinoderms, among which are 1 crinoid, 12 asteroids, 1 ophiuroid, 16 echinoids, and 7 holothuroids. The echinoderms are listed below in taxonomic order. For each species, information on habitat, locality, and behavior, if known, is given.

Class: CRINOIDEA

Family: TROPIOMETRIDAE

1. *Tropiometra carinata* (Lamarck)

(Fig. 1)

1816. *Comatula carinata* Lamarck. J.B.P.A.de Hist. nat. anim. s. vert., 2:534

1971. *Tropiometra carinata* : Clark, A.M. and Rowe, F.W.E. Monograph of Shallow-water Indo-West Pacific echinoderms, 10-11 (distribution) and 25 (key).

Material examined: E-12, E-40 /MBRC/ZSI 2 exs.

Habitat: Reefs, rocks, rocks and coral, sand and shell, dark sand, black specks and rocks (Clark, 1911), Littoral and down to 30 fathoms in Clark (1911). Found attached to rocks in shallow waters; rare **Colour:** Uniformly dark brown

Locality: Mundal, Fish Landing Centre (FLC).

Class: ASTEROIDEA

Family: LUIDIIDAE

2. *Luidia maculata* Muller and Troschel

(Fig. 2)

1842. *Luidia maculata* Muller, J. and Troschel, F.H. System der Asteriden, p.77

1971. *Luidia maculata* : Clark, A.M. and Rowe, F.W.E. Monograph of shallow-water Indo-West Pacific echinoderms, 30-31(distribution) and 43 (key).

Material examined: E-54/MBRC/ZSI 1 ex.

Habitat: Mudflats **Colour:** Upper side with characteristic blackish-brown marks and the lower side whitish.

Table 1. Checklist of Echinoderms in the waters of the Gulf of Mannar

Name of the species	James, 1985	Venkataraman <i>et al.</i> , 2002	Present study
Class: Crinoidea			
Family: Comasteridae			
<i>Capillaster multiradiatus</i> (Linnaeus)	*	*	-
<i>Comanthina schlegeli</i> (P.H.Carpenter,1881)	*	*	-
<i>Comanthus parvicirrus</i> (J.Muller)	*	*	-
<i>Comaster gracilis</i> (Hartlaub)	*	-	-
<i>Cometella stelligera</i> (P.H. Carpenter)	*	*	-
Family: Himerometridae			
<i>Heterometra reynaudi</i> (J. Muller)	*	*	-
Family: Mariametridae			
<i>Lamprometra palmata</i> (J. Muller)	*	*	-
<i>Stephanometra indica</i> (Smith)	*	*	-
Family: Tropiometridae			
<i>Tropiometra carinata</i> (Lamarck, 1816)	*	*	*
Class: Asteroidea			
Order: Paxillosida			
Family: Luidiidae	-	*	-
<i>Luidia hardwicki</i> (Gray, 1980)			
<i>Luidia maculata</i> Muller and Troschel, 1810	*	-	*
Family: Astropectinidae			
<i>Astropecten bengalensis</i> Doderlein, 1917	-	*	-
<i>Astropecten indicus</i> Doderlein, 1889	*	*	*
<i>Astropecten hemprichi</i> Muller and Troschel, 1842	*	*	-
<i>Astropecten monacanthus</i> Sladen, 1883	*	*	*
<i>Astropecten polyacanthus</i>	*	-	*
<i>Craspidaster hesperus</i> (Muller & Troschel)	*	-	-
Family: Asterinidae			
<i>Asterina burtoni</i> Gray, 1840	*	*	*
<i>Asterina cornata</i> V. Martens	*	*	-
<i>Asterina lorioli</i> Koehler, 1910	*	*	-
<i>Asterina sarasini</i> (de Loriol, 1897)	-	*	-
<i>Tegulaster ceylonica</i> Doderlein	*	-	-
Family: Goniasteridae			
<i>Anthenea pentagonula</i> (Lamarck, 1816)	*	*	*
<i>Goniodiscaster scaber</i> (Mobius, 1859)	*	*	*
<i>Siraster tuberculatus</i> H.L.Clark, 1915	*	*	-
<i>Stellaster equestris</i> (Retzius, 1805)	*	*	-
Family: Oreasteriidae			
<i>Asterodiscus elegans</i> Gray, 1847	*	*	-
<i>Culcita schmideliana</i> (Ritzius, 1806)	*	*	-
<i>Pentacaster mammillatus</i> (Audoin)	-	-	*
<i>Pentacaster affinis</i> (Muller and Troschel, 1842)	*	*	-
<i>Pentacaster regulus</i> (Muller and Troschel, 1842)	*	*	-
<i>Poraster superbus</i> (Mobius, 1859)	-	*	-
<i>Protoreaster lincki</i> (de Blainville, 1834)	*	*	*

Name of the species	James, 1985	Venkataraman <i>et al.</i> , 2002	Present study
Family: Ophidiasteridae			
<i>Linckia laevigata</i> (Linnaeus)	*	*	*
<i>Linckia multifora</i> (Lamarck)	*	*	*
<i>Andora faouzii</i> (Macan, 1938)	*	*	-
<i>Nardoa mollis</i> de Loriol, 1891	-	*	-
Family: Pterasteridae			
<i>Euretaster cribrosus</i> (V. Mortens, 1867)	*	*	-
Family: Echinasteridae			
<i>Echinaster purpureus</i> (Gray, 1840)	*	*	*
Class: Ophiuroidea			
Family: Ophiomyxidae			
<i>Ophiomyxa australis</i> Lutken, 1869	-	*	-
Family: Gorgonocephalidae			
<i>Astroboa clavata</i> (Lyman)	*	-	-
Family: Amphiuridae			
<i>Amphioplus</i> (<i>Amphioplus</i>) <i>gravelyi</i> James	-	*	-
<i>Amphioplus squamata</i> (D. Chiaje, 1829)	*	*	-
<i>Dougaloplus echinatus</i> (Ljungman)	*	*	-
Family: Ophiactidae			
<i>Ophiactis savignyi</i> (Muller and Troschel, 1842)	*	*	-
<i>Ophiactis modesta</i> Brock, 1888	*	*	-
Family: Ophiotrichidae			
<i>Gymnolophus obscura</i> (Ljungman)	*	-	-
<i>Macrophiothrix aspidota</i> (Muller and Troschel, 1842)	*	*	-
<i>Macrophiothrix longipeda</i> (Lamarck, 1816)	*	*	-
<i>Macrophiothrix variabilis</i> (Duncan, 1887)	*	*	-
<i>Ophiocnemis marmorata</i> (Lamarck, 1816)	*	*	-
<i>Ophiiothrix exigua</i> Lyman, 1874	*	*	-
<i>Ophiiothrix accedens</i> Koehler	*	*	-
<i>Ophiiothrix</i> (<i>Keystonea</i>) <i>nereidina</i> (Lamarck, 1816)	-	*	-
<i>Ophiogymna lineata</i> H.L. Clark, 1938	-	*	-
<i>Ophiiothela danae</i> Verrill, 1869	*	*	-
<i>Ophiocoma scolopendrina</i> (Lamarck, 1826)	*	*	-
<i>Ophiocoma erinaceus</i> Muller and Troschel, 1842	-	*	-
<i>Ophiocomella sexradia</i> (Duncan, 1887)	*	*	-
<i>Ophinoereis dubia</i> (Muller and Troschel, 1842)	*	*	-
<i>Ophiarchnella gorgonia</i> (Muller and Troschel, 1842)	*	*	*
<i>Ophiarchnella infernalis</i> (Muller and Troschel, 1842)	-	*	-
<i>Ophiogymna elegans</i> (Ljungman)	*	-	-
<i>Ophiomaza cacaotica</i> Lyman	*	-	-
Class: Echinoidea			
Family: Cidaridae			
<i>Prionocidaris baculosa</i> (Lamarck, 1816)	-	*	-

Name of the species	James, 1985	Venkataraman <i>et al.</i> , 2002	Present study
Family: Diadematidae			
<i>Astropyga radiata</i> (Leske, 1778)	*	*	*
<i>Echinothrix diadema</i> (Linnaeus)	-	-	-
Family: Stomopneustidae			
<i>Stomopneustes variolaris</i> (Lamarck, 1816)	*	*	*
Family: Temnopleuridae			
<i>Salmaciella dussumieri</i> (L. Agassiz & Desor, 1846)	*	*	-
<i>Salmacis bicolor</i> (L. Agassiz & Desor, 1846)	*	*	*
<i>Salmacis virgulata</i> (L. Agassiz & Desor, 1846)	*	*	*
<i>Temnopleurus alexandri</i> (Bell)	-	-	-
<i>Temnopleurus toreumaticus</i> (Leske, 1778)	*	*	*
Family: Toxopneustidae			
<i>Pseudoboletia maculata</i> Torschel, 1869	-	*	-
<i>Toxopneustes pileolus</i> (Lamarck, 1816)	*	*	*
<i>Tripneustes gratilla</i> (Linnaeus, 1758)	*	*	*
Family: Echinometeridae			
<i>Echinometra mathaei</i> (de Blainville, 1825)	*	*	-
Family: Clypeasteridae			
<i>Clypeaster humilis</i> (Leske, 1788)	*	*	*
<i>Clypeaster rarispinus</i> de Meijere	-	-	*
<i>Clypeaster reticulatus</i> (Linnaeus)	-	-	*
Family: Laganidae			
<i>Laganum depressum</i> Lesson 1841	*	-	*
<i>Laganum laganum</i> (Leske)	*	-	-
<i>Peronella orbicularis</i> (Leske)	*	-	-
Family: Arachnodiidae			
<i>Fibularia volva</i> L. Agassiz and Desor, 1846	-	*	-
Family: Scutellidae			
<i>Echinodiscus auritus</i> Leske, 1778	*	*	*
<i>Echinodiscus bisperforatus</i> Laske, 1778	*	*	
Family: Echinolampas			
<i>Echinolampas alexandri</i> de Lorient, 1876	*	*	*
<i>Echinolampas ovata</i> (Leske, 1778)	*	*	
Family: Lovenia			
<i>Lovenia elongata</i> (Gray, 1845)	*	*	*
Family: Brissidae			
<i>Brissus latecarinatus</i> (Leske)	-	-	*
<i>Metalia latissima</i> H.L. Clark, 1925	-	*	-
<i>Metalia sternalis</i> (Lamarck)	*	-	-
<i>Rhynobrissus pyramidalis</i> A. Agassiz, 1872	-	*	-

Name of the species	James, 1985	Venkataraman <i>et al.</i> , 2002	Present study
Class: Holothuroidea			
Family: Holothuriidae			
<i>Actinopyga miliaris</i> (Quoy and Gaimard, 1833)	-	*	-
<i>Bohadschia marmorata</i> Jager, 1833	*	*	*
<i>Holothuria</i> (<i>Halodeima</i>) <i>atra</i> Jager, 1833	*	*	*
<i>Holothuria</i> (<i>Halodeima</i>) <i>edulis</i> Lesson, 1830	*	*	-
<i>Holothuria</i> (<i>Lessonothuria</i>) <i>pardalis</i> Selenka, 1867	*	*	-
<i>Holothuria</i> (<i>Mertensiothuria</i>) <i>leucospilota</i> (Brandt, 1835)	*	*	*
<i>Holothuria</i> (<i>Metriatyla</i>) <i>scabra</i> Jager, 1833	*	*	*
<i>Holothuria</i> (<i>Selenkothuria</i>) <i>moebii</i> Ludwig	*	*	-
<i>Holothuria</i> (<i>Semperothuria</i>) <i>cinerascens</i> (Brandt, 1835)	-	*	-
<i>Holothuria</i> (<i>Theelothuria</i>) <i>spinifera</i> Theel, 1886	*	*	*
<i>Holothuria</i> (<i>Thymiosycia</i>) <i>hilla</i> Lesson, 1830	*	*	-
<i>Holothuria</i> (<i>Theelothuria</i>) <i>arenicola</i> Semper, 1868	-	*	-
<i>Holothuria</i> (<i>Thymiosycia</i>) <i>impatiens</i> (Forsskal, 1775)	-	*	-
Family: Stichopodidae			
<i>Stichopus choloronotus</i> (Brandt, 1835)	*	*	-
<i>Stichopus variegatus</i> Semper, 1868	*	*	-
<i>Stichopus herrmanni</i>	-	-	*
Family: Psolidae			
<i>Psolus mannarensis</i> James 1987	*	*	
Family: Cucumariidae			
<i>Havelockia versicolor</i> (Semper, 1868)	*	*	-
<i>Hemithyone semperi</i> (Bell, 1884)	*	*	-
<i>Pentacta quadrangularis</i> (Lesson & Troschel, 1846)	*	*	-
<i>Pseudocolochirus violaceus</i> (Theel, 1882)	*	*	-
<i>Stolus buccalis</i> (Simpson, 1885)	*	*	-
<i>Stolus conjugens</i> (Semper)	-	*	-
Family: Phyllophoridae			
<i>Afrocucumis typicus</i> Ludwig	*	*	-
<i>Phyllophorus</i> (<i>Phyllophorella</i>) <i>parvipedes</i> (H.L.Clark,1938)	*	*	-
Family: Caudinidae			
<i>Acaudina molpadioides</i> (Semper, 1868)	*	*	*
Family: Synaptidae			
<i>Protankyra asymmetrica</i> (Ludwig)	*	-	-
<i>Synapta maculata</i> (Chamisso and Eysenhard)	-	*	-
<i>Synaptula recta</i> (Semper 1868)	-	*	-
<i>Synaptula striata</i> (Sluiter 1868)	-	*	-
Family: Chiridotidae			
<i>Polycheira rufescens</i> (Brandt)	-	*	-
Total	93	103	37

Remarks: This species is commonly found in intertidal regions of coastal waters Keelakari Ervadi and Mandapam

Locality: Tharuvaikulam FLC, Tuticorin

Family: ASTROPECTINIDAE

3. *Astropecten indicus* Doderlein

(Fig. 3)

1888. *Astropecten indicus* Doderlein, L. Zool. Jb. Syst., 3: 828.

1971. *Astropecten indicus* : Clark, A.M. and Rowe. F.W.E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 30-31 (distribution) and 45 (key).

Material examined: E-24, E-43, E-56 MBRC/ZSI 36 exs.

Habitat: Sandy shore to depth of 10-20 mm.
Colour: Light blue with upper marginal plates dark bean orange spot at the base each spine. Lower side is white colour. Common.

Locality: Mandapam, Keelakarai, Ervadi and Mundal FLC

4. *Astropecten monacanthus* Sladen

(Fig. 4)

1883. *Astropecten monacanthus* Sladen. W.P. J. Linn Soc (Zool) 17: 216.

1971. *Astropecten monacanthus* : Clark, A.M. and Rowe. F.W.E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 30-31 (distribution) and 45, 46 (key).

Material examined: E-10, E-25, MBRC/ZSI 21 exs.

Habitat: Sandy bottom, from shore to 20 m depth. **Colour:** V-shaped black markings on upper side and white on the lower side.

Locality: Mandapam, Keelakarai, Ervadi and Mundal FLC

5. *Astropecten polyacanthus*

Muller & Trotschel

(Fig. 5)

1842. *Astropecten ploycanthus* Muller & Trotschel. F.H. *System der Asteriden*. P. 69.

1971. *Astropecten ploycanthus*: Clark, A.M. and Rowe. F.W.E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 30-31 (distribution) and 44 (key).

Material examined: E-55, MBRC/ZSI 2 exs

Habitat: Reef-dwelling sea stars are sometimes found on sand and soft bottom, but sand-dwelling forms (with pointed tube feet) are unable to climb on rocky reefs and would have difficulty finding food. **Colour:** Sandy brown

Locality: Mandapam FLC.

Family: GONIASTERIDAE

6. *Anthenea pentagonula* (Lamarck)

(Fig. 6)

1816. *Anthenea pentagonula*: Lamarck, J.B.P.A. de Hist. nat. anim. s. vert. 2: 554

1971. *Anthenea pentagonula* : Clark, A.M. and Rowe. F.W.E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 32-33 (distribution) and 52 (key).

Material examined: E-9, MBRC/ZSI 3 exs.

Habitat: Sandy shore. **Colour:** Upper side red or green lower side yellow colour may vary juveniles and adults.

Locality: Mundal FLC

Family: OREASTERIDAE

7. *Goniodiscaster scaber* (Möbius)

(Fig. 7)

1859. *Goniodiscaster scaber* Möbius, K. Abh. Geb. naturw. Hamburg. 4(2): 10.

1971. *Goniodiscaster scaber*: Clark, A.M. and Rowe. F.W.E. *Monograph of shallow-water Indo-West Pacific echinoderms*. 32-33 (distribution). 50 (keys.)

Material examined: E-15, E-44, E-57 MBRC/ZSI 13 exs.

Habitat: Sandy shore. **Colour:** Ash colour on upper side and white on the lower side.

Locality: Mandapam, Keelakarai, Ervadi and Mundal FLC

Family: OREASTERIDAE

8. *Pentaceraster mammillatus*

(Audouin, 1826)

(Fig. 8)

1826. *Asterias mammillata* Audouin, V. Explication SOMMAIRE DES PLANCHES D'Echinodermes de l'Egypte et de la Syrie publiées par J. C. de Savigny. In: *Description de l'Egypte*. Histoire naturelle. Paris I (4): 203-212pp.

1842. *Oreaster mammillatus* : Muller, J. & Trotschel, F. H. *System der Asteriden*. Braunschweig: XX: 134pp.

1875. *Pentaceraster mammillatus* : Perrier. *Revision de la collection de Stellerides du museum d' Histoire Naturelle de Paris*. 1-384. [Also published in *Arch. Zool. Exp. Gen.*, 4 (1875): 263-449; 5 (1876): 1-104]

Material examined: E-8, E-13 MBRC/ZSI 195 exs.

Habitat: Sandy shores, Coral reef flats and in Sea weed areas. **Colour:** varies. A number of color varieties exists, sometimes even in the same location. It occurs in intertidal regions throughout the Gulf of Mannar and it is very common, and at 3-5 m depths on the sea grass beds, coral, sandy bottom.

Locality: Mandapam, Keelakarai, Ervadi and Mundal, Vembar, Tharuvaikulam and Tutuicorin FLC.

9. *Protoreaster lincki* (de Blainville)
(Fig. 9)

1830. *Asterias lincki* de Blainville H.M. *Dictionnaire des Sciences Naturelles*. 60: 238

1971. *Protoreaster lincki*: Clark, A.M. and Rowe.F.W.E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 34-35(distribution) and 54(key).

Material examined: E-2, E-33 MBRC/ZSI 15 exs.

Habitat: Sandy bottom; 15-20 m deep. **Colour:** Yellow with brick red in colour in reticulate pattern on the upper side lower side is yellow in colour. It occurs in intertidal regions.

Locality: Mandapam, Keelakarai, Ervadi and Mundal, Vembar, Tharuvaikulam and Tutuicorin FLC.

Family: OPHIDIASTERIDAE
10. *Linckia laevigata* (Linnaeus)
(Fig. 10)

1758. *Asterias laevigata* Linnaeus C.*Systema Naturae*, Ed. 10:662

1971. *Linckia laevigata*: Clark, A.M. and Rowe. F.W.E. *Monograph of Shallow-water Indo-West Pacific echinoderms*, 36-37 (distribution) and 62 (keys).

Material examined: E-52 MBRC/ZSI 1 exs.

Habitat: It is found on Coral reefs, young one live among corals and adults lying in sandy areas and sea grass beds this star fish can be easily recognized. **Colour:** Brilliantly blue in colour. When these gills (papulae) are extended they often give the sea star a soft, velvety appearance.

Locality: Mandapam.

11. *Linckia multifora* (Lamarck)
(Fig. 11)

1816. *Asterias multifora* Lamarck. J.B.P.A. de *Hist.nat.anim.s.vert.*, 2:565.

1971. *Linckia multifora*: Clark, A.M. and Rowe.F.W.E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 36-37(distribution) and 62 (key).

Material examined: E-17, E-31, E-58 MBRC/ZSI 17 exs.

Habitat: It occurs on reef flats and in shallow water on coral reefs where it feeds on algae and detritus. The species reaches a size of 200 mm. **Colour:** Although well known by its most common colour form, this species is subject to colour variation and may be pink, grey, brown, or yellowish. In one of its juvenile stages it is generally grey with darker patches.

Locality: Mandapam, Keelamundal and Mundal FLC.

Family: ASTERINIDAE
12. *Asterina burtoni* Gray
(Fig. 12)

1840. *Asterina burtoni* Gray. J.E. *Ann. Mag. nat. Hist.*, 6 (37): 289.

2005. *Asterina burtoni*: Sastry, D.R.K. *Rec. zool. Surv. India. Occ. Paper No. 233:23*.

Material examined: E- 59 MBRC/ZSI 1 ex.

Habitat: Coral reefs. **Colour:** Rose-red on upper lower sides.

Locality: Mandapam FLC

Family: ECHINASTERIDAE
13. *Echinaster (Echinaster) purpureus* (Gray)
(Fig. 13)

Materials examined: E-14, E-42 MBRC/ZSI 2 exs.

1840. *Othilia purpurea* Gray, J.E. *Ann Mag. nat. Hist.*, 6 (37): 282.

1996. *Echinaster (Echinaster) purpureus*: Clark, A.M. *Echinoderm Studies*, 5:225 [non: *E.purpureus* Domantay and Roxas. 1938: 230 = *E. luzonicus* (Gray)]. *Indian Ocean 0-10 m*.

Habitat: Coral reefs: **Colour:** Brick red.

Locality: Ervadi

Class : OPHIUROIDEA
Family : OPHIODDERMATIDAE
14. *Ophiarachnella gorgonia* (Muller & Troschel)

1842. *Ophiarachnella gorgonia* Muller, J. and Troschel, F.H. *System der Asteriden*, p.105

1971. *Ophiarachnella gorgonia* : Clark, A. M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 88-89 (distribution) and 125 (key).

Material examined: E-21 MBRC/ZSI 1 ex.

Habitat: Yong forms associated with Soft Corals, Sponges and Corals, Adults inhabits sandy bottom. **Colour**: Arms of younger forms with white and green bands and adults brown bands.

Locality: Mandapam FLC.

Class: ECHINOIDEA

Family: DIADEMATIDAE

15. *Astropyga radiata* (Leske)
(Fig. 14)

1778. *Cidaris radiata* Leske. N.G. *Additamenta ad Kleinii naturalem dispositionem Echinodermatum*, p.116.

1971. *Astropyga radiata* : Clark, A. M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 140-141 (distribution) and 153 (key).

Material examined: E-36 MBRC/ZSI 1 ex

Habitat: Pearl banks , 10-15 m depth. **Colour**: Reddish brown on the upper side with sky blue spots arranged in rows.

Locality: Ervadi FLC.

Family: STOMOPNEUSTIDAE

16. *Stomopneustes variolaris* (Lamarck)
(Fig. 15)

1816. *Echinus variolaris* Lamarck. J.B.P.A. *de Hist.nat.anim.vert.* 3. 47.

1971. *Stomopneustes variolaris* : Clark, A.M and Rowe, F.W.E. *Monograph of shallow-water Indo- West Pacific echnioderms*, 140-141 and 153 (key).

Material examined: E-4, E-39 MBRC/ZSI 3 exs.

Habitat: Rough surge zones of coral reefs.
Colour: Dark purple to black.

Locality: Mandapam group Islands and Ervadi

Family: TEMNOPLEURIDAE

17. *Salmacis bicolor* L.A. gassiz
(Fig. 16)

1841. *Salmacis bicolor* Agassiz. L. *Mon. Ach. Anat. Echinus*. viii.

1971. *Salmacis bicolor* : Clark, A.M and Rowe, F.W.E.

Monograph of shallow-water Indo-West Pacific echnioderms, 144-145 and 156 (key).

Materials examined: E-20, E-37/MBRC/ZSI 4 exs.

Habitat: Shallow waters, 5-10 m depth,
Colour: Spines larger banded with red and yellow, smaller ones in red in colour.

Locality: Mandapam, Keelakarai , Ervadi and Mundal, Vembar, Tharuvaikulam and Tutuicorin FLC.

18. *Salmacis virgulata* (L. Agassiz)
(Fig. 17)

1846. *Salmacis virgulata*: Agassiz. L. In: L Agassiz and E. Desor. *Ann. Sci nat.* (3) 6: 359.

1971. *Salmacis virgulata* : Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 140-141 and 156 (key).

Materials examined: E-16 MBRC/ZSI 5 exs.

Habitat: Shallow water and lives coral reef areas.

Colour: Body black , white or greenish spines reddish in colour. Well defined sutural pits at all triple junctions.

Locality: Mandapam, Keelakarai , Ervadi and Mundal, Vembar, Tharuvaikulam and Tutuicorin FLC

19. *Temnopleurus toreumaticus* (Leske)
(Fig.18)

1778. *Cidaris toreumaticus* Klein In: Leske.N.G. *Additamenta ad Kleinii naturalem dispositionem Echinodermatum*. p.155.

1888. *Temnopleurus toreumaticus* : Bell. F.J. *Proc. zool. Soc. Lond.* 1888: 384: Tamil Nadu Gulf of Mannar (Tuticorin).

Material examined: E-60 MBRC/ZSI 1 ex.

Description: It is a long spined urchin, with a diameter of about 8 cm. It is generally black in colour, and always dark. Ambulacra narrow and straight; pore-pairs non-conjugate, uniserial; phyllodes developed adorally. Ambulacral plating trigeminate with single large primary tubercle per plate except adorally where there may be fewer. The spines are closed at the tip; the anal sac is spotted light and dark.

Locality: Mandapam FLC.

Family: TOXOPNEUSTIDAE

20. *Toxopneustes pileolus* (Lamarck)
(Fig. 19)

1816. *Echinus pileolus* Lamarck. J.B.P.A. de Hist. nat. anim. vert. 3. 45.

1971. *Toxopneustes pileolus*: Clark, A.M and Rowe, F.W.E. Monograph of shallow-water Indo-West Pacific echnioderms, 142-143 and 156 (key).

Materials examined: E30, E-38, E-49-MBRC/ ZSI 14 exs.

Habitat: This urchin is commonly found in all the island areas of Tuticorin group Pearl banks and corals areas at the depth of 5-10 m. **Colour:** Look like bunch of yellow with reds spots.

Locality: Vaan, Karaichalli Islands.

21. *Tripneustes gratilla* (Linnaeus)
(Fig. 20)

1758. *Echnius gratilla* Linnaeus. C. Systema Naturae. Ed. 10: 664

1971. *Tripneustes gratilla*: Clark, A. M. and Rowe, F.W.E. Monograph of shallow-water Indo-West Pacific echnioderms, 142-143 and 156 (key).

Materials examined: E-29, E-50 MBRC/ ZSI 2 exs.

Habitat: Shallow water and coral reef areas. **Colour:** Body black, white or greenish in colour, spines reddish.

Locality: Appa Islands, Keelakari.

Family: CLYPEASTERIDAE

22. *Clypeaster humilis* (Leske)
(Fig. 21)

1778. *Echinanthus humilis* Leske, N.G. Additamenta ad Kleinii naturalem dispositionem Echinodermatum, P.121 pl XIX fig A.B.

1971. *Clypeaster humilis*: Clark, A.M and Rowe, F.W.E. Monograph of shallow-water Indo-West Pacific echnioderms, 144-145 and 161(key)

Materials examined: E-28, E-46 MBRC/ ZSI 68 exs.

Description: Shell flat, thickened with small spines distributed all over the body. **Habitat:** Pearl banks off Tuticorin 15-20 m depth, coral reef areas. **Colour:** Spines yellow-brown.

Locality: Mandapam, Ervadi and Keelakarai FLC.

23. *Clypeaster rarispinus* de Meijere
(Fig. 22)

1903. *Clypeaster rarispinu* de Meijere, J.C.H. Tjdschr. ned. dierk. Veeren., (2) 8: 7

1971. *Clypeaster rarispinus*: Clark, A.M. and Rowe, F.W.E. Monograph of shallow-water Indo- West Pacific echnioderms, 144-145. (distribution) and 160 (key)

Materials examined: E-45 MBRC/ ZSI 10 exs.

Habitat: Pearl banks off Tuticorin 1520 m depth, coral reef areas. **Colour:** Spines yellow.

Locality: Ervadi and Keelakarai FLC

24. *Clypeaster reticulatus* (Linnaeus)
(Fig. 23)

1758. *Echinus reticulatus* Linnaeus. C. System Naturae Ed. 10: 666

1971. *Clypeaster reticulatus*: Clark, A.M. and Rowe, F.W.E. Monograph of shallow-water Indo-West Pacific echnioderms, 144-145 (distribution) and 160 (key).

Materials examined: E-62 MBRC/ ZSI 19 exs.

Habitat: Pearl banks off Tuticorin 1520 m depth, coral reef areas. **Colour:** Spines yellow.

Locality: Ervadi and Keelakarai FLC.

Family: LAGANIDAE

25. *Laganum depressum* Lesson

1841. *Laganum depressum* L. Agassiz, Monographie di Echinodermes II. Monographie des scutelles, p. 110.

1971. *Laganum depressum*: Clark, A.M. and Rowe, F.W.E. Monograph of shallow-water Indo-West Pacific echnioderms, 144-145 (distribution) and 162 (key).

Materials examined: E-18 MBRC/ ZSI 1 ex.

Habitat: Sandy bottom where it buries. **Colour:** Body slightly yellow, spines yellowish-brown.

Locality: Keelakarai, Ervadi FLC

Family: ASTRICLYPEIDAE
26. *Echniodiscus auritus* Leske
(Fig. 24)

1778. *Echniodiscus auritus* Leske, N.G. Additamenta ad Kleinii naturalem dispositionem Echinodermatum, P. 121 pl XIX fig A.B.

1971. *Echniodiscus auritus*: Clark, A.M. and Rowe, F.W.E. Monograph of shallow-water Indo-West

Pacific echnioderms, 144-145 (distribution) and 162 (key).

Materials examined: E-26, E-48 MBRC/ZSI 16 exs.

Habitat: Pearl banks, Coral reef flats 15-20 m depth. **Colour**: Body slightly reddish with white markings, spines yellowish-brown.

Locality: Ervadi and Keelakarai FLC

Family: SCUTELLIDAE

27. *Echniodiscus bisperforatus* Leske

1778. *Echinodiscus bisperforatus* Leske N.G. *Additamenta ad Kleinii naturalem dispositionem Echinodermatum*, P.132.

1971. *Echinodiscus bisperforatus*: Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 144-145 (distribution) and 162 (key).

Materials examined: E-27 MBRC/ZSI 12 exs.

Habitat: Pearl banks, Coral reef flats 15-20 m depth. **Colour**: Shell without spines in white.

Locality: Ervadi FLC.

Family: ECHINOLAMPADIDAE

28. *Echinolampus ovata* (Leske)
(Fig. 25)

1778. *Echinanthus ovatus* Leske, N.G. *Additamenta ad Kleinii naturalem dispositionem Echinodermatum*, P.127.

1971. *Echinolampus ovata*: Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 144-145 (distribution) and 163 (key).

Materials examined: E-41 MBRC/ZSI 1 ex.

Description: Shell egg-shaped, star-shaped marks seen on the upper side.

Habitat: Reef flats,

Colour: White and pale yellow.

Remarks: Occurs in large numbers at one place.

Locality: Ervadi FLC

Family: LOVENIIDAE

29. *Lovenia elongata* (Gray)
(Fig. 26)

1845. *Spatangus elongata* Gray, J.E. *Exped. Australia*, 1: 436

1971. *Lovenia elongata*: Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 146-147. and 164 (key)

Materials examined: E-63 MBRC/ZSI 3exs.

Habitat: Sandy areas, burrows into the sand and feeds on organic matter, **Colour**: Brown-Reddish.

Remarks: Occurs in large numbers at one place.

Locality: Mandapam FLC

Family: BRISSIDAE

30. *Brissus latecarinatus* Leske
(Fig. 27)

1778. *Spantagus brissus var. latecarinatus* Leske, N.G. *Additamenta ad Kleinii naturalem dispositionem Echinodermatum*, p.185.

1971. *Brissus latecarinatus*: Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 146-147. and 165 (key).

Materials examined: E-11, E-19, E-47 MBRC/ZSI 9 exs.

Habitat: Mostly shallow water sands to shell gravels

Locality: Mandapam, Mundal FLC and Tuticorin group of Islands

Class : HOLOTHUROIDEA

Order : ASPIDOTROCHOTIDA

Family : HOLOTHURIIDAE

31. *Bohadschia marmorata* (Jaeger, 1833)

Common Name: Chalkyfish

Local name: Nool Attai (Tamil)
(Fig. 28)

1833. *Bohadschia marmorata* Jaeger.G.F. *De Holothuriis* p.18

Habitat: Lies buried in silty sand. Distributed at depths of 0-15 m.

Location: Mandapam FLC.

32. *Holothuria atra* Jaeger

Common Name: Lolly Fish

Local Name: Kutchii attai.
(Fig. 29)

1833. *Holothuria atra* Jaeger, G.R. *De Holothuriis*, p. 22.

1895. *Holothuria atra*: Thruston E. *Madras Govt. Mus. Bull.* No. 3(11): 115.

Materials examined: E-5, E-53 MBRC/ZSI 3 exs.

Habitat: Dead coral reef flats, sandy, muddy patches occurs in 10 m depth.

Status: Common Value: Low value.

Location: Mandapam and Keelakarai group of Islands, Periapattanam FLC,

33. *Holothuria leucospilota* Brandt

Common Name: Lolly Fish

Local Name: Kutchii attai.

(Fig. 30)

1835. *Stichopus (Gymnochirota) leucospilota* Brandt
Prodromus descriptionis animalium, 1:51

1971. *Holothuria (Mertensiothuria) leucospilota* Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 176-177 (distribution).

Habitat: It tucks the rear end of the body under coral stones. **Colour:** uniformly velvet blue
Common. Value: Low value.

Location: Mandapam FLC.

34. *Holothuria scabra* Jaeger

Common Name : Sand Fish

Local Name: Vellai attai.

(Fig. 31)

1833. *Holothuria scabra* Jaeger G.F. *De Holothuriis* p.23.

1971. *Holothuria (Metriatyla) scabra* Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 178-179 (distribution).

Materials examined: E-3 MBRC/ZSI 2 exs.

Habitat: Sandy areas buries into the sand exposing the rear end.

Status: Common,

Value: High value. **Colour:** grey to black on upper side with white or yellow stripes; lower side white with black spots.

Location: Mandapam FLC, Keelakari and Ervadi

35. *Holothuria (Theelothuria) spinifera* Theel

Common Name : Brown Fish

Local Name : Rajaattai or Chena attai.

(Fig. 32)

1886. *Holothuria spinifera* Theel, H. *Rep. Scient. Results. Voy. "Challenger"* (Zool.), 39:175.

1971. *Holothuria (Theelothuria) spinifera* Clark, A.M. and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 178-179 (distribution).

Materials examined: E-22, E-23 MBRC/ZSI 3 exs.

Description: Body tubular in shape, sharp projections all over the body hence the name maximum length 350mm: **Colour** : Uniform brown lower part is light in colour.

Habitat: Clean sandy areas and deeper in water and buries into the sand completely.

Status: Common,

Value: medium valued.

Location: Mandapam FLC.

Family: STICHOPODIDAE

36. *Stichopus herrmanni* Semper

Common Name: Curry Fish

Local Name: Mullu attai

(Fig. 33)

1868. *Stichopus variegatus herrmanni* Semper C. *Risen Archip. Philipp. 2. Wiss Result Wetlands*, 2 (1): 73.

1995. *Stichopus herrmanni* : Rowe, F.W.E and Gates, J. *Zoological Catalogue of Australia*, 33:324.

Materials examined: E-7 MBRC/ZSI 1 ex.

Description : Body wall gelatinous upper side with large fleshy projections; underside with 3 bands of maximum length 500 mm : **Colour** Uniformly black.

Habitat: Dead coral reef flats, sandy, muddy patches occurs in 10 m depth

Status: Common. Value: Low valued.

Location: Mandapam FLC

Order : MOLPADIIDAE

Family : CAUDINIDAE

37. *Acaudina malpadioides* Semper 1868

(Fig. 34)

1938. *Haplodactyla malpadioides* Semper C. *Reisen Archip. Philipp. 2. Wiss Result*: 41.

1971. *Acaudina malpadioides* Clark, A.M and Rowe, F.W.E. *Monograph of shallow-water Indo-West Pacific echnioderms*, 184-185.

Materials examined: E-6 MBRC/ZSI 1 ex.

Description: Body fusiform with smooth surface; at the front end ten small digit-like

structure surrounding the mouth **Colour:** light pink.

Habitat: Adults bury in the mud, 10-15 m deep

Status: **Common** Value: Low valued.

Location: Mandapam FLC.

DISCUSSION

The echinoderm fauna of Gulf of Mannar has been studied by James (1988) from Central Marine Fisheries Research Institute. General faunal diversity of Gulf of Mannar Biosphere Reserve was studied by Venkataraman *et al.* (2002). In these studies, 9 crinoids, 56 starfishes, 30 Echinoidea, and 33 holothuroids were recorded. Of which 38 species were recorded and 23 species were found common to present study. Species such as *Pentaceraster mammillatus*, *Echinothrix diadema*, *Temnopleurus alexandri*, *Clypeaster rarispinus*, *Clypeaster reticulatus*, *Brissus latecarinatus* and *Stichopus herrmanni* were not recorded earlier and are new to Gulf of Mannar.

In Gulf of Mannar, Holothuroidea and Echinoidea are considered as economically important. The *beeche-de-mer* soup is believed to possess curative properties for whooping cough, bronchial inflammation, and respiratory disorders. This resource is vulnerable for over-exploitation. The population and distribution of most economically important species like *Holothuria scabra*, *Holothuria spinifera* were drastically reduced due to overexploitation.

Holothurians (sea cucumbers) even though protected under schedule I of Indian wildlife (Protection) Act, 1972 trade is continuing in Gulf of Mannar regions. Species of *Holothuria scabra* and *H. atra* are mainly collected by skin-

diving from a depth of 1-5 m along with ornamental fish and seashells. Sea cucumbers which enter in the trawl nets are also used. Major area of collection includes Dhanuskodi, Mandapam, Keelakarai, Vembar and Tuticorin. The export route is not clearly known, but the collected sea cucumbers are home dried and are handed to a middle man in the village, through him only all trade is taking place. The dried sea cucumbers known as *beche-de-mer* are a delicacy in south East Asian countries. Fishermen engaged in this activity are well aware that these species are protected and illegal trade can attract heavy fine and punishments, they still continue this because of huge profits from this business. From fishermen point of view sea cucumber numbers are not dwindling, but increasing. The inclusion of holothurians in the list of protected animals under Indian Wildlife (Protection) Act, 1972 has left the holothurian fishery dependent community in wild. Provision of alternate income generating schemes to safeguard the livelihoods of people, conducting regular awareness programmes can only save the echinoderm resources of Gulf of Mannar.

ACKNOWLEDGEMENTS

We are very grateful to Dr. K. Venkataraman, Director, Zoological Survey of India, for his encouragement and providing facilities to carry out this survey. We are highly thankful to Dr. D. B. James, Retired Principle Scientist, CMFRI for his untiring help in identification and confirmation of Echinoderm specimens. We thank Chief Wildlife Warden, Chennai, Wildlife Warden, Gulf of Mannar, and Staff of Tamil Nadu Forest Department for their permission to carry out this work.

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Fig. 1. *Tropiometra carinata*



Fig. 2. *Luidia maculata*



Fig. 3. *Astropecten indicus*



Fig. 4. *Astropecten monacanthus*



Fig 5. *Astropecten polyacanthus*



Fig. 6. *Anthenca pentagonula*



Fig. 7. *Goniodiscaster scaber*



Fig. 8. *Pentaceraster mammillatus*



Fig. 9. *Protoreaster lincki*



Fig. 10. *Linckia laevigata*

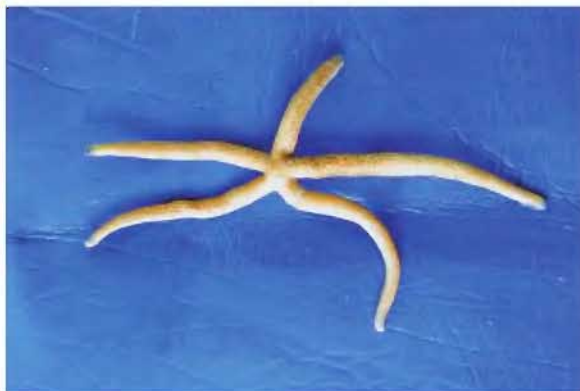


Fig. 11. *Linckia multifora*



Fig. 12. *Asternia burtoni*



Fig. 13. *Echinaster purpureus*



Fig. 14. *Astropyga radiata*



Fig. 15. *Stomopneustes variolaris*



Fig. 16. *Salmacis bicolor*



Fig. 17. *Salmacis virgulata*



Fig. 18. *Temnopleurus toreumaticus*

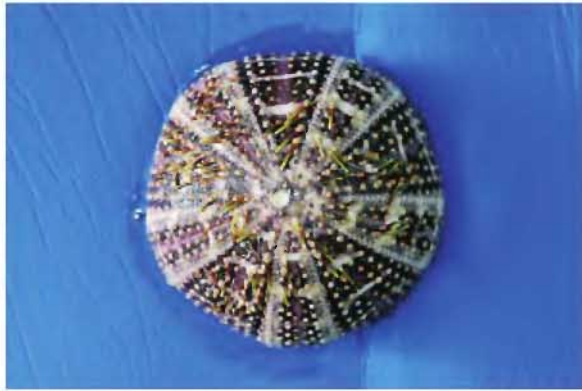


Fig. 19. *Toxopneustes pileolus*



Fig. 20. *Tripneustes gratilla*



Fig. 21. *Clypeaster humilis*



Fig. 22. *Clypeaster rarispinus*



Fig. 23. *Clypeaster reticulatus*

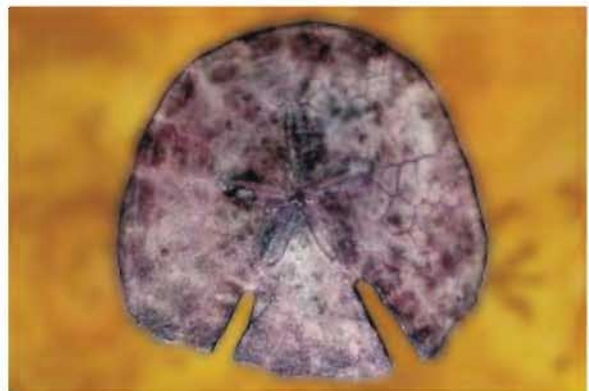


Fig. 24. *Echinodiscus auritus*



Fig. 25. *Echinolampas ovata*



Fig. 26. *Lovenia elongata*



Fig. 27. *Brissus latecarinatus*



Fig. 28. *Bohadschia marmorata*



Fig. 29. *Holothuria atra*



Fig. 30. *Holothuria leucospilota*



Fig. 31. *Holothuria scabra*



Fig. 32. *Holothuria spinifera*



Fig. 33. *Stichopus herrmanni*



Fig. 34. *Acaudina molpadioides*



A STUDY ON VESPID WASPS (INSECTA: HYMENOPTERA: VESPIDAE) OF ITANAGAR WILDLIFE SANCTUARY, ARUNACHAL PRADESH

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INTRODUCTION

Itanagar Wildlife Sanctuary is situated in Papumpare district of Arunachal Pradesh which is spread over an area of about 140.30 sq. km with rare and varied species of fauna and flora. This sanctuary is surrounded by Poma River in the East, Pachin River in the South, Neorch River in the North West. It is situated at 27° 5' 35.72" N 93°37' 30.72" E latitude and longitude coordinates having an altitude of 250-2000 msl receiving an average annual rainfall of ca 400 mm. The climate is moist and humid with the varying temperature range of 10-30° C.

The present paper includes the systematic account of the family Vespidae from Itanagar Wildlife Sanctuary. The family Vespidae belongs to the superfamily Vespoidea of the order Hymenoptera. The members of this family are commonly known as hornet wasps, yellow wasps, paper wasps, hover wasps, potter wasps, etc., in which potter wasps are solitary in behaviour and others are social wasps. In this paper, we are reporting about 17 species of Vespidae from Itanagar Wildlife Sanctuary.

MATERIAL AND METHODS

All the insects were collected from various localities of the Itanagar Wildlife Sanctuary by using sweep net specially made for the purpose. The collected specimens were killed by using ethyl acetate and preserved as dry specimens. The

pinned specimens were subjected to taxonomic studies by using Wild Heerbrugg Stereozoom microscope.

Most of the materials examined have been deposited at the museum of Arunachal Pradesh Regional Centre of Zoological Survey of India, Itanagar and two specimens at the 'National Zoological Collections' of Hymenoptera Section of Zoological Survey of India, Kolkata.

Acronyms for museums and depositories: APRC/ZSI = Arunachal Pradesh Regional Centre of Zoological Survey of India, Itanagar, India; BMNH = The Natural History Museum, London, England; MHNG = Muséum d'Histoire naturelle, Genève, Switzerland; MNHN = Museum National de Histoire Naturelle, Paris, France; NZSI = 'National Zoological Collections' of Hymenoptera Section, Zoological Survey of India, Kolkata, India; ZMB = Zoologisches Museum der Humboldt Universität, Berlin, Germany.

SYSTEMATIC ACCOUNT

Family VESPIDAE

Subfamily EUMENINAE

1. *Delta pyriforme pyriforme* (Fabricius, 1775)

1775. *Vespa petiolata* Fabricius, *Ent. Syst.*, ii, 278. Syntype, Sex not mentioned, Type loc. Malabar, India (BMNH).

2010. *Delta pyriforme pyriforme* (Fabricius): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2(12): 1314.

Diagnosis: Female: Size 25-27 mm. Head yellow, a broad black band between the eyes on the vertex; occiput black; antenna reddish brown; pronotum entirely and mesoscutum anteriorly yellow, the latter posteriorly black; scutellum and postscutellum reddish brown; propleuron black; mesopleuron, metapleuron and legs reddish brown variegated with black; propodeum reddish brown with a narrow medial vertical black line; the sutures between the scutellum, postscutellum and propodeum black; petiole and basal third of the second gastral segment reddish brown, the former black at base and with a subapical black band, the middle of the latter black, its posterior third and the remaining abdominal segments yellow. Wings deep flavohyaline. Frons and vertex of the head and thorax with close shallow punctures, petiole smooth, the rest of the abdomen with the surface finely longitudinally aciculate; clypeus pyriform, its apex truncate; petiole broadening towards the apex and slightly flattened. *Male:* Size 20-25 mm. Similar to female in general appearance but slender, the fifth and sixth gastral segments at base and the whole of the seventh segment black.

Material examined: 1 F, ZSI Office, 5.xii.2004, Regd. No. IV/2139/APRC/ZSI; 1 F, ZSI Colony, 6.iii.2005, Regd. No. IV/2140/APRC/ZSI; 1 M, ZSI Colony, 19.vi.2005, Regd. No. IV/2141/APRC/ZSI; 2 F, ZSI Office, 21.vi.2005, Regd. Nos. IV/2142/APRC/ZSI & IV/2143/APRC/ZSI; 1 M, ZSI Office, 22.vi.2005, Regd. No. IV/2144/APRC/ZSI; 4 M & 1 F, ZSI Office, 5.x.2005, Regd. Nos. IV/2145/APRC/ZSI to IV/2149/APRC/ZSI; 1 F, ZSI Office, 28.vi.2006, Regd. No. IV/2150/APRC/ZSI; 1 F, ZSI Colony, 16.viii.2006, Regd. No. IV/2151/APRC/ZSI; 1 M, ZSI Colony, 24.viii.2006, Regd. No. IV/2152/APRC/ZSI; 1 F, ZSI Colony, 25.viii.2006, Regd. No. IV/2298/APRC/ZSI; 1 F, ZSI Colony, 27.viii.2006, Regd. No. IV/2153/APRC/ZSI; 1 M, ZSI Office, 30.viii.2006, Regd. No. IV/2154/APRC/ZSI; 1 F & 1 M, ZSI Colony, 4.ix.2006, Regd. Nos. IV/2155/APRC/ZSI & IV/2156/APRC/ZSI; 1 F, ZSI Colony, 5.ix.2006, Regd. No. IV/2157/APRC/ZSI; 1 F, ZSI Office, 20.ix.2006,

Regd. No. IV/2158/APRC/ZSI; 5 M & 3 F, Police Colony, 24.x.2007, Regd. Nos. IV/2159/APRC/ZSI to IV/2166/APRC/ZSI; 6 M & 2 F, Police Colony, 30.x.2007, Regd. Nos. IV/2167/APRC/ZSI to IV/2174/APRC/ZSI; 1 M & 3 F, Police Colony, 30.x.2008, Regd. Nos. IV/2175/APRC/ZSI to IV/2178/APRC/ZSI. All the specimens were collected by the first author.

Distribution: India: Arunachal Pradesh, Gujarat, Karnataka, Kerala, Odisha, Rajasthan, Sikkim, Tamil Nadu and West Bengal. *Elsewhere:* Bhutan, Cambodia, China, Hawaii, Hong Kong, Indonesia, Malaysia, Moluccas, Myanmar, Nepal, New Guinea, Sri Lanka, Taiwan, Thailand and Vietnam.

2. *Delta esuriens* (Fabricius, 1787)

1787. *Vespa esuriens* Fabricius, *Mant. Ins.*, 1: 293. Syntype, Sex not mentioned, Loc. India (BMNH).

2010. *Delta esuriens* (Fabricius, 1787): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2 (12): 1315.

Diagnosis: Female: Size 14-20 mm. Head yellow to brownish yellow with following black markings: a broad band on vertex including upper half of frons extending behind vertex to outer side of temple and to occiput, a black mark on anterior tentorial pit extending to subantennal suture to dorsal side of antennal scrobe and touches the black band on frons and vertex (this black markings highly variable and absent in some specimens); antennae light reddish (in some specimens a black mark present on scape dorsally and apical antennal segments more dark); pronotum and postscutellum yellow; propleuron and pronotal collar basally black or blackish brown; mesopleuron yellow to brownish yellow except mesepimeron brown to blackish brown and mesosternum black; mesoscutum black except a large brown area posteriorly; scutellum, propodeum and legs light reddish (in some specimens fore coxa, all trochanters and mid and hind tarsal segments except basitarsus black); petiole light reddish except at base black, at apex a black band and then a yellow band; second gastral segment basally light reddish then a black band and remaining apical half yellow; all remaining gastral segments yellow, with their bases (when

drown out) black. Wings flavohyaline with a narrow subapical dark infumation on forewing. Clypeus smooth, strongly convex, flattened at middle, its anterior margin transversely truncate at apex; frons, vertex and thorax with close fine but shallow punctures; gaster smooth, slightly shining. *Male*: Size 11.5 mm. Similar to female in general appearance but more slender.

Material examined: 1 F, ZSI Colony, 2.iii.2006, Regd. No. IV/2179/APRC/ZSI; 1 F, ZSI Colony, 5.iii.2006, Regd. No. IV/2180/APRC/ZSI; 1 F, ZSI Colony, 5.iv.2006, Regd. No. IV/2181/APRC/ZSI; 1 M, ZSI Colony, 6.iv.2006, Regd. No. IV/2182/APRC/ZSI; 1 F, ZSI Colony, 10.vi.2006, Regd. No. IV/2183/APRC/ZSI; 1 M, ZSI Colony, 12.iv.2006, Regd. No. IV/2184/APRC/ZSI; 2 F, Indira Gandhi Park, 5.iii.2008, Regd. Nos. IV/2185/APRC/ZSI & IV/2186/APRC/ZSI; 4 F, Police Colony, 6.iii.2008, Regd. Nos. IV/2187/APRC/ZSI & IV/2190/APRC/ZSI; 3 F, ZSI Colony, 27.x.2008, Regd. Nos. IV/2191/APRC/ZSI & IV/2193/APRC/ZSI. All the specimens were collected by the first author.

Distribution: *India*: Arunachal Pradesh, Delhi, Gujarat, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttarakhand and West Bengal. *Elsewhere*: Arabia, Indonesia, Iran, Iraq, Myanmar, Pakistan, Philippines, Sri Lanka and Thailand.

3. *Delta companiforme gracilior* (Giordani Soika, 1986)

1852. *Eumenes gracilis* de Saussure, *Et. Fam. Vesp.*, i, 57. Female, Male, Syntypes, Type Loc. Egypt and Senegal (MNHN).

2010. *Delta companiforme gracilior* (Giordani Soika): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2(12): 1315, 1316.

Diagnosis: *Female*: Size 18-20 mm. Black. The following yellow parts: Clypeus and frons up to the sinus of eyes, a line on the inner side of temple, pronotum, a large spot on mesopleuron, postscutellum except basal part, sides of propodeum, a narrow subapical band on petiole, posterior half of the second and following abdominal segments. The following reddish portions: antenna (sometimes a black mark on

scape and blackish apical antennal segments), scutellum (sometimes yellow), legs, remaining parts of petiole and basal part of second abdominal segment. A small band on the petiole near to yellow apical band, on the middle of the second gastral segment, bases of the remaining gastral segments (usually not visible externally) black. In some specimens fore coxa, all trochanters, mid and hind tarsal segments except basitarsus, black. *Male*: Size 16-18 mm. Similar to female in general appearance but more slender.

Material examined: 1 F, ZSI Colony, 20.iii.2006, Regd. No. IV/2194/APRC/ZSI; 1 F, ZSI Colony, 25.iii.2006, Regd. No. IV/2195/APRC/ZSI; 1 M, ZSI Office, 8.viii.2006, Regd. No. IV/2196/APRC/ZSI; 1 M, ZSI Colony, 10.viii.2006, Regd. No. IV/2197/APRC/ZSI; 1 M, ZSI Colony, 15.viii.2006, Regd. No. IV/2198/APRC/ZSI. All the specimens were collected by the first author.

Distribution: *India*: Arunachal Pradesh, Sikkim and West Bengal. *Elsewhere*: Australia, Egypt, Indonesia, Malaysia, Myanmar, Philippines, Senegal, Sumatra and Thailand.

4. *Delta dimidiatipenne* (de Saussure, 1852)

1852. *Eumenes dimidiatipennis* de Saussure, *Et. Fam. Vesp.*, Mon. Guep. Sol.: 51. Female, Male, Syntypes, Type loc. Arabia (Djidda), The East Indies (India), Egypt (MNHN).

2010. *Delta dimidiatipenne* (de Saussure): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2 (12): 1316.

Diagnosis: *Female*: Size 24-27 mm. Body obscure dull red with following black markings: vertex, extending to occiput usually at the apex of antennae, propleuron, mesopleuron except two red patches, metapleuron except a red patch on upper metapleuron, mesoscutum, base of petiole, apical half of second tergite and whole of the remaining tergites. Wings ferruginous, with apical half of forewing fuscous having a purple reflection. Clypeus smooth, oval, convex, anterior margin transverse; abdomen smooth and shiny. *Male*: Size 22-25 mm. Similar to female in general appearance except the clypeus and the lower half of frons yellow, smaller and slender.

Material examined: 2 M, ZSI Office, 5.x.2005, Regd. Nos. IV/2216/APRC/ZSI & IV/2217/APRC/ZSI; 1 F, ZSI Office, 3.xi.2005, Regd. No. IV/2218/APRC/ZSI; 1 M, ZSI Colony, 3.iii.2006, Regd. No. IV/2219/APRC/ZSI; 1 M & 1 F, ZSI Colony, 14.iii.2006, Regd. Nos. IV/2220/APRC/ZSI & IV/2221/APRC/ZSI; 1 F, ZSI Colony, 11.xi.2006, Regd. No. IV/2222/APRC/ZSI. All the specimens were collected by the first author.

Distribution: India: Arunachal Pradesh, Delhi, Gujarat, Kerala, Maharashtra, Punjab, Uttarakhand and Uttar Pradesh. *Elsewhere:* Afghanistan, Africa, Algeria, Arabia, Central Africa, Central Sahara, Egypt, Ethiopia, Iran, Madagascar, Pakistan, Palestine, Somalia, South Africa, Syria and Yemen.

5. *Delta conoideum* (Gmelin, 1790)

1787. *Vespa conica* Fabricius, *Mant. Ins.*, 1-293. Female, Syntype. Type loc. China (BMNH).

2010. *Delta conoideum* (Gmelin): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2(12): 1316, 1317.

Diagnosis: Female: Size 23-26 mm. Head yellow except mandibles and antenna reddish, a broad transverse band across the apex between the tops of the eyes black, black mark extends behind the vertex to occiput; thorax dark red with black patches on mesoscutum, metapleuron and median area of propodeum, propleuron entirely black; legs pale reddish; gaster dark red with base of the second tergite and a short transverse medially interrupted band on its middle above black; forewing basally flavohyaline and apically fuscohyaline, with a slight purplish refringes. Head above the antenna and thorax closely and lightly punctured; clypeus pyriform, its apex truncate; gaster smooth and shining with the surface minutely aciculate. *Male:* Size 18-22 mm. Similar to female in general appearance but smaller and slender.

Material examined: 1 F, ZSI Colony, 3.xii.2004, Regd. No. IV/2223/APRC/ZSI; 1 F, ZSI Colony, 10.iii.2005, Regd. No. IV/2224/APRC/ZSI; 1 M, Police Colony, 28.iii.2005, Regd. No. IV/2225/APRC/ZSI; 1 F, Police Colony, 28.vi.2005, Regd. No. IV/2226/APRC/ZSI; 1 F & 1

M, ZSI Office, 5.x.2005, Regd. Nos. IV/2227/APRC/ZSI & IV/2228/APRC/ZSI; 1 F, Police Colony, 13.xi.2005, Regd. No. IV/2229/APRC/ZSI; 1 M, ZSI Colony, 2.iii.2006, Regd. No. IV/2230/APRC/ZSI; 1 F, ZSI Colony, 16.xii.2006, Regd. No. IV/2231/APRC/ZSI; 2 F, ZSI Colony, 21.iii.2006, Regd. Nos. IV/2232/APRC/ZSI & IV/2233/APRC/ZSI; 1 F, Police Colony, 24.vi.2006, Regd. No. IV/2234/APRC/ZSI; 1 F, ZSI Colony, 1.ix.2006, Regd. No. IV/2235/APRC/ZSI; 1 F, ZSI Colony, 5.ix.2006, Regd. No. IV/2236/APRC/ZSI; 1 F, ZSI Office, 5.iii.2007, Regd. No. IV/2237/APRC/ZSI; 6 F, Police Colony, 24.x.2007, Regd. Nos. IV/2238/APRC/ZSI to IV/2243/APRC/ZSI. 4 M & 2 F, Police Colony, 27.x.2007, Regd. Nos. IV/2244/APRC/ZSI to IV/2249/APRC/ZSI; 2 M, Indira Gandhi Park, 3.iii.2008, Regd. Nos. IV/2250/APRC/ZSI & IV/2251/APRC/ZSI; 3 M, Indira Gandhi Park, 4.iii.2008, Regd. Nos. IV/2252/APRC/ZSI to IV/2254/APRC/ZSI; 1 M, Indira Gandhi Park, 5.iii.2008, Regd. No. IV/2255/APRC/ZSI; 1 M, ZSI Office, 28.iii.2008, Regd. No. IV/2256/APRC/ZSI; 4 F, Police Colony, 24.x.2008, Regd. Nos. IV/2257/APRC/ZSI to IV/2260/APRC/ZSI; 1 M & 7 F, Police Colony, 30.x.2008, Regd. Nos. IV/2261/APRC/ZSI to IV/2268/APRC/ZSI. All the specimens were collected by the first author.

Distribution: India: Arunachal Pradesh, Odisha, Sikkim, Tamil Nadu, Tripura and Uttar Pradesh. *Elsewhere:* Arabia, China, Malaysia, Myanmar, Pakistan, Sri Lanka and Thailand.

6. *Phimenes flavopictum continentale* (Zimmermann, 1931)

1931. *Eumenes arcuata continentalis* Zimmermann, *Zietschr. Morph. Oek. Tiere*, 22: 203, Female, Male, Syntypes, Type Loc. Sikkim (ZMB).

2010. *Phimenes flavopictum continentale* (Zimmermann): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2(12): 1317, 1318.

Diagnosis: Female: Size 24-26 mm. Black. The following yellow markings: Clypeus, interantennal space, inner orbit, ocular sinus, a line behind the eyes, pronotum in front, two curved spots and two parallel longitudinal lines

on mesoscutum, a broad outer border to the tegula, a spot on each side of the scutellum, a broad line on the posterior margin of postscutellum, a broad vertical mark on mesopleuron, sides of dorsum of propodeum (with median Maltese cross-shaped black mark), two small lateral spots at the base of the petiole, two about the middle and a subapical band of the same above, two large pyriform spots near the base of second gastral segment, two minute lateral spots on second gastral sternites, subapical interrupted bands on the posterior margins of second and the following segments. Legs black, variegated with yellow. Wings fuscohyaline. Clypeus smooth, pyriform, the apex sharply truncated; frons, vertex and thorax with fine shallow punctures, petiole and gaster smooth. *Male*: Size 19-22 mm. Similar to female in general appearance but slighter, with last abdominal segment entirely black. Depth of yellow markings varies in different individuals.

Material examined: 1 F, ZSI Office, 3.xi.2005, Regd. No. IV/2199/APRC/ZSI; 1 M, ZSI Colony, 18.iii.2006, Regd. No. IV/2210/APRC/ZSI; 2 F, ZSI Colony, 24.iii.2006, Regd. Nos. IV/2211/APRC/ZSI & IV/2212/APRC/ZSI; 1 M, ZSI Colony, 25.viii.2006, Regd. No. IV/2213/APRC/ZSI; 1 M, ZSI Colony, 28.viii.2006, Regd. No. IV/2214/APRC/ZSI; 1 M, ZSI Colony, 15.iii.2008, Regd. No. IV/2215/APRC/ZSI. All the specimens were collected by the first author.

Distribution: *India*: Arunachal Pradesh, Karnataka, Kerala, Meghalaya, Sikkim, Uttarakhand and West Bengal. *Elsewhere*: China, Hong Kong, Indonesia (Bangka, Sumatra, Sunda), Malaysia, Myanmar, Singapore and Thailand (Siam).

7. *Eumenes architectus* Smith, 1858

1858. *Eumenes architectus* Smith, *J. Linn. Soc.*, 3: 20. Female, Male, Syntypes. Type locality. Celebes (BMNH).

2010. *Eumenes architectus* Smith: Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2 (12): 1317, 1318.

Diagnosis: Female: Size 11-12 mm. Black with the following yellow marks: a spot between the antenna, an obscure very short line behind the

eyes at top, a narrow interrupted line on the pronotum, a mark on the postscutellum, a narrow line on the apical margins of the petiole and the segment of the abdomen. Legs black variegated with yellow. Wings fuscohyaline with coppery reflections. Head, thorax and abdomen finely and densely punctured, obscurely pubescent; clypeus convex, apex deeply emarginate.

Material examined: 1 F, ZSI Office, 3.xi.2005, Regd. No. IV/2269/APRC/ZSI; 1 F, ZSI Colony, 2.iv.2007, Regd. No. IV/2270/APRC/ZSI; 1 F, ZSI Colony, 4.iv.2007, Regd. No. IV/2271/APRC/ZSI; 1 F, ZSI Office, 10.iv.2007, Regd. No. IV/2272/APRC/ZSI; 2 F, Police Colony, 11.iii.2008, Regd. Nos. IV/2273/APRC/ZSI & IV/2274/APRC/ZSI; 2 F, Police Colony, 12.iii.2008, Regd. Nos. IV/2275/APRC/ZSI & IV/2276/APRC/ZSI; 4 F, Police Colony, 13.iii.2008, Regd. Nos. IV/2277/APRC/ZSI to IV/2280/APRC/ZSI; 2 F, ZSI Colony, 14.iii.2008, Regd. Nos. IV/2281/APRC/ZSI & IV/2282/APRC/ZSI. All the specimens were collected by the first author.

Distribution: *India*: Arunachal Pradesh, Assam, Meghalaya and Sikkim. *Elsewhere*: Indonesia, Japan, Malaysia, Myanmar, South Korea and Thailand.

8. *Eumenes punctatus* de Saussure, 1852

1852. *Eumenes punctata* de Saussure, *Et. Fam. Vesp.*, *Mon. Guep. Sol.*: 37. Female, Male, Syntypes, Type loc. China (BMNH).

2010. *Eumenes punctatus* de Saussure: Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2 (12): 1318, 1319.

Diagnosis: Female: Size 11-13 mm. Black. The following yellow markings: clypeus, interantennal space, antennal scape at base ventrally, behind the eyes at top, basal margin of pronotum broadly, tegula, postscutellum, a mark on mesopleuron below tegula, propodeum on sides (sometimes reduced or absent), lateral spots on the middle of petiole (sometimes absent), large spot on lateral sides of second gastral tergite, posterior margins of all tergites. Yellow band on the second gastral tergite deeply emarginate at middle; tegula sometimes yellowish brown; legs

yellowish brown except coxa, trochanters and base of femora black, fore femur and fore tibia yellow dorsally. Wings hyaline suffused with brown. Head, thorax and abdomen finely and densely punctured, obscurely pubescent; clypeus convex, deeply emarginate. *Male*: Size 10-11 mm. Similar to female in general appearance.

Material examined: 1 F, ZSI Colony, 4.iv.2007, Regd. No. IV/2283/APRC/ZSI; 1 F, Police Colony, 11.iii.2008, Regd. No. IV/2284/APRC/ZSI; 1 M & 1 F, ZSI Colony, 15.iii.2008, Regd. Nos. IV/2285/APRC/ZSI & IV/2286/APRC/ZSI. All the specimens were collected by the first author.

Distribution: *India*: Arunachal Pradesh, Sikkim and Uttarakhand. *Elsewhere*: Myanmar, Russia and South Korea.

9. *Pareumenes quadrispinosus* (de Saussure, 1855)

1855. *Eumenes quadrispinosus* de Saussure, *Et. fam. vesp.*, 3: 134. Female, Male, Syntypes, Type loc. The East Indies (India) (BMNH).

2010. *Pareumenes quadrispinosus* (de Saussure, 1855): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2(12): 1319.

Diagnosis: *Female*: Size 21-23 mm. Black with the following yellow markings: clypeus, interantennal space extends up to anterior ocellus, ocular sinus, elongated mark on temple, antennal scape ventrally, large area of pronotum except posterior angle, two parallel lines of mesoscutum, two marks on scutellum, a band on postscutellum posteriorly, tegula except a black spot on middle, parategula, a spot at the base of the mesopleuron, a spot above and a large spot below, on each side of propodeum, propodeal valvulae, two spots on apex of petiole above, two linear subapical marks on petiole ventrally, an interrupted band on the posterior half of second abdominal tergite, a broad mark basally on second abdominal sternite, remaining gastral tergites. Legs black variegated with yellow, wings fuscohyaline. Head and thorax sparsely punctured except at side of frons closely punctured; abdomen densely pruinose; clypeus broadly pyriform, convex, the apex sharply incised; propodeum with a broad median

longitudinal furrow with two sharp teeth on each side of it at apex.

Material examined: 1 F, ZSI Colony, 16.iii.2006, Regd. No. IV/2287/APRC/ZSI; 1 F, ZSI Colony, 18.iii.2006. Regd. No. IV/2288/APRC/ZSI; 1 F, ZSI Colony, 9.iv.2007, Regd. No. IV/2289/APRC/ZSI. All the specimens were collected by the first author.

Distribution: *India*: Arunachal Pradesh, Assam, Karnataka, Sikkim, Tamil Nadu, Uttarakhand and West Bengal. *Elsewhere*: Bhutan, China, Hong Kong, Indonesia, Malaysia, Myanmar and Vietnam.

10. *Rhynchium brunneum* (Fabricius, 1793)

1793. *Vespa brunnea* Fabricius, *Ent. Syst.*, 2: 264. Syntype, sex not mentioned. Type Loc. Tranquebariae, India (BMNH).

2010. *Rhynchium brunneum* (Fabricius): Srinivasan and Girish Kumar, *J. Threatened Taxa*, 2(12): 1319, 1320.

Diagnosis: *Female*: Size 17-20 mm. Brownish red with the following black marks: a spot on interantennal space, a vertical line on lower frons, around ocelli, occiput, a large triangular mark on mesoscutum in front, a transverse line along its apex, propleuron, mesopleuron (except brownish red below tegula), metapleuron, propodeum in the middle and lateral sides below, basal two thirds of the first and the basal half of the second abdominal tergite, first and second abdominal sternites, base of third abdominal sternite. Legs brownish red with variegated black markings. The black markings are highly variable. Wings yellowish hyaline, deeper and darker towards base. Clypeus strongly convex, pyriform, the apical third with a broad medial vertical groove, the extreme apex truncate or slightly incised; mesoscutum posteriorly and scutellum impunctate; metanotum somewhat compressed medially.

Material examined: 4 F, ZSI Office, 3.xi.2005, Regd. Nos. IV/2291/APRC/ZSI to IV/2294/APRC/ZSI; 1 F, ZSI Office, 8.iii.2006, Regd. No. IV/2295/APRC/ZSI; 1 F, ZSI Office, 27.x.2007, Regd. No. IV/2296/APRC/ZSI; 1 F, Indira Gandhi Park, 4.iii.2008, Regd. No. IV/2297/APRC/ZSI. All the specimens were collected by the first author.

Distribution: India: Arunachal Pradesh, Delhi, Meghalaya, Sikkim, Uttarakhand and West Bengal. *Elsewhere:* Afghanistan, Indonesia, Iran, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand

Subfamily STENOGASTRINAE

11. *Eustenogaster scitula* (Bingham, 1897)

1897. *Ischnogaster scitula* Bingham. *Fauna Brit. India, Hym.*, 1: 377 (Key), 379, female-“Rangit Valley, Sikkim; Margherita, Assam” (BMNH).

2009. *Eustenogaster scitula* (Bingham): Srinivasan and Girish Kumar, *Rec. zool. Surv. India*, 109 (Part-3): 38, 39.

Diagnosis: Female. Size 16- 20 mm. Body black. Yellow markings as follows: A large mark on clypeus, propodeum with one circular small yellow mark on each side at apex, a line on fore tibia below, an elongated mark on each side of third gastral segment basally. Yellowish brown markings as follows: pronotum with an apical band interrupted in middle and not reaching tegula; a large mark on mesepisternum ventrally. Legs largely and gastral petiole laterally and ventrally with reddish tinct. Wings fusco- hyaline and iridescent. Body covered with silvery pubescence; supraclypeal area reticulate; interantennal space, frons, vertex up to posterior ocelli, pronotum on sides, mesoscutum, scutellum, mesepisternum above dorsal episternal groove and mesepimeron rugoso-reticulate. Vertex behind posterior ocelli with close large and small punctures. Pronotum smooth with moderately close deep punctures; postscutellum, dorsal and ventral metapleuron and propodeum with fine close superficial punctures.

Material examined: 1 F, Doimukh, 29.vi. 2005, Coll. G. Srinivasan, Regd. No. IV/10/APRC/ZSI.

Distribution: India: Arunachal Pradesh, Assam, Meghalaya and Sikkim. *Elsewhere:* Malaysia and Myanmar.

12. *Parischnogaster mellyi* (de Saussure, 1852)

1852. *Ischnogaster mellyi* de Saussure. *Ann. Soc. Ent. France.*, (2) 10: 25, Pl. 2, Fig. 1, Male- “Java” (MHNG).

2009. *Parischnogaster mellyi* (de Saussure): Srinivasan and Girish Kumar, *Rec. zool. Surv. India*, 109 (Part-3): 39, 40.

Diagnosis: Female. Size 10- 11.5 mm. Head black, thorax dark brown. Yellow markings are: mandible (except basal area and teeth reddish), antennal scape below, interrupted band on pronotal collar, broad apical uninterrupted band on pronotum, two oval marks at base and a circular mark at apex of mesoscutum, two circular marks on scutellum, a band on post scutellum at base, two marks on mesepisternum, one on dorsal metapleuron, two circular marks on propodeum at apex, a mark on fore and mid femora apically, a line below fore and mid tibia. Antenna, pronotum, mesopleuron and metapleuron (except the yellow marks), sides of propodeum, legs (except yellow marks) reddish brown. Gaster reddish brown. Yellow portions are: one short line on gastral petiole on sides towards apex, another on the side of petiolate second gastral tergite, two vertical lines on second gastral sternite on sides, third to sixth sternites with large marks on sides. Body narrow covered with fine silvery pubescence. Clypeus with a characteristic pointed tooth apically, basal two- thirds rugoso-reticulate, apical one- third with a few scattered large punctures; supraclypeal area, interantennal space, frons, vertex up to posterior ocelli, mesoscutum, scutellum, mesopleuron almost entirely rugoso- reticulate; inner orbit, ocular sinus almost smooth. Postscutellum with a few punctures in the middle; metapleuron with a few punctures in the middle; metapleuron mat; propodeum with irregular narrow striations and narrow but distinct median groove. Gastral petiole long, strongly swollen towards apex, slightly narrowed again at apex; maximum width of gaster lies at both second and third gastral segment.

Material examined: 2 F, ZSI Office, 20.ii.2005, Coll. G. Srinivasan, Regd. Nos. IV/12/APRC/ZSI & IV/13/APRC/ZSI.

Distribution: India: Arunachal Pradesh, Assam, Meghalaya and Sikkim. *Elsewhere:* Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

Subfamily VESPINAE

13. *Vespa soror* du Buysson, 1905

1905. *Vespa ducalis* var. *soror* du Buysson, *Ann. Soc. Ent. France*, **73**: 490 (key), 519.

2010. *Vespa soror* du Buysson: Girish Kumar and Srinivasan, *Rec. zool. Surv. India*, **110** (2): 63.

Diagnosis: *Sterile female:* Size: 23- 29 mm. Head, scutellum, postscutellum, two large marks on propodeum, area around propodeal spiracle and often anterior border of pronotum yellow or brownish yellow; area around ocelli black; first and second gastral tergites yellow with reddish brown stripe in the middle; third and sixth gastral tergites wholly black. Head strongly widened and produced behind the eyes; temple in profile more than 1.8x as wide as eye; posterior ocelli 3x farther from occiput than from eye; clypeus coarsely punctate; clypeus strongly emarginate apically, lateral lobes largely and broadly rounded.

Material examined: 1 F, ZSI Colony, 26.xi.2004, Regd. No. IV/1/APRC/ZSI; 1 F, ZSI Colony, 6.x.2005, Regd. No. IV/2/APRC/ZSI; 1 F, Ganga lakeside, 23.xi.2007, Reg. No. IV/4/APRC/ZSI; 1 F, Ganga lakeside, 24.ii.2008, Regd. No. IV/5/APRC/ZSI. All the specimens were collected by the first author.

Distribution: India: Arunachal Pradesh and Meghalaya. *Elsewhere:* China, Laos, Myanmar, Thailand and Vietnam.

14. *Vespa tropica* (Linnaeus, 1758)

1758. *Sphex tropica* Linnaeus, *Syst. Nat.*, ed. 10, 1-517.

2010. *Vespa tropica* (Linnaeus): Girish Kumar and Srinivasan, *Rec. zool. Surv. India*, **110** (2): 63, 64, 65.

Diagnosis: *Sterile female:* Size: 19- 30 mm. Head and thorax black. Body rather large and thick, covered with strong and stiff hairs; clypeus coarsely punctate, apical margin hairy; clypeus apically with a broad emargination, its apicolateral angle triangular; lower vertical area of pronotum with strong transverse ridges near pronotal pit; second gastral tergite yellow with a slight brown area basally.

Material examined: 1 F, ZSI Colony, 2.xi.2004, Regd. No. IV/14/APRC/ZSI; 3 F, ZSI Complex, 6.x.2005, Regd. Nos. IV/15/APRC/ZSI to

IV/15/APRC/ZSI; 3 F, ZSI Colony, 6-10.x.2008, Regd. Nos. IV/19/APRC/ZSI to IV/19/APRC/ZSI. All the specimens were collected by the first author.

Distribution: India: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Pondicherry, Sikkim, Tamil Nadu, Uttarakhand and West Bengal. *Elsewhere:* Afghanistan, Bhutan, Cambodia, China, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Thailand and Vietnam.

15. *Vespa affinis* (Linnaeus, 1764)

1764. *Apis affinis* Linnaeus, *Mus. Ludov. Ulricae*: 417.

2010. *Vespa affinis* (Linnaeus): Girish Kumar and Srinivasan, *Rec. zool. Surv. India*, **110** (2): 65, 66, 67.

Diagnosis: *Sterile female:* Size: 16- 23 mm. Body slender and moderate in size; apical margin of clypeus less hairy and with short broadly rounded lobes on each side of the median emargination; punctures on vertex, temple, mesoscutum, scutellum, postscutellum, metapleuron and propodeum small and crowded; second gastral tergum largely or entirely orange yellow; body hairs fine, shorter and comparatively dense.

Material examined: 7 F, ZSI Colony, 6.x.2005, Coll. G. Srinivasan, Regd. Nos. IV/22/APRC/ZSI to IV/28/APRC/ZSI.

Distribution: India: Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal. *Elsewhere:* China, Indonesia, Japan (in Ryukyu Island), Laos, Malaysia, Myanmar, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam and New Zealand.

16. *Vespa basalis* Smith, 1852

1852. *Vespa basalis* Smith, *Trans. Ent. Soc. Lond.*, **2** (2): 46.

2010. *Vespa basalis* Smith: Girish Kumar and Srinivasan, *Rec. zool. Surv. India*, **110** (2): 69, 70.

Diagnosis: Sterile female: Size: 15-21mm. Head and antenna orange to reddish brown; mandible concolorous with head except at apex including teeth and baso-lateral corner black; thorax black with following reddish brown patches: a long band on pronotal collar, pronotum almost entirely, a large spot on mesoscutum postero-medially, scutellum, postscutellum, tegula and mesepimeron anteriorly; legs predominantly reddish brown with black areas on coxa, trochanter and femur of all legs; gaster black except a narrow reddish brown stripe at the apex of first gastral tergum; posterior ocelli 0.77x farther from occiput than from eye; clypeus almost impunctate; vertex depressed medially, depression more strong in fertile females; ovipositor sheath strongly curved; body hairs rather long and dense, yellowish brown in colour.

Material examined: 3 F, Ganga Lakeside, 28.ii.2008, Coll. G. Srinivasan, Regd. Nos. IV/29/APRC/ZSI to IV/31/APRC/ZSI.

Distribution: India: Arunachal Pradesh, Assam, Himachal Pradesh, Meghalaya, Mizoram, Odisha, Sikkim, Uttarakhand, Uttar Pradesh and West Bengal. *Elsewhere:* China, Indonesia, Laos, Myanmar, Nepal, Pakistan, Taiwan, Thailand and Vietnam.

17. *Vespa bicolor* Fabricius, 1787

1787. *Vespa bicolor* Fabricius, *Mant. Ins.*, 1: 288.

2010. *Vespa bicolor* Fabricius: Girish Kumar and Srinivasan, *Rec. zool. Surv. India*, **110**(2): 70, 71.

Diagnosis: Sterile female: Size: 15-19 mm. Body sulphur yellow; Black colour as follows: apex of mandible including teeth, head dorsally including antennal scrobe and lateral margins of clypeus, mesoscutum entirely, a mark below

tegula, a median line on scutellum, margins of postscutellum, a Y-shaped mark at junction of postscutellum and propodeum, mesopleuron ventrally near to fore coxa, line between mesopleuron and metapleuron and base of first tergite. Antenna black dorsally; brownish bands on first gastral tergum subapically and base of second tergum widely; legs yellow; wings flavohyaline, darker along costal margin of fore wing; clypeus almost impunctate; body dorsally covered with fine, rather stiff erect blackish hairs.

Material examined: 1F, Ganga Lakeside, 3.xi.1981, Coll. S. K. Gupta & Party, NZSI Regd. No. 11241/H3; 1 F, Konkon Nallah, Nahar Lagun, 11.ix.2003, Coll. N. Tahar, NZSI Regd. No. 11252/H3.

Distribution: India: Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, Uttarakhand and West Bengal. *Elsewhere:* Bhutan, Cambodia, China, Laos, Myanmar, Nepal, Thailand and Vietnam.

SUMMARY

Seventeen species of Vespidae were identified and reported from Itanagar Wildlife Sanctuary, Arunachal Pradesh, India.

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Fig. 1 : *Delta companiforme gracilior* (Giordani Soika, 1986).



Fig. 2 : *Delta conoideum* (Gmelin, 1790),



Fig. 3 : *Delta dimidiatipenne* (de Saussure, 1852)



Fig. 4 : *Delta esuriens* (Fabricius, 1787)



Fig. 5 : *Delta pyriforme pyriforme* (Fabricius, 1775)



Fig. 6 : *Eumenes architectus* Smith, 1858



Fig. 7 : *Eumenes punctatus* de Saussure, 1852



Fig. 8 : *Eustenogaster scitula* (Bingham, 1897)

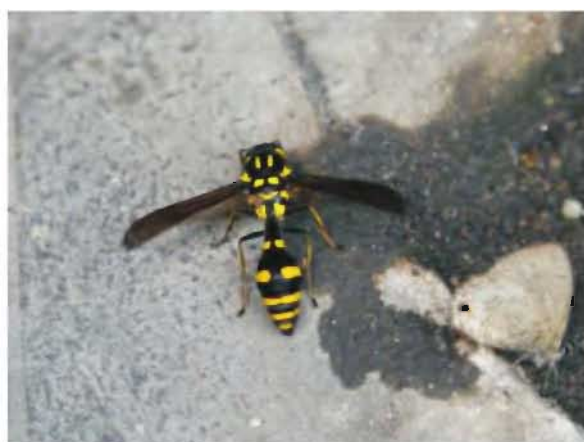


Fig. 9 : *Pareumenes quadrispinosus* (de Saussure, 1855)



Fig. 10 : *Parischnogaster mellyi* (de Saussure, 1852)



Fig. 11 : *Phimenes flavopictum continentale*
(Zimmermann, 1931)



Fig. 12 : *Rhynchium brunneum* (Fabricius, 1793)



Fig. 13 : *Vespa affinis* (Linnaeus, 1764)



Fig. 14 : *Vespa basalis* Smith, 1852



Fig. 15 : *Vespa bicolor* Fabricius, 1787



Fig. 16 : *Vespa soror* du Buysson, 1905



Fig. 17 : *Vespa tropica* (Linnaeus, 1758)



**NEW RECORDS OF TWO REEF FISHES *GYMNOTHORAX*
RETICULARIS, BLOCH, 1795 (FAMILY: MURAENIDAE)
AND *SCARUS GHOBBAN*, FORSSKAL, 1775
(FAMILY: SCARIDAE) FROM WEST BENGAL COAST, INDIA**

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INTRODUCTION

There are numerous studies carried out so far on Ichthyofaunal diversity of West Bengal (Manna and Goswami, 1985; Goswami, 1992; Talwar *et al.*, 1992; Chatterjee *et al.*, 2000; Das *et al.*, 2007, Yennawar *et al.*, 2011) which did not report the occurrence of Indo-Pacific Banded Eel *Gymnothorax reticularis*, Bloch, 1795; family Muraenidae and Blue-Barred Parrotfish *Scarus ghobban*, Forsskal, 1775 of family Scaridae recently collected from West Bengal coastal waters.

The fish diversity of West Bengal was recently encountered by Talwar *et al.*, (1992) reports the 7 species, Goswami (1992) reports one species, Chatterjee *et al.*, (2000) 3 species, Das *et al.*, (2007) reports the 11 species and Yennawar *et al.*, (2011), 2 species of family Muraenidae from the West Bengal coastal water. The Parrot fishes, family Scaridae represented by 2 subfamilies, 10 genera and 95 species throughout the world (Froese & Pauly, 2011 & Nelson, 2006), there are 18 species and 6 genera belonging to 2 subfamilies known to occur in Indian coastal water (Barman and Misra, 2005).

The present paper reports new distribution record of *G. reticularis*, Bloch; 1795 and *S. ghobban*; Forsskal, 1775 in the coastal waters of West Bengal

and compares the distinguishing features with other matching species of family whereas the family Scaridae was reported for first time from the coastal water of West Bengal.

MATERIALS AND METHODS

2 examples of *Gymnothorax reticularis* and 2 examples of *Scarus ghobban* are collected from locality Digha Mohana (21°37.843'N and 87°32.827'E). Both the specimens were caught in trawler operated by local fisherman during their regular fish catching. One example of *G. reticularis* was displayed in the Marine Museum of Marine Aquarium and Regional Centre, Zoological Survey of India, Digha and Reg. no. ZSI/MARC F1586, date of collection 29.11.2010. Other example was displayed at the Museum of Experimental Prawn Hatchery, Department of Fisheries, W. B. Digha, Regd no. ZSI/MARC F1970 collected on May 2010. Counts of the bars and measurements were followed as Smith & Bohlke (1997). Proportional measurements were given in total length (TL) and head length (HL). The measurements of total length (mm), distance from snout to anus, head length, depth at anus, snout length, eye diameter, and distance from snout to rectus of mouth were carried out. Vertebral counts were calculated by manually counting vertebrae from X-Ray film and recording the number of vertebrae anterior to the

origin of the dorsal fin, the number of vertebrae anterior to the origin of the anal fin and the total number of vertebrae as described by Smith & Böhlke (1997).

Both the examples of *S. ghobban* are collected during June 2011 and deposited in the collection of Marine Museum of Marine Aquarium and Regional Centre, Zoological Survey of India, Digha, and Reg. No: F1850 & F1892. All external morphological measurements are given in Table.1 and Table.2 respectively. All the measurements are done by Dial caliper in millimeter scale and photograph are taken Nikon D90 SLR camera.

1. Indo-Pacific Banded Eel *Gymnothorax reticularis*, Bloch, 1795

SYSTEMATICS ACCOUNTS

Class: ACTINOPTERYGII

Sub Class: NEOPTERYGII

Division: TELEOSTEI

Sub Division: ELOPOMORPHA

Order: ANGUILLIFORMES

Family: MURAENIDAE

Sub-Family: MURAENINAE

Genus: *Gymnothorax* Bloch 1795

Gymnothorax reticularis Bloch 1795

Synonyms

1877. *Muraena reticularis* Day, *Fishes of India*: vol. 1. p. 669.

1916. *Muraena (Priodonophis) reticularis* Weber & Beaufort, *The fishes of Indo-Australian Archipelago*, vol III, p. 387-389.

1984. *Gymnothorax reticularis* Talwar, & Kacker, *Commercial Sea Fishes of India*: p. 221-222.

Diagnostic Characters : 15 - 18 bars, total vertebrae 115-119. Dorsal fin starts before the gill opening from head. Colour pattern of this species very distinct which was quite different from other species in the group. The brown spots on the head and chin tend to be drawn out longitudinally, separated by narrow pale interspaces gave an appearance of horizontal lines, which forms the reticulated structure especially on the branchial region. The spotting on the body is sharply

restricted to the dorsal half of the body, and the spots continuous, i.e. pale on the dark bars and dark on the interspaces. Body behind the gill opening with 15-18 bars, continuous across dorsal and ventral midlines, pigmentation more prominent in the dorsal region specially in margins of fins. Body had distinct bars due to the small white spots appears in regular interval forming the dorsal bands.

Distribution : In India, it is reported from Coromandal coast (Smith & Böhlke, 1997), Visakhapatnam (Krishnan & Mishra, 1993), Andhra Pradesh (Barman *et al.*, 2004), Tamilnadu (Nagabhushanam & Krishnan, 1993), Puducherry and Karaikal (Mishra & Krishnan, 2003) and present specimen was from Digha Mohana, West Bengal, so its distribution over the entire east coast of India. Elsewhere, Red Sea, Gulf of Aqaba (Smith & Böhlke, 1997), Indonesia (Allen & Erdmann, 2009), South China Sea, Hong kong (Ni & Kowk, 1999) and Indo-Pacific.

2. Blue-Barred Parrotfish *Scarus ghobban*, Forsskal, 1775

Order: PERCIFORMES

Family: SCARIDAE

Sub-Family: SCARINAE

Genus: *Scarus* Forsskal, 1775

Scarus ghobban Forsskal, 1775

Synonyms

1877. *Pseudoscarus ghobban* Day, *Fishes of India*: Vol.1, p. 412.

1984. *Scarus ghobban* Talwar & Kacker, *Commercial Sea Fishes of India*: p. 759.

Diagnostic Character : Meristic Formula: D: IX, 10; A: III, 9; P: 14; V: I, 5; LL: 24; GR: 45 (28+17).

Diagnosis: Median pre-dorsal scale 6 (4th scale largest), three rows of scale on cheek and upper row with 6-7 scales, more than half of dental plate cover by lips. Posterior nostril larger than anterior nostril, caudal fin truncate with lobes. Dorsal fin sub-equal and flexible, rays slightly longer than spines. Spines of first anal fin were minute, third

Table 1: Morphometric characters of *Gymnothorax reticularis*.

S.No.	Character	Measurement
1	Total length (TL) (mm)	288-304
2	Snout-anus (%TL)	2.00-2.06
3	Head length (HL) (%TL)	5.62-6.13
4	Depth at anus (mm)	22-24
5	Eye (%HL)	7.23-9.33
6	Snout-eye (%HL)	6.71-7
7	Predorsal vertebrae	5-6
8	Preanal vertebrae	48-49
9	Total vertebrae	115-119

Table 2: Comparison of morphometric characteristics of the Blue-Barred Parrotfish *Scarus ghobban*.

Character	Initial phase	Terminal phase
Total Length (TL)	299 mm	516 mm
Standard Length (SL)	248 mm	450 mm
Head Length (HL)	80 mm	134 mm
Caudal fin length	51 mm	66 mm
Dorsal fin base length	114 mm	215 mm
Anal fin base length	57 mm	98 mm
Pectoral fin length	55 mm	88 mm
Ventral fin Length	43 mm	66 mm
Eye diameter (ED)	12mm	19 mm
Inter orbital space (IOS)	37 mm	62 mm
Body Depth(BD)	84 mm	153 mm
Snout Length (Sn)	31 mm	51 mm
TL/HL	3.73	3.85
SL/HL	3.1	3.35
TL/BD	3.51	3.51
SL/BD	2.94	2.95
HL/ED	6.95	7.05
HL/IOS	2.16	2.16
HL/Sn	2.58	2.68

longest, rays longer than third spine. The morphometric measurements of two different phases are given in Table 2. Among the two examples, one example was observed in Initial Phase (IP) (Fig. 2a) and another was in Terminal Phase (TP) (Fig. 2b). The differentiation of two phases were observed with 2 canines on upper dental plate and slightly emarginated caudal fin in IP which became lunate in the TP males.

Colouration pattern: Initial Phase: Body and median fin light gray overall; Scales on body bluish, white or pale red on thorax; 5 diffuse blue bands on dorsum not extending to ventral mid-line; head yellow to orange; broad blue bar across snout and chin with irregular blue spots on throat; blue line from mouth to orbit; dental plates white; usually 2 pale streaks on abdomen extending from base of pectoral to origin of anal fin; median fins blue basally, orange centrally with blue outer margins; caudal orange-yellow with broad blue upper and lower margins; pectoral pale yellow with upper margin blue; pelvic fins yellow-white with blue anterior margin.

Terminal phase: Head and body green dorsally; each scale narrowly edged with salmon pink or orange; green becoming progressively reduced ventrally; cheek and operculum pale orange; chin throat and isthmus blue-green; upper lip orange with green band on snout; lower lip orange followed by green bar; chin with irregular series of green bars; green markings from mouth to orbit, and surrounding orbit as in blue markings of IP, interspaces between postorbital bars pink; median fins orange to pink with broad blue-green distal margin and green base; caudal fin green with band of salmon pink in each lobe; pectoral fins blue-green with broad orange to pink streak extending from midbase to tips of longest rays; dark spot at upper pectoral base; pelvic fins salmon pink with broad blue anterior margin; dental plates pinkish, white at edges.

Distribution : From Indian waters this species was reported from Andaman and Nicobar Island (Rao, 2003 & Rao *et al.*, 2000), Andhra Pradesh (Barman *et al.*, 2004), Tamil Nadu (Krishnan *et al.*,

2007), Gulf of Mannar (Varghese *et al.*, 2011), Laccadives (Murty, 2002). Elsewhere, Indo-Pacific: Red sea and Algoa Bay, South Africa to Rapa and Ducie Island, north to southern Japan, south to Perth, New South Wales and India (Rajan, 2010).

DISCUSSION AND CONCLUSION :

The present species was *G. reticularis* Bloch, 1795, which was so long been always confused with another similar species, *G. minor* (Temmick and Schlegel, 1846). There are other five species which are similar with the *G. reticularis* in color pattern in which dark bands on a pale back ground and teeth are finely serrated. These five species are *G. annulatus* (Smith and Bolhke, 1997), *G. chlamydatus* (Snyder, 1908), *G. mccoskeri*, *G. punctatofasciatus* (Bleeker, 1863), *G. randalli* (Smith and Bolhke, 1997), *G. enigmaticus* (McCosker & Randall, 1982). From the literature study it is observed that, *G. reticularis* is very similar and confused with the *G. minor* from the Western Pacific and Australia, but it is different in color pattern and vertebral count. *G. minor* have the vertebral count of 129-143 whereas *G. reticularis* have 114-126 (Smith & Böhlke, 1997).

In case of *S. ghobban*, the color pattern varies between different growth stages and sexes. The initial phase, IP, includes the female and primary male; the terminal phase, TP, represents secondary males after a sex change. Most scarids are protogynous hermaphrodites and undergo a complex series of colour pattern changes associated with their sexual ontogeny. There are

typically three distinct colour phases: the juvenile phase, initial phase (IP) and terminal phase (TP).

As a result, scarids are a major bioeroding agent on coral reefs. It has been estimated that up to 9 kg/m²/yr may be removed by scarid grazing on the Great Barrier Reef (Kiene, 1988). There have been several reports of scarids feeding on live corals (Hiatt & Strasburg, 1960; Glynn *et al.*, 1972; Frydl, 1979). The close observation of the present species also shows that the species was equipped with strong dental plates and capable scrapers of reef.

The recent studies along the Digha coast of West Bengal reported few more coral reef inhabitant fishes. These species are reported first time in Digha waters and are significant records of the area since there is no reef in the vicinity. The presence of this species along with few other reef dwellers focus on the need of further studies on their behavioral patterns and proximity of reefs in the nearby area.

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Fig. 1a: *Gymnothorax reticularis* (Bloch, 1795)



Fig. 1b: Reticulated head of *Gymnothorax reticularis* (Bloch, 1795).



Fig. 2a : Initial Phase: Blue-barred parrotfish, *Scarus ghobban* Forsskal, 1775



Fig. 2b : Terminal Phase: Blue-barred parrotfish, *Scarus ghobban* Forsskal, 1775



NEW RECORD OF A GENUS AND FOUR SPECIES OF FAMILY ARCTIIDAE (INSECTA : LEPIDOPTERA) FROM INDIA

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INTRODUCTION

Arctiidae is a major Noctuid family of order Lepidoptera with estimated number of 10,945 species from the Globe (Heppner 1991) including more than 500 from India (Kirti & Gill 2010). Members of this family tend to be small to medium size with aposematic colours. The meta thoracic tymbal organ, a pre-spiracular counter tympanal hood and a pair of pheromonal glands between the ovipositor lobes are the main apomorphic characters of family Arctiidae. Family Arctiidae is of great economic importance as some of its larvae like Red hairy caterpillar, Bihar hairy caterpillar, Woolly bear caterpillar, Sun hemp hairy caterpillar have a massive economic impact with wide host range and cosmopolitan distribution. Besides this, many of the other Arctiid species are also known to be serious pests of agricultural crops and forest trees. The larvae of some Arctiid species cause irritation to the sensitive skin and responsible for different type of allergies. Therefore, knowledge about the new records and distributional limits of such a group of insects with high economic impact is of utmost importance. In this regard, Kirti and Gill (2008) reported a Sulawesi Arctiid genus *Satara* Walker for the first time from India. Again in 2010, through different publications, Kirti and Gill reported three Arctiid species i.e., *Spilarctia castanea* (Hampson), *Lyclene rosalia* (Hampson) and *L. semifascia* (Walker) for the first time from India. The present communication deals with new

records of some more taxa of family Arctiidae from India.

MATERIALS AND METHODS

The present observations are based on the Arctiid collections made from more than 90 localities of this bio-diverse country. The Arctiid moths were exclusively collected with the help of fluorescent lights at night hours and were killed with the ethyl acetate vapors in the killing bottles. The collected specimens were processed using standard techniques in lepidopterology. The identification was done with the help of relevant literature. For authentication, the collected species were also compared with the identified collections lying in the entomology section of Indian Agricultural Research Institute, New Delhi and Natural History Museum, London. In this research paper, old distribution and taxonomic note has been given for the newly recorded genus whereas, old distribution, material examined and taxonomic notes have been provided for each of the newly reported species.

OBSERVATIONS

I. New record of genus from India

Pareuchaetes Grote

1865 Grote, *Proc. ent. Soc. Phila.*, 5: 245.

Type species : *Pareuchaetes cadaverosa* Grote

Old Distribution : Sri Lanka, Borneo, Guam, Thailand Palawan Nearctic and Neotropical region.

Taxonomic note: Genus *Pareuchaetes* was erected by Grote in 1865 on the type species *P. cadaverosa* Grote (= *insulata* Walker) from Caribbean. Hampson (1901), synonymised it under genus *Ammalo* Walker. Whereas, Rego Barros (1956) recognised *Pareuchaetes* Grote as a distinct genus. The genus can easily be identified from unmarked, dull and usually pale yellow wings. Other apomorphic characters of genus *Pareuchaetes* Grote are: fore wing with vein R_{2+5} stalked, hind tibia with two pair of tibial spurs and male genitalia with a pair of supra-uncal processes arising dorsally from the junction of uncus and tegumen (Rego Barros, 1956; Cock and Holloway, 1982). During the collection surveys the genus was reported from Tamil Nadu and Kerala states of India which is its first time report from this country.

II. New records of species from India

Pareuchaetes pseudoinsulata Rego Barros

1956, *Pareuchaetes pseudoinsulata* Rego Barros, Revta Brass. Ent. 6:79

Old distribution: Venezuela, Trinidad, Sri Lanka, Borneo, Palawan and Guam.

Material examined : Tamil Nadu : Gudalur (900 m), 23.iv.03 – 1 m, 28.ix.03 – 1 m; Coonoor (1880 m), 8.iv.03 – 1 m.

Kerala : Vadasserikkara (30 m), 7.ix.04 – 4 m; Agali (520 m), 6.x.03– 1m; Vithura (120 m), 5.ix.04 – 1 m, 4.ix.04 – 2 m; Vallakadava (780 m), 9.ix.04 – 3 m, 10.ix.04 – 1m, 11.ix.04– 10 m 3f; Chendruni (70 ms.), 3.ix.04 – 2 m 1 f, Prambiculum (580 mtrs), 17.ix.04 – 1m; Rani (40 m), 8.ix.04– 1 m.

Taxonomic note: The species under reference can be identified from the general ground colour pale yellow, thorax and tegula laden with buff scales, fore tibia and tarsus fuscous, hind legs buff, abdomen with dorsal series of black spots and under side of second abdominal segment with a patch of white colour. *Pareuchaetes pseudoinsulata* Rego Barros is reported to be a potential biological control agent of *Chromolaena odorata*, a serious weed in South Asia. The taxonomic and ecological details of the species were discussed by Cock and Holloway in 1982.

Olepa duboisi Orhant

Olepa duboisi Orhant, 1986, Bull Sciences Nat, 50:11.

Old distribution: Sri Lanka.

Material examined : Kerala : Agali (520 mtrs.), 6.x.03 – 1m.

Taxonomic note: The present species can be identified from pale brown fore wings and reddish white hind wings. Male genitalia bears digitiform cucullus, V- shape vinculum with a small outgrowth at proximal end and single spine carina penis. The wing span of *duboisi* Orhant is 32 mm. The species under reference was described and illustrated in detail by Orhant (1986).

Macotasa orientalis (Hampson)

1905, *Phaeosia orientalis* Hampson, Ann. Mag. Nat. Hist., 15(7):433

Old distribution: Myanmar, Malaysia and Borneo.

Material examined : Karnataka : Bhagamandala (900 m.), 25.xi.03 – 3 m, 26.xi.03 – 1 f; Kulagi (420 m.), 16.vii.04 – 1 f.

Taxonomic note: The members of *Macotasa orientalis* (Hampson) shows sexual dimorphism. In males, fore wings are ochreous with costal and marginal area bright. A medial quadrate patch is present on costa along with modified scales in cell of fore wing. Whereas, in females, forewings are of uniform orange colour with a medial series of five black spots.

Poliosia binotata (Hampson)

1893, *Prabhasa binotata* Hampson, Ill. Lep. Het., 9:81.

Old distribution : Sri Lanka.

Material examined : Karnataka : Kulagi (420 mtrs), 24.x.09 – 1 m.

Taxonomic note: *Poliosia binotata* (Hampson) can be separated from the other species of its genus with the help of grey brown fore wings with irroration of fuscous. Black points in end of cell and below end of cell in sub median interspace. Hind wing pale fuscous.



Macotasa orientalis (Hampson) (Male)



Olepa duboisi Orhant.



Pareuchaetes pseudoinsulata Rego Barros



Poliosia binotata (Hampson)

SUMMARY

The present observations are based on the collections made during the DST funded research projects on taxonomic revision of Indian Arctiidae. A total number of more than 300 species of Indian Arctiidae were studied, out of which one genus *Pareuchaetes* Grote and four species *Pareuchaetes pseudoinsulata* Rego Barros, *Olepa duboisi* Orhant, *Macotasa orientalis* (Hampson) and *Poliosia binotata* (Hampson) have been reported for the first time from India.

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REDESCRIPTION OF *BARDESANES SIGNATUS* DISTANT (HEMIPTERA : REDUVIIDAE) FIRST RECORD FROM INDIA

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INTRODUCTION

Bardesanes signatus Distant (1909) belonging to subfamily Stenopodainae is characterized by elongate, dull-colored; with, often pentagonal or hexagonal, large cells formed on corium by cubital and post-cubital veins. Antenniferous tubercles sometimes strongly produced anteriorly; first antennal segment elongate, rather strongly developed, remaining segments more slender and in repose folded back against first; ocelli present; legs long, slender; hemelytral development variable, males macropterous, females often with more reduced forewings.

The subfamily Stenopodainae follows the Ectrichodiinae with 39 species under 14 genera. As observed for the Reduviinae and the Peiratinae, a single genus *Oncocephalus* holds the major constituent with 19 species. The genus *Canthesancus* has three species and the following five genera, viz., *Aulacogenia*, *Pygolampis*, *Sastrapada*, *Staccia* and *Thodelmus* have two species each. The remaining seven genera, viz., *Bardesanes*, *Caunus*, *Hemisastrapada*, *Kumaonocoris*, *Neoklugia*, *Neothodelmus* and *Streptophorocoris* are represented by one species each (Ambrose, 2006a). Livingstone & Ravichandran (1988b) erected new genus *Hemisastrapada*. Barber (1930) revised the new world fauna and Giacchi (1984)

has subsequently added considerably to our knowledge of diversity of the group in South America.

Earlier work on genus *Bardesanes* Distant, 1909 was done by Distant, 1910. He reported *Bardesanes signatus*, Distant 1909 from Myanmar. This species was also reported by Ambrose, 2006b & Biswas and Mitra, 2011.

MATERIALS AND METHODS

While studying the collection of Hemiptera from Central India, an interesting species identified as *Bardesanes signatus* Distant was collected from Chhindwara district in Madhya Pradesh, India. Photography and morphology of bug was studied by Leica microscope M 205-A. The species was identified with the help of 'Fauna of British India, vol. V, by Distant (1909) and deposited in National Zoological Collection of Zoological Survey of India, Kolkata.

RESULTS AND DISCUSSIONS

Bardesanes signatus Distant 1909

1909. *Bardesanes signatus* Distant, *The fauna of British India including Ceylon and Burma. Rhynchota*, V: 185-188.

Material examined: 1ex., Madhya Pradesh, Chhindwara, Pench Tiger Reserve, Totladoh, 11.ix.01, coll. S.K. Mishra & Party.

REDESCRIPTION

The species *Bardesanes signatus* was described by Distant (1909) without any illustrations, required for the accurate determination of species and hence the redescription of the species along with detailed measurements, illustrations and additional diagnostic features based on observations are provided.

Colour: Body fuscous in colour, apical area of abdomen beneath black, anterior tibia brown, corium longitudinally castaneous brown between the veins and with a pale creamy patch before the membrane.

MEASUREMENTS

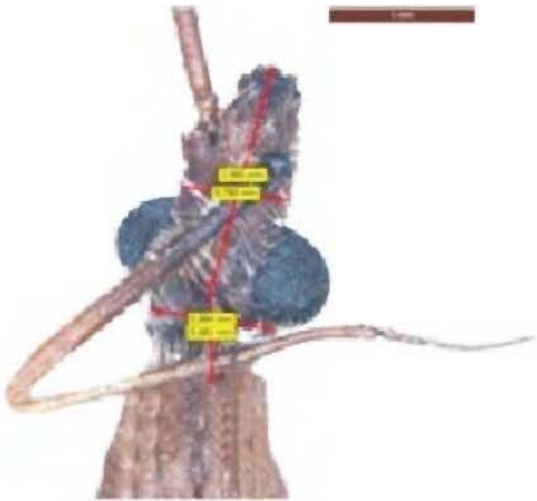
BODY: Total length from head to abdomen 10.75 ± 0.05 mm, head to membrane 10.85 ± 0.06 mm (Fig. A); **EYES:** length 0.432 mm, width 0.270 mm, black in colour; **HEAD:** length 1.201 mm, length of anterior ocular region 0.846 mm; length of post ocular region 0.335 mm, width of anterior lobe of head 0.472 mm, width of posterior lobe of head 0.649 mm. Head sub oval, narrow in front of eyes than behind (Fig. B); **ANTENNAE:** First joint 6.614 mm, second joint 5.153 mm. 1st joint of antennae about as long as the intermediate femora and longer than second joint. **ROSTRUM:** Total length 0.802 ± 0.03 mm, First joint 0.425 mm, second joint 0.397 mm, third joint 0.380 mm. Rostrum with the first joint reaching middle of anteocular portion of head, second joint sub equal to first, third slightly shorter than second (Fig. C). **LEGS- FORE LEG:** length (excluding tarsi) 6.869 ± 0.05 mm, length of Coxa 1.626 mm, length trochanter 0.398 mm, femur length 2.967 mm, tibia length 1.878 mm, tarsus length 1.007 mm, length of 1st, 2nd and 3rd tarsal joints are 0.172 mm, 0.156 mm and 0.071

mm respectively; Claw 0.071 mm in length; anterior femora moderately incrassated and finely spinous beneath, anterior tibia and tarsi united, about as long as femora, tarsi 3-jointed (Fig. F). **MID LEG:** Total length (excluding tarsi) 18.137 ± 0.05 mm, Length of Coxa 0.582 mm, Length of trochanter 0.475 mm, femur length 7.493 mm, tibia length 9.587 mm. Femora annulated with creamy white at apices. **HIND LEG:** Total length (excluding tarsi) 25.697 ± 0.05 mm, Length of Coxa 0.649 mm, Length of Trochanter 0.351 mm, Femur length 10.024 mm, Tibia length 14.673 mm, Length of 1st, 2nd and 3rd tarsal joints are 0.064 mm, 0.113 mm and 0.160 mm respectively. Posterior femora as long as entire body. Femora annulated with creamy white at apices. **PRONOTUM:** Length of anterior lobe of pronotum 1.332 mm, width of anterior lobe of pronotum 0.887 mm, length of posterior lobe of pronotum 1.334 mm, width of posterior lobe of pronotum 1.305 mm. Pronotum more than twice as long as head, the anterior lobe constricted, which is gibbous with a central longitudinal narrow ridge and with a nodule near each posterior angle, its basal margin sinuate, anterior margin black. **HEMELYTRON:** Length 7.102 mm, width 1.600 mm, Hemelytra passing abdominal apex, exterior cell of membrane longer than interior cell (Fig.D). **CORIUM:** Corium longitudinally castaneous brown between the veins and with a pale creamy patch before the membrane, the later with a central pale vein; corium transversely striate in each lateral area, membrane brown in colour. **ABDOMEN:** Length 5.427 mm, apical area of abdomen beneath black. **SCUTELLUM:** Length 0.298 mm, Width 0.282 mm, Scutellum black triangular (Fig. E). **CONNEXIVUM:** Length 6.806 mm, Width 1.830 mm.

	Genus <i>Bardesanes</i>	Genus <i>Caunus</i>
1.	Anterior femora spined.	Anterior femora unarmed.
2.	1 st joint of rostrum little longer than second joint.	1 st joint of rostrum subequal to 2 nd joint.
3.	1 st and 2 nd joint of antennae subequal.	2 nd joint of antennae longer than 1 st .
4.	Apical spine of scutellum moderately curved upwards	Apical spine obliquely erect



A. Dorsal view of *Bardesanes signatus* Distant



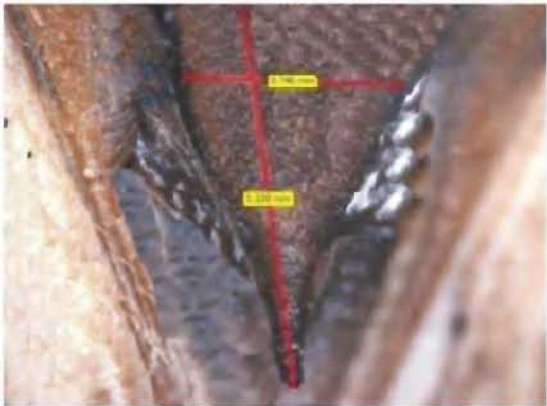
B. Head



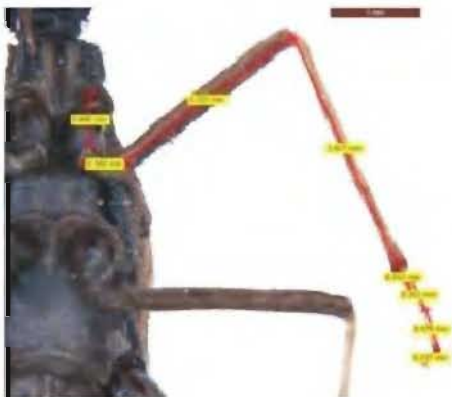
C. Rostrum



D. Hemelytra



E. Scutellum



F. Ventral view of left fore leg

The genus *Bardesanes* is alike to the genus *Caunus*, which may be differentiated with the following characters as mentioned in the table.

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The authors are thankful to Dr. K. Venkataraman, Director, Zoological Survey of India for providing necessary facilities and encouragement.

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FIRST REPORT ON THE OCCURRENCE OF FOUR FISHES OF FAMILY : NEMIPTERIDAE FROM DIGHA ON THE EAST COAST OF INDIA

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INTRODUCTION

Fishes from family Nemipteridae are of the major component of fishery along Indian coast which consists of 24 species from 3 genera in India out of 64 species from 5 genera throughout the world (Barman and Mishra, 2009; Fishbase, 2010). These snapper-shaped fishes inhabitant of shallow coastal waters of the Indo-west Pacific region have considerable importance because of its edible value. Despite of its fishery importance, occurrences of this family is list reported throughout northern east coast of India. Digha being one of the major marine fish landing station of the state West Bengal as well as the East coast of India, several efforts were made regarding incidences of ichthyofauna of region (Manna and Goswami, 1985; Goswami, 1992). The latest updated list of the fish fauna of Digha coast was published by Chatterjee *et al.* (2000). Review of all previous works revealed report of only 3 species of family Nemipteridae in Digha waters. During the local surveys for ornamental faunal studies in the Centre, four more fish species of the family Nemipteridae was collected. Careful observations of distinguishing features of these species show that these species were not reported from the coast previously. The species identified are *Nemipterus nematophorus* (Bleeker, 1853), *Nemipterus randalli* Russel, 1986, *Parascolopsis aspinosa* (Rao and Rao, 1981) and *Scolopsis vosmeri* (Bloch, 1792). The paper describes the detailed characteristics of all the four

species which are recorded for the first time from Digha coast.

SYSTEMATIC ACCOUNT

Class : ACTINOPTERIGII

Order : PERCIFORMES

Family: NEMIPTERIDAE

1. *Nemipterus nematophorus* (Bleeker, 1853)

Double-whip threadfin

1853. *Dentex nematophorus* Bleeker, *Nat. Tijdschr. Ned. Indie*, 5:500.

1990. *Nemipterus nematophorus* Russell, *FAO, Fish Synop.* (125) 12: 45

Materials examined: 3 ex, SL 121-172 mm, Location: Digha Mohana, Date, 14.12.2010, Collection: Mr. P.C. Tudu & D. Ray, Identified: Dr. Prasanna Yennawar, Dr. A. Mohapatra & P.C. Tudu, Reg. No. F749.

Diagnostic Characters: D X+9, A III+7, P 17, V I+5, GR 12-14, LL 47-48, three rows of chick scales, Dorsal fin with first and second spines close together, almost fused and produced into a long filament which is the unique characteristics of the specimen (Fig.1), both pectoral and pelvic fins reach the level of anus, caudal fin forked and the upper lobe prolonged into a long filament. Body depth is 2.9 to 3.2 times in standard length and head length is 3.4 to 3.8 times in standard length. Upper part of the body pinkish to silvery white on ventral surface.

Distribution: The species is reported from western Indian-West Pacific from the east coast of India including Andaman Sea, Strait of Malacca, to the Philippines, South China Sea, Gulf of Thailand and Indonesia. From Indian waters the species is also reported from the Andaman Islands (Rajan, 2003), Andhra Pradesh (Barman *et al.*, 2004), Chennai coast (Krishnan *et al.*, 2007).

2. *Nemipterus randalli* (Russell, 1986)
Randall's threadfin

1986. *Nemipterus randalli* Russell, *Senckenbergiana Biol.* **67**: 23,

Materials examined: 3 ex, SL 123-160 mm, Location: Digha Mohana, Date, 30.11.2010, Collection: Dr. A. Mohapatra, P.C. Tudu & D. Ray, Identified: Dr. A. Mohapatra & P.C. Tudu, Reg. No. F744.

Diagnostic Characters: D X+9, A III+7, P 15, V I+5, GR 13-15, LL 46-52, 3 rows of chick scales, snout length almost equal to eye diameter, Upper caudal fin filamentous with light reddish in colour, Pectoral and pelvic fins very long reaching the origin of anal fin, Dorsal fin transparent with pale yellow medial stripe and upper margin edged with red, Caudal fin yellow-orange, edged with pink and with yellow stripe along the upper margin, pectoral fins 1.11 to 1.26 in head length, and pelvic fins 1.08 to 1.26 in head length, body silvery-pink with 3-4 faint yellow stripes on each side below lateral lines (Fig. 2).

The species differs from the closely related species *N. japonicus* (Bloch, 1791) reported from the coast (Chatterjee *et al.* 2000) in having less numbers of stripes 3-4 instead of 11-12, both pectoral and pelvic fins comparatively long and reaches the anal fin origin and the colour of the anal fin filament.

Distribution: The species is reported from western Indian Ocean, Pakistan, Persian Gulf, Red Sea, Gulf of Aden, East African coast, Seychelles and Madagascar. The original distribution of the *N. randalli* is Western Indian Ocean, from Western India (Russell, 1990). From Indian waters the species is also reported from the Andaman Islands (Mishra and Krishnan, 1992;

Rao *et al.*, 2000), Andhra Pradesh (Barman *et al.*, 2004), Gujarat coast (Barman *et al.*, 2000), Chennai coast (Krishnan *et al.*, 2007). This species is not yet reported from Odisha and this is the first report from Digha coastal waters of West Bengal.

3. *Parascolopsis aspinosa* (Rao and Rao, 1981)
Smooth dwarf monocle bream

1981. *Scolopsis aspinosa* Rao and Rao, *Proc. Kon Ned. Akad Wetensch (Series C, Biol. and Med. Sci.)* v. **84** (no. 1): 134, Fig. 1, 3.

1986. *Parascolopsis jonesi* Talwar, In: James, P.S.B.R. (ed), *Recent Advances in Marine Biology...*: 2, fig. 1.

1990. *Parascolopsis aspinosa*: Russell, *FAO fish Synop.*, (125)12: 67, fig. 117, pl. IVb. 1986. *Scolopsis jonesi* Talwar, In: James, (ed), *Recent Advances in Marine Biology*: pp.1-12, i-xxx + 1-591.

Materials examined: 1ex, SL 102 mm, Location: Digha Mohana, Date, 29.11.2010, Collection: P.C. Tudu & D. Ray, Identified : Dr. A. Mohapatra & P.C. Tudu, Reg. No. F745.

Diagnostic Characters: D X+9, A III+7, V I+5, GR 10, LL 36, pectoral fin with 2 simple and 15 branched rays, Pectoral and pelvic fins long and reaching the level of anus, snout length less than eye diameter, head 2.91 in standard length, head scales reaching forward to between level of anterior border of eyes and nostril. Body rosy orange in colour, a black blotch at the base of dorsal fin between eighth spine and first ray. Dorsal fin with orange margin, Anal fin pale rosy, pectoral fins yellowish. Posterior margin of sub-orbital smooth. (Fig. 3).

Distribution: The distribution of the species is around Indian Ocean including the Persian Gulf, Gulf of Oman, Gulf of Aeden, Arabian Sea, Bay of Bengal. From Indian waters the species is also reported from Andhra Pradesh (Barman *et al.*, 2004), Gujarat coast (Barman *et al.*, 2000). This species is not yet reported from Odisha and this is the first report from Digha coastal waters of West Bengal.

4. *Scolopsis vosmeri* (Bloch, 1792)
White cheek monocle bream

1792. *Anthias vosmeri* Bloch, *Naturges. Ausland Fische*, **6**: 120, pl. 321.



Fig. 1 : *Nemipterus nematophorus* (Bleeker, 1853)



Fig. 2. : *Nemipterus randalli* Russel, 1986



Fig. 3 : *Parascolopsis aspinosa* (Rao and Rao, 1981)



Fig. 4 : *Scolopsis vosmeri* (Bloch, 1792)

1990. *Scolopsis vosmeri* Russell, *FAO. Fish. Synop.*, (125) 12:122.

Materials examined: 1 ex, SL 112 mm, Location: Digha Mohana, Date, 14.12.2010, Collection: D. Ray, Identified: Dr. P.L. Yennawar, Dr. A. Mohapatra, P.C. Tudu, Reg. No. F750.

Diagnostic Characters: D X+9, A III+7, P II+15, V I+5, GR 11, LL 42, Body depth 2.2 in standard length, snout length is little less than eye diameter, Antronose suborbital spine present below eye, head scales reaching beyond the anterior nostril, lower limb of pre-opercle scaly, Pelvic fin long reaching just behind the anus, Caudal fin forked. Four rows of scales between lateral line and the first dorsal spine. Body is brownish with a reddish-purple tinge; a broad white vertical bar extending from top of head to opercle. Opercular membrane is blood red in

colour. Body scales with dark spots. Pectoral fin moderate not reaching to anus and anterior part of anal fin is pale (Fig. 4).

Distribution: The species is reported from Indo-West Pacific from East African coast, Red Sea and the Persian Gulf to northern Australia. This species is reported from the Andaman Islands (Rajan, 2003), Odisha (Barman *et al.*, 2007), Andhra Pradesh (Barman *et al.*, 2004), Chennai coast (Krishnan *et al.*, 2007), Gujarat coast (Barman *et al.*, 2000).

Remarks: Record of four more species of fisheries importance from Digha further enriches the fish faunal diversity in the area. This also highlights the need of consistent monitoring of fish fauna in the area for updating the previous records of availability.

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FRUIT-FLIES (DIPTERA: TEPHRITIDAE) FROM NORTH-EAST INDIA

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INTRODUCTION

Northeast India consists the present day Assam or Assam valley and rest of the contiguous - Arunachal Pradesh, Meghalaya, Mizoram, Nagaland and former princely states of Manipur and Tripura, state of Sikkim and parts of North Bengal (districts of Darjeeling, Jalpaiguri and Koch Bihar). The present paper based on old collections present in Zoological Survey of India records 6 species under 4 genera from North-East India.

Order DIPTERA

Family TEPHRITIDAE

Subfamily DACINAE

Tribe DACINI

Genus *Bactrocera* Macquart

1835. *Bactrocera* Macquart, *Hist. nat. Ins. Dipt.*, 2: 452, 453. Type-species: *Bactrocera longicornis* Macquart.

Subgenus *Zeugodacus* Hendel

1927. *Zeugodacus* Hendel, in Lindner, *Fliegen palaearkt. Reg.*, 49: 26. Type-species: *Bactrocera caudatus* Fabricius

Key to the species

1. Costal band interrupted and very thin, abdomen largely black.....*Bactrocera (Zeugodacus) scutellaris* (Bezzi). (Fig. a, Plate-1).
- Costal band distinct and largely enlarged at apex; abdomen largely yellow..... *Bactrocera (Zeugodacus) tau* (Walker) (Fig. b, Plate-1).

Bactrocera (Zeugodacus) scutellaris (Bezzi)

1913. *Bactrocera scutellaris* Bezzi, *Mem. Indian Mus.*, 3: 98.
Type-loc: India: (Meghalaya: Shillong; West

Bengal: Suiliguri, Kurseong; Uttarakhand: Kumaon, Bhowali).

Material examined: 1 ♀, Dentam, West Sikkim dist., 18.x.1995, coll. S.C. Mitra.

Distribution: India: Sikkim, Arunachal Pradesh, Bihar, Himachal Pradesh, Karnataka, Meghalaya, Uttarakhand, West Bengal. *Elsewhere*: China, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand.

Remarks: This species is being reported for the first time from Sikkim.

Subgenus *Zeugodacus* Hendel

1927. *Zeugodacus* Hendel, in Lindner, *Fliegen palaearkt. Reg.*, 49: 26. Type-species, *Dacus caudatus* Fabricius.

Bactrocera (Zeugodacus) tau (Walker)

1849. *Dasyneura tau* Walker, *List Dipt. colln Br. Mus.*, 4: 1074. Type-Loc: Foochow, China.

Material examined: 1 ♀, Tuikual south, Aizawl dist., 31.iii.94, coll. A.K. Hazra; 1 ♀, Belonia, South Tripura dist., 25.iii.91, coll. G.K. Srivastava.

Distribution: India: Mizoram, Tripura, Andaman & Nicobar Islands, Arunachal Pradesh, Bihar, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Maharashtra, Meghalaya, Punjab, Sikkim, Tamil Nadu, Uttarakhand, West Bengal. *Elsewhere*: Bhutan, Myanmar, China, Taiwan, Laos, Thailand, Cambodia, Vietnam, Malaysia, Singapore, Brunei, Indonesia.

Remarks: This species is being reported for the first time from Mizoram and Tripura.

Subfamily TEPHRITINAE

Tribe TEPHRELLINI

Subtribe TEPHRELLINA

Genus *Oxyaciura* Hendel

1927. *Oxyaciura* Hendel, In Lindner (ed.) *Die Fliegen der Palaearktischen Region*, 5: 111. Type species, *Aciura tibialis* Robineau-Desvoidy.

Oxyaciura xanthotricha (Bezzi)

1913. *Aciura xanthotricha* Bezzi, *Mem. Indian Mus.*, 3: 151. Type-loc: India: Uttarakhand (Dhikata).

Material examined: 1 ♀, Singhat, Churachandpur dist., 18.xii.92, coll. R.S. Mridha; 1 ♂, 2 ♀, Pangian Village, Churachandpur dist., 17.xii.92, coll. R.S. Mridha; 1 ♀, Malsa, Moreh, Chandel dist., 25.xii.92, coll. R.S. Mridha; 2 ♀, Rangpo, East Sikkim dist., 12.x.95, coll. S.C. Mitra.

Diagnosis: The species has flat, white, occipital setae (bristles) and postocellar bristles and scapular hairs lacking, typical of Tephritinae, but lacks recumbent, gray white setae over mesonotum and the 6th abdominal segment of the female is distinctly shorter than the 5th as in Trypetinae; upper occipital setae are flat and white; with only 3 hyaline marks in hind margin of wing; basal segment of ovipositor approximately as long as remainder of abdomen; piercer slender, tapered to a long thin point, extended ovipositor. (Fig. c, Plate-1).

Distribution: India: Manipur, Sikkim, Himachal Pradesh, Meghalaya, Uttarakhand. *Elsewhere*: Indonesia, Myanmar, Sri Lanka, Thailand, Vietnam, China.

Remarks: This species is being reported for the first time from Manipur and Sikkim.

Tribe TEPHRITINI

Genus *Campiglossa* Rondani

1870. *Campiglossa* Rondani, *Bull. Soc. Entomol. Ital.*, 2: 121. Type-species, *Tephritis irrorata* Fallen.

Key to the species

1. Wing entirely dark brown with numerous dark brown spots along periphery, cell r4+5 with a hyaline spot at apex..... *Campiglossa cribellata* Bezzi. (Fig.d, Plate-2).

- Posterior region of wing more hyaline with few dark patches or spots, cell r4+5 with an apical hyaline spot..... *Campiglossa gemma* (Hering) (Fig.e, Plate-2).

Campiglossa cribellata Bezzi

1913. *Campiglossa cribellata* Bezzi, *Mem. Indian Mus.*, 3: 161. Type-loc: India (West Bengal: Kurseong).

Material examined: 4 ♀, Nongpoh, Ri-Bhoi dist., 22.xii.1978, coll. P.T. Cherian.

Distribution: India: Meghalaya, Bihar, Haryana, Himachal Pradesh, Sikkim, West Bengal. *Elsewhere*: Nepal.

Remarks: This species is being reported for the first time from Meghalaya.

Campiglossa gemma (Hering)

1939. *Paroxyna gemma* Hering, *Verh. VII Intern. Kongr. Entomol.*, 1: 183. Type-loc: India: Tamil Nadu (Kodaikanal).

Material examined: 6 ♀, 2 ♂, Far Pak, Blue Mountain, Chhimpuitui dist., 9.iv.1994, coll. A.K. Hazra.

Distribution: India: Mizoram, Jammu & Kashmir (Ladakh), Karnataka, Tamil Nadu. *Elsewhere*: Nil.

Remarks: This species is being reported for the first time from Mizoram and is endemic to India.

Genus *Dioxyina* Frey

1954. *Dioxyina* Frey, *Commentat. Biol. Soc. Sci. Fenn.* (1944), 8(10): 62. Type-species, *Trypeta sororcula* Wiedemann.

Dioxyina sororcula (Wiedemann)

1830. *Trypeta sororcula* Wiedemann, *Aussereurop. Zweifl. Insekt.*, 2: 509. Type-loc: Teneriffe, Canary Islands.

Material examined: 1 ♂, Far Pak, Blue Mountain, Chhimpuitui dist., 9.iv.1994, coll. A.K. Hazra; 1 ♀, Belonia, South Tripura dist., 25.iii.91, coll. G.K. Srivastava.

Diagnosis: Head longer than high, epistoma and sides of face protruded, proboscis slender, elongate, geniculate, two pairs of inferior and superior fronto-orbital bristles present, dorsocentral bristles situated distinctly in front of

a line between the anterior supraalars; subcostal cell of wing dark brown; base of ovipositor shining black, subequal in length to terga 4-6. (Fig. f, Plate-2).

Distribution: India: Mizoram, Tripura, Andhra Pradesh, Assam, Bihar, Chandigarh, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal. *Elsewhere:* Widespread over Tropics and subtropics of the world, Japan, Australia, S. Europe, Korea, Southern Canada to Chile. Belonia, South Tripura dist., 25.iii.91, coll. G.K. Srivastava.

Diagnosis: Head longer than high, epistoma and sides of face protruded, proboscis slender, elongate, geniculate, two pairs of inferior and superior fronto-orbital bristles present, dorsocentral bristles situated distinctly in front of a line between the anterior supraalars; subcostal cell of wing dark brown; base of ovipositor

shinning black, subequal in length to terga 4-6. (Fig. f, Plate-2).

Distribution: India: Mizoram, Tripura, Andhra Pradesh, Assam, Bihar, Chandigarh, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal. *Elsewhere:* Widespread over Tropics and subtropics of the world, Japan, Australia, S. Europe, Korea, Southern Canada to Chile.

Remarks: This species is being reported for the first time from Mizoram and Tripura.

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Plate -1



a. *Bactrocera (Zeugodacus) scutellaris* (Bezzi)



a. wing



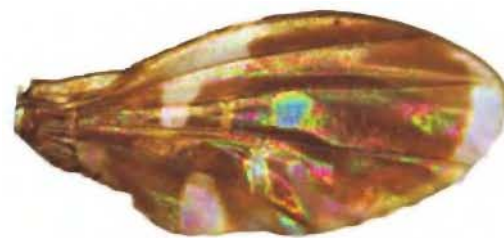
b. *Bactrocera (Zeugodacus) tau* (Walker)



b. wing



c. *Oxyaciura xanthotricha* (Bezzi)



c. wing

Plate - 2



d. *Campiglossa cribellata* Bezzi



d. wing



e. *Campiglossa gemma* (Hering)



e. wing



f. *Dioxya sororcula* (Wiedemann)



f. wing



ADDITIONAL RECORDS OF FRUIT-FLIES (DIPTERA: TEPHRITIDAE) FROM INDIA

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INTRODUCTION

Members of family Tephritidae include several economically important pest species across the globe. Various species of fruit fly cause damage to fruit and other plant crops, some fruit flies are used as agents of , thereby reducing the populations of pest species. Most fruit flies lay their eggs in plant tissues, where the larvae find their first food upon emerging. The adults usually have a very short lifespan.

Fruit flies of the family Tephritidae comprise 4,500 species, 500 genera under six subfamilies namely Blepharoneurinae, Dacinae, Phytalmiinae, Tachiniscinae, Tephritinae and Trypetinae, Korneyev (1999). Among the species reported worldwide, 325 species of fruit flies are known to occur in the Indian subcontinent, of which 243 in 79 genera are from India alone under four subfamilies, namely Dacinae, Phytalmiinae, Tephritinae and Trypetinae (Agarwal and Sueyoshi, 2005; David and Ramani, 2011). Bezzi (1913, 1915, 1916), Brunetti (1917), Senior-White (1922, 1924), Munro (1935, 1938, 1939), Perkins (1938), Hering (1938, 1941, 1956), Hardy (1971), Kapoor (1971, 1993), Kapoor *et al.*, (1980), White and Hancock (1997) and Hancock and Drew (2005) studied the tephritid fauna of the Indian subcontinent. Drew and Raghu (2002) reported 21 species of dacines from the Western Ghats. Taxonomic keys are of paramount importance in the identification of the species. The present paper is based on old collections present in Zoological Survey of India. 11 Species under 9 genera recorded here of

which *Philophylla indica* is endemic to India. This family can be distinguished from all other families of Diptera by the combination of well developed mesocline frontal setae and subcostal vein bent sharply anteriorly at right angle before the apex, weakened or evanescent beyond the bend. In addition, the costa has three breaks *viz.*, costal, humeral and subcostal (Hardy, 1973, 1974), vein R1 dorsally with setulae; wing usually with colour pattern; cell bcu usually with an acute extension (White and Elson-Harris, 1992).

Family TEPHRITIDAE

Subfamily PHYTALMIINAE

Tribe ACANTHONEVRINI

Genus *Rioxa* Walker

1856. *Rioxa* Walker, J. Proc. Linn. Soc. Lond., Zool., (1857), 1: 35. Type species: *Rioxa lanceolata* Walker.

Rioxa sexmaculata (Wulp)

1880. *Ptilona sexmaculata* Wulp, Tijdschr. Entomol., 23: 185. Type-loc: Sumatra.

Material examined: 1 ♀, Cinchona, Anamalai Hills (3500 ft), 1.iv.1956, coll. P.S. Nathan.

Diagnosis: Predominantly yellow species; upper superior fronto orbital bristles yellow; face yellow, except for a prominent subshinning dark brown spot on each side; hind femur with two prominent preapical dorsal bristles; wings brown with a hyaline spot in cell R1 just beyond vein R1, a small spot in apical portion of cell R3 just beyond R2+3, apical portion of cell R5 hyaline, a small hyaline spot on apex of 2nd M2 and also at apex of cell M4, crossvein r-m situated near apical $\frac{3}{4}$ of

cell 1st M2; abdomen brown with a broad median band extending from base over 5th tergum down to middle, 6th tergum brown, tinged with yellow at base. (Fig. j, plate IV)

Distribution: India: Tamil Nadu, Arunachal Pradesh, Karnataka, West Bengal. *Elsewhere:* China, Indonesia, Malaysia, Myanmar, Philippines, Solomon Islands, Thailand.

Remarks: This species is being reported for the first time from Tamil Nadu.

Subfamily TRYPETINAE

Tribe TRYPETINI

Genus *Philophylla* Rondani

1870. *Philophylla* Rondani, *Bull. Soc. Entomol Ital.*, 2: 9. Type species, *Musca caesio* Harris.

Key to the species

1. Wing with apical portion hyaline; dark brown basal portion; body black and shining; wing with posterior apical band from R4+5 to M absent *Philophylla indica* Hancock & Drew. (Fig. c, plate I)
- Wing with isolated posterior apical band from R4+5 to M present. *Philophylla fossata* (Fabricius). (Fig. h, plate III)

Philophylla fossata (Fabricius)

1805. *Tephritis fossata* Fabricius, *Syst. Antliat.*, p. 320. Type-locality: India (Kerala: Tranquebar).

Material examined: 4 ♀, Cinchona, Anamalai Hills, 1.v.1957, coll. P.S. Nathan; 1 ♀, loc. Cinchona, Anamalai Hills, 1.iv.1956, coll. P.S. Nathan; 1 ♀, dist. Coimbatore, Coimbatore, 1.vii.1957, coll. P.S. Nathan.

Distribution: India: Tamil Nadu, Arunachal Pradesh, Assam, Karnataka, Kerala. *Elsewhere:* Indonesia, Laos, Malaysia, Myanmar, New Ireland, Pakistan, Philippines, Singapore, Solomon Islands, Taiwan, Thailand, Vietnam; Japan, Korea, Papua New Guinea; Australia.

Remarks: This species is being reported for the first time from Tamil Nadu.

Philophylla indica Hancock & Drew

1994. *Philophylla indica* Hancock & Drew, *Raffles Bull. Zool.*, 42(3): 581. Type-locality: India (Karnataka: Western Ghats: Kemmannugundi, near Tarikere).

Material examined: 1 ♀, dist. Jabalpur, Jabalpur (1600 ft.), 1.ix.1957, coll. P.S. Nathan.

Distribution: India: Madhya Pradesh, Karnataka. *Elsewhere:* Nil.

Remarks: This species is being reported for the first time from Madhya Pradesh.

Subfamily TEPHRITINAE

Tribe DITHRYCINI

Genus *Platensina* Enderlein

1911. *Platensina* Enderlein, *Zool. Jahrb. Abt. Syst. Geogr. Biol. Tiere*, 31: 453. Type species, *Platensina sumbana* Enderlein.

Platensina acrostacta (Wiedemann)

Material examined: 1 ♀, Dist. Balsar, Umbergaon, 12.xi.1973, coll. P.T. Cherian.

Diagnosis: Face and genae entirely yellow, with a faint tinge of brown on the latter; thorax covered with grey pollen, humeri, mesonotum and venter of scutellum yellow, pleura yellow, tinged with brown and densely grey pollinose; legs entirely yellow; wings lacks hyaline spot in apical portion of cell R1 and two hyaline spots in 1st M2; abdomen black, yellow on sides of 1st two terga, 2nd yellow with yellow color extending over the middle of terga 3 and 4, 5th tergum shining black. (Fig. i, plate III).

Distribution: India: Gujarat, Karnataka, Kerala, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, West Bengal. *Elsewhere:* Bangladesh, Cambodia, China, Pakistan, Sri Lanka, Thailand.

Remarks: This species is being reported for the first time from Gujarat.

Tribe PLIOMELAENINI

Genus *Pliomelaena* Bezzi

1918. *Pliomelaena* Bezzi, *Bull. ent. Res.*, 8: 220. Type species, *Pliomelaena brevifrons* Bezzi.

Pliomelaena zonogastra (Bezzi)

Material examined: 1 ♀, dist. Sanand, Kalot, 5.xii.1973, coll. P.T. Cherian; 1 ♀, dist. Ahmedabad, Khan, 12.ii.1974, coll. P.T. Cherian.

Diagnosis: Head and thoracic bristles yellow, anterior dorsocentral bristles situated in line with supraalars, gena setose; thorax black, grey

pollinose, scutellum dark brown but yellow around margin; legs yellow to rufous; Wing normal in shape, mostly brown with hyaline wedges on both margins, vein R4+5 setose to $\frac{1}{2}$ distance to r-m crossvein; abdomen brown, tinged rufous of first two terga and yellow at apex of 5th tergum. (Fig. d, plate II).

Distribution: India: Gujarat, Andaman & Nicobar Island, Assam, Bihar, Himachal Pradesh, Karnataka, Orissa, Punjab, Uttarakhand, Uttar Pradesh. *Elsewhere*: China.

Remarks: This species is being reported for the first time from Gujarat.

Genus *Sunderesta* Hering

1953. *Sunderesta* Hering, *Verh. Naturforsch. Ges. Basel*, **64**: 78. Type species, *Sunderesta hilaris* Hering.

Sunderesta malaisei (Hering)

Material examined: 1 ♀, Loc. Kewzing (Alt. 1800m), 19.v.1962, coll. G. Ramakrishna.

Diagnosis: Black in ground colour; Face concave, epistoma projected; head yellow, brown colour with grey pollen, arista short pubescent; thorax grey pubescent with a faint brown spot on each side at level with suture in line with dorsocentrals; legs yellow; third costal section of wing about $\frac{3}{5}$ as long as 2nd section, two costal spines present at subcostal break, vein R4+5 setose through entire length, r-m crossvein near apical $\frac{1}{4}$ of cell 1st M2; abdomen grey pubescent with a pair of anterobasal submedian brown spots each on terga 2-5, apex of 5th tergum yellow. (Fig. f, plate II).

Distribution: India: Sikkim, Karnataka, Tamil Nadu. *Elsewhere*: China, Laos, Myanmar, Thailand.

Remarks: This species is being reported for the first time from Sikkim.

Tribe TEPHRELLINI

Genus *Sphaeniscus* Becker

1908. *Sphaeniscus* Becker, *Mitt. Zool. Mus. Berl.*, **4**: 138. Type species, *Sphaeniscus brevicauda* Becker.

Sphaeniscus atilius (Walker)

Material examined: 1 ♀, dist. Bhavnagar, Neelam bag, 3.iii.1975, coll. V.D. Shrivastava.

Diagnosis: Body shining black, grey pollinose on mesonotum; wings dark brown with hyaline base, one hyaline wedge on anterior margin in middle of wing and four hyaline wedges on posterior margin of wing, vein R4+5 bare, r-m crossvein is situated about its own length from m crossvein; sixth tergum of female shorter than fifth and basal segment of ovipositor almost equal in length to terga 5+6. (Fig. k, plate IV).

Distribution: India: Gujarat, Bihar, Himachal Pradesh, Jammu & Kashmir, Uttarakhand, West Bengal.

Elsewhere: Widespread Oriental, Russia, Japan; Australia, New Britain & Oceania, China, Korea, Malaysia, Moluccas, New Caledonia, Taiwan, Thailand.

Remarks: This species is being reported for the first time from Gujarat.

Tribe TEPHRITINI

Genus *Campiglossa* Rondani

1870. *Campiglossa* Rondani, *Bull. Soc. Entomol. Ital.*, **2**: 121. Type-species, *Tephritis irrorata* Fallen.

Key to the species

1. Wing entirely dark brown with numerous hyaline spots along periphery, cell r4+5 with a hyaline spot at apex..... *Campiglossa cribellata* Bezzi (Fig. a, plate I)
- Posterior region of wing brown with numerous hyaline spots, cell r 4+5 without an apical hyaline spot *Campiglossa deserta* (Hering) (Fig. g, plate III)

Campiglossa cribellata Bezzi

1913. *Campiglossa cribellata* Bezzi, *Mem. Indian Mus.*, **3**: 161. Type-loc: India (West Bengal: Kurseong).

Material examined: 2 ♀, Rongli (810 m), 2.v.1962, coll. S. Ali.

Distribution: India: Sikkim, Bihar, Haryana, Himachal Pradesh, West Bengal. *Elsewhere*: Nepal.

Remarks: This species is being reported for the first time from Sikkim.

Campiglossa deserta (Hering)

Material examined: 1 ♀, Dist. Dindigul, Kodaikanal, 30.iii.1962, coll. K.V.L. Narayana.

Distribution: India: Tamil Nadu, Karnataka.
Elsewhere: China, Japan, Korea, Thailand, Vietnam.

Remarks: This species is being reported for the first time from Tamil Nadu.

Genus *Dioxyna* Frey

1954. *Dioxyna* Frey, *Commentat. Biol. Soc. Sci. Fenn.* (1944), 8(10): 62. Type-species, *Trypeta sororcula* Wiedemann.

Dioxyna sororcula (Wiedemann)

1830. *Trypeta sororcula* Wiedemann, *Aussereurop. Zweifl. Insekt.*, 2: 509. Type-loc: Teneriffe, Canary Islands.

Material examined: 1 ♀, Dist. Senapati, Mao (5700 m), 8.iii.1975, coll. P.T. Cherian; 1 ♀, Dist. Ukhrul, Ukhrul (6200 m), 4.iii.1975, coll. P.T. Cherian; ♀ 3, Dist. Ukhrul, Ukhrul (6000 m), 5.iii.1975, coll. P.T. Cherian; ♀ 4, Dist. Churachandpur, Churachandpur, 17.ii.1975, coll. P.T. Cherian; ♀ 2, Khujma (5500 m), 7.iii.1975, coll. P.T. Cherian.

Diagnosis: Head longer than high, epistoma and sides of face protruded, proboscis slender, elongate, geniculate, two pairs of inferior and superior fronto-orbital bristles present, dorsocentral bristles situated distinctly in front of a line between the anterior supraalars; subcostal cell of wing dark brown; base of ovipositor shining black, subequal in length to terga 4-6. (Fig. b, plate I).

Distribution: India: Manipur, Nagaland, Andhra Pradesh, Assam, Bihar, Chandigarh, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal.
Elsewhere: Widespread over Tropics and

subtropics of the world, Japan, Australia, Europe, Korea. Throughout New world from southern Canada to Chile. Hawaii (introduced).

Remarks: This species is being reported for the first time from Manipur and Nagaland.

Genus *Spathulina* Rondani

1856. *Spathulina* Rondani, *Dipterol. Ital. Prodr.*, 1: 113. Type-species, *Spathulina sicula* Rondani.

Spathulina acroleuca (Schiner)

Material examined: 1 ♀, Dist. Sundergarh, Bisal Bari, 9.i.1972, coll. P.K. Maity; 1 ♀, Dist. Balsar, Umbergaon, 12.xi.1973, coll. P.T. Cherian.

Diagnosis: Dark coloured species with brown-black wings, hyaline spots along margin, apical portion of wing completely hyaline with a tiny brown spot at extreme apex of cell R3 and with 2 or 3 isolated hyaline spots in wing field, vein R4+5 is bare except for a few inconspicuous setae at base; ovipositor is short. (Fig. e, plate II).

Distribution: India: Gujarat, Orissa, Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Madhya Pradesh, Punjab, Rajasthan, West Bengal. *Elsewhere:* Widespread Oriental; Afrotropical; Southern Palaearctic; Australasian Region.

Remarks: This species is being reported for the first time from Gujarat and Orissa.

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Plate - 1



a. *Campiglossa cribellata* Bezzi



a. wing



b. *Dioxyina sororcula* (Wiedemann)



b. wing



c. *Philophylla indica* (Hancock & Drew)



c. wing

Plate - 2



d. *Pliomelaena zonogastra* (Bezzi)



d. wing



e. *Spathulina acroleuca* (Schiner)



e. wing



f. *Sundaresta malaisei* (Hering)



f. wing

Plate - 3



g. *Campiglossa deserta* (Hering)



g. wing



h. *Philophylla fossata* (Fabricius)



h. wing



i. *Platensina acrostacta* (Wiedemann)



i. wing

Plate - 4



j. *Rioxa sexmaculata* (Wulp)



j. wing



k. *Sphaeniscus atilius* (Walker)



k. wing



ON SOME ANTS (INSECTA: HYMENOPTERA: FORMICIDAE) FROM NAGALAND, INDIA

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INTRODUCTION

Nagaland is the hilly state of northeastern India having an area of 16,579 km² lies between 25°6' and 27°4' latitude, north of equator and between the longitudinal lines 93°20'E and 95°15'E latitude, bounded by Tirap district of Arunachal Pradesh in north-east, Assam in the west and northwest, Manipur in the south while the eastern limits are continuous with the international boundary between India and Myanmar. This is predominantly a hilly state with valleys, streams and mountains. Nagaland includes the former Naga hill district of Assam (established in 1881) and the Tuensang division of North East Frontier Agency (NEFA, now Arunachal Pradesh). The administrative "unit" known as the "Naga hills" and tuensang Area" (NHTA) was established on 1st December 1957. NHTA was renamed as Nagaland on 18th February 1961. The State of Nagaland was formally inaugurated on December 1st, 1963, as the 16th State of the Indian Union. The state consists of seven administrative districts which are Kohima, Mokokchung, Mon, Phek, Tuensang, Wokha, Zunheboto and Dimapur. The climate of Nagaland is pleasant. Heavy rainfall occurs in the period of June to September with high humidity (67-88%).

Ants have the most highly organized social life among all the insects. The major factor responsible for their ecological success is division of labour, performing different biological functions. Ants live in highly

organized and integrated units the societies or colonies.

Bingham's (1903) fauna is the main source of knowledge of ants in India. Chapman and Capco (1951) published a checklist of the ants of Asia. Bolton (1995) has dealt with taxonomic and Zoogeographical census of the extant ant taxa (Hymenoptera: Formicidae). Bolton has published a Catalogue of Ants of the World CD-ROM 2007(1758-2005). Datta & Raychaudhuri (1985) has reported a new species of ant (Hymenoptera : Formicidae) from Nagaland, north-east India in Science and Culture. In the *State Fauna Series* (Fauna of Nagaland, 2005) 5 Orders namely Orthoptera, Lepidoptera, Odonata, Diptera and Coleoptera of Class Insecta has been worked out, but Order Hymenoptera has not been worked out.

The present studies are based on the material collected by Dr. P. H. Roy, Scientist (Retd.), Zoological Survey of India, Kolkata. We are thankful to him.

SYSTEMATICS

Order HYMENOPTERA

Family FORMICIDAE Latreille, 1809

(i) Subfamily MYRMICINAE Emery, 1877

1. *Solenopsis geminata geminata* (Fabricius, 1804)
2. *Meranoplus bicolor* (Guerin, Meneville, 1844)
3. *Lophomyrmex quadrispinosus* (Jerdon, 1851)

4. *Pheidologeton affinis affinis* (Jerdon, 1851)
5. *Aphaenogaster beccarii* (Emery, 1887)
6. *Aphaenogaster smythiesii smythiesii* (Forel, 1902)
7. *Monomorium indicum indicum* (Forel, 1902)
8. *Monomorium latinode* (Mayr, 1872)
9. *Pheidole smythiesii* (Forel, 1902)
10. *Tetramorium christiei* (Forel, 1902)
11. *Tetramorium tortuosum* (Roger, 1863)

(ii) Subfamily FORMICINAE
Lepeletier, 1809

12. *Anoplolepis gracilipes* (Smith, F., 1857)
Anoplolepis longipes (Jerdon, 1851)
(Junior synonym of *gracilipes*)
13. *Plagiolepis dichroa* (Forel, 1902)
14. *Oecophylla smaragdina smaragdina* (Fabricius, 1775)
15. *Camponotus (Tanaemyrmex) invidus* (Forel, 1892)
16. *Camponotus (Orthonotomymex) sericeus sericeus* (Fabricius, 1798)
17. *Paratrechina longicornis longicornis* (Latreille, 1802)
18. *Paratrechina taylori taylori* (Forel, 1894)
19. *Paratrechina aseta* (Forel, 1902)
20. *Formica rufibarbis rufibarbis* (Fabricius, 1793)

(iii) Subfamily PONERINAE
Lepeletier, 1835

21. *Pachycondyla rufipes rufipes* (Jerdon, 1851)
22. *Pachycondyla melanaria melanaria* (Emery, 1893)
23. *Pachycondyla sulcata sulcata* (Mayr, 1867)

(iv) Subfamily DOLICHODERINAE Forel, 1878

24. *Tapinoma melanocephalum melanocephalum* (Fabricius, 1793)

Ants are polymorphic social insects having three distinct forms- the perfect and fertile female, the male and workers (major or minor). The largest forms are soldiers. Identification of ants is mainly based on the worker caste.

**IDENTIFICATION KEY IS BASED ON THE
WORKER CASTE OF ANTS**

Key to the sub-families of family FORMICIDAE
(Modified from Bolton, 1994)

1. Body with a single reduced segment ie. petiole between alitrunk and abdomen..... 2
- Body with a two reduced segment ie. petiole and post petiole between alitrunk and abdomen..... *Myrmicinae*
2. Apex of gaster with a semicircular or circular acidopore, usually guarded by setae, sting absent..... *Formicinae*
- Apex of gaster without a semicircular or circular acidopore, sting present..... 3
3. Either pygidium or hypopygidium armed with peg like teeth or short spines..... *Ponerinae*
- Pygidium or hypopygidium unarmed..... *Dolichoderinae*

Subfamily MYRMICINAE Emery, 1877

Key to the genera of subfamily MYRMICINAE

1. Antennae with less than 12 joints..... 2
- Antennae 12 jointed..... 5
2. Antennae 9 or 10 jointed..... 3
- Antennae 11 jointed..... 4
3. Antenna 10 jointed. Pronotum and metanotum unarmed..... *Solenopsis*
- Antenna 9 jointed. Pronotum and metanotum armed with two teeth..... *Meranoplus*
4. Pronotum armed with two spines.
..... *Lophomyrmex*
- Pronotum not armed..... *Pheidologeton*
5. Flagellum of antennae scarcely thickened towards apex without a distinct club
..... *Aphaenogaster*
- Flagellum of antennae with a distinct club
..... 6
6. Clypeus bicarinate..... *Monomorium*
- Clypeus not bicarinate, occasionally with one carina..... 7
7. Neuters or workers strongly dimorphous
..... *Pheidole*
- Neuters or workers monomorphous
..... *Tetramorium*

Genus *Solenopsis* Westwood, 1840

Solenopsis geminata geminata (Fabricius, 1804)

Original Combination - *Atta geminata* Fabricius, 1804

1804. *Solenopsis geminata*, Fabricius, *Syst. Piez.*, : 423, (*Atta*).

1862. *Solenopsis geminata*, Roger, Berl. Ent. Zeitschr., 6: 289, Male, Female, Worker.

1903. *Solenopsis geminata*, Bingham, Fauna Brit. India, Hym., 2: 158-159. Male, Female, Worker, Soldier.

Material examined: Worker - 2 exs, Mokokchung (Munkong), 27.9.1994, P.H. Roy Coll. (Regd. No. 12858/H3).

Diagnostic Characters: Worker: Length 2.2- 2.5 mm. Pale yellow, smooth and shining. Mandibles narrow with four acute teeth. Antennae 12 jointed, scape extending beyond the top of the head, flagellum with a distinct club. Alitrunk convex above not sub-margined, alitrunk seen in profile deeply emerginate at the meso- metanotal suture. The 1st node of petiole squamiform, anteriorly petiolate, 2nd node smoothly rounded and little broader in front than posterior. Abdomen more than twice as long as broad.

Distribution : **India:** Rajasthan, Gujarat, Tamil Nadu, Punjab, Karnataka, Himachal Pradesh, Jammu & Kashmir, West Bengal(Kolkata), Orissa, Andaman & Nicobar Islands. **Elsewhere:** Spread over both the hemispheres, Oceania, Philippines, Sri Lanka, Central America.

Remarks: Reported for the first time from Nagaland state.

Genus *Meranoplus* Smith F., 1853

Meranoplus bicolor (Guerin, Meneville, 1844)

Original Combination – *Cryptocerus bicolor*, Guerin, 1844

1844. *Meranoplus bicolor*, Guerin (*Cryptocerus*) Cuv. Inconogr. Regm. Anim. Insect, iii, p. 425.

1875. *Meranoplus bicolor*, Smith, Trans. Ent. Soc. Lond., p. 34, pl I, fig. 1-3.

1903. *Meranoplus bicolor*, Bingham, Fauna Brit. India, Hym., 2: 168-169.

Male, Female, Worker

1951. *Meranoplus bicolor*, Chapman and Capco, Monogr. Inst. Sci. Tech., Manila (Check List Ants Asia), 1: 112.

1995. *Meranoplus bicolor* Bolton, B., A New General Catalogue of the Ants of the World, : 250.

Material examined: Worker – 5 exs, Dimapur (Forest colony), 3.10.1994, 9 exs, Dimapur (Rangapahar reserve forest), 1.10.1994, P.H. Roy Coll. (Regd. No. 12859/H3, 12860/H3).

Diagnostic Characters: Worker: Length 4-5 mm. Head, alitrunk, leg and petiole of the abdomen bright ferruginous red in color and abdomen black, pilosity very long soft, abundant and of grey colourd. Head, a little bit longer than broader and broader posteriorly than in front. Mandibles narrow, armed with 4 teeth. Clypeus convex in middle, inclined downwards. The promesonotal shield of the alitrunk about as broad as long, with the anterior angles prominent and acute, the sides posteriorly with a small incision, and beyond that produced backwards into a long laminate spine on each side overhanging the metanotum, the latter, vertical, slightly convex with a carina on each side ending above in an acute spine. The 1st node of petiole smooth, triangular 2nd node globose. Abdomen cordate.

Distribution: **India:** Gujarat, Karnataka, Kerala, Maharashtra, Manipur, Orissa, Rajasthan, Tamil Nadu, Tripura, Punjab, Uttar Pradesh, West Bengal, Uttarakhand, Chandigarh, Delhi. **Elsewhere:** China, Bhutan, Indonesia, Malaysia, Myanmar, Nepal, Pakistan, Singapore, Sri Lanka, Thailand.

Remarks: Reported for the first time from Nagaland state.

Genus *Lophomyrmex* Emery, 1892

Lophomyrmex quadrispinosus (Jerdon, 1851)

Original Combination – *Oecodoma quadrispinosus* Jerdon, 1851

1851. *Lophomyrmex oecodoma quadrispinosus* Jerdon, Madras Jour. Lit. Sc., 17: 111, (Worker) (*Oecodoma*).

1903. *Lophomyrmex quadrispinosus*, Bingham, Fauna Brit. India, Hym., 2: 195-196.

1995. *Lophomyrmex quadrispinosus* Bolton, B., A New General Catalogue of the Ants of the World, : 248.

Material examined: Workers – 1 ex, Mokokchung (Munkong), 27.9.1994, P.H. Roy Coll. (Regd. No. 12854/H3).

Diagnostic Characters: Worker: - 3 – 3.5 mm. Head and abdomen chestnut or reddish brown, alitrunk and petiole brownish yellow. Head a little longer than broad, with a broad posterior margin. Mandibles striate at base, slightly convex, the masticatory margin dentate. Antennae 11

jointed, slender the scape barely extending beyond the top of the head. Alitrunk the pro-mesonotal suture lying immediately behind the flattened top of the pronotum is almost more or less rounded above. Pronotum armed with two short spines or teeth. Petiole the 2nd node broader than the 1st, this latter with a long petiole in front and shorter one posteriorly, the 2nd node rounded above. Abdomen broadly oval.

Distribution : **India :** Karnataka, Kerala, Sikkim, Orissa, W. Bengal, Tamil-Nadu, Uttar-Pradesh, Meghalaya, Chandigarh. *Elsewhere :* Sri Lanka.

Remarks: Reported for the first time from Nagaland state.

Genus *Pheidologeton* Mayr, 1862

Pheidologeton affinis affinis (Jerdon, 1851)

Original Combination – *Oecodoma affinis* Jerdon, 1851

1851. *Pheidologeton affinis* Jerdon, *Madras J. Lit. Sci.*, **17**: 110, Worker, Soldier.

1903. *Pheidologeton affinis*, Bingham, *Fauna Brit. India*, *Hym.*, **2**: 164-165, Male, Female, Worker, Soldier.

1951. *Pheidologeton affinis*, Chapman and Capco, *Monogr. Inst. Sci. Tech., Manila (Check List Ants Asia)*, **1**: 159.

1994. *Pheidologeton affinis*, Tiwari, et al., *State Fauna Series 5: Fauna of West Bengal*, **8**: 52.

Material examined: Workers – 5 exs, Mokokchung (Tsumarshong), 28.9.1994, 12 exs., Dimapur (Chumuksdina) 2.10.1994, Many exs, Dimapur (Rangapahar reserve forest), 1.10.1994, P.H. Roy Coll. (Regd. No. 12855/H3, 12856/H3, 12857/H3).

Diagnostic Characters: Worker- Length 2 – 2.5 mm. Light brownish yellow, polished and shining and the mandibles black, the antennae and legs yellowish red. Sculpture more feeble and the median longitudinal furrow less deeply impressed. Head proportionately much longer and anteriorly striate. Ocellus absent. Mandibles large, smooth, the masticatory margin with two strong teeth at apex. Antennae 11 jointed, scape short, club of the antennae formed of 2 apical joints of flagellum. Alitrunk smaller, scutellum

prominent and gibbous, the basal portion of the metanotum transversely striate armed with two spines, pronotum anteriorly striate and not armed. Petiole with 1st node narrower, more conical and not emarginate above, the keel below less strongly marked. Abdomen broadly oval.

Distribution: **India:** Assam, Karnataka, Kerala, Maharashtra, Manipur, Rajasthan, Tamil Nadu, West Bengal. *Elsewhere:* Malaysia, Myanmar, Sri Lanka.

Remarks: Reported for the first time from Nagaland state.

Key to the species of Genus *Aphaenogaster*

1. Head posteriorly produced and constricted forming a more or less cylindrical neck or collar..... *beccarii*
- Head posteriorly not produced into a neck *smythiesii*

Genus *Aphaenogaster* Mayr, 1853

Aphaenogaster beccarii Emery, 1887

Original Combination – *Aphaenogaster (Ischnomyrmex) beccarii* Emery, 1887

1887. *Aphaenogaster (Deromyrma) beccarii* Emery, *Ann. Mus. Civ. Stor. Nat. Genova*, **25**: 456, pl. 1, fig. 12, (Worker, Female, Male) (*Ischnomyrmex beccarii*).

1903. *Aphaenogaster (Deromyrma) beccarii* Bingham, *Fauna Brit. India, Hym.*, **2**: 271-272. Male, Female, Worker.

Material examined: Worker – 1 ex, Mokokchung (Tsumarshong), 28.9.1994, P.H. Roy Coll. (Regd. No. 12861/H3).

Diagnostic Characters: Worker: Length – 6.5 – 7 mm. Light castaneous brown, smooth and shining, alitrunk posteriorly and the abdomen slightly darker. Head including the mandibles viewed from above elongate and oval. Mandibles triangular, broad at masticatory margin which is furnished with three conspicuous teeth towards the apex, finely striate at base. Antennae 12 jointed, scape extending well beyond the top of the head, club of the flagellum formed of the apical four joints. Alitrunk - pro-mesonotal suture generally slight, mesonotum oblique, convex above, roundly raised a little anteriorly, meso- metanotal suture deeply impressed, the basal portion of the metanotum

elongate, metanotum transversely rugose above, obliquely and somewhat coarsely striate on the sides, rounded above the apex divided into two acute dentate angles. Petiole with 1st node conical, rounded above, 2nd node suboval. Abdomen short, broadly oval.

Distribution : **India:** Karnataka, Maharashtra, Nagaland. *Elsewhere:* Sumatra.

Remarks: Reported for the first time from Nagaland state.

Aphaenogaster smythiesii smythiesii (Forel, 1902)

Original Combination – *Stenammina* (*Aphaenogaster*) *smythiesii* Forel, 1902

1902. *Aphaenogaster* (*Attomyrma*) *smythiesii* Forel, *Rev. Suisse zool.* **10**: 222, (Worker, Female, Male).

1903. *Aphaenogaster* (*Attomyrma*) *smythiesii* Bingham, *Fauna Brit. India, Hym.*, **2**: 276-277. Male, Female, Worker.

1995. *Aphaenogaster* (*Attomyrma*) *smythiesii* Bolton, B., *A New General Catalogue of the Ants of the World.* : 73.

Material examined: Worker – 8 exs, Kohima Fort (L.B. Garden, stem of garden), 22.9.1994; 12 exs, Kohima (Forest), 23.9.1994; 20 exs, Kohima (rest house), 20.9.1994; 4 exs, Mokokchung (Fazl Ali College campus under grass), 26.9.1994; 10 exs, Mokokchung (Munkong forest), 27.9.1994, P. H. Roy Coll. (Regd. No. 12862/H3, 12863/H3, 12864/H3, 12865/H3, 12866/H3).

Diagnostic Characters: Worker: Length – 4.5 – 5.5 mm. Dark castaneous brown to piceous black, smooth polished and shining. Head without the mandibles rectangular, the posterior lateral angles rounded. Mandibles triangular, striate at base, the masticatory margin dentate at apex, dentate above. Antennae 12 jointed, scape extending well beyond the top of the head, club of the flagellum formed of the apical four joints, 2-7 of joints flagellum only a little longer than broad. Alitrunk – pronotum convex, pro-mesonotal suture emarginate at the meso-metanotal suture, which is deeply marked, *pro* and mesonotum not forming a continuous convexity, *pro*-mesonotal suture distinct, anterior margin of mesonotum behind the suture raised into a crest or ridge, metanotum rounded from side to side and a little

convex longitudinally, the metanotal spines broad at base, short and acute. Petiole with 1st node obliquely sloped posteriorly, rounded above, 2nd node longer than broad. Abdomen broadly oval.

Distribution : **India :** Meghalaya, N.W. Himalayas.

Remarks: Reported for the first time from Nagaland State.

Key to the species of Genus *Monomorium*

1. Head more or less rugulose, opaque *indicum*
- Head not rugulose and opaque, but more or less smooth and shining *latinode*

Genus *Monomorium* Mayr, 1855

Monomorium indicum indicum Forel, 1902

Original Combination – *Monomorium salomonis* r. *indicum* Forel, 1902.

1902. *Monomorium salomonis* Linn. race *indicum* Forel, *Rev. Suisse Zool.*, **10**: 213.

1903. *Monomorium indicum* Bingham, *Fauna Brit. India, Hym.*, **2**: 205-206, Male, Female, Worker.

1995. *Monomorium* (*Xeromyrmex*) *salomonis indicum* Bolton, B., *A New General Catalogue of the Ants of the World*: 263.

Material examined: Workers – 10 exs, Dimapur (Rangapahar reserve forest), 1.10.1994, P.H. Roy Coll. (Regd. No. 12867/H3).

Diagnostic Characters : Length worker : 3-3.5 mm.

Worker : Ferruginous red with abdomen dark brown. Head opaque almost as broad as long, broader anteriorly than posteriorly. Mandibles narrow with three to four teeth, when closed partially concealed under the projecting margin of the clypeus. Antennae moderately long, the scape not quite reaching the posterior margin of the clypeus. Alitrunk anteriorly rounded moderately broad, the meso-metanotal suture distinct, the basal portion of the metanotum broadening posteriorly, Petiole - Seen from above 2nd node broader than 1st, nodes subequal. The rounded 1st node higher than the 2nd node and petiolate anteriorly. Abdomen oval.

Distribution : **India:** Uttarakhand, Rajasthan, Gujarat, Maharashtra, Chandigarh, Karnataka, Punjab, West Bengal, Andhra Pradesh, Tamil Nadu. *Elsewhere:* Myanmar, All tropical countries (Europe)

Remarks: Reported for the first time from Nagaland state.

***Monomorium latinode* Mayr, 1872**

Original Combination – *Monomorium latinode* Mayr, 1872.

1872. *Monomorium (Monomorium) latinode* Mayr, *Ann. Mus. Civ. Stoc. Nat. Genova*, 2: 152, (Worker).

1903. *Monomorium (Monomorium) latinode* Bingham, *Fauna Brit. India, Hym.*, 2: 211-212.

Material examined: Workers – 1 exs, Mokokchung (Tsumarshong), 28.9.1994 ; 10 exs, Kohima (Jotsama basti), 23.9.1994, P.H. Roy Coll. (Regd. No. 12868/H3, 12869/H3).

Diagnostic Characters : Length Worker – 3 – 3.7 mm.

Worker : Light castaneous brown, mandibles, antennae smooth, polished and shining. Head longer than broad, mandibles smooth armed with four teeth. Antennae 12 jointed, moderately long, scape nearly reaching the top of the head. Alitrunk elongate, pro-mesonotum convex, broad nearly as broad as head, emarginate at the mesonotal suture. Petiole 1st petiolate in front, a little higher than the 2nd node which is very much broader than the 1st. Abdomen long oval.

Distribution : **India :** Rajasthan, Tamil Nadu, W. Bengal (Kolkata), Orissa, Manipur. *Elsewhere :* Sri-Lanka, Myanmar extending to Borneo, Formosa, Oceania.

Remarks: Reported for the first time from Nagaland state.

Genus *Pheidole* Westwood, 1839

***Pheidole smythiesii* Forel, 1902**

Original Combination – *Pheidole (Ceratopheidole) smythiesii* Forel, 1902

1902. *Pheidole smythiesii* Forel, *Rev. Suisse Zool.*, X: 165 & 185, (Worker, Female, Male); id *J. Bombay nat. Hist. Soc.* xiv (1902): 523 & 538.

1903. *Pheidole smythiesii* Bingham, *Fauna Brit. India, Hym.*, 2: 227-228. Male, Female, Worker.

1995. *Pheidole (Ceratopheidole) smythiesii* Bolton, B., *A New General Catalogue of the Ants of the World.* : 330

Material examined: Workers – 5 exs, Mokokchung (Munkong forest rest house), 25.9.1994; 6 soldier, 7 female, Kohima (Jotsama basti), 23.9.1994, P. H. Roy Coll. (Regd. No. 12870/H3, 12871/H3).

Diagnostic Characters : Length worker – Soldier – 6 8.5 mm. Worker –

Clear light or reddish chestnut, brown all over, slightly shining covered with abundant reddish-yellow erect hairs. Head enormously large, much broader than long, posteriorly deeply emarginate. Mandibles punctured and sparsely striate, the masticatory margin acutely pointed at apex, without distinct teeth. Antennae short, the scape from its insertion reaching barely halfway to the top of the head, the apical four joints subequal. Alitrunk elongate, meso-metanotal suture distinct, metanotum with the basal portion sloping and ending posteriorly in a spine or tooth. Petiole 2nd node oval longer than broad. Abdomen broadly oval.

Distribution : **India :** Chandigarh, Meghalaya, Assam. *Elsewhere :* Vietnam.

Remarks: Reported for the first time from Nagaland state.

Key to the species of Genus *Tetramorium*

- (1) Antenna 12 jointed. *christiei*
- Antenna 11 jointed. *tortuosum*

Genus *Tetramorium* Mayr, 1855

***Tetramorium christiei* Forel, 1902**

Original Combination – *Tetramorium christiei* Forel, 1902.

1902. *Tetramorium christiei* Forel, *Rev. Suisse Zool.*, X: 232.

1903. *Tetramorium christiei*, Bingham, *Fauna Brit. India, Hym.*, 2: 178.

1995. *Tetramorium christiei*, Bolton, B., *A New General Catalogue of the Ants of the World.* : 406.

Material examined: Workers – 6 exs,

Mokokchung (Munkong Reserve forest), 27.9.1994; P. H. Roy Coll. (Regd. No. 12872/H3).

Diagnostic Characters: Worker:- 3 mm. Dark brown or black, mandibles, antennae, alitrunk reddish brown. and petiole brownish yellow. Head without the mandibles, seen from front rectangular, posteriorly longer than broad. Mandibles longitudinally striate, triangular the masticatory margin dentate. Clypeus not carinate. Antennae 12 jointed, slender the scape barely extending beyond the top of the head. Alitrunk elongate and narrow, convex, without an emargination above, the pro-mesonotal suture obsolete, meso-metanotal suture slightly impressed, basal portion of the metanotum short, metanotal spines very short, barely a quarter of the length of the space between their bases. Petiole elongate the nodes rounded slightly longer than broad, first node of petiole distinctly longer than broad, the 2nd node a little broader than the 1st, this latter with a long petiole in front. Abdomen oval, convex, somewhat truncate anteriorly.

Distribution : **India :** Chandigarh, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Meghalaya, Sikkim, West Bengal.

Remarks: Reported for the first time from Nagaland State.

***Tetramorium tortuosum* Roger, 1863**

Original Combination – *Tetramorium tortuosum* Roger, 1863

1863. *Tetramorium tortuosum* Roger, *Berlin. ent. Zeit.* VII:181.

1903. *Tetramorium tortuosum* Bingham, *Fauna Brit. India, Hym.*, 2:188.

1977. *Tetramorium tortuosum* Bolton, B., *The ant tribe Tetramoriini* (Hymenoptera : Formicidae). The genus *Tetramorium* Mayr in the Oriental and Indo-Australian regions, and in Australia. *Bull.Br.Mus.(Nat. Hist.) Entomol*, 36:83.

Material examined: Workers – 4 exs, Dimapur (Rangapahar reserve forest), 1.10.1994, P.H. Roy Coll. (Regd. No. 12873/H3).

Diagnostic Characters: Length worker – 3 – 3.5 mm. Chestnut red. Head without the mandibles elongate, trapezoidal, posteriorly broader than in front. Mandibles longitudinally striate, triangular the masticatory margin

comparatively broad, dentate. Antennal carinae produced posteriorly almost to the top of the head. Antennae 12 jointed, stout and long, the scape extending up to the top of the head. Alitrunk elongate, broad anteriorly, pronotum in front arched, meso and metanotum narrowing posteriorly, the sutures almost obsolete, the spines on the posterior lateral angles of basal portion of metanotum slender, acute, pointing divergently backwards. Petiole the 1st node longer than broad, petiolate in front, the 2nd node transverse broader long. Abdomen oval.

Distribution : **India :** Western India, Karnataka. *Elsewhere :* Sri Lanka, Philippines.

Remarks: Reported for the first time from Nagaland State.

Key to the genera of sub-family FORMICINAE

1. Antenna 11 jointed.....2
- Antenna 12 jointed.....3
2. Length over 2 mm. Scape of antennae extending beyond top of head by less than half its length.....*Anoplolepis*
- Length under 2 mm. Scape of antennae barely extending beyond the top of head*Plagiolepis*
3. Maxillary palpi 5 jointed.....*Oecophylla*
- Maxillary palpi 6 jointed.....4
4. Antennae inserted at a perceptible distance from posterior margin of clypeus*Camponotus*
- Antennae inserted immediately above posterior margin of clypeus, almost touching it.....5
5. Antennal and clypeal hollows not confluent, distinct. Ocelli absent.*Paratrechina*
- Antennal and clypeal hollows confluent, distinct. Ocelli present.....*Formica*

Genus ***Anoplolepis*** Santschi, 1914

Anoplolepis gracilipes (Smith, F., 1857)

Anoplolepis longipes (Jerdon, 1851)
(Junior synonym of *gracilipes*)

Original Combination – *Formica longipes* Jerdon, 1851

1851. *Anoplolepis longipes* Jerdon, *Madras Jour. Lit. Sc.*, 17: 122, (Worker) (*Formica longipes*).
1903. *Plagiolepis longipes* Bingham, *Fauna Brit. India, Hym.*, 2: 320-321.
1995. *Anoplolepis longipes* Bolton, B., *A New General Catalogue of the Ants of the World*: 67.

Material examined: Workers - 1 ex, Mokokchung (Munkong forest), 27.9.1994, P.H. Roy Coll. (Regd. No. 12852/H3).

Diagnostic Characters: Worker: 3.5 - 4.5 mm
In colour from honey yellow to a light orange yellow, antennae, legs a lighter shade, abdomen with a tinge of brown. Alitrunk and abdomen shining with a few scattered erect yellow hairs. Head oval, very roundly posteriorly. Mandibles narrow, acutely dentate along the masticatory margin with the apices crossing and folded beneath the margin of the clypeus. Maxillary palpi 6 jointed. Antennae 12 jointed, the joints of the flagellum much longer than broad. Alitrunk narrow, elongate constricted at the metanotum, meso-metanotal suture slightly emarginate, the metanotum rounded, convex and gibbous. Node of the petiole thick, low, conical, rounded above. Abdomen broadly oval, short and massive oval.

Distribution : **India** : Maharashtra, Central India, Tripura, Punjab, Kerala, E Himalayas, Karnataka, West Bengal, Meghalaya, Sikkim, Andaman & Nicobar Islands. *Elsewhere* : Dutch New Guinea; Maffin bay.

Remarks: Reported for the first time from Nagaland state.

Genus *Plagiolepis* Mayr, 1861

Plagiolepis dichroa Forel, 1902

Original Combination - *Plagiolepis dichroa* Forel, 1902

1902. *Plagiolepis dichroa* Forel, *Rev. Suisse Zool.*, 10 : 235, footnote, (Worker).
1903. *Plagiolepis dichroa* Bingham, *Fauna Brit. India, Hym.*, 2: 323.
1995. *Plagiolepis longipes* Bolton, B., *A New General Catalogue of the Ants of the World*, : 335.

Material examined: Workers - 7 exs, Mokokchung (Tsumarshong), 28.9.1994, P.H. Roy Coll. (Regd. No. 12853/H3).

Diagnostic Characters: Worker: 2 mm. From pale dull brownish yellow abdomen with a tinge of brown. Head, alitrunk and abdomen smooth, not punctured. Head shading to light or sometimes to dark brown. Head without the mandibles nearly square, broader posteriorly and proportionately more narrowed anteriorly. Mandibles narrow, acutely dentate along the masticatory margin. Maxillary palpi 6 jointed. Antennae 12 jointed, slender the scape barely extending beyond the top of the head. Alitrunk the meso-metanotal emargination distinct, the metanotum about as broad as the pronotum, its basal portion very short, much shorter than its oblique portion, convex and gibbous. Node of the petiole, low, somewhat thick at base, rounded above. Abdomen broadly oval, gibbous anteriorly.

Distribution : **India**: Meghalaya, Sikkim, West Bengal (Barrackpore), Karnataka.

Remarks: Reported for the first time from Nagaland state.

Genus *Oecophylla* Smith, 1860

Oecophylla smaragdina smaragdina (Fabricius, 1775)

Original Combination - *Formica smaragdina* Fabricius, 1775

1775. *Oecophylla smaragdina* Fabricius, *Syst. Ent.*, : 828, Worker.
1806. *Oecophylla smaragdina* Smith, *J. Proc. Linn. Soc. Lond. Zool.*, 4 (Suppl.): 102.
1903. *Oecophylla smaragdina* Bingham, *Fauna Brit. India, Hym.*, 2: 311, Male, Female, Worker.
1951. *Oecophylla smaragdina*, Chapman and Capco, *Monogr. Inst. Sci. Tech., Manila (Check List Ants Asia)*, 1: 220.
1995. *Oecophylla smaragdina* Bolton, B., *A New General Catalogue of the Ants of the World*: 298.

Material examined: Workers: 8 exs, Dimapur (Forest training school), 3.10.1994; P.H. Roy Coll. (Regd. No. 12851/H3).

Diagnostic Characters: Worker: Length of Worker Maj. 9.5- 11 mm. Worker Min. 7- 8 mm. Rusty red in colour. Head of Maj. and Min.

relatively the same size, roundly quadrangular, posteriorly not emarginated and slightly broader than in front. Mandibles long with masticatory margin very broad in proportion to length, dentate and the apical tooth acute and curved. The clypeus strongly convex about two third as high as broad and its anterior margin strongly arched. Antennae 12 jointed, originating from the anterior margin of the clypeus. Alitrunk elongated. The pronotum convex, anteriorly narrowed into a collar, mesonotum constricted, narrow, saddle shaped and metanotum rounded above and gibbous. Petiole elongated, incrassate in the middle scarcely nodiform. Abdomen short and oval.

Distribution : **India:** Andaman, Assam, Gujarat, Karnataka, Kerala, Maharashtra, Meghalaya, North- West Himalayas, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand (Dehradun), Uttar Pradesh, West Bengal, Chandigarh. *Elsewhere:* Australia, Java, Malaysia, Myanmar, New Guinea, South China, Sri Lanka, Philippines.

Remarks: Reported for the first time from Nagaland state.

Key to the species of *Camponotus*

1. Thorax viewed from side from side forming a regular arch. *invidus*
- Regular arch of the thorax interrupted at the meso-metanotal suture by the metanotum forming an angle with the mesonotum, basal portion of metanotum horizontal, flat or slightly concave, apical portion excavate *sericeus*

Genus *Camponotus* Mayr, 1861

Camponotus (Tanaemyrmex) invidus

Forel, 1892

Original Combination – *Camponotus invidus* Forel, 1892

1892. *Camponotus (Tanacmyrmex) invidus* Forel, J. *Bombay nat. Hist. Soc.*, 7: 225 & 234, fig. 2, Worker, Soldier.

1903. *Camponotus (Tanaemyrmex) invidus* Bingham, *Fauna Brit. India, Hym.*, 2: 367.

1995. *Camponotus (Tanaemyrmex) invidus* Bolton, B., A *New General Catalogue of the Ants of the World*: 105.

Material examined: Workers: 3 exs, Mokokchung (Tsumarshong), 28.9.1994, P.H. Roy Coll. (Regd. No. 12843/H3).

Diagnostic Characters: Length worker – 5 – 6 mm.

Worker : Head, alitrunk and abdomen entirely pale yellow with sparse erect yellowish pubescent. Head more or less elongate, sides of the head straight not convex. Mandibles with 6 teeth; clypeus comparatively broad. Antennae 12 segmented, comparatively long and thick. Alitrunk convex anteriorly, strongly laterally compressed posteriorly, with the pro-meso and metanotum more strongly curved. Legs stout, tibia cylindrical. Petiole one jointed, node low, convex in front, flat posteriorly, abdomen comparatively long and massive.

Distribution : **India:** Uttarakhand, Rajasthan, Orissa, Himachal Pradesh, Sikkim, West Bengal, Delhi, Uttar Pradesh, Andaman & Nicobar Islands.

Remarks: Reported for the first time from Nagaland State.

Camponotus (Orthonotomyrmex)

sericeus sericeus (Fabricius, 1798)

Original Combination – *Formica sericea* Fabricius, 1798

1798. *Camponotus (Orthonotomyrmex) sericeus* Fabricius, *Ent. Syst. Suppl.*, 279, Worker (*Formica*).

1903. *Camponotus (Orthonotomyrmex) sericeus* Bingham, *Fauna Brit. India, Hym.*, 2: 376-377.

Material examined: Workers : 12 exs., Dimapur (Rangapahar reserve forest), 1.10.1994, P. H. Roy Coll. (Regd. No. 12844/H3).

Diagnostic characters : Length worker maj. 10 mm.

Worker : Black with the head blood red in colour Abdomen with a dense silky golden pubescence hiding the sculpture. Head very broad, emarginate posteriorly, mandibles with 5 teeth. The anterior border of clypeus emarginate in the middle. Alitrunk broad in front, strongly

compressed posteriorly, emarginate at the meso-metanotal suture, the basal face of the metanotum horizontal, flat the sides margined posterior face excavate. Tibia of legs spinous beneath. Node of petiole rounded knob like. Abdomen very broad, globose.

Distribution : **India:** Uttarakhand, Rajasthan, Gujarat, Maharashtra, Chandigarh, Karnataka, Tamil Nadu, West Bengal, Meghalaya, Punjab, Orissa, Manipur, Delhi.

Elsewhere: Myanmar, Sri Lanka, Africa, Arabia, Egypt, Indo-China, Senegal.

Remarks: Reported for the first time from Nagaland state

Key to the species of *Paratrechina*

1. Scape of antennae extending beyond top of head by less than half its length.....*longicornis*
- Scape of antennae remarkably long, extending beyond top of head by more than half its length.....2
2. Head oval, narrowed posteriorly.....*taylori*
- Head more or less quadrangular, broad posteriorly.....*aseta*

Genus *Paratrechina* Motschoulsky, 1863

Paratrechina longicornis longicornis (Latreille, 1802)

Original Combination - *Formica longicornis*, 1802

1802. *Prenolepis longicornis* Latreille, *Hist. Nat. Fourmis*, pp. 113, (*Formica longicornis*), Worker.

1894. *Prenolepis longicornis* Forel, *J. Bombay. nat. Hist. Soc.*, 8: pp. 406 & 407, (Worker, Male).

1903. *Prenolepis longicornis* Bingham, *Fauna Brit. India, Hym.*, 2: 326-327. (Worker, Female, Male).

Material examined: Workers - 10exs., Dimapur (Forest Colony under log), 3.10.1994; 4 exs, Mokokchung (Tsumarshong), 28.9.1994, 3 exs, Kohima (Jalsana basti), 23.9.1994, P. H. Roy Coll. (Regd. No. 12845/H3, 12846/H3, 12847/H3).

Diagnostic characters : Length: Worker - 2.5 - 3 mm. Dull coppery brown in colour, with fairly abundant, long, erect, somewhat coarse hairs. Head oval as broad in front as posteriorly. Mandible small with 5-6 teeth. Antennae 12

jointed, scape of antennae remarkably long, extending beyond the top of the head by more than half its length. Alitrunk elongate, rounded above viewed from side lightly emarginate at the mesonotum, not constricted at the mesometanotal suture. Node of the petiole not so broad as high. Abdomen anteriorly gibbous oval and massive.

Distribution : **India:** Uttarakhand, Rajasthan, Western India, Maharashtra, Orissa, West Bengal, Uttar Pradesh, Tamil Nadu, Lakshadweep, Manipur, Andaman & Nicobar Islands, Karnataka, Meghalaya, Tripura, N.W. India. **Elsewhere:** Srilanka, Senegal, Oceania, Australia, New Caledonia, All tropical countries (Europe).

Remarks: Reported for the first time from Nagaland State.

Paratrechina taylori taylori (Forel, 1894)

Original Combination - *Paratrechina taylori* Forel, 1894

1894. *Prenolepis taylori* Forel, *J. Bombay. nat. Hist. Soc.*, 8: 407, (Worker, Female, Male).

1903. *Prenolepis taylori* Bingham, *Fauna Brit. India, Hym.*, 2: 328, (Worker, Female, Male).

1995. *Paratrechina taylori* Bolton, B., *A New General Catalogue of the Ants of the World*: 315.

Material examined: Workers - 3exs, Mokokchung (Tsumarshong), 28.9.1994, P.H. Roy Coll. (Regd. No. 12848/H3).

Diagnostic characters : **Length** Worker : 1.5 - 2 mm. Pale yellow in colour, body covered with scattered, short semi-erect, pale hairs. Head oval longer than broad, very convex in front. Mandibles narrow, the masticatory margin oblique. Antennae 12 jointed, scape of antennae remarkably long, extending beyond the top of the head by more than half its length. Alitrunk elongate, the pro-meso- and meso-metanotal sutures distinct, mesonotum not constricted. Node of the petiole low, inclined forward, flat, rounded above. Abdomen massive, convex above, gibbous in front.

Distribution : **India :** West Bengal, Orissa, Western India. **Elsewhere :-** Sri Lanka.

Remarks: Reported for the first time from Nagaland state.

***Paratrechina aseta* (Forel, 1902)**

Original Combination – *Prenolepis aseta* Forel, 1902

1902. *Prenolepis aseta* Forel, *Ann. Soc. Ent. Belg.*, **46** : 292, (Worker).

1903. *Prenolepis aseta* Forel, *Fauna Brit. India, Hym.*, **2** (1903):335, (Worker)

1995. *Paratrechina aseta* Bolton, B., *A New General Catalogue of the Ants of the World* :312.

Material examined: Workers – 8 exs, Kohima (Jalsana basti), 23.9.1994, P.H. Roy Coll. (Regd. No.12849/H3).

Diagnostic characters : **Length:** Worker : 1.5 – 2 mm. Brownish, alitrunk reddish yellow. Head rectangular the sides straight , a little longer than broad, posteriorly, slightly emarginated. Mandibles narrow, armed with 6 teeth. Antennae 12 jointed, scape of antennae passing extending beyond the top of the head about one fourth of its length. Alitrunk the pro-meso- and meso-metanotal sutures distinct but feeble, the meso-metanotal suture slightly emarginate, metanotum raised a little. Node of the petiole somewhat quadrangular, inclined forwards. Abdomen broad anteriorly.

Distribution : **India :** Sikkim, West Bengal, Gujarat.

Remarks: Reported for the first time from Nagaland state.

Genus *Formica* Linnaeus, 1758

***Formica rufibarbis rufibarbis* Fabricius, 1793**

Original Combination – *Formica rufibarbis* Fabricius, 1793

1793. *Formica rufibarbis* Fabricius, *Ent. Syn.*, **2** : 355, (Worker),

1903. *Formica rufibarbis* Bingham *Fauna Brit. India, Hym.*, **2** : 335.

Material examined: Workers – 2exs, Kohima (Jotsama village), 23.9.1994, P.H. Roy Coll. (Regd. No.12850/H3).

Diagnostic characters: Length-Worker –5–6 mm.

Head, alitrunk, mandibles, antennae and abdomen yellowish red, abdomen fuscous

brown. Mandibles broad with the minute teeth on the masticatory margin. Alitrunk the constriction at the meso-metanotal suture deep, the metanotum viewed from side regularly arched. Antennae 12 jointed, scape of antennae passing beyond the top of the head about one fourth of its length. Node of the petiole flat or a little convex, both anteriorly and posteriorly. Abdomen broad.

Distribution : **India :** Sikkim, Himachal Pradesh. *Elsewhere :* Europe, Northern America, France, China.

Remarks: Reported for the first time from Nagaland State.

Sub-family **PONERINAE** Lepeletier

Key to the species of Genus *Pachycondyla*

1. Posterior margin of node of petiole armed with a number of blunt processes.....*rufipes*
- Node of petiole simple, unarmed.....2
2. Meso-metanotal suture well marked*melanaria*
- Meso-metanotal suture obsolete*sulcata*

Genus *Pachycondyla* Smith, 1858

***Pachycondyla rufipes rufipes* (Jerdon, 1851)**

Original Combination – *Ponera rufipes* Jerdon, 1851

1851. *Ponera rufipes* Jerdon, *Madras J. Lit. Sci.*, **17**: 119, Worker.

1858. *Pachycondyla rufipes*, Smith, *Cat. Hym. Brit. Mus.*, **4**:106.

1903. *Bothroponera rufipes*, Bingham, *Fauna Brit. India, Hym.*, **2**: 96-97, Worker.

1911. *Pachycondyla (bothroponera) rufipes*, Emery, *Genera Insect*, **118**: 76-77.

1951. *Bothroponera rufipes*, Chapman and Capco, *Monogr. Inst. Sci. Tech., Manila (Check List Ants Asia)*, **1**: 50.

1994. *Bothroponera rufipes*, Tiwari et al., *State Fauna Series 3: Fauna of West Bengal*, **8**: 21.

1995. *Pachycondyla rufipes*, Bolton, B., *A New General Catalogue of the Ants of the World* :309.

Material examined:

Workers : 6 exs, Mokokchung (Minkong forest- rotten tree) , 27.9.1994; 1 ex., Kohima

(forest), 22.9.94, P.H. Roy Coll. (Regd. No. 12836/H3, 12837/H3).

Diagnostic Characters : Worker: length 13- 15 mm. Dull black, mandibles, antennae and legs castaneous red, the apical two or three abdominal segment bright ferruginous. The whole insect covered with an abundant pale reddish yellow pilosity. Mandibles longitudinally striate without distinct teeth. Eyes small. Antennae 12 jointed, scape of antennae reaching to posterior margin of head, club thick at apex. Alitrunk rounded above, metanotum unarmed, the apical truncated face of metanotum smooth and shining and strongly margined on the sides and above. The node of pedicel about twice as broad as long, convex and rounded above, posteriorly concave, smooth and shining, spinous processes on the posterior margin above irregular. Abdomen very massive, constriction between the basal two segments distinct, sting powerful and exerted, claws simple.

Distribution : **India:** Andaman & Nicobar Islands, Assam, Karnataka, Kerala, Maharashtra, Meghalaya, Orissa, Sikkim, Tripura, Western India (from Kanara to Malabar), West Bengal. *Elsewhere:* Myanmar, Sri Lanka, Vietnam.

Remarks: Reported for the first time from Nagaland State.

Pachycondyla melanaria melanaria
(Emery, 1893)

Original Combination – *Ponera melanaria* Emery, 1893

1893. *Euponera* (*Mesoponera*) *melanaria* Emery, *Ann. Soc. Ent. Fr.*: 260, (Worker) (*Ponera*).

1903. *Mesoponera melanaria* Bingham, *Fauna Brit. India, Hym.*, 2: 100, Worker.

Material examined: Workers : 4 exs, Kohima (forest), 22.9.94; 6 exs, Dimapur (Chumuksdina), 3.10.1994, P.H. Roy Coll. (Regd. No. 12839/H3, 12840/H3).

Diagnostic Characters : Worker: Length 7.5- 8.5 mm. Dark, castaneous brown, smooth and shining, mandibles, antennae and legs much lighter, pilosity almost wanting. Head without the mandibles rectangular, longer than broader,

the posterior lateral angle rounded not prominent, broad posteriorly in front. Mandibles strong, triangular, masticatory margin of mandible very long. Posterior margin of clypeus defined by a suture. Antennae 12 jointed, scape reaching to the posterior margin of head. The pronotum of the alitrunk, broad and convex. The mesonotum prominent, more or less gibbous. The pro-meso and meso-metanotal sutures well marked. The metanotum more or less acute along its basal portion above, the obliquely truncate posteriorly viewed from the back the apical face is subtriangular. Petiole one jointed, node very convex in front, flat, almost concave posteriorly, not so broad at the apex as at base. Gaster with powerful and exerted sting, claws simple.

Distribution : **India:** Karnataka, Kerala. *Elsewhere:* Myanmar, Singapore, Sri Lanka, Sumatra.

Remarks: Reported for the first time from Nagaland state.

Pachycondyla sulcata sulcata (Mayr, 1867)

Original Combination – *Ponera sulcata* Mayr, 1867

1867. *Bothroponera sulcata* Frauenfeld, *Verh. zool.-bot. Ges. Wien*, 17 (1867): 441, (Worker) (*Ponera*).

1903. *Bothroponera sulcata*, Bingham, *Fauna Brit. India, Hym.*, 2: 98-99, Worker.

1995. *Pachycondyla sulcata* Bolton, B., *A New General Catalogue of the Ants of the World*: 310.

Material examined: Workers : 2 exs, Mokochung (Minkong forest), 27.9.1994, P.H. Roy Coll. (Regd. No. 12838/H3).

Diagnostic Characters: Worker: length 8 – 11.5 mm. Dull black, mandibles, antennae and legs castaneous red, alitrunk and abdominal with a dense pubescence.. Mandibles triangular, masticatory margin with 7-8 teeth. Eyes small. Antennae 12 jointed, 1st joint of flagellum of antennae distinctly longer than 2nd. Alitrunk convex, rounded above as the head, narrowing towards the apex which is truncate. Node of petiole thick, about as long as broad, comparatively flat and truncate anteriorly and

posteriorly. Abdomen very massive and cylindrical.

Distribution : **India** : Maharashtra, Western India, Andhra-Pradesh, Tamil-Nadu, W.Bengal, Orissa, Central India, N.W. Provinces.

Remarks : Reported for the first time from Nagaland state.

Sub-family DOLICHODERINAE Forel

Genus *Tapinoma* Forster, 1850

Tapinoma melanocephalum melanocephalum
(Fabricius, 1793)

Original Combination – *Formica melanocephala*, 1793

1793. *Tapinoma (Micromyrma) melanocephalum* Fabricius,
Ent. Syst., 2: 353, (*Formica melanocephala*).

1903. *Tapinoma (Micromyrma) melanocephalum* Bingham,
Fauna Brit. India, Hym., 2: 304.

Material examined: Workers: 12 exs, Dimapur (Chumuksdina), 3.10.1994; 5 exs, Dimapur (Rest house complex), 31.10.1994, P.H. Roy Coll. (Regd. No. 12841/H3, 12842/H3).

Diagnostic characters : Length worker : 1.5 mm.

Worker : Head and thorax dark brown in colour abdomen yellowish white. Head longer than broad. Oval, not emarginate, rounded posteriorly. Mandibles triangular broad with the masticatory margin equal to the outer margin and armed with minute teeth. Clypeus evenly convex, broader than high, its anterior margin slightly arched. Antennae thick the scape extending beyond the top of the head. The joints of the flagellum longer than broad. Alitrunk viewed from the side not emarginate, the pro-meso and

meso-metanotal sutures distinct slightly constricted at the latter suture. Petiole with a distinct node. Base of the abdomen overhanging the pedicel.

Distribution : **India**: Uttarakhand, Rajasthan, Gujarat, Maharashtra, Meghalaya, Tripura, Chandigarh, Karnataka, Tamil-Nadu, West Bengal, Orissa, Lakshadweep, Andaman & Nicobar Islands. *Elsewhere*: Spread through both the hemispheres, S. America, French Guiana.

Remarks: Reported for the first time from Nagaland state.

SUMMARY

The manuscript deals with 24 species distributed under 15 genera of the family Formicidae comprising four subfamilies namely Ponerinae with 1 genera, and 3 species, Dolichoderinae with 1 genera, and 1 species, Formicinae with 5 genera and 9 species, Myrmicinae with 8 genera and 11 species. All the 24 species and 15 genera are new records from Nagaland state.

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ON A COLLECTION OF AQUATIC AND SEMI-AQUATIC BUGS (HEMIPTERA: HETEROPTERA) FROM CHHATTISGARH, INDIA

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INTRODUCTION

Aquatic Heteroptera occupy a broad spectrum of aquatic habitats, have a multitude of shapes, and are adapted to a broad variety of niches (Spencer and Andersen, 1994). The aquatic and semi aquatic groups of insects represent a significant level of diversity in India (Ghosh, 1996). Aquatic hemipterans stand out as an important group of aquatic insects, which are considered important in environmental reclamation of aquatic habitats and are often used to gauge toxins in an environment (Jansson 1987; Papacek 2001; Wollmann 2001). The true bugs practice extra-oral digestion and may be predaceous, phytophagous, granivorous, or ectoparasitic, or they may use combinations of several modes of feeding (Haddad *et al.*, 2010). Williams (1996) have pointed out that invertebrates inhabiting temporary streams can have high diversity similar to permanent streams, therefore they should be considered in conservation plans designed to protect species and their habitats. Thirumalai (2002, 2007) reported 128 species of Gerromorpha and 153 species of Nepomorpha from India respectively. Since, there is no comprehensive account on aquatic Heteroptera of Chhattisgarh, the present study is undertaken.

Infraorder GERROMORPHA Popov, 1971

Family **Hydrometridae** Billberg, 1820

Subfamily Hydrometrinae Esaki, 1927

Genus **Hydrometra** Latreille, 1796

1. **Hydrometra greeni** Kirkaldy, 1898

1898. *Hydrometra greeni* Kirkaldy, *Entomologist*, 31: 2.

2005. *Hydrometra greeni* Kirkaldy: Yang & Zettel., *Raff. Bull. Zool.*, 53(1): 84.

Material examined: Bilaspur Dist., 5 mac. ♂, 2 mac. ♀ exs., Karidongri Rest House, 19.ix.2012; Durg Dist., 1 ♂ ex., Balod Beat, 25.ix.2012; Kabirdham Dist., 1 ♂ ex., Rengakhar RH, 6.vi.2012; 1 mac. ♂ ex., Kawardha Range, Saroda Dam, 22.ix.2012, Coll. A. Raha & Party; Korba Dist., 1 ♀ ex., Sericultural Farm, 1.vi.2012., 1 ♂, 2 ♀ exs., Bijakhara Nala, 1.vi.2012, Coll. K. Chandra & Party; Raipur Dist., 8 ♂, 1 ♀ exs., Dullibahal, 1.xi.2011, Coll. A. Sarsavan & A. Gangopadhyay; 1 mac. ♂, 1 mac. ♀, Barnawapara WLS, 7.vii.2011, Coll. S.K. Gupta & Party; Surguja Dist., 1 mac ♂, 1 mac ♀, Tara Range, Lekhutdand, 15.ix.2012; 2 mac. ♂, 4 mac. ♀ exs., Ambikapur Range, Bilgumpha, 14.ix.2012; 4 mac. ♂, 4 mac. ♀ exs., Tara FRH, 16.ix.2012; 9 mac. ♂, 2 mac. ♀, Tara, Abhay nala, 17.ix.2012, Coll. A. Raha & Party.

Diagnosis: (Fig. 1A), Body elongate with thread-like legs; head longer than pronotum; eyes far from anterior margin of pronotum; antenna 4-segmented. 1st segment very short, 2nd and 4th subequal, 3rd segment longest; pronotum long; hemelytra shorter than abdomen. The hemelytra extends upto the 5th abdominal segment in both sexes. Seventh abdominal sternum of male depressed. Sixth and seventh sternum of male with dispersed hairs.

Distribution: Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan,

Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Mayanmar, Japan, Malay Peninsula, Philippines, Sri Lanka, Thailand and Vietnam.

Remarks: The species is widely distributed all over India and is also reported to have been attracted towards light.

Family **Gerridae Leach, 1815**

Subfamily **Gerrinae Bianchi, 1896**

2. ***Aquarius adelaidis* (Dohrn, 1860)**

1860. *Aquarius adelaidis* Dohrn., *Stettin. ent. Ztg.*, **21**: 408.

2002. *Aquarius adelaidis* (Dohrn): Thirumalai., *Rec. zool. Surv. India*, **100**(1-2): 60.

Material examined: Durg Dist., 18 ♂ (6 mac., 12 brachy.), 54 ♀ (17 mac., 37 brachy.) exs., Balod Range, Borid Gaon, 26.ix.2012, Coll. A. Raha & Party.

Diagnosis: (Fig. 1B), Length male 12.3 mm, female 15 mm; head and anterior lobe of pronotum black; base of the head ochraceous, centroapical half of head with furrow, lateral and apical region with dense grayish white pubescence; antennae 1st segment longer, 2nd and 4th subequal in length, 3rd segment shorter; apex of fore and mid femora with two spines; rostrum reached upto the fore coxa; scent orifice with a transverse sulcus; 8th sternum of female with a median longitudinal slit; connexival spines surpassing the tip of abdomen in females and in males it is not surpassing the tip of abdomen; between 7th and 8th abdominal sternum of male with an excavation; 8th abdominal sternum of male depressed; wings pale brown.

Distribution: Andhra Pradesh, Bihar, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Bangladesh, China, Indonesia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.

Remarks: This species is confined to lentic ecosystem.

Genus ***Limnogonus* Stål, 1868**

Subgenus ***Limnogonus* Stål, 1868**

3. ***Limnogonus (Limnogonus) fossarum* fossarum** (Fabricius, 1775)

1775. *Cimex fossarum* Fabricius, *Syst. Ent.*, 727.

2002. *Limnogonus (Limnogonus) fossarum* (Fabricius): Thirumalai, *Rec. zool. Surv. India*, **100**(1-2): 62.

Material examined: Kabirdham Dist., 1 mac ♂, 1 mac ♀ exs., Kawardha Range, Saroda Dam, 22.ix.2012, Coll. A. Raha & Party.

Diagnosis: (Fig. 1C), Body of moderate size; antennae 4-jointed, 2nd and 3rd joints shortest and nearly subequal in length; 4th antennal joint slightly smaller than the 1st joint or subequal; pronotum with the mid-longitudinal carination moderately prominent, posterior tip of pronotum remarkably angular; 7th abdominal segment with connexival spines. Pronotal lobe with median longitudinal yellow stripe and anterior region with two oblong spots.

Distribution: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu and West Bengal. *Elsewhere*: Bangladesh, China, Hong Kong, Indonesia, Japan, Malay Peninsula, Myanmar, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam.

Remarks: This is an uncommon species of the genus *Limnogonus* in Madhya Pradesh. This species is attracted towards light.

4. ***Limnogonus (Limnogonus) nitidus***

(Mayr, 1865)

1865. *Hydrometra nitida* Mayr, *Verh. Zool.-bot. Ges. Wien*, **15**: 443.

2002. *Limnogonus (Limnogonus) nitidus* (Mayr): Thirumalai, *Rec. zool. Surv. India*, **100**(1-2): 62.

Material examined: Kabirdham Dist., 1 ♀ ex., Bhoramdev WLS, Suuwahi Forest, 8.xi.2011, Coll. S.K. Gupta & Party.

Diagnosis: (Fig. 1D), Piceous; baso-central region of head ochraceous, anterior pronotal lobe with two linear yellow stripes, near to which suppressed; lateral margin of pronotum with yellow fascia; males connexival spines short and not reaching the apex of abdomen, but in female

very prominent connexival spines and surpassing the abdomen; scent orifice not pigmented.

Distribution: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Karnataka, Kerala, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* China, Indonesia, Malaysia, Maldives Islands, Myanmar, Nepal, Singapore, Sri Lanka, Thailand and Vietnam.

Remarks: Large number of this species gets attracted towards light. This species is also inhabited both lentic and lotic ecosystems and is distributed throughout India.

Genus *Limnometra* Mayr, 1865

5. *Limnometra fluviorum* (Fabricius, 1798)

1798. *Cimex fluviorum* Fabricius, *Ent. Syst. Suppl.*, 543.

2002. *Limnometra fluviorum* (Fabricius): Thirumalai, *Rec. zool. Surv. India*, **100**(1-2): 63.

Material examined: Kabirdham Dist., 2♂, 5♀ exs., Bhoramdev WLS, Jalmala Forest, 23.xi.2011, Coll. A. Sarsavan & A. Gangopadhyay.

Diagnosis: (Fig. 1E), Length: 11-12.5 mm; Body brown colour; 1st antennal segment long, 2nd, 3rd and 4th segments more or less subequal in length; head with two ochraceous stripes; pronotum with a black median stripe and lateral margin with black continuous fascia; lateral margin of mesonotum with a black fascia; middle coxa with a dorsolateral spine like projection; wings dark brown.

Distribution: Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Puducherry, Tamil Nadu and West Bengal. *Elsewhere:* Philippines and Sri Lanka.

Remarks: It is found in almost all freshwater ecosystems. This species can be differentiated from other known species of this genus by the presence of a spine like projection on the dorsolateral margin of the middle coxa.

Genus *Neogerris* Matsumura, 1913

6. *Neogerris parvulus* (Stål, 1859)

1859. *Gerris parvula* Stål, *Zoology*, **4**: 265.

2002. *Neogerris parvula* (Stål): Thirumalai., *Rec. zool. Surv. India*, **100**(1-2): 61-62.

Material examined: Bilaspur Dist., 1 ♀ ex., Hasdeo River, 18.ii.979, Coll. K. Reddiah & Party.

Diagnosis: (Fig. 1G), Body elongate; anterior pronotum with a single yellow spot; 1st antennal segment longest and as long as or little longer than the 2nd and 3rd segments together; 4th antennal segment remarkably smaller than the 1st segment; mid longitudinal carination of pronotum indistinct and present on anterior half, male abdomen narrow but female abdomen stout, scent orifice with reddish brown spot.

Distribution: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Kerala, Madhya Pradesh, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Bangladesh, China, Iran, Japan, Java, Malay Peninsula, Myanmar, New Guinea, Oman, Philippines, Pakistan, Singapore, Sri Lanka, Solomon Islands, Taiwan and Vietnam.

Remarks: This species is widely distributed in India and present in both lentic and lotic ecosystem. Very few were attracted towards light.

Subfamily Cyndrostethinae Matsuda, 1960

Genus *Cylindrostethus* Mayr, 1865

7. *Cylindrostethus productus* (Spinola, 1840)

1840. *Gerris productus* Spinola, Esaki. *Sur less insectes hemipteres rhynchotes on heteropteres*, 64.

2002. *Cylindrostethus productus* (Spinola): Thirumalai, *Rec. zool. Surv. India*, **100**(1-2): 58.

Material examined: Jashpur Dist., 4♂, 3♀ exs., Badalkhol WLS, Kharanala, 27.v.2012, Coll. A. Raha & Party; Kabirdham Dist., 4♂, 5♀ exs., Bhoramdev WLS, Suuwahi Forest, 18.xi.2011, Coll. S.K. Gupta & Party; 7♂, 9♀ exs., Jamunpani Forest, 22.xi.2011, Coll. A. Gangopadhyay; Surguja Dist., 9♂, 10♀ exs., Munakhand village, Baharaghat Nala, 16.i.975, Coll. S.K. Mishra & Party; 27♂, 21♀ exs., Surguja Forest RH, 15.i.1975, Coll. D.S. Mathur.

Diagnosis: (Fig. 1F), First antennal segment longer than the combined length of 2+3+4 antennal segments; 4th antennal segment slightly bended; lateral margin of thorax with a silvery white fascia, which is surrounded by black bands forming a sand-witch appearance; rostrum short, not surpassing 1st sternum; meta sternum just above its apex with a distinct groove; connexival

spines are convergent in female, but in male connexival spines are divergent.

Distribution: Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Sri Lanka.

Remarks: This is the largest species of the genus so far known from the eastern Hemisphere.

Subfamily Ptilomerinae Bianchi, 1896

Genus *Ptilomera* Amyot & Serville, 1843

Subgenus *Ptilomera* Amyot & Serville, 1843

8. *Ptilomera (Ptilomera) agroides* Schmidt, 1926

1926. *Ptilomera agroides* Schmidt, *Ent. Mitt.*, **15**(1): 63.

2002. *Ptilomera (Ptilomera) agroides* Schmidt: Thirumalai, *Rec. zool. Surv. India*, **100**(1-2): 69.

Material examined: Kabirdham Dist., 1 ♂ ex., Bolda, 8.vi.2012, Coll. A. Raha & Party; Korba Dist., 1 ♂, 4 ♀ exs., Lemru Range, Telemanala, 3.vi.2012, Coll. K. Chandra & Party; Surguja Dist., 4 ♂, 1 ♀ exs., Forest RH, 15.i.1975, Coll. D.S. Mathur.

Diagnosis: (Fig. 1H), Apex of frontoclypeus trilobed, from the lateral lobe antennae arises and from the central lobe rostrum arises; vertex of head bulged, having a slanting brown band inner to the eyes; lateral margin of meso and metanotum with silvery white fascia; first antennal segments longer than the combined length of 2+3+4 segments; basal fore tarsal segment very long; fore tibial process well developed in females and poorly developed in females; hind coxa with lateral spines; inner margin of mid femur in males fringed with hairs but it is devoid in females; dorso-lateral projection of pygofer in males extends beyond lateral wings of suranal plate.

Distribution: Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra and Tamil Nadu.

Remarks: It is a very common gerrid found in flowing mountain streams, rivers etc.

Subfamily Halobatinae Bianchi, 1896

Tribe Metrocorini Matsuda, 1960

Genus *Metrocoris* Mayr, 1865

9. *Metrocoris communis* (Distant, 1910)

1910. *Euodus communis* Distant, *Ann. Mag. nat. Hist.*, **5**(8): 151.

2002. *Metrocoris communis* (Distant): Thirumalai, *Rec. zool. Surv. India*, **100**(1-2): 65-66.

Material examined: Bilaspur Dist., 3 ♂ exs., Tan River, 12.ii.1979, K. Reddiah & Party; Kabirdham Dist., 2 ♂, 5 ♀ exs., Bhoramdev WLS, Kudai Dhona Forest, 15.xi.2011; 5 ♂, 4 ♀ exs., Suuwahi Forest, 18.xi.2011, Coll. S.K. Gupta & Party; 3 ♂, 4 ♀ exs., Loop Forest, 20.xi.2011, Coll. A. Sarsavan & A. Gangopadhyay; Korba Dist., 13 ♂, 14 ♀ exs., Lemru Range, Telemanala, 3.vi.2012, Coll. K. Chandra & Party; Raipur Dist., 4 ♂, 5 ♀ exs., Hardipathar, 5.xi.2011, Coll. A. Sarsavan & A. Gangopadhyay; Surguja Dist., 2 ♂, 3 ♀ exs., Kamaleshwarpur, 15.i.1975, Coll. H. Khajuria & Party; 5 apt. ♂, 5 apt. ♀, Sankarghat, Mainpath Range; 14 ♂ (1 mac, 13 apt), 13 ♀ (1 mac, 12 apt), Mainpath FRH, 12.ix.2012, Coll. A. Raha & Party.

Diagnosis: (Fig. 1I), Female 4.1 mm (5.4 mm including wings); fore femur not stout; 1st antennal segment long, 2nd and 3rd subequal in length, 4th segment smaller; inner margin of hind trochanter fringed with hairs; apex of pronotal lobe very acute; head and thorax with black marking; the pronotum of wingless forms with T-shaped black marking and the winged form with a black longitudinal stripe almost reaching tip with a pair of lateral black stripes on posterior lobe. The 7th ventral segment of female with a tuft of dark brown hairs on either side laterally.

Distribution: Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Uttar Pradesh. *Elsewhere:* Afghanistan, Iran, Iraq and Oman.

Remarks: It is a common species in Northwestern and central India.

Infraorder NEPOMORPHA Papov, 1968

Superfamily NEPOIDEA Latreille, 1802

Family Belostomatidae Leach, 1815

Subfamily Belostomatinae Leach, 1815

Genus *Diplonychus* Laporte, 1833

10. *Diplonychus annulatus* (Fabricius, 1781)

1781. *Nepa annulata* Fabricius, *Carol. Ernest. Bokhni. Hamburgi et Kiloni*, 333.

2007. *Diplonychus annulatus* (Fabricius): Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* **273**: 11-12.

Material examined: Bastar Dist., 1 ♂, 2 ♀ exs., Jagadapur, 12.i.1974, Coll. R.K. Singh & Party; Bilaspur Dist., 3 ♀ exs., Khutaghat, 7.iii.1992; Korba Dist., 2 ♂, 1 ♀ exs., 8.iii.1992, Coll. U.A. Gajbe & Party; Raipur Dist., 2 ♀ exs., Khosi Nala, 5.xii.1991, Coll. H.S. Sharma & Party; Surguja Dist., 1 ♂ ex., Ambikapur, 9.i.1975, Coll. H. Khajuria & Party.

Diagnosis: (Fig. 2A), Body broad and oval, maximum width of hemelytra together is almost equal to their length; head as long as the interocular space; anterior tarsus with two segments; hemelytra devoid of any shining spot beyond the middle of the inner margin. Body more than 20 mm long.

Distribution: Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Bangladesh and Pakistan.

Remarks: This is the larger species of the genus *Diplonychus* in India. Sometimes it feeds on dragonfly nymphs.

11. *Diplonychus molestus* (Dufour, 1863)

1863. *Appasus molestum* Dufour, *Ann. Soc. Ent. France*, 4(3): 395.

2007. *Diplonychus molestus* (Dufour): Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* 273:12.

Material examined: Bilaspur Dist., 1 ♂, 3 ♀., 8.iii.1992, Rajnandagon Dist., 1 ♂ ex., Shanti Nagar, 22.xii.1983, Coll. U.A. Gajbe & Party; Raipur Dist., 2 ♂ exs., Baloda Bazar, 7.xii.1991, Coll. H.S. Sharma & Party; Rajgarh Dist., 1 ♀, Newas River, 8.x.1995, Coll. Y.N. Gupta & H.S. Sharma.

Diagnosis: (Fig. 2B), Length: 13.5 mm to 17.5 mm; colour: ochraceous with ash tinct; posterior pronotal angles obtuse; respiratory straps without cluster of setae; spiny wing patch almost round; pubescent stripe of abdominal sternum broad and obscure; well developed wing membrane.

Distribution: Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya

Pradesh, Maharashtra, Manipur, Odisha, Punjab, Tripura, Uttar Pradesh and West Bengal.

Remarks: This species attracted towards light. The colour of this species varies depend on the habitat the live.

12. *Diplonychus rusticus* (Fabricius, 1781)

1781. *Nepa rustica* Fabricius, *Species insectorum*, 2: 333.

2007. *Diplonychus rusticus* (Fabricius): Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* 273:12-13.

Material examined: Korba Dist., 1 ♂, 4 ♀ exs., 8.iii.1992, Coll. U.A. Gajbe & Party; Surguja Dist., 6 ♂, 9 ♀ exs., Ambikapur, 9.i.1975, Coll. H. Khajuria & Party.

Diagnosis: (Fig. 2C), Length: 15 mm to 16 mm. Colour: ochraceous brown; posterior pronotal angles acute; respiratory straps with cluster of setae; spiny wing patch almost oblong; pubescent stripe of abdominal sternum linear and prominent; wing membrane very small.

Distribution: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Australia, Austria, China, Formosa, Indonesia, Japan, Malay Peninsula, Myanmar, New Zealand, Philippines, Sri Lanka, Thailand and New Guinea.

Remarks: This species enormously reduce mosquito larvae. It is also a voracious feeder and has been reported to attack fish fry and fingerlings.

Subfamily Lethocerinae Lauck & Menke, 1961

Genus *Lethocerus* Mayr, 1853

Subgenus *Lethocerus* Mayr, 1853

13. *Lethocerus indicus*

(Lepeletier & Serville, 1825)

1825. *Belostoma indica* Lepeletier & Serville, *Encycl. Meth.*, X: 272.

2007. *Lethocerus indicus* (Lepeletier & Serville): Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* 273:13-14.

Material examined: Bilaspur Dist., 2 ♀ exs., Kota, Kora Sagar, 10.ii.1979, Coll. K. Reddiah & Party; Bilaspur Dist., 2 exs., Atariya forest, 18.vi.2004, 1 ex., Lamni forest, 27.vi.2004., 1 ex., 28.vi.2004, Coll. A. Singh & Party; Jashpur Dist., 1 ♀ ex., Badalkhol WLS, 26.v.2012, Coll. A. Raha & Party; Kabirdham Dist., 1 ♀ ex., Chilpi Forest, 14.xi.2011, Coll. Sunil & Party; Raipur Dist., 2 ♂ exs., Khosi Nala, 5.xii.1991; Raipur Dist., 1 ex., Dhamtari, Mahanadi River, 29.xi.1991, Coll. H.S. Sharma & Party.

Diagnosis: (Fig. 2F), Body dorsoventrally flattened with large size. Head between eyes with parallel sides; pronotum with a transverse fasciae at the basal end and a fine longitudinal carination in the middle; thick sets of swimming hairs on intermediate and posterior legs on the ventral side.

Distribution: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Indonesia, Malay Peninsula, Myanmar, Pakistan and Philippines.

Remarks: This is the largest species of aquatic Hemipteran recorded from all wet land ecosystem. It has been reported to kill even a full-grown frog, while some are known to feed on snails.

Family Nepidae Latreille, 1802
 Subfamily Nepinae Latreille, 1802
 Tribe Nepini Latreille, 1802
 Genus *Laccotrephes* Stål, 1866
 Subgenus *Laccotrephes* Stål, 1866
 14. *Laccotrephes griseus*
 (Güerin-Méneville, 1844)

1844. *Nepa griseus* Güerin-Méneville, *Iconogr. Regne. Anim. Ins.*, 352.

2007. *Laccotrephes griseus* (Güerin-Méneville): Thirumalai, *Rec. zool. Surv. India, Occ. Paper No. 273*: 5-6.

Material examined: Bilaspur Dist., 1 ♀ ex., Ratanpur, Jagdev Ban, 10.xii.1991, Coll. H.S. Sharma & Party; 1 ♀ ex., Karidongri RH,

19.ix.2012, Coll. A. Raha & Party; Raigarh Dist., 1 ♂, 1 ♀ exs., 26.ix.1991, Coll. H.P. Agrawal & Party; 1 ♂, 1 ♀ exs., Newaj River, 8.x.1995; 1 ♂, 4 ♀ exs., Chhapi River, Jeerapur, 10.x.1995, Coll. Y.N. Gupta & H.S. Sharma; Surguja Dist., 3 ♀ exs., Ambikapur, 9.xi.1975, Coll. H. Khajuria & Party; 2 ♀ exs., Barnawapara WLS, Fatehpur Talab, 17.ix.2012, Coll. A. Raha & Party.

Diagnosis: (Fig. 2E), Abdomen above with light bluish tinge; anterior area of prosternum provided with a strong acute spine-like structure; abdominal appendages distinctly shorter than the body; parameres symmetrical and slightly hooked.

Distribution: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Malaysia, Myanmar, Seychelles, Sri Lanka and Thailand.

Remarks: This species was recorded in moderate numbers from all types of wetlands. It inhabits the bottom littoral weedy zone of stagnant water. It is very common in Peninsular India and occurs in permanent pond near the edges.

15. *Laccotrephes ruber* (Linnaeus, 1764)

1764. *Nepa ruber* Linnaeus, *Mus. Lud. Ulr.*, 165.

2007. *Laccotrephes ruber* (Linnaeus): Thirumalai, *Rec. zool. Surv. India, Occ. Paper No. 273*: 7.

Material examined: Bilaspur Dist., 1 ♀ ex., Ratanpur, Nawa Talab, 20.ii.1979; 1 ♀ ex., Haf River, 5.ii.1979; 1 ♂ ex., Tan River, 12.ii.1979, Coll. K. Reddiah & Party; 1 ♂ ex., Sakri, 9.iii.1992, Coll. U.A. Gajbe & Party; 2 ♀ exs., Ratanpur, Jagdev Ban, 10.xii.1991; 1 ♂, 1 ♀ exs., Harpa River, 9.xii.1991, Coll. H.S. Sharma & Party; Raigarh Dist., 1 ♂, 1 ♀ exs., Dharinjoygarh, 2.x.1991, Coll. H.P. Agrawal & Party; Raipur Dist., 1 ♂, 1 ♀ exs., Mahanadi River, 6.xii.1991; 1 ♂, 1 ♀ exs., Shivnath River, 7.xii.1991, Coll. H.S. Sharma & Party; 1 ♂ ex.,

Latadadar Tara, 8.vii.2012, Coll. S.K. Gupta & Party; Surguja Dist., 1 ♂, 1 ♀ exs., Murakhand Village, 16.i.1975, Coll. S.K. Mishra & Party; 2 ♂, 2 ♀ exs., Kamaleshwarpur, 18.i.1975; 1 ♀ ex., Champerma Village, 21.i.1975, Coll. S.K. Mishra & Party; 1 ♂, 2 ♀ exs., Ambikapur, Forest RH, 9.i.1975; 1 ♂, 1 ♀ exs., 15.i.1975; 1 ♀ ex., 6.ii.1975, Coll. H. Khajuria & Party.

Diagnosis: (Fig. 2D), The abdominal appendages are distinctly longer than the body; prosternum is convex in the middle; male paramere curved and hook shaped.

Distribution: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* China, Japan, Nepal, Pakistan and Taiwan.

Remarks: It is a common species with wide distribution in the Indo-Australian region and is found in almost all freshwater ecosystem.

Subfamily Ranatrinae Douglas & Scott, 1865

Tribe Ranatrini Douglas & Scott, 1865

Genus *Cercotmetus* Amyot & Serville, 1843

16. *Cercotmetus fumosus* Distant, 1904

1904. *Cercotmetus fumosus* Distant, *Entomologist*, **37**: 278.

2007. *Cercotmetus fumosus* Distant: Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* **273**: 8.

Material examined: Bilaspur Dist., 1 ♀ ex., Haf River, 5.ii.1979, Coll. K. Reddiah & Party.

Diagnosis: (Fig. 3A), Length: 48 mm; Colour: dark fuscous; vertex of head with a tubercle; hemelytra not reaching the apex of 5th abdominal segment; pronotum as long as mid femur.

Distribution: Bihar, Chhattisgarh, Himachal Pradesh, Madhya Pradesh, Punjab, Tamil Nadu and Uttar Pradesh. *Elsewhere:* Sri Lanka.

Remarks: Species belonging to this genus is poorly known in India (Thirumalai and Sharma, 2008).

Genus *Ranatra* Fabricius, 1790

Subgenus *Ranatra* Fabricius, 1790

17. *Ranatra elongata* Fabricius, 1790

1790. *Ranatra elongata* Fabricius, *Skrif. Nat. Selesk.*, **1**: 228.

2007. *Ranatra elongata* Fabricius: Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* **273**: 9.

Material examined: Raipur Dist., 1 ♀ ex., Jail Road, 30.vi.2011, Coll. K. Chandra & Party; Surguja Dist., 1 ♀ ex., 15.i.1975, Coll. D.S. Mathur; 1 ♂, 5 ♀ exs., Murakhand Village, 16.i.1975, Coll. S.K. Sharma & Party.

Diagnosis: (Fig. 3B), Length: 40-60 mm; vertex flat; basal portion of eyes ochraceous and remaining part black; pronotum with a central longitudinal furrow; head, pronotum and legs fulvous; fore tarsus very short; fore femur with two pairs of spines, one on sub-apex and another bigger beyond middle; metasternal process with sulcation; respiratory longer than the body.

Distribution: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Australia, Nepal and Sri Lanka.

Remarks: This species feeds on frog tadpole and immature of aquatic insects.

18. *Ranatra filiformis* Fabricius, 1790

1790. *Ranatra filiformis* Fabricius, *Skrif. Nat. Selesk.*, **1**: 228.

2007. *Ranatra filiformis* Fabricius: Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* **273**: 9-10.

Material examined: Jashpur Dist., 1 ♂ ex., Badalkhol WLS, Kharanala, 27.v.2012, Coll. A. Raha & Party.

Diagnosis: (Fig. 3C), Body elongated, about 27-28 mm long with abdominal appendages about 23 mm; head occasionally with a distinct tubercle on the vertex; metasternal process posteriorly triangle with a distinct mid-longitudinal ridge; interocular space slightly greater than the diameter of an eye.

Distribution: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. **Elsewhere:** China, Malay Peninsula, Nepal, Pakistan, Philippines, Sri Lanka and Thailand.

Remarks: The species mostly occurs shallow region of water bodies where it clings to the submerged vegetation.

Superfamily Notonectoidea Latreille, 1802

Family Notonectidae Latreille, 1802

Subfamily Anisopinae Hutchinson, 1929

Tribe Anisopini Hutchinson, 1929

Genus Anisops Spinola, 1837

19. *Anisops barbatus* Brooks, 1951

1951. *Anisops barbata* Brooks, *Kans. Univ. Sci. Bull.*, **34**: 387.

2007. *Anisops barbatus* Brooks: Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.* **273**: 37.

Material examined: Raipur Dist., 2 ♀ exs., Barnawapara WLS, 11.xi.2011, Coll. S.K. Gupta & Party.

Diagnosis: (Fig. 3D), Length: 8.0-9.3 mm; tylus of males having a pair of tufts of bristles which reaches the base of labrum, which is absent in females; tylus swollen in both male and female; stridulatory comb of fore tibia having 20-25 broad teeth.

Distribution: Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. **Elsewhere:** China, Indonesia, Malaya, Myanmar, Sri Lanka, Taiwan and Vietnam.

Remarks: This is the largest species of the genus reported from India (Thirumalai, 2001), presently it was collected through light trap.

20. *Anisops kuroiwae* Matsumura, 1915

1915. *Anisops kuroiwae* Matsumura, *Ent. Mag. Kyoto*, **1**: 109.

2007. *Anisops kuroiwae* Matsumura: Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.*, **273**: 39.

Material examined: Durg Dist., 3 ♂, 9 ♀, Balod Beat, 25.ix.2012, Coll. A. Raha & Party.

Diagnosis: (Fig. 3E), Length male, 5.6-6.4, female 5.4-6.3; width, male 1.5-1.6, female 1.3-1.8. Interocular space anteriorly produced into a cephalic projection; in dorsal view cephalic projection rounded at apex, in lateral view extending in front of eye less than half the total length of the frons; frons diverging ventrally. Tylus and frons are excavate with two carinae on each in frontal view. Males are easily recognized by the structure of the cephalic projection and the frons (Fig. 3F).

Distribution: Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Madhya Pradesh, Manipur, Sikkim, Tripura, Uttar Pradesh and West Bengal. **Elsewhere:** Widespread in Australasia from southern China to Australia, Southeastern Palaearctic (Japan) and West Malaysia.

SUMMARY

So far, 65 species (see Thirumalai and Sharma, 2008, Thirumalai *et al.*, 2007, Chandra and Jehamalar, 2011, Chandra *et al.*, 2010 and Chandra *et al.* 2012) of aquatic bugs are reported from Madhya Pradesh, the mother state of Chhattisgarh. But, only 20 species belonging to 5 families and 14 genera are recorded from nine districts (Fig. 4) of Chhattisgarh in the present study, this number is quite low. More species of aquatic bugs are expected to occur from Chhattisgarh, if intensive surveys are undertaken.

ACKNOWLEDGEMENT

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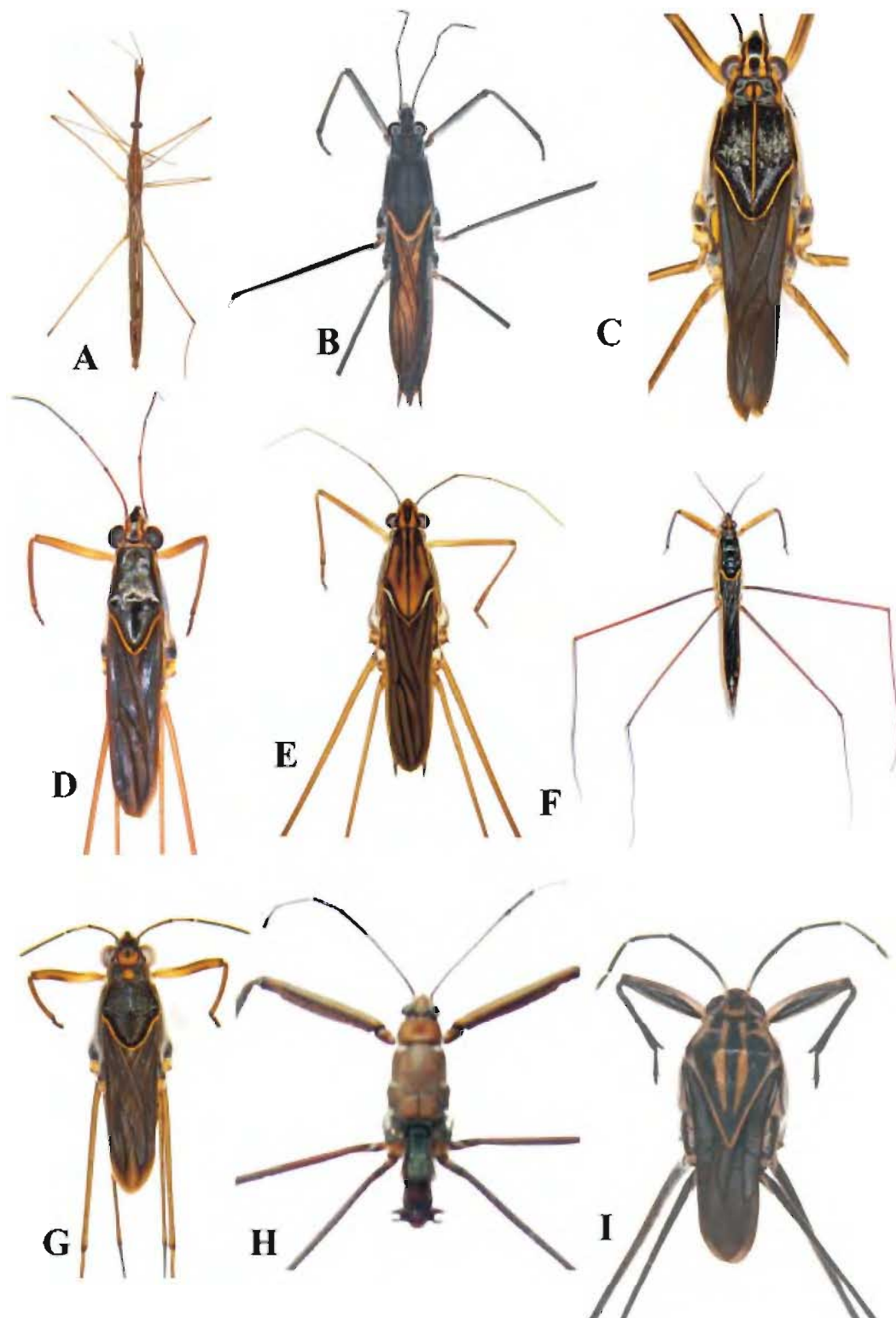


Fig. 1 : A-I. Semi-aquatic Heteroptera of Chhattisgarh. A- *Hydrometra greeni*; B- *Aquarius adelaidis* (Female); C- *Limnogonus* (*Limnogonus*) *fossarum*; D- *Limnogonus* (*Limnogonus*) *nitidus*; E- *Limnometra fluviorum*; F- *Cylindrostethus productus*; G- *Neogerris parvulus*; H- *Ptilomera* (*Ptilomera*) *agroides*; I- *Metrocoris communis*.

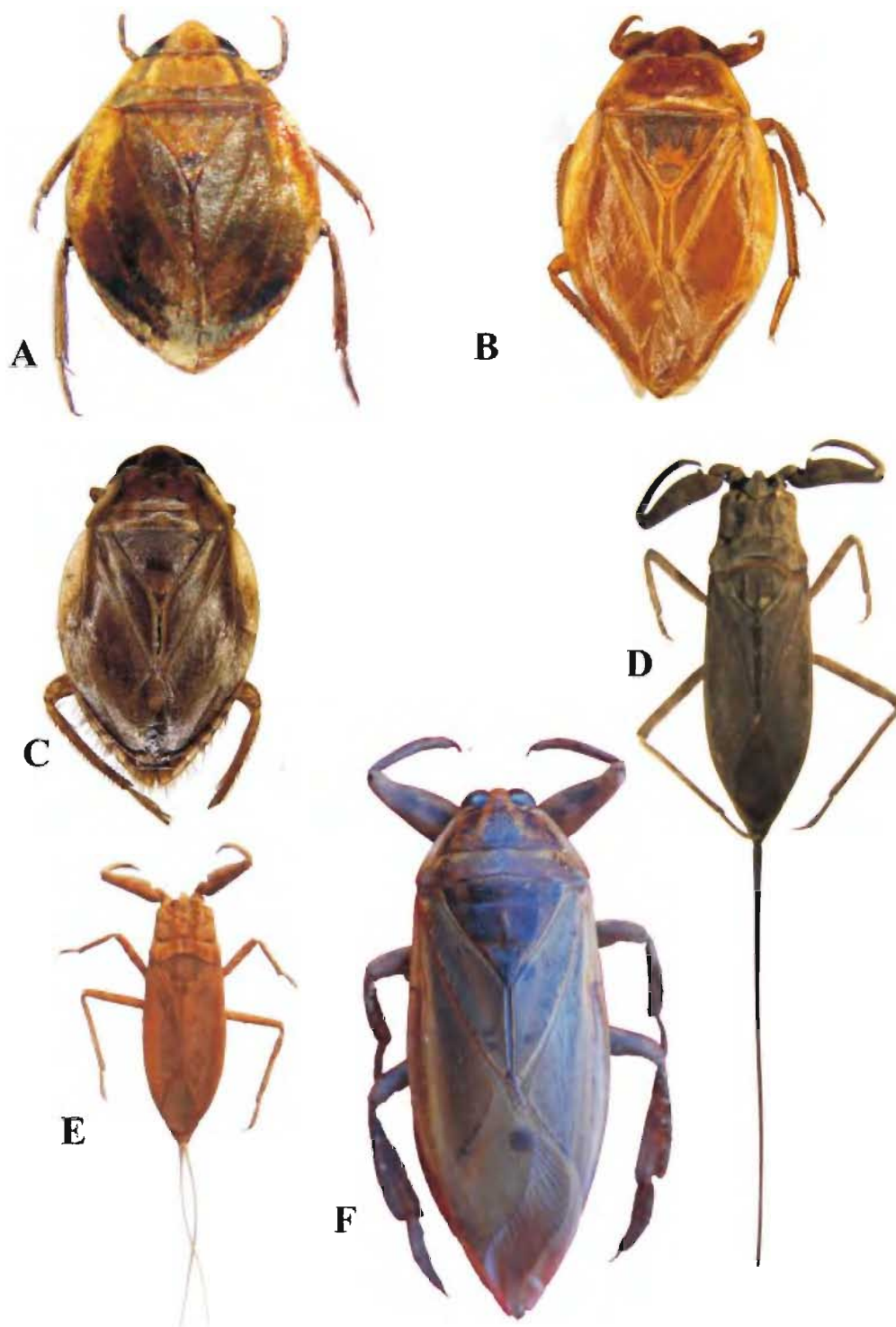


Fig. 2: A -F. Aquatic Heteroptera of Chhattisgarh. A- *Diplonychus annulatus*; B- *Diplonychus molestus*; C- *Diplonychus rusticus*; D- *Laccotrephes (Laccotrephes) ruber*; E- *Laccotrephes (Laccotrephes) griseus*; F- *Lethocerus (Lethocerus) indicus*.

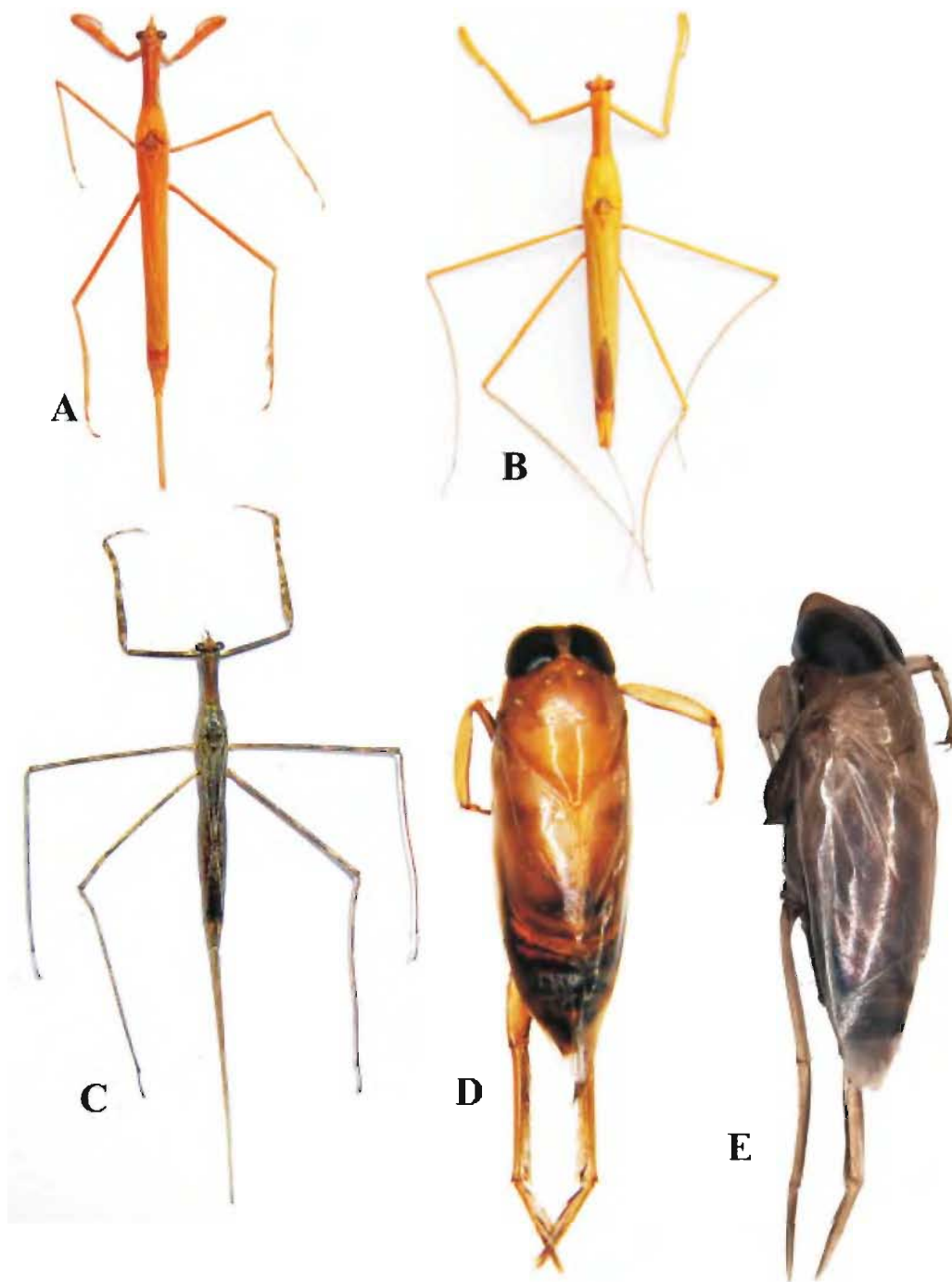


Fig. 3: A-D. Aquatic Heteroptera of Chhatisgarh. A- *Cercotmetus fumosus*; B- *Ranatra (Ranatra) elongata*; C- *Ranatra (Ranatra) filiformis*; D- *Anisops barbatus*; E- *Anisops kuroiwae*.

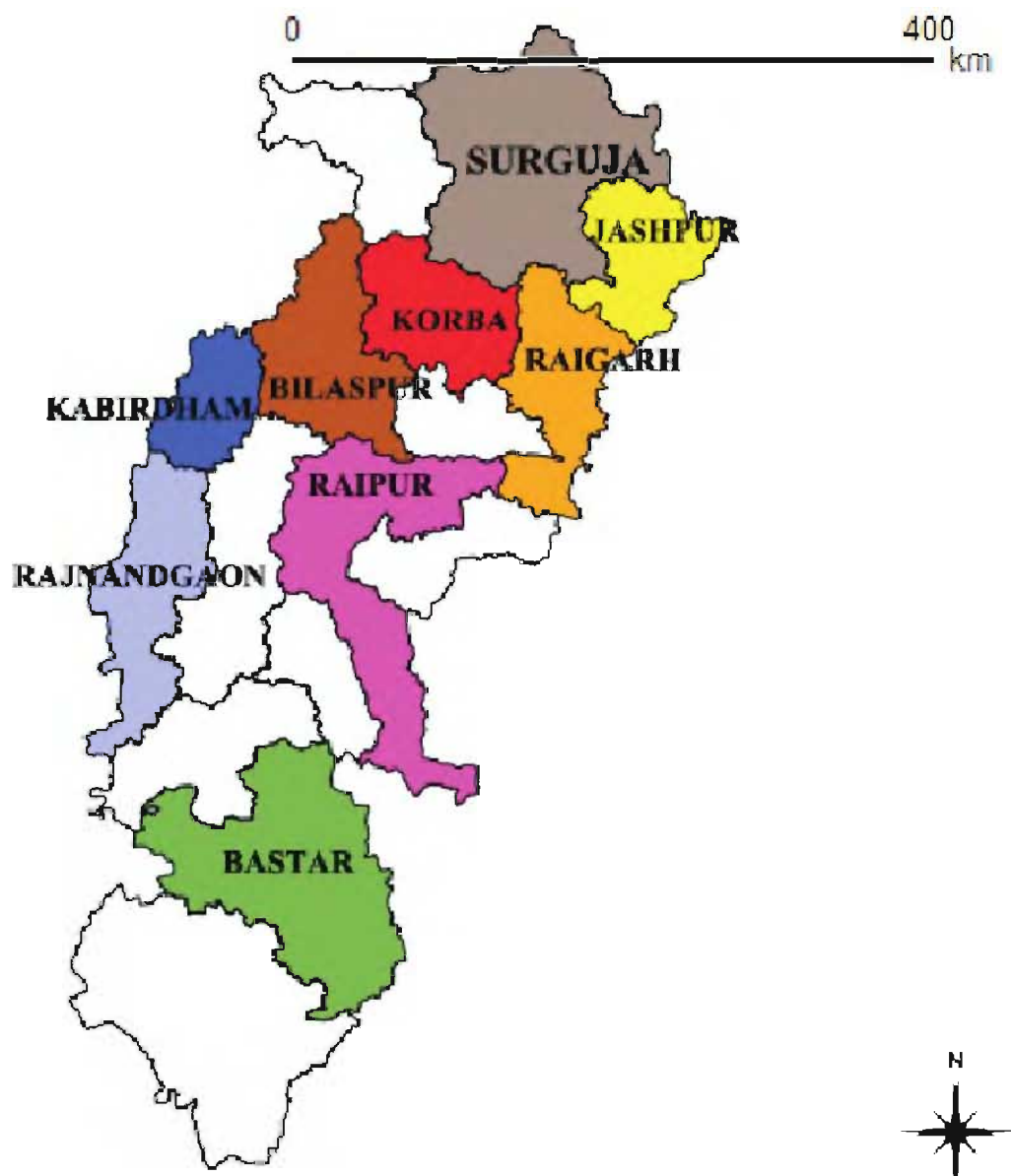


Fig. 4: . Map of Chhattisgarh. The colour area of the map showing the records of aquatic Heteroptera.



NEW REPORT OF THE HERMIT CRABS *DARDANUS LAGOPODES* (FORSKAL, 1775), *PAGURISTES MIYAKEI* FOREST & MCLAUGHLIN, 1998 AND *ONCOPAGURUS MONSTROSUS* (ALCOCK, 1894) (CRUSTACEA: DECAPODA: ANOMURA) FROM THE INDIAN COAST

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INTRODUCTION

Anomuran crabs are best described by having an assortment of adult body shapes from lobster-like to crab-like; markedly reduced fifth pereopods, the articulated or missing eighth thoracic sternite and the cephalothorax that is not fused to the epistome as it is in brachyurans (McLaughlin *et al.*, 2010). Anomura is represented by six superfamilies; Aegloidea, Hippoidea, Lithodoidea, Lomisoidea, Paguroidea and Galatheaidea. Super family Paguroidea includes hermit crabs and their relatives in the families: Coenobitidae, Diogenidae, Paguridae, Parapaguridae, Pylochelidae and Pylojacquesidae. Hermit crabs of the Family Diogenidae commonly called 'Left-handed hermits' are among the most diverse group represented by about 20 genera (McLaughlin *et al.*, 2010). They have antennules with upper rami of flagellum terminating in tapered filaments and chelipeds equal, sub-equal or unequal with left frequently largest (McLaughlin *et al.*, 2007). Among Diogenidae, genus *Dardanus* has the largest and most widely distributed species of the marine hermit crabs in tropical waters, with rostrum broadly rounded, ocular acicles subtriangular or subquadrate and telson armed with spines or spinules. Dactyls and fixed finger of chelae corneous tipped and opening obliquely (McLaughlin *et al.*, 2007). Genus *Paguristes* is with

nonchelate 4th pereopods, unpaired pleopods 3-5 on left side of abdomen (McLaughlin, 2002). Family Parapaguridae is usually deep water hermit crabs. Members of the Genus *Oncopagurus* is with ocular acicles terminating in a single spine, ventral surface of palm of right cheliped without prominently elevated tuberculate or spinose area medially, carpus of left cheliped with only dorsodistal spine, merus of right third pereopod without several spines on dorsal surface (McLaughlin *et al.*, 2007). This paper records the occurrence of three species of hermit crabs *Dardanus lagopodes*, *Paguristes miyakei* and *Oncopagurus monstrosus*, for the first time from India.

SYSTEMATIC ACCOUNT

Phylum ARTHROPODA
Subphylum CRUSTACEA
Class MALACOSTRACA
Order DECAPODA
Family DIOGENIDAE

1. *Dardanus lagopodes* (Forsk, 1775)

(Fig 1A- 1E)

1775. *Cancer lagopodes* Forskal, Descriptiones Animalium, Avium, Amphibiorum, Piscium, Insectorum, Vermium, p. 93.

1824. *Pagurus sanguinolentus* Quoy & Gaimard, Voyage autour du monde, entrepris par ordre du roi, sous le ministère et conformément aux instructions

- de S. Exc. M. le Viconote du Bouchage, secrétaire d'état au département de la marine, exécuté sur corvettes de S.M. l'Uranie et la Physicieene, pendant le 3, p. 532, pl. 79, fig. 2.
1836. *Pagurus affinis* H. Milne Edwards, Annales des Sciences Naturelle Zoologie, Paris. 2, p. 274.
1852. *Pagurus euopsis* Dana, United States Exploring Expedition, during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N. 13, p. 452.
1861. *Pagurus depressus* Heller, Teil. Sitzungs-Berichte der Mathematisch-Physikisch Klasse der Kaiserlichen Akademie der Wissenschafte, Wien., 44, p. 248.
1875. *Dardanus hellrii* Paul'son., Izsledovaniya rakoobraznykh krasnago morya s zametkami otnositel'no rakoobraznykh drugikh morei. Chast' 1. Podophthalmata i Edriophthalmata (Cumacea), S.V. Kul'zhenko, Kiev., p. 90, pl. 12, figs. 4, 4a-c.
1923. *Dardanus euopsis* Maki & Tsuchiya, Monograph of the decapod crustaceans from Formosa, Dept. Agriculture Government Research Institute, Formosa. 3, p. 98, pl. 8, fig. 4.
1956. *Dardanus sanguinolentus* Forest, Bulletin du Muséum national d'Histoire naturelle, 2(25), p. 49
1969. *Dardanus lagopodes* - Lewinsohn, Zoologische Verhandlungen, 104, p. 32, pl. 2, figs. 1, 2.

Materials examined: one specimen, female (total length 45.5 mm), collected from Vizhinjam Bay (08° 22'33" N Lat., 76°15'E long.) from a depth of about 15m. Thiruvananthapuram district, Kerala, India. The reference material is deposited at the Zoological Survey of India (ZSI/WGRC/IR/2117) and museum collections of Department of Aquatic Biology and Fisheries, University of Kerala (AR AN 9), India. The hermit was collected from the gastropod shell of *Tibia insulaechorab curta*.

Diagnosis: Carapace mottled with red and white, anterior portion with purplish-red patch. Ocular peduncles yellowish-brown with yellow band distally near corneas. Antennal and antennular peduncles light blue with antennular flagellum orange. Chelipeds mottled red, brown, maroon and white; Chelae reddish to maroon on fingers and palm, Carpi red-brown with large purplish-blue patch dorsally, meri also red-brown and white. Ambulatory legs reddish-brown to

maroon mottled with patches of pale violet; carpi reddish-brown dorsally with purplish-blue patch on segments. Setae red with cream tips (Fig 1A). Shield longer than broad with rostrum rounded and depressed carapace. Ocular peduncles long, slender, sub-cylindrical and broadened distally, overreaching both antennal and antennular peduncles. Ocular acicle subtriangular or subquadrate with 3-4 spines at distal margin. Antennular peduncle longer than antennal peduncle. Antennal acicle overreaching the proximal margin of the ultimate peduncular segment terminating in a single spine and with 3-4 spines mesially (Fig 1B). Chelipeds subequal, left not appreciably longer than right. Upper and outer surface of palm of left chelae with acute spines (Fig. 1C). Right cheliped also with tubercles on upper surface of chela. Third pereopod with dactyls and propodus of nearly equal length, dorsal and ventral margin of each with row of strong corneous-tipped spines or tubercles. Dactyls with a median longitudinal groove on the lateral face while that of propodus is weakly concave (Fig 1D). Carpi of both pereopods with a strong dorsodistal spine. Chelipeds and ambulatory legs are usually covered with long, stiff setae all over the segments. Telson asymmetrical left lobe larger, each lobe with corneous ventrally directed spines (Fig 1E).

Remarks: *Dardanus lagopodes* is widely distributed in intertidal to shallow subtidal regions of East Africa, Seychelles, Mauritius, Madagascar, Red Sea, Southern India, Thailand, Philippines, Malaysia, New Guinea, Australia, Taiwan, Japan, Samoa, French Polynesia (Gherardi & McLaughlin, 1994; McLaughlin *et al.*, 2007). The present record of this species from the southwest coast of India shows its extended distribution in Indian subcontinent.

2. *Paguristes miyakei* Forest & McLaughlin, 1998 (Fig 2A-2E)

1978. *Paguristes setosus* Miyake, The crustacean Anomura of Sagami Bay, p. 27, fig. 8.
1978. *Paguristes puniceus* Miyake, The crustacean Anomura of Sagami Bay, p. 37, fig. 13.
1998. *Paguristes miyakei* Forest & McLaughlin, Proc. Biol. Soc. Wash., 111, p. 191, figs. 2, 3.

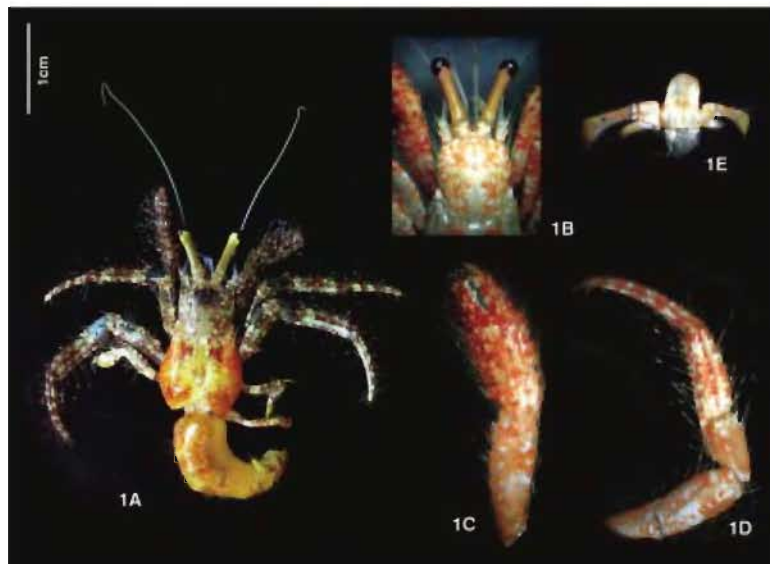


Fig. 1A. *Dardanus lagopodes* (Forskal, 1775) - Entire

Fig. 1B. Shield and cephalic appendages

Fig. 1C. Left cheliped

Fig. 1D. Left third pereopod

Fig. 1E. Telson

Fig. 2A. *Paguristes miyakei* Forest & McLaughlin, 1998 - Entire

Fig. 2B. Shield and cephalic appendages

Fig. 2C. Left cheliped

Fig. 2D. Left second pereopod

Fig. 2E. Telson



Fig. 3A. *Oncopagurus monstrosus* (Alcock, 1894) - Entire

Fig. 3B. Shield and cephalic appendages

Fig. 3C. Right cheliped

Fig. 3D. Telson

Materials Examined: Seven specimens, 4 males (total length 83-86 mm) and 3 female (total length 52-70 mm) collected from trawl by-catch at Sakthikulangara harbour (08°30' N lat.; 76° 53.3' E long.), Kollam district, Kerala, India. Two voucher specimens are deposited at the Zoological Survey of India (ZSI/WGRC/IR/2118) and museum collections of Department of Aquatic Biology and Fisheries, University of Kerala (AR AN 10, AR AN 11), India. The specimens occupied the shells of *Biplex bozetti*, *Polinices mamilla*, *Xenophora corrugata*, and *Xenophora solaris*.

Diagnosis: Carapace and basal segment of pereopods dark orange brown; the distal portion of pereopods light yellowish-brown. Antennae and antennules reddish-brown, ocular peduncles light yellowish (Fig 2A). Shield longer than broad; rostrum triangular (Fig 2B). Dorsal and anterior margins of branchiostegites with spinules. Ocular peduncles short, slender; corneas not dilated. Ocular acicles each with simple terminal spine. Corneas overreached by both antennal and antennular peduncles. Antennal peduncle slightly overreaching the distal corneal margin, antennular peduncles overreaching by half the length of ultimate segment. second segment with terminal prominent bifid spine, fourth segment with small dorsodistal spine; antennal acicle not overreaching distal margin of ultimate peduncular segment, with simple terminal spine; mesial margin with 4-6 small spines, lateral margin with 3 spines; antennal flagellum thick with several long randomly-set setae. Chelipeds subequal; left slightly larger (Fig 2C); both chelipeds with similar armature; mesial faces of dactyls each with small corneous tipped spines arranged in longitudinal rows; dorsomesial margin of palm with 3-4 large spines; dorsal surface with 4-5 rows smaller spines; dorsolateral face convex and; dorsomesial margin of carpus with 4-5 large spines, two irregular rows of smaller spines on dorsal surface separated from dorsolateral row of acute spines by unarmed longitudinal area. Second pereopods with dactyls longer than propodi; dorsal margin with row of small corneous-tipped spines proximally, mesial

faces unarmed, ventral margins each with row of 22-26 small corneous spines; dorsal margins of propodi and carpi each with 1 or 2 rows of prominent spines, irregular row of small spines on ventral margins (Fig 2D). Dactyls of third pereopod with a row of 24-26 spines on ventral face; 7-8 spines on ventral margin of propodi; carpi each with dorsodistal spine and 1 -2 proximal spinules. Telson with a row of small spines on terminal margin (Fig 2E).

Remarks: *Paguristes miyakei* is widely distributed in Japan, Taiwan, northern Western Australia, (McLaughlin *et al.*, 2007). The present record of this species from the southwest coast of India shows its extended distribution from North Pacific Ocean to Indian Ocean.

Family PARAPAGURIDAE

3. *Oncopagurus monstrosus* (Alcock, 1894) (Fig 3A- 3D)

- 1894. *Parapagurus monstrosus* Alcock, *Annals and Magazine of Natural History*, 6(13), p. 243.
- 1896. *Sympagurus monstrosus* Henderson, *J. Asiatic Soc. Bengal*, 65, p. 533.
- 1905. *Sympagurus arcuatus* var. *monstrosus* Alcock, Anomura. Fasc. I. Pagurides. Catalogue of the Indian decapod Crustacea in the collections of the Indian Museum, 2, p. 104, pl. 10, fig. 5.
- 1933. *Eupagurus brevimanus* Yokoya, *J. College of Agriculture Tokyo Imperial University*, 12, p. 90, fig. 34.
- 1982. *Parapagurus monstrosus* Miyake, Japanese crustacean decapods and stomatopods in color. vol. 1. Macrura, Anomura and Stomatopoda, p. 119, pl. 40, fig. 1.
- 1996. *Oncopagurus monstrosus*- Lemaitre, *Rec. Aust. Mus.*, 48, p. 199, figs. 19, 20.

Materials Examined: Two specimens, male (total length 25-36 mm), collected from trawl by-catch at Sakthikulangara harbour (08°30' N lat.; 76° 53.3' E long.), Kollam district, Kerala, India. The reference materials are deposited at the Zoological Survey of India (ZSI/WGRC/IR/2119) and museum collections of Department of Aquatic Biology and Fisheries, University of Kerala (AR AN 12, AR AN 13), India. The hermits occupied the gastropod shell of *Polinices didyma*.

Description: Carapace creamish-orange. Right cheliped creamy-white with proximal portion of merus and carpus reddish-orange. Left cheliped and ambulatory legs light pink. Lateral faces of merus, carpus and propodus with one or two reddish-orange patches (Fig 3A). Shield as long as broad with weakly calcified dorsal surface; rostrum broadly rounded, with short median ridge (Fig 3B). Ocular peduncles broadened distally, reaching more than half shield length, corneas slightly dilated; ocular acicles terminating in prominent spine. Corneas overreached by both antennular and antennal peduncles, antennular peduncles longer than antennal peduncle. Antennal acicle moderately long, reaching upto or beyond the distal margin of ultimate peduncular segment, mesial margin with 8-17 spines. Epistomal spine prominently curved upward. Chelipeds unequal and somewhat iridescent with moderately dense setation; ventromesial margin of right cheliped concave bordered by upper and lower rows of spines, dorsolateral margins of palm each with row of spines, irregular rows of small spines on dorsal surface; carpus spinulose, dorsolateral margin with a row of 6-8 moderately large spine (Fig 3C). Palm of left cheliped unarmed; carpus with dorsodistal spine. Ambulatory legs similar with dactyls longer than propodi, a row of 5-15 small corneous spines on the ventromesial face, dorsal and dorsomesial faces obscured by rows of long setae; carpi each with a dorsodistal spine;

merus of third right pereopod unarmed. Telson with posterior lobes separated by moderately deep median cleft, irregular single or double row of corneous spines on terminal margin of each lobe (Fig 3D).

Remarks: *Oncopagurus monstrosus* was reported from Bay of Bengal, Gulf of Aden, Australia, Indonesia, Philippine Islands, Taiwan, and Japan. The present record of this species from the southwest coast of India shows its extended distribution in the western Indian Ocean, from the east coast of Africa to India.

SUMMARY

Present paper records the occurrence of three species of hermit crabs, *Dardanus lagopodes*, *Paguristes miyakei* and *Oncopagurus monstrosus*, for the first time from Indian coast. *D.lagopodes* was collected from Vizhinjam Bay, Thiruvananthapuram district, Kerala while *P.miyakei* and *O.monstrosus* was collected from trawl by-catch at Sakthikulangara harbour, Kollam district, Kerala.

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PRESENT STATUS OF THREE MONITOR LIZARDS (*VARANUS BENGALENSIS*, *V. FLAVESCENS* AND *V. SALVATOR*) IN THE SUNDERBANS

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INTRODUCTION

Sunderbans is one of the important biosphere reserve's and a world heritage site too. They cover of about 9630 sq/km, out of which 4264 sq/km holds mangrove forest and an area of 1330.1 sq/km is designated as core area. It has more than 106 Islands. It is one of the largest wetland ecosystems with number of rivers, rivulets and creeks. It is home for a rich and varied fauna and flora and also a feeding and breeding ground for the nesting water monitor and also is the ground for Olive Ridley Turtle.

The modern squamates evolved from a common ancestral Diapsid reptile stock which inhabited earth roughly about 155 million years ago in the middle of the Jurassic period of the Mesozoic era. The Order comprises nearly 3272 species under 357 Genera included in 12 Families from all over the world except Arctic, New Zealand and Ireland. The reptilian fauna of India comprises 500 species (Das, 2003) and they occur in varied habitats from plains to mountains, low to heavy rain fall area and even in deserts, occupying every ecological niche of the Republic of India.

The monitor lizards are the largest Saurians of the world and inhabit Africa, Arabian Peninsula, South and South-East Asia as well as Indo-Australian Archipelago including Australia and several Pacific Islands. One of the comprehensive listings of monitor lizards was published by Lisle

(1998) who listed about 77 species and recently Bohme (2003) listed about 58 different species and 28 subspecies of monitor lizards. Very recently Koch et. al. (2010) who listed 73 extant species of monitor lizards in the world. There were 46 species of monitor lizards so far found on three continents namely Africa, Australia and Asia and only about 9 species of monitor lizards were reported from Asian Continent (Bennett, 1998). There are only four species of monitor lizards in India i.e. *Varanus bengalensis*, *V. flavescens*, *V. salvator* and *V. griseus*. Excepting the Desert monitor, the remaining three species are recorded from the study areas.

The populations of monitor lizards have severely shrink in number and the lizards are at risk throughout the range of their occurrence. The monitor lizards have been exploited commercially for their valuable skin and also captured for eating by fisher folk in the Sunderbans. Hence, all the four species of monitor lizards were protected under Schedule I of IWPA, 1972. The protection and preservation of the endangered species in the wild is one of the primary goals of wildlife conservation and management. The objectives of the present study were to accumulate information on diversity and distribution of monitor lizard in Sunderbans and (ii) to determine current status and threat faced by the monitor lizards in Sunderbans. Since, the information would be helpful for conservation and management of monitor lizards in its natural

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habitats. It is hoped that the results achieved during the study will help a better management of the valuable and endangered reptiles.

TAXONOMY

Systematic position of Indian Monitor Lizards are:

CLASS: REPTILIA
ORDER: SQUAMATA
FAMILY: VARANIDAE
Genus: *Varanus* Merrem
Varanus bengalensis (Daudin, 1758)
Common Monitor

Size: Adult, medium

Weight: 3.5 Kg

Length: From snout to vent = 74 cm; Tail 100.0 cm.

Field notes: The Indian monitor is dorsally dark brownish or olive brown with blackish dots and ventrally yellowish, spotted with numerous black spots. Tail is quite long and compressed. It always preferring undisturbed places far from human settlements, the common monitor is active during the summer.

Varanus flavescens (Hardwicke & Gray, 1827)

Yellow Monitor

Size: Adult, medium

Weight: 3.0 Kg.

Length from Snout to vent: 31.5 cm; tail 38.4 cm.

Field notes: The yellow monitor is dorsally light brown or yellow, with fused light transverse bars. The tail is very short. It is partial to wetlands where it can burrow easily and seek its food.

Varanus salvator (Laurent, 1768)

Water Monitor

Size: Grown up adult

Weight: More than 6.0 Kg.

Length: Total length including tail approximately 250 cm.

Field notes: The water monitors dorsally looks dark alive, snout light with transverse black bars. Ventrally yellow, head is tapering, long slender neck. It is the longest of all the monitor lizards.

KNOWN DISTRIBUTION

The Indian Monitor occurs throughout the Indian subcontinent including Western Ghats. In addition, the species is recorded in Sri Lanka, Myanmar, Bangladesh, South east Iran, Afghanistan, Pakistan and South eastern Uzbekistan.

The Yellow monitor is recorded from Northern and North eastern India from Punjab to Orissa, West Bengal and Assam. In Orissa, it inhabits the drainage system of Brahmani and Mahanadi rivers. In West Bengal, it is widely distributed and is found in Terai, Siliguri in Darjeeling District; Botanical gardens in Howrah District; Sagar Island, Pathar Protima and Kakdwip in 24 Parganas District; Krishnagar in Nadia District; Singur in Hooghly District; Goalbathan, Pakur, Kharagpur and Medinipur in Medinipur District. In Assam the yellow monitors reported from Guwahati and Goalpara in Dhubri District. In Bihar the monitor was reported from Patna. In Uttar Pradesh the monitor was recorded from Gorakhpur, Fatehgarh, Varanasi, Mirzapur and Agra District. Also reported the county's capital, New Delhi. Elsewhere known from Bangladesh, Nepal and also Pakistan.

The water monitor restricted to the mangrove swamps of Sunderbans in West Bengal, Bhitarkanika in Orissa and Andaman and Nicobar Islands. Very recently it has been recorded from Khasi Hills from Meghalaya. Outside India recorded from South east Asia, Bangladesh, Bhutan, Brunei, Burma, Southern China, Hong Kong, Indonesia, Kampuchea Laos, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Thailand and Vietnam.

STUDY AREA

The study was carried out throughout the Sunderbans selecting localities Gosaba, Sajnekhali, Pakhralaya, Sajalya and Basanti; Bakkhali and Bhagbatpur; Kakdwip, Bishalakshipur, Namkhana, Pathar Protima and Sagar Island (Chhayerghari, Sreedham, Chamagudi and Kali Bazar).

TOPOGRAPHY AND CLIMATE OF THE STUDY AREA

- (i). Physical features: In Sunderbans tides influence the water quality and water movement caused by surface and bottom currents. The circulation of water is a major factor in maintaining the populations of sessile and benthic organisms. The salinity of the water is an important factor influencing the distribution and biology of organisms. The depth and width of estuary are also varied with season and depends upon influence of fresh water and distance from sea. Turbidity is high during monsoon and low during winter.
- (ii). Climate: The weather of Sunderbans can be classified into three types as monsoon-it starts from July and continues upto October with occasional rains throughout the year. The post monsoon is characterised by cold weather with thunder storms, of which usually happen during March-June every year.
- (iii). Vegetation: the Sunderbans is unique in nature and their tools for survival evolved over millions of years makes interesting scientifically. The mangrove forests are salinity resistant and hence they are called as halophytes where they developed extensive root system with a number of pneumatophores to draw oxygen. In all there are 26 species of mangrove plants are found in in Sunderbans. In terms of the faunal elements, there are more than 980 species of vertebrates and invertebrates. The fishes, birds among vertebrates and arthropods, mollusca and annelids among invertebrates constitute the dominant group of animals.

STUDY PERIOD

Totally four surveys were undertaken during different seasons to assess the population and

status of these species in Sunderbans and the details are as given below :

First survey was undertaken from 20.10.2008 to 29.10.2008

Second survey was undertaken from 13.08.2009 to 22.08.2009

Third survey was undertaken from 26.03. 2010 to 04.04.2010

Fourth and final survey was undertaken from 13.09.2010 to 22.09.2010

METHODOLOGY

The survey were undertaken throughout the Sunderbans in selected localities for the period from April, 2008 to march, 2011. The surveys were conducted at different habitat types including the protected areas.

The observations on monitor lizards were made using visual encounter surveys method (VEL) (Campbell and Christman, 1982; Com and Bury, 1990; Crump and Scott, 1994) to gather data on population of Varanus and general areas. Surveys were carried out in different aquatic and terrestrial habitats using a binocular. Thorough investigation were conducted in different habitat types including forest, grassland, human settlements, wetlands and agricultural lands the time of sighting, number of individuals, size and the habitat types were noted with GPS coordinates. Morphological measurements were taken using 1 m measuring tapes. After recording the measurements, the animals were released into their original habitats. The representative habitats were surveyed by foot between 1000 hr to 1600hr. The animals were identified and verified by the help of field guide of Daniel (2002).

ECOLOGY AND BEHAVIOUR

Indian Monitor

Habit and Habitat: The Indian monitor is diurnal in habits. It inhabits forest, desert, river banks, by the side of nullah, marshy land, and tidal creeks. It occupies burrows, dense vegetation, hollows of trees, creeks and cervices. It is a good climber, runner and also a good swimmer.

Food and Feeding habit: It is carnivorous and feeds mainly on terrestrial vertebrates like birds and their eggs, rats, frogs, fish and also feeds on crustaceans mainly crabs.

Breeding patterns: It is oviparous, laying around 10-20 eggs in holes or debris between February and March.

Yellow Monitor

Habit and Habitat: the Yellow monitor inhabits sandy areas, bordering large rivers, heavily forested tract dotted with marshes and canals. It is partial to wetland. It is a good swimmer and makes burrows on muddy bunds around ponds, lakes and marsh lands.

Food and Feeding Habit: A carnivore, mainly feeding on freshwater crabs and fishes. It also feeds on mice, frogs, toads, and eggs of reptiles, birds and also small mammals.

Breeding patterns: It lays 3 to 30 eggs in a single clutch and eggs are smooth, soft and leathery. Visser (1985) reported that incubation of captive monitor is 149-155 days period at temperature of 30° C and August is usually supposed to be suitable for laying eggs

Water Monitor

Habit and Habitat: The water monitor is more aquatic than all the monitor lizards. It inhabits wet, marshy, and humid forests, banks of rivers canals, sea coast, particularly in the estuarine forests.

Food and Feeding habit: It is carnivorous, feeding insects, crabs, fish, rats, birds, frogs and rotten flesh.

Breeding patterns: It mainly breeds during June to August and lays 15 to 30 eggs in holes on the river banks or in the hollows of trees close to water.

Basking of Indian Monitor

It was very interesting to observe the monitors at their favourite pastime-basking in the wild. We had sighted an Indian monitor basking at Sagar Island area. It was around 12:00hr. The monitor made its body vertically expanded with the head directed upwards. It remained

motionless during basking nearly for about two to three hours. During basking it did not get upset even after repeated disturbance. It stayed calm and quiet near burrow. Almost the lizard was so much motionless that it appeared dead.

STRUCTURE OF BURROWS OF MONITORS

The burrows of *Varanus* are very interesting in nature and it is a notable feature of these species when compared to other burrow making animals. During our survey, we noticed many burrows very commonly one in every hundred or two hundred meters transects and it is more in area where no trees compared to area with trees. The number of openings used by monitor varies from two to six and opening size varies from minimum 10 cm to 25 cm. There has been clear distinction in the nature of burrows the monitor excavates compared to that of other burrowing animals. We have recorded many burrows even at less than 20 cm. However, these burrows were excavated by crustaceans, mainly crabs. The burrows of crabs have very small openings and not too deep inside the openings in comparison to the burrow excavated by monitor lizards. It is not surprising to see that sometime monitor lizards inhabit termitearia. I personally experienced presence of monitors in its burrows or nearby its burrows. One interesting observations made during our survey at Bakkhali where there more than six to eight burrows on all the four sides of paddy fields, fresh water ponds and bamboo trees. Each burrow had more than four to six openings and in burrows the monitors were also sighted. The monitor while entering its hole, it bends its body into U" shape with the head and tail facing the opening. The males are very active than females throughout the year.

The Indian monitor excavates its own burrows. It will dig into earthen mounds. It always prefers slopes, under exposed roots and also large stones. The burrows are oval in shape. Inside the burrow the lumen are more cylindrical, widest at its mouth and taper towards the extreme end to accommodate its head and body.

The remarkable behaviour of monitor lizards was the excavation of their burrows where they

Table. 1: Details of observations of monitor lizards in different habitat types in Sunderbans.

Habitat Types	Number of examples/species recorded		
	<i>Varanusbengalensis</i>	<i>Varanusflavescens</i>	<i>Varanussalvator</i>
A. Forested area			
1. Mangrove forest			2
2. Freshwater swamp area	2	4	
B. Agriculture area			
1. Paddy field	4		
2. Grassland	4		
C. Human habitation	2		

Table. 2: Details of observations of monitor lizards at different localities of Sunderbans.

Serial No.	Locality	<i>Varanusbengalensis</i>	<i>Varanusflavescens</i>	<i>Varanussalvator</i>
1.	Bakkhali	04*		
2.	Bishalakshipur			01
3.	Kakdwip	02		
4.	Patharprotima	02		
5.	Sajnekhali			01
6.	Sagar island	04	02	
7.	Surjobindha**		02	

□: Number of examples sighted.

: New locality of *Varanusflavescens* recordedTable. 3:** Number of burrows of monitor lizards scored at different locality during the survey in Sunderbans.

Serial No.	Name of the area	Number of burrows scored
1.	Bakkhali	22
2.	Bhagabatpur	04
3.	PatharProtima	16
4.	Namkhana	06
5.	Sagar Island	34
6.	Kakdwip	24
7.	Bishalakshipur	18
8.	Gosaba	04
Total	8 localities	128 burrows

always prefer to make two openings, one meant for entry of the animal and opposite end for exit doors. In order to confuse the other (including man), the monitor lizards excavates a false

burrow sometimes. When confronted, the monitor emits a loud hiss-like noise to warn its enemy.

RECENT OBSERVATIONS AND RESULTS

The present study is an outcome of four surveys conducted to assess the status, diversity and distribution of monitor lizards in Sunderbans. First survey was undertaken to Sajnekhali area where Sunderban Tiger reserve is situated. We hired the launch after obtaining the permission from STR office to survey the areas. Survey was undertaken in and around the Sajnekhali, Nethidopani and Chamta areas by launch. Launch cruised along the river on both sides, using the binocular keep on watching movement of animals in the mangroves. Around 12:00hr one example of *Varanussalvator* was noticed in between the mangroves.

Second survey was undertaken to Bakkhali and Bhagabatpur area. It was a very interesting day of our survey as on the fourth day of our survey at Bakkhali near a paddy field and fresh water ponds we noticed six to eight fresh muddy burrows slightly above the ground. The entire area was covered with grasses and herbs. The burrows sighted were found to have openings both for entry and exit. At 11:30 hrs in the survey morning, a monitor lizard emerged and found its way to an open burrow. In all four specimens of *Varanus bengalensis* were recorded at one locality at different burrows.

Third survey was undertaken to Kakdwip and Bishalakshipur area. There were many bamboo trees and muddy burrows. In addition, locals told us they have been regularly noticing the monitor in the pond. One example of *Varanus salvator* was observed in the area. At Kakdwip also two examples of *Varanus bengalensis* were sighted.

Fourth survey was undertaken to Sagar Island. Four examples of *Varanus bengalensis* and two examples of *Varanus flavescens* were recorded from the area. For the first time we recorded two examples of *Varanus flavescens* from Surjobindha area of Sunderbans.

During the whole survey we have sighted 12 examples of *Varanus bengalensis*, 4 examples of *Varanus flavescens* and 2 examples of *Varanus salvator*. In addition, there are more than 128 burrows of monitor lizards were sighted

throughout the survey. Some were old burrows and some were very new burrows where fresh marks of finger scratches, tail drags were clearly visible at the entry openings. Even hole shape also indicates the feature of new burrows.

During the entire period of survey the highest number of sightings were occurred at Sagar Island and then Bakkhali with 6 and 4 individual respectively were observed (Table. 2). The maximum number were sighted at paddy field and freshwater ponds and highest during monsoon (breeding period) compared to pre and post monsoon period. Two individuals each were sighted at Kakdwip and Patharprotima and one individual each were sighted at Bishalakshipur and Sajnekhali areas of Sunderbans. It indicates the Bakkhali and Sagar Island provided suitable habitat types for these species.

TABULATION OF OBSERVATIONS AND RESULTS

PRESENT STATUS OF MONITOR LIZARDS IN SUNDERBANS

During our survey we could spot all the three monitor lizards at different localities but their population is declining. Though widely distributed, the monitor lizards are threatened animals, because of heavy exploitation for their valuable skin an edible meat and eggs. In order to maintain healthy populations, habitat conservation may be the best suggestive measure. Its habitat mainly the plains along rivers have already been using for agricultural purposes. During first rains there were a good number of monitor lizards were seen and later it was difficult to notice the species in its habitat. It is the right time to initiate captive breeding programmes, so that the population of these species in the wild can be increased.

PRESENT THREATS TO THE SPECIES IN SUNDERBANS

The population of all the three species of monitor lizards has drastically declined throughout their range due to illegal and extensive exploitations and adults for their commercially valuable skin, food purposes by local fisherman community and traditional

medicinal values. The skin is used in manufacture of luxury items, which were traded in India and abroad. Locally the species were exploited for meat, eggs and traditional values. Habitat loss and human settlements nearby rivers and mangroves resulted in loss of virgin habitat of these reptiles. Conversion of marshland into paddy field also caused serious threat to the survival of these species in Sunderbans.

CONSERVATION MEASURES SO FAR TAKEN AND IMPORTANT SUGGESTIONS TO PROTECT THE SPECIES

All the three species of monitor lizards were considered endangered and declared as protected species under Schedule I of Indian Wildlife (Protection) Act, 1972. The International Union of Conservation of Nature and Natural Resources (IUCN) has also considered them as endangered and listed in Appendix I. The monitors also included in Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The establishment of National Parks, Wildlife Sanctuaries and Biosphere Reserves paved the way for protection of these species in the wild.

The most useful recommendations to protect the species are as follows (i) At present there is no special management of these species in respect of the population monitoring, habitat

conservation and control measures. Introduction of strict legislation to conservation and protection and initiation of severe action against those violating wildlife laws and policies (ii) Formulation a legislation to protect the habitat, feeding and breeding sites and hibernating spots of these species (iii) Creation of awareness among the public to protect of these species in the wild (iv) Prevention of poaching, illegal killing and trading products of these species and (v) Initiation of captive breeding programmes to increase the populations of these species in the wild.

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**PLACOBDELLA GAURIPURENSIS SP. NOV.
(HIRUDINEA: GLOSSIPHONIDAE):
A NEW LEECH FROM WEST BENGAL, INDIA**

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INTRODUCTION

Out of 667 species of leeches known in the world, 64 species are recorded in India (Mandal, 2009). There are 26 species of leeches belong to the genus *Placobdella* Blanchard 1893 in the world. Sixteen species of the genus *Placobdella* are described from North America, one species from Europe, three species from South America and 6 species from Asia. Out of six species of this genus reported from India, five species are endemic. Soos (1965) is the pioneer in Taxonomy of leeches in the world. He has described a number of new species. Majority of the new species of leeches were described by Harding and Moore (1924, 1927), Bhatia (1931). Mandal (2004a and 2004b) has described two new species, collected from West Bengal. Bandyopadhyay (2004 and 2005), Mandal (2004 and 2010), have done some work on ecology of leeches. Soota (1977), Chandra (1983), Ghosh (1998) also contributed considerably to the taxonomy of leeches of India.

MATERIAL AND METHODS

After making the collection, leeches were sorted out and cleaned. Then the cleaned leeches were placed in a tray with a small quantity of water and were slowly killed by anaesthetizing with 70% alcohol by adding drop by drop at frequent intervals. Leeches usually die in an extended condition by this process. Just after death, the leeches were kept in 70% alcohol for permanent preservation. This new species

Placobdella gauripurensis has been collected from Gauripur Kalibari, Birati (Latitude 22° 65' 92" North and Longitude 88° 43' 84" East), Kolkata, West Bengal, India during recent faunistic survey carried out by Zoological survey of India. The new species is compared with the material of other species available in hand and information on other species is taken from literature.

Placobdella gauripurensis sp. nov.

Holotype: Z.S.I. Reg. No. An 3626/1, 1 ex., Coll. C.K. Mandal, 15.viii.2008, Pond of Gauripur Kalibari, Birati, Kolkata, West Bengal, India.

Paratype: Z.S.I. Reg. No. An 3626a/1, 1 ex., collection details as of Holotype.

Diagnosis: *Body:* Flattened, beetle vine shaped body, head region distinct, Length and breadth almost equal. Papillae are seen on the mid ventral dorsal side. Four circular lines are seen laterally on the two sides of the body.

Length: The total length of the body is 4 mm inclusive anterior sucker and posterior suckers.

Breadth: 4 mm. Middle part of the body contains the maximum length.

Head: It is somewhat elongated, contains anterior sucker, mouth and eyes.

Sucker: Anterior sucker 0.5 mm in diameter, posterior sucker 1mm. in diameter. Posterior sucker is almost round, anterior sucker almost round. Mouth is with muscular ridges but without jaws.

Table 1: Comparison of characters of different species of the genus *Placobdella* in India.

	<i>P. ceylanica</i>	<i>P. mydae</i>	<i>P. fulva</i>	<i>P. horai</i>	<i>P. indica</i>	<i>P. undulata</i>	<i>P. gauripurensis</i>
Body	Lanceolate	Elongated flattened body	Claviform	Ovate acuminate	Eliptic lanceolate	Eliptic lanceolate	Flattened and beetle-vine leaf shaped
Eyes	Three pairs	Single pair Almost round	Single pair	Single pair,	Single pair cup shaped	Single pair	Single pair, comma shaped
Caecae	Seven pairs branched	Seven pairs not branched	Seven pairs Most branched	Seven pairs branched	Seven pairs more branched	Seven pairs branched	Seven pairs, not branched
Ring	71	71	67	66	70	71	67
Colour	Brown	Grayish green	Reddish yellow	Brown	Greyish	Gray	Light green

Papillae: Papillae small, closely set along the dorsal line.

Eyes: One pair invited comma shaped on ring 2.

Rings: Total number of body rings is 67.

Crop: Crop is without any branch or caeca.

Male and female pores: Open between the rings 24/25 and 26/27 respectively. Small to medium sized.

Colour: Light green in living condition, fade up in preserved state. Two sides are white, yellow in the middle after preservation.



Photograph of *Placobdella gauripurensis* n. sp.
(Dorsal view)

Host and habitat: The animal on which leech sticks on and suck blood for their food is called host. The mollusc which having operculum on the body to protect them and body is not divided into two parts called gastropod mollusc. *Placobdella gauripurensis* found in ponds and sucks the blood of gastropod molluscs (*Lymnea accuminata*) sticking on them.

Distribution: India: West Bengal.

Etymology: The specific name is proposed according to the name of the place where from the first example was collected.

Remarks: The present form *Placobdella gauripurensis* is somewhat similar to *Placobdella horai* in body shape. It is distinguished from *P. horai* in its eye shape, colour, number of rings and unbranched crop caeca in the body (Table. 1). Numbers of rings are same in *P. fulva* and *P. gauripurensis* sp. nov., but eyes and crops are completely different in these two species. *P. ceylanica* is clearly distinct in having three pairs of eyes. *P. indica*, *P. mydae* and *P. undulata* differs from the species under discussion in having 70 or 71 body rings. *P. gauripurensis* sp. nov. is different from the new world species and others, viz., *Placobdella* sp. (Brackish water leech of Spain), *P. maurica* (Freshwater leech of New Zealand), *P. parasitica* (fresh water species), *P. lamothei* (Mexican marine leech), *P. stuhlmanni* (American marine leech), *P. costata* (brackish water leech), *P. ornata* (Marine) and Marine turtle leeches *P. translucens*, *P. bistrata*, *P. hollensis*, *P. mexicana*, *P. montifera*, *P. nuchalis*, *P. multilineata* etc. by the body pigmentation pattern and disposition of eyespots.

Comparative material:

Placobdella emydae : An 2772/1, 1 ex., Howrah, West Bengal; An 2862/1, 1 ex., Jalpaiguri, West Bengal; An 2997/1, 1 ex. Krishna, Andhra Pradesh; An 3367/1, 1 ex., Mysore, Karnataka.

Placobdella fulva : An 2762/1, 3 exs., Kolkata, West Bengal; An 2767/1, 1 ex. Howrah, West Bengal; An 2782/1, 1 ex. Midnapur, West Bengal; An 2802/1, 1 ex. Bankura, West Bengal; An 2813/1, 1 ex. South 24 Parganas, West Bengal; An 2825/1, 1 ex. Nadia, West Bengal; An 2839/1, 1 ex. Murshidabad, West Bengal; An 2864/1, 1 ex. Jalpaiguri, West Bengal.

Placobdella horai : An 2783/1, 1 ex. Midnapur, West Bengal.

Placobdella undulata: An 2791/1, 1 ex. Burdwan, West Bengal; 2827/1. 1 ex., Nadia, West Bengal.

SUMMARY

The presented form has been collected from Gauripur, Birati, Kolkata from West Bengal. This

species is distinguished from other species by possessing the following characters. Body is beetle vine shaped. Eyes single pair and inverted comma shaped. 5-8 semicircular lines are found on the both side of the mid-dorsal line. Caeca is seven pairs, not branched. Mid dorsal papilla are also found. The leech is light green in colour when it is alive. Length of a full-grown preserved specimen is 4 mm and width is also 4 mm. Posterior sucker is 1mm in diameter; anterior sucker measures 0.5 mm in diameter. Both suckers are cylindrical. It can be easily identified by its flattened beetle vine shape.

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DNA FINGERPRINTING STUDY OF SOME OF THE INDIAN NON-HUMAN PRIMATE HAIRS

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INTRODUCTION

There have been some studies using molecular aspects such as that of Zhang and Shi (1993) on phylogeny of rhesus in China and that of Melnick *et al.* (1993) on rhesus from India and some of its neighbouring countries. Karanth *et al.* (2008) have researched on molecular phylogeny and biogeography of langurs and leaf monkeys (Colobine) of South Asia and Zhang and Ryder (1998) have worked on old world monkeys including Asian Colobines. There have been studies on new world monkeys as well (Ascunce *et al.*, 2007). Many of these molecular studies have been done using blood samples or hair samples (Ascunce *et al.*, 2007; Karanth, 2008). Earlier, Ascunce *et al.* (2003) have demonstrated amplification of mitochondrial *CoII* gene from DNA extracted from hair samples of some species of New World monkeys. However, the present study is an attempt on molecular aspects of taxonomy on the basis of DNA fingerprinting using only hair samples. The objectives of the present study included - extraction and amplification of DNA from available non-human primate hair samples and secondly to process the available DNA sequences using appropriate softwares to align sequences independently for each gene and to conduct phylogenetic and molecular evolutionary analysis.

METHODS

Initially hair samples obtained from National Zoological Collection, Zoological Survey of India,

Kolkata were sent to CCMB, Hyderabad for DNA fingerprinting. However, as these samples did not give good amplifiable DNA, so fresh hair samples of monkeys provided by Zoo were sent to CCMB for analysis. Out of this also, DNA could not be obtained from two samples, so the DNA isolated from exhibits A, B, C and F were subjected to PCR (Polymerase Chain Reaction) amplification using the universal Primers (Verma and Singh, 2003; US Patent No. 71,41,364) to generate species specific molecular signature. The following protocol was used for extraction of DNA from hairs

Ten to fifteen hair pieces with hair roots about 0.5 cm were cut and placed into a 1.5 ml eppendorf tube. A lysis buffer of 50ul consisting of 1 mM Tris pH 8.3, 50 mM KCL and 0.5% Tween was used. Besides, 10 l of 20 g/ml solution of Proteinase K in 10 mM Tris-HCL (pH 7.5) was also added to the above. This was vortexed for 30 seconds. Then, ultracentrifuge was done 1t 13000 rpm for one second. It was then put in incubator for overnight in a 56-60 degree centigrade waterbath. Thereafter, it was incubated overnight for 10 minutes and cooled down to room temperature. Again it was ultracentrifuged at 13000 rpm for one second. The DNA so extracted was used for PCR.

Sequences were aligned independently for each gene using MUSCLE (Edgar, 2004). Phylogenetic and molecular evolutionary analyses were conducted using MEGA5 (Tamura *et al.*, 2011). Best fit model for nucleotide substitution was selected based on minimum

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Akaike Information Criterion (AIC) value (Posada & Crandall, 2001). We constructed phylogenetic trees based on maximum parsimony (MP) and maximum likelihood (ML). Reliability of the phylogenetic tree was estimated using bootstrap values run for 1000 iterations. ML tree was used for further predicting the molecular time scale of species divergence using the calibration points 29.2 myr divergence between *Hylobates* and *Macaca* and 16.7 myr divergence between *Semnopithecus* and *Macaca* based on time tree (Hedges *et al.*, 2006). *Hylobates hoolock* was used as an outgroup. A molecular clock test was performed to find out whether the substitution rates were uniform (Tamura *et al.*, 2011).

RESULTS

The DNA sequences obtained from different hair samples are shown in Table 1. Samples A, B and F are similar to *Macaca mulatta*. They are monophyletic with a high bootstrap support (Fig. 1). While sample C belongs to *Macaca nemestrina* which is also supported by high bootstrap value. In the cladogram, *Hylobates hoolock* (an ape) was used as an outgroup and other old world monkey species were used for comparison and it was

found that none of the samples came from *Semnopithecus entellus* (Hanuman langur). Maximum likelihood method (Fig. 2) showed similar results as Maximum parsimony method as in the former method again three samples belong to *Macaca mulatta* and one sample belonged to *Macaca nemestrina*. The sample in question was 100% same as *Macaca nemestrina nemestrina* (Gen Bank accession Number AF350394). It was first tested whether the molecular clock hypothesis is true. Table 2 shows that the null hypothesis of equal evolutionary rate throughout the tree was accepted ($p=0.05$). No nucleotide divergence was found among samples A, B and F as compared to *Macaca mulatta* (Table 3).

DISCUSSION

Molecular taxonomy is a useful tool. Cytochrome b gene (also used in the present study) is widely used in identifying vertebrate species. Parson *et al.* (2000) have used nucleotide sequence analysis of cytochrome b gene to identify 44 different animal species belonging to 5 major vertebrate groups. Earlier workers have used molecular approaches to study primates.

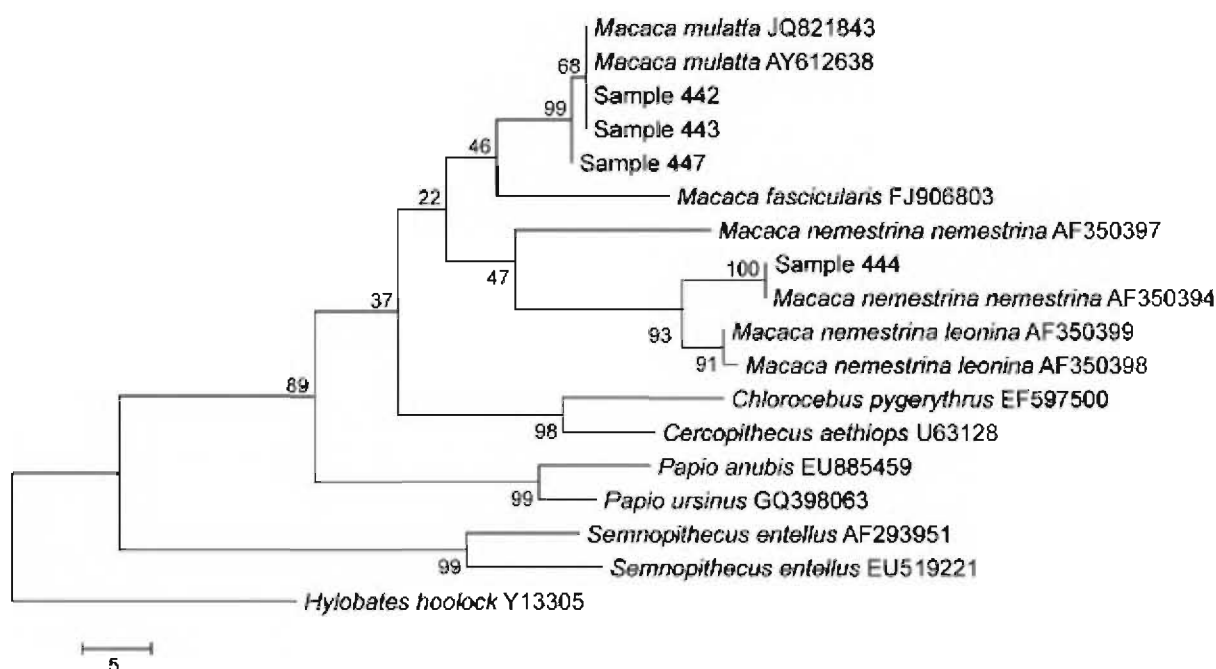


Figure 1: Maximum parsimony tree of samples and related species. Sample numbers as per Table 2. There were 310 bases in final analysis. Bootstrap values are based on 1000 iterations. *Hylobates hoolock* is used as an outgroup. GenBank accession numbers are provided after the species name.

Table - 1: Cytochrome b gene sequence of four samples

S N	Exhibit	BLAST outcome (GenBank Accession No. and species)	Maximum identity	Sequence
1	A 442	JQ821843 (<i>Macaca mulatta</i>)	100%	GGCTTTTCATGGGTTATGTTCTCCCATGAGGCCAAATATCATTTCTGGGAGCAACAGTAATCAGAAACCTGC TATCAGCAATCCCGTATATCGGAACCAATCTCGTCCAATGAATCTGAGGAGGATACGCCATCGACAGCCCT ACTCTCACAGATTCTTACCTTACACCTTATCCTACCTTCATCATCATCGCCCTCACAACCGTGACACCTA CTATTCTGACGAAACAGGATCAAAACACCTTGCGGAATCTCTCCGACTCAGACAAAATCGCCTTCCA CCCTACTACACAACCAAGACATCTGGGCTAGTCTCTTCTCTTCATCTAGCAACACTAACACTACT CTACCCAACTCTTAAACGACCCAGACAACACTACATTCCAGCCGACCCATTAAACA
2	B 443	AY612638 (<i>Macaca mulatta</i>)	100%	CACGATTCTTCACCTTACACTTTATCTACCTTCATCATCATCGCCCTCACAACCGTGACCTACTATTCT GCAAGAAACAGGATCAAAACACCTTGCGGAATCTCTCCGACTCAGACAAAATCGCCTTCCACCCCTAC TACACAACCAAGACATCTGGGCTAGTCTCTTCTCTTCATCTAGCAACACTAACACTACTCTCACCC AACCTCTAAACGACCCAGACAACACTACATTCCAGCCGACCCATTAAACACTCCCCACATATCAAACAG AGTGATACTTCTATT
3	C 444	AF35039 (<i>Macaca nemestrina nemestrina</i>)	100%	CACCCTACACTTCATCCTACCTTCATCATCGTCCCTCACAACCGTACACCTACTTTCTCTACAGAAAC AGGATCAAAACACCTTGCGGAATTTCTCCGACTCGGATAAAATCACCTTTACCCCTATTATACAATCA AAGACATCTAGGCCTAATCTCTCTCTTTTGGCCTAACAACTAACTAACTATTCTTACCCAACTCTTAA ACGACCCAGACAACACTATTCAGCTGACCCACTAAATACCCCCACATATCAAGCCAGAGTGATACCT CTATTTCATACACAATCTCAGAT
4	F 447	JQ821843 (<i>Macaca mulatta</i>)	99%	TCTCACAGATTCTTACCTTACACTTTATCTACCTTCATCATCATCGCCCTCACAACCGTGACCTACTA TTCTTGCAAGAAACAGGATCAAAACACCTTGCGGAATCTCTCCGACTCAGACAAAATCGCCTTCCACCC CTACTACACAATCAAAGACATCTGGGCTAGTCTCTTCTCTTCATCTAGCAACACTAACACTACTCTC ACCCAACTCTTAAACGACCCAGACAACACTATTCAGCCGACCCATTAAACACTCCCCACATATCAA CCAGAGTGATCTCTATTTCATACACAATCTTACGATCCATCCCAACAACTGGGAGGCGTACTAGC ATCTTTCTATCGATCTCTATCTAGCAGCCATCCT

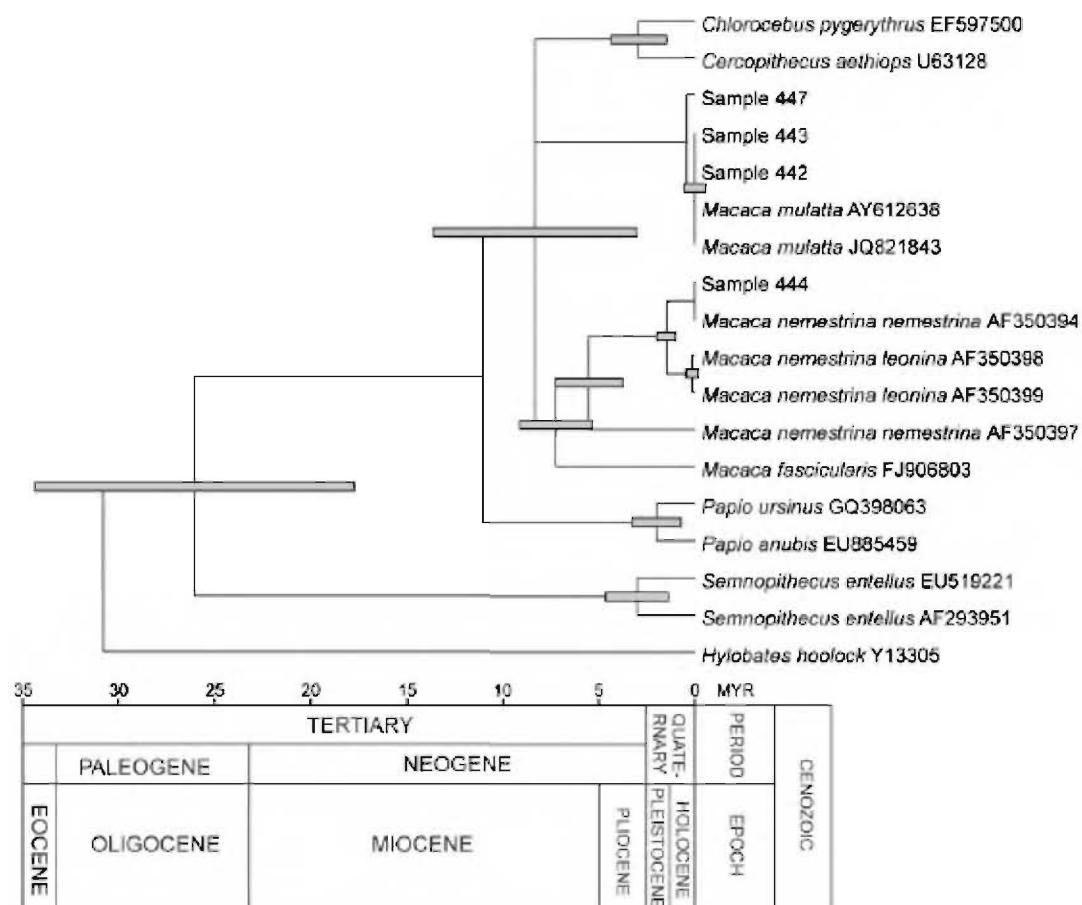


Figure 2: Molecular time clock for the evolution of *Macaca* and related species based on maximum likelihood method with Tamura and Nei (1993) model of nucleotide substitution and invariant sites. *Hylobates hoolock* is used as an outgroup. GenBank accession numbers are provided after the species name. Calibration points are 29.2 myr divergence between *Hylobates* and *Macaca* and 16.7 myr divergence between *Semnopithecus* and *Macaca* based on time tree (Hedges *et al.*, 2006).

Table-2: Results from a test of molecular clocks using the Maximum Likelihood method. The null hypothesis of equal evolutionary rate throughout the tree was accepted ($P=0.05$).

	lnL	Parameters	(+G)
With Clock	-1273.248	23	0.371
Without Clock	-1259.835	39	0.36

Table-3: Nucleotide Sequence of Various *Macaca* Species.

Macaca_mulatta_JQ821843	10	20	30	40	50	60
Macaca_mulatta_AY612638	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X442	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X443	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X447	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_nemestrina_AF350394	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X444	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_nemestrina_AF350397	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_leonina_AF350399	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_leonina_AF350398	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_fascicularis_FJ906803	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
	↑	↑	↑	↑	↑	↑
Macaca_mulatta_JQ821843	70	80	90	100	110	120
Macaca_mulatta_AY612638	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
X442	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
X443	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
X447	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
Macaca_nemestrina_nemestrina_AF350394	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
X444	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
Macaca_nemestrina_nemestrina_AF350397	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
Macaca_nemestrina_leonina_AF350399	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
Macaca_nemestrina_leonina_AF350398	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
Macaca_fascicularis_FJ906803	UUCAGGAAACAG	CAAAACACCG	UUCAGGAAAC	CGGAAACCG	CGGAAACCG	CGGAAACCG
	↑	↑	↑	↑	↑	↑
Macaca_mulatta_JQ821843	130	140	150	160	170	180
Macaca_mulatta_AY612638	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X442	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X443	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X447	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_nemestrina_AF350394	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
X444	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_nemestrina_AF350397	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_leonina_AF350399	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_nemestrina_leonina_AF350398	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
Macaca_fascicularis_FJ906803	CACCGACACG	UUAACGACCG	CAUACGACCG	CAUACGACCG	CACACGACCG	GCACGACCG
	↑	↑	↑	↑	↑	↑
Macaca_mulatta_JQ821843	190	200	210	220	230	240
Macaca_mulatta_AY612638	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
X442	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
X443	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
X447	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
Macaca_nemestrina_nemestrina_AF350394	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
X444	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
Macaca_nemestrina_nemestrina_AF350397	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
Macaca_nemestrina_leonina_AF350399	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
Macaca_nemestrina_leonina_AF350398	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
Macaca_fascicularis_FJ906803	ACAAACACACAC	CAACCAACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG	CAAAACACCG
	↑	↑	↑	↑	↑	↑
Macaca_mulatta_JQ821843	250					
Macaca_mulatta_AY612638	AAACACACAC					
X442	AAACACACAC					
X443	AAACACACAC					
X447	AAACACACAC					
Macaca_nemestrina_nemestrina_AF350394	AAACACACAC					
X444	AAACACACAC					
Macaca_nemestrina_nemestrina_AF350397	AAACACACAC					
Macaca_nemestrina_leonina_AF350399	AAACACACAC					
Macaca_nemestrina_leonina_AF350398	AAACACACAC					
Macaca_fascicularis_FJ906803	AAACACACAC					
	↑					

Zhang and Shi (1993) classified rhesus in China into 6 sub-species using mitochondrial DNA. Work of Karanth *et al.* (2008) using two unlinked nDNA markers (lysozyme and protamine P1) and one mtDNA (cytochrome b) marker on langurs and leaf monkeys from South Asia support the classification of langurs of Indian sub-continent (Hanuman, Nilgiri and Purple-faced langurs) in the genus *Semopithecus* and leaf monkeys from South-East Asia in the genus *Trachypithecus*.

Macaca mulatta and *Macaca nemestrina* diverged around 9 m years ago i.e. mean divergence is 9 m years ago (confidence interval 4-14 m years ago, because one gene only was used so confidence interval was very large).

Ascunce *et al.* (2007) have used blood and hair samples for their molecular study on New World Monkey species *Alouatta caraya* and Karanth *et al.* (2008) have used blood, tissue and hair samples. The present work is based exclusively on DNA extracted from hair samples. So, the approach used in the present study is non-invasive based on hair samples which may be useful in identification of seized material. Besides, it may also be useful in studies involving free-living animals (removing the problem of catching the individuals for taking out blood samples).

SUMMARY

The present work uses a non-invasive approach for study of taxonomy of some of the

Indian non-human primates based on DNA sequences obtained through cytochrome b gene from hairs. The DNA isolated was subjected to PCR (Polymerase Chain Reaction) amplification using the universal Primers to generate species specific molecular signature. The DNA sequences sent by CCMB, Hyderabad were analysed.

Reliability of phylogenetic tree was estimated using bootstrap values run for 1000 iterations. A molecular clock test to check whether substitution rates were uniform showed that the null hypothesis of equal evolutionary rate throughout the tree was accepted ($p=0.05$). Maximum likelihood method showed results similar to that of Maximum Parsimony method. Nucleotide substitution sites in cytochrome-b gene among different study species were also found out. No nucleotide divergence was found among *Macaca mulatta* samples in question. Future studies incorporating more genes and larger number of samples and species may provide further insight.

DNA based taxonomy is useful in wildlife forensics and non-invasive method is particularly useful in free-living and zoo primates as it does not involve catching them.

ACKNOWLEDGEMENT

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**A NEW RECORD OF YELLOW TAIL ANEMONEFISH,
AMPHIPRION CLARKII (BENNETT, 1830) FROM TUTICORIN
TROPICAL WATERS, SOUTHEAST COAST OF INDIA**

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INTRODUCTION

In September 2008, four numbers of clownfishes were obtained during the cage operation for ornamental fish collection carried out at Van Island of Tuticorin, Southeast coast of India. For the better health and survival, the fishes were packed in individual polythene bags filled with sufficient air and they were transported to the Marine ornamental fish hatchery at the Centre of Advanced Study in Marine Biology, Annamalai University. They were accommodated in the quarantine tank with two numbers of sea anemones, *Stichodactyla mertensii* for three days. Among the four, one fish has died and the same was measuring a total length of 111 mm and weight of 25 g. Based on the observed meristic characters and available literatures (Fautin and Allen, 1992; Rao, 2003) it was identified as Yellow tail anemonefish, *Amphiprion clarkii* (Fig. 1) which was not reported before in the coastal waters of Indian mainland.

DESCRIPTION

The body was oval, elongated and compressed. The entire body colour was blackish brown except at trunk region. The pectoral, pelvic and caudal fins were bright yellowish in colour. Head profile steep, snout blunt, mouth small, terminal and protractile. Teeth are present on both the jaws with single nostril. Scales are

present on operculum to caudal base and the opercle and pre-opercle are serrated.

Three white bands were present on the body, among them first two were broad. First band starts from the nape and runs across the head behind the eye. The second band occurs on the middle of the body just behind the pectoral fin starts from the base of the 10th dorsal spine and end at the base of 2nd dorsal soft ray. In ventral part, this band occurs in between anus and first anal spine. Third white band runs down the caudal fin and the caudal peduncle. The width of first, second and third white bars were 9 mm, 10 mm and 4 mm likewise. The gap between first and second band was 28 mm and between second and third it was 20 mm. The first band joined at the upper side and incomplete in ventral side of the body. Snout and thorax were yellowish in colour. Prominent lateral line and nasal pore were present. The maximum length of the pectoral fin base was 10 mm. The length of pelvic fin base, anal fin base and caudal fin base were 11 mm, 24 mm and 14 mm.

Morphometric Characters

The morphometric characters were taken to the nearest millimeter and given in Table.1

Meristic characters

The fins include a single dorsal with 10 spines

Keywords: Yellow tail anemonefish, *Amphiprion clarkii*, Tuticorin reef waters.

Table : 1. Morphometric measurements of *Amphiprion clarkii*

CHARACTERS	(IN MM)
Total length	111
Fork length	107
Standard length	86
Maximum body depth	46
Head length	27
Pectoral fin length	24
Pelvic fin length	31
Dorsal fin length	52
Eye diameter	7
Anal fin length	26
Pre orbital length	7
Post orbital length	13

and 16 soft rays and the anal fin with 2 spines and 13 soft rays. Pectoral fin has 19 soft rays. Pelvic fin was found with one spine and five soft rays. There are 33 opercula spines and 39 lateral line scales and the same was found to be Ctenoid. Upper jaw and lower jaw had 12 and 17 teeth respectively. Rao (2003) reported this species from Andaman and Nicobar waters and mentioned the characters as in the case of present study, D.X-XII, 14-16; A.II, 12-14; P.19-20; V.I, 5.

The taxonomic position of this species is given below

Phylum : CHORDATA
 Subphylum : VERTEBRATA
 Super class : GNATHOSTOMATA
 Grade : TELEOSTOMI
 Class : ACTINOPTERYGII
 Sub class : NEOPTERYGII
 Division : TELEOSTEI
 Super order : ACANTHOPTERYGII
 Order : PERCIFORMES
 Suborder : LABROIDEI
 Family : POMACENTRIDAE
 Sub family : AMPHIPRIONINAE
 Genus : *Amphiprion* (Bloch and Schneider, 1801)
 Species : *Amphiprion clarkii* (Bennett, 1830)

DISTRIBUTION

This species is widely distributed in tropical and subtropical waters of the Indo-West Pacific region (Fautin and Allen, 1992). It is found in tropical shallow waters, lagoons and on the outer reef slopes of Persian Gulf, Western Australia, Melanesia, Taiwan, Southern Japan and the Ryukyu islands at a depth of 1-50 meters.

REMARKS

The marine ornamental fishes are one of the most popular attractions in world wide due to their

**Fig. 1. :** *Amphiprion clarkii* (Bennett, 1830)

adaptability to live in confinement. Among all coral associated ornamental fishes, anemonefishes are abundant (Kumaraguru, 1997). About 28 species of known anemonefishes are recognized under two genera *Amphiprion* and *Premnas* (Fautin and Allen, 1992). Compared to other damsel fishes, these fishes have some remarkable behavioral characteristics like symbiotic association with sea anemones (Mariscal, 1970; Allen, 1972; Fautin & Allen, 1992), formation of a group consisting of monogamous pair and protandrous hermaphroditic character (Allen, 1972; Fautin and Allen, 1992; Fricke and Fricke, 1977; Moyer and Nakazono, 1978; Ross, 1978).

Among clownfishes, *Amphiprion clarkii* has the symbiotic relationship with ten types of symbiotic sea anemones (Fautin & Allen, 1992). It is not commercially important as a food fish and is generally not edible. This species is however popular as an aquarium fish and can be bred and reared in captivity. It is omnivorous and feeds on algae and marine invertebrates such as copepods, amphipods and isopods. The new arrival of this species in Tuticorin tropical waters may be the post tsunami outcome.

Abréviations and symboles

D = Dorsal fin

A = Anal fin

P = Pectoral fin

V = Ventral / pelvic fin

Above letters followed by Arabic numerals = Number of rays

A coma (,) in between Roman and Arabic numeral means that the fin is continues

Above letters followed by Romanian numerals in capitals = Number of fin spines

SUMMARY

Yellow tail anemonefishes were recorded for the first time at Tuticorin coral reef waters (Lat. 8° 45' N; Long. 78° 10' E), Southeast coast of India during cage operation. Since this species is uncommon to the Indian main land waters, it has been taken for studying the morphometric and meristic characters to probe taxonomical aspects and distribution pattern. These fishes were identified as *Amphiprion clarkii* belonging to the family Pomacentridae.

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FISH FAUNA OF ITANAGAR WILD LIFE SANCTUARY ARUNACHAL PRADESH, INDIA

DEBASHREE DAM

*Arunachal Pradesh Regional Centre,
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INTRODUCTION

Itanagar Wildlife Sanctuary (IWS hereafter) which is situated in Papumpare District of Arunachal Pradesh covering a total area of 140.30 sq. km is bound by the Senki stream in the north, Pachin in the south, Neorochi on the North East and Pam river in the East. The township of Itanagar, capital of Arunachal Pradesh is located within the sanctuary.

Till date there is no record available on the fish fauna of IWS except for Tamang et al, (2007), Nath & Dey (2000) who have reported ichthyofauna from Senki and Pachin streams which are the major drainages of IWS. The present report is an attempt to compile the fish fauna of IWS based on specimens collected by various workers of Zoological Survey of India (ZSI) from different localities of IWS. This is likely to be the first comprehensive compilation of fish fauna of IWS based on surveys and also those reported by other workers from different localities of IWS.

METHODOLOGY

Various workers of ZSI have surveyed different drainages (As in table1) within the IWS and fish representatives collected were kept preserved in Arunachal Pradesh Regional Centre, Zoological Survey of India, Itanagar (APRC/ZSI/ITA) laboratory. With a view to ascertain the fish fauna of IWS these specimens were studied and taxonomic details were noted. Besides these, fresh collections were also made through various local surveys. Senki stream is one of the main drainages in IWS and was selected as one of the major collection site as it is contiguous with Pachin Stream which finally falls into the Brahmaputra through the river Dikrong. The collections were made using a cast net, gill net and also various indigenous fishing methods. The representatives were all preserved in 10% formalin and have been registered and deposited in APRC/ZSI / ITA.

Table No. 1 : Collection sites

Sl.No	Collection Sites	Abbreviations used in Table 2
1	Senki Stream, Itanagar (in and around Chandranagar)	SR1 (Ita)
2	Senki Stream, Itanagar (bordering Police Colony & around)	SR2 (Ita)
3	Stream near Raj Bhavan, Itanagar	RB (Ita)
4	Stream near Indira Gandhi Park, Itanagar	IGP (Ita)
5	Ganga Lake near Itanagar	GL (Ita)
6	Pachin stream, Jollang	RP (Jol)

RESULTS AND DISCUSSION

The present enumeration of fishes was compared with previous studies (Tamang, 2007; Nath & Dey, 2000) and a detailed list of 66 species belonging to 42 genera and 17 families have been prepared (Table.2). The list contains the number of specimens examined with their corresponding registration number along with the localities from where they have been collected. Out of these 66 species, 37 species have been recorded in our

present collections. 12 species reported exclusively from Senki stream, 7 species from Pachin and 10 species common to both Pachin and Senki (Tamang, 2007; Nath & Dey, 2000) have been included in the compilation for a comprehensive account of the fish fauna of IWS.

An analysis of the composition of fish fauna shows that Siluriformes is the most dominant order with 8 families followed by Cypriniformes and Perciformes with 4 families each and

Table. 2 : List of fish fauna of Itanagar WLS

Sl. No.	Type	No. of Specimens examined	Registration no. in our museum APRC/ZSI/P-	Collection sites in the present study	Reported by (Tamang, et al. 2007 Nath & Dey, 2000)
	Order : Cypriniformes				
	<i>Family : Cyprinidae</i>				
1	<i>Aspidoparia jaya</i> (Hamilton)	-	-	-	Senki
2	<i>Barilius bendelisis</i> (Hamilton)	13	13,14,22,187,492	SR1,SR2(Ita) ;RP(Jol)	-
3	<i>Barilius barna</i> (Hamilton)	-	-	-	Pachin,Senki
4	<i>Barilius tileo</i> (Hamilton)	-	-	-	Pachin,Senki
5	<i>Raiamas bola</i> (Hamilton)	01	491	RP(Jol)	-
6	<i>Danio dangila</i> (Hamilton)	01	53	SR1(Ita)	-
7	<i>Danio rerio</i> (Hamilton)	09	52	SR1(Ita)	-
8	<i>Devario aequipinnatus</i> McClelland	43	44,45, to 48,152	SRI(Ita)	-
9	<i>Devario devario</i> (Hamilton)	-	-	-	Senki
10	<i>Rasbora rasbora</i> (Hamilton)	1	98	SRI(Ita)	-
11	<i>Tor putitora</i> (Hamilton)	1	490	RB(Ita)	-
12	<i>Tor tor</i> (Hamilton)	-	-	-	Pachin,Senki
13	<i>Neolissochilus hexagonolepis</i> (McClelland)	2	2,185	SR2(Ita)	-
14	<i>Chagunius chagunio</i> (Hamilton)	1	493	RP(Jol)	-
15	<i>Puntius chola</i> (Hamilton)	1	93	RB(Ita)	-
16	<i>Puntius conchoni</i> (Hamilton)	1	92	IGP(Ita)	-
17	<i>Puntius sophore</i> (Hamilton)	1	89	SRI(Ita)	-
18	<i>Puntius ticto</i> (Hamilton)	2	90, 91	SRI(Ita)	-
19	<i>Cyprinion semiplotum</i> McClelland	-	-	-	Pachin, Senki
20	<i>Labeo gonius</i> (Hamilton)	10	64	SRI(Ita)	-
21	<i>Bangana dero</i> (Hamilton)	-	-	-	Pachin, Senki
22	<i>Crossocheilus latius</i> (Hamilton)	-	-	-	Pachin, Senki
23	<i>Schizothorax</i> sp.	13	102, 103	SR1(Ita)	-
24	<i>Schizothorax richardsoni</i> (Gray)	-	-	-	Pachin
25	<i>Schizothorax esocinus</i> Heckel	-	-	-	Pachin
26	<i>Garra annandalei</i> Hora	-	-	-	Pachin, Senki
27	<i>Garra lissorhynchus</i> (McClelland)	1	303	SR1(Ita)	-
28	<i>Garra gotyla</i> (Gray)	1	183	SR2(Ita)	-
29	<i>Garra maclellandi</i> (Jerdon)	-	-	-	Pachin
30	<i>Oreochthys cosuatis</i> (Hamilton)	-	-	-	Senki
	<i>Family : Psilorhynchidae</i>				
31	<i>Psilorhynchus balitora</i> (Hamilton)	1	88	SR2(Ita)	-
	<i>Family : Balitoridae</i>				
32	<i>Acanthocobitis botia</i> (Hamilton)	-	-	-	Pachin, Senki
33	<i>Balitora brucei</i> Gray	1	27	SR2(Ita)	-
34	<i>Schistura rupecula</i> McClelland	1	182	SR2(Ita)	-

Sl. No.	Type	No. of Specimens examined	Registration no. in our museum APRC/ZSI/P-	Collection sites in the present study	Reported by (Tamang, et al. 2007 Nath & Dey, 2000)
35	<i>Schistura devdevi</i> (Hora)	2	177, 184	SR2(Ita)	-
36	<i>Schistura sikimaiensis</i> (Hora)	1	188	SR2(Ita)	-
37	<i>Aborichthys elongatus</i> Hora	2	178	SR2(Ita)	-
38	<i>Aborichthys kempi</i> Chaudhuri	-	-	-	Pachin
	Family : Cobitidae				
39	<i>Botia rostrata</i> Gunther	1	376	SR2(Ita)	-
40	<i>Botia dario</i> (Hamilton)	1	149	SR2(Ita)	-
41	<i>Lepidocephalichthys guntea</i> (Hamilton)	5	70,388	SR2; SR2(Ita)	-
42	<i>Lepidocephalichthys annandalei</i> Chaudhuri	3	67	SR1(Ita)	-
	Order : Siluriformes				
	Family: Bagridae				
43	<i>Mystus tengara</i> (Hamilton)	1	82	SR1(Ita)	-
44	<i>Mystus montanus</i> (Jerdon)	-	-	-	Senki
	Family : Amblycipitidae				
45	<i>Amblyceps arunachalensis</i> Nath & Dey	9	180	SR2(Ita)	-
46	<i>Amblyceps mangois</i> (Hamilton)	1	5	SR1(Ita)	-
	Family : Sisoridae				
47	<i>Glyptothorax indicus</i> Talwar	1	181	SR2(Ita)	-
48	<i>Glyptothorax cavia</i> (Hamilton)	-	-	-	Senki
49	<i>Glyptothorax telchitta</i> (Hamilton)	-	-	-	Senki
50	<i>Glyptothorax brevipinnis</i> Hora	-	-	-	Senki
51	<i>Glyptothorax pectinopterus</i> (McClelland)	-	-	-	Senki
52	<i>Bagarius bagarius</i> (Hamilton)	-	-	-	Pachin
	Family : Erithistidae				
53	<i>Hara hara</i> (Hamilton)	1	179	SR2(Ita)	-
54	<i>Pseudolaguvia shawi</i> (Hora)				Senki
	Family : Claridae				
55	<i>Clarius magur</i> (Hamilton)	-	-	-	Senki
	Family : Heteropneustidae				
56	<i>Heteropneustes fossilis</i> (Bloch)	-	-	-	Senki
	Family : Chacidae				
57	<i>Chaca chaca</i> (Hamilton)	1	35	SR2(Ita)	-
	Family : Olyridae				
58	<i>Olyra longicaudata</i> McClelland	-	-	SR2(Ita)	-
	Order: Beloniformes				
	Family: Belonidae				
59	<i>Xenentodon cancila</i> (Hamilton)	-	-	-	Pachin
	Order : Perciformes				
	Family : Chandidae				
60	<i>Chanda nama</i> (Hamilton)	-	-	-	Pachin, Senki
61	<i>Parambassis ranga</i> (Hamilton)	-	-	-	Pachin, Senki
62	<i>Parambassis baculis</i> Hamilton	-	-	-	Pachin
	Family : Badidae				
63	<i>Badis badis</i> (Hamilton)	1	15	GL(Ita)	-
	Family : Cichlidae				
64	<i>Oreochromis mossambicus</i> (Peters)	-	-	-	Senki
	Family : Channidae				
65	<i>Channa striata</i> (Bloch)	1	41	GL(Ita)	-
66	<i>Channa marulius</i> (Hamilton)	02	39	SR1(Ita)	-

Beloniformes with a single family Belonidae represented by a single species, *Xenentodon cancila*. The study also shows that Cyprinidae is the most dominant family with 30 species. Balitoridae forms the next dominant family with 7 species, Sisoridae with 6 species, *Chandidae* with 3 species followed by *Bagridae*, *Amblycipitidae*, *Erithistidae* and *Channidae* with 2 species each and the remaining 9 families-*Psilorhynchidae*, *Cobitidae*, *Claridae*, *Heteropneustidae*, *Chacidae*, *Olyridae*, *Belonidae*, *Badidae* and *Cichlidae* with a single representative each. (Table no.3)

It has been observed that the distribution of 7 species namely *Schizothorax richardsoni*, *Schizopyge esocinus*, *Garra maclelland*, *Aborichthyes kemp*, *Bagarius bagarius*, *Xenentodon cancila* and *Parambassis baculis* are restricted to Pachin river. Out of 66 species, record of 4 species-*Chaca chaca*, *Schistura rupecula*, *Mystus tengara* and *Glyptothorax indicus* from Senki are significant as they have not been reported by earlier workers from IWS and hence form new records of IWS. Tamang et al, 2006 reported *Pseudolaguvia shawi* (Hora, 1921) from Senki which formed a new record for the state. An analysis of the record shows that out of 66 species reported from different localities of IWS, Senki

stream dominates the list with 50 species. The record of higher diversity and also rare species indicates that it is an important drainage of IWS. The record of *Mystus tengara* from this drainage is significant as it could be a new record for the state. This lotic system drains into the Brahmaputra through the Pachin and Dikrong rivers. The three water bodies are contiguous and as there is no barrier there is equal chance of migration of fishes to and fro from all the three water bodies. It is important to mention that *Mystus tengara*, *Schistura rupecula* and *Chaca chaca* have been studied from collections made in the early 90s. However these species were not found in the more recent surveys undertaken by the ZSI team members. The Senki stream from where they were collected flows through the township of Itanagar. This water body has been immensely affected by the rapid urbanisation and spread of settlements. Tons of waste and garbage are disposed in the stream from the nearby settlements. Washing of clothes and bathing in the Senki stream could have also lead to depletion of the aquatic faunal diversity. Removal of sand, boulders and stones seem to change the microhabitats of the stream and could be a sound reason in depletion of

Table. 3 : Record of fish fauna of IWS at a glance

Sl. No.	Order	Family	Genera	Species
1	Cypriniformes	Cyprinidae	18	30
		Psilorhynchidae	01	01
		Cobitidae	02	04
		Balitoridae	04	07
2	Siluriformes	Bagridae	01	02
		Amblycipitidae	01	02
		Sisoridae	02	06
		Erithistidae	02	02
		Claridae	01	01
		Heteropneustidae	01	01
		Chacidae	01	01
		Olyridae	01	01
3		Belonidae	01	01
4	Perciformes	Chandidae	02	03
		Badidae	01	01
		Cichlidae	01	01
		Channidae	01	02
		Total	42	66

species inhabiting the water bodies. Fishing by the nearby local inhabitants could also pose to be a serious threat to the fish fauna. Strict conservation measures by the administration are definitely the need of the hour which can save this water body from further depletion.

This communication has been compiled based on the fish fauna recorded primarily from two main drainages of IWS namely the Senki stream and the Pachin. The ichthyofaunal diversity of IWS could be much higher than what has been recorded keeping in view the different unexplored streams and rivers draining the IWS. The survey and seasonal sampling of these unexplored water bodies could reveal many more interesting ichthyofaunal compositions and also

throw light on the distribution and status of the species.

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NEW LOCALITY RECORD OF THE LEECH *POECILOBDELLA MANILLENSIS* FROM DARJEELING DISTRICT, WEST BENGAL, INDIA

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INTRODUCTION:

This paper deals with the new locality record of a leech (Class Hirudinea) *Poecilobdella manillensis* at Siliguri (Latitude 26°49'59"N and Longitude 88°44'08"E), Darjeeling district. So far, 8 species of leeches under two families (Hirudidae and Haemadipsidae) are reported in the district of Darjeeling (Harding and Moore, 1927). Hirudidae family has two species (*Dinobdella ferox*, *Hirudo birmanica*) of leech found in the district. This leech forms the Third species of the family which has been collected recently. Harding and Moore (1927), Soota and Ghosh (1977), Ghosh (1998), Chandra (1976) worked on the records of leeches in India. Bandyopadhyay and Mandal (2005), Mandal (1996, 2000, 2002 and 2010) recorded several species of leech from West Bengal, Tamil Nadu, Andhra Pradesh, Karnataka, UttaraKhand, Arunachal Pradesh and Jharkhand of India.

MATERIALS AND METHODS

This leech specimen is collected from under a stone surrounded by grasses of the mountain spring near Gaiganga tea garden (Jhora) of Siliguri, district Darjeeling. Collection is made by hand having gloves in the hand. After collection the leech is kept in a wide mouth bottle and cleaned by fresh water. After cleaning the leech specimen is placed in a tray with little water and it is slowly killed by adding drops of 70% alcohol. Leeches usually die in an extended condition by the process and this extended body of the leech

helps in identification. After death, the leech is kept in 70% alcohol for permanent preservation.

Material examined: 1 ex., Gaiganga tea garden (Jhora) Siliguri, Darjeeling district, West Bengal, India, 16.09.2011, collected by Munmun Chakraborty.

Other materials examined: An 2754/1 2 exs., Lakhimpur, Uttar Pradesh, collected on 08.03.1990 by G.C. Ghosh; An 2812/1, 2 exs., South Dinajpur, West Bengal, India, collected on 24.03.1995 by Dr. C.K. Mandal; An 2856/1, 2 exs., Karandighi, South Dinajpur, West Bengal, India, collected on 24.03.1995 by Dr. C.K. Mandal.

Diagnostic characters: Body is elongated, attains a length of about 6.2 centimeter, Width 1.4 centimeter. The leech has two suckers. Anterior and posterior suckers are 6mm. and 8.5 mm. in diameter respectively. Colour is brown dorsally, light green ventrally in living form. Colour fades up in preserved state. There is no sign of green ventrally in preserved state. Dorsalside bears eleven black breaking chain stripes. Two blackish lines are nearer to marginal cream colour in preserved condition. Number of teeth is one hundred. There are 111 annuli in the body. Male and female pores separated by five annuli. Vaginal stalk is absent.

Distribution: India: Landour (U.P.); Andhra Pradesh; Assam; Bihar; M.P.; Maharashtra; Orissa; Tamil Nadu; Cachar (Assam); Karnataka; Cochin (Kerala); Calcutta, West Dinajpur, Bunkura, Birbhum, Burdwan, Coochbihar, Hooghly,

Photographs of a leech collected from Siliguri, Darjeeling, West Bengal:



Poecilobdella manillensis(V) *Poecilobdella manillensis*(D)

Howrah, Jalpaiguri, Malda, Purulia, South 24 Parganas, North 24 Parganas, Darjeeling, West Bengal.

Outside India: Pakistan; Sri Lanka; Myanmar; Borneo; Malaysia; Philippines and China.

Remarks: The present distributional record of this species may contribute to the result of climate change. It has been seen that increase in temperature of a region, particularly in aquatic habitats, compelled the ambient species to

migrate to cooler regions. Similarly, some species earlier could not invade the cooler region may now spread in to with conducive temperature rise. Meteorological data's (1994 and 1995) shows that within last ten years average temperature of some region of Himalaya, especially at Darjeeling is increasing. As a result, some places of the region becoming devoid of ice fall and it is well noticed by the local people. *Poecilobdella manillensis* has earlier been collected from the districts of Jalpaiguri and Cooch Bihar in lower parts of Bengal duars, but several faunal surveys failed to find this leech from Darjeeling district prior to the recent survey. It may be possible that *Poecilobdella manillensis* now invaded the district with change of temperature that makes the environment conducive for its survival and established in the plains below the hills of the district.

SUMMARY:

Present study reveals the extended distribution record of leech *Poecilobdella manillensis*. So far it has not been reported from Darjeeling District. The present record from Siliguri in Darjeeling District may possibly due to climate change.

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Short Communication

ON THE OCCURRENCE OF A GIANT SQUILLA, *HARPIOSQUILLA RAPHIDAE* (CRUSTACEA: MALACOSTRACA: STOMATOPODA) IN CHILIKA LAGOON, ODISHA

INTRODUCTION

Two giant female mantis shrimps were collected from the Outer Channel of the Chilika lagoon, Odisha by the staff of the Chilika Development Authority, Bhubaneswar, on 20-03-2002 during the course of their regular monitoring surveys. A detailed taxonomic examination of the specimen revealed its identity as *Harpiosquilla raphidae* (Fabricius, 1798), the largest known stomatopod, first time ever from brackish water ecosystem.

The Malacostracan Crustacean or Stomatopod fauna of the Indo-Pacific region has been well studied and illustrated by Kemp (1913), Shanbhogue (1975) and Manning (1968, 1978). The mantis shrimps of the Chilika Lagoon, Odisha were recorded by Kemp (1915) and Ghosh (1995). Of the 115 species of stomatopods known to occur in the Indian Ocean, only three have been reported from the Chilika Lagoon, viz. *Cloridopsis immaculata* (Kemp, 1913), *Cloridopsis scorpio* (Latreille, 1825) and *Oratosquilla interrupta* (Kemp, 1913) to date.

Although Stomatopods are primarily marine inhabitants, *C. immaculata* (Kemp) has been reported to thrive in waters of quite low salinities. Possibly due to shallowness and low salinity of water the marine form *C. scorpio* (Latreille) reported earlier (Kemp, 1913) from the Chilika lagoon and the outer channel could not be detected during 1985-87 (Ghosh, 1995). As a part of Aquatic studies of the Chilika lagoon by the Chilika Development Authority, Bhubaneswar, Odisha, two well grown adult specimens of Mantis shrimp *Harpiosquilla raphidae* (Fabricius) were collected from the outer channel of Chilika lagoon. The report, from view point of geographic distribution, is of significance, as despite extensive studies on the stomatopod fauna, there has been no record of the giant Stomatopoda from this pear-shaped brackish water lagoon. It was therefore considered fit to attempt a brief taxonomic description of the species with its morphological attributes.



Fig. A. Photograph of the female specimen

TABLE 1 - Showing Morphometric Measurements (in mm) of *Harpiosquilla raphidae*.

	Female	Male
Total length including rostral 'plate'	342	225
Length of Carapace at median point	66	50
Width of Carapace below anterolateral angle	31	21
Width of Carapace at posterolateral end	65	47
Length of rostral plate	13	10
Corneal width	12	09
Stalk width	06	03
Raptorial claw	270	188
Coxa & Basis	19	10
Ischium	21	13
Merus	58	42
Carpus	15	12
Propodus	75	51
Dactylus	82	60
Telson length	56	37
Telson width	70	46
Length of uropod	61	51

Phylum - Arthropoda
 Sub-Phylum - Crustacea
 Class - Malacostraca
 Sub-Class - Eumalacostraca
 Super-Order - Stomatopoda
 Family - Squillidae
 Genus - *Harpiosquilla* Holthuis

***Harpiosquilla raphidae* (Fabricius, 1798)**

1798. *Squilla raphidae* Fabricius, *Ent. Syst. Suppl.*: 416.

1913. *Squilla raphidae*: Kemp, *Mem. Ind. Mus.*, 4: 88.

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1997. *Harpiosquilla raphidae*: Lyla *et. al.*, *Stomatopods of Parangipettai Coast*, 19: Fig. 25.

Material Examined: 2 exs. (♀, 342 mm TL and ♂, 225 mm TL), Chilika Development Authority, Bhubaneswar, date .20-03-2002, depth-285 cm., Magarmukh, mouth of Chilika lagoon.

Description: Eyes large, cornea broader than stalk, bilobed and set obliquely on stalk [fig. 2 (1-2)]. Rostral plate larger than broad with long apical projection (fig. 2). Post lateral margin of

carapace with deep excavation (fig. 2). Propodus of raptorial claw with erect and stiff spines, well spaced, large and small alternating more or less regularly (fig. 3). Fifth thoracic somite with lateral spine (double process) [fig. 5]. Sub-median carina of 5th abdominal somite unarmed (fig. 8). Ventral keel of 8th thoracic somite rounded. Propodi of last 3 merillapeds elongate, not beaded or ribbed ventrally. Telson with sharp median carina (fig. 4). Median teeth of telson without movable apices, 7 - 8 intermediate denticles are present between the teeth of telson (fig. 4). Exopods of uropods two segmented, proximal only with movable spines. Distal segment of uropodal exopod with inner half only dark. The various morphometric measurements of the two specimens are furnished in table-1.

Distribution: India: West Bengal, Odisha, Tamil Nadu, and Maharashtra. Elsewhere: East Coast of Africa to Thailand and Indonesia.

Remarks: The present report forms the first record of the giant Stomatopod from a brackish

water ecosystem, the Chilika lagoon. Earlier it was recorded from the sea off Puri and Gopalpur, Odisha Coast (Kemp, 1913) and from Chandipur, Balasore, Odisha (Tiwari and Biswas, 1951). A notable feature of the find is the rare size of the female specimen (342 mm), a rare occurrence. Despite the fame, such giant size specimen has not been recorded to date. Perhaps, following historic interventional measure (Dredging of the Magarmukh region) a more productive aquatic environment is responsible for luxuriant growth of the Mantis Shrimp.

The genus *Harpiosquilla* is represented by four species in the Indian Ocean, viz. *H. annadelai*, *raphidae*, *harpax* and *melanoura*. Of these four species *H. raphidae* has close resemblance with *harpax*, it differs from *harpax* and *melanoura* in having lateral spine on the 5th thoracic somite, and species *H. annadelei* differs from *raphidae* in the presence of sub-median carina of 5th abdominal

somite armed posteriorly and distal segment of uropodal exopod black with a white mid-rib.

The other three species reported earlier from Chilika lagoon, Odisha have the characteristics of propodus of raptorial claw is pectinate without erect spines and posterolateral margin of carapace entire whereas in *H. raphidae*, propodus of raptorial claw with erect spines and posterolateral margin of carapace with deep excavation.

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