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DR. A. K. GHOSH
Director
Zoological Survey of India

RECORDS
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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 occurence 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 goup 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 surveped and 29 hanuman langur groups were observed, out of which 25 were bisexual groups and 4

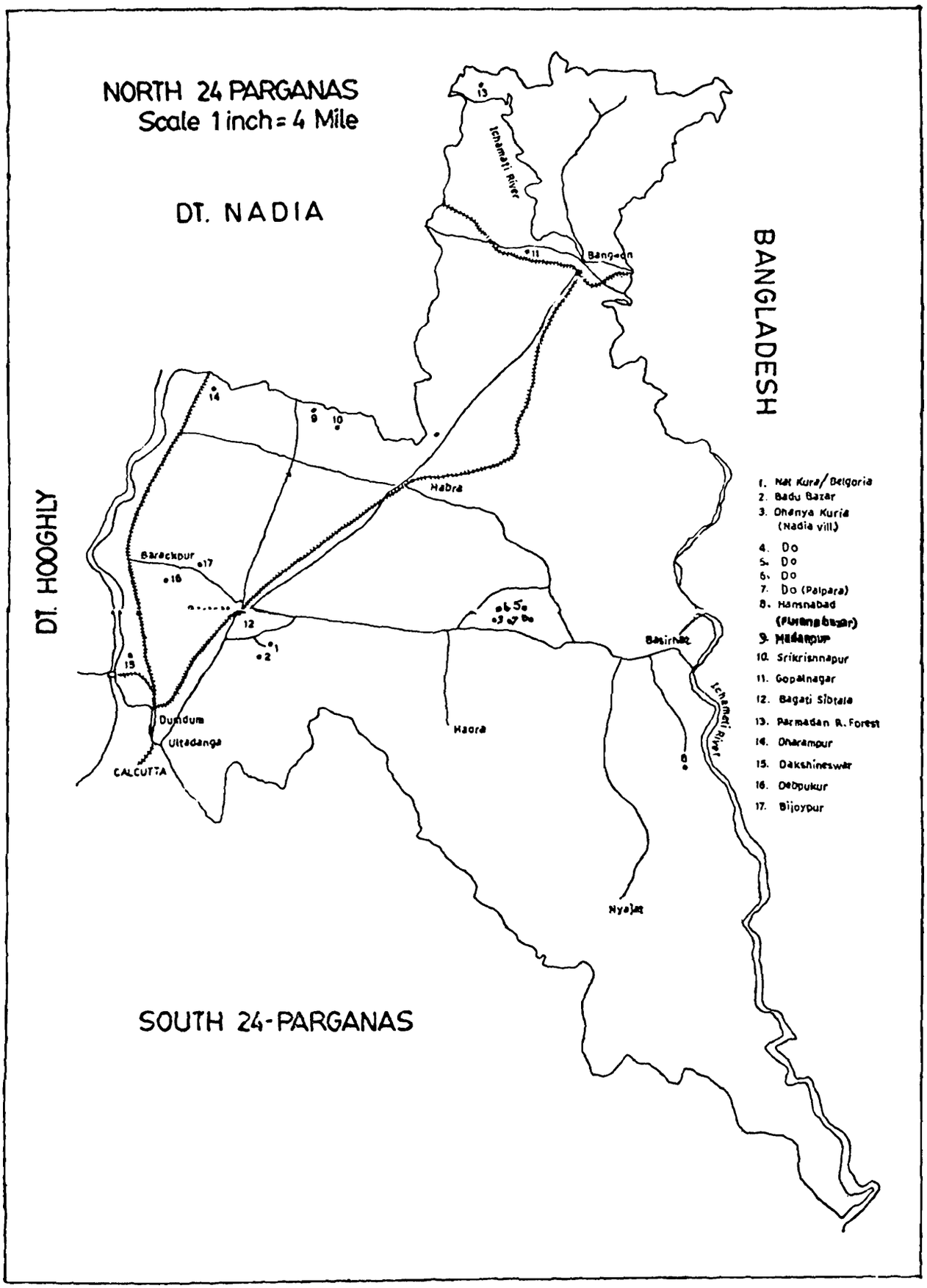

Fig. 1. Map showing the distribution of hanuman langur groups in North 24-Parganas district.

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 juvenilec 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, socirl 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

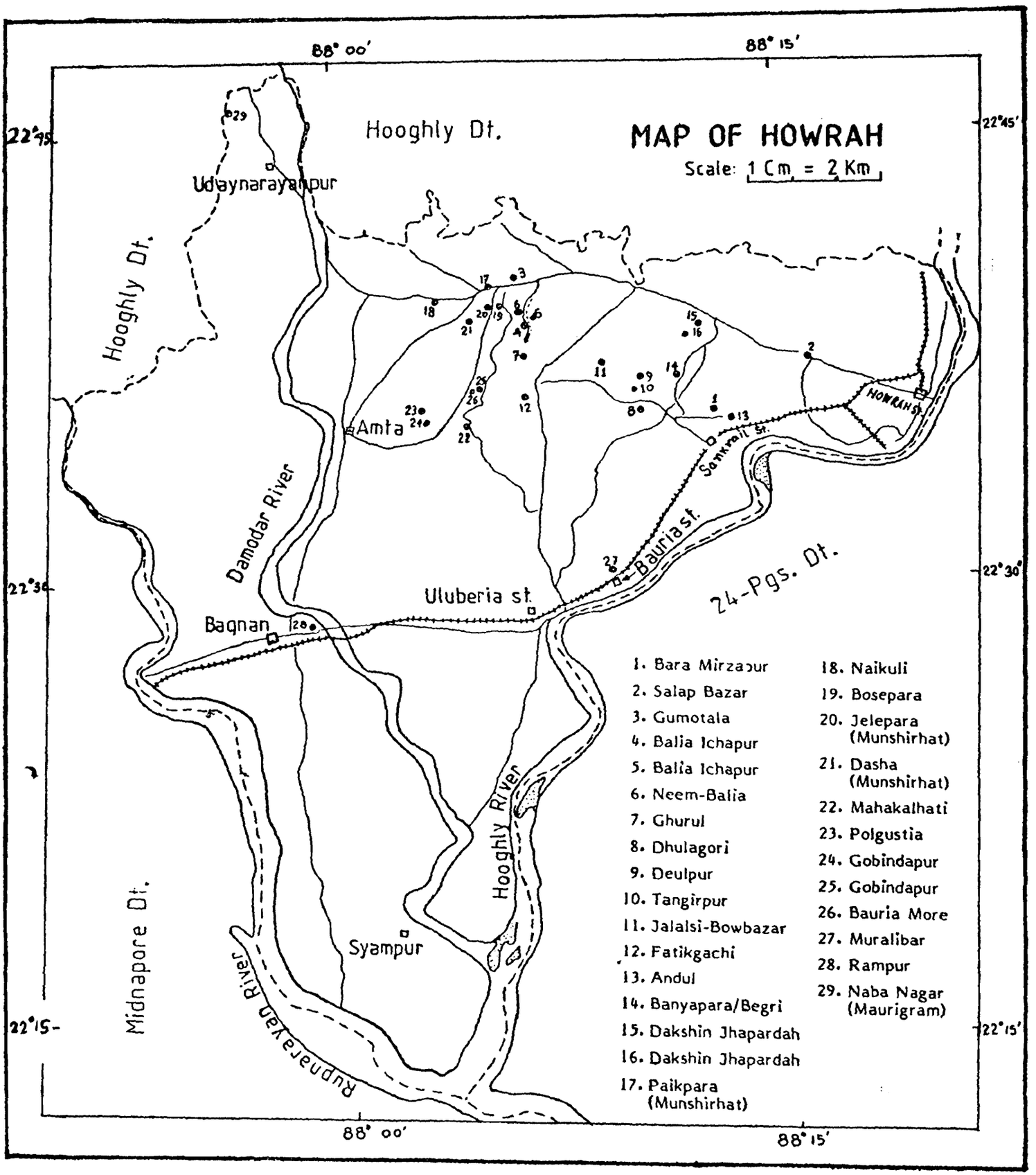

Fig. 2. Map showing the distribution of hanuman langur groups in Howrah district.

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.

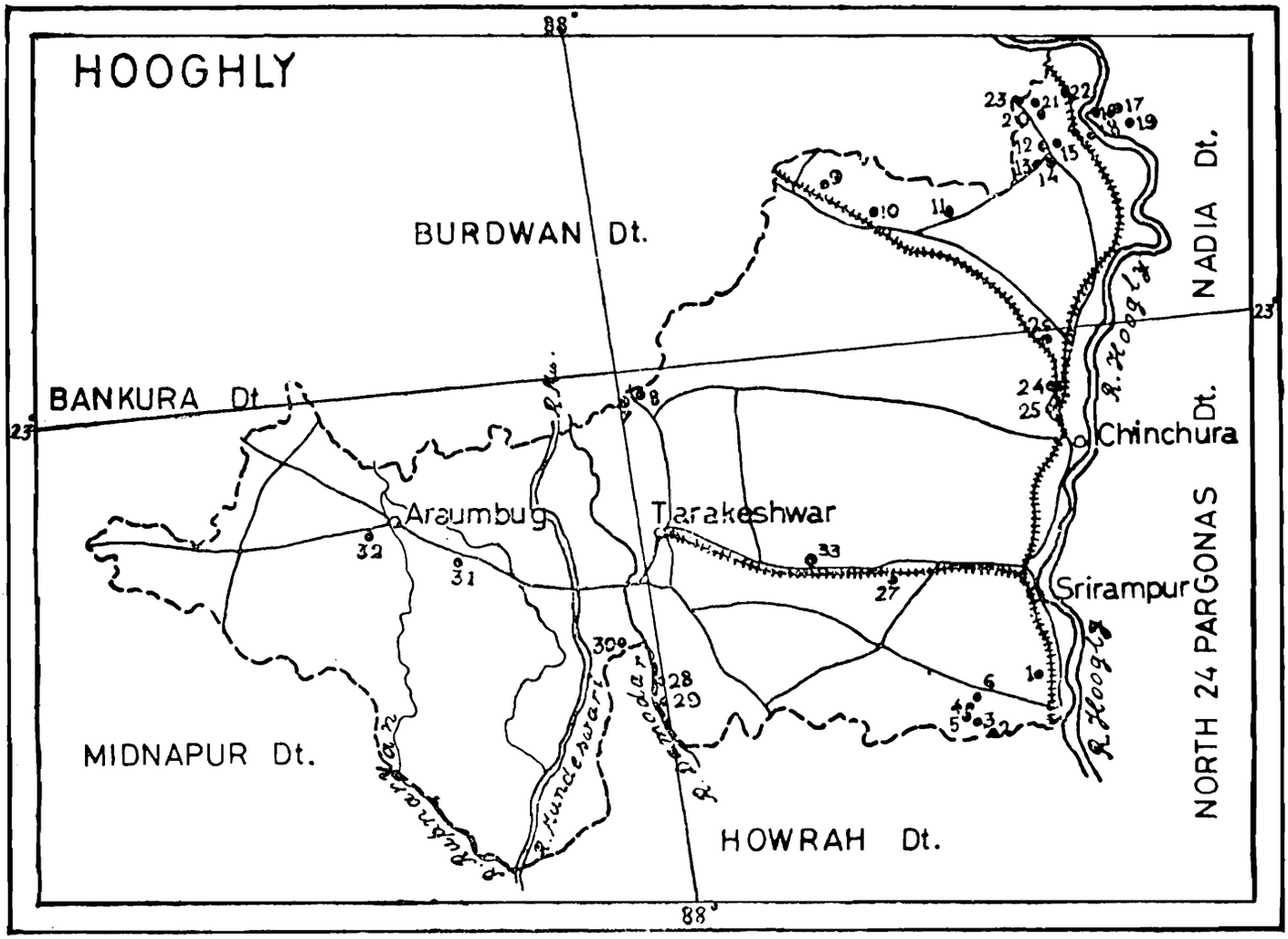

Fig. 3. Map showing the distribution of hanuman langur groups in Hooghly district.
1. Konnagarh. 2. Chamrail. 3. Majheraat. 4. Kalipur. 5. Kalipur (Krishnapur). 6. Chanditolla. 7. Khanpur. 8. Balidanga. 9. Baichigram. 10. Simlagarh. 11. Mondalia. 12. Karolla. 13. Karolla. 14. Somra. 15. Sukharia. 16. Somra. 17. Somra. 18. Sukharia (Baligori). 19. Sukharia (Siddeshwar). 20. Ghose Pukur. 21. Bankipur. 22. Bankipur. 23. Natagarh. 24. Konsoti (Tribeni). 25. Bagati Sibtola (Tribeni). 26. Kazidanga. 27. Dattapara. 28. Rashidpur. 29. Rampur 30. Shyampur. 31. Mayapur. 32. Kalipur College. 33. Dakati Kalibari (Singur).

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 factorsfor 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 theyraid 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-

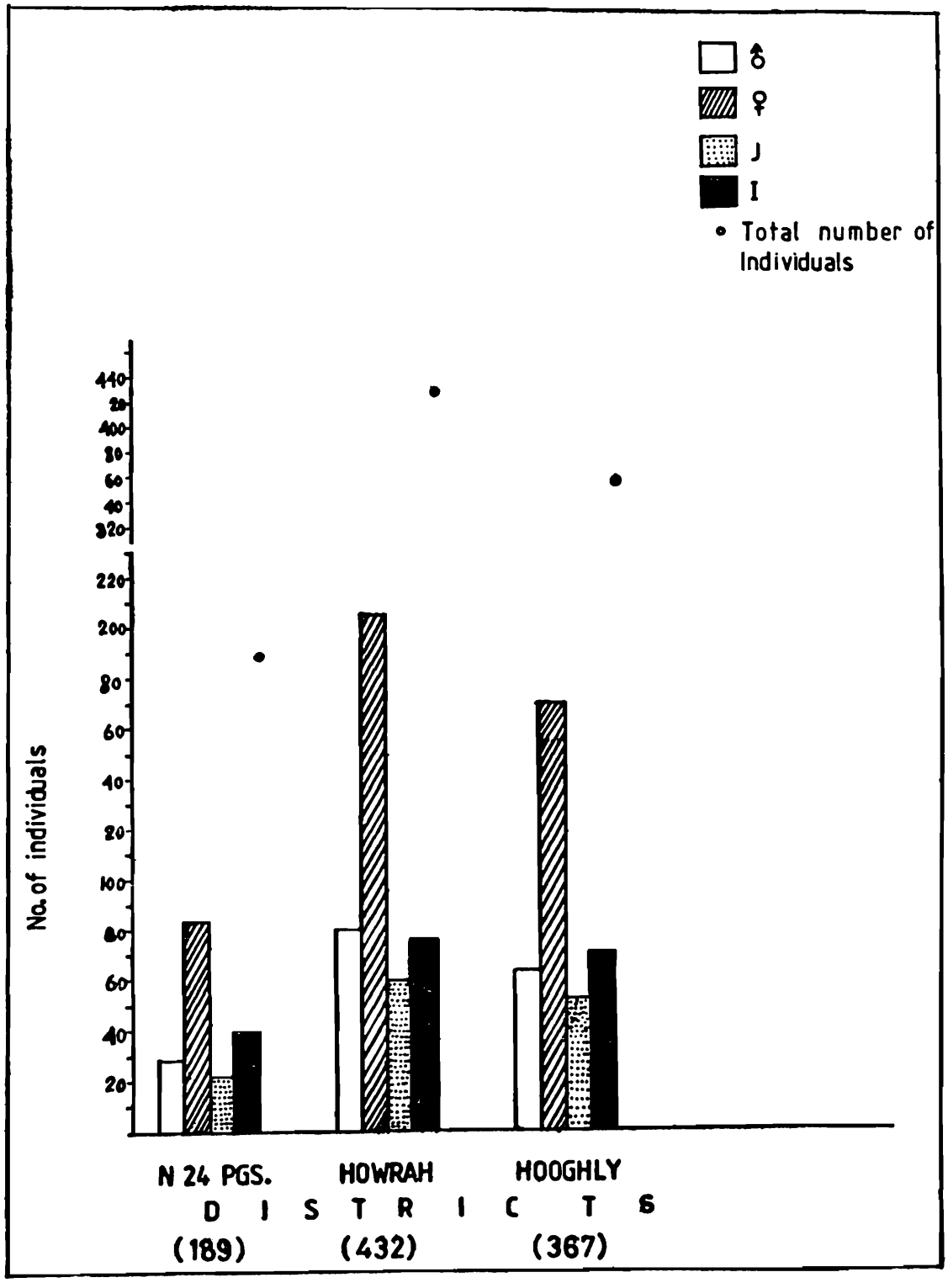

Fig. 4. Group sizes and compositions of hanuman langur groups in three different districts

servation 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.

SUMMARY

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 wide spread 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.

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

TABLE—II

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

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

Sl. No.	Locality	Habitat	Male	Female	Juvenile	Infant	Total
1.	Bara Mirzapur	T	1	5	2	2	10
2.	Salap Bazar	V	—	—	—	—	10
3.	Gumotala	V	2	8	1	2	13
4.	Balia Ichapur	V	2	9	3	3	17
5.	—do—	V	2	10	3	3	18
6.	Neem-Balia	V	3	16	5	3	27
7.	Ghurul	V	2	14	6	5	27
8.	Dhulagori	V	3	7	2	7	19
9.	Deulpur	V	2	5	1	3	11
10.	Tangirpur	V	1	6	2	1	10
11.	Jalalsi-Bowbazar	V	2	10	—	2	14
12.	Fatikgachi	V	2	6	1	3	12
13.	Andul	T	3	9	3	3	18
14.	Banyapara/Begri	V	2	14	4	3	23
15.	Dakshin Jhapardah	V	1	4	—	2	7
16.	—do—	V	8 (all male group)				8
17.	Paikpara (Munshirhat)	T	1	14	4	6	25
18.	Naikuli	V	1	5	1	1	8
19.	Bosepara	T	1	9	4	5	19
20.	Jelepara (Munshirhat)	T	2	5	2	1	10
21.	Dasha (-do-)	V	1	9	2	4	16
22.	Mahakalhati	V	1	6	1	1	9
23.	Polgustia	V	15 (all male group)				15
24.	Gobindapur	V	11 (all male group)				11
25.	—do—	V	1	5	2	1	10
26.	Bauria More	T	5 (all male group)				5
27.	Muralibar	V	1	4	1	1	7
28.	Rampur	V	2	10	2	5	19
29.	Naba Nagar (Maurigram)	V	2	16	7	10	35
		Total	80	206	59	77	432

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

TABLE—IV

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

Sl. No.	Locality	Habitat	Male	Female	Juvenile	Infant	Total
1.	Konnagarh	T	1	6	1	3	11
2.	Chamrail	V	2	10	3	5	20
3.	Majheraat	V	2	11	2	—	15
4.	Kalipur	V	3	(all male group)			3
5.	Kalipur/Krishnapur	V	1	5	—	—	6
6.	Chanditolla	V	1	6	1	2	10
7.	Khanpur	V	1	6	2	1	10
8.	Balidanga	V	1	8	2	4	15
9.	Baichigram	V	1	7	2	6	16
10.	Simlagarh	V	1	(Solitary)			1
11.	Mondlai	V	2	9	3	7	21
12.	Karolla	V	10	(all male group)			10
13.	—do—	V	2	8	3	4	17
14.	Somra	V	1	3	1	1	6
15.	Sukharia	V	2	6	2	4	14
16.	Somra	V	12	(all male group)			12
17.	—do—	V	4	(all male group)			4
18.	Sukharia (Baligari)	V	1	6	—	3	10
19.	—do— (Siddheswari)	V	1	7	7	2	17
20.	Ghoshpukur	V	—	2	—	—	2
21.	Bankipur	V	1	6	2	2	11
22.	—do—	V	1	4	1	4	10
23.	Natagarh	V	1	5	3	2	11
24.	Konsti	T	1	(Solitary)			1
25.	Bagati Sibtala	T	1	7	2	2	12
26.	Kazidanga	V	1	2	—	—	3
27.	Dattapara	V	1	5	—	2	8
28.	Rashidpur	V	1	5	1	1	8
29.	Rampur	V	2	10	2	5	19
30.	Shyampur	V	—	—	—	—	12
31.	Mayapur	V	1	7	—	3	11
32.	Kalipur College	T	1	4	1	2	8
33.	Dakati Kalibari (Singur)	T	2	16	10	5	33
		Total	63	171	51	70	367

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

ACKNOWLEDGEMENTS

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FOOD AND FEEDING HABITS OF SOME AMPHIBIAN SPECIES OF NORTHEAST INDIA

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INTRODUCTION

Amphibians in general are voracious feeder. 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 where ever identifications were possible they were identified upto 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 period 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 histograme of 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.

Sl. No.	Species	Collection localities	Season	Year of collection
1.	*Rana gerbillus* Annandale	Assam, Meghalaya, Arunachal Pradesh, Mizoram, Nagaland, Manipur, Tripura.	January-December	1968-1978
2.	*Rana limnocharis* Weig.	Assam, Meghalaya, Arunachal Pradesh, Mizoram, Nagaland, Manipur, Tripura.	January-December	1968-1979
3.	*Amolops afghanus* (Gunther)	Assam, Meghalaya, Arunachal Pradesh, Mizoram.	January-April, June-November	1971-1972 1975-1978
4.	*Bufo melanostictus* Schn.	Assam, Meghalaya, Arunachal Pradesh, Mizoram, Nagaland, Manipur, Tripura.	January-July, Oct.-Dec.	1968-1979
5.	*Microhyla berdmorei* (Blyth)	Assam, Maghalaya, Arunachal Pradesh, Mizoram.	January-March, April, July-October, December.	1971-1976, 1978, 1983.

Sl. No.	Species	Collection localities	Season	Year of collection
6.	*Microhyla ornata* (Dum. & Bibron)	Assam, Meghalaya, Mizoram, Nagaland, Tripura.	January-March, July, Oct.-Dec.	1971-1972, 1976, 1978.
7.	*Polypedates leucomystax* (Kuhl.)	Assam, Meghalaya, Manipur.	December-May, July-Oct.	1966-1968, 1971-1973, 1975.
8.	*Philautus shillongensis* Pillai & Chanda	Meghalaya	January-May, July-August, Oct.-Dec.	1970-1978.

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 orthoptern 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 (.5%) are found at the bottom of preference. Dipteran insects constituting 6.5% of the gut-contents come next to coleopteran insects.

Miscellaneous food items (2.7%) follow the dipteran insects. Isopteran insects (2.5%) and orthopteran insects (1.5%) follow the miscellaneous food items.

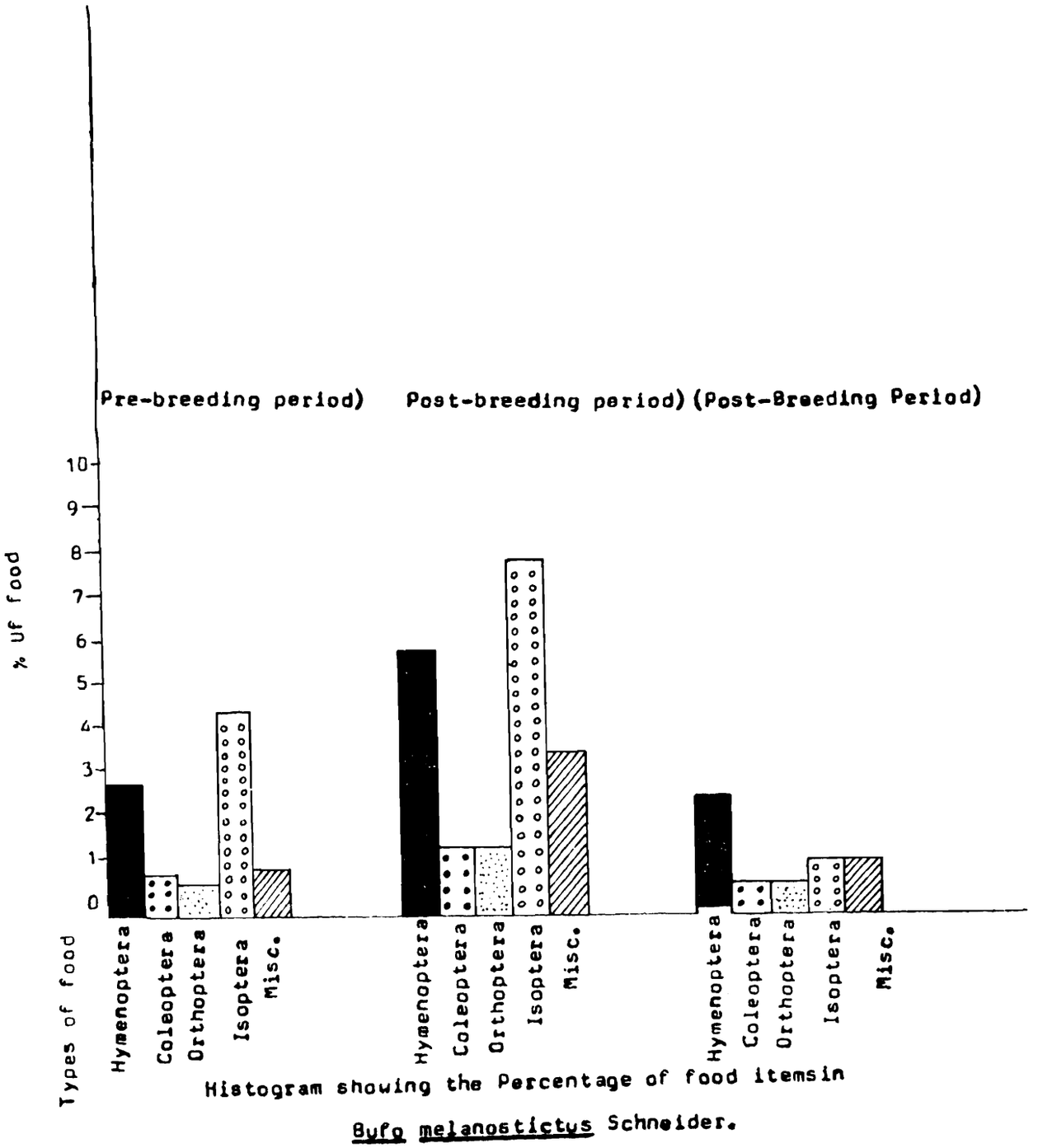

Fig. 1.

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. Coleopteran 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 coleoptran insects which

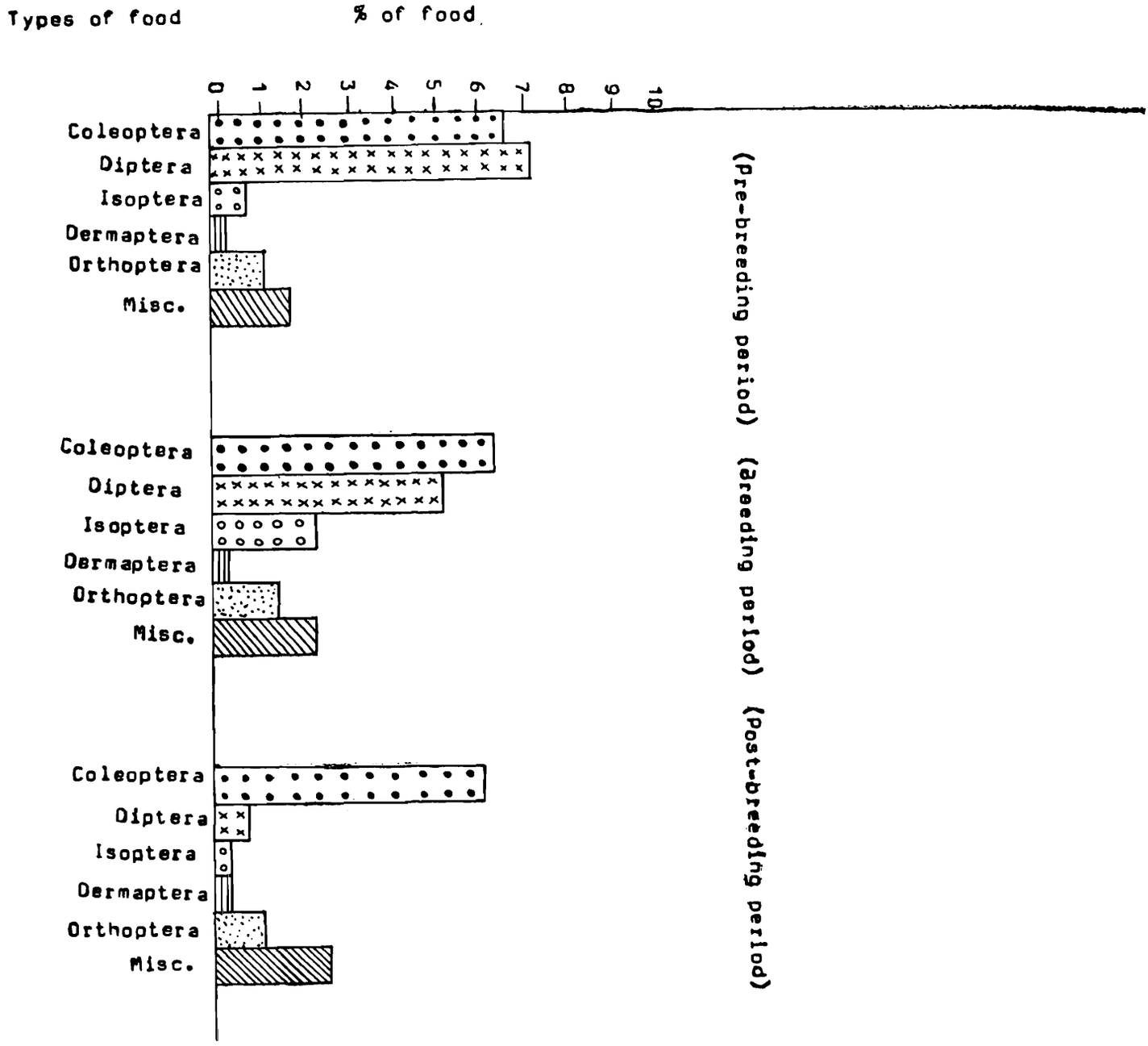

Fig. 2. Histogram showing percentage of food items in *Rana limnocharis* Weigmann

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 histograme (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.

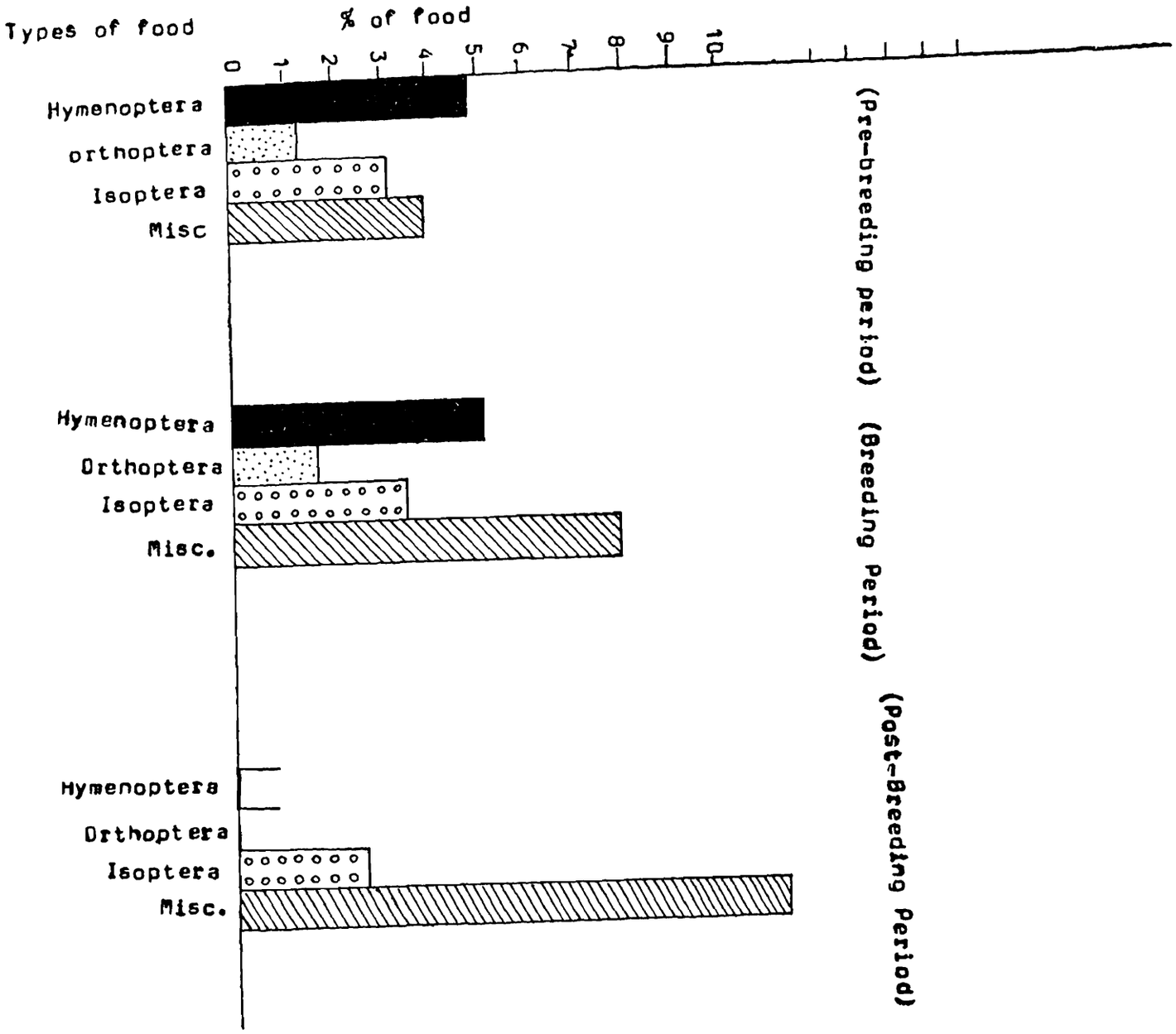

Fig. 3. Histogram showing the percentage of food items in *Rana gerbillus* Annandale

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 histograme (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 histograme (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.

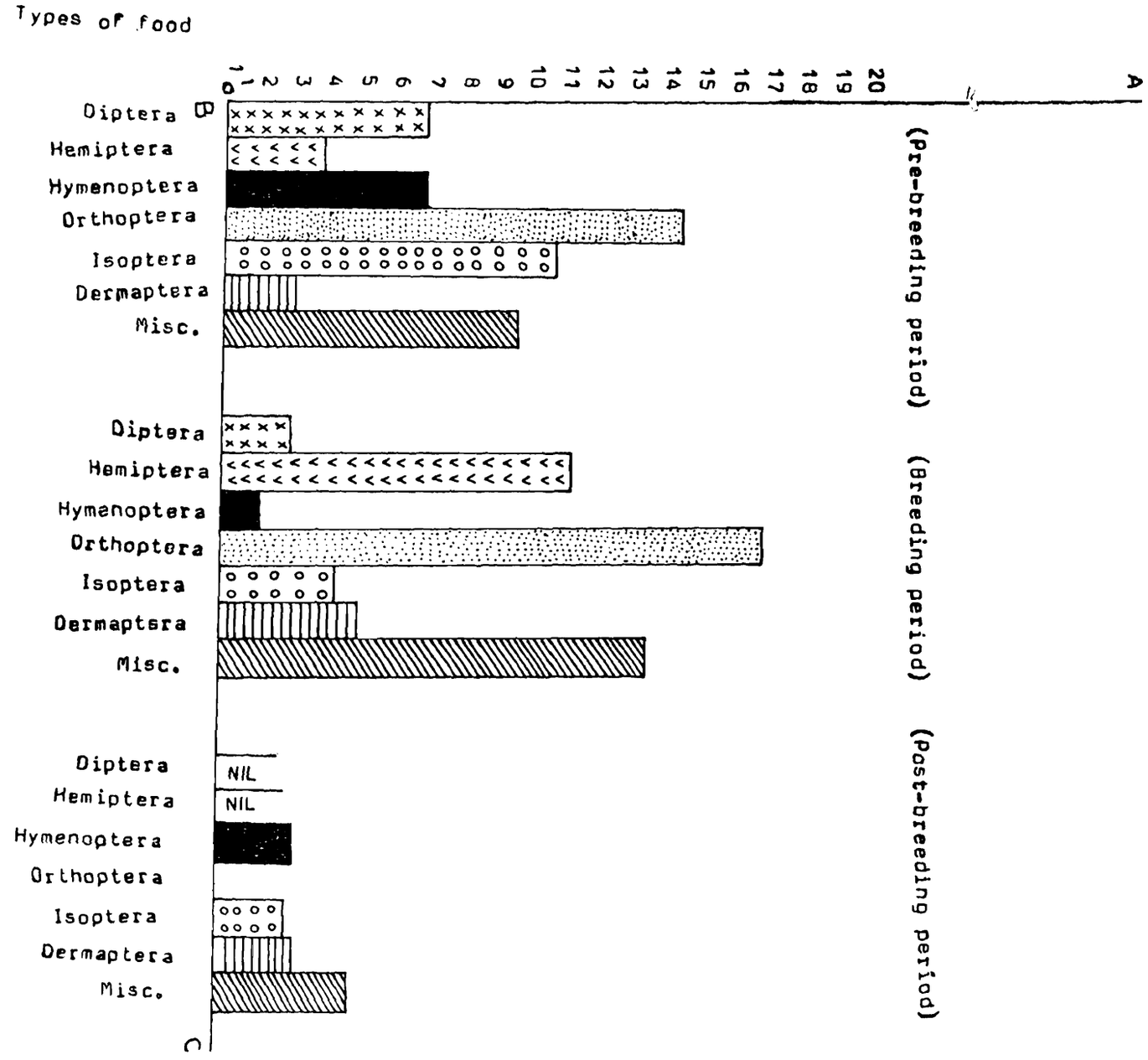

Fig. 4. Histogram showing the percentage of food items in *Amolops afghanus* (Gunther)

Food-intake during pre-breeding period is eomparatively 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 histograme (Fig. 5).

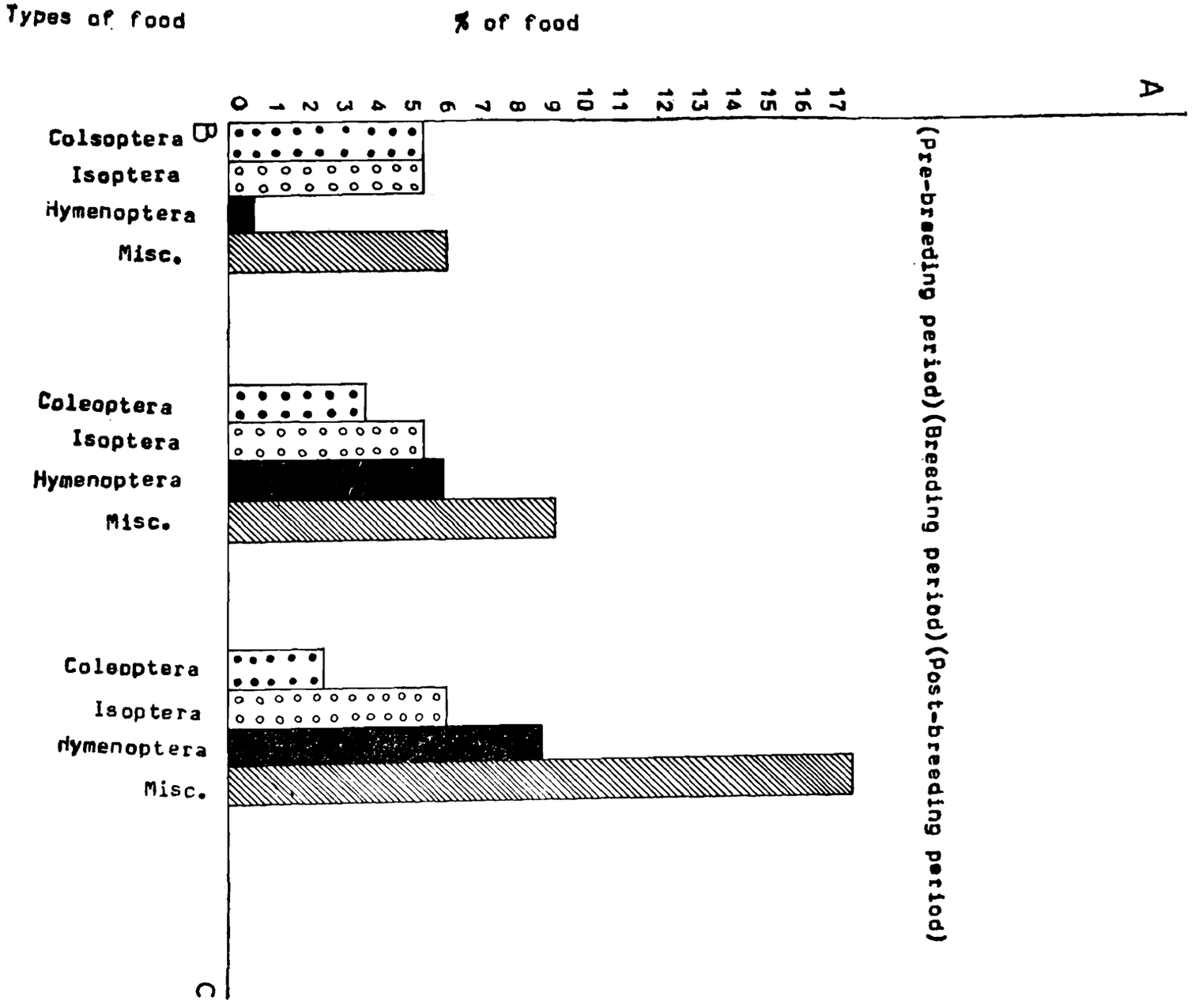

Fig. 5. Histogram showing the percentage of food items in *Microhyla berdmorei* (Blyth)

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 preferes 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.

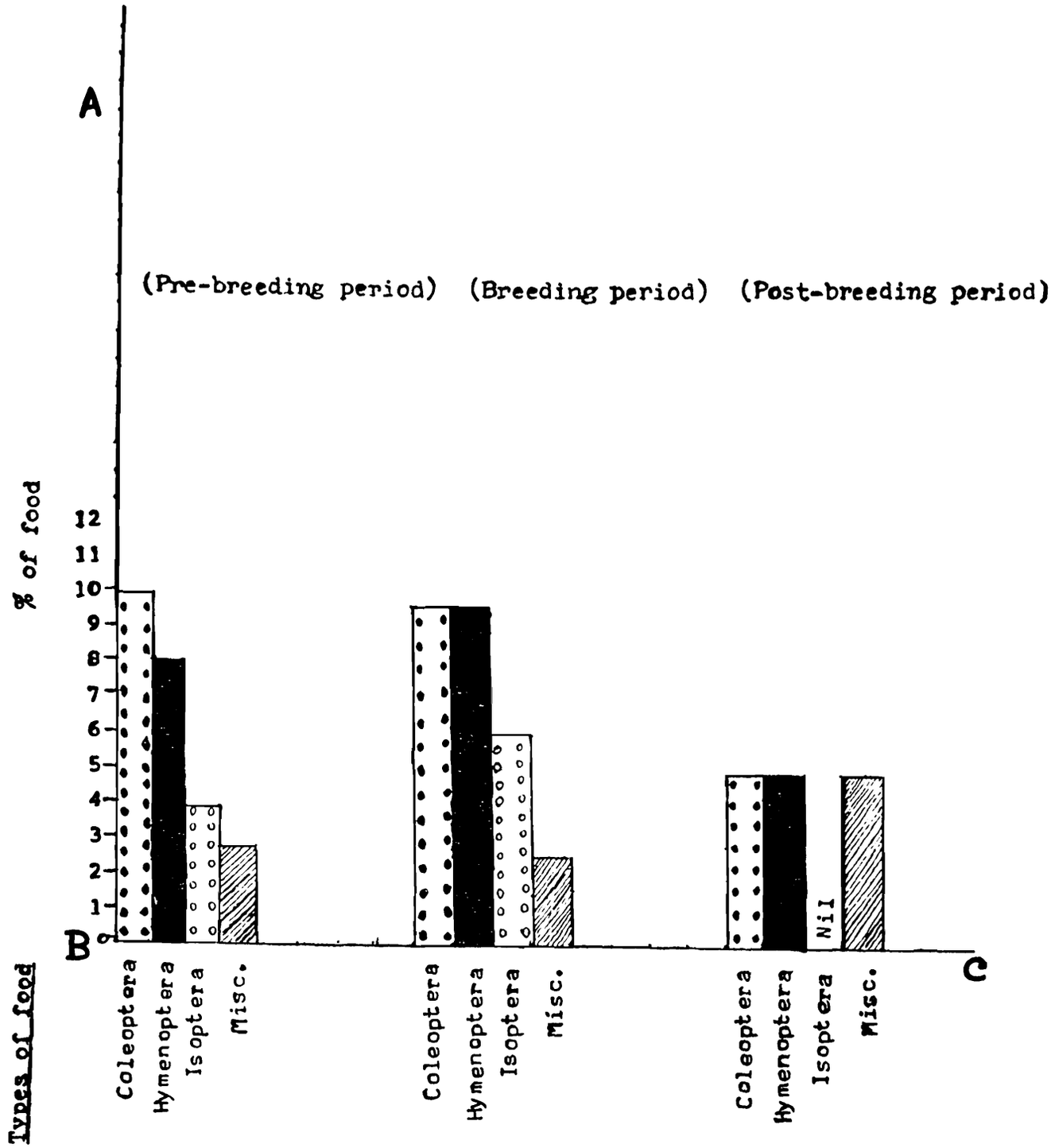

Fig. 6. Histogram showing the percentage of food items in *Microhyla ornata* (Dum & Bibr.)

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 percentagc of food-items have been shown in histograme (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 histograme (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.

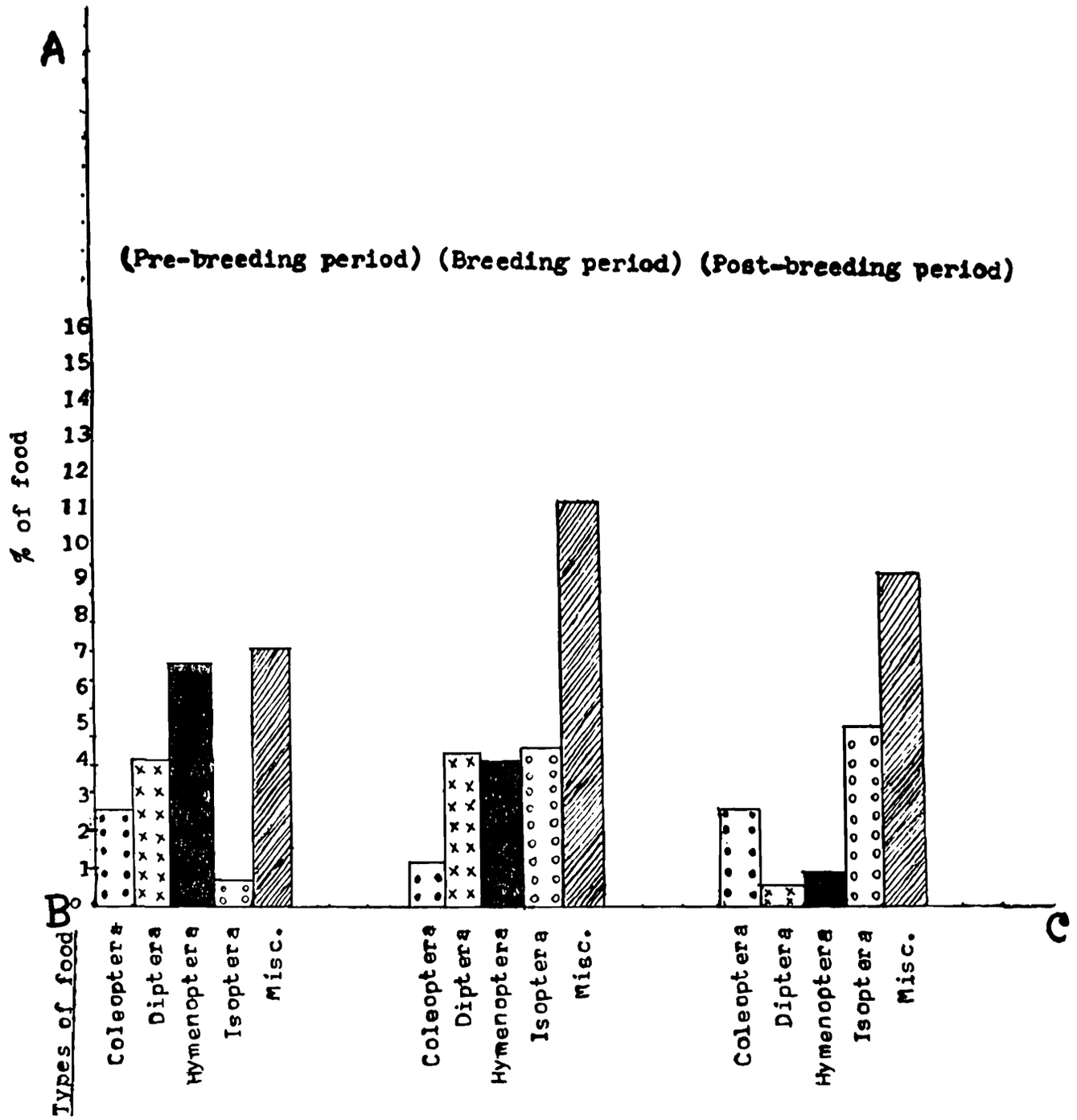

Fig. 7. Histogram showing percentage of food items in *Polypedates leucomystax* (Kuhl)

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 isopteran insects (6%) each come next to miscellaneous food-items in decreasing order. The percentage of food items have been shown in histograme (Fig. 8).

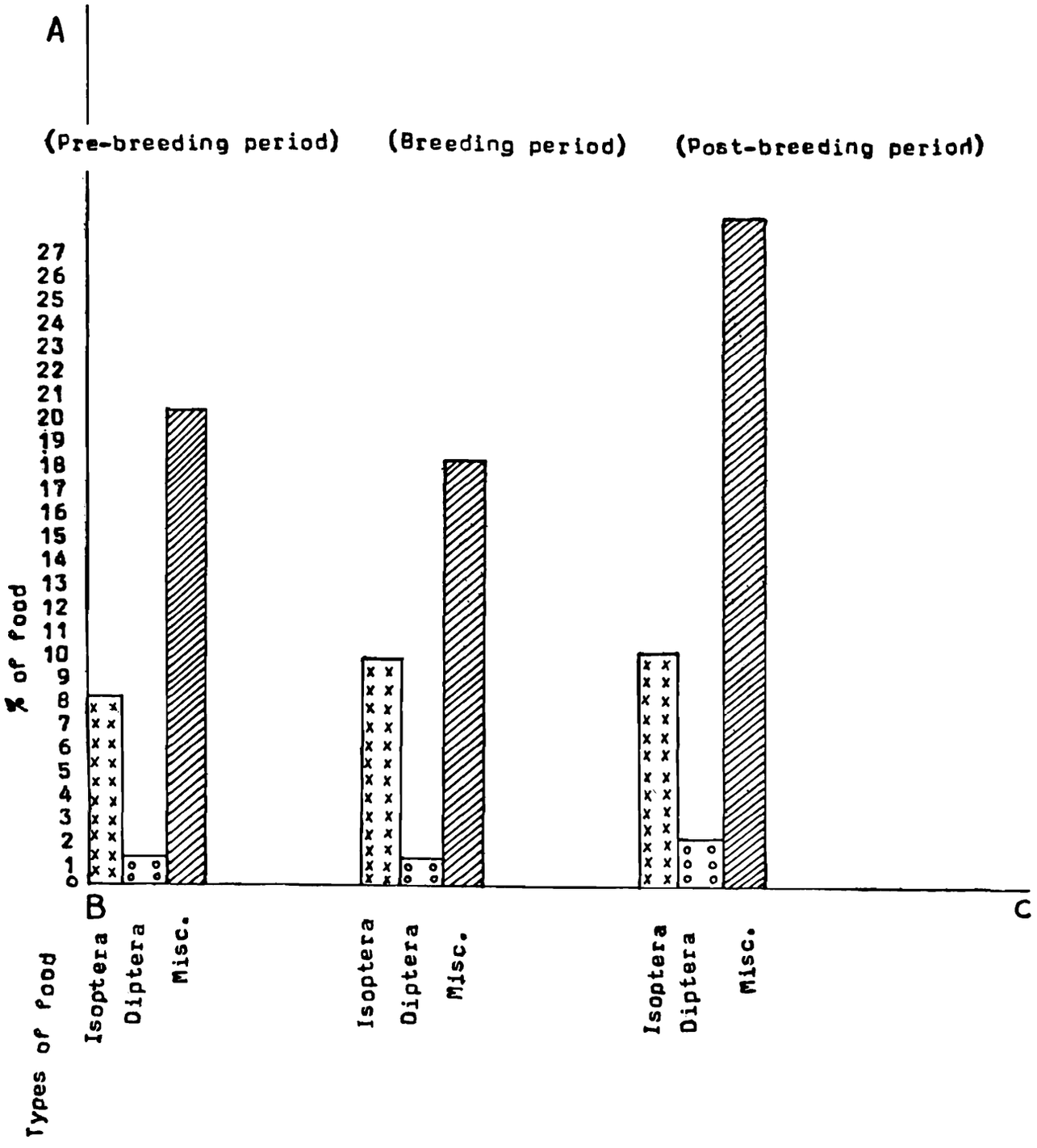

Fig. 8. Histogram showing the percentage of food items in *Philaitus shillongensis* Pillai & Chanda

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 puausity of the preferred type of food material, which in turn is governed by seasonal effect.

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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

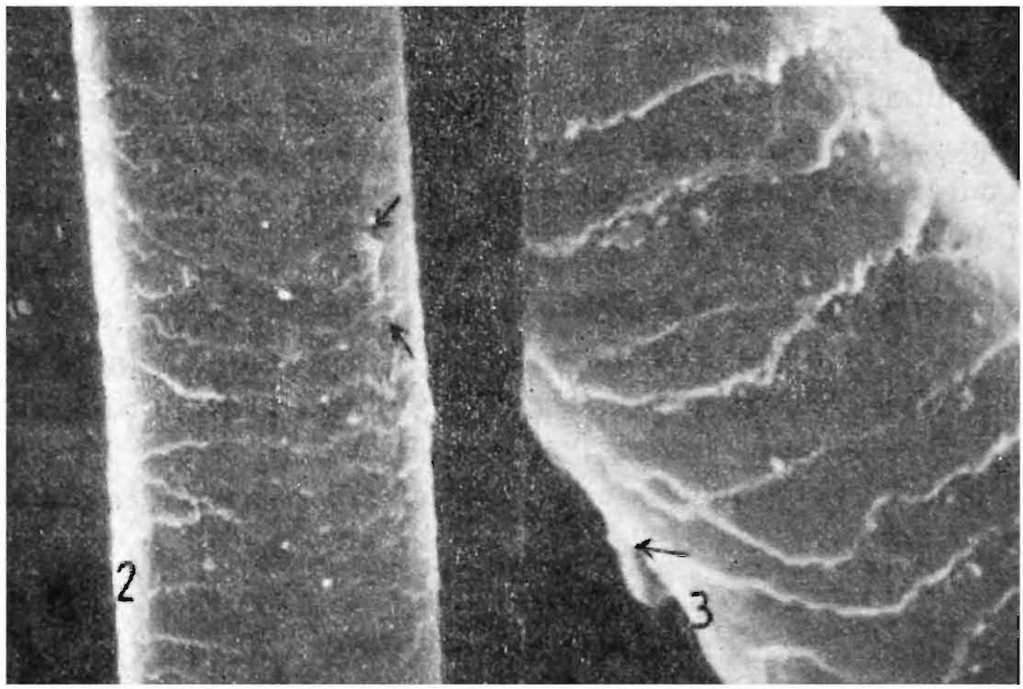
Hair samples were collected from the rump region of three species of the genus *Macaca* collected during 1878 to 1880 and preserved in the National Zoological Collections, Zoological Survey of India, Calcutta.

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 :—

Macaca 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 assemensis 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. Occationally 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 veriable 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 deffe-rent mammalian species.

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FIEH, MOLLUSC AND CRUSTACEAN CYTOGENETICS IN INDIA : A BIBLIOGRAPHY

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INTRODUCTION

It has been increasingly recognised that the existing literature in any subject always provide a feed back 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.

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105. *Puntius javanicus* 33, 62, 65.
106. *Puntius melanampyx* 4, 48, 62, 65.
107. *Puntius sarana* 14, 62, 119.
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146. *Hemiramphus lutkei* 25, 65, 112.
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148. *Heteropneustes fossilis* 16, 62, 65, 75, 83, 94, 105, 107, 114, 116, 150, 189, 190, 195.
149. *Heteropneustes* sp. 66.

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151. *Leiognathus bindus* 62, 65, 112.

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152. *Lobotes surinamensis* 62, 184, 185.

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26. *Trichoniscus* sp. 8.

ERRATA

FISH CYTOGENETICS

Ref. No.

17. Chromosomal study not reported.
28. Deals only with an amphibian species.
174. Natarajan, R. and Subrahmanyam, K. 1974.

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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 erraneous 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 *Pseudosciaena diacanthus* and type locality (Karachi) of the latter genus. Further, she revised the diagnosis of the subfamily Orientodiploprocdaeinae 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

Syn. Cryptocollaritrematinae Srivastave, C.B. 1982 (n. syn.)

Genus **Orientodiploproctodaeum** Bhutta and Khan

1970. *Orientodiploproctodaeum* Bhutta and Khan, *Pakistan J. Zool.*, 2 (2) : 163.

1974. *Cryptocollaritrema* Madhavi, *Proc. 3rd. Internat. Congr. Parasit.*, München, Section G2 (12) 1616. (Abstract) (n. syn.)

1974. *Multiovarium* Bilqees, *Sind Univ. Res. J. (Sci. Ser.)*, 8 (1/2) : 33. (n. syn.)

1974. *Anterodiscus* Bilqees, *Sind Univ. Res. J. (Sci. Ser.)*. 8 (1/2) : 7 (n. syn.)

1976. *Cryptocollaritrema* : Madhavi, *Riv. Parassit.*, 37 (2/3) : 313.

1982. *Cryptocollaritrema* : Srivastava, C. B., *The Fauna of India and the Adjacent Countries, Platyhelminthes Vol. I (Supplement), Trematoda—Digenea. Additiuns to Prof. H. R. Mehra's Volume on Trematoda—Digenea* : 139.

Orientodiploproctodaeum diacanthi Bhutta and Khan

(Figs. 1-6)

1970. *Orientodiploproctodaeum diacanthi* Bhutta and Khan, *Pakistan J. Zool.*, 2 (2) : 163.

1974. *Cryptocollaritrema provesiculatum* Madhavi, *Proc. 3rd. Internat, Congr. Parasit.*, München, Section G2 (12) : 1616. (n. syn.)

1974. *Multiovarium heteroformis* Bilqees, *Sind Univ. Res. J. (Sci. Ser.)*, 8 (1/2) : 34. (n. syn.)

1974. *M. interruptum* Bilqees, *Ibid*, 8 (1/2) 36. (n. syn.)

1974. *Anterodiscus biseminalis* Bilqees, *Ibid*, 8 (1/2) : 38. (n. syn.)

1974. *A. triuteri* Bilqees, *Ibid*, 8 (1/2) : 40. (n. syn.)

1976. *Cryptocollaritrema provesiculatum* : Madhavi, *Riv. Parassit.*, 37 (2/3) : 313.

1982. *C. provesiculatum* : Srivastava, C. B., *The Fauna of India and the Adjacent Countries, Platyhelminthes Vol. I (Supplement), Trematoda—Digenea. Additions to Prof. H, R. Mehra's Volume on Trematoda—Digenea* : 140.

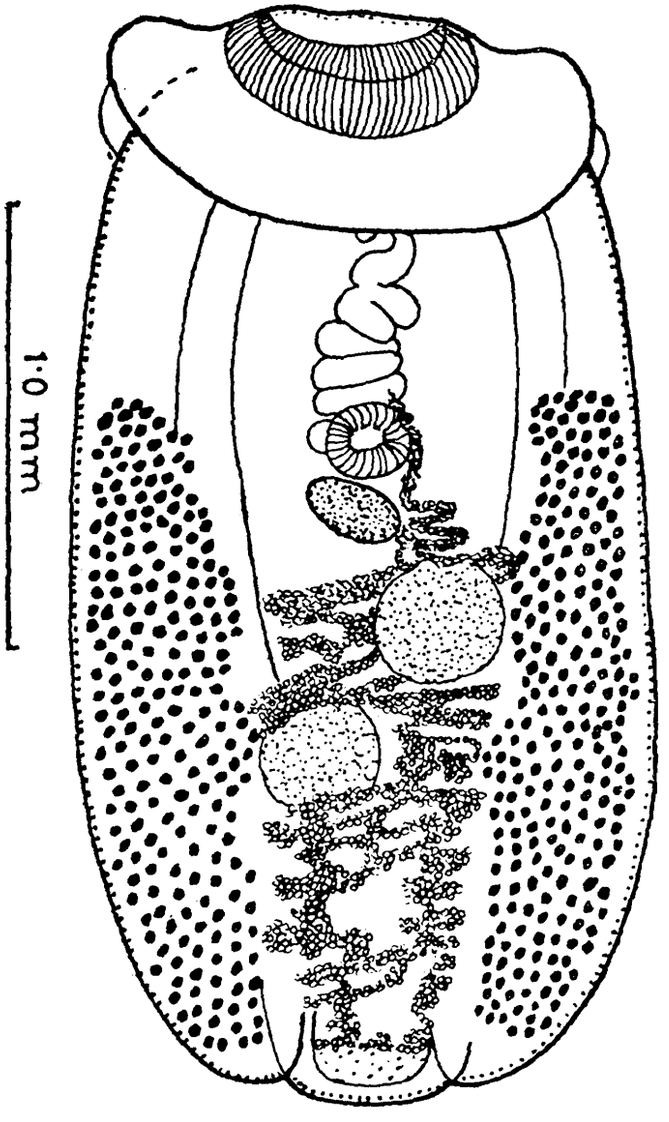

Fig. 1. *Orientodiploproctodaum diacanthi* Bhutta and Khan, 1970 (After Bhutta and Khan, 1970).

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*, *Multiovarium* 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, *Multiovarium* 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,

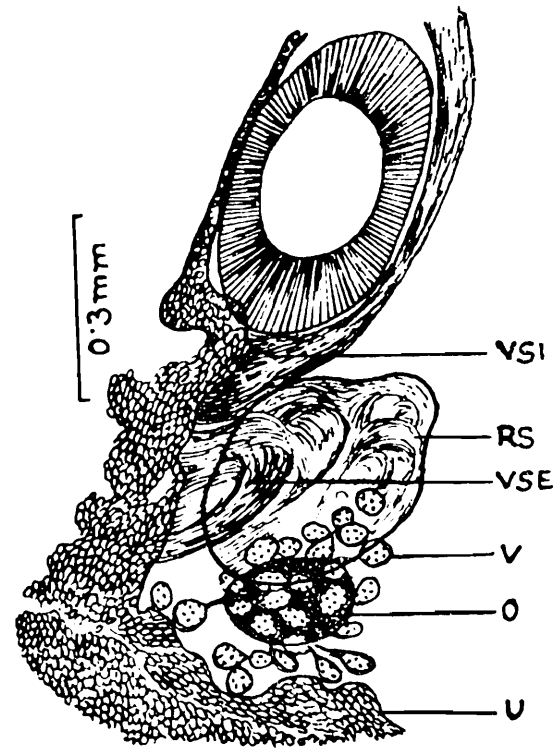

Fig. 2. *Anterodiscus biseminalis* Bilqees, 1974 showing postacetabular region (After Bilqees, 1974).

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 synoymy. 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 textat 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

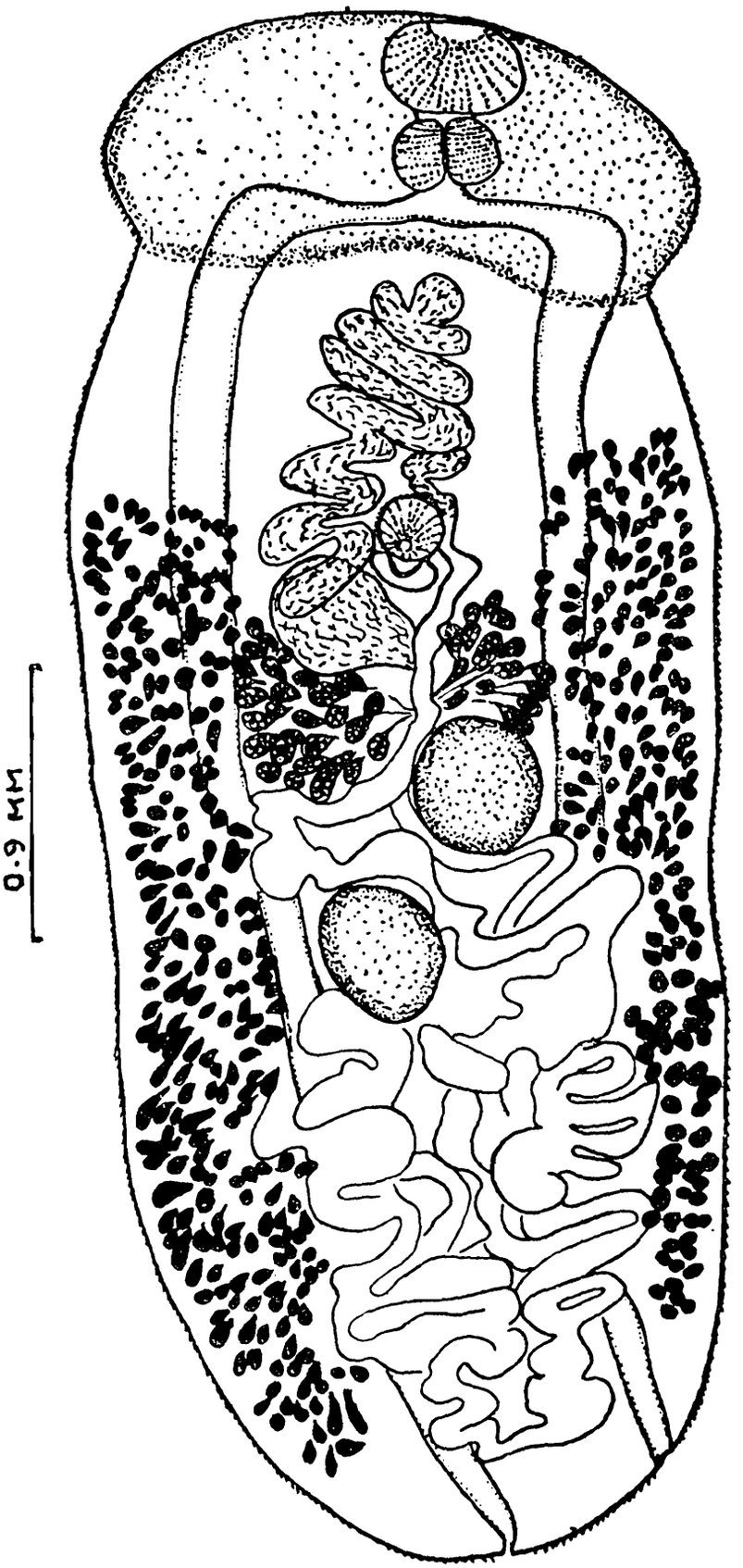

Fig. 3. *Cryptocollaritrema provesiculatum* Madhavi, 1974 (After Madhavi, 1976).

space. In the author's material also the vitelline follicles are mainly extracaecal 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 ovay are nearly as large as those of vitellarium, and can get

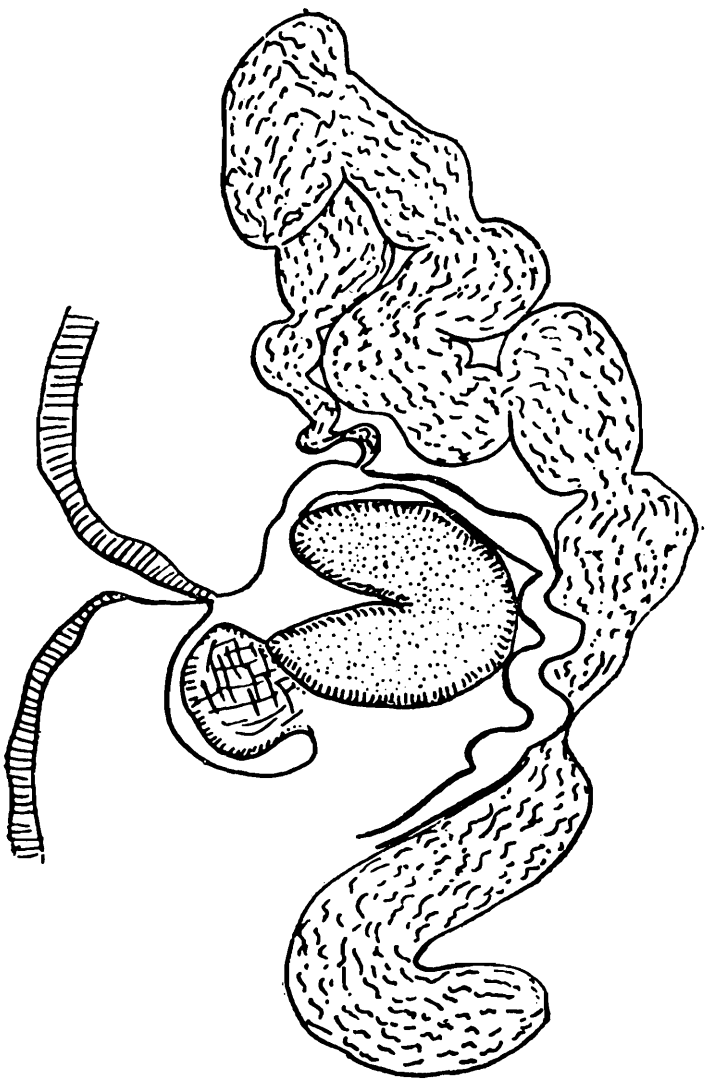

Fig. 4. *C. provesiculatum.* Terminal genitalia (After Madhavi, 1976).

mixed up and become continuous with latter due to overflattening giving erroneous roading as vitelline follicles intruding into the intercaecal field in the pretesticular space. Bilqees (1974), instead of improving upon the diagnosis o *Orientodiplpproctodaeum* 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 *Multiovarium 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 posterion 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

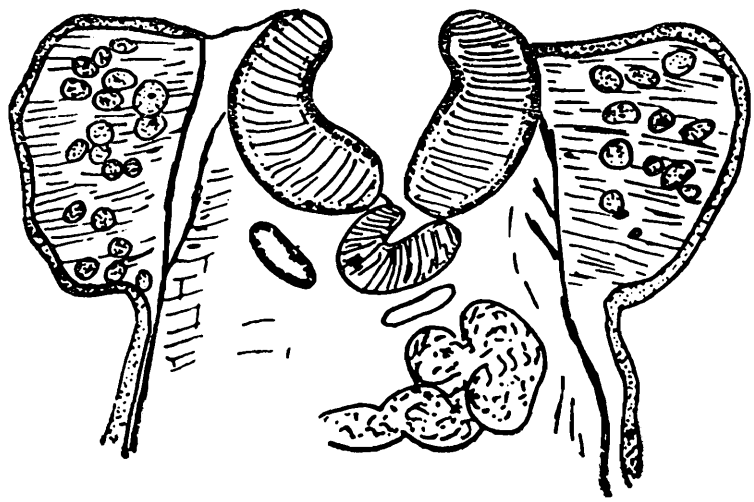

Fig. 5. *C. provesiculatum.* Section through anterior region showing cushion-like expanded part (After Madhavi, 1976).

and preacetabular regions up to posterior level of phrrynx 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 parencyma 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 speies *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.

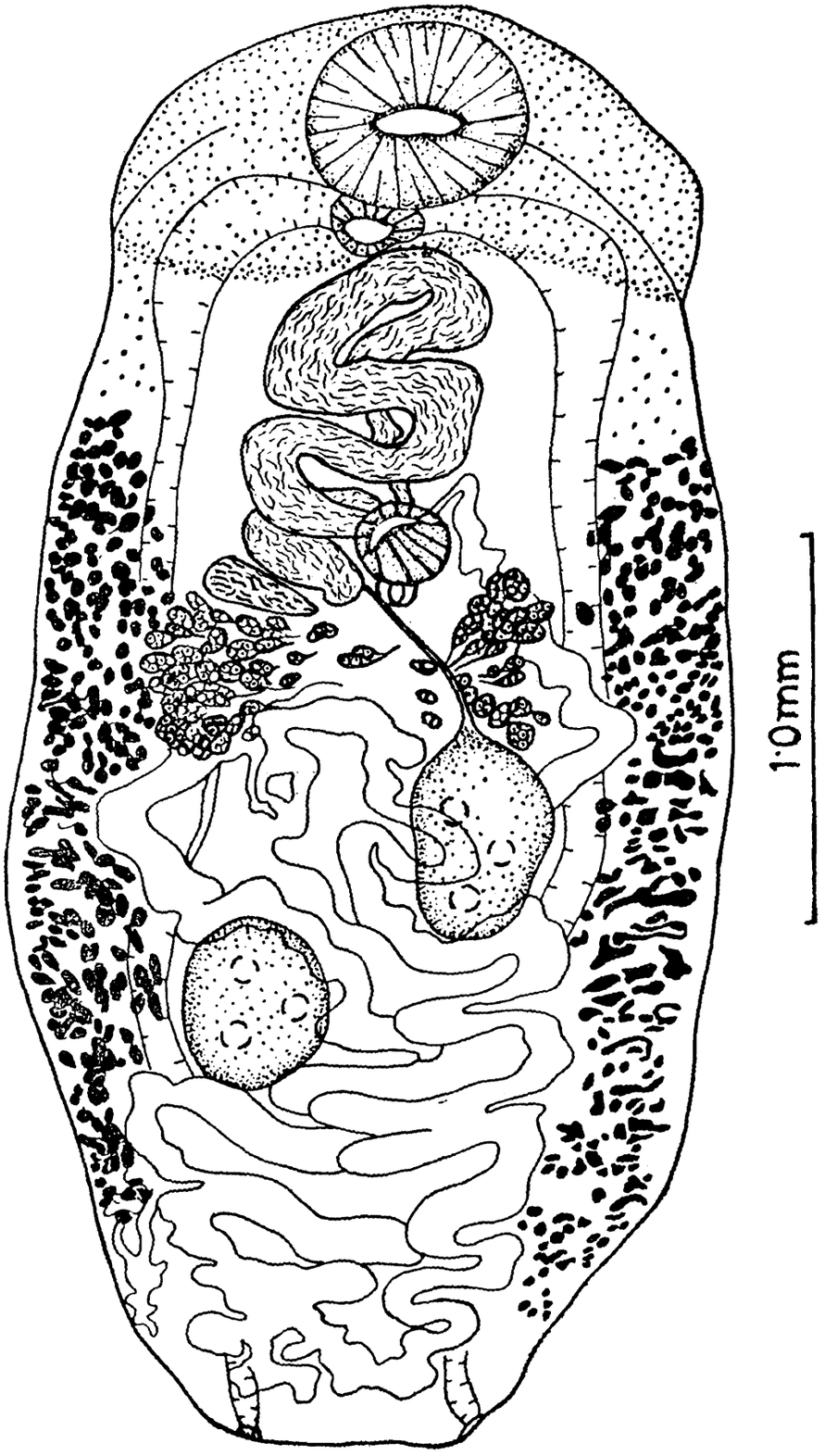

Fig. 6. *Orientodiploproctodaeum diacanthi* Bhutta and Khan, 1970 (Present material).

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 provesiculatum, Multiovarium heterformis, M. interruptum, Anterodiscus biseminalis* and *A. triuteri* all seem to have been described from indentical materials. *C. provesiculatum* 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. provesiculatum, M. heteroformis, M. interruptum, A. biseminalis* and *A. triuteri* are all synonyms of *O. diacanthi.*

The subfamily Orientodiploproctodaeinae Bhutta and Khan, 1070 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 ptesent with a sunken weakly developed ventral sucker, a muscular bulb-like gonotyl near its posterior part, and male and famale pores opening separtely in it anteriorly. Gland cells present in forebody intruding into anterior disc. Testes postovarian, postacetabular. Cirrus sac absent. Seminal vesicle tubular, coiled, running upto 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. Is was accommodated in a new subfamily Orientodiploptoctodaeinae Bhutta and Khan, 1970 which was placed under the family Diploproctodaeidae Ozaki, 1976. Later on, *Multiovarinm* 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 Cryptocollaritrematinae to accommodate *Cryptocollariirema*. 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. heteroforformis*, *M. interruptum*, *A. biseminalis* and *A. triuteri* are synonyms of *O. diacanthi* ; add thus Cryptocollaritrematinae falls as a synonym of Orietodiploproctodaeinae 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, Zoclogical 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.

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ABBREVIATIONS :

VIS : Anterior lobe of seminal vesicle.
VES : Posterior lobe of seminal vesicle.
RS : Seminal receptacle.
V : Vitellaria.
O : Ovary.
U : Uterus.

Rec. zool. Surv. India, 93 (1-2) : 77-80, 1993

SOME DESCRIPTIVE NOTES ON *CHANGWHANIA CEYLONENSIS* (BAKER) (HOMOPTERA : CICADELLIDAE) FROM INDIA

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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 it's identity and therefore it is described here in detail.

Changwhania ceylonensis (Baker

(Figs. 1-10)

1903. *Deltocephalus bimaculatus* Melichar, *Hom. Fauna, Ceylon*, 204.

1908. *Deltocephalus bimaculatus* : Distant, *Fauna Brit. India, Rhynchota*, 4 : 388.

1925. *Deltocephalus ceylonensis* Baker, *Nom. nov*,. *Pro. Deltocephalus bimaculatus* Melichar, 1903, *nec. Deltocephalus bimaculatus* Gillette and Baker, 1895, *Philippine Jour. Sci.* 27 : 537.

1930, *Cicadula bipunctatus* Sing-Pruthi, *Mem. Indian Mus.*, 11 : 59 ; *Datta* 1972, *Zool. Anx.*, 189 : 420.

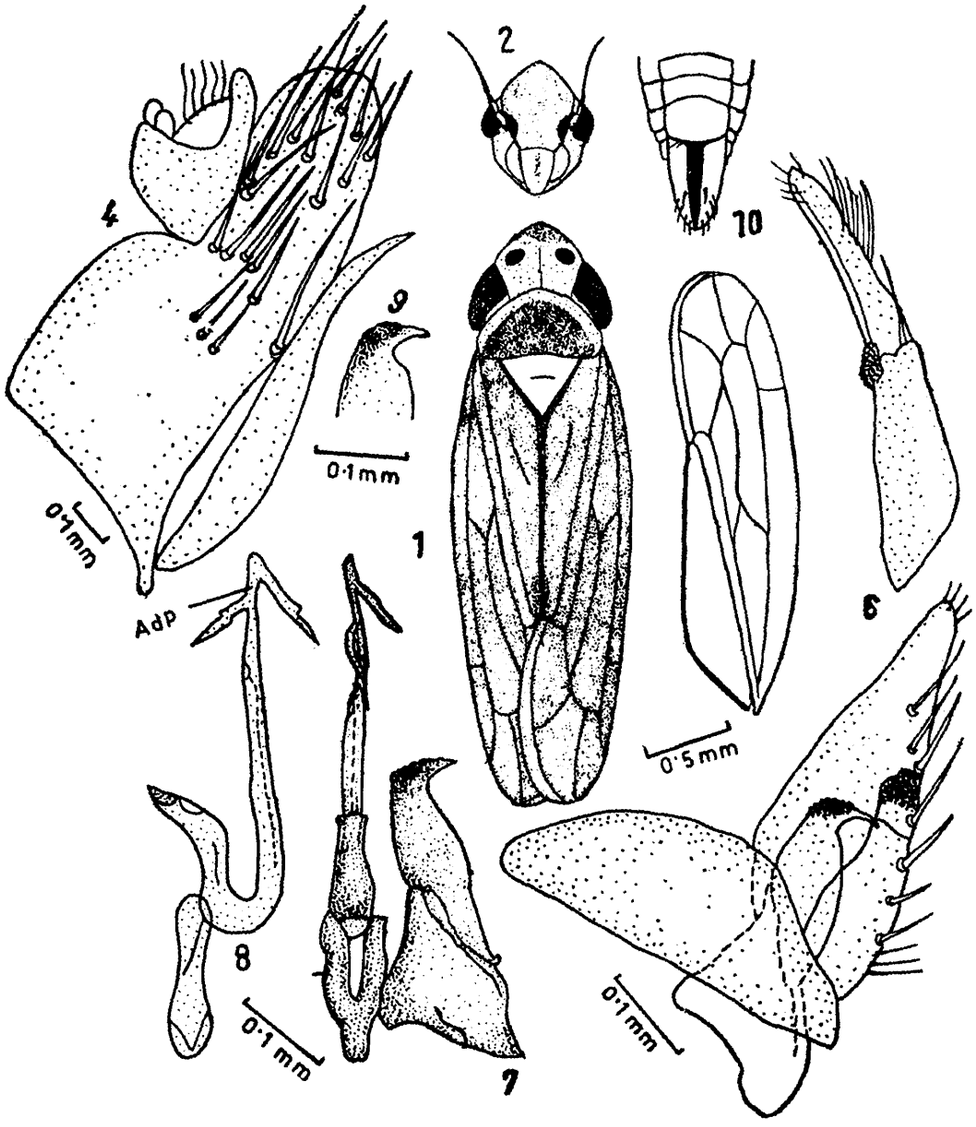
1980. *Changwhania changwhani* Kwon, *Comm. Pap. Kim's.* 60th *Ann.*, 95 : 102.

1990. *Changwhania ceylonensis* : Webb and Heller, *Stutt. Beitr. Natur. Ser. A.* (*Biol*) 452 : 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,



LEGEND

Changwhania ceylonensis (Baker)

Fig. 1. Habitus ... Dorsal view
Fig. 2. Face ... Ventral view
Fig. 3. Forewing ... Dorsal view
Fig. 4. Pygofer ... Dorsal view
Fig. 5. Value, Male Plate and Style ... Ventral view
Fig. 6. Male Plate ... Lateral view
Fig. 7. Style, Connective and Aedeagus ... Dorsal view
Fig. 8. Aedeagus and Connective ... Lateral view
Fig. 9. Style, apex ... Dorsal view
Fig. 10. Female genitalia ... Ventral view

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.

Measurments :

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 :

3.♂♂ 4 ♀♀, Meghalaya : Mairang Nongklah, 1.×1. 1977 Coll. K. R. Rao ; 1♂, 299, Tamilandu : Periyar Dist : Geethsal, Hassanur 4.1-1990, Coll. P.T. Cherian.

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 teraucnii* (Matsumara) and *C. changwhani* Kwon.

ABSTRACT

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

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

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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. ... *N. scutellatus* Dist.
— Scutellum black with three pale spots, one on each side, and the other at apex ... 2
2. Tegmina black with rufous spots ... *N. rufopunctatus* de/Motsch.
— Tegmina black or brown and at middle with a wavy transverse series of five pale spots ... *N. acocephaloides Melich.*

Neodartus acocephaloides Melichar

1903. *Neodartus acocephaloides* Melichar, *Hom. Fauna Ceylon*, 163.
1908. *Neodartus acocephaloides* ; Distant, *Fauna Brit. India, Rhynchota*, 4 : 246 ; Distant, 1918, *Ibid.* 7 : 25.
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1962. *Neodartus acocephaloides* : Metcalf, *General catalogue of the Homoptera, Cicadellidae*, vi (3) : 205-210.

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.

Material examined : 1 ♀, Pudupettu, Javadhi hills, 28-4-1984, N. A. Dist. Coll. K. R. Rao ; 1 ♀, Yalugam, 10-3-1986, 1 ♀, Adamkottai, 11-5-1986, Pudukkottai dist. Coll. G. Thirumalai ; 1 ♀, Talikkampalli, 1-8-1988, Kamaraj Dist. Coll. G. Thirumalai ; 1 ♂, 1 ♀, Poonamanai, Kulasekaram Rd. 26-3-1989, 1 ♂, Lower Kodayar, 31-3-1989, Kanyakumari dist. Coll. K. Mathew ; 1 ♀, Mettupalayam, 27-4-1989, 1 ♀, Thanikattigam, 28-4-1989, Thanjavur dist. Coll. K. R. Rao : 1 ♀, Kondanur, Nilgiri Biosphere, 21-11-1989, Coll. G. Thirumalai.

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.

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PROTOZOA FAUNA OF SUNDARBAN MANGROVE ECOSYSTEM

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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 dealth 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.*

Nandi *et. al.* (1984) reported a few species of avian haemoproteids from Sagar Island. Ray and Sarkar (1985) recorded a species of coccidian parasite in wild boar, *Sus scrofa.* Ghosh and Choudhury (1986, 1987) and Basu *et al.*, (in press) have reported/isolated few species of amoebae from the soil of Sagar Island. D. S. T. report (1987) of the Department of Marine Science, University of Calcutta incorporated investigations on mangrove Protista and appended a list of species of flagellates, rhizopods, foraminiferans, sporozoans and ciliates. Jamadar and Choudhury (1988) contributed much to our knowledge of the entocommenasal ciliates of marine and estuarine molluscs. However, it is worth mentioning that Mandal and Choudhury (1981-1988) made valuable contribution on the parasitofauna of wild animals of Sundarban mangrove forest.

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

Species	*Locality*	*Remarks*
	Subkingdom : Protozoa	
	Phylum : Sarcomastigophora	
	Subphylum : Mastigophora	
	Class : Phytomastigophorea	
	Order : Dinoflagellida	
	Family : Noctilucidae	
	Genus : **Notiluca** Suriray	
1. *N. miliaris* Suriray	Hooghly-Matla estuary	Freeliving, occurring in estuarine and coastal waters

Species	*Locality*	*Remarks*
	Family : PERIDINIIDAE	
	Genus : **Peridinium** Ehrenberg	
2. *P.* spp.	Hooghly-Matla estuary	Freeliving, reported from estuaries
	Genus : **Ceratium** Schrank	
3. *C. hirundinella*	Hooghly-Matla estuary	Freeliving, occurring in estuarine waters
4. *C. tripos* Nitzsch	Hooghly-Matla estuary	Freeliving, occurring in estuaries.
	Order : EUGLENIDA Suborder : EUGLENINA Family : EUGLENIDAE	
	Genus : **Euglena** Ehrenberg	
5. *E.* sp.	Hooghly estuary	Freeliving, occurring as estuarine plankton
	Genus : *Phacus* Dujardin	
6. *P.* sp.	Hooghly-Matla estuary	Freeliving in estuarine planktonic samples
	Family : ASTASIIDAE	
	Genus : **Copromonas** Dobell	
7. *C. ruminantum* Woodcock	Bhagabatpur, Sundarban	Parasitic occurring in faecal sample of *Sus scrofa*
	Class : ZOOMASTIGOPHOREA Order : KINETOPLASTIDA Family : TRYPANOSOMATIDAE	
	Genus : **Trypanosoma** Gruby	
8. *T. anabasi* Mandal	Canning	In blood of *Anabas testudineus*
9. *T. bengalensis* Mandal	Canning	In blood of *Mystus bleekeri*
10. *T. cancili* Mandal	Raidighi	In blood of *Xenentodon cancila*

	Species	*Locality*	*Remarks*
11.	*T. gobida* Mandal	Canning	In blood of *Glossogobius giuris*
12.	*T. striati* Mandal	Canning	In blood of *Channa striatus*
		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 : HOLOMASTIGOTOIDAE	
		Genus : **Holomastigotoides** Grassi and Foa	
15.	*H. bengalensis* Chakravarty and Banerjee	Bamankhali, 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	Mamankhali, Sagar Island	In gut contents of *Coptotermes heimi*

Species	*Locality*	*Remarks*
	Subphylum : SARCODINA	
	Class : LOBOSEA	
	Subclass : GYMNAMOEBIA	
	Order : AMOEBIDA	
	Suborder : TUBULINA	
	Family : ENDAMOEBIDAE	
	Genus : **Entamoeba** Casagrandi and Barbagallo	
20. *E. cervis* Mandal and Choudhury	Sundarban Tiger Reserve	In faecal sample of Spotted deer, *Axis axis* and Rhesus monkey, *Macaca mulatta*
21. *E. chattoni* Swellengrebal	Sundarban forest	In faecal sample of Rhesus monkey, *Macaca mulatta*
2 *E. chiropteris* Mandal and Choudhury	Sajnakhali, 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	
29. *T.* spp.	Mangrove zone	Freeliving forms in soil

Species	*Locality*	*Remarks*
	Genus : **Platyamoeba** Page	
30. *P.* spp.	Mangrove zone	Freeliving forms in soil
	Genus : **Vannella** Bovee	
31. *V.* spp.	Mangrove zone	Freeliving forms in soil
	Suborder : FLABELLINA	
	Family : FLABELLULIDAE	
	Genus : **Flabellula** Schaeffer	
32. *F.* sp.	Mangrove zone	Freeliving forms in soil
	Suborder : CONOPODINA	
	Family : PARAMOEBIDAE	
	Genus : **Mayorella** Schaeffer	
33. *M.* sp.	Mangrove zone	Freeliving forms in soil
	Suborder : ACANTHOOPODINA	
	Family : ACANTHAMOBIDAE	
	Genus : **Acanthamoeba** Volkonsky	
34. *A. astronyxis* (Ray and Hayes)	Sagar Island	Freeliving, inhabiting soils of intertidal zone
35. *A. palestinensis* (Reich)	Sagar Island	Freeliving, soil inhabiting forms
36. *A. culbertsoni* (Singh and Das)	Sagar Island and Kakdwip	Freeliving, inhabiting soils of intertidal zone
37. *A. rhysodes* (Singh)	Sagar Island	Freeliving in intertidal soils.
38. *A.* sp.	Mangrove zone	Freeliving forms in soil
	Order : SCHIZOPYRENIDA	
	Family : VAHLKAMPFIIDAE	
	Genus : **Naegleria** Alexieff	
39. *N. thortoni* (Singh)	Sagar Island	Freeliving, occurring in grassy fields
	Subclass : TESTACEALOBOSIA	
	Order : ARCELLINIDA	
	Family : ARCELLIDAE	
	Genus : **Arcella** Ehrenberg	
40. *A.* spp.	Hooghly-Matla estuary	Freeliving in planktonic samples

Species	*Locality*	*Remarks*
Family : DIFFLUGIIDAE		
Genus : **Centropyxis** Stein		
41. *C.* spp.	Hooghly-Matla estuary	Freeliving in planktonic samples
Class : GRANULORETICULOSEA		
Order : FORAMINIFERIDA		
Family : CALCARINIDAE		
Genus : **Calcarina** d' Orbigny		
42. *C. calcar* Parker and Jones	Sundarban	Freeliving forms
43. *C.* sp.	Sundarban	Freeliving forms
Suborder : MILIOLINA		
Family : MILIOLIDAE		
Genus : **Quinqueloculina** d' Orbigny		
44. *Q.* sp.	Sundarban	Freeliving forma
Suborder : ROTALIINA		
Family : NONIONIDAE		
Genus : **Elphidium** Montfort		
45. *E.* sp.	Sundarban	Freeliving forms
Phylum : APICOMPLEXA		
Class : SPOROZOEA		
Subclass : GREGARINIA		
Order : EUGREGARINIDA		
Suborder : SEPTATINA		
Family : CEPHALOIDOPHORIDAE		
Genus : **Cephaloidophora** Mawrodiadi		
46. *C. metaplaxi* (= *Steinina metaplaxi*)	Port Canning	Intestine of crab *Metaplax dentipes*
Subclass : COCCIDIA		
Order : EUCOCCIDIIDA		
Suborder : ADELINA		
Family : HAEMOGREGARINIDAE		
Genus : **Haemogregarina** Danilewsky		
47. *H. colisa* Mandal, Ray, Sarkar and Kahali	Canning	In blood of fish *Colisa fasciatus*

Species	*Locality*	*Remarks*
Suborder : EIMERIINA Family : EIMERIIDAE Genus : **Eimeria** Schneider		
48. *E. harpodoni* Setna and Bana	Port Canning	In intestine of fish, *Harpadon nehereus*
49. *E. southwelli* Halwani	Sundarban	In intestine of shark, *Scoliodon sorrakowah*
50. *E. zygaenae* Mandal and and Chakravarty	Sundarban	In small intestine of shark, *Zygaena blochii*
51. *E. najae* Ray and Dasgupta	Sundarban	In small intestine of snake, *Naja naja*
52. *E. charadrii* Mandal	Narayantala	In small intestine of bird, *Charadrius asiaticus*
53. *E. gallinagoi* Mandal	Basanti	In small intestine of bird *Gallinago gallinago*
54. *E. numeni* Mandal	Namkhana	Intestine of bird *Numenius arquata*
55. *E. roscoviensis pluvialtna* Mandal	Namkhana	In small intestine of bird *Pluvialis appricaria*
56. *E. vanelli* Mandal	Basanti	In small intestine of *Vanellus malabaricus*
57. *E. ahsata* Honess	Basanti	In faecal sample of goat, *Capra hircus*
58. *E. arloingi* (Marotel)	Basanti	In faecal sample of *Capra hircus*
59. *E. cervis* Mandal and Choudhury	Sundarban Tiger Reserve	In faecal sample of spotted deer, *Axis axis*
60. *E. neodeblicki* Vetterling	Sundarban forest	In faecal sample of wild boar, *Sus scrofa*
Genus : **Isospora** Schneider		
61. *I. emberizae* Mandal and Chakravarty	Sundarban	In small intestine of *Emberiza bruniceps*
62. *I. sundarbanensis* Ray and Sarkar	Sajnakhali	In faecal sample of *Sus scrofa*

Species	*Locality*	*Remarks*
Suborder : HAEMOSPORINA		
Family : HAEMOPROTEIDAE		
Genus : **Haemoproteus** Kruse		
63. *H. columbae* Kruse	Kakdwip	In blood of *Columba livia intermedia*
64. *H. oryzivorae* Anschütz	Sagar Island	In blood of *Turdoides striatus*
65. *H. pastoris* de Mello	Sagar Island	In blood of *Sturnus malabaricus*
66. *H.* sp.	Sagar Island	In blood of *Acrocephalus dumetorum*
Subclass : PIROPLASMIA		
Order : PIROPLASMIDA		
Family : BABESIIDAE		
Genus : **Babesia** Starcovici		
67. *B. muris* (Fantham)	Sundarban Tiger Reserve	In blood of rat, *Rattus rattus arboreus*
68. *B. vesperuginis*	Sundarban Tiger Reserve	In blood of bat, *Scotophilus kuhli kuhli*
Family : HAEMOHORMIDAE		
Genus : **Haemohormidium** Henry (=**Babesiosoma**)		
69. *H.* sp.	Canning market	In blood of fish *Muraenesox* sp.
Phylum : MYXOZOA		
Class : MYXOSPOREA		
Order : BIVALVULIDA		
Suborder : BIPOLARINA		
Family : MYXIDIIDAE		
Genus : **Myxidium** Bütschli		
70. *M. boddaerti* Choudhury and Nandi	Port Canning, Kakdwip	In gut contents of *Boleophthalmus boddaerti*
71. *M. lieberkuhni* Butschli	Port Canning, Kakdwip	In gall bladder of *Boleophthalmus boddaerti*

Species	*Locality*	*Remarks*
Genus : **Sphaeromyxa** Thelohan		
72. *S. theraponi* Tripathi	Port Canning	In gall bladder of *Therapon jarbua*
Suborder : EURYSPORINA		
Family : CERATOMYXIDAE		
Genus : **Ceratomyxa** Thelohan		
73. *C. sagarica* Choudhury and Nandi	Port Canning	In gall bladder of fish *Boleophthalmus boddaerti*
Phylum : CILIOPHORA		
Class : KINETOFRAGMINOPHOREA		
Subclass : GYMNOSTOMATIA		
Order : PROSTOMATIDA		
Suborder : HAPTORINA		
Family : TRACHELIIDAE		
Genus : **Dileptus** Dujardin		
74. *D. americanus* Kahl	Rajat jubilee	Alga-mud-scum sample, new record from West Bengal
Subclass : VESTIBULIFERIA		
Order : TRICHOSTOMATIDA		
Suborder : TRICHOSTOMATINA		
Family : PLAGIOPYLIDAE		
Genus : **Plagiopyla** Stein		
75. *P. nasuta* Stein	Kalas	Freeliving, occurring in algal sample of freshwater pond
	Datta river	Floating fungal sample
Family : BALANTIDIIDAE		
Genus : **Balantidium** Claparede and Lachmann		
76. *B. coli* (Malmsten)	Sundarban forest	In faecal sample of *Sus scrofa*
77. *B.* sp.	Sundarban forest	In faecal sample of *Sus scrofa*

Species	*Locality*	*Remarks*
Subclass : HYPOSTOMATIA		
Superorder : NASULIDEA		
Order : NASSULIDA		
Suborder : MICROTHORACINA		
Family : MICROTHORACIDAE		
Genus : : **Drepanomonas** Fresenius		
78. *D. revoluta* Penard	Gosaba	Mud-scum sample
Superorder : PHYLLOPHARYNGIDEA		
Order : CYRTOPHORIDA		
Suborder : CHLAMYDODONTINA		
Family : CHLAMYDODONTIDAE		
Genus : **Chlamydomonas** Ehrenberg		
79. *C. mnenosyne* Ehrenberg	Datta river	Freeliving in floating fungal sample
	Gosaba	Mud-scum sample, new record from West Bengal
Family : CHILODONELLIDAE		
Genus : **Chilodonella** Strand		
80. *C. cucullulus* (Müller)	Kalas	Freeliving, in algal sample of sweet water pond.
	Gosaba	Mud-scum sample
Superorder : RHYNCHODEA		
Order : RHYNCHODIDA		
Family : ANCISTROCOMIDAE		
Genus : **Ancistrocoma** Chatton and Lwoff		
81. *A. pelseneeri* Chatton and Lwoff	Hooghly estuary	Inhabiting gills and labial palps of *Mactra luzonica*
Genus : **Raabella** Chatton and Lwoff		
82. *R. helensis* Chatton and Lwoff	Hooghly estuary	Inhabiting gills of *Modiolus striatulus*

Species	*Locality*	*Remarks*
Class : OLIGOHYMENOPHOREA		
Subclass : HYMENOSTOMATIA		
Order : HYMENOSTOMATIDA		
SUBORDER : PENICULINA		
Family : PARAMECIIDAE		
Genus : **Paramecium** Hill		
83. *P. caudatum* Ehrenberg	Kalas	Freeliving in fresh water pond algal sample
Family : FRONTONIIDAE		
Genus : **Frontonia** Ehrenberg		
84. *F. leucas* (Ehrenberg)	Gosaba	Freeliving in mud-scum sample
Ordet : SCUTICOCILIATIDA		
Suborder : PLEURONEMATINA		
Family : CYCLDIIDAE		
Incertae sedis		
Genus : **Cristigera** Roux		
85. *C. susmai* Jamadar and Choudhury	Sagar Island	Inhabiting gills and labial palps of *Crassostrea cucullata*
Suborder : THIGMOTRICHINA		
Family : ANCISTRIDAE		
Genus : *Ancistrumina* Raabe		
86. *A. barbata* (Issel)	Sagar Island	Occurring in the mantle cavity and buccal mass of *Cerithidea obtusa*
87. *A. obtusae* Jamadar and Choudhury	Sagar Island	Occurring in the buccal cavity of *Cerithidea obtusa.*
Genus : **Boveria** Stevene		
88. *B. teredinidi* Nelson	Hooghly estuary	Infaunating the labial palps and gills of *Mactra luzonica*
Genus : **Fenchelia** Raabe		
89. *F. kapili* Jamadar and Choudhury	South-west coast of Sagar Island	Occurring abundantly in the ctenidium and scanty in the mantle cavity of *Cerithidea obtusa*

Species	*Locality*	*Remarks*
90. *F. sagarica* Jamadar and Choudhury	South-west coast of Sagar Island	Infaunating abundantly in the mantle cavity of *Cerithidea obtusa*
Genus : **Protophrya** Kofoid		
91. *P. indica* Jamadar and Choudhury	Sagar Island	Occurring abundantly in the mantle cavity and buccal mass of *Littorina melanostoma*
Subclass : PERITRICHIA		
Order : PERITRICHIDA		
Suborder : SESSILINA		
Family : VORTICELLIDAE		
Genus : **Carchesium** Ehrenberg		
92. *C. polypinum* (Linnaeus)	Port Canning	Sedentary, freeliving in brackishwater ponds
93. *C.* sp.	Kakdwip	Sedentary, attached to eggs of *Liza parsia*
Genus : **Vorticella** Linnaeus		
94. *V.* sp.	Matla estuary	Freeliving forms
Genus : **Zoothamnium** Bory		
95. *Z.* sp.	Rajat jubilee	Alga and mud-scum sample
Family : SCYPHIDIIDAE		
Genus : **Scyphidia** Dujardin		
96. *S. bengalensis* Jamadar Choudhury	Mandirtala mudflat, Sagar Island	Occurring abundantly in the mantle cavity and buccal mass of gastropod molluscs *Cerithidia cingulata*
97. *S. ubiquita* Horshfield	Sagar Island	Occurring abundantly in the mantle cavity and buccal mass of gastropod molluscs, *Littorina melanostoma* and *L. scabra*
Class : POLYHYMENOPHOREA		
Subclass : SPIROTRICHIA		
ORDER : HETEROTRICHIDA		
Suborder : COLIPHORINA		
Genus : **Folliculina** Lamarck		
98. *F. ampula* (Müller)	Port Canning	Occurring in brackishwater ponds

Species	*Locality*	*Remarks*
	Order : OLIGOTRICHIDA	
	Suborder : TINTINNINA	
	Family : TINTINNIDIIDAE	
	Genus : **Tintinnidium** Stein	
99. *T.* sp.	Hooghly-Matla estuary	Freeliving in planktonic sample
	Order : HYPOTRICHIDA	
	Suborder : SPORADOTRICHINA	
	Family : OXYTRICHIDAE	
	Genus : **Oxytricha** Bory	
100. *O. fallax* Stein	Datta river	Freeliving, occurring in ffoating mangrove fungal mass (culture)
	Kalas	Fresh water algal sample
	Family : EUPLOTIDAE	
	Genus : **Euplotes** Ehrenberg	
101. *E. gracilis* Kahl	Gosaba	Freeliving in mangrove mud scum sample (culture)
102. *E. patella* (Muller)	Datta River	Free living in fregh water pond
103. *E.* sp.	Kalas	Freeliving in fresh water pond
	Rajat jubilee	Association with floating mangrove fungal mass
	Gosaba	Mud-scum sample
	Genus : **Diophrys** Dujardin	
104. *D. appendiculata* (Ehrenberg)	Rajat jubilee	Freeliving in floating fungal sample ; New record from West Bengal

DISCUSSION

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.

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

(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.

Group	No. of species (family) occurring in		
	West Bengal	South 24-Parganas	Sundarban
Freeliving Protozoa	248 (76)	77 (38)	41 (27)
Parasitic Protoza	596 (63)	84 (28)	68 (15)
Symbiotic Protozoa	127 (8)	19 (5)	5 (2)
	Total=971 (147)	180 (71)	104 (44)

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.

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BEETLES (COLEOPTERA : INSECTA) OF WETLANDS OF CALCUTTA AND ITS SURROUNDINGS

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INTRODUCTION

Wetlands comprises a unique habitat exhibiting many features of the aquatic and terrestrial ecosystems. The species riches 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 :

Specimens		*Class*
100 +	=	Profusely abundant
∠ 100	=	Abundant
∠ 50	=	Common
∠ 20	=	Rare

It is realised that this system may not truely 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 voraceous eater and predaceous and cannibalistic in nature. The common genera of Dytisciade found in the wetlands surveyed are *Laccophilus, Canthydurs, Hydrovatus, Guignotus, Hyphydrus, Uvarus, Clypcodytes, Hydaticus* and *Cybistcr.*

(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 maxilary palpi which exceeds the antennae in length and resembles antennae. The antennae are short, clavate and consealed.

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 locmotion 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 tbe 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 swimmer, 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 consealing all but apices of hind femora ; pronotum with a notch on lateral sides, before posterior angles ... Haliplidae ... *Haliplus*
... *H. angustifrons* Regimbart

1.	Hind coxae not produced into such plates ...	2
2(1').	Hind coxae with medial portion extending posteriorly to divide 1st abdominal sternite into lateral sclerites ; prothorax with distinct notopleural sutures ...	3
2'.	Hind coxae not extending posteriorly to divide 1st abdominal sternite ; notopleural sutures almost always absent ...	20
3(2)	Eyes divided into dorsal and ventral parts ; antenna short and thick, 2nd segment with a process ... Gyrinidae	4
3'.	Eyes not divided ; antenna long, filiform or moniliform ... Dytiscidae	5
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*	*D. unidentatus* (Aubé)
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 ond a half times longer than the preceeding 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*	*O. productus* Règimbart
5(3).	Scutellum visible	6
5'.	Scutellum not visible ...	7
6(5)	Hind margins of the four basal metatarsal segments not fringed with any ciliae and posterior claw equal ; elytra black with green metalic 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*	... *H. ricinus* (Macley)
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 a little depressed ...	16
8(7)	Claws of the hind tarsi mostly unequal ; prosternal process oblong ; puncturation on elytra double mixed with small and large punctures ...	*Hyphydrus 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

12(11'). Elytra with a sutural striae ... *Guignotus* 13

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* (Sharp)

13'. Laterobasal plica on pronotum distinctly continued on elytra ... 14

14(13'). Elytra brownish yellow to grey with pale yellow markings ... *G. inconstans* (Règimbart)

14'. Elytra brownish yellow with dark markings ... 15

*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* ... 17

16'. Posterior legs with two tarsal claws of equal length ; sides of the pronotum rebordered ... 18

17(16). Length 3.0-3.2 mm ; elytry 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* 19

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* (Walker)

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

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* ... *S. gibbus* Champion

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 ... Hydrophilidae 21

21(20'). Scutellum no longer or not much longer than its width at basis ; antenna at most 9-segmented (6+3) ... 22

21'. Scutellum a long triangle ; antenna at most 8-segmented (5+3) ... 25

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 covex anteriorly ; length 2.5 mm ... *Enochrus* *E. escuriens* (Walker)

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

24(22'). Antenna with normal club ; prostital carina ridgelike with an anterior brush of long

setae ; claws simple ; shinny black insect ; length 13 mm ... *Sternolophus* ... *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 shinny specimens ; length 35 mm ... *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 ... *Amphiops* 26

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

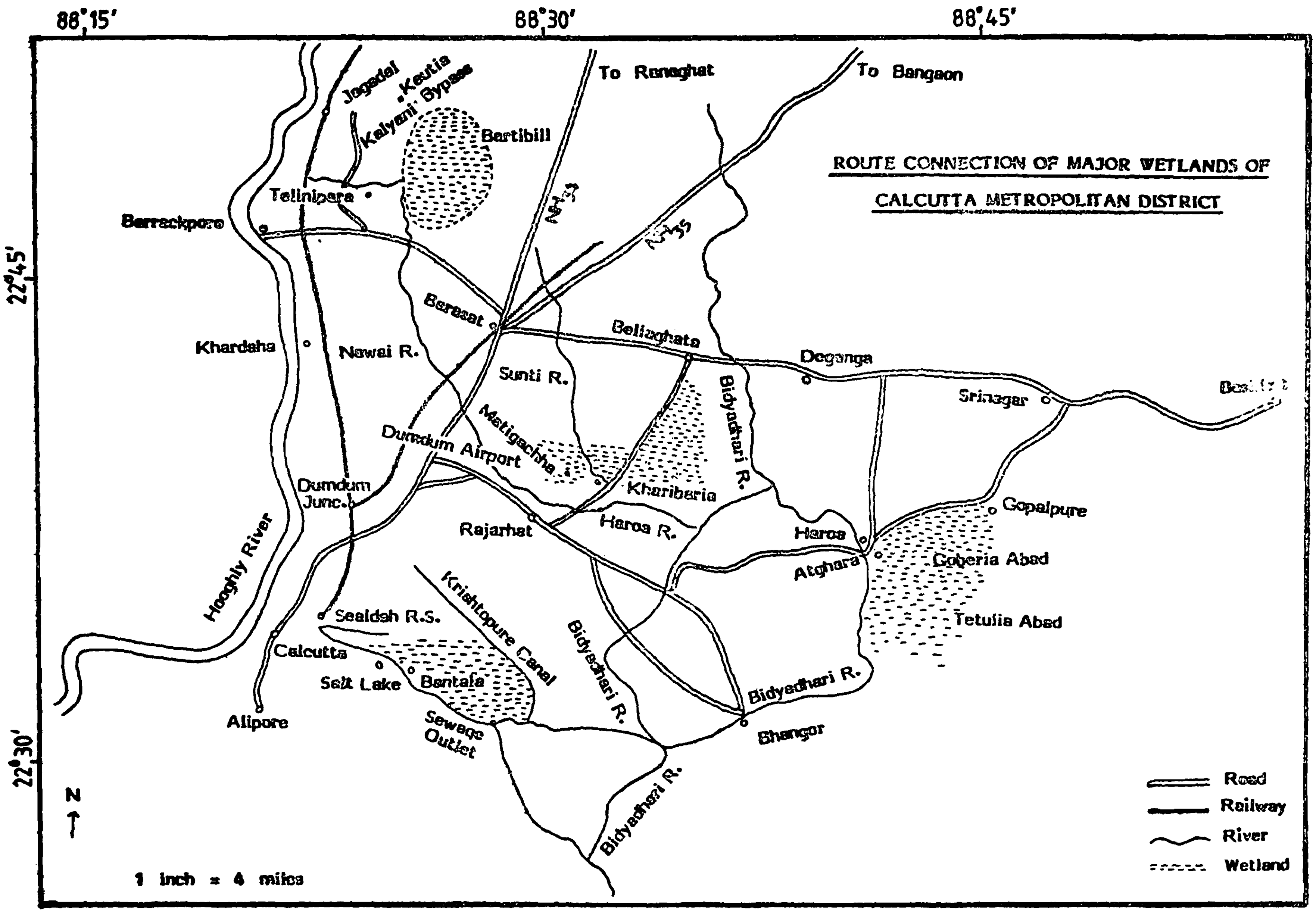
26(25), Blackish brown insect ; length 3.5 mm ; elytra with series of punctures and the interstitial punctures on sides are large and coarse, almost similar to serial punctures ...
Amphiops mirabilis Sharp

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

27(25'). Five ventral not retracile segments ; antenna composed of 7 segment ; convex and elongate ; upper surface not black but brown to yellowish ... *Berosus* ... *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 shinning black ... *Regimbartia*
... *R. attenuata* (Fabricius)

15



ROUTE CONNECTION OF MAJOR WETLANDS OF CALCUTTA METROPOLITAN DISTRICT

Family : HALIPLIDAE

1. **Haliplus angustifrons** Régimbart

1892. *Haliplus angustifrons* Règimbart, *Ann. Soc. ent. Belg.*, **36** : 112.

1984. *Haliplus angustifrons*, Vazirani, *The Fauna of India* (*Coleoptera* : *Gyrinidae and Halplidae*) **2** : p. 122-124.

Diagnostic characters : General appearance (Fig. 1) broad, narrowed in front and more sharply so posteriorly. *Head* brownish yellow, vertex finely and sparsely punctured, puncturation 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, puncturation 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 intetstitial 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, *Spe´cies cole´opt`eres*, **6** : 788.

1984. *Dineutus unidentatus*, Vazirani, *The Fauna of India* (*Coleoptera* : *Gyrinidae and Haliplidae*), p. 20-22.

Diagnostic characters : General appearance (Fig. 2) elongate, slightly depressed posteriorly and black, with copper colour anteriorly and on sides, puncturation 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, puncturation 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.

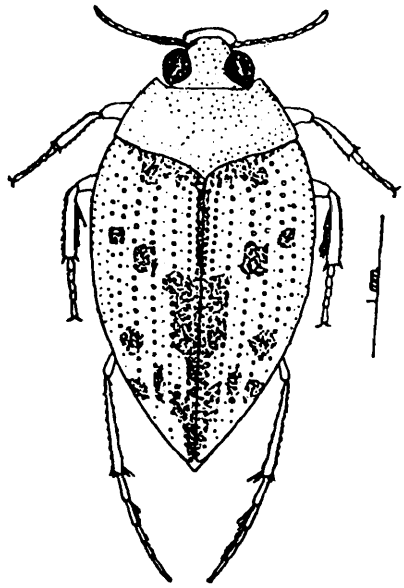


Fig. 1

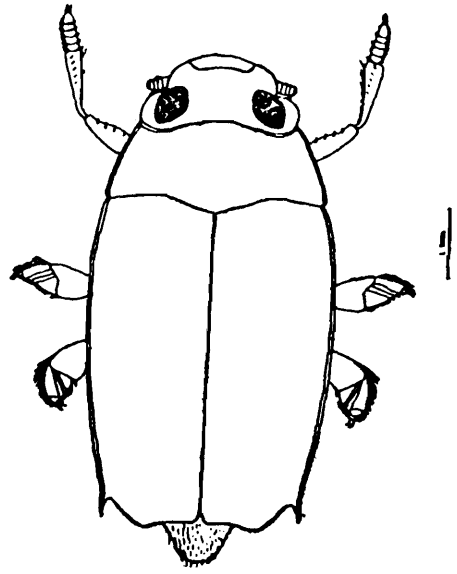


Fig. 2

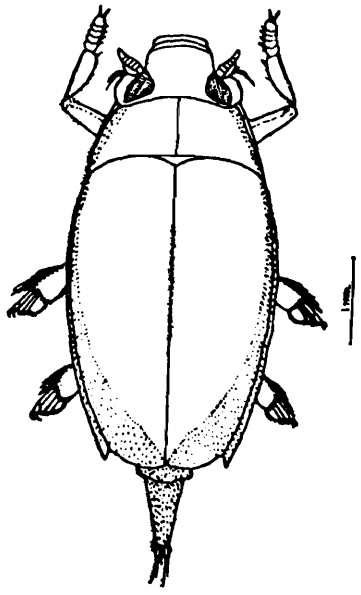


Fig. 3

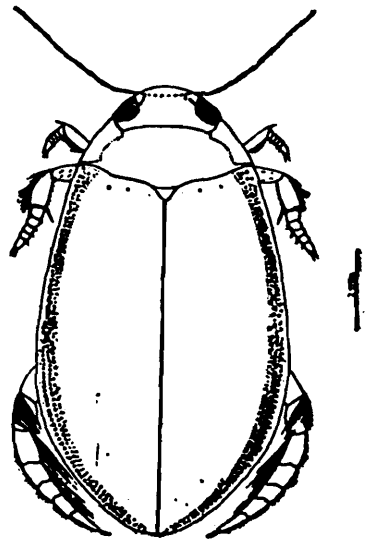


Fig. 4

Figs. 1-4 : *Haliplus angustifrons* Régimbart, dorsal view (1). *Dineutus unidentatus* (Aubé), dorsal view (2). *Orectochilus productus* Règimbart, dorsal view (3). *Cybister tripunctatus asiaticus* Sharp, dorsal view (4).

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

1883. *Orectochilus productus* Règimbart, *Ann. Soc. ent. Fr.*, (6) 5 : 422.
1984. *Orectochilus productus*, Vazirani, *The Fauna of India* (*Coleoptera* : *Gyrinidae and Haliplidae*), p. 51-52.

Diagnostic characters : General appearance (Fig. 3) narrowly elongate and black. *Head* black, puncturation indistinct, clypeus slightly raised anteriorly and eyes divided. Antenna very short and brownish black. *Prothorax* black and leteral margins yellow, puncturation 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, puncturation 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 tripunctatus asiaticus** Sharp

1882. *Cybister asiaticus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 731.
1899. *Cybister tripnnctatus* var. *asiaticus*, Règimbart, *Ann. Soc. ent. Fr.*, 68 : 351-352.
1968. *Cybister tripunctatus asiaticus*, Vazirani, *Orient. Ins.*, 2 (3-4) : 290-292.

Diagnostic characters : General appearance (Fig. 4) elongate-oval, narrower in front and moderately wider behind the middle. *Head* small, black with greenish metalic 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 metalic 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.

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)

1833. *Hydaticus fabricii* Macley, *Annulosa Javanica*, Paris, p. 134.
1968. *Hydaticus fabricii*, Vazirani, *Orient. Ins.*, 2 (3-4) : 266-269.
1979. *Hydaticus ricinus*, Wewalka, *Koleopt. Rdsch.*, 54 : 119-139.

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, Maharastra, 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

1890. *Hyphydrus renardi* Severin, *Ann. Soc. ent. Belg.*, 34 : 191.
1968. *Hyphydrus renardi* Vazirani, *Orient. Ins.*, 2 (3-4) : 308-309.

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

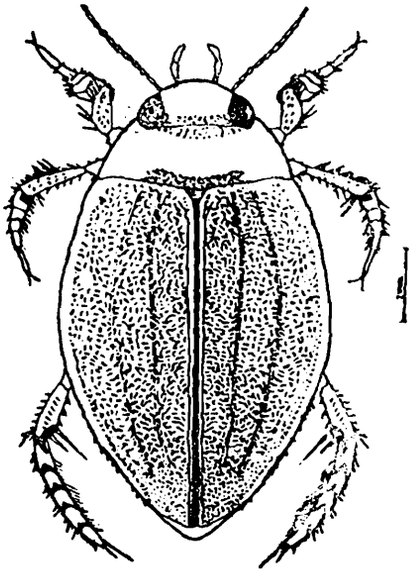


Fig. 5

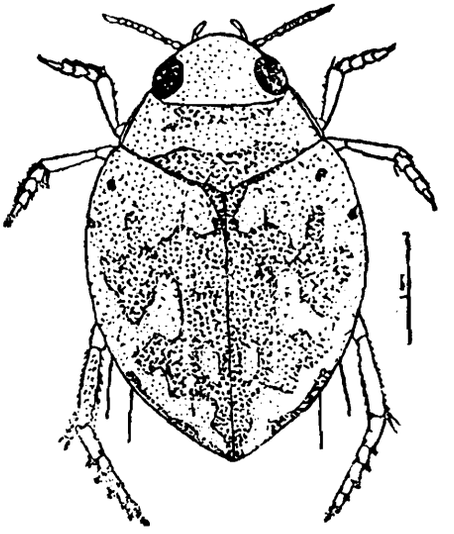


Fig. 6

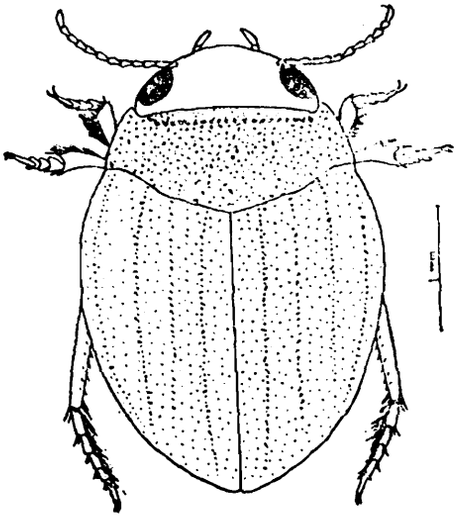


Fig. 7

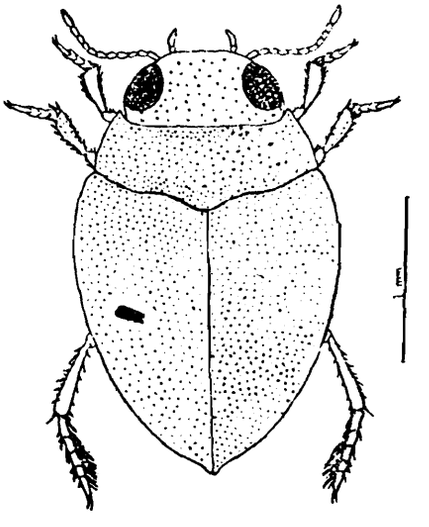


Fig. 8

Figs. 5-8. *Hydaticus ricini* (Macley), dorsal view (5). *Hyphydrus renardi* Severin, dorsal view (6). *Hydrovatus bonvouloiri* Sharp, dorsal view (7). *Hydrovatus confertus* Sharp, dorsal view (8).

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.

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

1882. *Hydrovatus bonvouloiri* Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 335 (India).
1970. *Hydrovatus bonvouloiri*, Vazirani, *Orient. Ins.*, 4 (1) : 99.

Diagnostic characters : General appearance (Fig. 7) moderately convex, oval and shinning. *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, puncturation 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 puncturation 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

1882. *Hydrovatus coufertus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 329 [Thailand (Siam)].
1970. *Hydrovatus coufertus*, Vazirani, *Orient. Ins.*, 4 (1) : 102-103.

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

1968. *Clypeodytes orissaensis* Vazirani, *Orient. Ins.*, 2 (3-4) : 328-329.

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)

1923. *Bidessus quadrilineatus* Zimmermann, *Ent. Blatt*, 19 : 34-48.
1968. *Uvarus quadrilineatus*, Vazirani, *Orient. Ins.*, 2 (3-4) : 331-352.

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

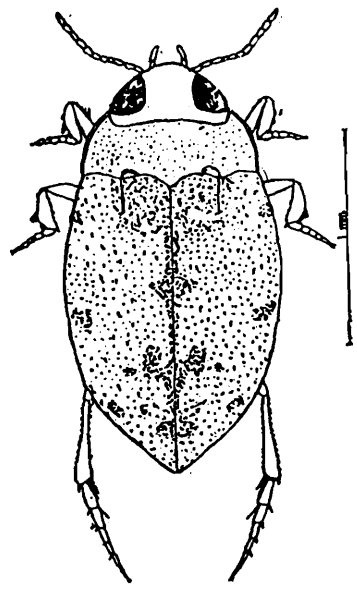


Fig. 9

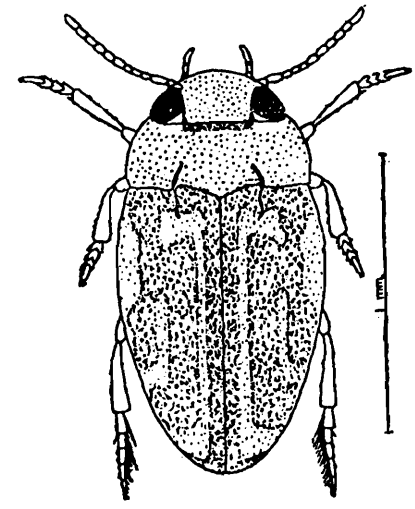


Fig. 10

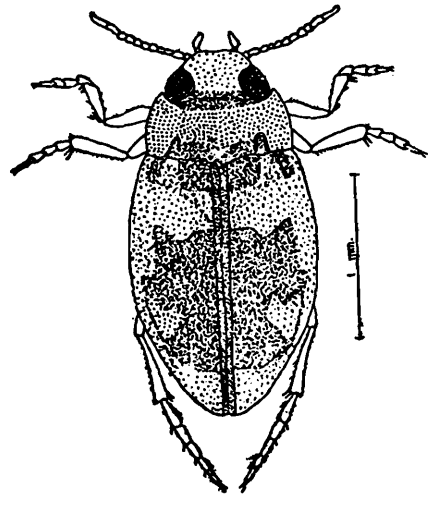


Fig. 11

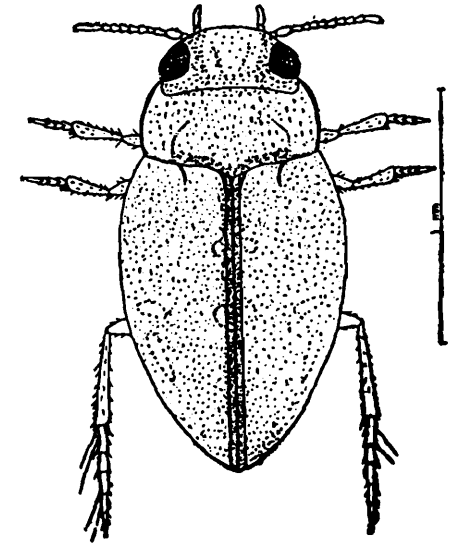


Fig. 12

Figs. 9-12 : *Clypeodytes orissaensis* Vazirani, dorsal view (9). *Uvarus quadrilineatus* (Zimmermann), dorsal view (10). *Guignotus flammulatus* (Sharp), dorsal view (11). *Guignotus inconstans* (Règimbart), dorsal view (12).

detrital debris e.g. branches, roots of vegetation etc. They are predator (piercer) in habit and very scarce in wetland.

11. **Guignotus flammulatus** (Sharp)

1882. *Bidessus flammulatus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 359.
1954. *Guignotus flammulatus*, Guignot, *Opusc. ent.*, 19 : 221.
1968. *Guignotus flammulatus*, Vazirani, *Orient. Ins.*, 2 (3-4) : 313-315.

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 puncturation. *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)

1892. *Bidessus inconstans* Règimbart, *Ann. Soc. enn. Belg.*, 36 : 119.
1968. *Guignotus inconstans* Vazirani, *Orient. Ins.*, 2 (3-4) : 322-323

Diagnostic characters : General appearance (Fig. 12) oblong, oval, a little convex and pubescent. *Head* brownish yellow, puncturation fine and sparse and eyes large. Antenna brownish yellow, narrow and long. *Prothorax* brownish yellow with its anterior and prebasal portion darker, puncturation 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, puncturation 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.

13. **Guignotus pendjabensis** Guignot

1954. *Guignotus pendjabensis* Guignot, *Opusc. ent.*, 19 : 221.
1968. *Guignotus pendjabensis*, Vazirani, *Orient. Ins.*, 2 (3-4) : 320-321.

Diagnostic characters : General appearance (Fig. 13) moderately elongate and oval. *Head* brownish yellow, puncturation 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), puncturation 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.

14. **Guignotus** sp.

Diagnostic characters : General appearance (Fig. 14) oval, sub-depressed and finely pubescent. *Head* brownish yellow, puncturation 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), puncturation fine, latero-basal plica slightly oblique and shape as figured (Fig. 14). *Elytra* brownish yellow with blackish markings, puncturation 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*, *pradhani*, *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.

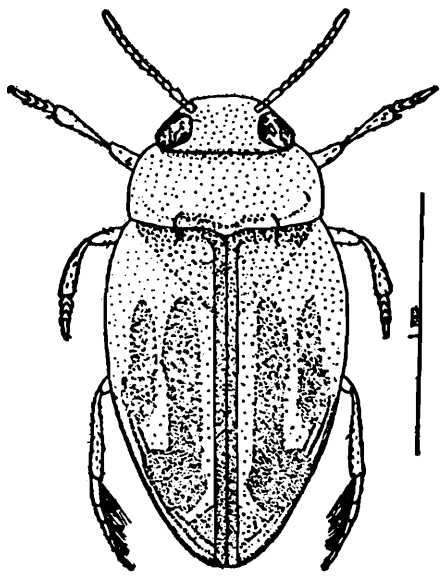


Fig. 13

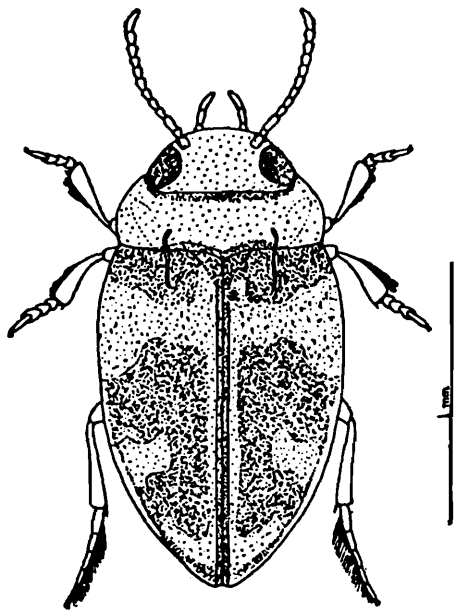


Fig. 14

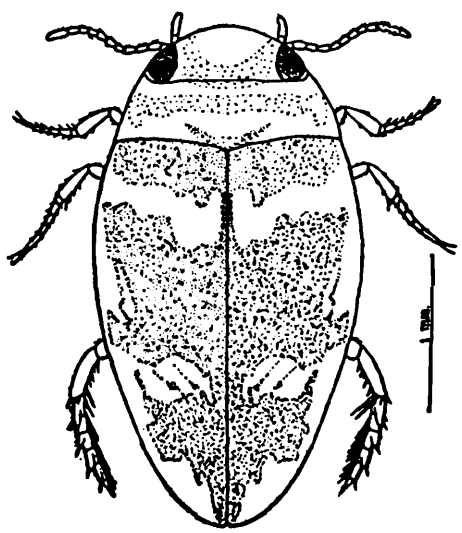


Fig. 15

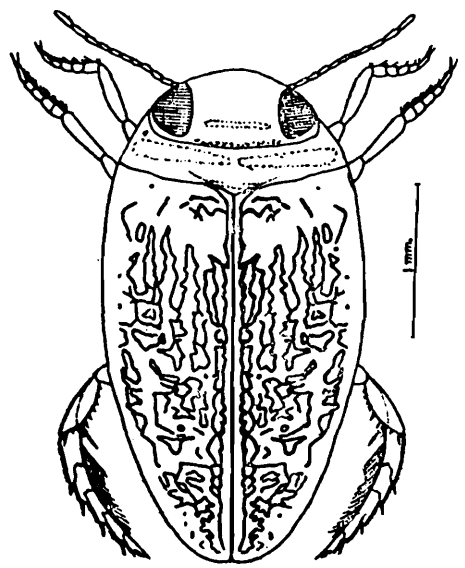


Fig. 16

Figs. 13-16 : *Guignotus pendjabensis* Guignot, dorsal view (13). *Gaignotus* sp. dorsal view (14). *Laccophilus anticatus* Sharp, dorsal view (15). *Laccophilus parvulus* Aubé, dorsal view (16).

15. **Laccophilus anticatus** Sharp

1890. *Laccophilus anticatus* Sharp, *Trans. ent. Soc. Lond.* p. 341.
1968. *Laccophilus*, Vazirani, *Orient. Ins.*, 2 (3-4) : 240-241.

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

1838. *Laccophilus parvulus* Aubé, *Dejean's spe'cies Coléopt`eres*, Paris, 6 : 429.
1968. *Laccophilus parvulus*, Vazirani, *Orient. Ins.*, 2 (3-4) : 247-249.

Diagnostic characters : General appearance (Fig. 16) elongate, oval and subdepressed. *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, stirdulatory 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

1860. *Hydrocoptus subvittulus* Motschulsky, *E'ltud Ent.*, 8 : 43.
1968. *Hydrocoptus subvittulus*, Vazirani, *Orient. Ins.*, 2 (3-4) : 223-224.

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)

1858. *Hydroporus laetabilis* Walker, *Ann. Mag. nat. Hist.*, (3) 2 : 205.
1882. *Canthydrus laetabilis*, Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 227.
1968. *Canthydrus laetabilis*, Vazirani, *Orient. Ins.*, 2 (3-4) : 229-231.

Diagnostic characters : General appearnce (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.

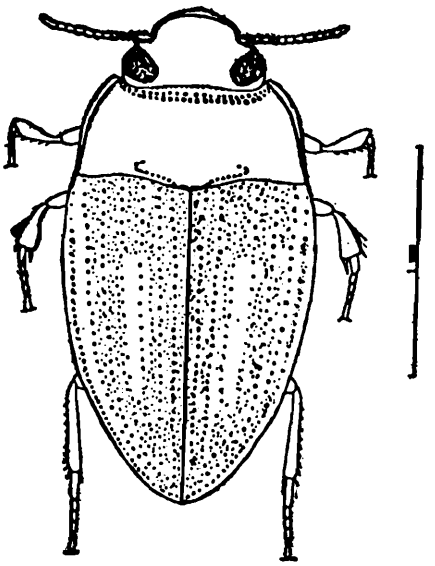


Fig. 17

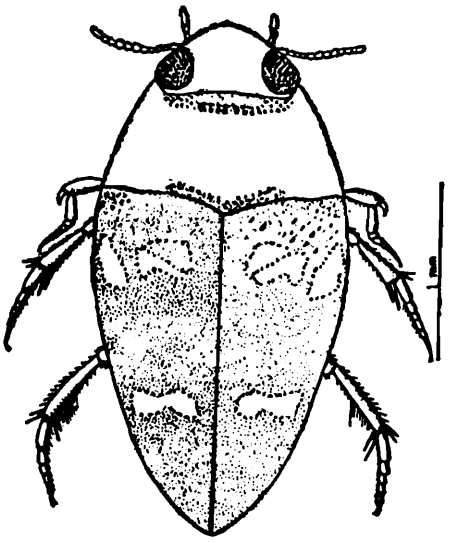


Fig. 18

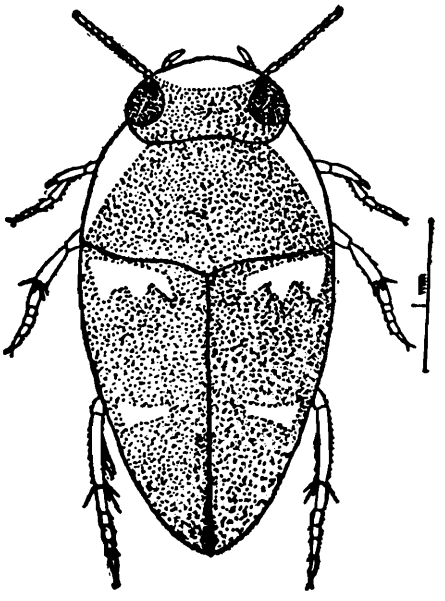


Fig. 19

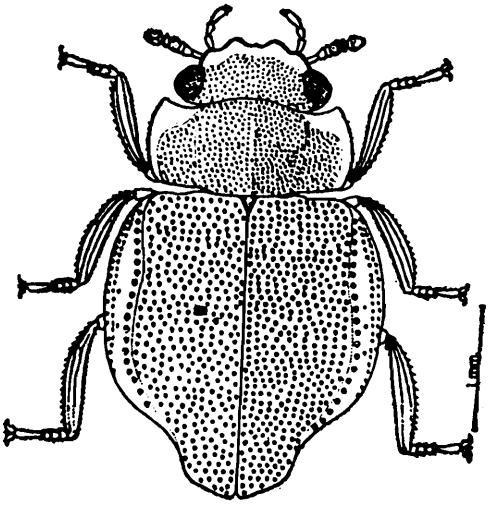


Fig. 20

Figs. 17-20 : *Hydrocoptus subvittulus* Motschulsky, dorsal view (17). *Canthydrus laetabilis* (Walker), dorsal view (18). *Canthydrus luctuosus* (Aubé) dorsal view (19). *Spercheus gibbus* champion, dorsal view (20).

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 spécies Coléoptères*, 6 : 408.
1882. *Canthydrus luctuosus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 276.
1968. *Canthydrus luctuosvs*, Vazirani, *Orient. Ins.*, 2 (3-4) : 231-232.

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, Maharshtra, 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

1919. *Spercheus gibbus* Champion, *Ent. Mon. Mag.*, 55 : 238.
1928. *Spercheus gibbus*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 30.

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), puncturation 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)

1958. *Philhydrus escuriens* Walker, *Ann. Mag. nat. Hist.*, (3) 2 : 209.
1890. *Ohiydrus escuriens*, Sharp, *Trans. ent. Soc. Lond.*, p. 350,
1928. *Enochrus escuriens*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 112.

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 brackishwater but less so in freshwater and sewage-fed water.

22. **Helochares anchoralis** Sharp

Helochares (*Hpdrobaticus*) *anchoralis* Sharp, *Trans. ent. Soc. Lond.* p. 352.
1928. *Helochares anchoralis*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 105.

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. *Scutellnm* 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

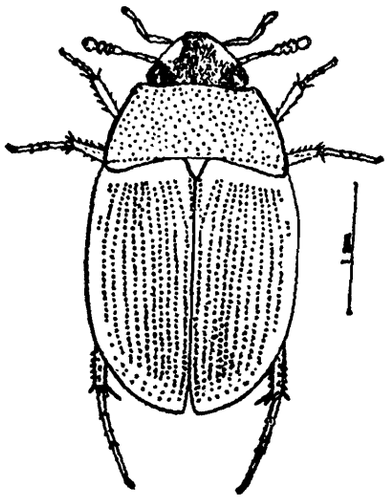


Fig. 21

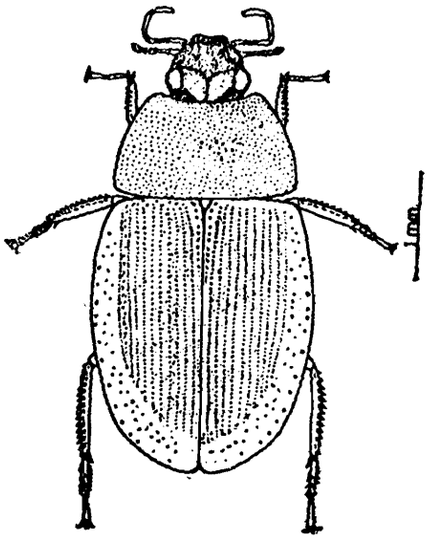


Fig. 22

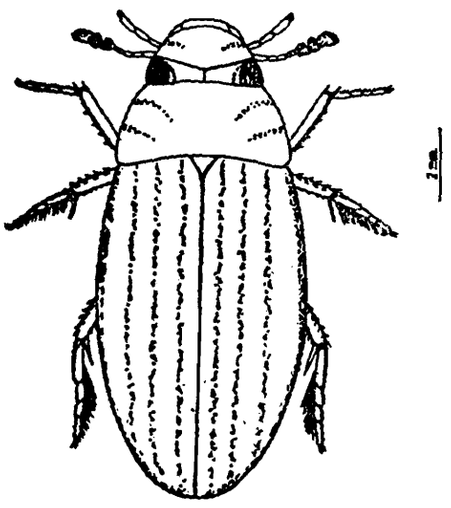


Fig. 23

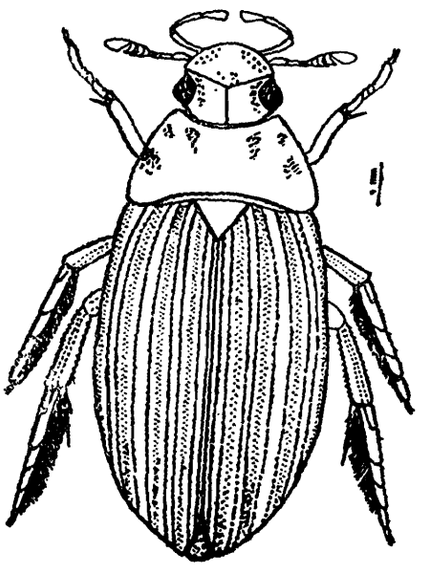


Fig. 24

Figs. 21-24 : *Enochrus escuriens* (Walker), dorsal view (57). *Helochares anchoralis* Shap, dorsal view (22). *Sternolophus rufipes* Fabricius, dorsal view (23). *Hydrophilus* sp. dorsal view (24).

beneath abdomen. These are quite common in brackishwater and less so in sewage-fed water.

23. **Sternolophus rufipes** Fabricius

1792. *Sternolophus rufipes* Fabricius, *Entom. Syst.*, **1** : 183.

1928. *Sternolophus rufipes*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 121.

Diagnostic characters : General appearance (Fig. 23) broadly elongate, slightly convex, shinny 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 shinny. *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

1890. *Amphiops mirabili* Sharp, *Trans. ent. Soc. Lond.*, p. 355.
1928. *Amphiops mirabilif*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 131.

Diagnostic characters : General appearance (Fig. 25) strongly convex, roundish, brown to blackish brown and puncturation large and dense. *Head* transverse (exposed part), puncturation 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, puncturation 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, puncturation 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

1890. *Amphiops pedestris* Sharp, *Trans. ent. Soc. Lond.*, p. 354.
1928. *Amphiops pedestris*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 131.

Diagnostic characters : General appearance (Fig. 26) strongly convex, somewhat rounded and punctate. *Head* reddish brown, transverse, puncturation 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, puncturation 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 elytra

provided with a large, central, setiferous puncture. *Legs* similar to *A. mirabilis*. *Ventral surface* reddish brown.

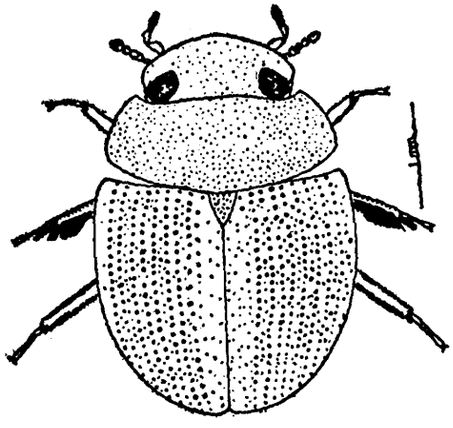


Fig. 25

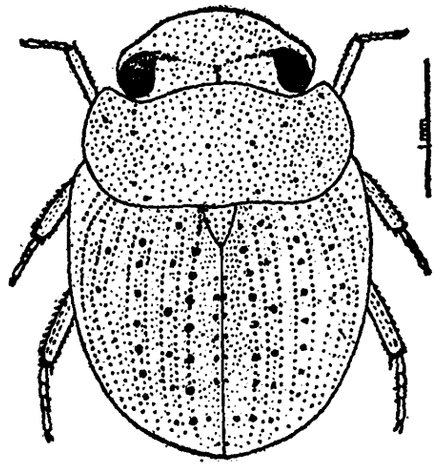


Fig. 26

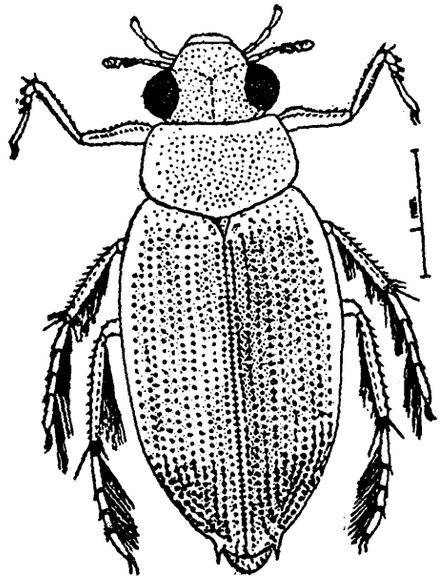


Fig. 27

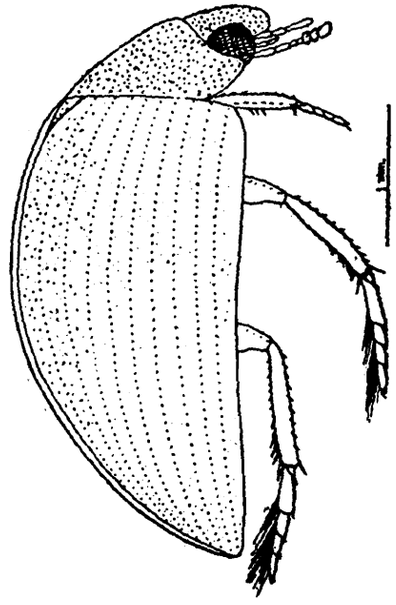


Fig. 28

Figs. 25-28 : *Amphiops mirabilis* Sharp, dorsal view (25). *Amphiops pedestris* Sharp, dorsal view (26). *Berosus indicus* Motschulsky, dorsal view (27). *Regimbartia attenuata* (Fabricius), lateral view (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

1861. *Berosus indicus* Motschulsky, *Bull. Soc. Nat. Mosc.*, 34 (1) : 110.

1928. *Berosus indicus*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 138.

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)

1801. *Hydrophilus attenuata* Fabricius, *Syst. Eleut.*, 1 : 253.

1928. *Régimbartia attenuata*, d'Orchymont, *Catalogue of Indian Insects, Palpicornia*, pt. 14 : 138-139.

Diagnostic characters : General appearance (Fig. 28) strongly convev, elongate, compressed on sides, uniform deep and shinning black and punctate. *Head* small, rounded anteriorly and puncturation dense and distinct and eyes large, convey 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 triangled. *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.

	Species	Freshwater (Barrackpore)	Sewage-fed water (Bantala)	Brackishwater (Khariberia)
1.	*Haliplus angustifrons*	+	−	−
2.	*Dineutus unidentatus*	+	−	+
3,	*Orectochilus productus*	+	−	−
4.	*Cybister tripunctatus*	+	−	−
5.	*Hydaticas ricinus*	+	−	+
6.	*Hyphydrus renardi*	−	−	+
7.	*Hydrovatus bonvouloiri*	++	+	−
8.	*Hydrovatus confertus*	++	++	++
9.	*Clypeodytes orissaensis*	+	−	+
10.	*Uvarus quadrilineatus*	+	−	−
11.	*Guignotus flammulatus*	++	+	++
12.	*Guignotus inconstans*	+	+	−
13.	*Guignotus pendjabensis*	+	−	+
14.	*Guignotus* sp	+	−	+
15.	*Laccophilus anticatus*	+++	+++	++
16.	*Laccophilus parvulus*	++	+	++
17.	*Hydrocoptus subvittulus*	+	−	+
18.	*Canthydrus laetabilis*	+++	++	+++
19.	*Canthydrus luctuosus*	++	++++	++
20.	*Spercheus gibbus*	−	−	+
21.	*Enochrus escuriens*	+	+	+++
22.	*Helochares anchoralis*	−	+	++
23.	*Sternolophus rufipes*	+	−	++
24.	*Hydrophilus* sp.	−	−	+
25.	*Amphiops mirabilis*	++	++	++
26.	*Amphiops pedestris*	+	−	+
27.	*Berosus indicus*	+	+	++
28.	*Regimbartia attenuata*	−	−	+

++++	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. Camparatively 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 anticatus* and *Canthydrns 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 anticatus* 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 monson 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 differnt 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

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 focilities. 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.

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PARONELLIDES SCHÖTT (1925)—*PSEUDOPARONELLIDES* SALMON (1941)—*MICRONELLIDES* SALMON (1944) COMPLEX FROM AUSTRALIA, TASMANIA AND NEW ZEALAND

[Collembola : Entomobryidae : Paronellinae]

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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

1925. *Paronellides* Schött, *Sarawak Mus. Journ.*, 3 : 107-127.
1925. *Pericrypta* Schött, 1925, *ibid.* [*Lapsus* for *Perikrypta* Ritter, 1911. Unavailable name.]
1944. *Micronellides* Salmon, *Rec. Dom. Mus., N. Z.*, 1 (2) : 123-182. New Synonymy.

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.

Material Examined : *Paronellides mjobergi* (Schött) : Slide No. 1300 labelled as "*Pericrypta mjöbergi* n. sp. austr. H. Schött." Slide No. 1301, labelled as "*Pericrypta mjöbergi* ; alk. H. Schött". Slide No. 1302, labelled as "*Pericrypta mjöbergi*, austr". (the specimen does not belong to *Paronellides*). Slide No. 4170, labelled as "*Pericrypta mjöbergi* Schött, 1917. Lectotype, Lamington Plateau, Queensland. E. Mjöberg. Oct. 1912". Slide No. 4171, labelled as "*Pericrypta mjöbergi* Schött, 1917. Paratype, lamington Plateau, Queensland. E. Mjöberg. Oct. 1912".

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".

Paronellides novaezealndiae Salmon : 1 paratype mounted on a slide No. Dominion Museum, N. Z. 3/850, labelled as "*Paronellides novaezealandiae*. Loc. Maruia Valley. In leaf mould, 9/2/1940, coll. J. T. Salmon. Det. J. T Salmon. Mounted Euparal (P-type)".

Paronellides noveaezealandiae purpurea Salmon : 1 specimen mounted on a slide No. Dominion Museum, N. Z. 3/1571, labelled as "*Paronellides novaezealandiae*, ssp. *purpurea*. Loc. Homer, beaten from grass, 1/1/1944, coll. J. T. Salmon. Mount J. T. Salmon, Diaphane. Det. J. T. Salmon, 1945".

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-SPECISS

Paronellides (Paronellides) mjöebergi (Schött) 1917

1917. *Pericrypta mjöbergi* Schött, *Ark. Zool.*, 17 (8) : 60 ; 1925, *Sarawak Mus. Journ.*, 3 : 107-127 ; Womersley, 1934, *Trans. Proc. Roy. Soc. Sth. Austr.*, 58 : 86-138.

1925. *Paronellides mjöbergi* Schött, *Sarawak Mus. Journ* 3 : 107-126 ; Womersley, 1939, *Primitive Insects of South Australia*, Adelaide, 322 pp.

1936. *Perictypta tasmaniae* Womersley, *Rec. Sth. Austr. Mus.*, (4) 5 : 175-485 *sensu* Womersley, 1939.

1936. *Perictypta tasmaniae maculata*, Womersly, *ibid.*

1937. *Perictypta lineata maculata*, Womersley, *Trans. Proc. Roy. Soc. Sth. Austr.*, 61 : 154-157 *sensu* Womersley, 1939.

1937. *Perictypta lineata tasmaniae*, Womersley, *ibid.*

1939. *Perictypta dandenongensis tasmaniae*, Womersley, *Primitive Insects of South Australia, Adelaide*, 322 pp.

1939. *Paronellides dandenongensis maculata*, 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 ; Ths. II, III, Abds. 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

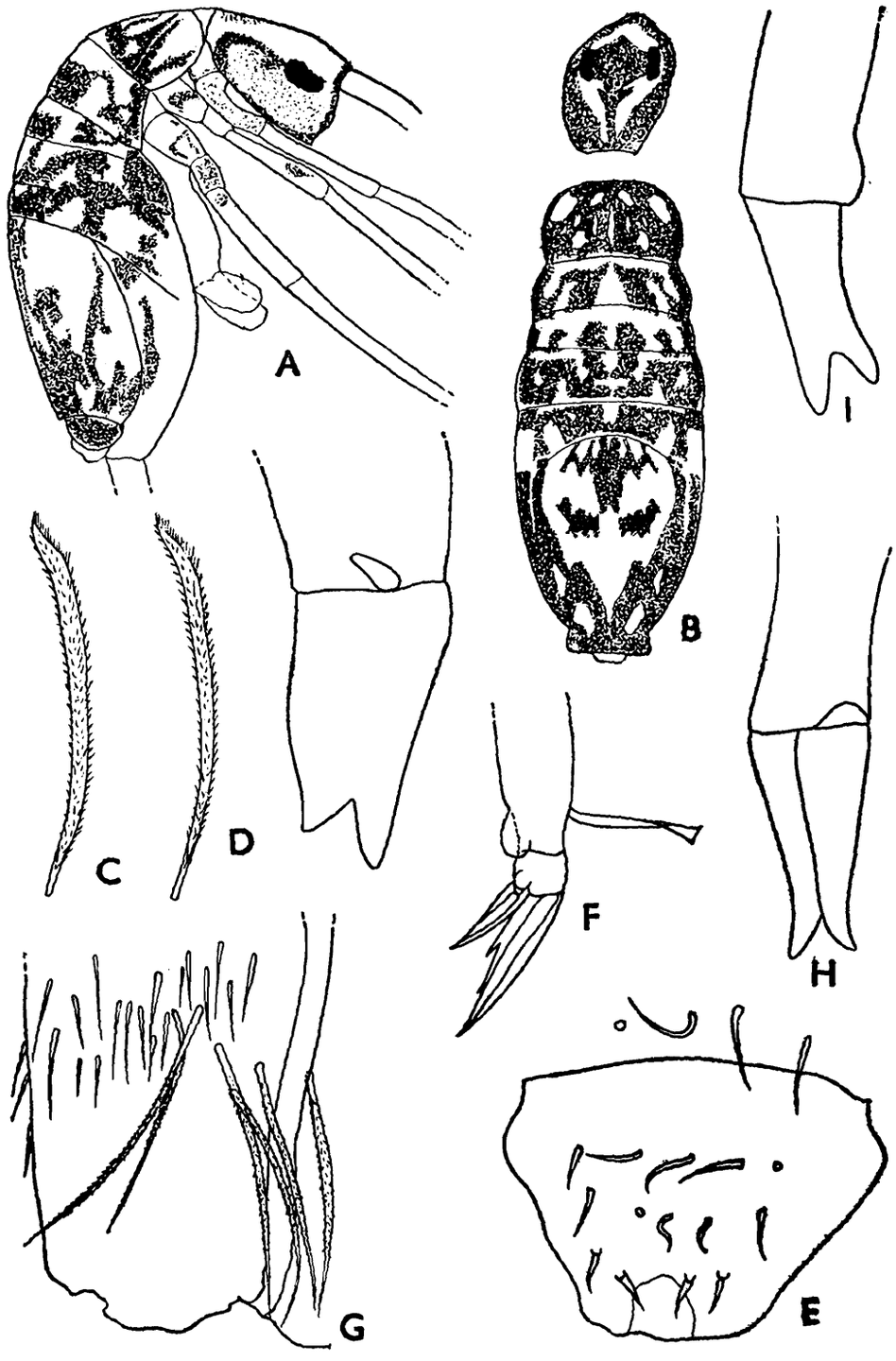


Fig. 1. Features of *Paronellides* (*Paronellides*) *mjöebergi* (Schött). A, profile (lateral) showing pigmentation (from a paralectotype, in alcohol) ; B, profile (dorsal) showing pigmentation (from a paralectotype, in alcohol) ; S, D, flexed macrochaetae from thorax ; E, labral chaetotaxy ; f, footcomplex 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 Abds. V and VI ; obliquely truncated, flexed, ciliated macrochaetae present on Ths. II, III, Abds. I, II and III (Fig. 1 C, D).

CHAETOTAXY

Head : Vertex with V_0+V_{1-6}, all of which macrochaetae, V_1, V_2 arranged in a trapezoid fashion and V_0 falls medially on the line joining V_1-V_1 ; dorsal region represented by D_0+D_{1-9}, all of which macrochaetae ; subdorsal region represented by 8 setae of which SD_{5-8} macrochaetae ; ocular region has 4 setae (oc_{1-4}), all microchaetae ; postocular region represented by a single macrochaeta on either side (PO) ; parietal region represented by a single macrochaeta on each side (P_1) ; occipital region with O_{1-10} ; all macrochaetae, arrangement of which characteristic ; area cervicalis represented by macrochaetae, (C_{1-5}) ; area genalis represented by 3 macrochaetae (G_{1-3}) [Fig. 2].

Body : Number of macrochaetae on each targite ranges from Ths. II (68—69), III (46—47), Abds. I (23—26), II (10—11), III (9—10) ; Abid. 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 ; ungues and unguiculi slender ; unguis moderately curved, with paired inner teeth at almost the middle of the claw, middle unpaired tooth

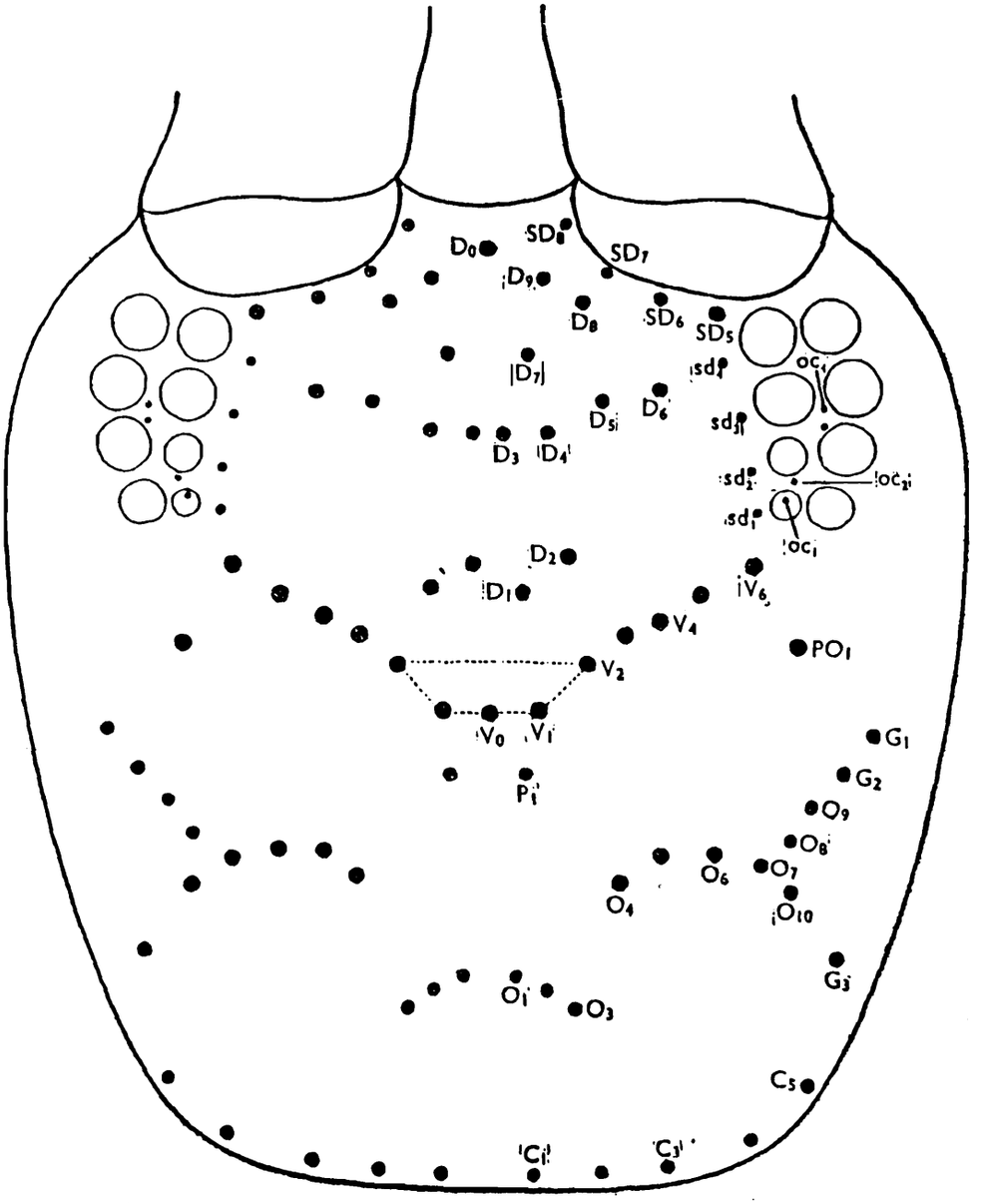


Fig. 2. Cephalic chaetotaxy in *Paronellides* (*Parouellides*) *mjöebergi* (Schött).

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 : Abds. I : II : 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,

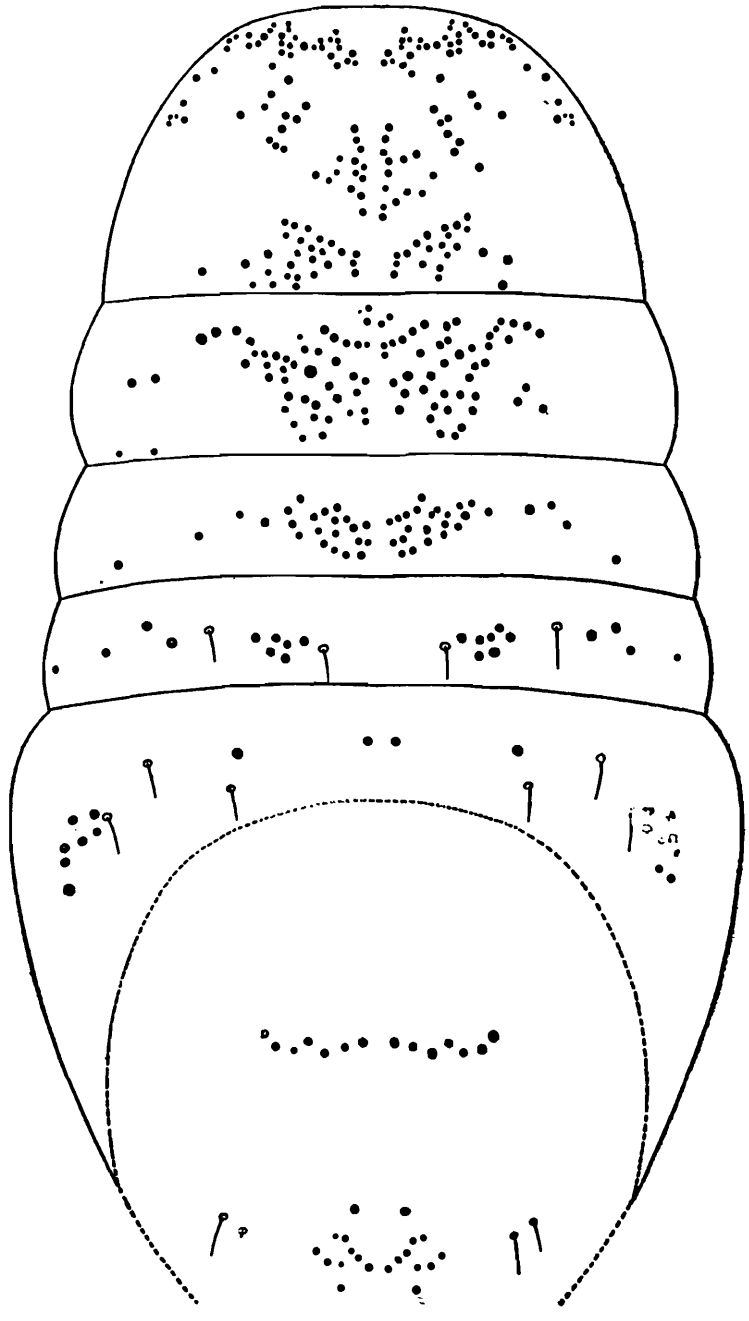


Fig. 3. Chaetotaxy of Ths. II, III and Abds. I-IV in *Paronellides* (*Paronellides*) *mjöebergi* (Schött).

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. mjöebergi* 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, Abds. 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 "*muculata*" 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, Abds. 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 Abds. III, 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, Abds. 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 ungues 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 dentes (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 accuminate setae (Fig. 4 B), interspersed profusedly with obliquely truncated ciliated flexed macrochaetae (Fig. 4 C), head, cervix and Abds. IV, V, VI, in addition, with flexed accuminate macrochaetae (Fig. 4 D), antennae thickly clothed with short accuminate 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

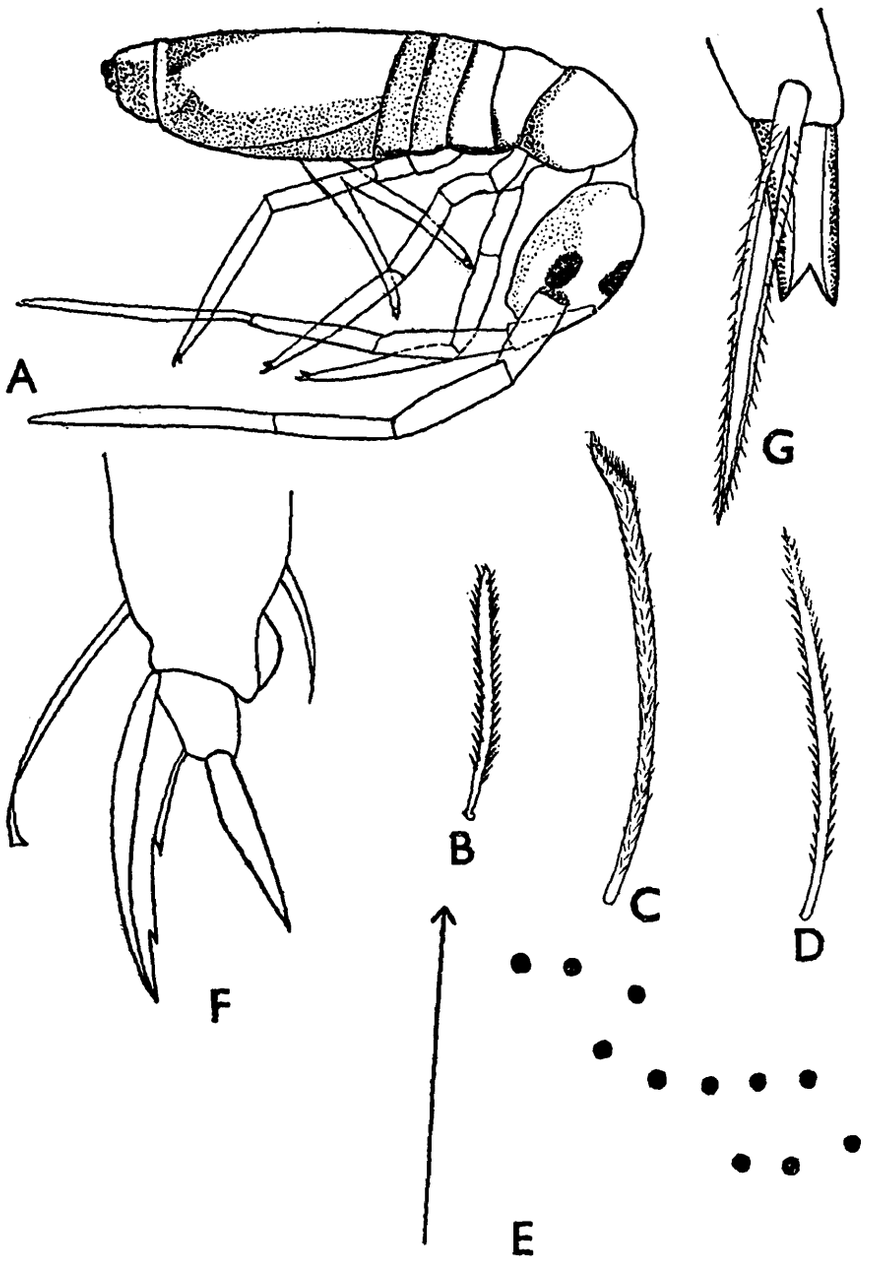


Fig. 4. Features of *Paronellas* (*Paronellidides*) *novaezealandiae* Salmon. A, profile showing pigmentation (Paratype, slide No. 3/850, Dominion Museum, N. Z.) ; D, a seta from general surface of body ; C, a flexed macrochaeta ; D, a flexed accuminate macrochaeta from cervix ; E, arrangement of macrochaetate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

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 alongwith chaetotaxy of tergites could not be ascertained from the mounted specimen, however, arrangement of macrochaetae in 3 transverse rows anterodorsally on Abd.

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.*) *novaezealandiae* 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.*) *novaezealandiae.*

Paronellides (Paronellides) novaezealandiae 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 novaezealandiae*, ssp. *purpurea*, Loc. Homer, beaten from grass, 1/1/1944. Ceoll., 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 profusedly 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 Abds. IV, V, VI (Fig. 5, A, B), (b) accuminate ones mostly remain distributed on Abds. IV, V, VI and a few of such

setae also present on head and cervix (Fig. 5, D) ; antennae clothed with ciliated, accuminate 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

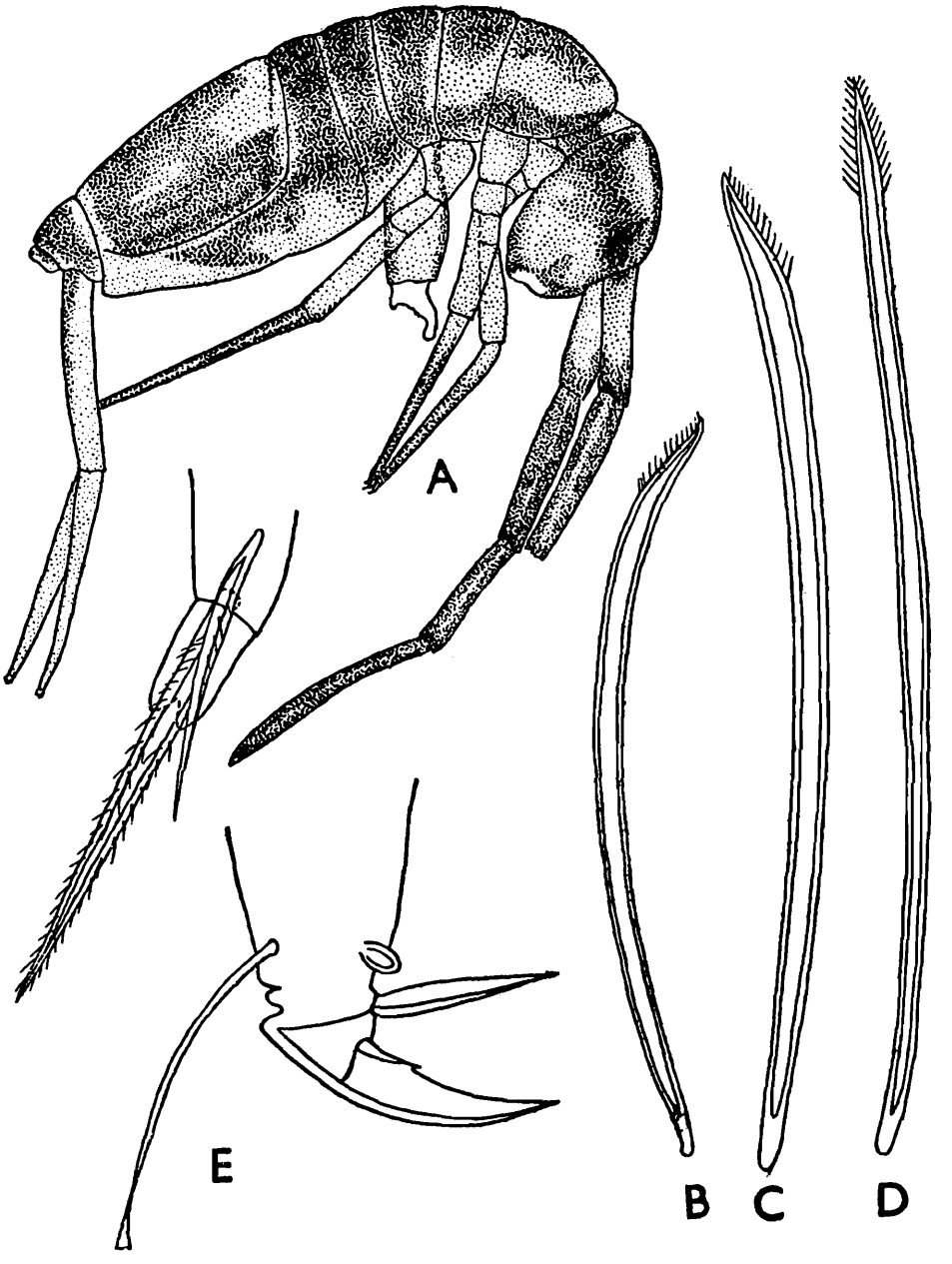


Fig. 5. Features of *Paronellides* (*Paronellides*) *novaezealandiae purpurea* Salmon, 1941. A, profile showing pigmentation (Paratype, slide No. 3/1571, Dominion Museum, N. Z.) ; B, a macrochaeta from head ; C, a macrochaeta from Abd. I ; D, a macrochaeta from Abd. IV ; E, footcomplex from leg III ; F, mucrodens complex.

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],

mucrones bidentate, apical tooth appears some what 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.

Sub-genus 2 : Pseudoparonellides Salmon, 1941. New Status.

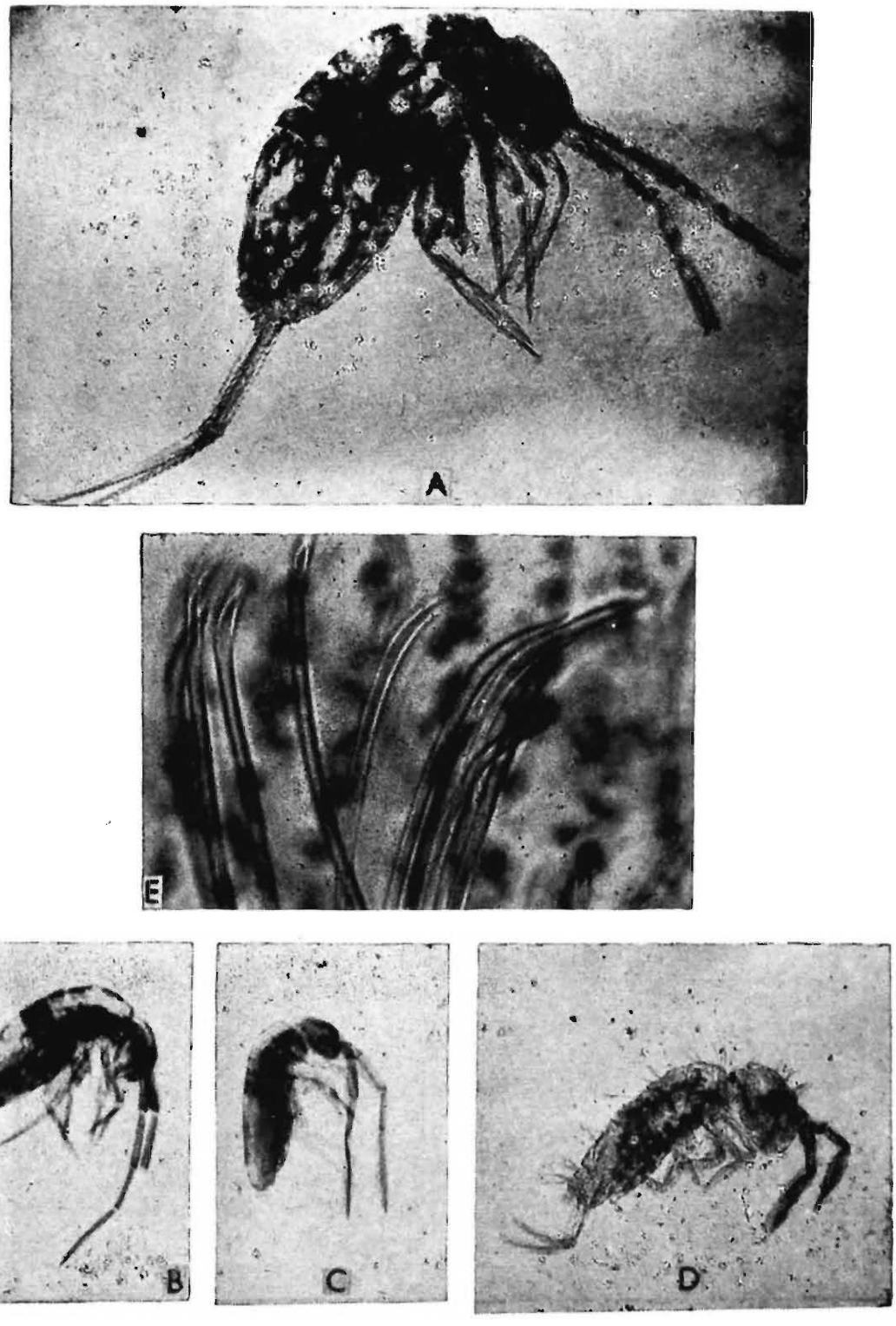
1941. *Pseudoparonellides* Salmon, *Trans. Roy. Soc., N. Z.*,70 : 282-431 ; 1944, *Rec. Dom. Mus., N. Z.*, 1 : 123-182.

Material Examined : *Pseudoparonellides badius* Salmon : 1 paratype mounted on a slide, labelled as "Dominion Museum, N. Z. 3/862 : *Pseudoparonellides badia.* Loc. Weheka, in leaf mould in bush, 17/2/1940, coll. J. T. Salmon. Det. J. T. Salmon. Mounted Euparal (Fig. P-type)".

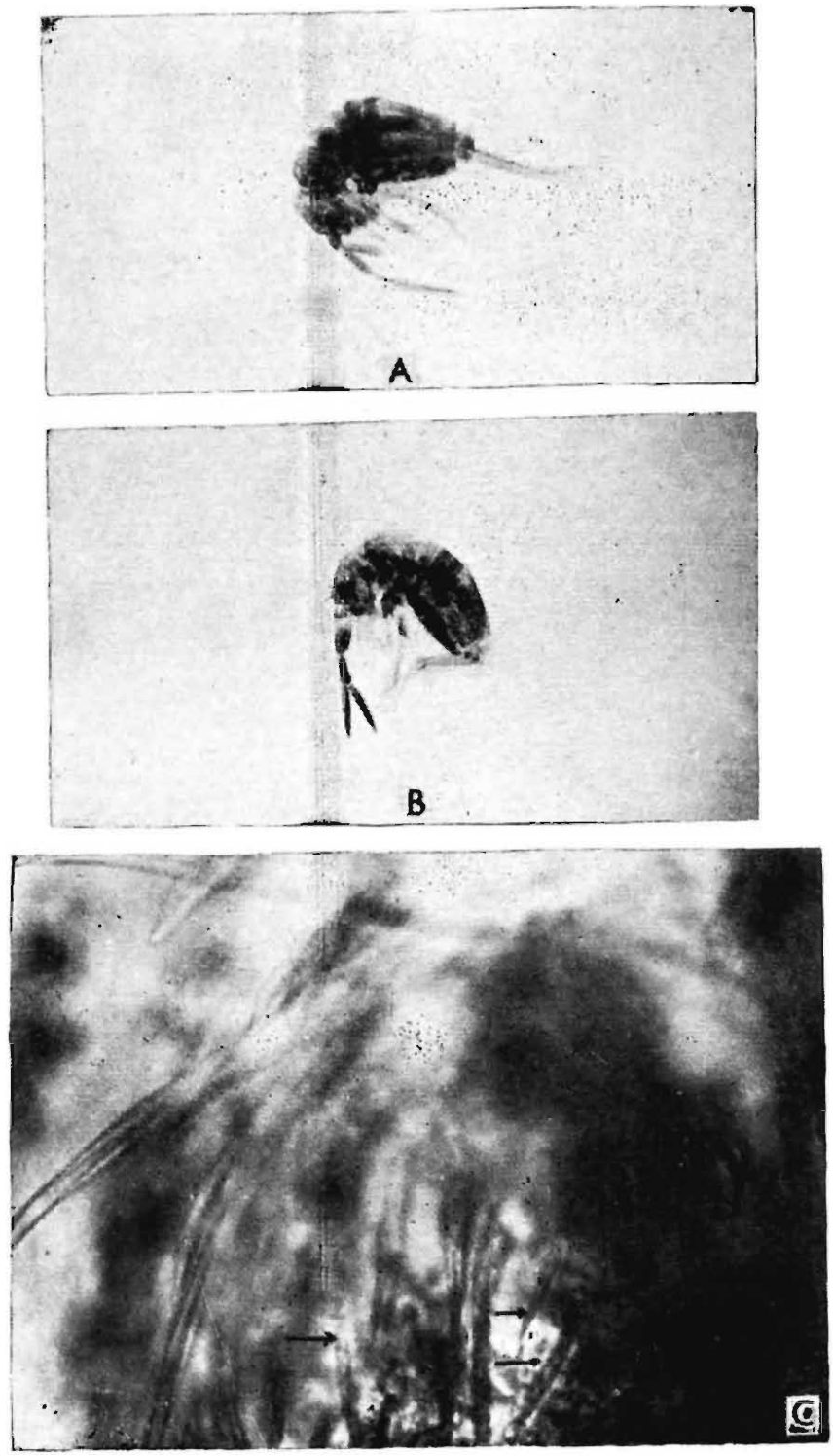
Pseudoparonellides cryptodontus Salmon : 1 paratype mounted on a slide, labelled as "Dominion Museum, N. Z. 3/1562 ; *Pseudoparonellides cryptodonta.* Loc. Bold Peak, 3000 ; in leaf mould in beach forest, 11/2/1943, coll. J. T. Salmon. Det. J. T. Salmon. Mounted Diaphane (Fig. 6, A Paratype)".

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 setea to be ciliated, in fact, the setae he depicted



PL. 1. A, a paralectotype of *Paronellides* (*Paronellides*) *mjöebergi* (Schött) (Slide No. 4171) in Swedish Museum Natural History, Stockholm) ; *Paronellides* (*Paronellides*) *novaezealandiae purpurea* Salmon (Slide No. N. Z. 3/1571, Dominion Museum, New Zealand) ; C, *Paronellides* (*Paronellides*) *novaezealandiae* Salmon (Paratype, slide No. N. Z. 3/850, Dominion Museum, New Zealand) ; D, *Micronellides oliveri* Salmon (=*Paronellides*) cf. *novaezealandiae*, juvenile. Paratype, slide No. N. Z. 3/1353, Dominion Museum, New Zealand) ; E, flexed macrochaetae from Th. II of *Paronellides* (*Paronellides*) *badius* (Salmon).



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 coarsley ciliated on margins and not flattended (Fig. 6, E, F, PL. 2, C).

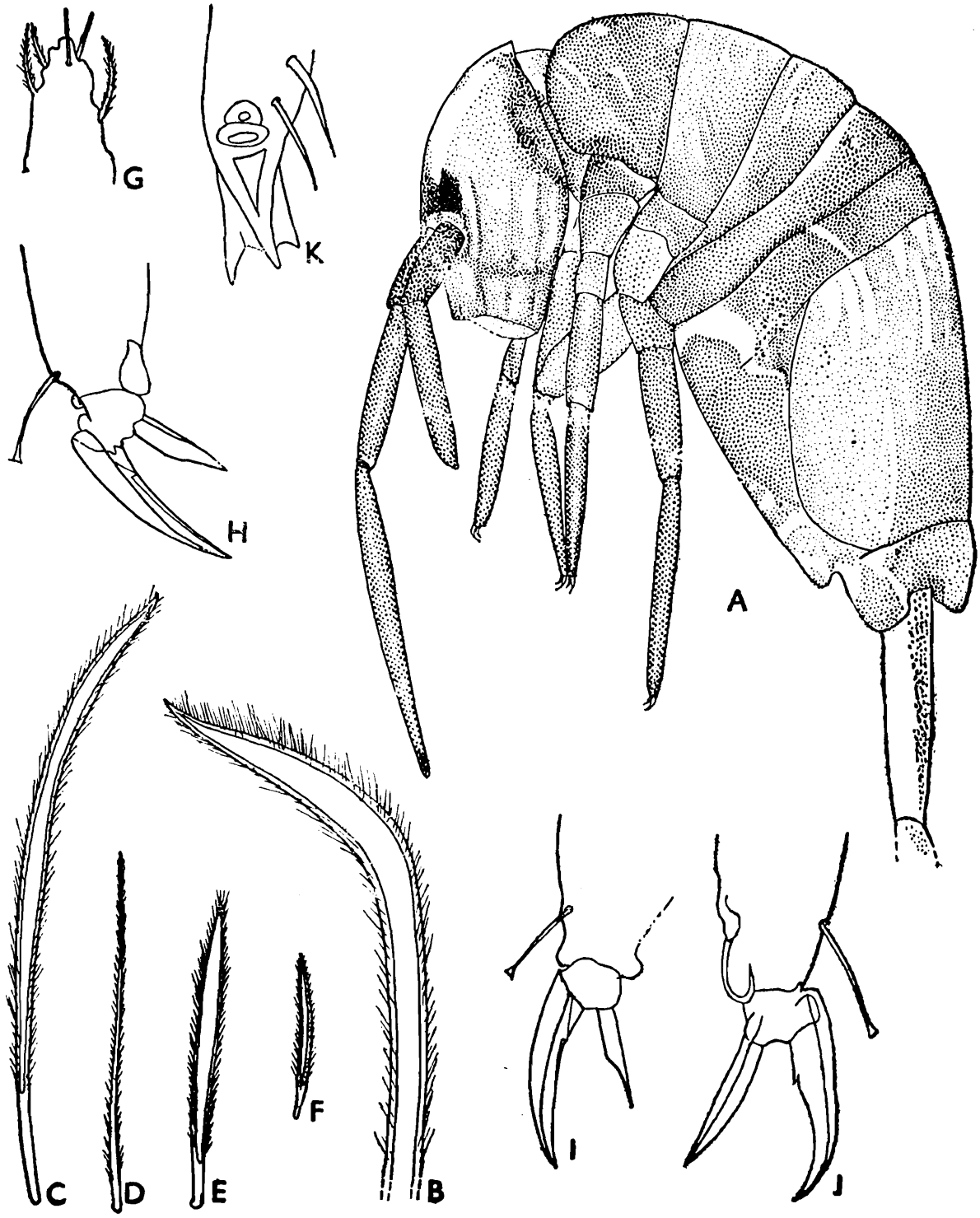


Fig. 6. Features of *Paronellides* (*Pseudoparonellides*) *badius* (Salmon). A, Profile, showing colour pattern (Paratype, slide No. 3/862 N. Z., Dominion Museum, New Zealand) ; B, apex of a flexed macrochaeta from Th. II ; C, a flexed macrochaeta from Th. II (front view) ; D, E, F, various microchaetae 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.

1941. *Pseudoparonellides badius* Salmon, *Trans. Roy. Soc., N. Z.*, 70 : 398-407 ; Salmon, 1944 *Rec. Dom. Mus., N. Z.*, 1 : 123-182.

1964. *Pseudoparonellides badius* Salmon, *Bull. Roy. Soc., N. Z.*, (7) 2 : 145-644.

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, Abds. 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 marcochaeta 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 flattended, 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 wich the median tooth is smaller and indistinct.

Paronellides (Pseudoparonellides) cryptodontus (Salmon)

1944, new comb.

1944. *Pseudoparonellides cryptodonta* Salmon, *Rec. Dom. Nus., N. Z.*, **1** : 123-182.

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

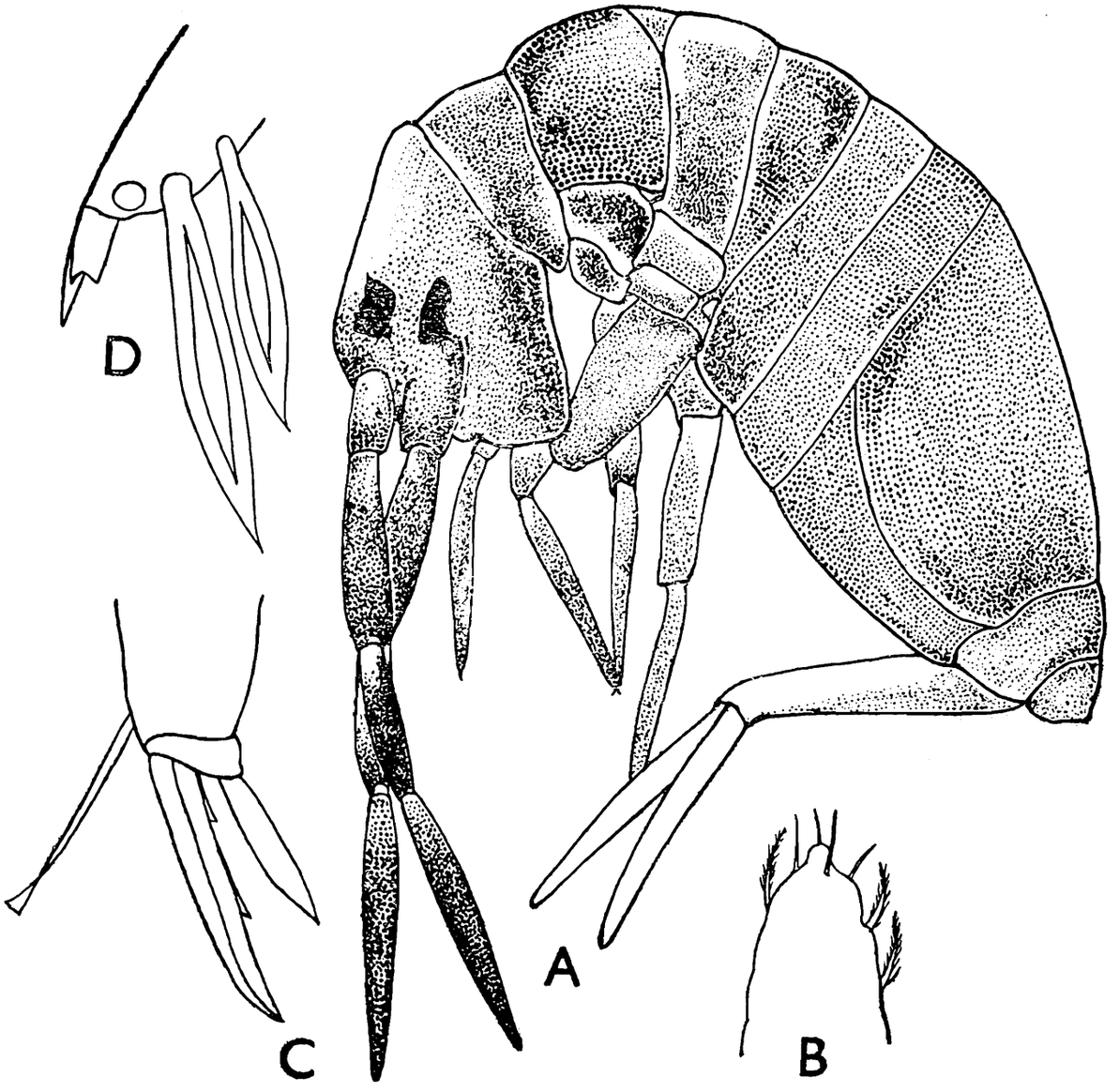


Fig. 7. Features of *Paronellides* (*Pseudoparonellides*) *cryptodontus* (Salmon). A, profile showing pigmentation (Paratype, slide No. 3/1562, Dominion Museum, N. Z.) ; B, apex of Ant. IV ; C, footcomplex of leg I ; D, mucrodens complex.

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

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 : *Pseudoparonellies* 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.

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Rec. zool. Surv. India, 93 (1-2) : 159-160, 1993

COLOUR VARIATION IN THE CENTIPEDE *SCOLOPENDRA MORSITANS* LINNAEUS (MYRIAPODA : CHILOPODA) FROM MAHARASHTRA, INDIA

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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 dirtricts and local survey of Pune, Maharashtra, four distinct colour-morphs of *S. morsitons* 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.

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Rec. zool. Surv. India, **93** (1-2) : 161-164, 1993

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

RAMAKRISHNA

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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 adaptibility. 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 inititated, 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

Phylum	:	PORIFERA
Class	:	DAEMOSPONGIAE
Order	:	HAPLOSCLERIDA
Family	:	SPONGILLIDAE
Genus	:	**Eunapius** Gray 1867

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 leuckartii, 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

Parameters	Summer	Monsoon	Winter
Water Temperature (°C)	28.00	26.30	27.6
pH	8.08	7.95	8.12
Free Carbondioxide	Nil	Nil	Nil
Alkalinity	153	237	348
Calcium	37.25	66.00	63.50
Magnesium	56.00	54.00	60.00
Hardness	116.5	122.00	125.00
Dissolved oxygen	5.25	6.10	7.00
Chloride	131.50	88.00	80.00
Specific conductance (U mho/cm)	820.00	650.00	644.00
Total Dissolved solids	524.00	415.00	412.00

(Values are in mg/1, 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.

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Rec. zool. Surv. India, 93 (1-2) : 165-174, 1993

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

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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 occuring 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 comorising 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 centipdes.

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 centipdes.

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.

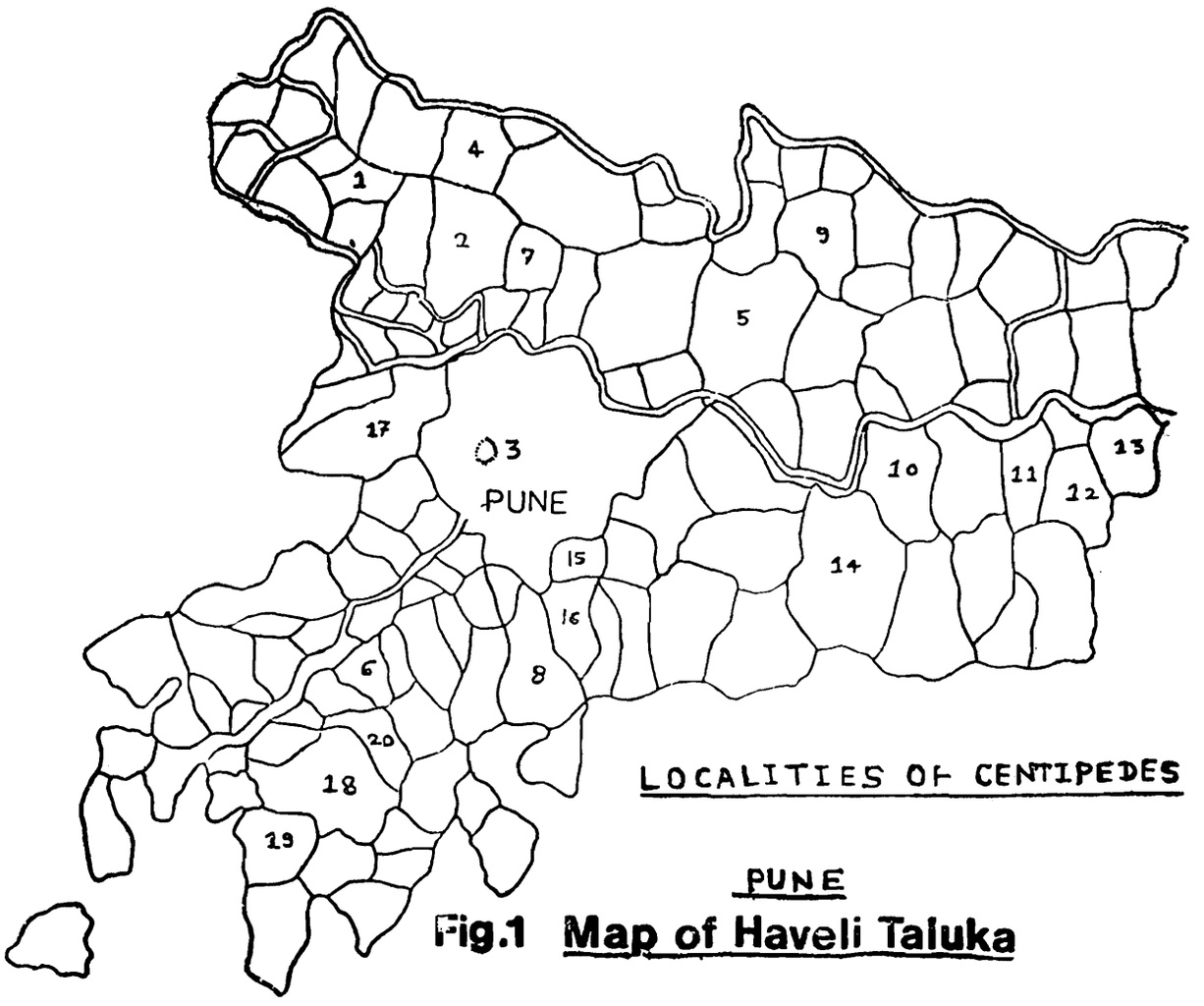

Fig.1 Map of Haveli Taluka

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 centipdes 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.

14. *Loni Kalbhor* : Loni Kalbhor is at 11 kms. East of Pune on Sholapur road.

15. *Kondhave* : Kondhave is stuated 8 kms. SE of Pune.

16. *Pashan* : This village is *C* 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 *C* 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

1946. *Scolopendra amazonica* Bucherl. *Mem Inst. Butantan*, 19 (1-10) ; 135-158.

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, Vaghur, 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

1758. *Scolopendra morsitans* Linnaeus *Syst. Nat.*, ed. 10 p. 638.

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

1845. *Scolopendra hardwickei* Newport, Trans, *Linn. Soc.*, London, 19 : 349-439.

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

1984. *Scalopendra punensis* Jangi & Dass, *J. Sci. Ind. Res.* Vol. 43, 43 : 27-54.

Distributton : Maharashtra, Pune district.

Diagnostic features : Cephalic plate rugose.

5. **Scolopendra andhrensis** Jangi & Dass

1984. *Scolopendra andhrensis* Jangi & Dass, *J. Sci. Ind. Res.*, 43 : 27-54.

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

Distribution : Andhra Pradesh, Vishakhapattanam dist., Maharashtra—pune district.

Diagnostic feature : Cephalic plate having coarse pit like puncta.

6. **Cormocephalus pilosus** Jangi

1955. *Cormocephalus pilosus* Jangi, *Ann. Mag. nat. Hist.*, Ser 12.

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.

1984. *Cormocephalus nudipes* Jangi & Dass, *J. Sci. Ind. Res.*, 43 : 27-54.

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

1984. *Cormocephalus pseudonudipes* Jangi & Dass, *J. Sci. Ind. Res.*, 43 : 27-54.

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

Distribution : Maharashtra, Andhra Pradesh, Tamil Nadu.

Diagnostic features : Lateral tergital margination present anteriorly to 21. Maxillipede with prefemoral process. Anal legs in both sexes smooth.

9. **Asanada brevicornis** Meinert

1886. *Asanada brevicornis* Meinert, Viden. Skabl. Meddel. mathi. Fore. Kjobe, Pt. 3.

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 sokotrana** Pocock

1891. *Asanada sokotrana* Pocock, *Ann. Mag. nat. Hist* ; 7 : 51-68 and 221-231.

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

1984. *Asanada indica* Jangi & Dass, *J. Sci. Ind. Res.*, 43 : 27-54.

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

1984. *Digitipes barnabasi* Jangi & Dass, *J. Sci. Ind. Res.*, 43 : 26-54.

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

Distribution : Maharashtra, Tamil Nadu.

Diagnostic features : Nine paris of oval spiracles. Femur of anal leg, in male, with a posteriomedial process. Claw of 2nd maxilla without spur. Porous area of coxopleuron almost touching dorsal margin. Identification revealed the occurrence of *D. chhotanii* Jangi & Dass and *D. indicus* Jangi & Dass at Khandala ghat.

13. **Otostigmus (Otostigmus) orientalis** (Porat)

1876. *Otostigmus (Otostigmus) orientalis* Porat, *Bihan. Sevens vent. handlinger*, 4 : 1-48.

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 throny tracts.

14. **Rhysida nuda** (Newport)

1845. *Rhysida nuda* (Newport), Trans. *Linn. Soc.*, London, 19 : 349-439.

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 lateraliy, and except anterior one, with complete paramedian sutures.

15. **Rhysida lithobioides** Newport

1845. *Rhysida lithobioides* Newport, Trans. *Linn. Soc.*, London, **19** : 349-439.

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

1984. *Rhysida lithobioides trispinosus* Jangi & Dass, *J. Sci. Ind. Res.*, **43** : 27-54.

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, occuring 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, Chaturshingi hill, Urulikanchan, Lonikand, Paud, Yavat and Saswad villages of Haveli, Mulshi and Purandar talukas, showing preference for brown and mixed type of soil.

Cornmocephalus 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. nud pes* Jangi & Dass was collected from Pune University campus which is also a greenery with plenty of dry foliage.

Rhysida nuda (Newporr) shows mixed distribution and general preferenee 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 onlv 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 *Cormocephalus* 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 everngreen 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 centipdes 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 sarveyed, Haveli represented rich distribution of centipedes.

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

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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.

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Jangi, B. S. & Dass, C. M. S. 1984. Scolopendridae of the Deccan *J. Sci. Ind. Res.*, 43 : 27—54.

Khanna, V. & Tripathi, J. C. 1984. Observations on the seasonal incidence within the centipde genus *Cormocephalus* (Chilopoda) Scolopendridae). Uttar Pradesh, *J. zool.* 4 (2) : 217—219.

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

Rec. zool. Surv. India, 93 (1-2) : 175-200, 1993

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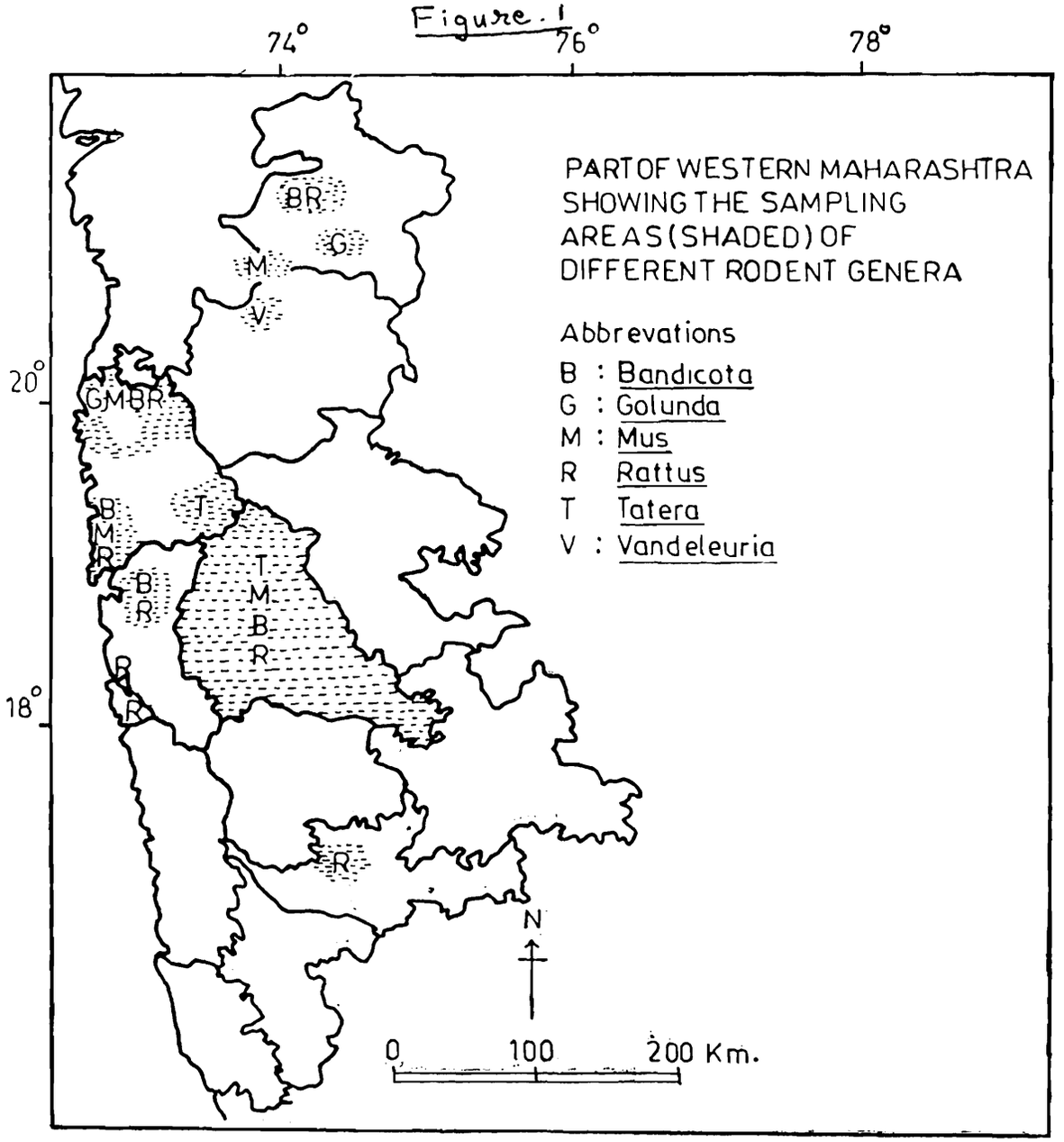
3. Chaemotaxonomy of rodents from Pune district.
4. Ecological and taxonomic studies of rodents in and around Calcutta.

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

Figure. 1



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 ($4°C \pm 1°C$), 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 smaples 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 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 ($P = 0{\cdot}05$). Although the measurements of these specimens come quite close to those of *B. indica malasbarica*, 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 distribulion. 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 locii (Nei, 1972).

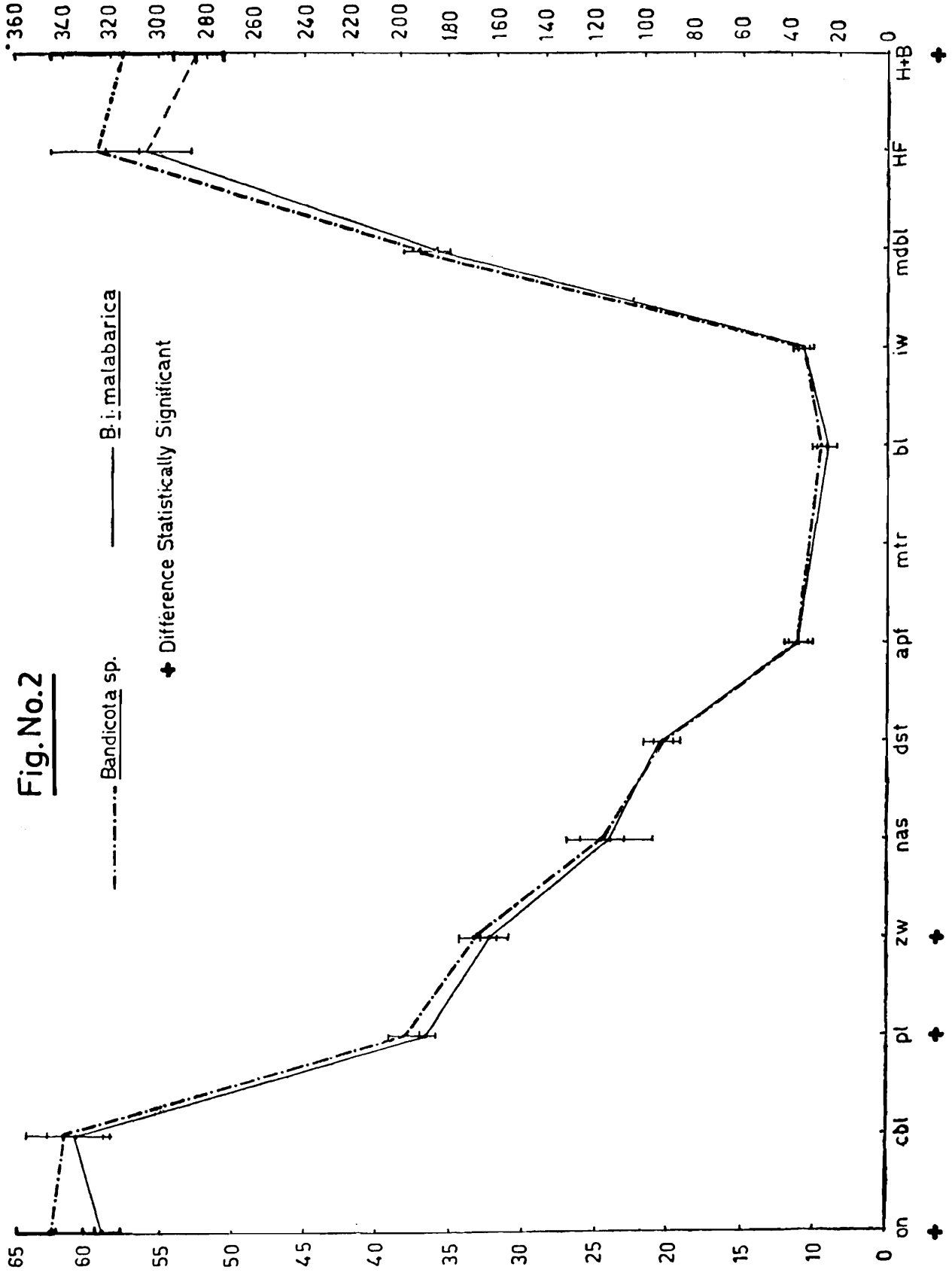


Fig.No.2

Table 4 represents the I values for individual proteins as well as mean I (I) for all

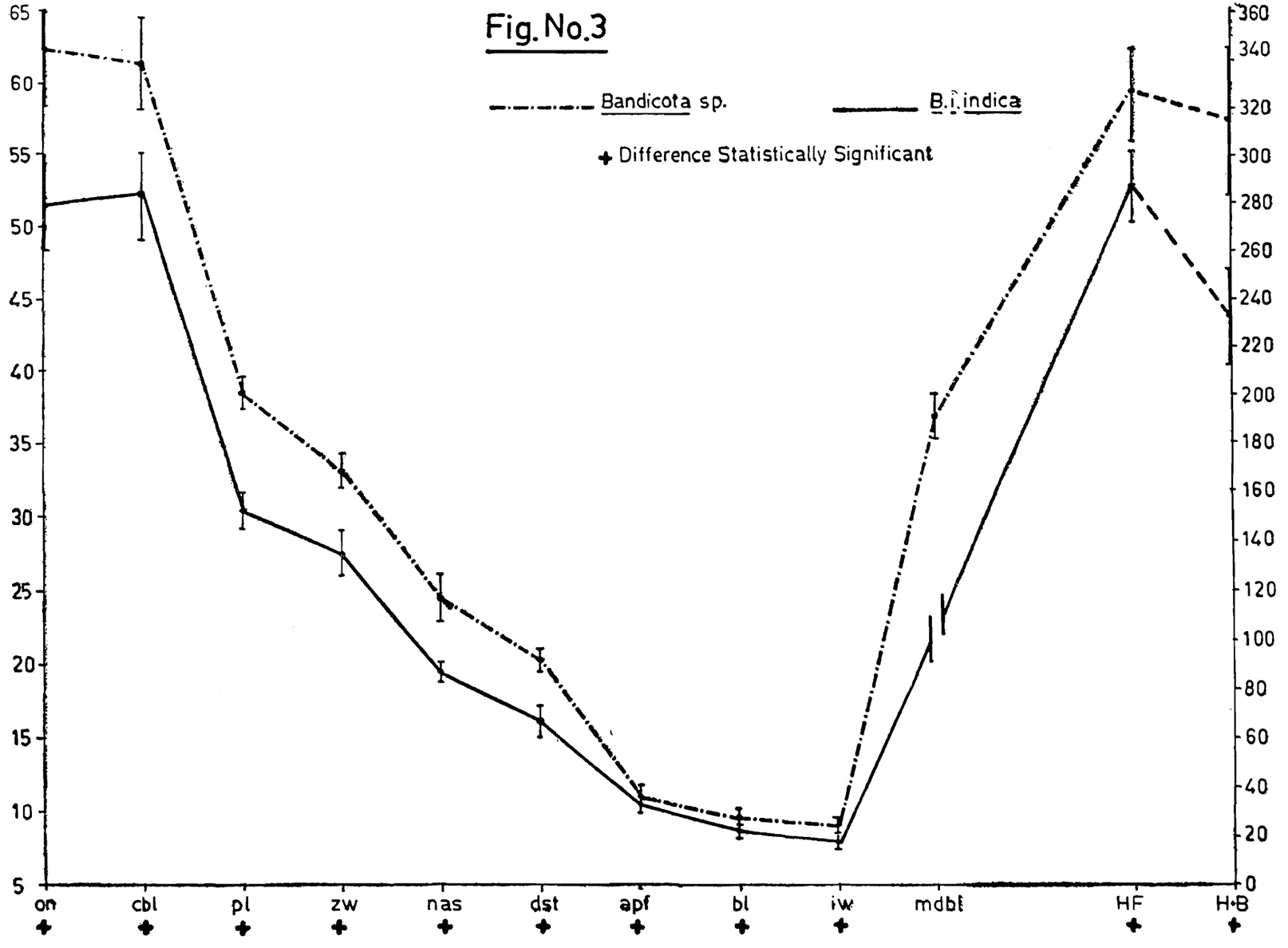


Fig. No.3
Bandicota sp.
B. indica
+ Difference Statistically Significant
65
60
55
50
45
40
35
30
25
20
15
10
5
360
340
320
300
280
260
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220
200
180
160
140
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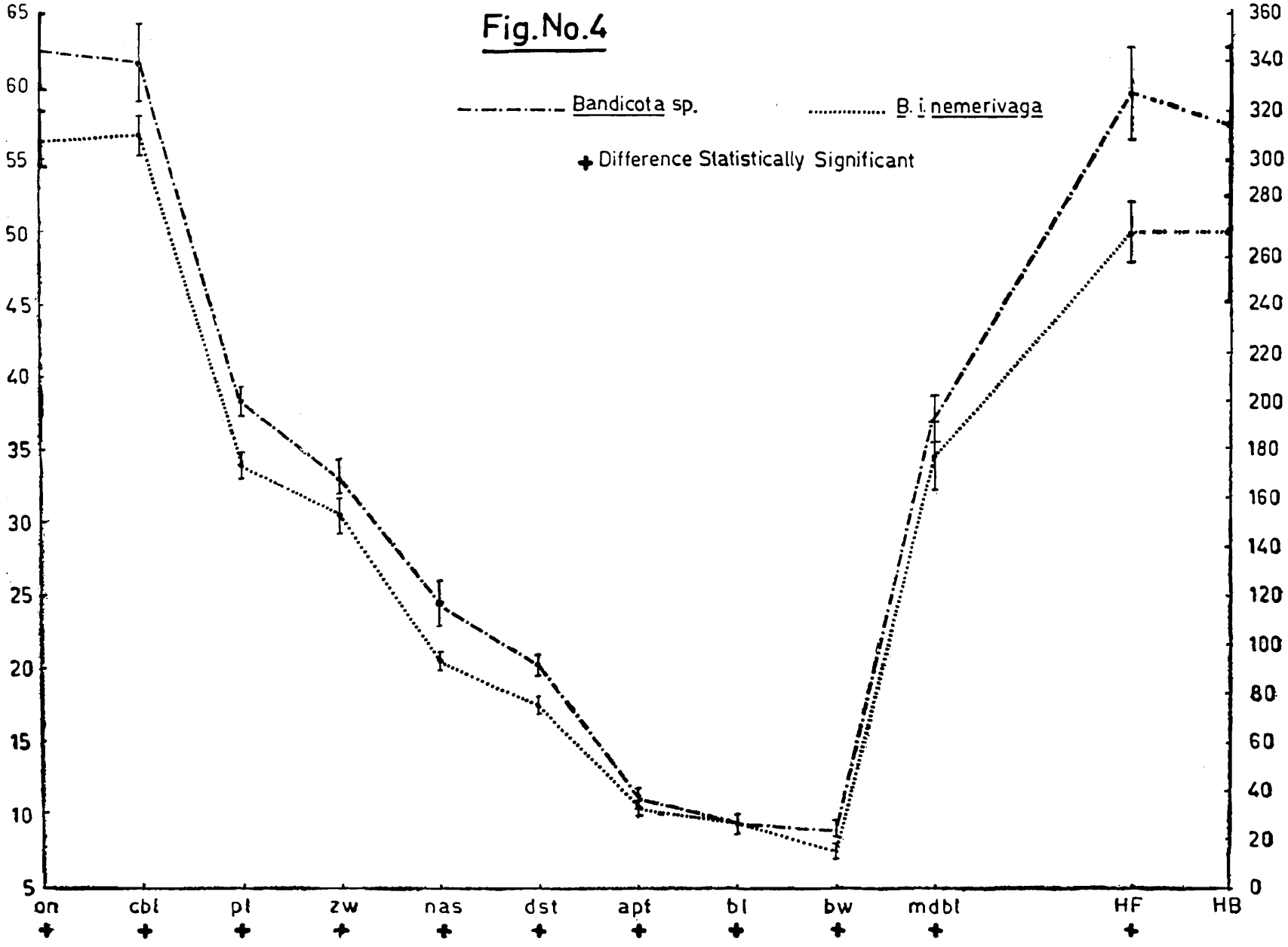
Fig.No.4
Bandicota sp.
B. i. nemerivaga
Difference Statistically Significant
65
60
55
50
45
40
35
30
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20
15
10
5
360
340
320
300
280
260
240
220
200
180
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bw
mdbl
HF
HB

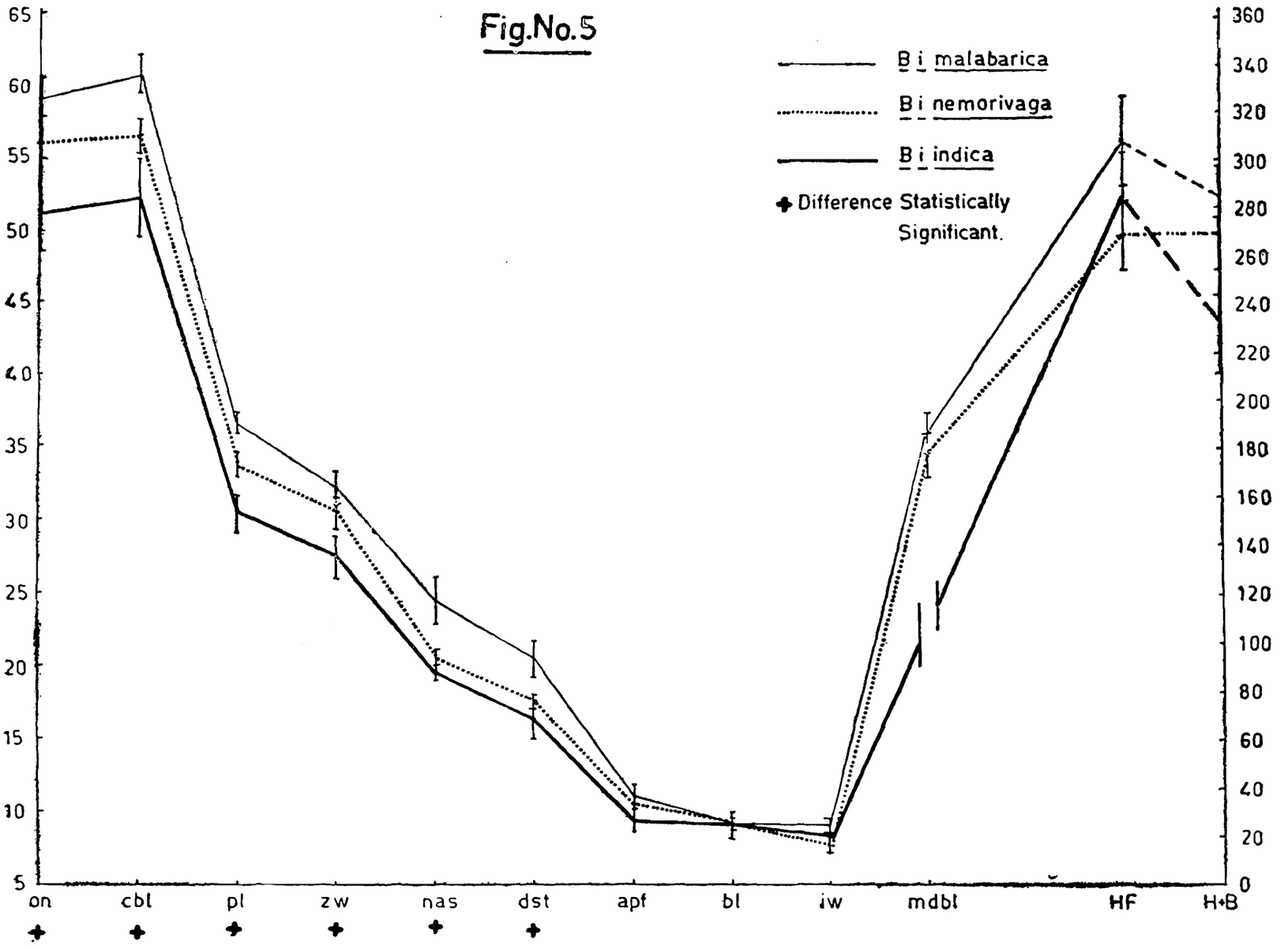
Fig.No.5
B i malabarica
B i nemorivaga
B i indica
Difference Statistically Significant.
65
60
55
50
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15
10
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apf
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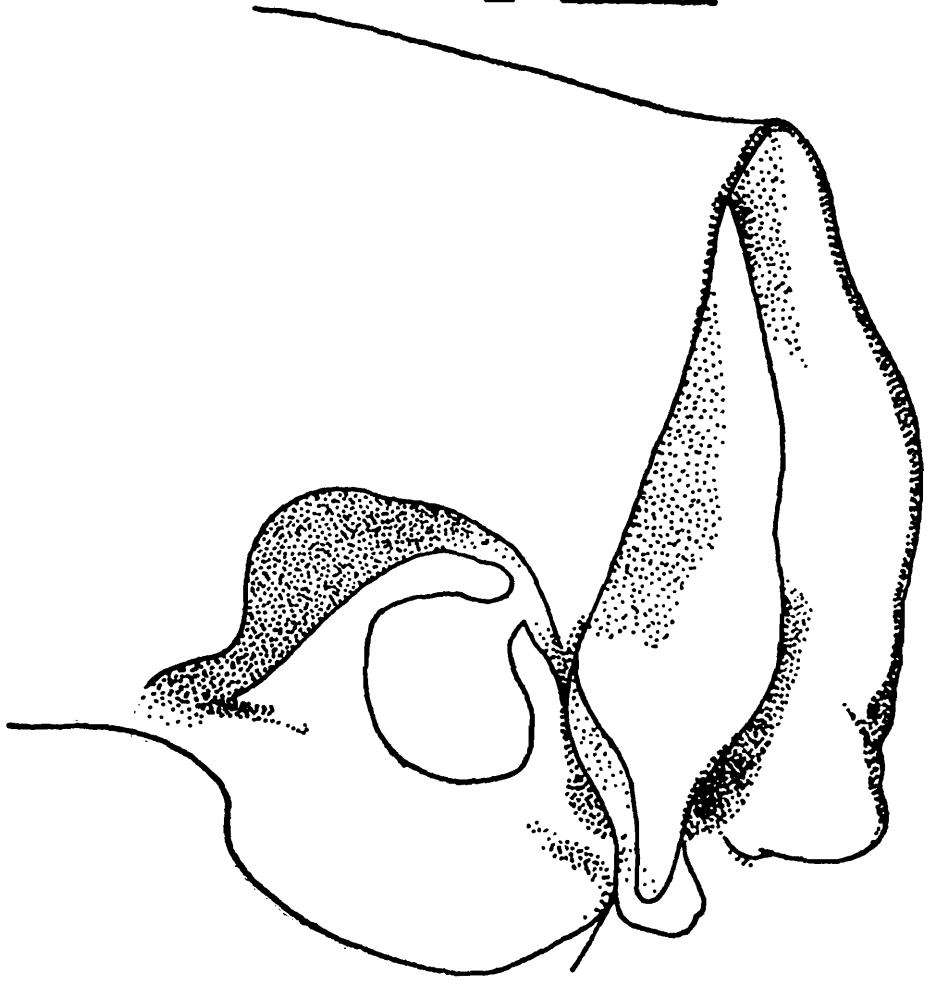
iw
mdbl
HF
H+B

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).

FIG. 6

Occiput region of B. indica skull (M/415)

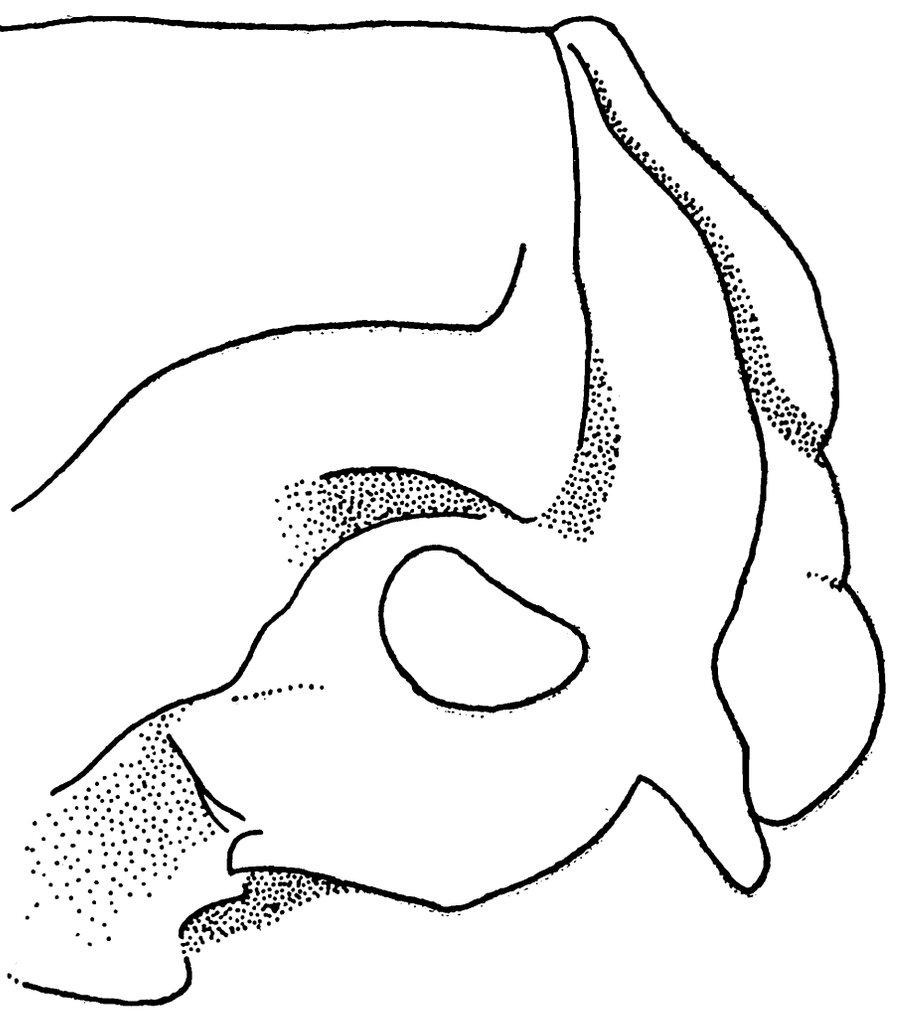


Pradhan *et al.* (1989) have discussed at lenght the status of the large-sized bandicoot population and have doubted its inclusion in *B. indica.* Along with several osteomorphological characters they had used two protein fractions, Hb and eye lens proteins, to examine the differences. During the present study, additional proteins namely LDH, non-specific esterases and plasma low molecular proteins in the albumin zone representing a total of about 52 gene locii 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

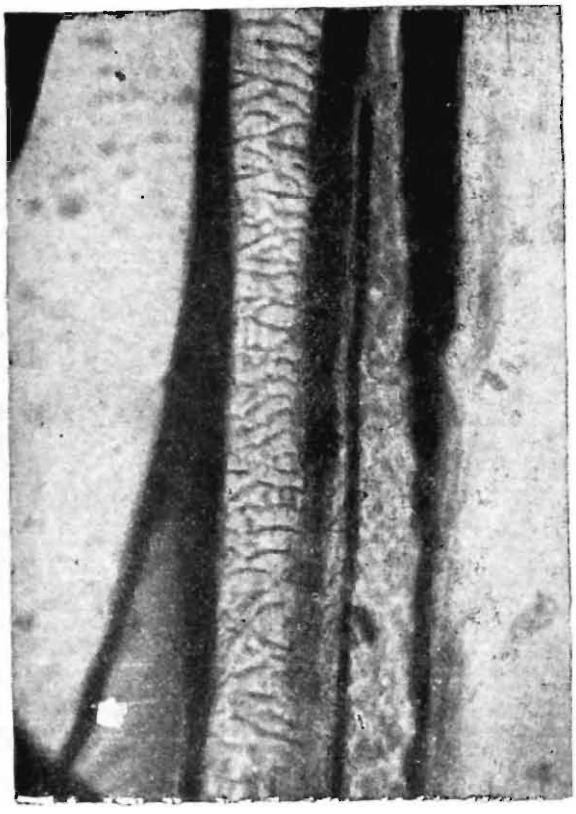
Occiput region of Bandicota sp. skull (M/95)



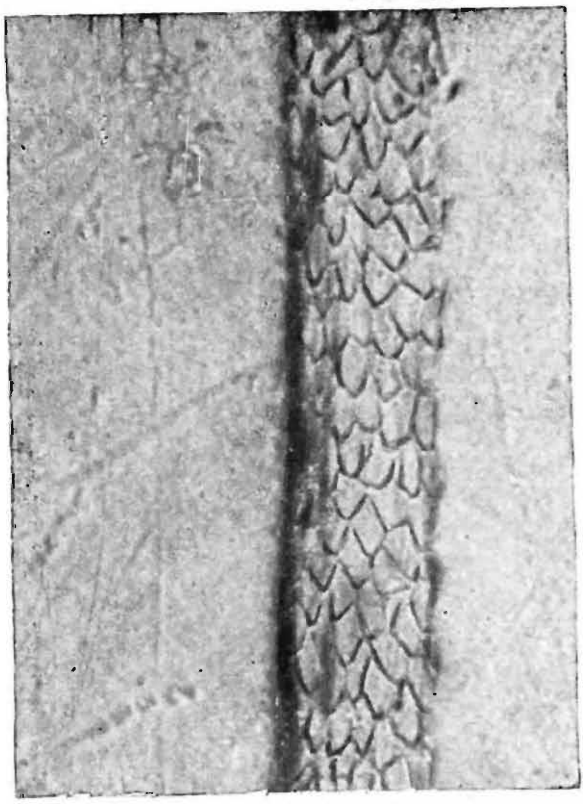
Dendrograms constructed from the above data (Fig. 11) clearly establish the patterns of branching in phylogeny of the three species. The dendrogram representing average genetical identities at locii controlling the five specific proteins suggests that all the three species of genus *Bandicota* were separated from each other more or less at the same time. However, it was *B. indica* that got separated early from the common

PLATE—I

A



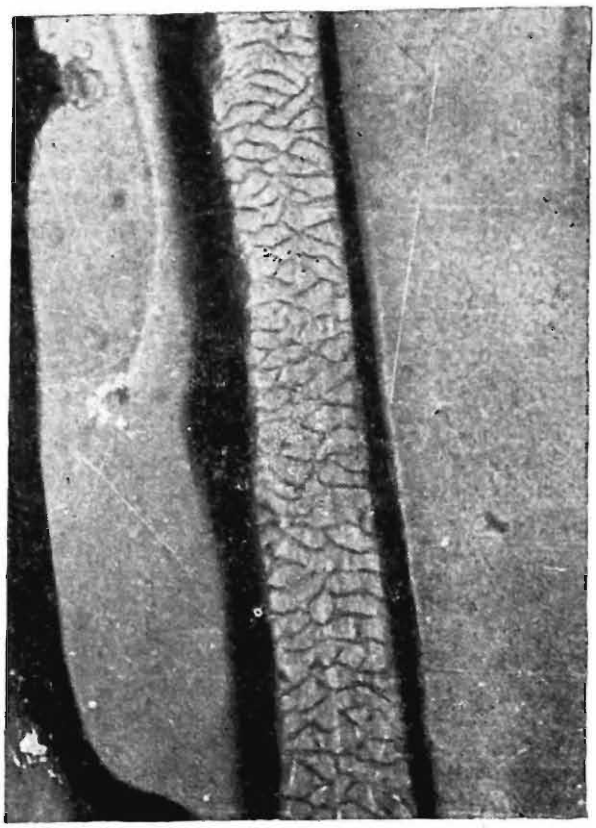
B



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



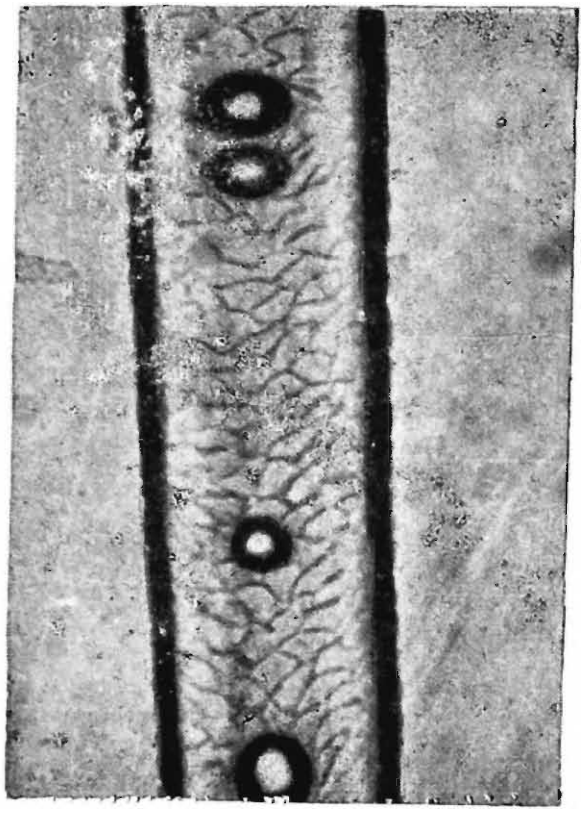
D

C : Photograph showing cuticular impression pattern of *B. indica* (M/248) hair between basal and middle region. (Magnification : Photographed at X200).

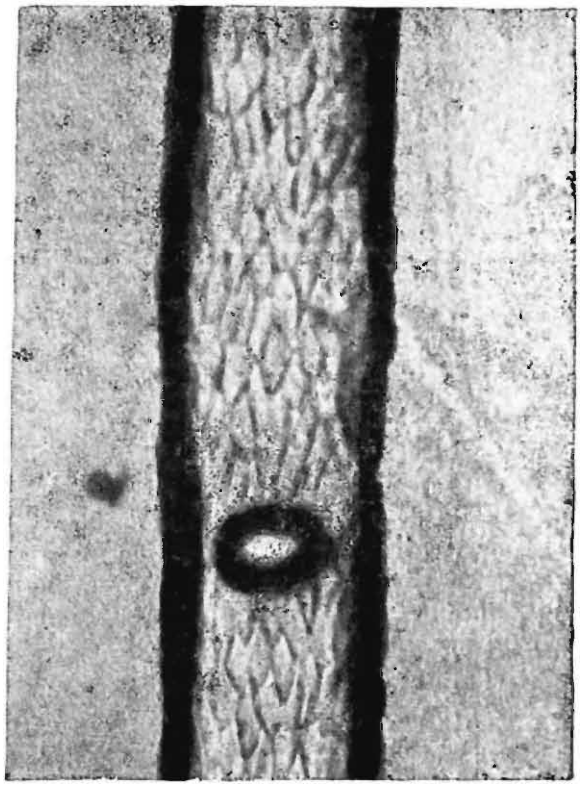
D : Photograph showing cuticular impression patter of *Bandicota* sp. (M/125) hair between basal and middle region.. (Magnification : Photographed at X200).

PLATE—II

A



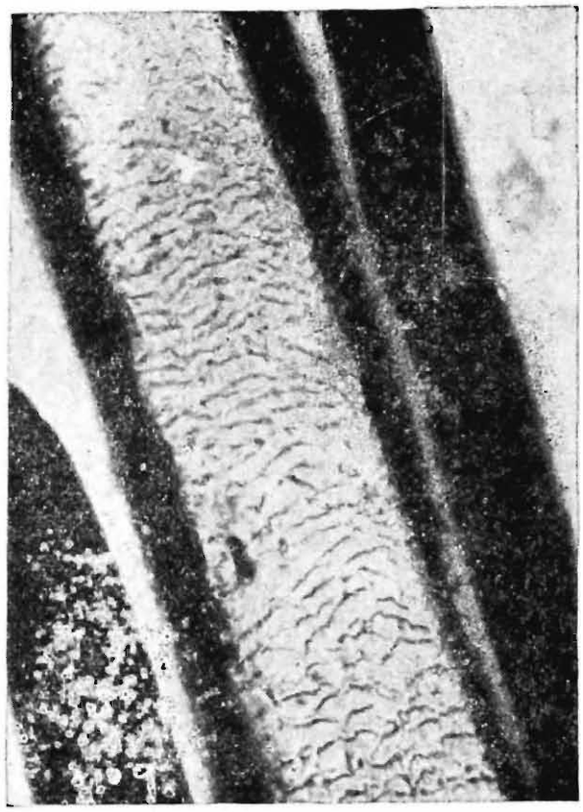
B



A : Photograph showing cuticular impression patter 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



D

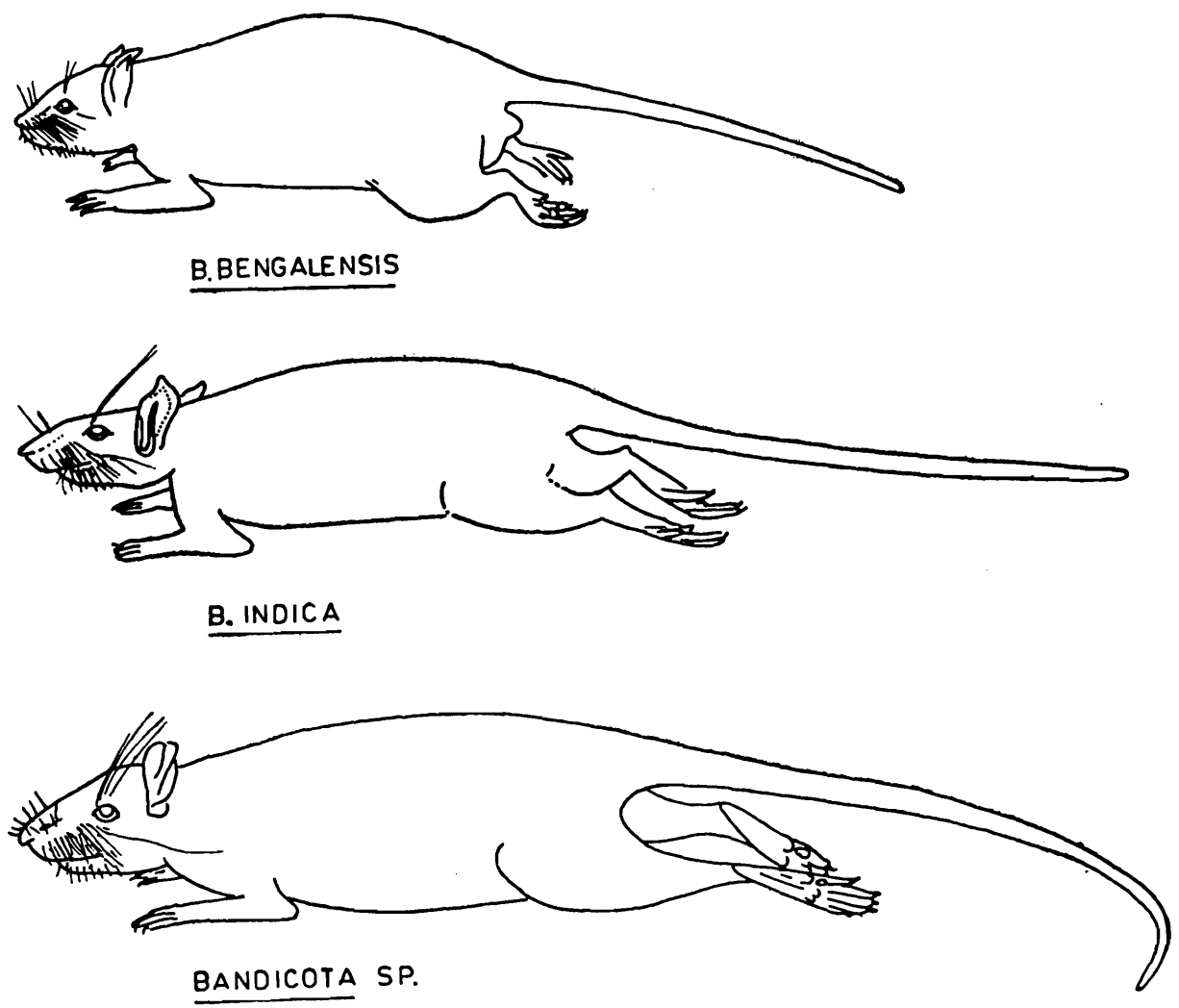
C : Photograph showing cuticular impression pattern of *B. indica* (M/415) hair in the middle region.
(Magnification : Photographed at X200).

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

FIG.8



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

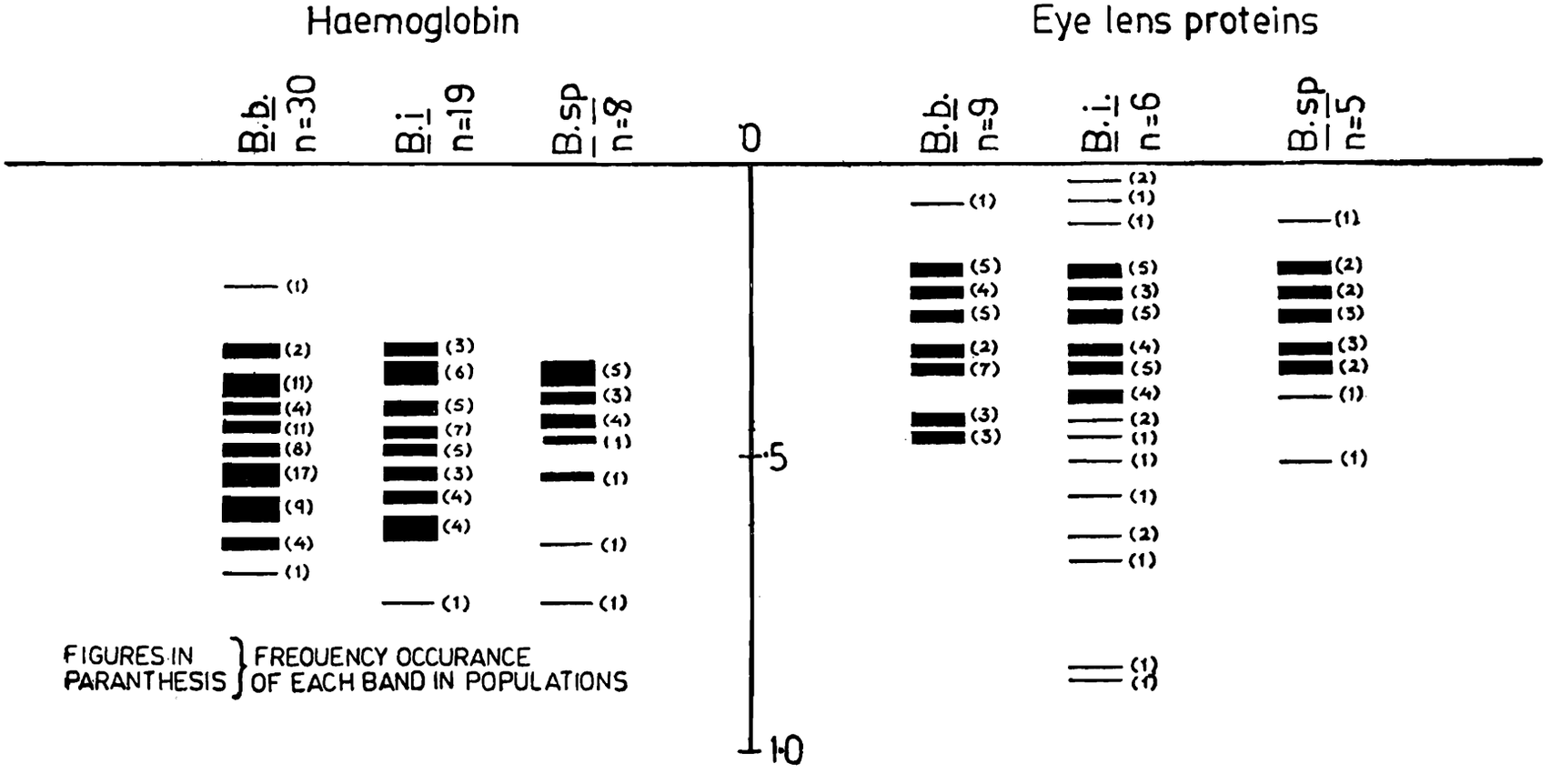
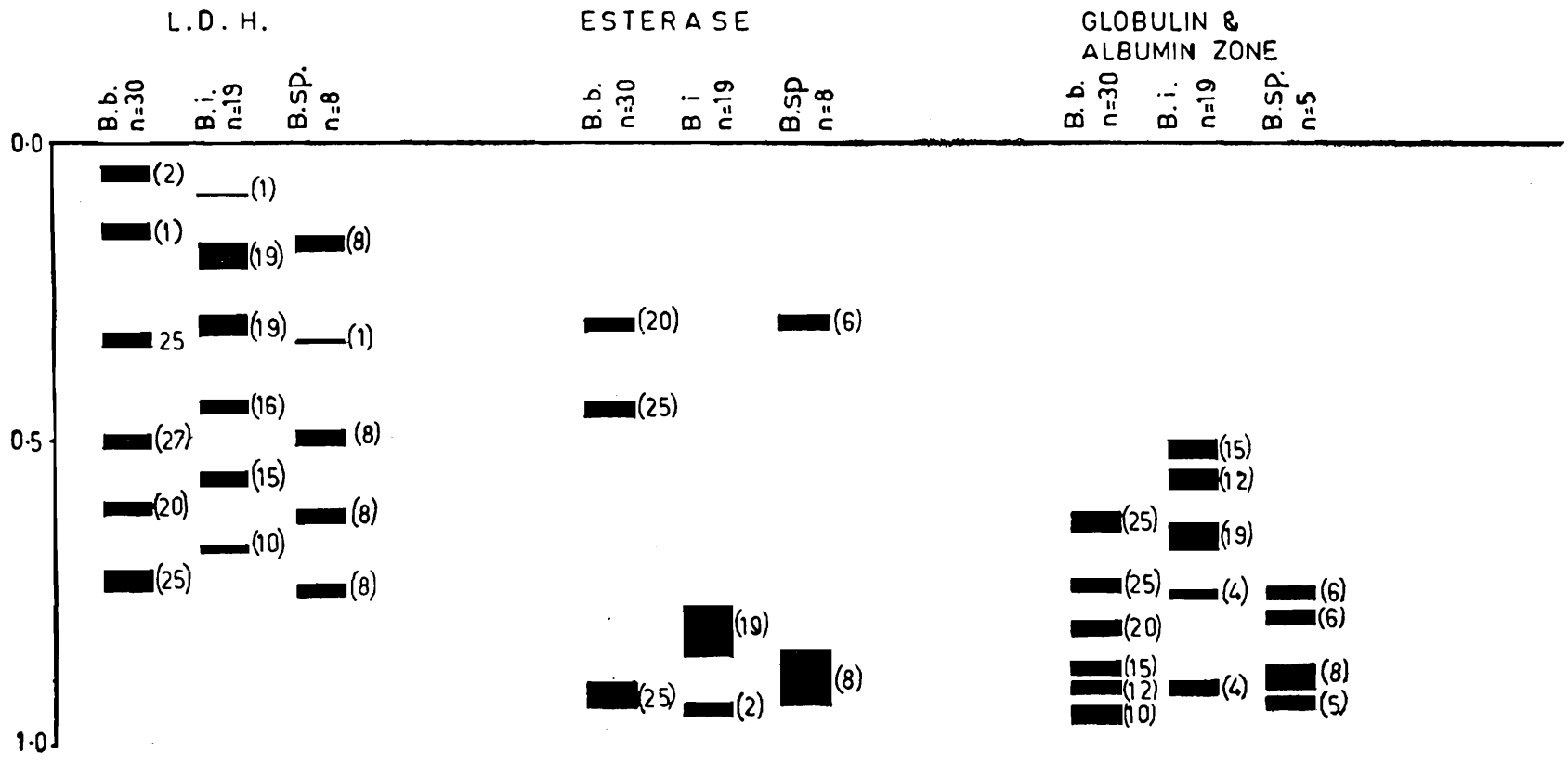


FIG. 10

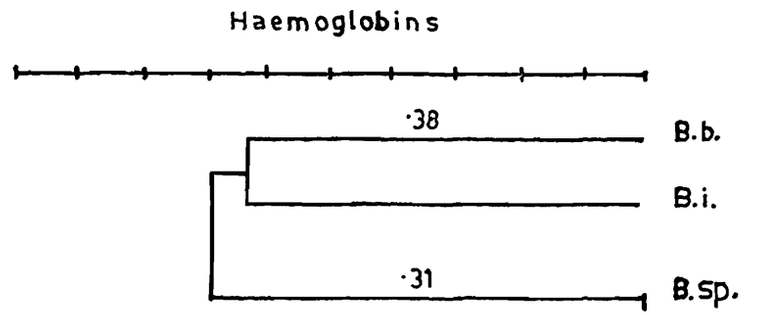
Electrophoretic patterns (PAGE) of some enzymes and low molecular plasma proteins of Bandicota spp.

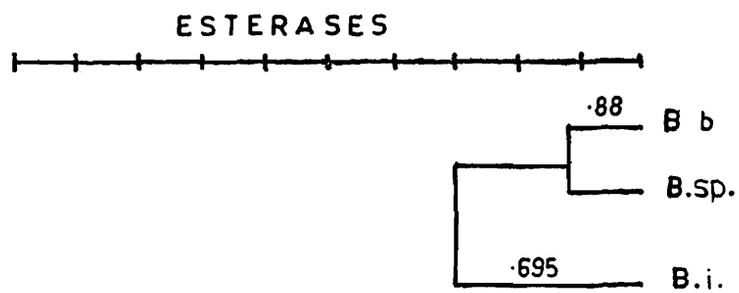


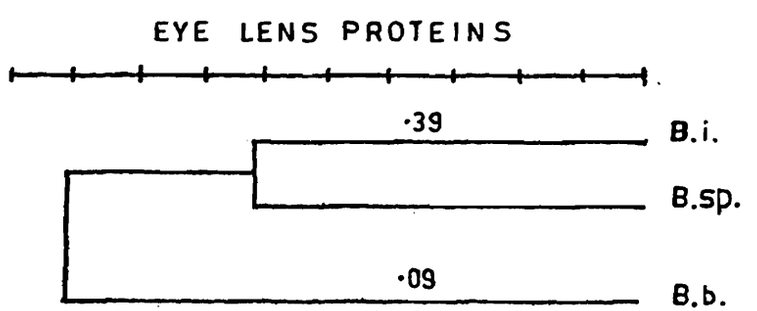
Figures in paranthesis } Frequency of occurance of each band in populations

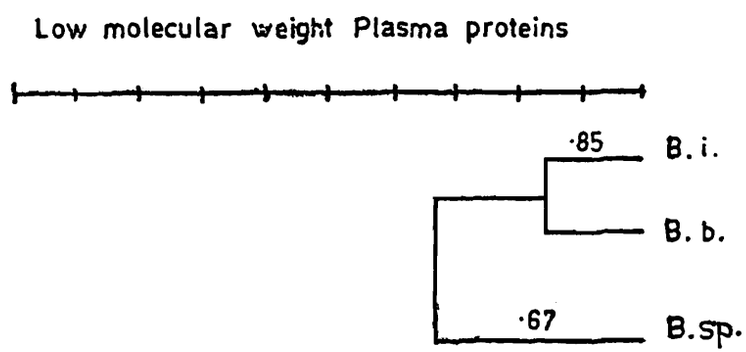
FIG. 11

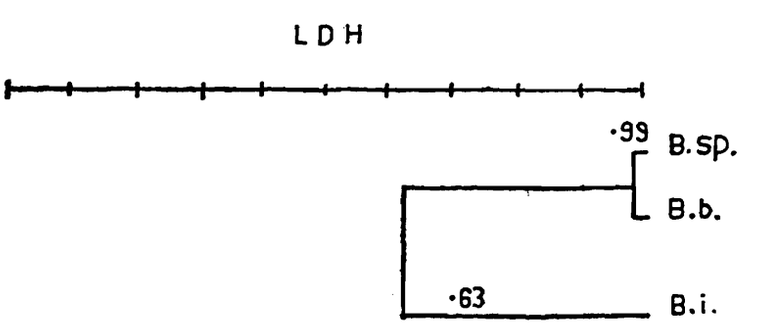
Dendrograms constructed using UPGMA method of cluster analysis & data in table











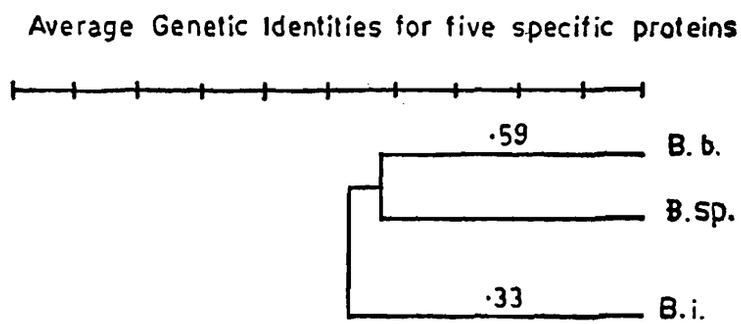


TABLE No. 1

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.)

Type		Head + Body	Hind foot	Occipito-nasal	Condylo-basal	Nasals	Palate	Molar tooth row (upper)	Bullae	anterior palatal foramina	zygomatic width	inter orbital width	mandibles	diastema
Bandicota sp. n=20	Range	250.0-370.0	55.0-63.0	58.5-68.1	57.2-67.9	23.3-27.0	37.2-40.2	10.0-10.3	8.9-10.0	10.1-12.6	31.2-36.5	8.6-9.6	35.0-38.8	19.0-21.6
	Mean (X)	314.71	59.42	62.6	61.62	24.55	38.12	10.18	9.66	11.15	33.14	9.1	37.08	20.28
	Standard Deviation	±30.26	±3.14	±2.71	±2.96	±1.56	±1.08	–	±0.41	±1.04	±1.42	±0.36	±1.37	±0.85
	Percentage (of HB/on)	100%	18.91%	100%	98.43%	39.22%	60.89%	16.26%	15.43%	17.81%	52.92%	14.21%	59.22%	32.31%
B. i. malabarica (Shaw) n=45	Range	270 0-305.0	53.0-61.0	57.5-61.2	59.0-63.4	23.5-26.6	36.2-37.7	10.2-10.4	8.8-10.0	9.8-11.8	30.7-35.5	8.6-9.3	34.7-37.5	19.5-22.0
	Mean (X)	284.3	56.16	59.04	60.88	24.28	36.67	10.27	9.3	11.1	31.97	8.9	36.06	20.4
	Standard Deviation	±10.14	±3.02	±1.15	±1.37	±2.82	±0.60	–	±0.56	±0.63	±1.01	±0.23	±1.15	±0.95
	Percentage (of HB/on)	100%	19.74%	100%	103.11%	41.19%	62.05%	17.39%	18.79%	18.79%	54.15%	15.08%	61.08%	34.51%
B. i. indica (Bechstein) n=15	Range	208.0-267.0	50.0-57.0	48.0-55.8	48.8-56.5	18.5-20.1	29.2-32.0	10.0-10.3	8.2-9.4	8.9-9 4	25.5-30.4	7.8-8.0	–	15.1-18.0
	Mean (X)	233.33	52.83	51.4	52.18	19.4	30.35	10.2	8.8	9.15	27.66	7.85	–	16.12
	Standard Deviation	±23.99	±2.74	±2.72	±2.93	±0.67	±1.05	–	±0.45	±0.22	±1.74	±0.007	–	±1.10
	Percentage (of HB/on)	100%	22.64%	100%	101.51%	37.74%	39.06%	19.84%	17.12%	17.82%	53.81%	15.27%	–	31.36%
B. i. nemorivaga (Hodgson) n=20	Range	245.0-290.0	48.0-51.0	53.5-57.7	54.3-57.6	20.0-21.0	32.3-34 4	9.2-10.0	9.0-10. 0	9.6-11.2	29.7-31.9	7.2-7.9	32.4-35.5	17.2-18.1
	Mean	270.0	50.0	56.27	56.67	20.52	33.75	9.62	9.45	10.65	30.6	7.63	34.43	17.65
	Standard Deviation	±25.0	±2.25	±1.63	±1.37	±0.43	±0.87	–	±0.36	±0.64	±0.80	±0.27	±1.72	±0.33
	Percentage (of HB/on)	100%	18.52%	100%	100.71%	36.48%	59.98%	17.09%	16.77%	18.92%	54.38%	13.56%	61.19%	31.36%

Table No. 2

Morphological differences between *Bandicota* sp. & *B. indica*

Bandicota sp.	*Bandicota indica*
1. Hindfoot exceeds 57 mm in adults.	Hindfoot less than 57 mm except in *malabarica* where it sometimes exceeds 57 mm.
2. Occipitonasal length exceeds or equal to condylobasal length.	Occipitonasal length less than condylobasal length.
3. Zygomatic width in adulth less than 53.6% of occipitonasal.	Zygomatic width in adults more than 53.6% of occipitonasal.
4. Mandibular length below 60% of occipitonasal length.	Mandibular length exceeds 60% of occipitonasal length.
5. Occiput inflated, ridges less prominent.	Occiput flattened, ridges prominent.

Table No. 3

Morphological differences between subspecies of *Bandicota indica* (*indica*, *malabarica* and *nemorivaga*).

B. i. malabarica	*B. i. indica*	*B. i. nemorivaga*
1. Hindfoot less than 20% of head & body length.	Hindfoot exceeds 20% of head & body length.	Hindfoot less than 20% of head & body length.
2. Nasals exceed 40% of occipitonasal length.	Nasals below 40% of occipitonasal length.	Nasals below 40% of occipitonasal length.
3. Zygomatic width less than 55% of occipitonasal length.	Zygomatic width less than 55% of occipitonasal length.	Zygsmatic width exceeds 55% of occipitonasal length.
4. Diastema more than one-third of occipitonasal length.	Diastema less than one-third of occipitonasal length.	Diastema less than one third of occipitonasal length.
5. Palate more than 35 mm in length in adults.	Palate less than 32 mm in length in adults.	Palate 32-35 mm in length in adults.
6. Occipitonasal length in adults more than 58 mm.	Occipitonsal length in adults less than 58 mm.	Occipitonasal length may cross 58 mm in adults.

Table No. 4

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

Haemoglobins
(from Pradhan et al. 1989)

Species	*B. b.*	*B.i.*	*B.* sp.
B. b.	–	0.38	0.28
B. i.	0.98	–	0.35
B. sp.	1.27	1.05	–

L D H

Species	*B. b.*	*B. i.*	*B.* sp.
B. b.	–	0.63	0.99
B. i.	0.46	–	0.63
B. sp.	0.01	0.46	–

Low molecular weight
Plasma Proteins

Species	*B. b.*	*B. i.*	*B.* sp.
B. b.	–	0.85	0.70
B. i.	0.16	–	0.64
B. sp.	0.36	0.45	–

Eye lens proteins
(From Pradhan *et. al.* 1989)

Species	*B. b.*	*B. i.*	*B.* sp.
B. b.	–	0.06	0.12
B. i.	2.12	–	0.39
B. sp.	2.81	0.85	–

Esterases

Species	*B. b.*	*B. i.*	*B.* sp.
B. b.	–	0.65	0.88
B. i.	0.43	–	0.74
B. sp.	0.13	0.30	–

Average Genetic Identities
for all the five proteins

Species	*B. b.*	*B. i.*	*B.* sp.
B. b.	–	0.51	0.59
B. i.	0.67	–	0.55
B. sp.	0.53	0.60	–

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 mosiac (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.

Material examined : Holotype : ZSI/WRS, Reg. No. M/98, adult female ; Nanapeth, Pune, Maharashtra ; 3 Aug 1977 ; collected by M. S. Pradhan.

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 No. 5

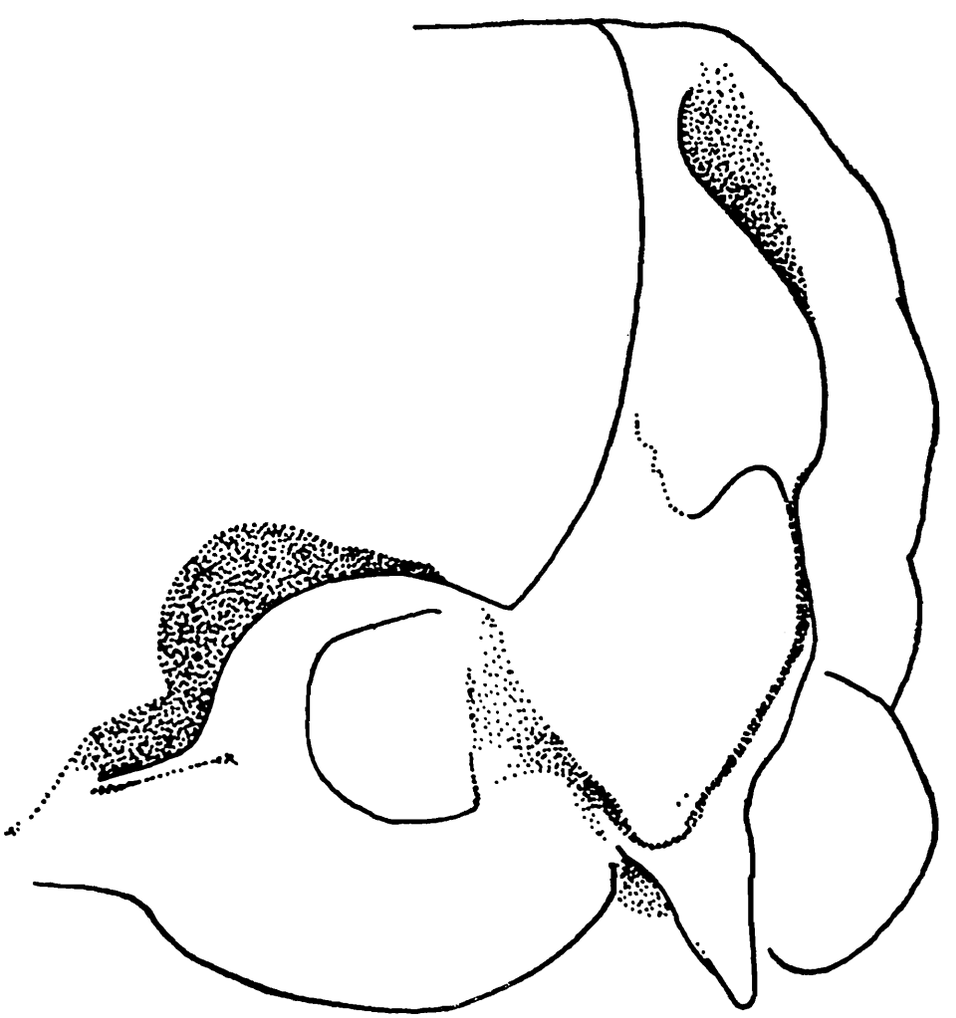
Measurements of type series
(All measurements in mm.)

Measurements	Holotype	Paratypes	
	1 ♀	1 ♀	1 ♂
External :			
Head+Body	370	292	340
Tail	290+	271	280
Hindfoot	63	58	55
Ear	33	31	23
Cranial :			
Occipitonasal	67.8	62.4	59.7
Condylobasal	67.6	61.6	58.8
Nasal	27.0	23.3	24.1
Interorbital width	9.6	8.5	9.0
Zygomatic width	36.5	32.1	31.7
Palate	40.2	38.1	35.3
Molar teeth row	10.2	10.2	10.2
Bullae	9.8	10.0	8.9
Diastema	21.6	19.9	19.0
Palatal foramina	12.6	12.0	10.8

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

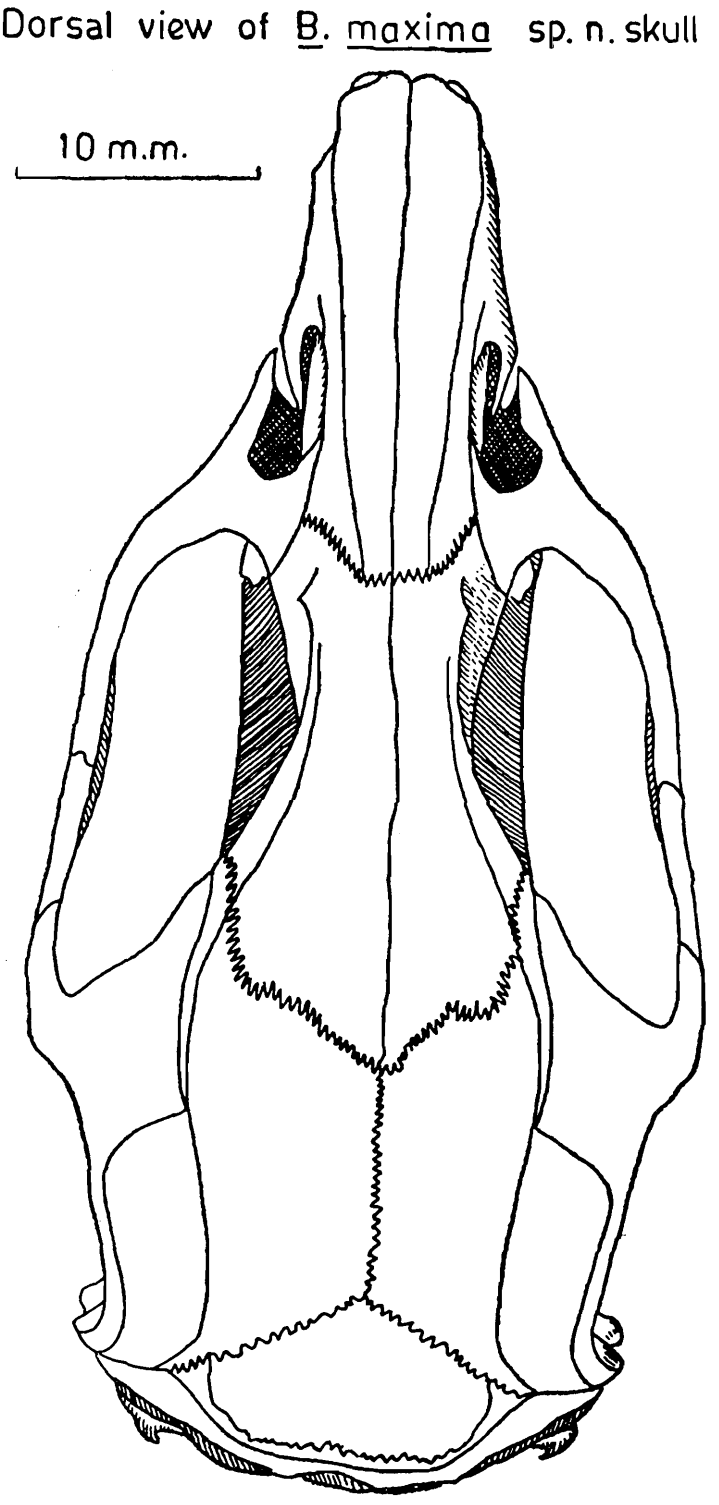


FIG. 13

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*.

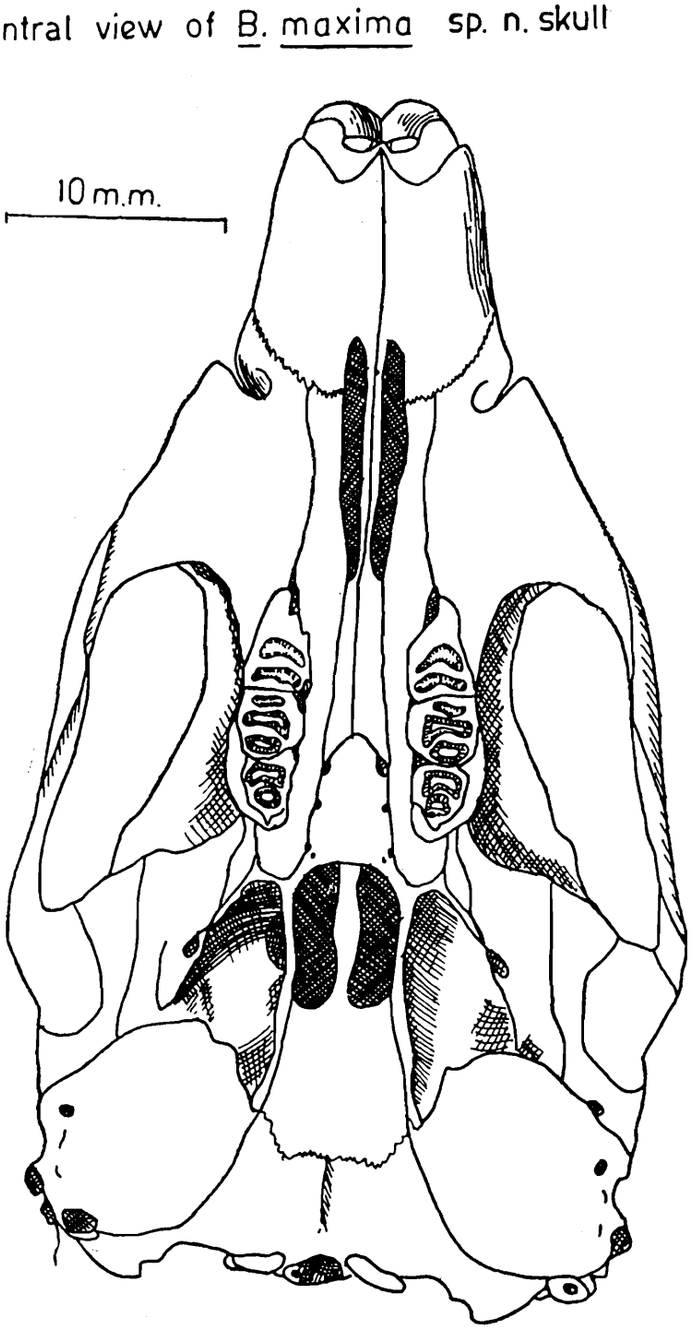


FIG. 14

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. ...	*B. bengalensis*
	Occipitonasal length more than 45 mm ; Zygomatic width less than 57%, bulla less than 20%, and nasals more than one-third of occipitonasal length. ...	2
2.	Occipitonasal length less than condylobasal length ; sculpture pattern of dorsal hair mozaic (at lower magnification). ...	*B. indica*
	Occipitonasal length equal to or more than condylobasal length ; sculpture pattern of dorsal hair chevron (at lower magnification). ...	*B. maxima*

Key to Indian subspecies of *Bandicota indica*

1.	Nasals and diastema exceeds 40% and 33% of ONL respectively. ...	*B. i. malabarica*
	Nasals and diastema less than 40% and 33% of ONL respectively. ...	2

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

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

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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 existance, 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 : LAMNIFOMES
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 elopsoides** 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 : TRIGLIDAE
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 : DACTYLOPTERIDAE
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 poecilopterus** 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 : **Abudefduf** Forsskal

83. **Abudefduf septemfasciatus** (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 : SPHYRAENOIDEI

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 : AMMODYTOIDEI
Family : AMMODYTIDAE
Genus : **Bleekeria** Gunther

96. **Bleekeria kallolepis** Gunther
Suborder : GOBIOIDEI
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 : BALISTOIDEI
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

1841. *Chiloscyllium griseum* Muller and Henle, *Syst. Beschr. Plagiost.*, pt. 1 : 19, pl. 4 (India, Japan).

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)

1841. *Trygon walga* Muller and Henle, *Syst. Beschr. Plagiost.* : 159, Pl. 51, fig. 1 (India, Red Sea).

1969. *Dasyatis* (*Himantura*) *walga* : Misra, *Fauna of India*, Pisces (ed. 2), 1 : 169, fig. 58.

Material examined : 1, 340 mm TL, collected fron Uppada on 29. 2. 29.

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

3. **Narcine brunnea** Annandale

1909. *Narcine brunnea* Annandale, *Mem. Indian Mus.*, 2 : 45.

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.
1878. *Narcine timlei* : Day, *Fishes of India* : 733.

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)

1801. *Rhinobatus dipterygia* Bloch and Schneider, *Syst. Ichth.* : 359.
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 elopsoides** Bleeker

1849. *Dussumieria elopsoides* Bleeker, *Verh. Bat. Gen*, 22 : *Ichth. Madura* : 42.

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)

1847. *Kowala albella* Valenciennes, *Hist. nat. poiss.*, 20 : 362 (Pondicherry).
1973. *Sardinella albella* : Whitehead, *J. mar. biol. Ass. India*, 14(1) : 183, fig. 13.

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)

1847. *Spratella fimbriata* Valenciennes, *Hist. nat. poiss.*, 20 : 359, pl. 601 (Malabar).
1973. *Sardinella fimbriata* : Whitehead, *J. mar. biol. Ass. India*, 14 (1) : 184, fig. 14.

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)

1801. *Clupea melastoma* Schneiedr, *Syst. Ichth.Bloch.* : 427 (Indian ocean near Coromandel).
1976. *Ilisha melastoma* : Whitehead, *J. mar. biol. Ass. India*, 14 (1) : 212, fig. 37.

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.

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

11. **Opisthopterus tardoore** (Cuvier)

1829. *Pristigaster tardoore* Cuvier, *Regne Animal* (2nd ed.), 2 : 321 (Visakhapatnam).
1973. *Opisthopterus tardoore* : Whitehead, *J. mar. biol. Ass. India*, 14 (1) : 215, fig. 39.

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

1848. *Coilia reynaldi* Valenciennes, *Hist. nat. poiss.*, 21 : 81 (Irrawady river at Rangoon, Burma).

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)

1848. *Engraulis dussumieri* Valenciennes, *Hist. nat. poiss.*, 21 : 69.
1973. *Thryssa dussumieri* : Whitehead, *J. mar. biol. Ass. India*, 14 (1) : 232, fig. 56.

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)
1988. *Thryssa kammalensoides* : Whitehead *et al. FAO Fish. Synop.*, (125) 7(2) : 434-435.

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)

1801. *Clupea mystax* Schneider, *Syst. Ichth. Bloch* : 426, pl. 83 (Malabar).
1973. *Thryssa mystax* : Whitehead, *J. mar. biol. Ass. India*, 14 (1) : 231, fig. 54.

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

1983. *Thryssa* (*Scutengraulis*) *polybranchialis* Wongratana, *Japan. J. Ichthyol.*, 29 (4) : 402, fig. 21 (Canara, Cochin, Porto Novo and Waltair, India).

1988. *Thryssa polybranchialis* : Whitehead *et al*, *FAO Fish, Synop.*, (125) 7 (2) : 439.

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)

1782. *Clupea setirostris* Broussonet, *Ichthyol.* : text and pl. 2 (Tana Island, New Hebrides in Pacific).

1968. *Thryssa setirostris* : Whitehead, *J. mar. biol. Ass. India*, 9 (1) : 22.

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)

1908. *Engraulis vitrirostris* Gilchrist and Thompson, *Ann. S. Afr. Mus.*, 6 : 201 (Durban)

1973. *Thryssa vitrirostris* : Whitehead, *J. mar. biol. Ass. India*, 14 (1) : 223, fig. 57.

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

1795. *Gymnothorax reticularis* Bloch, *Naturges. Ausland. Fische*, (9) : 85 (Tranquebar).

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

Distribution : Indo-west Pacific.

21. **Uroconger lepturus** (Richardson)

1845. *Congrus lepturus* Richardson, *Zool. Voy. Sulphur* : 106, pl. 56, figs. 1-6.

1878. *Uroconger lepturus* : Day, *Fishes of India* : 661, pl. 170, fig. 1.

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)

1822. *Pimelodus gulio* Hamilton-Buchanan, *Fishes of Ganges* : 201, 379, pl. 23, fig. 66 (Gangetic estuaries).

1991. *Mystus gulio* : Talwar and Jhingran, *Inland Fishes*, 2 : 560, fig. 185.

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

1840. *Arius caelatus* Valenciennes, *Hist. nat. poiss.*, 15 : 66 (Bombay).

Material examined : 2, 138-171 mm, collected from Uppada on 29. 2. 92.

Fin formnla : 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

1939. *Saurida longimanus* Norman, Fishes, *Rept. John Murray Exped.*, 1933-34, 7 (1) : 1-116 (Gulf of Oman).

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.

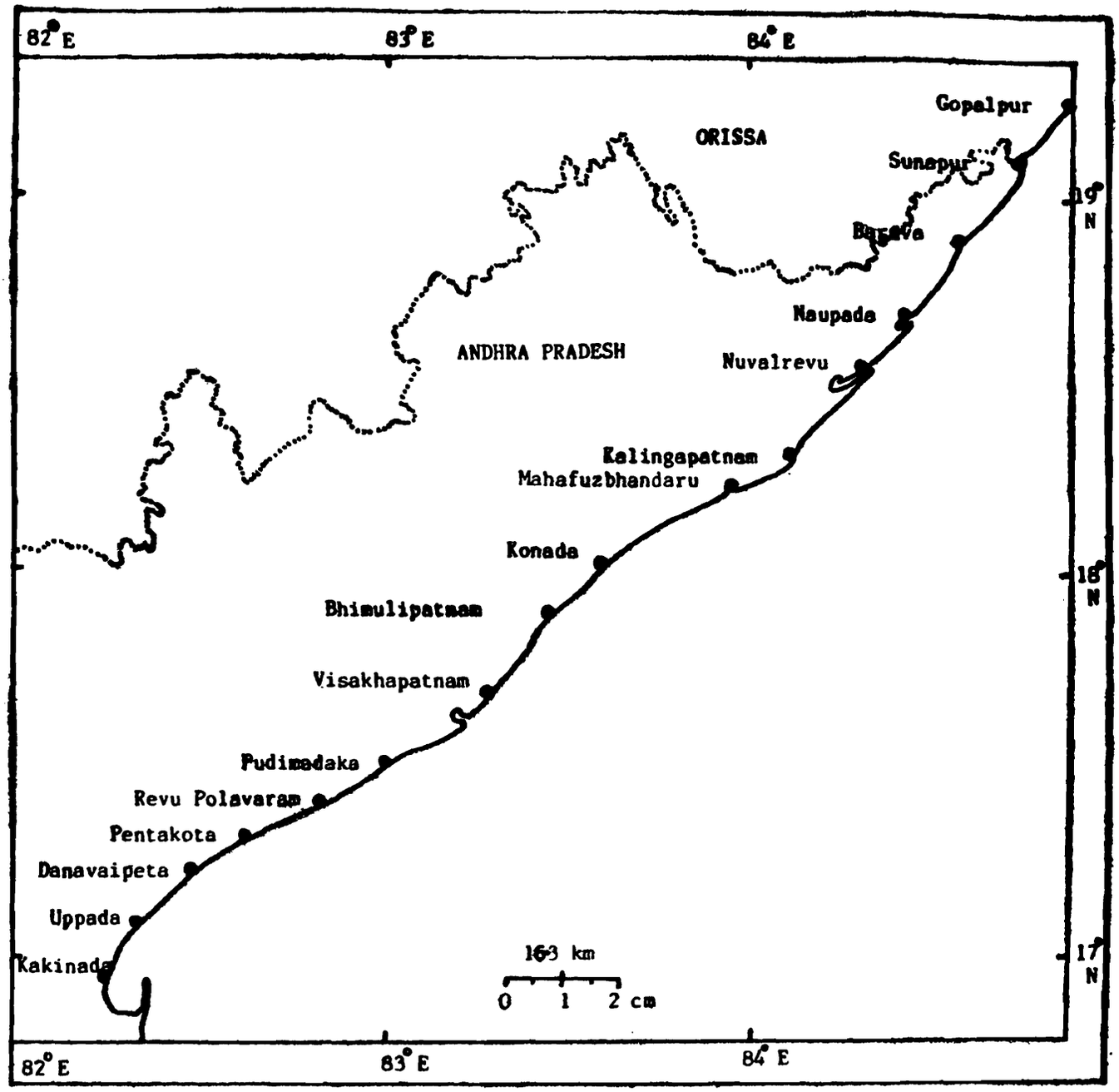
Distribution : Gulf of Oman, north Arabian Sea, East coast of India.

25. **Saurida micropectoralis** Shindo and Yamda

1972. *Saurida micropectoralis* Shindo and Yamda, *UO Jap. Soc. Ichthyol.*, 11 : 1-13 ; 12 : 1-14 (Gulf of Thailand).

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)

1795. *Salmo tumbil* Bloch, *Naturges. Ausland. Fische*, (9) : 112, pl. 430 (Malabar).
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).
1976. *Trachinocephalus myops* : Misra, *Fauna of India*, Pisces (2nd ed.), 2 : 302, fig. 84.

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).
1986. *Lophiodes mutilus* : Caruso, *Smith's Sea Fishes* : 364, fig. 101. 2.

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).
1850. *Antennarius hispidus* : Cantor, *Journ. Asiatic Soc. Bengal* (1849), **18** : 1185.

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. **Halieutea indica** Annandale and Jenkins

1910. *Halieutea indica* Annandale and Jenkins, *Mem. Indian Mus.*, 3 (1) : 19 (Bay of Bengal).

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

1852. *Hippocampus kuda* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 3 : 82 (Singapore).

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

1803. *Fistularia petimba* Lacepede, *Hist. nat. poiss.*, 5 : 189 (New Britain).

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

1890. *Minous coccineus* Alcock, *Ann. Mag. nat. Hist.*, (6) 6 : 428 (Bay of Bengal).

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 upto Thailand.

36. **Minous inermis** Alcock

1889. *Minous inermis* Alcock, *Ann. Mag. nat. Hist.*, (6) 4 (23) : 379-399.

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)

1801. *Scorpaena monodactyla* Bloch and Schneider, *Syst. Ichth.* : 195.

1875. *Minous monodactylus* : Day, *Fishes of India* : 159.

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)

1957. *Pteropterus mombasae* Smith, *Ichthyol. Bull. Rhodes Univ.*, (5) : 80, fig. 7. (Mombasa).

1986. *Pterois mombasae* : Eschmeyer, *Smith's Sea Fishes*, Scorpaenidae : 467, pl. 25. fig. 149-9.

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.

Distribution : East coast of Africa, Sri Lanka, East coast of India, New Guinea.

39. **Pterois russelli** Bennett

1831. *Pterois russelli* Bennett, *Proc. Zool. Soc. Lond.*, 1 : 128 (India).

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 archipelego ; 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

1977. *Lepidotrigla riggsi* Richards and Saksena, *Bull. Mar. Sci.*, 27 (2) : 215 (Ganjam, India).

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)

1758. *Cottus scaber* Linnaeus, *Syst. Nat.*, 1 : 264.

1955. *Grammoplites scaber* : Munro, *The marine and freshwater fishes of Ceylon* : 251.

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)

1758. *Callionymus indicus* Linnaeus, *Syst. Nat* , 1 : 250 (Asia).

1939. *Platycephalus indicus* : Herre, *Rec. Indian Mus.*, 41 : 340.

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)

1829. *Platycephalus pristiger* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 4 : 260 (Japan).

1975. *Rogadius pristiger* : Murty, *J. mar. biol. Ass. India*, 17 (3) : 682, pl. 1.

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

1987. *Sorsogona melanoptera* Knapp and Wongratana, *Proc. Biol. Soc. Wash.*, 100 (2) : 381-385 (Cochin, India).

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)

1829. *Platycephalus tuberculatus* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 4 : 258 (Sri Lanka).

1983. *Sorsogona tuberculata* : Knapp in Fischer and Bianchi, *FAO species identification sheet, Fishing area 51 (W. Indian Ocean)*, 3 : PLATYC Sor 1.

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)

1829. *Platycephalus rodericensis* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 4 : 253.

1975. *Suggrundus rodericensis* : Murty, *J. mar. biol. Ass. India*, 17 (3) : 689.

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 ; GR 2+7.

Distribution : From Gulf of Oman to Australia.

47. **Dactyloptena macracanthus** (Bleeker)

1854. *Dactylopterus macracanthus* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 7 : 449.

1962. *Dactyloptena macracanthus* : de Beaufort, *Fish. Indo-Aust. Archip.*, 11 : 176.

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

1846. *Priacanthus tayenus* Richardson, *Rep. Br. Ass. Advmt Sci.*, 15th meet. 1845 : 237 (Canton, China).

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)

1828. *Apogon poecilopterus* Cuvier and Valenciennes, *Hist. nat. poiss.*, **2** : 114.
1929. *Apopon (Apogonichthys) poecilopterus* : Weber and de Beaufort, *Fish. Indo-Aust. Archip.*, **5** : 331.

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. $1\frac{1}{2}/6$; GR 1+9–10.

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

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

1828. *Apogon quadrifasciatus* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, **2** : 153 (India).
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+1. 9 ; A. II. 8 ; P. ii. 13 ; V. I. 5 ; C. 17 ; LL 26-28 ; L. tr. $1\frac{1}{2}/6$; Pred. scales 5 ; GR 5+14.

Distribution : Indo-west Pacific.

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

1828. *Apogon taeniatus* Cuvier, *Hist. nat. poiss.*, **2** : 159 (Red Sea).
1986. *Apogon (Nectamia) taeniatus* : Gon, *Smith's Sea Fishes* : 553, fig. 175. 24.

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)

1849. *Sillago chondropus* Bleeker, *Verh. Batav. Gen.*, **22** ; 61 (Jakarta, Indonesia).
1984. *Sillaginopodys chondropus* : Talwar and Kacker, *Commercial Sea fishes of India* : 421.

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)

1775. *Atherina sihama* Forsskal, *Descript. Animal* : 70 (Lohaja, Red Sea).
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)

1801. *Scomber lactarius* Schneider, *Syst. Ichth. Bloch* : 31 (Tranquebar, India).
1910. *Lactarius lactarius* : Seale, *Philippine Journ. Sci.*, 5 : 270.

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

1758. *Echeneis neucrates* Linnaeus, *Syst. Nat.*, 1 : 261 (*Pelago Indico*) (species name mis-spelled).

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. **Alepes djeddaba** (Forsskal)

1775. *Scomber djedaba* Forsskal, *Descript. Animal* : 56 (Djedda, Red Sea).
1981. *Alepes djeddaba* : van der Elst, *A guide to the common sea fishes of southern Africa*, C. Struik, Cape Town : 367.

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. **Alepes para** (Cuvier)

1833. *Caranx para* Cuvier, *Hist. nat. poiss.*, 9 : 58 (Malabar).
1984. *Alepes para* : Talwar and Kacker, *Commercial Sea fishes of India* : 440.

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)

1830. *Citula armata* Ruppell, *Atlas Nordl. Afrika Fische Rothen Meeres* : 103 (Red Sea).
1980. *Carangoides armatus* : Williams *et al*, *Bull. Mar. Sci.*, 30 (1) : 14, fig. 1 a & b.

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)

1830. *Caranx caerulopinnatus* Ruppell, *Atlas Nordl. Afrika Fische Rothen Meeres* : 100 (Red Sea).
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 ; GR 6+16.

Distribution : Indo-west Pacific.

60. **Carangoides malabaricus** (Bloch and Schneider)

1801. *Scomber malabaricus* Bloch and Schneider, *Syst. Ichth.* : 31 (Tranquebar, India).
1905. *Carangoides malabaricus* : Fowler, *Proc. Acad. nat. sci. Philad.*, 21 (2) : 512.

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 ; GR 10+25.

Distribution : Indo-west Pacific.

61. **Caranx sexfasciatus** Quoy and Gaimard

1824. *Caranx sexfasciatus* Quoy and Gaimard, *Voy. Uranie et Physic. Zool.* : 358, pl. 65, fig. 4 (Isles des Papous, Indonesia).

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)

1801. *Zeus maculatus* Bloch, *Syst. Ichth.* : 95, pl. 22 (Tranquebar, India).
1876. *Mene maculata* : Day, *Fishes of India* : 249, pl. 53, fig. 5.

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 ; GR 6+23.

Distribution : Central tropical Indo-Pacific.

63. **Gazza minuta** (Bloch)

1797. *Scomber minutus* Bloch, *Ichthyologie* : 110, pl. 429, fig. 2 (Malabar).
1876. *Gazza minuta* : Day, *Fishes of India* : 224, pl. 53, fig. 1.

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)

1835. *Equula berbis* Valenciennes, *Hist. nat. poiss.*, 10 : 85 (Red Sea).
1978. *Leiognathus berbis* : James, *J. mar. biol. Ass. India*, 17 (1) : 161.

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)

1835. *Equula bindus* Valenciennes, *Hist. nat. paiss.*, 10 : 78 (Visakhapatnam).
1978. *Leiognathus bindus* : James, *J. mar. biol. Ass. India* (1975), 17 (1) : 153-155, pl. 1. G.

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)

1835. *Equula blochii* Valenciennes, *Hist. nat. poiss.*, **10** : 84 (Malabar).
1923. *Leiognathus blochii* : Choudhuri, *Mem. Indian Mus.*, **5** : 732.

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)

1835. *Equula brevirostris* Valenciennes, *Hist. nat. poiss.*, **10** : 83 (Malabar).
1978. *Leiognathus brevirostris* : James, *J. mar. biol. Ass. India* (1975), **17** (1) : 159-161, pl. 3. B.

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)

1787. *Zeus insidiator* Bloch, *Naturges. Ausland. Fische*, (3) : 41, pl. 92 (Surat).
1928. *Secutor insidiator* : Fowler, *Fish. Oceania, Mem. B. P. Bishop Mus.*, **10** : 154.

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)

1801. *Sparus malabaricus* Bloch and Schneider, *Syst. Ichth.* : 278 ("in *mari Indico*").
1875. *Lutjanus malabaricus* : Day, *Fishes of India* : 31, pl. 9, fig. 4.

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)

1791. *Sparus japonicus* Bloch, *Naturges. Ausland. Fische*, (5) : 110.
1907. *Nemipterus japonicus* : Jordan and Seale, *Bull. Bur. Fish.*, **26** (1906) : 21.

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

1986. *Nemipterus randalli* Russell, *Senckenberg. Biol.*, 67 : 23, fig. 2 (Persian Gulf, Red Sea, Gulf of Aden, Zanzibar, Seychelles, Madagascar, Pakistan, India).

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. 2½/10 ; GR 6+8.

Distribution : East coast of Africa to East coast of India.

72. **Gerres filamentosus** Cuvier

1829. *Gerres filamentosus* Cuvier, *Regne. Animal* (ed. 2), 3 : 188 (Vizagapatnam).

Meterial 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

1854. *Gerres macracanthus* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 6 : 195 (Batavia, Java).

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).
1876-77. *Pomadasys maculatus* : Bleeker, *Atl. Ichth.* : 27.

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)

1830. *Umbrina russelli* Cuvier, *Hist. nat. poiss.*, 5 ; 178 (Vizagapatnam).
1991. *Dendrophysa russelli* : Talwar and Jhingran, *Inland Fishes*, 2 : 854.

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)

1830. *Corvina sina* Cuvier, *Hist. nat. poiss.*, 5 : 122 (Malabar and Pondicherry).
1991. *Johnieops sina* : Talwar and Jhingran, *Inland Fishes*, 2 : 854.

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)

1833. *Umbrina dussumieri* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 9 : 481 (Coromandel, India).
1984. *Johnius dussumieri* : Mohan in Fischer and Bianchi, *FAO Species Identification Sheets for fishery purposes. W. Indian ocean (Fishing area 51)*, 4 : SCIAEN John 4.

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

1793. *Johnius carutta* Bloch, *Naturges. Ausland. Fische*, (7) : 133, pl. 356 (Tranquebar, Tamilnadu).

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. poiss.*, 5 : 113 (Malabar).
1984. *Kathala axillaris* : Talwar and Kacker, *Commercial Sea Fishes of India* : 656, fig. 261.

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)

1855. *Upenoides moluccensis* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 8 : 409 (Ambonia).

1984. *Upeneus moluccensis* : Kumaran in Fischer and Bianchi, *FAO Species identification sheets for fishery purposes. W. Indian ocean (Fishing area 51)*, 3 : MULL Upen 1.

Material examined : 1, 100 mm, collected from Visakhapatnam on 10.3.92.

Fin formula : B.iv ; D.VIII+I.8 ; A.I.6 ; P.16 ; V.I.5 ; LL 36 ; L.tr. $2\frac{1}{2}/7$; 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)

1775. *Mullus vittatus* Forsskal, *Descr. Anim.* : 31 (Djedda).

1984. *Upeneus vittatus* : Kumaran in Fischer and Bianchi, *FAO Species identification sheets for fishery purposes. W. Indian ocean (Fishing area 51)*, 3 : MULL Upen 3.

Material examined : 3, 100-106 mm, collected from Visakhapatnam on 10.3.92.

Fin formula : B.iv ; D.VIII+I.8 ; A.I.6 ; P.16 ; V.I.5 ; LL 34-37 ; L.tr.$2\frac{1}{2}/7$; GR 8+18.

Distribution : Indo-Pacific, eastward to French Polynesia.

82. **Drepane longimana** (Bloch and Schneider)

1801. *Chaetodon longimanus* Bloch and Schneider, *Syst. Ichth.* : 229 (Tranqebar).

1969. *Drepane longimana* : Murty, *J. mar. biol. Ass. India*, 10 (1) : 126, pl. 1a.

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)

1830. *Glyphiodon semifasciatus* Cuvier and Valenciennes, *Hist. nat. poiss.*, 5 : 463.

1901. *Abudefduf semifasciatus* : Seale, *Occ. Papers B. P. Bishop Mus.*, 1 : 82.

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)

1835. *Cepola abbreviata* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 10 : 403.

1984. *Acanthocepola abbreviata* : Smith-Vaniz in Fischer and Bianchi, *FAO Species identification sheets for fishery purposes. W. Indian ocean (Fishing area 51)*, 1 : CEPOL : 2.

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)

1836. *Mugil melinopterus* Valenciennes, *Hist. nat. poiss.*, 11 : 146, pl. 313 (Vanicola).
1906. *Liza melinoptera* : Jordan and Seale, *Bull. Bur. Fish.*, 25 (1905) : 217.

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+I.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

1758. *Mugil cephalus* Linnaeus, *Syst. Nat.*, (ed. 10), 1 : 316 (European seas).

Material examined : 4, 104-122 mm, collected from Mahafuzbhandaru on 11.3.92.

Fin formula : B.vi ; D.IV+I.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)

1853. *Mugil buchanani* Bleeker, *Verh. Batav. Genoot. Kunst. Wet.*, 25 : 99 (Hooghly river)
1975. *Valamugil buchanani* : Luther, *J. mar. biol. Ass. India*, 16 (1) : 290, fig.

Material examined : 2, 112-121 mm, collected from Mahafuzbhanru on 11.3.92.

Fin formula : B.vi ; D.IV+I.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

1829. *Sphyraena obtusata* Cuvier, *Hist. nat. poiss.*, 3 : 359, pl. 10, fig. 2 (Pondicherry).

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+I.9 ; A.I.9 ; P.14 ; V.I.5 ; LL 90 ; GR 2.

Distribution : Indo-west Pacific.

89. **Polydactylus konadaensis** Mishra and Krishnan

Mateaial 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)

1839. *Julis nebulosus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, **13 : 461** (Bombay).

1901. *Halichoeres nebulosus* : Seale, *Occ. Papers B. P. Bishop Mus.*, **1 : 88.**

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 $1\frac{1}{2}$ – 2/1/9-10.

91. **Opistognathus rosenbergii** Bleeker

1856. *Opisthognathus rosenbergii* Bleeker, *Nat. Tijdschr. Ned.-Indie*, **12 : 220.**

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.i.11.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

1850. *Uranoscopus cognatus* Cantor, *Journ. Asiatic Soc. Bengal*, **18 (2) : 1003 (Sea of Pinang).**

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)

1836. *Salarias dussumieri* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, **11 : 310** (Malabar).

1986. *Istiblennius dussumieri* : Springer in Smith and Heemstra, *Smith's Sea Fishes* : 748, fig. 235. 17.

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)

1801. *Blennius edentulus* Bloch and Schneider, *Syst. Ichth.* : 172 (Huahaine).

1986. *Istiblennius edentulus* : Springer in Smith and Heemstra, *Smith's Sea Fishes* : 748, fig. 235. 18.

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)

1861. *Blennius emarginatus* Gunther, *Cat. Brit. Mus.*, 3 : 224.

1986. *Scartella emarginata* : Springerin Smith and Heemstra, *Smith's Sea Fishes* : 754, fig. 235. 40.

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

1863. *Bleekeria kallolepis* Gunther, *Cat. Brit. Mus.*, 4 : 387 (Coromandel coast : Waltair and Madras).

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)

1853. *Eleotris gyrinoides* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 4 : 272.

1941. *Bunaka gyrinoides* : Koumans, *Mem. Indian Mus.*, 13 (3) : 327.

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)

1828. *Gobius fuscus* Ruppell, *Atl. Reise N. Afr. Fische* : 137 (Red Sea).
1941. *Bathygobius fuscus* : Koumans, *Mem. Indian Mus.*, 13 (3) : 267.

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)

1853. *Chaeturichthys polynema* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 5 : 325 (Japan).
1941. *Parachaeturichthys polynema* : Koumans, *Mem. Indian Mus.*, 13 (3) : 218.

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).
1951. *Rastrelliger kanagurta* : de Beaufort and Chapman, *Fish. Indo-Aust. Archip.*, 9 : 212-215, fig. 36.

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)

1801. *Pleuronectes erumei* Schneider in Bloch and Schneider, *Syst. Ichth. Bloch* : 150 (Tranquebar, India).

1877. *Psettodes erumei* : Day, *Fishes of India* : 422, pl. 91, fig. 4.

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

1965. *Cephalopsetta ventrocellatus* Dutt and Rao, *Proc. Indian Acad. Sci.*, 62 (4) : 180-187 (Visakhapatnam).

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)

1889. *Rhomboidichthys azureus* Alcock, *J. Asiatic Soc. Bengal*, 58 : 283.

1955. *Crossorhombus azureus* : Munro, *The marine and freshwater fishes of Ceylon* : 261.

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

1912. *Pseudorhombus elevatus* Ogilby, *Mem. Qd. Mus.*, 1 : 45.

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)

1801. *Pleuronectes triocellatus* Schneider in Bloch and Schneider, *Syst. Ichth* : 145.

1877. *Pseudorhombus triocellatus* : Day, *Fishes of India* : 424.

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.

107. **Heteromycteris oculus** (Alcock)

1889. *Solea oculus* Alcock, *J. Asiatic Soc. Bengal*, 58 (2) : 285, pl. 18, fig. 3.
1955. *Heteromycteris eculus* : Munro, *Marine and freshwater fishes of Ceylon* : 262, pl. 50, fig. 759.

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.

108. **Synaptura commersoniana** (Lacepede)

1802. *Pleuronectes commersonien* Lacepede, *Hist. nat. poiss.*, 3 : pl. 12, fig. 2 (Mauritius).
1877. *Synaptura commersoniana* : Day, *Fishes of India* : 428, pl. 94, fig. 1.

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.

109. **Zebrias altipinnis** (Alcock)

1890. *Synaptnra altipinnis* Alcock, *Ann. Mag. Nat. Hist.*, 6 (6) : 441.
1984. *Zebrias altlpinnis* : Talwar and Kacker, *Commercial Sea fishes of India* : 868.

Material examined : ?, 122-205 mm, collected from Visakhapatnam on 9/10.3.92.

Fin formala : 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.

110. **Cynoglossus arcal** (Schneider)

1801. *Pleuronectes arel* Schneider, *Syst. Ichth. Bloch* : 159 (Tranquebar, India).
1984. *Cynoglossus arel* : Talwar and Kacker, *Commercial Sea fishes of India* : 873, fig. 359.

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

1850. *Triacanthus brevirostris* Schlegel in Temminck and Schlegel, *Fauna of Japan, Pisces*, pt. 6 : 294.

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)

1758. *Ostracion gibbosus* Linnaeus, *Syst. Nat.* (ed 10) : 332 (India).
1955. *Tetrosomus gibbosus* : Munro, *Marine and freshwater fishes of Ceylon* : 276, pl. 54, fig. 805.

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)

1801. *Tetraodon lunaris* Bloch and Schneider, *Syst. Ichth.* : 505 (Malabar).
1980. *Lagocephalus lunaris* : Tyler, *NOAA tech. Rep. NMFS Circ.*, (434) : 326.

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)

1844. *Tetraodon spadiceus* Richardson, *The zoology of the voyage of H.M.S "Sulphur"*, 2 : 123.
1925. *Lagocephalus spadiceus* : Jordan and Hubbs, *Mem. Carnegie Mus.*, 10 : 257.

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.

ZOOGEOGRPAHICAL REMARKS

The range of distribution of the species in analysis has been investigated to throw more light on the zoogeographical affiinities 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 upto Japan in north to Queensland in south.

Thirty eight species (33.3%) are spread over the Indo-Polynesian province, *i. e.*, from the coasts of India and/or extended upto 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 upto 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 kammalensoides* 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 upto Myanmar coast. Other species of this group are *Thryssa polybranchialis* Wongratana, *Mystus gulio* (Hamilton-Buchanan), *Saurida longimanus* Norman, *Minous inermis* Alcock, *Lepidotrigla 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 extened upto 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 deterrant 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 deterrant 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.

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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%)

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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 ane 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)

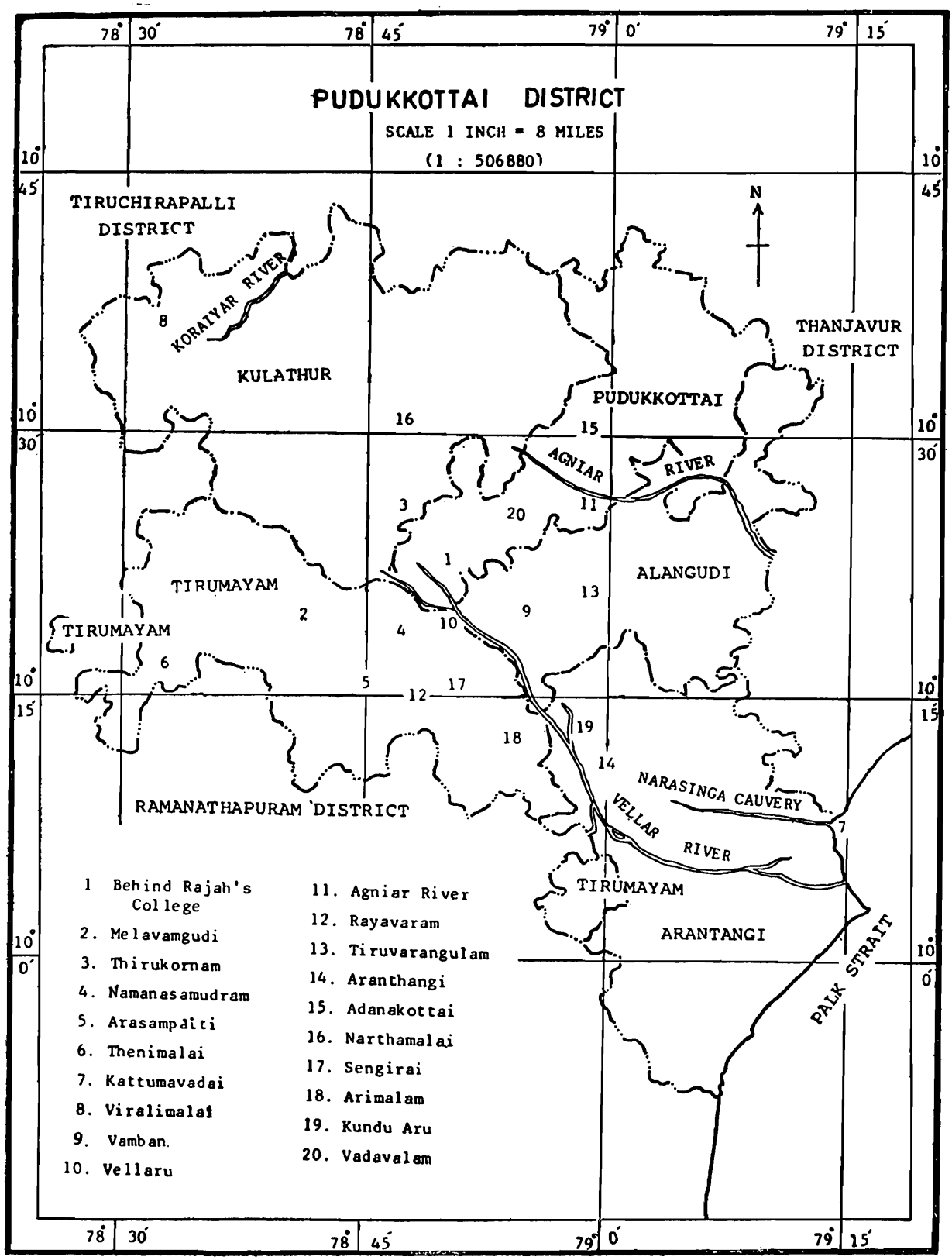
Sub Family : Cyprininae

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 : POECILIDAE

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* (Petera)

Family : GOBIIDAE

20. *Glossogobius giuris* (Hamilton)

SYSTEMATIC ACCOUNT

1. **Amblypharyngodon microlepis** (Bleeker)

1853. *Leuciscus microlepis* Bleeker, *Verh. Batav. Genootsch.* **25** : p. 41. (Type locality : River Hooghly).

Material : 1 ex., 23.5 mm SL, Melvelemkudi, Pudukkottai-Ponnamaravathi road, 20.1.1985 ; 2 exs., 27.0-30.0 mm SL, Pudukkottai-Royavaram road, 6.5.1986 ; 15 exs., 13.0-35.0 mm SL, Thiruvarangulam R. F., 7.5.1986 ; 3 exs., 20.0-25.0 mm SL, Sengirai, Arimalam-Mimisal road, 13.5.1986.

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

Amblyphar yngodon while in *Rasbora*, the scales are large and few in number (Ll, scales 48 ; 24-33 in *Rasbora*). This can also be readily distinguished from *A. mola* (Ham.) by its lesser number of lateral trensverse 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, Thiruvarangulam 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. l is complete in some specimens (L.l 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).**

Material : 2 exs., 22.0-23.5 mm SL, Melvelamkudi, Pudukkottai-Ponnamaravathi road, 20.1.1985 ; 3 exs., 21.0-46.0 mm SL, Hill slopes of Narthamalai, Thirukonam, 21.1.1985 ; 4 exs., 13.0-21.5 mm SL, Namanasamudram, 22.1.1985 ; 5 exs., 11.0-11.5 mm SL, Thenimalai, 29.1.1985 ; 2 exs., 11.0-22.0 mm SL, Viralimalai road, 2.2,1985 ; 1 ex., 27.0 mm SL, Vamban, 3.2.1985 ; 1 ex., 26.0 mm SL, Vellaru, Melathemathapatti, 3.5.1986 ; 25 exs., 22.0-35.0 mm SL, Agniaru, Pudukkottai-Tanjore road, 5.5.1986 ; 4 exs., 17.0-25.0 mm SL, Thiruvangulam R.F., 7.5.1986 ; 14 exs., 23.0-26.0 mm SL, Arimalam-Mimisal road, 13.5.1986 and 8 exs., 15.0-180 mm SL, Vadavalam, 15.5.1986.

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**

1822. *Cyprinus chola* (Hamilton), *Fish Ganges*. p. 312, 389. (Type locality : north-eastern parts of Bengal).

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, Malaieedu, 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)

1849. *Systomus dorsalis* Jerdon, *Madras J. Lit. & Sci.*, p. 314, 316. (Type locality : Tanks and rivers in the neighbourhood of Madras).

Material : 30 exs., 16.0-18.0 mm SL, Thiruvarangulam R.F., 7.5.1986.

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)

1822. *Cyprinus sophore* Hamilton, *Fish Ganges*. p. 310, 319, pl. 19, fig. 86. (Type locality : Ponds of Bengal).

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.l to ventral base being 3γ2. However, since *P. stigma* has been synonymised with *P. sophore*, which has 4 barbels and 2γ2 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

1865. *Puntius vittatus* Day, *Proc. Zool. Soc. London*, p. 303. (Type locality Madras).

Material : 6 exs., 12.5-25.0 mm SL, Melvelamkudi, Ponnamaravathi road, 20.1.1985 ; 1 ex., 26.5 mm SL, Hill slopes of Narthamalai, in and around Tirukonam, 21.1.1985 ; 1 ex., 13·0 mm SL, Adanakottai, 11.5.1986 and 15 exs., 10.-23.0 mm SL, 15.5.1986.

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. $4/3\frac{1}{2}$.

Distribution : Karnataka, Kerala, Tamilnadu, Goa, Cutch, Rajasthan, Srilanka, Pakistan.

8. **Lepidocephalus thermalis** (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, *Hist. nat. Poiss.*, 17 p. 78. (Type locality : Ceylon).

Material : 2 exs., 28.0 and 45.0 mm SL, Melvelamkudi, Ponnamaravathi road, 20.1.1985 ; 1 ex., 35.0 mm SL, Thirukonam, 21.1.1985 ; 5 exs., 19.5-22.0 mm SL, Namanasamudram, 22.1.1985 ; 2 exs., 28.0 & 29.0 mm SL, Thirumayam and Arasampatti, 22.1.1985 ; 2 exs., 19.0 and 21.0 mm SL, Viralimalai road, 2.2.1985 ; 6 exs., 22.0-40.0 mm SL, Vembal, 3.2.1985 ; 42 exs., 20.0-39.0 mm SL, Agniaru, 5.5.1986 ; 27 exs., 20.5-33.0 mm SL, Pudukkottai-Royavaram Road, 6.5.1986 ; 22 exs., 13.0-77.0 mm SL, Thiruvarangulam R.F., 7.5.1986 ; 2 exs., 12.0 & 44.0 mm SL, Namanasamudram road, 8.5.1986 ; 49 exs., 19.0-39.0 mm SL, Narthamalai, 12.5.1986 ; 1 ex., 46.0 mm SL, Arimalam-Mimisal Road ; 5 exs., 30.0-46.0 mm SL, Malaieedu, 14.5.1986 and 3 exs., 21.0-26.5 mm SL, Vudavattam, 15.5.1986.

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)

1865. *Hyselobagrus armatus* Day, *Proc. Zool. Soc. London*, p. 289. (Type locality : Malabar).

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)

1877. *Macrones bleekeri* Day, *Fish India*, p. 451, p. 101. fig. 7. (Type locality : Sind, Jamuna, Upper waters of Ganges, Burma).

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)

1797. *Silurus vittatus* Bloch, *Ichthyol Hist. Nat.*, 11, p. 40, pl. 371. fig. 2. (Type locality : Tranquebar, S. India).

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)

1911. *Haplochilus nanchax* var, *blockii* (Arnold), *Wschv.* Terrar-u. Terrariank 8, p. 672.

1916. *Panchax parvus*, Sundara Raj, *Rec. Ind. Mus.*, 12 : 249-294. (Rivers and tanks of Madras city).

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-

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.l.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.l 26-27, L.tr, 7 in *A. blockii* and L.l 31-34, L.tr, 9-10 in *A. panchax*)

Sexual dimorphism is seen as colour variation and in fin length. In males, leteral 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)

1839. *Aplocheilus melastigmus* McClelland, *Asiat. Res.*, **19** : pp. 301, 427, pl. 42, fig. 3. (Type locality : tanks in Calcutta).

Material : 19 exs., 10.5-26.0 mm SL, Melvelamgudi, Ponnamaravathi road, 20.1.1985 ; 1 ex., 9.5 mm SL, Viralimalai road, 2.2.1985 ; 6 exs., 17.0-21.0 mm SL, Vellaru, Melathemathapatti, 3.5.1986 ; 64 exs., 13.0-24.0 mm SL, Agniaru, Pudukkottai-Tanjore road, 5.5.1986 ; 167 exs., 9.5-29.0 mm SL, Aranthangi, 9.5.1986 and 3 exs., 17.0-21.0 mm SL, Adanakottai, 11.5.1986.

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)

1853. *Heterensia patrualis* Baird and Girard, *Proc. Acad. nat. Sci. Philad.* 6, p. 390. (Type locality : Rio Sabinal, Texas).

Material : 3 exs., 15.5.-20.5 mm SL, behind Rajas College, 19.1.1985.

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).

Material : 4 exs, 18.0-25.0 mm SL, Thirukonam, hill slopes of Narthamalai, 21.1.1985.

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, Malaieedu, 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).

Material : 2 exs., 37.0-39.0 mm SL, Kattumavedai, 1.2.1985 ; 1 ex., 26.0 mm, SL, Vallaru, Melatemathapetti, 3.5.1986 ; 5 exs., 40.0-59.0 mm SL, Aranthangi, 9.5.1986 and 13 exs., 31.0-56.0 mm SL, Malaieedu, 14.5.1986.

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)

1785. *Chaetodon suratensis* Bloch, *Syst. Ichth.*, pl. 217. (Type locality : Surat).

Material : 1 ex., 48.0 mm SL, Kattumavadai. 1.2.1985.

Distribution : India, fresh and brackish waters of Orissa, Madras, Malabar, Travancore, Cochin, Ceylon,

19. **Oreochromis mossambica** (Peters)

1852. *Chromis mossambica* Peters, *Monatsb. Akad. Wiss.*, Berlin, p. 681. (Type locality : Zambesi river, S. Africa).

Material : 26 exs, 9.5-34.0 mm SL, behind Rajas College, 19.1.1985 ; 2 exs., 9.0-13.5 mm SL, Melvelamgudi-Ponnamaravathi road, 20.1.1985 ; 1 ex., 21.5 mm SL, Hill slopes of Narthamalai, 21.1.1985 ; 1 ex., 43.0 mm SL, Thirumayam-Arasampatti, 22.1.1985 ; 28 exs., 12.0-45.0 mm SL, Kattumavadai, 1.2.1985 ; and 17 exs., 9.0-33.0 mm SL, Thenimalai, 29.1.1985 and 2 exs., 160.0 and 17.00 mm SL, Vellaru, Melathemathapatti, 3.5.1986.

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 freshweters 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.

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Rec. zool. Surv. India, **93** (1-2) : 253-266, 1993

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), occured 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

1863. *Echinosama horridum* Dohrn, *Stettiner entmol. Z.*, **24** : 66 (♂ ; Java).
1959. *Echinosoma horridum* ; Hincks, *Syst. monogr. Dermaptera*, **2** : 134, figs. 131-132.

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

1867. *Platylabia major* Dohrn, *Stettiner entomol. Z.*, **28** : 347 (1 ♀ ; Celebes).
1981. *Platylabia major* ; Srivastava, *Bull. zool. Surv. India*, **4** (1) : 104, figs. 1-5.

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 exauined : 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 specimsn up to species level.

LABIDURIDAE

ALLOSTETHINAE

Allostethella guttata (Bormans)

(Fig. 2)

1899. *Psalis guttata* Bormans, *Annali Mus. civ. Stor. nat. Giacomo Doria*, 2 (20) : 44 (♂, ♀ ; Mentawai Islands : Sipora, 1894, E. Modigliani—Museo civico storia naturale Genova).

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), 18.6.1989, 1 ♀, 30.6.1989 ; 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

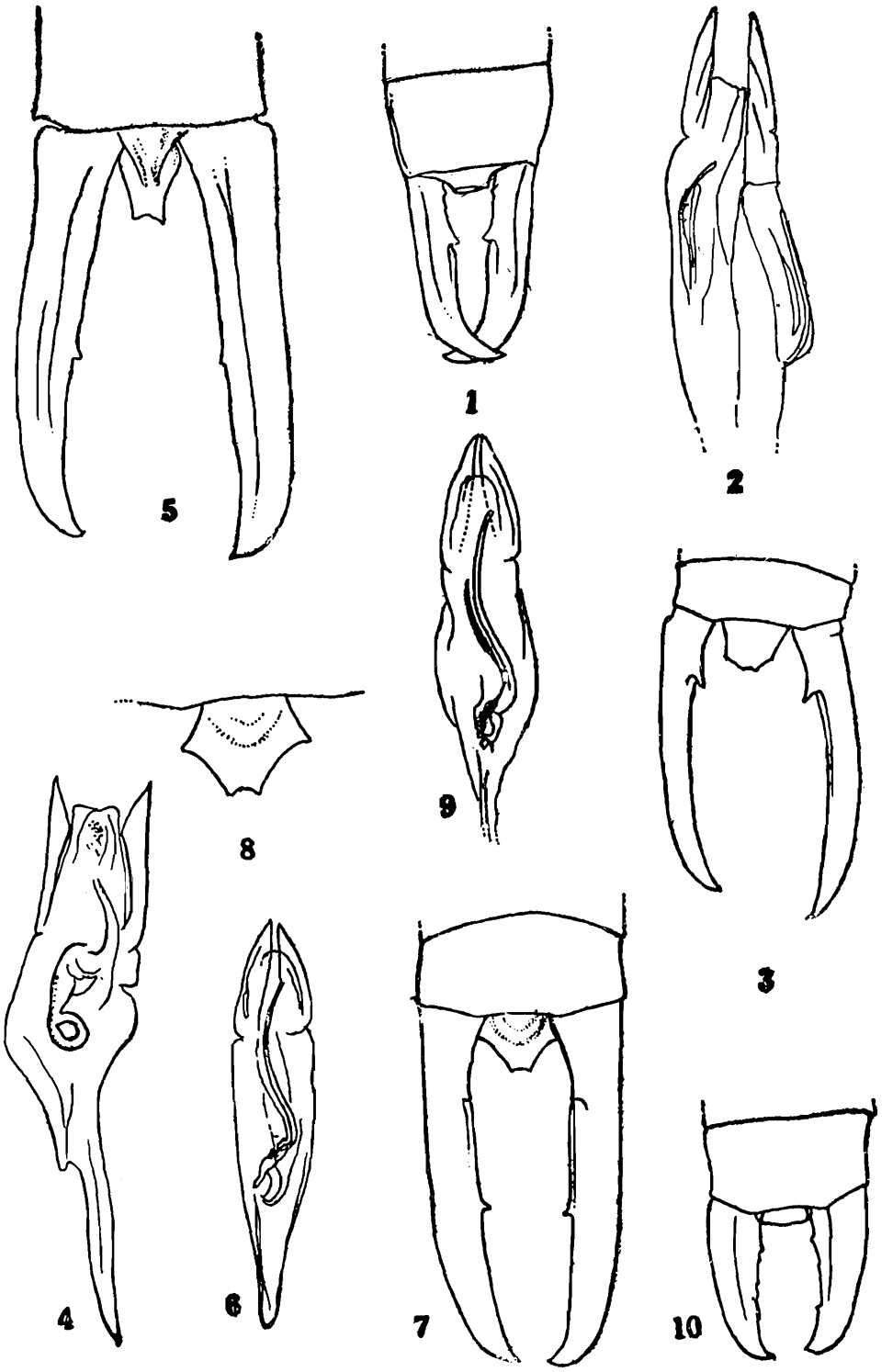
SPONGIPHORINAE

Spongovostox mucronatus (Stàl)

(Fig. 3)

1960. *Forficula mucronata* Stàl, *Eug. Resa zool. Ins.*, : 303 (♂ not ♀ ; Java).

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* (Stàl), ♂, (3) Ultimate tergite and forceps ; *Paralabella curvicauda* (Motschulsky), ♂, (4) Genitalia ; *Chaetospania feae* Bormans, ♂, (5) Ultimate tergite and forceps, (6) Genitalia ; *Chaetospania feuerborni* Günther, ♂, (7) Ultimate tergite and forceps, (8) Pygidium, enlarged, (9) Genitalia ; *Chaetolabia* sp., ♀ ; (10) Ultimate tergite and forceps.

LABIINAE

Paralabella curvicauda (Motschulsky)

(Fig. 4)

1863. *Forficesila curvicauda* Motschulsky, *Bull. Soc. Imp. Moscou*, **36 : 2, pl. 2, fig. 1** (♂, ♀ ; Nura Illia Mountains, Ceylon).

1989. *Paralabella curvicauda ; Steinmann, Das Tierreich*, **106 : 479, figs. 920-922.**

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)

1894. *Chaetospania feae* Bormans, *Annali Mus. civ. Stor. nat. Giacomo Doria*, **2 (14) : 390** (♂, ♀ ; Burma).

Measurements : ♂, Length : body – 5.2-6.5 mm, forceps – 2.2-2.4 mm ; ♀, Length : body – 6.5-7.5 mm, forceps – 1.6-1.88 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 ♂, 1 ♀, 23.10.1991 ; 1 ♂, 2 ♀ ♀, 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)

1867. *Platylabia thoracica* Dohrn, *Stettiner entomol. Z.*, **28 : 348** (♂, ♀ ; Penang Island [Strait settlements] ; Ceylon).

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.

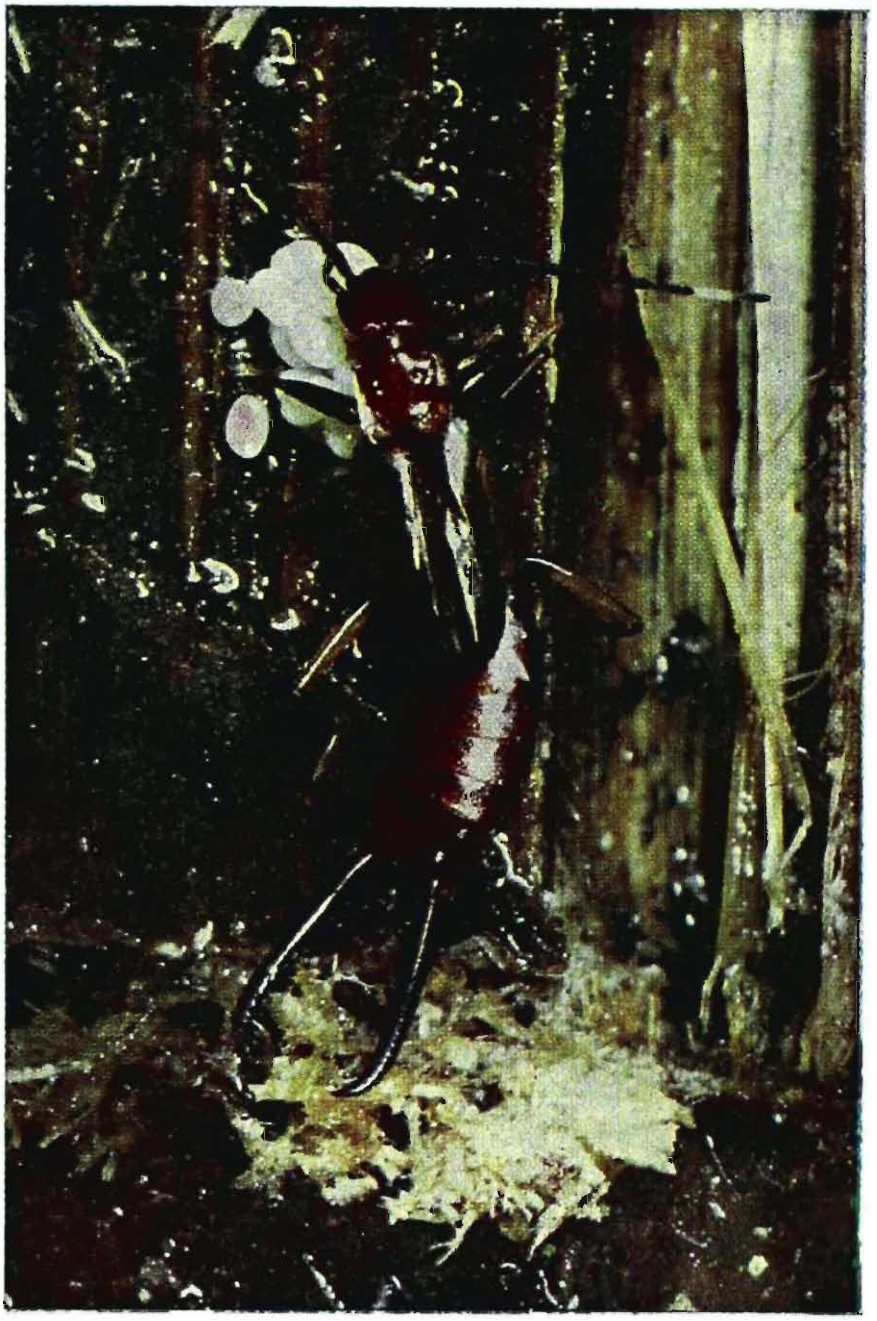
Chaetospania feuerborni Günther

(Figs. 7-9)

1933. *Chaetospania feuerborni* Günther, *Arch. Hydrobiol.*, **12** (Suppl.) : 512, fig. 10 (1 ♂ ; Java).

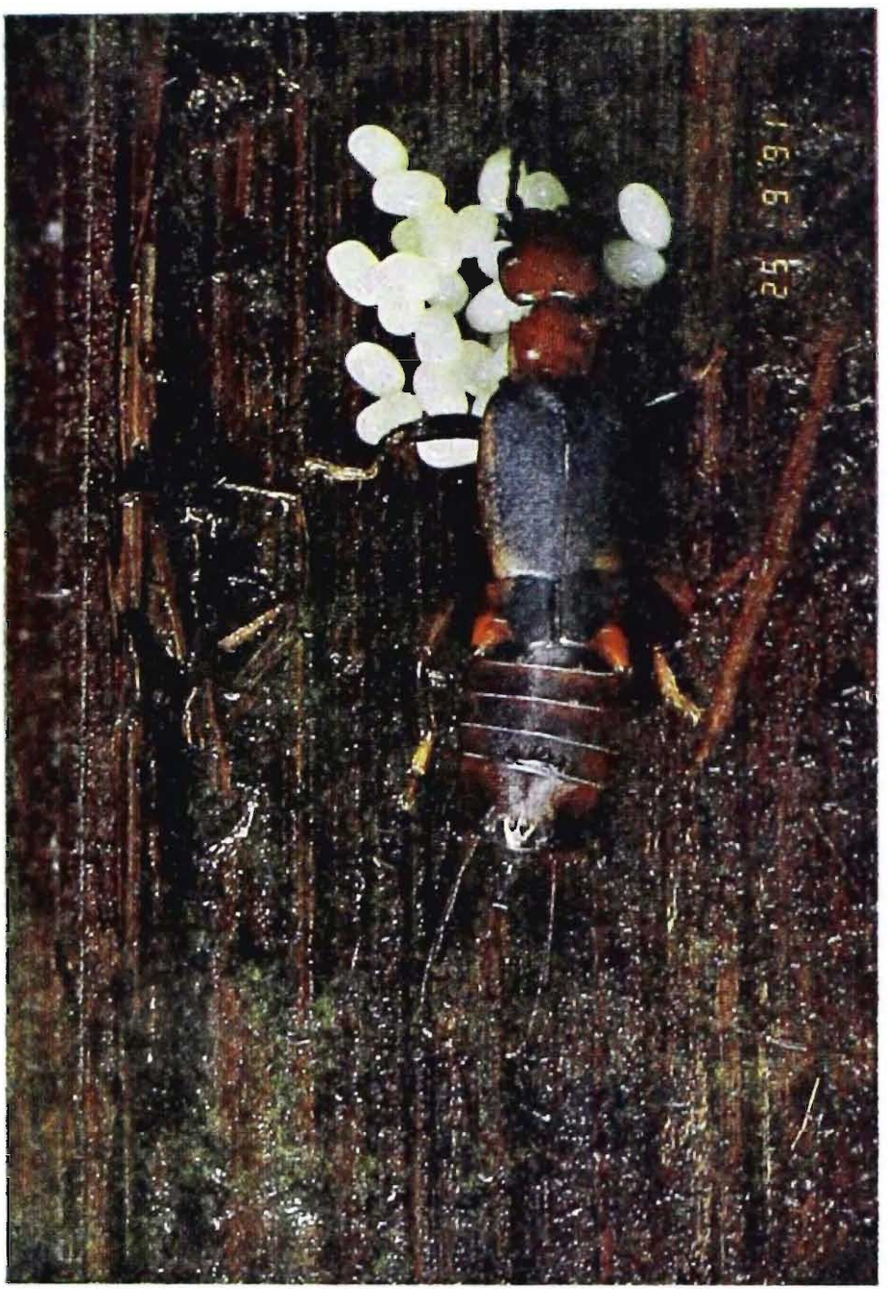
Measurements : ♂ ♂, Length : body – 6.0-8.1 mm, forceps – 3.0-3.5 mm.

SRIVASTAVA & KOVAC PLATE 1



Euenkrates brindlei sp. n., female with eggs.

SRIVASTAVA & KOVAC PLATE 2



Proreus pygidiatus sp. n., female with eggs.

SRIVASTAVA & KOVAC PLATE 3

Internodes of bamboo, *Gigantochloa scortechinii* with a hole made by the lerva of chrysomelid beetle, *Lasiochila goryi* (size of the hole : 7x3 mm, diameter of internodh : 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)

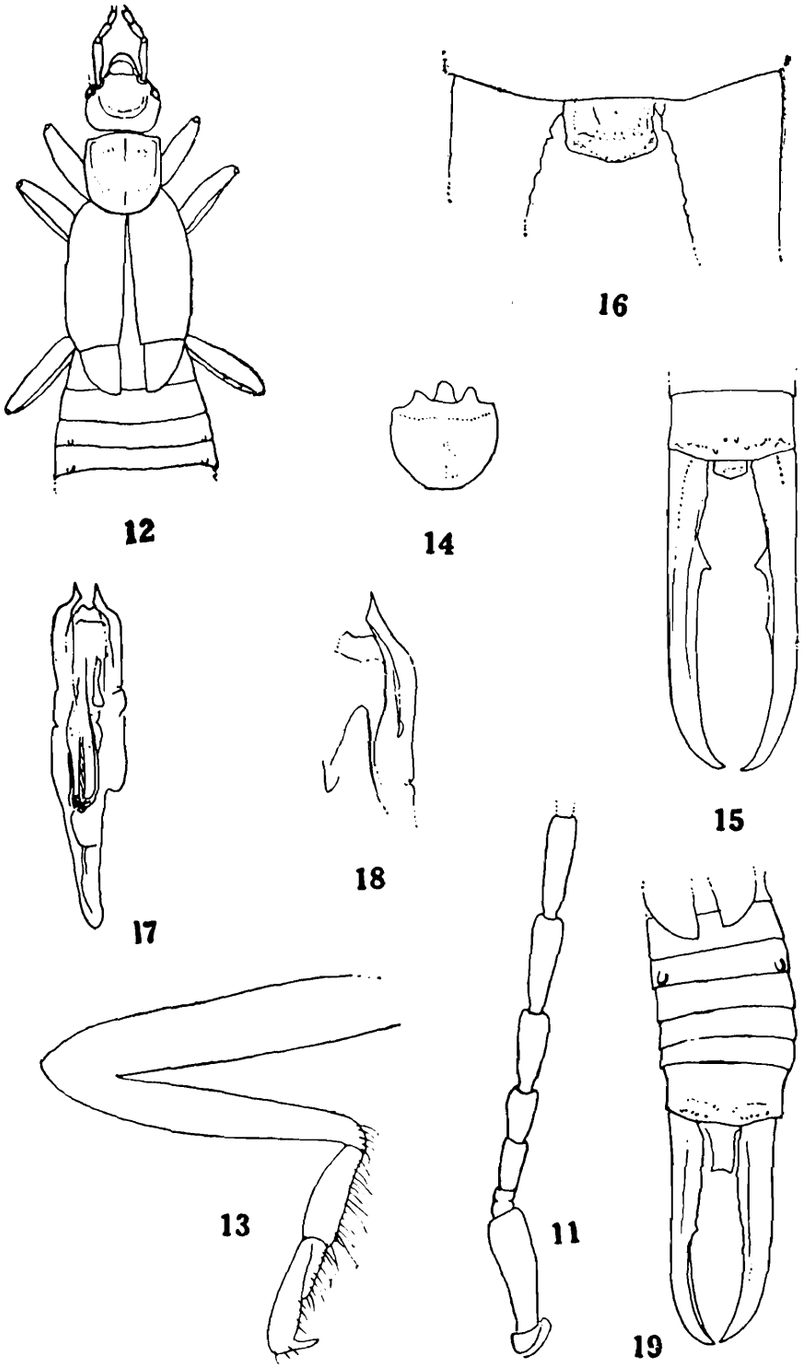
♂ : General colour blackish brown ; head and pronotum orange ; antennae dark blackish brown with 11th and 12th segments yellowish white ; legs yellow, fore femur and middle femur in basal two fifth brownish black ; elytra yellowish with uniform shade of black, hind wings black ; abdomen, forceps brown 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,



Figs. 11-19. *Euenkrates brindlei* sp. n., Holotype ♂, (11) A few basal antennal segments, (12) Anterior portion of body, (13) Hind leg, (14) Penultimate sternite, (15) Ultimate tergite and forceps, (16) Pygidium and basal portion of ultimate tergite and forceps, enlarged, (17) Genitalia, (18) Right paramere, enlarged ; Paratype ♀, (19) Abdomen and hind portion of body.

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 punctation 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. Pubscence 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 : *Abryna 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 : Spartaeinae). 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 fliget ; 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 covex above, sides straight, strongly declivious 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.

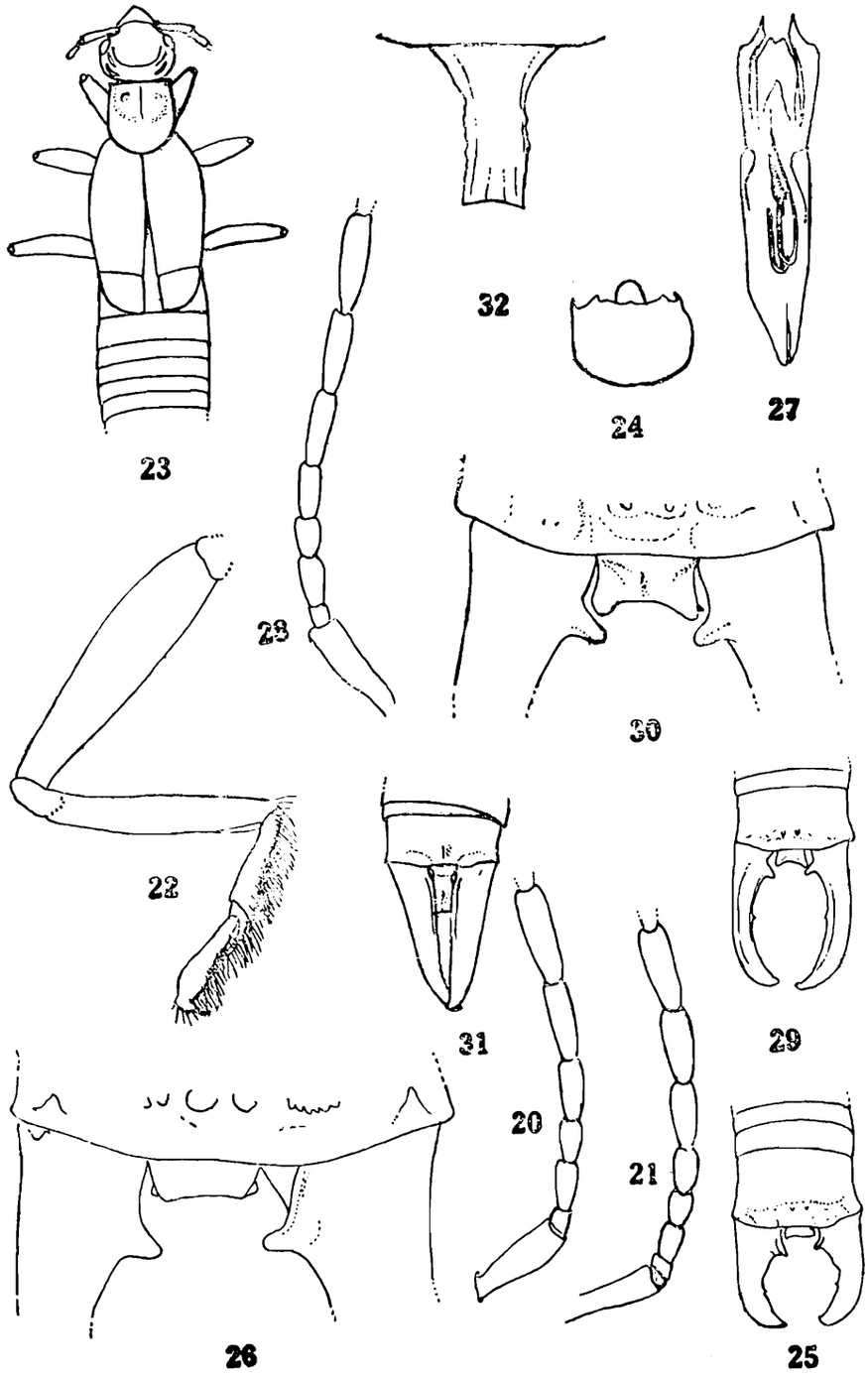
Mesurements : Holotype ♂ (cyclolabic), Length : head – 1.5 mm, pronotum – 1.5 mm, elytra – 2.7 mm, wings – 0.9 mm, body – 9.7 mm, forceps – 2.3 mm ; Width : head – 1.4 mm, pronotum – 1.4 mm.

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.

Material examined : MALAYA : Selangor, Ulu Gombak Field Studies Centre, 250 m, Holotype ♂ (cyclolabic, genitalia mounted between two coverslips and pinned with the specimen), Paratypes, 1 ♂ (cyclolabic), 1 ♂ (macrolabic). 30.6.1989, 1 ♀, 18.6.1989 ; 2 ♂ ♂ (cyclolabic), 2 ♀ ♀, 11.3.1991 ; 2 ♀ ♀, 2.7.1991 ; 1 ♀ 8.7.1991 ; 1 ♂ (macrolabic), 7.8.1991 ; 1 ♀, 25.9.1991 ; 1 ♂ (macrolabic), 28.9.1991 ; 1 ♂ (cyclolabic), 26.9.1991 ; 2 ♂ ♂ (cyclolabic), 6 ♀ ♀, 1.10.1991 ; 1 ♀, 10.10.1991 1 ♂ (macrolabic) 4 ♂ ♂ (cyclolabic), 3 ♀ ♀, 23.10.1991 ; 1 ♂ (cyclolabic), 1 ♀, 26. 10.1991 and 1 ♂ (macrolabic), 6.11.1991.

Paratypes 2 ♂ ♂, 2 ♀ ♀ deposited in the Zoological Survey of India, Calcutta.

Remarks : Some variations are noted in the shape and length of antennal



Figs. 20-32. *Proreus pygidiatus* sp. n., Holotype ♂ (cyclolabic), (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* prefrably 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)

1905. *Mecomera kervillei* Burr, *Ann. Mag. nat. Hist.*, 16 (7) : 489 (1 ♂, 1 ♀ ; Java).

1913. *Lamprophorus kervillei* ; Burr, *Rec. Indian Mus.*, 8 : 143 (India : Arunachal Pradesh and Assam).

1976. *Laprophorella kervillei* ; Srivastava, *Rec. zool. Surv. India. Occ. pap.*, 2 : 53 (India : Assam and West Bengal).

Measurements : Length : body – 10.5 mm ; forceps – 2.1 mm.

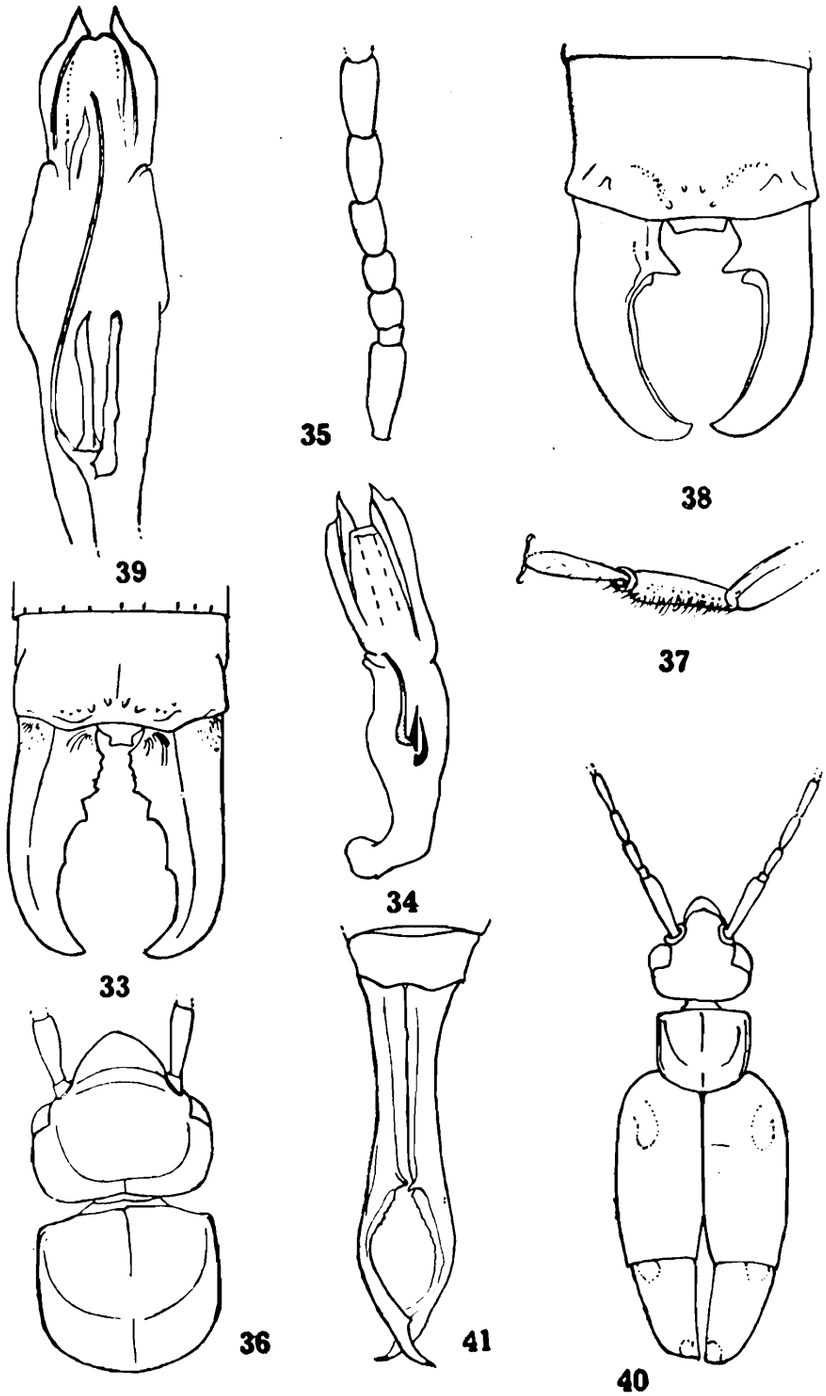
Material examined : MALAYA : Selangor, Genting Highlands, c. 1000 m, 1 ♂ (genitalia mounted between two coverslips and pinned with the specimen), 28.2.1991.

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 ♂ 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), ♂ (Indian specimen), (33) Ultimate tergite and forceps, (34) Genitalia, ♂ (Malayan specimen), (35) A few basal antennal segments, (36) Head and pronotum, (37) Hind tarsi, enlarged (38) Ultimate tergite and forceps, (39) Genitalia ; *Eparchus forcipatus* (Haan), ♂, (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 punctulated elytra and wings, the above specimen is referrable to *Hamaxas* Burr.

FORFICULIDAE

OPISTHOCOSMIINAE

Eparchus forcipatus (Haan)

(Figs. 40-41)

1842. *Forficula* (*Opisthocosmia*) *forcipata* Haan, *Verh. Natuurgesch. Nederl. Overz. Bezitt.*, **1842** : 243 (♂, ♀ ; Batang, Singalang, Sumatra).

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.

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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.

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Rec. zool. Surv. India, 93 (1-2) : 267-273, 1993

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 photogtaph 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.

The Trichinopoloy Cretaceous fossils are essentially marine, formed between the transgression and regression of the Bay of Bengal. We owe our knowledge on trace fossils of Indian Region to Casshyap *et al.*, (1983), Chakrabarti (1972), Chiplonkar *et al.*, (1970, 1972, 1975 a, b, 1980, 1981), Gupta *et al.*, (1966), Howell (1956), Jacob (1938), Kumar & Singh (1983), Kummel & Teichert (1970), Mathur & Verma (1983), Maithy *et al.*, (1986), Misra & Dube (1952), Sahni (1936), Sahni & Shrivastava (1954), Sambe Gowda & Nagaraj (1978), Teichert (1964), Verma & Prasad (1968) and West *et al.* (1983).

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 ethnological 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.

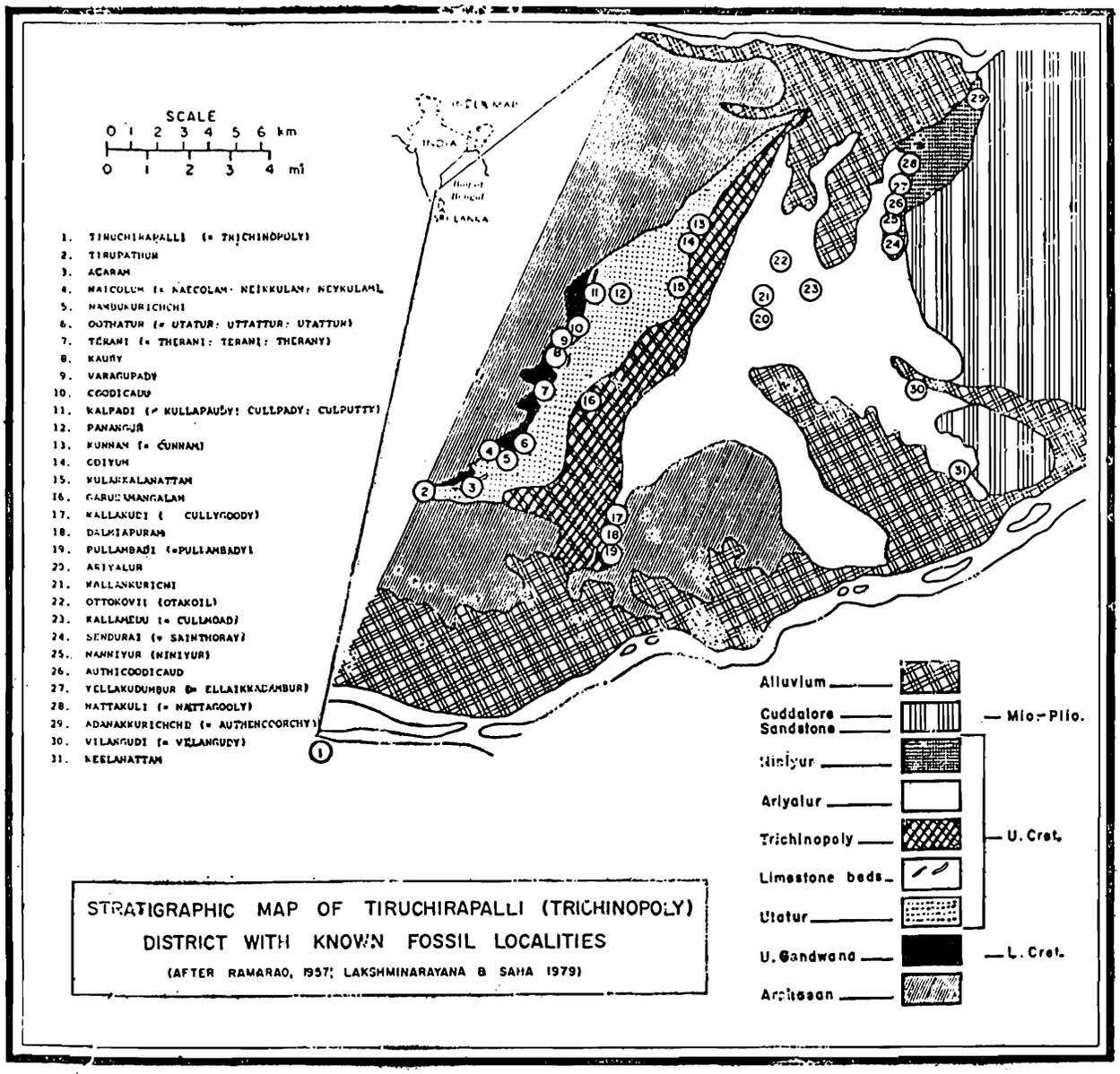

Fig-I

Fig. 1. Stratigraphic map of Tiruchirapalli (Trichinopoly) District showing the fossil Cretaceous beds. (After Lakshminaryana & 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* Hantzschel, *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

Fig - 2

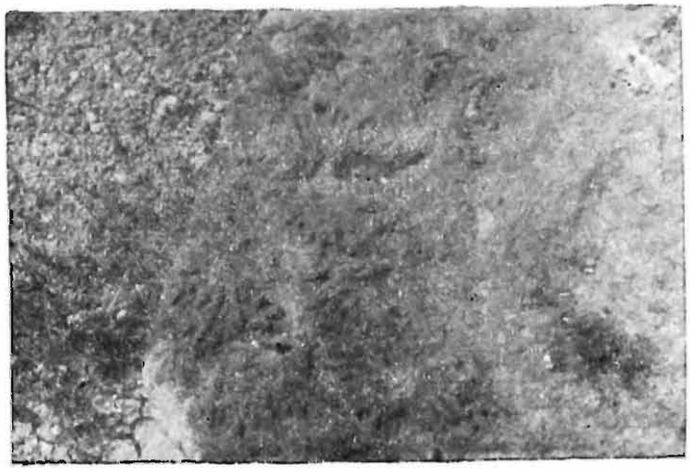

Fig - 3a

Fig - 3b

Fig. 2. "Echinoid" beds near Ottokovil.

Fig. 3. *Haentzschelinia* sp., a new record of Ichnofossil in the "Echinoid" beds : (a) general view ; (b) enlarged.

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.

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. The 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, Hantzsehel (*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 repor ed during Cretaceous elsewhere.

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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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Rec. zool. Surv. India, **93** (1-2) : 275-281, 1993

SEASONAL ABUNDANCE OF IMPORTANT SOME SPIDER GROUPS IN RICE AGRO-ECOSYSTEM

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West Bengal ; India.

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 colar 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 dependant 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.*

Time scale Month	Fortnight	*Thomisus* spp.	*Lycosa* spp.	*Oxyopes* spp.	*Phidippus* spp.	*Antypena* spp.	*Tetragnatha* spp.	*Araneus spp.*	*Spider complex*
March	1	4.50±0.70	3.25±1.60	2.00±1.10	6.50±1.72	1.00±1.00	1.75±1.04	0.00±0.00	19.00±2.08
1991	2	0.25±0.66	2.00±1.46	1.25±1.14	2.75±1.66	1.00±0.84	5.00±1.80	0.00±0.00	12.25±2.04
April	3	0.50±0.70	3.25±1.50	1.50±0.70	0.75±0.68	1.00±1.32	10.25±3.18	0.00±0.00	17.25±3.50
	4	1.50±1.06	5.00±1.46	5.00±0.84	1.25±0.90	4.25±1.04	10.75±1.44	0.00±0.00	27.75±1.98
May	5	2.25±1.50	0.75±0.90	0.25±0.66	0.25±0.66	1.25±0.90	0.75±0.90	1.00±1.10	6.50±0.92
	6	1.50±1.06	1.75±2.18	2.00±1.10	1.25±1.14	3.75±3.68	3.00±1.26	1.75±1.22	15.00±2.04
June	7	0.50±0.70	1.00±0.00	3.00±1.52	1.00±0.84	2.75±1.22	0.25±0.66	0.75±0.68	9.25±2.28
	8	0.75±1.14	0.75±0.66	3.50±1.78	0.25±0.66	2.25±4.68	0.00±0.00	0.50±0.92	8.00±2.66
July	9	0.00±0.00	0.25±0.66	1.25±0.90	0·00±0.00	0.50±0.70	0.25±0.66	0.25±0,66	2.50±1.34
	10	0.00±0.00	0.25±0.66	0.75±0.66	0.25±0.66	0.25±0.66	1.35±1.14	0 00±0.00	2.75±1.44
August	11	0.00±0.00	1.25±0.68	1.25±0.68	0.00±0.00	0.25±0.66	0.75±1.14	0.00±0.00	3.50±1.42
	12	0.00±0.00	0.75±0.90	0.75±0.90	0.00±0.00	0.00±0.00	1.25±0.90	0.00±0.00	2.75±1.50
September	13	0.00±0.00	1.75±0.66	1.75±1.18	0.25±0.66	0.25±0.66	2.75±2.18	0.00±0·00	6.75±1.38
	14	0.25±0.66	1.50±1,06	1.50±0.70	0.00±0.00	0.00±0.00	2.50±0.92	0.25±0.66	6.00±1.66
October	15	0.25±0.66	0.25±0.66	0.75±0.90	0.25±0-66	1.75±1.22	3.25±1.82	0.00±0.00	6.50±1.62
	16	0.00±0.00	0.75±0.90	1.25±0.90	0.25±0.66	0.00±0.00	1.50±0.70	0.00±0.00	3.75±0.90
November	17	0.00±0.00	1.25±0.68	1.50±0.74	0.50±0.74	1.00±0.50	2.75±0.68	0.00±0.00	7.00±0.84
	18	0.00±0,00	2.25±1.28	1.75±0.68	0.00±0.00	0.25±0.66	2.25±0.18	0.00±0.00	6.50±1.06
December	19	0.00±0.00	9.50±2.22	6.75±2.56	1.25±1.14	3.50±1.74	5.00±1.00	1.00±1.10	27.00±3.68
	20	0.00±0.00	1.00±1.36	4.50±7.24	0·00±0.00	2.00±1.86	2.75±1.76	0.25±0.66	10.50±2.94
January	21	0.00±0.00	1.50±2.74	1.25±1.68	0.00±0.00	0.25±0.66	0.25±0.66	0.00±0.00	3.25±1.84
1992	22	0.00±0.00	0.25±0.66	0.25±0.66	0.25±0.66	1.50±1.62	0.25±0.66	0.00±0.00	2,50±1.94
February	23	0.25±0.66	0.00±0.00	0.00±0.00	0.25±0.66	0.50±0.92	0.00±0.00	0.25±0.66	1.25±1.48
	24	0.00±0.00	2.00±0.84	2.50±0.92	0.75±0.68	0.75±0.66	1.25±0.18	0.00±0.00	7.25±0.90

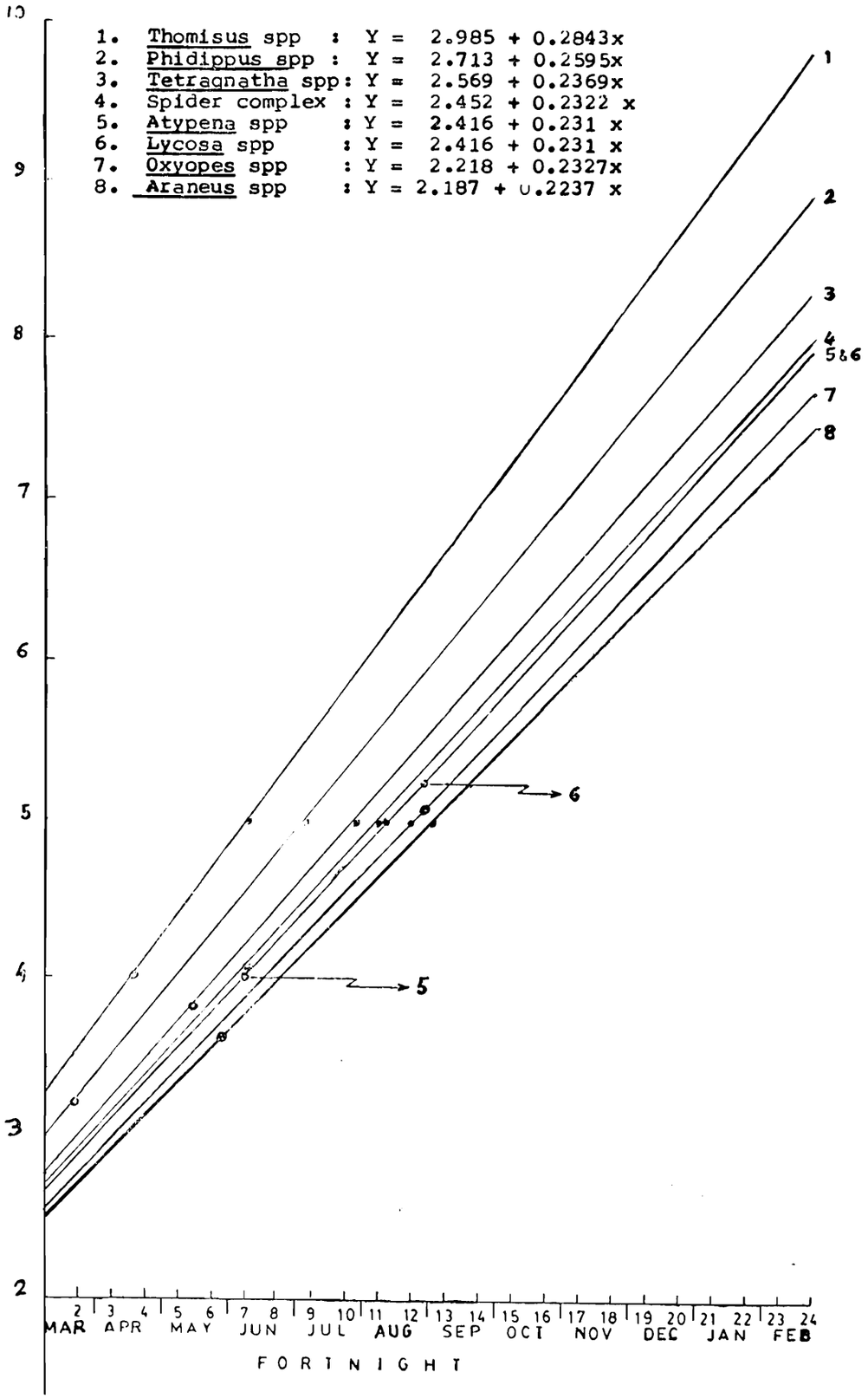

Fig. 1. *Probit Regression of some common spider groups in rice agro-eco system.*

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 *Cyrtorhinus 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 : SARCOPHAGIDAF) 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*-post-alar 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 : TEPHROMYIINI

1. **Blaesoxipha aldrichi** Nandi

1992. *Blaesoxipha aldrichi* Nandi, *Hexapoda*, 4(1) : 65.

Material examined : 2 ♂ ♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990.
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

1992. *Boettcherisca bengalensis* Nandi, *J. Beng. nat. Hist. Soc.*, **11** (1) : 35.

Material examined : 2♂♂, Nagpur Maharajabagh, 314 m., 13. vi. 1990 ; 1♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 1♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990.

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

1961. *Boettcherisca nathani* Lopes, *Mem. Inst. Oswaldo Cruz.*, **59** (1) : 79.

Material examined : 1♂, Khandala, 960 m., 21. vi. 1990.

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)

1830. *Myophora peregrina* Robineau—Desvoidy, *Mém. Prés. Acad. Sci. Inst. Fr.*, (2) **2** : 356.
1992. *Boettcherisca peregrina* : Nandi, *J. Beng. nat. Hist. Soc.*, **11** (1) : 38.

Material examined : 1♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990.

5. **Parasarcophaga (Liopygia) ruficornis** (Fabricius)

1794. *Musca ruficornis* Fabricius, *Ent. Syst.*, **4** : 314.
1991. *Parasarcophaga* (*Liopygia*) *ruficornis* : Nandi, *J. Beng. nat. Hist. Soc.*, **10** (2) : 39.

Material examined : 1♂, Pune Rly. Station area, 559 m., 19. vi. 1990.

6. **Parasarcophaga (Liosarcophaga) brevicornis** (Ho)

1934. *Sarcophaga brevicornis* Ho, *Bull. Fan. meml. Inst. Biol.*, **5** : 23.
1991. *Parasarcophaga* (*Liosarcophaga*) *brevicornis* : Nandi, *J. Beng. nat. Hist. Soc.*, **10** (2) : 39.

Material examined : 2♂♂, Nagpur Maharajabagh, 314 m., 13. vi. 1990 ; 1♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 1♂, Ellora, 370 m., 17. vi. 1990 ; 1♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990 ; 1♂, Lonavale, 950 m., 21. vi. 1990.

It is recorded for the first time from this state.

7. **Parasarcophaga (Liosarcophaga) dux** (Thomson)

1868. *Sarcophaga dux* Thomson, *K. svenska Fregatten Eugenies Resa.*, p. 534.
1991. *Parasarcophaga* (*Liosarcophaga*) *dux* : Nandi, *J. Beng. nat. Hist. Soc.*, **10** (2) : 39.

Material examined : 1♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 3♂♂, Ajanta, 533 m., 16. vi. 1990 ; 1♂, Ellora, 370 m., 17. vi. 1990 ; 2♂♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990 ; 4♂♂, Panchgani, 380 m., 20. vi. 1990.

8. **Parasarcophaga (Pandelleisca) ballardi** (Senior-White)

1924. *Sarcophaga ballardi* Senior—White, *Rec. Indian Mus.*, **26** (3) : 254.
1977. *Parasarcophaga* (*Pandelleisca*) *ballardi* : Lopes, Kano, Shinonaga and Kurahashi, *Cat. Dipt. Orient. Region*, 3 : 570.

Material examined : 1♂, Daulatabad, 340 m., 17. vi. 1990.
It is new record for the state.

9. **Parasarcophaga (Pandelleisca) kurahashii** Nandi

1992. *Parasarcophaga* (*Pandelleisca*) *kurahashii* Nandi, *Hexapoda*, **4**(1) : 71.

Material examined : 1♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 1♂, Daulatabad, 340 m., 17. vi. 1990 ; 2♂♂, Panchgani, 380 m., 20. vi. 1990.
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)

1826. *Sarcophaga albiceps* Meigen, *Syst. europ. zweifl. Insekt.*, **5** : 22.
1991. *Parasarcophaga* (*Parasarcophaga*) *albiceps* : Nandi, *J. Beng. nat. Hist. Soc.*, **10** (2) : 39.

Material examined : 1♂, Nagpur Maharajabagh, 314 m., 13. vi. 1990 ; 1♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 1♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990 ; 1♂, Pune Rly. Station area, 559 m., 19. vi. 1990 ; 3♂♂, Khandala, 960 m., 21. vi. 1990.

11. **Parasarcophaga (Parasarcophaga) hirtipes** (Wiedemann)

1830. *Sarcophaga hirtipes* Wiedemann, *Aussereurop. zweifl. Insekt.*, **2** : 361.
1990. *Parasarcophaga* (*Parasarcophaga*) *hirtipes* : Nandi, *J. Beng. nat. Hist. Soc.*, **9** (2) : 17.

Material examined : 1♂, Nagpur Maharajabagh, 314 m., 13. vi. 1990 ; 2♂♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 2♂♂, Ajanta, 533 m., 16. vi. 1990 ; 2♂♂, Ellora, 370 m., 17. vi. 1990 ; 3♂♂, Daulatabad, 340 m., 17. vi. 1990 ; 4♂♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990 ; 1♂, Pune Rly. Station area,

559 m., 19. vi. 1990 ; 1♂, Mahabaleshwar, 1, 362 m., 20. vi. 1990 ; 2♂♂, Wai, 680 m., 20. vi. 1990.

It is a new record for the state.

12. **Parasarcophaga (Parasarcophaga) sericea** (Walker)

1853. *Sarcophaga sericea* Walker, *Ins. Saunders., Dipt.*, **4** : 326.
1917. *Sarcophaga knabi* Parker, *Proc. U. S. natn. Mus.*, **54** : 96.
1990. *Parasarcophaga (Parasarcophaga) knabi* : Nandi, *J. Beng. nat. Hist. Ssc.*, **9** (2) : 17.
1989. *Parasarcophaga (Parasarcophaga) sericea* : Lopes, *Cat. Dipt. Australasia* and *Oceania Regions*, p. 728.

Material examined : 1♂, Ajanta, 533 m., 16.vi. 1990 ; 1♂, Ellora, 370 m., 17.vi. 1990 ; 1♂, Daulatabad, 340 m., 17.vi. 1990 ; 1♂, Aurangabad Siddhartha Garden, 350 m., 18.vi. 1990 ; 1♂, Pune Rly. Station area, 559 m., 19.vi. 1990 ; 1♂, Khandala, 960 m., 21.vi. 1990.

13. **Parasarcophaga (Parasarcophaga) misera** (Walker)

1849. *Sarcophaga misera* Walker, *List. Dipt. Brit. Mus.*, **4** : 829.
1913. *Sarcophaga orchidea* Böettcher, *Annls hist-nat. Mus. natn. Hung.*, **11** : 375.
1990. *Parasarcophaga (Parasarcophaga) orchidea* : Nandi, *J. Beng. nat. Hist. Soc.*, **9** (2) : 18.
1989. *Parasarcophaga (Parasarcophaga) sericea* : Lopes, *Cat. Dipt. Australasia* and *Oceania Regions*, p. 728.

Material examined : 2♂♂, Nagpur Seminary Hills, 350 m., 14.vi. 1990 ; 2♂♂, Ajanta, 533 m., 16.vi. 1990 ; 2♂♂, Ellora, 370 m., 17.vi. 1990 ; 2♂♂, Lonavale, 950 m., 21.vi. 1990.

Subtribe : HELICOPHAGELLINA

14. **Pierretia (Ascelotella) calicifera** (Böettcher)

1912. *Sarcophaga calicifera* Böettcher, *Ent. Mitt.*, **1** : 169.
1988. *Pierretia (Ascelotella) calicifera* : Nandi, *J. Beng. nat. Hist. Soc.*, **7** (1) : 21.

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

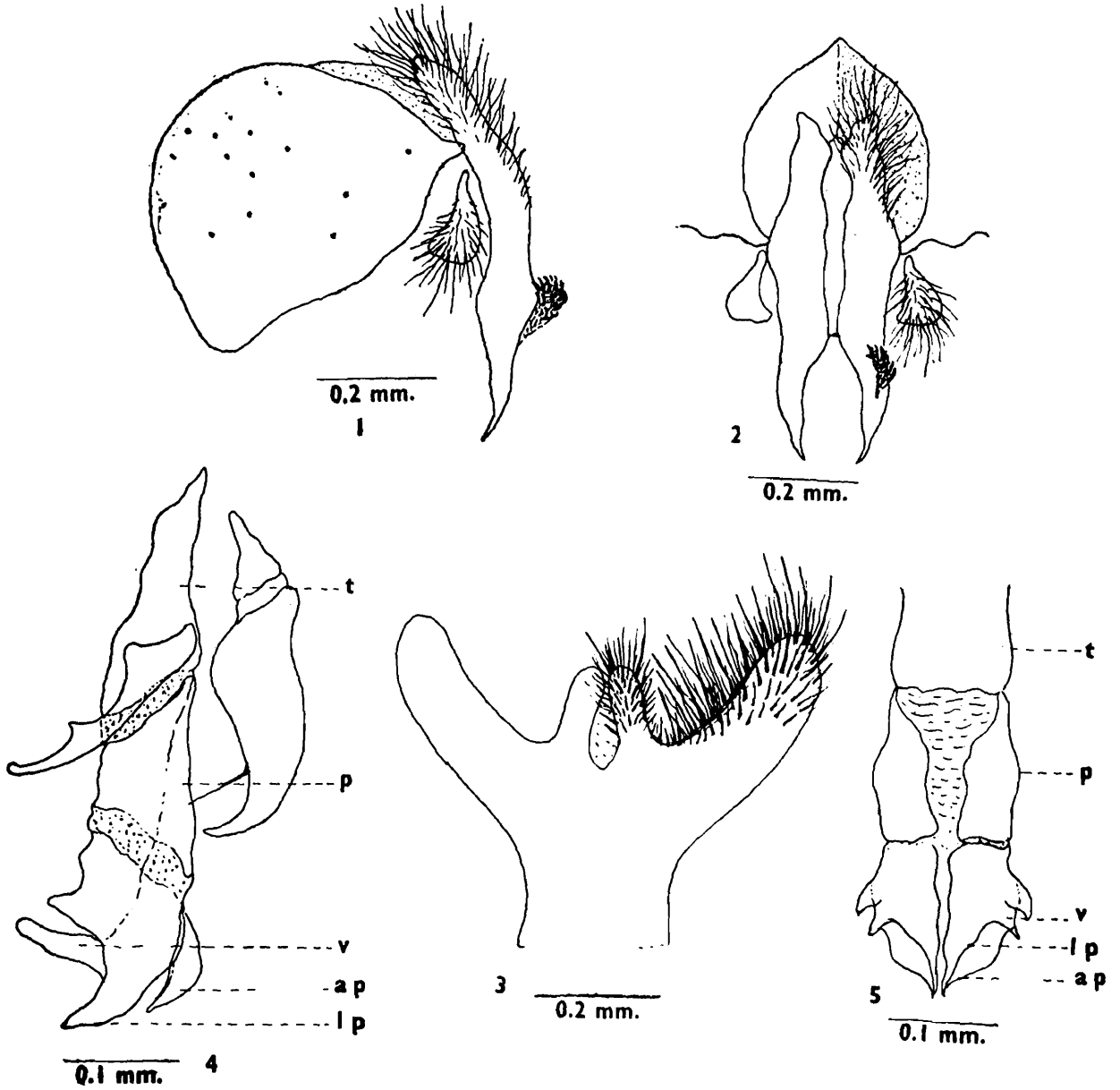
1975. *Tnyrsocnema (Pseudothyrsocnema) indica* Shinonaga and Lopes, *Pacif. Insects*, **16** (4) : 459.

Material examined : 1♂, Ellora, 370 m., 17.vi. 1990 ; 1♂, Daulatabad, 340 m., 17.vi. 1990 ; 3♂♂, Panchgani, 1, 132 m., 20.vi. 1990.

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



Figs. 1-5. *Kozlovea vervesi* sp. nov.
1, inner and outer forceps, lateral view ; 2, same, posterior view ; 3, fifth sternite ; 4, penis, lateral view ; 5, same, ventral view.

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 forwads ; 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 discance from the distal end ; mid tibia with 1 bristle each on anterodorsal suaface 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 anterovental 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 ftom 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 mlddle ; 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.

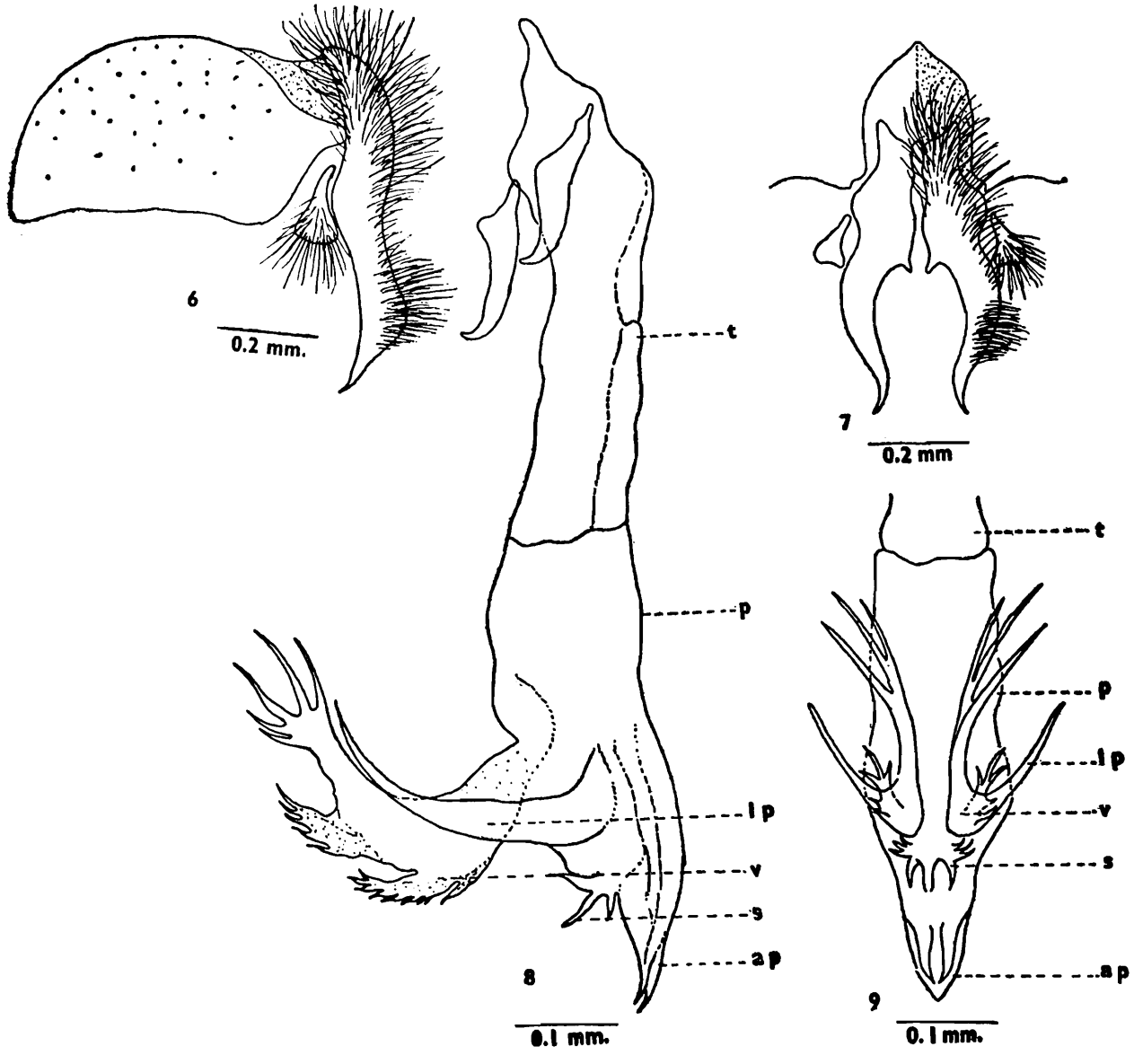
Subtribe : HARPAGOPHALLINA

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 2below 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 vertcal 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 ; *pq* 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 ; 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 to r-m and 4 short setae present on ventral surface of basal node of R_{4+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 furface, 1 short bristle on posterodorsal 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 posterodosal 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)

1924. *Sarcophaga futilis* Senior-White, *Rec. Indian Mus.*, 26 (3) : 246.
1990. *Iranihindia futilis* : Nandi, *J. Beng. nat. Hist. Soc.*, 9 (2) : 19.

Material examined : 1 ♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 8 ♂ ♂, Ellora, 370 m., 17. vi. 1990 ; 14 ♂ ♂, Daulatabad, 340 m., 17. vi. 1990 ; 1 ♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990 ; 3 ♂ ♂, Lonavale, 950 m., 21. vi. 1990.

19. **Iranihindia martellata** (Senior-White)

1924. *Sarcophaga martellata* Senior-White, *Rec. Indian Mus.*, 26 (3) ; 47.
1992. *Iranihindia martellata* : Nandi, *Hexapoda*, 4(1) : 77.

Material examined : 1 ♂, Nagpur Seminary Hills, 350 m., 14. vi. 1990 ; 1 ♂, Lonavale, 950., 21. vi. 1990.

It is recorded for the first time from this state.

20. **Iranihindia martellatoides** (Baranov)

1931. *Sarcophaga martellatoides* Baranov, *Konowia*, 10 : 114.
1992. *Iranihindia martellatoides* : Nandi, *Hexapoda*, 4(1) : 77.

Material examined : 1 ♂, Ellora, 370 m., 17. vi. 1990 ; 1 ♂, Daulatabad, 340 m., 17. vi. 1990 ; 1 ♂, Aurangabad Siddhartha Garden, 350 m., 18. vi. 1990.

This is the first record of this species from this state.

Subtribe : SENIORWHITEINA

21. **Seniorwhitea reciproca** (Walker)

1856. *Sarcophaga reciproca*, Walker, *J. Proc. Linn. Soc. Lond., Zool.*, 1 : 22.
1912. *Sarcophaga krameri* Böettcher, *Ent. Mitt.*, 1 : 165.
1990. *Seniorwhitea krameri* : Nandi, *J. Beng. nat. Hist. Soc.*, 9 (2) : 20.
1989. *Seniarwhitea reciproca* : Lopes, *Cat. Dipt. Australasia* and *Oceania Regions*, p. 730.

Material examined : 1 ♂, Khandala, 960 m., 21.vi. 1990.

SUMMARY

Systematic position of twentyone species are dealt with. Two new species, *viz.*, *Kozlovea vervesi* and *Harpagophalla panchganiesis* are described and figured. Ten species are recorded for the first time from this state.

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Rec. zool. Surv. India, 93 (1-2) : 295-311, 1993

ASILIDAE (DIPTERA) FROM ANDAMAN ISLANDS

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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 albibarbis* Macquart ; designated by Hermann (1919 : 340).

1. **Laxenecera albibarbis** Macquart

1838. *Laxenecera albibarbis* Macquart, *Dipt. exot.*, 1 (2) : 195. Type-locality : Bengal, India.
1983. *Laxenecera albibarbis* : Joseph & Parui, *Oriental Ins.*, 17 : 297.

Material : 2 ♀, Little Andaman : Hut Bay, 22.i.1988, Call. A. N. T. Joseph & Party.

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 flavibarbis* 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

1914. *Orthogonis* Hermann, *Ent. Mitt.* 3 : 132. Type-species : *Laphria scapularis* Wiedemann, 1828 ; Original designation.

2. **Orthogonis andamanensis** Joseph & Parui

1981. *Orthogonis andamanensis* Joseph & Parui, *Ent. Scand.* 12 : 221. Type-locality : Wrightmyo, S. Andaman.

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 ... *tomentosus* Oldroyd

   —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.
1975. *Stichopogon inaequalis* : Oldroyd, *A Catalog of Diptera of the Oriental Region*, 2 : 129.

Material : 2 ♀, S. Andaman : South Point, 24. i. 1988. Coll. A. N. T. Joseph.

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 brownish 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.

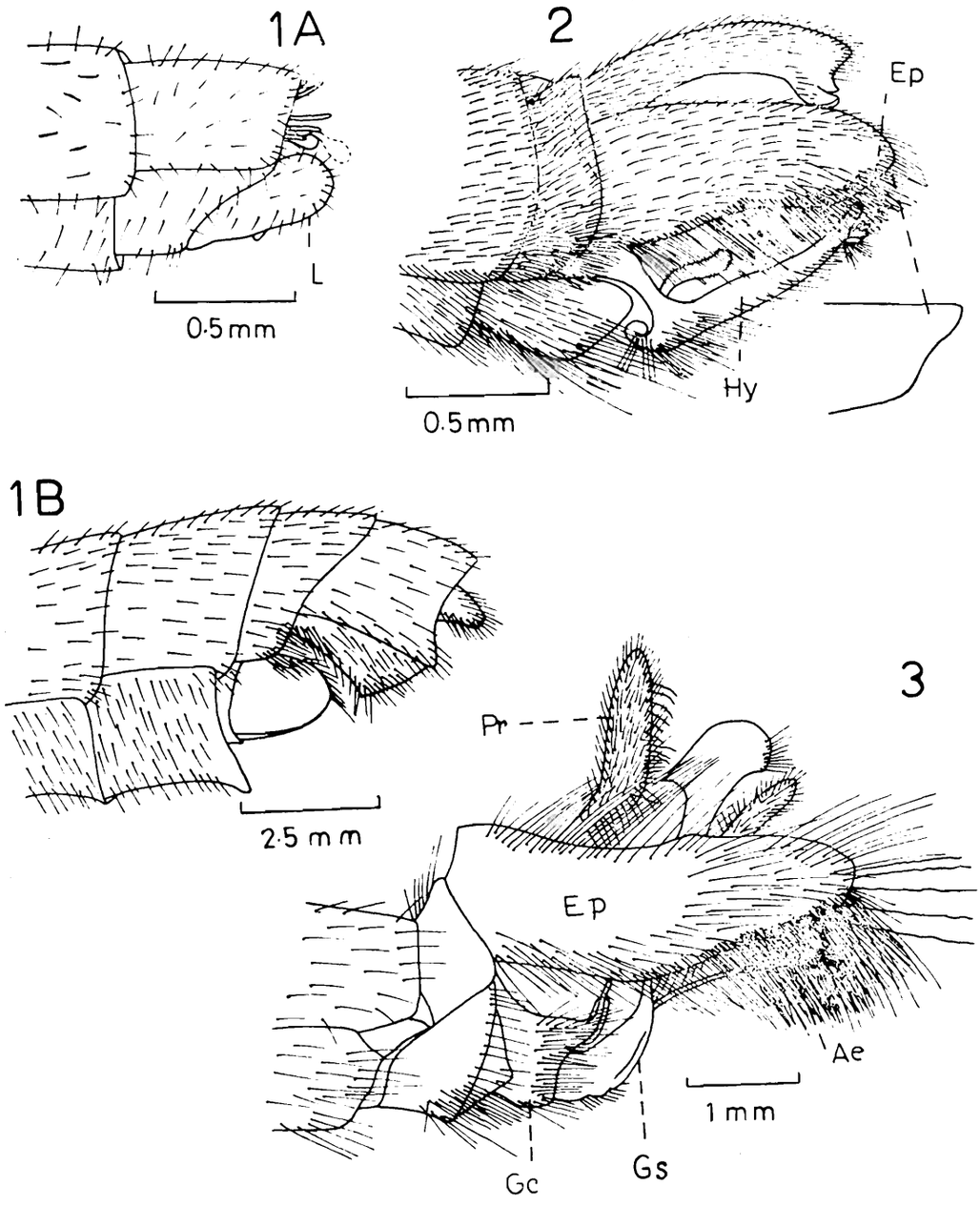
Thorax black, grey or greyish-yellow tomentose ; pronotum with white setae laterally, in holotype scutum with a broad mediolongitudinal black stripe, the stripe lightly grey tomentose on anterior half which is divided by a narrow black stripe, paratypes similar but tomentum on mediolongitudinal stripe 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.

Holotype ♀, Reg. No. 7601/H6, S. Andaman, South Point, 24.i.1988, Coll. A. N. T. Joseph & Party. *Paratypes* 1 ♀, 4 ♂, Reg. Nos. 7602/H6 to 7606/H6, rest of data as in holotype ; 1 ♀, Reg. No. 7607/H6, Little Andaman, Hut Bay, 27.i.1988, Coll. A. N. T. Joseph & Party.

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

1948. *Stichopogon tomentosus* Oldroyd, *Entomologist's Mon. Mag.* **84** : 243. Type-locality : Bannar, Bihar, India.

1983. *Stichopogon tomentosus* : Joseph & Parui, *Oriental Ins.* **17** : 326.

Material : 2 ♂, 1 ♀, Little Andaman : Netaji Nagar, 25.i.1988, Coll. A. N. T. Joseph.

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

1958. *Cophinopoda* Hull, *Proc. Ent. Soc.* Wash. **60** : 251. Type-species : *Asilus chinensis* Fabricius, 1794 : 383 ; original designation.

6. **Cophinopoda chinensis** (Fabricius)

1794. *Asilus chinensis* Fabricius, *Ent. Syst.* **4** : 383. Type-locality : China.

1975. *Cophinopoda chinensis* : Oldroyd, *A Catalog of Diptera of the Oriental Region*, **2** : 129.

Material : 1 ♂, 2 ♀, South Andaman : Port Blair : Corbyn's Cove Beach, 14.i.1988 ; 2 ♀, Chiriatapu, 15.i.1988 ; 3 ♂, Rutland Island, 3.ii.1988, all Coll. A. N. T. Joseph.

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

1821. *Ommatius* Wiedemann, *Dipt. Exot.* **1** : 213. Type-species : *Asilus marginellus* Fabricius ; designated by Coquillett (1910 : 579).

Key to species

1. Epandrium linear and gradually narrowed at apex 2
—Epandrium stout, hind femur with a postero-ventral 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

1983. *Ommatius andamanensis* Joseph & Parui, *Ent. Scand.* **14** : 90. Type-locality : Mannarghat, S. Andaman.

Material : Holotype ♂, ZSI. Reg. No. 7641/H6 ; ***Paratype*** ♀, Reg. No. 7642/H6, S. Andaman : Mannarghat, 1.iv.1964, Coll. B. S. Lamba.

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.

Holotype ♂, Reg. No. 7614/H6, Little Andaman, Hut Bay, Government School, 23.i.1988, Coll. A. N. T. Joseph and Party. *Paratype* ♂, Reg. No. 7615/H6, Little Andaman : Ramakrishnapuram, 19.i.1988, Coll. A. N. T Joseph and Party.

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

1983. *Ommatius nicobarensis* Joseph & Parui, *Ent. Scand.* **14** : 91. Type-locality : Compbell Bay, Great Nicobar.

Material : 2♂, 1♀, South Andaman : Port Blair : Corbyn's Cove Beach, 14.i.1988 ; 1♂, Little Andaman : Ramakrishnapuram, 20.i.1988 ; 1♂, 1♀, Little Andaman : Hut Bay, 21.i.1988 ; 4♂, 11♀, Hut Bay, 22.i.1988 ; 2♀, Hut Bay : Government School compound, 23.i.1988 ; 3♀, Hut Bay, 27.i.1988 ; 3♂, 2♀, Harmendar Bay, 28.i.1988 ; 1♂, 4♀, Vivekanandapuram, 29.i.1988, all Coll. A. N. T. Joseph.

Distribution : So far the species has been recorded only from Nicobar. It is recorded here for the first time from Andaman.

Genus **Astochia** Becker

1913. *Astochia* Becker, *Ann. Mus. Zool. Acad.* St. Petersbourg, 17 : 538. Type-species : *Astochia metatarsata* Becker ; monotypic.

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 ♂, Reg. No. 7623/H6, S. Andaman, South Point, 24.i.1988, Coll. A. N. T. Joseph and Party. *Paratypes* 6♂, 9♀, Reg. No. 7624/H6 to 7638/H6, Little Andaman, Netaji Nagar, 17.i.1988, Coll. A. N. T. Joseph and Party ; 1♂, 1♀, 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 shishodiai* n. sp. can be separated from all the other known regional species by this together with the narrow epandrium.

Genus **Heligmoneura** Bigot

1858. *Heligmoneura* Bigot, in Thomson, *Arch. Ent.* 2 : 356. Type-species : *Heligmoneura modesta* Bigot, 1858 : 356 ; monotypic.

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

1980. *Heligmoneura andamanensis* Joseph & Parui, *Ent. Scand.* **11** : 284. Type-locality : South Andaman.

Material : 1♂, 5♀, Little Andaman : Ramakrishnapuram, 19.i.1988 ; 6♂, 3♀, 20.i.1988, rest of data as in preceding ; 1♂, Little Andaman : Hut Bay, 21.i.1988 ; 5♂, Hut Bay : Government School Compound, 23.i.1988 ; 8♂, 6♀, Vivekanandapuram, 29.i.1988 ; all Coll. A. N. T. Joseph.

Distribution : The species has so far been recorded only from Andaman.

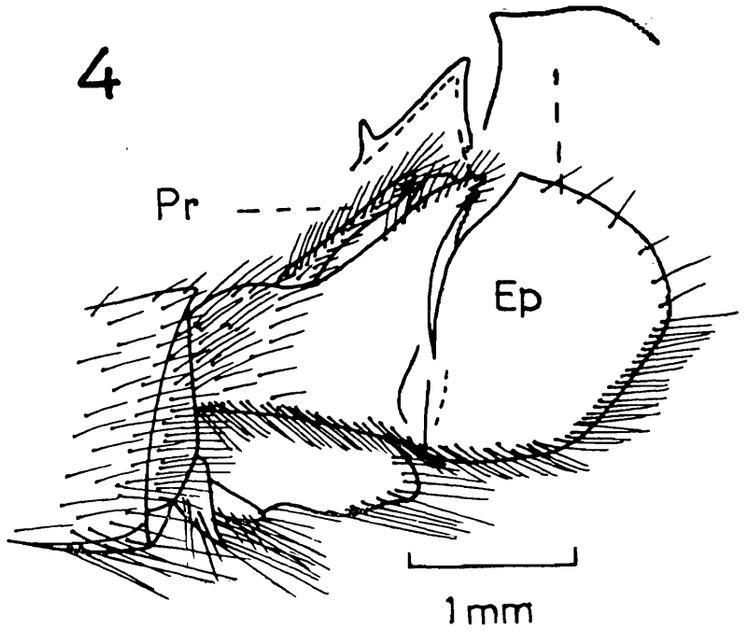
12. **Heligmoneura mehtai** n. sp.

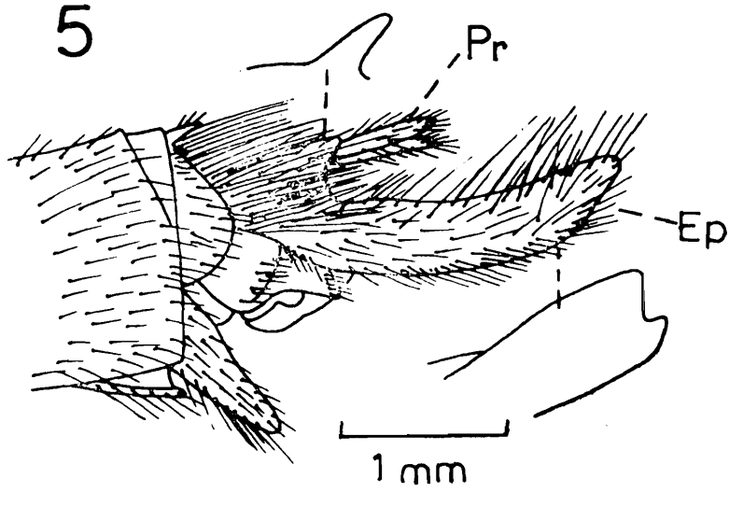
(Fig. 4)

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. *Heligmoneura mehtai* n. sp., lateral view of male genitalia.
5. *Promachus pseudocontractus* 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 ususal 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.

Holotype ♂, Reg. No. 7620/H6, S. Andaman, South Point, 24.i.1988, Coll. A.N.T. Joseph and Party. *Paratypes* : 1 ♀, Reg. No. 7621/H6, rest of data as in holotype ; 1 ♂, Reg. No. 7622/H6, Little Andaman, 4 Kms from Hut Bay, 21.i.1988, Coll. A.N.T. Joseph and party.

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 Osterrichischen Fregatte Novara*, Dipt. : 179, Type-locality : Sri Lanka.
Philodicus ceylanicus : Joseph & Parui, *Oriental Ins.* 17 : 361

Material : 27 ♂, South Andaman : Port Blair : Corbyn's Cove Beach, 1.ii.1988, Coll. A.N.T. Joseph.

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

1848. *Promachus* Loew, *Linn. Ent.* 3 : 390. *Asilus maculatus* Fabricius ; designated by Coquillett (1910 : 595).

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)

1860. *Trupanea apivorus* Walker, *Trans. ent. Soc. Lond.* 5 : 282. Type-locality : Burma.
1975. *Promachus apivorus* : Oldroyd, *A Catalog of Diptera of the Oriental Region*, 2 : 152.

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 Osterreichischen Fregatte Novara, Dipt.* : 177. Type-locality : Kar Nicobar, Nicobar Islands.
1983. *Promachus nicobarensis* : Joseph & Parui, *Oriental Ins.* 17 : 368.

Material : 3 ♂, S. Andaman : South Point, 24. i. 1988, Coll. A.N.T. Joseph.

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, medially 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 postalans, 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.

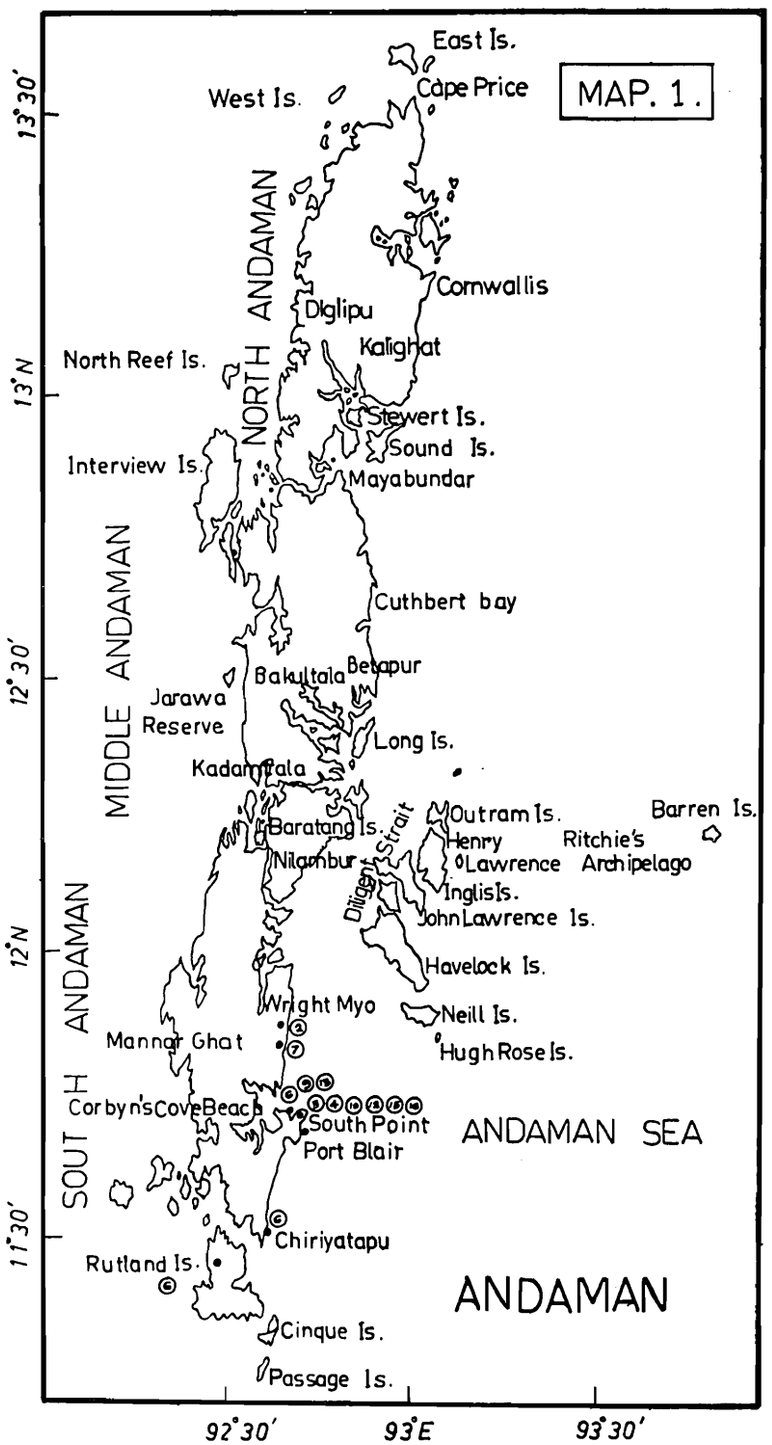
Wing light brown with a grey streak in the first submarginal cell.

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.

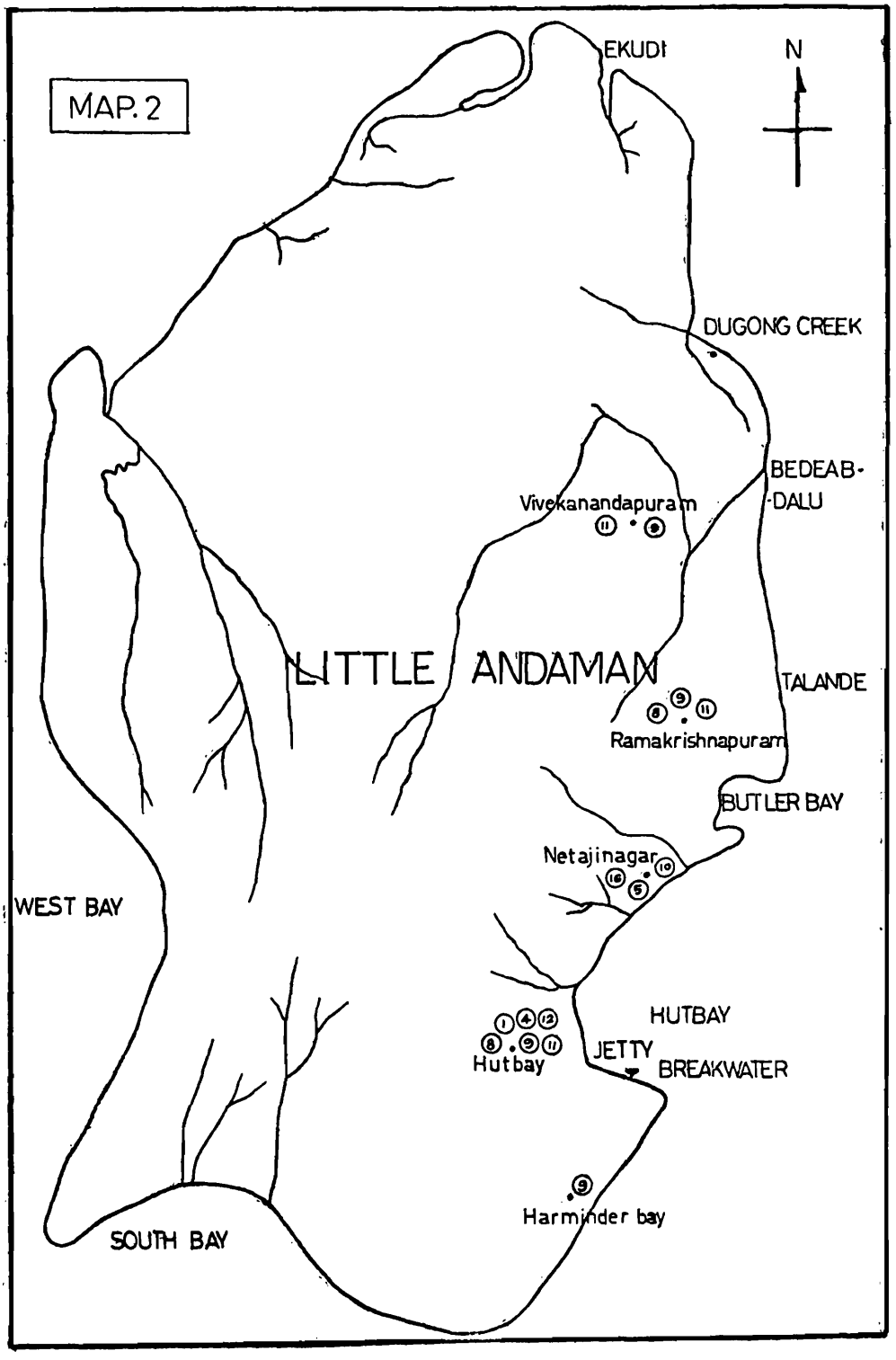
Holotype ♂, Reg. No. 7608/H6, S. Andaman : South Point, 24. i. 1988, Coll. A. N. T. Joseph & Party. *Paratypes* : 3 ♂, Reg. No. 7609/H6 to 7611/H6, rest of

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, *Heligmoneura 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 shishodiai* n. sp.; 11, *Heligmoneura 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. Incidently, 7 more species are reported from Nicobar : *Clinopogon nicobarensis* (Schiner), *Ommatius frauenfeldi* 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

*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

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ABBREVIATIONS

Ae, aedeagus ; Ep, epandrium ; Gc, gonocoxite ; Gs, gonostylus ; Hy, hypandrium ; L, lamella ; Pr, proctiger.