Records of the Zoological Survey of India

A JOURNAL OF INDIAN ZOOLOGY

Zoological Survey of India
COMPUTERISED DATA ON NATIONAL ZOOLOGICAL COLLECTION

The National Zoological Collections comprising nearly 15000 types are housed in the Zoological Survey of India, Calcutta and are properly maintained. All these specimens have Registration numbers and are readily available for study as and when required. Data pertaining to locality, date of collection, name of collector, sex, up to date valid species name, name of the host (for parasite), etc., of each type collection have already been computerised. The computerised data are stored in the computer centre of Zoological Survey of India. Scientists / Naturalists interested for any information on type species present in Zoological Survey of India may contact the Director, Zoological Survey of India, ‘M’ Block, New Alipur, Calcutta-700 053.

Dr. A. K. Ghosh
Director
Zoological Survey of India
AN APPEAL

In order to enrich the "National Zoological Collection" (NZC) and to update information on the occurrence and distribution of animal species in India, Scientists/Naturalists and researchers working on animal taxonomy/systematics are requested to deposit their identified specimens to the Zoological Survey of India at the following address:

Officer-in-Charge, Identification and Advisory Section, Zoological Survey of India, M. S. Building, Nizam Palace, 234/4, A.J.C. Bose Road, Calcutta-700 020.

These specimens will be registered and their data will be computerised. They are further requested to deposit their type collection positively to ZSI and use the Registration number in their publication of the new taxon.

Dr. A. K. Ghosh
Director
Zoological Survey of India
# Records of the Zoological Survey of India

**Volume 93 (1—2)**

**1993**

**Pages: 1—311**

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SURVEY OF NON-HUMAN PRIMATES OF THE THREE DISTRICTS OF WEST BENGAL

S. BHUINYA, S. CHAUDHURI AND A. MURMU

Zoological Survey of India, Calcutta.

INTRODUCTION

For centuries the monkeys in India survive because of their sacred status. The religious and philosophical beliefs and tolerance towards these animals are the factors for the rigorous protection that they have enjoyed for a long period even after independence. In the present time, breaking down of these taboos and the rapid cultural changes are the factors that majority of the people no longer considered the monkeys as sacred but are taken as pests and destructive agents to their crops and property. The two common species of monkeys that are found in many parts of India and occupy diverse habitats, ranging from dense forests in montane regions to open lands and human habitations, are the rhesus macaque (Macaca mulatta) and the hanuman langur (Presbytis entellus).

The three districts of West Bengal—North 24-Parganas, Howrah and Hooghly have been referred to Zoological Survey of India by the Chief Wildlife Warden of West Bengal for surveys of non-human primates. The Forest Department received frequent complaints about the widespread depredation of the crops and the damage caused to the properties by the monkeys from these districts. Survey of the three districts was conducted from 25 March to 14 April, 1991 and this paper contain the findings of the census.

NON-HUMAN PRIMATES OF WEST BENGAL

In India 15 species of non-human primates are known to occur excepting the three species of tree shrews. These include 7 species of macaques, 5 species of leaf eating monkeys, 1 species of ape and 2 species of loris. Out of these only one species of leaf eating monkey, the Hanuman langur (Presbytis entellus), and two species of macaques, the Rhesus macaque (Macaca mulatta) and Assamese macaque (Macaca assamensis) are known to occur in West Bengal. However, their distribution, abundance, social structure, present status, etc., in different districts of West Bengal have not been known. The two other primates—the Capped langur (Presbytis pileatus) and Hoolock gibbon (Hylobates hoolock) were introduced in the forests of Sukna, Darjeeling district,
FIELD STUDIES OF NON-HUMAN PRIMATES OF WEST BENGAL

In spite of the occurrence of non-human primates in many parts of West Bengal not much work has been done on the monkeys. Mandal (1964) studied the behaviour of rhesus macaque in the Sunderbans. Southwick et al. (1964) conducted a road side survey in some areas of West Bengal to study the distribution and abundance of non-human primates. Mukherjee and Gupta (1965) studied the habits of the rhesus macaque in the Sunderbans. Khajuria (1966) published a brief account of the distribution of Assamese macaque in certain parts of Darjeeling district. Oppenheimer (1973, 1976a, 1976b, 1977) studied the hanuman langur at Singur. Mukherjee et al. (1985) conducted a survey of Darjeeling district and studied the distribution, abundance and social structures of rhesus and Assamese macaques.

ECOLOGY OF THE SURVEY AREAS

The state of West Bengal lies in the eastern side of India, extending from 22° to 27° north latitude and from 86° to 90° east longitude. It is composed of about 88,000 sq. km area. Approximately 64% of the total area of West Bengal is under cultivation. The major crops are rice, jute, potato, wheat and mustard. Forest areas in West Bengal are largely in the Sunderbans and in the north Bengal and is about 11,000 sq. km. The climate is tropical and it varies from season to season. The winter season is from November to February. The summer season is from March to June when it is hot in the plains but in the foothills and mountains more moderate temperatures prevail. The monsoon season, extending from July to October, is hot and humid. The rainfall is heavy. Almost entire rain is received during the monsoon season but summer and winter rains are fairly common. The highest humidity is reached in the monsoon season (Table I).

SURVEY METHODS

Villages, towns, cities, temples, road side and forest were surveyed during the period under study. The observations were carried out on foot or by a vehicle. The surveys were carried out from early morning to late at evening and the areas were searched thoroughly for the presence of monkeys and the local people were enquired upon the presence of monkeys and the problems they face due to their presence in the area. The methods that were used to locate the monkeys were road side survey and transect. The procedure adopted by the party is to move slowly and stop at suitable places and scan the areas thoroughly and enquired about the presence of monkeys. The visual and auditory signals were utilised for locating the groups. A slow moving vehicle (an Ambassador car placed at the disposal to the survey party by
the Forest Department of West Bengal) was used with 4 observers to locate the monkeys.

Once a group was located the notes on their social structure, habitat, interactions with man and other animals, if there is any, were noted down. Attitude of the local people about these groups was enquired upon and recorded. The mechanical aid that was used in the field was binoculars.

**Result of Survey**

**(A) North 24-Parganas District:** In this district 2500 sq. km. areas was surveyed and 17 groups of hanuman langur were sighted. Out of this 14 groups were bisexual and 3 were all male groups. These 17 groups composed of 189 animals of which 29 were adult males, 84 adult females, 22 juveniles and 39 infants. It was not possible to classify the rest 15 individuals. The group size varies from 2 to 35. This provide a population estimate of 0.007 groups per sq. km. comprising of 0.075 individuals per sq. km. The average group size of bisexual grous was 12.50 individuals. The 14 bisexual groups composed of 18 adult males, 84 adult females, 22 juveniles and 39 infants and 15 unclassified individuals. In the 17 groups a total of 12 new born infants were observed. These 17 groups of hanuman langur were seen in four habitat categories-12 groups were located in the villages, 3 groups were seen in temples, 1 group was recorded from bazar and the other group was observed in the forest. The total number of langurs counted in 12 village groups was 101, which composed of 22 adult males, 49 adult females, 11 juveniles and 19 infants. The adult male and adult female ratio was 1 : 2.89 and the adult female to juvenile and infant ratio were 1 : 0.26 and 1 : 0.46 respectively. The three temple groups composed of 52 langurs of which 4 were adult males, 25 adult females, 6 were juveniles and the rest 17 were infants. The sex ratio of adult male to female was 1 : 6.25 and the adult female to juvenile and infant were 1 : 0.24 and 1 : 0.68 respectively. There was significant difference in the village group and one of the temple group of Dakshineswar.

A group of 15 langurs was seen in Badu Bazar but individual counts was not possible in this group. One group was located in the Parmadan forest and it composed of 3 adult males, 10 adult females, 5 juveniles and 3 infants. This indicates that the bulk of the hanuman langurs population in this district is distributed in village habitat category. However, this idea does not provide an accurate concept of relative abundance habitat wise distribution of hanuman langur in whole of West Bengal. The social structure and the habitats where the groups were seen are given in Table II and their distribution is given in Fig. 1.

**(B) Howrah District:** In this district 730 sq. km. area was surveyed and 29 hanuman langur groups were observed, out of which 25 were bisexual groups and 4
Fig. 1. Map showing the distribution of hanuman langur groups in North 24-Parganas district.
BHUINYA et ale: Survey of non-human primates

were all male groups. This 29 groups composed of 432 langurs of which 80 were adult males, 206 were adult females, 59 were juveniles and 77 were infants as also the 10 unclassified individuals. The group size varies from 7 to 35. This gives a population estimate of 0.040 groups per sq. km. and 0.59 individuals per sq. km. The average group size of bisexual groups was 15.95 individuals and composed of 41 adult males, 206 adult females, 59 juveniles and 77 infants. A total of 27 new born infants were observed in the 29 groups. These groups were inhabited in two habitat categories. Six groups were inhabited in the temple and the rest 23 groups were located in the villages.

The 6 temple groups containing 87 individuals with an average group size of 14.5 individuals and composed of 13 adult males, 42 adult females, 15 juveniles and 17 infants. Out of the 6 temple groups one was all male group.

The 23 village groups contained 345 individuals with an average group size of 15.00 individuals and composed of 67 adult males, 164 adult females, 44 juveniles and 60 infants and 10 unclassified individuals.

The sex ratio of adult male to adult female was 1 : 3.23 and 1 : 2.44 in temple and village groups respectively. The adult female to juvenile and infant ratio were 1 : 0.35, 1 : 0.40 and 1 : 0.26, 1 : 0.36 in temple and village groups respectively. It was not possible to classify the 10 individuals of the Salap bazar village group. Like North 24-Parganas the bulk of the hanuman langur population is distributed in the villages. Next to village the langurs inhabited in the temple where the food and shelter are easily available and the groups feel secured. The habitat, social structure and group size of these groups are given in Table III and the distribution is shown in Fig. 2.

(C) Hooghly District: A total of 1050 sq. km. area was surveyed in this district and 33 langur groups were recorded out of which 4 were all male groups and 2 groups were with a single male each and the rest were bisexual groups. This composed of 367 langurs of which 63 were adult males, 171 were adult females, 51 were juveniles and 70 were infants and 12 unclassified individuals. This gives a population estimate of 0.03 groups per sq. km. and 0.035 individuals per sq. km. respectively. The average group size of bisexual groups was 12.44 individuals and composed of 32 adult males, 171 adult females, 51 juveniles and 70 infants. A total of 26 new born infants were seen. The groups in this district can be divided into two habitat categories—the village and the temple. There were only 5 temple groups and the rest were village groups. The Konnagarh temple group contained one Bonnet macaque. The bisexual temple groups contained 8 to 33 langurs. Only one temple group composed of a single adult male. The 5 temple groups contained 65 individuals which composed
Fig. 2. Map showing the distribution of hanuman langur groups in Howrah district.
of 6 adult males, 33 adult females, 14 juveniles and 12 infants. The average group size was 13.00.

The village groups contained 3 to 21 individuals. In one village group only 2 adult females were counted and the rest of the members were not seen. The village groups contained total of 302 langurs with 57 adult males, 138 adult females, 37 juveniles and 58 infants and 12 unclassified individuals. The average group size was 10.35. The sex ratio of adult male to adult female was 1 : 4.25 and 1 : 2.42 in temple and village groups respectively. Like the previous two districts in this district also the bulk of the langur population is in the village. The habitat, social structure and the group size of different groups of langur in this district are given in Table IV and their distribution is shown in Fig. 3.

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**Fig. 3.** Map showing the distribution of hanuman langur groups in Hooghly district.

Population Composition and Habitat Distribution

Out of total 988 individuals counted in all the three districts, 18.02% were adult males, 48.30% were adult females, 14.00% were juveniles and 19.68% were infants. The overall sex ratio of adult male and female was 1 : 2.68 and the adult female to juvenile and infant were 1 : 0.28 and 1 : 0.40 respectively. However, some significant differences in population composition between different survey categories did occur. The village represented the most important habitat categories for the langurs as it contained the bulk of the population. Villages afford ideal physical habitat for langurs as large trees, agricultural fields and orchards provide abundant food supplies and shelter, the water is available in irrigation canals and ponds and the houses provide them the shelter against the rains and dust storms. The major disadvantage of the village habitat for monkeys exist in the villages as it afford plenty of trees to feed, an ideal habitat for the langurs, and by the tolerance and consent of the villagers. For centuries this tolerance has been maintained by social tradition and religious belief. Currently this tradition and belief are undergoing rapid changes and the attitudes of the villagers toward monkeys are also changing. This and the loss of habitat are the main factors for the conservation of monkeys in the villages. Many villagers reported to the survey party that they could no longer afford to have monkeys in their villages as they raid their agriculture crops and damage their houses and occasionally attack the villagers. The monkeys in the villages are now trapped, driven away and killed. The villagers informed the survey party that they engaged professional trappers to trap or to kill the monkeys.

Conclusion

The present survey indicates that among the three districts the hanuman langur population is more in Howrah district (Fig. 4). Most primates are graminivorous and frugivorous and are in direct competition with human population around villages and in agricultural lands. The villagers have become decreasingly tolerant of monkeys and are interested in their removal. Changing social mores of common people are eroding the scared image of the monkeys and account for lessening of one time stringently protective attitudes.

Habitat deterioration, pressure of human population, changing human attitude, hunting and trapping are the forces threatened to decimate primate population throughout the world. Several primate species are now approaching extinction. It is apparent from the present trend that the primate populations can become extinct even in areas where they are common and generally honoured and revered if the factors which are acting against them are not checked. So, it becomes necessary to undertake more vigorous conservation and management programmes and field studies to protect
the non-human primates. From the present survey and from the enquiries from the villagers it can be concluded that most of these factors are working against the con-

![Graph showing group sizes and compositions of hanuman langur groups in three different districts.](image)

Fig. 4. Group sizes and compositions of hanuman langur groups in three different districts.

...ervation of primates in West Bengal. The villagers in the study area no longer tolerate the monkeys. Due to extensive crop depredations and property damage caused by the langurs the villagers encourage trapping and killing of monkeys.
A survey of non-human primates of the three districts of West Bengal viz., North 24-Parganas, Howrah and Hooghly was conducted in the months of March-April, 1991 to find out the abundance, distribution and man-monkey relationship in these districts. The Forest Department of West Bengal has referred to ZSI to conduct this survey as they received frequent complaints from the villagers about the widespread depredation of crops and damage to public properties caused by the monkeys. The survey conducted revealed the presence of hanuman langur (*Presbytis entellus*) in these three districts. The survey also revealed that the bulk of hanuman langur population, in all the three districts, is distributed in the village habitat and next to village the langurs occupied the temple habitat.

From the enquiries of the villagers it was apparent that the man-monkey interactions were frequent. Changing social mores of villagers were eroding the sacred image of the monkeys that they were enjoying so far and account for the decrease in the population of monkeys in the villages.

**Table—I**

Some ecological features of the three districts.

<table>
<thead>
<tr>
<th>Characters</th>
<th>N 24-Parganas</th>
<th>Howrah</th>
<th>Hooghly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>14136 sq km (N &amp; S)</td>
<td>1467 sq km</td>
<td>3149 sq km</td>
</tr>
<tr>
<td>Longitude</td>
<td>88°15'-89°0'E</td>
<td>87°47'-88°23'E</td>
<td>87°0'-88°30'E</td>
</tr>
<tr>
<td>Latitude</td>
<td>22°10'-23°15'N</td>
<td>22°13'-22°50'N</td>
<td>22°37'-23°13'N</td>
</tr>
<tr>
<td>Rainfall</td>
<td>1579 mm</td>
<td>1676 mm</td>
<td>1516 mm</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>25.6°C</td>
<td>26.1°C</td>
<td>26.1°C</td>
</tr>
<tr>
<td>Winter</td>
<td>21.1°C</td>
<td>23.9°C</td>
<td>23.9°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>30-95%</td>
<td>30-95%</td>
<td>30-95%</td>
</tr>
<tr>
<td>Human Population (1981 census)</td>
<td>1,07,39,000</td>
<td>29,66,000</td>
<td>35,57,000</td>
</tr>
</tbody>
</table>
### Table—II

Showing the distribution and social structure of hanuman langur of
North 24-Parganas district

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Locality</th>
<th>Habitat</th>
<th>Male</th>
<th>Female</th>
<th>Juvenile</th>
<th>Infant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Nalkura/Belgoria</td>
<td>V</td>
<td>1</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Badu Bazar</td>
<td>B</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>15</td>
</tr>
<tr>
<td>3.</td>
<td>Dhanyakuria</td>
<td>V</td>
<td>1</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>—do—</td>
<td>V</td>
<td>7</td>
<td>(all male group)</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>—do—</td>
<td>V</td>
<td>1</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>5</td>
</tr>
<tr>
<td>6.</td>
<td>—do—</td>
<td>V</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>7.</td>
<td>Pal Para (—do—)</td>
<td>V</td>
<td>2</td>
<td>11</td>
<td>2</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>8.</td>
<td>Hasnabad (Purana Bazar)</td>
<td>T</td>
<td>2</td>
<td>(all male group)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Madanpur</td>
<td>V</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>10.</td>
<td>Srikrishnapur</td>
<td>V</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>11.</td>
<td>Gopalnagar</td>
<td>T</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>12.</td>
<td>Bagati Sibtala</td>
<td>V</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>13.</td>
<td>Parmadan</td>
<td>F</td>
<td>3</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>14.</td>
<td>Dharampur</td>
<td>V</td>
<td>2</td>
<td>(all male group)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Dakshineswar</td>
<td>T</td>
<td>1</td>
<td>18</td>
<td>5</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>16.</td>
<td>Debpukur</td>
<td>V</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>17.</td>
<td>Bijaypur</td>
<td>V</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>—</td>
<td>5</td>
</tr>
</tbody>
</table>

Total

29  84  22  39  189

( V = Village, B = Bazar, T = Temple, F = Forest )
### Table—III

Showing the distribution and social structure of hanuman langur in Howrah district

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Locality</th>
<th>Habitat</th>
<th>Male</th>
<th>Female</th>
<th>Juvenile</th>
<th>Infant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bara Mirzapur</td>
<td>T</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>Salap Bazar</td>
<td>V</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
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<tr>
<td>25.</td>
<td>—do—</td>
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<td>(all male group)</td>
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(\(V=\) Village, \(B=\) Bazar, \(T=\) Temple, \(F=\) Forest)

Total 80 206 59 77 432
TABLE IV

Showing the distribution and social structure of hanuman langur in Hooghly district

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<th>Sl. No.</th>
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Total 63 171 51 70 367

(V = Village, B = Bazar, T = Temple, F = Forest)
Acknowledgements

Thanks are due to the Director, Zoological Survey of India, for his keen interest and providing all facilities. Thanks are also due to Shri S. C. Dey, Chief Conservator of Forests and Chief Wildlife Warden, Govt. of West Bengal, for full co-operation in survey and the D.M.'s and D. F. O.'s of the three said districts for extending facilities to the party members for providing accommodation and other facilities.

References


FOOD AND FEEDING HABITS OF SOME AMPHIBIAN SPECIES OF NORTHEAST INDIA

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INTRODUCTION

Amphibians in general are voracious feeders. They take mainly insects like beetles, termites, flies, grasshoppers, butterflies, moths, bugs, earwigs, dragonflies and also their larvae, etc. Although insects are their principal diet they can feed also on small mammals, rarely small birds, snakes, lizards, other frogs, earthworms, crabs, spiders and in fact any living creature which they can capture and overpower. Some species of frog such as *Rana tigerina* is said to be a regular cannibal and feeds readily on the young of its own species.

Except a number of stray papers by Aitken (1895), Gostling (1895), Chibber (1911), Agharkar (1912), Muller (1912), Davidson (1918), Bhaduri (1945), Gray (1954), Banerjee (1955), Smith (1959), Wadekar (1963), Joshee (1968), Abdulali (1985), on food habits of *Rana tigerina*, no comprehensive work on the food and feeding habits on amphibians has so far been carried out from the Indian region. However, in course of studying the amphibian fauna of northeast India an attempt has been made to report on the food habits of eight species of amphibians of this region viz., *Bufo melanostictus* Schneider, (Fig. 1), *Rana limnocharis* Weigmann, (Fig. 2), *Rana gerbillus* Annandale, (Fig. 3), *Amolops afghanus* (Gunther), (Fig. 4), *Microhyla berdmorei* (Blyth), (Fig. 5), *Microhyla ornata* (Dum. & Bibron), (Fig. 6), *Polypedates leucomystax* (Kuhl), (Fig. 7), *Philautus shillongensis* Pillai & Chanda, (Fig. 8). Out of these, some observation of food habits of *Bufo melanostictus* have been studied by Behura et al. (1960), Rangaswamy and Channabasavanna (1973), and Sabins and Kolhatkar (1977).

MATERIALS AND METHODS

To achieve the purpose of the present work collections were made from different localities of northeast India viz., Assam, Meghalaya, Arunachal Pradesh, Manipur, Nagaland, Mizoram and Tripura, from different habitats such as marshes, pools or streams, river banks, under big boulders and stones, vicinity of shaded mountain streams and so on. As the amphibians swallow only the living creatures, most of the
food materials were found either intact, half-digested or partly digested form and wherever identifications were possible they were identified up to the levels of orders and the rest have been mentioned as "miscellaneous" (for broken materials) and/or unidentified food particles. The data collected from the gut-contents from each of eight species during different periods of the year was recorded. The whole year was divided into three different periods. i. Pre-breeding period. ii. Breeding period. iii. Post-breeding period. Percentage of food consumption for each variety of food for the above species have been represented histographically. In histogram for each species the apex (AB) stands for the percentage of food materials whereas the base (BC) stands for the types of food taken.

**Table—I**

Table showing the species, collection localities, season and year of collection of different species.

<table>
<thead>
<tr>
<th>Sl. No.</th>
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<th>Collection localities</th>
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<th>Year of collection</th>
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<tr>
<td></td>
<td>(Gunther)</td>
<td></td>
<td></td>
<td>1975-1978</td>
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<tr>
<td></td>
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</table>
In *Bufo melanostictus*, the analysis of the gut-contents reveals that the maximum food-intake is during breeding period followed by pre-breeding and post-breeding period. During breeding period this species prefers isopteran insects which is 15% of the total gut-contents examined and in that list of preference, coleopteran and orthopteran insects (2.5%) are found at the bottom. Hymenopteran insects (11%) follow the isopteran insects. Miscellaneous food items, which are half-digested and broken materials (6.5%) follow the hymenopteran insects.

During pre-breeding period, food-intake is comparatively less than the breeding period. During this period they prefer as in the breeding period the isopteran insects which is 8% of the total gut-contents examined and in that list of preference, orthopteran insects which is 1% is found at the bottom of preference. Hymenopteran insects (5%) follow the isopteran insects. Rest of the food-items in decreasing orders are miscellaneous food items (2%) and coleopteran insects (1.5%).

During post-breeding period, food-intake is lowest in comparison to the previous ones. During this period they prefer hymenopteran insects which is 4.5% of the total gut-contents examined and in that list of preference, coleopteran and orthopteran insects are found at the bottom, which is 1% each. Rest of the food-items in decreasing order are miscellaneous food-items (1.8%) and isopteran insects which are in equal percentage. The percentage of food-items have been shown in histogram (Fig. 1).

The analysis of the gut-contents of *Rana limnocharis* shows that food-intake during pre-breeding and breeding period is maximum followed by post-breeding period.

During breeding period this species prefers coleopteran insects which is 7.8% of the total gut-contents examined and in that list of preference, dermapteran insects (0.5%) are found at the bottom of preference. Diptaran insects constituting 6.5% of the gut-contents come next to coleopteran insects.
Miscellaneous food items (2.7%) follow the dipteran insects. Isoptera insects (2.5%) and orthoptera insects (1.5%) follow the miscellaneous food items.

Percentage of food intake during pre-breeding period is same like breeding period. During this period this species prefers dipteran insects which is 8.2% of the total gut-contents examined and in that list of preference, dermapteran insects as in the breeding period which is only 0.5% is found at the bottom of preference. Coleoptera insects (8.2%) comes next to the dipteran insects. Miscellaneous food
items (1.8%), orthopteran insects (1.8%) and isopteran insects (0.8%) are observed in decreasing order.

Food-intake during the post-breeding period is lowest in comparison to the previous ones. During this period this species prefers the coleopteran insects which is 7% of the total gut-contents examined and in that list of preference, isopteran and dermapteran insects, each represented by 0.5%, are found at the bottom. Miscellaneous food-items (3%), comes next to coleopteran insects, and orthopteran and dipteran insects which are 1% and 0.5% come respectively next to miscellaneous food-items. The percentage of food-items have been shown in histogram (Fig. 2).
Analysis of the gut-contents of *Rana gerbillus* reveals that the maximum food-intake takes place during the breeding period followed by pre-breeding and post-breeding period.

![Histogram showing the percentage of food items in Rana gerbillus Annandale](image)

During breeding period this species has been found to consume the highest percentage of the miscellaneous food-items which is 10.5% of the total gut-contents examined and in that list of preference, orthopteran insects (2.5%) is found at the bottom of preference. Hymenopteran insects (6.5%) comes next to the miscellaneous food-items and isopteran insects (4.5%) are followed by hymenopteran insects.
During pre-breeding period food-intake is comparatively less than the breeding period. During this period this species prefers hymenopteran insects which is 6.5% of the total gut-contents examined as in the breeding period and in that list of preference, orthopteran insects (1.8%) is found at the bottom of preference. Miscellaneous food-items and isopteran insects are 5.2% and 4.2% come respectively next to hymenopteran insects.

Food-intake during post-breeding period is very negligible. During this period this species prefers only the miscellaneous food-items and isopteran insects which are 14.8% and 3.5% respectively. The percentage of food-items have been shown in histogram (Fig. 3).

In *Amolops afghanus* the analysis of gut-contents reveals that the maximum food-intake takes place during the breeding period followed by pre-breeding and post-breeding period.

During breeding period this species prefers orthopteran insects which is 15.8% of the total gut-contents examined and in that list of preference, hymenopteran insects (1%) are found at the bottom. Miscellaneous food-items constituting (12.5%) of the total gut-contents come next to orthopteran ones. Hemipteran insects (10%) follow the miscellaneous food-items. Rest of the food-items in decreasing orders are dermapteran insects (3.5%) and dipteran insects (2.5%).

Food-intake during pre-breeding period is comparatively less than the breeding period. During this period they prefer as in the breeding period orthopteran insects which is 13.2% of the total gut-contents examined and in that list of preference, dermapteran insects (2%) are found at the bottom of preference. Isopteran insects (9.5%) come next to orthopteran insects. Rest of the food-items in decreasing orders are miscellaneous food-items (8.2%), dipteran insects (5.8%), hymenopteran insects (5.8%) and hemipteran insects (2.8%).

Food-intake during post-breeding period is lowest in comparison to the previous ones. During this period they prefer hymenopteran insects and miscellaneous food-items and both of them are 14% of the total gut-contents examined. Rest of the food constituting of dipteran insects, hemipteran and isopteran insects which are in equal percentage (2%) and orthopteran insects (8%). The percentage of food-items have been shown in histogram (Fig. 4).

Analysis of the gut-contents of *Microhyla berdmorei* reveals that the maximum food-intake takes place during the post-breeding period followed by breeding and pre-breeding period.

During breeding period this species has been found to consume highest percentage of miscellaneous food-items which is 11.5% of the total gut-contents examined and
in that list of preference, coleopteran insects (5.2%) are found at the bottom of preference. Hymenopteran insects (7.5%) and isopteran insects (7.2%) come next to miscellaneous food-items.

Food-intake during pre-breeding period is comparatively less than the breeding period. During this period this species has been found to consume highest percentage of miscellaneous food-items as in the breeding period which is 8% of the total gut-contents examined and in that list of preference, hymenopteran insects (1.2%) are found at the bottom. Coleopteran and isopteran insects are 7% each comes next to miscellaneous food-items.
Food-intake during post-breeding period is maximum in comparison to the previous ones. During this period this species consume highest percentage of food-items which is 22% of the total gut-contents examined and in that list of preference, coleopteran insects (3.8%) is found at the bottom. Hymenopteran insects (11%) and isopteran insects (8%) come next to miscellaneous food-items. The percentage of food-items have been shown in histogram (Fig. 5).

In *Microhyla ornata* the analysis of the gut-contents shows that food-intake during breeding period is maximum followed by pre-breeding and post-breeding period.

During breeding period this species prefers coleopteran and hymenopteran insects, both of them are 9.8% of the total gut-contents examined and in that list of
preference, miscellaneous food items (2.8%) are found at the bottom of preference. Isopteran insects constituting 6% of the gut-contents come next to coleopteran and hymenopteran insects.

Food-intake during pre-breeding period is comparatively less than the breeding period. During this period this species prefer coleopteran insects which is 9.8% of the total gut-contents examined and in that list of preference, miscellaneous food-items (2.8%) are found at the bottom of preference. Hymenopteran insects (8%) and isopteran insects (3.8%) respectively each come next to coleopteran insects.
During post-breeding period food-intake is lowest in comparison to the previous ones. During this period this species shows no preference for their food. Food normally is composed coleopteran of insects (5%), hymenopteran insects (5%) and miscellaneous food items (5%) each of the total gut-contents examined. The percentage of food-items have been shown in histogram (Fig. 6).

Analysis of the gut-contents of *Polypedates leucomystax* reveals that the maximum food-intake takes place during breeding period followed by pre-breeding and post-breeding period.

During breeding period this species has been found to consume highest amount of miscellaneous food-items which is 11% of the total gut-contents examined and in that list of preference, coleopteran insects (1.5%) are found at the bottom of preference. Dipteran insects (4.5%), isopteran insects (4.5%) and hymenopteran insects (4.3%) each come next to miscellaneous food-items in decreasing order.

In pre-breeding period food-intake is comparatively less than the breeding period. During this period this species has been found to consume maximum amount of hymenopteran insects and miscellaneous food items, both of them are 6.5% of the total gut-contents examined and in that list of preference, isopteran insects (0.8%) are found at the bottom of preference. Rest of the food-items in decreasing order are dipteran insects (4.2%) and coleopteran insects (2.5%) come next to hymenopteran insects and miscellaneous food-items.

Food-intake during post-breeding period is lowest in comparison to the previous ones. During this period this species has been found to consume the highest amount of miscellaneous food-items which is 9% of the total gut-contents examined and in that list of preference, dipteran insects are found at the bottom which is 0.5%. Isopteran insects (5%) come next to miscellaneous food-items. Rest of the food-items in decreasing order are coleopteran insects (2.8%) and hymenopteran insects (1%). The percentage of food items have been shown in histogram (Fig. 7).

In *Philautus shillongensis* the analysis of the gut-contents reveals that the maximum food-intake takes place during post-breeding period followed by breeding and pre-breeding period.

During breeding period this species has been found to consume highest amount of miscellaneous food-items which is 11.5% of the total gut-contents examined. Isopteran insects (6.2%) and dipteran insects (0.8%) each come next to miscellaneous food items in decreasing order.

Food-intake during pre-breeding period is comparatively less than the breeding period. During this period this species has been found to consume maximum amount
of miscellaneous food-items like breeding period which is 13% of the total gut-contents examined. Isopteran insects (5%) and dipteran insects (0.8%) each come next to miscellaneous food items in decreasing order.

![Histogram showing percentage of food items in Polypedates leucomystax (Kuhl)](https://example.com/histogram.png)

Fig. 7. Histogram showing percentage of food items in Polypedates leucomystax (Kuhl)

During post-breeding period food-intake is highest in comparison to the previous ones. During this period this species has been found to consume highest amount of miscellaneous food-items like pre-breeding and post-breeding period which is 18.5%
of the total gut-contents examined. Dipteran insects (1%) and isopteron insects (6%) each come next to miscellaneous food-items in decreasing order. The percentage of food items have been shown in histogram (Fig. 8).

Fig. 8. Histogram showing the percentage of food items in *Philalus shillongensis* Pillai & Chanda
Discussion

It has been observed that in most species food-intake is the minimum during hibernating period which increases gradually during the pre-breeding period and becomes maximum during the breeding period when they consume food voraciously. This may be attributed to the availability or paucity of the preferred type of food material, which in turn is governed by seasonal effect.

Acknowledgements

I am greatful to Dr. A. K. Ghosh, Director, Zoological survey of India, for providing facilities for this work and critically going through the manuscript.

References


STUDY OF SURFACE STRUCTURE OF HAIR OF SOME PRIMATES OF INDIAN SUB-CONTINENT

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INTRODUCTION

Hairs of some species of *Macaca* were investigated with the help of a Scanning Electron Microscope (SEM) to obtain fine structural details on hair surface. Attempt to identify the specific characters of hair structures of these species have been made.

Hairs have certain distinct advantages from the point of taxonomy and systematics (Cole, 1924; Mathiak, 1938), forensic sciences (Seta et al., 1975), criminology (Curry, 1972) etc. The aim of the present study was to find out basic characters of the surface ultra-structures of hairs of *Macaca* spp. Initially hairs of *Macaca assamensis assamensis* (M'Clelland), *Macaca fascicularis aurea* Geoffroy and *Macaca mulatta* (Zimmermann) were studied with the help of the Scanning Electron Microscope (SEM).

Information regarding surface ultra-structure of hairs in Indian wild mammalian forms is meagre. Some works on the surface of hair have been done by Kopikar and Sabnis (1976, 1977). During early twentieth centuries animals hair studies were extensively made by a number of workers such as Friedenthal (1911), Hausman (1924), Williams (1938) etc. Their studies were, however, mainly confined to the light microscopic observation only.

MATERIALS AND METHODS

Hair samples were collected from the rump region of three species of the genus *Macaca* collected during 1878 to 1880 and preserved in the National Zoological Collections, Zoological Survey of India, Calcutta.

Twenty to 25 hair strands of each species were taken for investigation. Hair strands were thoroughly washed in petroleum ether to dissolve external contamination as well as fatty substances. Subsequently the samples were studied under SEM following the technique of Pal and De (1978).
RESULTS

Results of three-dimensional structure of hairs of three species of *Macaca* are detailed below:—

*M. fascicularis aurea* (Fig. 1):

Figs. 1-3. 1. Scanning electron micrograph of a part of hair of *Macaca fascicularis aurea* showing highly crenated scales (dark arrows) and exogenous particles (White arrows). X 1344.

2. 3D structure of a part of hair of *Macaca assamensis assamensis* depicting puncture and depression (arrows) on the surface. X 672.

3. Scanning electron micrograph of a part of hair of *Macaca mulatta* showing extension of cortical scale (arrow). X 2688.
Diameter of hair varies from 37.30 to 62.50 μ. Surface consists of cuticular scales with crenate margins. Amplitude of bare portion of scales varies from 4.45 to 6.50 μ. Occasionally surface shows extensive breakages of cortical scales.

**Macaca assamensis assamensis** (Fig. 2):

The surface of hairs consists of regularly arranged cuticular scales of crenate type. Diameter varies from 35.25 to 52.25 μ and interscaler portion varies from 5.90 to 11.95 μ. Occasionally the surface is punctured by ridges and furrows.

**Macaca mulatta** (Fig. 3):

Diameter remains within the range of 29.00 to 42.50 μ and amplitude of bare portion of scales remains within 3.35 to 5.35 μ. Cortical scales are of crenate type. But crenation is ill developed. Extensions of cortical scales are found occasionally. Sometimes crystal like exogenous substances are found on the surface.

**DISCUSSION**

The hairs for the present study possess highly crenated type of scales with variable inter-scalar portion. The breadth of the bare portion of scales within these species of *Macaca* varies from 3.35 to 11.95 μ. Hair strands for the present study consist of crenate type of scales. This observation is quite different from the findings of Kopikar and Sabnis (1976) who have noted that the hair in *Macaca mulatta* is devoid of scales. This scaleless feature observed by the above authors may be due to the association of microbes on the hair shaft. The unusual changes in the cortical scales are due to attack of dermatophytes such as mycelial form of saprophytic yeasts which are responsible for surface erosion and subsequent obliteration of scales (Carteaud, 1973; De 1982; Pal et al., 1981).

Hairs of the species studied above have number of overlapping characters. Further extensive studies are, therefore, required to formulate a suitable key at specific level.

Oglae and Mitsinka (1973) concluded that the shape and arrangement of the scales on the cuticle vary considerably in different species and to a lesser extent within the same species. Thus, cuticular scale pattern and their disposition on the hair surface may serve as useful diagnostic feature for the identification of different mammalian species. Further, according to Sudo and Seta (1975) and Kind (1965), medullary index may be helpful for the identification of animal species. However, this may not be true for the hairs of Rhinocerotidae. It would, thus appear that further studies on the surface ultra-structure along with medullary index may be helpful in identifying different mammalian species.
ACKNOWLEDGEMENTS

I am very much thankful to the Director, Zoological Survey of India for providing facilities for this work. I am also grateful to the officers and staff of the Mammal and Osteology Section and Higher Chordata Division, Zoological Survey of India, for their suggestions and help in various ways.

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INTRODUCTION

It has been increasingly recognised that the existing literature in any subject always provide a feedback and form a base for future research needs.

This bibliography includes all contributions which have been published on cytogenetics and cytotaxonomy of Fishes, Crustacea and Mollusca between 1953 to 1991. It also brings together material published or discussed at seminar symposia. The literature has been alphabetically arranged. We have attempted to make the bibliography entirely complete and correct, but some lapses in a work of such nature is obvious. The lapses pointed out will be thankfully acknowledged, and correction of any errors will be appreciated. This bibliography will serve as a reference tool for scientists, university graduates, researchers and for all those who are concerned with the study of cytogenetics and systematic zoology of these groups.

I FISH CYTOGENETICS


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II MOLLUSCAN CYTOGENETICS


III CRUSTACEAN CYTOGENETICS


ADDENDA

FISH CYTOGENETICS


**MOLLUSCAN CYTOGENETICS**


**ACKNOWLEDGEMENTS**

We express our gratitude to Dr. A. K. Ghosh, Director, Zoological Survey of India, for his keen interest and encouragement in the work, and facilities provided to us. Dr. N. V. Subba Rao, Dr. K. V. Surya Rao, Dr. A. K. Karmakar, Dr. P. Krishna Moorthy, Mr. S. Kar and Mr. P. Mukherjee have been very helpful in confirming the current names of species. We also thank to Dr. R. K. Kacker, for constant encouragement and suggestions.

**SPECIES INDEX**

All the species are listed alphabetically under the genera to which they have been assigned in the most recent literature: the genera are also alphabetically arranged.

**FISH**

**Anabantidae**


**Antennariidae**


**Apogonidae**


**Ariidae**


**Bagridae**

BELONIDAE
18. Belone choram 186.
19. Tylosurus leiurus 65, 112.
20. Xenentodon cancila 65, 89, 155.

BELONTIDAE

BOTHIDAE

CARANGIDAE
34. Scomberoides tala 24, 25.
35. Seriolina nigrofasciata 62, 185, 186.
36. Trachinotus baillonii 24.
37. Trachinotus blochii 24, 65, 66.

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40. Chanda ranga 48, 62.

CHANNIDAE
41. Channa barca 29, 62.
42. Channa marulius 65, 76, 94.
45. **Channa stewartii** 62, 129, 147.
46. **Channa striatus** 29, 62, 65, 75, 76, 94, 105, 191.
47. **Channa sp.** 153.

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48. **Etroplus maculatus** 174.
51. **Tilapia sp.** 67, 97, 167.

**Clariidae**
52. **Clarias batrachus** 62, 65, 75, 94, 102, 103, 114, 116, 125, 169, 190.

**Clupeidae**
53. **Gudusia chapra** 38, 62, 65.
54. **Sardinella melanura** 62, 65, 112.

**Cobitidae**
55. **Acanthophthalmus pangia** 62, 65.
56. **Botia bardi** 27, 59, 62, 65, 90.
57. **Botia dario** 62, 65, 129.
58. **Botia hymenophysa** 62, 129.
60. **Lepidocephalichthys guntea** 2, 62, 65, 87, 151, 159, 161, 182.
63. **Noemacheilus savona** 48, 62.

**Cynoglossidae**
64. **Cynoglossus puncticeps** 24, 65, 66, 101.
65. **Paraplagusia bilineata** 24, 101.
66. **Symphurus plagiusa** 24.

**Cyprinidae**
67. **Amblypharyngodon mola** 54, 62, 65, 70, 72, 92.
68. **Aspicoparia morar** 1, 46, 62.
69. **Barilius barila** 58, 62, 65.
71. **Barilius bendelisis var. chedra** 8.
72. **Barilius bula** 58, 62, 65.
73. **Barilius sp.** 58.
74. **Carassius auratus** 62, 65, 66, 118, 119.
75. *Carassius carassius* 62, 66, 163.
76. *Catla catla* 51, 56, 62, 65, 70, 72, 82, 144, 181.
77. ♀ *Catla catla* × ♂ *L. calbasu* 65.
78. ♀ *Catla catla* × ♂ *L. rohita* 62, 65.
82. *Crossocheilus latius punjabensis* 62, 65, 92.
84. *Cyprinus carpio* 66, 144, 146.
86. *Danio aequipinnatus* 9, 48, 62.
88. *Danio neilgherriensis* 194.
94. *Hypophthalmichthys molitrix* 62, 65, 70, 72, 144, 181.
95. *Labeo bata* 51, 62, 65, 70, 72, 144, 181.
96. *Labeo calbasu* 53, 62, 65, 70, 72, 82, 92, 134, 181.
100. *Labeo pangusia* 150.
103. *Osteobrama cotio* 53, 62, 65, 70, 72, 110.
110. *Puntius sp.* 78.
114. *Schizopyge progastus* 62, 142.
117. *Tor mosal mahanadicus* 48, 62.
120. *Tor sp.* 44.

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122. *Aplocheilus lineatus* 62.
123. *Aplocheilus panchax* 37, 38, 62, 65, 66.
124. *Aplocheilus* sp. 183.

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**GERREIDAE**

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134. *Awaous grammepomus* 46, 62.
139. *Glossogobius giuris* 24, 32, 62, 65, 75, 80, 105, 137, 184.
140. *Gobiodon citrinus* 66.
Gobioiidae

144. *Odontamblyopus rubicundus* 46, 62, 65, 75, 80, 105.

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146. *Hemiramphus lutkei* 25, 65, 112.

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Lobotidae

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Megalopidae


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**Muraenidae**

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**Pentapodidae**

**Platycephalidae**

**Plotosidae**
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186. Mollienesia sphenops 62, 65, 66, 123.

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197. Eutropiichthys vacha 53, 62, 65, 73.

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203. Otolithes cuvieri 7, 62.
204. Paranibea semiluctusa 6, 62.
205. Protonibea diacanthus 7, 62.
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214. Ompok pabda 47, 62.

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216. Gagata cenia 62, 84.
218. Nangra viridescens 62, 65, 156.

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222. Monopterus cuchia 54, 62, 65, 128.
223. Ophisternon bengalensis 174.

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2. *Aplysia benedicti* 17.

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ARIOPHANTIDAE
4. *Cryptozona belangeri* 16.
5. *Cryptozona bistrialis* 13, 14, 15.
7. *Cryptozona semirugata* 13, 14, 16.
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13. Haminea crocata 17.

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16. Melampus ceilonicus 12, 16.
17. Pythia plicata 12, 16.

ENIDAE
18. Rhachis punctata 16.

HYDATINIDAE

LYMNAEIDAE
20. Lymnaea luteola 2, 16.

NERITIDAE
22. Nerita chamaeleon 23.
27. Neritina layadri 23.
29. Septaria compressa 23.
30. Septaria tessellata 23.

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37. *Thiara crenulate* 3, 6, 11.
38. *Thiara lineatus* 3, 5, 6, 8, 11.
40. *Thiara (Melanoides) tuberculata* 3, 5, 6, 8, 11.

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ONISCIDAE
PAGURIDAE

PALAEMONIDAE
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12. Macrobrachium malcomsonii 1, 7.
13. Macrobrachium rosenbergii 1, 7.
15. Macrobrachium scabriculum 1.

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PORTUNIDAE
18. Charybdis (Goniosoma) annulata 11.
20. Scylla serrata 11.

POTAMONIDAE
22. Paratelphusa (Barytelphusa) jacquemontii 11.
23. Paratelphusa (Barytelphusa) masoniana 4, 5, 7, 8.
24. Potamon koolooense 5, 7, 8.

TELPHUSIDAE
25. Acanthotelphusa (Potamon) martensi 11.

TRICHONISCIDAE
26. Trichoniscus sp. 8.

ERRATA

FISH CYTOGENETICS

Ref. No.
17. Chromosomal study not reported.
28. Deals only with an amphibian species.
ON THE TREMATODE GENUS *ORIENTODIPLOPROCTOdaeUM*
BHUTTA AND KHAN, 1970

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INTRODUCTION

A number of contemporary investigators of the Indian subcontinent are engaged in studying digenetic trematodes collected from the coastal fishes to the Arabian Sea and the Bay of Bengal. Consequently, overlappings in the reporting of these flukes have occurred and the literature on them is not scanty. This has happened as a result of inadequate literature consultation leading to erroneous taxonomic judgements. What is more alarming and distressing is that some such inferences are marked mainly by faulty processing of material and interpretations. The present study deals with some such glaring examples, with the attempt to straighten the literature on the group.

The drawings have been made with the aid of a camera lucida. The material will be deposited with the National Helminthological Collection of Zoological Survey of India, Calcutta.

Bhutta and Khan (1970) proposed the genus *Orientodiploproctodaeum* (type species: *O. diacanthi*) on the basis of fifty flukes recovered from the marine fish *Pseudosciaena diacanthus* (Sciaenidae) from the Arabian Sea caught off Karachi coast. They diagnosed their genus and described the species with the help of an illustration of entire fluke showing some details of anatomy. They accommodated the genus in a new subfamily Orientodiploproctodaeinae under the family Diploproctodaeidae Ozaki, 1928. Madhavi (August, 1974) presented a paper on three new cryptogonimid trematodes in the Third International Congress of Parasitology held at Munchen, West Germany, one of them being *Cryptocollaritrema provesiculatum* n. gen., n. sp. The abstract of the paper was published in the Proceedings of the Congress with the salient features of the new genus *Cryptocollaritrema* which was found distinct from all other cryptogonimid genera. The material of the genus was recovered from the marine fish *Lutjanus* sp. (Lutjanidae) from the Bay of Bengal off Waltair coast. Later on, she (1976) published it in full paper with the help of a series of diagrams. Madhavi (August, 1974; 1976) did not compare her genus *Cryptocollaritrema* with *Orientodiploproctodaeum* Bhutta and Khan, 1970, while placing it in the family Cryptogonimidae.
Ciurea, 1933. Further, she did not name any cryptogonimid subfamily for her genus. Bilqees (December, 1974) proposed two new genera, *Multiovarium* (type species: *M. heteroformis*; other species: *M. interruptum*) and *Anterodiscus* (type species: *A. biseminalis*; other species: *A. triuteri*) as against *Orientodiploproctodaeum* on the basis of several specimens recovered from the type host *Pseudoscatena diacanthus* and type locality (Karachi) of the latter genus. Further, she revised the diagnosis of the subfamily Orientodiploproctodaeinae Bhutta and Khan, 1970 on the basis of her two genera without naming any family for it but obviously considering it under the family Diploproctodaeidae Ozaki, 1928. It is obvious that Madhavi's (August, 1974) abstract and Bilqees' (December, 1974) full paper were simultaneously in press, and therefore they were unaware of each other’s work. As a matter of fact, Madhavi (1974, 1976) was unaware of the work of Bhutta and Khan (1970) too. Srivastava, C. B. (1982) also, while including *Cryptocollaritrema* Madhavi, 1974 in his compilation work on Indian fauna did not take into account the genera *Orientodiploproctodaeum, Multiovarium* and *Anterodiscus*. Further, he (1982) proposed a new subfamily *Cryptocollaritrematinae* for the genus *Cryptocollaritrema* in the family Cryptogonimidae.

**SYSTEMATIC CONSIDERATIONS**

Family Cryptogonimidae Ciurea, 1933

Subfamily Orientodiploproctodaeinae Bhutta and Khan, 1970


Genus *Orientodiploproctodaeum* Bhutta and Khan


**Orientodiploproctodaeum diacanthi** Bhutta and Khan

(Figs. 1-6)


**Fig. 1. Orientodiploproctodaum diacanthi** Bhutta and Khan, 1970 (After Bhutta and Khan, 1970).

**Material examined:** Host—*Protonibea diacanthus* (Lacépède)

[Syn. *Pseudosciaena diacanthus*], Spotted croaker, (Family Sciaenidae); location-intestine, localities—Pondicherry (Bay of Bengal), Trivandrum and Margao (Arabian Sea); no. of specimens—*7 + 2 + 4* respectively, on *3 + 1 + 2* slides; dates of collection—*5.12. 75, 6.8.76 and 24.2.80* respectively.
Remarks: The preliminary study of this material showed that it comes close to four genera, viz., Orientodiploproctodaeum, Cryptocollaritrema, Multi卵巢um and Anterodiscus. Confronted with this difficulty, its detailed study was made which revealed that they all may be one and the same. A scrutiny of the results of the study further disclosed that Orientodiploproctodaeum was inadequately and incorrectly described, Multi卵巢um and Anterodiscus were based on erroneous study of material and only Cryptocollaritrema was correctly and adequately described and correctly placed in the family Cryptogonimidae; otherwise the four genera seem to be identical. Thus, only Orientodiploproctodaeum with correct and detailed account as given by Madhavi (1976) in the form of Cryptocollaritrema may be held valid on priority basis and the remaining three genera should fall into its synonomy. The accounts of Orientodiploproctodaeum and O. diacanthi Bhutta and Khan, 1970 are inadequate in the sense that a ventrogenital pit, a gonotyl in its posterior part and the gland cells in the forebody including the anterior disc or collar have altogether been missed to be mentioned; the ascending and descending coils of the long and tubular seminal vesicle have been correctly shown in the figure but this character has not been described in the text at all; and the real bilobed follicular ovary immediately in the pretesticular region has not been shown. It is inaccurate because the large and prominent seminal receptacle behind the acetabulum has been mistaken as unlobed ovary, and the follicles of bilobed
ovary behind the seminal receptacle in the intercaecal field have been misinterpreted as those of extracaecal follicles of vitellarium intruding into the intercaecal

Fig. 3. *Cryptocollaritrema proveisculatum* Madhavi, 1974 (After Madhavi, 1976).
space. In the author's material also the vitelline follicles are mainly extracæcal and, at the most, caecal at places. They do not intrude in the intercaecal space. It is at the ovarian level where such a confusion in the study may occur because the follicles of ovary are nearly as large as those of vitellarium, and can get mixed up and become continuous with latter due to overflattening giving erroneous reading as vitelline follicles intruding into the intercaecal field in the pretesticular space. Bilqees (1974), instead of improving upon the diagnosis of Orientodiploproctodaeum and description of its type species O. diacanthi with the help of her identical material recovered from its type host and the type locality, chose to propose two new genera Multi ovarium and Anterodiscus distinct from Orientodiploproctodaeum on the basis of inadequate and partly inaccurate account of O. diacanthi as given by Bhutta and Khan (1970) as well as erroneous study of her own material. She also could not detect the presence of a gonotyl immediately posterior to the sunken acetabulum in the ventrogenital pit. She erred in interpreting only postacetabular and acetabular parts of seminal vesicle as complete seminal vesicle, and long coiled and recurved.
preacetabular part of the same organ as hermaphroditic duct opening near pharynx. As a matter of fact, no hermaphroditic duct is formed and the male and female pores separately open immediately anterior to ventral sucker in the ventrogenital pit. The seminal vesicle commences in the postacetabular region, continues in the acetabular

Fig. 5. *C. provesiculatum*. Section through anterior region showing cushion-like expanded part (After Madhavi, 1976).

...and preacetabular regions up to posterior level of pharynx as a closely coiled tube, and then reflexes back and opens as a small pars prostatica in the ventrogenital pit (which Madhavi calls a genital atrium) in which acetabulum lies sunken. The ventrogenital pit in which the acetabulum lies embedded and in whose anterior wall the male and female ducts open separately is the characteristic feature of the family Cryptogonimidae. Further more, she did not at all mention the presence of gland cells in the parenycma of the forebody including the collar in *Multiovarium*. Conversely, in *Anterodiscus*, she misinterpreted these gland cells as vitelline follicles. Again, in *Anterodiscus* she mentioned the presence of unlobed ovary repeating the error of Bhutta and Khan (1970). In the type species *A. biseminalis* (her Fig. 8) which has been taken as Fig. 2 in the present work she has shown that the unlobed ovary is situated in the postacetabular region behind the large seminal receptacle slightly overlapping the latter. This postacetabular area of the median field has also been shown interdispersed with vitelline follicles, whereas in the description of the species the position of the vitelline follicles has been mentioned to be lateral. This is a self-contradiction which is the result of misinterpretation of some structures. It is to be pointed out that the seminal receptacle has been erroneously called as unlobed ovary, the follicles in the midfield have been misinterpreted as follicles of vitellarium, and the posterior terminal part of the coiled and twisted tubular seminal vesicle has been mistaken as seminal receptacle. Further, neither the seminal vesicle is bilobed as mentioned in *A. biseminalis* nor there are two additional lateral uterine branches as described...
to be present in *A. triuteri*. As a matter of fact, the descending and ascending limbs of uterus have lateral coils and not branches.

Fig. 6. *Orientodiploproctodaeum diacanthi* Bhutta and Khan, 1970 (Present material).
RESULTS

From all indications it is evident the Bilqees (1974) had badly processed material of *Orientodiploproctodaeum diacanthi* Bhutta and Khan, 1970 only which she utilised to propose two new genera each with two new species. She also made use of the lapses on the part of Bhutta and Khan (1970) and herself committed some mistakes in doing so. As a matter of fact, she (Bilqees) ought to have used her material to correct and improve the diagnosis of *Orientodiploproctodaeum* and description of *O. diacanthi* instead of erecting two new genera and describing four new species out of it. It is obvious now that *Orientodiploproctodaeum diacanthi*, *Cryptocollaritrema provesculatum*, *Multiovarium heteroformis*, *M. interruptum*, *Anterodiscus biseminalis* and *A. triuteri* all seem to have been described from identical materials. *C. provesculatum* is the improved version of *O. diacanthi*. Thus, it construes that the genera *Multiovarium* Bilqees, 1974 and *Anterodiscus* Bilqees, 1974 are synonyms of *Orientodiploproctodaeum* Bhutta and Khan, 1970, and the species *C. provesculatum*, *M. heteroformis*, *M. interruptum*, *A. biseminalis* and *A. triuteri* are all synonyms of *O. diacanthi*.

The subfamily *Orientodiploproctodaeinae* Bhutta and Khan, 1970 is retained to accommodate the only genus *Orientodiploproctodaeum* Bhutta and Khan, 1970 (type species: *O. diacanthi*) but it is transferred from the family Diploproctodaeidae Ozaki, 1928 to the family Cryptogonimidae Ciurea, 1933, and the subfamily Cryptocollari­trematinae Srivastava, C. B., 1982 is its synonym. The subfamily *Orientidiploprocte­daeinae* may be redefined as follows:

Subfamily : *Orientodiploproctodaeinae* (emended)

Body divisible into two parts: (i) an anterior disc-like or cushion-shaped thick structure containing a large oral sucker and pharynx, and (ii) a cylindrical or elongated trunk containing a small ventral sucker, all other systems and intestinal caeca communicating to the exterior at posterior end of body on either side of excretorypore. Small prepharynx present; oesophagus absent. A ventrogenital pit present with a sunken weakly developed ventral sucker, a muscular bulb-like gonotyl near its posterior part, and male and female pores opening separately in it anteriorly. Gland cells present in forebody intruding into anterior disc. Testes postovarian, postacetabular. Cirrus sac absent. Seminal vesicle tubular, coiled, running up to base of pharynx and then reflexing back to open into ventrogenital pit. Ovary follicular, in midfield. Seminal receptacle present anterior to ovary. Coils of uterus filling midfield of hindbody. Vitellarium follicular, largely extracaecal, in hindbody. Eggs small. Excretory vesicle Y-shaped. Gut parasites of marine fishes.
Summary

The genus *Orientodiploproctodaeum* Bhutta and Khan, 1970 (type species: *O. diacanthi*) was reported from the marine fish *Pseudosciaena diacanthus* from Karachi coast. It was accommodated in a new subfamily Orientodiploproctodaeinae Bhutta and Khan, 1970 which was placed under the family Diploproctodaeidae Ozaki, 1976. Later on, *Multiovarium* Bilqees, 1974 (type species: *M. heteroformis*; other species: *M. interruptum*) and *Anterodiscus* Bilqees, 1974 (type species: *A. biseminalis*; other species: *A. triuteri*) were also reported from the type host and type locality of *O. diacanthi*. These genera were also considered under the same family and subfamily. The genus *Cryptocollaritrema* Madhavi, 1974 (type species: *C. provesiculatum*) was erected on the basis of the material recovered from the marine fish *Lutjanus* sp. from Waltair coast and was placed in the family Cryptogonimidae Ciurea, 1933. Srivastava, C. B. (1982) proposed a new subfamily Cryptocollaritremae to accommodate *Cryptocollaritrema*. The present author collected digenean material from the type host of *O. diacanthi* Bhutta and Khan, 1970 from the Arabina Sea as well as Bay of Bengal. On the study of this material, it is found that *Cryptocollaritrema* *Multiovarium* and *Anterodiscus* are synonyms of *Orientodiploproctodaeum* and the species *C. provesiculatum*, *M. heteroformis*, *M. interruptum*, *A. biseminalis* and *A. triuteri* are synonyms of *O. diacanthi*; add thus Cryptocollaritremae falls as a synonym of Orientodiploproctodaeinae which subfamily is transferred to the family Cryptogonimidae Ciurea, 1933. An emended diagnosis of Orientodiploproctodaeinae is also furnished.

Acknowledgements

The author is thankful to Dr. S. K. Bhattacharya, Joint Director-in-Charge, Zoological Survey of India, Calcutta for providing necessary facilities, and to Dr. J. R. B. Alfred, Joint Director, for going through the manuscript and giving useful suggestions.

References


**ABBREVIATIONS:**

VIS : Anterior lobe of seminal vesicle.
VES : Posterior lobe of seminal vesicle.
RS : Seminal receptacle.
V : Vitellaria.
O : Ovary.
U : Uterus.
SOME DESCRIPTIVE NOTES ON *CHANGWHANIA CEYLONENSIS* (BAKER) (HOMOPTERA : CICADELLIDAE) FROM INDIA

K. RAMACHANDRA RAO

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INTRODUCTION

*Changwhania ceylonensis* (Baker) is known to have a wide range of distribution. Originally it was described and reported from Sri Lanka by Melichar (1903) while Pruthi (1930) recorded it from “Bengal”, Central “India” and “Madras”. Kwon (1980) and Webb and Hellar (1990) reported it from South East Asia. While working on Indian leafhoppers, the author came across the species from Meghalaya and from Periyar district of Tamil Nadu and the same is reported here. Although this species is well distributed, it has been described by various authors under different taxa causing much difficulty in its identity and therefore it is described here in detail.

*Changwhania ceylonensis* (Baker

(Figs. 1-10)


Vertex brightly ochraceous with two large round spots at the anterior margin of eyes. Face longer than broad ochraceous, frontoclypeus below antenna at the lateral margins with oblique piceous spots, lateral frontal sutures extending to ocelli ; lora small narrow, not reaching apex of clypellus ; clypellus long, ochraceous. Eyes grey with irregular dark maculations. Pronotum as long as vertex, anterior margin rounded, posterior margin almost truncate. Scutellum ochraceous, transversely impressed in the middle Forewing hyaline, margin brown, with three apical and two anteapical cells. abdomen and legs ochraceous ; posterior femoral spinulation 2+1+1.
Male genitalia:
Pygofer dorsoventrally flattened with numerous setae at the dorsocaudal end, each pygofer with a ventral process which is curved ventrally near apex. Male plate long,
broad at base and narrowed towards apex with numerous hair-like setae on the lateral margin. Style broad at base, preapical lobe poorly developed apophysis short, its caudal lateral angle produced to form beak-like structure and end of style with fine tooth-like serration and sculphum. Aedaeagus with well developed dorsal apodeme, shaft considerably long with two asymmetrical processes at the ends, the processes notched in the middle on the outer margin.

**Female genitalia:**

Seventh sternum small, ochraceous, posterior margin produced slightly in the middle. Pygofer large with stout setae on lateral and posterior margins; ovipositor long reaching posterior extremity of abdomen.

**Measurements:**

Males 2.68 to 3.05 mm long and 0.67 to 0.81 mm wide. Females 2.82 to 3.44 mm long and 0.72 to 0.84 mm wide.

**Specimens examined:**


**Distribution:** India, Sri Lanka, South East Asia,

**Remarks:**

*Changwhania ceylonensis* (Baker) resembles *Changwhania terauchii* (Matsumara) and *Changwhania distanti* (Baker) in having two black round spots on the vertex but differs from the former in the possession of deeply curved pygofer process, asymmetrical aedeagal processes and smaller black spots on the frontoclypeal margins. Besides it differs from the latter species in the absence of a mid longitudinal ridge on the face.

**Summary**

*Changwhania ceylonensis* (Baker) is described in detail and its occurrence in Meghlaya and Periyar dist. of Tamil Nadu is reported for the first time.

**Acknowledgements**

The author thanks Dr. K. V. Lakshmi Narayana, Officer-in-Charge for all the laboratory facilities offered. He also thanks Dr. Webb of the Natural History Museum at London, for having sent the illustrations of *Changwhania terauchii* (Matsumara) and *C. changwhani* Kwon.
ABSTRACT

Detailed description of *Changwhania ceylonensis* (Baker) is given along with a note on its distribution.

REFERENCES


A NOTE ON *NEODARTUS ACOCEPHALOIDES* MELICHAR (HOMOPTERA : CICADELLIDAE) FROM TAMILNADU

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Southern Regional Station, MADRAS

INTRODUCTION

While working on leafhoppers of Tamil Nadu, the author came across *Neodartus acocephaloides* Melichar showing different colour patterns and the same is recorded. Three species of the genus *Neodartus* are known from the Indian subcontinent as reported by Distant (1908-1918). Metcalf (1962) catalogued other species of the world. *Neodartus acocephaloides* is economically important as it affects many plants. Variations in the colour pattern of the species is discussed here and a key to the hitherto known species of the genus from India is also given.

Key to the Indian species of *Neodartus* Melichar

1. Scutellum pale with four basal and two central black spots. 
   — Scutellum black with three pale spots, one on each side, and the other at apex  
   2. Tegmina black with rufous spots  
      — Tegmina black or brown and at middle with a wavy transverse series of five pale spots  
      3. N. acocephaloides Melich.

*Neodartus acocephaloides* Melichar

1908. Neodartus acocephaloides ; Distant, Fauna Brit. India, Rhynchota, 4 : 246 ; Distant, 1918, Ibid. 7 : 25.

Vertex, pronotum and Scutellum black, with greyish pubescens. Scutellum black with three ochraceous spots, one on each side and the other at apex. Tegmen black or ochraceous with four pale greyish spots at apex and a wavy transverse series of five greyish spots at the middle of tegmen ; sometimes with four spots only, spots either oval, elliptical, or circular. Body beneath black or ochraceous. Legs long spinulose; pygofers long convex; ovipositor long extending beyond the tip of abdomen.
Measurements: Males 3.60 to 3.88 mm long and 1.60 to 1.64 mm wide. Females 3.84 to 4.20 mm long and 1.64 to 1.84 mm wide.


Distribution: It is so far reported from Sri Lanka and Philippines and from India it is known from Madras, Coorg, Bengal and Punjab. Now it is being reported from various districts of Tamil Nadu.

Remarks: This species is found to vary in colouration of body and tegmen. Vertex, pronotum and scutellum are usually black otherwise fuscous. Tegmen usually with five spots as as a transverse series at the middle, but sometimes only four are seen. The spots may be either oval, elliptical or circular. The males exhibit very small spots as a transverse series at the middle of tegmen.

Abstract

Variations of colour pattern as seen in Neodartus acocephaloides Melichar are studied and a key to the Indian species of Neodartus Melichar is given.

Summary

Colour variations in Neodartus acocephaloides Melichar are noted and distributional records of the species from Tamil Nadu are reported for the first time. A key to the Indian species of Neodartus Melichar is also given.

Acknowledgements

The author thanks Dr K. V. Lakshmi Narayana, Officer-in-Charge, Southern Regional Station, Madras, for all facilities offered. Thanks are also due to Dr Koshy Mathew, Scientist ‘SD’ (Retd.), for valuable suggestions.

References


PROTOZOA FAUNA OF SUNDARBAN MANGROVE ECOSYSTEM

N. C. NANDI, A. K. DAS AND N. C. SARKAR

Zoological Survey of India
Calcutta

INTRODUCTION

In the course of several faunistic surveys for the period from 1979 to 1984 and 1989-90 protozoa fauna belonging diversified groups have been collected from different parts of Sundarban mangrove ecosystem. These collections as well as those reported earlier in the literature are being dealt with in the present communication. Altogether 104 species of the subkingdom Protozoa belonging to four different phyla viz., Sarcomastigophora, Apicomplexa, Myxozoa and Ciliophora have been reported from this region. A complete systematic list along with a note on the composition of species is presented in the paper as per revised classification of the society of Protozoologists (see Levine et al., 1980). The diagnostic characters and key to the species of these protozoa have not been incorporated in this account since majority of the species were adequately dealt with in the protozoa fauna of West Bengal (Das et al., 1993).

The first report of protozoa from Sundarban mangrove region may be credited to Annandale in 1907 when he recorded two species of ciliates from the brackish-water ponds of Port Canning, a place still having sparsely distributed mangrove. Subsequently, Pearse (1932) reported a gregarine from the intestine of an estuarine Crab, Metaplax dentipes, also from Port Canning. Incidentally this is the only species of gregarine reported so far from Sundarban. Ray and Dasgupta (1936, 1937) recorded a coccidian parasite from the intestine of Indian cobra from Sundarban. Tripathi (1952) encountered a myxosporidan parasite, Spheromyxa theraponi from fish Therapon jarbua from Port Canning. Shetty et al., (1961) and Gopalkrishnan (1971) reported a number of free living flagellates, rhizopods and ciliates from the planktonic samples of Hooghly-Matla estuary. However, specific identity of many of those protozoa were not ascertained by them. Mandal, A. K. (1965, 1976, 1978, 1984 and in press) and his associates (1964, 1965, 1984) published several new species of coccidian parasites and haemoflagellates from fishes and birds of this region. Choudhury and Nandi (1973) described two new species of Myxozoa from an estuarine gobiid fish, Boleophthalmus boddaerti. Tiwari (1978) recorded 5 species of termite flagellates from Sagar Island. Mandal, D. and Choudhury (1981, 1982, 1984, 1985, 1986a, b, c, 1988) studied the intestinal parasites of wild mammals of Sundarban Tiger Reserve and also
reported on the occurrence of two species of piroplasms in the blood of the rat, *Rattus rattus arboreus* and the bat *Scotophilus kuhli kuhli*.


**Materials and Methods**

During the course of investigation both freeliving as well as parasitic protozoans were collected and studied. Mangrove habitat herein considered as areas with at least sparsely distributed mangroves which include Canning, Kakdwip, Namkhana and Sagar Island. The zones III and V of the Hooghly-Matla estuary as mentioned in the study of planktons by Gopalakrishnan (1971) have also been taken into consideration.

Water samples, faecal sample, blood and host samples were collected and examined under the microscope following Mandal *et al.* (1990) and Das *et al.* (1993).

**Systematic List of Protozoa Fauna from Sundarban Mangrove Ecosystem**

<table>
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<tr>
<th>Species</th>
<th>Locality</th>
<th>Remarks</th>
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<td><strong>Phylum</strong></td>
<td><strong>Sarcomastigophora</strong></td>
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<td><strong>Noctilucidae</strong></td>
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<td><strong>Notiluca</strong> Suriray</td>
<td>Freelying, occurring in estuarine and coastal waters</td>
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<td><strong>1. N. miliaris</strong> Suriray</td>
<td>Hooghly-Matla estuary</td>
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<td>Species</td>
<td>Locality</td>
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<td>2. P. spp.</td>
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<td>Freeliving, reported from estuaries</td>
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<td>Peridinium Ehrenberg</td>
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<td>3. C. hirundinella</td>
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<td>Freeliving, occurring in estuarine waters</td>
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<td>5. E. sp.</td>
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<td>Freeliving, occurring as estuarine plankton</td>
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<td>6. P. sp.</td>
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<td>Astasiidae</td>
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<td>7. C. ruminantum Woodcock</td>
<td>Bhagabatpur, Sundarban</td>
<td>Parasitic occurring in faecal sample of Sus scrofa</td>
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<td>Genus :</td>
<td>Copromonas Dobell</td>
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<td>8. T. anabasi Mandal</td>
<td>Canning</td>
<td>In blood of Anabas testudineus</td>
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<td>9. T. bengalensis Mandal</td>
<td>Canning</td>
<td>In blood of Mystus bleekeri</td>
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<td>10. T. cancili Mandal</td>
<td>Raidighi</td>
<td>In blood of Xenentodon cancila</td>
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<td>11. <em>T. gobida</em> Mandal</td>
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<td>In blood of <em>Glossogobius giuris</em></td>
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<td>12. <em>T. striati</em> Mandal</td>
<td>Canning</td>
<td>In blood of <em>Channa striatus</em></td>
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**Order : Trichomonadida**
**Family : Monocercomonadidae**

**Genus : Monocercomonas Grassi**

13. *M. ruminantium* (Braune)  Sundarban forest  In faecal sample of spotted deer, *Axis axis*

**Family : Trichomonadidae**

**Genus : Tetratrichomonas Hibler, Hammond, Caskey, Johnson and Fitzgeruld**

14. *T. butteryi* (Hibler *et al.*)  Sundarban forest  In faecal sample of wild boars, *Sus scrofa*

**Order : Hypermastigida**
**Family : Holomastigotoidea**

**Genus : Holomastigotoides Grassi and Foa**

15. *H. bengalensis* Chakravarty and Banerjee  Bamankhari, Sagar Island  In gut contents of *Coptotermes heimi*

16. *H. hartmanni* Koidznmi  Gangasagar, Sagar Island  In gut contents of *Coptotermes heimi*

17. *H. ogivalis* de Mello  Sapkhali, Sagar Island  In gut contents of *Heterotermes indicola*

**Family : Spirotrichonymphidae**

**Genus : Pseudotrichonympha Grassi and Foa**

18. *P. cardiformis* Karandikar and Vittal  Sapkhali, Sagar Island  In gut contents of *Heterotermes indicola*

19. *P. subapicalis* Karandikar and Vittal  Mamankhari, Sagar Island  In gut contents of *Coptotermes heimi*
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**Class** : Lobosea  
**Subclass** : Gymnamoebia  
**Order** : Amoebida  
**Suborder** : Tubulina  
**Family** : Endamoebidae | | |
| Genus : Entamoeba Casagrandi and Barbagallo | | |
| 21. *E. chattoni* Swellengrebal | Sundarban forest | In faecal sample of Rhesus monkey, *Macaca mulatta* |
| 2. *E. chiropterus* Mandal and Choudhury | Sajnakhal, Sundarban Tiger Reserve | In faecal sample of *Scotophilus kuhli kuhli* |
| 23. *E. coli* (Grassi) | Sundarban forest | Faecal sample of Rhesus monkey, *Macaca mulatta* |
| 24. *E. histolytica* Schaudinn | Sundarban forests | In faecal sample of Rhesus monkey, *Macaca mulatta* |
| 25. *E. muris* (Grassi) | Sundarban Tiger Reserve | In faecal sample of *Rattus rattus arboreus* |
| 26. *E. suis* Hartman | Sundarban Tiger Reserve | In faecal sample of wild boar, *Sus scrofa scrofa* |
| Genus : Dientamoeba Jepps and Dobell | | |
| 27. *D. fragilis* Jepps and Dobell | Sundarban forest | In faecal sample of Rhesus monkey, *Macaca mulatta* |
| 28. *I. butschlii* (Prowazek) | Sundarban forest | In faecal sample of Rhesus monkey, *Macaca mulatta* and Wild boar, *Sus scrofa scrofa* |
| Suborder : Thecina  
Family : Thecamoebidae  
Genus : Thecamoeba Formental | | |
<p>| 29. <em>T. spp.</em> | Mangrove zone | Freeliving forms in soil |</p>
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<td>57. <strong>E. ahsata</strong> Honess</td>
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**Genus:** Isospora Schneider

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A total of 104 protozoan species from Sundarban mangrove ecosystem have so far been recorded. These protozoans belong to four major phyla viz., Sarcomastigophora (45 spp.), Apicomplexa (24 spp.), Myxozoa (4 spp.) and Ciliophora (31 spp.)
Table 1. Composition of Protozoa fauna of Sundarban mangrove region in relation to South 24-Parganas district and West Bengal State.

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<th>Group</th>
<th>No. of species (family) occurring in</th>
<th>West Bengal</th>
<th>South 24-Parganas</th>
<th>Sundarban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum Sarcomastigophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subphylum Mastigophora</td>
<td>120 (23)</td>
<td>52 (16)</td>
<td>19 (9)</td>
<td></td>
</tr>
<tr>
<td>Subphylum Sarcodina</td>
<td>95 (18)</td>
<td>46 (11)</td>
<td>26 (10)</td>
<td></td>
</tr>
<tr>
<td>Subphylum Opalinata</td>
<td>6 (1)</td>
<td>1 (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phylum Apicomplexa</td>
<td>357 (30)</td>
<td>31 (9)</td>
<td>24 (6)</td>
<td></td>
</tr>
<tr>
<td>Phylum Microspora</td>
<td>5 (2)</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phylum Myxozoa</td>
<td>93 (4)</td>
<td>6 (4)</td>
<td>4 (2)</td>
<td></td>
</tr>
<tr>
<td>Phylum Ciliophora</td>
<td>295 (69)</td>
<td>44 (29)</td>
<td>31 (17)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total=971 (147)</td>
<td>180 (70)</td>
<td>104 (44)</td>
<td></td>
</tr>
</tbody>
</table>

(Table-1). The phylum Sarcomastigophora includes 19 species of the subphylum Mastigophora and 26 species of Sarcodina. The members of the subphylum Opalinata which are bound to be present in the gut of anuran amphibians have not yet been reported from this region. Dinoflagellates and foraminiferans are the two important groups of marine/estuarine Sarcomastigophora which are still under explored in this region. Among the members of the phylum Apicomplexa gregarines are the least studied group. Only one species of gregarine, *Cephaloidophora metaplaxi* has been reported so far from Sundarban. The phylum Myxozoa whose members are well known fish parasites is represented by four species only. The phylum Ciliophora was represented earlier mostly by entocommensal ciliatss of shell fishes while several species of freeliving ciliates have been recorded during the present investigation from water and soil samples of mangrove region.

Out of 104 protozoan species, 41 species represent freeliving forms, 68 species parasitic forms and 5 species as symbionts (Table 2). The symbiotic species include

Table 2. Distribution of freeliving, parasitic and symbiotic protozoa of Sundarban in relation to South 24-Pargans district and West Bengal State.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of species (family) occurring in</th>
<th>West Bengal</th>
<th>South 24-Parganas</th>
<th>Sundarban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeliving Protozoa</td>
<td>248 (76)</td>
<td>77 (38)</td>
<td>41 (27)</td>
<td></td>
</tr>
<tr>
<td>Parasitic Protozoa</td>
<td>596 (63)</td>
<td>84 (28)</td>
<td>68 (15)</td>
<td></td>
</tr>
<tr>
<td>Symbiotic Protozoa</td>
<td>127 (8)</td>
<td>19 (5)</td>
<td>5 (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total=971 (147)</td>
<td>180 (71)</td>
<td>104 (44)</td>
<td></td>
</tr>
</tbody>
</table>
termite flagellates only, reported by Tiwari (1978) from Sagar Island. No study of ruminant ciliates have so far been made from wild deer population or from any domesticated ruminant mammal of Sundarban. A comparison of the protozoan species occurring in the mangrove ecosytem of Sundarban region and those of South 24-Parganas district as well as West Bengal is presented in Table 1 & 2 (see Das et al., 1993; West Bengal State Fauna Series: Protozoa). It indicates that this region is not well explored in so far as protozoa fauna are concerned.

Acknowledgements

Authors are thankful to Dr. A. K. Ghosh, Director, Zoological Survey of India, Calcutta and Officer-in-Charge, Sundarban Field Research Station, Zoological Survey of India, Canning Town-743329, for providing facilities for this work and to Dr. R. K. Varshney, Scientist-SF for his kind interest in this work.

References


INTRODUCTION

Wetlands comprises a unique habitat exhibiting many features of the aquatic and terrestrial ecosystems. The species richness in such area is quite high, as it offers a specialised habitat for many macrophytes, invertebrates and vertebrates. Insect communities constitute the most varied and important invertebrate biotic component of wetland ecosystem.

Among a number of wetlands inspected in and around Calcutta 3 areas have been selected for detailed study. These are (i) Freshwater wetland of Bartibill near Barrackpore (ii) Sewage-fed wetland of Bantala of eastern Calcutta and (iii) Brackish-water wetland of Khariberia of north-east Calcutta.

Coleoptra comprise the largest order of insects which includes about 3,50,000 described species (Arnett, 1973) and approximately 5,000 aquatic members (White, Brigham and Doyen, 1984) and rank as one of the major groups of freshwater arthropods. Both adults and larvae are generally predaceous and carnivorous and prey upon larvae and adults of other aquatic insects, shrimps, warms, fishes, molluscs etc. On the other hand, these insects themselves are predated by fishes, amphibians, reptiles and aquatic birds. Thus they play a major role in the food chain of aquatic ecosystem.

Some of the important works on taxonomy and biology on aquatic beetles pertaining to the present study are done mainly by Sharp (1890), Regimbart (1903), Blunck (1912, d’Orchymont (1925, 1928), Ochs (1930), Hickman (1931), Crowson (1955), Zimmerman (1960), Leech and Chandler (1968), Vazirani (1968, 1970, 1984), Tonapi and Ozarkar (1969), Arnett (1973), Roy (1982), White et al. (1984) etc.

The materials for the present study were collected during the period 1986-88 in three ecologically different wetlands of Calcutta Metropolitan District as mentioned earlier. Besides a large collection present in Zoological Survey of India have helped considerably to complete this study. The collections have been made from different habitats eg. surface water, column water, bottom mud, aquatic weeds and bank of water at regular intervals using different collecting equipments such as drag net, sweeping net, sieve, D frame aquatic net, Ekman grab, enamel trap and hand picking.
The number of species in each hauling was counted. A simple method was adopted to determine the relative abundance as follows:

<table>
<thead>
<tr>
<th>Specimens</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 +</td>
<td>Profusely abundant</td>
</tr>
<tr>
<td>&lt; 100</td>
<td>Abundant</td>
</tr>
<tr>
<td>&lt; 50</td>
<td>Common</td>
</tr>
<tr>
<td>&lt; 20</td>
<td>Rare</td>
</tr>
</tbody>
</table>

It is realised that this system may not truly reflect the relative abundance of a species. But since qualitative aspect was the main consideration, the method was adopted for the study.

In the present survey 28 species of aquatic Coleoptera have been recorded belonging to five families, these are Dytiscidae, Hydrophilidae, Gyrinidae, Haliplidae and Spercheidae. Among them, the first two families are most common and abundant while the last three are less common in wetlands.

A brief introduction to the families is given below:

(i) The Dytiscidae or "predaceous diving beetles" are perhaps best adapted for aquatic life. The streamlined shape, flattened body and paddle like hind legs give them a characteristic appearance. The divided first visible abdominal sternite and short palpi distinguish them from Hydrophilidae which they resemble, and the single pair of eye separate them from Gyrinidae which are also streamlined.

The Dytiscidae are found in vascular hydrophytes both in flowing and stagnant water and they can live also in turbid water. They are active during daytime and attracted to light during night and sometimes cause nuisance to paddy fields. Dytiscidae are very good swimmer. Their hind legs are modified to a varying degree for swimming and provided with swimming devices like spines and swimming hairs. They can easily float, dive and swim up and return to the surface after a few seconds to fill the subelytral air chamber by breaking the surface film with elytray and abdomen. The swimming process is different from that of other aquatic beetles. Both hind legs are moved or kicked at the same time as opposed to the alternate swimming motions of other groups. In the males of certain genera e.g. *Hydrovatus*, *Laccophilus* etc. the first three segments of the fore tarsi are dilated to form highly efficient adhesive pads provided beneath with cup-like suckers, which secrete a glutinous secretion. According to Blunck (1912) the secretion helps in adhesion and sucker pads help to hold the female for long time. Dytiscidae are generally predator or engulfer and many are scavenger. Most species are carnivorous feeding on dragonfly and damselfly nymphs and other aquatic animals. Eggs are laid on plant on plant surface or within the plant tissues depending upon the structure of ovipositor.
The larvae are generally climber or swimmer. They are voracious eater and predaceous and cannibalistic in nature. The common genera of Dytiscidae found in the wetlands surveyed are *Laccophilus*, *Canthydurs*, *Hydrovatus*, *Guignotus*, *Hyphydrus*, *Uvarus*, *Clypodytes*, *Hydaticus* and *Cybister*.

(ii) The Hydrophilidae are commonly known as "water scavenger beetle" is a fairly large family and second in abundance to Dytiscidae. d'Orchymont (1928) recorded 363 species from India. They may usually be recognized by the long maxillary palpi which exceeds the antennae in length and resembles antennae. The antennae are short, clavate and concealed.

The Hydrophilidae inhabit shallow water with emergent vegetation and vascular hydrophytes, grass growing water and also live upon decomposing vegetable matter. They are also good swimmer but not as active as many of the Dytiscidae. The adults swim by alternate movement of hind legs. Adults are active flyers and large numbers may be attracted to light. They renew their air supply by breaking the surface film with unwettable hairy club of antennae and side of the head; this allows gas exchange along the plastron and air passage on the ventral surface of the thorax. Most adults are omnivorous consuming both living or dead material. Except a few genera larvae are not very common. The larvae are climber and poorer swimmer and generally found on soil near water edge. They are predaceous in nature. The common genera recorded from the wetlands surveyed are *Sternolophus*, *Amphiops*, *Berosus*, *Enochrus*, *Helochares*, *Regimbartia* and *Hydrophilus*.

(iii) The Gyrinidae is commonly known "as whirligig beetle", their broadly ovate and depressed body form, very flat and generally modified swimming legs and remarkable divided eyes serve to distinguish the family from the other beetles. Their habit of swimming in circles when alarmed has earned them their common name. This is a small family and Ochs (1930) catalogued nearly 130 species from India. The common genera in wetlands are *Dineutus* and *Orectochilus*. All the members of the Gyrinidae family glide or skate on the surface of the water and rarely dive. They cluster together and often swim rapidly in circles with their middle and hind legs, modified as fan like paddle for swimming. This is not only a normal mode of locomotion but is an alarming mechanism and when disturbed they scatter widely. Adults have divided eyes, lower portion remains completely submerged surveying aquatic habitat, the upper portion views the above water habitat. Divided vision and quick swimming movements allow them to avoid predators from above and below. For their respiration the air is stored in dorsal reservoir under the elytra. Gyrinidae are generally predator and predominantly surface film scavenger feeding on floating live or dead insects. Eggs are laid on stems just below the surface of water submerged.
objects with their apical abdominal hook. They are predaceous in nature feeding on small aquatic organisms.

(iv) The Haliplidae is commonly known as “crawling water beetle”. These peculiarly shaped water beetles cannot be mistaken for anything else once the extremely large hind coxal plates covering at least first two sternites are recognized.

The single genus common in wetlands is *Haliplus*. They are generally found at the edge crawling over mats of algae or similar vegetation. They are poorer swimmers, legs are not very helpful for swimming except few long hairs on middle and hind tarsi. Swimming is effected by alternate feeble movement of leg. Crawling is the most normal mode of locomotion. The air is stored in subelytral chamber and below the large hind coxal processes, they float up and break the surface film by tip of the abdomen (Hickman, 1931). Nothing is known about food, feeding habit and life history of any Indian species. But it is believed that there is only one generation in India.

(v) *Spercheidae*:

*Sphercheus gibbus* is the only representative of the family Spercheidae in the wetlands surveyed. According to Crowson (1955) this family perhaps forms a link between the Hydraenidae and the Hydrophilidae proper. Many authors gave it a subfamily status-Spercheinae. *Sphercheus* remains the only genus of this family.

List of the species of Coleoptera of wetlands of Calcutta and its surroundings

Family: **Haliplidae**

1. *Haliplus angustifrons* Regimbart

   Family: **Gyrinidae**
   Subfamily: **Enhydrinae**

2. *Dineutus unidentatus* (Aube)

   Subfamily: **Orectochilinae**

3. *Orectochilus productus* Regimbart

   Family: **Dytiscidae**
   Subfamily: **Dytiscinae**

4. *Cybister tripunctatus* Sharp

5. *Hydaticus ricinus* (Macley)

   Subfamily: **Hydroporinae**

6. *Hyphydrus renardi* Severin

7. *Hydrovatus bonvouloiri* Sharp
8. *H. confertus* Sharp
9. *Clypeodytes orissaensis* Vazirani
10. *Uvarus quadrilineatus* (Zimmerman)
11. *Guignotus flammulatus* (Sharp)
12. *G. inconstants* (Regimbart)
13. *G. pendjabensis* Guignot
14. *Guignotus* sp.

Subfamily: LACCOPHILINAE

15. *Laccophilus anticatus* Sharp
16. *L. parvulus* Aube

Subfamily: NOTERINAE

17. *Hydrocoptus subvittulus* Motschulsky
18. *Canthydrus laetabilis* (Walker)
19. *C. luctuosus* (Aube)

Family: SPERCHEIDAE
Subfamily: SPERCHEINAE

20. *Spercheus gibbus* Champion

Family: HYDROPHILIDAE
Subfamily: HYDROPHILINAE

Tribe: HYDROBIINI
21. *Enochrus escuriens* (Walker)
22. *Helochares anchoralis* Sharp

Tribe: HYDROPHILINAE
23. *Sternolophus rufipes* Fabricius
24. *Hydrophilus* sp.

Tribe: AMPHIOPINAE
25. *Amphiops mirabilis* Sharp
26. *Amphiops pedestris* Sharp

Tribe: Berosini
27. *Berosus indicus* Motschulsky
28. *Reqimbartia attenuata* (Fabricius)

Key to the families, genera and species of wetland-coleoptera

*1. Hind coxae produced into broad, flattened plates covering 2 or 3 abdominal sternites and concealing all but apices of hind femora; pronotum with a notch on lateral sides, before posterior angles ... Halipidae
   ... *H. angustifrons* Regimbart
1. Hind coxae not produced into such plates ...  

2(1'). Hind coxae with medial portion extending posteriorly to divide 1st abdominal sternite into lateral sclerites; prothorax with distinct notopleural sutures ...  

2'. Hind coxae not extending posteriorly to divide 1st abdominal sternite; notopleural sutures almost always absent ...  

3(2) Eyes divided into dorsal and ventral parts; antenna short and thick, 2nd segment with a process ... Gyrinidae  

3'. Eyes not divided; antenna long, filiform or moniliform ... Dytiscidae  

4(3) Episternum of the mesothorax not touching the base of elytral epipleurae; pronotum and elytra without pubescence; scutellum invisible; protarsi in male almost subparallel only slightly broader than female; elytral striae indistinct or obsolete, elytral apex with one spine in continuation of epipleural angle; length 6.0-7.2 mm ... Dineutus  

4. Episternum of the mesothorax touching the base of elytral epipleurae; pronotum and elytra with pubescence; scutellum visible at least in one of the sexes; apical segment of protarsi less than one and a half times longer than the preceding segment; pronotum and elytra pubescent-punctate on lateral sides only and glabrous in the middle, epipleural angle produced into a spine; length 4.5-5.4 mm ... Orectochilus  

5(3). Scutellum visible  

5'. Scutellum not visible ...  

6(5) Hind margins of the four basal metatarsal segments not fringed with any ciliae and posterior claw equal; elytra black with green metallic iridescence and with yellow
lateral stripes extending to and including the epipleurae, species without any sexual sculpture in the female ... *Cybister*

... *C. tripunctatus asiaticus* Sharp

6. Hind margins of the four basal metatarsal segments on both the anterior and posterior faces fringed with golden yellow ciliae overlapping the base of the next segment and posterior claw unequal; elytra reddish yellow with black markings as figured (Fig. 5) and sutural margin black ... *Hydaticus*

7(5'). 4th segment of the pro and mesotarsi much reduced, hardly visible; prosternal process arched and oblique ... 8

7'. 4th segment of pro and mesotarsi subequal to the 3rd tarsal segment, not reduced; prosternal process straight, occasionally a little depressed ... 16

8(7) Claws of the hind tarsi mostly unequal; prosternal process oblong; punctation on elytra double mixed with small and large punctures ... *Hyphyrus renardi* Severin

8'. Claws of hind tarsi equal ... 9

9(8). Prosternal process broadened at the apex; sutural angles of the elytra acuminate ... *Hydrovatus* 10

9'. Prosternal process not broadened at the apex ... 11

10(9). Length 3 mm or more; head reticulate and glabrous ... *H. bonvouloiri* Sharp

10'. Length less than 3.00 mm; head finely punctate ... *H. confertus* Sharp

11(9'). Clypeus distinctly thickened, semicircular in outline (with a transverse striae between the eyes); upper surface distinctly pubescent; pronotal striae continued on elytra ... *Clypeodytes* ... *C. orissaensis* Vazirani
11'. Clypeus not thickened, almost cut straight ...  
12(11'). Elytra with a sutural striae ... Guignotus  
12'. Elytra without a sutural striae, or if present, only near apex; elytra brownish yellow with 2 distinct longitudinal brown markings on each elytron ... Uvarus  

U. quadrilineatus (Zimmerman)  

13(12). Laterobasal plica on pronotum not continued on elytra at all; length 2.3-2.5 mm ... G. flammulatus  
13'. Laterobasal plica on pronotum distinctly continued on elytra ...  
14(13'). Elytra brownish yellow to grey with pale yellow markings ... G. inconstans  
14'. Elytra brownish yellow with dark markings ...  
*15(14') Elytral markings constituting two parallel longitudinal lines, terminating in the form of a crochet ... G. pendjabensis Guignot  
15'. Elytral markings different and its shape as figured (Fig. 14) ... Guignotus sp.  
16(7'). Posterior legs with a single tarsal claw; sides of the pronotum not rebodered ... Laccophilus ...  
16'. Posterior legs with two tarsal claws of equal length; sides of the pronotum rebodered ...  
17(16). Length 3.0-3.2 mm; elytra brownish black with 5 yellow fascia ... L. anticatus Sharp  
17'. Length 3.50-3.70 mm; elytra brownish yellow to reddish brown with zigzag double marking, generally thick and coalescent ... L. parvulus (Aube)  
18(16'). Curved spur present on the apex of fore tibiae ... Canthydrus  
18'. Curved spur not present on the apex of fore tibiae; length 1.8-2.2 mm; puncturation on elytra in distinct rows ... Hydrocoptus H. sabvittulus (Motschulsky)
19(18). Length 2.25-2.70 mm; pronotum brownish with its front margin darker. ... C. laetabills

19'. Length 3.0-3.25 mm; pronotum black marging into orange-yellow on sides ... C. luctuosus

20(2'). Front coxal cavities apparently more or less evidently closed behind; antenna with not more than 3 segments before cupula, 2nd segment and cupule pubescent, the latter appearing as part of the club; tarsi with large pleurisetose empodium between the claws; general form very convex dorsally, broad and tuberculate ... Spercheidae ... Spercheus

20'. Front coxal cavities apparently open behind; antenna usually with 5 well developed segments before cupula, antenna short, clavate and concealed, antennal club 3 segmented and pubescent, maxillary palpi long exceeding the length of antenna ... S. gibbus Champion

21(20'). Scutellum no longer or not much longer than its width at basis; antenna at most 9-segmented (6+3) ... Hydrophilidae 21

21'. Scutellum a long triangle; antenna at most 8-segmented (5+3) ... 22

22.(21) Meso and metasternal carina not reunited intimately ... 23

22'. Meso and metasternal carina reunited and forming only one ridge ... 24

23(22). Curved pseudobasal segment (actual basal segment very small) of maxillary palpi convex anteriorly; length 2.5 mm ... Enochrus

23'. Curved pseudobasal segment of maxillary palpi convex posteriorly; length 6 mm ... Helochares

24(22'). Antenna with normal club; prostital carina ridgelike with an anterior brush of long
setae; claws simple; shiny black insect; length 13 mm \(\ldots\) *Sternolophus* \(\ldots\) *S. rufines* Fabricius

24'. Antennal club perfoliate and asymmetrical; prostital carina without anterior brush of long setae; claws of all tarsi dentate at base, usually unequal and of different shape; blackish brown shiny specimens; length 35 mm \(\ldots\) *Hydrophilus* sp.

25(21'). Eyes divided by a conspicuous and complete canthus which reaches the vertex behind; posterior feet without swimming hairs; body with rolling up power with lunulated pronotum \(\ldots\) *Amphiops* 26

25'. Eyes very convex and prominent without complete canthus; posterior feet with long swimming hairs \(\ldots\) 27

26(25), Blackish brown insect; length 3.5 mm; elytra with series of punctures and the interstitial punctures on sides are large and coarse, almost similar to serial punctures \(\ldots\) *Amphiops mirabilis* Sharp

26'. Reddish brown insect; length 3 mm; elytra with series of coarse punctures, interstitial puncture large and distant

\(\ldots\) *Amphiops pedestris* Sharp

27(25'). Five ventral not retractile segments; antenna composed of 7 segment; convex and elongate; upper surface not black but brown to yellowish \(\ldots\) *Berosus* \(\ldots\) *B. indicus* Motschulsky

27'. Only four not retractile ventral segments, the first one invaded by the posterior coxal cavities; antenna composed of 8 segments; body strongly convex, elongated and compressed on sides; upper surface uniform, deep and shining black \(\ldots\) *Regimbartia* \(\ldots\) *R. attenuata* (Fabricius)
ROUTE CONNECTION OF MAJOR WETLANDS OF CALCUTTA METROPOLITAN DISTRICT
Family: Haliplidae

1. Haliplus angustifrons Réginbatt


Diagnostic characters: General appearance (Fig. 1) broad, narrowed in front and more sharply so posteriorly. Head brownish yellow, vertex finely and sparsely punctured, punctuation larger and more dense towards base which is darker and eyes large. Antenna long, slender and brownish yellow. Prothorax brownish yellow with marginal parts darker, a notch present on lateral margin before posterior angle, punctuation dense, irregular and sparse on pronotal disc. Elytra brownish yellow with rusty red brown markings as figured (Fig. 1), sutural punctures marked and closely situated, strial punctures moderate and shallow and interstitial punctures small and deep. Legs long, slender, brownish yellow and fringed with hairs, claws equal. Ventral surface brownish yellow.

Size: 2.9-3.8 mm in length.

Distribution: Bihar, Himachal Pradesh, Madhya Pradesh, Orissa, Punjab, Rajasthan and West Bengal.

Remarks: This species is found in shady places of wetlands among vascular hydrophytes and on edge of water. They are poor swimmer and climber in habit. They are very scarce in wetland and only two specimens have been collected from the freshwater of 'Bartibill'.

Family: Gyrinidae

2. Dineutus unidentatus (Aubé)

1838. Dineutus unidentatus Aubé, Spécies coleoptéræs, 6 : 788.

Diagnostic characters: General appearance (Fig. 2) elongate, slightly depressed posteriorly and black, with copper colour anteriorly and on sides, punctuation very fine, sparse and hardly visible and eyes large and divided by the sides of the head. Antenna very short, black with bronze colour shade. Prothorax black, copper colour on sides, lateral margin little arched and raised, punctuation sparse and little visible on disc. Elytra black, lateral margins slightly raised, striae of fine punctures hardly visible, epipleural angle extended into a strong spine and apex with fine denticles. Legs with front trasi simple armed with spines and spongy hairs, middle and hind legs short, paddle-like, flattened and tarsi folding fanwise. Ventral surface reddish brown.
Size: 6.0-7.2 mm in length.
Distribution: All over India.


Remarks: These beetles prefer clear water and surface swimmer and diver in habit. They are found to gyrate on water surface. This species is not very common.
and only a few specimens have been recorded from freshwater and brackishwater and none has been collected from sewage-fed water.

3. **Orectochilus productus** Régimbart


**Diagnostic characters:** General appearance (Fig. 3) narrowly elongate and black. *Head* black, punctuation indistinct, clypeus slightly raised anteriorly and eyes divided. Antenna very short and brownish black. *Prothorax* black and lateral margins yellow, punctuation on pronotum indistinct, pubescence on lateral sides projected posteriorly and as figured (Fig. 3) and faint depression of a median longitudinal line present. *Scutellum* short and markedly transverse. *Elytra* bronze-black and lateral margin yellow, punctuation indistinct, pubescence on lateral margin as figured (Fig. 3), epipleural angle extended into a small spine. Front *legs* simple and provided with spines, middle and hind legs short, paddle like, flattened and tarsi folded fanwise. *Ventral surface* bronze to black with legs and abdominal sternite paler.

**Size:** 4.5-5.4 mm in length.

**Distribution:** All over India.

**Remarks:** Like all other gyrinids this species is also surface swimmer. *Orectochilus* can be recognized in the field by its shape which is rather elongate with the last abdominal segment more or less lengthened like a tail. It is only recorded from freshwater wetland, none is found in sewage-fed and brackishwater.

**Family:** **Dytiscidae**

4. **Cybister triplunctatus asiaticus** Sharp


**Diagnostic characters:** General appearance (Fig. 4) elongate-oval, narrower in front and moderately wider behind the middle. *Head* small, black with greenish metallic iridescence, apical portion yellowish red and eyes whitish. Antenna long, narrow and yellowish red. *Prothorax* concolorus with head and with reddish yellow lateral stripe and shape as figured (Fig. 4). *Scutellum* small, triangular and black. *Elytra* black with green metallic iridescence with reddish yellow lateral border distinctly punctured as figured (Fig. 4). *Legs* reddish yellow with tibiae and tarsi darker, and provided with spines and swimming hairs. *Ventral surface* reddish-brown to black.

**Size:** 27-30 mm in length.
De & Sengupta: Beetles of Wetlands of Calcutta & Surroundings

Distribution: Andhra Pradesh, Assam, Andaman Islands, Bihar, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

Remarks: This is the largest Dytiscidae among all the species so far collected from different wetlands. Being larger in size they tend to inhabit the larger and slightly deeper part of water. They occur scarcely in the freshwater but none has been collected from the other two types of water.

5. Hydaticus ricinus (Macley)


Diagnostic characters: General appearance (Fig. 5) oblong, oval and moderately depressed. Head rather small, reddish yellow and black marking along posterior margin and eyes normal. Antenna reddish yellow, long, slender and segments narrow. Prothorax reddish yellow and a transverse blackish marking present on basal margin, shape as figured (Fig. 5). Scutellum black. Elytra reddish yellow with black markings as figured (Fig. 5) and sutural margin black. Legs with spines and hairs, male with basal three segments of the front tarsi broadly dilated and provided with 'sucker pallettes', middle tarsi with 'sessile palletes', hind tarsi long and provided with spines and swimming hairs and posterior claw unequal. Ventral surface black or brownish black.

Size: 8.75-10.70 mm in length.

Distribution: Assam, Bihar, Himachal Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu and West Bengal.

Remarks: This is moderately large and colourful species. This species is scarcely found in wetlands. Only a few specimens have been collected from freshwater and brackishwater wetland and none is recorded from sewage-fed water.

6. Hyphydrus renardi Severin


Diagnostic characters: General appearance (Fig. 6) rather broad, oval and convex. Head brownish yellow, puncturation moderately large, irregular and denser on vertex and eyes large. Antenna brownish yellow, rather short & 4th segment distinctly short. Prothorax brownish yellow with anterior and posterior portion black as figured (Fig. 6), puncturation slightly larger than vertex of head and irregular. Elytra brownish with black markings as figured (Fig. 6), puncturation mixed with small
and large one, denser and closer than on pronotum. *Legs* with spines and hairs, first three segments of front and middle tarsi in male dilated and with ventral 'sucker pallettes' and 4th segment minute or obsolete, hind tarsi long with spines as figured (Fig. 6). *Ventral surface* reddish brown, puncturation on metasternum and hind coxae large and dense.

**Beetles of Wetlands of Calcutta & Surroundings**

**Size**: 3.25-3.80 mm in length.

**Distribution**: Bihar, Madhya Pradesh, Rajasthan, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal.

**Remarks**: Their occurrence in wetlands is markedly few and only single specimen has been collected from brackishwater wetland.

7. **Hydrovatus bonvouloiri** Sharp


**Diagnostic characters**: General appearance (Fig. 7) moderately convex, oval and shining. **Head** reddish brown and glabrous and eyes moderately large. Antenna brownish, long and slender. **Prothorax** reddish brown, its front margin dark and with a large and dark row of punctures, punctuation on pronotum fine and dense. **Elytra** reddish brown, uniformly and densely punctate, four rows of setiferous punctures often present which sometimes obsolete. **Legs** with front and middle tarsi broader and armed with spines and hairs, their first three segments a little dilated, 4th segment minute or obsolete, hind tarsi elongate, slender and with swimming hairs. **Ventral surface** brownish and punctuation on metasternum large and prominent.

**Size**: 3.50 mm in length.

**Distribution**: Bihar, Karnataka and West Bengal.

**Remarks**: General habit and habitat of this species is similar to *H. confertus*; but it can be easily distinguished from the former by its larger size and unlike *H. confertus* they are less common in wetland.

8. **Hydrovatus confertus** Sharp


**Diagnostic characters**: General appearance (Fig. 8) oval and moderately convex. **Head** reddish brown and punctuation very fine and eyes large. Antenna reddish brown, elongate and with median segments thickened in male. **Prothorax** reddish brown, punctuation irregular, fine and denser anteriorly and posteriorly. **Elytra** reddish brown, punctuation somewhat regular, moderate and slightly denser than on pronotum. **Legs** similar to *Hydrovatus bonvouloiri*. **Ventral surface** brownish yellow and punctuation sparser.

**Size**: 2.25-2.50 mm in length.

**Distribution**: Bihar, Kerala, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.
Remarks: This species is more or less common in all three ecologically different wetlands. They inhabit shallow water with aquatic vegetation and also in the water containing debris near the bank.

9. Clypeodytes orissaensis Vazirani


Diagnostic characters: General appearance (Fig. 9) oblong-oval, moderately convex and pubescent. Head yellowish, puncturation fine and irregular and eyes large. Antenna slender and moderately long. Prothorax yellowish, puncturation distinct and irregular, pubescence fine, laterobasal plica oblique and slightly bent inwards. Elytra brownish with indistinct and irregular dark brown markings, which are more distinct between the discal plica, discal plica straight and long, puncturation moderately large and distinct. Legs simple with spines and hairs as figured (Fig.9), hind tarsi long, slender and with swimming hairs. Ventral surface reddish brown, punctate and pubescent.

Size: 1.90 mm in length.

Distribution: Orissa and present survey recorded it first time from West Bengal.

Remarks: This species has been collected from water weeds containing dead leaves, twigs, algae etc. along with the species of Guignotus. They scarcely occur in freshwater and brackishwater and none has been collected from sewage-fed water.

10. Uvarus quadrilineatus (Zimmermann)


Diagnostic characters: General appearance (Fig. 10) sub-oblong, convex and finely pubescent. Head brownish yellow, puncturation fine, narrow and finely dark spots present in the interocular space and eyes large. Antenna brownish yellow and slender. Prothorax (Fig. 10) brownish yellow, anterior margin brown and darker in the middle, puncturation fine and not very dense, latero-basal plica angulate and reaching almost middle of the pronotum. Elytra brownish yellow with dark brown marking consisting of bands as figured (Fig. 10), puncturation fine and dense, pubescence short and fine, discal plica subequal to pronotal plica. Legs with spines and hairs, 1st three segments of front and middle tarsi dilated and 4th segment minute or obsolete, hind tarsi elongate, slender and with swimming hairs. Ventral surface brownish yellow, puncturation and pubescence fine.

Size: 1.5 mm in length.

Distribution: Bihar and West Bengal.
Remarks: This is the smallest species among all the Dytiscidae collected from the three different wetlands. They are adapted for living on vascular hydrophytes or detrital debris e.g. branches, roots of vegetation etc. They are predator (piercer) in habit and very scarce in wetland.
11. **Guignotus flammulatus** (Sharp)


**Diagnostic characters:** General appearance (Fig. 11) oblong-oval, moderately elongate and quite densely pubescent. *Head* brownish yellow with a basal transverse blackish marking, vertex finely punctate and eyes large. Antenna brownish, long and slender. *Prothorax* brownish yellow with black streak on anterior and posterior border, punctate and latero-basal plica inverted U shaped and not extended to elytra. *Elytra* brownish yellow with black markings as figured (Fig. 11) and covered with minute setiferous, somewhat dense punctuation. *Legs* with front and middle tarsi armed with spines and hairs and their 1st three segments dilated and 4th segment minute or obsolete, hind tarsi elongate, slender and with swimming hairs. *Ventral surface* blackish, punctate and pubescent.

**Size:** 2.3-2.5 mm in length.

**Distribution:** Bihar, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

**Remarks:** Among the four species of the genus *Guignotus* recorded here, this species is largest in size and most common but less so in sewage-fed water.

12. **Guignotus inconstants** (Regimbart)


**Diagnostic characters:** General appearance (Fig. 12) oblong, oval, a little convex and pubescent. *Head* brownish yellow, punctuation fine and sparse and eyes large. Antenna brownish yellow, narrow and long. *Prothorax* brownish yellow with its anterior and prebasal portion darker, punctuation fine, latero-basal plica oblique and long. *Elytra* brownish yellow to grey, darker along suture and scutellar region, sometimes with small scattered pale yellowish spots, punctuation moderate, pubescence fine and sparse, discal plica short but sometimes long. *Legs* similar to *G. flammulatus*. *Ventral surface* dark, punctate and sparsely and finely pubescent.

**Size:** 1.80 mm in length.

**Distribution:** Bihar, Orissa, Rajasthan and present survey recorded it first time from West Bengal.

**Remarks:** The habitat of this species is similar to other species of *Guignotus* but unlike *G. flammulatus* they are small in size and rather scarce in wetlands of this area.
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13. Guignotus pendjabensis Guignot


Diagnostic characters: General appearance (Fig. 13) moderately elongate and oval. Head brownish yellow, punctuation very fine and sparse and eyes large. Antenna brownish yellow, elongate and slender. Prothorax brownish yellow with its anterior and prebasal portion darker and shape as figured (Fig. 13), punctuation moderate, latero-basal plica distinct, a little incurved and short. Elytra brownish yellow, punctate, finely pubescent and discal plica short, basal and stural margins dark brown and two longitudinal dark markings present on each elytron, which terminates apically, its shape as figured (Fig. 13). Legs with first three segments of front and middle tarsi dilated and 4th segment minute or obsolete, hind tarsi long and provided with swimming hairs. Ventral surface dark, punctate, finely and sparsely pubescent.

Size: 1.80 mm in length.

Distribution: Bihar, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu, and present survey recorded it from West Bengal.

Remarks: These small Guignotus species are rather uncommon and a few specimens have been collected from fresh and brackish water and none has been found in sewage-fed water. They are recorded from pile of dead leaves and twigs mixed with algae.


Diagnostic characters: General appearance (Fig. 14) oval, sub-depressed and finely pubescent. Head brownish yellow, punctuation fine and eyes large. Antenna brownish yellow, narrow and elongate. Prothorax brownish yellow, anterior border and prebasal portion darker and shape as figured (Fig. 14), punctuation fine, latero-basal plica slightly oblique and shape as figured (Fig. 14). Elytra brownish yellow with blackish markings, punctuation moderately dense and discal plica moderately long. Legs similar to G. flammulatus. Ventral surface brownish yellow with abdominal sternites slightly darker, punctate and pubescent.

These specimens are rather distinct and different from all other species described from India. They differ from flammulatus, pradhanii, orientalis, mysorensis and crassifrons having the latero-basal plica on pronotum distinctly continued on elytra. Size 1.80 mm separate them from angularis, pusillus and signatellus and elytral marking is very distinct type as figured (Fig. 14) which separate them from inconstans, pendjabensis and regimbarti. No attempt has been made to establish them as a new species, which need further study of more specimens and detail study of male genital organ.

Size: 1.80 mm in length.
Remarks: The occurrence of this species is markedly few and recorded from freshwater and brackishwater along with other species of *Guignotus* and none has been recorded from sewage-fed water.

15. **Laccophilus anticatus** Sharp


**Diagnostic characters**: General appearance (Fig. 15) oval and subpressed. *Head* transverse, brownish yellow and often with faint brownish marking as figured (Fig. 15), puncturation not visible and eyes large. Antenna brownish yellow, narrow and long. *Prothorax* transverse and almost concolourous with head and a faint transverse margin often present as figured (Fig. 15), prebasal portion with transverse dark streak. *Elytra* brownish black with puncturation indistinct, yellow patches present on anterior half and a pair of small patches on posterior half, prominent punctures present on sutural margin along anterior one fourth of elytra. Legs in male with basal three segments of front and middle tarsi a little dilated and armed with 'sucker pallettes' underneath, hind tarsi with swimming hairs and a straight single claw. *Ventral surface* brownish yellow and abdominal sternites slightly darker.

**Size**: 3.0-3.20 mm in length.

**Distribution**: Assam, Bihar, Manipur, Orissa and West Bengal.

**Remarks**: These are another common species in all the three wetlands, slightly more abundant in freshwater and sewage-fed water. They usually live in the midst of aquatic weeds and often found crawling or running easily on the edge of wetland, on algal mat or on dry land. They are good swimmer, diver, climber and often seen jumping.

16. **Laccophilus parvulus** Aubé


**Diagnostic characters**: General appearance (Fig. 16) elongate, oval and sub-depressed. *Head* brownish yellow and puncturation indistinct and eyes large. Antenna brownish yellow, narrow and long. *Prothorax* transverse, brownish yellow and often with a narrow streak of black towards the middle of anterior and posterior margin, prebasal portion as figured (Fig. 16). *Elytra* brownish yellow to reddish brown with zigzag black lines as figured (Fig. 16), few hairs present on posterior lateral margin. *Legs* similar to *L. anticatus*. *Ventral surface* with metacoxal plate reddish brown to black, other parts paler, stidulatory coxal file present.

**Size**: 3.50-3.70 mm in length.

**Distribution**: Andra Pradesh, Assam, Bihar, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and West Bengal.

**Remarks**: This species is very similar to *L. anticatus* and live in the same habitat like *L. anticatus* but slightly larger in size and less common. They are
insignificantly scarce in sewage-fed water. Jhingran (1985) mentioned that this species heavily predates on fish spawn.

17. *Hydrocoptus subvittulus* Motschulsky


**Diagnostic characters**: General appearance (Fig. 17) oblong-oval and moderately convex. *Head* rusty red, exposed part of head somewhat transverse, puncturation obsolete and eyes large with fine rows of punctures on its inner side. Antenna pale yellow with the apices brownish. *Prothorax* concolourous with head, puncturation obsolete on disc, its front margin darker with two transverse rows of punctures, prebasal portion with some transverse blackish spots which are arranged as figured (Fig. 17). *Elytra* brownish with a reddish border on the lateral margin extending to the apex and with a median long reddish band, shape as figured (Fig. 17), puncturation small and arranged in distinct rows and interstitial punctures obsolete. *Legs* long, slender, rusty red and armed with spines, claws simple and equal. *Ventral surface* largely pale yellow.

**Size**: 1.8-2.1 mm in length.

**Distribution**: Assam, Bihar, Orissa and West Bengal.

**Remarks**: This species is very scarce in wetlands and only a few specimens have been collected from freshwater and brackishwater.

18. *Canthydrus laetabilis* (Walker)


**Diagnostic characters**: General appearance (Fig. 18) oblong-oval and moderately convex. *Head* brownish yellow and eyes large. Antenna brownish yellow, short and slender. *Prothorax* concolourous with head, its front margin darker and with dark punctures, prebasal portion with a median transverse dark streak and with a few dark punctures as figured (Fig. 18). *Elytra* streamlined, brownish black with two basal orange-yellow spots arranged transeversely and one transverse irregular spot situated post-medially. *Legs* with front tibiae short and its apical spur curved, first tarsal segment elongate and segment two to five narrowed gradually, hind tarsi with swimming hairs, claws simple. *Ventral surface* smooth, brownish yellow except last few abdominal segments which are darker.

**Size**: 2.25-2.70 mm in length.
**Distribution**: Andhra Pradesh, Assam, Bihar, Kerala, Orissa, Punjab, Rajasthan, Uttar Pradesh and West Bengal.

**Remarks**: These are very common species occurring in all the three types of wetlands. They are abundant in freshwater and brackishwater, weeds, muddy water
on edge and found on algal mat. They are attracted to light during night. This species often predates on fish spawn and thus harmful to fish culture (Jhingran, 1985).

19. **Canthydrus luctuosus** (Aubé)

1838. *Hydrocanthus luctuosus* Aubé In Dejean's spéces Coléopt'eres, 6 : 408.

*Diagnostic characters:* This species (Fig. 19) is closely allied to *C. laetabilis* but differs in having head brownish black with anterior portion yellowish, prothorax black merging into orange-yellow on sides, elytra black with the orange-yellow markings and ventral surface brown to black.

*Size:* 3.00-3.25 mm in length.

*Distribution:* Andhra Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu and West Bengal.

*Remarks:* This species is very common and abundant in sewage-fed water and collected throughout the year in Bantala. They live in the similar habitat like *C. laetabilis* but unlike later they are less common in freshwater and brackishwater.

**Family: Spercheidae**

20. **Spercheus gibbus** Champion


*Diagnostic characters:* General appearance (Fig. 20) dark brown, very convex dorsally, broad, tuberculate and densely punctured. *Head* transverse and eyes large and protruberent. Antenna with not more than three segments before cupula, 2nd segment and cupula pubescent, the latter appearing as part of the club. *Prothorax* strongly transverse, its lateral margin crenulated and with prominent stiff hairs. *Scutellum* small triangular and punctate. *Elytra* broad and abruptly narrowed posteriorly, shape as figured (Fig. 20), punctuation larger than on head and pronotum. *Legs* with tibiae flattened and armed with spines, tarsi fringed with hairs and with large pleurisetose empodium between the claws. *Ventral surface* dark brown.

*Size:* 4 mm in length.

*Distribution:* Bihar and West Bengal.

*Remarks:* This species is very scarce in wetlands and only two specimens have been collected from brackishwater. Both the adults and larvae of *Spercheus* are reported as normally living in an inverted position walking on the underside of the water surface film (Crowson, 1955). The peculiar empodia may likewise be adapted for walking on the surface film.
Family: HYDROPHILIDAE

21. Enochrus escuriens (Walker)

1890. Ohiydrus escuriens, Sharp, Trans. ent. Soc. Lond., p. 350,

Diagnostic characters: General appearance (Fig. 21) oval, slightly more broadly and widely rounded behind and reddish brown. Head black with yellow somewhat triangular spot in front of eyes. Eyes normal. Antenna yellowish, 9-segmented, clubs darker and densely pubescent. Prothorax reddish brown, rather densely and finely punctate. Scutellum triangular. Elytra concolorous with prothorax, interstitial punctures smaller than serial punctures. Legs simple, provided with hairs and spines, 1st segment of tarsi short and last segment longest and claws simple. Ventral surface black.

Size: 2.5 mm in length.

Distribution: Early records mentioned its distribution in ‘India’ only. In the present study it has been recorded from South 24 Parganas, West Bengal.

Remarks: This species is known to occur in littoral water. In the present survey these beetles have been collected from weedy shallow areas of water, damp places and muddy edges of water. They abundantly occur in brackish water but less so in freshwater and sewage-fed water.

22. Helochares anchoralis Sharp


Diagnostic characters: General appearance (Fig. 22) elongate, moderately depressed and dark brown with blackish patches. Head small, densely punctate, dark posteriorly and with Y shaped frontal suture, maxillary palpi pale yellow and eyes normal. Antenna 9-segmented, last segment elongate and densely pubescent. Prothorax transverse and densely punctate. Scutellum small. Elytra densely and evenly punctate, finely striate, the striae nearly obliterated at the base, deeper at the extremity. Legs simple with distinct claws and spines, 1st segment of the hind tarsi very short and the 2nd segment longer and claws with a basal swelling and a characteristic empodium. Ventral surface dark brown, punctate and finely pubescent.

Size: 6 mm in length.

Distribution: Early records mentioned its distribution in ‘India’ only. In the present study it has been recorded that they abundantly occur in South 24 Pgs., West Bengal.

Remarks: These beetles are found in weedy shallow and in marshy places and
also occur in the mud just above the water edge. The female of this species is easily recognized by the egg mass which is enclosed in a nearly transparent bag shaped case beneath abdomen. These are quite common in brackishwater and less so in sewage-fed water.
23. **Sternolophus rufipes** Fabricius


*Diagnostic characters*: General appearance (Fig. 23) broadly elongate, slightly convex, shiny black and very finely punctate. *Head* small, with Y shaped frontal suture, fine setiferous punctures present in interocular area in a depression and on both sides of clypeus, maxillary palpi reddish brown with its apical portion black. Antenna 9-segmented (6+3) and pale yellow, palp normal, brownish black and pubescent. *Prothorax* transverse and with 2 rows of setiferous punctures on lateral side of pronotum. *Scutellum* triangular. *Elytra* with rows of setiferous punctures. *Legs* clothed at base with silky and dense pubescence, first segment of tarsi short, middle and hind tarsi compressed and oarlike. *Ventral surface* black and pubescent, prostital carina ridge like with an anterior brush of long setae.

*Size*: 13 mm in length.

*Distribution*: Bihar, Kashmir, Maharashtra, Punjab, South India and West Bengal.

*Remarks*: These moderate sized black beetles are found in the area of vascular hydrophytes and grass growing regions of wetland. Their population is fairly common in brackishwater and less so in freshwater and less so in freshwater wetland.

24. **Hydrophilus** sp.

*Diagnostic characters*: General appearance (Fig. 24) elongate, blackish brown and shiny. *Head* small with Y shaped frontal suture, punctures are rather restricted on inner side of eyes and anterior side of head and eyes normal. Antenna brownish and 9-segmented, club perfoliate and asymmetrical. *Prothorax* transverse, narrowed in front and setiferous punctures rather scattered and restricted in patches on front and near lateral side of pronotum. *Scutellum* large and triangular. *Elytra* with rows of punctures alternately two rows of non-setiferous and one row of setiferous punctures. Middle and hind *legs* similar and provided with spines and long, stiff swimming hairs whereas front leg without any hair, claws unequal and dentate at base. *Ventral surface* blackish. This species is near to *H. rufocinctus* and have similar type of elytral puncturation but differ from the latter by its pronotal and elytral margin being blackish brown whereas in *H. rufocinctus* it is yellowish red.

*Size*: 35 mm in length.

*Remarks*: This species is markedly large, and probably the largest beetle so far collected from the wetlands of Calcutta region. They can swim, dive and climb. They usually remain submerged in relatively deep water. Their long antenna with
characteristic club help them to reach the fresh air. They are not very common in wetlands of Calcutta region and only a few specimens have been collected from brackishwater.

25. **Amphiops mirabilis** Sharp


**Diagnostic characters:** General appearance (Fig. 25) strongly convex, roundish, brown to blackish brown and punctuation large and dense. *Head* transverse (exposed part), punctuation mixed with large and small punctures, eyes divided by a conspicuous and complete canthus reaching the vertex. Antenna 8-segmented (5 + 3), last three segments pubescent, second segment of maxillary palpi markedly thickened. *Prothorax* transverse, punctuation on vertex of pronotum moderately dense mixed with small and large punctures, lateral sides comparatively more densely so. *Scutellum* long, triangular and punctate. *Elytra* with irregular rows of punctures, punctuation on interstices mixed with small and large punctures, that of near suture rather indistinct. *Legs* simple, armed with spines, posterior leg without swimming hairs, 1st tarsal segment short. *Ventral surface* blackish brown.

**Size:** 3.5 mm in length.

**Distribution:** Assam and West Bengal.

**Remarks:** This species is truely aquatic with the body which has rolling up power. They can be collected from the water with emergent vegetation. They are also found walking on algal mat during January to March when algae grows on water. They are rather common in all the three types of water.

26. **Amphiops pedestris** Sharp


**Diagnostic characters:** General appearance (Fig. 26) strongly convex, somewhat rounded and punctate. *Head* reddish brown, transverse, punctuation moderately dense mixed with small and a few large punctures and eyes divided by a conspicuous and complete canthus reaching the vertex. *Prothorax* reddish brown with lateral margins rather short and rounded, punctuation moderately dense and with a few large, irregular, sparsely distributed punctures. *Scutellum* long, triangular and punctate. *Elytra* yellowish brown, shinning, with rows of punctures, interstices mixed with small and large punctures in addition to these rows of dark patches present on eyletra.
provided with a large, central, setiferous puncture. Legs similar to *A. mirabilis*. Ventral surface reddish brown.

**Fig. 25**

**Fig. 26**

**Fig. 27**

**Fig. 28**


*Size*: 3 mm in length.

*Distribution*: Bihar, Pondicherry, Tamil Nadu and West Bengal.
Remarks: The habitat is similar to that of *Amphiops mirabilis* but unlike *A. mirabilis* they are smaller in size and rather scarce in wetlands and represented only in freshwater and brackishwater.

27. *Berosus indicus* Motschulsky


Diagnostic characters: General appearance (Fig. 27) elongate, brown to yellowish and punctate. *Head* brownish with anterior portion yellowish, markedly deflexed often with a transverse groove, puncturation dense, larger on vertex and eyes prominent and protruberent. Antenna 7-segmented (4+3) and yellowish. *Prothorax* brownish yellow, not continuous with elytra in outline and with large, dense and prominent punctures specially on disc of pronotum. *Scutellum* a long triangle and punctate. *Elytra* usually highly patterned, brownish yellow, narrowed posteriorly and with ten rows of large and dark punctures with prominent intermediate punctures as figured (Fig. 27), epipleural angle extended into a strong spine. *Legs* with middle and hind tibiae fringed on inner side with long swimming hairs. *Ventral surface* dark brown and punctate.

Size: 2-6.0 mm in length and usually more than 3 mm.

Distribution: Assam, Bihar, Maharashtra and West Bengal.

Remarks: These littoral species are very strong swimmer with their long hairs on leg and able to rise forcefully enough to obtain air. They are also climber and diver in habit and able to dive from surface. They are fairly common in brackishwater and less so in the other two types of water.

28. *Regimbartia attenuata* (Fabricius)


Diagnostic characters: General appearance (Fig. 28) strongly convex, elongate, compressed on sides, uniform deep and shining black and punctate. *Head* small, rounded anteriorly and puncturation dense and distinct and eyes large, convex and prominent. Antenna 8-segmented (5+3). *Prothorax* narrowly applied within the emergination of anterior side of elytra and puncturation on pronotum dense. *Scutellum* elongate and triangulated. *Elytra* strongly narrowed posteriorly, striate, punctate and pubescent, intermediate punctures slightly smaller than on rows. *Legs* simple with spines and swimming hairs, middle and hind tibiae with long swimming hairs on inner side, 1st tarsal segment short. *Ventral surface* black and pubescent.

Size: 5 mm in length.

Distribution: Bihar, Maharashtra and West Bengal.
**Remarks:** These are scarcely found on the banks of wetland among the growing mass of aquatic plants. This is represented only in brackishwater wetland.

Relative abundance of wetland-Coleoptera in three ecologically different wetlands.

<table>
<thead>
<tr>
<th>Species</th>
<th>Freshwater (Barrackpore)</th>
<th>Sewage-fed water (Bantala)</th>
<th>Brackishwater (Khariberia)</th>
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<tbody>
<tr>
<td>1. <em>Haliplus angustifrons</em></td>
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<td>2. <em>Dineutus unidentatus</em></td>
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<td>3. <em>Orrectochilus productus</em></td>
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<td>4. <em>Cybister tripunctatus</em></td>
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<td>5. <em>Hydaticas ricinus</em></td>
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<td>6. <em>Hyphyrus renardi</em></td>
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<td>7. <em>Hydrovatus bonvouloiri</em></td>
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<td>8. <em>Hydrovatus confertus</em></td>
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<td>9. <em>Clypeodytes orissaensis</em></td>
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<td>12. <em>Guignotus inconstans</em></td>
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<td>13. <em>Guignotus pendjabensis</em></td>
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<td>14. <em>Guignotus sp</em></td>
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<td>16. <em>Laccophilus parvulus</em></td>
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<td>17. <em>Hydrocoptus subvittulus</em></td>
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<td>18. <em>Canthydrus laetabilis</em></td>
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<td>19. <em>Canthydrus luctuosus</em></td>
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<td>20. <em>Spercheus gibbus</em></td>
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<td>21. <em>Enochrus esuriens</em></td>
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<td>22. <em>Helochares anchoralisis</em></td>
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<td>23. <em>Sternolophus rufipes</em></td>
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<td>24. <em>Hydrophilus sp.</em></td>
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<td>25. <em>Amphiops mirabilis</em></td>
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<td>26. <em>Amphiops pedestris</em></td>
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<td>27. <em>Berosus indicus</em></td>
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<tr>
<td>28. <em>Regimbartia attenuata</em></td>
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+++ Profusely abundant
+++ Abundant
++ Common
+ Rare
- Nil
Discussion

The result obtained from the present survey of wetlands in and around Calcutta shows that there is a more or less distinct difference in beetle fauna both qualitatively and quantitatively in three different types of wetlands. Comparatively less manipulated wetland of Bartibill represents 23 species belonging to the 4 families. Out of 16 species of Dytiscidae 15 species except Hyphydrus renardi and 2 species of Gyrinidae are recorded here. The single species of Haliplidae Haliplus angustifrons has only been collected from the freshwater of Bartibill. Only 5 species of Hydrophilidae are recorded here which are poorly represented than brackishwater. The species Laccophilus anticus and Canthydrus laetabilis are comparatively more abundant. Unlike sewage-fed wetland no species is markedly and profusely abundant. The species Cybister tripuncatus, uvarus quadrilineatus, Haliplus angustifrons, Dineutus unidentatus etc. are rather scarce in freshwater which are not recorded from other wetlands. The sewage-fed wetland of Bantala is highly manipulated for fish culture. It is treated with sewage and rich with organic nutrients and the aquatic weeds are regularly removed. It has been observed that the coleopteran fauna of sewage-fed wetland is very rich quantitatively but less so qualitatively. Unlike freshwater wetland only 12 species have been recorded of which the species Canthydrus laetabilis is markedly and profusely abundant than Laccophilus anticus which is comparatively less. No Gyrinidae is collected from the sewage-fed wetland. The total number of species of sewage-fed wetland is significantly fewer than other two. The brackishwater wetland is a low saline wetland which becomes almost freshwater during monsoon being rainfed. The aquatic and semiaquatic vegetation is fewer than freshwater. This wetland represents 22 species of aquatic Coleoptera. As the Hydrophilidae has more affinity and attraction to saline water all the hydrophilid species so far recorded from Calcutta and its surroundings are well represented in this low saline wetland. The single species of Spercheidae, Spercheus gibbus is only represented by this brackishwater wetland.

It can be concluded that very few wetlands exist in natural and undisturbed condition in and around Calcutta. Most of the wetlands are converted into managed fishing impoundments. The freshwater of Bartibill appears to provide the most natural condition than the other two and is most productive and the fauna is rich and diverse. The sewage-fed and brackiswater wetlands are highly managed and the fauna in the former one is quantitatively rich and less diverse and in the latter one somewhat different due to salinity.

Summary

This is the first attempt to study on wetland-beetles of Calcutta and its surroundings for which extensive survey has been conducted during 1986-88 in three
Beetles of Wetlands of Calcutta & Surroundings

DB & SENGUPTA:

ecologically different wetlands, freshwater wetland of 'Bartibill' near Barrackpur, sewage-fed wetland of Bantala of eastern Calcutta and brackishwater wetland of Khariberia of north east Calcutta. This paper deals with 28 species of Coleoptera belonging to the families, Haliplidae, Gyrinidae, Dytiscidae, Spercheidae and Hydrophilidae with 28 illustrations. A key of 28 species under 21 genera of 5 families has been provided. Important bioecological observations have been made on habit, habitats, adaptations etc. and a comparative chart of relative abundance of beetles in three ecologically different wetlands has been given.

Acknowledgements

This work has been carried out in Zoological Survey of India. The authors are grateful to the Director, Zoological Survey of India for laboratory facilities. We are indebted to Dr. S. Biswas of Coleoptera Section, Zoological Survey of India and Dr. M. Brancucci, Basel Museum, Switzerland for helping in identification of the species.

References


The genus *Peterikrypta* was erected by Ritter (1911) with the description of two new species viz., *Pterikrypta sulcata* and *Pterikrypta fasciata* from Ceylon. *Pterikrypta* unquestionably is a synonym of *Salina* (in part) and the species *sulcata* is referable to the *celebensis* group (Mitra, 1973) by the nature of its mucrones and dental scale appendage and seems to be allied with the species *S. celebensis* (Schäffer, 1989). Ritter's (1911) other species viz., *P. fasciata* is worth–including in the genus *Callyntrura* Börner by the nature of its mucrones.

Schött (1917) although used the name *Pterikrypta* of Ritter in describing his new species *mjöbergi*, he, however, inadvertently spelled the name as *Pericrypta*. Thus the name (i.e. *Pericrypta* Schött, 1917) exists in the literature due to the subsequent mispelling of *Pterikrypta* Ritter, 1911 by Schött, 1917. This emendation (i.e. from *Pterikrypta* to *Pericrypta*) was by no means intentional as is evident from Schött's (1917) clear indication, "Gen. *Pericrypta* Ritter" (*Ark. Zool.*, 11: 22-24, 1917). Schött (1925) again used the same incorrect subsequent spelling (i.e. *Pericrypta*) and conceived that his species "*mjöbergi*" belongs to a genus other than the genus of Ritter, 1911 (i.e. *Pterikrypta*) and thus proposed the name *Paronellides* for this species. Obviously, *Pericrypta* Schött (1917) is a case of incorrect subsequent spelling and it has no status in nomenclature [Article 33 (C), I. C. Z. N., 1985]. *Paronellides*, therefore, is the valid name of the genus with the type-species *Pericrypta mjöbergi* Schött, 1917 and *Pericrypta* Schött, 1917 has no status in the meaning of the code and therefore, is not available.

Salmon (1944) described the genus *Micronellides* with the type-species *M. oliveri* not differing significantly from *Paronellides* except in the smaller size of its body and shorter antennae. Examination of a paratype (Dominion Museum, Slide. No. N. Z. 3/1353; Photomicrograph on Pl. 1, D) of *Micronellides oliveri* reveals that it represents a juvenile stage of a *Paronellides sp.* (cf. *novaezealandiae* Salmon) which is indicated by its usual juvenile body facies (head appears larger in relation to the total length of body), shorter antennae, undifferentiated flexed macrochaetae and dental
spiny appendages, poorly developed trochanteral organ (with c. 2-3 spines), sub-
lanceolate unguiculi and poorly developed or not developed ungual teeth.

Salmon (1941) established the genus *Pseudoparonellides* with the type-species
*Pseudoparonellides badia*. This genus is found to differ from *Paronellides* in the
possession of 3 mucronal teeth. Since the difference of one mucronal tooth only can
not justify the establishment of an independent genus, *Pseudoparonellides*, therefore, is
considered as a subgenus of *Paronellides* pending further investigations on other
characters, based on specimens preserved in alcohol.

**Paronellides** Schött, 1925


**Redefinition**: Antennae equal or subequal to the length of head and body; antennae and appendages without stiff outstanding darker macrochaetae; body clothed with obliquely truncated and club-shaped macrochaetae; frontal spines absent; 8+8 ocelli present; prelabral setae 4, apparently smooth, labral setae, 5, 5, 4, smooth; tibiotarsi may be superficially segmented; ventral tube anteriorly on anterior face with 5+5 macrochaetae; dentes not annulated, without spines; dental spiny appendages present; dental scale appendage absent; mucro small, with 2-3 teeth; abd. IV medially with a transverse row of macrochaetae.

**Type-species**: *Pericrypta mjöbergi* Schött, 1917, by monotypy and O. D.

**Sub-genus 1**: *Paronellides* Schött, 1925. New Status.


Paralectotypes (in spirit): Vial No. 1, 3 exs., labelled as “*Pericrypta mjöbergi* n. sp. Cedar creek, Queensland. Mjöberg., mars”. Vial No. 2, 6 exs., labelled as “*Pericrypta mjöbergi* n. sp. Lamington Plat., Queensland. Mjöberg, April”.


Micronellides oliveri  Salmon: 1 paratype (No. 3/1353) on slide from Dominion Museum, Wellington, New Zealand.

Diagnosis: Species in the sub-genus Paronellides relatively larger in size; antennae shorter or subequal to the length of body; flexed macrochaetae usually with subobliquely truncated to obliquely truncated apices; microchaetae acuminate of various sizes, coarsely or finely ciliated; unguis with inner paired basal teeth always well developed, distal unpaired tooth present, external basolateral teeth normal; unguiculus lanceolate; dental spines absent; tenent hairs clavate; 1-2 dental spiny appendages large, minutely ciliated; mucro moderately long with two teeth.

Type-species: Pericrypta mjöbergi Schött, 1917, by monotypy.

Description of the Type-Species

Paronellides (Paronellides) mjöbergi (Schött) 1917


1939. Pericypta lineata tasmaniae, Womersley, ibid.


Material Examined: As mentioned above.

Colouration: Ground colour pale yellow to white with violet to dirty brown blue-black patches; dark violet pigment on genae posteriorly to ocellar fields, vertex and at antennal bases, a longitudinal nonpigmented zone behind vertex; Tths. II, III, Abd. I, II, with longitudinal patches or streaks dorsolaterally, Abd. III dorsomedially with two rectangular patches, in addition, two longitudinal streaks, one on each side,
present; colour pattern of Abd. IV extremely variable, Abd. IV anteromedially with a few longitudinal strands which unite with several other patches present posteriorly, lateral margins of Abd. IV also with dark blue pigment; in some specimens Abd. IV

Fig. 1. Features of Paronellides (Paronellides) mjöebergi (Schött). A, profile (lateral) showing pigmentation (from a paralectotype, in alcohol); B, profile (dorsal) showing pigmentation (from a paralectotype, in alcohol); S, D, flexed macrochaetae from thorax; E, labral chaetotaxy; F, footcomplex from leg III; G, chaetotaxy of the anterior face of ventral tube; H, I, mucrodens from the lectotype; J, mucrodens from a paralectotype.
may be completely devoid of pigment except the anterior longitudinal and lateral patches; Abd. V with violet pigment and with two nonpigmented symmetrical zones, one on each side; precoxae, coxae and trochanter heavily pigmented, femora laterally with violet pigment, tibiotarsi usually nonpigmented; colour pattern of the species extremely variable specially in relation to Abd. IV; general distribution of pigmented patches on each tergite usually following a course in the form of "W" (Fig. 1. B, PL. 1, A).

Clothing: Body in general clothed with short, accuminate microchaetae; macrochaetae present in the middle of Abd. IV and posteriorly on Abd. V and VI; obliquely truncated, flexed, ciliated macrochaetae present on Ths. II, III, Abd. I, II and III (Fig. 1 C, D).

CHAETOTAXY

Head: Vertex with V₀ + V₁₋₆, all of which macrochaetae, V₁, V₂ arranged in a trapezoid fashion and V₀ falls medially on the line joining V₁ – V₁; dorsal region represented by D₀ + D₁₋₉, all of which macrochaetae; subdorsal region represented by 8 setae of which SD₁₋₈ macrochaetae; ocular region has 4 setae (oc₁₋₄), all microchaetae; postocular region represented by a single macrochaeta on either side (PO); parietal region represented by a single macrochaeta on each side (P₁); occipital region with O₁₋₁₀; all macrochaetae, arrangement of which characteristic; area cervicalis represented by macrochaetae, (C₁₋₅); area genalis represented by 3 macrochaetae (G₁₋₃) [Fig. 2].

Body: Number of macrochaetae on each tergite ranges from Ths. II (68–69), III (46–47), Abd. I (23–26), II (10–11), III (9–10); Abd. IV medially has a transverse row of at least 7 macrochaetae on either side.

The genus is polychaetoic in the presence of a large number of macrochaetae on each tergite.

Paronellides mjöbergi, type-species, has the largest number of macrochaetae on head and body (Fig. 3).

Head: Usually pear-shaped with 1 + 1 blue-black ocellar field, each field containing 8 ocelli, G and H being smaller than the rest; frontal spines absent; Ants. II, III and IV broken in all examples; Head/Ant. I = 45/50; prelabral setae 4, apparently smooth, slender; labral setae, 5, 5, 4, all short, slender and smooth; anterior labral margin without tubercles, median intursion of labrum inverted "U"-shaped (Fig. 1, E).
Thorax: Relative length index of Ths. II: III = 30 : 23; tibiotarsai longer, superficially divided distally; unguis and unguiculi slender; unguis moderately curved, with paired inner teeth at almost the middle of the claw, middle unpaired tooth prominent, distal tooth absent, external basolateral teeth present; inner tibiotarsal lobe well developed; unguiculi lanceolate, non-dentate; tenent hair relatively short, moderately clavate (Fig. 1, F)

Abdomen: Abd. I : II : IV : V : VI = 17 : 16 : 9 : 61 : 15 : 5; ventral tube appreciably long with 3 protusible vesicles, external vesicle shorter; anterior face of
ventral tube anteriorly with $5+5$ macrochaetae and with slender microchaetae (Fig. 1, G), posterior face clothed with slender setae; rami of retinaculum each with 4 teeth, corpus with a median seta; dentes appreciably long, slightly tapers distally,

Fig. 3. Chaetotaxy of Ths. II, III and Abds. I-IV in *Paronellides* (*Paronellides*) mjöebergi (Schött).

relative length index of manubrium: mucrodens = 51 : 79; dentes without spines and scale appendage; mucro bidentate, located apically on dentes, a prominent socket of dental spiny appendage located dorsally near base of mucro (Fig. 1, H-J).

Length (excluding appendages): 1-1.5 mm.
Type-specimens: Lectotype and four paralectotypes mounted on slides; 6 paralectotypes in spirit, in two vials; nothing is available from the label of the slide and also from literature as to who designated the lectotype. All remain preserved in the Swedish Museum Natural History, Stockholm, Sweden.

Type-locality: Lamington Plateau, Queensland, Australia.

Comparisons: The species is interesting from the point of view of its colour variations. Several of the paralectotypes examined exhibit colour pattern corresponding to the colour pattern of *P. tasmaniae* and *P. maculata*. Furthermore, the chaetotaxy of all those colour variants is identical. Womersley (1939) himself synonymised the colour forms which he previously had described as new with *P. mjoebergi* as mentioned above.

Interrelationships: In the gross morphological characters and in the chaetotaxy of vertex, the sub-genus *Paronellides* is apparently related to *Pseudosalina* from India. However, the absence of dental scale appendage, frontal spines and the nature of chaetotaxy of other regions of head in the sub-genus differentiate it from the Indian genus. It differs from *Paronana* Womersley of New Zealand in the absence of dental scale appendage and dental spines.

Distribution: Members of the sub-genus *Paronellides* remain restricted to Australia, Tasmania and New Zealand. *Paronellides alticola* (Arle, 1939) from South America is a dubious one and the type-specimens of the species were not available for examination inspite of the best endeavour.

Comments on Species and Subspecies of Subgenus

*Paronellides*

*Paronellides (Paronellides) dandenongensis* (Womersley, 1934)

Womersley (1934) described the species from Australia (Kalorama, Mount Dandenong, Victoria) on the basis of single example. The species was characterised by its yellowish ground colour of body and in the presence of blue pigment on Th. III, Abd. I, II, III and "some time on sides of Abd. IV" (Womersley, 1937). Womersley (1934, 1937) although did not indicate the presence of blue pigment on Th. II, his illustrations, however, clearly indicate its presence anteriorly and laterally on the segment. Foot complex, as depicted by Womersley (1934) (Fig. 16, b), indicates that the unguis of the species is armed with paired external basolateral teeth, paired inner basal and two distal unpaired teeth, nondentate lanceolate unguiculus and clavate
tenet hair, the distal end of which is not appreciably dilated. The mucrones in the species are typical in the presence of two, almost equal teeth. Simultaneously, Womersley (1934) described the other species, viz, *Paronellides* (*Paronellides*) *lineata* from Tasmania (Trevallyn) which was characterised by its larger and stout body facies, yellowish ground colour of body and having a single irregular bluish band mid-dorsally. The unguis in the species is provided with reduced external baso-lateral, paired inner basal teeth and a vestigial, almost obscure, unpaired subapical tooth also on inner margin. Unguiculus in the species is lanceolate, non-dentate and the tenent hair is long and slightly expanded distally. Mucrones in the species are as characteristic of the genus. Womersley (1936) added another species, viz., *Paronellides* (*Paronellides*) *tasmaniae* and its two varieties, viz, *maculata* and *fasciata* from Tasmania (Mt. Wellington). The principal form was differentiated by its yellow ground colour and the blue pigment all over the body with non-pigmented or pale spaces on each segment. Unguis in the species is provided with reduced external basolateral teeth, small paired inner basal teeth and 2 inner unpaired teeth closely loaced subapically. Unguiculus in the species is lanceolate, broader at base, nondentate and the mucrones are typically bidentate. The variety "*maculata*" was differentiated from the principal form by its pale pigmentation involving blue and brown pigment of which the later was found to remain restricted on the lateral edges of head, Ths. II, III, Abd. I-II and to form two parallel dorsomedian interrupted bands from the posterior margin of Th. II – Abd. III and constitute the central portion of a wavy band present anteriorly on Abd. IV including paired submedian patches on Abd. III and lateral patches on Abd. V. Rest of the wavy band on Abd. IV including the other patches on Abd. Ill, IV were stated to be represented by blue pigment. The other variety "*fasciata*" was characterised by its entirely blue black head which is lighter medially and in the presence of blue black pigment on Th. III, Abd. I-III and lateral margins of Abd. IV which is intruding on the segment dorsally in the posterior region and Abd. V is also with the same pigment. Womersley (1937) described a new variety of *P. lineata*, viz., *tristriata* from Tasmania (Risdon) which was characterised by its bright yellow ground colour with three dark stripes (median and 2 lateral) on body. In the same paper, he decided to consider *P. tasmaniae* as a variety of *P. lineata* and also linked two other varieties of *P. tasmaniae* (i.e. "*maculata*" and "*fasciata*") as the varieties of *P. lineata*. Womersley (1939), however, recognised only two species under the genus (i.e., *P. mjöebergi* and *P. dandenongensis*) and treated all the species and their varieties under the latter.

A detailed analysis on the basis of available informations of all the species and varieties, described by Womersley, reveals that *P. dandenongensis* s. str. (Womersley, 1939) represents a species—complex. Thus *P. lineata* and *P. lineata* var. *tristriata* can be characterised by their larger, bulky body facies and the structure of unguis from the other species and their varieties. Further, *P. dandenongensis* has an ungual structure
which is entirely different from others although its colour pattern and body facies, as depicted by Womersley (1939), appear strictly similar to *P. tasmaniae* var. *fasciata*. It must be noted that in *P. dandaneongensis* the location of two unpaired teeth on inner margin of ungues in relation to basal paired teeth is entirely different from *P. tasmaniae* (principal form). Over and above, it is difficult to link *P. tasmaniae* (principal form) and its variety *maculata* as the varieties of either *P. dandenongensis* or *P. lineata* owing to the absence of intermediate colour forms and in the existence of structural differences, mentioned above. A critical study on the chaetotaxy of head and tergites of all these species and their varieties on the basis of topotypes is required to solve the *P. dandenongensis* species-complex conclusively.

**Paronellides (Paronellides)** alticola (Arle, 1939)

Arle (1939) described the species together with a variety, *viz*, *pallida* under the generic name *Pericrypta* (*lapus* for *Pterikrypta* Ritter, 1911 by Schött, 1917) from Caxambu, Rio de Janeiro, Brazil, South America. He assigned this species to this genus owing to the absence of scales on body. The species radically differs from other species of this genus in the presence of very reduced stumpy mucrones and a number of strong ciliated spines ventrally near the end of dientes (vs. 1 or 2 dorsal dental spiny appendages in *Paronellides* s. str.). The presence of this Australian element in the Neotropical region is extremely interesting from the biogeographical view point and further investigations on the topotypes of *P. alticola* are required to confirm its placement under the genus.

**Paronellides (Paronellides)** novaezealandiae Salmon, 1941

Salmon (1941) based the description of the species on the basis of several examples from various localities of New Zealand. The author examined single paratype of the species mounted on a slide (No. Dominion Museum, N. Z. 3/850, labelled as: "*Paronellides novaezealandiae*. Loc. Maruia Valley. In leaf mould. 9/2/1940"). Following details are given to supplement the original description of the species.

Distribution of pigment on body very similar to *P* (*P.*) *dandenogensis* (Womersley, 1934); in the paratype examined, pigment reduced on Th. III, Abd. I and found restricted to margins only (Fig. 4, A, PL. 1, C); general body surface thickly clothed with short, coarsely ciliated some what broadly accumulate setae (Fig. 4 B), interspersed profusely with obliquely truncated ciliated flexed macrochaetae (Fig. 4 C), head, cervix and Abdns. IV, V, VI, in addition, with flexed accumulate macrochaetae (Fig. 4 D), antennae thickly clothed with short accumulate ciliated setae, Ants. I, II, in addition, with some very long ciliated outstanding macrochaetae, some apparently
smooth erect microchaetae present on Ants. III, IV being very predominant distally on Ant. IV; apical sense knob of Ant. IV not prominent; legs clothed with delicate acuminate ciliated setae interspersed with certain long ciliated outstanding setae specially on femora and tibiotarsi; furcula uniformly clothed with short acuminate ciliated setae; trochanteral organ consists of short spines exact number of which along with chaetotaxy of tergites could not be ascertained from the mounted specimen, however, arrangement of macrochaetae in 3 transverse rows anterodorsally on Abd.

Fig. 4. Features of *Paronellas* (*Paronellidides*) *novaezealandiae* Salmon. A, profile showing pigmentation (Paratype, slide No. 3/850, Dominion Museum, N. Z.); D, a seta from general surface of body; C, a flexed macrochaeta; D, a flexed acuminate macrochaeta from cervix; E, arrangement of macrochaetate anterodorsally on Abd. IV; F, footcomplex from leg I.
Records of the Zoological Survey of India

IV is quite, characteristic (Fig. 4, E); unguis with paired inner basal teeth located almost near the middle and single unpaired distal tooth, single external basolateral tooth present almost near the middle of the outer lamella on each side, unguiculus sublanceolate, nondentate, tenent hair appreciable long, slender clavate on all legs, a prominent tibiotarsal lobe overhanging the base of each unguiculus present (Fig. 4, F); furcula well developed, mucrones bidentate, teeth subequal, single ciliated dorsal dental spiny appendage present distally near the base of each mucrone. [Fig. 4, G]

Length (excluding appendages): c. 1.63 mm.

Remarks: The species comes close to Paronellides (Paronellides) dandenongensis (Womersley, 1934) in colour pattern, in general body facies and in the structure of mucrones. However, P. (P.) novaezelandiae differs from the cited species in the possession of single unpaired tooth on inner margin of unguis (vs. 2 in the cited species) and in little paler pigmentation of body. Studies on the chaetotaxy of both the species only can precise the status of P. (P.) novaezelandiae.

Paronellides (Paronellides) novaezelandiae purpurea Salmon, 1941.

Salmon (1941) described the subspecies from New Zealand (Monkey flat, Hollyford Valley) on the basis of its colour pattern specially that of the general body surface. The author had an opportunity to examine a specimen of the subspecies mounted on a slide (No. Dominion Museum, N. Z. 3/1571, labelled as “Paronellides novaezelandiae, ssp. purpurea, Loc. Homer, beaten from grass, 1/1/1944. Colll., mount & Det. J. T. Salmon, 1945”). A short redescription of the subspecies, based on the above-mentioned specimen, is given below and its status is also discussed. [Fig. 5 A ; PL. I B]

Stout, bulky body facies cf. Peronellides (Paronellides) lineata (Womersley, 1934); ground colour of body and appendages including furcula bright yellow or dark orange brown with a dark mid-dorsal longitudinal band passing from Th. II to the tip of Abd. VI and two lateral bands one on each side from head to the end of abdomen; in general, ground colour of body including the distribution of pigmented patches quite identical to Paronellides (Paronellides) lineata var. tristriata (Womersley, 1937); in “purpurea”, however, lateral bands on body originate from head vs. from Abd. II in “tristriata”; general surface of body thickly clothed with short, thin finely ciliated setae interspersed profusely with flexed, ciliated macrochaetae on head and body segments apices of which may be of two following configurations: (a) subobliquely truncated, present on head, body segments excluding Abd. IV, V, VI (Fig. 5, A, B), (b) acuminate ones mostly remain distributed on Abd. IV, V, VI and a few of such
setae also present on head and cervix (Fig. 5, D); antennae clothed with ciliated, acuminate setae interspersed with some long outstanding macrochaetae on Ants. I, II, in addition Ants. II, III, with some erect apparently smooth setae specially conspicuous at apex of Ant. IV, Ant. IV apically with an indistinct sense knob guarded with a few smooth setae; nature of trochanteral organ and chaetotaxy of body could not be determined owing to the mounted nature of the specimen; unguis little curved with paired inner basal teeth small, distal tooth not resolvable, unguiculus lanceolate, tibiotarsal lobe overhanging the unguiculus small, tenent hairs long, clavate [Fig. 5, E],

**Fig. 5.** Features of *Paronellides* (*Paronellides*) *novaezealandiae purpurea* Salmon, 1941. A, profile showing pigmentation (Paratype, slide No. 3/1571, Dominion Museum, N. Z.); B, a macrochaeta from head; C, a macrochaeta from Abd. I; D, a macrochaeta from Abd. IV; E, footcomplex from leg III; F, mucedone complex.
mucrones bidentate, apical tooth appears somewhat truncated in one of the mucrones, single dorsal dental spiny appendage conspicuous, another short but easily distinguishable from the general setae. [Fig. 5, F].

Length: c. 1.8 mm.

Remarks: The subspecies is similar to Paronellides (Paronellides) lineata var. tristriata in the ground colour of body and appendages as well as in the general pattern of pigmentation. Over and above, the structure of its footcomplex also appears to be similar to “tristriata”. Further studies on the chaetotaxy of head and tergites of P. (P.) novaezealandiae purpurea may justify the last two categories as the colour variants of the former.


Pseudoparonellides cryptodontus Salmon: 1 paratype mounted on a slide, labelled as “Dominion Museum, N. Z. 3/1562; Pseudoparonellides cryptodontus. Loc. Bold Peak, 3000; in leaf mould in beach forest, 11/2/1943, coll. J. T. Salmon. Det. J. T. Salmon. Mounted Diaphane (Fig. 6, A Paratype)”.

Salmon (1941) erected Pseudoparonellides as an independent genus differing from Paronellides only in the number of mucronal teeth (viz., 3 vs. 2). Salmon (1944) further reported the presence of “characteristic flattened ciliated scale-like setae” in the genus. In the present study it is felt pertinent to consider Pseudoparonellides as a sub-genus of Paronellides since the character like the difference of one tooth only in the mucro does not appear to be a sufficiently sound character for generic separation. Salmon (1946) also emphasised such character as an insignificant one for generic separation. Moreover, it is observed that characteristic flattened ciliated scale-like setae, mentioned and illustrated by Salmon (1944), do not conform to any type of setae actually present on body in Pseudoparonellides badius and Pseudoparonellides cryptodontus.

Salmon (1944) although in Paronellides novaezealandiae and Pseudoparonellides cryptodontus mentioned the scale-like setae to be ciliated, in fact, the setae he depicted
PL. 2. A, Paronellides (Pseudoparonellides) badius (Salmon) (Paratype, slide No. N. Z. 3/862, Dominion Museum, New Zealand); B, Paronellides (Pseudoparonellides) cryptodontus (Salmon) (Paratype, slide No. N. Z. 3/1562, Dominion Museum, New Zealand); C, microchaetae from Th. III of P. (P.) badius (note: arrows)
appear serrated (Pl. 62, Figs. 154, 155, 157). The setae, that Salmon (1944) described, are actually somewhat folded, cylindrical and coarsely ciliated on margins and not flattened (Fig. 6, E, F, PL. 2, C).

Fig. 6. Features of Paronellides (Pseudoparonellides) badius (Salmon). A, Profile, showing colour pattern (Paratype, slide No. 3/862 N. Z., Dominion Museum, New Zealand); B, apex of a flexed macrochaeta from Th. II; C, a flexed macrochaeta from Th. II (front view); D, E, F, various microchaetae from body; G, apex of Ant. IV; H, footcomplex from leg I; I, footcomplex from leg II; J, footcomplex from leg III; K, mucrodens.
However, the tridentate mucro in *P. badius* and *P. cryptodontus* is quite characteristic in the nature of orientation of the teeth and justifies their placement in a separate sub-genus under *Paronellides*.

**Redefinition:** Species in the sub-genus relatively smaller in size than the members of the subgenus *Paronellides*; antennae shorter than body; flexed macrochaetae, obliquely truncated, club-shaped (Fig. 6, B, C : PL. 1, E); microchaetae acuminate of various sizes, coarsely or finely ciliated, sometime folded (Fig. 6, D, E, F : PL. 2, C); unguis with inner paired basal teeth reduced or well-developed, distal unpaired tooth present or absent, external basolateral teeth reduced; unguiculus lanceolate to sublanceolate; dental spines and dental scale appendage absent; dental spiny appendages short, ciliated, may be slightly flattened; tenent hair clavate; mucro short with 3 teeth, located characteristically in the form of 3 triangular ridges, all the teeth being posteriorly directed.

**Type-species:** *Pseudoparonellides badius* Salmon, 1941, by original designation.

### DESCRIPTION OF THE TYPE-SPECIES

*Paronellides (Pseudoparonellides) badius* (Salmon) 1941, new comb.


**Material Examined:** As mentioned above.

**Colouration:** Entire body of the paratype examined pigmented with moderately dark bluish pigment with faint brownish tinge in suffusion, legs and antennae more intensely pigmented than body, furcula brownish; Th. III, Abd. I, II, III anteriorly lighter and posteriorly darker; certain longitudinal strands of dirty bluish pigment descend from the anterior margin of Abd. IV and unite posteriorly with pigmented patch covering the entire surface of Abd. IV, interstitial spaces of such longitudinal strands exhibit the yellowish ground colour (Fig. 6, A ; PL. 2, A).

**Clothing:** Clothed with flexed club-shaped macrochaetae, conspicuously ciliated with longer cilia at apex (Fig. 6 B, C ; PL. 1. E); each such macrochaeta either conspicuously or slightly curved sub-apically and thus appears club-shaped; general surface of body clothed with microchaetae of various sizes, which appear folded and cylindrical rather than flattened, coarsely ciliated at margins (Fig 6, E,F); delicate long and finely ciliated microchaetae also to be observed on the general
surface of body (Fig. 6, D); antennae and legs with ciliated, acuminate microchaetae; Ant. IV, in addition to usual ciliated setae, with slender apparently smooth microchaetae.

**Head**: Slightly larger in comparison to the total length of head and body; ocelli 8+8 in 2 dark pigmented ocellar fields, on each side of the head capsule; antennae shorter than body, relative length index of Ants. I : II : III+IV = 14 : 27 : 53; Ant. IV apically with a retractile senseknob guarded with a few erect, smooth setae (Fig. 6, G).

**Thorax**: Relative length index of Ths. II : III = 20 : 15; legs somewhat shorter, unguis little curved, with inner paired basal teeth reduced, inner unpaired distal tooth absent, external basolateral teeth not discernible; unguiculi sublanceolate on fore and mid legs, but lanceolate on hind legs (Fig. 6, H-J); tenent heir slender, short and slightly flattened and apex (Salmon, 1941, mentioned tenent hairs as absent); tibiotarsal lobe overhanging base of unguiculus well developed; trochanteral organ not clearly determinable from the mounted paratype, but provided with fewer setae.

**Abdomen**: Relative length index of Abds. I : II : III : IV : V : VI = 12 : 11 : 9 : 52 : 8 : 6; ventral tube short, nature of chaetotaxy not discernible from the mounted specimen; relative length index of manubrium: mucrodens = 33 : 47; dentes not appreciably tapering distally; mucro small with three prominent ridges each of which terminating posteriorly in the form of a tooth, such characteristic three-winged mucrone is the specialisation of the sub-genus (Fig. 6, K); dentes dorsally with 2 spiny appendages as indicated by the presence of two larger sockets; dental spines and scale appendage absent.

**Length** (excluding appendages): 1.2 mm.

**Type-specimens**: Holotype (Slide No. 3/861) and paratype (Slide No. 3/862, examined) remain deposited in the Dominion Museum, Wellington, New Zealand.

**Type-locality**: Weheka, New Zealand.

**Comparisons**: The sub-genus *Pseudoparonellides* is known by two species *viz.*, *P. badius* (type-species) and *P. cryptodontus*. Although the type-species resembles to *P. cryptodontus* in colour pattern, however, it is distinct from the latter in the absence of inner unpaired ungual tooth and in the presence of reduced paired inner teeth. Moreover, in *P. badius* all the mucronal teeth are equally developed in contrast to *P. cryptodontus* in which the median tooth is smaller and indistinct.
Paronellides (Pseudoparonellides) cryptodontus (Salmon)

1944, new comb.


**Material Examined**: One paratype mounted on a slide, No. 3/1562, Dominion Museum, N. Z., details mentioned above under subgenus. Paratype examined (Fig. 7)

uniformly pigmented with bluish pigment all over the head, body, antennae and legs (Fig. 7, A). General features of the species same as the type-species except the foot

Fig. 7. Features of *Paronellides (Pseudoparonellides) cryptodontus* (Salmon). A, profile showing pigmentation (Paratype, slide No. 3/1562, Dominion Museum, N. Z.); B, apex of Ant. IV; C, footcomplex of leg I; D, mucrodens complex.
complex bearing besides paired inner ungual teeth, a distinct median unpaired tooth, slightly longer tenent hair expanded apically (Fig. 7, C); the mucrone of the species characteristically differs having a reduced median tooth though structurally mucronal pattern same as the type-species (Fig. 7, D).

Interrelationships: Pseudoparonellides resembles closely to Paronellides in all the general characters and differs from it and other related genera in the possession of specialised mucrones only.

Distribution: The sub-genus is endemic to New Zealand and mainly restricted to South Island. Pseudoparonellides bulbosa, described by Salmon (1957) from Assam, India, is a species worth-including in the genus Salina in the nature of its mucrones and in the presence of distinct dental scale appendage.

Acknowledgements

I am grateful to the authorities of the Swedish Museum Natural History, Stockholm, Sweden and Dominion Museum, Wellington, New Zealand for providing me an opportunity to study the type-specimens of the species, dealt with in this investigation. Thanks are also due to the Director, Zoological Survey of India for providing facilities for this work.

Summary

In this investigation, the concept of Paronellides Schöt (1925) has been precised on the basis of the examination of type-specimens of the type-species with a discussion on the species-complex, known under Paronellides (Paronellides). Pseudoparonellides Salmon (1941) is considered as a subgenus of Paronellides since the difference of one tooth on mucrones is not a sufficiently strong character for generic separation. Micronellides Salmon (1944) established on the basis of juvenile individuals, is found to be a synonym of Paronellides s. str. Redescriptions of the type-species and other species, based on the type-specimens, are incorporated.

References


The large, robust centipede *Scolopendra morsitans* Linn., occurs in different colours in Nagpur (Maharashtra) and Amritsar (Punjab) (Jangi, 1955). In the course of mopping survey of Raigad, Satara, Sholapur, Nasik, Dhulia and Jalgaon districts and local survey of Pune, Maharashtra, four distinct colour-morphs of *S. morsitans* Linn. are recorded by studying adult specimens (80-110 mm, in length) collected from 1973 to 1990, which is worth reporting.

1. **Faint blue**: It is a normal colour-pattern. The head, 1st and 2nd tergites and sternites are yellow, legs, reddish yellow and tergites 2-20 faint bluish.

   Material examined: Pune, Wagholi, Dighi, Bhima-Koregaon, Katraj, Bhorghat, Nasik, Deola; Satara Mhaswad, Dhuldeo; Sholapur, Pandharpur, Gadegaon, Raigad, 65 km W of Khalapur, 22 exs. Drs. B. S. Lamba, A. S. Mahabal, Ramakrishna, D. B. Bastawde, M. B. Rao and R. M. Sharma, from the months of February to December.

2. **Dark bluish**: Of uniform dark blue colour from head to 21st tergite; sternites and legs bluish yellow.

   Material examined: Nasik, Vani, Athamble village, 1 ex. November, Dr. M. S. Pradhan.

3. **Dark green**: Head, 1st tergite and legs brownish yellow, tergites 2-20 dark green. One variety from Nasik (Karanjali), Dhulia and Jalgaon appeared green except sternites and legs.

   Material examined: Sholapur, 6 km SE of Mohal on Sholapur-pune road, Nasik, Peth, 10 kms. of Karanjali, Nifad, Bokhadhar, Dharangaon; Dhulia, Vanya Vihar, 6 kms. E of Talode; Jalgaon, Erandol, Padmalay Forest; 12 exs.; Drs. A. S. Mahabal, D. B. Bastawde, M. B. Rao and R. H. Kamble; collected in the months of February, August, October and December.

4. **Greenish grey**: Exceedingly flat forms, exhibiting uniform greenish grey colour; Sternites and legs greyish yellow.

   Material examined: Dhulia, Acrani, 15 kms. S. of Dhadgaon, Taloda road;
Shahada, Donergaon, Aslad road; 3 exs; Drs. R. M. Sharma and A. S. Mahabal, in January and July.

The colour variations among *S. morsitans* Linn. are prominent but fades in the preservative in course of time. In the phena of divergent colours all but two were males. This may have adaptive significance. A careful identification (Jangi & Dass 1984) avoids colour confusion.

**Acknowledgements**

I am grateful to the Director, Zoological Survey of India, Calcutta, to Dr. G. M. Yazdani, Scientist ‘SE’, O/C Western Regional Station, Pune, and to Dr. S. G. Patil, Asstt. Zool. for providing the laboratory facilities.

**References**


A FRESHWATER SPONGE *EUNAPIUS CARTERI* (BOWERBANK, 1863) FROM INDIRA SAGAR LAKE, HYDERABAD, ANDHRA PRADESH, INDIA.

**Ramakrishna**

*Zoological Survey of India*

*Freshwater Biological Station*

*Ashoknagar, Hyderabad.*

**INTRODUCTION**

Sponges are generally subject to great seasonal, geographic and habitat variability. Much reliability cannot be bestowed on the shape and structure of the spicules for taxonomic purposes, as they are frequently subjected to variations as a result of environmental influences and habitat adaptability. This subjectivity to environmental influences calls for an environmental study for a really valid taxonomic assessment, such as physico-chemical parameters, biochemical patterns and scanning electronic micrography (Soota pers. coom.). With this view in mind, studies on the freshwater sponges of Hyderabad and around are initiated, to assess the role of environmental factors influencing the distribution of freshwater sponges. As a first step, the collection made from a freshwater oligotrophic lake, in the environs of Hyderabad and a brief description of its hydrobiological characters are given in the present communication. A perusal on the literature of the freshwater sponges from Indian sub-continent is mainly from the work of Annandale (1911), Penney and Racek (1968), Soota and Pattanayak (1982), Soota *et al.* (1983), Soota (1987, 1991).

**SYSTEMATIC ACCOUNT**

<table>
<thead>
<tr>
<th>Phylum</th>
<th><strong>P</strong>orifera</th>
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<tr>
<td>Class</td>
<td><strong>D</strong>aemospongiidae</td>
</tr>
<tr>
<td>Order</td>
<td><strong>H</strong>aplosclerida</td>
</tr>
<tr>
<td>Family</td>
<td><strong>S</strong>pongillidae</td>
</tr>
<tr>
<td>Genus</td>
<td><strong>Eunapius</strong> Gray 1867</td>
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</table>

*Eunapius carteri* (Bowerbank, 1863)

*Spongilla carteri* Bowerbank, 1863

*Spongilla carteri* var *cava* Annandale, 1911., p. 88

*Spongilla carteri* var *lobosa* Annandale 1911., p. 89.

*Spongilla carteri* var *mollis* Annandale, 1911., p. 88

*Spongilla carteri* var *balatonensis* 1923., p. 79

*Present Address*: Marine Aquarium cum Research Centre, ZSI, Digha.
Material: Preserved specimen, ZSI, FBS, Hyderabad.
Collector: Ramakrishna
Locality: Indira sagar lake, Hyderabad East, Rangareddy District, 515m msl.

Description

Sponges fragile in dried condition, forming crust of several centimeter thickness on the boulders and rocks located 3—5m deep. On the littoral regions, present on the macrophytic vegetation and appears as bulbous. Sponge body on the rocks forms an irregular mass, with rough outer surface, oscula opening on the distal part of the body. Sponge body generally found submerged, however, exposed when the level of the water drops during the lean season. Sponge exhibits bright green colour, due to the presence of symbiotic algae, such symbiotic relationship is known in many species.

Dermal membrane well developed, skeleton consists of vertical fibres interconnected by varying number of irregular transverse fibres, megascleres stout fusiform, microscleres completely absent, gemmoscleres similar to that of megascleres, scattered throughout, pneumatic layer thick with air spaces, embedded irregularly.

Ecological Characters

Indira sagar lake located in the semi-arid region of Andhra Pradesh. No factor has so much moulding effect both directly and indirectly, as temperature. In tropics, temperature is one of the major factor affecting the water level of the lake, in addition to evapo-transpiration. This factor has an indirect bearing on the growth and gemmule formation in the sponge body. The period of growth is generally found to be related to the abundant supply of phyto-zooplankton and increase in the water level. The phytoplankton in the lake are mainly of cyanophycean members (Merismopedia, Microcystis, Oscillatoria); Chlorophyceae (Hydrodictyon reticulatum, Pediastrum simplex, Ankistrodesmus falcatus, Scenedesmus quadricauda, Selenastrum, Spirogyra hyalina, Cosmarium, Chara etc.) and Bacillario phyceae (Navicula, Cymbella, Asterionella, Synedra, Melosira, Pinnularia) and the zooplankton members belonging to Rotifera (Keratella tropica, Filinea longiseta, Brachionus quadridentata); Cladocera (Moina micrura, Ceridaphnia cornuta) and Copepoda (Mesocyclops leuckarti, Pseudodiaptomus sp.). The other factor that are likely to affect the general condition of the lake water quality are as described below:
Data on certain hydrobiological factors of Indira sagar

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Summer</th>
<th>Monsoon</th>
<th>Winter</th>
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<tr>
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<td>26.30</td>
<td>27.6</td>
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<tr>
<td>pH</td>
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<td>7.95</td>
<td>8.12</td>
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<tr>
<td>Free Carbon dioxide</td>
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<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>153</td>
<td>237</td>
<td>348</td>
</tr>
<tr>
<td>Calcium</td>
<td>37.25</td>
<td>66.00</td>
<td>63.50</td>
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<tr>
<td>Magnesium</td>
<td>56.00</td>
<td>54.00</td>
<td>60.00</td>
</tr>
<tr>
<td>Hardness</td>
<td>116.5</td>
<td>122.00</td>
<td>125.00</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>5.25</td>
<td>6.10</td>
<td>7.00</td>
</tr>
<tr>
<td>Chloride</td>
<td>131.50</td>
<td>88.00</td>
<td>80.00</td>
</tr>
<tr>
<td>Specific conductance (U mho/cm)</td>
<td>820.00</td>
<td>650.00</td>
<td>644.00</td>
</tr>
<tr>
<td>Total Dissolved solids</td>
<td>524.00</td>
<td>415.00</td>
<td>412.00</td>
</tr>
</tbody>
</table>

(Values are in mg/l, except otherwise mentioned)

The species diversity of sponges in the freshwaters of South India are limited (Annandale 1911), the reason for such limited distribution is not known. Further study on the distribution of sponges from South India, with knowledge of limnology of the lakes may throw light on this aspect.

Acknowledgements

The author wishes to express his deepfelt thanks to Dr. A. K. Ghosh, Director, Zoological Survey of India, Calcutta and to Dr. K. V. Ramarao, Officer-in-Charge, Freshwater Biological Station, Zoological Survey of India for help and facilities. Thanks are due to Dr. T. D. Soota, Emeritus Scientist, Dr. P. Haldar and Dr. J. G. Pattanayak, Zoological Survey of India, Calcutta for their help.

References


ON A COLLECTION OF CENTIPEDES (MYRIAPODA : CHILOPODA) FROM PUNE, MAHARASHTRA.

B. E. YADAV

Zoological Survey of India
Western Regional Station
Pune—411 005.

INTRODUCTION

The Centipedes are an important group of organisms. They are poisonous, cryptic, solitary, carnivorous and nocturnal. Their distribution and taxonomy have been studied by Attems (1930). The centipedes from Deccan area are reported by Jangi and Dass (1984). However, there is no upto-date account of centipedes occurring in and around Pune, Maharashtra.

On the basis of huge collection present in the Western Regional Station, Pune, an attempt has been made to record centipedes from Pune district.

The present paper deals with six genera comprising eighteen species of centipedes belonging to the family Scolopendridae, mostly collected from Haveli taluka (Fig. 1). Occasionally bling centipedes (Cryptopidae) as well as long centipedes possessing more than 21 trunk segments, were also observed.

DESCRIPTION ON LOCALITIES

Pune city is situated 18° 35' North latitude and 73° 53' East longitude at 558.6 m above MSL, with normal rainfall 675 mm per year in Maharashtra State.

Centipedes were collected in the vicinity of Pune from Haveli, Khed, Maval, Ambegaon, Sirur and Purandar talukas.

Haveli taluka:

Eastern portion of this taluka is characterised by brown soil and mixed deciduous forest.

1. Akurdi: Akurdi is a small village situated 18 kms. NW of Pune and at 575 m above MSL. This area occupies many stones and boulders.

2. Bhosri: Bhosri is a suburban area, 19 km. N of Pune on Pune-Nasik road. At the time of making collection, there was no human invasion.

3. Chaturshingi hill: This hill is C. 8 km from Pune, and 650 m above, MSL. It provided protective habitats for centipedes.
4. **Moshi**: Moshi is situated 22 km from Pune, and had wet soil. A good number of species were collected from this area.

5. **Wagholi**: This locality is situated at an altitude of 570.5 m above MSL, latitude 18°35' North and longitude 73°59' East on Pune-Nagar road. There were plenty of stones and boulders suitable for centipedes.

6. **Khadakwasla**: It is situated C 11 km SW of Pune where two localities of centipedes were recorded. One near the dam and the other in the foot hills of the Sahyadri.

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7. **Dighi**: Dighi is C 15 km North of Pune on Pune-Alandi road.

8. **Katraj**: Katraj village is 8 km south of Pune on Pune-Satara road. Centipedes were collected in the Ghat area, near Katraj tank and around village.

9. **Lonikand**: Lonikand is 13 km NE of Pune.

10. **Theur**: Theur is C 15 km East of Pune and situated on the bank of Bhima river.
11. Koregaon village is 30 kms. SW of Pune. A good number of centipedes were collected from this station.

12. Uruli-kanchan: This locality is 18 km East of Pune and a fair site for collecting the centipedes.

13. Khamgaon: This site is 22 kms. East of Pune. Collection was made near village and Khamgaon tank.


15. Kondhave: Kondhave is situated 8 kms. SE of Pune.

16. Pashan: This village is 9 kms. from Pune. Centipedes were collected around Pashan tank and on Sus-Baner road.

17. Aundh: Aundh is situated on the bank of Mula river 10 km from Pune. Centipedes were collected from underneath stones on the bank of river.

18. Sinhgad: Sinhgad is the highest locality 1440 M above MSL, 20 kms. SW Pune. It is located at 18° 22’ North latitude and 73° 46’ East longitude and has steep rocky way. The collection was made from the crevices of elevated land in Ghat area and at the top-Talai garden.

19. Khamgaon (Maval): This area is having mixed type of soil, black and murum.

20. Donje: Donje is situated 14 kms. SW of Pune at the base of Sinhgad fort.

21. Empress garden: Garden is situated East of the Race course on Prince of Wales Drive. It provides good natural habitat for centipedes.

22. Pune University compound: It is a vast green zone having stones, boulders, barks and dry foliage suitable for centipedes to obtain shelter. Cooler climate and thick vegetation provide good opportunity for terrestrial invertebrates to enrich their population.

23. Vaghur village: The centipedes were collected from black, moist soil.

24. Kowdi: This locality offered suitable habitat for centipedes, underneath stones and boulders.

25. Vetal hill: This is a hill near Symbiosis Institute, Pune.

26. Hanuman tekdi: It is a small hill in Pune city.

Ambegano Taluka:

In the extreme west, evergreen forest is dominant, and the soil is red in some area.

27. Bhimashankar: It is a high altitude station surrounded by evergreen forest, characterised by cooler climate. A new species of centipede has been described by Jangi & Dass (1984) from this locality.
Khed Taluka:
The brown soil is in the transition tract of Khed, Haveli, West of Sirur and Purandar taluka.

28. Alandi: Alandi is 20 km from Pune, situated on the bank of Indrayani river.
29. Chakan: Chakan is situated 32 km south of Pune on Nasik road.
30. Khed: Khed or Rajgurunagar is 45 km from Pune.

Maval taluka:
31. Taleganon Dabhade: It is 32 km from Pune at latitude 18° 45’ North, and longitude 73° 41’ East.
32. Kamshet: It is 46 km from Pune. Indrayani river passes near the village.
33. Karla: Karla is 57 km from Pune. The hill provides fairly protected habitats for centipedes.
34. Bhor ghat: Bhor ghat of Khandala ghat C 68 kms. from Pune, is the largest ghat in the area. The climate of this area remains cool throughout the year and the moist soil offers habitats for centipedes.

Mulshi taluka:
35. Mulshi: Mulshi is situated C 50 km from Pune.
36. Paud: Paud village is located 22 km from Pune.
37. Pirangut: It is located C 15 km East of Pune.

Purandar taluka:
38. Saswad: It is located at 18°21’ North latitude and 74° 1’ East longitude, 30 km from Pune on the bank of Karha river.
39. Yavat: Yavat is situated on Sholapur road.
40. Kamthadi: Kamthadi is situated C 20 kms. SW of Pune.

Sirur taluka:
The black soil observed in this taluka, while western portion occupies brown and red soil.
41. Kondapuri: This village is located 27 kms. SW of Pune, harbouring plenty of stones suitable for centipedes to hide.

Systematic Account

1. Scolopendra amazonica Bucherl


Material examined: 265 ex., Akurdi, Bhosri, Chaturshingi hill, Moshi, Wagholi, Khadakwasls, Dighi, Katraj, Lonikand, Theur, Koregaon, Uruli Kanchan, Khamgaon,
Kondave, Pashan, Aundh, Singhgad, Pune University, Vagahr, Kowdi, Vetal hill
Hanuman tekdi, Alandi, Chakan, Khed, Talegaon-Dabhade, Pirangut, Saswad, Yavat
and Kondapuri; collected in the months of February and from June to October.

**Distribution:** Maharashtra, Karaataka, Andhra Pradesh, Goa, Madhya, Pradesh,
Orissa, Pondicherry, Kerala, Tamil Nadu, in warmer lands.

**Diagnostic features:** Spiracles triangular; terminal leg segment with coxopleural
pores; 1st tergite overlaid by cephalic plate. Anal leg-prefemur ventrally have 9
spines in 3 longitudinal cows. 20th walking leg lacks tarsal spur.

2. **Scolopendra morsitans** Linnaeus


**Material examined:** 36 ex., Bhosri, Moshi, Wagholi, Dighi, Katraj, Lonikand,
Theur, Koregaon, Khamgaon, Kondhave, Empress garden, Kowdi, Alandi, Khed,
Talegaon Dabhade, Bhor ghat and Kondapuri; collected in the months of June to
October.

**Distribution:** Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, Madhya
Pradesh, Uttar Pradesh, Orissa, Himachal Pradesh, Jammu & Kashmir, Rajasthan,
Bihar, in all tropical lands.

**Diagnostic features:** Similar to *S. amazonica* but differs in the 20th walking leg,
having tarsal Spur.

3. **Scolopendra hardwickei** Newport


**Material examined:** 2 exs., Vetal hill, Bhimashankar; collected in the months
of June and August.

**Distribution:** Maharashtra, Andhra Pradesh, Karnataka, West Bengal, Andaman
and Nicobar Islands.

**Diagnostic features:** Alternate brown, dark, green or brownish yellow bands on
the trunk. Anal leg prefemur without speines ventrally.

4. **Scolopendra punensis** Jangi & Dass


**Distribution:** Maharashtra, Pune district.

**Diagnostic features:** Cephalic plate rugose.

5. **Scolopendra andhrensis** Jangi & Dass

Material examined: 1 ex. Vetal hill, Pune; collected in the month of September, by a survey party.

Distribution: Andhra Pradesh, Vishakhapatnam dist., Maharashtra—Pune district.

Diagnostic feature: Cephalic plate having coarse pit like puncta.

6. Cormocephalus pilosus Jangi


Material examined: 38 exs., Moshi, Wagholi, Dighi, Katraj, Theur, Koregaon, Uruli Kanchan, Kowdi, Vetal hill, Khed, Talegaon-Dabhade; collected from June to September and December.

Distribution: Maharashtra, Andhra Pradesh, Karnataka Mangalore and Karwar.

Diagnostic features: All legs without tarsal spur. Anal legs pilose.

7. Cormocephalus nudipes Jangi & Dass


Material examined: 1 ex., Pune University campus; collected in the month of June.

Distribution: Maharashtra—Pune, Andhra Pradesh-Nalgonda dist.; Karnataka—Mangalore and Karwar.

Diagnostic feature: Anal legs smooth.

8. Cormocephalus pseudonudipes Jangi & Dass


Material examined: 3 exs., Bhimashankar; collected in the month of May.

Distribution: Maharashtra, Andhra Pradesh, Tamil Nadu.


9. Asanada brevicornis Meinert


Material examined: 13 exs., Bhosri, Chaturshingi hill, Lonikand, Theur, Koregaon, Urulikanchan, Paud, Saswad, Yavat; collected in the months of February, July, August, October and December.

Distribution: Maharashtra, Rajasthan, Himachal Pradesh, Andaman Island,
Diagnostic features: Terminal leg segment without coxopleural pores; longitudinal dorsal median groove present posteriorly on anal leg prefemur, femur & tibia.

10. Asanada sokotranana Pocock


Material examined: 2 exs., Moshi, collected in the month of February.

Distribution: Maharashtra, Kerala, Tamil Nadu.

Diagnostic features: Longitudinal median groove present throughout on anal leg femur.

11. Asanada indica Jangi & Dass


Material examined: 1 ex., Uruli Kanchan, collected in August.

Distribution: Maharashtra.

Diagnostic features: Longitudinal median groove present only on posterior half of anal leg prefemur and femur.

12. Digitipes barnabasi Jangi & Dass


Material examined: 5 exs., Karla, Bhor ghat, Mulshi, Kamthadi; collected in the months of June, September October.

Distribution: Maharashtra, Tamil Nadu.


13. Otostigmus (Otostigmus) orientalis (Porat)


Material examined: 4 exs., Bhor ghat, collected in June.

Distribution: Maharashtra—Pune, Bombay districts.

Diagnostic features: Femur of anal leg, in male, without posteriomedial process; claw of 2nd maxilla with spur; tergites without thorny tracts.

14. Rhysida nuda (Newport)

Material examined: 74 exs., Bhosri, Moshi, Wagholi, Khadakwasla, Dighi, Katraj, Theur, Koregaon, Sinhgad, Vetal hill, Hanuman tekdi, Chakan, Talegaon Dabhade, Kamshet, Paud, Kondapuri; collected in April and from June to December.

Distribution: Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, Assam.

Diagnostic features: Ten pairs of oval spiracles; femur of maxillipede with median dental process; tergites 1-20, not marginated laterally, and except anterior one, with complete paramedian sutures.

15. Rhysida lithobioides Newport


Material examined: 2 exs., Vetal hill; collected in July and September.

Distribution: Old world; Maharashtra-Pune district.

Diagnostic features: Tergites 1-20 marginate laterally. Coxopleural process without lateral spines. Anterior sternites confined short suture. First 8 or more pairs of legs with two tarsal spurs.

16. Rhysida lithobioides trispinosus Jangi & Dass


Material examined: 24 exs., Wagholi, Khadakwasla, Katraj, Uruli Kanchan, Pashan, Kamthadi; collected in the months from June to September.

Distribution: Maharashtra, Tamil Nadu.

Diagnostic feature: Coxopleural process tipped with 3 spines; 21st Sternite tapering posteriorly.

Discussion

It is evident from systematic account that Scolopendra amazonica Bucherl and S. morsitans (Linn.) are common species, occurring in most of the localities in Pune. These species were recorded from more than 14 localities of Haveli and Khed taluka, having brown soil. S. hardwickei Newport, collected from Vetal hill and Bhimashankar, Digitipes barnabasi Jangi & Dass and Otostigmus (O.) orientalis porat collected from Bhorghat and Karla, indicate preference for places of high altitudes and Ghat areas.

Digitipes barnabasi Jangi & Dass is mostly restricted to Mulshi, Maval and Purandar talukas except one from Haveli. Moshi and Koregaon seem to be best localities represented by 6-7 species of centipedes.

Asanada brevicornis Meinert was obtained from Koregaon, Bhosri, Chatutshingi hill, Urulikanchan, Lonikand, Paud, Yavat and Saswad villages of Haveli, Mulshi and Purandar talukas, showing preference for brown and mixed type of soil.
YADAV : Collection of Centipedes from Pune

_Cornocephalus pilosus_ Jangi was mainly collected from Haveli taluka. _C. pseudonudipes_ Jangi & Dass was only noticed at Bhimashankar, an evergreen forest area on high altitude, and _C. nudipes_ Jangi & Dass was collected from Pune University campus which is also a greenery with plenty of dry foliage.

_Rhysida nuda_ (Newpour) shows mixed distribution and general preference for brown soil. _R. lithobioides_ (Newport) was collected from Vetal hill and Dighi. It appears that _Rhysida_ may shown liking for the hilly area.

Further, it was noticed that although surveys were conducted during monsoon and other months, actually a good number of collection was obtained in monsoon months (June to September). Since lower invertebrates undergo aestivation in winter months, few centipedes were located in these months. On account of their weaker cuticle and to conserve water, centipedes avoid direct solar radiation in summer and foliage during the hot day. Obviously only 3 examples of _C. pseudonudipes_ Jangi & Dass could be collected in May at Bhimashankar.

In contrast to the observation of Khanna & Tripathi (1984) indicating that the genus _Cornocephalus_ was collected by them mainly in winter, we mainly collected it in monsoon months and only 3 examples in winter and summer.

The collection data indicates that centipedes show general preference for brown soil and monsoon climate, and only a few were collected from the places of high altitudes, Ghat areas and evergreen forests.

The Pune and its environ provide suitable habitats, like stones, boulders, damp places, barks, on the ground, high hills, dense forests, etc., with sufficient entomofauna as food for successful survival of centipedes in the terrestrial ecosystem.

**Summary**

Six genera comprising eighteen species of centipedes were collected from Pune and around. _S. amazonica_ Bucharl and _S. morsitans_ (Linn.) were predominant species. Centipedes show preference for brown soil in Haveli taluka. Eight species were collected in Ghat area. Moshi and Koregaan are the localities from where 6-7 species were recorded. Out of 5 talukas surveyed, Haveli represented rich distribution of centipedes.

Centipedes were abundantly located in monsoon months (June to September). _Cornocephalus_ was found to be abundant in monsoon rather than in winter and summer.

**Acknowledgements**

I am grateful to the Director, Zoological Survey of India, Calcutta, to Dr. G. M. yazdani, Scientist ‘SE’, Officer-in-Charge, Western Regional Station, Pune, Dr. S. G.
Patil, Assistant Zoologist for the facilities, and to various survey parties of Western Regional Station, for their valuable contribution of centipede-collection.

I am indebted to Dr. V. C. Agarwal, Scientist ‘SF’, Zoological Survey of India, Calcutta, for critically going through the manuscript. Thanks are due to Mrs. U. R. Pawar for the typing.

REFERENCES


LOCALITIES OF CENTIPEDES : (HAVELI)

(1) Akurdi
( ) Bhosri
(3) Chaturshingi hill
(4) Moshi
(5) Wagholi
(6) Khadakwasla
(7) Dighi
(8) Katraj
(9) Lonikand
(10) Theur
(11) Koregaon (Mul)
(12) Uruli Kanchan
(13) Khamgaon (Tek)
(14) Loni Kalbhor
(15) Kondhave (Kurd)
(16) Kondhave (Budruk)
(17) Pashan
(18) Ghera Sinhgad
(19) Khamgaon (Maval)
(20) Donje
TAXONOMIC STUDIES OF INDIAN BANDICOOT RATS (RODENTIA: MURIDAE: MURINAE) WITH DESCRIPTION OF A NEW SPECIES

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Zoological Survey of India.

INTRODUCTION

Gray (1842) separated the bandicoot rats from the house rats under the genus *Nesokia*. Thomas (1907), however, divided them into three genera, *Nesokia*, *Gunomys* and *Bandicota*. Later, Wroughton (1908, 1919) maintained 6 species (*gigantea, malabarica, elliotana, indica, nemorivaga* and *savilei*) under the genus *Bandicota*, 7 species (*bengalensis, gracilis, wardi, varius, lordi, sindicus* and *kok*) under *Gunomys* and 4 species (*indica, huttoni, griffithi* and *beaba*) under *Nesokia* from the Indian subregion. Subsequently, Ellerman (1947, 1961) retained the genus *Nesokia* for the highly specialised bandicoot rats from Palaearctic and North-west India, *Bandicota* for the more generalised Indo-Malayan forms, and synonymised *Gunomys* with *Bandicota*. Further, based on the body colour and morphological characters, Ellerman (loc. cit.) maintained a single species *indica* under the genus *Nesokia* and two species, namely, *indica* and *bengalensis* under *Bandicota*. While doing so, he merged all the large-sized bandicoot rats with *indica* except *nemorivaga* and *savilei* which were given subspecific ranks under it. Tiwari et al. (1971), however, stressed the need of retaining *malabarica* from the Western Ghats as a separate subspecies of *B. indica*. Later, Pradhan et al. (1989), with the help of biochemical analysis found polymorphic populations in the species *Bandicota indica* which created confusion as to the status of different species synonymised with it. Hence, it was decided to undertake the study of large bandicoot rats afresh, covering all possible aspects like osteo-morphological, biochemical and hair sculpture studies.

The present work is based on the data collected for the following research projects:—

1. Ecological and taxonomic studies of the rats (subfamily Murinae) from Pune and adjacent areas.

2. Chaemotaxonomic studies of the commensal rodents and shrews from Bombay-Pune region.

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Calcutta-700 053
3. Chaemotaxonomy of rodents from Pune district.
4. Ecological and taxonomic studies of rodents in and around Calcutta.

**Areas Surveyed and Duration**

Initially, the sampling was restricted to the metropolis of Calcutta, Bombay and Pune. Later, it was extended to the western parts of Maharashtra. The sampling areas have been shown in Figure 1. The rodent collection in the sampling areas was made during the extensive surveys carried out over a period of four years from 1982 to 1986.
Material and Methods

More than 100 bandicoot specimens along with their skulls were studied in detail for the present work. The material, in addition to the freshly collected specimens, included the specimens present at the Bombay Natural History Society, Bombay, Zoological Survey of India, Calcutta, and the Western Regional Station of the Zoological Survey of India, Pune. The freshly collected specimens have been deposited at the Western Regional Station, Pune.

For osteomorphological studies, all measurements were taken after Roonwal and Agrawal (1966). The freshly collected material as well as the already identified specimens (vide Ellerman 1961) were reidentified with the help of keys provided with by Wroughton (1919) and then compared. For comparison of data only adult specimens were taken into consideration. The significance or student 't' test was applied to every character showing statistically significant differences (P = 0.05) in the average measurements.

For biochemical studies, haemoglobins were separated according to method described by Wright (1974). The samples of haemoglobin and plasma protein were resolved in individual patterns using polyacrylamide gel electrophoresis (PAGE) after Davis and Ornstein (1961), Whitaker (1967), and Gordan (1980). PAGE separation was carried out under carefully controlled factors like gel concentration (7.5%), pH of stacking (8.3) and running (9.5) gels, buffer system (Tris-glycine, pH 8.3), voltage current (4 watt per tube) temperature (4°C ± 1°C), the time of run, etc. The dye, bromophenol blue, mixed with sample before loading on the gel columns in the neutral glass tubes, served as a marker. To identify various specific proteins, gels were stained after Gordon (1980) for plasma proteins, Brewer and Sing (1970) for Lactate dehydrogenase (LDH) and non-specific esterases, and Ornstein (1967) for haemoglobin (Hb) fractions. The eye lenses were extracted according to Smith (1971), with certain modifications (Pradhan and Bhagwat 1990). After PAGE separation, the eye lens proteins were stained by the method of Gordon (1980). Consolidated protein profiles were prepared by analysing each sample in several replicates and averaging the electrophoretic mobilities with reference to marker (Rm values) for individual specimen. The final Rm values, obtained for individuals, were clubbed together to obtain characteristic profiles for the three populations of Bandicota under investigation.

For the analysis of hair structure, hair samples were collected from the region posterior to the neck on the dorsal surface. Five specimens each of Bandicota spp. under study were selected for the present work. For light microscopic study, the hair samples were first washed in warm water and then transferred to detergent solution (Teepol, 1% v/v). After this treatment, hair were repeatedly washed with warm distilled water and transferred to 1 : 1 mixture of ether and alcohol as suggested
by Dreyer (1966). After shaking this mixture, hair were once again washed with distilled water and dried in clean watch glasses. For routine study impressions of hair sculptures were obtained on gelatin or polyvinyl acetate (Brunner and Coman, 1974) and photographed using Olympus microphotography attachment at x 200.

Observation & Discussion

Osteo-morphological Study

The external and skull-measurement of the large-sized bandicoot rats (Tables 1 & 2) show that out of about 100 specimens examined from the distributional range of indica, malabarica and nemorivaga, 15 have the occipitonasal length more than the condylobasal length. The reverse is true in the rest. Not only that, these specimens are, on average, larger in size. When the average measurements (with standard deviations) of these specimens were plotted on a graph against the average measurements of indica, malabarica and nemorivaga (Figs. 2, 3, 4 & 5) for comparative study, distinct differences were noticed in the lengths of occipitonasal, condylobasal, palate and diastema and width of zygomatic arches. All these differences were found to be statistically significant (P = 0.05). Although the measurements of these specimens come quite close to those of B. indica malabarica, yet these differ in the length of occipitonasal, condylobasal and palate, and width of zygoma. Moreover, the longer occipitonasal, wider zygomatic arches and inflated occiput (Fig. 6 & 7) give a somewhat triangular shape to the head of these large-sized rats (Fig. 8).

From the above study it is clear that Bandicota i. malabarica not only differs from the other two populations, viz., B. indica indica and B. indica nemorivaga in the length of nasals, diastema and palate, but is also allopatric in distribution. Hence, it is treated as a separate subspecies of Bandicota indica (Bechstein). Our view finds support from the earlier work of Tiwari et al. (1971) who maintained malabarica as a separate subspecies of Bandicota indica.

As mentioned above, the large-sized bandicoot rat, Bandicota sp. differs from Bandicota indica (all three subspecies) in the occipitonasal length being more than condylobasal length, and in the width of zygomatic arches and length of mandibles (Tables 1-3). Although these bandicoot rats (Bandicota sp.) come very close to Bandicota indica malabarica, yet cannot be placed as a subspecies of Bandicota indica due to its India-wide distribution. Hence, it deserves a specific rank.

Biochemical Study

The consolidated population profiles for five specific proteins of three bandicoot populations in question are represented in Figs. 9 & 10. The data on protein
separation was used to calculate Genetic Identity (I) at the specific loci (Nei, 1972).

Table 4 represents the I values for individual proteins as well as mean I (I) for all
Fig. No. 3

---

Difference Statistically Significant
Fig. No. 4

Bandicota sp. — Binemerivaga

Difference Statistically Significant
Fig. No. 5

- **B. indica**
- **B. malabarica**
- **B. nemorivaga**

+ Difference Statistically Significant.
the proteins separated during the present study. On the basis of the data on I values and also applying the UPGMA method of cluster analysis, dendrograms showing relationships of the Bandicota species were also constructed (Fig. 11).

Pradhan et al. (1989) have discussed at length the status of the large-sized bandicoot population and have doubted its inclusion in B. indica. Along with several osteomorphological characters they had used two protein fractions, Hb and eye lens proteins, to examine the differences. During the present study, additional proteins namely LDH, non-specific esterases and plasma low molecular proteins in the albumin zone representing a total of about 52 gene loci in the populations were used to examine homologies at functional (enzyme) levels. From the tests (Table 4) it is
observed that for the two enzyme fractions, *B. bengalensis* showed a greater gene identity with the proposed *Bandicota* sp. than with *Bandicota indica* which had the least gene identity. The genes representing low molecular plasma proteins showed greater identities in the populations of *B. bengalensis* and *B. indica* (0.85). Here again, the genetic identity between *B. indica* and proposed *Bandicota* sp. was the least (0.64).

**FIG. 7**

**Occiput region of *Bandicota* sp. skull (M/95)**

Dendrograms constructed from the above data (Fig. 11) clearly establish the patterns of branching in phylogeny of the three species. The dendrogram representing average genetical identities at loci controlling the five specific proteins suggests that all the three species of genus *Bandicota* were separated from each other more or less at the same time. However, it was *B. indica* that got separated early from the common
A: Photograph showing cuticular impression pattern of *B. indica* (M/415) hair between basal and middle region. Kindly ignore air bubbles. (Magnification: Photographed at X200).

B: Photograph showing cuticular impression pattern of *Bandicota* sp. (M/98) hair between basal and middle region. Kindly ignore air bubbles. (Magnification: Photographed at X200).
C: Photograph showing cuticular impression pattern of *B. indica* (M/248) hair between basal and middle region. (Magnification: Photographed at X200).

D: Photograph showing cuticular impression pattern of *Bandicota* sp. (M/125) hair between basal and middle region. (Magnification: Photographed at X200).
A: Photograph showing cuticular impression pattern of *B. indica* (M/415) hair near middle region.
(Magnification: Photographed at X200).

B: Photograph showing cuticular impression pattern of *Bandicota* sp. (M/98) hair near middle region.
(Magnification: Photographed at X200).
C: Photograph showing cuticular impression pattern of *B. indica* (M/415) hair in the middle region.
(Magnification: Photographed at X200).

D: Photograph showing cuticular impression pattern of *Bandicota* sp. (M/98) hair in the middle region.
(Magnification: Photographed at X200).
ancestral stock, whereas *B. bengalensis* and proposed *Bandicota* sp. separated at a latter stage in the phylogeny.

Selander and Yang (1969) have suggested that subspecies should not have less than 90% identity at genomic level. They further state that sibling species show an identity close to 50%; and when identity is about 30% the population should be treated as a distinct species. Our results average about 50% identity for five protein expressions studied. Therefore, if one looks at the entire genome level and with a larger number of species specific proteins, this identity might come down to the level of distinct species. To conclude, therefore, it may be stated that on the basis of the analysis of five protein expressions the populations of *B. indica* and proposed *Bandicota* sp. cannot be treated as a single species. All the three species (*bengalensis, indica* and *B. sp.*) appear to be genetically distinct and hence, should be given the status of independant species.
**Fig. No. 9**

**Diagramatic representation of the electrophoretic patterns of the species specific proteins in the different species of the genus Bandicota**

<table>
<thead>
<tr>
<th></th>
<th>Haemoglobin</th>
<th>Eye lens proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Species</strong></td>
<td><strong>B. b.</strong></td>
<td><strong>B. b.</strong></td>
</tr>
<tr>
<td><strong>n</strong></td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td><strong>Figures</strong></td>
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<td><strong>1</strong></td>
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<td><strong>10</strong></td>
<td>(10)</td>
<td>(10)</td>
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</tbody>
</table>

**Figures in parentheses**

Frequency occurrence of each band in populations.
**FIG. 10**

Electrophoretic patterns (PAGE) of some enzymes and low molecular plasma proteins of Bandicota spp.

<table>
<thead>
<tr>
<th>L.D.H.</th>
<th>ESTERASE</th>
<th>GLOBULIN &amp; ALBUMIN ZONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.b. n=30</td>
<td>B.i. n=19</td>
<td>B.SP. n=8</td>
</tr>
<tr>
<td>0.0</td>
<td><img src="image" alt="Band diagram" /></td>
<td><img src="image" alt="Band diagram" /></td>
</tr>
<tr>
<td>0.5</td>
<td><img src="image" alt="Band diagram" /></td>
<td><img src="image" alt="Band diagram" /></td>
</tr>
<tr>
<td>1.0</td>
<td><img src="image" alt="Band diagram" /></td>
<td><img src="image" alt="Band diagram" /></td>
</tr>
</tbody>
</table>

Figures in paranthesis: Frequency of occurrence of each band in populations.
Dendrograms constructed using UPGMA method of cluster analysis & data in table

**Haemoglobins**

- B.b.
- B.i.
- B.sp.

- 0.38
- 0.31

**ESTERASES**

- B.b.
- B.sp.
- 0.88
- 0.695

**EYE LENS PROTEINS**

- B.i.
- B.sp.
- 0.39
- 0.09

**Low molecular weight Plasma proteins**

- B.i.
- B.sp.
- 0.85
- 0.67

**LDH**

- B.sp.
- B.b.
- 0.99
- 0.63

**Average Genetic Identities for five specific proteins**

- B.b.
- B.sp.
- 0.59
- 0.33

Records of the Zoological Survey of India
<table>
<thead>
<tr>
<th>Type</th>
<th>Head + Body</th>
<th>Head foot</th>
<th>Hind nasal</th>
<th>Occipito- + foot</th>
<th>Condylar basal</th>
<th>Nasals</th>
<th>Palate</th>
<th>Molar tooth row</th>
<th>Bullae anterior palatal foramina</th>
<th>zygomatic width</th>
<th>inter orbital width</th>
<th>mandibles diastema</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandicota sp.</td>
<td>Range 250.0-370.0</td>
<td>Mean (X) 314.71</td>
<td>Standard Deviation ±30.26</td>
<td>Percentage 100%</td>
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<tr>
<td></td>
<td>Mean (X) 284.3</td>
<td>Standard Deviation ±10.14</td>
<td>Percentage 100%</td>
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<td></td>
</tr>
<tr>
<td>B. i. malabarica</td>
<td>Range 270.0-305.0</td>
<td>Mean (X) 284.3</td>
<td>Standard Deviation ±10.14</td>
<td>Percentage 100%</td>
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</tr>
<tr>
<td></td>
<td>Mean (X) 233.33</td>
<td>Standard Deviation ±23.99</td>
<td>Percentage 100%</td>
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</tr>
<tr>
<td>B. i. indica</td>
<td>Range 208.0-267.0</td>
<td>Mean (X) 233.33</td>
<td>Standard Deviation ±23.99</td>
<td>Percentage 100%</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Mean (X) 245.0-290.0</td>
<td>Standard Deviation ±25.0</td>
<td>Percentage 100%</td>
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<td></td>
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</tbody>
</table>

Table showing the measurements with S. D. and relative percentages of different key characters of *Bandicota* sp. and the Indian subspecies of *B. indica* (Bech.).
Table No. 2
Morphological differences between Bandicota sp. & B. indica

<table>
<thead>
<tr>
<th>Bandicota sp.</th>
<th>Bandicota indica</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hindfoot exceeds 57 mm in adults.</td>
<td>Hindfoot less than 57 mm except in <em>malabarica</em> where it sometimes exceeds 57 mm.</td>
</tr>
<tr>
<td>2. Occipitonasal length exceeds or equal to condylobasal length.</td>
<td>Occipitonasal length less than condylobasal length.</td>
</tr>
<tr>
<td>3. Zygomatic width in adult less than 53.6% of occipitonasal.</td>
<td>Zygomatic width in adults more than 53.6% of occipitonasal.</td>
</tr>
<tr>
<td>4. Mandibular length below 60% of occipitonasal length.</td>
<td>Mandibular length exceeds 60% of occipitonasal length.</td>
</tr>
<tr>
<td>5. Occiput inflated, ridges less prominent.</td>
<td>Occiput flattened, ridges prominent.</td>
</tr>
</tbody>
</table>

Table No. 3
Morphological differences between subspecies of Bandicota indica (indica, malabarica and nemorivaga).

<table>
<thead>
<tr>
<th>B. i. malabarica</th>
<th>B. i. indica</th>
<th>B. i. nemorivaga</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hindfoot less than 20% of head &amp; body length.</td>
<td>Hindfoot exceeds 20% of head &amp; body length.</td>
<td>Hindfoot less than 20% of head &amp; body length.</td>
</tr>
<tr>
<td>2. Nasals exceed 40% of occipitonasal length.</td>
<td>Nasals below 40% of occipitonasal length.</td>
<td>Nasals below 40% of occipitonasal length.</td>
</tr>
<tr>
<td>3. Zygomatic width less than 55% of occipitonasal length.</td>
<td>Zygomatic width less than 55% of occipitonasal length.</td>
<td>Zygomatic width exceeds 55% of occipitonasal length.</td>
</tr>
<tr>
<td>4. Diastema more than one-third of occipitonasal length.</td>
<td>Diastema less than one-third of occipitonasal length.</td>
<td>Diastema less than one-third of occipitonasal length.</td>
</tr>
<tr>
<td>5. Palate more than 35 mm in length in adults.</td>
<td>Palate less than 32 mm in length in adults.</td>
<td>Palate 32-35 mm in length in adults.</td>
</tr>
<tr>
<td>6. Occipitonasal length in adults more than 58 mm.</td>
<td>Occipitonasal length in adults less than 58 mm.</td>
<td>Occipitonasal length may cross 58 mm in adults.</td>
</tr>
</tbody>
</table>
### Table No. 4

Genetic Identities (above diagonal) and Genetic Distances (below diagonal) for the loci representing five specific proteins of the three *Bandicota* species in question.

<table>
<thead>
<tr>
<th>Haemoglobins</th>
<th>L D H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(from Pradhan et al. 1989)</td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>B. b.</td>
</tr>
<tr>
<td>B. b.</td>
<td>–</td>
</tr>
<tr>
<td>B. i.</td>
<td>0.98</td>
</tr>
<tr>
<td>B. sp.</td>
<td>1.27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low molecular weight Plasma Proteins</th>
<th>Eye lens proteins (From Pradhan et al. 1989)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>B. b.</td>
</tr>
<tr>
<td>B. b.</td>
<td>–</td>
</tr>
<tr>
<td>B. i.</td>
<td>0.16</td>
</tr>
<tr>
<td>B. sp.</td>
<td>0.36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Esterases</th>
<th>Average Genetic Identities for all the five proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>B. b.</td>
</tr>
<tr>
<td>B. b.</td>
<td>–</td>
</tr>
<tr>
<td>B. i.</td>
<td>0.43</td>
</tr>
<tr>
<td>B. sp.</td>
<td>0.13</td>
</tr>
</tbody>
</table>

### HAIR SCULPTURE

The pattern of hair was analysed on the basis of nomenclature given by Brunner and Coman (1974) and Keogh (1983, 1985). Recently, Ingale (1986) studied hair sculpture pattern of some rodents using SEM, and used the patterns to establish phylogenetic relationships amongst them. The hair sculpture and scale patterns of *Bandicota indica* and *Bandicota* sp. are represented in Pls. I and II. Under low magnification, the hair of *B. indica* shows an irregular waved mosaic pattern at near base and half-way mark. There are not more than two scales across the width of the hair. The scales are of fairly uniform depth. The margins of the scales are slightly rippled and crenate. A very shallow groove on the hair is also visible at lower magnification. The scale margins appear to be distant. The scale characteristics more or less remain constant even in the near apical region of the hair, however, due to
reduction in diameter, the number of scales across the width of the hair is further reduced to one scale.

The hair of *Bandicota* sp. (Plates I & II) exhibits a distinct chevron pattern which in the near middle region appears double chevron. Thus, there is only one scale across the width of the hair in the basal and the near middle regions. The scales are wider then deep and their ends overlap the base in front. The margins of the scale are almost smooth at lower magnification. Though the general scale pattern remains more or less identical in the middle and apical regions, the margin patterns become sharper in the near middle region.

The scale pattern in the hair of *Bandicota bengalensis* (vide Ingale, 1986) is petaloid, with several scales across the width of the hair. Scales are of uniform size and have crenate margins. Thus the pattern of scales in *Bandicota bengalensis* does not match with those exhibited by *Bandicota indica* and *Bandicota* sp.

The differences on the scale pattern observed in the present study on *B. indica* and *Bandicota* sp. are very distinct, waved mosaic (Plate 1A) and chevron (Plate 1B) respectively.

**Conclusion**

From the above study it is clear that four populations of the large-sized bandicoot rats occur in India, which differ from each other in one or more characters (Tables 1-4, figs. 2-5). The three, namely, *indica*, *nemorivaga* and *malabarica* are allopatric in distribution, hence, treated here as three subspecies of *Bandicota indica*; *malabarica* occurring in Western Ghats, *nemorivaga* in West Bengal and northeastern India and *indica* in the rest of India.

The fourth population of the large-sized bandicoot rats is India wide in distribution and differs from the other three (*indica*, *nemorivaga* and *malabarica*) together in the structure of skull, biochemical characters and hair-sculpture. Hence, the same is described below as a new species.

**Systematic Account**

Pradhan *et al.* (1989) described this population of large-sized bandicoot rats as *Bandicota gigantea non* Hardwicke. But since the skull of the type of *B. gigantea* present in the British Museum is broken, it is not possible to confirm (the main key character), whether the ONL was more than CBL in that specimen or not. Hence, it is described here as a new species.
Bandicota maxima sp. nov.


Paratypes: ZSI/WRS Reg. No. M/125; adult female; Raviwarpeth, Pune, Maharashtra; 8 May 1979; collected by M. S. Pradhan. ZSI/WRS Reg. V/1182; adult male; Barisha, 24 Parganas district, West Bengal; 14 Jan 1980; collected by A. K. Mondal.

All the collections are deposited at the Western Regional Station, Zoological Survey of India, Pune. All measurements are in millimetre (Table 5).

Description: A very large-sized rat (Fig. 8), with triangular head, rounded snout, and tail shorter than head and body length. Body covered with smooth coarse

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Holotype</th>
<th>Paratypes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1♀</td>
<td>1♀</td>
</tr>
<tr>
<td><strong>External:</strong></td>
<td>370</td>
<td>292</td>
</tr>
<tr>
<td>Head+Body</td>
<td>290</td>
<td>271</td>
</tr>
<tr>
<td>Tail</td>
<td>63</td>
<td>58</td>
</tr>
<tr>
<td>Ear</td>
<td>33</td>
<td>31</td>
</tr>
<tr>
<td><strong>Cranial:</strong></td>
<td>67.8</td>
<td>62.4</td>
</tr>
<tr>
<td>Occipitalnasal</td>
<td>67.6</td>
<td>61.6</td>
</tr>
<tr>
<td>Condylarbasal</td>
<td>27.0</td>
<td>23.3</td>
</tr>
<tr>
<td>Nasal</td>
<td>9.6</td>
<td>8.5</td>
</tr>
<tr>
<td>Interorbital width</td>
<td>36.5</td>
<td>32.1</td>
</tr>
<tr>
<td>Zygomatic width</td>
<td>40.2</td>
<td>38.1</td>
</tr>
<tr>
<td>Palate</td>
<td>10.2</td>
<td>10.2</td>
</tr>
<tr>
<td>Molar teeth row</td>
<td>9.8</td>
<td>10.0</td>
</tr>
<tr>
<td>Bullae</td>
<td>21.6</td>
<td>19.9</td>
</tr>
<tr>
<td>Palatal foramina</td>
<td>12.6</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Table No. 5
Measurements of type series
(All measurements in mm.)
fur; long bristles present in hind quarter. Tail thinly covered with short hairs but has a leathery texture due to presence of broken scales along its entire length. Dorsal colour varies from dark slaty to light brown, ventral greyish white; specimens from Calcutta lighter in overall coloration than those from Bombay-Pune region. Tail dark and unicoloured. Thumb rudimentary but with a blunt claw. Legs having 5 toes, studded with prominent claws. Soles dark, bearing six plantar pads. Mammae $3 + 3 = 12$.

**FIG.12**

Occiput region of *B. maxima* sp.n. (M/98)

Skull (Figs. 12-14 and Table 5) more or less similar to that of *Bandicota indica* except the swollen occiput (Fig. 7). Occipito nasal length equal to or more than
condylobasal length; interparietal prominent; palatal foramina long, more than 10 mm

or more than 18% of occipitonasal length. Postero-internal (7th) cusp present in first and second upper molars.
Hair sculpture: Hair of *Bandicota maxima* exhibits distinct chevron pattern (Wildman, 1954) as against irregularly waved mosaic pattern in *Bandicota indica*.

*Relationship*: *Bandicota maxima* comes close to *Bandicota indica* but differs from it in the occipito nasal length of skull being more than condylobasal, and chevron type of hair sculpture pattern.
**Distribution**: The species was recorded from Gujarat, Maharashtra, Rajasthan, Karnataka, Kerala, Andhra Pradesh and West Bengal; also Nepal and Bangladesh. Hence, its distribution appears to be throughout India.

**Habitat**: *Bandicota maxima* normally occurs near human habitation and lead epizotic life. It is nocturnal and fossorial. It makes burrows in open yards, gardens, under the foundations of residential premises, granaries, store houses, etc. Its preferred food is grains and vegetables but can switch over to other diet.

To accommodate the new species *Bandicota maxima*, the genus *Bandicota* may be redefined as large rats having proodont / orthodont incisors, condylobasal length may or may not exceed occipitonasal length, anterior palatal foramina more than 6.5 mm or over 15% of ONL, and the postero-internal cusp present in first and second upper molars.

### Key to species of genus *Bandicota*

1. Occipitonasal length, in Indian species, less than 45 mm; Zygomatic width more than 57%, bulla more than 20%, and nasals less than one-third of occipito-nasal length. ... 

   Occipitonasal length more than 45 mm; Zygomatic width less than 57%, bulla less than 20%, and nasals more than one-third of occipitonal length. ... 

2. Occipitonasal length less than condylobasal length; sculpture pattern of dorsal hair mosaic (at lower magnification). ... 

   Occipitonasal length equal to or more than condylobasal length; sculpture pattern of dorsal hair chevron (at lower magnification). ... 

### Key to Indian subspecies of *Bandicota indica*

1. Nasals and diastema exceeds 40% and 33% of ONL respectively. ... 

   Nasals and diastema less than 40% and 33% of ONL respectively. ... 

   **B. i. malabarica**

   **B. maxima**

   **B. bengalensis**
2. Zygomatic width less than 55% of ONL; hindfoot more than one-fifth of head and body length. 

\[ B. \textit{i. indica} \]

Zygomatic width more than 55% of ONL; hindfoot less than one-fifth of head and body length. 

\[ B. \textit{i. nemorivaga} \]

**Summary**

Rodent genus *Bandicota* was split earlier, into a number of species. Ellerman (1961) reduced the number and merged all species into two species viz. *B. bengalensis* and *B. indica*. His studies were based on the British Museum material. However, it has been found out by the present workers that it is rather difficult to allot any taxonomic status to the freshly collected bandicoot material based on Ellerman's keys (1961). It was, then, decided to undertake a detailed comparative osteo-morphological, biochemical and hair impression analysis studies of such a bandicoot population which is not fitting in Ellerman's keys. The studies show that large-sized bandicoot rat populations belong to a separate species. This species has been named as *B. maxima*. Keys to the identification and description of the new species have also been given in the present communication.

**Acknowledgements**

We would like to gratefully acknowledge the Director, Zoological Survey of India, Calcutta, the Principal, R. J. College, Ghatkopar, Bombay, and the Officer-in-Charge, Zoological Survey of India, Pune, for providing facilities. We are also grateful to Dr. S. Chakraborty, Scientist-SD & Officer-in-Charge, Mammals & Osteol. Sec., ZSI, Calcutta, and J. C. Daniel, Curator, B. N. H. S., Bombay, for access to the registered rodent collections. We wish to express our deep sense of appreciation for help rendered by Dr. S. T. Ingale, Lecturer, R. J. College, Bombay, Dr. R. M. Sharma, Asstt. Zoologist, ZSI, WRS, Pune and Dr. D. B. Bastawade, Asstt. Zoologist ZSI, A. P. F. S., Itanagar, (A.P.). Thanks are, also due to Dr. P. D. Jenkins, Mammals Group, Dept. of Zool., British Mus. (N. H.), Cromwell Street, London, for studying our material.

We wish to record our gratitude for the kind help and cooperation received from the Staff of Bombay and Pune Municipal Corporations. We would like to thank Shri P. W. Garde, Sr. Artist and Shri D. J. Kamble, Artist Gr. I, for preparing line drawings and also to Shri K. H. Valecha, Stenographer, ZSI, WRS, Pune, for typing final manuscript.
Pradhan et al.: Taxonomic studies of Indian Bandicoot rats

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Hardwicke, Thomas, 1804. Description of a large species of Rat, a Native of East Indies. Trans. Linn. Soc. Lon., 7.


ON A COLLECTION OF FISH FROM KAKINADA—GOPALPUR SECTOR OF THE EAST COAST OF INDIA.

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Marine Biological Station
Zoological Survey of India
Madras-600 028

INTRODUCTION

The present paper is based on the fish fauna collected from the Kakinada-Gopalpur sector of the east coast of India during February—March, 1992 in pursuance of the approved annual programme of work. It contains information about 114 species belonging to 86 genera and 55 families. While indentifying the specimens most of the literature pertaining to the locality (Day, 1878; Day, 1889-1898; Bleeker et al., 1913; Weber and de Beaufort, 1916-1936; de Beaufort, 1940; de Beaufort and Chapman, 1951; Koumans, 1953; de Beaufort and Briggs, 1962; Kagwade, 1970; Fischer and Whitehead, 1974; Fischer and Bianchi, 1984; Talwar and Kacker, 1984; Smith and Heemstra, 1986; Whitehead et al., 1988; Russell, 1990; Talwar and Jhingran, 1991) have been consulted.

One new species, one teratogenic phenomenon, remarks on variations in meristic characters and distribution, confirmation of marine existence, questioning the necessity to raise a monotypic genus and discarding of a synonymy have been included and the systematic details along with geographical distribution are presented.

FISH FAUNA OF THE KAKINADA-GOPALPUR SECTOR

SYSTEMATIC LIST

Class: CHONDRICHTHYES
Subclass: ELASMOBRANCHII
Order: LAMNIFORMES
Genus: Chiloscyllium Muller & Henle

1. Chiloscyllium griseum Muller & Henle

Order: RAJIFORMES
Family: DASYATIDAE
Genus: Dasyatis Rafinesque

2. Dasyatis walga (Muller & Henle)

Order: TORPEDENIDAE
Genus: Narcine Henle
3. Narcine brunnea Annandale

4. Narcine timlei (Bloch & Schneider)

5. Narke dipterygia (Bloch & Schneider)
   
   Class: OSTEICHTHYES
   Subclass: ACTINOPTERYGII
   Order: CLUPEIFORMES
   Family: CLupeidae
   Subfamily: Dussumieriinae
   Genus: Dussumieria Valenciennes

6. Dussumieria acuta Valenciennes

7. Dussumieria elongoides Bleeker
   
   Subfamily: CLupeinae
   Genus: Sardinella Valenciennes

8. Sardinella albella (Valenciennes)

9. Sardinella fimbriata (Valenciennes)
   
   Family: PRISTIGASTERIDAE
   Genus: Ilisha Richardson

10. Ilisha melastoma (Schneider)
    
    Genus: Opisthopterus Gill

11. Opisthopterus tardoore (Cuvier)
    
    Family: ENGRAULIDIDAE
    Genus: Coilia Gray

12. Coilia reynaldi Valenciennes
    
    Genus: Stolephorus Lacepede

13. Stolephorus commersonii (Lacepede)
    
    Genus: Thryssa Cuvier

14. Thryssa dussumieri (Valenciennes)
15. *Thryssa kammalensoides* Wongratana
16. *Thryssa mystax* (Schneider)
17. *Thryssa polybranchialis* Wongratana
18. *Thryssa setirostris* (Broussonet)
19. *Thryssa vitrirostris* (Gilchrist & Thompson)
   - Order: **ANGUILLIFORMES**
   - Family: **MURAENIDAE**
   - Genus: *Gymnothorax* Bloch

20. *Gymnothorax reticularis* Bloch
   - Family: **CONGRIDAE**
   - Genus: *Uroconger* Kaup

21. *Uroconger lepturus* (Richardson)
   - Order: **SILURIFORMES**
   - Family: **BAGRIDAE**
   - Genus: *Mystus* Scopoli

22. *Mystus gulio* (Hamilton-Buchanan)
   - Family: **ARIIDAE**
   - Genus: *Arius* Valenciennes

23. *Arius caelatus* Valenciennes
   - Order: **AULOPIFORMES**
   - Family: **SYNODIDAE**
   - Genus: *Saurida* Valenciennes

24. *Saurida longimanus* Norman
25. *Saurida micropectoralis* Shindo & Yamda
26. *Saurida tumbil* (Bloch)
   - Genus: *Trachinocephalus* Gill

27. *Trachinocephalus myops* (Schneider)
   - Order: **OPHIDIIFORMES**
   - Family: **OPHIDIIDAE**
   - Genus: *Brotula* Cuvier
28. **Brotula multibarbata** Temminck & Schlegel  
   Order: **LOPHIIFORMES**  
   Suborder: **LOPHIOIDEI**  
   Family: **LOPHIIDAE**  
   Genus: **Lophiodes** Goode & Bean

29. **Lophiodes mutilus** (Alcock)  
   Suborder: **ANTENNARIOIDEI**  
   Family: **ANTENNARIIDAE**  
   Genus: **Antennarius** Cuvier

30. **Antennarius hispidus** (Bloch & Schneider)  
   Family: **OGCOCEPHALIDAE**  
   Genus: **Halieutea** Valenciennes

31. **Halieutea stellata** (Vahl)  
   Order: **SYNGNATHIFORMES**  
   Family: **SYNGNATHIDAE**  
   Genus: **Hippocampus** Leach

32. **Hippocampus kuda** Bleeker  
   Family: **FISTULARIDAE**  
   Genus: **Fistularia** Linnaeus

33. **Fistularia petimba** Lacepede  
   Order: **SCORPAENIFORMES**  
   Suborder: **SCORPAENOIDEI**  
   Family: **SCORPAENIDAE**  
   Genus: **Apistus** Cuvier

34. **Apistus carinatus** (Bloch & Schneider)  
   Genus: **Minous** Cuvier & Valenciennes

35. **Minous coccineus** Alcock

36. **Minous inermis** Alcock

37. **Minous monodactylus** (Bloch & Schneider)  
   Genus: **Pterois** (Cuvier) Oken
38. Pterois mombasae (Smith)

39. Pterois russelli Bennett
   Family: Trigidae
   Genus: Lepidotrigla Gunther

40. Lepidotrigla riggsi Richards & Saksena
   Suborder: Platycephaloidei
   Family: Platycephalidae
   Genus: Grammoplites Fowler

41. Grammoplites scaber (Linnaeus)
   Genus: Platycephalus Bloch

42. Platycephalus indicus (Linnaeus)
   Genus: Rogadius Jordan & Richardson

43. Rogadius pristiger (Curvier)
   Genus: Sorsogona Herre

44. Sorsogona melanoptera Knapp & Wongratana

45. Sorsogona tuberculata (Cuvier)
   Genus: Suggrundus Whitley

46. Suggrundus rodericensis (Cuvier)
   Order: Dactylopteriformes
   Family: Dactylopteraidae
   Genus: Dactyloptena Jordan & Richardson

47. Dactyloptena macracanthus (Bleeker)
   Order: Perciformes
   Suborder: Percoidei
   Family: Priacanthidae
   Genus: Priacanthus Oken

48. Priacanthus tayenus Richardson
   Family: Apogonidae
   Genus: Apogonichthys Bleeker

49. Apogonichthys poeciloapterus Cuvier & Valenciennes
   Genus: Apogon Lacepede

50. Apogon (Nectamia) quadrifasciatus Cuvier
51. *Apogon (Nectamia) taeniatus* Cuvier & Valenciennes
   
   **Family**: Sillaginidae  
   **Genus**: Sillaginopodys Fowler

52. *Sillaginopodys chondropus* Bleeker
   
   **Genus**: *Sillago* Cuvier

53. *Sillago sihama* (Forsskal)
   
   **Family**: Lactaridae  
   **Genus**: Lactarius Valenciennes

54. *Lactarius lactarius* (Schneider)
   
   **Family**: Echeneidae  
   **Genus**: Echeneis Artedi

55. *Echeneis naucrates* Linnaeus
   
   **Family**: Carangidae  
   **Genus**: Alepes Swainson

56. *Alepes adjeddaba* (Forsskal)

57. *Alepes para* (Cuvier)
   
   **Genus**: Carangoides Bleeker

58. *Carangoides armatus* (Ruppell)

59. *Carangoides caerulopinnatus* (Ruppell)

60. *Carangoides malabaricus* (Bloch)
   
   **Genus**: Caranx Lacepede

61. *Caranx sexfasciatus* Quoy & Gaimard
   
   **Family**: Menidae  
   **Genus**: Mene Lacepede

62. *Mene maculata* (Bloch)
   
   **Family**: Leiognathidae  
   **Genus**: Gazza Ruppell

63. *Gazza minuta* (Bloch)
   
   **Genus**: Leiognathus Lacepede

64. *Leiognathus berbis* (Valenciennes)

65. *Leiognathus bindus* (Valenciennes)

66. *Leiognathus blochii* (Valenciennes)
67. **Leiognathus brevirostris** (Valenciennes)
   Genus: *Secutor* Gistel

68. **Secutor insidiator** (Bloch)
   Family: **Lutjanidae**
   Genus: *Lutjanus* Bloch

69. **Lutjanus malabaricus** (Bloch & Schneider)
   Family: **Nemipteridae**
   Genus: *Nemipterus* Swainson

70. **Nemipterus japonicus** (Bloch)

71. **Nemipterus randalli** Russell
   Family: **Gerreidae**
   Genus: *Gerres* Cuvier

72. **Gerres filamentosus** Cuvier

73. **Gerres macracanthus** Bleeker
   Family: **Haemulidae**
   Genus: *Pomadasys* Lacepede

74. **Pomadasys maculatus** (Bloch)
   Family: **Sciaenidae**
   Genus: *Dendrophysa* Trewavas

75. **Dendrophysa russelli** (Cuvier)
    Genus: *Johnieops* Mohan

76. **Johnieops sina** (Cuvier)
    Genus: *Johnius* Bloch

77. **Johnius dussumieri** (Valenciennes)

78. **Johnius carutta** Bloch
    Genus: *Kathala* Mohan

79. **Kathala axillaris** (Cuvier)
    Family: **Mullidae**
    Genus: *Upeneus* Cuvier

80. **Upeneus moluccensis** (Bleeker)

81. **Upeneus vittatus** (Lacepede)
    Family: **Drepanidae**
    Genus: *Drepane* Cuvier
82. **Drepane longimana** (Bloch & Schneider)
   Family: Pomacentridae
   Genus: Abudeuduf Forsskal

83. **Abudeuduf septumfasciatus** (Cuvier & Valenciennes)
   Family: Cepolidae
   Genus: Acanthocepola Bleeker

84. **Acanthocepola abbreviata** (Valenciennes)
   Suborder: Mugiloidei
   Family: Mugilidae
   Genus: Liza Jordan & Swain

85. **Liza melinoptera** (Valenciennes)
   Genus: Mugil Linnaeus

86. **Mugil cephalus** Linnaeus
   Genus: Valamugil Smith

87. **Valamugil buchanani** (Bleeker)
   Suborder: Sphyraenoidae
   Family: Sphyraenidae
   Genus: Sphyraena Rose

88. **Sphyraena obtusata** Cuvier
   Suborder: Polynemoidei
   Family: Polynemidae
   Genus: Polydactylus Lacepede

89. **Polydactylus konadaensis** Mishra & Krishnan
   Suborder: Labroidei
   Family: Labridae
   Genus: Halichoeres Ruppell

90. **Halichoeres nebulosus** (Valenciennes)
   Suborder: Trachinoidei
   Family: Opistognathidae
   Genus: Opistognathus Cuvier
91. **Opistognathus rosenbergii** Bleeker  
   **Family:** Uranoscopidae  
   **Genus:** Uranoscopus Linnaeus

92. **Uranoscopus cognatus** Cantor  
   **Suborder:** Blennioidei  
   **Family:** Blennidae  
   **Genus:** Istiblennius Whitley

93. **Istiblennius dussumieri** (Valenciennes)  
94. **Istiblennius edentulus** (Bloch)  
   **Genus:** Scartella Jordan

95. **Scartella emarginata** (Gunther)  
   **Suborder:** Ammodytoidae  
   **Family:** Ammodytidae  
   **Genus:** Bleekeria Gunther

96. **Bleekeria kallolepis** Gunther  
   **Suborder:** Gobioidae  
   **Family:** Eleotrididae  
   **Genus:** Bunaka Herre

97. **Bunaka gyrinoides** (Bleeker)  
   **Family:** Gobiidae  
   **Genus:** Bathygobius Bleeker

98. **Bathygobius fuscus** (Ruppell)  
   **Genus:** Parachaeturichthys Bleeker

99. **Parachaeturichthys polynema** (Bleeker)  
   **Suborder:** Scombroidei  
   **Family:** Trichiuridae  
   **Genus:** Trichiurus Linnaeus

100. **Trichiurus lepturus** Linnaeus  
   **Family:** Scombridae  
   **Genus:** Rastrelliger Jordan & Starks
101. **Rastrelliger kanagurta** (Cuvier)
   Order: Pleuronectiformes
   Suborder: Psettodoidei
   Family: Psettodidae
   Genus: Psettodes Bennett

102. **Psettodes erumei** (Schneider)
   Suborder: Pleuronectoidei
   Family: Bothidae
   Genus: Cephalopsetta Dutt & Rao

103. **Cephalopsetta ventrocellatus** Dutt & Rao
   Genus: Crossorhombus Regan

104. **Crossorhombus azureus** (Alcock)
   Genus: Pseudorhombus Bleeker

105. **Pseudorhombus elevatus** Ogilby
106. **Pseudorhombus triocellatus** (Bloch)
   Suborder: Soleoidei
   Family: Soleidae
   Genus: Heteromycteris Kaup

107. **Heteromycteris oculus** (Alcock)
   Genus: Synaptura Cantor

108. **Synaptura commersoniana** (Lacepede)
   Genus: Zebrias Jordan & Snyder

109. **Zebrias altipinnis** Alcock
   Family: Cynoglossidae
   Genus: Cynoglossus Hamilton-Buchanan

110. **Cynoglossus arel** (Schneider)
   Order: Tetraodontiformes
   Suborder: Balistoides
   Family: Triacanthidae
   Genus: Triacanthus Cuvier
111. Triacanthus brevirostris Schneider
   Family: Ostraciidae
   Genus: Tetrosomus Swains

112. Tetrosomus gibbosus (Linnaeus)
   Family: Tetraodontidae
   Genus: Lagocephalus Swainson

113. Lagocephalus lunaris (Bloch)
114. Lagocephalus spadiceus (Richardson)

SYSTEMATIC NOTES

The material studied has been collected from the inshore areas of Kakinada, Uppada, Danavaipeta, Pentakota, Revu Polavaram, Pudimadaka, Visakhapatnam, Konada, Mahfuzbhandaru, Kalingapatnam, Baruva and adjacent villages. The identified samples have been deposited with the Marine Biological Station, Zoological Survey of India, Madras. Length of the specimen means standard length, excepting the ones specifically indicated as TL (Total Length).

1. Chiloscyllium griseum Muller and Henle


*Material examined*: 2, 135-161 mm TL, collected from Baruva on 15.3.92.

*Distribution*: Indo-west Pacific: from the 'Gulf' to Malay archipelago, the Philippines, Papua New Guinea, China, Japan.

2. Dasyatis walga (Muller and Henle)


*Material examined*: 1, 340 mm TL, collected from Uppada on 29.2.29.

*Distribution*: Red Sea, India, Sri Lanka, through the East Indies to China.

3. Narcine brunnea Annandale


*Material examined*: 1, 145 mm TL, collected from Baruva on 15.3.92; 1, 182 mm TL, collected from Konada on 7.3.92.
Distribution: Seas of India, Malay archipelago.

4. Narcine timlei (Bloch and Schneider)
1801, Raja timlei Bloch and Schneider, Syst. Ichth. : 359.
Material examined: 1, 280 mm TL, collected from Visakhapatnam on 10.3.92.
Distribution: Seas of India, Malay archipelago.

5. Narke dipterygia (Bloch and Schneider)
1955. Narke dlpterygia : Munro, The marine and freshwater fishes of Ceylon : 17, pl. 2, fig. 49.
Material examined: 1, 98 mm TL ; 2, 90-124 mm TL, collected from Pentakota on 3. 3. 92.
Distribution: Seas of India to the Malay archipelago, China, Japan.

6. Dussumieria acuta Valenciennes
1847. Dussumieria acuta Valenciennes, Hist. nat. poiss., 20 : 467, pl. 606 (Bombay, Coromandel).
Material examined: 1, 113 mm, collected from Kakinada on 1. 3. 92.
Fin formula: B xiv, D. 19 ; A. 15 ; P. 14 ; V. 8 ; lower g. r. 21.
Distribution: Throughout the tropical Indo-Pacific.
Remarks: As most of the scales have fallen off before examination, lateral line scale count not given. Due to the presence of horizontal striae on exposed portion of scales and the body depth being 25% of standard length, the specimen is assigned to this species.

7. Dussumieria elopoides Bleeker
Material examined: 2, 146-155 mm, collected from Kalingapatnam on 13. 3. 92.
Fin formula: B xv ; D. 18 ; A. 16 ; P. 14 ; V. 8 ; LL 52-55 ; lower g. r. 26-27.
Distribution: Seas of India, Malay archipelago, China.
Remarks: This species differs from D. actua by a slender body (depth less than 22% of SL) and by the absence of horizontal striae on exposed portion of scales.

8. Sardinella albella (Valenciennes)
**Material examined:** 1, 110 mm, collected from Kakinada on 1. 3. 92; 6, 90-105 mm, collected from Kalingapatnam on 13. 3. 92.

**Fin formula:** B vi; D. ii. 16; A. 16-19; P. 15; V. 8; belly scutes 17-18+13-14; LL 40-42; lower g. r. 41-52.

**Distribution:** East coast of Africa, Red Sea, Seas of India, the East Indies to Taiwan.

9. **Sardinella fimbriata** (Valenciennes)


**Material examined:** 2, 71-73 mm, collected from Baruva on 13. 3. 92.

**Fin formula:** B. vi; D. 18; A. 19; P. 15; V. 8; LL 45; lower g. r. 60.

**Distribution:** Seas of India, Malay archipelago.

10. **Ilisha melastoma** (Schneider)


**Material examined:** 3, 113-118 mm, collected from Kakinada on 1. 3. 92; 1, 137 mm, collected from Kalingapatnam on 13. 3. 92.

**Fin formula:** B. vi; D. iii. 14; A. iii. 38-42; P. 15; V. 7; LL 43-44; belly scutes 17-20+8; lower g. r. 21-22.

**Distribution:** Seas of India, Sri Lanka, Indonesia to Hong Kong, north east coast of Australia.

11. **Opisthopterus tardoore** (Cuvier)


**Material examined:** 1, 164 mm, collected from Kalingapatnam on 13. 3. 92.

**Fin formula:** B. vi; D. ii. 11; A. ii. 50; P. i. 13; ventral scutes 30; LL 50; G R 10+25.

**Distribution:** Western and southern coasts of India, Sri Lanka, Indonesia.

12. **Coilia reynaldi** Valenciennes


**Material examined:** 2, 126-139 mm, collected from Kakinada on 1. 3. 92.
Fin formula: B. ix; D. I. iii. 11; A. ii. 98-110; P. xi-xii+6-7; V. i. 6; ventral scutes 9+9-10; lower g. r. 30-32.

Distribution: East coast of India, Myanmar.

13. Stolephorus commersonii Lacepede

1803. Stolephorus commersonii Lacepede, Hist. nat. poiss., 5: 381, pl. 12, fig. 1 (Mauritius)

Material examined: 1, 108 mm, collected from Uppada on 29. 2. 92; 3, 103-107 mm, collected from Kalingapatnam on 13. 3. 92.

Fin formula: B. x; D. iii. 12; A. iii. 18-20; P. i. 14; V. i. 6; LL 38-40; lower g. r. 23; pre-pelvic scutes 3-4.

Distribution: East coast of Africa, coasts of India, Malay archipelago, the Philippines to Samoa.

14. Thryssa dussumieri (Valenciennes)


Material examined: 1, 101 mm, collected from Danavaipeta on 3. 3. 92.

Fin formula: B. xii; D. I. iii. 11; A. iii. 31; P. i. 9; V. i. 6; keeled ventral scutes 15+7; lower g. r. 20.

Distribution: Coasts of Pakistan, India, Malay archipelago, the East Indies to Hong Kong.

15. Thryssa kammalensoides Wongratana

1983. Thryssa (Scutengraulis) kammalensoides Wongratana, Japan. J. Ichthyol., 29 (4): 401, fig. 20 (Godavary estuary)

Material examined: 1, 112 mm, collected from Uppada on 29. 2. 92.

Fin formula: B. xi; D. I. iii. 11; A. iii. 32; P. i. 12; V. i. 6; keeled ventral scutes 18+10; lower g. r. 24.

Distribution: Godavary estuary, East coast of India.

Remarks: Whitehead et al (1988) mention that there is no indication as to whether the fish is marine or riverine. The present specimen has been collected from the inshore waters of Uppada north of Kakinada approximately 50 km away from the type locality signifying the possibility of being marine.

16. Thryssa mystax (Schneider)

Material examined: 1, 123 mm, collected from Uppada on 29. 2. 92.

Fin formula: B. xiii-xiv; D. I. iii. 12; A. iii. 33-36; P. i. 12; V. i. 6; ventral scutes 17+11; lower g. r. 14-16.

Distribution: Coasts of India, Sri Lanka, Myanmar, the East Indies.

17. Thryssa polybranchialis Wongratana


Material examined: 1, 120 mm, collected from Uppada on 29. 2. 92.

Fin formula: B. xi; D. iii. 11; A. iii. 34; P. i. 11; V. i. 6; keeled ventral scutes 17+10; lower g. r. 25.

Distribution: The east and west coasts of India.

18. Thryssa setirostris (Broussonet)


Material examined: 2, 95-132 mm, collected from Uppada on 29. 2. 92; 1, 97 mm, collected from Kalingapatnam on 13. 3. 92.

Fin formula: B. x; D. I. iii. 12; A. iii. 34-35; P. i. 12-13; V. i. 6; ventral scutes 17+10; lower g. r. 10.

Distribution: Indo-west Pacific (wide spread).

19. Thryssa vitrirostris (Gilchrist and Thompson)


Material examined: 3, 124-134 mm, collected from Uppada on 29. 2. 92.

Fin formula: B. xii-xiii; D. I. iii. 11; A. iii. 32-33; P. i. 11-12; V. i. 6; lower g. r. 19-21; ventral scutes 16-18+10-11.

Distribution: From the east coast of South Africa to the coasts of India.

20. Gymnothorax reticularis Bloch


Material examined: 6, 245-295 mm TL, collected from Visakhapatnam on 10. 3. 92.

Distribution: Indo-west Pacific.
21. **Uroconger lepturus** (Richardson)


*Material examined*: 2, 225-300 mm TL, collected from Visakhapatnam on 10.3.92.

*Distribution*: Widespread in tropical Indo-west Pacific.

22. **Mystus gulio** (Hamilton-Buchanan)


*Material examined*: 3, 103-111 mm, collected from Mahfuzbhandaru on 11.3.92.

*Fin formula*: B. ix; D. I. 7; A. iii. 11; P. I. 9; V. i. 5.

*Distribution*: Pakistan, India, Bangladesh, Myanmar.

23. **Arius caelatus** Valenciennes


*Material examined*: 2, 138-171 mm, collected from Uppada on 29.2.92.

*Fin formula*: B. vi; D. I. 7; A. 19; V. i. 5.

*Distribution*: Pakistan, India, Sri Lanka, Bangladesh, Myanmar, Thailand, the East Indies.

24. **Saurida longimanus** Norman


*Material examined*: 5, 110-137 mm, collected from Visakhapatnam on 9.3.92.

*Fin formula*: B.xiii; D. 11-12; A. 11-12; P. 14; V. 9; LL 48-50.

*Distribution*: Gulf of Oman, north Arabian Sea, East coast of India.

25. **Saurida micropectoralis** Shindo and Yamada


*Material examined*: 1, 98 mm, collected from Baruva on 15.3.92.

*Fin formula*: B. xiii; D. 11; A. 11; P. 14; V.9; C.19; predorsal scales 18; LL 56; L, tr. 4/6.
Map-1. Kakinada-Gopalpur Sector
Distribution: East coast of India, Andaman Sea to South China Sea, the Philippines.

26. Saurida tumbil (Bloch)

1877. Saurida tumbil : Day, Fishes of India : 504, pl. 117, fig. 6.

Material examined: 1, 101 mm, collected from Visakhapatnam on 9.3.92; 1, 102 mm, collected from Danavaipeta on 3.3.92.

Fin formula: B. xiii; D. 12; A. 10-11; P. 14-15; V.9; C. 19; LL 55-56.

Distribution: East coast of Africa (excluding Kenya and Somalia), Madagascar, Red Sea, the Gulf, Pakistan, India, Sri Lanka, Malay archipelago, the East Indies, China Sea and southward to New South Wales (Australia).

27. Trachinocephalus myops (Forster)

1801. Salmo myops Forster in Bloch and Schneider, Syst. Ichth : 421 (St. Helena).

Material examined: 3, 85-193 mm, collected from Visakhapatnam on 10.3.92; 4, 93-116 mm, collected from Baruva on 15.3.92.

Fin formula: B. xvi; D. 12; A. 15; P. 12; V. 8; C. 18-19; LL 54-55.

Distribution: Worldwide in tropical and warm temperate waters.

28. Brotula multibarbata Temminck and Schlegel

1846. Brotula multibarbata Temminck and Schlegel, Fauna Japonica : 251, pl. 111, fig. 2 (Simbara Bay, Japan).

Material examined: 1, 62 mm TL, collected from Visakhapatnam on 10.3.62.

Fin formula: D+ A+C = 182; P. 22; V. 2.

Distribution: Indo-Pacific.

Remarks: The sample is a juvenile and the fin ray count is uncertain. Following the conclusions of Hubbs (1944, Copeia No.3, p. 162) the sample is assigned to this species.

29. Lophiodes mutilus (Alcock)

1893. Lophius mutilus Alcock, Journ. Asiatic Soc. Bengal, 62 : 179, pl. 10, fig. 2 (Bay of Bengal).

Material examined: 2, 110-124 mm TL, collected from Visakhapatnam on 9.3.92.
Fin formula: D. I+I+I+I+8; A. 6; P. 15-16; V. I. 5.
Distribution: East coast of Africa through India to East Indies.

30. Antennarius hispidus (Bloch and Schneider)
1801. Lophius hispidus Bloch and Schneider, Syst. Ichth.: 142 (Coromandel, India).
Material examined: 4, 53-71 mm, collected from Visakhapatnam on 9.3.92.
Fin formula: D. I+I+I+12; A. 7; P. 10; V. 5.
Distribution: South Africa, India, Malay archipelago to Hawaii.

31. Halieutaea indica Annandale and Jenkins
Material examined: 3, 61-85 mm, collected from Visakhapatnam on 9.3.92.
Fin formula: D. 4; A. 4; P. 13; V. 5.
Distribution: Bay of Bengal, New Guinea.

32. Hippocampus kuda Bleeker
Material examined: 1, 81 mm TL, collected from Baruva on 15.3.92.
Fin formula: D. 18; A. 4; P. 15; Rings 11+35.
Distribution: Indo-west Pacific, from coasts of India to Hawaii, north to Japan.

33. Fistularia petimba Lacepede
Material examined: 2, 262-300 mm, collected from Visakhapatnam on 10.3.92.
Fin formula: D. 13-14; A. 13; P. I. 14; V. 6.
Distribution: From the east coast of Africa through India to Malay archipelago, China, Japan, Southern Australia, Hawaii, the tropical Atlantic.

34. Apistus carinatus (Bloch and Schneider)
1801. Scorpaena carinata Bloch and Schneider, Syst. Ichth.: 193.
1875. Apistus carinatus: Day, Fishes of India: 155, pl. 37, fig. 4.
Material examined: 2, 62-65 mm, collected from Visakhapatnam on 9.3.92.
Fin formula: B. vi; D. XV. 9; A. III. 7; P. 10+1; V. I. 5; LL 55; L. tr. 7/15.
Distribution: South Africa, Mozambique, the Red Sea, the ‘Gulf’, India, Malay archipelago, from Japan in the north to Queensland in the south.
35. Minous coccineus Alcock


*Material examined:* 1, 107 mm TL, collected from Visakhapatnam on 9.3.92.

*Fin formula:* B. vii ; D. X. 12 ; A. 11 ; P. 11+1 ; V. I. 5 ; C. 10.

*Distribution:* South Africa, Red Sea, India up to Thailand.

36. Minous inermis Alcock


*Material examined:* 1, 101 mm TL. collected from Visakhapatnam on 9.3.92.

*Fin formula:* B. vii ; D. X. 12 ; A. 10 ; P. 11+1 ; V. I. 5 ; C. 10.

*Distribution:* Gulf of Oman, India, Myanmar.

37. Minous monodactylus (Bloch and Schneider)


*Material examined:* 1, 71 mm TL, collected from Visakhapatnam on 9.3.92 ; 2, 60-61 mm TL, collected from Baruva on 15.3.92.

*Fin formula:* B. vii ; D. X.11 ; A.10 ; P. 10+1 ; V.I.5 ; C. 10.

*Distribution:* Red Sea, the ‘Gulf’, coasts of India through Indonesia to China.

38. Pterois mombasae (Smith)


*Material examined:* 1, 144 mm, collected from Visakhapatnam on 9.3.92.

*Fin formula:* B.vii ; D.XIII.11 ; A.III.7 ; P. 18 ; V.I.5 ; C.14 ; LL.54 ; L.tr. 7/11.


39. Pterois russelli Bennett


*Material examined:* 1, 72 mm, collected from Baruva on 15.3.92 ; 1, 65 mm, collected from Visakhapatnam on 9.3.92.

*Fin formula:* B. vii ; D. XIII.11(12) ; A.III.8 ; P. 13 ; V. I. 5 ; C. 14 ; LL (above) 72 ; L.tr. 8/17.

*Distribution:* East coast of Africa, Mauritius, the ‘Gulf’, Pakistan, India, Malay archipelago ; South China, New Guinea, Western Australia.

*Remark:* In both the specimens ventrals are longer than head as they are
juveniles. We refrain from assigning them to *P. lunulata* Schlegel due to the presence of 10 inferior scales on the cheek.

40. **Lepidotrigla riggsi** Richards and Saksena


*Material examined*: 1, 80 mm, collected from Visakhapatnam on 10.3.92.

*Fin formula*: B.v; D.IX.15; P. 11+3; V.I.5; LL 58.

*Distribution*: Coasts of India and Andaman Sea.

41. **Grammoplites scaber** (Linnaeus)


*Material examined*: 1, 148 mm, collected from Pentakota on 3.3.92; 1, 124 mm, collected from Baruva on 15.3.92.

*Fin formula*: B.vi; D.I.VIII+12; A.12; P.20; V.I.5; LL 52-54; GR 1+5.

*Distribution*: Indo-west Pacific (from Pakistan eastwards).

42. **Platycephalus indicus** (Linnaeus)


*Material examined*: 3, 135-193 mm, collected from Mahfuzbhandaru on 11.3.92.

*Fin formula*: B.vii; D.I.VIII+13; P.18; A.13; V.I.5; LL 70; GR 2+8.

*Distribution*: Indo-west Pacific.

43. **Rogadius pristiger** (Cuvier)


*Material examined*: 5, 105-153 mm, collected from Visakhapatnam on 10.3.92.

*Fin formula*: B.vi; D.I.VIII+11; A.11; P.21; V.I.5; LL 53; GR 1+6-7.

*Distribution*: Indo-Pacific.

44. **Sorsogona melanoptera** Knapp and Wongratana


*Material examined*: 1, 77 mm, collected from Baruva on 15.3.92.
**Fin formula:** B. vi; D.IX+12; A 12; P. 21; V.I.5; LL 54, 14 anterior scales spinous; L. tr. 6/12; GR 2+9.

**Distribution:** Gulf of Oman to the Andaman Sea off Southern Thailand.

45. *Sorsogona tuberculata* (Cuvier)


**Material examined:** 4, 64-92 mm, collected from Baruva on 15.3.92.

**Fin formula:** B. vi; D.IX+11; A.11; P.20; V.I.5; C.15; LLp 55; LL spines 19-20; GR 1+7.

**Distribution:** From India to Australia through Thailand, Indonesia and the Philippines.

46. *Suggrundus rodericensis* (Cuvier)


**Material examined:** 4, 114-150 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula:** B. vii; D.IX+12; A.12; P.20; V.I.5; C.13; LLp 56; LL spines 19-20; GR 2+7.

**Distribution:** From Gulf of Oman to Australia.

47. *Dactyloptena macracanthus* (Bleeker)


**Material examined:** 4, 126-185 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula:** B. v; D.I+I+V+1+8; A.6; P.5.27; V.I.4; Sq.1.45; L.tr.21.

**Distribution:** South and east coast of India, Sri Lanka, Singapore, the Philippines, Ambon, Banda, Makassar, Menado.

48. *Priacanthus tayenus* Richardson


**Material examined:** 2, 112-124 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula:** B. vi; D. X. 12; A. III. 13; P. i. 16; LL 55-56; lower g. r. 17.

**Distribution:** Indo-west Pacific.
49. *Apogonichthys poecilopterus* (Cuvier and Valenciennes)


*Material examined*: 8, 66-93 mm, collected from Visakhapatnam on 10. 3. 92.

*Fin formula*: B. vii; D. VII+I. 9; A. II. 8; P. ii. 14; V. I. 5; C. 17; LL 25; L. tr. 1 1/6; GR 1+9-10.

*Distribution*: East coast of India to the Philippines, Japan.

50. *Apogon (Nectamia) quadrifasciatus* (Cuvier)

1986. *Apogon (Nectamia) quadrifasciatus*: Gon, *Smith’s Sea Fishes*: 552, pl. 49, fig. 175. 20.

*Material examined*: 4, 60-67 mm, collected from Visakhapatnam on 10. 3. 92.

*Fin formula*: B. vii; D. VII+I. 9; A. II. 8; P. ii. 13; V. I. 5; C. 17; LL 26-28; L. tr. 1 1/6; Pred. scales 5; GR 5+14.

*Distribution*: Indo-west Pacific.

51. *Apogon (Nectamia) taeniatus* (Cuvier)


*Material examined*: 1, 62 mm, collected from Visakhapatnam on 10. 3. 92.

*Fin formula*: B. vii; D. VII+I. 9; A. II. 8; V. I. 5; P. 15; C. 17; LL 27; L. tr. 2/7.

*Distribution*: Indo-west Pacific.

52. *Sillaginopodys chondropus* (Bleeker)


*Material examined*: 1, 112 mm, collected from Uppada on 29. 2. 92.

*Fin formula*: B. vi; D. XI+I. 22; A. II. 22; P. 15; V. I. 5; LL 71; L. tr. 6/11; lower g. r. 7.

*Distribution*: Indo-west Pacific.

53. *Sillago sihama* (Forsskal)

1876. *Sillago sihama*: Day, *Fishes of India*: 265, pl. 57, fig. 3.

*Material examined*: 1, 58 mm, collected from Pentakota on 3. 3. 92; 2, 152-
159 mm, collected from Mahfuzbhandaru on 11. 3. 92; 1, 94 mm, collected from Uppada on 15. 3. 92.

*Fin formula*: B. vi; D. X+I. 20-21; A. II. 21-22; P. 16-17; V. I. 5; LL 70-72; L. tr. 6/11; lower g. r. 7-8.

*Distribution*: Indo-west Pacific.

54. *Lactarius lactarius* (Schneider)


*Material examined*: 2, 94-98 mm, collected from Uppada on 29. 2. 92.

*Fin formula*: B. vii; D. VII+I. 21; A. III. 26; P. 17; V. I. 5; LL 75; GR 18.

*Distribution*: Indo-west Pacific.

55. *Echeneis naucrates* Linnaeus


*Material examined*: 1, 185 mm, collected from Baruva on 15. 3. 92.

*Fin formula*: B. vii; D. 26+40; A. 36; P. 20; V. 5; C. 17; lower g. r. 13.

*Distribution*: Red Sea, Seas of India, Malay archipelago, all tropical and temperate seas.

*Remarks*: A light blue band running from snout to caudal disappeared on preservation.

56. *Alepis djeddaba* (Forsskal)


*Material examined*: 2, 56-64 mm, collected from Baruva on 15. 3. 92.

*Fin formula*: B. vii; D. I. VIII+I. 23; A. II+I. 20; P. 21; V. I. 5; LL 77 (40 scutes); lower g. r. 29.

*Distribution*: Indian Ocean, Mediterranean, Red Sea.

57. *Alepis para* (Cuvier)


*Material examined*: 1, 121 mm, collected from Mahfuzbhandaru on 11. 3. 92.
Fin formula: B. vii; D. I. VIII+I. 23; A. II+I. 18; P. 20; V. I. 5; LL 80+4 (scutes 40+4); lower g. r. 28.

Distribution: Widespread in the Central Indo-Pacific.

Remarks: According to Smith-Vaniz (1984), generic allocation of this species is uncertain and that it might eventually be assigned to a separate monotypic genus. But the specimen examined conforms in toto to the description of Alepes Swainson and hence the erection of a separate monotypic genus is felt unnecessary. The presence of an unusual procumbent spine of 4.4 mm length in front of the anal fin may be a teratogenic phenomenon as there is no wear or tear of skin at that region.

58. Carangoides armatus (Ruppell)


Material examined: 1, 61 mm, collected from Baruva on 15.3.92.

Fin formula: B. vii; D. I. VIII+I. 22; A. II+I. 18; P. 21; V. I. 5; LL 32 in straight part; GR 10+22.

Distribution: East coast of Africa, Red Sea, Seas of India, Malay archipelago, Thailand, Hong Kong, Japan.

59. Carangoides caerulopinnatus (Ruppell)

1975. Carangoides caerulopinnatus : Sreenivasan, Indian J. Fish., 21 (1) : 24, fig. 2-5.

Material examined: 2, 50-75 mm, collected from Baruva on 15.3.92.

Fin formula: B. vii; D. I. VIII+I. 22; A. II+I. 18; P. 21; V. I. 5; LL scutes 18; OR 6+16.

Distribution: Indo-west Pacific.

60. Carangoides malabaricus (Bloch and Schneider)

1801. Scomber malabaricus Bloch and Schneider, Syst. Ichth. : 31 (Tranquebar, India).

Material examined: 1, 75 mm, collected from Konada on 7.3.92; 1, 63 mm, collected from Baruva on 15.3.92.

Fin formula: B. vii; D. I. VIII+I. 21-22; A. II+I. 18; P. 21; V. I. 5; LL scutes 33-35; OR 10+25.

Distribution: Indo-west Pacific.
61. *Caranx sexfasciatus* Quoy and Gaimard


**Material examined**: 1, 80 mm, collected from Mahfuzbhandaru on 11.3.92.

**Fin formula**: B. vii; D. I. VIII+I. 20; A. II+I. 15; P. ii. 18; V. I. 5; LL scutes 34; GR 7+16.

**Distribution**: Indo-west Pacific.

62. *Mene maculata* (Bloch)


**Material examined**: 1, 129 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula**: B. vii; D. iii. 42; A. 33; P. 15; V. I. 5; OR 6+23.

**Distribution**: Central tropical Indo-Pacific.

63. *Gazza minuta* (Bloch)


**Material examined**: 1, 68 mm, collected from Baruva on 15.3.92.

**Fin formula**: B. v; D. VIII. 16; A. III. 14; P. 18; V. I. 5; LL 40.

**Distribution**: Tropical Indo-Pacific.

64. *Leiognathus berbis* (Valenciennes)


**Material examined**: 1, 61 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula**: B. v; D. VIII. 16; A. III. 14; P. 17; V. I. 5.

**Distribution**: Indo-west Pacific.

65. *Leiognathus bindus* (Valenciennes)


**Material examined**: 1, 50 mm, collected from Baruva on 15.3.92.

**Fin formula**: B. v; D. VIII. 16; A. III. 14; P. 15; V. I. 5.

**Distribution**: Indo-west Pacific.
66. **Leiognathus blochii** (Valenciennes)


*Material examined:* 10, 66-71 mm, collected from Kakinada on 1.3.92.

*Fin formula:* B. v ; D. VIII. 16 ; A. III. 14 ; P. 15 ; V. I. 5 ; LL 52 ; L. tr. 8/21.

*Distribution:* Pakistan, India, Gulf of Thailand, the Philippines, Northern Australia.

67. **Leiognathus brevirostris** (Valenciennes)


*Material examined:* 2, 66-69 mm, collected from Danavaipeta on 3.3.92.

*Fin formula:* B. v ; D. VIII. 16 ; A. III. 14 ; P. 18 ; V. I. 5 ; C. 19 ; LL 53 ; lower g.r. 22.

*Distribution:* India, Sri Lanka, through the East Indies to China, the Philippines.

68. **Secutor insidiator** (Bloch)


*Material examined:* 3, 50-55 mm, collected from Kakinada on 1.3.92 ; 2, 74-81 mm, collected from Konada on 7.3.22 ; 2, 57-58 mm, collected from Kalingapatnam on 13.3.92.

*Fin formula:* B. v ; D. VIII. 16 ; A. III. 14 ; P. 17 ; V. I. 5.

*Distribution:* Indo-west Pacific.

69. **Lutjanus malabaricus** (Bloch and Schneider)


*Material examined:* 1, 83 mm, collected from Visakhapatnam on 10.3.92.

*Fin formula:* B. vii ; D. XI. 14 ; A. III. 9 ; P. 16 ; V. I. 5 ; C. 17 ; LL 58 ; L. tr. 8/21.

*Distribution:* Widespread in the tropical Indo-west Pacific.

70. **Nemipterus japonicus** (Bloch)


*Material examined:* 2, 100-110 mm, collected from Visakhapatnam on 10.3.92,
Fin formula:  B. vi ; D. X. 9 ; A. III. 7 ; P. ii. 15 ; V. I. 5 ; LL 48.
Distribution:  Indo-west Pacific.

71. Nemipterus randalli Russell

Material examined:  1, 93 mm, collected from Visakhapatnam on 10.3.92.
Fin formula:  B. vi ; D. X. 9 ; A. III. 7 ; P. ii. 16 ; V. I. 5 ; LL 45 ; L. tr. 7/10 ; GR 6+8.
Distribution:  East coast of Africa to East coast of India.

72. Gerres filamentosus Cuvier

Material examined:  2, 76-87 mm, collected from Uppada on 29.2.92 ; 2, 75-80 mm, collected from Mahfuzbhandaru on 11. 3. 92.
Fin formula:  B. vi ; D. IX. 10 ; A. III. 7 ; P. 15 ; LL 46.
Distribution:  Indo-west Pacific.

73. Gerres macracanthus Bleeker

Material examined:  1, 64 mm, collected from Kakinada on 1.3.92.
Fin formula:  B. vi ; D. IX. 10 ; A. III. 7 ; P. 15 ; V. I. 5 ; LL 42 ; L. tr. 6/11.
Distribution:  India, East Indies, New Guinea, the Philippines.

74. Pomadasys maculatus (Bloch)

1797. Anthias maculatus Bloch, Naturges. Ausland. Fische, (7) : 9, pl. 326, fig. 2 (East Indies).
Material examined:  1, 89 mm, collected from Konada on 7.3.92 ; 3, 59-70 mm, collected from Baruva on 15.3.92.
Fin formula:  B. vii ; D. XII. 14 ; A. III. 7 ; P. 16 ; V. I.5 ; LL 50 ; L. tr. 5/12.
Distribution:  Tropical Indo-west Pacific.

75. Dendrophysa russelli (Cuvier)

Material examined:  1, 119 mm, collected from Kakinada on 1.3.92.
Fin formula: B. vii ; D. X+I. 27 ; A. II. 7 ; P.i.16 ; V.I.5.

Distribution: India, Sri Lanka through the East Indies to Kwangtung.

76. Johnieops sina (Cuvier)


Material examined: 1, 129 mm, collected from Konada on 7.3.92.

Fin formula: B. vii ; D.X+I. 28 ; A. II.7 ; P.i.16 ; V.I.5 ; C.17 ; LL 49 +3 ; lower g.r. 15.

Distribution: Indo-west Pacific excluding East coast of Africa.

77. Johnius dussumieri (Valenciennes)


Material examined: 1, 107 mm, collected from Uppada on 29.2.92.

Fin formula: B. vii ; D.X+I. 25 ; A. II.7 ; P.i.16 ; V.I.5 ; LL 49 ; lower g.r.7.

Distribution: Indo-west Pacific.

78. Johnius carutta Bloch


Material examined: 1, 128 mm, collected from Danavaipeta on 3.3.92.

Fin formula: B. vii ; D.X+I. 29 ; A. II.7 ; P.i.17 ; V.I.5 ; C.17 ; LL 45.

Distribution: Pakistan, India, Sri Lanka, eastwards to the Malay Peninsula, Thailand.

79. Kathala axillaris (Cuvier)

1830. Corvina axillaris Cuvier, Hist. nat. pois., 5 : 113 (Malabar).

Material examined: 1, 103 mm, collected from Uppada on 29.2.92 ; 1, 96 mm, collected from Konada on 7.3.92 ; 1, 102 mm, collected from Visakhapatnam on 9.3.92.

Fin formula: B. vii ; D.X+I.27-28 ; A. II.7 ; P.i.16 ; V.I.5 ; C.17 ; LL 48-50 ; lower g.r. 21.

Distribution: India, Sri Lanka, Java, the Philippines, Southern China, Australia.
80. **Upeneus moluccensis** (Bleeker)


**Material examined**: 1, 100 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula**: B.iv; D.VIII+1.I.8; A.I.6; P.16; V.I.5; LL 36; L.tr. 2½/7; GR 9 + 19.

**Distribution**: The east coast of Africa (north of 12°S), the Red Sea, coasts of India, the East Indies, the Philippines, Japan, China to Australia; eastern Mediterranean (as immigrant)

81. **Upeneus vittatus** (Forsskal)


**Material examined**: 3, 100-106 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula**: B.iv; D.VIII+1.I.8; A.I.6; P.16; V.I.5; LL 34-37; L.tr.2½/7; GR 8 + 18.

**Distribution**: Indo-Pacific, eastward to French Polynesia.

82. **Drepane longimana** (Bloch and Schneider)


**Material examined**: 2, 43-46 mm, collected from Baruva on 15.3.92.

**Fin formula**: B.vi; D.VIII.22; A.III.19; P.17; V.I.5; C.18; LL 45.

**Distribution**: West and east coast of Africa, the Red Sea, Seas of India to Japan, New Guinea, Samoa.

83. **Abudefduf semifasciatus** (Cuvier and Valenciennes)


**Material examined**: 10, 14-17 mm, collected from Revu Polavaram on 4.3.92.

**Fin formula**: B.v; D.XIII.13; A.II.12; P.17; V.I.5; LL 29; L.tr.3/11.

**Distribution**: Indo-Pacific.

84. **Acanthocepola abbreviata** (Valenciennes)

Material examined: 2, 140-194 mm, collected from Visakhapatnam on 9.3.92.

Fin formula: B.vi; D.72-74; A.70-74; P.19; V.I.5; C.13.

Distribution: India, through the East Indies to China.

85. **Liza melinoptera** (Valenciennes)


Material examined: 1, 84 mm, collected from Uppada on 29.2.92; 3, 105-127 mm, collected from Mahafuzbhandaru on 11.3.92.

Fin formula: B.vi; D.IV+1.8; A.III.9; P.15; V.I.5: LL 30-31; L.tr.10.

Distribution: Indo-west Pacific. Inhabits shallow coastal waters; enters lagoons and estuaries.

86. **Mugil cephalus** Linnaeus


Material examined: 4, 104-122 mm, collected from Mahafuzbhandaru on 11.3.92.

Fin formula: B.vi; D.IV+1.8; A.III.8; P.16; V.I.5; LL 40-42; L.tr. 14.

Distribution: Worldwide, in temperate and tropical waters; inhabits seas, estuaries and rivers.

87. **Valamugil buchanani** (Bleeker)


Material examined: 2, 112-121 mm, collected from Mahafuzbhandaru on 11.3.92.

Fin formula: B.vi; D.IV+1.8; A.III.9; P.16; V.I.5; predorsal scales 15; LL 33; L.tr. 11.

Distribution: Indo-west Pacific; marine, entering rivers.

88. **Sphyraena obtusata** Cuvier


Material examined: 3 (juveniles), 55-63 mm, collected from Konada on 7.3.92; 1, 229 mm, collected from Kalingapatnam on 13.3.92.

Fin formula: B.vii; D.V+1.9; A.I.9; P.14; V.I.5; LL 90; GR 2.

Distribution: Indo-west Pacific.
89. **Polydactylus konadaensis** Mishra and Krishnan

*Material examined:* 2, 96-106 mm, collected from Konada on 7.3.92.

*Fin formula:* B.vii; D.VIII+I.12; A.III.11; P.15+6; V.I.5; C.17; LL 49; L.tr.5/10; pyloric caecae 16; GR 18+21.

*Distribution:* East coast of India, Konada in Andhra Pradesh.

*Remarks:* Description and other details reported elsewhere.

90. **Halichoeres nebulosus** (Valenciennes)


*Material examined:* 3, 32-55 mm, collected from Pudimadaka on 5.3.92.

*Fin formula:* B.vi; D.IX.11; A.III.11; P.ii.12; V.I.5; C.14; LL 28; L.tr.2/8.

*Distribution:* Red Sea, Coasts of India, Malay archipelago, the Philippines to Australia.

*Remarks:* Transverse scales 2/8 in all the three specimens examined while Day (1877: 400) recorded it as 3/12 and de Beaufort (1940: 218) as 1⅓ - 2/1/9-10.

91. **Opistognathus rosenbergii** Bleeker


*Material examined:* 1, 104 mm, collected from Visakhapatnam on 9.3.92.

*Fin formula:* B.vi; D.X.14; A.II.13; P.ii.19; V.I.ii.3; C.i11.i; LL 76; GR 11+23.

*Distribution:* Seas of India to Malay archipelago.

*Remarks:* The genus *Opistognathus* Cuvier is incorrectly spelled by most authors as *Opisthognathus*. Day (1876) recorded the species from Madras and described it as a rare occurrence.

92. **Uranoscopus cognatus** Cantor


*Material examined:* 6, 53-143 mm TL, collected from Visakhapatnam on 10.3.92.

*Fin formula:* B.vi; D.III.iii.11; A.13; P.i.16; V.I.5; LL 60-67.

*Distribution:* East coast of India, Malay archipelago.
93. *Istiblennius dussumieri* (Valenciennes)


*Material examined*: 16, 23-48 mm, collected from Revu Polavaram on 4.3.92; 7, 34-88 mm, collected from Pudimadaka on 5.3.92.

*Fin formula*: B.vi; D.XIII.20-21; A.II.22-23; P.13-14; V.I.2; C.ii.9.ii.

*Distribution*: Indo-Pacific.

94. *Istiblennius edentulus* (Bloch and Schneider)


*Material examined*: 1, 38 mm, collected from Revu Polavaram on 4.3.92.

*Fin formula*: B.vi; D.XIII.19; A.III.21; P.14; V.I.2; C.ii.9.ii.

*Distribution*: Indo-Pacific.

95. *Scartella emarginata* (Gunther)


*Material examined*: 2, 37-63 mm, collected from Pudimadaka on 5.3.92.

*Fin formula*: B.vi; D.XII.15; A.II.16; P.14; V.I.3; C.11.

*Distribution*: Southern Angola to India.

*Remark*: An Atlantic species supposed to have migrated along with warm water currents towards the east coast of India and established throughout the range.

96. *Bleekeria kallolepis* Gunther


*Material examined*: 1, 77 mm, collected from Baruva on 15.3.92.

*Fin formula*: B.vi; D.38; A.15; P.11; C.13; LL 100; L.tr.3/14.

*Distribution*: Coasts of India.

97. *Bunaka gyrinoides* (Bleeker)

Material examined: 1, 58 mm, collected from Visakhapatnam on 9.3.92.

Fin formula: B.vi; D.VI+I.8; A.I.8; P.16; V.I.5; LL 60; L.tr.17.

Distribution: India, Sri Lanka, the Philippines, Australia.

Remark: Pectoral rays 16 versus 18 or 19 as described by Day (1878: 313) and Koumans (1941).

98. Bathygobius fuscus (Ruppell)


Material examined: 5, 30-32 mm, collected from Revu Polavaram on 4.3.92; 1, 43 mm, collected from Pudimadaka on 5.3.92.

Fin formula: B.v; D.VI+I.9-10; A.I.8; P.i.18-19; LL 38; L.tr. 13.

Distribution: Indo-west Pacific.

99. Parachaeturichthys polynema (Bleeker)


Material examined: 9, 73-91 mm, collected from Visakhapatnam on 10.3.92.

Fin formula: B. v; D. VI+I. 10; A. I. 9; P. 20; LL 30; L. tr. 8; predorsal scales 12.

Distribution: South Africa, India, Japan, China, Australia.

100. Trichiurus lepturus Linnaeus

1758. Trichiurus lepturus Linnaeus (partim) (ex Artedi), Syst. Nat. (ed. 10): 246 (South Carolina).

Material examined: 2, 310-355 mm TL, collected from Visakhapatnam on 10.3.92.

Fin formula: B. vii; D. 133; A. 100 (spinules); P. 12.

Distribution: Throughout tropical and temperate waters of the world.

101. Rastrelliger kanagurta (Cuvier)

1817. Scomber kanagurta Cuvier, Regne Animal, 2: 313 (Vizagapatnam).

Material examined: 3, 65-75 mm, collected from Baruva on 15.3.92.

Fin formula: B. vi; D. VIII+I. 11+5 finlets; A. I. 11+5 finlets; P. 20; V. I. 5,

Distribution: Indo-west Pacific.
102. *Psettodes erumei* (Schneider)


*Material examined*: 1, 114 mm, eyes on left side, collected from Visakhapatnam on 9.3.92; 1, 128 mm, eyes on right side, collected from Visakhapatnam on 10.3.92.

*Fin formula*: B. vii ; D. 53-54 ; A. 39-40 ; P. 14 ; L. 6 ; LL 70-72.

*Distribution*: Indo-west Pacific.

103. *Cephalopsetta ventrocellatus* Dutt and Rao


*Material examined*: 1, 124 mm, collected from Visakhapatnam on 9.3.92.

*Fin formula*: B. v ; D. 65 ; A. 52 ; P. sin. 12 ; P. dextr. 10 ; V. 6 ; C. 6 ; LL 72 ; GR 7 + 17.

*Distribution*: East coast of India.

104. *Crossorhombus azureus* (Alcock)


*Material examined*: 3, 57-65 mm, collected from Baruva on 15.3.92.

*Fin formula*: B. vi ; D. 85-87 ; A. 65-68 ; P. 11 ; V. 6 ; LL 57-59.

*Distribution*: India, Sri Lanka.

105. *Pseudorhombus elevatus* Ogilby


*Material examined*: 1, 84 mm, collected from Danavaipeta on 3.3.92; 1, 85 mm, collected from Pentakota on 3.3.92.

*Fin formula*: B. vi ; D. 68-71 ; A. 53-54 ; P. sin. 11 ; P. dextr. 10 ; V. 6 ; LL 70-71.

*Distribution*: Indo-west Pacific.

106. *Pseudorhombus triocellatus* (Schneider)


*Material examined*: 1, 95 mm, collected from Uppada on 29.2.92; 1, 82 mm, collected from Pentakota on 3.3.92; 3, 81-85 mm, collected from Baruva on 15.3.92.
**Fin formula**: B. vi; D. 68-71; A. 50-51; P. sin. 12; P. dextr. 11; V. 6; C. 17; LL 65-70.

**Distribution**: Coasts of India, Sri Lanka, Malay archipelago.

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**107. **Heteromycteris oculus** (Alcock)

1889. *Solea oculus* Alcock, *J. Asiatic Soc. Bengal*, 58 (2) : 285, pl. 18, fig. 3.


**Material examined**: 3, 51-70 mm, collected from Baruva on 15.3.92.

**Fin formula**: B. vi; D. 94-95; A. 64-65; L. 5; LL 92-95.

**Distribution**: Coasts of India, Sri Lanka, possibly in Malay archipelago.

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**108. **Synaptura commersoniana** (Lacepede)


**Material examined**: 1, 131 mm, collected from Pentakota on 3.3.92.

**Fin formula**: B. vi; D. 73; A. 57; P. sin. 7; P. dextr. 7; V. 4; C. 12; LL 140.

**Distribution**: Seas of India through Myanmar to Malay archipelago.

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**109. **Zebrias altipinnis** (Alcock)


**Material examined**: 7, 122-205 mm, collected from Visakhapatnam on 9/10.3.92.

**Fin formula**: B. vi; D. 80; A. 68; P. sin. 11; P. dextr. 9; V. 5; C. 17; LL 118.

**Distribution**: East coast of India, Malay archipelago.

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**110. **Cynoglossus areal** (Schneider)


**Material examined**: 1, 154 mm, collected from Danavaipeta on 3.3.92; 1, 182 mm, collected from Visakhapatnam on 10.3.92.

**Fin formula**: D. 116; A. 86; V. 4; C. 11; LL 65; scales between LL 8.

**Distribution**: From the "Gulf" through the seas of India to the Philippines and Indonesia.
111. **Triacanthus brevirostris** Schlegel


*Material examined*: 3, 110-128 mm, collected from Visakhapatnam on 10.3.92.

*Fin formula*: B. vi ; D. V + 22-24 ; A. 18-19 ; P. 14 ; V. I ; C. 12.

*Distribution*: Seas of India through Malay archipelago to Japan.

*Remarks*: Hutchins (1984) considered *Triacanthus brevirostris* to be a synonym of *Triacanthus biaculeatus* (Bloch). But de Beaufort and Briggs (1962 : 270-274) described them as two distinct species. Since the material examined completely conforms to the description of *T. brevirostris* and differs considerably from *T. biaculeatus*, synonymy has not been taken cognizance of.

112. **Tetrosomus gibbosus** (Linnaeus)


*Material examined*: 2, 117-126 mm, collected from Visakhapatnam on 9/10.3.92.

*Fin formula*: D. 9 ; A. 9 ; P. 10 ; C. 10.

*Distribution*: Indo-west Pacific.

113. **Lagocephalus lunaris** (Bloch and Schneider)


*Material examined*: 1, 180 mm, collected from Baruva on 15.3.92.

*Fin formula*: D. i. 12 ; A. i. 10 : P. i. 15.

*Distribution*: Indo-west Pacific.

114. **Lagocephalus spadiceus** (Richardson)


*Material examined*: 2, 75-79 mm, collected from Konada on 7.3.92 ; 2, 130-140 mm, collected from Visakhapatnam on 9.3.92 ; 1, 64 mm, collected from Baruva on 15.3.92.

*Fin formula*: D. i. 12-13 ; A. i. 9-11 ; P. i. 15. i.

*Distribution*: Indo-west Pacific.
ZOOGEOGRAPHICAL REMARKS

The range of distribution of the species in analysis has been investigated to throw more light on the zoogeographical affinities of the coastal fish fauna of Kakinada-Gopalpur sector of the east coast of India. The samples in our collection have been arranged in six groups (Table 1) according to zoogeographical relationships.

Of the 114 species reported here, five species, viz. Trachinocephalus myops (Schneider), Fistularia petimba Lacepede, Echeneis naucrates Linnaeus, Mugil cephalus Linnaeus and Trichiurus lepturus Linnaeus (4.4%) are circumtropical in distribution. Fifty six species (49.1%) are widely distributed in the Indo-west Pacific region, ranging from the east coast of Africa to Malay archipelago or even extended up to Japan in north to Queensland in south.

Thirty eight species (33.3%) are spread over the Indo-Pacific province, i.e., from the coasts of India and/or extended up to the Gulf of Oman in west to Malay archipelago or beyond in east. Of this, Gymnothorax reticularis Bloch, Saurida micropectoralis Shindo and Yamda, Halieutea stellata (Vahl), Apogonichthys poecilopterus Cuvier and Valenciennes, Opistognathus rosenbergii Bleeker, Uranoscopus cognatus Cantor and Zebrias altipinnis Alcock are distributed westwardly up to the east coast of India and are yet to be reliably recorded from the west coast.

Twelve species (10.5%) are endemic to the Indian continental shelf waters. Out of them, four species, viz. Coilia reynaldi Valenciennes, Thryssa kammalenoides Wongratana, Polydactylus konadaensis sp. nov. and Cephalopsetta ventrocellatus Dutt and Rao are reported only from the east coast of India with the exception of C. reynaldi which has an extended range up to Myanmar coast. Other species of this group are Thryssa polybranchialis Wongratana, Mystus gulio (Hamilton-Buchanan), Saurida longimanus Norman, Minous inermis Alcock, Lepadotrigla riggsi Richards and Saksena, Sorsogona melanoptera Knapp and Wongratana, Bleekeria Kallolepis Gunther and Crossorhombus azureus (Alcock). M. gulio is more known to be an estuarine form. All these eight species are known from the coasts of India or in one or two cases extended up to the Gulf of Oman in the west and Myanmar in the east, but not extended further eastward to Malay peninsula.

The remaining three species (2.6%) namely, Thryssa vitrirostris (Gilchrist and Thompson), Nemipterus randalli Russell and Scartella emarginata (Gunther) are distributed from South African coast to the east coast of India.

Notably, the first three groups comprising 86.8% of the studied material are found in Malay peninsula and its adjacent shallow shelf waters. This region is considered to be the richest faunistic centre from which the other sub-divisions of the Indo-west Pacific region recruited their shore faunas (Ekman, 1953). In accordance
with the observations of Menon (1961) and Rama Rao (1972), the present study indicates that the Malayan area is the centre of evolution of the marine shore fish fauna of the Indo-west Pacific region and India undoubtedly derived its shore fish fauna from this centre of distribution.

Possibilities are more for *Thryssa vitritostris* (Gilchrist and Thompson) and *Nemipterus randalli* Russell to have originated somewhere between the Gulf of Oman and the Somali coast. The high saline warm water currents coupled with South-West Monsoon would have resulted in spreading of these species upto the east coast of India. The low saline gradients of the Gangetic fan could have been a possible deterrent to the extension of these peripheral species. This observation goes hand in hand with that of Briggs (1974) who inferred that species arising in the peripheral regions apparently have been unable to penetrate and successfully colonise the eco-stable evolutionary centre in the Malayan region. Further, a comparison of the deterrent action of the Gangetic fan may be made to the boundary effect of Kei river mouth in South Africa (Smith, 1949; Penrith, 1970). In addition, *Scartella emarginata* (Gunther), supposedly an Atlantic species also could have failed in its run because of the Gangetic fan effect.

**Summary**

The Kakinada-Gopalpur sector of the east coast of India was surveyed during 1992 and a systematic account of the fish collection is given. In all 114 species of fish are listed including a new species. A brief zoogeographical discussion of the shore fishes in the collection is also included in the paper.

**Acknowledgements**

The authors are thankful to the Director, Zoological Survey of India, Calcutta and the Scientist-SF-in Charge, Marine Biological Station, Madras for permission, facilities and encouragements. They are thankful to Dr. A. G. K. Menon, Emeritus Scientist for advise, comments and critical evaluation of the paper. Thanks are due to the Zonal Director, FSI and Officer-in-charge, CIFNET, Visakhapatnam for their help in the field. Several courtesies have been extended to us by the staff of MBS for which we are thankful. Dr. K. V. Rama Rao, FWBS, Hyderabad confirmed our identification of Scorpaenid fishes.

**References**


### Table 1. Range of distribution of species

| Area                                | Species serial number | Total/(%)
|-------------------------------------|-----------------------|-----------
| I. Circum tropical                  | 27, 33, 55, 86, 100.  | 5 (4.4%)  |
| II. Indo-west Pacific Region:       |                       |           |
| From East coast of Africa to west Pacific (Widespread) | 1, 2, 6, 8, 13, 18, 21, 26, 28, 29, 30, 34, 35, 37, 38, 39, 42, 43, 48, 50, 51, 52, 53, 54, 56, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 70, 72, 74, 77, 80, 81, 82, 83, 85, 87, 88, 93, 94, 98, 99, 101, 102, 105, 112, 113, 114. | 56 (49.1%) |
| III. Indo-Polynesian Province:      |                       |           |
| From Gulf of Oman to west Pacific.  | 3, 4, 5, 7, 9, 10, 11, 14, 16, 20, 23, 25, 31, 32, 41, 45, 46, 47, 49, 57, 66, 67, 73, 75, 76, 78, 79, 84, 90, 91, 92, 97, 106, 107, 108, 109, 110, 111. | 38 (33.3%) |
| IV. Indian continental shelf waters only. | 17, 22, 24, 36, 40, 44, 96, 104. | 8 (7.0%)  |
| V. East coast of India only.        | 12, 15, 89, 103.      | 4 (3.5%)  |
| VI. Western Indian Ocean; From East coast of Africa to East coast of India | 19, 71, 95. | 3 (2.6%)  |
ON A COLLECTION OF FISH FROM PUDUKKOTTAI, DISTRICT TAMIL NADU

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INTRODUCTION

Pudukkottai District lies by the Palk Strait in the Bay of Bengal between latitudes 9°-50''-30' N and 10°-44' N and longitudes 78°-25''-5' E and 79°-16' E. The District with an area of 4650 sq. km. (Map. 1) resembles a star fish with its five radiating arms. Dry open lands with cultivation and semi-barren wastelands form the basic terrain and there are no perennial rivers.

The studies are based on collections brought by two survey parties from S. R. S., Z. S. I. led by Shri T. S. N. Murthy and Dr G. Thirumalai, Scientists ‘SD’ who visited the area in 1985 and 1986 respectively. The collections included 952 fish specimens comprising 20 species belonging to 13 genera, 7 families and 5 orders.

The systematic list of the species and the systematic account of the species are provided which includes its first reference, the material examined, length range in mm SL, locality and date of collection, the distribution and remarks (wherever noteworthy observations are present).

LIST OF FISHES OF PUDUKKOTTAI DISTRICT

Order: CYPRINIFORMES
Family: CYPRINIDAE
Sub Family: RASBORINAE

1. Amblypharyngodon microlepis (Bleeker)
2. Esomus barbatus (Jerdon)
3. Rasbora (Rasbora) daniconius (Hamilton)

Sub Family: CYPRININAE

4. Puntius chola (Hamilton)
5. Puntius dorsalis (Jerdon)
6. Puntius sophore (Hamilton)
7. Puntius vittatus (Day)
Family: COBITIDAE
Sub Family: COBITINAE

8. *Lepidocephalus thermalis* (Valenciennes)
Order: Siluriformes
Family: BAGRIDAe
9. Mystus armatus (Day)
10. Mystus bleekeri (Day)
11. Mystus vittatus (Bloch)

Order: Atheriniformes
Family: Cyprinodontidae
12. Aplocheilus blockii (Arnold)
13. Oryzias melanostigma (McClelland)

Family: Poeciliidae
14. Gambusia affinis patruelis (Baird & Girard)

Order: Channiformes
Family: Channidae
15. Channa orientalis (Schneider)
16. Channa punctatus (Bloch)

Order: Perciformes
Family: Cichlidae
17. Etroplus maculatus (Bloch)
18. Etroplus suratensis (Bloch)
19. Orechromis mossambica (Peters)

Family: Gobiidae
20. Glossogobius giuris (Hamilton)

SYSTEMATIC ACCOUNT

1. Amblypharyngodon microlepis (Bleeker)


Remarks: Found mainly in road side fields and ponds; very small species; the juveniles resemble those of Rasbora but can be distinguished by the position of the anal fin which is inserted before or below the middle of dorsal in the former and below the posterior tip of dorsal in the latter; the scales are small and numerous in
Amblypharyngodon while in Rasbora, the scales are large and few in number (L1, scales 48; 24-33 in Rasbora). This can also be readily distinguished from A. mola (Ham.) by its lesser number of lateral transverse row of scales (4-5 in A. microlepis and 9-10 in A. mola), from A. melattina in its head length (H.L. less than 5 in T.L. in A microlepis and H.L. more than 5 in T.L. in A. melattina).

Distribution: “Hooghly through Orissa and down the Coramandal Coast in Madras”, (Day, 1875-78).

2. Esomus barbatus (Jerdon)

1849. Leuciscus barbatus Jerdon, Madras J, Lit. & Sci., 15 p. 322. (Type locality: Rivers and tanks all over Mysore and Carnatic).

Material: 1 ex., 36.0 mm SL, Melvelamgudi, Pudukkottai-Ponnamaravathi road, 20.1.1985; 1 ex., 36.0 mm SL, Melatemathapatti, Vellaru, 3.5.1986; 7 exs., 32.0-42.5 mm SL, Agniaru; 3 exs., 35.0-39.0 mm SL, Pudukkottai-Royavaram road, 6.5.1986; 70 exs., 15.0-26.0 mm SL, Thiruvanragulum R.F., 7.5.1986; 2 exs., 40.0-57.0 mm SL, Sengirai, Arimalam road, 13.5.1986 and 1 ex., 43.5 mm SL, Mallaieedu, 14.5.1986.

Remarks: In the present collection the L.I is complete in some specimens (L.I 34+2) and incomplete in some. In the number of predorsal scales (17-18) this is closer to E. barbatus, but the broad, black, lateral band reported to be absent in barbatus (Hora and Mukerji, 1928.) is present in these specimens. The length of maxillary barbel is found to vary, extending a little beyond pectoral base to as far as the anal base.

Distribution: India; Confined to South India. Recorded so far from Nellore district, Andhra Pradesh, Chingleput and Mysore.

3. Rasbora daniconius daniconius (Hamilton)

1822. Cyprinus daniconius Hamilton, Fish Ganges, p. 327, pl. 15, fig. 89. (Type locality: Rivers of Southern Bengal).


Remarks: The post dorsal distance in relation to the distance from eye to dorsal origin, a character used in distinguishing Rasbora caverii (Jerdon) and
R. daniconius (Ham.) is found to vary with the length of the fish. The present collections resemble R. daniconius (Ham.) in its greater post dorsal distance which when carried forwards falls before the posterior border of eye. However, in very small specimens this distance is found to be greater than in the adults, in which it falls on or just behind the posterior border of eye.

**Distribution**: Throughout India, Pakistan, Nepal, Bangladesh, Sri Lanka, Burma, Malay Archipelago, Zanzibar.

### 4. Puntius chola


**Material**: 8 exs., 36.0-51.0 mm SL, Pudukkottai-Royavaram road, 6.5.1986; 2 exs., 75.0-78.0 mm SL, Aranthangi, 9.5.1986 and 1 ex., 49.0 mm SL, Kundu aru, Malaiyedu, 14.5.1986.

**Remarks**: Colouration is as given by Day (1889), in addition in some specimens a faint lateral band is seen which extends to the blotch on the posterior end of caudal peduncle; scales with dark bases; dorsal spine strong but articulated at tip; 8-9 scale rows before the dorsal fin; sensory canal pores seen on head in smaller specimens.

**Distribution**: Throughout India, Pakistan, Bangladesh, Burma and Sri Lanka.

### 5. Puntius dorsalis (Jerdon)


**Remarks**: These juvenile specimens have a spot on the caudal peduncle (Day 1889 remarks that *B. tetraspilus* presently a synonym of *B. dorsalis*) differs in having a dark spot at the caudal fin in addition to the spot at the end of the dorsal base present in both species); numerous sensory canal pores are seen on cheek.

**Distribution**: Krishna, Cauvery, Coleroon river systems in India.

### 6. Puntius sophore (Hamilton)


**Material**: 1 ex., 30.0 mm SL, Melvelamkudi, Ponnamaravathi road, 20.1.1985; 1 ex., 36.5 mm SL, Thiruvarangulam R.F., 7.5.1986; 1 ex., 67.0 mm SL, Aranthangi,
9.5.1986; 5 exs., 28.0-45.0 mm SL, Nartha malai, 12.5.1986 and 9 exs., 43.0-52.5 mm SL, Kunduaru, Malaieedu, 14.5.1986.

**Remarks**: The present collections answer very much to the description of *Puntius stigma* (Val.) (Day, 1875-78) in the absence of barbels, the lateral transverse row of scales from L.1 to ventral base being 3½. However, since *P. stigma* has been synonymised with *P. sophore*, which has 4 barbels and 2½ rows of lateral transverse scales, the present collection is tentatively placed under *P. sophore*.

**Distribution**: Throughout India, Pakistan, Bangladesh, Sri Lanka.

7. *Puntius vittatus* Day


**Remarks**: Day (1875-78) remarks that the colour markings are highly variable in the species. In the present collection a vertical crescent shaped blotch is seen in mid dorsal, a spot on caudal base and in some a dark spot on anus; a thick pad is present on inside of lower jaw and tubercles are present on snout in some specimens; predorsal 6-7, L. tr. 4/3½.

**Distribution**: Karnataka, Kerala, Tamilnadu, Goa, Cutch, Rajasthan, Sri Lanka, Pakistan.

8. *Lepidocephalus thermalis* (Valenciennes)


**Remarks**: Colour variations are observed in the present collection especially in the caudal fin markings, the number of bands and their thickness in the caudal fin is
found to vary from a few thick bands to several narrow bands. Also the present specimens are deeper and head length smaller than that given for *L. thermalis* in Jayaram (1981).

**Distribution**: Southern Karnataka, Kerala, Tamil Nadu, Srilanka.

9. **Mystus armatus** (Day)


**Material**: 2 exs., 42.0 and 52.0 mm SL, Agniaru, 5.5.1986 and 6 exs., 64.0-78.0 mm SL, Pudukkottai-Royavaram road, 6.6.1986.

**Remarks**: The two specimens (fingerlings) have been tentatively identified as these answer to the description of *M. armatus*.

**Distribution**: Wynaad range of hills, Western Ghats, Cauvery Watershed, South India.

10. **Mystus bleekeri** (Day)


**Material**: 1 ex., 15.0 mm SL, Thirukonam and 1 ex., 27.0 mm SL, and Narthamalai, 12.5.1986.

**Distribution**: Throughout India, Pakistan, Bangladesh, Burma.

11. **Mystus vittatus** (Bloch)


**Material**: 2 exs., 51.0 and 57.0 mm SL, Thirukonam and hill slopes of Narthamalai, 21.1.1985.

**Distribution**: Throughout India, Pakistan, Burma, Thailand, Bangladesh and Sri Lanka.

12. **Aplocheilus blockii** (Arnold)


**Material**: 4 exs., 17.0-23.0 mm SL, Melvelamgudi, Ponnamaravathi road, 20.1.1985, 1 ex., 14.5 mm SL, Viralimalai road, 2.2.1985 ; 43 exs., 9.0-22.0 mm SL, Vellaru, Melatemathapatti, 3.5.1986 ; 43 exs., 12.0-20.0 mm SL, Agniaru, Pudukkottei-
Records of the Zoological Survey of India

Tanjore Road, 5.5.1986; 35 exs., 9.5-20.0 mm SL, Adanakkottai, 11.5.1986 and 1 ex., 16.0 mm SL, Narthamalai, 12.5.1986.

Description: C.5-7/11-12/5-7; P.1/12; V.1/5; D.2/5/1 A.2-3/12/1; L.1.25-27+3; L.tr. 7-7½; predorsal 21-22, prepelvic scale-11; Gill rakers 9.

Remarks: Aplocheilus blockii can be readily differentiated from A. lineatus (Val.) in the absence of prolonged pelvic ray and the bold vertical stripes on body. It can also be distinguished from A. panchax from its lesser lateral line count. (L.1 26-27, L.tr, 7 in A. blockii and L.1 31-34, L.tr, 9-10 in A. panchax)

Sexual dimorphism is seen as colour variation and in fin length. In males, lateral horizontal stripes are visible and the posterior dorsal and anal rays prolonged extending beyond caudal base. In the females, about eleven vertical stripes are visible from the back to the upper-third of body; a blotch (from 2nd to 5th ray base) in both the sexes.

Distribution: Fresh and brackish waters of Peninsular India.

13. Oryzias melanostigma (McClelland)


Remarks: D.1/5; P.1/9-10; V.1/5; C. (5/9/5); A.2/19-21; The posterior anal rays are found to be filiform in males and also the number of anal rays are more in the males.

Distribution: Throughout India, Burma, Pakistan, Ceylon.

14. Gambusia affinis patruelis (Baird & Girard)


Distribution: Throughout India, Pakistan, Bangladesh, Sri Lanka, Burma.

15. Channa orientalis (Schneider)

1801. Channa orientalis Schneider, Syst. Ichth., p. 496, pl. 90, fig. 2. (Type : locality : Not given).

Distribution: Throughout India, Pakistan, Afghanistan, Bangladesh, Sri Lanka, Burma, Thailand, Malay Archipelago, Vietnam.

16. *Channa punctatus* (Bloch)

1793. *Ophiocephalus punctatus* Bloch, *Naturg, Ausland, Fisch.*, 2, p. 139, pl. 356. (Type locality: Coromandal Coast.)

Material: 1 ex., 24.5 mm SL, Melvelamgudi, Ponnamaravathi road, 20.1.1985; 1 ex., 25.5. mm SL, Thirukonam, 21.1.1985; 1 ex., 24.5 mm SL, Thirumayam-Aresampatti, 22.1.1985; 1 ex., 60.0 mm SL, Vellaru, Melatemathapatti, 3.5.1986; 1 ex., 44.0 mm SL, Agniaru, 5.5.1986; 5 exs., 30.0-48.0 mm SL, Narthamalai, 12.5.1986 and 2 exs., 47.0-60.0 mm SL, Malaiededu, 14.5.1986.

Remarks: The pelvic fin is more than half length of pectoral fin and the pectoral fin has rows of spots unlike given in Jayaram (1981).

Distribution: Throughout India, Pakistan, Nepal, Bangladesh, Burma, Sri Lanka.

17. *Etroplus maculatus* (Bloch)

1785. *Chaetodon maculatus* Bloch, *Syst. Ichth.*, pl. 427, fig. 2. (Type locality: Not given).


Remarks: In this species also variation in colour pattern is seen in that there are specimens with only a single prominent lateral blotch while specimens exhibit the specific three spots. In darker specimens about five broad vertical bands are seen with the spotted area being a little broader and only slightly prominent, of these, the central spot is the most prominent.

Distribution: India, Tamil Nadu, Kerala, S. Kenara, Sri Lanka.

18. *Etroplus suratensis* (Bloch)


Distribution: India, fresh and brackish waters of Orissa, Madras, Malabar, Travancore, Cochin, Ceylon.
19. Oreochromis mossambica (Peters)


Remarks: In the young, several vertical bands are seen and the dorsal has a dark spot extending from the last spine to the fourth branched rays in the dorsal. In the adults, in some paler specimens the vertical bands are still discernible and no dorsal spots are present; some specimens are very dark.

Distribution: East Africa to Natal. Widely introduced in India and Pakistan.

20. Glossogobius giuris (Hamilton)

1822. Gobius giuris Hamilton, Fish Ganges, p. 51, 336, pl. 33, fig. 15. (Type locality: Ponds and freshwaters of Gangetic provinces).

Material: 1 ex., 51.0 mm SL, Kattumavadai, 1.1.1985; 1 ex., 70.0 mm SL, Vellaru, Melatemathapatti, 3.5.1986; 3 exs., 44.0-55.0 mm SL, Aranthangi, 9.5.1986 and 4 exs., 35.0-44.0 mm SL, Malaieedu, 14.5.1986.

Distribution: Throughout India, Pakistan, Burma, Bangladesh, Sri Lanka. This species has a wide range of distribution from the East Coast of Africa to Japan, Australia and S. Pacific.

Discussion

Since few perennial rivers occur in Pudukkottai District, collections could be had only from partly dry beds; stagnant pools, puddles and from artificial tanks. In all 20 species belonging to 13 genera, 7 families and 5 orders were recorded. Most of the species collected were small species which are suited for the dry conditions.

The larvivorous fish viz., Aplocheilus blockii, Oryzias melanostigma and Gambusia affinis were encountered in large numbers wherever they were present. Rasbora daniconius (Ham.) and Lepidocephalus thermalis were frequently encountered from the many collection sites.

The tanks in the District are stocked every year with fingerlings of Catla, Rohu, Mrigal and other carps collected from the Cauvery delta for fishery development and exploitation.
ACKNOWLEDGEMENTS

We wish to thank our Director and Officer-in-Charge, Southern Regional Station for providing the necessary facilities and to Dr A. G. K. Menon, Scientist for critically going through the manuscript.

SUMMARY

Results of studies on fishes of Pudukkottai District collected by Z. S. I. survey parties (mostly from temple tanks, puddles etc.) are presented. Some morphological observations on the species are also given.

REFERENCES


NOTES ON SOME DERMAPTERA FROM MALAYA WITH THE DESCRIPTION OF TWO NEW SPECIES

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The present paper is based on some material collected by one of us (D. Kovac) in the course of a broad study involving the fauna of bamboo internodes of *Gigantochloa scortechinii* Gamble in the Malay Peninsula. Twelve species (plus three additional ones identified only to genus level) are listed, two of which, belonging to the genera *Euenkrates* Rehn and *Proreus* Burr, are new to science. Biological observations on the new species are given. Most earwigs were found in internodes of dead bamboo culms, whereas two new species and *Spongovostox mucronatus* (Stal), occurred in living bamboo culms.

All the specimens including types are deposited in the Senckenberg Museum, Frankfurt, Germany except if otherwise stated.

**PYGIDICRANIDAE**

**ECHINOSOMATINAE**

*Echinosoma horridum* Dohrn


*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 6.11.1991, 1 ♀, 4.11.1991.

**ANISOLABIDIDAE**

**PLATYLABIINAE**

*Platylabia major* Dohrn

1867. *Platylabia major* Dohrn, Stettiner entomol. Z., 28 : 347 (1 ♀ ; Celebes).

*Measurements*: Length : body-7.5 mm, forceps-1.9 mm.

*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1 ♀, 26.10.1991.
Remarks: Out of the three known species of *Platylabia* Dohrn, this is the most widely distributed one in the Oriental region.

**Carcinophorinae**

**Euborellia** sp.

*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1♂, 22.3.1991.

*Remarks*: In the absence of a ♀ it is not possible to determine the specimen up to species level.

**Labiduridae**

**Allostethinae**

**Allostethella guttata** (Bormans)

(Fig. 2)


*Measurements*: ♂, Length: body –10.4-10.9 mm, forceps –1.8-2.0 mm; ♀, body –10.4-10.9 mm, forceps –1.8-2.0 mm.

*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1♂ (genitalia mounted between two coverslips and pinned with the specimen), 1♀, 30.6.1989; 1♂, 1♀ (genitalia mounted between two coverslips and pinned with the specimen), 1♀, 9.3.1991; 1♀, 23.11.1991; 1♀, 18.11.1991.

1♂, 1♀ deposited in the Zoological Survey of India, Calcutta.

*Remarks*: This species had hitherto been known only from its “Types”. This is the first record after a lapse of 92 years.

Srivastava (1993) has redescribed the species on the basis of the “Type” series and the present material agrees with it in all relevant details.

**Spongiphoridae**

**Spongiphorinae**

**Spongovostox mucronatus** (Stål)

(Fig. 3)


*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1♂, 1♀, 7.6.1991.
Figs. 1-10. *Platylabia major* (Dohrn), ♀, (1) Ultimate tergite and forceps; *Allostethella guttata* (Bormans), ♂, (2) Genitalia; *Spongovostox mucronatus* (Stål), ♂, (3) Ultimate tergite and forceps; *Paralabe/la curvicauda* (Motschulsky), ♂, (4) Genitalia; *Chaetospania feae* Bormans, ♂, (5) Ultimate tergite and forceps, (6) Genitalia; *Chaetospania feuernborni* Günther, ♂, (7) Ultimate tergite and forceps, (8) Pygidium, enlarged, (9) Genitalia; *Chaetolabia* sp., ♀; (10) Ultimate tergite and forceps.
LABIINAE

Paralabella curvicauda (Motschulsky)
(Fig. 4)


*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1 ♀, 26.10.1991; 2 ♀ ♀, 23.10.1991; 1 ♂, 24.10.1991; 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 1 ♀, 7.11.1991.

*Remarks*: In the investigated material the male genitalia were found to have a short virga and some chitinous accessory plates.

Chaetospania feae Bormans
(Fig. 5-6)


*Measurements*: ♂ Length: body - 5.2-6.5 mm, forceps - 2.2-2.4 mm; ♀ Length: body - 6.5-7.5 mm, forceps - 1.6-1.8 mm.

*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 1 ♀, 15.3.1989; 1 ♀, 25.9.1991; 1 ♀, 12.10.1991; 1 ♂, 23.10.1991; 1 ♂, 7.11.1991.

*Remarks*: In the present material the ♂ pygidium is declivious at its base, afterwards rectilinear; it is apically narrowed with the hind margin concave. The inner tooth of the forceps is feebly marked.

Chaetospania thoracica (Dohrn)


*Material examined*: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 22.3.1991.

Chaetospania feuerborni Günther
(Figs. 7-9)

1933. *Chaetospania feuerborni* Günther, *Arch. Hydrobiol.*, 12 (Suppl.): 512, fig. 10 (1 ♂; Java).

*Measurements*: ♂ ♀ Length: body - 6.0-8.1 mm, forceps - 3.0-3.5 mm.
Euenkrates brindlei sp. n., female with eggs.
Proteus pygidiatus sp. n., female with eggs.
Internodes of bamboo, *Gigantochloa scortechinii* with a hole made by the larva of chrysomelid beetle, *Lasiochila goryi* (size of the hole: 7x3 mm, diameter of internode: 10.5 cm).
**Material examined**: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 2 ♂ ♂ (1 ♂ with genitalia mounted between two coverslips and pinned with the specimen), 7.11.1991.

**Chaetolabia sp.**

(Fig. 10)

**Material examined**: MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 2 ♀ ♀ , 4.10.1991.

**CHELISOCHIDAE**

**CHELISOCHINAE**

**Euenkrates brindlei** sp. n.

(Figs. 11-19)

♂: General colour blackish brown; head and pronotum orange; antennae dark blackish brown with 11th and 12th segments yellowish white; legs yellow, fore femur and middle femur in basal two fifth brownish black; elytra yellowish with uniform shade of black, hind wings black; abdomen, forceps brown with shades of black in varying intensity.

Head slightly longer than broad, smooth, impunctate, frons and occiput feebly convex, sutures obsolete, in place of transverse suture a depression, hind margin hardly emarginate in middle. Eyes small, shorter than post-ocular area. Antennae 16-segmented, 1st segment stout, gently expanded apically, slightly longer than the antennal bases; 2nd small; 3rd long and slender; 4th about as long as the preceding but slightly stouter; 5th onwards longer and slender.

Pronotum slightly longer than broad, smooth and impunctate, sides straight, hind margin rounded, prozona feebly raised and metazona depressed, median sulcus faintly marked. Elytra and wings well developed, both smooth and impunctate, former with hind margin concave posteriorly. Legs typical for the genus, fore tibiae in apical 1/3 deplanate, middle and hind tibiae deplanate at extreme apex, hind tarsi with 1st and 3rd segments almost equal in length.

Abdomen feebly convex and extremely finely punctate, lateral folds on 3rd tergite feebly, on 4th distinctly marked. Penultimate sternite punctate, hind margin truncate, medially with a faint linear groove, manubrium short. Ultimate tergite transverse, sides straight, posterior angles a little projecting, with margin in middle straight and laterally, above the bases of the forceps, feebly concave, smooth, impunctate, with low tumid elevation above the bases of the forceps and depressed in middle, with two pairs of compressed tubercles, median sulcus faint and short. Pygidium slightly longer than broad, sides straight, turned upwards apically, with hind margin obtusely rounded.
Forceps long and slender, with a few shallow, remotely placed punctations, almost straight, gently narrowed apically with tips pointed and hooked, trigonal near base,

afterwards rounded in cross-section, internally armed with a triangular tooth in basal 1/3. Genitalia as in Figs. 17 and 18.

♀: Agrees with males in most characters except that punctuation on abdominal tergites more pronounced; pygidium broader at base, declivious, afterwards rectilinear, longer than broad, sides parallel, with margin wavy, hind margin concave, with angles a little projecting externally; forceps with inner margin finely serrated.

**Measurements:** Holotype ♂, Length: head - 1.5 mm, pronotum - 1.4 mm, elytra - 2.7 mm, wings - 1.1 mm, body - 10.8 mm, forceps - 5.1 mm; Width: head - 1.4 mm and pronotum -- 1.5 mm.

Paratypes ♂ ♂, Length: body - 8.4-12.6 mm, forceps - 6.0-6.5 mm; ♀ ♀, Length: body - 8.1 - 10.7 mm, forceps - 4.5 - 4.6 mm.

**Material examined:** MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, Holotype ♂ (genitalia mounted between two coverslips and pinned with the specimen), 30.6.1989; Paratypes, 1 ♀, 30.6.1989; 1 ♀, 9.2.1991; 2 ♂ ♂, 1 ♀, 26.9.1991; 2 ♂ ♂, 28.9.1991; 1 ♂, 1.10.1991; 2 ♂ ♂, 3 ♀ ♀, 10.10.1991 and 4 ♂ ♂, 23.10.1991.

Paratypes 2 ♂ ♂, 1 ♀ deposited in the Zoological Survey of India, Calcutta.

**Remarks:** The described species is similar to *Euenkrates variegatum* (Kirby, 1891) from West Africa and *Euenkrates simplex* Ramamurthi, 1967 from Bismarck Islands. It differs from both, in males, by the shape of the pygidium being longer than broad and turned upwards apically, with the posterior margin obtuse in the middle. It can be further distinguished from *E. variegatum* by the uniformly coloured elytra and from *E. simplex* by its long and slender forceps, armed with a minute tooth in basal 1/3.

It can be easily separated from *Euenkrates boesmani* Steinmann, 1981, known from a single female from Sumatra, by female pygidium being longer than broad.

**Biology:** *E. brindlei* was the most common earwig species found in bamboo internodes. This species colonized live bamboo internodes up to 3 metres above ground as well as internodes of dead bamboo stems. Pubescence on their tarsi enables these animals to walk on the smooth bamboo stems, in contrast to other earwig species that were found in the leaf litter. The internodes were entered through holes made by various wood-boring insects, such as Coleoptera (Cerambycidae: *Abyrna regispetri* Paiva; Chrysomelidae: *Lasiochila goryi* (Guér.) and Lepidoptera (Pyralidae), and by woodpeckers. The smallest hole used for entering an internode, made by a pyralid larva, was 2x3 mm (height 2.70 m). All internodes colonized by *E. brindlei* were filled with rain water. In a few cases, internodes inhabited by *E. brindlei* were detected by constantly moving antennae of these animals protruding from the entrance holes.

After copulation the males leave the internode and the females lay their eggs in a
cluster of 20–30 (n = 5), always close to the water surface. The females guard the eggs until the nymphs hatch. If the water level rises due to rainfall or the eggs fall onto the water surface, the female stretches out from the edge to retrieve the eggs and place them above the water surface again. After the eggs are hatched the nymphs stay together with the female for c. 1-2 weeks. Afterwards, most of the nymphs disperse and colonize other internodes. One individual was seen to feed on decaying organic material.

In the course of a 6-month field study, during which one hundred (dead) bamboo internodes were checked daily (Kovac & Streit in prep.) there were a total of 33 observations of predation on E. brindlei. The majority of these (both nymphs and adults) fell victim to combfooted spiders (Theridiidae, n = 24). On two occasions freshly moulted adult earwigs were caught by an internode-inhabiting jumping spider (Salticidae: Sparteinae). The jumping spider was also seen to feed on the eggs of E. brindlei. In two cases the eggs were sucked out by true bugs (Heteroptera: Miridae and Veliidae). In the case of the veliid water strider, Baptista sp., the eggs had first fallen onto the water surface. The remaining victims of predation were one adult earwing caught by a fly larva (Mycetophilidae) with the help of its slime-net and earwig nymph that was caught by predaceous mosquito larva (Toxorhynchites) after falling onto the water surface.

The anti-predator defense of the earwigs is flight; on occasion, both adults and nymphs of E. brindlei may even flee below the water surface for a brief time. This behavior has been observed also in Proreus pygidiatus and Allostethella guttata. In the latter species one individual remained submerged for several minutes.

**Proreus pygidiatus** sp. n.

(Figs. 20-32)

♂: General colour brownish black, head and pronotum yellowish with shades of black on sides of occiput; antennae dark black with one or two pre-apical segments yellowish white; elytra and wings yellowish black; legs yellow with basal half of femora and two thirds of tibiae black; abdominal tergites brownish black and hind margin of ultimate tergite, pygidium and forceps black.

Head slightly longer than broad, smooth and impunctate, frons depressed, occiput raised with a pair of faint oblique grooves on each side, sutures obsolete, the transverse suture marked by the raised margin of occiput. Eyes small. Antennae 17-segmented, 1st segment stout, gently expanded apically, almost equal in length to distance between antennal bases; 2nd short; 3rd long and cylindrical; 4th a trifle shorter than preceding but slightly stouter; 5th slightly longer than 3rd and stouter, remaining gradually increasing in length and thinning.
Pronotum about as long as broad, smooth and impunctate, anterior margin convex in middle with lateral angles a little projecting externally, sides straight, hind margin rounded, prozona raised and metazona depressed, median sulcus distinct and present along the entire length. Legs typical for the genus, tibiae sulcate in apical 1/4, hind tarsi with 1st segment almost equal to 3rd. Elytra and wings well developed, both smooth and impunctate, former with hind margin concave.

Abdomen long and slender, convex above, tergites smooth and impunctate. Penultimate sternite with posterior margin truncate in middle, obscurly punctulated. Ultimate tergite transverse, smooth, impunctate and convex above, sides straight, strongly declivous in posterior 1/4, at this point in middle with two pairs of compressed tubercles, of which inner pair situated on either side of middle line. Pygidium transverse, declivious, hind margin concave in middle with a point above posterolaterally and below a little posteriorly another small tubercle present. Forceps (in cyclolabic ♂) short, stout, depressed, incurved in apical 1/2, narrowed apically, with tip pointed and hooked, internally at base above with a large triangular tooth, in apical 2/3 another small tooth below present and (in macrolabic form) slightly elongated. Genitalia as seen in Fig. 27.

♀: Agrees with ♂ in most characters except that head with frons and occiput depressed and sutures finely marked; abdominal tergites finely punctulated; pygidium longer than broad, declivious at base, afterwards rectiliner, sides serrated with hind margin truncate and forceps simple and straight with internal margin serrated.

Measurements: Holotype ♂ (cyclolabic), Length: head - 1.5 mm, pronotum - 1.5 mm, elytra - 2.7 mm, wings - 0.9 mm, body - 9.7 mm, forceps - 2.3 mm; Width: head - 1.4 mm, pronotum - 1.4 mm.

Paratypes, ♂ ♂ (cyclolabic), Length: body - 7.8 - 9.6 mm, forceps - 1.8 - 2.0 mm; ♂ ♂ (macrolabic), Length: body - 8.3 - 9.3 mm, forceps - 2.2 - 2.8 mm; ♀ ♀, Length: body - 8.2 - 9.9 mm, forceps - 2.7 - 3.0 mm.


Paratypes 2 ♂ ♂, 2 ♀ ♀ deposited in the Zoological Survey of India, Calcutta.

Remarks: Some variations are noted in the shape and length of antennal
Fig. 20-32. Proreus pygidiatus sp. n., Holotype ♂ (cycloabic). (20 and 21) A few basal segments of right and left antennae, (22) Hind leg, enlarged. (23) Anterior portion of body and abdomen, (24) Penultimate sternite, (25) Hind portion of body with last four tergites, pygidium and forceps, (26) Hind portion of ultimate tergite, pygidium and basal portion of forceps, enlarged. (27) Genitalia; Paratype ♂ (macrolabic), (28) A few basal antennal segments, (29) Last two tergites, pygidium and forceps, (30) Hind portion of ultimate tergite, pygidium and basal portion of forceps, enlarged; Paratype ♀, (31) Ultimate tergite and forceps; (32) Pygidium, enlarged.
segments, especially 3rd and 4th, which may represent typical form on one side and on the other may be less stout and cylindrical.

In macrolabic males pygidium is distinctly concave posteriorly with posterolateral angles sharply pointed and forceps as usual more elongated.

This species comes close, in macrolabic males, to Proreus corporaali Boesman, 1954 from Sumatra but differs by the shape of ultimate tergite provided with two pairs of compressed, distantly placed tubercles in middle and pygidium concave posteriorly with angles produced into sharp point.

Besides, it has close resemblance with Proreus variopictus (Bormans, 1900), known from Sumatra, in having short and stout forceps, in cycloabic males, but differs by the shape of pygidium, inner armature of forceps and paramers.

Biology: P. pygidiatus was the second most common species in bamboo internodes. It appears to prefer dead internodes, but in one case was also discovered in a live internode at a height of 1.7 m. The females of P. pygidiatus preferably lay their eggs into crevices within the internode wall, if present, whereas the eggs of Euenkrates brindlei are deposited openly on a horizontal surface. The principle predators of P. pygidiatus likewise are spiders of the family Theridiidae.

Laprophorella kervillei (Burr)  
(Figs. 33-39)

1913. Lamprophorus kervillei ; Burr, Rec. Indian Mus., 8 : 143 (India: Arunachal Pradesh and Assam).

Measurements: Length : body - 10.5 mm ; forceps - 2.1 mm.

Material examined: MALAYA: Selangor, Genting Highlands, c. 1000 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 28.2.1991.

Remarks: The original description of the species is based on 1 ♂, 1 ♀ from Java. It has been subsequently recorded from India by Burr (1913) on the basis of 2 ♀ ♀ from Rotung and 1 ♂ from Dosing (Arunachal Pradesh) and 3 ♂ ♂, and 3 ♀ ♀ from Dibrugarh (Assam).

A part of the Burr’s material, i.e., 1 ♀ from Rotung and 1 ♂, 1 ♀ from Dibrugarh and other specimens from Darjeeling dist., W. B. preserved in the Zoological Survey of India, Calcutta were examined. The Figs. 33-34 are based upon this material.

In comparison with Figs. 38-39 from the present material, the shape of ♂ pygidium and genitalia (especially parameres) are slightly different. In all other details both samples are identical.
Since the \( \delta \) genitalia of holotype is not yet known it is difficult to say which of the two lots really belong to this species.

Figs. 33-41. *Laprophorella kervillei* (Burr), \( \delta \) (Indian specimen), (33) Ultimate tergite and forceps, (34) Genitalia, \( \delta \) (Malayan specimen), (35) A few basal antennal segments, (36) Head and pronotum, (37) Hind tarsi, enlarged (38) Ultimate tergite and forceps, (39) Genitalia; *Eparcmenus forcipatus* (Haan), \( \delta \), (40) Anterior portion of body, (41) Ultimate tergite and forceps.
A brief description of the present ♂ is provided which would help in defining the proper identity of the species.

Head, antennae, elytra, wings and sides of certain abdominal tergites dark brownish black; pronotum and legs yellowish and abdomen and forceps dark brown with shades of black on certain parts. Head depressed, sutures obsolete. Pronotum about as long as broad, anteriorly convex and angles feebly projecting, sides almost straight and hind margin broadly rounded. Elytra and wings well developed. Legs with 1st hind tarsal segment compressed and slightly shorter than third, second produced below the third as narrow projection. Ultimate tergite, pygidium, forceps and genitalia as seen in figs. 35-39.

Hamaxas sp.

**Measurement:** Length: body – 8.9 mm; forceps – 1.5 mm.

**Material examined:** MALAYA: Selangor, Ulu Gombak Field Studies Centre, 250 m, 1 ♀, labelled as Hamaxas sp.

**Remarks:** Since the taxonomy of the whole Order is based on males it is often difficult to determine isolated females up to species level.

In having the body covered with long and short pubescence and punctated elytra and wings, the above specimen is referrable to Hamaxas Burr.

**FORFICULIDAE**

**Opisthocosmiinae**

Eparchus forcipatus (Haan)  
(Figs. 40-41)


**Material examined:** MALAYA: Selangor, Genting Highlands, c. 1000 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 4 ♂ ♂, 2 nymphs, 28. 2. 1991; 1 ♂, 1 ♀, 23. 3. 1991; 2 ♀ ♀, 15. 3. 1991; 1 nymph, 7. 11. 1991.

1 ♂, 1 ♀ deposited in the Zoological Survey of India, Calcutta.

**Acknowledgements**

Dr. G. K. Srivastava is thankful to the Director, Zoological Survey of India, Calcutta for necessary facilities during the course of study and preparation of this paper.
Dr. D. Kovac would like to thank Prof. H. S. Yong, Dr. F. W. Fong and Dr. I. Azarae, University of Malaya, for supplying the facilities of the Ulu Gombak Field Studies Centre. The project was supported by funds of the Deutscher Akademischer Austauschdienst (DAAD) and Deutsche Forschungsgemeinschaft (DFG).

REFERENCES


NOTES ON A NEW RECORD OF AN ICHNOFOSSIL FROM TRICHINOPOLY CRETACEOUS (SOUTH INDIA)

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INTRODUCTION

In the district faunal survey programme, the authors have incidentally surveyed the Trichinopoly Cretaceous beds of Tiruchirapalli district in Tamil Nadu (Fig. 1) and made collections of fossils for the museum of the station. In the Ottokovil "Echinoid" beds (Ariyalur stage of Trichinopoly Cretaceous) (Fig. 2), the authors found few Ichnofossil remains on one rock. It was not possible for the party to break the substratal sedimentary rock, and therefore, it was felt desirable to photograph them at least for posterity and record, before they are lost.

The first author had surveyed these beds earlier as the Head of the Palaeozoology Division of the Zoological Survey of India and published a number of papers including the descriptions of some new species and a new genus. A comprehensive work on the fossil fauna of Trichinopoly Cretaceous is available in Pascoe (1959) and Anonymous (1968). Only one trace fossil (Chiplonkar & Tapaswi, 1975) is known from the Trichinopoly Cretaceous prior to the present find.

It may not be out of place to mention here that some of the areas from where collections were made earlier are now depleted of their fossil fauna, while some new areas have yielded species because of quarrying of hitherto, unexploited areas.


These reports are mostly from Vindhyans, Punjab, Rajasthan, Pondicherry Cretaceous, Salt Ranges and Nepal. The Ichnofossils or trace fossils occurring in marine, lacustrine and continental sedimentary rocks from the Pre-cambrian to Recent and they are most abundant and best preserved in classic rocks with alternating sandy and shaly beds (Hantzschel, 1975). They serve as stratigraphic, palaeoclimatological
and ethnoveterinary indicators of the extinct and more recent animals. Seilacher (1970) considers them very useful for the age determination and stratigraphic correlation of the otherwise "unfossiliferous" beds.

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**Fig. 1**

Fig. 1. Stratigraphic map of Tiruchirapalli (Trichinopoly) District showing the fossil Cretaceous beds. (After Lakshminarayana & Saha, 1979).

The *International Code of Zoological Nomenclature* 1964, included under trace fossils or *Lebensspur*, the works of animal(s) viz., fossil and recent tracks, trails, burrows, borings, coprolites, etc. Abel (1912), while defining his *Lebensspur*, in addition included the death agony, pathological phenomena, symbiotic and parasitic associations, gastroliths, etc. (*vide* Hantzsche, *op cit.*). Osgood (1970) considered the
trace fossils as evidences of the activity of an organism in, or on the sediment produced by some voluntary action of that organism. Simpson (1957), restricted the term to the activity of an animal moving on, or in the sediment at the time of its accumulation which excludes borings in the shells or in consolidated sediment.

Fig. 2. "Echinoid" beds near Ottokovil.

Fig. 3. *Haentzschelina* sp., a new record of Ichnofossil in the "Echinoid" beds:
(a) general view; (b) enlarged.
More recent traces or trails formed by extant animals are found on the surface of sediments and the same may be true of the extinct species also as exogene epireliefs. The surficial trails formed in marine environment especially in shallow water with tidal environments according to Hantzschel (1975), have very little chance of preservation, since they are often destroyed by tidal wave action. However, certain conditions, such as, rapid drying up of the shore bottom, mucus cementation of the sediment, filling up of the trails by wind blown sand, or rapidly accumulated sediment can fossilise, the surficial trails. They are also most common in quite, current free deep waters. Ethologically, the surficial trails are movement traces, like running or crawling and more seldom swimming trails, resting traces or sediment ingesting trails (Hantzschel, 1975).

Material

Series of argillaceous impressions found on a rock in the “Echinoid” beds near Ottokovil (Ariyalur stage of Trichinopoly Upper Cretaceous), (fig. 3), Tamil Nadu (S. India).

Description

Hantzschel (1962, 1975) listed all known Ichnofossils providing brief descriptions. The work is well illustrated. Basing on the work, the Ichnofossil observed by us can be easily relegated to the Ichnogenus Haentzschelinia Vyalov, 1964. The genus belongs to the stellar type of Ichnofossils. Hantzschel (1975) redescribed the Ichnofossil as star like trail with elevated centre, about 5 cm in diameter, generally with 6-10 radiating grooves rather irregularly and often unilaterally developed.

The genus is so far known from Triassic of Asia in N.E. Siberia of former U.S.S.R. and Upper Cretaceous of Germany. Therefore, the present find forms the first record of the genus from India. Our specimens may belong to yet another Ichnospecies, since the tentacular grooves range from 10-16. However, we are not naming it, since we have not collected the specimens for establishing a holotype.

Remarks

We named the beds, where the Ichnofossil was located as “Echinoid” beds (fig. 2) as Hemicidaris (Echinodermata) is the predominant form of fossil found here.

Though Haentzschelinia Vyalov with type species H. ottoi (Geinitz) was originally described as a sponge, Hantzschel (op. cit.) considers it as a feeding burrow made by crustaceans or worms. But the present authors opine that this Ichnofossil genus may be the marks of an apodous group of Holothurians (Echinodermata) whose tentacles
range from 10 to 20 in numbers. Fossils apodous Holothurians have also been reported during Cretaceous elsewhere.

Acknowledgements

The authors thank Prof. M.S. Jairajpuri, Director of Zoological Survey of India, Calcutta, and Dr J.R.B. Alfred, Joint Director (SRS), Calcutta, for all facilities and encouragement.

SUMMARY

In a recent survey, an Ichnofossil belonging to the genus *Haentzschelinia* Vyalov was discovered in the Ariyalur stage of Trichnopoly Cretaceous. It is the first record of the genus from India.

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SEASONAL ABUNDANCE OF IMPORTANT SOME SPIDER GROUPS IN RICE AGRO-ECOSYSTEM

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INTRODUCTION

Spiders are very important biocontrol agents in rice agro-ecosystem and play a major role as potential defender by suppressing the pest population to a safe level which emphasize the concept of Integrated Pest Management in modern Agriculture. Three years' routine field sweeping from 1989 to 1991 revealed that the spider complex alone contributed about 57.98%, 61.0% and 55.6% yearly population out of the following predators like Cyrtorhinus lividipennis Reuter; Ophionea nigrofasciata (Schmidt-Goebel); Paedarus sp.; Micraspis sp., Harmonia sp.; Menochilus sp.; Agriocnemis spp. including diversified spider groups respectively (Rice Annual Report, 1989-91). Among the spider species only seven groups of spiders were taken into account in the present study.

Lycosa spp. (Family-Lycosidae), both adults and spiderlings, are generally noticed in the collar region of the paddy hills and are efficient hunters. They directly attack preys like stem borer moths, plant and leaf hoppers and can consume 5-15 in number a day. Atypena (=Callitrichia) spp. (Family-Linyphiidae) prefer wetland habitat and make webs within the tillers near basal region. They consume 4-5 preys, mainly leaf and plant hoppers, per day. Oxyopes spp. (Family-Oxyopidae) hide in the crop canopy and are waiting for their preys, mostly moths. As soon as the latter comes within the striking range it grabs them and thus can consume 2-3 moths/day. Phidippus spp. (Family-Salticidae) wait in a small retreat web in the rice foliage looking for their preys. Their daily diet comprises of 2-8 hoppers. Tetragnatha spp. (Family-Tetragnathidae) are also a dweller of wetland habitat, wait for their preys in weak ring shaped webs in the crop canopy. When a hopper hits the web it goes for action and consume 2-3 preys daily. Araneus spp. (Family-Araneidae)—late colonizers of rice field, capture flying insects like hoppers, butterflies, grass hoppers, etc. sitting in their circular webs (Shepard et al, 1987) Thomisus spp. (Family-Thomisidae) with the restricted mobility, are found in the upper crop canopy zone. They catch the prey with extreme swiftness as soon as it comes within striking range (Rod and Ken, 1984).

In the present work efforts have been made to make a comparative study among
the above mentioned spider groups with special reference to their seasonal abundance, variation in the trend of population fluctuation and dimension in relation to the time scale and crop stage.

**Method:** During the period from March, 1991 to February, 1992 routine collection of spiders was made at 7.30 A.M. by a standard sweepnet with 30 complete strokes twice a week (Tuesday and Friday) covering seedbed, main field and the levies depending on the crop season. The enmeshed spiders were chloroformed, groupwise separated and counted. Fortnightly catch consisting of 4 days’ collection for each spider group, as well as the spider complex, were computed and the mean values of spider population for each of the 24 fortnights were estimated (Table—1) and subjected to “Probit Analysis” (Finney, 1972). The analysis was preferred for the easy transformation of sigmoid relationship, based on cumulative values, into rectilinear relationship which enabled to pinpoint the maximum sensitive points depicting the peak period of activity of the spiders in time scale by minimising the operational errors. The probit regression lines (PRL) for different groups and the spider complex were worked out separately and had been delineated in Fig-1. showing the maximum sensitive time point in respect of 50% population (MT-50) and the estimated time point of the 50% population actually found (ET-50). The flatness and steepness of the PRL expressed the degree of variation in the population fluctuation of the spider spp. and the closeness and remoteness of the ET-50 from the MT-50 depicted the nature and trend of temporal distribution and population activities towards Boro or Aman season in relation to the crop stage and the prey substrates acting as major pests.

**Results and Discussion:** The present work, based on the critical study of different spider groups, revealed that though the spider complex maintained a stable population throughout the year, the different groups were active at different times of the season showing their prey preference at the different stages of crop growth.

The spider complex, consisting of seven spider groups, maintained a fairly high population from the first of March and the ET-50 & MT-50 points were in the first fortnight of June and first fortnight of August (PRL-4) respectively. This signified that the spider complex was comparatively more active in Boro season (March to June) than Aman season (July to December). Incidentally boro paddy harboured a high population of major insect pests like stem borer, leaf folder, leaf and plant hoppers especially Brown Plant Hopper and catered the spider complex with those pests. The PRL of the spider complex, slightly flat in nature, indicated more variation in the population fluctuation throughout the year. It revealed that the peak and fall of the population were more dependent on the availability of their respective prey substrates in the time scale and the crop stage.
Table 1—Fortnightly population of the spider groups (mean of 4 days' collection±2SE) for the year 1991-92.

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Fig. 1. Probit Regression of some common spider groups in rice agro-eco system.

1. *Thomisus* spp: $Y = 2.985 + 0.2843x$
2. *Phidippus* spp: $Y = 2.713 + 0.2595x$
3. *Tetragnatha* spp: $Y = 2.569 + 0.2369x$
4. Spider complex: $Y = 2.452 + 0.2322x$
5. *Atypena* spp: $Y = 2.416 + 0.231x$
6. *Lycosa* spp: $Y = 2.416 + 0.231x$
7. *Oxyopes* spp: $Y = 2.218 + 0.2327x$
8. *Araneus* spp: $Y = 2.187 + 0.2237x$
Lycosa spp. are wellknown predator group of rice ecosystem having an efficient hunting ability, fast mobility and abundance. This group appeared in early March and maintained a sizable population upto late June covering the entire Boro season. After maintaining a low profile in July, its population increased again from August and continued upto December-covering the Aman season. During January to the first fortnight of February the population was low but from the second fortnight of February it again appeared in the field in good number. This group attained the ET-50 & MT-50, as expressed on the PRL-6, in the first fortnight of September and around the first fortnight of August respectively. The closeness of these two points indicated a uniform temporal distribution of the spider population covering both Boro and Aman season having a wide range of prey spectrum like stem borer moths, major leaf and plant hoppers etc. The regression line exhibited almost the same slope as that of the spider complex (PRL-4) revealing significant variation in the population fluctuation. This was due to the wide adaptibility of this spider group in the different time periods of the season throughout the year with respect to the availability of prey species in relation to different crop growth stages.

Atypena spp. are found to predate in the same niche where various plant hoppers, especially Brown Plant Hoppers, are active. Fairly good number of these spiders were enmeshed during March to June and October to February but the ET-50 & MT-50 were in the first fortnight of June and the first fortnight of August respectively. This suggested that Atypena spp. were mainly active during the Boro season when plant hoppers actively caused damage to the crop. However, in the Aman season this spider group predated on the hopper complex and later migrated to the boro seedbed which was sown in the late November to mid December. During January and February it continued its activity in the paddy field when the activity of the other spiders was negligible. The PRL-5 superimposed on the PRL-6 expressing the same kind of population fluctuation and distribution as that of Lycosa spp. but the remoteness of the ET-50 from the MT-50 revealed that, it was mainly active in the Boro season in contrast to Lycosa spp. which was active both in Aman and Boro.

Tetragnatha spp. are another important group of defenders, commonly found throughout the year, having a wide range of prey substrates including moths and leaf hoppers. Unlike Lycosa spp., Oxyopes spp. and Phidippus spp. they are stationary feeders and their area of operation is less. Here, the MT-50 & ET-50 on the PRL-3 came in the second fortnight of July and in the middle of May respectively which denoted that it was more prevalent in the Boro season (March to May) as compared to the Aman season (August to December). The PRL-3 was less flat in nature and steeper than those of Lycosa–Atypena spp., Oxyopes spp and Araneus spp. which indicated that the variation in the population fluctuation of Tetragnatha spp. was less than those of the above mentioned spider groups.
Oxyopes spp. are well established, efficient predators of paddy ecosystem. Here the MT-50 and ET-50 were very close to each other and came on mid way of the PRL-7 in the second fortnight of August and middle of August respectively. This indicated that the spider group was equally active both in Boro and Aman season and was found almost throughout the year. The flatness of this PRL-7 as compared to the others excepting that of Araneus spp (PRL-8) suggested that, although it prevailed in the field round the year, it exhibited maximum degree of variation in the population fluctuation in comparison to the other spiders mentioned above.

Phidippus spp. prefer dryland habitats but are found in wetland condition also. This group mainly predates on leaf hoppers and other small insects. The regression line (PRL-2) representing this spider group bore MT-50 & ET-50 in the first fortnight of July and the second fortnight of March indicating its special preference for the dry Boro season, although it maintained a low profile throughout the year. The PRL-2 was somewhat different and steeper than those of other spider groups excluding that of Thomisus spp (PRL-1) suggesting less variation in population fluctuation.

Araneus spp. form webs around the rice canopy and capture various types of insect pests. The MT-50 and ET-50 of this particular group (PRL-8) came at the end of August and in the first fortnight of June respectively. The remoteness of these two points from each other indicated that they were active only in the late Boro season (May-June) and during the remaining part of the year they were scarcely found. This regression line was flattest of all, indicating maximum variation in population fluctuation due to their erratic distribution both in time and space.

Thomisus spp. are active at the upper portion of the paddy hills and prey upon the visiting insects. This group attained MT-50 and ET-50 as estimated on PRL-1 in the first fortnight of June and in the middle of April respectively. This suggested that this group was more active during the reproductive phase of Boro rice (April-May) and in the remaining part of the year its occurrence was negligible. This regression line was the steepest of all the probit lines indicating minimum variation in population fluctuation at the time of their occurrence.

The overall analysis highlighted that Lycosa spp., Atypena spp, Oxyopes spp and Tetragnatha spp. were more important and active both in the Boro and Aman season, maintained a good population level throughout both the seasons and played a major role in suppressing the insect pest population as compared to the other groups of the spider complex. Phidippus spp., Araneus spp. and Thomisus spp. were less important because their activities were mostly restricted to a part of the crop season and the population levels were very low in the remaining part of the year. The spider complex as a whole maintained a fairly high population level throughout the year whereas other predators under study like Cytorhinus lividipennis, Reuter, Ophionea
nigrofasciata (Schmidt-Goebel), Paedarus sp, Micraspis sp., Harmonia sp., Menochilus sp and Agriocnemis sp. were mostly seasonal in their activities.

The above discussion emphasizes that the palladium of these important defender groups as a part of Integrated Pest Management rests on the judicious use of pesticides in rice agro-ecosystem for maintaining natural balance.

ACKNOWLEDGEMENT

We are very much grateful to Dr. B. K. Tikader, Director (Retd), Zoological Survey of India, Calcutta, for his valuable comments on the manuscript.

SUMMARY

The seasonal abundance of some important spider groups in rice agro-ecosystem was studied in the year 1991-92 by standard sweeping method and analysing the data through Probit Regression. The result showed that Lycosa spp., Atypena spp., Oxyopes spp. and Tetragnatha spp. are more important both in Boro and Aman season and maintain a good population level. Phidippus spp., Araneus spp. and Thomisus spp. are comparatively less important because their activities are mostly restricted to a part of the crop season and they maintain a low profile in the remaining part of the year. The spider complex as a whole have a higher population level through out the year than that of the other predators present in the system.

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SARCOPHAGID FAUNA (DIPTERA : SARCOPHAGIDAE) OF MAHARASHTRA, INDIA

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INTRODUCTION

Senior-White (1924) reported a total of eight species, viz., Sarcophaga peregrina R. D., Sarcophaga ruficornis Fabricius, Sarcophaga dux Thomson, Sarcophaga albiceps Meigen, Sarcophaga knabi Parker, Sarcophaga orchidea Boettcher, Sarcophaga futilis Senior-White and Sarcophaga krameri Boettcher from Maharashtra. Nandi (1988) reported Thyrsocnema (Pseudothyrsocnema) indica Shinonaga and Lopes from Mahabaleshwar, Maharashtra. The author collected these flies from different parts of this state in 1990 and reported a total of twentyone species.

ABBREVIATIONS USED IN THE TEXT

ac-acrostichal bristles, dc-dorsocentral bristles, ia-intra-alar bristles, h-humeral bristles, ph-posthumeral bristles, np-notopleural bristles, sa-supra-alar bristles, pa-postalar bristles, st-sternopleural bristles, mpl-mesopleural bristles, hpl-hypopleural bristles.

ABBREVIATIONS USED IN THE FIGURES

ap-apical plate of paraphallus, lp-lateral plate of paraphallus, p-paraphallus, s-styli of glans, t-theca of penis, v-ventralia of penis.

The type materials will be deposited in the National Collection of Zoological Survey of India, Calcutta, in due course.

SYSTEMATIC ACCOUNT

Subfamily : SARCOPHAGINAE
Tribe : TEPHROMYINII

1. Blaesoxipha aldrichi Nandi


This species is recorded for the first time from this state.

Distribution : Karnataka ; Kaimara, Maharashtra ; Nagpur Seminary Hills.
Tribe: Sarcophagini
Subtribe: Parasarcophagina

2. Boettcherisca bengalensis Nandi


This species records for the first time from this state.

Distribution: Maharashtra; Nagpur Seminary Hills, Nagpur Maharajabagh, Aurangabad Siddhartha Garden, West Bengal; Bankura, Birbhum, Midnapore.

3. Boettcherisca nathani Lopes


This is the first record of this species from this state.

Distribution: Maharashtra; Khandala, Tamil Nadu; Karikal (Korumbagaram), West Bengal; Darjeeling.

4. Boettcherisca peregrina (Robineau-Desvoidy)


Material examined: 1 ♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990.

5. Parasarcophaga (Liopygia) ruficornis (Fabricius)


Material examined: 1 ♂, Pune Rly. Station area, 559 m., 19. vi. 1990.

6. Parasarcophaga (Liosarcophaga) brevicornis (Ho)


It is recorded for the first time from this state.
7. **Parasarcophaga (Liosarcophaga) dux** (Thomson)


8. **Parasarcophaga (Pandelleisca) ballardi** (Senior-White)


*Material examined*: 1 ♂, Daulatabad, 340 m., 17. vi. 1990.

It is a new record for the state.

9. **Parasarcophaga (Pandelleisca) kurahashii** Nandi


This is the first record of this species from this state.

*Distribution*: Karnataka; Mysore Zoo., Maharashtra; Nagpur Seminary Hills, Daulatabad, Panchgani.

10. **Parasarcophaga (Parasarcophaga) albiceps** (Meign)


11. **Parasarcophaga (Parasarcophaga) hirtipes** (Wiedemann)


It is a new record for the state.

12. Parasarcophaga (Parasarcophaga) sericea (Walker)


13. Parasarcophaga (Parasarcophaga) misera (Walker)


Subtribe: Helicophagellina

14. Pierretia (Ascelotella) calicifera (Böettcher)


Material examined: 1♂, Nagpur Seminary Hills, 350 m., 14.vi. 1990. It records for the first time from this state.

15. Thyrsocnema (Pseudothyrsocnema) indica Shinonaga and Lopes


16. **Kozlovea vervesi** sp. nov. (Figs. 1-5)

**Male**: Body length 8-10 mm.

**Head**: Width of frons about half that of one eye; frontal vitta black, its width at narrowest point of frons about more than twice that of each parafrontal; parafrontal and parafacial black with silvery pollen, the former with short scattered hairs, the latter with a now of 7 hairs near the eye margin; antennae blackish-brown, reaching to about 0.85 distance to vibrissae, 1st and 2nd segments black with short black hairs and spines, 3rd brownish with silvery pollen, its length about twice that of the 2nd; arista long plumose along basal two-thirds; facial ridge brownish with silvery pollen.
and long hairs; vibrissae long, distance between vibrissae equal to the parafacial width; frontal bristles 10, upper 2 reclinate, lower 3 below base of antennae and reaching to about half of the 2nd antennal segment, rest cruciate and directed forwards; gena black with long hairs; post gena black with long hairs; ocellar triangle black with short black hairs; outer vertical moderately developed; inner vertical well developed; post vertical equal to the ocellar and about one-third the inner vertical; two rows of regular postocular setae besides postocular cilia, rest of the area with short brownish hairs; palpi slender, blackish; proboscis black.

Thorax: Blackish with three black longitudinal stripes; ac 0+1; dc 5+4; ia 1+3; ps 1; h 3; ph 2; np 4; sa 3; pa 2; st 1+1+1; mpl 7; hpl 6; upper part of propleura bare; prostigmatic and propleural bristles well developed and accompanied with short hairs; pro- and mesothoracic spiracles brown; apicoscutellar bristles well developed, 1 pair; discoscutellar bristles wanting; lateroscutellar bristles well developed, 2 pairs.

Wings: Hyaline with brown veins; R 1 bare; R 4+5 with a row of short setae located dorsally and extending up to two-thirds the distance from the basal node r-m and 5 short setae present on ventral surface of basal node of R 4+5; 3rd costal segment greater than 5th, the latter with short spines along more than basal half of its anterior margin; costal spines stout; epaulet yellowish with short spines; basicostal scale brownish; squama whitish; halter brownish.

Legs: Black; fore femur with two rows of bristles along posterodorsal surface and a row of bristles along posterior margin of ventral surface; fore tibia with a row of 3 bristles along basal one-third of anterodorsal surface and 1 bristle on posterodorsal surface at about one-third the distance from the distal end; mid femur with a row of bristles along anterolateral surface, a row of bristles along basal half of anteroventral surface and with comb-like spines along distal half of anteroventral and posteroventral surfaces, a row of long hairs along basal two-thirds of posteroventral surface and 1 bristle each on posterodorsal, posterolateral and posteroventral surfaces at about one-third the distance from the distal end; mid tibia with 1 bristle each on anterodorsal surface at about one-third and two-thirds the distances from the distal end, a row of bristles along basal half of posterolateral surface and 1 bristle on posteroventral surface at about one-third the distance from the distal end; hind femur with 2 rows of bristles along anterolateral surface, a row of bristles along anteroventral surface at about one-third the distance from the distal end, 1 bristle each on posterodorsal and posterolateral surfaces at about one-fifth the distance from the distal end and with long hairs along ventral surface; hind tibia with 1 bristle each on anteroventral and posteroventral surfaces at about one-third and two-thirds the distances from the basal end, 3 bristles along posterodorsal surface at about three-
fourths the distance from the basal end, 1 bristle on anteroventral surface at about one-third the distance from the distal end and with numerous long hairs along anterior and posterior margins of ventral surface.

**Abdomen:** Black with silvery checkered pattern; median marginal bristles on 2nd and 3rd abdominal tergites absent but 2nd with 2 and 3rd with 1 lateral marginal bristles; 4th tergite with 2 median marginal bristles; 5th with a row of 16 marginal bristles; 1st to 4th sternites with short hairs; 5th sternite v-shaped with long hairs and bearing two knob-like projections basally; 1st and 2nd genital segments brownish and without marginal bristles; inner forcep elongated, slightly curved and pointed at end; outer forcep slightly elongated; anterior paramere elongated with slight projection at the middle; posterior paramere deeply curved at end, pointed and with single hair; theca shorter than paraphallus, both are sclerotised; apical plate of paraphallus curved, pointed at end; lateral plate of paraphallus blunt at end; ventralia elongated and membranous.

**Female:** Unknown.

**Holotype:** 1 ♂, Nagpur Seminary Hills, 350 m., 14.vi. 1990; **Paratype:** 1 ♂, Khandala, 960 m., 21.vi. 1990.

**Remarks:** This species closely resembles *Kozlovea cavangarei* Nandi but differs from it by the structures of apical plate of paraphallus and ventralia as well.

**Bionomics:** This species was collected from bushes underneath the hill trees.

This species is named after Yu. G. Verves of U.S.S.R.

**Subtribe:** Harpagophallina

17. Harpagophalla panchganiensis sp. nov.

(Figs. 6-9)

**Male:** Body length 8 mm.

**Head:** Width of frons about two-fifths that of one eye; frontal vitta black, its width at narrowest point of frons about less than each parafrontal; parafrontal and parafacial black with golden pollen, the former with short scattered hairs, the latter with a row of 6 short black hairs near the eye margin; antennae blackish-brown, reaching to about 0.8 distance to vibrissae, 1st and 2nd segments black with black hairs, the latter with 1 long hair, 3rd segment black with silvery pollen, its length about three times that of the 2nd; arista long plumose along basal two-thirds; facial ridge brownish with golden pollen and with few short hairs; frontal bristles 10, upper 2 reclinate, lower 2 below base of antennae and reaching to about half of the 2nd antennal segment, rest cruciate and directed forwards; gena black with very short black hairs and with golden pollen; post gena black with long greyish hairs; outer
vertical absent; inner vertical well developed; post vertical short, half the length of inner vertical; ocellar triangle black with short black hairs; two rows of regular postocular setae besides postocular cilia, rest of the area with black and white hairs; palpi slender, black; proboscis blackish.

Figs. 6-9. *Harpagophalla panchganiensis* sp. nov.
6, inner and outer forceps, lateral view; 7, same, posterior view; 8, penis lateral view; 9, same, ventral view.

Thorax: Black with three black longitudinal stripes; ac 0+1; dc 5+5 (post. dc stout); ia 0+2; ps 1; h 3; ph 3; np 3; sa 3; pg 2; st 1+1+1; mpl 6; hpl 9; upper part of propleura bare with silvery pollen; prostigmatic and propleural bristles well developed and accompanied with short hairs; pro- and mesothoracic spiracles brownish; apicoscutellar and discoscutellar bristles well developed, 1 pair each, the former is longer; lateroscutellar bristles 2 pairs.
Wings: Hyaline with brown veins; R₁ bare; R₄₊₅ with a row of short setae located dorsally and extending up to two-thirds the distance from the basal node to r-m and 4 short setae present on ventral surface of basal node of R₄₊₅; 3rd costal segment greater than the 5th, the latter with spines along basal half of its anterior margin; costal spines almost stout; basicostal scale yellowish; epaulet black with short spines; squama whitish; halter brown.

Legs: Black; fore femur with two rows of bristles along posrerodorsal surface and a row of bristles along posterior margin of ventral surface; fore tibia with a row of 3 short bristles along basal one-third of anterodorsal surface, 1 short bristle on posrerodorsal surface and 1 on posterolateral surface at about one-third the distance from the distal end; mid femur with a row of 3 short bristles along one-third of anterolateral surface from basal end; a row of short setae along anteroventral and posteroventral surfaces at about one-third the distance from the distal end, 2 long bristles each on posterodorsal and posterolateral surfaces on distal end and with long hairs posteroventrally along basal half; mid tibia with 2 bristles medially on anterolateral surface, 3 bristles along posterodorsal surface on basal one-third, 1 bristle each on posterodorsal, anteroventral and posterolateral surfaces at about one-third the distance from the distal end; hind femur with 2 rows of bristles along anterolateral surface, a row of bristles along anterior and posterior margins of ventral surface and 1 bristle on distal part of posterodorsal surface; hind tibia with a row of bristles along anterodorsal surface, 3 bristles along posterodorsal surface on two-thirds the distance from the basal end, 1 bristle on anteroventral surface at about one-fourth the distance from the distal end and with long hairs along anterior and posterior margins of ventral surface.

Abdomen: Black with silvery checkered pattern; median marginal bristles on 2nd and 3rd abdominal tergites absent but each with 1 lateral marginal bristle; 4th tergite with a pair of median and 3 lateral marginal bristles; 5th tergite with a row of 18 marginal bristles; 1st to 3rd sternites with tuft of short hairs; 4th and 5th sternites with short hairs basally and numerous short spines distally; 1st and 2nd genital segments brown and without marginal bristles; inner forcep almost straight, curved at end, beak-shaped and provided with long hairs on subbasal end; outer forcep elongated with long hairs; anterior paramere slightly curved at end; posterior paramere slightly curved at end and without hairs; theca shorter than paraphallus, both are sclerotised; apical plate of paraphallus elongated; ventralia long, broad with five elongated branched processes and two subbasal spinous projections; styli of glans short and trilobed.

Female: Unknown.

Holotype: 1 ♂, Panchgani, 1,732 m., 20. vi. 1990.
Remarks: This species closely resembles Harpagophalla talonata (Senior-White) but differs from it by the structures of apical olate of paraphallus and ventralia. The structure of lateral plate of paraphallus is also quite different.

Bionomics: This species was collected from bush-sweeping.

18. Iranihindia futilis (Senior-White)


19. Iranihindia martellata (Senior-White)


It is recorded for the first time from this state.

20. Iranihindia martellatoides (Baranov)

1931. Sarcophaga martellatoides Baranov, Konowia, 10: 114.


This is the first record of this species from this state.

Subtribe: Seniorwhiteina

21. Seniorwhitea reciproca (Walker)


Summary

Systematic position of twentyone species are dealt with. Two new species, viz., Kozlovea veresi and Harpagophalla panchganiesis are described and figured. Ten species are recorded for the first time from this state.
Acknowledgements

The author is grateful to the Director, Zoological Survey of India, Calcutta, for permission to work on this group under Collaborative Research Project and Contractual Services in Z.S.I., Calcutta, to the Officer-in-Charge, Z. S. I. Western Regional Station, Pune, for help during survey work and to the Principal and Head of the Deptt. of Zoology, Presidency College, Calcutta, for laboratory facilities. Financial help to the author by the Govt. of India is also duly acknowledged.

References


The Andaman group of islands were surveyed for asilids by us during January 1988. Besides Andaman, Little Andaman and Rutland islands were also thoroughly surveyed. Though several parties from the Zoological Survey of India had surveyed these islands earlier for other groups, this was the first time an intensive survey of Andaman Islands was undertaken for robberflies.

The Andaman and Nicobar group of islands are situated in the South eastern region of Bay of Bengal, 6° 45’ N and 13° 41’ N lat. and 92° 12’ E and 93° 57’ E long. The total land mass is approximately 8,249 Sq. Km. The Andaman group has 6,408 Sq. Km. of more than 325 islands (21 inhabited) and Nicobar group 1,841 Sq. Km. of more than 24 islands (13 inhabited) (Saldanha, 1989). Tropical rain forests cover practically all the islands. Our original plan was to survey both Andaman and Nicobar Islands but due to some unavoidable circumstances we had to restrict it to Andaman group of islands.

Genus Laxenecera Macquart

1838. Laxenecera Macquart, Dipt. exot. 1 (2) : 77. Type-species: Laxenecera albivarbis Macquart; designated by Hermann (1919 : 340).

1. Laxenecera albivarbis Macquart

1838. Laxenecera albivarbis Macquart, Dipt. exot., 1 (2) : 195. Type-locality: Bengal, India.


Distribution: It was described from 'Bengal', India, and the other recorded localities are Bihar, Gujarat, Himachal Pradesh, Maharashtra and Uttar Pradesh. Here it is recorded for the first time from Andaman Island.

Diagnosis: It resembles Laxenecera flavivarbis Macquart. Head and scape bear long, white setae; mystax black with some white setae; setae of thorax white, wing yellow stained; posterior abdominal segments with white setae below.
Genus Orthogonis Hermann


2. Orthogonis andamanensis Joseph & Parui


Material: Holotype ♂, ZSI. Reg. No. 7643/H6, S. Andaman: Wrightmyo, alt. 18 m, 1. iv. 1964, Coll. B. S. Lamba.

Distribution: The species has so far been recorded only from Andaman Islands.

Diagnosis: A large black and violet species with contrasting yellow legs and light brown wings. It differs from the type species Orthogonis scapularis (Wiedemann) by the male genitalia, proportional length of veins at the distal part of discal cell (the lower end vein of discal cell and of the closed and stalked fourth posterior cell) and the details of body colouration.

Genus Stichopogon Loew

1847. Stichopogon Loew, Linn. Ent. 2 : 499. Type-species: Dasypogon elegantulus Wiedemann, 1820; original designation.

Key to species

1. Fore femur partly or wholly orange, or yellow ... 2
   —Fore femur black, lamella of female shining black brown with a tuft of yellow setae fringing all upper margin, mystax and face white ... inaequalis (Loew)

2. Tibiae orange except black apex of hind tibia, disc of scutellum bare, base of lamella much narrower than apex ...
   —All tibiae pale yellow with black apex, scutellar disc bears sparse, long setae, base of lamella much narrower than apex oldroydi n. sp.

3. Stichopogon inaequalis (Loew)

1847. Dasypogon inaequalis Loew, Linn. Ent. 2 : 505. Type-locality: Portugal, Greece.

Distribution: The species was described from Palaearctic Region. In the Oriental Region it has been recorded from Sri Lanka and India. In India it has been reported from Andhra Pradesh, Bihar, Maharashtra and Tamil Nadu. It is reported for the first time from Andaman.

4. Stichopogon oldroydi n. sp.  
(Fig. 1)

A tiny black species with grey tomentum, black and pale yellow legs and brown- nish tinged wings, female lamella without tuft. Male: length 4-6 mm, wing 3-4 mm; female; length 6 mm, wing 4-5 mm

Females: Head as broad as or slightly broader than thorax, mystax pale yellow with a few white bristles; fronto-orbital plate with white setae, ocellar bristles white or pale yellow, postocular bristles pale yellow, posterior to ocellar triangle with a few pale yellow bristles, postcranium with white setae, postgena with dense white setae. Antenna black, densely grey tomentose, pedicel with a few white bristly setae, scape about two-thirds length of pedicel, first flagellomere longer than combined length of scape and pedicel, style about two-thirds length of first flagellomere. Palpus and proboscis black with sparse white setae.

Thorax black, grey or greyish-yellow tomentose; pronotum with white setae laterally, in holotype scutum with a broad mediolongitudinal black stripe, the stripe lightly grey tomentose on anterior half which is divided by a narrow black stripe, paratypes similar but tomentum on mediolongitudinal stripe may be densely greyish-yellow, also with two submedian black spots; chaetotaxy: 1 notopleural, 1 postalar, 1 (with or without an additional) supra-alar; vestiture white and bristles pale yellow; scutellum with hind border bearing 6-8 bristles, disc with sparse long setae and two bristles; pleura sparsely grey tomentose. Haltere pale yellow with yellowish-brown stalk.

Legs black and pale yellow to yellowish-brown; coxa black and pale yellow to a varying extent, trochanter pale yellow, femur black but basally pale yellow, the latter colour increases from fore to hind femur so much so it occupies slightly less than half on hind femur, tibia pale yellow with black apex, black colour extensive and occupies about one-third on hind tibia, tarsus pale yellow with the segments wholly pale yellow or pale yellow with varying extent black, fore tibia with 2-3 posteroventral bristles, mid tibia with 2-3 posteroventral bristles, 2 anteroventral bristles and 2 anterior bristles, vestiture and bristles white with a few of the bristles pale yellow.

Wing light brown.

Abdomen black with varying extent grey tomentose, terga grey tomentose anteriorly, especially laterally, and in some cases narrowly grey tomentose along
posterior border, tergum 1 laterally with a bunch of white setae, vestiture white. Female genitalia (Fig. 1A) black with eighth tergum bearing a circlet of about ten spines, lamella without apical tuft of setae.

Figs. 1-3. 1. *Stichopogon oldroydi* n. sp., A, lateral view of female genitalia; B, lateral view of male genitalia.
2. *Ommatius mitrai* n. sp., lateral view of male genitalia.
3. *Astochia shishodiai* n. sp., lateral view of male genitalia.

*Male*: Similar but with the following differences: mystax in some paratypes wholly pale yellow, length of scape variable from two-thirds to slightly shorter to pedicel; in some examples scutellar border with lesser number of bristles, bristles on
scutellar disc may be absent; on hind femur with pale yellow colouration not so extensive; abdomen with white and black vestiture. Male genitalia (Fig. 1B) figured.


It is generally similar to Stichopogon indicus Joseph & Parui (1984b) and S. menoni Joseph & Parui (in press). Of these S. oldroydi n. sp. is quite close to S. menoni Joseph & Parui from which it can be readily separated by the short lamella together with its shape. The species is named in honour of Dr Harold Oldroyd, the distinguished student of robberflies who revised the Indian species of the genus Stichopogon.

5. Stichopogon tomentosus Oldroyd


Distribution: It was described from Bihar and subsequently recorded from West Bengal. Here it is reported for the first time from Andaman.

Genus Cophinopoda Hull


6. Cophinopoda chinensis (Fabricius)

1794. Asilus chinensis Fabricius, Ent. Syst. 4 : 383. Type-locality: China.


Distribution: It is a cosmopolitan species and it is widely distributed in India. Here it is recorded for the first time from Andaman.

Genus Ommatius Wiedemann

Key to species

1. Epandrium linear and gradually narrowed at apex 2
   —Epandrium stout, hind femur with a posteroventral and anteroventral row of stout bristles ... mitrai n. sp.

2. Fore femur with a row of stout bristles ventrally, setae of hypandrium short ... andamanensis Joseph & Parui
   —Fore femur without row of bristles, mid femur basally with a few posteroventral pale yellow bristles, hypandrium bears a few long setae ... nicobarensis Joseph & Parui

7. Ommatius andamanensis Joseph & Parui


Distribution: The species has so far been recorded only from the type locality.

8. Ommatius mitrai n. sp.
   (Fig. 2)

A medium black species with black and pale yellow legs, swollen femora, black wings and clavate abdomen. Male; length 10-11 mm, wing 7.5-8 mm.

Male: Head black with greyish-yellow and grey tomentum; mystax black above and pale yellow below; fronto-orbital setae and ocellar bristles black postocular bristles black, postcranium with sparse white, or white and black setae, postgena with dense white setae. Antenna black, scape and pedicel with black bristles, pedicel slightly shorter than, or subequal to scape, first flagellomere longer than scape. Palpus and proboscis black, former with black setae while latter with white setae.

Thorax black, grey tomentose; pronotum sparsely with white setae and 4 black bristles in a transverse row; scutum without mediolongitudinal stripe but with or without a very short, narrow, median grey band on anterior border; chaetotaxy: 2 notopleurals, 1 postalar, 1 supra-alar, 1 intra-alar, 3 or 5 dorsocentral; vestiture black except for a few setae on postpronotal lobes being white, bristles black, pleura with dense grey tomentum; scutellum with a pair of black bristles on border, disc with white setae in holotype, and black and pale yellow setae in paratype; katatergite with black and pale yellow bristles. Haltere pale yellow and yellowish-brown.

Legs black and pale yellow; coxa and trochanter black, femur black with brown marking anteriorly, ventrally and posteriorly on fore and mid femora, and anteriorly
on hind femur, in holotype brown marking not so distinct, tibia pale yellow with black apex, mid tibia or both fore and mid tibiae anterodorsally also black, tarsus black with basitarsus black and pale yellow, vestiture black and pale yellow, bristles black, hind femur with a posteroventral row of short bristles and an anteroventral row of about 4 similar bristles.

Wing black but gradually becoming lighter posteriorly, and posterolaterally almost hyaline.

Abdomen black, tergum 1 posterolaterally with pale yellow bristles, vestiture black and pale yellow. Male genitalia (Fig. 2) black with black, and a few pale yellow setae.

Female: Unknown.


It is generally similar to Ommatius pseudodravidicus Joseph and Parui (1983) differing from which in the comparatively stout built, darker colouration, swollen hind femur, black abdomen and in the shape of male genitalia. It is named in honour of our colleague Sri Bulganin Mitra, who helped us in our Andaman survey of robberflies.

9. Ommatius nicobarensis Joseph & Parui


Distribution: So far the species has been recorded only from Nicobar. It is recorded here for the first time from Andaman.

Genus Astochia Becker


10. Astochia shishodiai n. sp.

(Fig. 3)

A medium black species with grey tomentum, black and pale yellow legs, in male fore tarsus bearing spatulate bristles, and distally infuscated wings. Male: length 12-20 mm, wing 10-12 mm; female: 17-20 mm, wing 11-13 mm.
Male: Head broader than thorax, black, grey and greyish-yellow tomentose; mystax black with a few white bristles below, fronto-orbital setae and ocellar bristles black, postcranium with black setae above and white setae below, postocular bristles black, postgena with dense white setae. Antenna black, scape and pedicel with black bristles, pedicel about three-fourths length of scape, first flagellomere subequal to the combined length of scape and pedicel, style much longer than first flagellomere. Palpus and proboscis black with white setae.

Thorax black, grey tomentose; pronotum with white setae and a pair of black bristles; scutum with a broad mediolongitudinal black stripe extending from anterior border to middle of transverse suture and hind border, the stripe faintly divided by a narrow grey stripe, submedially with three black spots in a longitudinal row; chaetotaxy: 2-3 notopleurals, 3 postalars, 1 supra-alar, 1 intra-alar, in some examples a few bristly setae present in a dorsocentral row posteriorly; vestiture black except for setae on postpronotal lobes being pale yellow; scutellar disc with dense, long, black setae, border with 4-6 black bristles; pleura grey tomentose. Haltere light brown to brown.

Legs black and pale yellow to yellowish brown, coxa, trochanter and tarsus black, fore femur black with a pale yellow to yellowish-brown marking ventrally and laterally slightly beyond middle, on mid femur pale yellow to yellowish-brown more extensive, hind femur black, tibia pale yellow to yellowish-brown with black apex, hind tibia wholly black; fore tarsus with 2 or more spatulate bristles, hind femur posteriorly bearing dense pale yellow bristles or bristly setae and below to it with elongate pale yellow setae, ventrally at apex with dense, short, black, spiny setae, hind tibia basally with a pair of black incurved bristles posteriorly, vestiture black and white to pale yellow, bristles black.

Wings infuscated distally which extends into fifth posterior cell.

Abdomen black, each tergum with a transverse band of faint grey tomentum posteriorly, sides of tergum 1 with a few black bristles amidst long pale yellow setae, tergum 2 laterally with long black, or black and pale yellow, setae, vestiture on tergum 1 pale yellow and black to varying extent, while on rest black. Male genitalia (Fig. 3) black with black setae.

Female: Similar but with the following differences: pronotum without black bristles; pale yellow to yellowish-brown more extensive on legs so much so hind femur and tibia pale yellow to yellowish-brown with black apex, hind femur without pale yellow bristly setae, elongate setae and short spiny setae, hind tibia devoid of basal bristles; pale yellow setae comparatively more extensive on abdomen and in some examples present on tergum 4 also. Female genitalia black, becoming slender from segments 6-9, the last segment short and laterally compressed.
Holotype $\delta$, Reg. No. 7623/H6, S. Andaman, South Point, 24.1.1988, Coll. A. N. T. Joseph and Party. Paratypes 6 $\delta$, 9 $\varphi$, Reg. No. 7624/H6 to 7638/H6, Little Andaman, Netaji Nagar, 17.1.1988, Coll. A. N. T. Joseph and Party; 1 $\delta$, 1 $\varphi$, Reg. No. 7639/H6 and 7640/H6, rest of details as in holotype.

It is the first time species with striking spatulate bristles on front tarsus has been observed in Astochia from Andaman. Astochia shishodai n. sp. can be separated from all the other known regional species by this together with the narrow epandrium.

Genus Heligmoneura Bigot


Key to species

1. Epandrium with profuse long bristles, mystax black above and pale yellow below andamanensis Joseph & Parui
   —Epandrium without bristles, mystax white with a few black bristles above mehtai n. sp.

11. Heligmoneura andamanensis Joseph & Parui


Material: 1 $\delta$, 5 $\varphi$, Little Andaman: Ramakrishnapuram, 19.1.1988 ; 6 $\delta$, 3 $\varphi$, 20.1.1988, rest of data as in preceding ; 1 $\delta$, Little Andaman : Hut Bay, 21.1.1988 ; 5 $\delta$, Hut Bay: Government School Compound, 23.1.1988 ; 8 $\delta$, 6 $\varphi$, Vivekanandapuram, 29.1.1988 ; all Coll. A. N. T. Joseph.

Distribution: The species has so far been recorded only from Andaman.

12. Heligmoneura mehtai n. sp.

(Fig. 4)

A large black species with high facial tubercle, mystax white with a few black bristles above, yellowish-brown legs, abdomen bearing golden yellow setae and bristles, epandrium with cleft. Male: length 21 mm, wing 16-17 mm ; female: length 23 mm, wing 18 mm.

Male: Head broader than thorax, black with pale yellow face, tomentum white and greyish-yellow, facial tubercle high and extending to the antennal base, mystax with a few black bristles above ; fronto-orbital bristles golden yellow and black above, ocellar bristles black, postcranium with white to pale yellow and black setae. Antennal scape and pedicel yellowish-brown with black bristles, remainder black, scape long,
pedicel short, less than half of scape and slightly shorter than first flagellomere, style long. Palpus and proboscis black, former with black and pale yellow setae while latter with wholly pale yellow setae.

Figs. 4-5. 4. Heligioneura mehtai n. sp., lateral view of male genitalia. 5. Promachus pseudoncontractus n. sp., lateral view of male genitalia.

Thorax black, greyish-yellow and grey tomentose; pronotum with yellow and black setae and with a median transverse row of black bristles; scutum with a broad mediolongitudinal black stripe extending from anterior border to well beyond transverse suture, the stripe divided by a grey stripe, submedially with the usual three
black spots in longitudinal row; chaetotaxy: 2 notopleurals, 2-3 postalars, 3 supra-alars, 2-4 dorsocentrals; bristles black, vestiture black but for a few pale yellow setae both anterolaterally and posterolaterally; scutellar disc with black setae but a few laterally pale yellow, hind border with a pair of black bristles. Haltere yellowish-brown with black marking on head.

Legs: yellowish-brown with hind femur nearly brown, apex of femur black, distal tarsal segments also black, vestiture black and pale yellow, bristles black.

Wing: light brown with apex dark brown, medially and anteriorly almost hyaline.

Abdomen: black, each tergum on hind border narrowly golden yellow, vestiture golden yellow, terga 1 and 2 with lateral, long, golden yellow setae some of which form bristles, succeeding terga laterally with 2 or more golden yellow bristles which gradually decrease in size on posterior terga. Male genitalia (Fig. 4) shining black with black setae, epandrium with deep incision.

Female: Similar but with the following differences: comparatively darker, mystax with black bristles predominant; fronto-orbital bristles wholly black; abdomen with tergum 1 laterally bears black bristles, vestiture black and golden yellow, the latter predominant. Genitalia black, tergum 8 and sternum 8 well developed and cover the succeeding tergum and sternum, proctiger black with black and pale yellow setae.


It is the fourth species under Oligoschema group (which is characterised by high facial tubercle and shape of epandrium) from India, the other three being Heligmoneura andamanensis Joseph & Parui (1980), H. bigoti Joseph & Parui (1984a) and H. assamensis Joseph & Parui (1987). Of these H. mehtai n. sp. is closely allied to H. andamanensis Joseph & Parui, from which it can be recognised by the stout built, and in the shape of epandrium. Besides, epandrium is devoid of elongate, dense bristles in the former. It is named in honour of our colleague Dr H. S. Mehta, for various facilities extended to us during our survey of Andaman.

Genus Philodicus Loew

1848. Philodicus Loew, Linn. Ent. 3: 391. Type-species: Asilus javanus Wiedemann, 1819: 4; original designation.

13. Philodicus ceylanicus (Schiner)

1868. Philodicus ceylanicus Schiner, in Reise der Osterreichischen Fregatte Novara, Dipt.: 179, Type-locality: Sri Lanka.

Philodicus ceylanicus: Joseph & Parui, Oriental Ins. 17: 361

Distribution: In India it has been recorded from Andaman, Kerala, Pondicherry, Tamil Nadu and West Bengal.

Diagnosis: It is closely allied to Philodicus chinensis Schiner but differs from it by the presence of only two weak setae on the border of scutellum and small size.

Genus Promachus Loew


Key to species

1. Legs wholly black, abdomen with yellow setae, male genitalia with a tuft of white setae ... nicobarensis Schiner
   —Legs not wholly black, male genitalia without a tuft of white setae ... 2

2. Fore and mid femora yellowish-brown with black dorsally and anteriorly, vestiture of legs black and white and that of abdomen black ... pseudocontractus n. sp.
   —Fore and mid femora reddish with black apex, pubescence of legs and vestiture on abdomen mainly white ... apivorus (Walker)

14. Promachus apivorus (Walker)


Material: Recorded from literature.

Distribution: The species was described from Burma. Later it was recorded from Thailand and India. In India it has been recorded only from Andaman Island.

15. Promachus nicobarensis Schiner

1868. Promachus nicobarensis Schiner, in Reise der Oesterreichischen Fregatte Novara, Dipt.: 177. Type-locality: Kar Nicobar, Nicobar Islands.


Distribution: This is the second record of the species and the first from Andaman.
16. **Promachus pseudocontractus** n. sp.

(Fig. 5)

A rather large black species with greyish-yellow and grey tomentum, black and yellowish-brown legs, and light brown wings with a grey streak in the first submarginal cell. Male: length 20-23 mm, wing 13-16 mm.

*Males*: Head as broad as thorax with dense greyish-yellow or grey tomentum; mystax pale yellow, fronto-orbital bristles pale yellow and black, postcranium with white and pale yellow setae, postocular bristles black above and pale yellow below, postgena with dense, white setae. Antenna black, setae on scape, and pedicel black, pedicel slightly longer than half of scape, first flagellomere a little shorter than scape, style elongate. Palpus and proboscis black with black and pale yellow setae.

*Thorax* black, tomentum sparse; pronotum with pale yellow and white setae whose extent variable, mediadly with a transverse row of eight black bristles; scutum with a broad mediolongitudinal black stripe extending slightly beyond transverse suture to midway between transverse suture and hind border, which is divided by a rather broad, median stripe, submedially with the usual three black spots in a row; chaetotaxy: 2 notopleurals, 2 postalar, 2 supra-alars, 4 dorsocentrals of which 1 in some examples weakly developed; bristles black, vestiture black but for a few pale yellow setae both anterolaterally and posterolaterally; scutellar disc with pale yellow setae, a few of which medially black, hind border with two rows or exceptionally with three rows of varying number of black bristles. Haltere pale yellow to dark brown with the stalk comparatively lighter coloured.

*Legs* black and yellowish-brown; fore and mid femora black dorsally and anteriorly while the rest yellowish-brown, hind femur black with yellowish-brown dorsally on basal half, the extent of colouration quite variable; tibia yellowish-brown with black basally and distally, the black area gradually extends from fore to hind tibia; tarsus black; vestiture black and white with the white setae comparatively dense and long on hind femur, bristles black, mid and hind femora with anteroventral row of black bristles.

*Wing* light brown with a grey streak in the first submarginal cell.

*Abdomen* black with hind border of tergum grey, sides of tergum 1 with pale yellow setae and bristles, in some cases one or more bristles black, tergum 2 laterally with rather long, pale yellow setae, succeeding terga laterally with short, pale yellow setae, vestiture black. Male genitalia (Fig. 5) shining black with a dorsal tuft of white setae, sternum 8 rather well developed.

*Female*: Unknown.

**Holotype** ♂, Reg. No. 7608/H6, S. Andaman: South Point, 24. i. 1988, Coll. A. N. T. Joseph & Party. **Paratypes**: 3 ♂, Reg. No. 7609/H6 to 7611/H6, rest of
data as in holotype; 2 ♂, Reg. No. 7612/H6, to 7613/H6, Little Andaman: Netaji Nagar, 17, i. 1988, Coll. A. N. T. Joseph & Party.

MAP 1. Andaman Islands, distribution of asilids; 2, Orthogonis andamanensis Joseph & Parui; 3, Stichopogon inaequalis (Loew); 4, S. oldroydi n. sp.; 6, Cophinopoda chinensis (Fabricius); 7, Ommatius andamanensis Joseph & Parui; 9, O. nicobarensis Joseph & Parui; 10, Astochia shishcdiai n. sp.; 12, Heligioneura mehtai n. sp.; 13, Philodicus ceylanicus Schiner; 15, Promachus nicobarensis Schiner; 16, P. pseudocontractus n. sp.
Promachus pseudocontractus n. sp. is similar to Promachus contractus (Walker) (1851) from which it differs in the large size, first sub-marginal cell with a grey streak and in the differences in the shape of male genitalia, especially epandrium.

MAP 2. Little Andaman, distribution of asilids: 1, Laxenecera albibarbis Macquart; 4, Stichopogon oldroydi n. sp.; 5, S. tomentosus Oldroyd; 8, Ommatius mitrai n. sp.; 9, O. nicobarensis Joseph & Parui; 10, Astochia shishodiae n. sp.; 11, Heligmoreura andamanensis Joseph & Parui; 12, H. mehtai n. sp.; 16, Promachus pseudocontractus n. sp.
DISCUSSION

Until this study, asilid fauna of Andaman was known by 5 species of 5 genera: *Orthogonis andamanensis* Joseph & Parui, *Ommatius andamanensis* Joseph & Parui, *Heligmoneura andamanensis* Joseph & Parui, *Philodicus ceylanicus* Schiner and *Promachus apivorus* (Walker). Consequent to our survey the species has increased to 16 numbers. Of these 6 are new records, viz., *Laxenecera albibarbis* Macquart, *Stichopogon inaequalis* (Loew), *S. tomentosus* Oldroyd, *Cophinopoda chinensis* (Fabricius), *Ommatius nicobarensis* Joseph & Parui and *Promachus nicobarensis* Schiner*; and 5 are new species, *Stichopogon oldroydi*, *Ommatius mitrai*, *Astochia shishodiai*, *Heligmoneura mehtai* and *Promachus pseudocontractus*.

Of these 16 species known from Andaman only 2 species, *Ommatius nicobarensis* Joseph & Parui and *Promachus nicobarensis* Schiner, are also as well distributed in Nicobar. Undoubtedly other species known from Andaman are also distributed in Nicobar, and will be found when it is surveyed intensively. Incidentally, 7 more species are reported from Nicobar: *Clinopogon nicobarensis* (Schiner), *Ommatius frauentfeldi* Schiner, *O. nigra* (Schiner), *O. spathulatus* Doleschall, *Astochia longistylus* Wiedemann, *Machimus nicobarensis* (Schiner) and *Promachus pseudomaculatus* Ricardo.

The 16 species of asilids from Andaman belong to 9 genera, of which the genera *Laxenecera* Macquart, *Stichopogon* Loew, *Cophinopoda* Hull and *Astochia* Becker are recorded for the first time.

*Orthogonis andamanensis* Joseph & Parui, *Ommatius andamanensis* Joseph & Parui and *Heligmoneura andamanensis* Joseph & Parui are endemic to Andaman. Besides the 3 endemic species and the 5 new species, there are 8 species of which 6, viz., *Laxenecera albibarbis* Macquart, *Stichopogon inaequalis* (Loew), *S. tomentosus* Oldroyd, *Cophinopoda chinensis* (Fabricius), *Philodicus ceylanicus* Schiner and *Promachus apivorus* (Walker), are distributed in the Oriental region thus showing affinity mainly to this region.

SUMMARY

This paper deals with 16 species of asilids from Andaman, of which 5 species, viz., *Stichopogon oldroydi*, *Ommatius mitrai*, *Astochia shishodiai*, *Heligmoneura mehtai* and *Promachus pseudocontractus*, are new, and 6 are new records. They belong to 9 genera, of which *Laxenecera* Macquart, *Stichopogon* Loew, *Cophinopoda* Hull and *Astochia* Becker are recorded for the first time. There are only 2 species, *Ommatius nicobarensis* Joseph & Parui and *Promachus nicobarensis* Schiner distributed both in

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*Inadvertently omitted to include this species under the new records in the abstract of the paper submitted to the Second International Congress of Dipterology, Bratislava, Czechoslovakia, August 27—September 1, 1990.*
Andaman and Nicobar. The three species endemic to Andaman are *Orthogonis andamanensis* Joseph & Parui, *Ommatius andamanensis* Joseph & Parui, *Ommatius andamanensis* Joseph & Parui and *Heligmoneura andamanensis* Joseph & Parui. Several species of Andaman are well distributed in the Oriental Region thus showing greater affinity to that geographical region.

The types of the new species are deposited in the National Collection of Zoological Survey of India, Calcutta.

**Acknowledgements**

We are grateful to Prof. Mohammad Shamim Jairajpuri, Director, Zoological Survey of India, Calcutta, for facilities and encouragements. We are indebted to Prof. A. G. Scarbrough, Biology Department, Towson State University, Towson, Baltimore, U. S. A., for critical reading of this paper.

**References**


**Abbreviations**

Ae, aedeagus; Ep, epandrium; Gc, gonocoxite; Gs, gonostylus; Hy, hypandrium; L, lamella; Pr, proctiger.