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

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ULTRA-STRUCTURAL STUDIES OF HAIRS OF SEVENTEEN SPECIES OF CARNIVORES MAMMALS USING SCANNING ELECTRON MICROGRAPHS

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Zoological Survey of India, Calcutta

INTRODUCTION

The illegal trade in skin of a number of Wild animals exists in India despite the introduction of Wild Life (Protection) Act. It is becoming difficult for the scientists and large enforcement agencies such as wildlife department, customs, etc., to punish the offenders. It is often difficult to identify the material based on the morphological characteristics. This study attempts to provide the surface ultra-structure of dorsal guard hairs of 17 species of carnivores mammals using Electron Micrographs.

The study on hairs dates back to eighteenth century. In recent years, hair study has become one of the outstanding disciplines in science due to its manifold implications such as identification of prey species from the gut contents and scats of large predator-species.

Scanty information is available regarding ultra-structural details using SEM on mammalian hairs (Day, 1966 ; Short, 1978 ; Homan & Genoways, 1978 and De, 1993). Therefore, the present study is made on 17 species of carnivores under six families enlisted in CITES and Schedule I & Part II of Schedule II of Indian Wild Life (Protection) Act, 1972.

MATERIAL AND METHODS

Five to six dorsal guard hairs from 17 carnivore's species of mammals were collected with the help of a fine scissor and a fine forcep from the identified National Zoological Collections of the Zoological Survey of India, Calcutta. Collected samples were washed and cleaned with different dilutions of acetone, and air dried. The samples were coated with carbon and gold in a vacuum evaporator JEE-4X, and scanned using Jeol JSM—840A.

RESULTS

The surface structure of hairs of each species shows cuticular scales, with variable inter-scalar portion and diameter (Table I).

Hairs of *Canis aureus* and *Canis lupus* possess flattened scales with slightly crenated margins along the entire length of the hair (Figs. 1 to 5). Mosaic pattern scales are observed on the hairs of *Felis bengalensis*, *Felis chaus* and *Felis marmorata* (Figs. 23 to 28). Highly crenated and short wide scales are found on the hairs of *Panthera tigris* (Figs. 33 & 34). Hairs of *Felis concolor* and *Felis rubiginosa* have thickly arranged cortical scales, with flattened edges (Figs. 29 to 32).

Herpestes edwardsi and *Herpestes smithi* possess hairs having narrow scale and smooth margins (Figs. 15 to 18), whereas hairs of *Herpestes auropunctatus* and *Herpestes urva* contain irregular petal-shaped scales (Figs. 13, 14 & 19, 20). Short wide scales with crenated edges are observed on the hairs of *Melogale personata* (Figs. 11 & 12). Flattened cuticular scales with flattened margin is found on the hair of *Arctonyx collaris* (Fig. 9), whereas hair of *Mellivora capensis* possess broad cuticular scales, with heavily crenated margins (Fig. 10). Regularly arranged cortical scales with crenated margins are found on the hair of *Ailurus fulgens* (Figs. 6 to 8).

DISCUSSION

From the scale pattern of different carnivores, it is observed that flattened scales with slightly crenated margins occur in the family Canidae and mosaic pattern occur in three species and thickly arranged scales with flattened edges in two species of the family Felidae.

One species of Viverridae has short wide scales, with highly crenated margin, other two species contain narrow scales with smooth margins and another two species contain irregular petal form of cortical scales.

Crenated margined cuticular scales are found in two species of Mustelidae and flattened cuticular scales with flattened margin in another one species. Hairs of one species of Procyonidae has regularly arranged cortical scales with crenated margin.

In the present study it is found that diameter of hair shaft is not specific and it varies from root up to the tip, as observed by Short (1978).

TABLE No : I

Name of the specimen	Family	Diameter	Mean of the inter-scalar portion
<i>Canis aureus</i> Linnaeus, 1758	Canidae	63.8 μ	20.2 μ
<i>Canis lupus</i> Linnaeus, 1758	"	55.2 μ	7.759 μ
<i>Ailurus fulgens</i> F. Cuvier, 1825	Procyonidae	74.5 μ	
<i>Arctonyx collaris</i>	Mustelidae	56.4 μ	12.08 μ
<i>Melivora capensis</i> (Schreber, 1776)	"	69.4 μ	14.526 μ
<i>Melogale personata</i> I. Geoffroy, 1831	"	133.3 μ	8.752 μ
<i>Herpestes auropunctatus</i> (Hodgson, 1836)	Viverridae	58.8 μ	5.55 μ
<i>Herepestes edwardsi</i> (E. Geoffroy, 1818)	"	103.3 μ	9.06 μ
<i>Herepestes smithi</i> Gray, 1837	"	126.0 μ	8.875 μ
<i>Herpestes urva</i> (Hodgson, 1836)	"	116.0 μ	10.06 μ
<i>Hyaena hyaena</i> (Linnaeus, 1758)	Hyaenidae	91.4 μ	13.93 μ
<i>Felis bengalensis</i> Kerr, 1792	Felidae	77.4 μ	6.012 μ
<i>Felis chaus</i> Guldenstaedt, 1776	"	81.3 μ	19.27 μ
<i>Felis marmorata</i> Martin, 1837	"	60.0 μ	14.14 μ
<i>Felis rubiginosa</i> I. Geoffroy, 1831	"	47.2 μ	16.804 μ
<i>Felis concolor</i> Linnaeus, 1771	"	69.3 μ	6.126 μ
<i>Panthera tigris</i> (Linnaeus, 1758)	"	65.9 μ	11.456 μ

The width of inter-scalar portion may have some significance in identifying different mammalian species, if it is considered with other parameters *viz.*, length, width, cross-sectional appearance, and pigment patterns, etc. (Short, 1978, Homan & Genoways, 1978). More and more studies are required to establish a concrete differences between species.

CONCLUSION

So far, identification of hairs is done based on the cuticular and medullary patterns by making cross-section. Till to-day, no laboratory has established a method for their identification by any other means. In view of the above situation, the present study was conducted. A large number of endangered and vulnerable animal species are poached regularly for trade for products obtained from them. Identification of animal species based on morphological characteristics is possible only if the large body parts are available. Therefore, it is important to develop a technique which could enable the identification of species from the hair. The present study is aimed at serving the need to some extent.

SUMMARY

Scanning Electron Microscopic (SEM) observations were made on the dorsal guard hairs of 17 species of mammals belonging to schedule I and part II of schedule II of the Wild life (Protection) Act. Results show that the micrographs of six families of carnivores differ in their morphology and inter-scalar portion. The present study is aimed at providing an atlas of the ultra-structure of hairs using SEM. It is apparent that the micrographs of hairs can provide a valuable tool to Wild Life researchers, customs department and other groups of investigators in identification of the animal species.

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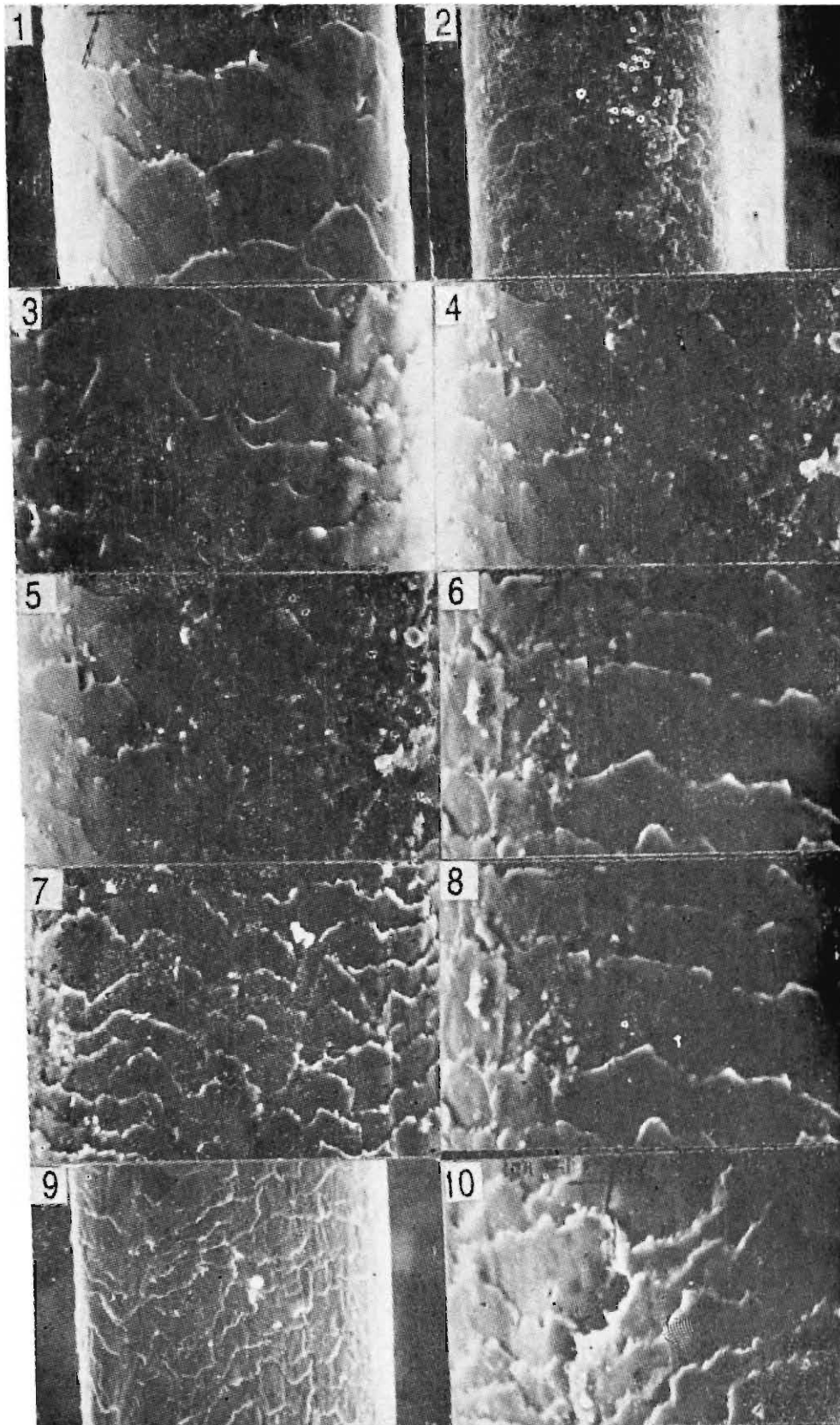


Fig. 1—10 Scanning Electron micrographs of mammalian hairs
Figs. 1 & 2 *Canis aureus* (X2, 500, X1, 700)
Figs. 3 — 5 *Canis lupus* (X2, 500, X2000, X2000)
Figs. 6 — 8 *Ailurus fulgens* (X2000, X1700, X2000)
Fig. 9 *Arctonyx colluris* (X750)
Fig. 10 *Melivora capensis* (X3000)

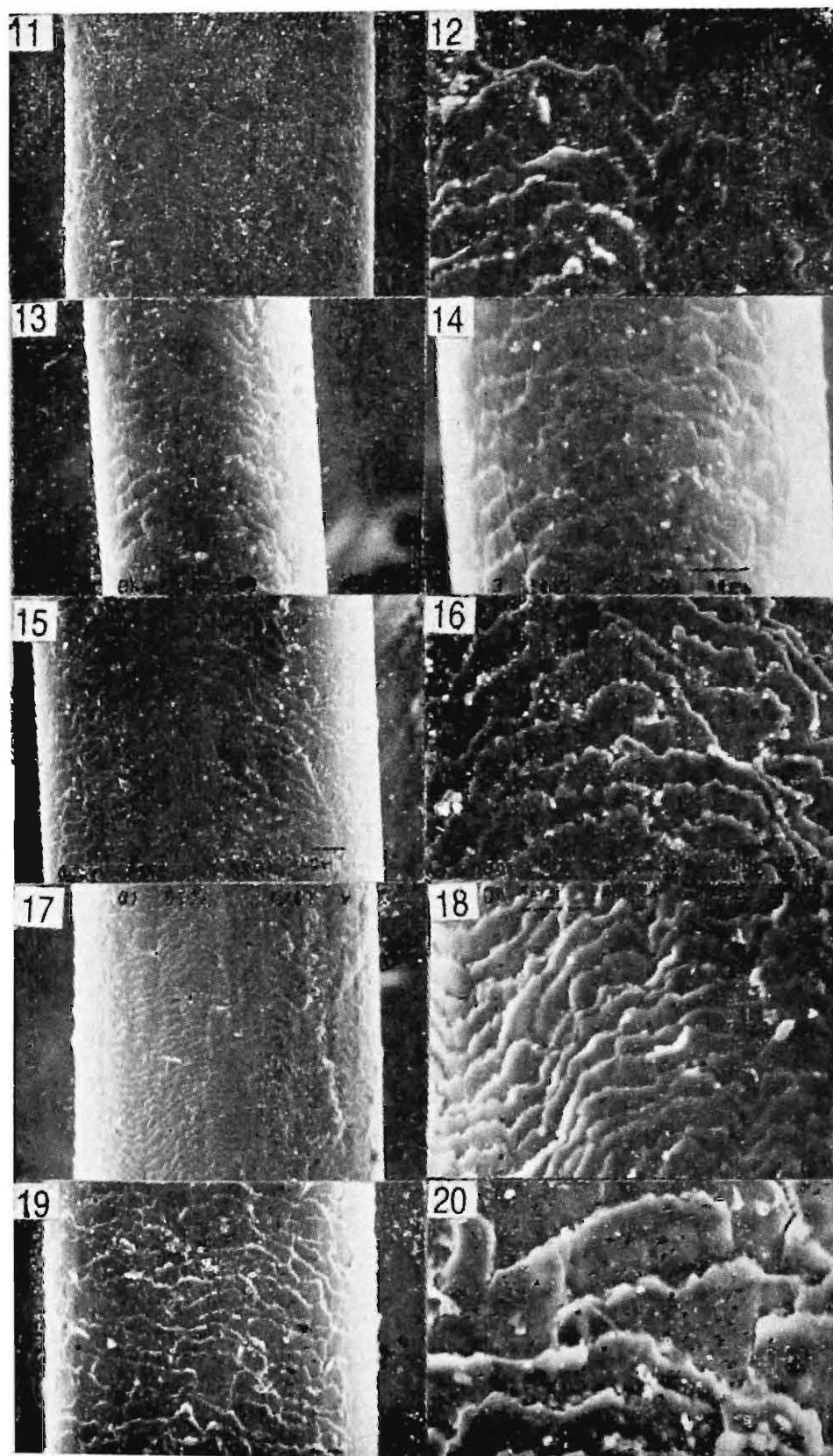


Fig. 11—20 *Scanning Electron micrographs of mammalian hairs*
Figs. 11 & 12 *Melogale personata* (X600, X2000)
Figs. 13 & 14 *Herpestes aurepunctatus* (X1700, X1700)
Figs. 15 & 16 *Herpestes edwardsi* (X800, X2000)
Figs. 17 & 18 *Herpestes smithi* (X650, X2000)
Figs. 19 & 20 *Herpestes urva* (X800, X2000)

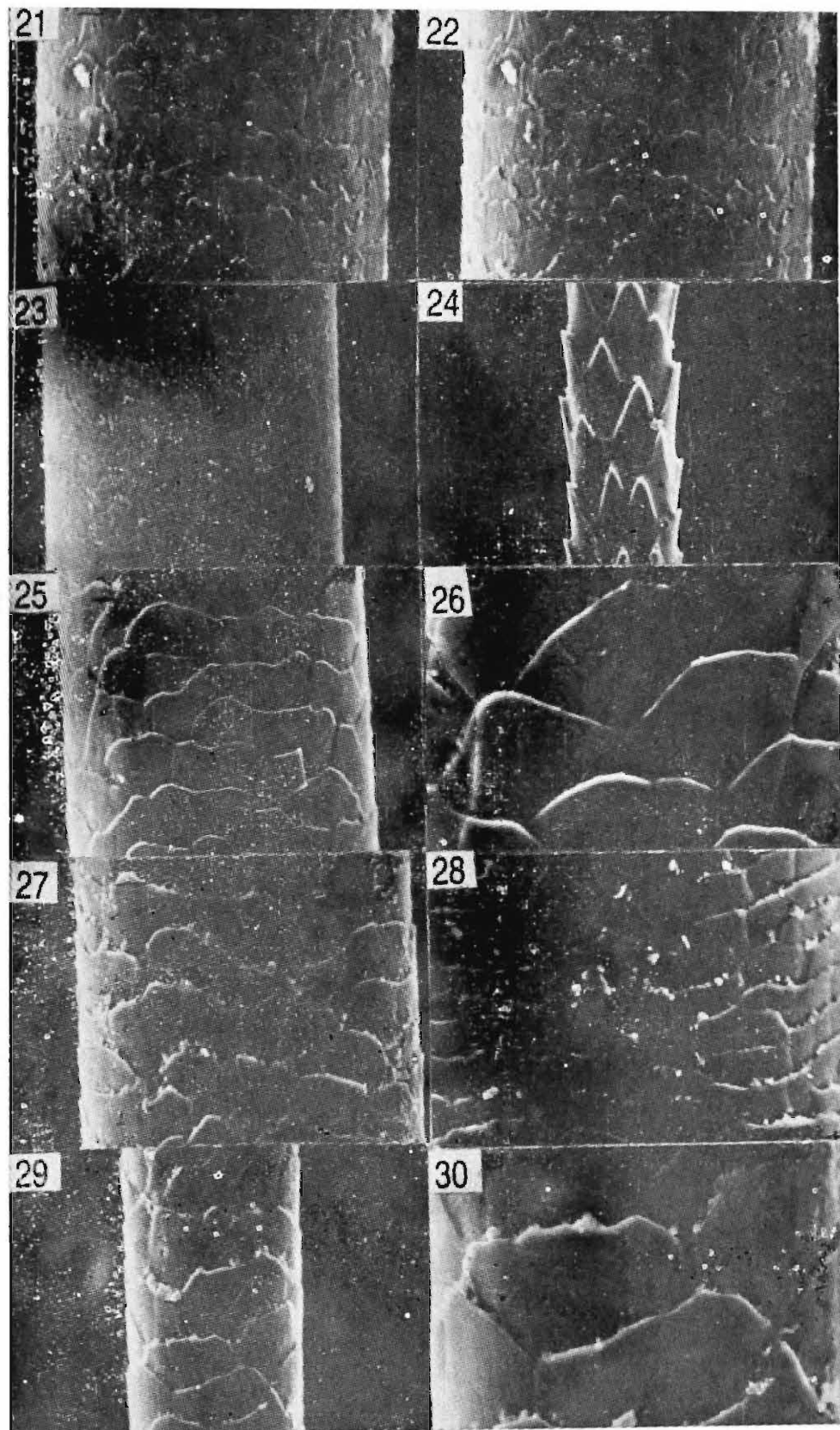


Fig. 21—30 *Scanning Electron micrographs of mammalian hairs*
Figs. 21 & 22 *Hyaena hyaena* (X1000, X2000)
Figs. 23 & 24 *Felis bengalensis* (X1000, X2000)
Figs. 25 & 26 *Felis chaus* (X1000, X2000)
Figs. 27 & 28 *Felis marmorata* (X1500, X2000)
Figs. 29 & 30 *Felis rubiginosa* (X1000, X2000)

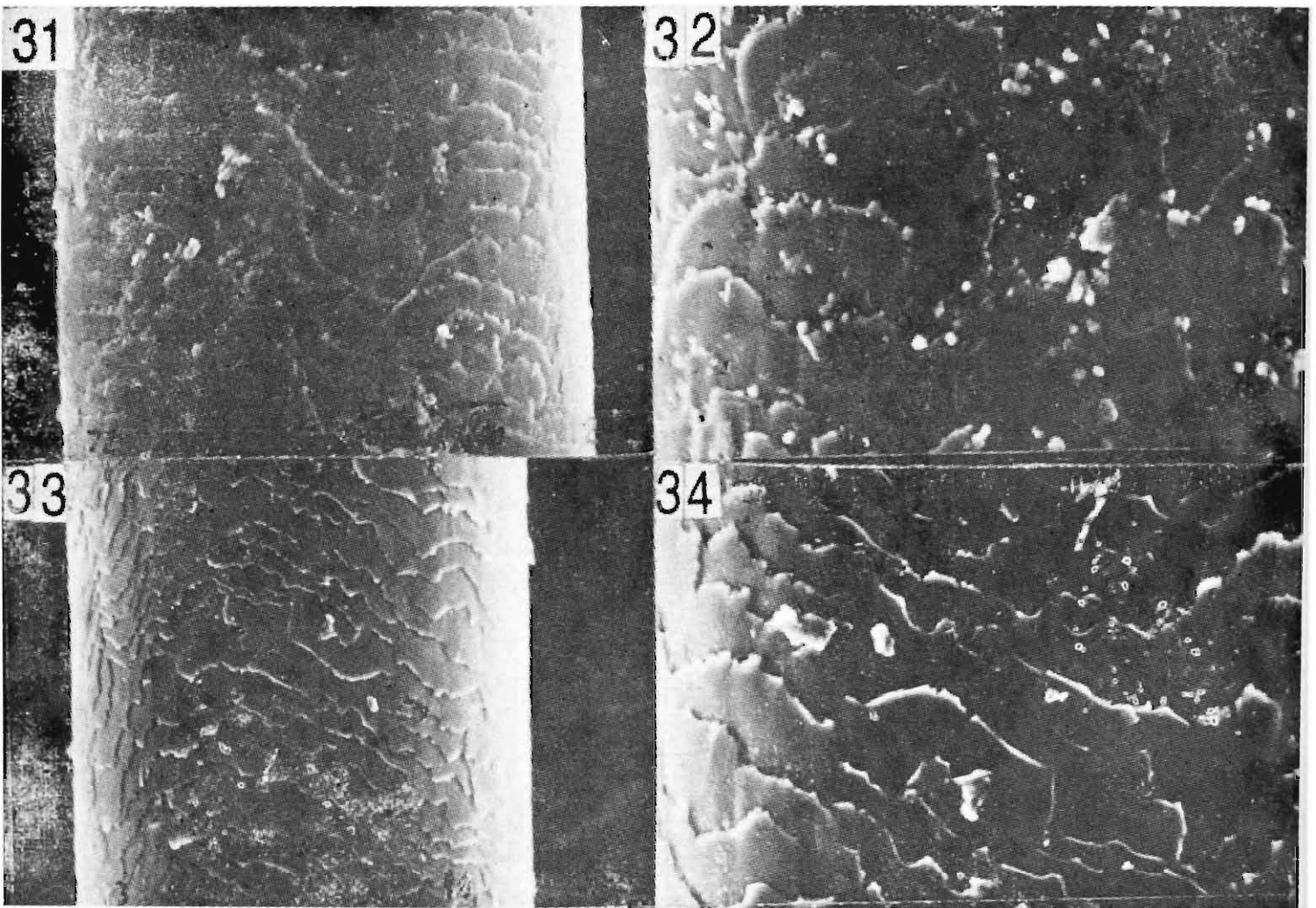


Fig. 31—34 *Scanning Electron micrographs of mammalian hairs*
Figs. 31 & 32 *Felis concolor* (X1300, X2000)
Figs. 33 & 34 *Panthera tigris* (X1000, X2000)

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TWO NEW SPECIES OF A LITTLE KNOWN GENUS *MYRMECINA*
CURTIS (INSECTA : HYMENOPTERA : FORMICIDAE)
FROM KERALA, INDIA

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INTRODUCTION

The genus *Myrmecina*, described by Curtis (1829) for the reception of Type-species *Myrmecina latreilli* from South of England, belongs to subfamily Myrmecinae of the family Formicidae. Altogether 20 species under this genus (mostly small sized) have been reported from the world, viz., *M. bandarensis* Forel, 1913, *M. brevicornis* Emery, 1897, *M. butteli* Forel, 1913, *M. curtisi* Donisthorpe, 1829, *M. graminicola* (Latreille, 1802), *M. mandibularis* Vichmeyer, 1914, *M. opeiventris* Emery, 1897, *M. pilicornis* Smith, 1858, *M. polita* Emery, 1897, *M. punctata* Emery, 1897, *M. sauteri* Forel, 1912, *M. semipolita* Forel, 1905, *M. striata* Emery, 1890, *M. sulcata* Emery, 1887, *M. transversa* Emery, 1897, *M. undulata* Emery, 1900, *M. rugosa* Forel, 1902, *M. siculo* André', 1882. This genus is Indo-Malayan and Indo-Australian in distribution and has been reported from India, Burma, Sumatra, Kalimentau, China, Sulawesi, Taiwan, Java, New Guinea and New-Zealand.

The author wanted to place both the species under a new genus, basing on the nature of transverse striation on prothorax, and convergent longitudinal striation giving a shape of "Y" on the rest of alitrunk, which has never been reported in the species described under genus *Myrmecina* till date. However, for the time being, the species are described here under genus *Myrmecina*. In course of time, if the author comes across some other species and gets sufficient characters to separate it from *Myrmecina*, the new genus would be erected.

Myrmecina pilicornis ♂ Smith, 1858 from Bombay (India) is a doubtful species. Bingham (1903) mentions, "*M. pilicornis* Smith, 1858 is possibly a *Tetramorium* sp." If this may be the case, the record of this genus from India is a new record from Indian subcontinent.

Myrmecina urbanii sp. nov.

(Fig. 1, a-d)

Description : Worker : Head and alitrunk dark reddish-brown ; antennae and pedicel paler ; legs brownish yellow ; abdomen dark brown, laterally and apically brownish yellow. Body fairly densely hairy ; mandibles fairly hairy ; clypeus with a few long anteriorly directed hairs.

Head capsule sub-squarish, deeply emarginate at posterior margin ; postero-lateral angles rounded ; dorsal surface longitudinally striated, sides weakly convex. Clypeus bi-carinate and tridentate, carinae fused with postero-lateral ridges. Eyes small (0.05 mm in diameter), round to oval, situated antero-laterally in front of middle of head and surrounded by paler area. Mandibles smooth, hairy ; masticatory margins with three teeth, molar plate with a number of round crenulations. Antennae 12-segmented ; scape shorter than flagellum, reaching almost upto the hind margin of the head or weakly extending beyond ; 1st segment of flagellum longer than succeeding segments ; club formed of 3 segments, apical segment of club longer than its two preceding segments put together.

Alitrunk convex above, triangular, gradually tapering posteriorly ; pronotum striated transversely ; meso and metanotum with posteriorly converging longitudinal striae, forming a distinct 'Y' shaped structure at its base ; anterior margin of pronotum round with narrow, rectangular collar ; pro-meso and meso-metanotal sutures somewhat discernible laterally ; pronotum armed with a small spine on each antero-lateral corner, spines directed downwards ; mesonotum armed with a pair of small acute spines, thick at base and situated at the postero-lateral end of the mesonotum ; metanotum armed with a pair of long spines directed outwards and slightly bent upwards at tips. Legs long ; fore tibia with a pectinate spur, pectination visible only under high power ; tarsi 5-jointed, with a pair of claws at the tip, 1st joint longer than succeeding joints put together. Pedicel 2-jointed ; 1st joint of pedicel longer than broad, flat dorsally and with weak longitudinal striae ; 2nd joint broader than long, coarsely striated, attached to the emarginated anterior end of abdomen.

Gaster broadly oval, truncated anteriorly to enclose the posterior end of post petiolar node ; smooth, in profile rounded beneath.

<i>Measurements</i>	<i>Range in mm. (2 exs.)</i>		
Total length of body (excluding antennae)	3.2	—	3.4
Length median of head including clypeus	0.77	—	0.87
Head width	0.73	—	0.75
Length of the scape	0.86	—	0.88
Maximum width of alitrunk	0.50	—	0.60
Maximum length of alitrunk	0.66	—	0.77
Maximum width of 1st pedicel	0.21	—	0.25
Maximum width of 2nd pedicel	0.27	—	0.30
Head Index (head length x 100/max. width)	96.70	—	103.90
Scape Head length Index (scape length x 100/head length)	112.5	—	112.9
Scape head width index (scape length x 100/head width)	116.8	—	117.0
Pedicel index (width of anterior pedicel x 100/width of posterior pedicel)	77.78	—	85.19

Holotype : 1 worker. India : Kerala : Thekkadi (2500 ft.), March, 1969 (coll. No. 029/4), coll. O.B. Chhotani and R. N. Tiwari. *Paratype* : 1 worker, same data as of *Holotype*.

Remarks : This species is similar to *M. striata* Emery (1890) in having colour pattern of the body, pilosity and pubescence, placement of the eye, scape reaching up to the top of the head ; but it differs with the same in having following characters : transverse striations on alitrunk, 'Y'-shaped striation on meso and metanotum, mesonotum armed with a pair of small acute spines and head longer than broad. The species is named in Honour of eminent Myrmecologist Dr. C.B. Urbani, Zoological Institute of the University, Rheinspring 9, CH-4051 Basel, Switzerland, and Naturhistorisches Museum Basel, CH-4001 Basel, Switzerland.

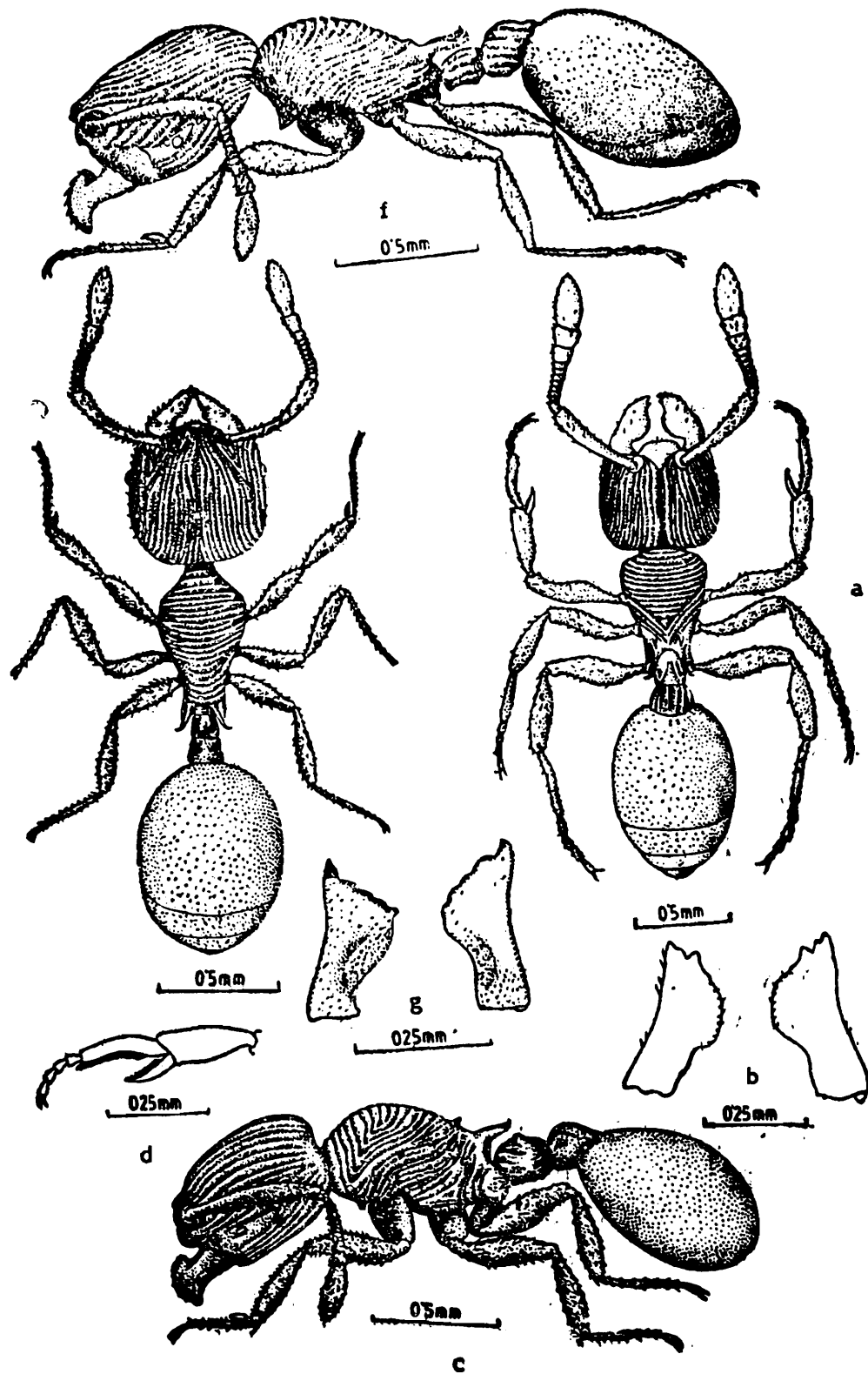


Fig. 1 (a-d): *Myrmecina urbanii* sp. nov.: (a) body, dorsal view; (b) mandibles, dorsal view; (c) body, lateral view; (d) anterior leg.

(e-g): *Myrmecina vidyae* sp. nov.: (e) body, dorsal view; (f) body, lateral view; (g) mandibles, dorsal view.

Myrmecina vidyae sp. nov.

(Fig. 1, e-g)

Description : Worker : Head excluding clypeus, antennae and mandibles, alitrunk, abdomen and post-petiolar node dark chocolate with blackish tint. Antennae, clypeus, mandibles, legs, metanotal spines and 1st petiolar node pale yellow. Hairs almost sparse on alitrunk, whitish in colour, rest of the body without hairs ; sparse pilosity on antennae, mandibles and dorsum of the abdomen.

Head excluding mandibles subsquarish, width slightly more than its length ; deeply emarginate at posterior margin ; postero-lateral angles of head slightly conical ; dorsal surface slightly striated, the striae outwardly divergent behind ; antennal carinae enlarged into a flap like structure covering the base of insertion of antennae. Clypeus non-carinate, anteriorly transverse and pressed, posteriorly extended in between the bases of antennae ; antennal and clypeal fossa confluent. Eyes small, round to oval, placed more anteriorly on antero-lateral side of the head, placement hardly differentiated from the surrounding portion of the head. Mandibles smooth, hairy, masticatory margin with one acute apical tooth ; molar plate with four round crenulations. Antennae 12-segmented, scape shorter than the flagellum ; 1st segment of the flagellum equal to 2 following segments put together ; club of flagellum formed of 3 apical segments ; scape hardly reaching to the top of the head.

Alitrunk convex above, triangular, gradually tapering posteriorly. Pronotum striated transversely ; meso and metanotum with slightly anteriorly divergent striae. Anterior margin of pronotum round with narrow triangular collar. Pro-meso and meso-metanotal suture somewhat discernible laterally ; pronotum armed with a small triangular spine on each antero-lateral corner ; mesonotum unarmed ; metanotum armed with a pair of long divergent spines, thick at the base, slightly bent outwardly at the apex, wide enough to enclose 1st petiolar node. Pedicel 2-jointed ; 1st joint longer than wide, rugose on its outer surface ; 2nd joint higher than the 1st, almost round, posterior end wider than the anterior with thick half downwardly divergent striae, the basal portion minutely granulated. Legs long ; tibiae of the fore leg with pectinate spur, pectination visible only under high power, femora and tibia swollen in middle ; tarsi 5-jointed with a pair of claws at the top ; 1st joint of tarsi smaller than the succeeding joints put together.

Gaster broadly oval with finer granulations on the dorsum, more prominent on the basal portion, distal portion comparatively with lesser granulations in profile rounded beneath.

<i>Measurements</i>	<i>Range in mm. (3 exs)</i>
Total length of body (excluding antennae)	2.28 — 3.00
Length median of head including clypeus	0.62 — 0.65
Head width	0.64 — 0.66
Maximum length of scape	0.52 — 0.55
Maximum width of alitrunk	0.46 — 0.49
Maximum length of alitrunk	0.08 — 0.09
Maximum width of 1st pedicel	0.18 — 0.19
Maximum width of 2nd pedicel	0.22 — 0.26
Head index (head length x 100/max. width)	96.8 — 98.2
Scape head length index (scape length x 100/head length)	83.87 — 84.0
Scape head width index (scape length x 100/head width)	81.2 — 81.5
Pedicel index (width of anterior pedicel x 100/width of post-pedicel)	81.8 — 82.2

Holotype : 1 worker. India : Kerala : Silent Valley Expedition camp site, 14.i.1980, coll. S. K. Bhattacharyya. **Paratypes** : 2 workers, same data as of Holotype.

Remarks : This species is close to *Myrmecina urbanii* sp. nov. in having body pattern, antennae, legs and thorax similar but it differs with the same in having following characters : mandibles with mandibular formula "1+6" i.e., one apical tooth and 6 small subapical teeth ; absence of mesonotal spine ; metanotal spines thinner and longer in shape ; striae on meso-metanotum outwardly divergent ; gaster not truncate anteriorly and having finer granulations all over the dorsum.

SUMMARY

This paper deals with the description of two new species of ants (Insecta : Hymenoptera : Formicidae), viz., *Myrmecina urbanii* sp. nov. and *Myrmecina vidyae* sp. nov. from Kerala, India. This genus is reported here for the first time from India.

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RODENT PESTS IN SOME CROPS OF GUJARAT

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INTRODUCTION

It is well established that by virtue of extremely adaptable nature, highly intelligent pattern of behaviour and tremendous potential to multiply, rodents maintain large population which cause considerable damage to crops in all stages of production and storage. However, intensity of damage differ according to rodent species, from crop to crop and from one ecological niche to another. Thus, for the formulation of an integrated control measure, it is necessary to study the rodent species composition, rodent population, intensity of damage, and crop pattern of the different ecological regions. Except the reports of BNHS Mammal Survey (1912-14) Madsen (1975), Shah (1979), Jhala *et al.* (1990), Mittal *et al.* (1991), and Rodent control measures undertaken in Gujarat (Anon, 1990, 91), we have very little knowledge about the rodent species, their population, and relationship with the agricultural crops of Gujarat.

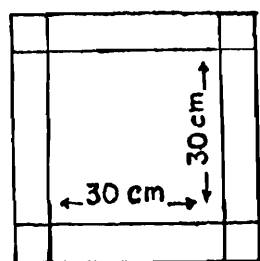
FAO of the united Nations reports that in the warmer regions of the world there are three rats per human inhabitant (Anon, 1975). Another report mentions that India's rodent population is as great as six times than that of humans (Anon, 1974). The impact of such population which is largely dependent on food grains is alarming. Recent estimates of India's food grain loss due to rodents are in millions of tons, at a cost of hundreds of millions of rupees (Srivastava 1968, Patnaik 1969). Such estimates are quite speculative, but the number of rodents and the extent of damage are indeed great. On the other hand, several field studies clearly showed that the cost-benefit ratio in rodent control operations in India ranges from 1 : 75 to 1 : 100 (Prakash 1976). Gujarat produces chief cash crops of India which also earns foreign exchange. Thus, an attempt has been made to fill up the lacunae between crop production and loss due to rodent menace,

STUDY AREA

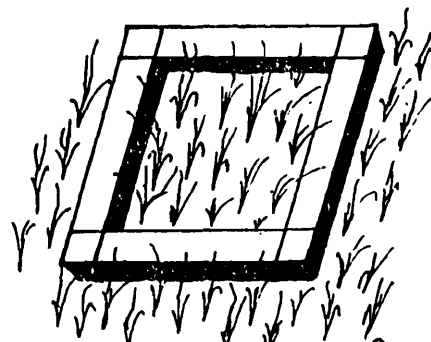
Gujarat, the western most state of India is bounded by Pakistan and Rajasthan at the north, Arabian Sea at the west and south and Madhya Pradesh and Maharashtra at the east. Politically it is divisible into nineteen districts of which Jamnagar, Rajkot, Surendranagar, Junagadh, Amreli, Bhavnagar, Dangs, Surat, Varuch, Vadodara were surveyed from 1990-1992.

MATERIAL AND METHODS

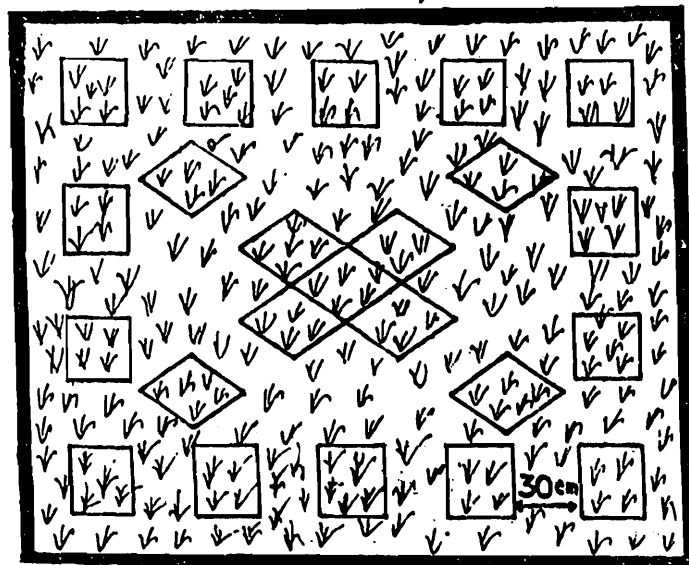
The present investigation was carried out in the crop fields, weed fields, barren lands and also in the godowns, residential areas and orchards. Systematic trappings



a) Sampling frame



b) Placement of sampling frame



c) Positions of sampling frames in a plot

FIG. 1

were conducted with Shermom, Break-back and wonder traps to find out the species composition. Yield loss has been expressed in terms of percent crop damage with a slight modification of the method of Posamentier and van Elsen (1984). Aluminium frames were selected for that, each frame covering an area of 2500 sq. cm., placed diagonally and peripherally (Fig. 1) at a distance of 30 cm in the selected fields. The plants in the squares were marked with small aluminium pieces. The damaged plants among the marked plants were counted from time to time at seedling, immature and mature stages. The aluminium frames can be disarticulated easily for carrying and resetting. Data based on at least 25 sample fields per taluka were compared and statistically analysed. The formula applied $D\% = 100 \times B/A$ where $D\%$ denotes percentage of damage, 'A' denotes number of plants counted, 'B' denotes total number of plants damaged.

Table 1. Rodent pests recorded from Gujarat and their Pest Status

Common Name	Scientific Name	Pest Status
Indian Antelope Rat	<i>Tatera indica</i> Hardwicke	+ + +
Indian Desert Gerbil	<i>Meriones hurrianae</i> (Jerdon)	+ +
Hairy footed Gerbil	<i>Gerbillus gleadowi</i> (Murray)	+
Common Indian Rat	<i>Rattus rattus</i> Linn.	+ + +
Cutch Rock Rat	<i>Cremnomys cutchicus</i> (Wroughton)	+
House Mouse	<i>Mus musculus</i> Linnaeus	+ + +
Indian Field Mouse	<i>Mus booduga</i> (Gray)	+
	<i>Mus dumni</i> Wroughton	+
	<i>Mus cervicolor</i> Hodgson	+
Brown spiny Mouse	<i>Mus platythrix</i> Bennett	+
Soft furred Metad	<i>Millardia meltada</i> (Gray)	+ +
Lesser Bandicoot Rat	<i>Bandicota bengalensis</i> Gray	+ + +
Large Bandicoot Rat	<i>Bandicota indica</i> (Bechstein)	+
Indian Bush Rat	<i>Golunda ellioti</i> (Gray)	+
Indian Crested Porcupine	<i>Hystrix indica</i>	+
Five striped Palm Squirrel	<i>Funambulus pennanti</i> Wroughton	+

+ + + Very serious and widespread

+ + Serious

+ Not so serious

RODENT SPECIES RECORDED

Tatera indica Hardwicke

The Indian Antelope Rat

Colour sandy brown, reddish dorsally and offwhite ventrally ; eyes large ; round ears with white patch above and behind the eyes and a spot behind the ears ; feet whitish, soles of hind foot naked and pale in colour ; tail darker with a pencil of black hairs. TL longer than HB which may ranges up to 187 mm. Mammae 8, BW 100-250 g (♂) and 70-200 g (♀).

Distribution : From Syria through Turkestan, Iraq, Iran, northern Saudi Arabia, Afganistan, Baluchistan to India and Sri Lanka.

Present records : Crop fields, weeds and barren lands, godowns, residential areas and orchards.

Meriones hurrianae (Jerdon)

The Indian Desert Gerbil

Dark sandy grey or brownish grey above, offwhite below ; feet whitish or light brown, soles partly haired. HB 106-143 mm, TL 100-164 mm, Hf 27-28 mm, E 8-12 mm, Mammae 8, BW 40-160 g.

Distribution : Southern Afganistan, SE Iran, Pakistan and Western India.

Present records : Crop fields, weeds and barren lands.

Rattus rattus Linnaeus

Common Indian Rat

Dorsal parts with various shades of grey, ventrally paler, long tail obviously

HB — Head and Body

BW — Body weight

Hf — Hind foot.

E — Ear,

more than HB length, body slender and snout pointed. Mammae usually $2+3=10$ or $3+3=12$.

Distribution : Throughout the world as a human commensal.

Present records : Crop fields, godowns, residential areas and orchards.

***Cremnomys cutchicus* (Wroughton)**
Cutch Rock Rat

Dorsally greyish and ventrally paler, HB 105-149 mm; tail normally longer than HB and fairly well haired; hind foot appears somewhat arboreal; mammae $1+2=6$.

Distribution : Peninsular India, Maharashtra and Gujarat.

Present records : Forested areas, weed fields, barren lands, and cotton cultivation.

Mus musculus
House Mouse

A small greyish mouse, HB 65-95 mm, TL 60-105 mm but generally longer than HB. BW 12-30 g.

Distribution : Perhaps naturally from the Mediterranean region to China, now found partly as a human commensal throughout the world.

Present records : Godowns, crop fields and residential areas.

***Mus booduga* (Gray)**
Indian Field Mouse

Tiny grey field mouse, HB 80 mm; slender, short, naked and bicolour tail, measuring 40-80 mm, BW ± 10 g.

Distribution : India, Sri Lanka and Mayanamar.

Present record : Cultivation.

Mus dunni Wroughton

Sympatric species of *M. booduga*, only differs by having an extra cusp on the anterior lamina of first upper molar; undersurface of body grey. HB \pm 77 mm, TL \pm 55 mm, Hf \pm 14.5 mm and E \pm 12 mm.

Distribution : India : West Bengal (Bankura dist.), Bihar, Gujarat, Orissa, Karnataka, Maharashtra and Uttar Pradesh.

Present records : Cultivation, weeds and barren lands.

Mus cervicolor Hodgson

Fawn coloured medium sized mouse, HB \pm 70 mm, TL \pm 65 mm and definitely shorter than HB length; BW 10-15 g.

Distribution : Found partly as a human commensal from Nepal to Manipur and Southern India. Perhaps introduced to Indochina, Sumatra and Java.

Present records : Crop fields, godowns, residential areas, orchards, weeds and barren lands.

Mus platythrix Bennett**Brown Spiny Mouse**

Colour brownish, HB 100 mm approx.; TL 90 mm approx.; hairs are crisp and usually tend to be spiny.

Distribution : India.

Present records : Crop fields, weeds and barren lands.

Millardia meltada (Gray)**Soft-furred Field Rat**

Fur soft, upper parts sandy grey, greyish brown or whitish buff lined with

brown ; underparts whitish or greyish ; tail dark above and light below. HB 80-200 mm, TL 68-186 mm, BW 70 g.

Distribution : Pakistan, India, Nepal and Sri Lanka.

Present records : Crop fields, weeds (in fodder growing fields).

***Gerbillus gleadowi* (Murray)**

Hairy footed Gerbil

Slender, sandy buff gerbil. sides and flanks paler ; underparts pale sandy grey or whitish. Tail longer than head and body, moderately well furred, proximal end darker and distal end darkest, underside lighter, fairly long ears ; hind foot very long, usually over 25 percent of the head and body length, claws fairly long and soles hairy. HB 50-130 mm, TL 70-150 mm, BW 20-40 g.

Distribution : Pakistan and western India.

Present records : Weeds and barren lands.

***Golunda ellioti* (Gray)**

Indian Bush Rat

Fur may be coarse and slender with fine spiny hairs or sometimes fairly soft with only a few harsh hairs. Coat generally thin but the hairs rather long. Upperparts greyish, yellowish brown, reddish brown or fairly dark brown ; underparts light grey, bluish grey or white. Head short and rounded ; ears rounded and hairy ; tail shorter than head and body and stout at the base, tapers towards the tip and covered with coarse short hairs. HB 110-115 mm, TL 90-130 mm, BW 50-80 g, Mammae 8.

Distribution : Pakistan, India, Nepal, Bhutan and Sri Lanka.

Present records : Weed fields, Barren lands and crop fields.

Bandicota bengalensis (Gray)
Lesser Bandicoot rat

Dark greyish brown speckled with buff, underside paler ; tail wholly dark, feet dark, digits paler. Robust build with rounded head and ears ; short and broad muzzle. Fur coarse, sometimes with long blacktipped piles throughout the upper surface. HB 132-266 mm, TL 130-180 mm, shorter than head and body. Mammae 12-18.

Distribution : From Pakistan to Myanmar, Sri Lanka, Penang Island off west coast of Malay Peninsula, Sumatra and Java.

Present records : Crop fields, weeds and barren lands, godowns, residential areas and orchards.

Bandicota indica (Bechstein)
Large Bandicoot Rat

Very large rat, dorsum blackish or blackish brown, underparts grey, drab or dark. Tail usually shorter than head and body, naked with certain growth of short hairs throughout its length. Fur harsh, with plenty of long hairs on the back ; ears rounded, limbs very powerful ; mammae 12. HB 200-366 mm, TL 130-258 mm, BW 500-1000 g but may reach up to 1,500 g (Grzimek, 1975).

Distribution : From Rajasthan south and east to almost throughout India ; Bangladesh of SE. Asia.

Present records : Residential areas and godowns.

Funambulus pennanti Wroughton
Five-striped Palm Squirrel

A medium sized rodent with bushy tail which may be equal to head and body length. Dorsum brownish grey with five whitish stripe separated by four off white bands. Three middle stripes longer than the two lateral ones. Colour of the tail basally white with a blackish mid portion and whitish tip. Ears small and covered with soft fur. HB 115-178 mm.

Distribution : India, Pakistan and Nepal.

Present records : Orchards, residential areas, sugarcane and groundnut cultivation.

***Hystrix indica* Kerr**
Indian Porcupine

Hairs modified more or less completely into spines; neck and shoulders crowned with a crest of bristles about 15-30 cm long; quills on the back very profuse and ornamented with dark brown or black and white rings; large white rattling quills on the tail. HB 700 900 mm, TL 80-100 mm, BW 11-18 kg.

Distribution : From India, westwards through Persia and Baluchistan to Syria, Asia minor and Palestine.

Present records : Restricted to the crop fields near forested areas.

Table 2. Rodent species recorded from different crop fields

Bajri & Jowar	<i>Tatera indica</i> , <i>Bandicota bengalensis</i> , <i>Mus booduga</i> .
Maize	<i>Bandicota bengalensis</i> , <i>Millardia meltada</i> , <i>Tatera indica</i> .
Wheat	<i>Bandicota bengalensis</i> , <i>Millardia meltada</i> , <i>Tatera indica</i> , <i>Mus musculus</i> , <i>Mus booduga</i> .
Pulses	<i>Tatera indica</i> , <i>Bandicota bengalensis</i> , <i>Meriones hurrianae</i> , <i>Millardia meltada</i> , <i>Rattus rattus</i> , <i>Mus dunni</i> , <i>Mus musculus</i> , <i>Mus booduga</i> .
Rice	<i>Bandicota bengalensis</i> , <i>Tatera indica</i> , <i>Millardia meltada</i> , <i>Mus platythrix</i> , <i>Mus dunni</i> , <i>Mus musculus</i> , <i>Mus booduga</i> , <i>Mus cervicolor</i> .
Cotton	<i>Bandicota bengalensis</i> , <i>Tatera indica</i> , <i>Millardia meltada</i> , <i>Mus platythrix</i> , <i>Mus dunni</i> , <i>Mus musculus</i> , <i>Mus booduga</i> , <i>Mus cervicolor</i> , <i>Cremnomys cutchicus</i> .
Sugarcane	<i>Bandicota bengalensis</i> , <i>Tatera indica</i> , <i>Golunda ellioti</i> , <i>Millardia meltada</i> , <i>Mus booduga</i> , <i>Mus platythrix</i> , <i>Funambulus pennanti</i> , <i>Hystrix indica</i> .

Groundnut	<i>Tatera indica</i> , <i>Bandicota bengalensis</i> , <i>Millardia meltada</i> , <i>Meriones hurrianae</i> , <i>Mus platythrix</i> , <i>Mus musculus</i> , <i>Mus</i> <i>cervicolor</i> , <i>Funambulus pennanti</i> , <i>Hystrix indica</i> .
Orchards	<i>Funambulus pennanti</i> , <i>Rattus rattus</i> , <i>Bandicota bengalensis</i> .
Vegetable Cultivation	<i>Bandicota bengalensis</i> , <i>Millardia meltada</i> , <i>Golunda ellioti</i> , <i>Rattus rattus</i> , <i>Hystrix indica</i> .
Chillie Cultivation	<i>Meriones hurrianae</i> , <i>Tatera indica</i> , <i>Mus booduga</i> , <i>Bandicota</i> <i>bengalensis</i> .

Table 3. Percentage of rodent species recorded from residential areas and godowns

<i>Rattus rattus</i>	49
<i>Mus musculus</i>	32
<i>Bandicota bengalensis</i>	} 19
<i>Bandicota indica</i>	
<i>Tatera indica</i>	
<i>Funambulus pennanti</i>	
<i>Mus cervicolor</i>	

Table 3A. Percentage of rodent species recorded from weed fields and barren lands

<i>Gerbillus gleadowi</i>	18.7
<i>Tatera indica</i>	43.0
<i>Meriones hurrianae</i>	19.3
<i>Golunda ellioti</i>	4.5
<i>Bandicota bengalensis</i>	7.0
<i>Mus dunnii</i>	} 4.6
<i>Mus cervicolor</i>	
<i>Mus platythrix</i>	
<i>Millardia meltada</i> (only in fodder growing fields)	2.1
<i>Cremnomys cutchicus</i>	0.8

Table 4. Percent damage of different crops

	Seedling	Flowering	Fruits (Immature)	Fruits (Mature)
Rice (<i>Oryza sativa</i>)	0.2	1.3	10.7	30.2
Bajri (<i>Pennisetum typhoides</i>)	—	2.7	8.3	34.3
Jowar (<i>Andropogon sorghum</i>)	0.7	—	3.8	27.8
Wheat (<i>Triticum aestivum</i>)	0.8	1.8	11.2	31.8
Maize (<i>Zea mays</i>)	—	1.2	14.3	30.0
Sugarcane (<i>Saccharum officinarum</i>)	2.8	—	8.7	20.1
Groundnut (<i>Arachis hypogaea</i>)	4.5	—	2.8	42.7
Cotton (<i>Gossypium</i> sp.)	—	—	23.3	18.2
Chilly (<i>Capsicum frutescens</i>)	0.0	—	1.1	15.0
Potato (<i>Solanum tuberosum</i>)	7.2	—	2.2	27.5
Sweet Potato (<i>Ipomoea batatas</i>)	—	—	2.9	28.3
Tomato (<i>Lycopersicon esculentnm</i>)	0.3	1.8	—	28.7
Banana (<i>Musa</i> sp.)	3.2	—	—	27.7
Papaya (<i>Carica papaya</i>)	—	—	—	19.3
Watermelon (<i>Citrullus vulgaris</i>)	0.3	—	8.5	27.6

It is well known that rodents damage standing crops both 'kharif' and 'rabi', almost at every stage of their vegetative growth and at the same time also cause damage in the godowns. The chief food crops of Gujarat are bajri, jowar, wheat, maize, rice, pulses, etc. and main cash crops are sugarcane, groundnut and cotton. Among the vegetables, potato, chilly, sweet-potato, onion, tomato, cabbage, carrot are the main products and mango, banana, papaya, watermelon are the main fruits. There are three main crop seasons in Gujarat i.e., 'kharif', 'rabi' and summer. 'Kharif' crops receive about 95% of monsoon rain and other crops usually depend on irrigation. Among the sixteen species of rodent pests recorded from Gujarat, it has been observed that *Tatera indica* is most predominant in the drier region and *Meriones hurrianae* appears to be more in purely sandy zone. *Bandicota bengalensis*, *Millardia meltada* and *Tatera indica* cause maximum damage to the crops and *Funambulus pennanti* in the gardens and orchards. *Rattus rattus* and *Mus musculus* cause maximum nuisance in the godowns and residences. Rodent species composition and population varies greatly according to the crop. Rodent species composition in major crop fields is stated below :

A. Food Crops

a. cereals

(i) Millet

T. indica is the predominant species in bajri and jowar fields followed by *B. bengalensis* and *M. booduga* whereas *B. bengalensis* is most abundant in maize cultivation followed by *M. meltada* and *T. indica* (Table 2). In seedling stage percent plant damage by rodents was only 0.7 in jowar. The same in seedlings of bajri and maize was not recorded. When the plants were with bloom, it was slightly higher i.e., 2.7 in bajri and 1.2 in maize and while the plants were with milky seeds or immature fruits a sharp rise of percent plant damage was observed up to 14.3 in maize but in bajri and jowar it was only 8.3 and 3.8 respectively and it was always high in mature plants as 34.3, 27.8 and 30.00 in bajri, jowar and maize respectively (Table 4).

It was noted that percent damage of mature tillers deviate highly from one crop field to another and also from one year to another. It also depends on the position of the crop fields. If the cultivation is adjacent to weeds and barren lands then the rodent damage was comparatively higher as the rodents used to come from the adjacent fields temporarily for feeding only. As the kharif maize is grown for grain purpose and rabi for green cobs, so percent damage in kharif crop is higher than rabi. So the total yield loss due to rodent menace in millet may reach up to ± 41.03 percent,

(ii) Wheat

Severe rodent damage to wheat has already been reported in the districts Amreli, Bhavnagar, Junagadh and Rajkot and medium damage has been reported in Ahmedabad and Gandhinagar districts (Anon, 1990). It was observed that *B. bengalensis* is the most predominant rodent pest in the wheat cultivation followed by *Millardia meltada* and *T. indica* (Table 2). In seedling stage, average plant damage was only 0.8 percent and it was slightly higher i.e., 1.8 percent in blooming plants. As soon as milky seeds appeared, a sharp rise of plant damage from 1.8 to 11.2 percent was observed. Maximum damage was estimated to be 31.8 percent as the wheat was harvested and thus total yield loss may reach up to ± 46.6 percent (Table 4). Rodent menace was maximum in the Junagadh and Amreli districts particularly in the forest side cultivation. In those districts *M. musculus* and *M. booduga* were also collected from the wheat fields but no burrow system was observed.

(iii) Rice

Rice is chiefly a kharif crop and fourth major cereal crop of the state. Maximum damage to rice is caused by *B. bengalensis* followed by *T. indica*, *M. meltada*, *M. booduga*, *M. platythrinx* and *M. cervicolor* (Table 2). Rodent damage to rice starts from sowing when water level is low for germination of seed and continued till it ripens. During sowing the sprouted seeds are consumed by rodents. In seedling stage rodent damage was observed only in 0.2 percent plants. In the flowering plants and in the plants with milky seeds it was 1.3 and 10.7 percent respectively. But when the seeds ripen, a sharp rise of percent damage from 10.7 to 30.2 percent was observed causing a total yield loss of ± 42.4 percent (Table 4).

The damage assessment of cereals is far from satisfactory as the rodents damage a lot when the cereals are ready for harvesting and in godown also. Sridhara (1992) stated that 'damage concentrated in the centre of the field is indication of heavy rodent attack'. But it was noticed that in heavily damaged fields also, the rodents damage not only concentrated in the centre but also scattered throughout the field even in case of roadside and bundh side fields where damage in the centre is very common. It may be due to community cultivation as stated by Lavoie *et al.* (1970). It was also noticed that like other cereals rodent species diversity in the rice fields by the side of barren lands and weed fields is much higher than the other. The burrow systems of all recorded rodent species were not observed in the rice fields. Burrows of some rodents which were observed in the weed fields and barren lands were captured from the crop fields at night.

Hoarding of Cereals :

Hoarding habit of bandicoots is well known and reported by many (Sridhara, 1992)

in respect of rice. Among the bandicoots *B. bengalensis* hoards maximum, the average hoarding of rice is 2.67 kg/burrow, bajri 2.53 kg/burrow and jowar only 1.27 kg/burrow. Hoarding of kharif maize by *B. bengalensis* was observed only in the burrows of bundhs but not measured, and that of rabi maize was not observed though it damages both *kharif* and *rabi* maize in the field in every stage of its growth. It was mentioned earlier that rabi maize is grown mainly for green cobs where seeds are not fully ripened. It may appear, therefore, that *B. bengalensis* does not store the milky seeds.

b. Pulses

Among the pulses Mung, Moth, Black gram, Gram, Horse Gram, Lang or Chickling vetch, Val or Indian bean and Tuver or Pigeon per-tur are usually cultivated. From pulse cultivation *T. indica*, *B. bengalensis*, *M. hurrianae*, *M. meltada*, *R. rattus*, *M. dumni*, *M. musculus*, *M. booduga* were collected (Table 2). Percent plant damage was not estimated as the variety of pulse was different in different districts even in different talukas but overall *T. indica* was most predominant in western districts and *B. bengalensis* in southern and eastern districts. Population density varies much from one field to another and also differs according to the species but high population density of rodents were always observed when the pulses were ready for harvesting. Altogether 43 rodents were captured from the pulse field : *T. indica* 15, *B. bengalensis* 14, *M. hurrianae* 5, *Millardia meltada* 3, *R. rattus* 1, *M. dumni* 2, *M. musculus* 2, and *M. booduga* 1 in number.

c. Vegetables

Vegetables like potato, sweet potato, tomato, onion, gourd, pea, cabbage, carrot and brinjals are usually cultivated in Gujarat of which plant damage was only estimated in potato, sweet potato and tomato fields. Percent plant damage was high at the time of sowing in tubers i.e., 7.2 in potato and the same is rather less in tomato i.e., 0.3 in seedling stage. At the time of sowing the rodents used to dig the field and take out the seed tubers for consumption. Percent damage in immature plants was rather less i.e., 2.2, 2.9 and 1.8 in potato, sweet potato and tomato respectively, but there was also a sharp rise in percent plant damage in matured plants i.e., 27.5, 28.3 and 28.7 in potato, sweet potato and tomato respectively (Table 4). It was observed that in tomato cultivation where *telephone* system (tying of a single row of plant with a single wire) was applied, crop damage by rodents was rather less. It was also observed that the rodents never consume more than 30 percent of any vegetable. In vegetable gardens *B. bengalensis* was the most abundant species followed by *M. meltada*, *G. ellioti* and *R. rattus* (Table 2). *Histrix indica* was only observed in potato and sweet potato cultivation in forest side villages. Population density of the porcupine gradually increases with the crop maturity and varies greatly according to the type of crop. The total yield loss calculated was \pm 32.96 percent.

Chilly is the chief spice cultivated in Gujarat. The rodents captured from chilly cultivation were *M. hurrianae* and *T. indica* (Table 2). *B. bengalensis* was captured only thrice and *M. booduga* only once. Burrows of *M. hurrianae* and *T. indica* were observed in the chilly fields but no burrow system of other species was observed. Rodents usually do not damage the seedlings and only 1.1 percent of immature plants were attacked by them. Extensive burrow systems of rodents mainly damaged the immature plants but 15 percent plants with mature chillies got damaged (Table 4) and the total yield loss was estimated to be ± 16.1 percent. Actually gerbils are very fond of chilly seeds and they caused more damage when chilly was spread out for drying.

B. Cash Crops

Among the cash crops, cotton, sugarcane and groundnut are the three main crops cultivated in Gujarat. There has been a considerable increase in recent years in the cultivation of non-food or cash crops mainly tobacco and cotton along with edible sugarcane and groundnut.

Cotton

Gujarat is one of the chief cotton producing states of India for its black cotton soil and favourable atmosphere for cotton cultivation. Usually three types of cotton are cultivated i.e., closed ball or *dhollera*, *mathio* and American cotton *deviraj* or Co-2-170. It is usually sown in June-July, begins to flower by the end of November and picking of seeds starts by the end of February and lasts up to mid April.

It was observed that rodent damage in seedling stage was minimum. Maximum damage was caused by the rodents to the buds and flowers of the plants. As the rodents usually do not damage the whole plant, so the same plant bears both damaged and undamaged buds. The buds which are present near the soil are damaged more than the upper ones. Percent damage calculated in flowering or immature plants was 23.3 but percent damage in matured seed cotton was not more than 18.2 (Table 4). Thus, the total yield loss may reach up to ± 41.5 . Severe rodent damage to cotton was observed in Rajkot, Jamnagar, Junagadh, Amreli, Varuch and Vadodara districts and medium damage in the districts Surendranagar and Bhavnagar. But in earlier years severe damage was reported from Bhavnagar and medium damage in Gandhinagar district (Anon, 1990).

In the cotton cultivation, *B. bengalensis* is the most predominant species followed by *T. indica* and *M. meltada*. The other species recorded are *M. platythrix*, *M. dumni*, *M. musculus*, *M. booduga* and *C. cutchicus* (table 2). *B. bengalensis* and *T. indica* also

damage the roots of the plants resulting in death or ill-health. Though *G. ellioti* was not captured in the cultivation yet damage of cotton buds by them was reported by farmers.

Cotton is normally grown by rotation with other crops. In Gujarat, it is usually rotated with jowar, bajri and sesamum. It was noted that though species composition is not same in the cotton and rotating crops yet the major pests are same in both i.e. *B. bengalensis* and *T. indica*. It is splendid enough though major pests are very fond of buds and flowers yet minor pests mainly *Mus* relish capsules.

Sugarcane

Sugarcane is an important cash crop of Gujarat which is sown in February and harvested by December-January. It was observed that the most abundant rodent species in sugarcane field is *B. bengalensis* followed by *M. melstaa*, *G. ellioti*, *T. indica*, *M. booduga*, *M. platythrix* and *F. pennanti* (Table 2). *Hystrix indica* was also seen in the sugarcane cultivation near forest area at moonlit night. Sithanatham (1986) has also reported *H. indica* from sugarcane field.

Though eight species of rodents were recorded from sugarcane cultivation yet *B. bengalensis* can only be stated as a pest. Srivastava (1992) also stated that "despite frequent attacks, rats have been rated as occasional pest in sugarcane with low potential for damage and generally posing no serious problem" whereas many scientists stated rodents as serious pest of sugarcane (Bates 1967, Bhutani & Bhatnagar 1978, Kalra 1979, Gupta *et al* 1982, Prakash & Avasthy 1980, Avasthy & Prakash, 83, Ahmad & Parshad 1985, Parshad 1987).

It was observed that population of *B. bengalensis* in sugarcane field in southern and eastern districts of the state was very high, about 78 percent, whereas that in western districts was rather low and replaced by *T. indica*. Population of *T. indica* in southern and eastern districts was only 3 percent whereas about 32 percent in northern and western districts. Thus, it can be stated that population of *T. indica* was comparatively high in the drier zone than the wet areas.

Rodents are frequent in this crop right from the seedling stage but their population density increases proportionately with the development of the crop reaching a peak during crop maturity as has also been observed by Srivastava (1992) in Uttar Pradesh. Burrows of *B. bengalensis* and *M. booduga* were frequent in the sugarcane fields but other rodents usually migrate from the fringes to the crop fields.

B. bengalensis damages the plants by making extensive burrows and consumes the roots also. It usually damages first and second internode from the ground and rarely upper ones. Srivastava (1992) also stated that it damages first one or two

internodes resulting cane death but after lodging 1—5 internodes are eaten out. *Mus* sp. are usually seen to lodge in the cane cavity. Rodents damage this crop from the seedling stage and percent damage was 2.8 which was rather higher than cereals. Apical buds and growing tissues were also taken by rodents. Damage of immature plants (up to 120 cm) was estimated to be 8.7 percent and the same was more than double in sweet juicy matured plants and estimated as 20.1 percent (Table 4) causing a total yield loss of \pm 31.6 percent. But in fact, this assessment in case of sugarcane may have errors as it is very difficult to enter a sugarcane field and to locate the damaged plants when sugarcane is fully grown.

Sugarcane is simultaneously affected by fungi, insects and rodents so it is rather difficult to identify rat damage from the drying crown and leaves as stated earlier (Srivastava, 1992) but lodging of clumps and heaps of soil around clumps and boat shaped cavities are prominent sign of rodent damage.

Groundnut

Rodents are serious pests of groundnut in Gujarat and effect much on state economy. Though attempts have been made by many viz , Mittal and Vyas (1992), Mittal *et al.* (1991), Patel and Nayak (1987), Shah (1979), Shihari *et al.* (1979) to assess species composition, relative abundance, and yield loss by rodents in groundnut yet many more informations are required to check rodent menace. *Kharif* groundnut is sown in June—July and harvested in October. Rodents affect groundnut fields from sowing to harvesting. As soon as the seeds were sown, the rodents damage the pods by eating the same. At that time no hoarding was observed in the rodent's burrow. It was observed that 4.5 percent germinating plants or seedlings were damaged by rodents which decreases to 2.8 percent during August and sharp rise up to 42.7 percent at the time of harvesting (Table 4). Though 42.7 percent plants were affected by rodents yet all the pods of a plant were not damaged. Percent pod damage may vary from 5 to 73 in respect of individual plants.

B. bengalensis is probably the most important rodent pest in groundnut followed by *T. indica* and *M. meltada*. Beside these *M. hurrianae*, *M. platythrix* and *M. musculus* were also trapped from the fields. *H. indica* was only seen twice in the forestside fields. Ratio of population among *B. bengalensis*, *T. indica* and *M. meltada* in the drier western district was 40 : 40 : 20, but that in the wetter southern and eastern districts was 70 : 10 : 20. Only *M. meltada* maintain an approximate stable population.

Farmers do not want to disturb the crop fields after peg formation which encourage the rodents for invading the field and to make extensive burrow system. Where there was less rainfall rodents made burrow under the shades of the plants and while the rainfall was much they made burrows at the bundhs, In the bundhs burrows of *B. bengalensis*

have only be seen with a few negligible exception. In case of heavy rainfall area rodents usually take shelter in nearby weed fields and barren lands. Burrows of *T. indica* was very common in the barren lands near groundnut cultivation. *B. bengalensis* did not hoards pods in the month of August / September, that may be due to immaturity or heavy rainfall. The population of rodents was maximum at the time of harvesting. At thnt time groundnut pods were hoarded to the extent of 485 gm/burrow but earlier it was recorded as 320 gm/burrow (Patel & Nayak, 1987). Yield loss was much higher in the isolated fields than cooperative farmings because *Kharif* groundnut cultivation used to affect much by visiting rodents from the adjacent barren lands and weed fields than residential ones. Mittal and Vyas (1992) also reported that "extent of yield loss in one isolated field surrounded by Barren/fallow was as much as 85.42 percent during summer."

In Gujarat state loss due to damage by rodents in groundnut was estimated to be to the tune of Rs. 243, Rs. 815 and Rs. 669/ha during the year 1988, '89 and '90 respectively (Mittal & Vyas, 1992). But in the present study only plant damage was estimated and it was thought that assessment of yield loss will be rather speculative as most of the plants were partly damaged and the damaged mature plants were always with undamaged mature pods.

C. Orchard

Area under fruits is not extensive in the state. The main fruits grown are mango, papaya, banana, watermelon and grape cultivation has recently been started. Among the rodents *F. pennanti* causes maximum damage to the orchards. Other than five-striped palm squirrel, *R. rattus* and *B. bengalensis* also invade in the orchards. But it is rather difficult to estimate the loss caused by rodents as non-rodents species like aves and chiropterans cause maximum damage. It was observed that forestside orchards are usually more affected by both rodent and non-rodent species than other areas. *H. indica* was seen in the watermelon cultivation only on two occasions.

SPECIES COMPOSITION IN THE WEED-FIELDS, BARREN LAND AND GODOWNS

Rodent species composition was rather high in the weed field and barren lands. Among the rodent species recorded from the weed fields and barren land *T Indica* (43.0%) was the most predominant one followed by *M. hurrianae* (19.3%), *G. gleadowi* (18.7%), *B. bengalensis* (7.0%), *G. ellioti* (4.5%), and *M. dunni*, *M. cervicolor*,

M. platythrix comprised only 4.6 percent. *M. meltada* was only recorded from the fodder grass growing fields and *C. cutchicus* (0.8%) comprised even less than one percent (Table 3A).

In the godowns and residential areas percent population of *R. rattus* was about 49 followed by *M. musculus* (32). Other rodent species comprised only 19 percent, which are *B. bengalensis*, *B. indica*, *T. indica*, *F. pennanti* and *M. cervicolor* (Table 3).

DISCUSSION

From the above study it is revealed that though most of the rodents are responsible for agricultural damage yet all the rodents cannot be stated as pest. Ten rodent species are usually considered as serious pest to agriculture (Prakash, 1976) but it was noticed that *B. indica* is not so serious pest in the agriculture of Gujarat while Chakraborty (1992) considered it as an agricultural pest in West Bengal. Prakash (1976) also stated *H. indica* as a pest but in Gujarat it was seen active only in the forestside crop lands and can be treated only as pest of tubers, melons, etc. Prakash (1976) stated *M. hurrianae*, *T. indica* and *M. meltada* are the predominant rodent species in crops of Gujarat but from the present study it is revealed that *B. bengalensis* is dominating over *T. indica* and *M. hurrianae* in many places. So among sixteen species recorded from the crop fields of Gujarat only *T. Indica* and *B. bengalensis* may be stated as very serious, and wide spread pests, and *M. hurrianae* and *M. meltada* are serious pest of crops (Table 1). *F. pennanti* regarded as serious pest of orchards and *R. rattus* and *M. musculus* are predominant in the residential areas and godowns (Table 1). So pest status of a species differs from place to place and also from crop to crop.

ACKNOWLEDGEMENT

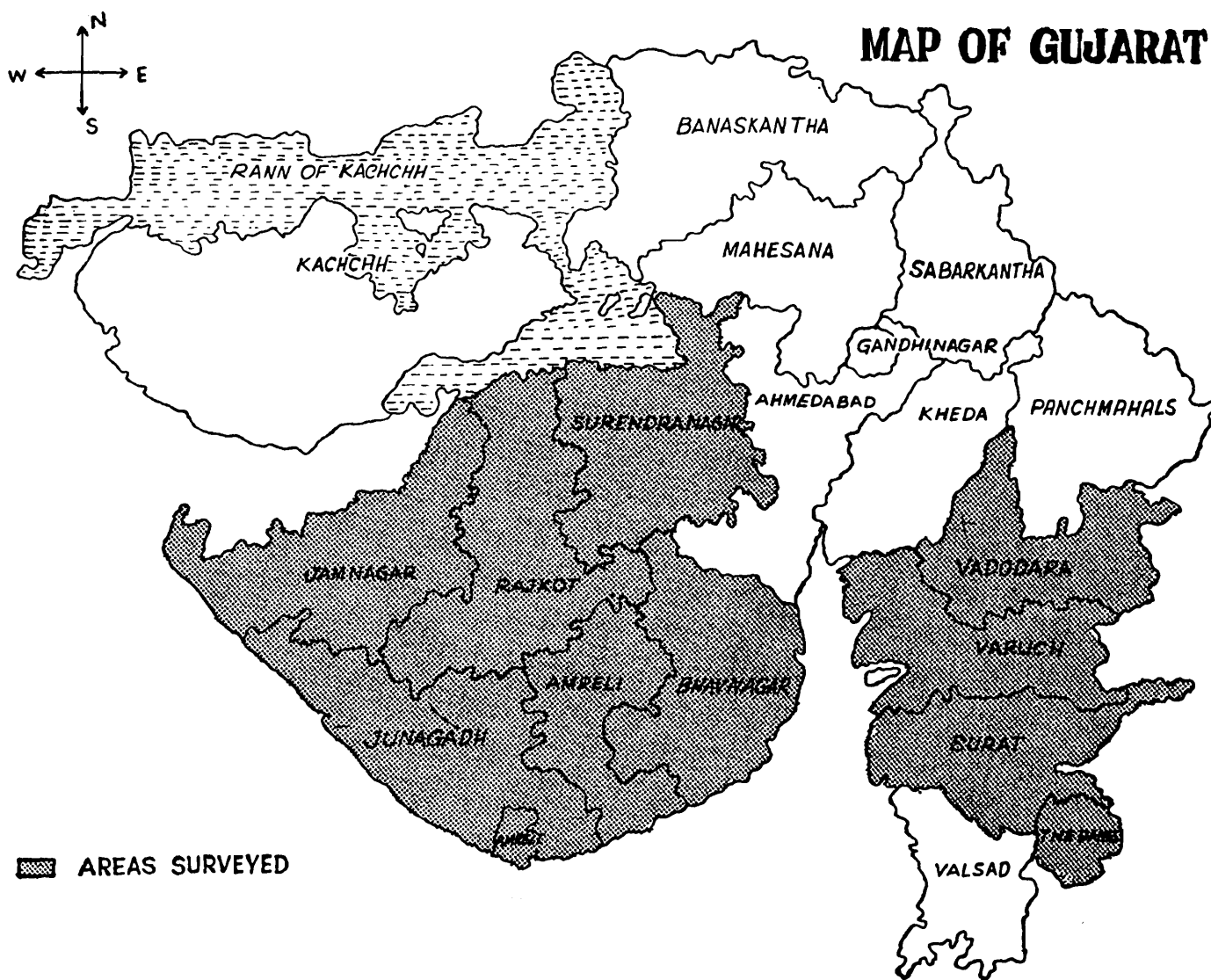
I am thankful to the Director, Zoological Survey of India for rendering all facilities to carry out the research work. I am really grateful to Dr. S. Chakraborty for his guidance both in fields as well as in the laboratory. Thanks are also due to Dr. J. K. Dey for continuous help during field study. I am also thankful to Dr. Ishwar Prakash for critically going through the manuscript. Thanks are also due to Sri S. S. Saha and Sri D. K. Pal for designing of text figures.

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NOTES ON THE FISHES FROM ANDAMAN SEA COLLECTED DURING
FORV SAGAR SAMPADA VOYAGE NO. 113

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INTRODUCTION

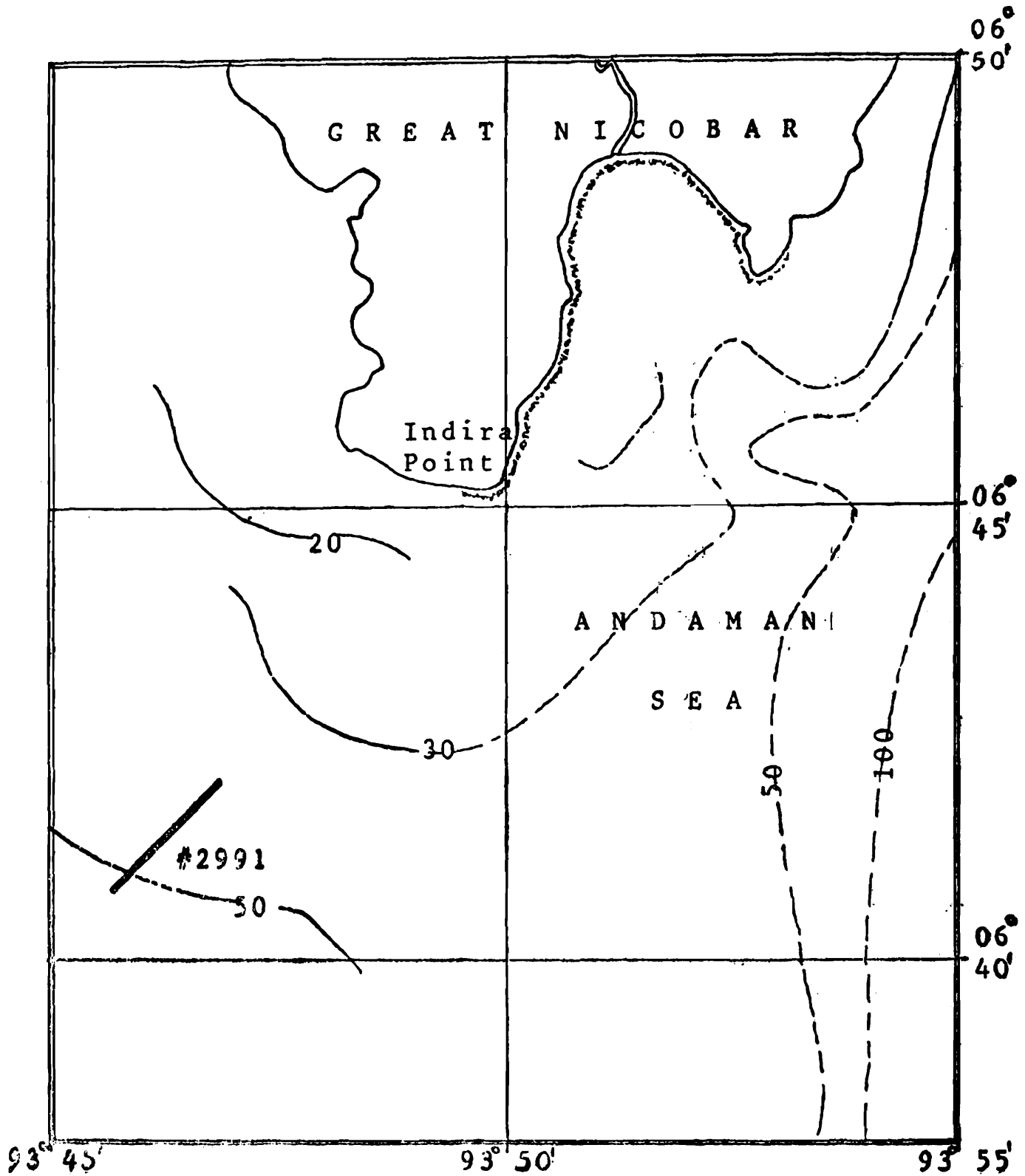
At the early hours of 21 January, 1993 the Danish ship VLCC *Maersk Navigator*, carrying about 300,000 tons of light crude oil from Oman to Japan collided with the Singapore registered empty oil-tanker *Sanko Honour* while negotiating a narrow passage through the small Indonesian islands at the entry point to the Strait of Malacca. As a result, one of its tanks ruptured and an estimated 18,000 tons of oil spilled on the sea over several days. The oil patches were just 16 nautical miles south of Indira Point, The Great Nicobar right within the EEZ of India. In order to assess the long-term impact of the oil-spill a cruise of FORV *Sagar Sampada* (Cruise No. 113) was organised during 21.09.1993 to 10.10.1993 in the Andaman Sea (Map : 1). Fish samples have been collected with a view to identify and to study morphological deformities, if any.

MATERIAL AND METHODS

The fish samples have been collected by deployment of bottom trawl net operated from FORV *Sagar Sampada* hauling at a speed of approximately 4 knots per hour in the Grid No. 2991 (06°40'76"N, 93°45'67"E to 06°42'08"N, 93°46'91"E) where the depth was 50 ± 3 mts. The net was damaged due to the uneven bottom topography and the salvaged specimens have been studied.

RESULTS

Altogether 21 samples belonging to 3 families, 4 genera and 5 species have been collected and identified. One sample of each species has been brought and



Map 1 : Collection Station # 2991.

deposited with the Marine Biological Station, Zoological Survey of India, Madras while the rest have been handed over to other participating agencies. None of the samples exhibited any teratogenic phenomenon, stunted growth, visible tar deposit and meristic variations. The samples with MBS/ZSI, Madras have been identified as under.

Class : OSTEICHTHYES

Order : PERCIFORMES

Family : LETHRINIDAE

Genus : *Gymnocranius* Klunzinger, 1870

1870. *Gymnocranius* Klunzinger, *Verh. Zool. Bot. Ges. Wien.*, 20 : 764 (Type : *Dentex rivulatus* Ruppell, 1838 = *Cantharus grandoculis* Valenciennes, 1830).

1. *Gymnocranius grandoculis* (Valenciennes, 1830)

1830. *Cantharus grandoculis* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 6 : 341 (Seychelles).

1974. *Gymnocranius robinsoni* (Gilchrist and Thompson) : Fischer and Whitehead, *FAO species Identification sheets for fishery purposes. Fishing Areas 57, 71 (E. Ind. Ocean and W. Cent. Pacific)*, 3 : PENTAP Gymno 2.

1989. *Gymnocranius grandoculis* : Carpenter and Allen, *FAO Fish. Synop.*, (125) 9 : 27.

Material examined : 1, 275 mm in SL, off Indira Point, 29.09.93.

Distinguishing characters : DX, 10 ; A III, 10 ; P 14 ; VI, 5 ; GR 2+5 ; LL 48+2 ; Ltr $5\frac{1}{8}/17$; cheek scale 5 ; depth 2.6 in SL ; head 2.9 in SL ; eye 3.0 in head.

Distribution : Widely distributed in Indo-west Pacific.

Remarks : This species has been referred to as *G. robinsoni* (Gilchrist and Thompson, 1908) in recent literature. The sample is 2.64 times in SL deviating from the range (2.4 to 2.5) prescribed by Carpenter and Allen (1989),

Genus : **Lethrinus** Cuvier, 1829

1829. *Lethrinus* Cuvier, *Regne Animal.*, 2 : 184 (Type : *Sparus choerynchus* Bloch and Schneider, 1801 = *Lethrinus nebulosus* (Forsskal, 1775).

2. **Lethrinus conchyliatus** (Smith, 1959)

1959. *Lethrinella conchyliatus* Smith, *Rhodes Univ. Ichth. Bull.*, 17 : 292, pl. 22, fig. B (Pinda, Mozambique).
 1963. *Lethrinella conchyliatus* : Silas and Toor, *J. mar. biol. Assoc. India*, 4 (1 & 2) : 243, fig. 1 (Andamans).
 1989. *Lethrinus conchyliatus* : Carpenter and Allen, *FAO Fish. Synop.*, (125) 9 : 53.

Material examined : 1, 323 mm in SL, off Indira Point, 29.09.93.

Distinguishing characters : D X, 9 ; A III, 8 ; P 13 ; V I, 5 ; GR 4+5 : LL 48 ; Ltr $4\frac{1}{2}/16$; depth 3.3 in SL ; head 2.8 in SL ; eye 4.9 in head.

Distribution : Indian Ocean—Tanzania, Madagascar, Chagos, Andamans to southern Indonesia.

3. **Lethrinus microdon** Valenciennes, 1830

1830. *Lethrinus microdon* Valenciennes, *Hist. nat. poiss.*, 6 : 295 (Bourou).

Material examined : 1, 324 mm in SL, off Indira Point, 29.09.93.

Distinguishing characters : D X, 9 ; A III, 8 ; P 13 ; V I, 5 ; GR 4+5 ; LL 48 ; Ltr $4\frac{1}{2}/16$; depth 3.4 in SL, head 2.9 in SL ; eye 5.0 in head.

Distribution : Wide-spread in Indo-west Pacific.

Order : TETRAODONTIFORMES

Family : BALISTIDAE

Genus : **Pseudobalistes** Bleeker, 1866

1866. *Pseudobalistes* Bleeker, *Ned. Tijdschr. Dierk.*, 3 : 11 (Type : *Balistes flavimarginatus* Ruppell, 1829)

4. *Pseudobalistes flavimarginatus* (Ruppell, 1829)

1829. *Balistes flavimarginatus* Ruppell, *Atlas Reise N. Afrika* : 33 (Red Sea) : Day, 1878. *Fishes of India* : 690.
1986. *Pseudobalistes flavimarginatus*: Smith and Heemstra, *Smith's Sea Fishes* : 880, pl. 136, fig. 263.11.

Material examined : 1, 420 mm in SL, off Indira Point, 29.09.93.

Distinguishing characters : D III+26 ; A 24 ; P 15 ; LS 32 ; Ltr 20 ; depth 2.0 in SL, 2.6 in TL ; head 3.0 in SL ; eye 5.8 in head.

Distribution : Wide-spread in Indo-Pacific.

Family : OSTRACIIDAE

Genus : *Ostracion* Linnaeus, 1758

1758. *Ostracion* Linnaeus, *Syst. Nat.* (ed. 10), 1 : 330 (Type : *Ostracion cubicus* Linnaeus, 1758) .

5. *Ostracion meleagris* Shaw, 1796

1796. *Ostracion meleagris* Shaw in Shaw and Nodder, *Nat. Miscell.*, 7 : pl. 253 (South Pacific).
1878. *Ostracion punctatus* Bloch and Schneider : Day, *Fishes of India* : 696,
1955. *Ostracion lentiginosa* Bloch and Schneider : Munro, *The marine and freshwater fishes of Ceylon* : 277.
1962. *Ostracion meleagris*: de Beaufort and Briggs, *Fish. Indo-Aust. Archip.*, 11 : 356.

Material examined : 1, 28.5 mm in TL (22.2 mm in carapace length), off Indira Point, 29.09.93.

Distinguishing characters : D 9 ; A 9 ; P 10 ; C 10 ; depth 2.0 in TL, 1.02 in width ; head 3.2 in TL ; eye 2.25 in head ; carapace 4-ridged and spineless, ridges blunt ; dorsal ridge absent ; back convex ; mouth opening in carapace less than eye.

Colour : Greenish-brown to black with white spots.

Remarks : This is the first record of occurrence from Andaman and Nicobar group of Islands.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta for deputing him to participate in the Cruise; to the Officer-in-Charge, Marine Biological Station, ZSI, Madras for facilities; to the Chief-Scientist and participants for courtesies; to Dr. S. Krishnan for encouragement and to Dr. A. G. K. Menon for critical evaluation of the manuscript.

ON SOME ASILIDAE (DIPTERA) FROM INDIA PRESENT
IN THE SMITHSONIAN INSTITUTION III

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INTRODUCTION

This is the third and last part of a series of papers on Asilidae from India present in the Smithsonian Institution, Washington. The first and the second parts were published in 1978 and 1989 respectively. Specimens for the present study were received through the courtesy of Dr. Lloyd Knutson, Director, Insect Identification and Beneficial Insect Introduction Institute, U. S. D. A. and Mr. Gary F. Hevel, Collections Manager, Department of Entomology, Smithsonian Institution. The arrangement of genera followed in this paper is after Joseph and Parui, 1990.

The types are deposited in the Smithsonian Institution, Washington, and the Zoological Survey of India, Calcutta.

SYSTEMATIC ACCOUNT

Genus : *Laphria* Meigen

1803. *Laphria* Meigen, *Illiger's Mag. f. Ins.*, 2 : 270.

*Retired ; Present address : Nellissery House, P. O. Edathuruthi-680 703, Kerala.

1. *Laphria nathani* Joseph and Parui

1981. *Laphria nathani* Joseph and Parui, *Ent. scand.*, 12 : 217.

Material : 13 ♂, 18 ♀, Tamil Nadu : Cherangode, 1060 m, v. 1950, coll. P. S. Nathan (S. W. Bromley coll. 1955); 3 ♂, 1 ♀, Cherangode, 1060 m, xi. 1950, coll. P. S. Nathan ; 1 ♂, Karnataka : South Coorg : Ammathi South, 1125 m, v. 1951, coll. P. S. Nathan.

Distribution : Karnataka, Kerala and Tamil Nadu.

Genus : *Laxenecera* Macquart

1838. *Laxenecera* Macquart, *Dipt. exot.*, 1 (2) : 194.

2. *Laxenecera flavibarbis* Macquart

1838. *Laxenecera flavibarbis* Macquart, *Dipt. exot.*, 1 (2) : 194.

Material : 6 ♂, 6 ♀, Madhya Pradesh : Jabalpur, 360 m, ix. 1957, coll. P. S. Nathan ; 3 ♀, Jabalpur, ix. 1958, coll. P. S. Nathan.

Distribution : Bihar, Goa, Gujarat, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

Remarks : This is the first record from Madhya Pradesh.

Genus : *Nusa* Walker

3. *Nusa karaikalensis* Joseph and Parui

1989. *Nusa karaikalensis* Joseph and Parui, *Orient. Insects*, 23 : 193.

Material : 1 ♂, Pondicherry : Karaikal : Bagaram : Kurum, iii. 1947, coll. P. S. Nathan.

Distribution : Pondicherry.

Genus : *Microstylum* Macquart

1838. *Microstylum* Macquart, *Dipt. exot.*, 1 (2) : 26.

4. *Microstylum ananthakrishnani* Joseph and Parui

1984. *Microstylum ananthakrishnani* Joseph and Parui, *Ent. scand.*, 15 : 449.

Material : 1 ♀, Tamil Nadu : Nilgiri hills : Cherangode, 1060m, 15.v.1950, coll. P. S. Nathan.

Distribution : Karnataka and Kerala.

Remarks : This is the first record from Tamil Nadu.

Genus : *Saropogon* Loew

5. *Saropogon hulli* Joseph and Parui

1981. *Saropogon hulli* Joseph and Parui, *Orient. Insects*, 15 : 27.

Material : 1 ♀, Tamil Nadu : Nilgiri hills : Singara 1030 m, v. 1948, coll. P. S. Nathan ; 1 ♂, 2 ♀, Nilgiri hills : Naduvatum, 1820 m, v. 1958, coll. P. S. Nathan ; 1 ♀, Nilgiri hills : Gudalur, 1065 m, iv. 1959, coll. P. S. Nathan.

Distribution : Karnataka and Kerala.

Remarks : This is the first record from Tamil Nadu.

Genus : *Trigonomima* Enderlein

1914. *Trigonomima* Enderlein, *Wein. Ent. Ztg.*, 33 : 164.

6. *Trigonomima anamaliensis* Joseph and Parui

1980. *Trigonomima anamaliensis* Joseph and Parui, *Bull. zool. Surv. India*, 2 : 197.

Material : 3 ♂, 16 ♀, Tamil Nadu : Nilgiri hills : Cherangode, 1060m, coll.

P. S. Nathan ; 1 ♂, Nilgiri hills : Gudalur, 1060m, iv.1959, coll. P. S. Nathan ; 1 ♂, 2 ♀, Karnataka : Mudigore, 6.iv.1980, coll. Mathis and Freidberg.

Distribution : Kerala and Tamil Nadu.

Remarks : This is the first record from Karnataka.

Genus : *Stenopogon* Loew

1847. *Stenopogon* Loew, *Linn. Ent.*, 2 : 453.

7. *Stenopogon manii* Joseph and Parui

1981. *Stenopogon manii* Joseph and Parui, *Orient. Insects*, 15 : 106.

Material : 1 ♀, Kerala : S. Malabar : Walayar forest, 1063 m, v.1947, coll. P. S. Nathan ; 2 ♂, 1 ♀, Tamil Nadu : Nilgiri hills : Hooker Estate, 1150 m, 4.xi.1950, coll. P. S. Nathan ; 2 ♀ Nilgiri hills : Wood Estate, 1420 m, 5.xi.1950, coll. P. S. Nathan ; 1 ♂, Tamil Nadu : Anamalai hills : Cinchona, 1065 m, iv.1957, coll. P. S. Nathan ; 2 ♂, Tamil Nadu : Nilgiri hills : Naduvatum, 1820 m, v.1958, coll. P. S. Nathan.

Distribution : Kerala and Tamil Nadu.

8. *Stenopogon raven* (Bromley)

1938. *Scleropogon raven* Bromley, *Indian J. Agric. Sci.*, 8 (6) : 865.

Material ; 1 ♀, Kerala : S. Malabar : Walayar forest, 1065 m, v.1947, coll. P. S. Nathan ; 2 ♂, 1 ♀, Tamil Nadu : Nilgiri hills : Hooker Estate, 1150 m, 4.xi.1950, coll. P. S. Nathan ; 2 ♀, Nilgiri hills ; Wood Estate, 1420 m, 5.xi.1950, coll. P. S. Nathan ; 2 ♂, Nilgiri hills : Naduvatum, 1820 m, v.1958, coll. P. S. Nathan.

Distribution : Tamil Nadu.

Remarks : This is the first record from Kerala.

Genus : Damalis Fabricius

1805. *Damalis* Fabricius, *Systema Antliatorum* : 147.

9. Damalis dravidica (Joseph and Parui)

1984. *Xenomyza dravidica* Joseph and Parui, *Ent. scand.*, 15 : 444.

1990. *Damalis dravidica* : Joseph and Parui, *Rec. zool. Surv. India, Occ. Paper No. 113* : 32.

Material : 3 ♂ . 17 ♀ , Tamil Nadu : Nilgiri hills : Cherangode, 1060 m, v.1950, coll. P. S. Nathan.

Distribution : Karnataka, Kerala and Tamil Nadu.

10. Damalis fusca Walker

1849. *Damalis fusca* Walker, *List. Dipt. Colln Br. Mus.*, 2 : 481.

Material : 3 ♂ , 1 ♀ , Tamil Nadu : Nilgiri hills : Cherangode, 1060 m, v.1950, coll. P. S. Nathan (S. W. Bromley coll. 1955).

Distribution : Karnataka, Kerala, Pondicherry, Uttar Pradesh and West Bengal.

Remarks : This is the first record from Tamil Nadu.

Genus : Merodontina Enderlein

11. Merodontina spinulosa Joseph and Parui

1990. *Merodontina spinulosa* Joseph and Parui, *Colemania*, Bangalore (in press).

Material : 2 ♂ , Meghalaya : Nongpoh forest, 25-28.iv.1980. coll. A. Freidberg,

Distribution : Meghalaya.

Genus : Michotamia Macquart

1838. *Michotamia* Macquart, *Dipt. exot.*, 1 (2) : 75.

12. *Michotamia aurata* (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent. Syst.*, 4 : 387.

Material : 2 ♂, 4 ♀, Orissa : Balugaon : Chilka Lake, 16.iv.1944, coll. D. E. Hardy.

Distribution : Andhra Pradesh, Bihar, Delhi, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Orissa, Pondicherry, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

13. *Michotamia macquarti* Joseph and Parui

1984. *Michotamia macquarti* Joseph and Parui, *Rec. zool. Surv. India, Occ. Paper No. 66* : 28.

Material : 1 ♂, Meghalaya : Nongpoh forest, 25-28.iv.1980, coll. A. Freidberg.

Distribution : Uttar Pradesh.

Remarks : Here, this is the first record from Meghalaya.

Genus : *Ommatius* Wiedemann

1821. *Ommatius* Wiedemann, *Dipt. exot.*, 1 : 213.

14. *Ommatius jabalpurensis* Joseph and Parui

1983. *Ommatius jabalpurensis* Joseph and Parui, *Ent. scand.*, 14 : 90.

Material : 1 ♂, Madhya Pradesh : Jabalpur, 490 m, ix.1950, coll. P. S. Nathan.

Distribution : Madhya Pradesh and Orissa.

15. *Ommatius pseudokempi* Joseph and Parui

1987. *Ommatius pseudokempi* Joseph and Parui, *Bull. zool. Surv. India*, 8 : 210.

Material : 1 ♂, Pondicherry : Karaikal : Bagaran : Kurum, 26.vi.1950, coll. P. S. Nathan.

Distribution : Orissa, Rajasthan and Tamil Nadu.

Remarks : This is the first record from Pondicherry.

16. *Ommatius pillai* Joseph and Parui

1986. *Ommatius pillai* Joseph and Parui, *Rec. zool. Surv. India*, 84 : 158.

Material : 1 ♂, Tamil Nadu : Nilgiri hills : Chirambadi, 1060m, xi.1950, coll. P. S. Nathan.

Distribution : Kerala.

Remarks : This is the first record from Tamil Nadu.

Genus : *Astochia* Becker

1913. *Astochia* Becker, *Ann. Mus. zool. Acad. St. Petersbourgh*, 17 : 538.

17. *Astochia indica* Joseph and Parui

1984. *Astochia indica* Joseph and Parui, *Rec. zool. Surv. India, Occ. Paper No. 66* : 30.

Material : 24 ♂, 4 ♀, Tamil Nadu : Tranquebar, xi.1949, coll. P. S. Nathan (S. W. Bromley coll. 1955).

Distribution : Karnataka.

Remarks : This is the first record from Tamil Nadu.

18. *Astochia pseudoguptai* Joseph and Parui

1987. *Astochia pseudoguptai* Joseph and Parui, *Rec. zool. Surv. India*, 8 : 100.

Material : 4 ♂, 1 ♀, Kerala : S. Malabar, v.1947 ; 1 ♂, Tamil Nadu : Coimbatore, 19.ix.1947 : 1 ♂, Coimbatore, 18.iii.1950 ; 1 ♂, Coimbatore, 4.vii.1950,

all coll. P. S. Nathan (S. W. Bromley coll. 1955).

Distribution : Karnataka, Kerala, Rajasthan and Sikkim.

Remarks : This is the first record from Tamil Nadu.

Genus : Clephroneura Becker

1925. *Clephroneura* Becker, *Ent. Mitt.* 14 : 68.

19. Clephroneura apicalis Ricardo

1938. *Clephroneura apicalis* Ricardo, *Ann. Mag. nat. Hist.*, (11) 1 : 462.

Material : 1 ♂, Tamil Nadu : Nilgiri hills : Cherangode, 1060m, v.1950 coll. P. S. Nathan.

Distribution : Karnataka, Kerala and Tamil Nadu.

20. Clephroneura semirufa Oldroyd

1938. *Clephroneura semirufa* Oldroyd, *Ann. Mag. nat. Hist.*, (11) 1 : 465.

Material : 1 ♂, Tamil Nadu : Nilgiri hills : Cherangode, 1060m, v.1950, coll. P. S. Nathan.

Distribution : Tamil Nadu.

Genus : Machimus Loew

1849. *Machimus* Loew, *Linn. Ent.*, 4 : 1.

21. Machimus dubius Ricardo

1919. *Machimus dubius* Ricardo, *Ann. Mag. nat. Hist.* (9) 3 : 47.

Material : 12 ♂, 2 ♀, Himachal Pradesh : Dalhousie, 21.vi.1951, coll. P. N. Oman.

Distribution : Himachal Pradesh, Uttar Pradesh and West Bengal.

22. *Machimus montanus* Ricardo

1919. *Machimus montanus* Ricardo, *Ann. Mag. nat. Hist.*, (9) 3 : 52.

Material : 1 ♂, Tamil Nadu : Nilgiri hills : Naduvatum, 1820 m, 5.v.1950. coll. P. S. Nathan (S. W. Bromley coll. 1955).

Distribution : Maharashtra, Tamil Nadu and Uttar Pradesh.

23. *Machimus nilgiriensis* n. sp.

A medium black species with black and pale yellow mystax and infusate wing. Male : length 15 mm, wing 9-10 mm ; female : 13 mm, wing 10 mm.

Male : *Head* as wide as thorax, black with yellow tomentum ; mystax black with pale-yellow bristles in the middle ; fronto-orbital and oceller bristles black ; occiput with black pile and bristles ; postocciput largely pale yellow pilose with a few dorsal black bristles ; postgena pale yellow pilose. Antenna black except wholly yellow pedicel, bristles black ; first flagellomere subequal to combined length of scape and pedicel, arista longer than flagellum. Palpus and proboscis black, the former with black and pale yellow pile and the latter with only pale yellow pile.

Thorax black, pale yellow tomentose ; pronotum pale yellow with black pile ; scutum medially with three tomentose stripes, the middle stripe short, extending to transverse suture ; chaetotaxy : notopleurals 2, supra-alars 2, post-alars 2, dorsocentrals many, acrostichal absent ; katapisternum with fine yellow pile ; meron with a row of long, pale yellow long bristly pile ; vestiture black. Scutellum brownish-yellow tomentose, disc with black pile, border with a series of black bristles. Haltere yellow.

Leg black ; coxa with numerous long, pale, yellow pile, hind coxa with very thin, short pile ; anterior two pairs of femora and tibiae with long ventral pile, hind femur with less abundant ventral pile, pile absent in hind tibia ; except a few fore and mid femora devoid of bristles, hind femur with a row of anterodorsal pale yellow bristles ; fore and mid tibiae with a row of dorsal bristles, hind tibia with a row of dorsal and ventral bristles ; hind basitarsus with a mat of golden yellow pile.

Wing with apical half dark brown, basal half hyaline.

Abdomen black, tergum 1 posterolaterally with 1 or 2 black bristles and long, pale yellow pile, terga 2 and 3 laterally and sterna with pale yellow pile **Genitalia**

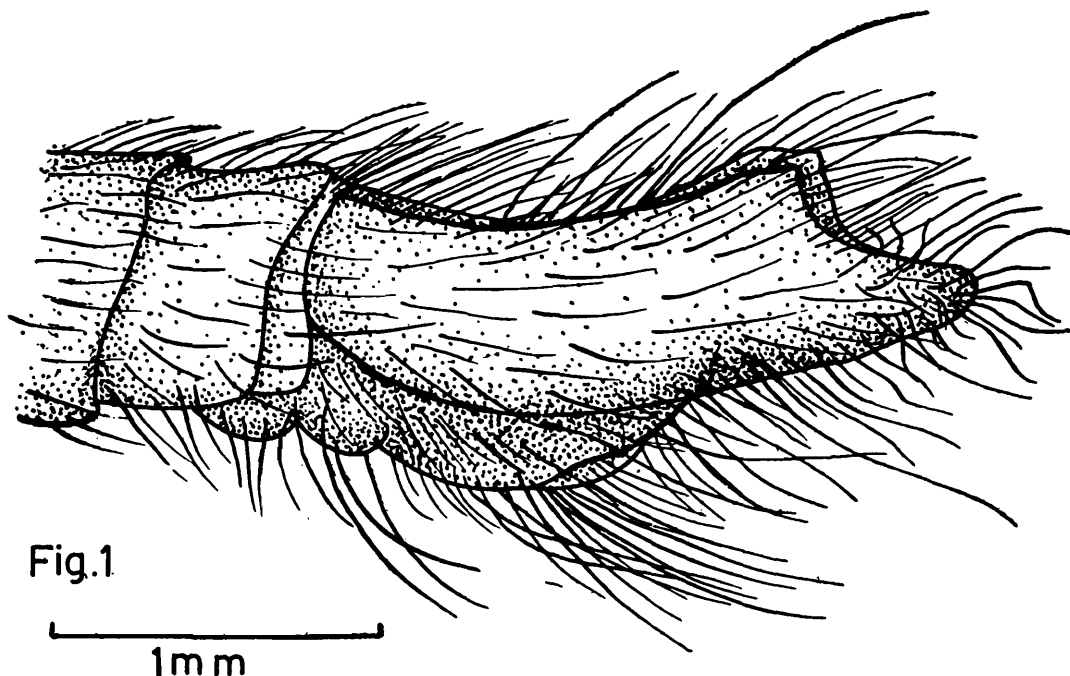


Fig. 1 : *Machimus nilgiriensis* n. sp.

(Fig. 1) black with concolourous pile and bristles; epandrium apically cleft ventrally at base with a few pale yellow pile.

Female : Similar with the following difference : mystax wholly black. Ovipositor yellowish-brown, longer than segments six and seven together.

Material : *Holotype* ♂, Tamil Nadu : Nilgiri hills : Hooker Estate, 1870 m, ix.1950, coll. P. S. Nathan. *Paratypes* 2 ♀, details as in holotype.

Remarks : The species is closely similar to *Machimus indicus* Joseph and Parui but differs in the wholly black pile on scutellum, smaller size and details of male genitalia.

24. *Machimus parvus* Ricardo

1919. *Machimus parvus* Ricardo, *Ann. Mag. nat. Hist.*, (9) 3 : 54.

Material : 1 ♂, 1 ♀, Tamil Nadu : Nilgiri hills ; Cherangode, 1060 m, xi.1950, coll. P. S. Nathan.

Distribution : Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

Genus : *Neoitamus* Osten Sacken

1878. *Neoitamus* Osten Sacken, *Smithson Misc. Collns*, 16 : 82, 235 replacement name of *Itamus* Loew 1849 : 84.

25. *Neoitamus sedlaceki* Joseph and Parui

1987. *Neoitamus sedlaceki* Joseph and Parui, *Bull. zool. Surv. India*, 8 : 231.

Material : 1 ♂, Meghalaya : Shillong Botanic Garden, 20.iv.1980, coll. A. Freidberg ; 2 ♂, Shillong Elephant Falls, 21.iv.1980, coll. A. Freidberg : 1 ♂, Nongpoh forest, 25-28.iv.1980, coll. A. Freidberg.

Distribution : Meghalaya.

Remarks : The species was described from Nepal.

26. *Neoitamus mussooriensis* Joseph and Parui

1984. *Neoitamus mussooriensis* Joseph and Parui, *Rec. zool. Surv. India, Occ. Paper No. 66* : 21.

Material : 1 ♂, Himachal Pradesh : Dalhousie, 21.vi.1961, coll. P. W. Oman.

Distribution : Uttar Pradesh. This is the first record from Himachal Pradesh.

Genus : *Philodicus* Loew

1848. *Philodicus* Loew, *Linn. Ent.* 3 : 391.

27. *Philodicus femoralis* Recardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. nat. Hist.* (9) 8 : 190.

Material : 9 ♂, 5 ♀, Tamil Nadu : Nilgiri hills : Cherangode, 1065 m, v.1950, coll. P. S. Nathan (S. W. Bromley coll. 1955)

Distribution : Assam, Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

28. *Philodicus pruthii* Bromley

1935. *Philodicus pruthii* Bromley, *Rec. Indian Mus.*, 37 : 224.

Material : 1 ♀, Tamil Nadu : Tranquebar, xi.1949, coll. P. S. Nathan ; 1 ♀, Karnataka : Bangalore, 3.iv.1980, coll. Mathis and Pritberg.

Distribution : Andhra Pradesh, Karnataka, Kerala, Rajasthan and Tamil Nadu.

Genus : *Promachus* Loew

1848. *Promachus* Loew, *Linn. Ent.*, 3 : 390.

29. *Promachus jabalpurensis* Joseph and Parui

1981. *Promachus jabalpurensis* Joseph and Parui, *Orient. Insects* 15 : 25.

Material : 2 ♂, Madhya Pradesh : Jabalpur, 460 m, x.1957 ; 1 ♂, Tamil Nadu : Coimbatore, xi.1957, all coll. P. S. Nathan.

Distribution : Madhya Pradesh.

Remarks : This is the first record from Tamil Nadu.

30. *Promachus smithi* n. sp.

A robust species with uniformly brown wing, yellow and black leg, black abdomen with broad yellow bands and shining black genitalia. Male : length 30 mm, wing 22 mm ; female : length 30-32 mm, wing 24 mm.

Males : *Head* broader than thorax, black, covered with dense pale yellow tomentum ; *mystax* yellowish-white with scattered black bristles ; *fronto-orbital bristles*

black with a few pale yellow pile near base of antenna; ocellar bristles black; postcranium with pale yellow pile: postocular bristles and bristles of postgena pale yellow. Antenna black, pedicel and base of first flagellomere pale yellow, scape and first flagellomere equal in length, arista as long as combined length of scape and pedicel. Palpus and proboscis black, the former with black and yellow bristles, the latter with long black and pale yellow pile.

Thorax black with dark brown tomentum; pronotum with pale yellow pile and a few scattered black pile and bristles; scutum without distinct mediolongitudinal stripes, vestiture black; chaetotaxy: notopleurals 2, supra-alars 3, post-alars 3, dorsocentrals 4 extending from behind transverse suture; scutellum with scattered black pile on disc, a few pale yellow pile at corner, border with six long black bristles and anterior to them with a row of six black bristles; katepisternum and anepisternum with long pale yellow and black pile; meron with long, pale yellow pile. Haltere dark brown.

Legs black and yellow; femora black except pale yellow posteriorly at apex, fore and mid femora with a row of ventral black bristles and a few scattered dorsal

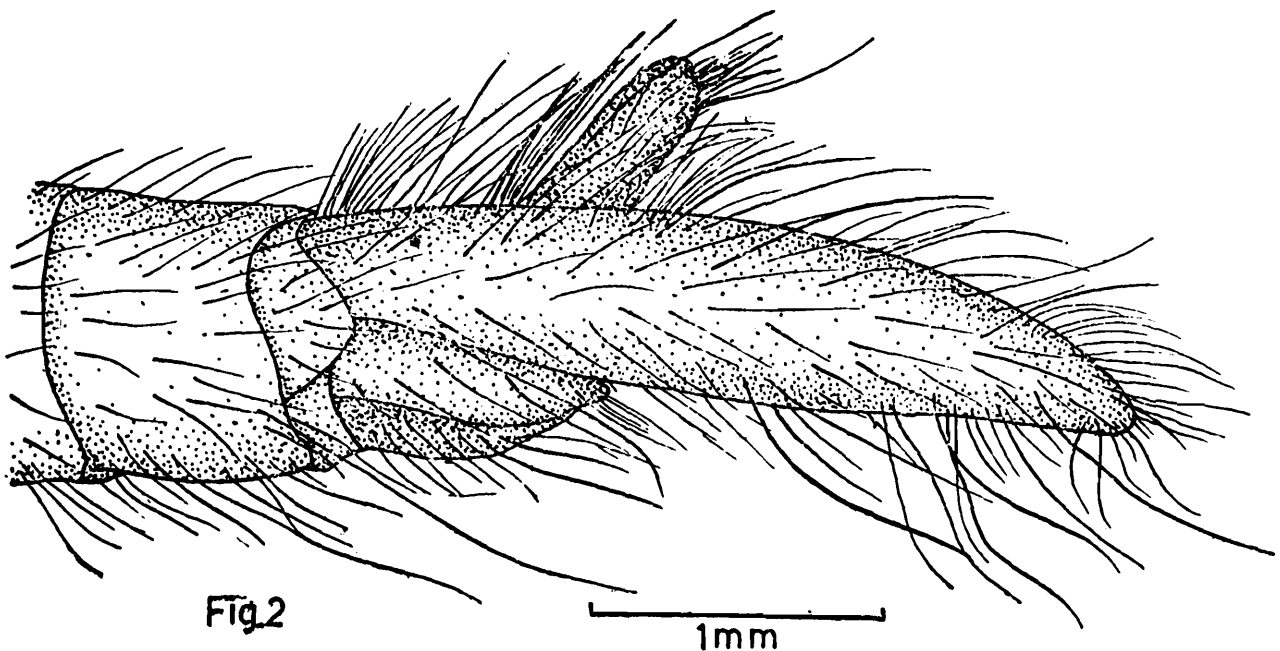


Fig. 2: *Promachus smithi* n. sp.

black bristles, hind femur with a row of ventral and a row of anterodorsal black bristles; tibiae yellow with dark apices, pile black ventrally, fore pair with two rows

of small dorsal black bristles, other two pairs with scattered black bristles.

Wing brown, first submarginal cell with a grey streak.

Abdomen black, terga 1-3 with long pale yellow pile laterally which being dense on first tergum, each tergum with a band of yellow tomentum at posterior margin which gradually diminishes in breadth posteriorly. Male genitalia (Fig. 2) shining black with similar pile.

Females: Similar but with the following differences: first flagellomere smaller than scape; genitalia black, tergum 8 elongate, cercus rectangular, shorter than tergum 9.

Remarks: The species is closely similar to *Promachus yerburiensis* Ricardo but differs from it by the robust size, absence of long white pile on femora and details of male genitalia.

The species is named in honour of the collector, Mr. M. E. Smith.

Material: Holotype: ♂, Tamil Nadu: Madras, 30.viii.1947. Paratypes: 1 ♂, Madras, 4.ix.1947; 1 ♀, Madras, 18.viii.1947; 1 ♀, Madras, 21.viii.1947; 1 ♀, Madras, 22.viii.1947; 1 ♀, Madras, 23.viii.1947; 1 ♀, Madras, 24.viii.1947; 1 ♀, Madras, 28.viii.1947; 1 ♀, Madras, 1.ix.1947; 1 ♀, Madras, 2.ix.1940, 1 ♀, Madras, 3.ix.1947; 1 ♀ Madras, 4.viii.1940; 1 ♀, Madras, 4.ix.1940, all coll. M. E. Smith. All S. W. Bromley collection, 1955.

Genus: *Trichomachimus* Engel

1933. *Trichomachimus* Engel, *Ark. zool.*, (A) 25 (22): 10.

31. *Trichomachimus omani* n. sp.

A rather large golden-yellow and black species with infuscated wing and reddish yellow and black legs. *Male* length 25 mm, wing 18 mm.

Male: *Head* black with greyish-yellow and yellowish-white tomentum; *mystax* pale yellow with a few black bristles above and on sides up to middle; *fronto-orbital* bristles black and pale yellow; *ocellar* bristles black; *postcranium* with a few black bristles above, rest pale yellow; *post-ocular* bristles pale yellow, *postgena* with dense pale yellow long pile. *Antennal* scape black with black and pale yellow bristles, *pedicel* pale

yellow with black bristles, first flagellomere more than twice the length of pedicel and equal to arista. Palpus and proboscis black with black bristles on the former and pale yellow pile on the latter.

Thorax black, grey tomentose ; pronotum with long pale yellow pile ; scutum with lateral yellowish-grey pollinose stripe ; chaetotaxy : posthumeral 2, notopleural 2,

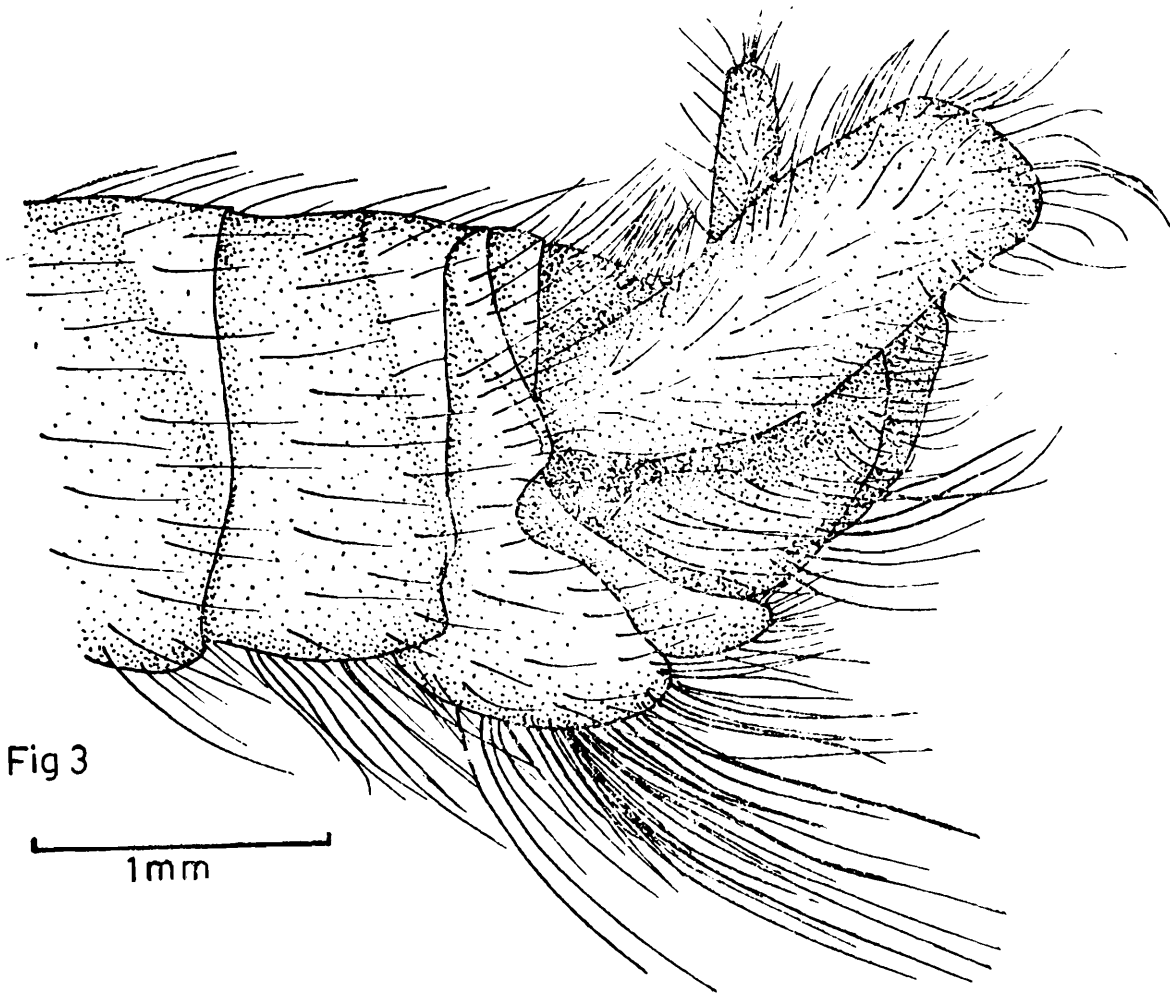


Fig. 3 : *Trichomachimus omani* n. sp.

supra-alars 5, post-alars 3, acrostichals absent, post-sutural dorsocentrals many ; vestiture and bristles black ; scutellar disc with black bristly pile and some pale yellow pile, border with a row of black bristles ; katapisternum with long, fine pile ; anepisternum with black and pale yellow bristles ; meron with long, stout bristly pile. Haltere reddish-yellow.

Legs black and reddish-yellow, femur black with black bristles and predominant

pale yellow pile, fore and hind femora with a row of posterodorsal bristles, mid femur without distinct row of bristles; tibia reddish-yellow, fore tibia ventrally with mixed long pale yellow and black bristly pile, a row of anteroventral bristles on basal half, a row of dorsal bristles on apical half and another row of ventral bristles on apical half; ventral pile of mid tibia lesser and with two rows of dorsal and two rows of ventral bristles on apical half; hind tibia bare of ventral pile and with two rows of dorsal bristles; vestiture predominantly black.

Wing dark brown but hyaline from base to posterior cells.

Abdomen black with golden-yellow pile; all terga with pale yellow pile laterally which gradually reduce in length towards tip. Male genitalia (Fig. 3) black with pale-pellow bristly pile, eighth sternum slightly produced with dense yellow and black bristly pile.

Material: *Holotype* ♂, Himachal Pradesh: Dalhousie, 21.vi.1961, coll. P. W. Oman.

Remarks: The species is closely similar to *Trichomachimus basalis* Oldroyd but differs from it by the pale yellow and black mytax; all coxae with pale yellow pile; uniformly reddish-yellow tibia and details of male genitalia. It also resembles to *T. epulentus* (Walker) but differs in the colouration of pile on scutellum and fore tibia, and shape of eighth sternum. The species is named after the collector, Mr. P. W. Oman.

SUMMARY

Thirty two species of Asilidae belonging to 18 genera are dealt with including three new species: *Machimus nilgiriensis*, *Promachus smithi* and *Trichomachimus omani*. Distributional records of all the species are given from India.

ACKNOWLEDGEMENTS

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**NOEMACHEILUS PAMBARENSIS, A NEW LOACH (CYPRINOIDEI :
BALITORIDAE : NOEMACHEILINAE), FROM WESTERN
GHATS, IDUKKI, KERALA, INDIA.**

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INTRODUCTION

A new hill-stream loach *Noemacheilus (Mesonoemacheilus) pambarensis* is described from Pambar River, Western Ghats, Idukki District, Kerala. This new species differs from all other known species of *Mesonoemacheilus* in its elongated form, colour pattern and in the number of branched dorsal rays. Seventynine noemacheiline species under 2 genera and 9 subgenera are known from India (Menon, 1987). The new species with 8-10 branched dorsal rays and the characteristic spot in the middle of the base of caudal fin can be included under the subgenus *Mesonoemacheilus* Banareescu and Nalbant, 1981. These loaches were found among the fish collections from Kerala deposited in the Southern Regional Station, Madras by Erik Ahlander and Suzzanne Wejland of the Swedish Museum Natural History. The specimens were collected from Pambar river draining into the Cauvery river system at the border of Chinnar Sanctuary, Western Ghats in Idukki District, Kerala.

***Noemacheilus (Mesonoemacheilus) pambarensis* sp. nov.**

(Fig. 1)

***Holotype* :** ZSI/SRS F. 4095, 38.0 mm SL., India : Kerala : Western Ghats : Pambar River at border of Chinnar Sanctuary ; Erik Ahlander, Suzzanne Wejland and Bert ; 9 Apr. 1990.

***Paratypes* :** ZSI/SRS F. 3496, 29 exs., 15.5-45.0 mm SL ; Same data as of holotype.

Diagnosis : A slender elongated species with usually 9 branched dorsal rays in specimens above 35.0 mm SL (8 branched rays in juveniles and rarely 10 in adults); with almost complete lateral line system; body with irregular vertical bands; dorsal with two rows of spots, caudal with 4-5 oblique bands and dark blotch at its base; males with suborbital flap.

Description : Based on 10 specimens 36.0-45.0 mm SL. D.3-4/8-10/1; P1/10-11; V 1/6/1, A2-3/5; C.1/16/1. Dorsal Profile slightly arched, ventral flattened, depth of body 13.55-16.61 (15.27), head broader than high, its length 20.49-24.43 (22.62) percent of SL; length of snout a little less than postorbital distance, it is 35.67-44.29 (41.25) of HL; eyes fairly large, situated nearer snout, not visible from ventral surface, its diameter 20.13-25.48 (23.64) of HL, equal to or a little greater than interorbital distance, 95.54-123.33 (106.42) of interorbital width; nostrils close to each other, situated closer to eye than to tip of snout, anterior nostrils somewhat tubular and flap like; mouth semicircular, lips fleshy, deeply furrowed, lower interrupted in the middle; barbels well developed, broad at base, thread like at the ends, inner rostral shorter, outer rostral shorter than maxillary, extending to margin of eye, when adpressed, maxillary reaching to perpendicular from middle of eye.

Scales : Small, imbricate, distinct posteriorly, absent on the whole of the flattened ventral surface before anal. Lateral line prominent, complete and extends up to middle of caudal peduncle.

Fins : Dorsal fin base long, height short, less than length of head, edge of dorsal straight, origin of dorsal fin equidistant between tip of snout and caudal base; origin of pelvic behind that of dorsal; pectoral almost equal to or slightly longer than head, extends to about two thirds the distance to pelvic; pelvic shorter than pectoral, separated from anal opening by a short distance; anal fin almost reaching caudal base; caudal fin a little longer than head, deeply forked, lobes pointed, of equal length.

Predorsal distance 99.44-112.09 (107.01) in postdorsal distance, 47.65-53.75 (49.96) of SL; prepelvic distance 48.72-58.10 (52.16), preanal distance 76.78-83.0 (79.16), pectoral to pelvic origin 28.82-34.85 (30.91) of SL. Height of dorsal 16.76-23.32 (19.40), length of pectoral 20.40-24.59 (22.25), length of pelvic 18.34-20.05 (19.17), length of anal 11.75-17.80 (15.59), base of dorsal 18.71-21.8 (20.18), base of anal 7.58-10.20 (9.0) of SL.

Caudal peduncle slender and long, its length 12.30-14.94 (13.92) of SL, 50.93-69.65 (59.87) of HL; its depth 9.5-10.8 (10.31) of SL, 41.37-50.25 (45.22) of HL; its depth is 68.90-87.80 (76.39) of its length.

A range in the number of branched dorsal rays is observed in the 12 juveniles

REMA DEBI & INDRA

PLATE

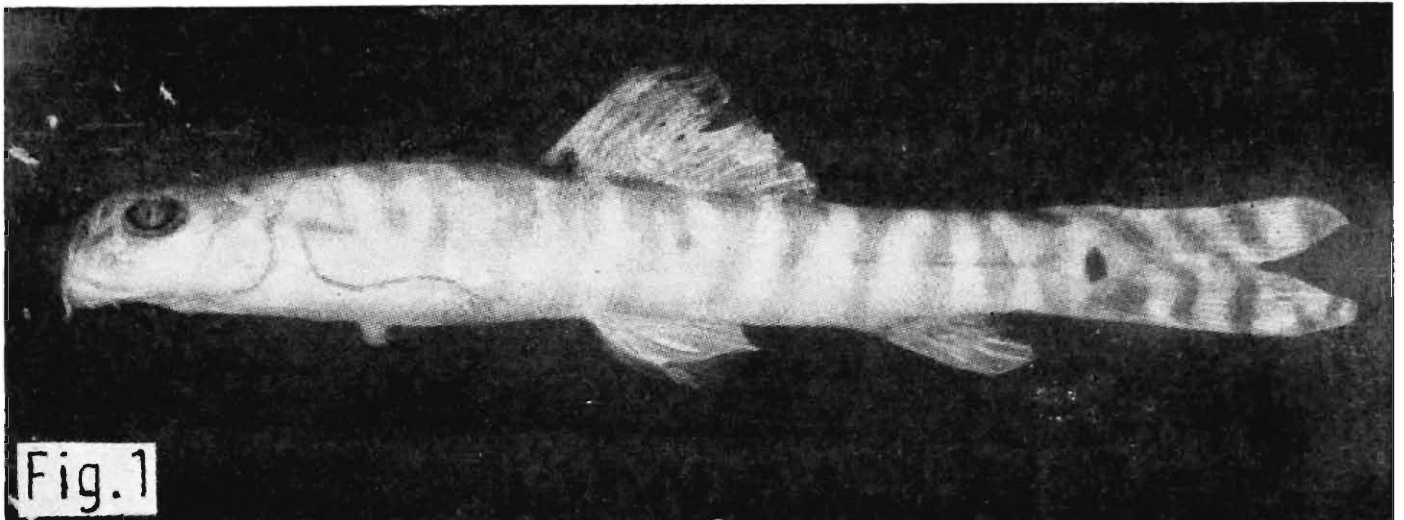


Fig. 1: Lateral view of *Noemacheilus pambarensis* sp. nov. 38.0 mm SL.

and 18 adults studied. In the juveniles the branched rays are 8 in number and in the larger specimens examined 83.3% have 9 branched rays and 16.7% have 10 branched rays. In one specimen 40.0 mm SL the pectoral fin formula is 2/9 for the right fin and 1/10 for the Left.

Sexual dimorphism : Males with suborbital flap ; the rays of pectoral thickened with breeding tubercles.

Colour : In the adults the body is marked with 4-5 broad bands on back and 9-13 irregular vertical bands on sides, two thirds the ground colour ; in some specimens adjacent bands are found to coalesce on the dorsal side—behind dorsal fin ; dorsal with a dark spot at origin, two rows of spots, along the fins, in larger specimens a third row of 2-3 spots near the tips ; an intensely black round to oval blotch at middle of base of caudal fin ; 4-5 dark V shaped to wavy bands on caudal.

Size : Largest specimen examined 45.00 mm SL.

Affinities : This species bears close resemblance to *N. pulchellus* Day in colour pattern in the caudal and dorsal fins and along the sides behind dorsal and the more number of branched rays in the dorsal. However, it differs from *pulchellus* in its slender body form, Depth of body 13.55-16.61 (15.27) vs. 21.53-23.75 (M=22.66) of SL in *pulchellus* ; elongated caudal peduncle, caudal peduncle 12.30-14.94 (13.62) vs. 10.0-14.13 (M=11.76) of SL in *N. pulchellus*. In addition sexual dimorphism is exhibited by this, whereas it is reported to be absent in *pulchellus*. In body colour pattern some specimens also resemble *N. petrubanarescui* Menon, but differ in body depth and dorsal fin.

Distribution : Western Ghats : Kerala : Idukki District : Pambar River.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India and the Officer-in-Charge of Southern Regional Station, Dr. P. T. Cherian, Sci. 'SF' for providing the necessary facilities. They are also grateful to Dr. A. G. K. Menon, Emeritus Scientist, Zoological Survey of India, Madras, for guidance rendered in their studies.

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OCCURRENCE OF LONG-WINGED BAT *MINIOPTERUS SCHREIBERSI*
FULIGINOSUS (HODGSON, 1835) (CHIROPTERA : VESPERTILIONIDAE)
IN MEGHALAYA, WITH SOME OBSERVATIONS ON ITS ECOLOGY

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INTRODUCTION

In connection with the study of bats of Siju Cave, Garo Hills, Meghalaya, 31 males and 19 females of *Miniopterus schreibersi fuliginosus* (Hodgson) were collected from Siju Cave as per details given below. This species was hitherto not reported from Meghalaya (Blanford 1891, Wroughton 1918, Kemp 1924, Hinton & Lindsay 1926, Tate 1942, Ellerman and Morrison-Scott 1951, Brosset 1962 and Kurup 1968)

Material examined : Meghalaya : West Garo Hills : Siju Cave : 22 Nov. 1990, 2 ♂♂ ; 26-30 Jun. 1991, 15 ♂♂, 6 ♀♀ : 23-26 Oct. 1991, 8 ♂♂, 11 ♀♀ ; 17 Feb. 1992, 4 ♂♂ ; 3 Jun. 1992, 2 ♂♂, 2 ♀♀ ; coll. Y. P. Sinha.

All measurements are given in millimetres and the arithmetic means in parentheses.

Measurements (in mm) : *External* : 31 ♂♂ ; Head and body 50.0-62.0 (57.0) ; tail 55.0-67.0 (61.0) ; forearm 49.0-52.0 (51.0) ; first phalanx of third finger 11.0-13.5 (12.5) ; second phalanx of third finger 35.0-43.0 (39.0) ; ear 11.0-14.0 (12.0) ; tragus 5.0-7.0 (5.5) ; tibia 20.0-23.0 (22.0) ; foot and claw 10.0-12.0 (11.5) ; wing span 300.0-350.0 (330.0) ; wing width 52.0-61.0 (57.0) ; penis length 9.0-15.0 (12.0). 19 ♀♀ : Head and body 54.0-58.0 (57.0) ; tail 56.0-64.0 (58.0) ; forearm 47.0-53.0 (50.0) ; first phalanx of third finger 10.8-13.0 (12.0) ; second phalanx of third finger 37.0-41.0 (40.0) ; ear 11.0-12.0 (11.6) ; tragus 5.0-7.0 (6.0) ; tibia 21.0-22.0 (21.5) ; foot and claw 10.0-11.0 (10.5) ; wing span 310.0-340.0 (330.0) ; wing width 55.0-59.0 (57.0).

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Skull: 5♂♂: Total length 16.6-17.7 (17.1); zygomatic width 9.5-10.0 (9.9); cranial width 8.0-8.7 (8.4); maxillary width ($m^s - m^s$) 7.3-8.0 (7.6); length of upper tooth row ($c - m^s$) 7.0 (in all); length of lower tooth row ($c - m^s$) 7.3-7.6 (7.4); mandibular length 12.7-13.5 (13.1); height of brain case 9.0-10.0 (9.7); height of muzzle 5.5-6.2 (5.9). 5♀♀: Total length 16.3-17.1 (16.9); zygomatic width 9.4-10.0 (9.8); cranial width 8.2-9.0 (8.6); maxillary width ($m^s - m^s$) 7.5-8.3 (7.8) length of upper tooth row ($c - m^s$) 6.9-7.1 (7.0); length of lower tooth row ($c - m^s$) 7.1-7.3 (7.2); mandibular length 12.1-12.5 (12.3); height of brain case 9.0-10.5 (9.7); height of muzzle 5.0-6.1 (5.7).

Additional material examined: Maharashtra: Satara Dist: Mahabaleshwar: 4 Jan 1915, present in the National collection of India at ZSI., Calcutta, 7♂♂, 13♀♀; 10 Aug 1967 W R S., Z S I., Pune. 8♂♂, 10♀♀; Karnataka: Nadakalsi, 28 Aug 1967, present in the National Institute of Virology, Pune, 3 (unsexed); Uttar Pradesh: Uttar Kashi Dist: Nakuri, c. 13 km. S. of Uttar Kashi, 28 May, 1989, ZSI., Calcutta, 2♀♀

Measurements of additional material: External: 15♂♂: Head and body 57.0-61.2 (59.5); tail 51.2-55.5 (53.4); forearm 47.0-49.0 (48.5); first phalanx of third finger 10.0-13.0 (11.5); second phalanx of third finger 34.2-42.1 (38.2); ear 10.0-12.0 (11.1); tragus 5.0-6.1 (5.8); tibia 17.0-20.0 (19.0); foot and claw 8.0-11.0 (10.0); wing span (not taken); wing width (not taken); penis length (not taken). 18♀♀ and 3 (unsexed): Head and body 65.0-60.0 (57.0); tail 52.0-56.0 (54.0); forearm 45.0-50.0 (48.0); first phalanx of third finger 10.0-12.5 (11.0); second phalanx of third finger 34.0-37.3 (36.2); ear 9.0-11.0 (10.4); tragus 5.0-6.5 (5.8); tibia 17.8-20.0 (19.2); foot and claw 8.0-10.5 (9.5); wing span (not taken); wing width (not taken). *Skull*: 5♂♂: Total length 15.0-16.0 (15.8); zygomatic width 9.0 (in all); cranial width 8.0 (in all); maxillary width ($m^s - m^s$) 6.5-7.0 (6.8); length of upper tooth row ($c - m^s$) 5.6-6.0 (5.9); length of lower tooth row ($c - m^s$) 6.5-6.9 (6.7); mandibular length 11.0-11.4 (11.2); height of brain case 8.0-9.7 (8.7); height of muzzle 4.5-5.0 (4.7). 5♀♀: Total length 15.5-16.1 (16.0); zygomatic width 8.9 (8.7); cranial width 8.0 (in all); maxillary width ($m^s - m^s$) 6.5-6.9 (6.7); length of upper tooth row ($c - m^s$) 6.0 (in all); length of lower tooth row ($c - m^s$) 6.1-6.7 (6.3); mandibular length 11.0-11.7 (11.2); height of brain case 8.6-9.3 (8.9); height of muzzle 4.7-5.6 (5.1).

From earlier records and above additional collections examined, this subspecies occurs in Maharashtra, Karnataka, Uttar Pradesh and West Bengal (Allen, 1908) in India. Therefore, the present material forms the basis of Authentic record of *Miniopterus schreibersi fuliginosus* Hodgson from Meghalaya.

Morphometric variation: Forearm (47.0-53.0) and skull (16.5-17.6) of Meghalaya population is slightly longer than that of Uttar Pradesh, Maharashtra and Karnataka

(forearm 45.0-50.0 and skull 15.0-16.0). However, these differences in size could be related to the level of maturity of specimens. Penis is very long (9.0-16.0). Ear small, 11.0-14.0 in length ; tragus short, 5.0-7.0 in length.

The tip of the right tragus is one specimen and that of both tragi in other specimen are found abnormally white. The length of second phalanx of the third finger is more than three times of the first phalanx as was observed by other authors. Colour blackish brown throughout. In one specimen partial albinism is observed in right wing between lower portion of the third and fourth finger.

Observations on ecology : It was observed that the colony fluctuates seasonally. Only males were observed in November (2 ex.) and February (4 ex.) while both sexes were abundant in June and October. The males outnumbered the females.

The ecological condition of Siju Cave with a subterranean river rushing through it, is an ideal habitat for this bat. A similar observation was made by Brosset (1962) for Robber's cave which constituted a "mother house" with another cave at Panchgani within a radius of 70 km which served as secondary habitat for the bat. However, I did not get the opportunity to explore deep inside the cave to find out any such off shoots, or outlets.

The Long-winged Bat was observed together with *Econycteris spelaea* (Dobson), *Rousettus l. leschenaulti* (Desmarest) and *Hipposideros lankadiva* Kelaart at the time of their emergence and collected all together in the mist-net in June and October and only with *E. spelaea* (Dobson) and *R. l. leschenaulti* (Desmarest) in November and February. This type of association has not been mentioned by Brosset (1962) in Robber's cave near Mahabaleshwar in Maharashtra.

Miniopterus s. fuliginosus was the first to emerge from the cave in the evening. The long-winged bat was found to emerge from the cave 5 minutes after sun-set in October, 8-10 minutes in November, 25 minutes in February and 12-15 minutes in June. It emerges early in the evening in October and November and late in the evening in February and June. It was not found hanging from ceiling near the entrance of the cave prior to emergence but it suddenly dispersed in all directions among trees which formed its hunting territory. While flying individuals of this bat keep close to each other in many rows. It was observed living in big crevices in the side wall of the cave in many places.

The gut contents of this species contained small wings of dipterans ; portions of small coleopteran ; isopteran and hymenopteran insects. The dentition is sharp but weak for bigger insects. Huge quantity of very small dipteran flies were observed in and around the cave.

All the females collected in the first and last week of June had well developed mammae, although none was found pregnant or with young. Brosset (1962) observes that the birth of young takes place in June but the females did not carry them in flight. Instead the young ones were put together in an enormous swarm.

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OBSERVATIONS ON THE ADYAR ESTUARINE SYSTEM, MADRAS (INDIA)
WITH REFERENCE TO RESTORATION OF BIOLOGICAL DIVERSITY

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INTRODUCTION

The forty kilometer long Adyar river which drains its contents into the Bay of Bengal within the southern limits of Madras city is unique in many aspects. The Adyar river, estuary and backwater form a veritable habitat for a number of species of plants and animals. The estuary, which gets cut off from the sea for the major part of the year due to the formation of a prominent sandbar impounding brackish water, is subjected to a lot of environmental variations by nature and urban civilisation. The Adyar estuarine system as a whole not only provides asylum to migrant avifauna but also harbours a host of other forms which may be wiped off from the niches by the way and rate at which the urban civilisation progresses. The few islets projecting out are also under stress. Contributing to the ill-health of the water body on the northern side of the estuary are quite a number of hutments of fishermen, housing board units, shops, small industrial establishments, schools and places of public utility on either side of river.

The most unusual aspect of this urban estuary is the presence of approximately 175 species of birds of which nearly 75 are migrants, 23 species of reptiles, 9 species of amphibians, and 4 varieties of shore crabs including the giant ghost crab which has become a rare sight (Tamilnadu Forest Department Correspondence, 1984). Five species of mammals frequent this area. The olive ridley turtles occasionally lay eggs near the sea-board and the sea eagles could be seen feeding on eggs and vermin.

The Adyar backwater beyond the crossing of Santhome High Road has been reclaimed by filling the area with city refuse, right from waste paper to discarded automobiles, waste coal-tar, wood shavings, slaughter house remains and unwanted domestic materials, etc. The ecological conditions of the Adyar estuarine system are fast changing. Scientific studies on the ecology of the estuary are few and far

between (Panikkar & Aiyer, 1937 ; Chacko & Ganapathi, 1949 ; Chacko *et al.*, 1954 ; Verma & Reddy, 1959 ; Sornavel, 1978 ; Anonymous, 1982 ; Nammalwar, 1984). Hence it becomes necessary at this stage a comprehensive study to find out the extent of alteration in the physicochemical and biological aspects in the last five decades and to suggest remedial measures to stall the rot and to restore optimal conditons for sustained living.

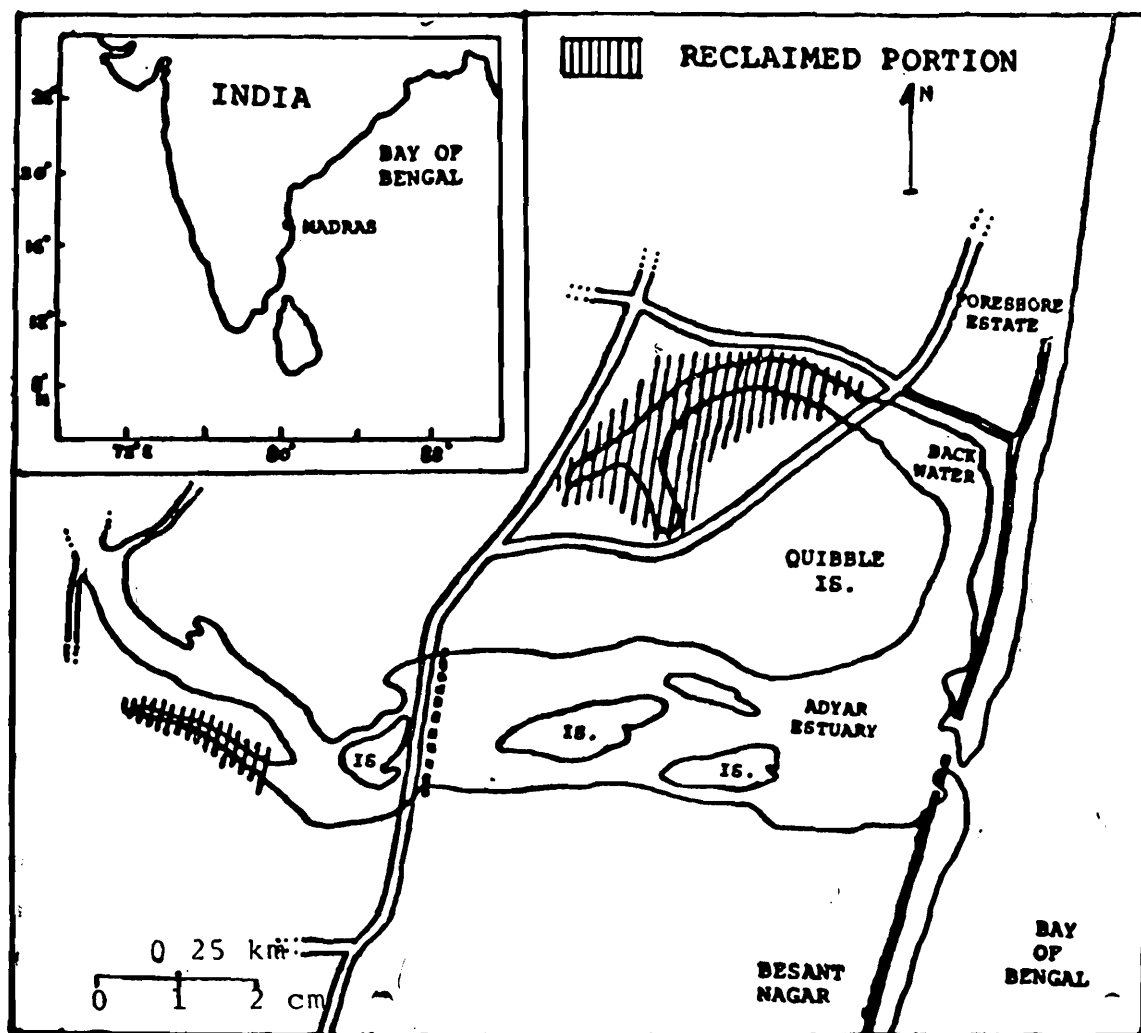
MATERIALS AND METHODS

Extensive study on the hydrological conditions and faunistics has been conducted by this station for over a decade. This has been supplemented by analysis of physicochemical parameters of water and sediments by the DOEn Pollution project from 1983 to 1986. Faunistic and floristic data enumerated by various agencies including Madras Naturalist's Society and the Tamilnadu Forest Department have been analysed. Hydro-biological readings consisting of phyto- and zooconstituents of plankton have been taken at irregular intervals for a period of five years from 1986 to 1991. Hydrological parameters have been worked out on a Hach-Europe water analysis kit. BOD and COD were found out according to standard methods. The distribution of heavy metals in brackish water biota and sediments has been analysed on IL 480 AAS. The species distribution and identification have been worked out and cross-checked with the available literature (Jones, 1937 ; Panikkar & Aiyer, 1937 ; Chacko & Subramaniam, 1947 ; Chacko *et al.*, 1954 ; Krishnamoorthy, 1963 ; Evangeline, 1967 ; Chacko, 1969 ; Srinivasan & Raghunathan, 1981 ; Nammalwar, *et al.* 1991).

DESCRIPTION OF THE AREA

The Adyar estuary is located within the South Madras urban limit (13°4'N and 80°17'E). The Adyar river in its northern course flows into the backwater of about two square kilometer area (Map 1). Geologically, Adyar estuary has the sandy soil characteristics of the Coromandel coast. Most of the topographic conditions have changed during the last sixty years. The Elphinstone Bridge has been replaced by another 20 mts. west of it. Quibble island in the Adyar estuary is a misnomer presently as the isolating water masses have been filled with sand and clay. The tail-end of Adyar backwater has been filled and land reclaimed. The mud flats and sandy islets remain exposed except during the north-east and south-west monsoon

regimes. For many years the monsoons were a failure and the river has been reduced to a languid line of water of sewage and sullage. Brackish water conditions are felt up to four kilometers in the river from the sea-board. The whole backwater's edge is muddy with inclines of clay up to the sides of Quibble island cemetery. The entire eastern sea-board of Adyar estuary is sandy. The sand bar raised by



Map 1. Adyar estuarine system.

breakers cuts off the river from the sea for major part of the year excluding monsoon period, if any, and when the authorities manually remove the sand to open the river mouth. During the last decade, for many years, both the summer and winter monsoons have failed virtually impounding the brackish water of this estuary in lentic state,

HYDROLOGICAL FEATURES

The various hydrological parameters analysed during 1985-86 are presented in Table 1. Some of these parameters for Adyar estuary studied by earlier authors are given in Table 2 for comparison.

Temperature: In the Adyar estuary, surface water temperature fluctuated between 24.2°C (Oct. 1986) and 32°C (Jun. 1985) whereas the maxima and minima in backwater were at the lower level. Scrutiny of previous and present data pertaining to surface temperature of water in the Adyar estuary leads one to deceptively feel that there is a remarkable increase by more than 5°C over a 50 years' time in the middle zone. As Adyar river is too shallow and at the estuarine zone the maximum depth known is less than 2.5 meters excepting for a few days during monsoons, the surface water temperature has to be more or less in conformity with the atmospheric temperature. It is true that the atmospheric temperature has gone up even to 41°C on a few occasions during the past decade and such increase will be reflected by water temperature.

Salinity: Salinity of this brackish water body ranged from 3.0 ppt (Nov. 85) to 32.0 (Apr. 86). The lowest salinity mark of the past sixty years occurred in November 1985 due to heavy rains (1017.4 mm) and breaching of Adyar river. The peaks of salinity appear to have been more or less constant for the entire period.

pH: Water samples collected during 1985-86 indicated alkaline nature (pH 7.32 in Sep. 1986 to 9.19 in Mar. 1985 for estuarine water). Comparison of pH values leads us to believe that the pH range has remained similar over the half-century with the exceptional acidic pH 6.5 during January 1979 reported by Nammalwar (1984).

Dissolved Oxygen: The dissolved oxygen levels were at a minimum of 2.3 ml l⁻¹ in Oct. 1985 and maximum of 6.8 ml l⁻¹ in April 1986. This is exactly in reverse with the observations of Chacko *et al.* (1954). There is every possibility that the reversed trend is due to heavy organic and inorganic contamination after the rainfall which opens up drainages and the effluent discharge systems directly into the river. Coincident during October-December is the mass fish-kill almost every year in the last decade (Nammalwar, 1984).

Suspended matter: The water samples were always turbid with more suspended matter during the study period whatever the season be. The lowest record of suspended matter is in February 1986 (106 mg l⁻¹) and maximum in July 1986

(939 mg l⁻¹) in the estuary while the range was more in the backwater 141 mg l⁻¹ (Jan. 1916) to 1948 mg l⁻¹ (July 1986).

Phosphates : In 1985 dissolved phosphate level rose from BDL in February to 10.348 mg l⁻¹ in September. Interestingly, in 1986 the peak was at 79.716 mg l⁻¹ in April, the reason for such an elevated level is obvious. The only level recorded in February 1949 was at 0.072 mg l⁻¹ (Chacko and Ganapathi, 1949).

Nitrates : In the Adyar estuary, nitrate levels fluctuated from BDL in October 1985 to 2.475 mg l⁻¹ in April 1986 whereas the level of 0.041 mg l⁻¹ in August 1985 rose to 7.425 mg l⁻¹ in February 1986 only to fall to BDL in Nov. 1986 in the Adyar backwater. Considering the nature of the water body one can surmise that the levels were quite reasonable.

BOD and COD : In 1986, the Adyar backwaters registered a nine fold increase in BOD level (94.0 mg l⁻¹ in August) whereas in the estuary a three-fold increase (54.0 in August) only was perceptible. COD in both the water bodies have been erratic and no acceptable correlation could be made out. The DO, BOD and COD levels were always comparable and explained the physical status of the water body synchronising with temperature, salinity, and pH.

Productivity ; Productivity rate was higher in the lentic backwaters (up to 23.4 mg C l⁻¹) whereas it remained lower and comparatively stable in the Adyar estuary.

BIODIVERSITY

The Adyar estuarine system is known for its biological diversity in general and for its nesting and migrating avifauna in particular, for which it is declared as a protected area. Our observations from 1986 to 1991 and analysis are discussed below.

To avoid voluminous repetition of data, we refrain from giving the complete list of flora and fauna.

Floristics : The Adyar estuarine system holds quantitatively and qualitatively poor vegetation. The macroflora of the shore line mainly consists of *Phoenix* sp., *Prosopis* sp., *Tephrosia* sp., *Indigopia* sp., *Acacia* sp., *Casuarina* sp., and crotons. Marsh plants like *Avicennia* sp. and *Sueda* sp. also occur. The once luxuriant growth of algal beds consisting of *Enteromorpha* sp. and *Chaetomorpha* sp. have become sporadic. The fresh water forms, viz. *Spirogyra* sp. and *Ceratophyllum* sp.

have also dwindled. In the last five decades, the greener aspects of the Adyar estuary and backwater have not only been greatly reduced, the species composition also has come down drastically.

The phytoplankton blooms have always resulted in reduction of the holding capacity by anoxic conditions prevailing in nights. Emanation of H_2S on a few occasions during the last decade could be easily noticed by the sudden blackening of silver utensils in the houses located around the estuary.

Adyar estuary is very rich in phytoplankton, which reportedly consists of at least 28 species belonging to diatoms, dinoflagellates and algae. Amongst them *Coscinodiscus* sp., *Asterionella* sp., *Thalassiothrix* sp., *Pleurosigma* sp., *Gyrosigma* sp., *Chaeloceros* sp., *Ceratium* sp. and *Fragilaria* sp. dominated the scene near the sea-board while *Anabaena* sp. and *Oscillatoria* sp. were found more in places where fresh water influx is noticed. During the period of observation in most cases the phytoplankton blooms were dominated by *Nitzschia* sp. and *Pleurosigma* sp.

Faunistics : The animal population of this estuarine system is represented by members of all phyla of the Animal Kingdom except Echinodermata. The surface water zooplankton samples were dominated by Copepods like *Oithona brevicornis*, *Oithona rigida*, *Microsetella* sp. *Macrosetella* sp., *Pseudodiaptomus* sp., *Acartia* sp. and the rotifer *Brachionus rubens* and *B. plicatilis*. Veliger larvae, penaeid prawn larvae and larval forms of some fishes mainly mullets are also found in the samples. But the species composition is relatively poor.

Among the poriferans, *Spongilla* sp. occurs near the Elphinstone Bridge. Coelenterates are mainly represented by hydrozoans especially *Campanularia* sp. and *Obelia* sp. near the sand bar while juveniles of Scyphomedusoid jelly fish *Acromitus flagellatus* move into the estuary when sand bar is open. Anthozoan constituents have become rarer and probably restricted to two species as opposed to the observation of seven species by Panikkar and Aiyer (1937).

Phylum Annelida is represented by mostly *Nereis* sp., *Diopatra* sp., *Polydora* sp., *Pontodrilus* sp., *Marphysa gravelyi*, and the sabellid *Laonome indica* is of rare occurrence; Serpulids are found on the bases of the broken bridge near sea shore. The polychaetes such as *Onuphis eremita*, *Glycera embranchiata*, *Loimia medusa*, *Marphysa gravelyi*, *Diopatra variabilis* and *Clymene insecta* reported by Krishnamoorthi (1963) and *Lumbriconeries* sp., *Prionospio cirrifera* reported by Panikkar and Aiyer (1937) to be present in abundance in this water body have become scarce at present with the lone exception of *Marphysa gravelyi*.

Phylum Arthropoda has major representatives quantitatively and qualitatively in

water, sediments and on shore-line both in the estuary and backwater. The clayey and muddy areas of backwater which have high humus content hold large sympatric populations of *Uca lactea annulipes* and *Uca triangularis bengali*. Pelagic crabs *Scylla serrata*, *Portunus pelagicus* and *Portunus sanguinolentus*, other crabs such as *Ocypoda macrocera*, *Ocypoda cardimana*, *Sesarma* sp., *Metaplex* sp., *Grapsus* sp., *Matuta* sp., *Philyra* sp., and prawn like *Palaemon* sp., *Penaeus* sp., *Metapenaeus* sp., *Alpheus* sp. occur in good number. Other arthropods, for example, *Ligia* sp. *Leander* sp., *Emerita* sp., *Diogenus* sp., and *Clibanarius clibanarius* are also common. Foraging activities, agonistic tendencies and migratory behaviour of the fiddler crabs are noteworthy (Krishnan, 1986).

Phylum Mollusca is also fairly represented and the oyster *Ostrea madrasensis* occurs on rocky substrate where water carries heavy organic contamination. Aplysids have become rarer. The commoner species of *Arca*, *Meretrix*, *Donax*, *Perna* etc. occur always on either banks of the river near the place of confluence. Gastropod juveniles occur at all the stations from where samples have been collected. At least four species of gastropods thrive in this area. *Littorina littorea* could be seen only on the sea-board.

Among the Chordates, Pisces forms the major component. Out of the eighty species of fishes reported by earlier workers (Panikkar & Aiyer, 1937 ; Chacko *et al.*, 1954 ; Nammalwar, 1984 ; Nammalwar *et al.*, 1991) at least 39 have economic value. However, from the fishery point of view Adyar estuary does not play any pivotal role. Neither the catches are free from contamination nor safely consumable. Introduction of the exotic fish *Tilapia mossambica* into the Adyar estuary has not enriched the fishery ; moreover, commercial catches are dominated by juveniles. The brackish water fish culture farm of the fishery department also does not contribute to any appreciable extent.

About 175 species of birds (approximately 75 migrants) including the rarer species like Frigate bird, greater and lesser Flamingoes, Oyster catcher, Eastern Ringed plover, Avocet, short-eared owl, collared sand Martin, Orange headed Ground-thrush, Forest wagtail, Eastern Grasshopper warbler, short-toed lark have been sighted in this estuary. Stone curlews, larks, pipits, bee-eaters, king-fishers red wattled and yellow wattled lapwings and others have nesting sites in the islets between the bridge and the sea shore and also at the open meadow on the northern bank.

The faunistic spectrum is further widened by the presence of nine species of frogs and toads, twenty three species of reptiles including two species of snakes and five species of mammals,

CONTAMINANTS

During the last two decades the Adyar estuary and backwater have been insulted by industrial effluents and untreated sewage enhancing the risk factors considerably. Approximately, 8 million litres of sewage and 0.75 million litres of industrial effluents are let out into the Adyar estuarine system every day (Sornavel, 1978, Anonymous 1982, Nammalwar, 1984). Heavy metals, organochlorine pesticides and petroleum hydrocarbons have drastically affected the hitherto conducive environment for optimal living. The detergent laden dhobikhana water (laundry effluents), the heavy metal carrying wash waters of paint, electroplating, tanning and chemical industries, sullage from households carrying heavy BOD components and high bacterial count emanating slaughter house remains and public convenience let offs have altered the composition of water and sediments of this estuary.

The five major heavy metals (Cd, Cu, Ni, Pb and Zn) analysed from the water and sediments of the estuary and backwater are presented in Table 3. When compared with available data of 1982-83 (Krishnan, 1992) we infer that the concentrations of these heavy metals have gone up in the Adyar estuary within a period of three years as in Table 4 with an exception for lead.

The organochlorine pesticides found (not quantified) are DDT, Heptachlore and Lindane from water and sediments. The petroleum hydrocarbons (undifferentiated) were noticed in high concentrations during July and November 1986 (246.33 ug g^{-1} and 147.15 ug g^{-1}) in water samples from the Adyar estuary.

Total coliform and faecal coliform bacterial counts during 1985-86 have consistently been more than 12,000 colonies per 100 ml and 1000 colonies per 100 ml of water respectively in Adyar estuary rendering water unfit for human consumption.

RESTORATIVE STRATEGIES

In conclusion, I propose a few strategies for restoring optimal ecological conditions for life to survive and sustain in a healthy way.

1. Adyar estuary and the shore line from Foreshore Estate to Besant Nagar should not be developed for tourism purposes since urbanisation will lead to enhancement of stress factor.

2. Simultaneously, people should be prevented from constructing huts and tenements on either banks of the Adyar river bordering the estuary.

3. Utilisation of the estuary and the backwater for fish culture systems for the reason that the available area is too less and the ecosystem is labile, the cultured fishes also may not be of good quality.

4. Fishing activity should be stopped totally during the period when migratory birds visit and the resident birds breed. During the other seasons indiscriminate fishing of brood stock and juveniles should not be permitted.

5. Prevention of pollution of Adyar estuary by meticulous licensing of industries with continuous monitoring of discharged effluents. Letting out of untreated sewage and sullage into the estuary directly should be prohibited.

6. Opening of sand bar and keeping the estuary open to the sea throughout the year will be the prime factor in keeping the estuary healthy, not only from the ecological point of view but also to limit water borne disease spreading from the stagnant pool. Of late, people inhabiting the banks of the Adyar river are reportedly suffering from cholera, amoebic dysentery, diarrhoea, filariasis, etc.

7. Planting of suitable shrubs and trees above the high tide mark on the shore line and on the islets should be encouraged from providing asylum to the birds.

8. Introduction of a ban on grazing by domestic animals and deforestation for firewood by local people recommended.

9. Creating an awareness in the minds of local population and educating them on the uniqueness of the Adyar estuary is necessary.

SUMMARY

The Adyar estuarine system, the urban confluence of the Adyar river within the southern limits of Madras city, India, is unique by every measure. During the last six decades the estuary has changed much in content and complexion. Steep alterations in physicochemical and biological conditions have not only resulted in depletion of biota but also disturbed mankind directly. Available literature has been scrutinised and compared with the results of present study on various parameters. Restorative strategies for survival and sustained life in the estuary are suggested.

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Table 1 : Hydrological parameter ranges in the Adyar estuary and backwater during 1985-86

Parameters	Adyar estuary		Adyar backwater	
	1985	1986	1985	1986
Temperature	25.0 — 32.0 (Jan) (Jun)	24.2 — 31.3 (oct) (Jun)	26.3 — 31.6 (Sep) (Jun)	22.4 — 30.2 (Jan) (May)
Salinity (ppt)	3.0 — 28.4 (Nov) (Apr)	4.6 — 32.0 (Nov) (Apr)	3.0 — 22.0 (Nov) (May)	3.2 — 29.6 (Dec) (Jul)
pH	7.80 — 9.19 (Nov) (Mar)	7.32 — 9.07 (Sep) (May)	7.49 — 9.14 (Sep) (Jun)	7.55 — 9.95 (Oct) (Nov)
Dissolved oxygen (ml l ⁻¹)	2.3 — 5.6 (oct) (Apr)	2.4 — 6.8 (Sep) (Apr)	1.2 — 6.1 (Dec) (Apr)	2.0 — 5.9 (Jul) (Apr)
BOD mg l ⁻¹	—	19.50 — 54.00 (Jun) (Aug)	—	10.50 — 94.00 (Nov) (Aug)
COD mg l ⁻¹	800 — 3733 (Dec) (Sep)	176 — 766 (Mar) (Feb)	609 — 2399 (Sep) (Oct)	267 — 905 (Nov) (Feb)
Suspended matter mg l ⁻¹	199 — 726 (Jun) (Dec)	106 — 939 (Feb) (Jul)	192 — 849 (May) (Apr)	141 — 1948 (Jan) (Jul)
Phosphate mg l ⁻¹	BDL — 10.348 (Feb) (Sep)	BDL — 79.716 (Feb) (Apr)	1.145 — 9.800 (Jul) (Apr)	0.153 — 67.452 (Jun) (Apr)
Nitrate mg l ⁻¹	BDL — 0.355 (Oct) (Nov)	0.005 — 2.475 (Feb) (Apr)	0.041 — 1.090 (Aug) (Sep)	BDL — 7.425 (Nov) (Feb)
Productivity mg l ⁻¹	BDL — 5.893 (Jul) (Mar)	BDL — 7.147 (Jan) (Jul)	BDL — 11.971 (Oct) (Nov)	BDL — 23.400 (Mar) (Jul)

Table 2 : Hydrological features of Adyar estuary

Year	Salinity ppt.	Temperature °C	Dissolved oxygen ml 1 ⁻¹	pH	Phosphate mg 1 ⁻¹	Source
1933	16.91 (Jun) to 30.44 (Feb)	25.0 (Jan) to 29.6 (May)	N.A.	8.46 (Mar) to 9.15 (Jul)	N.A.	Panikkar & Aiyer 1933
1949 (Feb.)	N.A.	29.5	2.44	8.1	0.072	Chacko & Ganapathi 1949
1952-53	19.03 (Nov. 52) to 31.5 (Apr. 53)	24.8 (Nov. 52) to 32.0 (Jul. 52)	2.20 (Jan. 52) to 6.90 (Oct. 52)	7.41 (Feb. 53) to 8.80 (Nov. 52)	N.A.	Chacko et al. 1954
1979-80	5.01 (Dec. 79) to 26.05 (Mar. 79)	26.0 (Dec. 79) to 32.9 (Apr. 80)	0.04 (Aug. 79) to 4.45 (Feb. 80)	6.50 (Jan. 79) to 8.60 (Oct. 79)	N.A.	Nammalwar, 1984
1985-86	3.00 (Nov. 85) to 32.00 (Apr. 86)	24.2 (Oct. 86) to 35.0 (Jun. 85)	2.30 (Oct. 85) to 6.80 (Apr. 86)	7.32 (Sep. 86) to 9.19 (Mar. 85)	BDL (Feb. 85, 86) to 79.71 (Apr. 86)	Present study

Table 3 : Ranges of concentration of heavy metals in water and sediment samples of Adyar estuary and backwater during 1985-86

		Cd	Cu	Ni	Pb	Zn
	Estuary	BDL*	0.002 (Dec. 85)	BDL*	0.002 (Sep. 86)	0.007 (Feb. 86)
		to	to	to	to	to
		0.084 (Jun. 85)	0.850 (Feb. 85)	0.270 (Jun. 85)	0.122 (Aug. 85)	1.040 (May 85)
Water in mg l ⁻¹	Backwater	BDL*	0.008 (Feb. 86)	0.003 (Oct & Jul. 86)	0.003 (Mar, Jun, Aug. 86)	0.019 (May 86)
		to	to	to	to	to
		0.006 (Apr. 85)	0.850 (Mar.85)	0.002 (Mar. 86)	0.030 (Jan. 85)	1.250 (Feb. 86)
	Estuary	BDL (Jul. 85)	BDL (Jan. 85 & Jun. 86)	BDL (Oct. 86)	0.51 (Feb. 85)	BDL (Mar. 85)
		to	to	to	to	& Sep. 86)
		2.5 (May 85)	275.5 (Feb. 86)	20.35 (Aug.85)	48.27 (Jul. 85)	216.9 (Feb. 85)
Sediment in ug g ⁻¹	Backwater	BDL (Jul & Nov 86)	BDL (Sep. 86)	BDL (Sep. & Oct. 86)	0.375 (Apr.86)	BDL (Mar. 85
		to	to	to	to	& May 86)
		0.3 (Apr & Dec 85)	258.8 (Nov.85)	23.9 (Jul. 85)	149.17 (Jan. 86)	458.1 (Nov. 85)

* For atleast 6 to 8 months in a year.

Table 4; Times of increase in heavy metal concentration from 1982-83 to 1985-86 in the Adyar estuary

	Cd	Cu	Ni	Pb	Zn
Water	2.6	2.4	1.4	0.3	1.4
Sediments	10.8	6.5	3.8	4.5	4.8

ON SOME SPIDERS (ARANEAE : ARACHNIDA)
FROM BASTAR DISTRICT (MADHYA PRADESH) INDIA

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INTRODUCTION

Few Surveys were undertaken during 1973, 74, 78, 84, 88 and 1990 to explore the faunal wealth of Bastar district by Zoological Survey of India. The total geographical area of the district according to the village papers is 39.18 lacks hectares. Out of this 29.92 lakh hectares (66%) is classified as forest. The geographical position is between 17°46' to 20°34'N latitude and between 80°15' to 82°15'E longitude. Physiographically the district is divided into two parts, Kotri Mahanadi plains in the North and Keskhal hills in the South. The district is more like a plateau with intervening Indravati plains in the Central part and a little low land in the South and South West.

Practically there was no work on the spiders of Bastar district. Pocock (1900) in his classical work on arachnids and Tikader (1980, 1982), has not recorded any species from this region.

This paper deals with 31 species under 21 genera of the families Eresidae, Filistatidae, Uloboridae, Hersiliidae, Thomisidae, Philodromidae, Gnaphosidae, Oxyopidae, Lycosidae and Araneidae, out of which eight species viz. *Callilepis lambai* Tikader & Gajbe, *Scopodes maitraiae* Tikader & Gajbe, *Pardosa sumatrana* (Thorell), *Arctosa himalayensis* Tikader & Malhotra, *Argiope aemula* (Walckenaer), *Argiope pulchella* Thorell, *Cyclosa hexatuberculata* Tikader, *Neoscona mukerjei* Tikader, are first time reported from this area.

Twenty species viz. *Filistata poonaensis* Tikader, *Uloborus danolius* Tikader, *Thomisus projectus* Tikader, *Thomisus cherapunjeus* Tikader, *Amyciaea forticeps* (Cambridge), *Xysticus kashidi* Tikader, *Xysticus minutus* Tikader, *Philodromus betrabatai* Tikader, *Philodromus bhagirathai* Tikader, *Zelotes shantae* Tikader, *Oxyopes sakuntalae* Tikader, *Oxyopes sunandae* Tikader, *Oxyopes ratnae* Tikader, *Hippasa greenalliae* (Blackwall),

Hippasa agelenoides (Simon), *Lycosa poonaensis* Tikader & Malhotra, *Lycosa nigrotibialis* Simon, *Leucage celebesiana* (Walckenaer), *Argiope pradhani* Sinha, *Araneus mitifica* (Simon), are reported for the first time from Madhya Pradesh.

Family I : ERESIDAE

1. *Stegodyphus sarasinorum* Karsch

1892. *Stegodyphus sarasinorum* Karsch, *Ent. Z. Berlin*, 36 : 275.

Specimen examined : 1 ♀, Gariapahar Kanker, Bastar dist., M. P. Coll. U.A. Gajbe, 4.1.1984. (Reg. No. A/2251).

Distribution : India : Karnataka, Maharashtra, Punjab, West Bengal, Madhya Pradesh.

Family II : FILISTATIDAE

2. *Filistata poonaensis* Tikader

1963. *Filistata poonaensis* Tikader, *J. Univ. Poona Sci. Tech.*, 24 : 35.

Specimen examined : 1 ♀, Orccha, Narayanpur Tahsil, Bastar dist., M. P. Coll. U.A. Gajbe, 28.12.1983 (Reg. No. A/2266). 1 ♀, Bargaon near Chhotedonger, Bastar dist., M. P. Coll. U.A. Gajbe, 24.12.1983 (Reg. No. A/2267). 2 ♀ ♀, Hutkachora near Jagadapur, Bastar dist., M.P. Coll. U.A. Gabe, 2.1.1984 (Reg. No. A/2269). 1 ♀, Chitrakote, Bastar dist., M.P. Coll. U.A. Gajbe, 1.1.1984 (Reg. No. A/2268).

Distribution : India : Maharashtra, Gujarat.

Family III : ULOBORIDAE

3. *Uloborus danolius* Tikader

1969. *Uloborus danolius* Tikader, *Proc. Indian Acad. Sci.*, 70 (3) : 129,

Specimen examined : 1 ♀, Hutkachora village near Jagadapur, Bastar dist., M.P. Coll. U.A. Gajbe, 2.1.1984 (Reg. No. A/2252).

Distribution : India : Maharashtra, West Bengal, Car-Nicobar.

Family IV : HERSILIIDAE

4. *Hersilia savignyi* Lucas

1836. *Hersilia savignyi* Lucas, *Mag. Zool.*, 8 : 10.

Specimen examined : 2 ♀ ♀, Tondabeda village near Orccha, Bastar dist., M.P. Coll. U.A. Gajbe, 29.12.1983 (Reg. No. A/2253). 3 ♀ ♀, Hutkachora near Jagadapur, Bastar dist., M.P. Coll. U.A. Gajbe, 2.1.1984 (Reg. No. A/2254). 4 ♀ ♀, Garhbengal near Narayanpur, Bastar dist., M.P. Coll. U.A. Gajbe, 30.12.1983 (Reg. No. A/2255). 1 ♀, Porpa village near Jagadapur, Bastar dist., M.P. Coll. U.A. Gajbe, 31.12.1983 (Reg. No. A/2256). 2 ♀ ♀, Bargaon near Chhotedonger, Bastar dist., M.P. Coll. U.A. Gajbe, 24.12.1983 (Reg. No. A/2257). 3 ♀ ♀, Orccha, Narayanpur Tahsil, Bastar dist., M.P. Coll. U.A. Gajbe 28.12.1983 (Reg.no. A/2258).

Distribution : India : Tamil Nadu, Karnataka, Maharashtra, Uttar Pradesh, West Bengal, Assam, Bihar, Orissa ; Sri Lanka ; Burma ; Pakistan.

Family V : THOMISIDAE

5. *Thomisus projectus* Tikader

1960. *Thomisus projectus* Tikader, *J. Bombay nat. Hist. Soc.*, 57 : 182.

Specimen examined : 2 ♂♂, Bijapur, Bastar dist., M.P. Coll. R. K. Ghose, 8.2.1990 (Reg. No. A/2227). 1 ♂, Bijapur, Bastar dist., M.P. Coll. R. K. Ghose, 7.2.1990 (Reg. No. A/2228)

Distribution : India; West Bengal.

6. *Thomisus cherapujeus* Tikader

1966. *Thomisus cherapujeus* Tikader, *Proc. Indian Acad. Sci.*, 64(1) : 54.

Specimen examined : 1 ♀, Kutru village, Bastar dist., M. P. Coll. R. K. Ghose, 26.1.1990 (Reg. No. A/2230).

Distribution : India : Meghalaya.

7. *Amyciaea forticeps* (Cambridge)

1873. *Amyciaea forticeps* Cambridge, *Proc. zool. Soc. Lond.*, 1873 : 122.

Specimen examined : 1 ♂, Bijapur, Bastar dist., M.P. Coll. R. K. Ghose, 26.1.1990 (Reg. No. A/2229).

Distribution : India : Maharashtra ; Burma ; Malaysia.

8. *Xysticus kashidi* Tikader

1963. *Xysticus kashidi* Tikader, *Proc. Indian Acad. Sci.*, 58 (5) : 261.

Specimen examined : 1 ♀, Orccha, Narayanpur Tahsil, Bastar dist., M. P. Coll. U. A. Gajbe, 28.12.1983 (Reg. No. A/2260).

Distribution : India : Karnataka.

9. *Xysticus minutus* Tikader

1960. *Xysticus minutus* Tikader, *J. Bombay nat. Hist. Soc.*, 57 (1) : 173.

Specimen examined : 1 ♀, Gariapahar Kanker, Bastar dist., M. P Coll. U.A. Gajbe, 4.1.1984 (Reg. No. A/2261). 1 ♀, Chitrakote, Bastar dist., M.P. Coll. U.A. Gajbe, 1.1.1984 (Reg. No. A/2262).

Distribution : India : West Bengal, Maharashtra, Meghalaya, Gujarat.

Family VI : PHILODROMIDAE

10. *Philodromus betrabatai* Tikader

1966. *Philodromus betrabatai* Tikader, *Proc. Linn. Soc.*, 177 (i) : 35.

Specimen examined : 1 ♀, (Subadult) Chitrakote, Bastar dist., M. P. Coll. U. A. Gajbe, 2.1.1984 (Reg. No. A/2263). 2 ♀ ♀, (Subadult), Hutkachora near Jagadapur, Bastar dist., M. P. Coll. U.A. Gajbe, 2.1.1984 (Reg. No. A/2264).

Distribution : India : Maharashtra.

11. *Philodromus bhagirathai* Tikader

1966. *Philodromus bhagirathai* Tikader, *Proc. Linn. Soc.*, 177 (1) : 200.

Specimen examined : 1 ♀, (Subadult), Gariapahar Kanker, Bastar dist., M, P. Coll. U. A. Gajbe, 4.1.1984 (Reg. No. A/2265).

Distribution : India : Uttar Pradesh, Tamil Nadu.

Family VII : GNAPHOSIDAE

12. *Callilepis lambai* Tikader & Gajbe

1977. *Callilepis lambai* Tikader & Gajbe, *Rec. zool. Surv. India*, 73 (1-4) : 50.

Specimen examined : 1 ♀, Kondagaon, Bastar dist., M. P. Coll. R. K. Ghose, 22.1.1990 (Reg. No. A/2226).

Distribmtion : India : Karnataka, Punjab, Madhya Pradesh.

13. *Scopodes maitraiae* Tikader & Gajbe

1977. *Scopodes maitraiae* Tikader & Gajbe, *Rec. zool. Surv. India.*, 73 (1-4) i 14.

Specimen examined : 1 ♀, Kondagaon, Bastar dist., M. P. Coll. R. K. Ghose, 22.1.1990 (Reg. No. A/2225).

Distribution : India : Maharashtra, Gujarat, Orissa, Bihar, Madhya Pradesh.

14. *Zelotes shantae* Tikader

1982. *Zelotes shantae* Tikader, *Fauna of India, Spiders*, 2 (2) : 483.

Specimen examined : 1 ♀, Orccha, Narayanpur Tahsil, Bastar dist., M.P. Coll, U.A. Gajbe, 28.12.1983 (Reg, No. A/2259).

Distribution : India : Maharashtra.

Family VIII : OXYOPIDAE

15. *Oxyopes sakuntalae* Tikader

1970. *Oxyopes sakuntalae* Tikader, *Rec. zool. Surv. India*, 64 (1-4) : 73.

Specimen examined : 1 ♀, Kondagaon, Bastar dist., M. P. Coll. R. K. Ghose, 22.1.1990 (Reg. No. A/2246).

Distribution : India : West Bengal.

16. *Oxyopes sunandae* Tikader

1970. *Oxyopes sunandae* Tikader, *Rec. zool. Surv. India*, 64 (1-4) : 74.

Specimen examined : 11 ♀ ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 7.2.1990 (Reg. No. A/2248). 5 ♀ ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 8.2.1990. (Reg. No. A/2249). 2 ♀ ♀, Kutru, Bastar dist., M. P. Coll. R. K. Ghose, 26.1.1990 (Reg. No. A/2250).

Distribution : India : Sikkim.

17. *Oxyopes ratnae* Tikader

1970. *Oxyopes ratnae* Tikader, *Rec. zool. Surv. India*, 64 (1-4) : 70.

Specimen examined : 2 ♀ ♀, Orccha, Bastar dist., M. P. Coll. U. A. Gajbe, 28.12.1983. (Reg. No. A/2283) 1 ♀, Gariapahar Kanker, Bastar dist., M. P. Coll, U. A. Gajbe, 4.1.1984 (Reg. No. A/2284). 4 ♀ ♀, Tondabeda village near Orccha, Bastar dist., M. P. Coll. U. A. Gajbe, 29.12.1983. (Reg. No. A/2285). 1 ♀ Chitrakote, Bastar dist., M. P. Coll. U. A. Gajbe, 1.1. 1984 (Reg. No. A/2286).

Distribution : India : Silkim, West Bengal.

Family IX : LYCOSIDAE

18. *Hippasa greenalliae* (Blackwall)

1867. *Lycosa greenalliae* Blackwall, *Ann. Mag. nat. Hist.*, 19 (3) ; 387.

Specimen examined : 3 ♀ ♀, Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 26.12.1983 (Reg. No. A/2270). 5 ♀ ♀, Bargaon village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12. 1983 (Reg. No. A/2271). 3 ♀ ♀, Dhaurai village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12.1983 (Reg. No. A/2272). 3 ♀ ♀, Chitrakote, Bastar dist., M. P. Coll. U. A. Gajbe, 1.1.1984 (Reg. No. A/2273).

Distribution : India : Tamil Nadu, Kerala, Karnataka, Maharashtra, Orissa, Sikkim, West Bengal ; Sri Lanka.

19. *Hippasa agelenoides* (Simon)

1884. *Pirata agelenoides* Simon, *Ann. Mus. Civ. Stor. nat. Genova*, 20 : 334.

Specimen examined : 1 ♀, (subadult), Kutru village, Bastar dist., M. P. Coll. R. K. Ghose, 28.1.1990 (Reg. No. A/2236). 1 ♀, (subadult). Kerpa village 20 km. NW of Kutru, Indrawati Tiger reserves, Bastar dist., M.P. Coll. R.K. Ghose. 31.1.1990 (Reg. No. A/2237). 2 ♀ ♀, Bargaon village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12.1983 (Reg. No. A/2281). 3 ♀ ♀, Charama, Bastar Dist., M. P. Coll. U. A. Gajbe, 5.1.1984 (Reg. No. A/2282).

Distribution : India : Kerala, Karnataka, Tamil Nadu, Uttar Pradesh, Maharashtra, Burma : Tharrawaddy and Rangoon.

20. *Pardosa sumatrana* (Thorell)

1890. *Lycosa sumatrana* Thorell, *Ann. Mus. Stor. nat. Genova*, 30 : 136.

Specimen examined : 3 ♀ ♀, Bijapur, Bastar dist. M. P. Coll. R. K. Ghose, 4.2.1990 (Reg. No. A/2231). 1 ♀ Kerpa, 20 km. of Kutru Indrawati Tiger Reserves, Bastar dist., M.P. Coll. R.K. Ghose, 31.1.1990 (Reg. No. A/2232). 1 ♀, Chhotedonger, Bastar dist., M. P. Coll. U.A. Gajbe, 26.12.1983 (Reg. No. A/2274).

Distribution : India : Kerala, Karnataka, Tamil Nadu, Bihar, Himachal Pradesh, West Bengal, Meghalaya, Rajasthan, Gujarat, Madhya Pradesh, Arunachal Pradesh, ; Bangladesh ; Sumatra ; Sri Lanka.

21. *Pardosa birmanica* Simon

1884. *Pardosa birmanica* Simon, *Ann. Mus. civ. stor. nat. Genova*, 20 : 333.

Specimen examined : 1 ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 4.2.1990 (Reg. No. A/2233). 1 ♂, (subadult), Kutru, Bastar dist., M.P. Coll. R. K. Ghose, 2.2.1990 (Reg. No. A/2234). 3 ♀ ♀, 1 ♂, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 5.2.1990 (Reg. No. A/2235). 7 ♀ ♀, 1 ♂, Bargaon village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12.1983 (Reg. No. A/2275). 1 ♀, Garhbengal, Naryanpur Tahsil, Bastar dist., M. P. Coll. U.A. Gajbe, 30.12.1983 (Reg. No. A/2276). 8 ♀ ♀, 4 ♂ ♂, Charama, Bastar dist., M. P. Coll. U.A. Gajbe, 5.1.1984 (Reg. No. A/2277). 1 ♀, 1 ♂, Orccha, Narayanpur Tahsil, Bastar dist., M. P. Coll. U. A. Gajbe, 28.12.1983 (Reg. No. A/2278). 4 ♀ ♀, 7 ♂ ♂, Bargaon village near Chhotedonger, Bastar dist., M.P. Coll. U.A. Gajbe, 24.12.1983. (Reg. No. A/2279).

Distribution : India : Maharashtra, West Bengal, Orissa, Uttar Pradesh, Rajasthan, Gujarat, Himachal Pradesh, Madhya Pradesh, Meghalaya, Bihar, Tamil Nadu, Andhra Pradesh ; Java ; Burma ; Pakistan.

22. *Aretosa himalayensis* Tikader & Malhotra

1982. *Arctosa himalayensis* Tikader & Malhotra, *Fauna of India, Spiders*, 2 (2) : 369.

Specimen examined : 1 ♀, Charama, Bastar dist., M. P. Coll. U. A. Gajbe, 5.1.1984 (Reg. No. A/2280).

Distribution : India : Uttar Pradesh.

23. *Lycosa poonaensis* Tikader & Malhotra

1980. *Lycosa poonaensis* Tikader & Malhotra, *Fauna of India, Spiders*, 1 (2) : 392.

Specimen examined : 1 ♀, Kutru, Bastar dist., M. P. Coll., R. K. Ghose, 31.1.1990 (Reg. No. A/2238).

Distribution : India : Poona, Maharashtra.

24. *Lycosa nigrotibialis* Simon

1884. *Lycosa nigrotibialis* Simon, *Ann. Mus. stor. nat. Genova*, 20 : 330.

Specimen examined : 1 ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 9.2.1990 (Reg. No. A/2239). 1 ♀, Kondagaon, Bastar dist., M. P. Coll. R. K. Ghose, 22.1.1990 ; Bihar, (Reg. No. A/2240).

Distribution : India : Maharashtra, Gujarat, Himachal Pradesh, West Bengal, Bihar, Sikkim, Assam ; Baluchistan, Zangi, Nawar, Afganistan ; Pakistan ; Burma.

Family X : (ARANEIDAE)**25. *Leucage celebesiana* (Walckenaer)**

1841. *Tetragnatha celebesiana* Walckenaer, *Hist. nat. Ins. Apt.*, 2 : 222.

Specimen examined : 1 ♀, Bargaon village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12.1983 (Reg. No. A/2289).

Distribution : India : West Bengal, Meghalaya, Tamil Nadu, Assam, Maharashtra, Sikkim ; Burma ; Sri Lanka ; China.

26. *Argiope aemula* (Walckenaer)

1841. *Epeire aemula* Walckenaer, *Hist. nat. Ins. Apt.* 2 : 118.

Specimen examined : 1 ♀, Bargaon village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12.1983 (Reg. No. A/2287). 1 ♀, Orccha, Narayanpur Tahsil, Bastar dist., M. P. Coll. U. A. Gajbe, 28.12.1983 (Reg. No. A/2288). 1 ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 9.2.1990 (Reg. No. A/2241).

Distribution : India : Tamil Nadu, Maharashtra, West Bengal, Gujarat, Andaman and Nicobar Islands ; Sri Lanka ; Burma ; Indo- and Astro-Malaysia.

27. *Argiope pulchella* Thorell

1881. *Argiope pulchella* Thorell. *Ann. Mus. civ. Genova.* 18 : 74.

Specimen examined : 1 ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 8.2.1990 (Reg. No. A/2242).

Distribution : India : Andaman and Nicobar Islands, West Bengal, Madhya Pradesh, Orissa, Assam, Maharashtra, Tamil Nadu ; Burma ; Malaya Peninsula.

28. *Argiope pradhani* Sinha

1951. *Argiope pradhani* Sinha, *Rec. Indian, Mus.*, 49 : 76.

Specimen examined : 1 ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 8.2.1990 (Reg. No. A/2243).

Distribution : India : West Bengal, Andaman and Nicobar Islands ; Burma ; Tharrawaddy, Moulmein ; Sri Lanka ; Indo and Austro-Malaysia,

29. *Cyclosa hexatuberculata* Tikader

1982. *Cyclosa hexatuberculata* Tikader, *Fauna of India, Spiders*, 2 (1) : 197.

Specimen examined : 3 ♀ ♀, Bijapur, Bastar dist., M. P. Coll. R. K. Ghose, 5.2.1990 (Reg. No. A/2245). 2 ♀ ♀, Hutkachora near Jagadalpur, Bastar dist., M. P. Coll. U.A. Gajbe, 2.1.1984 (Reg. No. A/2292). 1 ♂, (subadult), Dhaurai village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12.1983 (Reg. No. A/2297).

Distribution : India : Poona, Maharashtra.

30. *Araneus mitifica* (Simon)

1886. *Epeira mitifica* Simon, *Act., Soc. Linn. Bordeaux.*, 40 : 150.

Specimen examined : 3 ♀ ♀, 1 ♂, Bargaon village near Chhotedonger, Bastar dist., M. P. Coll. U. A. Gajbe, 24.12.1983. (Reg. No. A/2290).

Distribution : India : Maharashtra, Karnataka, West Bengal, Punjab ; Pakistan ; Bangladesh ; Burma ; Malaysia.

31. *Neoscona muckerjei* Tikader

1980. *Neoscona muckerjei* Tikader, *Proc. India Acad. Sci.*, 89 (3) : 247.

Specimen examined : 1 ♀, Bijapur, Bastar dist., M.P. Coll. R. K. Ghose, 6.2.1990 (Reg. No. A/2244). 2 ♀ ♀, Charama, Bastar dist., M. P. Coll. U. A. Gajbe, 5.1.1984 (Reg. No. A/2291).

Distribution : India : Maharashtra, West Bengal.

SUMMARY

This paper deals with 31 species under 21 genera of 10 families of which 8 species are reported for the first time from Bastar district and 20 species reported here for the first time from Madhya Pradesh.

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ON THE EXTENSION OF RANGE OF *HORALABIOSA* SILAS
(CYPRINIDAE ; CYPRININAE) TO SILENT VALLEY, KERALA

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INTRODUCTION

While studying the unidentified collections in the Southern Regional Station, Madras, one lot of 9 small specimens from Silent Valley was encountered, which turned out to be an interesting assemblage of hill stream fishes comprising *Horalabiosa* sp., *Garra menoni* Rema Devi & Indra and *Bhavana australis* Jerdon. The genus *Horalabiosa* was described by Silas in 1953 to accomodate an interesting hill stream species, *H. joshuai*. These superficially resemble *Garra* but lack a mental disc, instead possess a rostral groove and have a post-labial callous structure in the mental region. Its identity was disputed by subsequent workers and was either overlooked or synonymised with *Garra*. Recently its specific identity was re-established and the species redescribed based on a large series of specimens from different altitudes and drainages of the Western Ghats of the Kalakad Wildlife Sanctuary, Tirunelveli District (Rema Devi, 1992). Subsequently a new species *H. palaniensis* (Rema Devi and Menon, 1994) was described from Palani Hills of the Western Ghats, draining into the Cauvery system. The presence of *Horalabiosa* from the west flowing drainage of the Western Ghats is of great ichthyological significance.

Material examined : ZSI/SRS F 4100, 4 exs., 26-27.5 mm SL, India : Western Ghats : Kerala : Silent Valley ; R. S. Pillai, 1st Feb. 1979. Measurements were made with dial calipers with an accuracy of 0.02 mm and are presented following standard practices.

Diagnostic features : D 3/7 ; P 1/14 ; V 1/7/1 ; A 3/5 ; C 19 ; L1 35 ; L tr 4 $\frac{1}{2}$ -5/3 $\frac{1}{2}$; predorsal scale rows 15 approx. ; two pairs of barbels ; a deep and well defined rostral groove separating upper lip from snout ; a post-labial callous structure in the mental region ; body moderately elongate, depressed anteriorly with horizontally placed well developed paired fins ; compressed posteriorly ; lateral line complete ; origin

of dorsal fin is slightly in advance of that of the pelvic fins and the last undivided ray is non-osseous, weak and articulated.

Comparison with specimens from Kalakad: The different body proportions are compared with the populations from Kalakad (data pooled for different populations from different drainages and altitudes) are presented in Table 1. It is seen that the data for the specimens from Silent Valley fall within the range of the Kalakad population. The slight difference observed in the mean values could be attributed to the smaller size and number of the fish sampled from Silent Valley. These fall within the range observed for juvenile, namely larger eyes, smaller snout, smaller interorbital, longer fins and slender body. The meristic characters showed no difference except in the number of predorsal scales, 15 in the present specimens vs., 10-12 is the former. The predorsal distance is slightly greater in the present specimens compared with specimens of the same size group from Kalakad. The alimentary canal and air bladder studied in two specimens of the same length showed no difference; the gut length is 1.08 times in SL. The air bladder is slightly bigger with a comparatively

Table 1 : Comparison of body proportions of *H. joshuai* (n=59) from Kalakad and from Silent Valley (n=4).

	From Kalakad	From Silent Valley
Length range	30-116 mm TL 22.5-90 mm SL	35-36 mm TL 26-27.5 mm SL
<i>Morphometric</i>		
TL/Body depth	5.81 (5.08-7.22)	6.01 (5.77-6.25)
SL/Body depth	4.45 (3.92-5.56)	4.44 (4.19-4.77)
TL/Head length	4.59 (4.00-5.08)	5.01 (4.93-5.10)
SL/Head length	3.53 (3.09-3.92)	3.75 (3.66-3.91)
Head length/Head width	1.41 (1.23-1.70)	1.51 (1.48-1.56)
Head length/Head depth	1.59 (1.27-1.76)	1.51 (1.48-1.56)
Head length/Width of mental pad	4.57 (3.60-5.81)	4.78 (4.45-5.0)



- A. Lateral view of *Horlabiosa* sp. from Silent Valley ; 26.5 mm SL.
B. Lateral view of *H. joshuai* from Kalakad ; 25.5 mm SL.

Head length/Eye diameter	4.42 (3.40-5.75)	3.41 (3.29-3.45)
Head length/Interorbital width	2.35 (1.50-2.77)	2.62 (2.43-2.73)
Head length/Snout length	2.70 (2.39-3.17)	2.92 (2.82-3.20)
Snout length/Eye diameter	1.65 (1.27-2.28)	1.17 (1.08-1.22)
Interorbital width/Eye diameter	1.88 (1.37-2.63)	1.30 (1.25-1.42)
SL/Length of pectoral fin	4.02 (3.42-5.10)	4.39 (4.27-4.44)
SL/Length of pelvic fin	4.75 (4.09-6.00)	5.32 (5.15-5.45)
Body depth/Height of dorsal fin	1.01 (0.83-1.19)	1.05 (1.02-1.09)
Body depth/Length of anal fin	1.26 (0.75-1.63)	1.35 (1.14-1.55)
SL/Base of dorsal fin	7.39 (6.38-9.43)	6.75 (6.31-7.22)
SL/Base of anal fin	12.86 (10.0-17.9)	10.90 (9.61-12.0)
SL/Predorsal distance	1.94 (1.75-2.09)	1.90 (1.88-1.92)
Predorsal dist./Postdorsal dist.	1.00 (0.93-1.15)	1.10 (1.08-1.14)
SL/Length of body cavity	1.95 (1.74-2.23)	2.08 (2.01-2.20)
Dist. from Pelvic base to anal fin/Dist. from anus to anal fin	3.99 (2.50-5.99)	3.42 (2.89-3.79)
Length of caudal peduncle/Depth of caudal peduncle	1.24 (0.92-1.64)	1.45 (1.24-1.58)

Meristic

Lateral line scales	32-35	35
Scale rows between dorsal fin origin and lateral line & to anal origin	4-4½ 2½-3½	4½-5 3¼
Predorsal median scales	10-12	15 approx.
Dorsal fin rays	3/7-8	3/7
Pectoral fin rays	1/12-14	1/14
Pelvic fin rays	1/6-7/1	1/7/1
Anal fin rays	2-3/5	3/5
Caudal fin rays	19	19

smaller anterior chamber and a more tapering posterior chamber, in the present specimen its length is 2.98 times in SL vs., 3.15 in SL in the former.

Since the specimens from Silent Valley are juveniles (maximum length 36 mm TL) and resemble *H. joshuai* in almost all the characters studied except in the number of predorsal scales, the specimens are tentatively placed under *H. joshuai* (Fig. 1) This is known to attain a length of 116 mm TL. Studies on larger specimens alone can clarify the exact identity of the population from Silent Valley.

DISCUSSION

The genus *Horalabiosa* is endemic to India. Subsequent to its first description from the headwaters of the Tambraparni in Western Ghats, it is known from Palani Hills and now from Silent Valley, Kerala, from the Western slopes of the Western Ghats, thus exhibiting a wider range of distribution along the Western Ghats. The specimens differ from typical *H. joshuai* in possessing more number of predorsal scales and relatively greater predorsal distance. The scales are also smaller in size compared to specimens of the same size from Kalakad Wild life Sanctuary. Even in typical *H. joshuai* the predorsal scale rows become more subcutaneous with increase in size of the fish, only 8 scale rows are discernible in some, with a naked portion just behind the head. The scales are absent on the chest and are subcutaneous in the abdominal region. *H. palaniensis* is characterised by the complete absence of predorsal rows of scales. A general reduction in the extent of scalation and in scale size provides greater adaptation for life in the torrents with a smooth surface offering least resistance to water currents. In this regard the specimens from Silent Valley exhibit greater adaptation than those occurring in Kalakad and Tambraparni River.

The other specimens encountered along with *Horalabiosa* sp. from Silent Valley are *Garra menoni* Rema Devi and Indra and *Bhavana australis* Jerdon. All these species are slendered bodied with a flattened ventral surface, flattened and well developed paired fins and adhesive devices well adapted for life in the hill streams. So far 9 species have been reported from Silent Valley (Rema Devi and Indra, 1986). This report extends the range of distribution of *Horalabiosa* and *Bhavana australis* to Silent Valley.

SUMMARY

Horalabiosa Silas, 1953, described from the headwaters of the Tambraparni river draining the eastern face of the Western Ghats is now found to occur further north

along the Western face of the Western Ghats, in Silent Valley, Kerala. The greater range of distribution of this endemic genus is of great ichthyological significance. The specimens, all juveniles, are described here and compared with *H. joshuai* Silas from Kalakad Wildlife Sanctuary, Tirunelveli District. These differ in the number of predorsal scales and may possibly belong to a distinct species which only the study of adults will reveal.

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ON SOME SPIDERS (ARANEAE : ARACHNIDA) FROM KANHA
NATIONAL PARK (MADHYA PRADESH), INDIA

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INTRODUCTION

Few surveys were undertaken during the year 1961, 63, 64, 66, 70, 74, 79, 86, 91 and 1992 to explore the faunal wealth of Kanha Tiger Reserve by Zoological Survey of India. Kanha National Park is a living example of the pristine wilderness of the Central Indian highlands.

Practically there was no work on the spiders of Kanha National Park. Pocock (1900) in his classical work on arachnids and Tikader (1980, 1982) contains no record of any species from this area. Rane and Singh (1977) reported five species for the first time from this area.

This paper deals with 23 species under 16 genera of the families Gnaphosidae, Thomisidae, Philodromidae, Araneidae, Hersiliidae, Lycosidae and Salticidae, out of which eight species viz. *Haplodrassus sataraensis* Tikader & Gajbe, *Philodromus durvei* Tikader, *Nephila maculata* (Fab.), *Argiope pulchella* Thorell, *Hersilia savignyi* Lucas, *Pardosa annandalei* (Gravely), *Pardosa sumatrana* (Thorell) and *Pardosa birmanica* Simon, are reported for the first time from this area ; fourteen species viz. *Sosticus poonaensis* Tikader, *Zelotes nasikensis* Tikader & Gajbe, *Thomisus pugilis* Stol., *Thomisus cherapunjeus* Tikader, *Xysticus minutes* Tikader, *Argiope aemula* (Walck.), *Cyclosa hexatuberculata* Tikader, *Araneus nympha* Simon, *Neoscona bengalensis* Tikader & Bal, *Neoscona mukerjei* Tikader, *Hippasa pisaurina* Pocock, *Arctosa himalayensis* Tikader & Malhotra, *Lycosa madani* Pocock, and *Harmochirus brachiatus* (Thorell) being reported here for the first time from Madhya Pradesh and one species viz. *Hippasa partita* (Cambridge) reported for the first time from India. Gravely (1924) recorded *Hippasa partita* (Cambridge) from Karachi, hence Tikader & Malhotra (1980) included this species in his Fauna of India Volume 1 (II) on the presumption that this species may be available

in Gujarat and Rajasthan because there are some ecological affinities of Karachi with these regions.

Family 1 : GNAPHOSIDAE

1. *Sosticus poonaensis* Tikader

1982. *Sosticus poonaensis* Tikader, *Fauna of India, Spiders*, 2 (2) : 440.

Specimen examined : 1 ♀, on the bank of Chubarinala, Kanha National Park, Mandla dist., coll. R. K. Singh, 28.11.1986 (Reg. No. A/1734).

Distribution : India : Maharashtra.

2. *Zelotes nasikensis* Tikader & Gajbe

1976. *Zelotes nasikensis* Tikader & Gajbe, *Proc. Indian Acad. Sci.*, 83 (3) : 118.

Specimen examined : 1 ♀, Khatia village, Kanha National Park, Mandla dist., coll. U. A. Gajbe, 16.6.1992 (Reg. No. A/2145).

Distribution : India : Maharashtra.

3. *Haplodrassus sataransis* Tikader & Gajbe

1977. *Haplodrassus sataransis* Tikader & Gajbe, *Rec. zool. Surv. India*, 73 (1-4) : 70.

Specimen examined : 1 ♀, Kanha forest range, Mandla dist., coll. R. K. Ghose, 19.1.1991 (Reg. No. A/2006).

Distribution : India : Satara, Maharashtra ; Himachal Pradesh ; Madhya Pradesh ; Orissa ; Rajasthan ; Uttar Pradesh and Punjab.

Family II : THOMISIDAE

4. *Thomisus pugilis* Stoliczka

1869. *Thomisus (Xysticus) (Sic) pugilis* Stoliczka, *J. Asiat. Soc. Beng.*, 38 : 225.

Specimen examined : 1 ♀, Subadult, F. R. House Mukki, Kanha forest range, Balaghat dist., coll. R. K. Ghose, 21.1.1991 (Reg. No. A/2004).

Distribution : India : West Bengal ; Tamilnadu and Punjab. Elsewhere—Pakistan.

5. *Thomisus cherapunjeus* Tikader

1966. *Thomisus cherapunjeus* Tikader, *Proc. Indian Acad. Sci.*, 64 (1) : 54.

Specimen examined : 1 ♀, Khatia village, Kisli range, Kanha National Park, Mandla dist., coll. U. A. Gajbe, 16.6.1992 (Reg. No. A/2146). 1 ♀, Kanha forest range, Mandla dist., Coll. R. K. Ghose, 18.1.1991. (Reg. No. A/2166).

Distribution : India : Shillong, Meghalaya.

6. *Xysticus minutes* Tikader

1960. *Xysticus minutes* Tikader, *J. Bombay nat. Hist. Soc.*, 57 (1) : 173.

Specimen examined : 1 ♀, Supkhar, Kanha National Park, Balaghat dist., coll. R. K. Singh, 1.12.1986 (Reg. No. A/1763).

Distribution : India : West Bengal ; Maharashtra ; Meghalaya ; Gujarat.

Family III : PHILODROMIDAE

7. *Philodromus durvei* Tikader

1980. *Philodromus durvei* Tikader, *Fauna of India, Spiders*, 1 (1) : 204,

Specimen examined : 1 ♂, Supkhar, Chilpura tank, Balaghat dist., coll. R. K. Singh, 1.12.1986 (Reg. No. A/1771).

Distribution : India : Jabalpur, Madhya Pradesh.

Family IV : ARANEIDAE

8. *Nephila maculata* (Fabricius)

1793. *Aranea maculata* Fabricius, *Ent. Syst.*, 2 : 425.

Specimen examined : 1 ♀, Kisli near Silkum river Mandla dist., coll. R.K. Singh, 26.11.1986 (Reg. No. A/2007). 2 ♀ ♀, Supkhar, Kanha National Park, Balaghat dist., coll. R.K. Singh, 1.12.1986 (Reg. No. A/2040).

Distribution : India : Tamilnadu ; Karnataka ; Uttar Pradesh ; Madhya Pradesh ; Assam ; Sikkim ; West Bengal ; Maharashtra ; Gujarat ; Andaman and Nicobar Islands. Elsewhere—Burma ; Sri Lanka ; China ; Australia ; Malaysia ; Japan & New Guinea.

9. *Argiope aemula* (Walckenaer)

1842. *Epeira aemula* Walckenaer, *Hist. Nat. Ins. Apt.*, 2 : 118.

Specimen examined : 6 ♀ ♀, Around Forest rest house Mukki, Balaghat dist., coll. R.K. Ghose, 24.1.1991 (Reg. No. A/2043).

Distribution : India : Tamilnadu ; Maharashtra ; West Bengal ; Gujarat ; Andaman and Nicobar Islands. Elsewhere—Sri Lanka ; Burma ; Indo- and Austro-Malaysia.

10. *Argiope pulchella* Thorell

1881. *Argiope pulchella* Thorell, *Annali. Mus. civ. Genova*, 17 : 74.

Specimen examined : 3 ♀ ♀, Mukki, Balaghat dist., coll. R.K. Ghose, 24.1.1991 (Reg. No. A/2044). 10 ♀ ♀, 3 ♂ ♂, Mukki forest range, Balaghat dist., coll. R. K. Ghose, 21.1.1991. (Reg. No. A/2045). 8 , Supkhar, Balaghat dist., coll. R. K.

Ghose, 30.1.1991 (Reg. No. A/2046). 5 ♀ ♀, On the bank of Banjar river, Mukki, Balaghat dist., coll. R. K. Ghose, 25.1.1991 (Reg. No. A/2047). 4 ♀ ♀, Mukki, Balaghat dist., coll. R. K. Ghose, 23.1.1991 (Reg. No. A/2048). 1 ♀, Motinala, Balaghat dist., coll. R. K. Ghose, 4.2.1991 (Reg. No. A/2049). 1 ♀, Shrawantal, Mandla dist., coll. R. K. Ghose, 16.1.1991 (Reg. No. A/2050). 5 ♀ ♀, Kanha Rest House, Mandla Dist., coll. R. K. Ghose, 24.1.1991 (Reg. No. A/2102). 2 ♀ ♀, Mukki forest range, Balaghat dist., coll. R. K. Ghose, 24.1.1991 (Reg. No. A/2096).

Distribution : India : West Bengal ; Madhya Pradesh ; Orissa ; Assam Maharashtra ; Tamilnadu ; Andaman and Nicobar Islands. Elsewhere—Burma ; Malayn Peninsula.

11. *Cyclosa hexatuberculata* Tikader

1982. *Cyclosa hexatuberculata* Tikader, *Fauna of India, Spiders*, 2 (1) : 197.

Specimen examined : 7 ♀ ♀, 2 ♂ ♂, Mukki, Balaghat dist., coll. R. K. Ghose, 25.1.1991 (Reg. No. A/2104). 4 ♀ ♀, Mukki, Balaghat dist., coll. R. K. Ghose, 24.1.1991 (Reg. No. A/2106).

Distribution : India : Poona ; Maharashtra.

12. *Araneus nympha* Simon

1889. *Araneus nympha* Simon, *J. Asiat. Soc. Beng.*, 58 : 339.

Specimen examined : 1 ♀, Mukki forest range, Balaghat dist., coll. R. K. Ghose, 23.1.1991 (Reg. No. A/2101).

Distribution : India : Himalaya. Elsewhere—Pakistan.

13. *Neoscona bengalensis* Tikader & Bal

1981. *Neoscona bengalensis* Tikader & Bal, *Rec. zool. Surv. India, Occ. Pap.*, 24 : 15.

Specimen examined : 2 ♀ ♀, Mukki forest range, Balaghat dist., coll. R. K. Ghose, 24.1.1991 (Reg. No. A/2097). 1 ♀, Mukki forest range, Balaghat dist., coll. R. K. Ghose, 21.1.1991 (Reg. No. A/2098). 1 ♀, Mukki forest range, Balaghat dist., coll. R. K. Ghose, 25.1.1991. (Reg. No. A/2099).

Distribution : India : Calcutta, West Bengal.

14. *Neoscona mukerjei* Tikader

1980. *Neoscona mukerjei* Tikader, *Proc. Indian Acad. Sci.*, 89 (3) : 247.

Specimen examined : 1 ♀, Supkhar, Balaghat dist., coll. R. K. Singh, 4.12.1986 (Reg. No. A/2100).

Distribution : India : Maharashtra ; West Bengal.

Family V : HERSILIIDAE

15. *Hersilia savignyi* Lucas

1836. *Hersilia savignyi* Lucas, *Mag. Zool.*, 8 : 10.

Specimen examined : 7 ♀ ♀, 4 ♂ ♂, Banjar village, Balaghat dist., coll. R. K. Ghose, 25.1.1991 (Reg. No. A/1849). 11 ♀ ♀, 3 ♂ ♂, Forest rest house, Mukki, Balaghat dist., coll. R. K. Ghose, 21.1.1991 (Reg. No. A/1850). 4 ♀ ♀, 1 ♂, Mukki, Balaghat dist., coll. R. K. Ghose, 23.1.1991 (Reg. No. A/1851). 8 ♀ ♀, 1 ♂, Mukki, Balaghat dist., coll. R. K. Ghose, 24.1.1991 (Reg. No. A/1852). 1 ♀, Kanha rest house, Mandla dist., coll. R. K. Ghose, 24.1.1991 (Reg. No. A/1853). 4 ♀ ♀, Mukki, Balaghat dist., coll. R. K. Ghose, 23.1.1991 (Reg. No. A/2005).

Distribution : India : Tamilnadu ; Karnataka ; Bihar ; Maharashtra ; Uttar Pradesh ; West Bengal ; Assam ; Orissa ; Madhya Pradesh. Elsewhere—Sri Lanka ; Burma ; Pakistan.

Family VI : LYCOSIDAE

16. *Hippasa pisaurina* Pocock

1900. *Hippasa pisaurina* Pocock, *Fauna Brit. India, Arach.*, : 250.

Specimen examined : 1 ♀, Mukki, Balaghat dist., coll. R. K. Ghose, 24.1.1991

(Reg. No. A/2152). 1 ♀, Kanha, Mandla dist., coll. R. K. Ghose, 15.1.1991 (Reg. No. A/2153). 1 ♀, Around forest rest house, Mukki, Balaghat dist., coll. R. K. Ghose, 23.1.1991 (Reg. No. A/2154).

Distribution : India : Maharashtra ; Karnataka ; Bihar ; Gujarat. Elsewhere—Pakistan ; Iraq.

17. *Hippasa partita* (Cambridge)

1876. *Trochosa partita* Cambridge, *Proc. Zool. Soc.*, : 541.

Specimen examined : 2 ♀ ♀, Supkhar, Balaghat dist., coll. R. K. Ghose, 31.1.1991 (Reg. No. A/2177).

Distribution : Alexandria ; Egypt ; Arabia ; Central Asia and Pakistan.

18. *Pardosa annandalei* (Gravely)

1924. *Lycosa annandalei* Gravely, *Rec. Indian Mus.*, 26 : 606.

Specimen examined : 2 ♀ ♀ 1 ♂, Khatia village, Mandla dist., coll. U.A. Gajbe 16.6.1992 (Reg. No. A/2151). 2 ♀ ♀, 1 ♂, Kanha forest range, Mandla dist., coll. R. K. Ghose, 18.1.91 (Reg. No. A/2181).

Distribution : India : Kerala ; Maharashtra ; Karnataka ; Andhra Pradesh ; Tamilnadu ; Madhya Pradesh ; Bihar ; West Bengal ; Manipur ; Assam ; Gujarat. Elsewhere—Bangladesh ; Burma & Pakistan.

19. *Pardosa sumatrana* (Thorell)

1890. *Lycosa sumatrana* Thorell, *Ann. Mus. Stor. nat. Genova*, 30 : 136.

Specimen examined : 5 ♀ ♀, 2 ♂ ♂, Motinala, Mandla dist., coll. R. K. Ghose, 1.2.1991 (Reg. No. A/2747). 3 ♀ ♀, 1 ♂, Supkhar, Balaghat dist., coll. R. K. Singh, 1.12.1986 (Reg. No. A/2148). 7 ♀ ♀, 4 ♂ ♂, Forest rest house, Mukki, Balaghat dist., coll. R. K. Ghose, 21.1.1991 (Reg. No. A/2168). 6 ♀ ♀, 1 ♂. Kopedabari, Mandla dist., coll. U. A. Gajbe, 16.6.1992 (Reg. No. A/2169). 14 ♀ ♀, 1 ♂, Menhar nala, Kanha. Mandla dist., coll. R. K. Singh, 28.11.1986 (Reg. No. A/2170). 1 ♀, 1 ♂, Kanha forest range, Mandla dist., coll. R. K. Ghose, 18.1.1991 (Reg. No. A/2171).

Distribution : India : Kerala ; Tamilnadu ; Andhra Pradesh ; Maharashtra ; Assam ; Tripura ; Rajasthan ; Gujarat ; Madhya Pradesh ; Arunachal Pradesh ; Nicobar Islands ; Nepal Valley ; Eastern Himalayas. Elsewhere—Bangladesh ; Sumatra ; Sri Lanka.

20. *Pardosa birmanica* Simon

1884. *Pardosa birmanica* Simon, *Ann. Mus. civ. Stor. nat. Genova*, 20 : 333.

Specimen examined : 6 ♀ ♀, 3 ♂ ♂, Kisli near Sulkum river, Mandla dist., coll. R. K. Singh, 26.11.1986 (Reg. No. A/2172). 8 ♀ ♀, 5 ♂ ♂, Motinala, Mandla dist., coll. R. K. Ghose, 1.2.1991 (Reg. No. A/2149). 1 ♀, Mukki, Balaghat dist., coll. R. K. Ghose, 24.1.1991 (Reg. No. A/2150). 1 ♀, Shrivantal, Mandla dist., coll. U. A. Gajbe, 14.6.1992 (Reg. No. A/2174). 1 ♀, 1 ♂, Banjar valley near Mukki, Balaghat dist., coll. R. K. Ghose 25.1.1991. (Reg. No. A/2175). 1 ♀, Shrivantal, Mandla dist., coll. U. A. Gajbe, 14.6.1992 (Reg. No. A/2180A).

Distribution : India : Maharashtra ; Punjab ; West Bengal ; Orissa ; Uttar Pradesh , Meghalaya ; Bihar ; Tamilnadu ; Andhra Pradesh. Elsewhere—Burma ; Java and Pakistan.

21. *Arctosa himalayensis* Tikader & Malhotra

1980. *Arctosa himalayensis* Tikader & Malhotra, *Fauna of India, Spiders*, 1 (2) : 369.

Specimen examined : 3 ♀ ♀, 1 ♂, Kisli near Sulkum river, Mandla dist., coll. R. K. Singh, 26.10.1986 (Reg. No. A/2178). 3 ♀ ♀, 2 ♂ ♂, Shrivantal, Mandla dist., coll. U. A. Gajbe, 14.6.92 (Reg. No. A/2179).

Distribution : India : Dehradun, Uttar Pradesh.

22. *Lycosa madani* Pocock

1901. *Lycosa madani* Pocock, *J. Bombay nat. Hist. Soc.*, 13 (3) : 486.

Specimen examined : 1 ♀, Shrivantal, Mandla dist., coll. U. A. Gajbe, 14.6.1992 (Reg. No. A/2176).

Distribution : India : Maharashtra ; Kerala ; Karnataka ; Andhra Pradesh ; Orissa ; Bihar.

Family VII. : SALTICIDAE

23. *Harmochirus brachiatus* (Thorell)

1877. *Ballus brachiatus* Thorell, *Ann. Mus. Stor. nat. Genova*, 10 : 626.

Specimen examined : 1 ♂, Banjar valley, Balaghat dist., coll. R. K. Singh, 30.11.1986. (Reg. No. A/2107)

Distribution : India : Poona, Maharashtra. Elsewhere—Japan ; Pacific Islands and Indochina.

SUMMARY

This paper deals with 23 species under 16 genera of which one species is recorded for the first time from India, fourteen species reported for the first time from Madhya Pradesh and eight species are reported for the first time from Kanha National Park, Madhya Pradesh.

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ON A COLLECTION OF FISH FROM MIDDLE AND SOUTH ANDAMAN
GROUP OF ISLANDS

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INTRODUCTION

This paper is based on the fish fauna collected by one of us (S. K.) from South and Middle Andaman group of Islands during October, 1991 in pursuance of the approved annual programme of work. It contains information about 86 species belonging to 65 genera and 44 families. While identifying the specimens most of the relevant literature pertaining to the area (Day, 1878; Weber and de Beaufort, 1913-1936; de Beaufort, 1940; Herre, 1941; de Beaufort and Chapman, 1951; Koumans, 1953; de Beaufort and Briggs, 1962; Fischer and Whitehead, 1974; Talwar and Kacker, 1984; Whitehead, 1985; Carpenter, 1988; Whitehead *et al.*, 1988; Russell, 1990; Talwar, 1990; Kamla Devi, 1991; Krishnan and Mishra, in press; Mishra and Krishnan, in press) have been consulted.

Two new records to Indian waters *viz.* *Apogonichthys perdix* Bleeker and *Callionymus enneactis* Bleeker and eight new records to Andaman waters *viz.* *Sardinella gibbosa* (Bleeker), *Saurida nebulosa* Valenciennes, *Carangoides talamparoides* Bleeker, *Gymnocranius griseus* (Schlegel), *Nemipterus randalli* Russell, *Chrysiptera unimaculata* (Cuvier), *Scarus blochii* Valenciennes and *Engyprosopon grandisquama* (Temminck and Schlegel) are included in the paper. Systematic details and variations in meristic characters in addition to geographical distribution are presented. Extension of range of occurrence for one species reported.

Arrangement of families is according to Smith and Heemstra (1986) while genera and species in the family, in alphabetical order. Length of the samples studied is expressed as standard length (SL) unless and otherwise specifically mentioned as TL (total length) or FL (fork length).

All samples have been deposited with Marine Biological Station, Zoological Survey of India, Madras.

SYSTEMATIC LIST

Class : OSTEICHTHYES

Order : ANGUILLIFORMES

Family : CONGRIDAE

Genus : **Ariosoma** Swainson, 1838.

1. *Ariosoma anago* (Temminck and Schlegel, 1846).

Order : CLUPEIFORMES

Family : CLUPEIDAE

Genus : **Amblygaster** Bleeker, 1849.

2. *Amblygaster sirm* (Walbaum, 1762).

Genus : **Anodontosoma** Bleeker, 1849.

3. *Anodontosoma chacunda* (Hamilton-Buchanan, 1822).

Genus : **Herklotsichthys** Whitley, 1951.

4. *Herklotsichthys quadrimaculatus* (Ruppell, 1837).

Genus : **Sardinella** Valenciennes, 1847.

5. *Sardinella albella* (Valenciennes, 1847).
6. *Sardinella gibbosa* (Bleeker, 1849).

Family : ENGRAULIDIDAE

Genus : **Stolephorus** Lacepede, 1803.

7. *Stolephorus commersonii* Lacepede, 1803.
8. *Stolephorus waitei* Jordan and Seale, 1926.

Genus : **Thryssa** Cuvier, 1829.

9. *Thryssa baelama* (Forsskal, 1775).
10. *Thryssa encrasicholoides* (Bleeker, 1852).

Order : AULOPIIFORMES

Family : SYNODIDAE

Genus : **Saurida** Valenciennes, 1849.

11. *Saurida micropectoralis* Shindo and Yamada,

12. *Saurida nebulosa* Valenciennes, 1849.

13. *Saurida tumbil* (Bloch, 1795).

Order : ATHERINIFORMES

Family : ATHERINIDAE

Genus : *Atherinomorus* Fowler, 1903.

14. *Atherinomorus lacunosus* (Forster, 1801).

Order : SYNGNATHIFORMES

Family : FISTULARIDAE

Genus : *Fistularia* Linnaeus, 1758.

15. *Fistularia commersonii* Ruppell, 1838.

16. *Fistularia petimba* Lacepede, 1803.

Family : CENTRISCIDAE

Genus : *Centriscus* Linnaeus, 1758.

17. *Centriscus scutatus* Linnaeus, 1753.

Order : SCORPAENIFORMES

Family : PLATYCEPHALIDAE

Genus : *Rogadius* Jordan and Richardson, 1908.

18. *Rogadius pristiger* (Cuvier, 1829).

Order : PERCIFORMES

Family : AMBASSIDAE

Genus : *Ambassis* Cuvier, 1828.

19. *Ambassis urotaenia* Bleeker, 1852.

Family : SERRANIDAE

Genus : *Epinephelus* Bloch, 1793.

20. *Epinephelus caeruleopunctatus* (Bloch, 1790).

21. *Epinephelus quoyanus* (Valenciennes, 1830).

Family : TERAPONIDAE

Genus : *Terapon* Cuvier, 1816.

22. *Terapon jarbua* (Forsskal, 1775).

Family : PRIACANTHIDAE

Genus : **Priacanthus** Oken, 1817.

23. *Priacanthus blochii* Bleeker 1853.

Family : APOGONIDAE

Genus : **Apogon** Lacepede, 1802.

24. *Apogon (Nectamia) novemfasciatus* (Cuvier, 1828).

Genus : **Apogonichthys** Bleeker, 1854.

25. *Apogonichthys perdix* Bleeker, 1854.

Genus : **Fowleria** Jordan and Evermann, 1903.

26. *Fowleria aurita* (Valenciennes, 1831).

Genus : **Sphaeramia** Fowler and Bean, 1930.

27. *Sphaeramia orbicularis* (Kuhl and van Hasselt, 1828).

Family : HAEMULIDAE

Genus : **Plectorhinchus** Lacepede, 1802.

28. *Plectorhinchus orientalis* (Bloch, 1793).

Genus : **Pomadasys** Lacepede, 1802.

29. *Pomadasys argyreus* (Valenciennes, 1833).

Family : LUTJANIDAE

Genus : **Lutjanus** Bloch, 1790.

30. *Lutjanus biguttatus* (Valenciennes, 1830).

31. *Lutjanus bohar* (Forsskal, 1775).

32. *Lutjanus decussatus* (Cuvier, 1828).

33. *Lutjanus quinquelineatus* (Bloch, 1790).

34. *Lutjanus russelli* (Bleeker, 1849).

Family : CAESIONIDAE

Genus : **Caesio** Lacepede, 1801.

35. *Caesio caerulaureus* Lacepede, 1801.

Family : LETHRINIDAE

Genus : **Gymnocranius** Klunzinger, 1870.

36. *Gymnocranius griseus* (Schlegel, 1844).

Genus : **Lethrinus** Cuvier, 1829.

37. *Lethrinus mahsena* (Forsskal, 1775).

Family : NEMIPTERIDAE

Genus : **Nemipterus** Swainson, 1839.

38. *Nemipterus randalli* Russell, 1986.

Genus : **Scolopsis** Cuvier, 1816.

39. *Scolopsis bilineatus* (Bloch, 1793).

40. *Scolopsis ciliatus* (1802).

Family : SCATOPHAGIDAE

Genus : **Scatophagus** Cuvier, 1831.

41. *Scatophagus argus* (Linnaeus, 1766).

Family : GERREIDAE

Genus : **Gerres** Quoy and Gaimard, 1824.

42. *Gerres filamentosus* Cuvier, 1829.

Family : MULLIDAE

Genus : **Upeneus** Cuvier, 1829.

43. *Upeneus bensasi* (Schlegel, 1842).

44. *Upeneus vittatus* (Forsskal, 1775).

Family : SILLAGINIDAE

Genus : **Sillago** Cuvier, 1816.

45. *Sillago sihama* (Forsskal, 1775).

Family : MENIDAE

Genus : **Mene** Lacepede, 1803.

46. *Mene maculata* (Bloch, 1801).

Family : LEIOGNATHIDAE

Genus : **Gazza** Ruppell, 1835.

47. *Gazza minuta* (Bloch, 1797).

Genus : **Leiognathus** Lacepede, 1802.

48. *Leiognathus leuciscus* (Gunther, 1860).

49. *Leiognathus lineolatus* (Valenciennes, 1835).

Family : LACTARIDAE**Genus : Lactarius Valenciennes, 1833.**

50. *Lactarius lactarius* (Schneider, 1801).

Family : CARANGIDAE**Genus : Atule Jordan and Jordan, 1922.**

51. *Atule mate* (Cuvier, 1833).

Genus : Carangoides Bleeker, 1851.

52. *Carangoides talamparoides* Bleeker, 1852.

Genus : Caranx Lacepede, 1801.

53. *Caranx carangus* (Bloch, 1793).

54. *Caranx ignobilis* (Forsskal, 1775).

Genus : Selar Bleeker, 1851.

55. *Selar crumenophthalmus* (Bloch, 1793).

Family : POMACENTRIDAE**Genus : Abudefduf Forsskal, 1775.**

56. *Abudefduf septemfasciatus* (Cuvier, 1830).

Genus : Amphiprion Bloch and Schneider, 1801.

57. *Amphiprion percula* (Lacepede, 1802).

Genus : Chrysiptera Swainson, 1839.

58. *Chrysiptera glauca* (Cuvier, 1830).

59. *Chrysiptera unimaculata* (Cuvier, 1830).

Family : LABRIDAE**Genus : Cheilinus Lacepede, 1802.**

60. *Cheilinus fasciatus* Bloch, 1791.

Genus : Labroides Bleeker, 1851.

61. *Labroides dimidiatus* (Valenciennes, 1839).

Family : SCARIDAE**Genus : Scarus Forsskal, 1775.**

62. *Scarus blochii* Valenciennes, 1839.

Family : SPHYRAENIDAE

Genus : **Sphyraena** Rose, 1793.

63. *Sphyraena forsteri* Cuvier, 1829.

Family : BLENNIIDAE

Genus : **Istiblennius** Whitley, 1943.

64. *Istiblennius lineatus* (Valenciennes, 1836).

Family : CALLIONYMIDAE

Genus : **Callionymus** Linnaeus, 1758.

65. *Callionymus enneactis* Bleeker, 1879.

66. *Callionymus filamentosus* Valenciennes, 1837.

Family : GOBIIDAE

Genus : **Acentrogobius** Bleeker, 1874.

67. *Acentrogobius ornatus* (Ruppell, 1828).

Genus : **Bathygobius** Bleeker, 1878.

68. *Bathygobius fuscus* (Ruppell, 1818).

Genus : **Oplopomus** Valenciennes, 1837.

69. *Oplopomus caninoides* (Bleeker, 1852).

Genus : **Waitea** Jordan and Seale, 1906.

70. *Waitea mystacina* (Valenciennes, 1837).

Family : ACANTHURIDAE

Genus : **Acanthurus** Forsskal, 1775.

71. *Acanthurus matoides* Valenciennes, 1835.

Family : SIGANIDAE

Genus : **Siganus** Forsskal, 1775.

72. *Siganus canaliculatus* (Park, 1797).

73. *Siganus guttatus* (Bloch, 1787).

74. *Siganus spinus* (Linnaeus, 1758).

75. *Siganus virgatus* (Valenciennes, 1835).

Family : TRICHIURIDAE

Genus : **Trichiurus** Linnaeus, 1758.

76. *Trichiurus lepturus* Linnaeus, 1758.

Family : **SCOMBRIDAE**

Genus : **Rastrelliger** Jordan and Starks, 1908.

77. *Rastrelliger kanagurta* (Cuvier, 1816).

Order : **PLEURONECTIFORMES**

Family : **BOTHIDAE**

Genus : **Engyprosopon** Gunther, 1862.

78. *Engyprosopon grandisquama* (Temminck and Schlegel, 1846).

Family : **CYNOGLOSSIDAE**

Genus : **Cynoglossus** Hamilton-Buchanan, 1822.

79. *Cynoglossus arel* (Schneider, 1801).

80. *Cynoglossus lida* (Bleeker, 1851).

Genus : **Paraplagusia** Bleeker, 1865.

81. *Paraplagusia bilineata* (Bloch, 1787).

Family : **SOLEIDAE**

Genus : **Zebrias** Jordan and Snyder, 1900.

82. *Zebrias quagga* (Kaup, 1858).

Order : **TETRAODONTIFORMES**

Family : **MONACANTHIDAE**

Genus : **Paramonacanthus** Bleeker, 1866.

83. *Paramonacanthus choirocephalus* (Bleeker, 1852).

Family : **TRIACANTHIDAE**

Genus : **Pseudotriacanthus** Fraser and Brunner, 1941.

84. *Pseudotriacanthus strigifer* (Cantor, 1849).

Family : **OSTRACIIDAE**

Genus : **Lactoria** Jordan and Fowler, 1903.

85. *Lactoria cornuta* (Linnaeus, 1758).

Family : TETRAODONTIDAE

Genus : *Lagocephalus* Swainson, 1839.

86. *Lagocephalus scleratus* (Forster, 1789).

SYSTEMATIC NOTES

1. *Ariosoma anago* (Temminck and Schlegel, 1946)

1846. *Conger anago* Temminck and Schlegel, *Fauna Japonica, Pisces* : 259, pl. 113, fig. 1 (Japan).

1955. *Ariosoma anago* : Munro, *The marine and freshwater fishes of Ceylon* : 64, pl. 12, fig. 180,

Material examined : 10, 110-212 mm TL, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 170-190 (ca. 80 before vent) ; A 124-135 ; P 14 ; LL pore ca. 150 (ca. 60 before vent).

Distribution : From the east coast of India to Malay Archipelago, Japan.

2. *Amblygaster sirm* (Walbaum, 1762)

1762. *Clupea sirm* Walbaum in Artedi, *Gen. pisc.* : 38 (on Forsskal, 1775, *Descript. anim.* : 17-Arabia).

1985. *Amblygaster sirm* : Whitehead, *FAO Fish. Synop.*, (125) 7 (1) : 88.

Material examined : 1, 136 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin Formula : D iii, 15 ; A iii, 17 ; P i, 17 ; V i, 7 ; GR 12+36 ; LS 43 ; Ltr 11 ; belly scutes 17+15.

Distribution : Indo-west Pacific : east coast of Africa, Red Sea, Madagascar ; eastward to the Philippines, Taiwan, Okinawa, New Guinea, Fiji, northern coast of Australia.

3. *Anodontosoma chacunda* (Hamilton-Buchanan, 1822)

1822. *Clupanodon chacunda* Hamilton-Buchanan, *Fishes of Ganges* : 246 (Ganges estuaries).

1985. *Anodontosoma chacunda* : Whitehead, *FAO Fish. Synop.*, (125) 7 (1) : 252.

Material examined : 1, 140 mm, collected from Rangath Bay, Middle Andamans on 16.10.91.

Fin Formula : D iii, 15 ; A ii, 16 ; P i, 14 ; V i, 7 ; lower GR 77 ; LS 40 ; Ltr 13 ; belly scutes 18+10.

Distribution : Indian Ocean : the 'Gulf' to coasts of India, Andaman Sea ; Western Pacific : Gulf of Thailand, northern Australia, the Caroline Islands, New Caledonia ; Indonesia, the Philippines, Vietnam.

4. *Herklotsichthys quadrimaculatus* (Ruppell, 1837)

1837. *Clupea quadrimaculatus* Ruppell, *Nueu Wirbelth. Fische.* : 78, pl. 21, fig. 3.

1985. *Herklotsichthys quadrimaculatus* : Whitehead, *FAO Fish. Synop.*, (125) 7 (1) : 81.

Material examined : 2, 104-109 mm, collected from Yerata Jetty, Rangath, Middle Andamans on 18.10.91 ; 8, 94-103 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin Formula : D iii, 14-15 ; A ii-iii, 14-15 ; P i, 13-14 ; V i, 7 : GR (12-15)+(30-32) ; LS 39-42 ; belly scutes (17-19)+(11-13).

Distribution : Widespread in Indian Ocean and Western Pacific, also Hawaii.

5. *Sardinella albella* (Valenciennes, 1847)

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 : 2, 100-130 mm, collected from Rangath Bay, Middle Andamans on 16.10.91.

Fin Formula : D iv, 14-15 ; A iii, 16 ; P i, 13-14 ; V i, 7 ; GR (26-28)+(54-57) ; LS 39-44 ; belly scutes 18+(12-13), total 30-31.

Distribution : Indo-west Pacific : East African coast, Madagascar, Red Sea, coasts of India, eastward to Indonesia, north to Taiwan, south to Papua New Guinea, northern coasts of Australia.

6. *Sardinella gibbosa* (Bleeker, 1849)

1849. *Clupea gibbosa* Bleeker, *J. Ind. Arch.*, 3 : 92 (Macassar).

1973. *Sardinella gibbosa* : Whitehead, *J. mar. biol. Ass. India*, 14 (1) : 185, fig. 15.

Material examined : 1, 116 mm, collected from Rangath Bay, Middle Andamans on 16.10.91.

Fin formula : D iv, 15 ; A iii, 16 ; P i, 14 ; V i, 7 ; LS 38 ; GR 24+55 ; belly scutes 18+14.

Distribution : Indo-west Pacific : from East African coast eastward to Indonesia, north to Taiwan and Korea, south to northern Australia.

Remark : This is the first record of occurrence from Andaman and Nicobar Islands, reported elsewhere in detail.

7. *Stolephorus commersonii* Lacepede, 1803

1803. *Stolephorus commersonii* Lacepede, *Hist. nat. poiss.*, 5 : 381, 382, pl. 12, fig. 1 (Mauritius).

Material examined : 2, 88-92 mm, collected from Neil Island, South Andamans on 12.10.91.

Fin formula : D iii, 12 ; A iii, 20 ; P ii, 13 ; V i, 7 ; LS 34-35 ; Ltr 7 ; GR (16-17) + (24-25) ; pre pelvic scutes 3.

Distribution : Widespread in Indian Ocean and Western Pacific.

8. *Stolephorus waitei* Jordan and Seale, 1926

1926. *Stolephorus waitei* Jordan and Seale, *Bull. Mus. Comp. Zool. Harvard*, 67 (11) : 380 (Queensland).

Material examined : 1, 57 mm, collected from Neil Island, South Andamans on 12.10.91.

Fin formula : D iii, 12 ; A iii, 19 ; P ii, 13 ; V i, 7 ; LS 37 ; GR 15+20 ; pre pelvic scutes 6.

Distribution : Eastern Indian Ocean : from Cochin to Myanmar, Sri Lanka ; Western Pacific : Thailand, Java sea, the Philippine, Papua New Guinea, South to Queensland.

9. *Thryssa baelama* (Forsskal, 1775)

1775. *Clupea baelama* Forsskal, *Descript. anim.* : 72 (Djedda),

1988. *Thryssa baelama* : Whitehead et al, *FAO Fish. Synop.*, (125) 7 (2) : 425.

Material examined : 1, 63 mm, collected from Havelock Island South Andamans on 9.10.91.

Fin formula : D iii, 11 ; A iii, 29 ; P i, 12 ; V i, 6 ; GR 15+18 ; belly scutes 7+9.

Distribution : Widespread in Indian Ocean and western Central Pacific.

10. *Thryssa encrassicholoides* (Bleeker, 1852)

1852. *Engraulis encrassicholoides* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 3 : 173 (Jakarta, Suraqaya, Kammal, Kupang).

1988. *Thryssa encrassicholoides* : Whitehead et al, *FAO Fish. Synop.*, (125) 7 (2) : 430.

Material examined : 1, 47 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D iii, 13 ; A iii, 25 ; P i, 12 ; V i, 6 ; GR 15+18 ; belly scutes 1, 6+9.

Distribution : Sri Lanka, India, Java, Sulawesi, Timor, Ambon, the Philippines, northern Queensland.

Remark : As most of the scales have fallen off before examination, lateral scale count could not be given. Its distribution may be more widespread in Indian Ocean. Often confused with *T. baelama*.

11. *Saurida micropectoralis* Shindo and Yamada, 1972

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

Material examined : 1, 76 mm, collected from John Lawrence Island, South Andamans on 9.10.91; 3, 73-92 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 12-13 ; A 9-11 ; P 13-14 ; V 9 ; LL 48-52 ; Ltr $3\frac{1}{2}/5$.

Distribution : East coast of India, Andaman sea to South China Sea, the Philippines.

12. *Saurida nebulosa* Valenciennes, 1849

1849. *Saurida nebulosa* Valenciennes in Cuvier and Valenciennes, *Hist. nat, poiss.*, 22 : 504.

Material examined : 1, 78 mm, collected from John Lawrence Island, South Andamans on 9.10.91; 2, 75-136 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 10 ; A 9-10 ; P 12-13 ; V 9 : LL 48-52 : Ltr $3\frac{1}{2}/5$.

Distribution : Mauritius, Aldabra Islands, Southern India, Thailand to the Philippines, Australia, New Guinea, Okinawa, Guam, Palau, Tahiti, Hawaii.

Remark : It is often misidentified as *S. gracilis* (Quoy and Gaimard, 1824). This is the first record of occurrence from Andaman and Nicobar Islands, reported elsewhere in detail.

13. *Saurida tumbil* (Bloch, 1795)

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, 153 mm, collected from Rangath Bay, Middle Andamans on 19.10.91.

Fin formula : D 11 ; A 10 ; P 16 ; V 9 ; LL 57 ; Ltr 4/6.

Distribution : East coast of Africa (excluding Kenya and Somalia), from Red Sea eastward to the East Indies, Malay archipelago, north to China Sea, south to New South Wales (Australia).

14. *Atherinomorus lacunosus* (Forster, 1801)

1801. *Atherina lacunosa* Forster in Bloch and Schneider, *Syst. Ichthyol.* : 112 (Moreton Bay, Queensland).
 1984. *Atherinomorus lacunosus* : Talwar and Kacker, *Commercial Sea fishes of India* : 329, fig. 135.

Material examined : 4, 72-74 mm, collected from Kalapathar, Havelock Island, South Andamans on 5.10.91.

Fin formula : D V-VI+I, 9-10 ; A I, 12-13 ; P 15-16 ; V I, 5 ; GR (5-6)+(20-23) ; LS 44-46 ; Ltr 6.

Distribution : Throughout the Indian Ocean, central Pacific ; also in the southeastern Mediterranean.

15. *Fistularia commersonii* Ruppell, 1838

1838. *Fistularia commersonii* Ruppell, *Neue Wirbelth. Fauna Abyssinian gehoig, Fische* : 142 (Mohila, Red Sea).

Material examined : 2, 203-210 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 15-16 ; A 14 ; P 15 ; V 6 ; LL ca. 100.

Distribution : Throughout the tropical Indo-Pacific : east African coast to America north to Japan, south to Australia.

16. *Fistularia petimba* Lacepede, 1803

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

Material examined : 3, 169-220 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 14 ; A 14 ; P 16 ; V 6 ; LL ca. 80.

Distribution : East African coast to western Pacific to Hawaii, north to Japan, south to Southern Australia, also in tropical Atlantic.

17. *Centriscus scutatus* Linnaeus, 1753

1753. *Centriscus scutatus* Linnaeus, *Syst. Nat.*, (ed. 10) : 336.

Material examined : 3, 65-74 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D III+10 – 11 ; A 11-12 ; P 11 ; V 4.

Distribution : Indo-west Pacific : from Red Sea through coasts of India to the Philippines, China.

18. *Rogadius pristiger* (Cuvier, 1801)

1829. *Platycephalus pristiger* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 4 : 250 (Japan).

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

Material examined : 1, 67 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D IX+I, A 10 ; P 21 ; V I, 5 ; GR 1+7 ; LL pored 53 : Ltr 4/18.

Distribution : Indo-Pacific : east coast of Africa to the Philippines, Japan, Australia.

19. *Ambassis urotaenia* Bleeker, 1852

1852. *Ambassis urotaenia* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 3 : 257.

Material examined : 2, 38-40 mm, collected from Wilson Island, South Andamans on 9.10.91.

Fin formula : D VII+I, 9 ; A III, 9 ; P 16 ; V I, 5 ; GR 9+24 ; LL 26-27 ; Ltr 2/7, pre dorsal scales 9.

Distribution : Indo-west pacific : In India restricted to the Andaman and Nicobar Islands.

20. *Epinephelus caeruleopunctatus* (Bloch, 1790)

1790. *Holocentrus caeruleopunctatus* Bloch, *Naturges. ausland. Fische*, 4 : 94, pl. 242, fig. 2.
 1984. *Epinephelus caeruleopunctatus* : Talwar and Kacker, *Commercial sea fishes of India* : 382.

Material examined : 1, 112 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D XI, 16 ; A. IV, 8 ; P 18 ; V I, 5 ; GR 8+15 ; LL 55 ; transverse scales between LL and base of mid-dorsal spine 12.

Distribution : Widespread in Indo-Pacific.

21. *Epinephelus quoyanus* (Valenciennes, 1830)

1830. *Serranus quoyanus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 6 : 519.
 1984. *Epinephelus quoyanus* : Heemstra and Randall in Fischer and Bianchi, *FAO species identification sheets for fishery purposes. W Indian Ocean (Fishing Area 51)*, 4 : SERRAN Epin 49,

Material examined : 1, 145 mm, collected from John Lawrence Island, South Andamans on 8.10.91 ; 1, 203 mm, collected from Rangath Bay, Middle Andamans on 17.10.91.

Fin formula : D XI, 16-17 ; A III, 8 ; P 16 ; V I, 5 ; GR (5-6)+(13-14) ; LL 48 ; transverse scales between LL and base of mid-dorsal spine 9.

Distribution : Coasts of India, New Guinea.

Remark : Distribution of this species is not clear because of confusion with other species (Heemstra and Randall, 1984).

22. *Terapon jarbua* (Forsskal, 1775)

1775. *Sciaena jarbua* Forsskal, *Descript. anim.* : 50 (Jedda).
 1984. *Terapon jarbua* : Talwar and Kacker, *Commercial sea fishes of India* : 406, fig. 156.

Material examined : 1, 51 mm, collected from Wilson Island, South Andamans on 9.10.91.

Fin formula : D IX+I, 10 ; A III, 8 ; P 15 ; V I, 5 ; GR 6+13 ; LL 89 ; Ltr 15/23.

Distribution : Widespread in Indo-Pacific.

23. *Priacanthus blochii* Bleeker, 1853

1853. *Priacanthus blochii* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 4 : 456.

Material examined : 2, 71-75 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D X, 13 ; A III, 14 ; P 15 ; V I, 5 ; GR 4+16 ; LL 68 ; Ltr 7/40.

Distribution : Seychelles ; eastern Indian Ocean, Indonesia to Samoa.

Remark : Probably present in other insular areas of Indian Ocean but often mistaken for *P. hamrur* (Forsskal, 1775).

24. *Apogon (Nectamia) novemfasciatus* Cuvier, 1828

1828. *Apogon novemfasciatus* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 2 : 154.

Material examined : 1, 59 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D VII+I, 9 ; A II, 8 ; P 13 ; V I, 5 ; GR 3+13 ; LL 27 ; Ltr 2/7.

Distribution : Indo-west Pacific : from east coast of Africa, Red Sea, through coasts of India to the Philippines to Hong Kong, northern coast of Australia, southern Pacific Islands up to Society Islands.

25. *Apogonichthys perdix* Bleeker, 1854

1854. *Apogonichthys perdix* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 6 : 321 (Floris Is., East Indies).

Material examined : 1, 41 mm, collected from Rangath Bay, Middle Andamans on 17.10.91.

Fin formula : D VII+I, 9 ; A II, 8 ; P 13 ; V I, 5 ; GR 3+12 ; LL 24 ; Ltr $1\frac{1}{2}/6$.

Distribution : Indo-west Pacific : East African coasts ; Red sea ; Flores, Biaru, Buru, Ceram, Nusa Laut, Sulu Islands in western Pacific.

Remark : This is the first record of occurrence from Indian waters, details reported elsewhere.

26. *Fowleria aurita* (Valenciennes, 1831)

1831. *Apogon auritus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poissons*, 7 : 443 (Mauritius)

1986. *Fowleria aurita* : Gon in Smith and Heemstra, *Smith's Sea fishes* : Apogonidae : 556, pl. 50, fig. 175-39.

Material examined : 1, 47 mm, collected from Wilson Island, South Andamans on 9.10.91.

Fin formula : D VII+I, 9 ; A III, 8 ; P 14 ; V I, 5 ; GR 3+12 : LL 10 ; Ltr 1/6.

Distribution : Indo-Pacific : From east coast of Africa, Red Sea, through coasts of India to the Philippines, coasts of northern Australia to Samoa and Tonga Islands.

27. *Sphaeramia orbicularis* (Kuhl and Van Hasselt, 1828)

1828. *Apogon orbicularis* Kuhl and van Hasselt in Cuvier and Valenciennes, *Hist. nat. poissons*, 2 : 155 (Java).

1986. *Sphaeramia orbicularis* : Gon in Smith and Heemstra, *Smith's Sea fishes* : Apogonidae : 557, pl. 50, fig. 175-43.

Material examined : 1, 57 mm, collected from Havelock Island, South Andamans on 9.10.91 ; 1, 34 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D VI+I, 9-10 ; A II, 9 ; P 10 ; V I, 5 ; GR 5+19 ; LL 25 ; Ltr 2/6,

Distribution : Indo-west Pacific,

28. *Plectorhinchus orientalis* (Bloch, 1793)

1793. *Anthias orientalis* Bloch, *Ausland. Fische*, 7 : 10.

1984. *Plectorhinchus orientalis* : McKay in Fischer and Bianchi, *FAO species identification sheets for fishery purposes. W. Indian Ocean (Fishing Area 51)*, 2 : HAEM Plect 11.

Material examined : 1, 36 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D XII, 20 ; A III, 9 ; P 17 ; V I, 5 ; GR 8 + 21 ; LL 72 ; Ltr 13/17.

Distribution : Indo-west Pacific.

29. *Pomadasys argyreus* (Valenciennes, 1833)

1833. *Pristipoma argyreum* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 9 : 485.

1984. *Pomadasys argyreus* : McKay in Fischer and Bianchi, *FAO species identification sheets for fishery purposes. W. Indian Ocean (Fishing Area 51)*, 2 : HAEM Pomad 10.

Material examined : 1, 67 mm, collected from Neil Island, South Andamans on 12.10.91.

Fin formula : D XII, 13 ; A III, 7 ; P 15 ; V I, 5 ; GR 7 + 12 ; LL 54 ; Ltr 6/17.

Distribution : From Pakistan, coasts of India to the Philippines.

30. *Lutjanus biguttatus* (Valenciennes, 1830)

1830. *Serranus biguttatus* Valenciennes, *Hist. nat. poiss.*, 6 : 507 (Trincomallee, Sri Lanka).

1875. *Lutjanus biguttatus* : Day, *Fishes of India* : 34, pl. 10, fig. 6.

Material examined : 1, 155 mm, collected from Hut Bay, Little Andamans on 24.10.91.

Fin formula : D X, 12 ; A III, 8 ; P 15 ; V I, 5 ; GR 6 + 15 ; LL 55 ; Ltr 5/14.

Distribution : Sri Lanka, Andaman Sea, through the East Indies to the Philippines.

31. *Lutjanus bohar* (Forsskal, 1775)

1775. *Sciaena bohar* Forsskal., *Descript. anim.* : 46 (Red Sea).

1875. *Lutjanus bohar* : Day, *Fishes of India* : 44, pl. 13, fig. 4.

Material examined : 1, 160 mm, collected from Rangath Bay, Middle Andamans on 17.10.91.

Fin formula : D X, 14 ; A III, 8 ; P 15 ; V I, 5 ; GR 5+8 ; LL 52 ; Ltr 5/14.

Distribution : Widespread in the tropical Indo-west Pacific.

32. *Lutjanus decussatus* (Cuvier, 1828)

1828. *Mesoprion decussatus* Cuvier, *Hist. nat. poiss.*, 2 : 487 (Java).

1875. *Lutjanus decussatus* : Day, *Fishes of India* : 47, pl. 14, fig. 4.

Material examined : 2, 142-167 mm, collected from Wilson Island, South on 9.10.91.

Fin formula : D X, 13 ; A III, 8 ; P 16 ; V I, 5 ; GR 1+(7-8) ; LL 49-50 ; Ltr 6/17.

Distribution : India, Sri Lanka, Andaman Islands, the East Indies to the Philippines.

33. *Lutjanus quinquelineatus* (Bloch, 1790)

1790. *Holocentrus quinquelineatus* Bloch, *Naturges. ausland. Fische*, 4 : 84.

1984. *Lutjanus quinquelineatus* : Allen in Fischer and Bianchi, *FAO species identification sheets for fishery purposes. W. Indian Ocean (Fishing Area 51)*, 3 : LUT Lut40.

Material examined : 2, 84-98 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D X, 14 ; A III, 8 ; P 15 ; V I, 5 ; GR 6+14 ; LL 51-52 ; Scales between LL and the base of mid-dorsal spine 6.

Distribution : Sri Lanka, Southern coast of India, the eastern Indian Ocean and the western central Pacific.

34. *Lutjanus russelli* (Bleeker, 1849)

1849. *Mesoprion russelli* Bleeker, *Verh. Batav. Gen.*, 22, Percoiden : 41 (India).

1936. *Lutjanus russelli* ; Weber and de Beaufort, *Fish. Indo-Aust. Archip.*, 7 : 272.

Material examined : 1, 28 mm collected from Neil Island, South Andamans on 12.10.91 ; 1, 150 mm, collected from Yerata Jetty, Rangath, Middle Andamans on 18.10.91.

Fin formula : D X, 14-15 ; A III, 8 ; P 16 ; V I, 5 ; GR (5-6)+(7-10) ; LL 50 ; Ltr 6/17.

Distribution : Widely distributed in Indo-west Pacific.

35. *Caesio caerulaureus* Lacepede, 1801

1801. *Caesio caerulaureus* Lacepede, *Hist. nat. poiss.*, 3 : 85 (Moluccas).

Material examined : 2, 90-114 mm, collected from Hut Bay, Little Andaman on 24/25.10.91.

Fin formula : D X+ 14-15 ; A III, 12 ; P 21-22 ; V I, 5 ; GR (7-8)+(23-25) ; LL 66 ; Ltr 8/16.

Distribution : Widespread in the tropical Indo-west Pacific excluding the Persian Gulf.

36. *Gymnocranius griseus* (Schlegel, 1844)

1844. *Dentex griseus* Schlegel in Temminck and Schlegel, *Fauna Japonica, Pisces* : 72, pl. 36 (Japan)

1986. *Gymnocranius griseus* : Heemstra in Smith and Heemstra, *Smith's sea fishes, Lethrinidae* : 595, fig. 185-2.

Material examined : 2, 49-52 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D X, 10 ; A III, 10 ; P 14 ; V I, 5 ; GR 3+5 ; LL 48 ; Ltr 6/16.

Distribution : Widespread in tropical Indo-west Pacific.

Remark : This is the first record of occurrence from Andaman and Nicobar Islands, reported in detail elsewhere.

37. *Lethrinus mahsena* (Forsskal, 1775)

1775. *Sciaena mahsena* Forsskal, *Descript. anim.* : 52 (Red Sea).

1936. *Lethrinus mahsena* : Weber and de Beaufort, *Fish. Indo-Aust. Archip.*, 7 : 444.

Material examined : 1, 180 mm, collected from Rangath Bay, Middle Andamans on 17.10. 91.

Fin formula : D X, 9 ; A III, 8 ; P 13 ; V I, 5 ; GR 4+6 ; LL 48 ; Ltr 6/15.

Distribution : The east African coast, Red Sea, Madagascar, Seychelles, Aldabra, Mauritius, the "Gulf", Andamans, Chagos archipelago, northern Australia, western central Pacific.

38. *Nemipterus randalli* Russell, 1986

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

Material examined : 1, 82 mm, collected from Rangath Bay, Middle Andamans on 19.10.91.

Fin formula : D X, 9 ; A III, 7 ; P 17 ; V I, 5 ; GR 6+8 ; LL 45 ; Ltr 4/9.

Distribution : Western Indian Ocean : from east coast of South Africa to the east coast of India.

Remark : This is the first record of occurrence from Andaman and Nicobar Islands. Extension of range of occurrence reported in detail elsewhere.

39. *Scolopsis bilineatus* (Bloch, 1793)

1793. *Anthias bilineatus* Bloch, *Naturges. ausland. Fische*, 7 : 3, pl. 325, fig. 1 (Japan).

1990. *Scolopsis bilineatus* : Russell, *FAO Fish. Synop.* (125) 12 : 105, fig. 197, pl. 6, f, g, h.

Material examined : 1, 105 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D X, 9 ; A III, 7 ; P 17 ; V I, 5 ; GR 4+5 ; LL 46 ;
Ltr 3/16.

Distribution : The Laccadive Islands, Sri Lanka, Andaman Sea, western Australia, the western Pacific.

40. *Scolopsis ciliatus* (Lacepede, 1802)

1802. *Holocentrus ciliatus* Lacepede, *Hist. nat. poiss.*, 4 : 33.

1990. *Scolopsis ciliatus* : Russell, *FAO Fish. Synop.*, (125) 12 : 108, fig. 201, pl. 7, b.

Material examined : 1, 102 mm, collected from Rangath Bay, Middle Andamans on 24.10.91.

Fin formula : D X, 9 ; A III, 7 ; P 16 ; V I, 5 ; GR 4+6 ; LL 42 ;
Ltr 3/15.

Distribution : Andaman Sea, western Pacific up to Solomon Isles.

41. *Scatophagus argus* (Linnaeus, 1766)

1766. *Chaetodon argus* Linnaeus, *Systema Naturae* (ed. 12), 1 : 464 (India),

1991. *Scatophagus argus* : Talwar and Jhingran, *Inland fishes of India*, 2 : 875, fig. 264.

Material examined : 1, 42 mm, collected from Havelock Island, South Andamans on 14.10.91.

Fin formula : D XI, 16 ; A VI, 14 ; P 17 ; V I, 5 ; GR 5+12 ; LL ca. 100.

Distribution : India, Sri Lanka, through the East Indies to Australia, the New Hebrides, Solomon Islands.

42. *Gerres filamentosus* Cuvier, 1829

1829. *Gerres filamentosus* Cuvier, *Regne Animal* (ed. 2), 2 : 188 (based on Russell, 1803, *Fishes of Coromandel*, 1 : 52, fig. 67) (Vizagapatnam, India).

Material examined : 1, 192 mm, collected from Rangath Bay, Middle Andamans on 16.10.91.

Fin formula : D IX, 10 ; A III, 7 ; P 15 ; V I, 5 ; GR 1+7 ; LL 45 ; Ltr 5/12.

Distribution : Widespread in tropical Indo-Pacific.

43. *Upeneus bensasi* (Schlegel, 1842)

1842. *Mullus bensasi* Schlegel in Temminck and Schlegel, *Fauna Japonica, Pisces* : 30. pl. 1, fig. 2 (Bay of Nagasaki, Japan).

1969. *Upeneus bensasi* : Thomas, *The Goat fishes (Family : Mullidae) of the Indian Seas* : 10, pl. 1, fig. B.

Material examined : 1, 83 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D VII+I, 8 ; A I, 6 ; P 13 ; V I, 5 ; GR 6+20 ; LL 30 ; Ltr 2/6.

Distribution : Widespread in Indo-west Pacific.

44. *Upeneus vittatus* (Forsskal, 1775)

1775. *Mullus vittatus* Forsskal, *Descript. anim.* : 31 (Djedda).

1969. *Upeneus vittatus* : Thomas, *The Goat Fishes (Family : Mullidae) of the Indian Seas* : 23, pl. 2, fig. C.

Material examined : 1, 112 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D VIII+I, 8 ; A I, 6 ; P 15 ; V I, 5 ; GR 9+18 ; LL 36 ; Ltr 3/7.

Distribution : Throughout the Indo-Pacific region.

45. *Sillago sihama* (Forsskal, 1775)

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

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

Material examined : 1, 65 mm, collected from Wilson Island, South Andamans on 9.10.91 ; 1, 108 mm, collected from Havelock Island, South Andamans on 14.10.91 ; 1, 178 mm, collected from Yerata jetty ; Rangath, Middle Andamans on 18.10.91 ; 9, 38-129 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D XI+I, 21 ; A II, 21 ; P 15 ; V I, 5 ; GR 2+(9-11) ; LL 67-72 ; Ltr 5-6/9-10.

Distribution : Indo-west Pacific.

46. *Mene maculata* (Bloch, 1801)

1801. *Zeus maculatus* Bloch in Bloch and Schneider, *Syst. Ichth.* : 95, pl. 22 (Tranquebar, India).

1876. *Mene maculata* : Day, *Fishes of India* : 249, pl. 53, fig. 5.

Material examined : 1, 148 mm, collected from Yerata jetty, Rangath, Middle Andamans on 18.10.91.

Fin formula : D III, 43 ; A 33 ; P 15 ; V I, 5 ; GR 7+26.

Distribution : Central tropical Indo-Pacific.

47. *Gazza minuta* (Bloch, 1797)

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 Rangath Bay, Middle Andamans on 16.10.91.

Fin formula : D VIII, 16 ; A III, 14 ; P 17 ; V I, 5 ; GR 5+16 ; LL 58.

Distribution : Tropical Indo-Pacific.

48. *Leiognathus leuciscus* (Gunther, 1860)

1860. *Equula leuciscus* Gunther, *Cat. Fishes Br. Mus.*, 2 : 503 (Amboyna).

1978. *Leiognathus leuciscus* : James, *J. mar. biol. Ass. India*, 17 (1) : 156, pl. 2ç.

Material examined : 2, 76-90 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D VIII, 16 ; A III, 14 ; P 17 ; V I, 5 ; GR 4+12.

Distribution : Eastern Indian Ocean, eastward to the Philippines, Taiwan, Australia.

49. *Leiognathus lineolatus* (Valenciennes, 1835)

1835. *Equula lineolata* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 10 : 86.

1978. *Leiognathus lineolatus* : James, *J. mar. biol. Ass. India*, 17 (1) : 163, pl. 20.

Material examined : 1, 78 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D VIII, 16 ; A III, 14 ; P 16 ; V I, 5 ; GR 5+13.

Distribution : Madagascar, Red Sea, the Gulf, coasts of India, Indo-Australian Archipelago, Japan, the Philippines, Queensland.

50. *Lactarius lactarius* (Schneider, 1801)

1801. *Scomber lactarius* Schneider, *Syst. Ichth. Bloch* : 31 (Tranquebar, India).

1984. *Lactarius lactarius* : Talwar and Kacker, *Commercial Sea fishes of India* : 427, fig. 165.

Material examined : 1, 93 mm, collected from Neil Island, South Andamans on 12.10.91.

Fin formula : D VIII+1, 21 ; A III, 25 ; P 18 ; V I, 5 ; GR 3+13 ; LL 74.

Distribution : Widespread in Indo-west Pacific.

51. *Atule mate* (Cuvier, 1833)

1833. *Caranx mate* Cuvier, *Hist. nat. poiss.*, 9 : 54 (Pondicherry, Seychelles, New Guinea, Anjer strait).

1984. *Atule mate* : Talwar and Kacker, *Commercial Sea fishes of India* : 444, fig. 171.

Material examined : 1, 150 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D VIII+I, 23 ; A II, I, 20 ; P 22 ; V I, 5 ; GR 12+30 ; LL 102 (LL curved 55 ; LL straight 7+40 scutes).

Distribution : Widespread in the tropical Indo-west Pacific.

52. *Carangoides talamparoides* Bleeker, 1852

1852. *Carangoides talamparoides* Bleeker, *Makreel. Vissch. Verh. Batav. Gen.*, 24 : 91.

Material examined : 1, 77 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D I, VIII+I, 21 ; A II, 18 ; P 21 ; V I, 5 ; GR 7+21 ; LL 109 (LL curved 74+LL straight 35) ; LL scutes 21.

Distribution : Indo-west Pacific : from the Gulf of Oman through coasts of India to the Philippines, Australia.

Remark : This is the first record of occurrence from Andaman and Nicobar Islands, reported elsewhere in detail.

53. *Caranx carangus* (Bloch, 1793)

1793. *Scomber carangus* Bloch, *Naturges. ausland. Fische*, 7 : 69 (Antilles, Atlantic Ocean).

1876. *Caranx carangus* : Day, *Fishes of India* : 215, pl. 50, fig. 4.

Material examined : 1, 103 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D I, VIII+I, 20 ; A II, I, 16 ; P 21 ; V I, 5 ; GR 5+17 ; LL 96 (LL curved 57+LL straight 5+34 scutes).

Distribution : From India through the East Indies to China, Japan, the Philippines ; tropical Atlantic.

54. *Caranx ignobilis* (Forsskal, 1775)

1775. *Scomber ignobilis* Forsskal, *Descript. anim.* : 55 (Djedda and Lohaja, Red Sea).

1984. *Caranx ignobilis* : Talwar and Kacker, *Commercial sea fishes of India* : 461, fig. 176.

Material examined : 1, 51 mm, collected from Hut Bay, Little Andaman. on 25.10.91.

Fin formula : D I, VIII+I, 18 ; A, II, I, 16 ; P 21 ; V I, 5 ; GR 5+15 ; LL 86 (LL curved 53+LL straight 4+29 scutes).

Distribution : Tropical Indo-west Pacific.

55. *Selar crumenophthalmus* (Bloch, 1793)

1793. *Scomber crumenophthalmus* Bloch, *Naturges. ausland. Fische*, 7 : 77, pl. 343 (Acara Bay, Guinea).

1984. *Selar crumenophthalmus* : Talwar and Kacker, *Commercial sea Fishes of India* : 481, fig. 185.

Material examined : 1, 91 mm, collected from Havelock Island, South Andamans on 9.10.91 ; 1, 95 mm, collected from Rangath Bay, Middle Andamans on 19.10.91 ; 3, 107-196 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D VIII+I, 25-27 ; A II, I, 21-23 ; P 20-22 ; V I, 5 ; GR (8-9)+(28-29) ; LL 82-95 ; LL scutes 28-40.

Distribution : Worldwide, in tropical and subtropical Indo-Pacific and Atlantic.

56. *Abudefduf septemfasciatus* (Cuvier, 1830)

1830. *Glyphisodon septemfasciatus* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 5 : 463 (Mauritius).

1986. *Abudefduf septemfasciatus* : Allen in Smith and Heemstra, *Smith's Sea fishes* : 672, pl. 85, fig. 219-3,

Material examined : 2, 16-20 mm, collected from Havelock Island, South Andaman on 9.10.91 ; 6, 17-24 mm, collected from Rangath Bay, Middle Andamans on 16.10.91.

Fin formula : D XIII, 12-13 ; A II, 12-13 ; P 18 ; V I, 5 ; LL 21-22 ; total GR 17-19.

Distribution : Indo-west Pacific, Red Sea, South to Pinda, Mozambique.

57. *Amphiprion percula* (Lacepede, 1802)

1802. *Lutjanus percula* Lacepede, *Hist. nat. poiss.*, 4 : 194, 239.

1877. *Amphiprion percula* : Day, *Fishes of India* : 379, pl. 80, fig. 4.

Material examined : 1, 47mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D XI, 15 ; A II, 11 ; P · 15 ; V I, 5 ; GR 4+10 ; LL pored 38 ; LS 57 ; Ltr 6/24.

Distribution : Coasts of India to the Philippines, China, Queensland, eastward to Fiji. Solomon Islands, Society Islands.

58. *Chrysiptera glauca* (Cuvier, 1830)

1830. *Glyphisodon glaucus* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 5 : 475 (Guam).

1986. *Chrysiptera glauca* : Allen in Smith and Heemstra, *Smith's Sea Fishes* : 676, pl. 87, fig. 219·22.

Material examined : 5, 22-69 mm, collected from Havelock Island, South Andaman on 14.10.91.

Fin formula : D XIII, 12 ; A II, 12 ; P 18 ; V I, 5 ; Total GR 23-25 ; LL Pored 18 ; LS 26 ; Ltr $1\frac{1}{2}$ /8.

Distribution : Indo-west Pacific.

59. *Chrysiptera unimaculata* (Cuvier, 1830)

1830. *Glyphisodon unimaculatus* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 5 : 478 (Timor).

1986. *Chrysiptera unimaculata* : Allen in Smith and Heemstra, *Smith's Sea Fishes* : 676, pl. 84, fig. 219·24.

Material examined : 1, 53 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D XIII, 14 ; A III, 12 ; P 19 ; V I, 5 ; Total GR 22 ; LL pored 17 ; LS 26 ; Ltr $1\frac{1}{2}$ /7.

Distribution : Indian Ocean and Indo-Australian Archipelago.

Remark : This is the first record of occurrence from Andaman and Nicobar Islands.

60. *Cheilinus fasciatus* Bloch, 1791

1791. *Cheilinus fasciatus* Bloch, *Naturges. ausland. Fische*, 5 : 18.

Material examined : 1, 143 mm, collected from Peel Island, South Andamans on 9.10.91.

Fin formula : D IX, 10 ; A III, 8 ; P 12 ; V I, 5 ; C 13 ; GR 3+6 ; LL 15+9 ;
Ltr $1\frac{1}{2}/6$.

Distribution : Indo-west Pacific.

61. *Labroides dimidiatus* (Valenciennes, 1839)

1839. *Cossyphus dimidiatus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 13 : 136 (Mauritius).

1877. *Labroides dimidiatus* : Day, *Fishes of India* : 393.

Material examined : 1, 24 mm (30 mm TL), collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D IX, 11 ; A III, 10 ; P 13 ; V I, 5 ; LL 52 ; Ltr 3/16.

Distribution : Indo-Pacific.

62. *Scarus blochii* Valenciennes

1839. *Scarus blochii* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 14 : 219.

Material examined : 1, 185 mm, collected from John Lawrence Island, South Andamans on 10.10.91.

Fin formula : D IX, 10 ; A III, 9 ; P ii, 13 ; V I, 5 ; GR 50 ; LL 18+7 ;
Pre-dorsal scales 6.

Distribution : Seas of India, Malay Archipelago.

Remark : This is the first record of occurrence from Andaman and Nicobar Islands.

63. *Sphyraena forsteri* Cuvier, 1829

1829. *Sphyraena forsteri* Cuvier in Cuvier and Valenciennes, *Hist. nat. poiss.*, 3 : 261, 353 (Tahiti).

Material examined : 1, 136 mm, collected from Hut Bay, Little Andaman on 24.10.91.

Fin formula : D V+I, 9 ; A II, 9 ; P 14 ; LL 110 ; GR as spiny setae.

Distribution : Indo-Pacific.

64. *Istiblennius lineatus* (Valenciennes 1836)

1836. *Salarias lineatus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 11 : 314.

1984. *Istiblennius lineatus* : Bath in Fischer and Bianchi, *FAO species identification sheets for fishery purposes. W. Indian Ocean (Fishing Area 51)*. Blenniidae : 9.

Material examined : 19, 32-46 mm, collected from Panchavati, Rangath, Middle Andamans on 16.10.91.

Fin formula : D XIII, 22 ; A II, 23-24 ; P 14 ; V I, 3.

Distribution : Indo-west Pacific : from the Persian Gulf through India, the Philippines to Australia, Fiji, Samoa.

65. *Callionymus enneactis* Bleeker, 1879

1879. *Callionymus enneactis* Bleeker, *Versl. Akad. Amsterdam*, (2) 14 (1877) : 95.

Material examined : 1, 40 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D IV+8 ; A 7 ; P 17 ; V I, 5.

Distribution : Singapore, the Philippines, Pelew Island.

Remark : This is the first occurrence from Indian waters, reported elsewhere in detail.

66. *Callionymus filamentosus* Valenciennes, 1837

1837. *Callionymus filamentosus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 12: 303, pl. 359 (Celebes).

Material examined : 10, 41-81 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D IV+9 ; A 9 ; P 20 ; V I, 5.

Distribution : Indo-west Pacific.

67. *Acentrogobius ornatus* (Ruppell, 1828)

1828. *Gobius ornatus* Ruppell, *Atl. Reise N. Afr. Fische* : 135.

1941. *Acentrogobius ornatus* : Koumans, *Mem. Indian Mus.*, 13 (3) : 231.

Material examined : 1, 64 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D VI+I, 10 ; A I, 9 ; P 22 ; V I, 5 ; GR 4 ; LL 28 ; Ltr 7 ; Pre-dorsal scales 10.

Distribution : Indo-west Pacific. eastwards to Fiji, Solomon Islands.

Remark : The specimen described here has more pectoral rays (22, against 19-20) and less lateral transverse scales (7, against 8 or 9).

68. *Bathygobius fuscus* (Ruppell, 1828)

1828. *Gobius fuscus* Ruppell, *Atl. Reise N. Afr. Fische* : 137 (Red sea).

1941. *Bathygobius fuscus* : Koumans, *Mem. Indian Mus.*, 13 (3) : 267.

Material examined : 9, 23-49 mm, collected from Rangath Bay, Middle Andamans on 15.10.91.

Fin formula : D VI+I, 9 ; A I, 8 ; P 19 ; V I, 5 ; GR 8 ; LL 38 ; Ltr 13 ;
Predorsal scales 22.

Distribution : Indo-Pacific : from east coast of Africa, through Malay Archipelago, islands in Pacific to America.

69. *Oplopomus caninoides* (Bleeker, 1852)

1852. *Gobius caninoides* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 3 : 274.

1941. *Oplopomus caninoides* : Koumans, *Mem. Indian Mus.*, 13 (3) : 215.

Material examined : 15, 31-53 mm, collected from Hut Bay, Little Andamans on 25.10.91.

Fin formula : D VI+I, 10 ; A I, 10 ; P 17-18 ; V I, 5 ; GR 5+8 ; LL 30 ;
Ltr 9 ; **Predorsal scales** 12.

Distribution : Persian Gulf, Indo-Australian Archipelago, the Philippines.

70. *Waitea mystacina* (Valenciennes, 1837)

1837. *Gobius mystacinus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 12 : 124.

1941. *Waitea mystacina* : Koumans, *Fish. Indo-Aust. Archip.*, 10 : 107.

Material examined : 1, 43 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D VI+I, 10 ; A I, 9 ; P 17 ; V I, 5 ; GR 3+15 ; LL 38 ; Ltr 15.

Distribution : East coast of Africa ; Malay Archipelago, the Philippines, Australia, Japan.

71. *Acanthurus matoides* Valenciennes, 1835

1835. *Acanthurus matoides* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 10 : 204.

Material examined : 1, 28 mm, collected from Havelock Island, South Andamans on 14.10.91.

Fin formula : D IX, 25 ; AIII, 25 ; P 17 ; VI, 5 ; lower GR 14.

Distribution : Indo-west Pacific : from east coast of Africa to Hawaii in east, north to Japan, south to northern coast of Australia.

72. *Siganus canaliculatus* (Park, 1797)

1797. *Chaetodon canaliculatus* Park *Trans. Linn. Soc. Lond.*, 3 : 33 (Sumatra).

1984. *Siganus canaliculatus* : Talwar and Kacker, *Commercial Sea fishes of India* : 775, fig. 314.

Material examined : 1, 175 mm, collected from Neil Island, South Andamans on 12.10.91.

Fin formula : D XIII, 10 ; A VII, 9 ; P 16 ; V I, 3, I ; GR 5+16 ; Scale rows between lateral line and base of mid-dorsal spine 22.

Distribution : From the 'Gulf' along the coasts of India to the Indo-Malay Archipelago.

73. *Siganus guttatus* (Bloch, 1787)

1787. *Chaetodon guttatus* Bloch, *Naturges. ausland. Fische*, 3 : 55.

1951. *Siganus guttatus* : de Beaufort and Chapman, *Fish. Indo-Aust. Archip.*, 9 : 123.

Material examined : 2, 130 – 185 mm, collected from John Lawrence Island, South Andamans on 8.10.91.

Fin formula : D XIII, 10 ; A VII, 9 ; P 16 ; V I, 3, I ; GR (7 – 8) + (18 – 20) ; scale rows between lateral line and base of mid-dorsal spine 20-21.

Distribution : Indo-Malay Archipelago.

74. *Siganus spinus* (Linnaeus, 1758)

1758. *Sparus spinus* Linnaeus, *Syst. nat.* (ed. 10), 1 : 281.

1951. *Siganus spinus* : de Beaufort and Chapman, *Fish. Indo-Aust. Archip.*, 9 : 104, fig. 22.

Material examined : 3, 120 – 130 mm, collected from Kalapathar, Havelock Island, South Andamans on 5.10.91.

Fin formula : D XIII, 10 ; A VII, 9 ; P 16—17 ; V I, 3, I ; GR 5+18 ; Scale rows between lateral line and base of mid-dorsal spine 16.

Distribution : The 'Gulf', southern India, Sri Lanka, the Indo-Malay Archipelago coral reefs of Central and Western Pacific Ocean.

75. *Siganus virgatus* (Valenciennes, 1835)

1835. *Amphacanthus virgatus* Valenciennes in Cuvier and Valenciennes, *Hist. nat. poiss.*, 10 : 133.

1951. *Siganus virgatus* : de Beaufort and Chapman, *Fish. Indo-Aust. Archip.*, 9 : 113.

Material examined : 2, 32—171 mm, collected from John Lawrence Island, South Andamans on 8.10.91.

Fin formula : D XIII, 10 ; A VIII, 9 ; P 16 ; V I, 3, I ; GR 6+(16—17) ; scale rows between lateral line and base of mid dorsal spine 20.

Distribution : Southern India, the Indo-Malay Archipelago, Ryuku Islands, Irian Jaya, north-west Australia.

76. *Trichiurus lepturus* Linnaeus, 1758

1758. *Trichiurus lepturus* Linnaeus (*ex* Artedi), *Syst. Nat.* (ed. 10) : 246 (America and China).

Material examined : 1, 257 mm, collected from Yerata jetty, Rangath, Middle Andamans on 18.10.91.

Fin formula : D III, 130 ; A 104 ; P 12 ; GR 5+8.

Distribution : Throughout tropical and temperate waters of the world.

77. *Rastrelliger kanagurta* (Cuvier, 1816)

1816. *Scomber kanagurta* Cuvier, *Regne Anim.*, 2 : 313 (Vizagapatnam).

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

Material examined : 1, 200 mm in fork length (FL), collected from Neil Island, South Andamans on 12.10.91 ; 1, 120 mm FL, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D VIII-X+I, 11+5 finlets ; A I, 11+5 finlets ; P 20 ; V I, 5 ; GR (15-18)+(33-39).

Distribution : Indo-west Pacific.

78. *Engyprosopon grandisquama* (Temminck and Schlegel, 1846)

1846. *Rhombus grandisquama* Temminck and Schlegel, *Fauna Japonica*, Pisces : 183, pl. 92, fig. 3 and 4 (Nagasaki, Japan).

1986. *Engyprosopon grandisquama* : Hensley in Smith and Heemstra, *Smith's Sea fishes*, Bothidae : 858, fig. 259-8.

Material examined : 1, 85 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 86 ; A 63 ; P sup. 11 ; P dext. 9 ; V 6 ; LL 45 ; GR 0+6.

Distribution : Indo-west Pacific.

Remark : This is the first record of occurrence from Andaman and Nicobar Islands, reported elsewhere in detail.

79. *Cynoglossus arel* (Schneider, 1801)

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, 111 mm, collected from Neil Island, south Andamans on 18.10.91.

Fin formula : D 116 ; A 96 ; V 4 ; C 10 ; LL 72 ; scale rows between two LL 7.

Distribution : From the 'Gulf' through the seas of India to the Philippines, Indonesia.

80. *Cynoglossus lida* (Bleeker, 1861)

1851. *Plagusia lida* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 1 : 413 (Batavia).

1984. *Cynoglossus lida* : Talwar and Kacker, *Commercial sea fishes of India* : 879, fig. 364.

Material examined : 1, 126 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 98 ; A 84 ; V 4 ; C 10 ; LL 85 ; scale rows between two LL 12.

Distribution : Widespread in tropical Indo-west Pacific.

81. *Paraplagusia bilineata* (Bloch, 1787)

1787. *Pleuronectes bilineata* Bloch, *Naturges, ausland. Fische*, 3 : 29, pl. 188 (Chinese waters).

1928. *Paraplagusia bilineata* : Norman, *Rec. Indian Mus.*, 30 : 191, fig. 9.

Material examined : 1, 81 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 110 ; A 87 ; V 4 ; LL 100 ; scale rows between two LL 17.

Distribution : Widespread in tropical Indo-west Pacific.

82. *Zebrias quagga* (Kaup, 1858)

1858. *Aesopia quagga* Kaup, *Archiv. Naturges.* : 98.

1928. *Zebrias quagga* : Norman, *Rec. Indian Mus.*, 30 : 184, pl. 6.

Material examined : 4, 61-81 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 67-68 ; A 56-60 ; P sin. 11 ; P dext. 8 ; V 5 ; C 16 ; LL 90-94.

Distribution : From Red Sea through coasts of India to Malay Archipelago, China.

83. *Paramonacanthus choirocephalus* (Bleeker, 1852)

1852. *Monacanthus choirocephalus* Bleeker, *Verh. Batav. Gen.*, 24 : 11, 19.

1955. *Paramonacanthus choirocephalus* : Munro, *The marine and freshwater fishes of Ceylon*: 274, pl. 53, fig. 799.

Material examined : 2, 62-63 mm, collected from Havelock Island, South Andamans on 9.10.91.

Fin formula : D II+27-28 ; A 29-30 ; P 12 ; C 12.

Distribution : Sri Lanka, eastern coast of India, Thailand, Sumatra, Java, Celebes.

84. *Pseudotriacanthus striglifer* (Cantor, 1849)

1849. *Triacanthus striglifer* Cantor, *Journ. Asiat. Soc. Bengal*, 18 (2) : 1345 (Sea of Pinang).

1955. *Pseudotriacanthus striglifer* : Munro, *The marine and freshwater fishes of Ceylon* : 273, pl. 54, fig. 794.

Material examined : 1, 82 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D V+22 ; A 16 ; P 13 ; V I.

Distribution : From the Gulf of Oman through India to Indonesia, the Philippines.

85. *Lactoria cornuta* (Linnaeus, 1758)

1758. *Ostracion cornutus* Linnaeus, *Syst. Nat.* (ed. 10) : 331 (India).

1955. *Lactoria cornuta* : Munro, *The marine and freshwater fishes of Ceylon* : 277, pl. 54, fig. 807.

Material examined : 1, 29 mm, collected from Hut Bay, Little Andaman on 25.10.91.

Fin formula : D 9 ; A 9 ; P 11 ; C 10.

Distribution : Widespread in Indo-west Pacific.

86. *Lagocephalus scleratus* (Forster, 1789)

1789. *Tetraodon scleratus* Forster in Gmelin, *Syst. Nat.* (ed. 13) (1788), 1 (3) : 1444 (American and Pacific Oceans).

1986. *Lagocephalus scleratus* : Smith and Heemstra, *Smith's Sea fishes, Tetraodontidae* : 901 pl. 144, fig. 268·23.

Material examined : 2, 66-98 mm, collected from Hut Bay, Little Andaman on 24/25.10.91.

Fin formula : D 11 ; A 9-11 ; P 16.

Distribution : Widespread in Indo-west Pacific.

ZOOGEOGRAPHICAL REMARKS

The range of distribution of the species in analysis has been investigated to throw more light on the zoogeographical affinities of the fish fauna of Andaman waters. The samples in collection have been arranged in five groups according to zoogeographical relations.

Of the 86 species reported here, three species (3.5%) viz. *Fistularia petimba* Lacepede *Selar crumenophthalmus* (Bloch) and *Trichiurus lepturus* Linnaeus are circumtropical (Group I) in distribution. Fifty two species (60.5%) are widely distributed in the Indo-west Pacific region (Group II), ranging from east coast of Africa to the Philippines or even extended beyond eastwardly, north to Japan, south to Queensland. Of these fifty two species, *Ambasis urotaenia* Bleeker, *Apogonichthys perdix* Bleeker, *Scolopsis bilineatus* (Bloch) and *Waitea mystacina* Valenciennes are found only in and around reef islands of the Indian Ocean and Western Pacific indicating their insular origin and evolution around coral reefs of the Malay Archipelago. Twenty eight species (32.5%) are spread over the Indo-Polynesian province (Group III), i.e. from the coasts of the Indian subcontinent and/or extended up to the Gulf of Oman in the west to Malay Archipelago or beyond in the east, of which only *Caranx carangus* (Bloch) is found also in tropical Atlantic. Two species (2.3%), viz. *Scolopsis ciliatus* (Lacepede) and *Callionymus enneactis* Bleeker are restricted to Malay Archipelago and islands of Western Pacific Ocean (Group IV).

Ekman (1953) considered Malay Archipelago to be the richest faunistic centre and most of the shore fauna of Indo-west Pacific region have evolved at this centre. Andaman and Nicobar Islands, geomorphologically similar to the Malay Archipelago, being situated on the outcrops of north-western continuation of the Java ridge are separated from the Indian subcontinent by wide and deep ocean floor of the Bay of Bengal. Hence, by every conjecture the fish fauna shows semblance to that of Malay Archipelago excepting *Nemipterus randalli* Russell which is basically a western Indian Ocean (Group V) species.

SUMMARY

In all, eighty six species of fishes collected during the survey tour to South and Middle Andaman group of Islands in October, 1991 have been studied and a systematic account of the same is given. This includes two records for Indian waters and eight new records for Andaman waters. A brief zoogeographical discussion of the fishes in the collection is also included.

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ON THE CRICKETS (ORTHOPTERA : GRYLLIDAE) OF
DHARMAPURI DISTRICT, TAMILNADU, INDIA

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INTRODUCTION

Dharmapuri District of Tamilnadu was selected by Zoological Survey of India for faunistic surveys during 1985 and 1986. The district was surveyed twice by the Southern Regional Station of Zoological Survey of India—once in April 1985 and again in February-March 1986. The first survey focussed on the northwestern, western and southwestern areas, while the second was devoted to the southern and southeastern areas. As a member of both the survey teams, the present author was able to collect, observe and examine a considerable number of gryllids. The present paper deals with this material, totalling 212 specimens, belonging to 28 species under subfamilies of Family Gryllidae.

SYSTEMATIC ACCOUNT

I. Subfamily : GRYLLINAE

1. *Gymnogryllus kashmirensis* Bhowmik

1967. *Gymnogryllus kashmirensis* Bhowmik, *Sci. Cult.*, 33 : 244.

Material examined : Dharmapuri dist. : 1 ♀, Denkanikotta-Keesan Kuppam (Thalli), 09.iv.1985, Regd. No. SRS/ZSI/I/Or/87 ; 1 ♂, 3 ♀, Denkanikotta Forest RH, 07.iv.1985, Regd. No. SRS/ZSI/Or/86 (Koshy Mathew & pty. coll.).

Distribution : Assam and Meghalaya west to UP, Jammu, Rajasthan, MP,

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Goa and South India except Andhra Pradesh ; Burma ; Indonesia ; S. Vietnam.

Remarks : As mentioned by Vasanth (1982), the opinion of Bhowmik (1977) that *G. minor* Chopard, 1969 is a synonym of the present species, appears to be highly improbable. *G. kashmirensis*, as such, has not been recorded earlier from Tamilnadu. Chopard (1969) recorded *G. minor* from Coimbatore, Tamilnadu. The present record is the second from the state of Tamilnadu, and the first from Dharmapuri district.

The lone male and two female specimens examined have a rufous head, while the rest have a black head. The yellow colour at the apical part of the posterior femora is more marked in the specimens with the rufous head.

2. *Gryllus bimaculatus* De Geer

1773. *Gryllus bimaculatus* De Geer, *Mem. Ins.*, 3 : 521.

Material examined : Dharmapuri dist. : 3 ♂, 3 ♀, 4 nymphs, Denkanikotta-Sameri, 08.iv.1985, Regd. No. SRS/ZSI/I/Or/96 & 97 ; 1 ♂, Hogenekal, along R. Cauvery, c. 225m, 16.iv.1985, Regd. No. SRS/ZSI/I/Or/95 ; 1 ♂, Denkanikotta-Keesan Kuppam, 09.iv.1985, Regd. No. SRS/ZSI/I/Or/93 ; 1 ♀, 1 nymph, Denkanikotta-Ayyur RF, c. 850 m, 06.iv.1985, Regd. No. SRS/ZSI/I/Or/94 ; 1 ♂, Kottapatti Forest RH compound, 25.ii.1986, Regd. No. SRS/ZSI/I/Or/98 (Koshy Mathew & pty. coll.).

Distribution : Broadly distributed throughout India. Also Pakistan, Sri Lanka, Burma, Malaysia, Singapore, Nepal, Africa and Mediterranean Region.

Remarks : Two males show tegmina of light colouration which contrast with the shiny black pronotum. This lighter colour is, perhaps, the colour of the wings seen through the tegmina.

The earlier records of this widely dispersed species from Tamilnadu are from Coimbatore, Coonoor in the Nilgiri Hills, Kodaikanal in the Palani Hills, Yercaud in the Shevroy Hills and Tiruchirapalli. Vasanth & Shrinivasan (1986) and Vasanth (*in press-1*) have recorded this species from Javadi Hills.

Key to species of *Teleogryllus* from Dharmapuri district

Head with or without faint yellow band along internal margin of eyes ; all veins of lateral field of tegmina equally distant ; ovipositor subequal to body length
 *mitratus* (Burmeister)

Head with a prominent yellow band along internal margin of each eye ; veins of lateral field of tegmina divided into two groups by a space ; ovipositor generally shorter than body length *occipitalis* (Serville)

3. *Teleogryllus mitratus* (Burmeister)

1838. *Gryllus mitratus* Burmeister, *Handb. Ent.*, 2 : 34.

Material examined : Dharmapuri dist. : 7 ♂, 6 ♀, Hogenekal, along R. Chinnar, c. 225m, 17.iv.1985, Regd. No. SRS/ZSI/I/Or/83, 84, 85 ; 8 ♂, 3 ♀, Denkanikotta-Sameri, 08.iv.1985, Regd. No. SRS/ZSI/I/Or/78, 79, 80 ; 1 ♂, Hosur-Perhandipalli, c. 800m, 03.iv.1985, Regd. No. SRS/ZSI/I/Or/82 ; 1 ♂, Kottapatti : Chettigutta-Ammapeta aru, c. 330m, 26.ii.1986, Regd. No. SRS/ZSI/I/Or/133 ; 1 ♀, Shevroy Hills (Bommidi Section), c. 450m, 08.iii.1986, Regd. No. SRS/ZSI/I/Or/81 (Koshy Mathew & pty. coll.).

Distribution : Distributed widely in India including the Andaman and Nicobar Islands. Also in Sri Lanka, Nepal, Burma, Malaysia, Singapore, Indonesia, Thailand, Borneo, Indochina, Philippines, Tenasserim, China, Vietnam.

Remarks : This species was found to be abundant under stones in the bank of a *jheel* at Sameri.

4. *Teleogryllus occipitalis* (Serville)

1838. *Gryllus occipitalis* Serville, *Ins. Orthopt.*, 339.

Material examined : Dharmapuri dist. : 1 ♂, 1 ♀, Denkanikotta-Sameri, 08.iv.1985, Regd. No. SRS/ZSI/I/Or/77 ; 1 ♂, Denkanikotta-Keesan Kuppam (Thalli), 09.iv.1985, Regd. No. SRS/ZSI/I/Or/76 (Koshy Mathew pty. & coll.).

Distribution : Distributed over most Indian states. Also Bhutan, Nepal, Tibet,

Bangladesh, Sri Lanka, Malaysia, Japan, Philippines, Vietnam, Thailand, Indonesia, Borneo, Celebes.

Remarks : This is the first record of this species from Dharmapuri district and the third from Tamilnadu, the earlier ones being from Madurai and Valparai (Coimbatore district). Vasanth (*in press-2*) recorded it for the first time from Kerala.

5. *Plebeigryllus guttiventris* (Walker)

1871. *Gryllus guttiventris* Walker, *Cat. Derm. Salt. Br. Mus.*, 5, (suppl.) : 6.

Material examined : Dharmapuri Dist. : 8 ♂, 17 ♀, Hogenekal, along R. Chinnar, c. 225m, 17.iv.1985, Regd. No. SRS/ZSI/I/Or/117, 118, 121, 122, 123, 124; 1 ♂, Denkanikotta-Keesan Kuppam (Thalli), 09.iv.1985, Regd. No. SRS/ZSI/I/Or/120; 1 ♂, Anchetty Forest RH compound, c. 525m, 13.iv.1985, Regd. No. SRS/ZSI/I/Or/119; 1 ♀, Denkanikotta, Ayyur RF, c. 525m, 06.iv.1985, Regd. No. SRS/ZSI/I/Or/116 (Koshy Mathew & pty. coll.).

Distribution : Manipur, eastern India to UP south to Kerala with the absence of Andhra Pradesh. Also reported from Sri Lanka, Burma and Sudan (?).

Remarks : As far as is known at present, this species has a wider distribution in South India than in the northern, northwestern and northeastern parts of India. The present record extends its known range within Tamilnadu. Although Bhowmik (1985) included this species in his checklist of Gryllidae from the Eastern Himalaya, there is no record of it so far from that region.

6. *Platygryllus brunneri* (Saussure)

1877. *Gryllus brunneri* Saussure, *Mem. Soc. Geneve*, 25 : 170.

Material examined : Dharmapuri dist. : 1 ♂, 1 ♀, Hogenekal, along R. Chinnar, c. 225, 17.iv.1985. Regd. No. SRS/ZSI/I/Or/99; 1 ♀, Denkanikotta-Keesan Kuppam (Thalli), 09.iv.1985, Regd. No. SRS/ZSI/I/Or/101; 1 ♂, Kottapatti Forest RH compound, c. 325m, (night collection), 25.ii.1986; 1 ♂, Pudur & vicinity, c. 760m, 05.iii.1986, Regd. No. SRS/ZSI/I/Or/135.

Distribution : Limited in India to Bihar, Orissa, UP, HP, Rajasthan, MP and Tamilnadu. Also recorded from Bangladesh and Morocco.

Remarks : The present record is the third of this species from Tamilnadu, the earlier ones being from Coimbatore, and from the Javadi Hills (Vasanth, *in press-1*).

Key to the species of *Modicogryllus* from Dharmapuri district

1. Colouration blackish, with rufous or rufous-yellow legs ; head without ornamentation ; posterior emargination of epiphallus of male genitalia with a median projection *blennus* (Saussure)
- Colouration paler, without contrasting legs ; head ornamented with short yellow lines ; posterior emargination of epiphallus without median projection ... 2
2. Veins or lateral field of tegmina separated from one another and strongly curved ; epiphallus of male genitalia dorsoventrally broader apically, and ectoparameres posteriorly slender *confirmatus* (Walker)
- Veins of lateral field closer and straight ; in lateral view, epiphallus apically more slender and ectoparameres slender only at apex *ehsani* (Chopard)

7. *Modicogryllus blennus* (Saussure)

1877. *Gryllodes blennus* Saussure, *Mem. Soc. Geneve.*, 25 : 215.

Material examined : Dharmapuri dist. : 1 ♂, Bommidi, c. 440m, 08.iii.1986, Regd. No. SRS/ZSI/I/Or/147 ; 2 ♀, Bommidi, c. 440m, 11.iii.1986, Regd. No. SRS/ZSI/I/Or/158 & 159 (Koshy Mathew & pty. coll.).

Distribution : Assam (?), W. Bengal, UP, Rajasthan, Tamilnadu. Also recorded from Burma, Sri Lanka, Malaysia, Indonesia (Java), Australia, Solomon Islands.

Remarks : All the specimens studied show concave anterior margin of pronotum and completely rufous to yellow-rufous legs. Posterior tibiae of male with 5 internal and 6 external spines, those of females with 5 spines on both margins. Apical field of male tegmina with 4 regular veins. Ovipositor of females with apical valves blunt, not acute as described by Chopard (1969). Subgenital plate of male broad anteriorly, notched apically.

Although the male specimen appears to be quite definitely of the genus *Modicogryllus* Chopard, on the basis of its external features, its genitalia does not key down to this genus in Randell (1964) ; it differs in (1) having quite conspicuous transverse parameral

muscle apodeme in endoparameres, and (2) the absence of expanded parameral muscle insertion in endoparameres.

This is the second record of this species from South India, the first being from Madurai in Tamilnadu. Vasanth (1982) expressed doubts about the record of this species from Assam because he examined a female specimen in the collection of the Academy of Natural Sciences of Philadelphia (ANSP), USA, identified as *blennus* by Chopard, which he actually found to be a female of *Stephoblemmus humbertiellus* Saussure. Since Chopard (1969) mentions the repository of the specimen from Assam as ANSP, if this is the only specimen from Assam identified as *blennus* (Sauss.) in the ANSP collection, the specimen remains unknown from Assam. Hence, the query mark after 'Assam' under 'Distribution'.

8. *Modicogryllus confirmatus* (Walker)

1859. *Acheta confirmata* Walker, *Ann. Mag. nat. Hist.*, (3) 4 : 221.

Material examined : Dharmapuri dist. : 12 ♂, 1 ♀, Hogenekal, along R. Chinnar, c. 225m, 17.iv.1985, Regd. No. SRS/ZSI/I/Or/72, 104, 156 ; 1 ♀, Denkanikotta-Keesan Kuppam (Thalli), 09.iv.1985, Regd. No. SRS/ZSI/I/Or/66 ; 1 ♂, Lake near Anchetty Forest RH, c. 525m, 12.iv.1985, Regd. No. SRS/ZSI/I/Or/157 ; 3 ♀. Anchetty Forest RH, c. 525m, 10.iv.1985, Regd. No. SRS/ZSI/I/Or/154 ; 1 ♂, 2 Km. on Hogenekal-Dharmapuri Road, c. 220m, 18.iv.1985, Regd. No. SRS/ZSI/I/Or/152 ; 1 ♀, Hogenekal Forest RH, 18.iv.1985, Regd. No. SRS/ZSI/I/Or/153 ; 1 ♀, Kottapatti-Singleri and vicinity, c. 290m, 28.ii.1986, Regd. No. SRS/ZSI/I/Or/151 (Koshy Mathew & pty. coll.).

Distribution : Northeastern India west to Haryana and Rajasthan, south to Karnataka and Tamilnadu, Andaman Islands. Also known from Nepal, Bangladesh, Burma, Sri Lanka, Pakistan, Malaysia, Thailand, China and Iran.

Remarks : The earlier records of this species in Tamilnadu are from Masinagudi (Nilgiri Hills), Madurai, and Javadi Hills (Vasanth, *in press-1*).

A few of the specimens examined show a horizontal yellow band across the occiput connecting the short vertical lines. This may be distinct in some, indistinct in others,

9. *Modicogryllus ehsani* (Chopard)

1961. *Modicogryllus ehsani* Chopard, *Eos*, 37 : 273.

1969. *Gryllus ehsani*, Chopard, *Fauna Ind. Grylloidea*, 2 : 64.

Material examined : Dharmapuri dist. : 1 ♂, 6 ♀, Denkanikotta-Sameri, 08.iv.1985, Regd. No. SRS/ZSI/I/Or/105, 106, 113, 115 ; 4 ♂, 2 ♀, Hogenekal, along R. Chinnar, c. 225m, 17.iv.1985, Regd. No. SRS/ZSI/I/Or/109, 111, 112 ; 1 ♂, Anchetty Forest RH, c. 525m, 10.iv.1985, Regd. No. SRS/ZSI/I/Or/114 ; 1 ♀, Hogenekal, along R. Cauvery, c. 225m, 16.iv.1985, Regd. No. SRS/ZSI/I/Or/107 ; 1 ♂, Kottapatti-Singleri and vicinity, c. 290m, 20.ii.1986, Regd. No. SRS/ZSI/I/Or/108 ; 1 ♂, Bommidi, c. 440m, 11.ii.1986, Regd. No. SRS/ZSI/I/Or/110 (Koshy Mathew & pty. coll.).

Distribution : Very restricted distribution in India ; so far known only from Assam, Karnataka and Tamilnadu. Also recorded from Pakistan.

Remarks : One male and two female specimens examined are longer than mentioned by Chopard (1969), viz., 11.5, 11.0 and 12.0 mm respectively. In one male and female the veins in the lateral field of tegmina are more or less separated as in *M. confirmatus*.

The present record is the first of this species from Dharmapuri district, where it appears to be widely distributed.

10. *Turanogryllus maculithorax* (Chopard)

1969. *Gryllopsis maculithorax* Chopard, *Fauna Ind. Grylloidea*, 2 : 73.

Material examined : Dharmapuri dist. : 4 ♀, 1 nymph, Anchetty-Kulumuru pallam, c. 475m, 12.iv.1985, Regd. No. SRS/ZSI/I/Or/58 (Koshy Mathew & pty. coll.).

Distribution : So far confined to Karnataka and Tamilnadu in India.

Remarks : This is the first record of this species from Tamilnadu. The only other record in the country is from its type-locality in the western ghats in Karnataka.

The specimens examined have brown maxillary palpi, dark brown legs, and sometimes, 6-7 external spines on posterior tibiae.

11. *Gryllopsis furcata* (Saussure)

1877. *Grylloides furcatus* Saussure, *Mem. Soc. Geneve*, 25 : 231.

Material examined : Dharmapuri dist. : 1 ♂, Denkanikotta-Noganoor RF, c. 800m, 07.iv.1985, Regd. No. SRS/ZSI/I/Or/161 (Koshy Mathew & pty. coll.).

Distribution : Recorded so far only from MP (?), Karnataka and Tamilnadu in India. Also Burma.

Remarks : The type in Saussure's collection is from Central India. In India, this species has also been recorded from Shimoga in the western ghats and Shevroy Hills in the eastern ghats (Chopard, 1969). Its known range is now extended in South India.

The male specimen examined has the following measurements : body length 20.5 mm ; pronotal length 4 mm ; pronotal width 6.5 mm ; tegminal length 6 mm ; posterior femoral length 14 mm, posterior tibial length 8.5 mm.

12. *Grylloides sigillatus* (Walker)

1869. *Gryllus sigillatus* Walker, *Cat. Derm. Salt. Br. Mus.*, 1 : 46.

Material examined : Dharmapuri dist. : 1 ♂, Anchetty Forest RH, c. 525 m, 10.iv.1985, Regd. No. SRS/ZSI/I/Or/91 ; 1 ♂, 2 nymphs, Hogenekal, along R. Cauvery, c. 225m, 16.iv.1985, Regd. No. SRS/ZSI/I/Or/88 ; 1 ♀, Hogenekal, along R. Chinnar, c. 225m, 17.iv.1985, Regd. No. SRS/ZSI/I/Or/90 ; 1 nymph, Denkanikotta-Noganoor RF, c. 800m, 07.iv.1985, Regd. No. SRS/ZSI/I/Or/148 ; 1 ♂, Kottapatti-Singleri and vicinity, c. 290m, 28.ii.1986, Regd. No. SRS/ZSI/I/Or/91a ; 1 ♂, 1 ♀, Bommidi-Mookanur RF (south), c. 460m, 10.iii.1986, Regd. No. SRS/ZSI/I/Or/89 ; 1 ♀, Kottapatti-Vannathipaarai, R. Chinnar, c. 337 m, 25.ii.1986, Regd. No. SRS/ZSI/I/Or/92 (Koshy Mathew & pty. coll.).

Distribution : Distributed virtually throughout India and the Andaman and Nicobar Islands. Also recorded from Sri Lanka, Pakistan and Malaysia.

Remarks : Vasanth (in press-1) recorded this species from Javadi Hills in Tamilnadu. Its known range in that state is further extended by the present record.

One female specimen examined is macropterous, with tegmina 7.5 mm long, and

extending almost up to end of 5th abdominal tergite ; wings short, not extending beyond tegmina.

Although Chopard (1967) placed *G. supplicans* (Walker) as a synonym of *G. sigillatus* (Walker), Chopard (1969), which went to press earlier than the former but was published later, regarded *G. supplicans* as a separate species. It is the opinion of the present author that synonymising *supplicans* (Walker) with *sigillatus* (Walker) is justified. This is because macroptery appears to be the primary characteristic which distinguishes *supplicans* from *sigillatus*, and macropterous forms of *sigillatus* have been bred in the laboratory.

It is interesting to note that the genitalia of one male specimen from Kottapatti differs from Randell (1964) in one important feature, viz., presence of transverse parameral muscle apodeme on endoparameres. Additional differences are the absence of large U-shaped posterior emargination and a small V-shaped emargination.

13. *Cophogryllus martini* (Bolivar) ?

1899 (1900). *Cophogryllus martini* Bolivar, *Ann. Soc. ent. Fr.*, 68 : 798.

Material examined : Dharmapuri dist. : 1 ♀, Hogenekal, along R. Chinnar, c. 225m, 17.iv.1985, Regd. No. SRS/ZSI/I/Or/140 (Koshy Mathew & pty. coll.).

Distribution : India : Tamilnadu ; Sri Lanka.

Remarks : Although the specimen examined agrees reasonable well with Chopard's (1969) description, its shorter ovipositor (9mm), as compared with the length (12.5mm) given by Chopard (op. cit.) is remarkable.

C. martini is so far known to be restricted to Tamilnadu and Sri Lanka. The present specimen is the northernmost record for the species.

Key to the species of *Velarifictorus* from Dharmapuri district

Lateral ocelli connected by transverse yellow band ; face of male highly concave ;
mandibles of male greatly elongated and excavated ; postero-median projection of
epiphallus of male genitalia not deeply notched ... *aspersus* (Walker)

Lateral ocelli not connected by a band; face of male not concave; mandibles of male neither greatly elongated nor excavated; postero-median projection of epiphallus deeply notched to form two lobes ... *fallax* (Chopard)

14. *Velarifictorus aspersus* (Walker)

1869. *Gryllus aspersus* Walker, *Cat. Derm. Salt. Br. Mus.*, 1 : 39.

Material examined : Dharmapuri dist. : 1 ♂, Pudur & vicinity (Chitteri Hills), c. 760 m, 05.iii.1986, Regd. No. SRS/ZSI/I/Or/160 (Koshy Mathew & pty. coll.).

Distribution : Arunachal Pradesh and Meghalaya in Northeast India, W. Bengal, UP, Jammu & Kashmir, Maharashtra and South India. Also recorded from Sri Lanka, Burma, Malaysia, Singapore, Indonesia (Java), Borneo, Annam, Hong Kong, China.

Remarks : Chopard (1969) has mistakenly included Valparai in Karnataka state (erstwhile Mysore state) in the 'Range' of the present species. In fact, Valparai is in the state of Tamilnadu. This is the reason for Vasanth's (in press-1) mistaken opinion that his was the first record of this species from Tamilnadu (viz., Javadi Hills). Vasanth (1982) had earlier recorded it for the first time from Arunachal Pradesh. Further, the first report from Kerala was by Vasanth (in press-2). The present record is an extension of its range in Tamilnadu. Interestingly in that state the records of this species, so far, have only been from hilly regions.

15. *Velarifictorus fallax* (Chopard)

1969. *Scapsipedus fallax* Chopard, *Fauna Ind. Grylloidea*, 2 : 117.

Material examined : Dharmapuri dist. : 1 ♂, Kottapatti Forest RH compound, c. 325m (night collection), 25.ii.1986, Regd. No. SRS/ZSI/I/Or/162 (Koshy Mathew & pty. coll.).

Distribution : Restricted the following states in South India : Karnataka, Kerala, Tamilnadu.

Remarks : The tegmina of the specimen extend up to the 7th abdominal tergite.

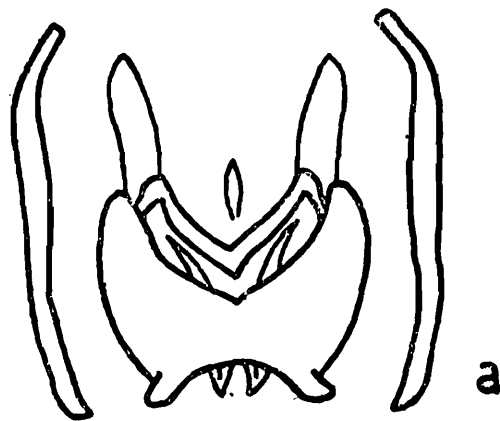
The present record from Tamilnadu is the first from that state.

16. *Loxoblemmus cavifrons* Chopard

(Fig. 1)

1928. *Loxoblemmus cavifrons* Chopard, *Rec. Ind. Mus.*, 30 : 20.

Material examined: Dharmapuri dist. : 1 ♂, Denkanikotta-Noganoor RF, c. 800m, 07.iv.1985, Regd. No. SRS/ZSI/I/Or/138 (Koshy Mathew & pty. coll.).



0.5 mm

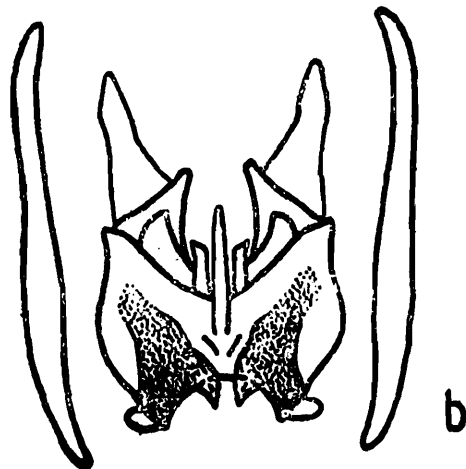


Fig. 1

Fig. 1 : Genitalia of the male of *Loxoblemmus cavifrons*.

a. Front view ; b. Back view.

Distribution : India : Pondicherry (type-locality), Tamilnadu.

Remarks : Since its description in 1928 this species is, so far, known only

from the type locality—Pondicherry. The specimen before the present author is the second record of the species, and the first from Tamilnadu.

Chopard (1928, 1969) has given only the body length as 8.5mm. The measurements of the specimen examined are as follows: Body 9 mm; pronotum 1.3mm; width of pronotum 2 mm; tegmina 4.2 mm; posterior femur 5 mm; posterior tibia 3 mm.

The genitalia of the male is figured here for the first time.

17. *Coiblemmus compactus* (Chopard)

1928. *Homaloblemmus compactus* Chopard, *Spol. Zeyl.*, 14 : 201.

Material examined: Dharmapuri dist. : 2 ♂, Hosur Cattle Farm campus, c. 860m, 04.iv.1985, Regd. No. SRS/ZSI/I/Or/28, 128, ; 1 ♂, 2 ♀, 1 nymph, Denkanikotta-Noganoor RF, c. 800m, 07.iv.1985, Regd. No. SRS/ZSI/I/Or/129; 1 ♂, Denkanikotta-Sameri, 08.iv.1985, Regd. No. SRS/ZSI/I/Or/134 (Koshy Mathew & pty. coll.).

Distribution: Limited to South India: Karnataka and Tamilnadu. Also Sri Lanka.

Remarks: The specimens were of smaller size (13-15 mm) than given by Chopard (1969).

This species, the only one described in the genus *Coiblemmus*, also has restricted range within India, like the previous species.

II. Subfamily : NEMOBIINAE

Key to Genera of subfamily Nemobiinae from Dharmapuri district

Tegminal venation different in the sexes, with males showing well-developed mirror; posterior legs shorter in relation to body size ... *Pteronemobius* Jacobson & Bianchi

Tegminal venation similar in the sexes, that of male without mirror; posterior legs longer in relation to body size ... *Paranemobius* Saussure

Key to species of *Pteronemobius* from Dharmapuri district

1. Posterior femora presenting blackish bands 2
 — Posterior femora without blackish bands 3
2. Maxillary palpi with 4th and 5th segments white, contrasting with other dark segments; posterior tibia of male with 4 internal spines, that of female with 3; epiphallus of male genitalia postero-medially not notched ... *fascipes* (Walker)
 — Maxillary palpi dull yellowish; posterior tibia of both sexes with 4 spines on internal margin; epiphallus postero-medially notched ... *csikii* (Bolivar)
3. Body of uniform colouration; posterior tibia of both sexes with 4 spines on each margin *concolor* (Walker)
 — Colour of tegmina yellowish, contrasting with dark head; posterior tibia of male with 3 external, 4 internal spines; that of female with 3 spines on each margin *bicolor* (Saussure)

18. *Pteronemobius concolor* (Walker)

1871. *Eneoptera concolor* Walker, *Cat. Derm. Salt. Br. Mus.*, 5 (suppl.): 10.

Material examined: Dharmapuri dist.: 1 ♀, Sitteri Forest RH (on ceiling), c. 920m, 03.iii.1986, Regd. No. SRS/ZZI/I/Or/64; 1 ♂, 1 ♀, Hosur-Muniyamma bridge (Teertham), c. 700m, 04.iv.1985; 1 ♂, Kottapatti Forest RH compound, c. 325 m, (night collection), 26.ii.1986, Regd. No. SRS/ZSI/I/Or/65 (Koshy Mathew & pty. coll.).

Distribution: Distributed over much of India and the Great Nicobar Island. Also Burma, Sri Lanka and Malaysia.

Remarks: A fairly common species but so far known in Tamilnadu from only one locality, viz., Coimbatore.

19. *Pteronemobius fascipes* (Walker)

1869. *Eneoptera fascipes* Walker, *Cat. Derm. Salt. Br. Mus.*, 1: 67.

Material examined: Dharmapuri dist.: 2 ♀, Perhandipalli, c. 800 m, 03.iv.1985,

Regd. No. SRS/ZSI/I/Or/61 ; 1 ♂, 1 ♀, Hosur-Muniyamma bridge (Teertham), c. 700 m, 04.iv.1985, Regd. No. SRS/ZSI/I/Or/60 ; 1 ♂, 1 ♀, Hogenekal, along R. Chinnar, c. 225 m, 17.iv.1985, Regd. No. SRS/ZSI/I/Or/59 ; 1 ♂, Kottapatti-Chettigutta, Ammapeta aru, c. 330 m, 26.ii.1986, Regd. No. SRS/ZSI/I/Or/126 ; 1 ♂, 4 ♀, Sitteri, around Thombakkal river, c. 760 m, 02.iii.1986, Regd. No. SRS/ZSI/I/Or/74 ; 1 nymph, Sitteri-Harur Road-around Maamarathu odai, c. 430-620 m, 04.iii.1986, Regd. No. SRS/ZSI/I/Or/150 (Koshy Mathew & pty. coll.).

Distribution : Distributed over much of the Indian mainland. Also Burma, Sri Lanka, Malaysia, Singapore, Indonesia (Java), China, Formosa and Philippines.

Remarks : A very widely distributed species. The previous records in Tamilnadu are from Tindivanam and Tiruchirapalli (Chopard, 1969), and the Javadi Hills (Vasanth, *in press-1*).

20. *Pteronemobius csikii* (Bolivar)

1901. *Nemobius csikii* Bolivar, *Zichy. Zool. Ergebn.* 2 : 243.

Material examined : Dharmapuri dist. : 2 ♂, 3 ♀, Kottapatti-Vannathipaarai, R. Chinnar, c. 335 m, 25.ii.1986, Regd. No. SRS/ZSI/I/Or/69 ; 1 ♂, 6 ♀, Kottapatti Forest RH compound, c. 325 m, (night collection), 25.ii.1986, Regd. No. SRS/ZSI/I/Or/125 ; 1 ♀, Kottapatti-Singleri & around, c. 290m, 28.ii.1986, Regd. No. SRS/ZSI/I/Or/71 ; 1 ♀, Sitteri, around R. Thombakkal, c. 760 m, 02.iii.1986, Regd. No. SRS/ZSI/I/Or/73 (Koshy Mathew & pty. coll.).

Distribution : Arunachal Pradesh and Assam, Bihar to Haryana and Rajasthan, and Karnataka and Tamilnadu. Also Sri Lanka, Burma, China, Siberia.

Remarks : This species, which is likely to be confused with *fascipes* (Walker) because of its similar colouration, was seen in substantial numbers on the sandy banks of the R. Chinnar at Vannathipaarai.

21. *Pteronemobius bicolor* (Saussure)

1877. *Nemobius bicolor* Saussure, *Mem. Soc. Geneve*, 25 : 98.

Material examined : Dharmapuri dist. : 1 ♀, Kottapatti Forest RH compound,

at 325 m, (night collection), 25.ii.1986, Regd. No. SRS/ZSI/I/Or/62 (Koshy Mathew & pty. coll.).

Distribution : India : W. Bengal, Bihar, MP, Karnataka, Tamilnadu. Also Burma, Sri Lanka and Thailand.

Remarks : The distribution of this species, as currently known, is rather patchy, with wide gaps in the northern, northeastern and western parts of India. There are only three records from Tamilnadu, including the present one from Dharmapuri district ; the other two are from Coimbatore and Tiruchirapalli.

The tegmina of the specimen show 2 or 3 large cells towards the rounded apex.

22. *Paranemobius pictus* (Saussure)

1877. *Paranemobius pictus* Saussure, *Mem. Soc. Geneve*, 25 : 67.

Material examined : Dharmapuri dist. : 1 ♂, 1 ♀, Anchetty RF—Todehalla river, c. 500 m, 11.iv.1895, Regd. No. SRS/ZSI/I/Or/127 ; 4 ♂, 2 ♀, 7 nymphs, Doddahalla river, south of Anchetty, c. 500 m, 14.iv.1985 (Koshy Mathew & pty. coll.).

Distribution : India : Bihar, Karnataka, Kashmir, Kerala, MP, Maharashtra. Also Sri Lanka.

Remarks : The present record extends the known range of this species within Tamilnadu,

III. Subfamily : PHALANGOPSINAE

23. *Arachnomimus annulicornis* Chopard

1936. *Arachnomimus annulicornis* Chopard, *Ceyl. J. Sc. (B)* 20 : 67.

Material examined : Dharmapuri dist. : 2 ♂ ♀ nymphs, Sitteri Forest RH (on ceiling), c. 920 m, 03.iii.1986, Regd. No. SRS/ZSI/I/Or/139 (Koshy Mathew & pty. coll.).

Distribution : Restricted to Tamilnadu. Also known from Sri Lanka,

Remarks : This species is reported here for the first time from India, the earlier record being from Sri Lanka. The only other species of the genus *Arachnomimus* known so far from Tamilnadu is *A. lepidus* Chopard. Further, *A. nietneri* (Saussure) is known from Kerala and W. Bengal.

IV. Subfamily : OECANTHINAE

24. *Oecanthus indicus* Saussure

1878. *Oecanthus indicus* Saussure, *Mem. Soc. Geneve*, 25 : 454.

Material examined : Dharmapuri dist. : 1 ♀, Kottapatti-Vannathipaarai, R. Chinnar, c. 335, 25.ii.1986, Regd. No. SRS/ZSI/I/Or/141; 1 ♀, Pudur & vicinity (Chitteri Hills) c. 760 m, 05.iii.1986, Regd. No. SRS/ZSI/I/Or/145; 1 ♀, Bommidi, c. 440 m, 11.iii.1986, Regd. No. SRS/ZSI/I/146 (Koshy Mathew & pty. coll).

Distribution : Eastern, northeastern and central India and parts of South India. Also Sri Lanka, Philippines, China and Japan.

Remarks : The known distributional range of this species in Tamilnadu is extended to the Dharmapuri district. Previous records are from coimbatore, Nilgiri Hills, Palni Hills (Kodaikanal), and the Javadi Hills (Vasanth, *in press-1*).

V. Subfamily : TRIGONIDIINAE

Key to genera of subfamily Trigonidiinae from Dharmapuri district

1. Tegmina quite different in the sexes, that of male always showing distinct mirror and anal field ; no finely striated appearance 2
- Tegmina quite similar in the two sexes, showing a finely striated appearance *Trigonidium* Rambur
2. Tegmina of female with false veins between principal veins ; pronotum rounded in front *Homoeoxipha* Saussure
- Tegmina of female without false veins ; pronotum not rounded in front, only a little convex *Anaxipha* Saussure

25. *Homoeoxipha lycoides* (Walker)

1869. *Phyllopalpus lycoides* Walker, *Cat. Derm. Salt. Br. Mus.*, 1: 71.

Material examined : Dharmapuri dist. : 1 ♀, Kottapatti-Chettigutta, Ammapeta aru, c. 330m, 26.ii.1986, Regd. No. SRS/ZSI/I/Or/63 (Koshy Mathew & pty. coll.).

Distribution : Northeastern, eastern and northern India west up to UP ; Karnataka and Tamilnadu in the south ; Andaman Islands. Also Sri Lanka, Burma, Bangladesh, Singapore, Malaysia, Formosa, China, Australia.

Remarks : The known distributional range of this species in Tamilnadu is extended to Dharmapuri district.

26. *Anaxipha longipennis* (Serville)

1839. *Trigonidium longipenne* Serville, *Ins. Orthopt.*, 351.

Material examined : Dharmapuri dist. : 1 ♀, Anchetty Forest RH, c. 525 m, 10.iv.1985, Regd. No. SRS/ZSI/I/Or/147 (Koshy Mathew & pty. coll.).

Distribution : Parts of northeastern and eastern India, and Karnataka and Tamilnadu in the south ; Andaman Islands ; Also recorded from Sri Lanka, Malaysia, Burma ; Mauritius, East Africa, Australia.

Remarks : This species was known in Tamilnadu from Coimbatore only, until Vasanth (in *press-1*) recorded it from the Javadi Hills.

Key to species of *Trigonidium* from Dharmapuri district

- | | | | |
|---|-----|-----|--------------------------------|
| Tegmina more convex ; wings not extending beyond tegmina ; anterior tibiae not perforated | ... | ... | <i>cicindeloides</i> Rambur |
| Tegmina longer and less convex ; wings long, extending well beyond tegmina ; anterior tibiae perforated | ... | ... | <i>humbertianum</i> (Saussure) |

27. *Trigonidium cicinideloides* Rambur

1839. *Trigonidium cicinideloides* Rambur, *Faune Andalous.*, 2 : 39.

Material examined : Dharmapuri dist. : 1 ♂, Lake near Anchetty Forest RH, c. 525 m, 12.iv.1985, Regd. No. SRS/ZSI/I/Or/136 ; 2 ♂, Sitteri-Harur Road, around Maamarathu Odai, c. 430-620 m, 04.iii.1986 (Koshy Mathew & pty. coll.).

Distribution : Northeastern and eastern India, HP, western India, and Karnataka and Tamilnadu in South India, and the Andaman Islands. Also recorded from Sri Lanka, Nepal, Burma, Malaysia ; widely distributed from South Europe to South Asia and all over Africa.

28. *Trigonidium humbertianum* (Saussure)

1878. *Homoeoxiphus humbertianum* Saussure, *Mem. Soc. Geneve*, 25 : 468.

Material examined : Dharmapuri dist. : 2 ♂, 2 ♀, Sitteri—around R. Thomabakkal, c. 760 m, 02.iii.1986, Regd. No. SRS/ZSI/I/Or/70 ; 2 ♀, Kottapatti Forest RH compound, c. 325 m, (night collection), 26.ii.1986 ; 1 ♀, Sitteri, c. 920 m, 04.ii.1986, Regd. No. SRS/ZSI/I/Or/132 ; 1 ♂, 1 ♀, Bommidi-Mookanur RF (north), c. 420 m, 09.iii.1986, Regd. No. SRS/ZSI/I/OR/131 (Koshy Mathew & pty. coll.).

Distribution : Widely distributed over much of the Indian mainland. Also known from Sri Lanka, Malaysia, Iran, Africa ; widely distributed in the Oriental Region.

Remarks : There is a difference of opinion among gryllid taxonomists regarding the actual status of this species (Vasanth, 1982).

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The author is thankful to the Director, Zoological Survey of India, Calcutta, for giving him an opportunity to carry out this work. He is grateful to Dr. R. S. Pillai, Joint-Director (Retd.) and former Officer-in-Charge, Southern Regional Station, Zoological Survey of India, Madras, for permitting him to participate in both the survey tours to Dharmapuri district. He is also indebted to Dr. Koshy Mathew, Scientist 'SD' (Retd.), Leader, and other members of the survey teams for their help in various ways. The

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**NEW RECORDS OF SCORPIONS (SCORPIONIDA : VAEJOVIDAE
AND CHAERILIDAE) FROM MEGHALAYA, INDIA**

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Calcutta.*

INTRODUCTION

The study of Scorpions from Meghalaya reveals the occurrence of five species of Scorpions of which two are new records from this area.

Order : SCORPIONIDA

Family : VAEJOVIDAE

Scorpiops (Scorpiops) hardwickii Gervais

Material : 3 ♂ (2 Juv.) ; 5 ♂ (Juv.) Khasi Hills, Dist. Khasi ; 20. IX. 1928 ; H. S. Pruthi (Reg. No. 5398/18)

Measurements (in mm.) : Total length 37.6 ; Carapace 5 ; Mesosoma 20 ; Metasoma 12.6.

Distribution : India : Khasi Hills, Meghalaya ; Kashmir ; Uttar Pradesh ;

Remarks : This species is usually found under rocks and has been reported for the first time from Meghalaya.

Family : CHAERILIDAE

Chaerilus gemmifer Pocock

Material : 1 ♀ Nonhyllam village, Khasi Hills, Dist. Khasi, 11.XII. 1977 ; K. R. Rao (Reg. No. 5399/18).

Measurements (in mm.) : Total length 40.3 ; Carapace 6 ; Mesosoma 16.8 ; Metasoma 23.9.

Distribution : India : Khasi Hills, Meghalaya ; West Bengal. Elsewhere : Sylhet, Bangladesh,

Remarks : This species has so far been recorded from very limited areas of North East India. Vast areas of India have remained still unsurveyed. The author is of the view that more extensive surveys will further extend the range of distribution of this Scorpion.

ACKNOWLEDGEMENT

I am thankful to the Director, Zoological Survey of India for assigning me the project—"The study of Scorpions from Meghalaya" and to Dr. S. K. Bhattacharyya, Scientist-SF for his encouragement. Thanks are also due to Dr. S. K. Gupta, Scientist-SE and Dr. B. K. Biswas, Scientist-E for their help in various ways.

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**CENTIPEDE FAUNA OF CORBETT NATIONAL PARK, UTTAR PRADESH, INDIA
(CHILOPODA : SCOLOPENDROMORPHA : SCOLOPENDRIDAE)**

VINOD KHANNA

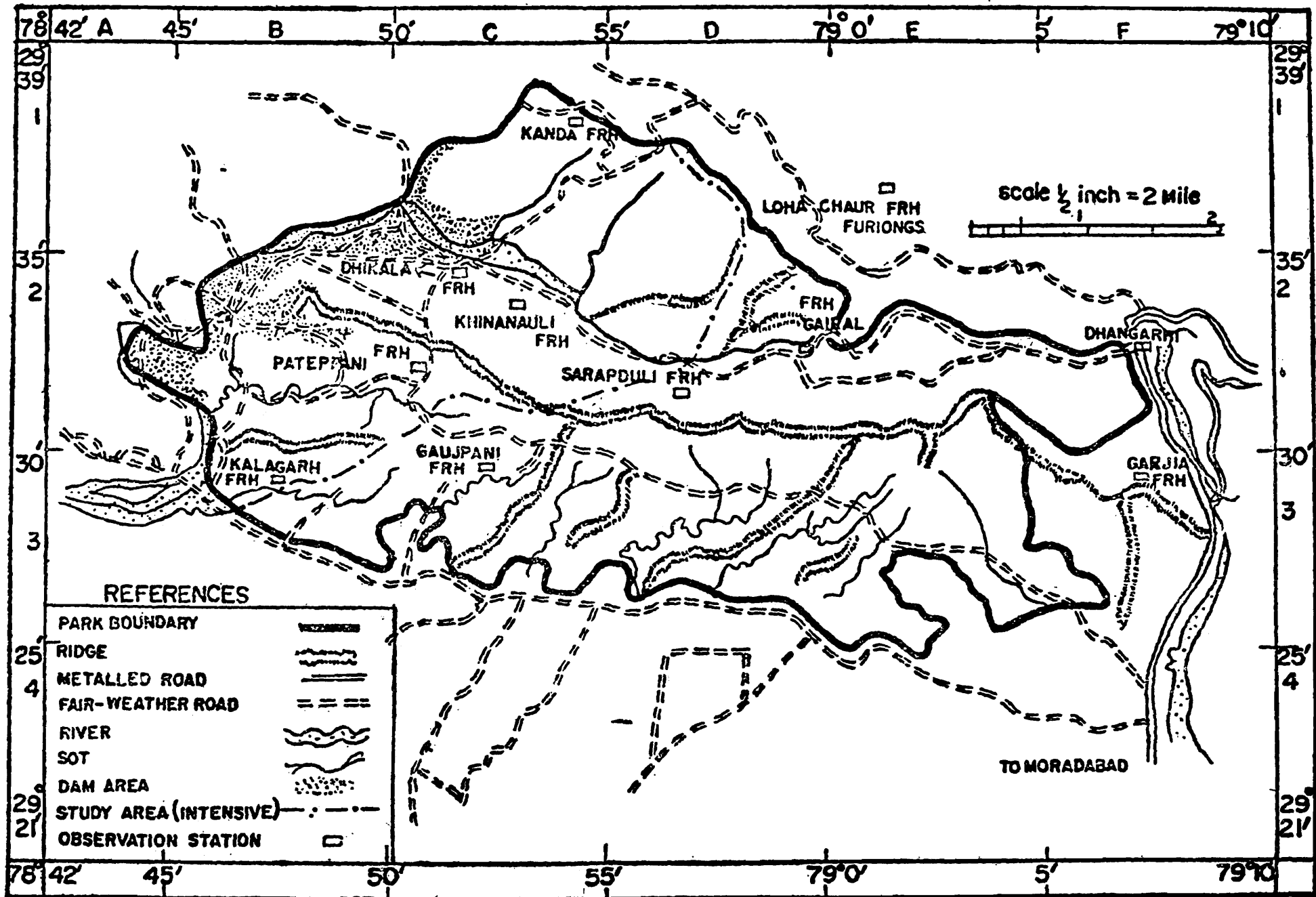
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INTRODUCTION

The centipede fauna of India, in general and of Western Himalaya in particular had received very little attention till very recently when Khanna and Kumar (1984), Khanna and Tripathi (1985a, 1985b and 1986) and Khanna (1987) made some useful contributions in the field of taxonomy and ecology. Khanna (1995 and in press) have also inventorised the species of scolopendrid centipedes from other Conservation Areas of U. P. State, like Rajaji National Park and Nanda Devi Biosphere Reserve. Present communication is one more such step in the inventorisation of the fauna of Conservation Areas. Jangi and Dass (1984) have, however, reported and described as many as 48 species from Peninsular States (i. e., Tamilnadu, Kerala, Karnataka, Andhra Pradesh, Orissa and Madhya Pradesh and Maharashtra).

Khanna (1987) has updated the check-list of the Indian species of scolopendrid centipedes provided earlier by Khanna and Kumar (1984) and has reported 86 species, including subspecies, from India, spreading over three tribes (Scolopendrini, Asanadini, and Otostigimini) and seven genera (viz., *Scolopendra*, *Cormocephalus*, *Asanada*, *Otostigmus*, *Rhysida*, *Ethmostigmus* and *Digitipes*). The genera *Trachycormocephalus* and *Arthrorhabdus* have now come to be designated as junior synonyms of the genus *Scolopendra* Linn. (Lewis, 1986) and the genus *Pseudocryptops* as the junior synonym of the genus *Asanada* (Jangi and Dass, 1978). Of these 86 forms, 24 species belonging to five genera are recorded from Uttar Pradesh, of which 11 species referable to four genera are reported from Corbett National Park, in the present paper.

MAP OF THE STUDY AREA: THE CORBETT NATIONAL PARK



CORBETT NATIONAL PARK—A Brief Account

Corbett National Park, the first National Park ever created in the state of Uttar Pradesh, was demarcated under "United Provinces National Park Act 1934", comprising an area of 99.07 sq. miles in the hills of outer Himalaya in the famous Patli Dun and the hill forests to the south of it. Today the Park covers an area of about 520 sq. kms between 29°13' to 29°35' N. Lat., 78°33' to 78°46' E. Long., spreading over Nainital and Pauri districts of Western Himalaya, U. P.

The Corbett National Park promises to be a wealth of experience for the Wildlife enthusiasts, ornithologists and botanists alike.

The natural forest of the Park is confined to Bhabar Tract of Shivalik formations at an altitude of 400-1200m above MSL., with varied topography of many marshy depressions, ravines and plateau land. The river Ram Ganga runs right through the Park. Another major source of water is the reservoir formed by the Ram Ganga Multipurpose Hydro-electric Project at Kolagarh.

There are three distinct seasons in the Park. The temperature ranges from 3°C in December to 42°C in June, a maximum winter temperature rarely exceeding 30°C and the minimum summer temperature normally remaining above 23°C. The rainfall occurs from mid June to September with maximum in the month of August. The North-east monsoon ushers in another wet spell in December to February receiving the maximum of winter rains. November is the driest month with minimal rainfall. Because of the park being located at the forested hills of outer Himalaya, it remains adequately humid throughout the year.

Flora, in which the Park abounds, is of the most abundantly growing *Sal* (*Shorea robusta*), *Shishum* (*Delbergia sissoo*), *Katha* (*Acacia catechu*) and Bamboo, besides various varieties of trees, bushes, ferns and other herbs like elephant grass, etc.

The centipede fauna of Corbett National Park resembles with that of overall Western Himalaya, U. P. but differs considerably from the adjoining 'Terai Tract' fauna in Uttar Pradesh.

SYSTEMATIC ACCOUNT

- Class : CHILOPODA
 Order : SCOLOPENDROMORPHA
 Family : SCOLOPENDRIDAE
 Subfamily : SCOLOPENDRINAE
 Tribe : SCOLOPENDRINI

1. *Cormocephalus dentipes* Pocock, 1891

1891. *Cormocephalus dentipes* Pocock, *Ann. nat. Hist., Ser. 6/7* : 66/67.

Type Locality : India, Bengal.

Material examined : Dhikala, 3.iii.1973, 2 exs., (Reg. No. NRS. A-4192); 2.xii.1971, 1 ex. (A-4022); 3.iii.1973, 1 ex. (A-4199); 28.vi.1971, 4 exs. (A-4233); 3.iii.1973, 3 exs. (A-4234), all Asket Singh coll.; 13.viii.1975, 5 exs., R.N. Chopra coll. (A-4232); Boxar, 22.i.1971, 1 ex., J. C. Tripathi coll. (A-4206); Sarapduli, 29.1.1971, 1 ex. (A-4207); 1.xii.1972, 1 ex. (A-4238), all J. C. Tripathi coll.; Bijrani, 22.xi.1972, 5 exs. (A-4212); 23.xi.1972, 7 exs. (A-4204). 19.xi.1972, 1 ex. (A-4223), all J. C. Tripathi coll.; Malani, 29.i.1971, 7 exs., J. C. Tripathi coll. (A-4205); 17.iii.1970, 2 exs., Asket Singh coll. (A-4208); Amdanda, 24.ii.1973, 28 exs. Asket Singh coll. (A-4225); Paterpani, 25.i.1971, 4 exs., J. C. Tripathi coll. (A-4227).

Remarks : *Cormocephalus dentipes* Pocock recorded from Parasnath (Bihar) by Gravely (1910) was redescribed by Jangi and Dass (1980) and compared with the specimens collected from Delhi, proposing earlier certain sexually dimorphic characters (Jangi and Dass, 1975). Ahmed (1980) reported it from Andaman Isls. Khanna and Tripathi (1984 b and 1985) reported it to be a widely distributed species occurring throughout Uttar Pradesh. Jangi and Dass (1984) reported it from Madhya Pradesh and Orissa. Khanna and Tripathi (1984b) have, however, discussed seasonal incidence in this species in Western Himalaya, U. P. Khanna (1987 and 1995) does not agree to the so called, "sexually dimorphic characters", proposed by Jangi and Dass (l. c.) on the basis of the material studied. There is a tremendous amount of overlapping of the characters that Jangi and Dass (l. c.) describe as males or females. It is also difficult to sex the juvenile specimen as also suggested by Jangi and Dass (l. c.) themselves.

2. *Scolopendra morsitans* Linn. 1758

1758. *Scolopendra morsitans* Linnaeus, *Syst. nat.*, Ed. 10 : 638.

Material examined : Sarapduli, 1.iv.1973, 2 exs., R. N. Chopra coll. (A-4160) ; 3.xi.1972, 2 exs., (A-4168) ; 26.i.1971, 1 ex. (A-4178), all J. C. Tripathi coll. ; Dhikala, 13.viii.1975, 1 ex., R. N. Chopra coll. (A-4176) ; 3.iii.1973, 2 exs., Asket Singh coll. (A-4187) ; Kanda, 13.xii.1970, 1 ex., Asket Singh coll. (A-4186).

Remarks : *Scolopendra morsitans* Linn. is a cosmopolitan species occurring throughout the year in all types of ecological habitats. It is morphologically very much a variable species occurring in various colour forms and sizes and has, therefore, been described by various authors under different specific and subspecific names, which they gave to the specimens in various stages of development. Khanna (1987) has redescribed the species, incorporating the variations noticed by various authors, as also in the material collected from Western Himalaya, U. P.

Tribe : OTOSTIGMINI

Subfamily : OTOSTIGMINAE

3. *Otostigmus amballae* Chamberlin, 1913

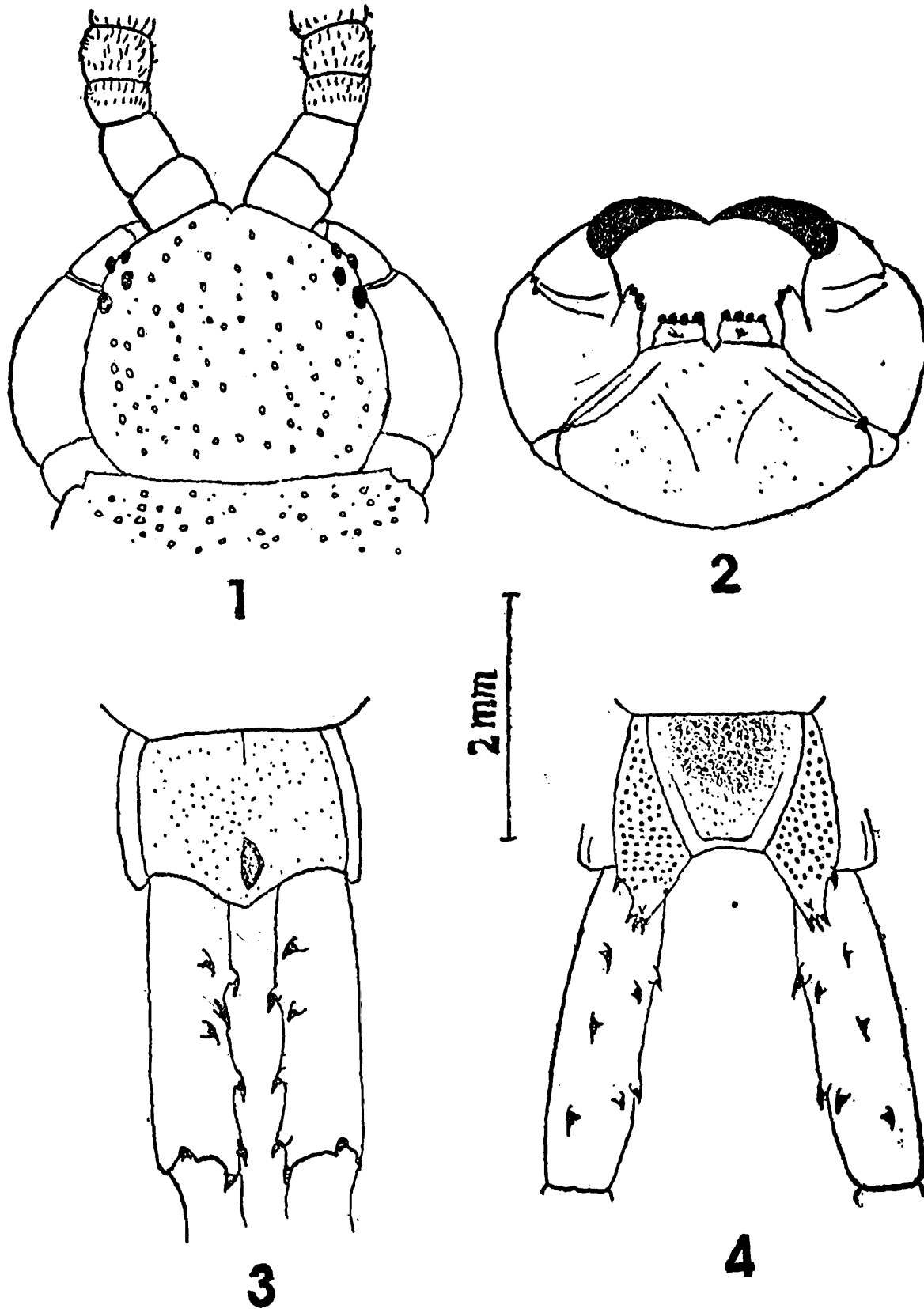
(Fig. 1-4)

1913. *Otostigmus amballae* Chamberlin, *Ent. News. Philad.*, 24 : 74.

Type Locality : India : Ambala (Haryana).

Material examined : Dhikala, 6.iii.1970, 11 exs., Asket Singh coll. (A-4026 and A-4339) ; Ramnagar, 26.ix.1978, 3 exs., Arun Kumar coll. (A-4338).

Remarks : Like *Cormocephalus dentipes* Pocock, this species is also fairly abundant in Western Himalaya, U. P. and H. P. (Khanna and Kumar, 1984 and Khanna and Tripathi, 1986). Also like *C. dentipes* and *S. morsitans* this species too exhibit a great degree of morphological variations within the same population. The data on the intra-specific variations have been recorded by the author [by studying the] huge collection from Western Himalaya, U. P. On the basis of which the species has been redescribed and illustrated here, incorporating the important ranges of variations of



Otostigmus amballae (Figs. 1-4)

1. Head (Dorsal view); 2. Coxosternum; 3. Endtergite with anal leg prefemur (Dorsal view);
4. Endsternite with coxopleurae and anal prefemur.

morphological characters so as to eliminate the taxonomic anarchy within the same or different populations.

Description : *Colour :* Antennae, head and 1st Tergite dark olive green ; rest of the tergal segments including anal legs light olive green ; coxosternum and anterior 2 to 3 segments of the sternites olive to yellowish green ; rest of the sternal segments and legs yellowish green. *Antennae :* 17-19 segmented (in two samples 20 and in one case 16 on the right and 17 on the left) ; the average no. of antennal segments is 18 ; with 2-1/4 to 2-2/3 basal segments glabrous. Apical eight segments dark olive green and basal light yellowish green with a clearcut demarcation of the colour. Reflexed antennae reaching the middle of the 5th segment. *Head :* Cephalic plate sparsely punctate, bearing anteriorly a short median groove ; head shield dome shaped, almost equal in length and width, distinctly overlapped by the 1st tergite (fig. 1). *Tergites :* Sparsely punctate, non-granulate with complete paramedian longitudinal furrows beginning from the middle of the 3rd segment ; in couple of the specimens studied the furrows are complete on 2-19 or 20th segment also ; the lateral emargination of tergites begins as early as from 6th segment ; endtergite shield shaped, broader than long with its posterior margins curving in on their sides and meeting posteriorly in a round bulge ; endtergite also with a median depression at the posterior end and a very small furrow (fig. 3) anteriorly also [in contrast to Attems (1930)] wherein the position of depression has been described anterior and furrow posterior]. *Sternites :* Sparsely punctate and granulate in the posterior segments ; 2-19 segments with a pair of complete paramedian longitudinal furrows (variations, 3-19 or 2-20) ; additionally an intermittently broken median sulcus on segment 3-19 is also visible ; endsternite also sparsely punctate (fig. 4) without furrows, tapering posteriorly with its posterior margin incurved, slightly longer than wide. *Coxopleura :* Densely punctate process of the coxopleura almost a third of its length extending behind endsternite, tipped with 4+4 spines on average, alongwith a spine on its lateral margins (variations : 3+3, 3+2, 3+1 or 4+2). The size of the puncts predominantly (fig. 4) large. *Legs :* 1-2, 1-3, 1-4, 1-5, 1-6, 1-7 or 1-8 pair of legs with two spurs to the first tarsal segment ; 21st pair of legs without such spurs ; all legs with 2 spurs to the claws. *Anal legs :* Prefemur of the anal legs nearly 4 times longer than wide with 4-2-3-3 thorns arranged in four rows ; prefemoral process present fig. 3, 4).

The species earlier recorded from Ambala (Haryana) by Chamberlin (1913), was first recorded from Uttar Pradesh by Khanna and Kumar (1984) and later by Khanna and Tripathi (1986) from Himachal Pradesh.

4. *Otostigmus nudus* Pocock, 1890

1890. *Otostigma nudum* Pocock, *Ann. nat. Hist. Ser.*, (6) 5 : 247.

Type Locality : India, Madras (Tamil Nadu).

Material examined : Dhikala, 3.iii.1973, 1 ex., Asket Singh coll. (A-4330).

Remarks : Reported earlier to occur in Madras (Tamil Nadu) by Attems (1930) and Himachal Pradesh by Khanna and Tripathi (1986) this is the first record of the species from Uttar Pradesh from within the perimeter of Corbett National Park.

5. *Rhysida afra cuprea* Kraepelin, 1903

1903. *Rhysida cuprea* Kraepelin, *Mitt. Mus.*, Hamburg, 20 : 153-154.

Type Locality : Bhutan.

Material examined : Dhikala, 3 iii.1973, 1 ex., Asket Singh coll. (A-4323).

Remarks : The species was described by Kraepelin (l. c.) from Southern slopes of Bhutan Himalaya as *R. cuprea*. Attems (1930) relegated it to the subspecies of *R. afra* (Peters). Gravely (1912) recorded it from West Bengal and Assam. Khanna and Kumar (1984) have already reported this species to occur in Western Himalaya, U. P.

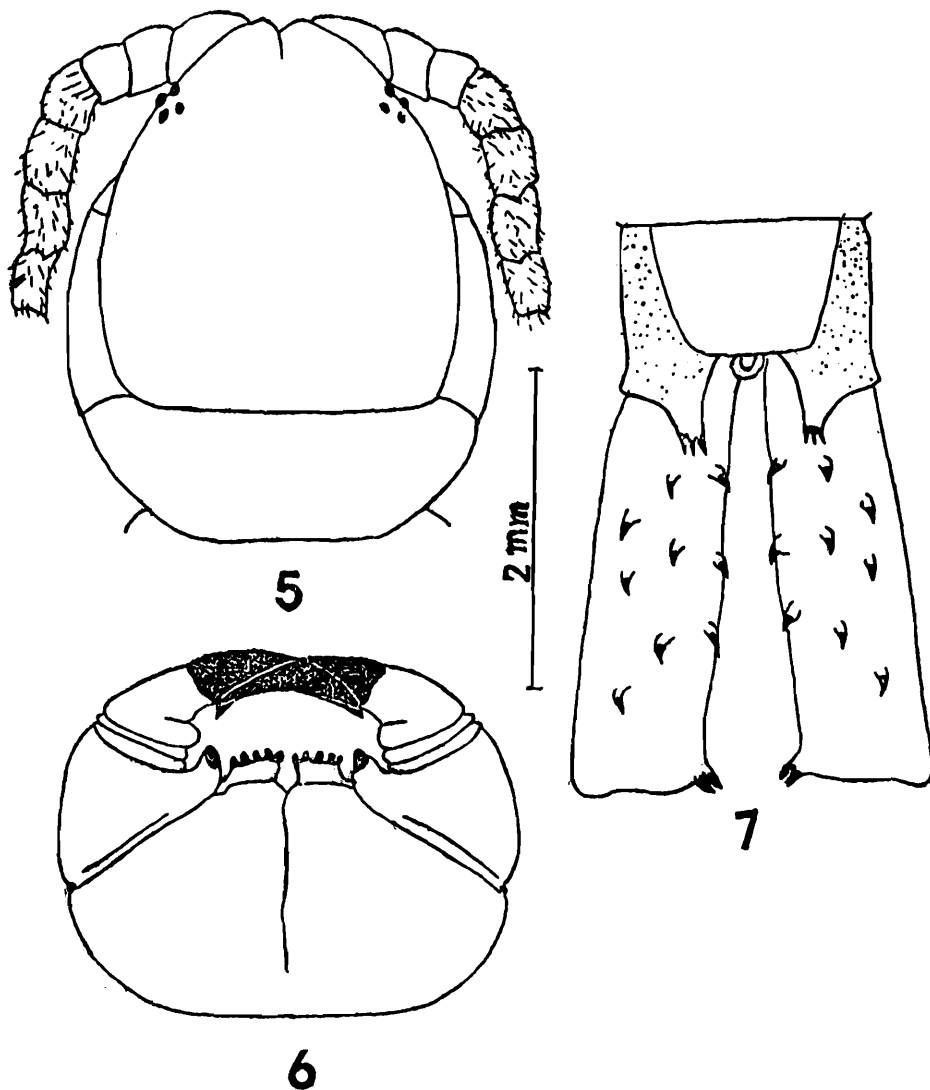
6. *Rhysida corbetti* sp. nov.

(Figs. 5-7)

Material examined : Sarapduli, 26.i.1971, 6 exs., J. C. Tripathi coll. (A-4292 ; Holotype and A-4293 ; Paratypes) ; Dhikala, 29.1.1972, 3 exs., Asket Singh coll, (A-4294, Paratypes).

Description : *Colour* : The colour of the animal completely decolourised due to long preservation. *Antennae* : 18 segmented with its 3 basal segments glabrous (fig. 5) ; reflexed antennae reaching to the middle of 3rd tergite. *Head* : Cephalic plate smooth, longer than wide with an anterior median groove (fig. 5). *Coxosternum* : Dental plate of the coxosternum with 5+5 separate teeth, without post-dental spur ; prefemoral process of the coxosternum unidentate ; base of the dental plate smooth but with a median sulcus running almost up to sternite-I ; no oblique or oblong sutures visible

(fig. 6). *Tergites*: Smooth, not punctate; 5-19 segments with a pair of complete paramedian longitudinal furrows, feebly represented in the middle segments; endtergite without furrow; emargination of tergal segments beginning on 19th; endtergite broader than longer; arched laterally; posteriorly without any notch or sutures. *Sternites*: Smooth, 2-19 segments with a pair of deep paramedian longitudinal furrows; endsternite tapering posteriorly with posterior margin truncate; almost equal in length and width (fig. 7). *Coxopleura*: Sparsely punctate process of coxopleura with 3 spines at its apex; without dorsal or lateral spines, extending slightly behind the endsternite (fig. 7). *Legs*: 1st pair of walking legs with 2, 2-19 with 1 spur to the 1st tarsal segment; 20th and 21st without such spur; all legs with 2 spurs to the claws. *Anal legs*: Anal leg prefemur about 3 times longer than its width; 9 thorns arranged in 3 rows of 3



Rhysida corbetti sp. nov. (Figs. 5-7)

5. Head & 1st tergite (Dorsal view); 6. Head (Ventral view); 7. Endsternite with coxopleura and anal leg prefemur.

each ; prefemoral process with 2 spines at the apex (fig.7). *Affinities* : *Rhysida corbetti* sp. nov. resembles *R. neocrassispina* Jangi and Dass, 1984 in having 2-19 sternal segments with complete paramedian longitudinal furrows but differs from it in having 1st pair of legs with two spurs on tarsal segment (vs. 1-3 pairs); 20th pair of leg without tarsal spur (vs. with tarsal spur); 3 basal segments of antennae glabrous (vs. 4-12); tergal emargination beginning on 18th (vs. 6th) segment; coxosternal teeth 5 + 5 (vs. 4 + 4); coxopleural process tipped with 3 spines (vs. 2 spines).

7. *Rhysida monalii* Khanna and Kumar, 1984

1984. *Rhysida monalii* Khanna and Kumar, *Uttar Pradesh J. zool.*, 4 (1) : 93-95.

Type Locality : India, Almora (U. P.).

Material examined : Gairal, 10.x.1972, 3 exs., J. C. Tripathi coll. (A-4261); 2 exs., 8.iii.1973, Asket Singh coll.; 2 exs., 6.iii.1973, Asket Singh coll. (A-4267); Mohan, 30.i.1971, 5 exs., J. C. Tripathi coll. (A-4246); Malani, 29.i.1971, 1 ex., J. C. Tripathi coll. (A-4248); Sultan, 7.iii.1973, 5 exs., Asket Singh coll. (A-4253); 24.i.1971, 4 exs., J. C. Tripathi coll. (A-4258); 1.xii.1971, 1 ex., R. K. Bhatnagar coll. (A-4280); Bijrani, 31.i.1971, 1 ex., J. C. Tripathi coll. (A-4268); Dhikala, 16.viii.1975, 1 ex., R. N. Chopra coll. (A-4247); Sarapduli, 26.i.1971, 50 exs., J. C. Tripathi coll. (A-4257); 1.xii.1972, 1 ex., J. C. Tripathi coll. (A-4260).

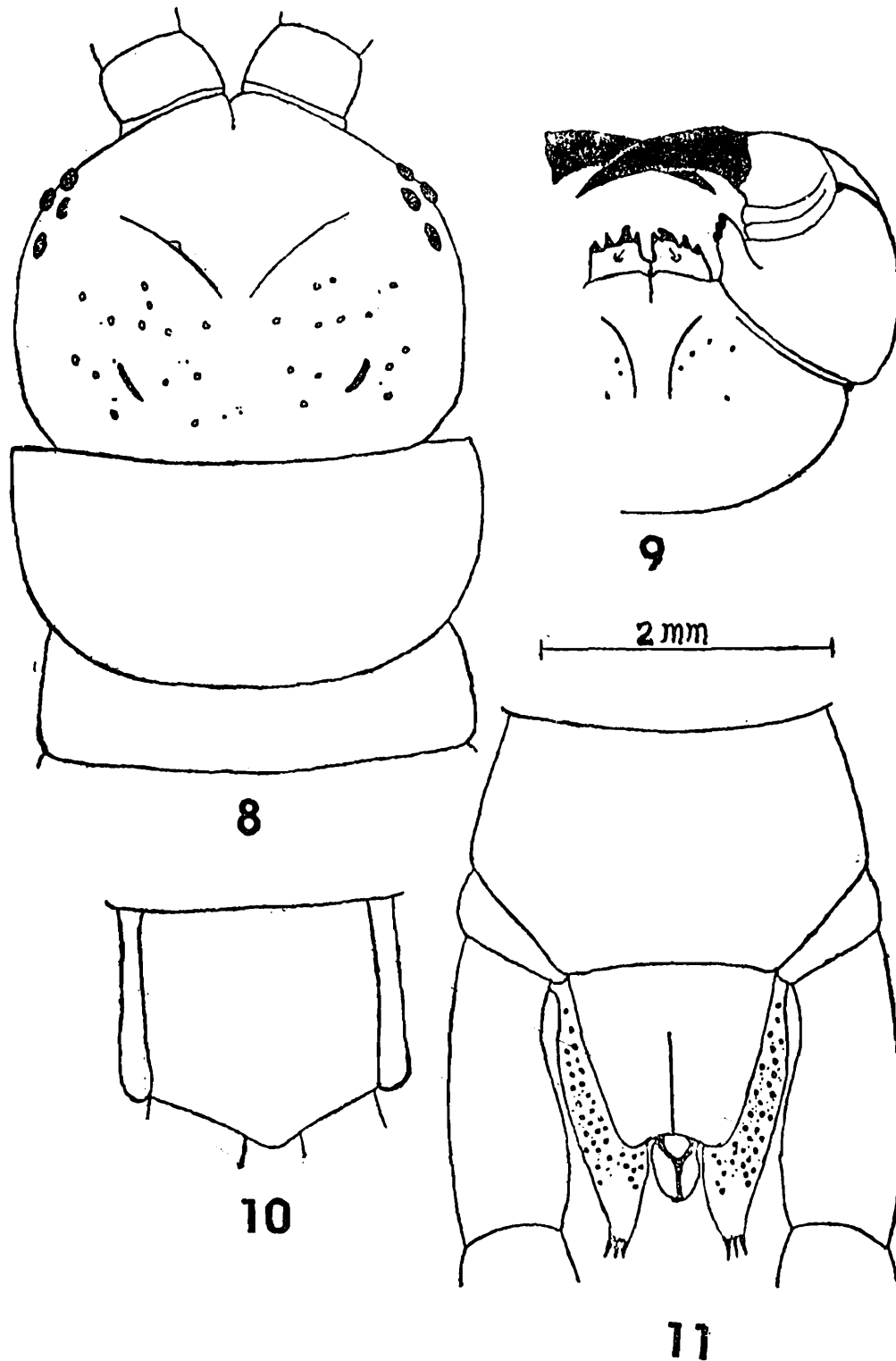
Remarks : It is a widely distributed species occurring throughout in U. P., H. P., and Jammu and Kashmir (Khanna and Kumar, 1984; Khanna and Tripathi, 1985).

8. *Rhysida lithobioides kumaoensis* s. sp. nov.

(Figs. 8-14)

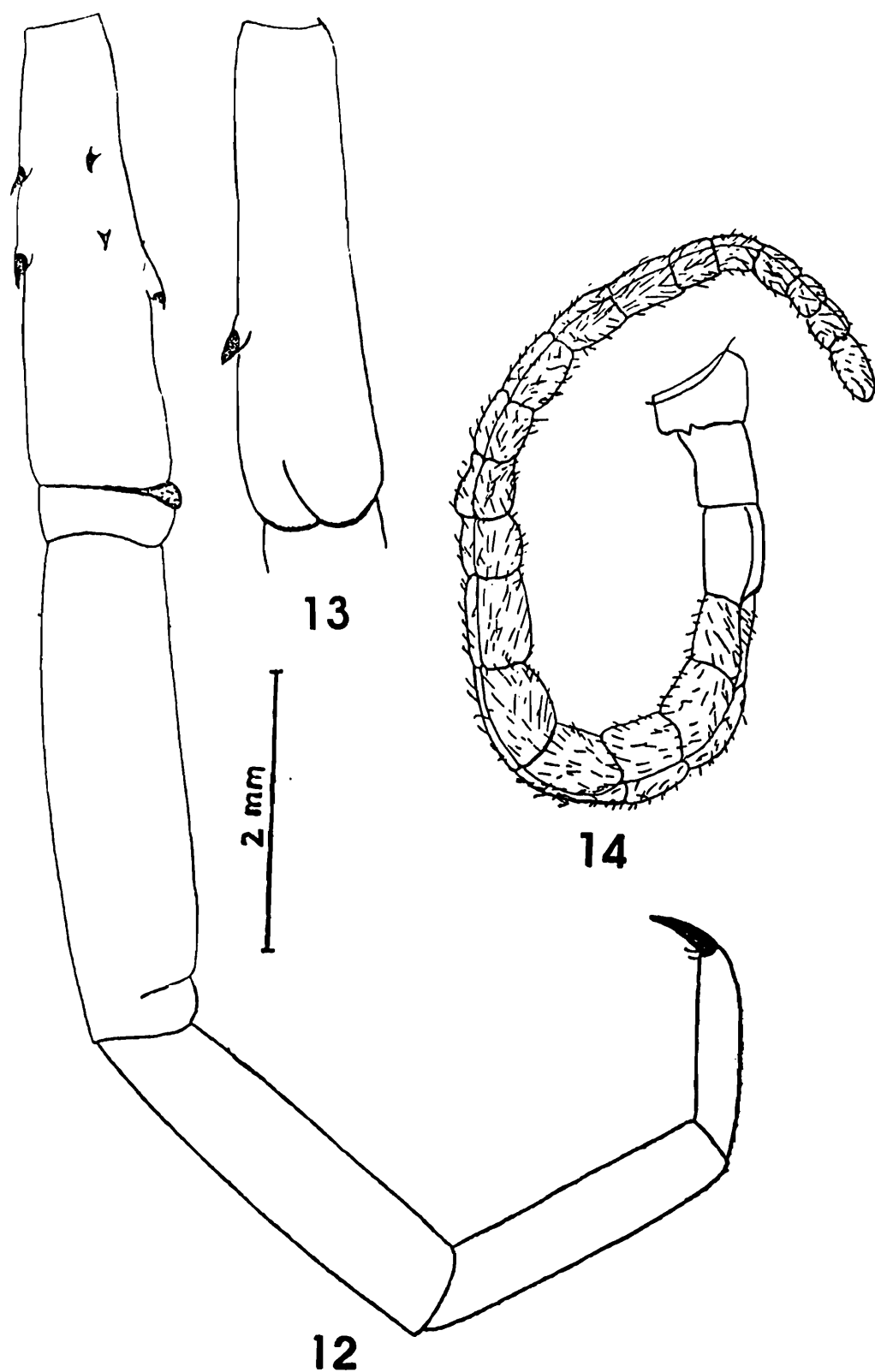
Material examined : India : U. P. : Nainital, Bijrani, 31.i.1971 1 ex., J. C. Tripathi coll. (A-4290, Holotype). Paratypes bearing the same data (4 exs.) (A-4291). Elsewhere : India : U. P. Terai : Lakhimpur Kheri, Chandan Chauki (Dudhwa National Park), 21.xii.1985, 3 exs., Raj Tilak coll.

Description : *Colour* : cephalic plate and anal legs dark olive green; sternites, coxosternum and legs yellow to yellowish green. *Antennae* : 21 segmented, with its 3 basal segment glabrous; reflexed antennae reaching up to the end of 3rd tergite or beginning of the 4th tergite. A deep longitudinal groove running all along the length of



Rhysida lithobioides kumaonensis s. sp. nov. (Figs. 8-14)

8. Anterior body segments showing punctation of cephalic plate & shape of the first tergal seg ;
9. Head (Ventral view) ; 10. Endtergite ; 11. 20th and endsternite with coxopleura.



Rhysida lithobioides kumaonensis s. sp. nov.

12. Anal leg showing the arrangement of spines on prefemur and relative length of tarsal 1 & 2;
13. Anal leg prefemur (Dorsal view) ; 14. 21 segmented antennae showing lateral furrow.

antennae is visible (fig. 14). *Head*: Cephalic plate sparsely punctate with a deep median notch present anteriorly; without median or longitudinal furrows; broader than long (fig. 8). *Coxosternum*: Dental plate with 4+4 teeth; base of the coxosternal plate sparsely punctate (fig. 9) with a very small median furrow present only anteriorly; prefemur of the coxosternum tridentate; dental plate longer than wide, with a post dental spur. *Tergites*: Smooth; 5 or 6 to 18 (or 20) with 2 complete paramedian longitudinal furrows; tergal emargination from 18th segment; endtergite without a median sulcus (fig. 10); *Sternites*: Without paramedian longitudinal furrows; endsternite tapering (fig. 11) posteriorly with a median notch; median sulcus present at posterior 2/3rd of endsternite. *Coxopleura*: Densely punctate process of coxopleura a third of its length longer than endsternite, at the apex studded with 3 spines but no sub-apical or lateral spine present (fig 11). *Legs*: 1-18 pair of walking legs with 2 spurs to 1st tarsal segment; 19th with one and 20th without such spur; all legs with 2 spurs to the terminal claws. *Anal Legs*: Prefemoral spines on anal legs confined only proximally; medially with 1, ventromedially with 2, ventrolaterally also with 2 spines (fig. 12 & 13); a deep transverse groove present ventrally at the prefemur, visible laterally up to middle on the femur; Tarsal II is about half the length of Tarsal I (fig. 12). *Affinities*: *Rhysida lithobioides kumaonensis* ssp. nov. is quite different from *R. l. abessynica* and *R. l. paucidens* in possession of 3 apical spines on coxopleural process (vs. 2 apical spines) and conspecific with *R. l. trispinosus* and *R. l. shivalikensis* Khanna. However, it differs from *trispinosus* in having 18-21 tergal segments laterally emarginate (vs. 13-21), as in *shivalikensis* from which it differs in possession of 21 segments on antennae (vs. 19) and endsternite with a median furrow (absent both in *shivalikensis* and *trispinosus*). It also differs from *trispinosus* in having none of the sternal segments with paramedian longitudinal furrows, the character which it shares with *shivalikensis*; 20th pair of legs without tarsal spurs (vs. with, both in *shivalikensis* and *trispinosus*).

The species *R. lithobioides* (Newport), in India, is represented by 5 subspecies viz., *R. l. paucidens* and *R. l. trispinosus* from Peninsular India (Jangi and Dass, 1984), *R. l. lithobioides* from Terai, U. P. (Khanna and Tripathi, 1985), *R. l. shivalikensis* Khanna from Rajaji National Park, U. P. (Khanna, 1995) and *R. l. kumaonensis* ssp. nov. from Corbett National Park.

9. *Rhysida nuda nuda* (Newport), 1845

1845. *Branchiostoma nudum* Newport, *Trans. Linn. Soc.*, London.
Type Locality: Paramata, New South Wales, Australia.

Material examined : Sarapduli, 1.xi.1972, 1 ex., J. C. Tripathi coll. (A-4311).

Distribution : Assam, Andhra Pradesh, Karnataka, Maharashtra, Orissa and Tamilnadu.

Remarks : This is a first record of the species from Uttar Pradesh.

10. *Rhysida nuda immarginata* (Porath), 1876

1876. *Branchiostoma immarginatum* Porath, *Bih. svenska vet. Akad.*, 4 (7) : 24.

Type Locality : Manilla, Philippines.

Material examined : Bijrani, 28.ii.1973, 2xs., Asket Singh coll. (A-4313); Sultan, 23.xi.1971, 2 exs., Asket Singh coll. (A-4314); Gairal, 15.xi.1972, 8 exs., J. C. Tripathi coll. (A-4315); Dhikala, 23.xi.1973, 1 ex., Asket Singh coll. (A-4316).

Remarks : Reported earlier by Gravely (1912) from Nainital (U. P.), Darjeeling, Calcutta and Punkhabari (West Bengal), Nareil and Jessore (Bangladesh); by Khanna and Tripathi (1985) from Lakhimpur Kheri (U. P.) and Khanna and Kumar (1984) from Almora and Dehradun, this is a further record of the species within the state from Corbett National Park.

11. *Rhysida stuhlmanni himalayanus* ssp. nov.

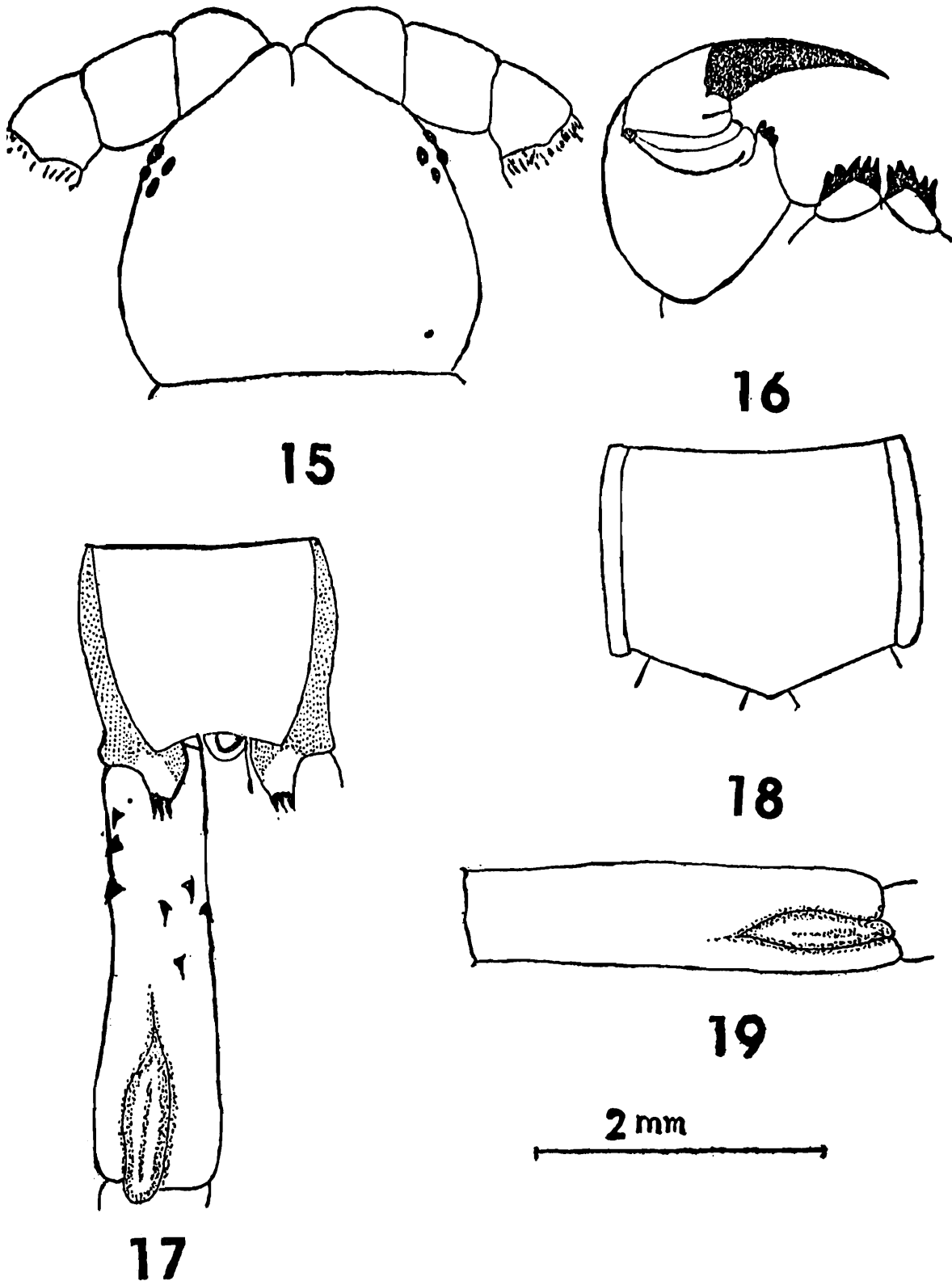
(Figs. 15-19)

Material examined : India : Uttar Pradesh : Nainital Kaladungi-Mangoli Road, 30.xi.1986, J. C. Tripathi coll. (Holotype). Paratypes : Mohan (C. N. P.), 30.i.1971, 6 exs., J. C. Tripathi coll. (A-4292 and 4293); Dhikala, 29.1.1972, 3 exs., Asket Singh coll. (A-4294).

Material collected from outside Park in Western Himalaya, U. P.

India : U. P. : Nainital, Kaladungi-Mangoli Road 1.xii.1986, 2 exs., J. C. Tripathi coll. ; Chamoli. Guptkashi, 16.x.1975, 5 exs., J. C. Tripathi coll.; Uttar Kashi, Barkot, 13.xi.1973, 1 ex., Asket Singh coll. ; Dharansu, 4.ii.1972, 1 ex., J. C. Tripathi coll.

Description : *Body Length* : 66 mm, including antennae and anal legs. *Colour* : Head, antennae, tergites and legs olive green; sternites and ventral surface of the head greenish yellow (in specimen preserved in 70% Alcohol). *Antennae* : Long, composed of 20 segments; 3 basal segments glabrous; reflexed antennae reaching back to the end of 5th or beginning of the 6th tergite. *Head* : Cephalic plate smooth, broader



Rhysida stuhlmanni himalayanus s. sp. nov. (Figs. 15-19)

15. Head (Dorsal view) ; 16. Coxosternum ; 17. Endsternite, Coxopleura & Anal leg prefemur ;
18. Endtergite ; 19. Femoral segment (Anal leg).

than long, with a deep median notch anteriorly followed by a small median furrow confined just below the notch ; head shield clearly overlapped by 1st tergite (fig. 15).
Coxosternum : Dental plate with 5+5 teeth, the three inner being more closer but not coalesced and separated from the outer two by a definite gap ; without any post dental spur ; prefemoral process of the maxillipede tridentate ; base of the coxosternum smooth, without furrows ; dental plates meeting each other at an angle of 120° (fig 16.)
Coxopleura : Densely punctate process of coxopleura, strong and slender extending slightly behind the endsternite, at the apex with three thorns ; no dorsal or lateral thorn present (fig. 17). *Tergites* : All tergal segments without any indication of the presence of paramedian longitudinal furrows, however, very small transverse furrows can be seen anteriorly on the posterior tergal segments and sternites as well ; only endtergite laterally emarginate (fig. 18). *Sternites* : Smooth, only very small paramedian longitudinal furrows visible on posterior body segments ; endsternite longer than wide with its lateral margins a little arched outward and posterior margin incurved (fig. 17). *Legs* : 1-19 pair of legs with 2, 20th with 1 and 21st without spur on first tarsal segment ; all legs with 2 spurs to the claws. *Anal legs* : Prefemur of the anal legs nearly five times longer than its width, with 7 thorns present in the proximal half, ventrolaterally with 1, laterally with 2, medially 1 and dorsolaterally with 3 thorns ; prefemoral process ("eckdorn") absent. A deep depression seen on the distal end of the anal leg prefemur (fig. 17) and femur (fig. 19). Pretarsus about five times longer than end claw. *Affinities* : *Rhysida stuhlmanni himalayanus* ssp. nov. resembles *R. stuhlmanni* Kraepelin in a number of characters but differs from it in having a tridentate projection on the prefemur of coxosternum (vs. unidentate) ; 20 segmented antennae (vs. 17-18) and disposition of spines on the anal leg prefemur.

The species *R. stuhlmanni* Kraepelin, 1903 should, therefore, be treated as *Rhysida stuhlmanni stuhlmanni* Kraepelin* (forma typica), which is an element of Ethiopian fauna.

Key to the Indian Species of the Genus *Rhysida* Wood

- | | | | |
|--|-----|-----|-----|
| 1. All tergites except anterior with a pair of complete paramedian longitudinal furrow | ... | ... | 2. |
| All tergite either without paramedian longitudinal furrows or only very small furrows partly visible on some of the segments | ... | ... | 17. |

* Khanna (in press) recently recorded *R. stuhlmanni stuhlmanni* from North East States, India.

- 2.** Tergite preceeding 21st segment normally not marginate laterally
 *Rhysida nuda* : 3.
 Tergites preceeding 21st segment clearly marginate and several of them involved
 4.
- 3.** 20th pair of walking legs without tarsal spur ; apex of the process of coxopleura
 tipped with 3 spines ; antennae 19 segmented ... *Rhysida nuda immarginata* (Porath)
 20th pair of walking legs with one tarsal spur ; apex of the process of coxopleura
 tipped 2 spines ; antennae (18)—(21) segmented ... *Rhysida nuda nuda* (Newport)
- 4.** Process of coxopleura studded with lateral spines *Rhysida longipes* (Newport) : 5.
 Process of coxopleura without lateral spines ... 7.
- 5.** Prefemur of the anal legs without 'eckdorn' ; 1-5 pair of legs with 2 spurs to the 1st
 tarsal segment ... *Rhysida longipes simplicior* Chamberlin
 Prefemur of the anal legs with 'eckdorn' ; 1-12 pairs of legs with 2 spurs to the first
 tarsal segment ... 6.
- 6.** Emargination of tergites begining from 15th segment ; dorsal median streak on tergum
 absent ... *Rhysida longipes longipes* (Newport)
 Emargination of tergites beginning from 9th segment ; dorsal median streak visible
 throughout the tergum ... *Rhysida longipes punctata* Khanna
- 7.** Sternites either at all without paramedian longitudinal furrows or only anteriorly
 with very small furrows ... 8.
 Majority of the sternites with a pair of complete paramedian longitudinal furrows
 ... 15.
- 8.** Tergite from 5th segment onwards with a longitudinal median carina
 *Rhysida carinulata* (Haase)
 None of the tergal segments with a median carina ... *Rhysida lithobioides*
 (Newport) : 9
- 9.** Process of the coxopleura at the apex tipped with 3 spines 10.
 Process of the coxopleura at the apex tipped with 2 spines 12.
- 10.** 20th pair of walking legs with a spur to the first tarsal segment, endsternite without
 median furrow ... 11.
 20th pair of walking legs without spur to the first tarsal segment ; endsternite
 with a median furrow ... *Rhysida lithobioides kumaonensis* ssp. nov.

11. Prefemoral process of the coxosternum with a tridentate projecton ; emargination of the tergites beginning on 17 or 18th segment ; paramedian furrows on sternites not present ... *Rhysida lithobioides shivalikensis* Khanna
 Prefemoral process of the coxosternum with a quadri-dentate projection ; emargination of the tergites beginning on 13th segment ; small paramedian longitudinal furrows on sternites visible ... *Rhysida lithobioides trispinosus* Jangi and Dass
12. Endsternite without a median groove ... 13.
 Endsternite with a median groove ... 14.
13. 1-18 pair of walking legs with 2 spurs to 1st tarsal segment ... *Rhysida lithobioides lithobioides* (Newport)
 1-15 pair of walking legs with 2 spurs to 1st tarsal segment ... *Rhysida lithobioides abessynica* Attems
14. 1-19 pair of walking legs with 2 spurs to 1st tarsal segment ; process of coxopleura long ... *Rhysida lithobioides longopito* Dobroruka
 1-18 pair of walking legs with 2 spurs to 1st tarsal segment ; process of coxopleura short ... *Rhysida lithobioides paucidens* Pocock
15. Only first pair of legs with 2 tarsal spurs ... 16.
 1-3 pair of walking legs with 2 tarsal spurs ... *Rhysida neocrassispina*
 ... Jangi & Dass
16. Emargination of tergites begins from 5th or 6th segment ; 20th pair of walking legs with 1 tarsal spur ... *Rhysida crassispina* Kraepelin
 Emargination of tergites begins from 18th segment ; 20th pair of walking legs without tarsal spur ... *Rhysida corbetti* sp. nov.
17. None of the tergite with paramedian longitudinal furrows ... 19.
 Only very small paramedian longitudinal furrows on tergites visible, restricted either anteriorly or posteriorly on tergal segments ... 18.
18. 1-9 pair of walking legs with 2 spurs to 1st tarsal segment ; only endtergite : emarginate ; paramedian longitudinal carinae on tergites not present ; only small furrows on sternites visible only anteriorly ... *Rhysida stuhlmanni himalayanus* ssp. nov.
 1-15 pair of walking legs with 2 tarsal spurs ; 14-21 tergal segments with their lateral margins emarginate ; 4-20 tergal segments with a pair of pronounced paramedian longitudinal carina ; all sternites without longitudinal furrows ... *Rhysida longicariculata* Khanna and Tripathi

19. Emargination of tergites begins from 6th segment ... *Rhysida ceylonica* Gravelly
 Only endtergite laterally emarginate 20.
20. 20th pair of walking legs with 1 tarsal spur ; all sternites without paramedian longitudinal furrows ... *Rhysida monalii* Khanna and Kumar
 20th pair of walking legs without tarsal spur ; very small paramedian longitudinal furrows visible on sternites anteriorly on anterior body segments only
 ... *Rhysida afra cuprea* Kraepelin

SUMMARY

In the the present paper altogether eleven species, belonging to four genera, collected from Corbett National Park, Uttar Pradesh, have been reported, of which two subspecies, *Rhysida lithobioides kumaoensis* and *R. stuhlmanni himalayanus* and one species *R. corbetti*, are new additions to science, described from the park. Further extension of range of distribution of species like *Scolopendra morsitans* Linn., *Cormocephalus dentipes* Pocock, *Rhysida afra cuprea* Kraepelin, *Rhysida monalii* Khanna and Kumar, *Rhysida nuda nuda* Newport, *Rhysida nuda immarginata* Porath, *Otostigmus amballae* Chamberlin and *O. nudus* have been given. Additional characters of taxonomic importance in *O. amballae* Chamberlin have been discussed. A key to facilitate the identification of Indian species of the genus *Rhysida* wood has also been provided.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta, for his kind permission to undertake the studies. He is also thankful to the Officer-in-Charge, Northern Regional Station, Zoological Survey of India, Dehradun, for providing necessary facilities and placing the material at his disposal.

TABLE SHOWING THE DISTRIBUTION OF CENTIPEDES IN
CORBETT NATIONAL PARK, UTTAR PRADESH

Name of the species	District PAURI						District NAINITAL					
	Dhikala	Kanda	Khinanauli	Paterpani	Boxar	Gairal	Sarapduli	Sultan	Mohan	Malani	Amdanda	Bijrani
1. <i>Cormocephalus dentipes</i> Pocock	+	-	-	+	+	-	+	-	-	+	+	+
2. <i>Scolopendra morsitans</i> Linnaeus	+	+	-	-	-	-	+	-	-	-	-	-
3. <i>Otostigmus amballae</i> Chamberlin	+	-	-	-	-	-	-	-	-	-	-	-
4. <i>Otostigmus nudus</i> Pocock	+	-	-	-	-	-	-	-	-	-	-	-
5. <i>Rhysida corbeti</i> sp. nov.	+	-	-	-	-	-	+	-	-	-	-	-
6. <i>Rhysida afra cuprea</i> Kraepelin	+	-	-	-	-	-	-	-	-	-	-	-
7. <i>Rhysida monalii</i> Khanna and Kumar	+	-	-	-	-	+	+	+	+	-	-	+
8. <i>Rhysida lithobioides kumaonensis</i> ssp. nov.	-	-	-	-	-	-	-	-	-	-	-	+
9. <i>Rhysida nuda nuda</i> (Newport)	-	-	-	-	-	-	+	-	-	-	-	-
10. <i>Rhysida nuda immarginata</i> (Porat)	+	-	-	-	-	+	-	+	-	-	-	+
11. <i>Rhysida stuhlmanni himalayanus</i> ssp. n.	+	-	-	-	-	+	-	-	+	-	-	-

Note :

1. Sarapduli is partly in Nainital and partly in Pauri Dist.
2. Boxar is now completely submerged under water.

(+) Present

(-) Not present

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DISTRIBUTION AND ETHO-ECOLOGY OF GROUSE LOCUSTS
OF CERTAIN LOCALITIES IN MAHARASHTRA
WITH
A NOTE ON THE STATUS OF TETRIGID TAXONOMY

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INTRODUCTION

Superfamily Tetrigoidea comprises of small sized, short-horned Orthopteran insects. These tetrigids are commonly known as grouse locusts. The diagnostic characters which distinguish them from grasshoppers are, the large generally backwardly extended pronotum, absence of arolia between the claws of all legs. The hood-like pronotum covers the entire or the greater part of the body and shows several structural and colour variations. Fore-wings are reduced and scale like whereas hind-wings mostly folded and hidden under the extended pronotum, are normal, membranous and useful in flight. Stridulatory and auditory organs are wanting.

Tetrigoidea includes about 185 genera and approximately 1000 species (Kevan, 1982). They are predominantly tropical or subtropical and occur abundantly in the Oriental Region. A few species also occur at high altitudes, in both temperate and tropical regions. Indian subcontinent is quite rich in many forms of tetrigids and there are certain semi-aquatic species which exclusively occur in India.

Survey of certain eco-geographically varying districts of Maharashtra State (Western India) was carried out to study the occurrence, identification, habit and

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habitat of the collected species of grouse locusts. The localities under study showed great variations in terms of ecological and geographical characteristics such as altitude, rainfall, humidity, temperature, soil, topography and cultivation of plants. (For example, the range in variations in two distant localities is as follows : Dhule : Lat. $20^{\circ}54'$ N, Long. $74^{\circ}47'$ E, Alt. 245 m, Rainfall : 674 mm, Temp. 25.8° to 40.7° C. and

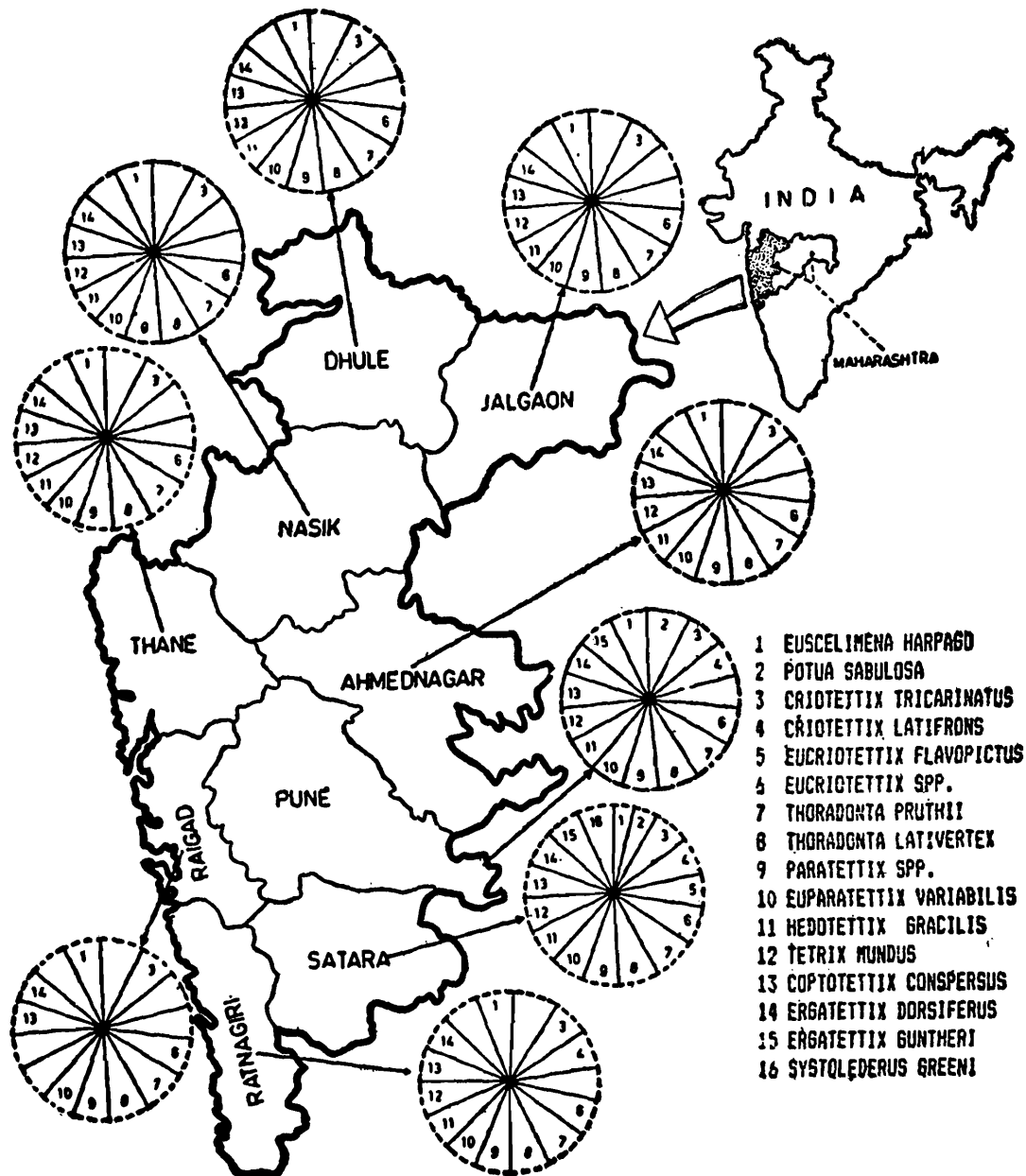


Fig. 1 : Nine eco-geographically varying districts in the state of Maharashtra.

Table 1

Identification report on *Tetrigidae* of certain localities of Maharashtra

SYSTEMATIC POSITION :

- Order : ORTHOPTERA
 Suborder : CAELIFERA
 Infraorder : TETRIGIDEA, TETRIGODEA
 Superfamily : TETRIGOIDEA
 Family : TETRIGIDAE

TAXANOMIC CHECK-LIST :

- (I) Subfamily : CLADONOTINAE
 i) *Potua sabulosa* Hancock
- (II) Subfamily : SCELIMENINAE
 i) *Euscelimena harpago* Seville
 ii) *Eucriotettix tricarinatus* Bolivar
 iii) *Eucriotettix flavopictus* Bolivar
 iv) *Eucriotettix* Spp.
 v) *Criotettix latifrons* Hebard
 vi) *Thoradonta lativertex* Gunther
 vii) *Thoradonta pruthii* Gunther
- (III) Subfamily : METRODORINAE
 i) *Systolederus greeni* Bolivar
- (IV) Subfamily : TETRIGINAE
 i) *Paratettix femoralis* Bolivar
 ii) *Paratettix dorsifer* Walker
 iii) *Euparatettix personatus* Bolivar
 iv) *Hedotettix gracilis* de Hann
 v) *Hedotettix lineifera* Walkar
 vi) *Coptotettix conrpersus* Hancock
 vii) *Ergatettix guntheri* Steinmann

Humidity : 55% ; Ratnagiri : Lat. 16°59' N, Long. 73°20' E, Alt. 35 m, Rainfall : 3023 mm, Temp. 23.1° to 30.8°C and Humidity : 76%). The localities surveyed were purposely selected to understand the effect of these various parameters on the occurrence, distribution and behaviour of grouse locusts.

OBSERVATIONS

In the present studies, 16 species of grouse locusts were collected from nine eco-geographically varying districts in the state of Maharashtra, India (Fig. 1). These represent 11 genera and 4 subfamilies. The subfamilies are Cladonotinae, Scelimeninae, Metrodorinae and Tetrigenae. Some of the species form the first record in this region. A list of identified specimens of grouse locusts collected at various localities is given in Table 1. Illustrations of the four representative grouse locusts (Fig. 2) and their diagnostic characters (Table 2) are presented with a view to facilitating field studies.

The distribution pattern and etho-ecological observations on four subfamilies are given below :

Subfamily : (I) CLADONOTINAE

Out of the 45 genera, only a single genus namely, *Potua* is commonly distributed in India and Indo-Malayan region (Rehn, 1952). In our study area, we came across only one pigmy locust namely, *Potua sabulosa* Hancock under this subfamily.

Ethoecological observations : *P. sabulosa* is found in various parts of Panchgani, Mahabaleshwar (Dist. Satara) and Sinhagad (Dist. Pune). These localities are situated in Western Ghats at an altitude of about 1340 to 1370 m from sea level, with an annual rainfall of about 3000 to 6600 mm. *Potua sabulosa* is typically found on the walls of old buildings, large trunks of plants, rocks and similar other habitats, that are generally covered with moss and other bryophytes. These insects are very sluggish and feed on humus, moss and other bryophytes. During summer the population of these insects gradually declines and practically no pigmy locust is easily observable in the months of March, April and May, as the aestivating forms remain hidden in crevices etc.

Table 2

Dignostic characters for field identification of the four representative grouse locusts of the subfamilies under study.

TETRIGIDAE

Small sized, short-horned hoppers, Greatly extended pronotum, arolia absent. Forewings reduced, & scale like, hindwings normal. Ovipositor slender and serated. Found in moist places.

Potua sabulosa

(Fig. 2 : a & b)

(Subfamily : Cladonotinae)

Smallest and bizarre form. Body tuberculated and dull brown. Head and femora large in size. Pronotum compressed, Shorter in length and with two large humps in the shoulder region. Wings considerably reduced to small scales. Found on the damp, moss-covered rocks and trees of forest.

Euscelimena harpago

(Fig. 2 : c & d)

(Subfamily : Scelimeninae)

Largest and massive form. Colour dull greyish black. Pronotum elongated with tubercles on shoulder. Lateral lobes of pronotum with yellow, triangular straight spines. Tegmina reduced, hind wings well developed. Tibiae and tarsi of hind legs lamellated. Found on the rocks very close to the water bodies,

Systolederus greeni

(Fig. 2 : g & h)

(Subfamily : Metrodorinae)

Large sized greyish insect. Head considerably higher than pronotum. Eyes large very close and higher than vertex. Antennae long. Presence of white or greyish granules on the pronotum. Lateral lobes slightly produced. Hindwings extend to the tip of the pronotum. Hind femur with oblique wrinkles. Found on the wet rocks, present near large water bodies.

Paratettix dorsifer

(Fig. 2 : e & f)

(Subfamily : Tetriginae)

Small sized, agile insect. Eyes prominent and raised about the level of pronotum. Presence of yellowish white patch on the shoulder region of pronotum. Lateral lobes of pronotum depressed and rounded. Hindwings longer than pronotum Hind femur with large tubercles. Found in moist places of river banks and fields.

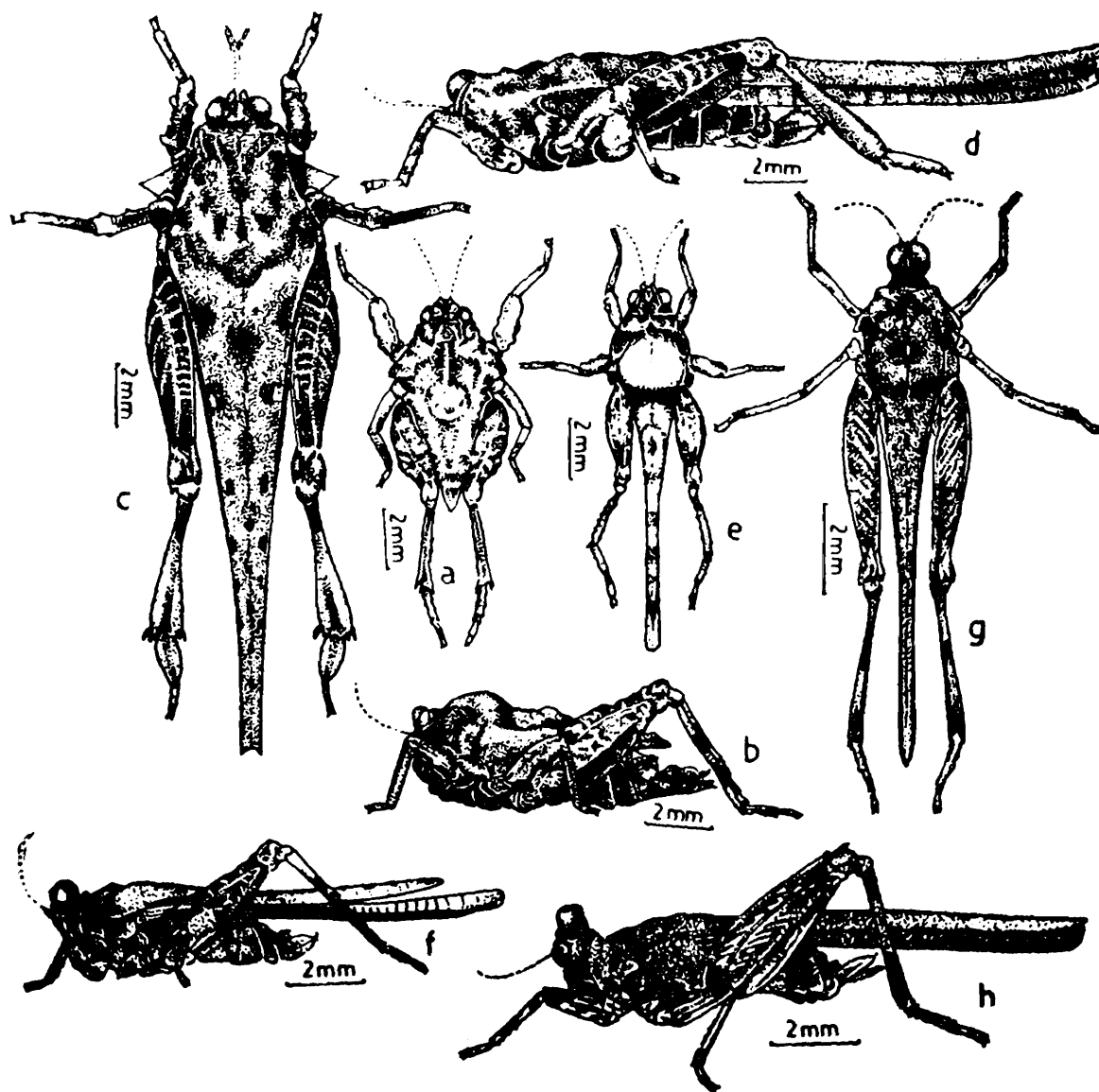


Fig. 2

a&b : *Potua sabulosa* ; c & d : *Euscelimena harpago* ;
g&h : *Systolederus greeni* ; e&f : *Paratettix dorsifer*.

Subfamily : (II) SCELIMENINAE

The members of the subfamily Scelimeninae occurring in the area under study belong to four genera and seven species.

Ethoecological observations : A large proportion of the members of Scelimeninae are widely distributed in the surveyed parts of Maharashtra. They are exclusively

dependent on the permanent fresh water bodies such as rivers, streams and lakes. The grouse locusts are generally found near the water line, on the solid substratum or in the muddy areas of the bank. Some species of scelimeninae are more aquatic and usually observed in the hilly regions, especially near the rushing mountain torrents.

Most of the species of Scelimeninae are comparatively larger in size, greyish black in colour and resemble very well with the substratum. They show various kinds of adaptations for semi aquatic mode of life. Different species of Scelimeninae feed on algae, moss and decaying vegetation. In some Scelimenids the tibiae and tarsi of hind legs are expanded or lamellated for swimming under water. *E. harpago* of Scelimeninae can stay submerged in water for about 15 to 20 min. and shows "Gas bubble respiration".

The sample collections made during various seasons showed that these insects occur throughout the year. However, their number is appreciably large in the post-monsoon period and tends to considerably dwindle during the summer.

Subfamily : (III) METRODORINAE

In our survey, so far, we have come across only one grouse locust, *Systolederus greeni* Bolivar under this subfamily.

Ethoecological observations : *S. greeni* representing this subfamily has, so far, been recorded for the first time near the streams close to Koyana Dam (Dist. Satara). These insects are generally sluggish but occasionally fly actively with the help of well developed hind wings. This species of Metrodorinae is grey coloured and large in size. Pronotal surface shows whitish, granular pattern resembling very well with the rocky habitat. The insect feeds on humus, algae and moss. Further, studies on this insect are being undertaken.

Subfamily : (IV) TETRIGINAE

The members of this subfamily that occur in the area surveyed belong to 5 genera and 7 species (Table 1).

Ethoecological observations : The grouse locusts belonging to this subfamily are

more widely distributed in various localities but showing somewhat similar habitats. They live on ground, particularly in marshy, humid situations. Most of these insects inhabit places such as banks of rivers, ponds, artificial canals and adjacent to the paddy fields. Some forms are also found in the arid zones present slightly away from the large permanent water bodies. Certain habitats, where these insects occur, are highly polluted with sewage and industrial waste.

Tetriginae show polychromatism, or long series of colour patterns and correlated tones. These broad range of inter-specific and intra-specific colour patterns are useful in giving abundant protection. These grouse locusts feed on decaying vegetation, lower plants and small fragments of grass seedlings. The population of Tetriginae is considerable from post-monsoon to late winter and these insects are scarce during summer. These are active fliers and also leap when disturbed. Most of the members of Tetriginae get attracted towards bright light sources during late evenings and in this process they show a unique phenomenon of "local migration".

DISCUSSION

The taxonomic studies of the region under study revealed that most of the species identified, form the first record. The list of which is as follows : *Potua sabulosa* Hancock, *Criotettix latifrons* Hebard, *Eucriotettix flavopictus* Bolivar, *Thoradonta lativertex* Gunther, *Thoradonta pruthii* Gunther, *Systolederus greeni* Bolivar, *Paratettix femoralis* Bolivar, *Euparatettix personatus* Bolivar, *Coptotettix conspersus* Hancock and *Ergatettix guntheri* Steinman. In the latest, available Government of Maharashtra Gazetteer (1974) only 6 species of Tetrigidae (Acridiinae) are reported. The scientific names of species are as follows : *Scelimena harpago* Serville., *Scelimena uncinata* Serville., *Tettix* (*Paratettix*) *dorsifer* Walker., *Hedotettix gracilis* De Hann, *Hedotettix lineifera* Walker and *Acantholobus curticornis* Hancock. Moreover, these insects were mostly recorded from Bombay and nearby areas and names of some of the species also need to be revised due to nomenclatural changes which have taken place afterwards.

In the taxonomic literature on grouse locusts various synonyms are noticed after the valid names of different species. These synonyms also show interesting changes from the past to the latest years. For example, *Euscelimena harpago* showed striking variations in the generic names right from *Gryllus* to *Euscelimena* with two main changes in between viz., *Tetrix* and *Scelimena*. Similar type of changes were noticed in the remaining 15 species of tetrigid insects under study.

The present investigations also revealed the interesting distribution pattern amongst different species of grouse locusts. The survey work of nine districts of Maharashtra state clearly indicated that some species of grouse locusts, for example, *E. harpago*, *Criotettix latifrons*, *Thoradonta* Sps., *Paratettix* Sps., *Hedotettix* Sps., *Euparatettix personatus*, *Coptotettix conspersus* and *Ergatettix guntheri* are practically found in all the localities, whereas, certain species like *Potua sabulosa*, *Eucriotettix tricarinatus* and *Eucriotettix* Sp. are found only in the hilly regions with greater altitude. Similarly, a grouse locust species from subfamily Metrodorinae namely, *Systolederus greeni* is found only at one locality. This presumably means that besides the nature of habitat, certain other ecological conditions could be playing some role in the distribution of these insects.

The survey also revealed variations in the relative density in population of the collected species of tetrigids. For example, *E. harpago*, *Eucriotettix flavopictus* (subfamily Scelimeninae), *Paratettix* Sps., *E. personatus*, *C. conspersus* (Subfamily : Tetriginae) are found to be showing higher relative density. On the other hand grouse locusts such as *Eucriotettix* Sps., *C. latifrons* and *Thoradonta* Sps. (Subfamily : Scelimeninae) and *S. greeni* (Subfamily Metrodorinae) show very low relative density.

As is known, insect taxonomy and phylogeny are by and large constructed on the basis of morphological data. But these are often insufficient. Hence, the use of ethoecological information is very promising for the correct identification of species (Ghilarov, 1974). In the present work, therefore, besides morphological studies some etho-ecological observations are also carried out which revealed interesting peculiarities. The grouse locusts of one subfamily show same type of habitat and nature of food and feeding behaviour. Furthermore, individuals of a species also show a typical micro-habitat and speciality in relation to feeding behaviour. The population studies revealed that there is a marked fall in the total number of grouse locusts especially during dry, summer season. During all the trips of "night collection" none of the species of Scelimeninae was observed near the bright light source. However, large number of Tetriginae species were collected near the bright light sources during night. There are many occasional records of grasshoppers flying near artificial light sources at night, sometimes in a good number. Certain observations on grasshoppers and locusts suggest that night flights are more characteristics of non-swarming species and phases (Uvarov, 1977). Observations on night flight of Tetrigidae of South Africa revealed that many species get attracted to light at night (Johnsen, 1985). The exact purpose of local migration in grouse locusts is still unknown.

Despite the near universal distribution, the information on the bionomics and ethoecology of grouse locusts has been very scanty. Moreover, practically there was

Table 3

Status/Nomenclature changes in the taxa of grouse locusts

Hancock 1906	Kirby 1914	Hancock 1915	Rehn 1952	Steinmann 1970	Kevan 1982
Order ORTHOPTERA	Order ORTHOPTERA	Order ORTHOPTERA	Order ORTHOPTERA	Order ORTHOPTERA	Order CAELIFERA
Family ACRIDIDAE	Family ACRIDIDAE	Family TETRIGINAE	Superfamily ACRYDOIDEA	Familia TETRICIDAE	Suborder TETRIGODEA
Subfamily TETRIGINAE (ACRYDIINAE)	Subfamily ACRYDIINAE		Family TETRIGIDAE		Infraorder TERIGIDEA
					Superfamily TETRIGOIDEA
					Family (i) TETRIGIDAE (ii) BATRACHIDEIDAE

Table 4

Nomenclature changes at the family level in grouse locusts

During 19th Century		During 20th Century	
1815	Acrydida : Leach	1902	Paratettigidae ; Krauss
1837	Acrydiadae (Sic) : W. Kirby	1902	Acrydidae : Krauss
1838	Tetridides (Sic) : Rambur	1902	Tetrigidae : Karuss
		(July)	
1838	Tetricidites : Audinet Serville	1902	Tetrigidae : Yakobson
		(Sept.)	
1840	Tetrigidae : Burmeister	1910	Acrydiinae : W. F. Kirby
1844	Peritrachelia (part). Tetrigidea, Tetricideae, Tetrigideae, Tettigidea, : Fieber	1955	Tetrigides : Beier
1846	Tettiges : Fischer von Waldheim	1956	Tetrigoidea : Kl Gunther
1853	Palyparyphea (part) : Feibr	1967	Tetricidae : Steinmann
1868	Tetricides : Scudder	1976	Tetrigoidea : Kevan
1870	Tettigidae : F. Walker		
1872	Tettigi : C. Thomas		
1895	Tettigides : Sharp		

no work on the biochemical studies on these insects. The relative abundance of Tetrigids in India and the total lack of bioecological and biochemical information on Indian Tetrigids indicated the need of initiating such studies. For the last few years, therefore, such studies are being carried out. An attempt on these lines resulted into publication of certain interesting findings and the approach has been well received at National and Interantional levels (Paranjape & Bhalerao, 1985 ; (Paranjape 1985 ; Bhalerao & Paranjape. 1986 ; Paranjape *et. al*, 1987(a) ; Paranjape *et al.*, 1987 ; Bhalerao & Paranjape, 1992).

Further etho-ecological observations and biochemical studies on various species of grouse locusts are in progress and the results seem to be promising.

Table 5

Status/Nomenclature changes in the Subfamilies of grouse locusts

Hancock 1906	Kirby 1914	Hancock 1915	Rehn 1952	Steinmann 1970	Kevan 1982
Section	Groups	Subfamilies	Subfamilies	Subfamilia	Subfamilies
Tripetalocerae	Tripetalocerini	Tripetalocerine	(Tripetalocerinae)	Tripetalocerinae	Tripetalocerinae
Cleostratae	(Cleostratini)	(Cleostratinae)	(Cleostratinae)	Cleostratinae	Cleostratinae
Discotettigidae	(Discotettigini)	(Discotettiginae)	(Discotettiginae)	Discotettiginae	Discotettiginae
Bufonidae	(Bufonidini)	(Bufonidinae)	(Bufonidinae)	(Bufonidinae)	(Bufonidinae)
Cladonotae	Cladonotini	Cladonotinae	Cladonotinae	Cladonotinae	Cladonotinae
Scelimenae	Scelimenini	Scelimeninae	Scelimeninae	Scelimeninae	Scelimenini (Tribe of Tetriginae)
Metrodoraе	Metrodorini	Metrodorniae	Metrodorniae	Metrodorniae	Amphorphopinae (= Metrodorniae)
Tettigiae	Acrydiini	Tettiginae	Tetriginae	Tetricinae	Tetriginae
Batrachidedae	Batrachidiini	Batrachidinae	(Batrnchidinae)	Batrachidinae	Batrachideidae (Family)

NOTE ON THE STATUS OF TETRIGID TAXONOMY

Tetrigid systematics is a seriously handicapped topic. Even the cursory survey clearly indicates that there is no unanimity in the available literature. There has been considerable diversity in the views amongst the workers. For example, Hancock (1915) considered Kirby's work (1914) inaccurate and incomplete. Gunther (1938) further revised Hancock's version, while Rehn (1952) states that Gunther's work has created added confusion.

The available information on the tetrigid taxonomy is rather difficult to follow due to various reasons. The major divisions of Tetrigidae have greatly changed from time to time. For the sake of brevity and clarity, these various changes in the taxa and their nomenclature are presented in Tables 3, 4 and 5.

It is a matter of relief that presently the tetrigid classification up to the subfamily level is largely agreeable and widely accepted by most workers.

However, the lack of unanimity yet persists largely at the generic and specific levels (vide supra : Discussion). According to Rehn (1952) these discrepancies are due to three important factors : namely, dimorphism or polymorphism, availability of neotenic forms and considerable polychromatism. Moreover, these variations occur largely within the species.

The above mentioned characteristics pose problems for taxonomists working on tetrigid insects. Blackith (1989), on the basis of multivariate analysis using even as many as 80 morphological characters, has felt that these characters are of limited use in finalising the taxonomy of Tetrigid insects.

In more recent years, Kevan (1982) has pointed out that the suprageneric classification is still unstable. Similarly, in the most recent catalogue of tetrigid insects, Blackith (1992) has attempted to synonymise many genera and species and has also experienced similar difficulties related to tetrigid determination.

Thus, even today the taxonomy of Tetrigidae is far from complete and most of the workers are of the opinion that a taxonomic revision of Tetrigid group is highly essential.

Considering the above mentioned problems, one feels that eventually recourse to some non-structural methods of taxonomic studies such as etho-ecological observations,

biochemical and immunological approaches may prove to be of great help and complementary to the morphological basis, in attempting to resolve the problem of taxonomic confusion in grouse locusts.

SUMMARY

The grouse locusts collected and studied during survey work of certain eco-geographically varying districts of Maharashtra State (Western India) belong to 16 species, 11 genera and 4 subfamilies of the family Tetrigidae. Findings of this survey are presented in the distribution-map. Etho-ecological observations on the four subfamilies indicate that these insects show interesting features in relation to habits and habitat, distribution pattern, polymorphism and polychromatism. The distribution pattern of most of the species forms the first record. The tetrigid taxonomic literature shows considerable diversity in views and nomenclature. A note on the status of the problem is therefore given specially at the end.

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**THE BREEDING BIOLOGY OF THE HOUSE SWIFT
APUS AFFINIS (J. E. GRAY)**

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and

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INTRODUCTION

Review of Literature : Some works were done on the breeding biology of the Shag, *Phalacrocorax aristotelis* by Snow (1960); the breeding biology of Shell Duck, *Tadorna tadorna* (Linnaeus) by Hori (1964) etc. In Bangladesh, works on the breeding biology of the House Sparrow, *Passer domesticus* (Linnaeus) by Khan (1971), M. Sc. Thesis (unpublished), notes on the breeding record of Common Myna, *Acridotheres tristis tristis* (Linnaeus) by Rahman & Husain (1988), breeding biology of Magpie Robin, *Copsychus saularis* in Dhaka city by Hossain *et al.* (1988) have been done. In Gujarat (India) the breeding biology of the House Swift, *Apus affinis* (J. E. Gray) studied by Razack and Naik (1964). In Malaysia the breeding biology of the Asian Palm Swift, *Cypsiurus batusiensis* by Hails and Turner (1982). No work has been made on the breeding of the House Swift, *Apus affinis* in Bangladesh. So the present work is an attempt to collect as much information as possible on the breeding biology of the House Swift, *Apus affinis*.

WORKING PROCEDURE

The study was undertaken from August, 1975 to August, 1976 in Dhaka city. Two nesting areas, namely, Asiatic Society of Bangladesh and Jagannath Hall of University of Dhaka situated at the centre of Dhaka city were selected for observation. A total of 65 nests were found and given serial numbers with coloured painting ink. The nesting areas were visited regularly once in the morning and once in the

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afternoon to observe the nest building, laying, incubation, hatching etc. with the help of a pair of binoculars and inspecting the nests.

Four pairs of adults belonging to four different nests were trapped, weighed and colour-marked with paint as male and female on assumption and then released for further observation of activities with regard to nesting, incubating and feeding the young. After the breeding season, these four pairs were trapped again and dissected in the laboratory for confirmation of the sexes.

The eggs of each nest were marked with black permanent ink as 1, 2, 3 and 4 according to the sequence of laying. Since the eggs were laid at night, these markings were done on the following morning, when each egg was weighed with spring balance accurate to one gram and the dimension was taken with a fine-tipped divider and a scale graduated to one millimetre. The young were also marked with coloured thread in one leg for identification. Any loss of young was recorded, with the cause of loss and the date. Later on, all the information were analysed. The methods and analysis of data to prepare the tables in this work were based on the works of Razack and Naik (1968), Lack (1954), Snow (1969), Khan (1971) and Rahman & Husain (1988).

OBSERVATIONS and RESULTS

Nesting

Nesting areas :

The building of the Asiatic Society is prism shaped three storied with a corridor of about 3.5 metre passing through the two portions of the building. The main building of Jagannath Hall is U-shaped, east facing, three storied old building bisected by the main gate. The lawns and surroundings of these buildings are ornamented with various types of bushes and trees and several other small buildings. A large water tank is situated at the south of the main building.

Nesting sites :

The House Swift used five kinds of nesting sites. The nesting sites were named according to the places where they were built, such as (i) ceiling nest—nest built against the ceiling, (ii) beam nest—nest built between the beam and the ceiling, (iii) arch nest—nest built between the arch and the ceiling, (iv) wall nest—nest built between the wall and

the ceiling and (v) hole nest—nest built in the holes of the walls of the building. In both the areas nests of the ground floor were situated at a height of about 6 metres and in the first floor about 11 metres from the ground.

Table 1 : Showing the distribution of nests in different sites.

Nesting sites	Total no. of nests	Nesting areas	
		Aasiatic society building	Jaganath hall
Ceiling nest	13	9	4
Beam nest	32	26	6
Arch nest	11	9	2
Wall nest	6	6	—
Hole nest	3	—	3
Total	65	50	15

Nesting materials:

The House Swift carried feathers of several species of birds e. g. *Corvus macrorhynchos*, *C. splendens*, *Milvus migrans*, *Psittaculus krameri*, *Oriolus xanthornus* and Domestic Fowl. Other nesting material were leaves of Onion, leaf bud of Gold Mohor, flowers of Graminae plant, seeds of *Anthocephalous kadamba*, pieces of white paper and rubber. The lining of the nest-cup was composed of either flowers of Graminae plant or down feathers of birds.

Collection of nesting material:

A constant watch was kept on one nest for two hours daily and two nests for one hour daily. The collection was rapid in the morning, gradually fell towards and again rose steadily towards afternoon, stopping suddenly later in the evening. The male was more active in the collection of nesting material than the female (Table 2).

Table 2 : Rate of collection of nesting material by pair no. 14 for 10 hours.

Collection of nesting material by	Rate of collection of nesting material in different hours										
	8 am. to 9 am.	9 am. to 10 am.	10 am. to 11 am.	11 am. to 12 am.	12 am. to 1 pm.	1pm. to 2 pm.	2 pm. to 3 pm.	3 pm. to 4 pm.	4 pm. to 5 pm.	5 pm. to 6 pm.	Ave- rag- e.
Male	2	10	9	5	2	1	4	5	8	7	6
Female	2	3	2	1	1	—	2	2	2	2	1.6

Nest building activities were not restricted to new nests only. New nests took more time and old nests took less time to be constructed and re-constructed.

After the breeding seasons the occupants used the nests as roosting place but at the beginning of the breeding season they only reconstructed the nests.

Eggs

Egg laying :

In the October-April breeding season, first egg laying started on 26th January and ended on 26th February. In the May-August breeding season, first egg laying started on 28th May and ended on 30th June. All the eggs were laid at night with an average interval of 2.37 days. The two-egg clutches were proportionately more in the October-April breeding season, but the three-egg clutches were proportionately more in the May-August season. Percentage of laying in the October-April season was maximum with clutch size 2, producing 49.2% and minimum with clutch size 4, producing 3.17%. Percentage of laying in the May-August breeding season was maximum with clutch-size 3, producing 63.52% and minimum with clutch-size 4, producing 4.7%. The mean clutch-size was 2.39 and 2.61 in the October-April and May-August breeding season respectively. All the pairs laid eggs only once in both the breeding seasons, with few exceptions in the October-April breeding season.

Nature of eggs :

The eggs were pure white just after laying, but became bluish white with the advancement of incubation. All the eggs were typically longish oval but a little pointed in the case of eggs having length of 25 mm. The length of eggs of both the seasons varied from 22 mm-27 mm with an average of 24.2 mm and the breadth varied from 13-16 mm with an average of 14.6 mm. The average weight of the eggs was 3.1g in the October-April and 3.3 g in the May-August breeding season.

Table 3 : Incubating and non-incubating (interval period) time by the female in nest No. 1 on the 10th day of incubation.

Time		Not incubating (in minutes)	Incubating (in minutes)
From	To		
6 : 45	— 7 : 35	—	51
7 : 36	— 7 : 47	12	—
7 : 48	— 8 : 40	—	52
8 : 41	— 9 : 05	25	—
9 : 06	— 10 : 45	—	100
10 : 46	— 11 : 00	15	—
11 : 01	— 11 : 55	—	55
11 : 56	— 12 : 14	19	—
12 : 15	— 12 : 35	—	81
13 : 36	— 13 : 59	24	—
14 : 00	— 14 : 58	—	58
14 : 59	— 15 : 20	22	—
15 : 21	— 16 : 30	—	70
16 : 31	— 16 : 50	20	—
16 : 51	— 17 : 35	—	45
17 : 36	— 17 : 42	7	—
17 : 43	— wholenight.	—	till morning.

Incubation :

Both the sexes were found to incubate the eggs. But the female took more interest in incubation. The male occasionally incubated the eggs which ranged from five to ten minutes at a stretch. Incubation of the eggs continued for the whole night but not for the whole day. The female went out at intervals only to take food. The incubation period in the day time ranged from 45 minutes to 100 minutes at a stretch (Table 3).

In the October-April breeding season, 47.61% of the eggs were incubated for 26 days, 12.69% for 25 days and 1.58% for 24 days, the average being 25.70 days. In the May-August breeding season, 22.94% of the eggs were incubated for 24 days, 19.41% for 23 days and 17.64% for 22 days, and the average being 22.91 days (Table 4).

Table 4 : Incubation periods in days.

Breeding seasons	Incubation periods in days	No. of eggs hatched	% of hatching
October-April	24	2	1.58
	25	16	12.69
	26	60	47.61
May-August	22	30	17.64
	23	32	19.41
	24	39	22.94

Hatching

All the eggs hatched at night. In the October-April breeding season, out of 126 laid eggs 100 (79.36%) were available for hatching, of which 78 (61.9%) hatched. In the May-August breeding season, out of 170 laid eggs, 131 (77.05%) were available for hatching, of which 102 (60%) hatched (Table 5). In the October-April breeding season, the mean brood size was 1.95 and in the May-August breeding season it was 2.21 (Table 6).

Table 5 : Hatching success.

Breeding season	No. of Eggs laid	Eggs available for hatching	No. of eggs hatched	% of hatching success
October-April	126	100	78	61.90
May-August	170	131	102	60

There were 40 broods in 40 nests against 52 clutches of 46 nests in the October-April season. Of these 12 clutches in all failed to raise any brood. There were 46 broods in 46 nests as against 65 clutches in 65 nests in the May-August season. Of these, 19 clutches in all failed to raise any brood.

Table 6 : Brood size.

Breeding season	No. of broods with complete no. of nestlings of			Total no of broods	Mean brood size
	1	2	3		
October-April	4	34	2	40	1.95
May-August	2	32	12	46	2.21

Post hatching

Types of food :

Both the parents shared the feeding activities. They brought various insects such as Zigzag leafhopper, fire bat, horse fly, pulse beetle, grasshopper, leaf-hopper, flower beetle, coreid bug, plant-hopper, dipterans, hymenopterans for their nestlings.

Time of feeding :

The number of feeding visits was the highest in the morning and lowest at noon in both the seasons (Table 7). The male's and female's average feeding visits per nestling with a brood size 1 were found to be 5 and 3 in the October-April; and 6 and 2 in the May-August breeding season. The brood size 2 received 6 feeding visits from male and 3 from female per hour in the October-April; and 7 from male and 3 from female in the May-August breeding season. The brood size 3 received 8 feeding visits from male and 2 from female per hour in the October-April; and 8 from male and 3 from female per hour in the May-August season.

Table 7 : No. of feeding visits in the morning, noon, afternoon for one hour in nest No. 1.

Breeding season	Time	No. of feeding visits on (date)					Mean
		15th March	16th March	17th March	18th March	19th March	
		7	8	8	8	9	8
October-7-8	A. M.						
April	12-1 P. M.	2	3	4	2	4	3
	4-5 P. M.	5	6	6	6	5	5.6
May-7-8	A. M.	7	8	9	9	9	8.4
August							
	12-1 P. M.	3	3	4	4	3	3.4
	4-5 P. M.	6	6	6	7	7	6.4

The weight of newly hatched nestling varied from 1.7 to 2.0 g, the average being 1.86 g in the October-April; the weight of newly hatched nestling varied from 1.8 to 2.1 g, the average being 1.98 g in the May-August breeding season. In the October-April season, the average individual nestling's weight was 28.1 g, ranging from 26.00 g to 30.5 g. In the May-August season, the average individual nestling's weight was 29.6 g ranging from 28.5 g to 31.00g.

Loss or infertility of eggs :

Out of 126 eggs laid in the October-April breeding season, 48 were lost or infertile. This loss included 22(17·46%) ejected by the House Swifts, 22(17·46%) infertile and 4(3·17%) damaged during handling. Out of 170 eggs laid in the May-August breeding season, 68 were lost or infertile. This loss included 30(17·64%) ejected by the House Swifts, 29(17·05%) infertile and 9(5·29%) damaged during handling. 2 clutches were completely infertile while 13 clutches were partially fertile in the October-April breeding season. 7 clutches were completely infertile while 7 clutches were partially fertile in the May-August breeding season.

Loss of nestlings :

In the October-April breeding season, out of 78 nestlings in two areas, 54 were lost ; and in the May-August season, out of 102 nestlings, 60 were lost during the feeding period due to starvation and fall-off (Table 8).

Table 8 : Causes of nestling losses.

Breeding season	Total No. of broods	Total No. of nestlings	No. and percentage of nestlings failed to fledge due to :		Total loss
			Starvation	Fall off	
October-April	40	78	21(26·92%)	33(42·3%)	54(69·23%)
May-August	46	102	27(26·47%)	33(32·35%)	60(58·8%5)

DISCUSSION

Nesting

Nesting site :

Referring to the nesting habit of *Apus affinis* (J. E. Gray) in South Africa, Siegfried (1968) cites Brooks and Vernon who found in three storied buildings. But Siegfried

(1968) does not mention the exact floor or floors where the nests were built. In the present case, the nests were found in the ground floor of Asiatic Society building, and ground and first floors of Jagannath Hall (North) though the majority (80%) of the same was in the first floor.

However, there were at least five kinds of nesting sites such as (i) ceiling nest, (ii) beam nest, (iii) arch nest, (iv) wall nest and (v) hole nest in both the breeding seasons to the places where the nests were built. It may be pointed out that the "ceiling-beam", "ceiling-wall" and "ceiling-arch" sites from "L" shaped spaces which give firm support on two sides. The birds seem to take the advantage of this arrangement, as 75.3% of the nests were situated at these "Angles".

Nesting material :

The House Swifts carried mainly the feathers of different birds as their nest building material. The nest cup was lined mainly with flowers of the Graminae plant.

Egg laying :

The egg laying started from January 26th and continued till February 26th in the October-April breeding season. The laying was maximum in February with 60.3% eggs and it was minimum in January with 39.6% eggs.

During the May-August breeding season, egg laying started from 28th May and continued till June 30th. The laying was maximum in June with 95.8% and it was minimum in May with 4.1% eggs.

Clutch size :

The clutch size of the House Swift varied from 2 to 3 eggs, a four-egg clutch was rarely laid. This is in agreement with the observations of the other workers, that several species of *Apus* do not lay more than 4 eggs in a clutch (Morean 1942, Lack and Lack 1951). The clutch size showed difference from the observations of Razack and Naik (1964) who noted clutch size 1.

Interval of laying :

The interval between the laying of successive eggs was different for the two

and three egg clutches in different breeding seasons. But according to Razack and Naik (1964) the interval was about the same for the two and three egg clutches in different breeding season. Lack (1954) observed that the weather had some effect on the interval of laying in *Apus apus* (Sweinoe). But the present authors did not find any effect of the weather on the interval of laying of *Apus affinis*.

Egg :

The average weight of eggs was 3.1 g in the October-April and 3.3 g in the May-August breeding season.

Incubation :

The incubation period in the October-April breeding season varied from 24 to 26 days, the average being 25.7 days. The incubation period in the May-August breeding season varied from 22 to 24 days, the average being 22.92 days. But according to Razack and Naik (1964) the variations were 18-26 days in Boroda of Gujarat, India. Both the sexes took part in incubation which was also mentioned by Ali (1979).

On an average from the 16th day after laying, the eggs were found to loss weight that varied between 0.2 and 0.85 g. Wallace (1963), referring to birds in general, said that this loss of weight of eggs prior to hatching was due to evaporation with continued incubation and with rising temperature.

Nestling :

The food-begging call and the highly vascularized buccal cavity of nestling probably acted as releasers to the parents for feeding the young. Both the sexes took part in brooding the youngs, but the female was more active than the male. There appears to be some co-relation between the increase in weight and the opening of eyes, that is, the eyes opened when the nestlings weighed between 9 and 12 g in both the breeding seasons.

Feeding :

Various winged insects were the food material of youngs. These were caught during flight with open mandibles of the swifts. As the youngs were too small to take food without others help, parents fed them directly dropping food from their gullet in the open

mouth of the nestlings. When the parents entered the nest with food, a competition took place among the hungry nestlings. Therefore, the strongest young had the food first and then the less stronger and so on.

Breeding success :

The percentage of total breeding success was 19.04% (Table 9) which was much lower than those of hatching and fledging successes which were 61.9% and 30.7% respectively in the October-April breeding season. The percentage of total breeding success was 24.7% (Table 9) which was much lower than those of hatching and fledging successes which were 60% and 41.1% respectively in the May-August breeding season.

Table 9 : Showing the breeding success.

Breeding seasons	Total No. of eggs laid	Total No. of eggs hatched	No. of nestlings leaving the nests	Percentage of breeding success (in relation to laying)
October-April	126	78(61.90%)	24	19.04
May-August	170	102(60.00%)	42	24.70

The higher percentage of breeding success in the May-August breeding season than that in the October-April breeding season was probably due to the favourable climatic conditions and abundance of food for the nestlings.

SUMMARY

A study was made on the breeding biology of the House Swift, *Apus affinis* (J. E. Gray) from August, 1975 to August, 1976, in two areas of Dhaka city. The bird was found to be a resident species, nesting in colonies. The swift was found to have two breeding seasons in a year. Total breeding success was 19%, 19.04% in the October-April and 24.7% in May-August breeding season. Ejection and infertility were the main causes of egg failure and fall-off and starvation were the main causes of loss of nestlings.

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ON THE GENUS *RHAGOVELIA* MAYR FROM INDIA WITH A NEW
RECORD AND DESCRIPTION OF A NEW SPECIES
(RHAGOVELIINAE : VELIIDAE : HETEROPTERA)

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INTRODUCTION

The knowledge on the genus *Rhagovelia* Mayr from India was based on recording of species from different parts of the country (Distant, 1910 ; Paiva, 1919 ; Hafiz and Mathai, 1938 ; Hafiz and Ribeiro, 1939 ; Pradhan, 1950 ; Thirumalai, 1989). While studying the Rhagoveliinae of Oriental region, Lundblad (1936) described *R. tibialis* from S. India and *R. sumatrensis* from Indonesia and Sikkim, based on few examples with inadequate morphological characters and without detailed figures. In the present study, *R. ceylanica* Lundblad, hitherto, known from Sri Lanka, is recorded for the first time from India and a new species of the genus is described from Western Ghats. Besides, a detailed description of *R. ceylanica* and *R. tibialis* additional taxonomical characters are also figured for the first time in this paper. A key to all the Indian species is also given. The study is based on materials collected by the author from different parts of Eastern and Lower Western Ghats of Tamilnadu and Kerala over a period of eleven years.

The genus *Rhagovelia*, cosmopolitan in distribution, is characterised by the presence of a deep cleft in middle tarsi which possess leaf like claws and plumose hairs, arising from the base. The hind tarsi is three segmented. Both winged and apterous forms are commonly encountered. Out of nearly 150 species of *Rhagovelia* known,

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about 100 of these are new world species. There are 13 Oriental species and three of which so far known to occur in India [includes *R. (R). nigricans* (Burmeister)]. The members of the genus have been recorded to occur in streams, rivers and springs.

Key to the Indian species of *Rhagovelia*

1. Pronotum long ; mesonotum less exposed ; hind trochanters unarmed. (Subgenus *Rhagovelia*) 2.
- Pronotum short ; mesonotum completely exposed ; hind trochanters armed (Subgenus *Neorhagovelia*) 3.
2. Body length 3·8 mm or more ; hind femora in males distinctly swollen ; two to three & half times as long as wide ; hind femoral spines absent in females
... .. *Rhagovelia (R) tibialis* Lundblad.
- Body length less than 3·8 mm ; hind femora in males not so proportionate ; hind femoral spines present in both sexes *Rhagovelia (R) ceylanica* Lundblad.
3. Abdomen more broader than long ; hind femora in males with 4-5 stout marginal spines *Rhagovelia (N) sumatrensis* Lundblad.
- Abdomen narrower and cylindrical ; hind femora in males with 1-2 stout marginal spines *Rhagovelia (N) nilgiriensis* sp. nov.

Rhagovelia (Rhagovelia) tibialis Lundblad

(Fig. 1 a-r)

1936. *R. tibialis* Lundblad, *Arkiv. Zool.*, 28 : 31.

Size	Length of body	Width of head (including eyes)	Width of Pronotum
Apterous male	3·8-4·5 mm	0·95 mm	1·3 mm
Apterous female	3·9-4·7 mm	0·94 mm	1·04 mm
Winged male	4·1-4·2 mm	0·92 mm	1·6 mm
Winged female	4·2-4·7 mm	0·99 mm	1·7 mm

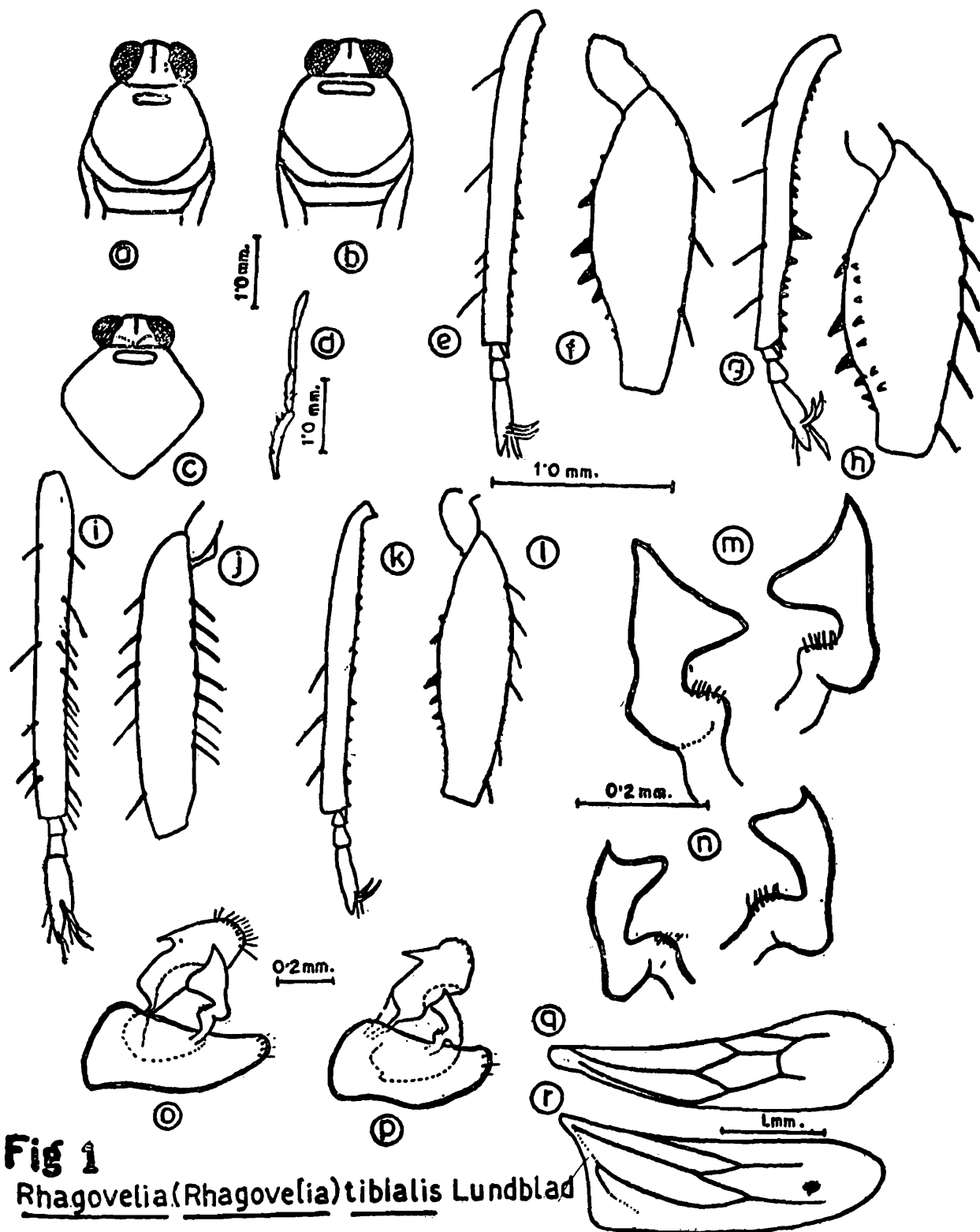


Fig 1
Rhagovelia (Rhagovelia) tibialis Lundblad

Fig. 1: *Rhagovelia (Rhagovelia) tibialis* Lundblad

- a. Dorsal view of head & thorax apterous male, b. Dorsal view of head & thorax apterous female, c. Dorsal view of head & pronotum winged male, d. Antenna of apterous male, e. g. Hind tibiae & tarsi of apterous males, f, h. Hind femora of apterous males, i. Hind tibia & tarsi of apterous female, j. Hind femur of apterous female, k. Hind tibia & tarsi of winged male, l. Hind femur of winged male, m. Left and right parameres of apterous male, n. Left and right parameres of winged male, o. Lateral view of genital segments of apterous male, p. Lateral view of genital segments of winged male, q. Fore wing, r. Hind wing.

Colour : Robust, black ; basal one-third of 1st antennal segments, all coxae, trochanters, basal half of fore femora, basal one-third of hind femora dark yellow ; antennae, legs, dark shining brown ; fore and hind wings dark brownish black ; pronotum with an orange elongate spot at anterior part below vertex ; lateral sides of thorax, tergites, connexiva with long brown hairs, denser towards connexival apices ; legs longly hairy ; venter black, hairy, genital segments brown.

STRUCTURAL CHARACTERISTICS

Apterous male : Head with a central median impressed line reaching middle of vertex ; a pair of oblique impressed line posteriorly, directed backwards ; rostrum reaching up to anterior coxae. Pronotum much longer than an eye, 1.2 x broader than long ; a little more twice longer than head on middle line ; posterior margin concave, exposing meso and metanota ; mesonotum short ; 2x shorter than metanotum. Abdominal tergites 1.6 subequal in length ; tergite 7 a little broader than long ; first genital segment not carinate ventrally ; connexiva obliquely upturned, without spines ; genital segments cylindrical, longly hairy, viewed laterally as in Fig. 1 o ; parameres symmetrical (Fig. 1 m).

Antennae I longest, curved, III & IV equal, II and shortets, length of antennal segments (mm) I-IV : 0.8, 0.4, 0.5, 0.5. Fore tibia broad, distally with a short tibial comb, I & II tarsi minute ; middle leg longest, hind tibia a little longer than mid tibia ; hind femur swollen, 2-3.5 x as long as broad, a row 4 stout short, thick curved spines below, armed with minute spines and pegs as in (Fig 1.f, h), hind tibia curved, armed with a row of short spines, some times the central one longest (Fig. 1.e, g) ; measurement of legs (mm) :

	Femur	Tibia	Tarsi
Fore leg	1.2	1.2	0.03, 0.03, 0.3
Middle leg	1.9	1.7	0.1, 0.7, 0.9
Hind leg	1.7	1.8	0.1, 0.12, 0.4

Apterous female : Similar to apterous male ; fore tibia lacks tibial comb ; hind femur not swollen and without spines (Fig. 1.j) ; hind tibia bare without spines (Fig. 1.i) ; tip of connexiva with a thick tuft of dark hair-like bristles looking like connexival

spines; antennae a little shorter than male, measurement of segments I-IV(mm) : 0.8, 0.43, 0.52, 0.4; measurement of legs (mm) :

	Femur	Tibia	Tarsi
Fore leg	1.1	1.1	0.03, 0.03, 0.3
Middle leg	1.7	1.4	0.12, 0.7, 0.8
Hind leg	1.4	1.6	0.1, 0.1, 0.4

Winged male : Pronotum as long as broad, gradually tapering, tip rounded (Fig. 1.c); connexiva broader than apterous forms, not obliquely upturned; femora with spines, same as that of apterous males (Fig. 1.l); hind tibia without a distinct midspine (Fig. 1.k); fore and hind wings as in fig. 1.q & r; paired longitudinal carinae on 2 & 3 abdominal tergites; otherwise similar to apterous male; measurement of legs (mm) :

	Femur	Tibia	Tarsi
Fore leg	1.1	1.2	0.03, 0.03, 0.3
Middle leg	1.8	1.4	0.1, 0.7, 0.8
Hind leg	1.5	1.6	0.1, 0.1, 0.4

Winged female : Same as winged male; fore tibia without comb, hind femur and tibia unarmed; hind femur shorter than tibia; measurement of legs (in mm) :

	Femur	Tibia	Tarsi
Fore leg	1.1	1.2	0.03, 0.03, 0.3
Middle leg	1.7	1.4	0.1, 0.7, 0.8
Hind leg	1.2	1.5	0.1, 0.1, 0.4

Material examined : Apterous 10 males, 14 females, winged 3 males, 1 female from Kummatamthodu, Silent valley, Kerala, alt. 910 M, 30. IV. 1960, coll. : R. S. Pillai, apterous 2 males, 9 females from a jungle stream above Singara Power House, Mudumalai Nilgiris, alt. 950—1000 M, 25.II.1988, coll. : M. Vasanth; apterous 4 males, 10 females winged 1 female, 5 immature stages from a jungle stream on the way to Siruvani

Dam site, Siruvani, Coimbatore, alt. 680 M, 11.II.1989 and apterous 2 females from Honnety Gunshola, Kothagiri, Nilgiris, alt. 1740 M, 12.II.1989, coll. : G. Thirumalai.

Distribution : India : Kerala, Tamilnadu.

Remarks : Lundblad (1936) while describing *R. tibialis* from Anamalai, Coimbatore District, Tamilnadu based on one male and two females (apterous) stated that the arrangement of spines in hind femora and a thick distinct spine in the middle portion of hind tibia are the distinguishing characters of the species. However, there was no subsequent report of the species from India or elsewhere. In the present study dealing with a series of specimens from different localities indicates that the presence of a distinct central spine in hind tibia is not a constant character, as different degrees of spine development ranging from total absence to well developed ones are met within apterous males, but absent in winged males. However, the parameres of both forms are similar showing no variation in size or shape. The femora are distinctly swollen in males (two to three and half times as long as wide) and not so in females.

Rhagovelia (*Rhagovelia*) *ceylanica* Lundblad

(Fig. 2 a-r)

1936. *R. ceylanica* Lundblad, *Arkiv. For Zoologi*, 28 : 32.

1979. *R. ceylanica* Polhemus, *Bull. Fish Res. Stn. Sri Lanka*, 29 : 97.

1989. *R. nigricans* Thirumalai, *Rec. Zool. Surv. India Occ. Pap.*, 118 : 51.

Size	Length of body	Width of head (including eyes)	Width of Pronotum
Apterous male	3.0-3.5 mm	0.75 mm	1.1 mm
Apterous female	2.6-3.4 mm	0.7 mm	1.1 mm
Winged male	3.1-3.4 mm	0.75 mm	1.3 mm
Winged female	3.1-3.3 mm	0.7 mm	1.3 mm

Colour : Dull black; basal one third of 1st antennal segment, all coxae, trochanters, basal half of fore femora yellow; legs, tergal segments, antennae brown; last abdominal segments, genital segments dark brown; fore wings brown, hind wings pale; connexivum yellow to dark brown. Pronotum with a pair of elongate yellow marking on anterior part below vertex. Venter black, covered with short silvery hairs, dorsal

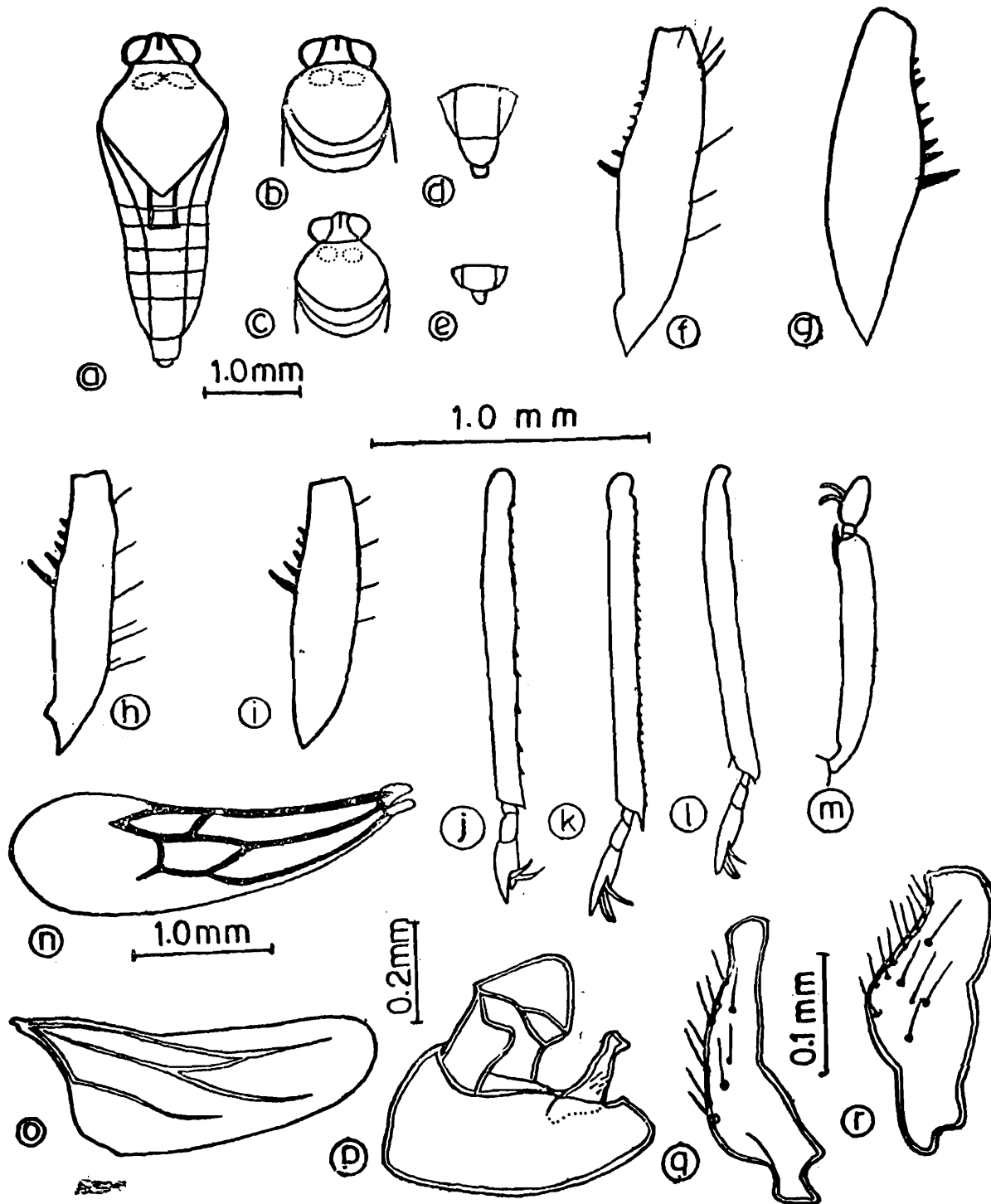


Fig.2

Rhagovelia (Rhagovelia) ceylanica Lundblad

Fig. 2 : *Rhagovelia (Rhagovelia) ceylanica* Lundblad

a. Dorsal view of winged male, b. Dorsal view of head & thorax of apterous male, c. Dorsal view of head & thorax of apterous female, d. Last dorsal abdominal segments of apterous male, e. Last dorsal abdominal segments of apterous female, f. Hind femur of winged male, g. Hind femur of apterous male, h. Hind femur of winged female, i. Hind femur of apterous female, j. Hind tibia & tarsi of apterous male, k. Hind tibia & tarsi of winged male, l. Hind tibia & tarsi of apterous female, m. Fore tibia & tarsi of apterous male, n. Fore wing, o. Hind wing, p. Lateral view of genital segments of apterous male, q. Paramere—lateral view, r. Paramere—dorsolateral view.

side of body with golden pilosity ; lateral sides of thorax, genital segments, apex of connexivua, femora, tibiae with erect brown hairs ; legs longly hairy.

STRUCTURAL CHARACTERISTICS

Apterous male : Head with a central median impressed line reaching middle of vertex ; rostrum reaching up to anterior coxae. Pronotum 1.3 x wider than long, longer than head on middle line ; posterior margin concave, exposing meso- and metanotum ; mesonotum short, 2 x shorter than metanotum. Abdominal tergites 1 to 6 subequal in length ; 7th tergite longer than first genital segment, not carinate ventrally ; connexivum hairy without spines ; genital segments cylindrical, longly hairy ; seen laterally as in Fig. 2.p ; parameres symmetrical, viewed in different angles as in Fig. 2.q, r.

Antennae long, Ist longest, stout, curved, rest slender, III & IV subequal, II shortest, length of segments I-IV (mm) : 0.65, 0.4, 0.55, 0.5. Fore tibia broad distally with a short tibial comb (Fig. 2 m), I & II tarsi minute ; middle leg longest, middle tibia almost equal to hind tibia ; hind femur stout, armed beneath with spines from middle to apex, 7 or 8 in a row, gradually reducing in size, central being the longest and curved (Fig. 2. g), hind tibia armed with a single row of small teeth (Fig. 2. j) ; measurements of legs (in mm) :

	Femur	Tibia	Tarsi
Fore leg	0.8	0.85	0.02, 0.02, 0.2
Middle leg	1.5	1.4	0.1, 0.4, 0.6
Hind leg	1.2	1.3	0.04, 0.1, 0.3

Apterous female : Similar to apterous male, except in the absence of fore-tibial comb, lesser number of spines in hind femur (4-5) (Fig. 2 i), hind tibia unarmed (Fig. 2. l). Connexivua a little more raised than in apterous male, tips with long numerous erect hairs. Antennae a little shorter, measurements of segments I-IV (mm) 0.55, 0.35, 0.5, 0.45. Measurements of legs (mm) :

	Femur	Tibia	Tarsi
Fore leg	0.7	0.8	0.02, 0.02, 0.2
Middle leg	1.3	1.1	0.1, 0.4, 0.6
Hind leg	1.1	1.1	0.04, 0.1, 0.3

Winged male (Fig. 2 a) : Pronotum as long as broad, gradually tapering, tip pointed, lateral angles broadly rounded ; connexivum broader than apterous forms, not obliquely curved ; hind femur and tibia as in Fig. 2 f, k ; mid & hind tibia equal in length ; fore and hind wings as in Fig. 2 n, o ; II & III abdominal tergites with paired longitudinal carinae ; tergites dark brown ; rest of the characters same as that of apterous male ; measurements of antennal segments I-IV (mm) : 0.6, 0.35, 0.45, 0.4 ; measurement of legs (mm) :

	Femur	Tibia	Tarsi
Fore leg	0.8	0.8	0.02, 0.02, 0.2
Middle leg	1.4	1.2	0.1, 0.4, 0.6
Hind leg	1.2	1.2	0.04, 0.1, 0.3

Winged female : Same as winged male ; fore tibia without tibial comb, mid and hind tibia subequal in length ; margins of last connexivum segments with tufts of long hairs ; VIII tergum broader than long ; hind femur as in Fig. 2 h ; measurements of antennal segments (mm) I-IV : 0.6, 0.35, 0.4, 0.4. Measurements of legs (mm) :

	Femur	Tibia	Tarsi
Fore leg	0.7	0.7	0.02, 0.02, 0.2
Middle leg	1.4	1.0	0.1, 0.4, 0.6
Hind leg	1.0	1.1	0.04, 0.1, 0.2

Distribution : India : Tamilnadu (Present record) ; Sri Lanka.

Material examined : Apterous 8 males, 18 females ; winged 3 males, 1 female from Amirdi, Javadi Hills, Tamilnadu, alt. 240 m, 2. V. 1984, coll. : Thirumalai ; apterous 2 males, 6 females from River Arjuna, Pilavakal Dam site, Tamilnadu, 14. VIII. 1987, coll. : Thirumalai ; apterous 33 males, 37 females, winged 1 male, 4 females & 28 immature stages from Arikkulam, Kanyakumari, Tamilnadu, 14.III. 1989. coll. ; K. V. L. Narayana.

Remarks : The present record of *R. ceylanica* is the first report of the species from India. While studying aquatic and semi-aquatic Hemiptera of Tamilnadu, this species was erroneously identified as *R. nigricans* (Burmeister) (Thirumalai, 1989).

Further, the report of *R. nigricans* from different localities from India by Hafiz & Mathai (1938), Hafiz & Ribeiro (1939) and Pradhan (1950) could also refer to the present species. *R. ceylanica* can easily be differentiated from *R. nigricans* by the absence of stiff blunt spines at the base of middle femur. According to Lundblad (1936), the parameres of *R. ceylanica* is not strongly twisted and not as broad as that of *R. nigricans*, even though the tip is obliquely pointed, thus appearing somewhat similar.

Rhagovelia (Neorhagovelia) nilgiriensis sp. nov.

(Fig. 3. a-p)

Size	Length of body	Width of head (including eyes)	Width of Pronotum
Apterous male	2.1 to 2.5 mm	0.6 mm	0.6 to 1.0 mm
Apterous female	2.2 to 2.8 mm	0.7 mm	1.0 to 1.2 mm
Winged male	2.5 mm	0.6 mm	0.8 mm
Winged female	2.9 mm	0.7 mm	1.1 mm

Colour : Black : a transverse yellow rectangular fascia on anterior margin of pronotum below interocular space of head ; antennae and legs dark brownish black except base of first antennal segments, coxae, trochanters and basal half of front femora, yellow ; thoracic pleura and venter black, covered with frosty grey ; genital segments brown, shining ; body and legs hairy.

STRUCTURAL CHARACTERISTICS (mm)

Antenna : 1 : 2 : 3 : 4 : 0.45, 0.3, 0.35, 0.4 (Fig. 3k)

	Femur	Tibia	Tarsi
Male :			
Front leg	0.6	0.7	0.04 (1+2), 0.15
Middle leg	1.2	0.8	0.08, 0.4, 0.6
Hind leg	0.9	0.9	0.04, 0.04, 0.2

Female :

Front leg	0.65	0.7	0.04 (1+2), 0.15
Middle leg	1.14	0.85	0.08, 0.35, 0.6
Hind leg	0.9	0.9	0.04, 0.04, 0.2

Head including eyes twice wider than long in male, two and a half times wider in female. Pronotum shorter than length of an eye, its rear margin weakly undulate. Mesonotum large, broadly rounded, medially slightly concave, exposing metanotum on sides and rear.

Apterous male (Fig. 3 a): Trochanters armed with very short thornlike spines; fore femur slightly shorter than tibia, armed with minute spines basally (Fig. 3 m); fore tibia broad distally with a longitudinal comb-like ridge at the distal end (Fig. 3 h); first and second tarsi minute; middle femur longest; hind femur armed with spines, the arrangement as in (Fig. 3 d, e); hind tibia incrassate, hind tarsi with third segment longest, first and second being equal. Pronotum at middle three times wider than long: mesonotum wider than long (3:5). Genital segments a little longer than the last abdominal tergite. Connexivum well developed. Black minute spines on the posterior margin on the seventh abdominal segment (Fig. 3.1). Lateral view of genital segments as in (Fig. 3 j); parameres symmetrical, narrowing towards tip, tip bent and pointed (Fig. 3.i).

Apterous female (Fig. 3 b): Fore tibia without comb; hind femur with spines as in (Fig. 3 f,g). Connexivum flat, moderately curved and terminating into a small spine reaching eighth abdominal tergite (Fig. 3 n). Seventh abdominal tergite with its basal width a little shorter than its length. *Winged male*: Pronotum broad wider than long (5:4) broadly rounded, tip triangular (Fig. 3 c). Meso- and metanota completely hidden. Tegmina and wing as in (Fig. 3 o. p). Rest same as that of apterous male. *Winged female*: Same as that of winged male. Pronotum slightly longer than the winged male.

Distribution : India : Tamilnadu.

Material examined : Holotype : Apterous male (pinned), from a mountain stream, foot hills of Kallukothimalai, Siruvani, Coimbatore, Tamilnadu, alt. 400 M, coll. : Thirumalai, 15 Feb, 1989.

Paratype : Apterous 35 males, 51 females; winged 1 male, data same as holotype, apterous 3 males, 3 females, 9 immature stages from a way side running stream, Samyarpallam, Siruvani, Coimbatore, Tamilnadu, alt. 460 M, coll. : Thirumalai, 14 Feb,

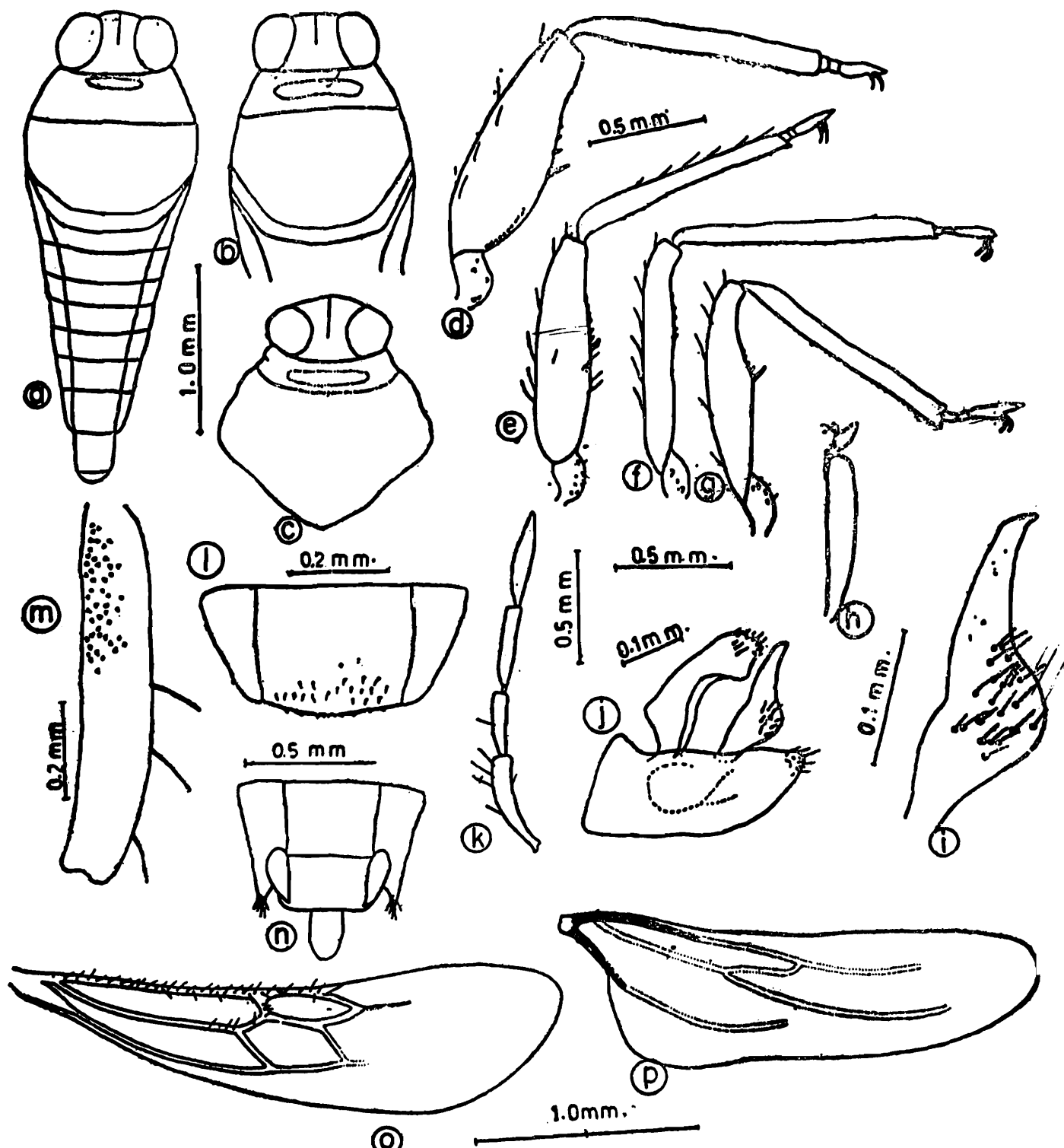


Fig 3

Rhagovelia (Neorhagovelia) nilgiriensis sp. nov.

Fig. 3: *Rhagovelia (Neorhagovelia) nilgiriensis* sp. nov.

a. Dorsal view of apterous male, b. Head & thorax of apterous female, c. Head & pronotum of winged male, d & e. Hind legs of apterous male, f & g. Hind legs of apterous female, h. Fore tibia & tarsi of apterous male, i. Paramere lateral view of apterous male, j. Genital segments lateral view of apterous male, k. Antenna of apterous male, l. Seventh dorsal abdominal segment of apterous male, m. Fore femur of apterous male, n. Last dorsal abdominal segments of apterous female, o. Tegmina, p. Wing.

1989 ; apterous 1 male, 8 immature stages from running stream at Kallukothimalai, Siruvani. Coimbatore, Tamilnadu, alt. 420 M, coll. : Thirumalai, 8 Feb, 1989 ; apterous 15 males, 16 females, 6 immature stages from a mountain stream between Gudalur and Nadugani, Nilgiris, Tamilnadu, alt. 1000 M, coll. Thirumalai, 29 Mar, 1991 ; apterous 1 male from a jungle stream, Siruvani, Coimbatore, alt. 1500 M, coll. : Thirumalai, 6 Feb 1992 ; apterous 1 male, 2 females, winged 1 female from Kovaicourtalam stream, Siruvani, Coimbatore, alt. 600 M, coll. : Thirumalai.

Remarks : This is the first record of the subgenus *Neorhagovelia* from India. From the known species of this subgenus, this species can be differentiated by the structure of paramere, the armed nature of all trochanters, the presence of a small connexival spine in female, the black minute spines on the posterior margin of the male seventh abdominal segment, the character of the fore femur and other characters mentioned in the text.

The type material is deposited in Southern Regional Station of Zoological Survey of India, Madras and will be transferred to the National Collections of ZSI, Calcutta in due course.

SUMMARY

This study reports a new species of the genus *Rhagovelia* and records *Rhagovelia ceylanica* Lundblad and the subgenus *Neorhagovelia* for the first time from India. A detailed description of *R. ceylanica* and *R. tibialis* Lundblad together with many new taxonomical characters are figured for the first time. A key to the Indian species of the genus is also provided.

ACKNOWLEDGEMENTS

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SOME ASPECTS OF WATER QUALITY IN A SHALLOW POND OF UDAIPUR, RAJASTHAN

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INTRODUCTION

Shallow water cemented ponds are commonly used for rearing carp seed, ornamental fish and plants. Such pond eco-systems are also comparable to the standing waters of swimming pools. In latter, the maintenance of water quality is an important aspect for having reduced algal population and high transparency. Thus, the studies on shallow water eco-systems may prove useful in efficient management of such systems for their appropriate use.

Udaipur waters including large reservoirs, lakes and temple tanks have been the foci for limnological researches (Vyas, 1968 ; Sharma, 1980 ; Sharma and Durve, 1982 ; Madhusudan *et al.*, 1984 ; Kumar, 1987 ; Rao, 1987 and Karki, 1988). In the present investigation, a shallow water pond of Udaipur has been studied.

MATERIAL AND METHODS

The shallow ponds selected for this study is located in the College campus (73°43'10"E long. and 24°34'46"N lat.) at Udaipur. This pond has a water spread of 242 sq. m. and average depth of 0.80 m. Surface and bottom water samples from shallow pond mentioned above were collected during April-June, 1988. A vandorn sampler was used for collecting bottom water samples at weekly intervals. Measurements for water clarity, air and water temperature were made at the pond site. Similarly, analysis for pH, dissolved-oxygen, free carbondioxide and alkalinities were made at the pond site immediately after collecting the sample. However, for analysing rest of the parameters *viz.* electrical conductivity, nitrate and orthophosphate, the samples were brought

Table 1 : Variation in physico-chemical factors in R. C. A. pond during April-June, 1988.

Parameters	April		May				June				Overall Average		
	23	29	5	11	17	23	29	4	10	16		22	29
Depth of Visibility (Cm)	87	61.50	61	63	64	66.30	90	80	78	75.50	82	80	74.35
Water Tempt. (S)	26.5	29	28	29.5	28	30	28.5	30	30.5	29	29	29	28.91
(B)	26	28.5	27.5	29	27	28.5	27.5	29	29	28	29.5	28	28.12
pH (S)	7.60	7.50	7.00	7.50	7.55	7.80	7.95	8.10	8.05	8.10	8.00	7.80	7.74
(B)	7.50	7.50	7.20	7.20	7.40	8.10	7.80	8.00	8.00	8.05	8.00	7.95	7.72
Dissolved Oxygen (ppm) (S)	4.48	3.92	4.20	1.82	3.64	3.08	2.80	1.82	1.68	1.96	2.46	8.26	3.34
(B)	3.36	3.64	3.64	1.68	3.36	3.41	2.24	1.51	1.54	1.68	2.12	7.84	3.00
Free CO ₂ (ppm) (S)	00	00	00	00	00	50.16	11.00	11.00	14.96	11.44	12.32	15.42	10.52
(B)	00	00	00	00	00	52.80	12.32	13.20	11.40	10.56	15.84	13.20	10.78

Alkalinity
(ppm as CaCO₃)

Total Alkalinity (S)	490	462	364	446	495	540	560	600	590	600	580	530	521.41
Carbonate	60	22	14	26	15	00	00	00	00	00	00	00	11.41
Bicarbonate	430	440	350	420	480	540	560	600	590	600	580	530	510.00
Total Alkalinity (B)	470	471	424	430	470	600	540	580	580	585	570	560	523.33
Carbonate	30	21	24	20	20	00	00	00	00	00	00	00	9.58
Bicarbonate	440	450	400	410	450	600	540	580	580	585	570	560	513.75
Inorganic phosphate (ppm)	0.10	0.12	0.12	0.13	0.10	0.15	0.14	0.13	0.16	0.18	0.14	0.15	0.135
Nitrate Nitrogen (ppm)	0.77	0.52	0.64	0.57	0.52	0.58	0.56	0.61	0.65	0.75	0.71	0.76	0.638
Electrical conductance (S)	430	420	420	480	453	450	450	425	450	560	433	420	449.25
(B)	420	451	430	470	445	443	455	435	445	465	430	4.5	442.83
µmhos/cm													

Note : (S) = Surface

(B) = Bottom

to the laboratory soon after collection. APHA (1976) methods were followed for water analysis.

RESULTS AND DISCUSSIONS

It is evident from Table 1 that the water temperature in general followed variations in air temperature. The surface to bottom gradient varied from 0.5 to 1.5°C. The relative humidity fluctuated between 33 in May to 64.25 in June. Moreover, the daily sunshine hours were more in April (10.80) and May (11.26).

Karki (1988) reported visibility values between 34-61 for a temple tank of Udaipur. In the present study, however, depth of visibility varied between 61-90 cm. Thus indicating higher water clarity due to meagre density of phytoplankton in this pond (Gupta, 1988). Based on water clarity values, pond could be designated as eutrophic (Sharma and Durve, 1991).

The temperature of air and water indicated significant positive correlation (0.8632) which is expected in such small waters (Ganpati, 1963 and Verma, 1967). However, Michael (1964) and Timms (1970) did not find such a relationship between air and water temperatures. Water temperature and dissolved oxygen showed inverse relationship (Reid, 1963). In this pond occasional low levels of dissolved oxygen probably caused asphyxiation in the stocked major carps, which died subsequently. However, common carps and golden carps being hardy fishes, could tolerate such low levels of dissolved oxygen. Thermal structure of shallow pond studied herein has indicated rather weaker thermal gradient (Table 1). Such minor differences in temperature have not been considered as thermocline (Ruttner, 1963) but a case of weak thermal stratification (Sreenivasan, 1968). Ruttner (1963) stated that for a thermocline development, there should be a gradient 3°C per meter. Considering this, the gradient observed in the present study could be explained as a case of weak thermal stratification (Sreenivasan, 1968). Ruttner (*Op. cit.*) while explaining the mode of thermal stratification in tropical waters stated that in such cases effective transfer of heat occurs between surface and bottom waters with slight cooling of surface water.

The water remained alkaline throughout the study period. 5.8-9.1 in arid region of Rajasthan. Interestingly, at times higher pH in the bottom waters may be accounted for higher photosynthetic activity at pond bottom by the periphytonic algae. This is further evidenced by highly significant (0.998) correlation between pH and

total alkalinity in bottom waters. Further, carbondioxide showed significant correlation with the total alkalinity and bicarbonates in bottom waters. The GPP and zooplankton population as such failed to exhibit clear relationship in the pond.

From Table 1 it is evident that in general the decline in carbonate was associated with a rise in bicarbonate and total alkalinity. The gradient in respect of carbonate and bicarbonate varied between 1-30 and 10-60 ppm respectively, which could be due to specific rates of photosynthetic activities in different strata of pond water. Wallen (1955) also considered importance of alkalinity because of its relationship with carbondioxide and photosynthesis. Barrett (1953) considered waters having total alkalinity above 80 ppm as productive. Similarly, Spence (1964) while investing Scottish lakes classified lakes with more than 60 ppm of total alkalinity as 'nutrient rich'. From this point of view, water quality of the shallow pond clearly speaks of its nutrient rich and productive status.

Atkins (1923) stated that phosphates in excess of 0.5 ppm are indication of pollution. Srinath and Pillai (1972) opined that concentration of phosphate in water should be less than 0.05 ppm for the control of algal growth. The data (Table 1) on inorganic phosphate obtained in the present study thus justifies non-polluted status of this water body.

Ganpati (1960) suggested that in Indian waters because of daily formation of and breaking of thermal gradient, adequate amount of phosphate is made available for production. In shallow water system, therefore, such a phenomenon could be expected to operate more efficiently due to small depth. The present findings (Table 1) are in confirmity to the observations of Sreenivasan (1972), who observed traces of phosphates in some waters of South India. Further, on the basis of E. C. values the shallow pond could be considered productive (Rawson, 1960).

In view of the trophic status of the shallow pond studied, the same could be used for rearing juvenile fishes or ornamental fishes after making arrangement for artificial aeration to cope with the occasional depletion in dissolved oxygen. Further studies on the use of various organic manures for the production of zooplankton and fishes may provide useful information for managing such shallow water systems efficiently.

SUMMARY

A shallow pond (22 x 11 x 0.8 m) located in the college campus was studied for selected water quality parameters during April-June, 1988. This pond indicated maximum

thermal gradient of 1.5°C and alkaline water (pH 7.73 ; total alkalinity 522.37 ppm)-Dissolved oxygen showed wide variations from 1.68 to 8.26 ppm. Occasional oxygen depletion led to elimination of major carps from this eco-system. However, common carp and golden craps could tolerate low dissolved oxygen. Considering nutrient level of inorganic phosphate (0.135 ppm), nitrates (0.638 ppm) and electrical conductance (446.04 µmhos/cm), this pond can be considered moderately eutrophic. Based on the water quality, this pond has been proposed for the culture of ornamental fish or rearing of fish seed after ensuring mechanical aeration to cope with the occasional anoxia.

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ON A COLLECTION OF FISHES FROM TANJAVUR
AND TRICHY DISTRICTS, TAMILNADU

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INTRODUCTION

Two faunistic surveys carried out by the staff of Southern Regional Station, Zoological Survey of India, Madras, of Tanjavur and Trichy districts in 1989 and 1991 resulted in the collection of 2245 specimens of fishes. Collections were made from different localities along the river Cauvery i.e., Tanjavur, Mayanur, Trichy, Musiri, Kulithalai, Papanasam and Ammaiappan. From river Mullaiyar, which is rather a small stream, collections could be made about 4 kms, from its estuary near Vedaranyam.

50 species coming under 16 families belonging to 6 orders were identified. Of the 50 species, 9 species i.e., *Dayella malabarica* (Day), *Rasbora caverii* (Jerdon), *Mystus montanus* (Jerdon), *Gambusia affinis patruelis* (Baird and Girard), *Anabas testudineus* (Bloch), *Rhinomugil corsula* (Ham.), *Macropodus cupanus* Val., *Noemacheilus pulchellus* (Day) and *Colisa fasciatus* (Schreider) were recorded exclusively from Tanjavur district. The following 10 species i.e., *Barilius bendelisis* (Ham.), *Puntius filamentosus* (Val.), *Labeo boga* (Ham.), *Labeo dero* (Hamilton), *Labeo pungusia* (Ham.), *Mystus gulio* (Ham.), *Channa orientalis* (Sch.), *Chanda nama* (Ham.), *Xenentodon cancila* (Ham.), *Macrogathus aculeatus* (Bloch) were recorded exclusively from Trichy district.

Dayella malabarica (Day) which has so far been recorded only from the rivers of West coast, is being reported for the first time from Mullaiyar river (East coast). *Rasbora caverii* (Jerdon) and *Rhinomugil corsula* (Ham.) which have so far been recorded from River Cauvery is being reported for the first time from Mullaiyar river. *Labeo dero* (Ham.) is being reported for the first time from Cauvery river, which is so far known to occur in North Indian river.

In addition to the freshwater fishes, 99 specimens of estuarine and marine fishes were also collected from salt pans and Muthupet lagoon near Vedaranyam.

They were identified as 29 species coming under 19 families and 6 orders. The list of 29 species is given below, but no detail systematic account is given for these fishes as they are available in Talwar (1984).

LIST OF MARINE FISHES

Order : ELOPIFORMES

Family : ELOPIDAE

Albula vulpes (Bloch) — 2 exs.

Elops machnata (Forsskal) — 2 exs.

Order : CLUPEIFORMES

Family : CLUPEIDAE

Sub-family : DOROSOMATINAE

Nematalosa nasus Blkr. — 19 exs.

Family : ENGRAULIDAE

Sub-family : ENGRAULINAE

Thryssa malabarica (Bloch) — 5 exs.

Order : SILURIFORMES

Family : BAGRIDAE

Mystus gulio (Ham.) — 2 exs.

Order : ATHERINIFORMES

Family : HEMIRAMPHIDAE

Hyporhamphus dussumeri (Val.) — 4 exs.

Hyporhamphus limbatus (Val.) — 5 exs.

Order : PERCIFORMES

Family : CHANDIDAE

Ambassis commersonii Cuvier — 8 exs.

Family : SILLAGINIDAE

Sillago sihama (Forsskal) — 4 exs.

Family : LEIOGNATHIDAE	
<i>Leiognathus brevirostris</i> (Val.)	— 5 exs.
<i>Leiognathus equulus</i> (Forsskal)	— 2 exs.
Family : GERRIDAE	
<i>Gerres limbatus</i> Cuv.	— 2 exs.
<i>Gerres filamentosus</i> Cuv.	— 1 ex.
<i>Gerres oyena</i> (Forsskal)	— 2 exs.
Family : SCIAENIDAE	
<i>Dendrophysa russelli</i> (Cuv.)	— 1 ex.
Family : SCATOPHAGIDAE	
<i>Scatophagus argus</i> (Linn.)	— 3 exs.
Family : CICHLIDAE	
<i>Etroplus maculatus</i> (Bloch)	— 3 exs.
<i>Etroplus suratensis</i> (Bloch)	— 1 ex.
<i>Oreochromis mossambica</i> (Peters)	— 6 exs.
Family : MUGILIDAE	
<i>Mugil cephalus</i> Linnaeus	— 3 exs.
<i>Liza parsia</i> (Ham.)	— 7 exs.
<i>Valamugil seheli</i> (Forsskal)	— 1 ex.
Family : GOBIIDAE	
<i>Oxyurichthys microlepis</i> (Blkr.)	— 1 ex.
Family : POMADASYIDAE	
<i>Pomadasys hasta</i> (Bloch)	— 1 ex.
Family : LUTJANIDAE	
<i>Lutjanus fulviflammus</i> (Forsskal)	— 1 ex.
Family : TERAPONIDAE	
<i>Terapon jarbua</i> (Forsskal)	— 1 ex.
<i>Terapon puta</i> Cuv.	— 6 exs.
Family : PLATYCEPHALIDAE	
<i>Platycephalus indicus</i> (Linnaeus)	— 1 ex.
Order : TETRAODONTIFORMES	
Family : TRIACANTHIDAE	
<i>Triacanthus brevirostris</i> Schlegel	— 1 ex.

LIST OF FRESHWATER FISHES

Order : CLUPEIFORMES

Family : CLUPEIDAE

Sub-Family : PELLONULINAE

1) *Dayella malabarica* (Day) — 2 exs.

Order : CYPRINIFORMES

Family : CYPRINIDAE

Sub-family CULTRINAE

2) *Chela (Chela) labuca* (Hamilton) — 10 exs.3) *Salmostoma boopsis* (Day) — 1 ex.4) *Salmostoma clupeoides* (Bloch) — 3 exs.

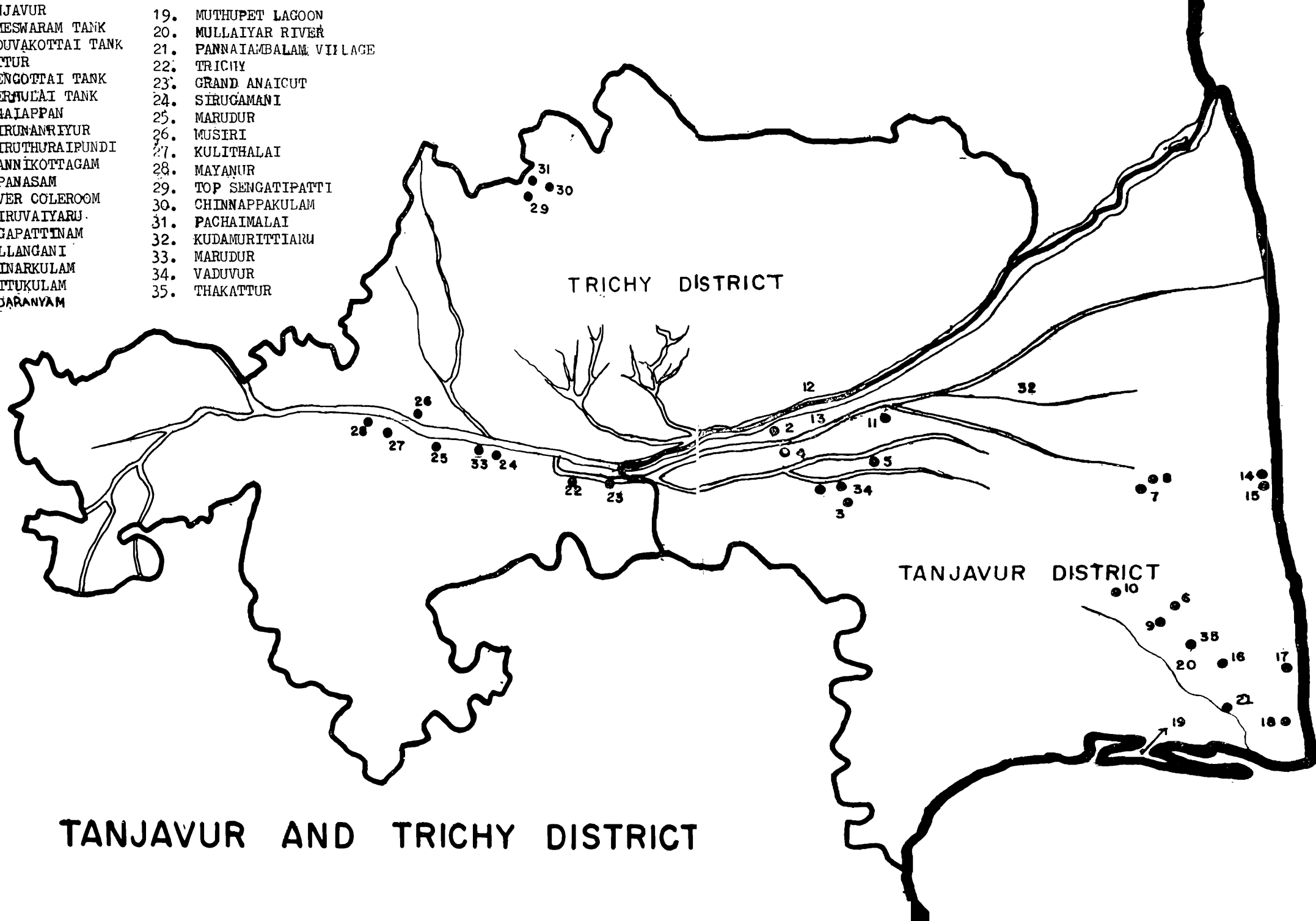
Sub-family : RASBORINAE

5) *Amblypharyngodon mellitina* (Val.) — 321 exs.6) *Barilius bendelisis bendelisis* Ham. — 36 exs.7) *Danio (Danio) aequipinnatus* (Mc Cl.) — 45 exs.8) *Esomus barbatus* (Jerdon) — 177 exs.9) *Esomus thermoicos* (Hamilton) — 252 exs.10) *Rasbora daniconius* (Hamilton) — 67 exs.11) *Rasbora caverii* (Jerdon) — 2 exs.

Sub-family : CYPRININAE

12) *Cirrhinus reba* (Hamilton) — 39 exs.13) *Labeo boga* (Hamilton) — 1 ex.14) *Labeo dero* (Hamilton) — 2 exs.15) *Labeo pangusia* (Hamilton) — 5 exs.16) *Puntius amphibius* (Valenciennes) — 48 exs.17) *Puntius chola* (Hamilton) — 55 exs.18) *Puntius dorsalis* (Jerdon) — 58 exs.19) *Puntius filamentosus* (Valenciennes) — 16 exs.20) *Puntius sarana subnastus* (Val.) — 26 exs.21) *Puntius sophore* (Hamilton) — 95 exs.

- | | |
|----------------------|---------------------------|
| 1. TANJAVUR | 19. MUTHUPET LAGOON |
| 2. SOMESWARAM TANK | 20. MULLAIYAR RIVER |
| 3. NEDUVAKOTTAI TANK | 21. PANNAIAMBALAM VILLAGE |
| 4. KATTUR | 22. TRICHY |
| 5. SHENGOTTAI TANK | 23. GRAND ANAICUT |
| 6. NEERULAI TANK | 24. SIRUGAMANI |
| 7. AMMAIAPPAN | 25. MARUDUR |
| 8. THIRUNANRIYUR | 26. MUSIRI |
| 9. THIRUTHURAI PUNDI | 27. KULITHALAI |
| 10. CHANNIKOTTAGAM | 28. MAYANUR |
| 11. PAPANASAM | 29. TOP SENGATIPATTI |
| 12. RIVER COLEROOM | 30. CHINNAPPAKULAM |
| 13. THIRUVAIYARU | 31. PACHAIMALAI |
| 14. NAGAPATTINAM | 32. KUDAMURITTIARU |
| 15. VELLANGANI | 33. MARUDUR |
| 16. NAINARKULAM | 34. VADUVUR |
| 17. VETTUKULAM | 35. THAKATTUR |
| 18. VADARANYAM | |



TANJAVUR AND TRICHY DISTRICT

- 22) *Puntius ticto ticto* (Hamilton) — 16 exs.
 23) *Puntius vittatus* (Day) — 74 exs.
- Sub-family : GARRINAE
- 24) *Garra mullya* (Sykes) — 3 exs.
- Family : HOMALOPTERIDAE
- Sub-Family : NOEMACHEILINAE
- 25) *Noemacheilus pulchellus* Day — 13 exs.
- Family : COBITIDAE
- 26) *Lepidocephaeus thermalis* (Val.) — 99 exs.
- Order : SILURIFORMES
- Family : BAGRIDAE
- 27) *Mystus bleekeri* (Day) — 9 exs.
 28) *Mystus cavasius* (Hamilton) — 9 exs.
 29) *Mystus gulio* (Hamilton) — 6 exs.
 30) *Mystus montanus* (Jerdon) — 8 exs.
 31) *Mystus vittatus* (Bloch) — 22 exs.
- Family : SCHILBEIDAE
- 32) *Pseudeutropius athcrinoides* (Bloch) — 1 ex.
- Order : CHANNIFORMES
- Family : CHANNIDAE
- 33) *Channa orientalis* (Schneider) — 16 exs.
 34) *Channa punctatus* (Bloch) — 22 exs.
 35) *Channa striatus* (Bloch) — 3 exs.
- Order : ATHERINIFORMES
- Family : BELONIDAE
- 36) *Xenentodon cancila* (Ham.) — 9 exs.
- Family : CYPRINODONTIDAE
- 37) *Aplocheilus blochii* (Arnold) — 58 exs.
 38) *Oryzias melanostigma* (Mc Cl.) — 72 exs.

Family : POECILIDAE

39) *Gambusia affinis patruelis* (Baird & Girard) — 11 exs.

Order : PERCIFORMES

Family : CHANDIDAE

40) *Chanda nama* (Ham.) — 2 exs.

Family : CICHILIDAE

41) *Etroplus maculatus* (Bloch) — 171 exs.

42) *Oreochromis mossambica* (Peters) — 225 exs.

Family : GOBIIDAE

43) *Glossogobiu giuris* (Hamilton) — 66 exs.

Family : MUGILIDAE

44) *Liza parsia* (Hamilton) — 4 exs.

45) *Rhinomugil corsula* (Hamilton) — 1 ex.

Family : ANABANTIDAE

46) *Anabas testudineus* (Bloch) — 16 exs.

Family : BELONTIDAE

47) *Macropodus cupanus* Val. — 19 exs.

48) *Colisa fasciatus* (Schneider) — 4 exs.

Order : MASTACEMBELIFORMES

Family : MASTACEMBELIDAE

49) *Mastacembelus armatus armatus* Lacepede — 15 exs.

50) *Macrogathus aculeatus* (Bloch)—1 ex.

SYSTEMATIC ACCOUNT

Dayella malabarica (Day)

1873. *Spratelloides malabaricus* Day, *Proc. zool. Soc. London.*, p. 240 (Type locality ; Malabar).

Material : 2 exs., 36.0 mm. SL., Pannaiambalam Village, Mullaiyar River, 28.4.89 (F. 2589).

Distribution : West coast of India, ascending rivers and estuaries.

Remarks : Talwar and Whitehead (1971) described this species from rivers and estuaries of west coast. This is the first record of this species from a river namely Mullaiyar on the east coast.

Chela (Chela) labuca (Hamilton)

1822. *Cyprinus labuca* Hamilton, *Fish Ganges*, p. 260, 384 (Type locality: Ponds in northern parts of Bengal).

Material : 2 exs., 19-27 mm. SL., Sirugamani, 19.2.91 (F.3732) ; 8 exs., 25-36 mm. SL., Kanoor, Tanjavur, 6.3.91 (F. 3670).

Distribution : Orissa, Ganjam, W. Bengal, Madhya Pradesh, Assam, Burma.

Remarks : Jayaram (1982) could not collect any specimens from River Cauvery. 10 examples were collected from R. Cauvery from Sirugamani and Kanoor.

Salmostoma boopsis (Day)

1873. *Chela boopsis* Day, *Proc. zool. Soc. London*, P. 708 (Type locality : South Canara).

Material : 1 ex., 30 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2783).

Distribution : Western Ghats, South Canara, Mutha-Mula river, Poona.

Remarks : Jayaram (1982) recorded this species from Upper reaches of Cauvery i. e. Chikalur. Occurrence of yet another specimen in middle reaches of Cauvery is of great importance.

Salmostoma clupeoides (Bloch)

1822. *Cyprinus clupeoides* Bloch, *Naturg. Ausland Fische*, 12, p. 49, pl. 408, fig. 2 (Type locality : Tranquebar),

Material : 1 ex., 46 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2505); 1 ex., 60 mm. SL., River Vennar, Tanjavur city, 23.4.89 (F. 2501); 1 ex., 105 mm. SL., Pannaiambalam Village, Mullaiyar River, 28.4.89 (F. 2594); 1 ex., 60 mm. SL. Rivery Cauvery at Kulithalai near Musiri-Kulithalai Bridge; 6.5.89 (F. 2792).

Distribution : Narmada, Tapi, Krishna, Godavary and Cauvery river systems. Also recorded from Nasik, Deolali and Jabalpur.

Amblypharyngodon melettina (Val.)

1842. *Leuciscus melettina* Valenciennes, *Hist. nat. Poiss.*, 17, p. 304, pl. 501 (Type locality: Bombay).

Material : 3 exs., 48-50 mm. SL., Vennar river, Tanjavur city, 23.4.89 (F. 2500); 47 exs., 17-30 mm. SL., Neduva-kottai Tank, 25.4.89 (F. 2530); 192 exs., Pannaiambalam village, Mullaiyar River, 28.4.89 (F. 2581); 6 exs., 24-31 mm. SL., Thannikottagam, 14 kms. south of Thiruthuraipundi, 28.4.89 (F. 2570); 44 exs., 41-66 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2142); 2 exs., 25-27 mm. SL., Ammaiappan near Thiruvarur, 1.3.91 (F. 3703); 23 exs., 24-40 mm. SL., Thirunanriyur, 4.3.91 (F. 3685); 4 exs., 20-30 mm. SL., Senduri, 23.2.91 (F. 3735).

Distribution : Western Ghats, Tamilnadu, Sri Lanka.

Barilius bendelisis bendelisis (Hamilton)

1807. *Cyprinus bendelisis* Hamilton, *Journey Mysore*, 3, p. 345, pl. 32 (Type locality: Rivers of Mysore).

Material : 8 exs., 20-27 mm. SL., River Cauvery at Trichy, 3.5.89 (F. 2611); 25 exs., 20-27 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2774); 1 ex., 113 mm. SL., River Cauvery at Mayanur canal, 7.5.89 (F. 7800); 2 exs., 28-46 mm. SL., Arasalar near Papanasam, 26.2.91 (F. 3699).

Distribution : Throughout India except Kerala, Nepal, Pakistan and Sri Lanka.

Danio (D.) aequipinnatus (Mc Clelland)

1839. *Perilampus aequipinnatus* Mc Clelland. *Asiatic, Researchers*, 19, p. 393 (Type locality : Assam).

Material : 3 exs., 33-52 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2503). 2 exs., 58-65 mm. SL., River Cauvery at Trichy, 3.5.89 (F. 2609) ; 26 exs., 41-51 mm. SL., Grand Anaicut at Trichy, 3.5.89 (F. 2636) ; 3 exs., 47-50 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2779) ; 5 exs., 24-54 mm. SL., River Coleroon near Musiri, 5.5.89 (F. 2913) ; 4 exs., 30-42 mm. SL., Sirugamani, Trichy, 19.2.91 (F. 3727) ; 2 exs., 19-45 mm. SL., Pallamvodai, Trichy, 22.2.91 (F. 3720).

Distribution : Throughout India, Pakistan, Sri Lanka, Bangladesh and Thailand.

Esomus barbatus (Jerdon)

1849. *Leuciscus barbatus* Jerdon, *Madras, J. Lit. & Sci.*, 15 p. 322 (Type locality : Rivers and tanks all over Mysore and Karnataka).

Material : 30 exs., 40-61 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2502) ; 2 exs., 30 mm. SL., Neduvakottai Tank, 25.4.89 (F. 2528) ; 3 exs., 43-60 mm. SL., Neermulai Tank on the way to Vellangani, 26.4.89 (F. 2544) ; 21 exs., Pannaiambalam village, Mullaiyar River, 28.4.89 (F. 2583) ; 15 exs., 38-48 mm. SL., Thanikottakam, 14 km. South of Thiruthuraipundi, 28.4.89 (F. 2575) ; 1 ex., 66 mm. SL., Grand Anaicut, River Cauvery, 3.5.89 (F. 2634) ; 13 exs., 45-64 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2749) ; 65 exs., 25-40 mm. SL., Malvarayanallur, 27.2.91 (F. 3710) ; 27 exs., 37-42 mm. SL., Kanoor, 6.3.91 (F. 3667).

Distribution : Confined to South India up to Nellore district in Andhra Pradesh.

Remarks : This species differs from *Esomus danricus* (Hamilton) in the lateral line system extending to anal fin.

Esomus thermoicos (Valenciennes)

1842. *Nuria thermoicos* Valenciennes, *Hist. nat. Poiss.*, 16, p. 238, pl. 472 (Type locality. Sri Lanka).

Material : 62 exs., 30-35 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2537); 22 exs., 27-49 mm. SL., Neermulai Tank, on the way to Vellangani, 26.4.89 (F. 2543), 2 exs., 36-38 mm. SL., Pannaiambalam village, Mullaiyar River, 30.4.89 (F. 2584); 28 exs., 33-37 mm. SL., Thanikottakam, 14 km. South of Thiruthuraipundi, 28.4.89 (F. 2576); 2 exs., 26-30 mm. SL., Arasalar near Papanasam, 26.2.91 (F. 3695); exs., 30-36 mm. SL., Malvarayanallur, 27.2.91 (F. 3709); 13 exs., 32-41 mm. SL., Thirunanriyur, 4.3.91 (F. 3684); 2 exs., 43-45 mm. SL., Muhandnur, 1.3.91 (F. 3718).

Distribution : Tamilnadu, Kerala, Karnataka and Sri Lanka.

Rasbora (R.) daniconius (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fish Ganges*, p. 327, pl. 15. fig. 89 (Type locality : Rivers of Southern Bengal).

Material : 1 ex., 47 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2506); 14 exs., 21-25 mm. SL., Kattur, 12 km. from Tanjavur, 24.4.89 (F. 2514); 1 ex., 36 mm. SL., Neduvakottai Tank, 25.4.89 (F. 2527); 20 exs., 23-31 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2539); 1 ex., 26 mm. SL., Thiruvakulam Tank on Thiruthuraipundi-Manargudi Road, 27.4.89 (F. 2556); 10 exs., 38-52 mm. SL., Pannaiambalam village, Mullaiyar River, 28.4.89 (F. 2584); 2 exs., 45-52 mm. SL., Thanikottakam, 14 km. south of Thiruthuraipundi, 28.4.89 (F. 2567); 1 ex., 70 mm. SL., Fish market, Trichy, 4.5.89 (F. 2741); 2 exs., 42 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2773); 8 exs., 35-54 mm. SL., Sirugamani., 19.2.91 (F. 3726); 1 ex., 74 mm. SL., Thirunanriyur, 4.3.91 (F. 3682); 5 exs., 20-25 mm. SL., Kanoor, 6.3.91 (F. 3668).

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka and Malayan Archipelago.

Rasbora (R.) caverii (Jerdon)

1848. *Leuciscus caverii* Jerdon, *Madras J. Lit. & Sci.*, 15 p. 320 (Type locality : Cauvery River, Coorg State).

Material : 2 exs., 65-80 mm. SL., Pannaiambalam village, Mullaiyar River, 28.4.89 (F. 2592).

Distribution : Cauvery river, Coorg, also Hemavathy and Kabbini rivers.

Remarks : This is the first record of *Rasbora caverii* (Jerdon) from Mullaiyar river.

***Cirrhinus reba* (Hamilton)**

1822, *Cyprinus reba* Hamilton, *Fish Ganges*, p. 280, 386 (Type locality : Rivers and ponds of Bengal and Bihar).

Material : 5 exs., 100-135 mm. SL., Surakottai near Tanjavur, 24.4.89 (F. 2521); 2 exs., 127-135 mm. SL., Shengottai Tank at Thiruthuraipundi, 26.4.89 (F. 2541); 1 ex., 109 mm. SL., Nainarkulam pond on way to Nagapattinam, 26.4.89 (F. 2550); 4 exs., 80-100 mm. SL., Marudur village, 30.4.89 (F. 2598); 2 exs., 92-150 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2747); 4 exs., 110-125 mm. SL., River Cauvery, Mayanur canal at Mayanur, 7.5.89 (F. 2793); 2 exs., 110-113 mm. SL., Grand Anaicut, 3.5.89 (F. 2805); 19 exs., 80-105 mm. SL., Cauvery river at Trichy, 19.2.91 (F. 3678).

Distribution : Throughout India.

***Labeo boga* (Hamilton)**

1882. *Cyprinus boga* Hamilton, *Fish Ganges*, p. 286, 386, pl. 28, fig. 80 (Type locality : River Bramhaputra).

Material : 1 ex., 140.0 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2754).

Distribution : Rivers of Gangetic Provinces, Tamilnadu and Myanmar.

***Labeo dero* (Hamilton)**

1822. *Cyprinus dero* Hamilton, *Fish Ganges*, p. 277, 331, 385, pl. 22, fig. 78 (Type locality : R. Bramhaputra).

Material : 2 exs., 113-152 mm. SL., Cauvery river, Trichy, 19.2.91 (F. 3679).

Distribution : All along the Himalaya, Bihar, West Bengal, Orissa, Rajasthan, Afganistan, Pakistan, Bangladesh, Nepal and Myanmar.

Remarks : This is the first record of *L. dero* (Hamilton) from River Cauvery.

Labeo pangusia (Hamilton)

1822. *Cyprinus pangusia* Hamilton, *Fish Ganges*, p. 285, 386, (Type locality : River Kosi).

Material : : 4 exs., 89-97 mm. SL., Grand Anaicut, River Cauvery, near Trichy, 19.2.91 (F. 3680).

Distribution : Himalayan ranges and generally throughout Sind, Deccan, Bengal and Assam.

Puntius amphibius (Valenciennes)

1842. *Capoeta amphibia* Valenciennes, *Hist. nat. Poiss.*, 16, P. 282, pl. 478 (Type locality : Bombay).

Material : 1 ex., 56 mm. SL., Vennar river, Tanjavur, 23.4.89 (F. 2495); 43 exs., 30-70 mm. SL., Pannaiambalam village, Mullaiyar river, 28.4.89 (F. 2580); 1 ex., 48 mm. SL., Vedaranyam, 1.5.89 (F. 2606); 2 exs., 55-65 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2639 & F. 2740); 1 ex., 45 mm. SL., River Cauvery at Mayanur, Mayanur Canal, 7.5.89 (F. 2772).

Distribution : Throughout India and Sri Lanka.

Puntius chola (Hamilton)

1822. *Cyprinus chola* Hamilton, *Fish Ganges*, p. 312, 313 (Type locality : North-eastern parts of Bengal).

Material : 2 exs., 88-90 mm. SL., Shengottai Tank at Thiruthuraipundi, 26.4.89 (F. 2540); 1 ex., 42 mm. SL., Thiruvacakulam on Thiruthuraipundi-Manargudi Road, 27.4.89 (F. 2555); 15 exs., 23 mm. SL., Pannaiambalam village, Mullaiyar river, 28.4.89 (F.2578); 2 exs., 38-40 mm. SL., Thanikottakam, 14 km. South of Thiruthuraipundi, 28.4.89 (F. 2569); 1 ex., 83 mm. SL., Maruudur village, 30.4.89 (F. 2602); 28 exs., 39-75 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2640 & F. 2738); 1 ex., 44 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89

(F. 2770), 3 exs., 36-45 mm. SL., Thirunanriyur, Tanjavur, 4.3.91 (F. 3688); 1 ex., 43 mm. SL., Ammaiappan, 1.3.91 (F. 3700); 1 ex., 22 mm. SL., Malvarayanallur, 27.2.91 (F. 3715).

Distribution : Throughout India, Pakistan, Bangladesh and Sri Lanka.

Puntius dorsalis (Jerdon)

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

Material : 6 exs., 104-122 mm. SL., Pudu canal, Tanjavur, 22.4.89 (F. 2488); 29 exs., 26-40 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2511); 2 exs., 94-99 mm. SL., Nainarkulam on way to Nagapattinam, 26.4.89 (F. 2547); 1 ex., 41 mm. SL., Pannaiambalam village, Mullaiyar river; 28.4.89 (F. 2577); 1 ex., 60 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2739); 1 ex., 28 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2776); 2 exs., 95-98 mm. SL., River Cauvery at Mayanur, Mayanur Canal, 7.5.89 (F. 2771); 1 ex., 105 mm. SL., Grand Anaicut, 3.5.89 (F. 2804); 9 exs., 24-30 mm. SL., Pullamvodai, 22.2.91 (F. 3721); 1 ex., 20 mm. SL., Malvarayanallur, 27.2.91 (F. 3716); 5 exs., 30-31 mm. SL., Kudamuruttiaru, 28.2.91 (F. 3731).

Distribution : River systems of Krishna, Cauvery, Coleroon in Southern India and Sri Lanka.

Puntius filamentosus (Valenciennes)

1844. *Leuciscus filamentosus* Valenciennes, *Hist. nat. Poiss.*, 17, p. 96, pl. 492 (Type locality : Alleppey, Kerala).

Material : 2 exs., 66-80 mm. SL., Vennar river, Tanjavur, 23.4.89 (F. 2497); 3 exs., 95 mm. SL., Grand Anaicut, River Cauvery, 3.5.89 (F. 2629 & F. 2637); 3 exs., 26-90 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2777); 8 exs., 80-90 mm. SL., River Cauvery at Mayanur, Mayanur canal, 7.5.89 (F. 2798).

Distribution : Freshwaters of Kerala, Southern Karnataka, Tamilnadu and Sri Lanka.

Puntius sarana subnasutus (Valenciennes)

1865. *Cyclochelichthys Pinnauratus* Day, *Proc. zool. Soc., London*, p. 300 (Type locality : Wynaad).

Material : 3 exs., 76-90 mm. SL., Vennar river, Tanjavur, 23.4.89 (F. 2496) ; 1 ex., 145 mm. SL., Surakottai Tank near Tanjavur, 24.4.89 (F. 2522) ; 4 exs., 75-100 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2736) ; 2 exs., 95-105 mm. SL., River Cauvery at Mayanur ; Mayanur canal, 7.5.89 (F. 2768) ; 15 exs. 74-145 mm. SL., Grand Anaicut, River Cauvery, 3.5.89 (F. 2803) ; 1 ex., 85 mm. SL., Cauvery River near Trichy, 19.2.91 (F. 3675).

Distribution : River Krishna in Andhra Pradesh, and river Cauvery in Karnataka and Tamilnadu.

Puntius sophore (Hamilton)

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

Material : 1 ex., 45 mm. SL., River Cauvery, Someswaram, 23.4.89 (F. 2509) ; 1 ex., 47 mm. SL., Kattur, 12 km. from Tanjavur, 24.4.89 (F. 2516) ; 3 exs., 30-40 mm. SL., Neduvakottai Tank, 25.4.89 (F. 2529) ; 37 exs., 30-50 mm. SL., Pannaiambalam village, Mullaiyar, 28.4.89 (F. 2579) ; 1 ex., 47 mm. SL., River Cauvery at Trichy, 3.5.89 (F. 2635) ; 34 exs., 39-84 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2641) ; 2 exs., 34-35 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2769) ; 1 ex., 38 mm. SL., Arasalar near Papanasam, 26.2.91 (F. 3693) ; 9 exs., 25-32 mm. SL., Thakattur, 27.2.91 (F. 3708) ; 1 ex., 28 mm. SL., Malvarayanallur, 27.2.91 (F. 3714) ; 1 ex., 45 mm. SL., Ammaiappan, 1.3.91 (F. 3701) ; 2 exs., 37-47 mm. SL., Thirunanriyur, 4.3.91 (F. 3687).

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka and Myanmar.

Puntius ticto ticto (Hamilton)

1822. *Puntius ticto* Hamilton, *Fish Ganges*, p. 314, 389, pl. 8, fig. 87 (Type locality : South-eastern parts of Bengal).

Material : 2 exs., 13-24 mm. SL., Kattur, 12 mm. from Tanjavur, 24.4.89

(F. 2515); 6 exs., 21-32 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2535); 2 exs., 24-32 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2775); 1 ex., 32 mm. SL., River Cauvery at Mayanur, Mayanur canal, 7.5.91 (F. 2799); 2 exs., 26-29 mm. SL., Sirugamani, 19.2.91 (F. 3728); 1 ex., 24 mm. SL., Thakattur, 27.2.91 (F. 3706); 2 exs., 18-21 mm. SL., River Cauvery near Thiruvaiyaru, 28.2.91 (F. 3673).

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka and Thailand.

***Puntius vittatus* Day**

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

Material : 1 ex., 23 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2534); 71 exs., 23-28 mm. SL., Pannaiambalam village, Mullaiyar river, 28.4.89 (F. 2590); 2 exs., 20-21 mm. SL., Thanikottakam, 14 km. South of Thiruthuraipundi, 28.4.89 (F. 2568).

Distribution : Karnataka, Kerala, Tamilnadu, also Goa, Kutch, Rajasthan, Sri Lanka and Pakistan.

***Garra mullya* (Sykes)**

1841. *Chondrostoma mullya* Sykes, *Trans. zool. Soc. London*, 2, p. 359, pl. 62, fig. 3. (Type locality : Poona waters).

Material : 3 exs., 64-95mm. SL., Cauvery river near Tanjavur, 19.2.91 (F. 3675).

Distribution : Throughout India, except Assam and Himalaya.

***Noemacheilus pulchellus* Day**

1873. *Noemacheilus pulchellus* Day, *J. Linn. Soc. London*, 11, p. 528 (Type locality : Bhavani River, Nilgiris).

Material : 1 ex., 26 mm. SL., Kudamuruttiaru, Tanjavur, 28.2.91 (F. 3729); 10 exs., 14-35 mm. SL., Arasaḷar near Papanasam, 26.2.91 (F. 3734).

Distribution : Bhavani and Cauvery river systems in South India.

Lepidocephalus thermalis (Valenciennes)

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

Material : 3 exs., 29-39 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2508); 61 exs., 27-41 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2531). 6 exs., 37 mm. SL., Thanikottakam, 14 km. south of Thiruthuraipundi, 28.4.89 (F. 2573); 13 exs., 30-37 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2780); 3 exs., 30-38 mm. SL., River Cauvery at Kulithalai, 6.5.89 (F. 2789); 1 ex., 35 mm. SL., River Cauvery at Mayanur, Mayanur Canal, 7.5.89 (F. 2797); 1 ex., 29 mm. SL., River Coleroon, near Silayathi, 5.5.89 (F. 2912); 2 exs., 30 mm. Pallamvodai, 22.2.91 (F. 3719); 2 exs., 20-27 mm. SL., Malvarayanallur, 27.2.91 (F. 3711); 1 ex., 36 mm. SL., Thakattur, 27.2.91 (F. 3706); 6 exs., 23-37 mm. SL. Thirunanriyur, 4.3.91 (F. 3683).

Distribution : Southern Karnataka, Kerala, Tamilnadu and Sri Lanka.

Mystus bleekeri (Day)

1846. *Bagrus Reletius* Valenciennes, *Nat. Geneesh Arch. Ned. Ind.*, 3 (2), p. 135 (Type locality: Bengal).

Material : 5 exs., 75-95 mm. SL., Pudu canal, Tanjavur city, 22.4.89 (F. 2493); 1 ex., 76 mm. SL., Grand Anaicut, Trichy, 3.5.89 (F. 2633); 1 ex., 90 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2734); 2 exs., 70-80 mm. SL., Cauvery river near Trichy, 19.2.91 (F. 3677).

Distribution : Throughout India, Pakistan, Bangladesh and Myanmar.

Mystus cavasius (Hamilton)

1822. *Pimelodus cavasius* Hamilton, *Fish Ganges* p. 203, 379, pl. II, fig. 67 (Type locality : Gangetic Provinces).

Material : 2 exs., 78-91 mm. SL., Pudu canal, Tanjavur city, 22.4.89 (F. 2491); 4 exs., 70-85 mm. SL., Vennar river, Tanjavur, 23.4.89 (F. 2493); 3 exs., 80-85 mm.

SL., Grand Anaicut, Trichy, 3.5.89 (F. 2632 & F. 2807).

Distribution : Throughout India, Pakistan, Bangladesh and Thailand.

***Mystus montanus* (Jerdon)**

1849. *Bagrus montanus* Jerdon, *Madras J. Lit. & Sci.*, 15, (2), p. 338 (Type locality : Manantody River, Wynaad).

Material : 2 exs., 60-65 mm. SL., Vennar River, Tanjavur city, 23.4.89 (F. 2499); 1 ex., 77 mm. SL., Surakottai near Tanjavur, 24.4.89 (F. 2523); 5 exs., 53-85 mm. SL., Pannaiambalam Village, Mullaiyar River, 28.4.89 (F. 2588).

Distribution : Manantoddy, Wynaad, Cauvery head waters.

***Mystus gulio* (Hamilton)**

1822. *Pimelodus gulio* Hamilton, *Fish Ganges*, p. 201, 379, pl. 23., fig. 6 (Type locality : Gangetic estuaries).

Material : 1 ex., 120 mm. SL., Nainarkulam on way to Nagapattinam, 26.4.89 (F. 2552); 4 exs., 82-92 mm. SL., Mullaiyar River at Thiruthuraipundi, 28.4.89 (F. 2558), 1 ex., 140 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2733).

Distribution : Throughout India, Pakistan, Bangladesh, Thailand, Sri Lanka (in fresh water, estuaries and even in seas).

***Mystus vittatus* (Bloch)**

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

Material : 1 ex., 73 mm. SL., Pudu canal, Tanjavur city, 22.4.89 (F. 2492); 20 exs., 67-100 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2735); 1 ex., 44 mm. SL., River Cauvery at Mayanur Canal, 7.5.89 (F. 2767).

Distribution : Throughout India, Pakistan, Thailand, Bangladesh and Sri Lanka.

Pseudentropius atherinoides (Bloch)

1797. *Silurus atherinoides* Bloch, *Naturges, Ausland, Fisches*, 8, p. 48, pl. 371, fig. 1. (Type locality : Pondicherry).

Material : 1 ex., 38 mm. SL., Thirunanriyur, 4.3.91 (F. 3690).

Distribution : Throughout India, Pakistan, Bangladesh except Kerala and Assam.

Channa orientalis (Schneider)

1801. *Channa orientalis* Schneider, *Syst. Ichth. Bloch.*, p. 496, pl. 90, fig. 2 (Type locality : Ponds and ditches of Bengal).

Material : 1 ex., 110 mm. SL., River Cauvery at Kulithalai, 6.5.89 (F. 2790); 8 exs., 32-105 mm. SL., Chinnappakulam on Nallampatti-Pachaimalai Road, 10.5.89 (F. 2810); 1 ex., 54 mm. SL., Top Sengatipatti, 10.5.89 (F. 2811); 2 exs., 51-63 mm. SL., Arasalar near Papanasam, 26.2.91 (F. 3698); 10 exs., 25-74 mm. SL., Senduri, 23.2.91 (F. 3736).

Distribution : Throughout India, Pakistan, Afganistan, Bangladesh, Sri Lanka and Thailand.

Channa punctatus (Bloch)

1793. *Ophiocephalus punctatus* Bloch, *Naturges. Ausland. Fisches*, 2 p. 139, pl. 358 (Type locality : Karnataka coast).

Material : 8 exs., 29-90 mm. SL., Kathur, 12 km. from Tanjavur, 24.4.89 (F. 2518); 1 ex., 126 mm. SL., Neduvakottai Tank, 25.4.89 (F. 2527); 2 exs., 126-140 mm. SL., Nainarkulam on way to Nagapattinam, 26.4.89 (F. 2551); 2 exs., 75 mm. SL., Pannaiambalam Village, Mullaiyar River, 28.4.89 (F. 2595); 1 ex., 85 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2643 & F. 2753); 1 ex., 53 mm. SL., Arasalar, 26.2.91 (F. 3697); 2 exs., 102-116 mm. SL., Challampatti, Tanjavur, 2.3.91 (F. 3691); 1 ex., 96 mm. SL., Kanoor, 6.3.91 (F. 3669).

Distribution : Throughout India, Pakistan, Nepal, Bangladesh and Sri Lanka.

Channa striatus (Bloch)

1793. ✓ *Ophiocephalus striatus* Bloch, *Naturg. Ausland. Fisches.*, 2, pl. 141, pl. 359 (Type locality : Malabar).

Material : 2 exs., 120-180 mm. SL., Pannaiambalam village, Mullaiyar River, 28.4.89 (F. 2596); 1 ex., 195 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2572).

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka, Thailand, South China and Philippines.

Xenentodon cancila (Hamilton)

1822. *Esox cancila* Hamilton, *Fish Ganges*, p. 213, 380, pl. 27, fig. 70 (Type locality : Gangetic provinces).

Material : 1 ex., 137 mm. SL., Grand Anaicut, Trichy, 3.5.89 (F. 2809); 1 ex., 210 mm. SL., River Cauvery at Kulithalai, 6.5.89 (F. 2791); 1 ex., 43 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2786); 6 exs., 97-115 mm. SL., Thakkatur, 27.2.91 (F. 3692).

Distribution : Throughout India, Bangladesh, Sri Lanka, Thailand and Malaysia.

Aplocheilus blochii (Arnold)

1911. *Haplocheilus panchax* var *blochii* Arnold, *Wschr. Terrarienk.*, 8, p. 672 (Type locality : Madras).

Material : 1 ex., 22 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2538); 41 exs., 12-26 mm. SL., Pannaiambalam Village, Mullaiyar River, 28.4.89 (F. 2587); 16 exs., 15-26 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2784).

Distribution : Peninsular India and Sri Lanka.

Oryzias melastigma (Mc Clelland)

1839. *Aplocheilus melastigma* Mc Clelland, *Asiat. Res.* 19, p. 301, 427, pl. 42, fig. 3 (Type locality : Tanks at Calcutta).

Material : 13 exs., 14-20 mm. SL., Thanikottakam, 14 km. south of Thiruthurai-pundi, 28.8.89 (F. 2574); 2 exs., 18-19 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2785); 4 exs., 22-28 mm. SL., Arasalar, 26.2.91 (F. 3694); 3 exs., 18-20 mm. SL., Malvarayanallur, 27.2.91 (F. 3713); 3 exs., 18-20 mm. SL., Kudamuruttiaru, 28.2.91 (F. 3733); 4 exs., 13-21 mm. SL., Ammaiappan, 1.3.91 (F. 3704); 43 exs., 16-22 mm. SL., Thirunanriyur, 4.3.91 (F. 3689).

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka. Introduced for larvicidal use.

Gambusia affinis patruelis (Baird & Girard)

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

Material : 11 exs., 15-22 mm. SL., Nainarkulam, 20 km. south of Thanikottakam, Thiruthuraipundi, 28.4.89 (F. 2560).

Distribution : Throughout India, Pakistan, Bangladesh, Sri Lanka. Exotic fish introduced in the fresh water ponds all over India for larvicidal use.

Chanda nama Hamilton

1822. *Chanda nama* Hamilton, *Fish Ganges* p. 109, 371, pl. 89, fig. 37 (Type locality : Bengal).

Material : 1 ex., 67 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2738); 1 ex., 80 mm. SL., River Cauvery at Mayanur, Mayanur canal, 7.5.89 (F. 2801).

Distribution : Throughout India, Pakistan, Nepal, and Bangladesh.

Etroplus maculatus (Bloch)

1785. *Chaetodon maculatus* Bloch, *Syst. Ichth.*, pl. 427, fig. 2 (Type locality : Not given).

Material : 41 exs., 64-70 mm. SL., Pudu Canal, Tanjavur City, 22.4.89 (F. 2490); 1 ex., 50 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2504); 45 exs., 10-31 mm. SL., Kattur, 12 km. from Tanjavur, 24.4.89 (F. 2512); 1 ex., 41 mm. SL., Surakottai near Tanjavur, 24.4.89 (F. 2520); 54 exs., 20-60 mm. SL.,

Pannaiambalam Village, 28.4.89 (F. 2586); 1 ex., 17 mm. SL., Nainarkulam 20 km. south of Thiruthuraipundi, 28.4.89 (F. 2565); 1 ex., 34 mm. SL., Vedaranyam, 1.5.89 (F. 2605); 1 ex., 50 mm. SL., River Cauvery at Trichy, 3.5.89 (F. 2608); 2 exs., 25-30 mm. SL., River Cauvery at Musiri-Kulithalai, Bridge, 6.5.89 (F. 2781) 8 exs., 27-40 mm. SL., River Cauvery at Kulithalai, 6.5.89 (F. 2788); 8 exs., 30-54 mm. SL. River Cauvery at Mayanur, Mayanur canal, 7.5.89 (F. 2796); 2 exs., 30-40 mm. SL., River Coleroon near Silayathi, 5.5.89 (F. 2914); 1 ex., 24 mm. SL., Pallam vodai, 22.2.91 (F. 3723); 3 exs., 30-41 mm. SL., Sirugamani, 19.2.91 (F. 3725); 1 ex., 28 mm. SL., Thakkatur, 27.2.91 (F. 3705); 1 ex., 53 mm. SL., River Cauvery at Thiruvaiyaru, 28.2.91 (F. 3671).

Distribution : Tamilnadu, Kerala, South Karnataka and Sri Lanka.

Oreochromis mossambica (Peters)

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

Material : 1 ex., 21 mm. SL. Kattur, 12 km. from Tanjavur, 24.4.89 (F.2513); 5 exs., 69-90 mm. SL., Surakottai near Tanjavur, 24.4.89 (F. 2519); 4 exs., 20-40 SL., Neduvakottai Tank, 25.4.89 (F. 2524); 11 exs., 24-40 mm. SL., Periyapalam, 1 km. from Vaduvar, 25.4.89 (F. 2533); 2 exs., 92-95 mm. SL., Shengottai Tank, Thiruthuraipundi, 26.4.89 (F. 2542); 2 exs., 107-115 mm. SL., Nainarkulam on way to Nagapattinam, 26.4.89 (F. 2548); 3 exs., 90-105 mm. SL., Mullaiyar River at Thiruthuraipundi, 28.4.89 (F. 2561); 21 exs., 15-78 mm. SL., Pannaiambalam Village, Mullaiyar River, 28.4.89 (F. 2585); 2 exs., 70-105 mm. SL., Marudur Village, 30.4.89 (F. 2601); 13 exs., 10-27 mm. SL., Vedaranyam, 1.5.89 (F. 2604); 80 exs., 14-69 mm. SL., River Cauvery at Trichy, 3.5.89 (F. 2607); 9 exs., 18-125 mm. SL., River Cauvery at Musiri-Kulithalai Bridge, 6.5.89 (F. 2782); 12 exs., 25-100 mm. SL., River Cauvery at Kulithalai, 6.5.89 (F. 2787); 7 exs., 19-72 mm. SL., River Cauvery at Mayanur, Mayanur canal, 7.5.89 (F. 2795); 12 exs., 87-100 mm. SL., Cauvery River, 17.2.91 (F. 3717); 1 ex., 40 mm. SL., Pallam vodai, 22.2.91 (F. 3717); 22 exs., 16-30 mm. SL., River Cauvery at Thiruvaiyaru, 28.2.91 (F. 3672); 18 exs., 20-39 mm. SL., Thirunanriyur, 4.3.91 (F. 3686).

Distribution : East Africa to Natal, widely introduced in India and Pakistan.

Glossogobius giuris (Hamilton)

1822. *Gobius giuris* Hamilton, *Fish Ganges*, p. 51, 366., pl. 33, fig. 15 (Type locality : Ponds, and fresh waters of Gangetic Provinces).

Material : 24 exs., 86-120 mm. SL., Pudu canal, Tanjavur City, 22.4.89 (F. 2489); 7 exs., 37-60 mm. SL., Kattur, 12 km. from Tanjavur city, 24.4.89 (F. 2517); 3 exs., 20-30 mm. SL., Neduvakottai Tank, 25.4.89 (F. 2526); 1 ex., 30 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2532); 1 ex., 127 mm. SL., Nainarkulam at Thiruthuraipundi, 28.4.89 (F. 2560); 20 exs., 20-63 mm. SL., Pannaiambalam Village, Mullaiyar river, 28.4.89 (F. 2582); 3 exs., 43-48 mm. SL., Nainarkulam, 20 km. south of Thiruthuraipundi, 28.4.89 (F. 2564); 1 ex., 130 mm. SL., Marudur Village, 30.4.89 (F. 2599); 1 ex., 130 mm. SL., Fish Market, Trichy, 14.5.89 (F. 2750); 1 ex., 150 mm. SL., River Cauvery at Mayanur, Mayanur Canal, 7.5.89 (F. 2794); 3 exs., 127-190 mm. SL., Grand Anaicut, Trichy, 3.5.89 (F. 2806); 1 ex., 30 mm. SL., Malvarayanallur, 27.2.91 (F. 3712).

Distribution : Throughout India, Pakistan, Nepal, Bangladesh, Sri Lanka. From East Coast of Africa to Japan, Australia and South Pacific.

Liza parsia (Hamilton)

1822. *Mugil parsia* Hamilton, *Fish Ganges*, p. 215, 380, pl. 17, fig. 71 (Type locality : Freshwater Rivers of Bengal).

Material : 2 exs., 140-155 mm. SL., Mullaiyar river at Thiruthuraipundi, 28.4.89 (F. 2563); 1 ex., 61 mm. SL., Pudu canal, Tanjavur city, 22.4.89 (F. 2494); 1 ex., 140 mm. SL., Marudur village, 30.4.89 (F. 2600).

Distribution : Coasts of Maharashtra, Kerala, West Bengal, Pakistan, and Sri Lanka.

Rhinomugil corsula (Hamilton)

1822. *Mugil corsula* Hamilton, *Fish Ganges*, p. 221, 381, pl. 8, fig. 91 (Type locality : River in Gangetic provinces, Southern parts of Bengal).

Material : 1 ex., 135 mm. SL., Mullaiyar River near Thiruthuraipundi, 28.4.89 (F. 2562).

Distribution : River Ganges, Chilka Lake, Krishnagiri and Sathannur reservoir across Pennaiar and River Cauvery.

Remarks : This is the first record of *Rhinomugil corsula* from Mullaiyar River.

Anabas testudineus (Bloch)

1792. *Anabas testudineus* Bloch, *Naturl. Ausland Fishes.*, 6, p. 121, pl. 322. (Type locality: Japan and East Indies)

Material : 3 exs., 75-85 mm. SL., Nainarkulam on way to Nagapattinam, 26.4.89 (F. 2553); 6 exs., 75-105 mm. SL., Vettukulam, Vellakudi, 27.4.89 (F. 2557); 3 exs., 66-93 mm. SL., Mullaiyar River at Thiruthuraipundi, 28.4.89 (F. 2559); 4 exs., 40-100 mm. SL., Pannaiambalam Village, Mullaiyar River, 28.4.89 (F. 2593).

Distribution : Throughout India, Pakistan, Sri Lanka, Bangladesh, Thailand, China and Philippines.

Macropodus cupanus Valenciennes

1831. *Macropodus cupanus* Valenciennes, *Hist. nat. Poiss.*, 7, p. 357 (Type locality : Arian Coopam river, Pondicherry).

Material : 1 ex., 20 mm. SL., Neermulai on way to Vellangani, 26.4.89 (F. 2546); 9 exs., 22-31 mm. SL., Thiruvacakulam on Thiruthuraipundi-Mannargudi Road; 27.4.89 (F. 2554); 3 exs., 21-24 mm. SL., Pannaiambalam village, Mullaiyar River, 28.4.89 (F. 2591); 4 exs., 28-34 mm. SL., Thannikottakam, 14 km. south of Thiruthuraipundi, 28.4.89 (F. 2571); 2 exs., 15-25 mm. SL., Arasalar near Papanasam, 26.2.91 (F.3696).

Distribution : Bhavani river and rivers at base of Nilgiri, South Kanara hills. Also in Coramandal coasts.

Remarks : Hora (1937) recorded this species from river Cauvery. Jayaram (1982) could not get any specimen from Cauvery. In the present collection of 19 examples, 2 specimens were collected from River Arasalar, i. e., tributary of river Cauvery.

Colisa fasciatus (Schneider)

1801, *Trichogaster fasciatus* Bloch & Schneider, *Syst. Ichth.* p. 164, fig. 36 (Type locality Bengal).

Material : 2 exs., 22 mm. SL., Periyapalam, 1 km. from Vaduvur, 25.4.89 (F. 2536); 1 ex., 26 mm. SL., Neermulai Tank on way to Vellangani, 26.4.89 (F. 2545); 1 ex., 32 mm. SL., Thanikottakam, 14 km. south of Thiruthuraipundi, 28.4.89 (F. 2572).

Distribution : Tamilnadu, Andhra Pradesh, Bihar, Punjab, Uttar Pradesh, Orissa, Assam, Pakistan, Bangladesh and Mayanmar.

Mastacembelus armatus armatus Lacepede

1800. *Macrogathus armatus* Lacipide, *Hlst. nat. Poiss.*, 2, p. 283 (Type locality : Not given).

Material : 13 exs., 139-207 mm. SL., Pudu canal, Tanjavur city, 22.4.89 (F. 2487), 1 ex., 111 mm. SL., River Cauvery at Someswaram, 23.4.89 (F. 2507); 1 ex., 340 mm. SL., River Cauvery at Mayanur, Mayanur canal, 7.5.89 (F. 2802).

Distribution : Throughout India, Pakistan, Sri Lanka, Bangladesh and Thailand.

Macrogathus aculeatus (Bloch)

1787. *Ophidium aculeatus* Bloch, *Ichthyologie*, 5 p. 60, pl. 159, fig. 2 (Type locality : East Indies).

Material : 1 ex., 194 mm. SL., Fish Market, Trichy, 4.5.89 (F. 2751).

Distribution : Throughout India, Pakistan, Sri Lanka, Bangladesh, Thailand and China.

SUMMARY & CONCLUSIONS

Based on the collections worked out and the results achieved thereof, some conclusions were drawn on the comparative richness of the Ichthyofauna of Tanjavur and Trichy Districts. The analysis were depicted in the form of Tables I, II and III. Of the 2229 exs. studied, belonging to 50 species, collected from both the districts, a total of 1657 exs. (74.34%) referable to 44 species (88%) were collected from Tanjavur

District. This clearly indicates that Tanjavur district, fish fauna is much more richer, quantitative as well as qualitative wise than Trichy district [No. Exs. 572 (25.66%) & No. Sps. 36 (72%) in Trichy district]. This is perhaps due to the prevalence of ponds and other wet water bodies of Tanjavur District.

The three major source of collections i. e. River Cauvery, River Mullaiyar and ponds were analysed for their species diversity and abundance (Table III). River Cauvery ranked 1st [No. Exs. 909 (40.78%) and No. Sps. 43 (86%)]. The ponds occupied the 2nd place [No. Exs. 750 (33.65%) and No. Sps. 27 (52.5%)], River Mullaiyar ranks 3rd [(No. Exs. 570 (25.77% and No. Sps. 25 (51.5%)).

Of the 50 species recorded, the following 19 species were encountered exclusively in River Cauvery, *Chela (Chela) labuca* (Ham.), *Salmostoma boopsis* (Day), *Barilius bendelisis bendelisis* (Ham.), *Danio aequipinnatus* (Mc. Cl.), *Labeo dero* (Ham.), *Labeo boga* (Ham.), *Labeo pangusia* (Ham.), *Puntius filamentosus* (Val.), *Puntius sarana subnasutus* (Val.), *Garra mullya* (Sykes), *Noemacheilus pulchellus* (Day), *Mystus bleekeri* (Day), *Mystus cavasius* (Ham.), *Mystus vittatus* (Bloch), *Pseudeutropius atherinoides* (Blkr.), *Chanda nama* (Ham.), *Mastacembelus armatus armatus* Lacepede, and *Macrogathus aculeatus* (Bloch). The following four species were encountered exclusively in River Mullaiyar: *Dayella malabarica* Day, *Rasbora caverii* (Jerdon), *Rhinomugil corsula* (Ham.) and *Puntius vittatus* (Day). Only two species i. e., *Gambusi affinis patruelis* (Baird & Girard) and *Colisa fasciatus* (Schneider) were recorded exclusively from ponds.

In the light of the above facts and figures, based on the relative abundance of the fish fauna (No. of species recorded) the species were graded as extremely rare, rare, fairly common and common, as presented in the Table I.

Apart from listing 50 freshwater species from Tanjavur and Trichy Districts, 4 new records i. e. *Dayella malabarica* (Day) from East Coast river, *Rasbora caverii* (Jerdon) and *Rhinomugil corsula* (Ham.) from River Mullaiyar and *Labeo dero* from River Cauvery were reported in this paper.

ACKNOWLEDGEMENTS

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Table I : Showing Species Diversity, Abundance, collected from Tanjavur and Trichy Districts, Tamilnadu.

Sl. No.	Name of the Species	Specimen collected from					Specimens collected from						Remarks
		Trichy Dist.		Tanjavur Dist.		Total	R. Cauvery		R. Mullaiyar		Ponds		
		No.	%	No.	%		No.	%	No.	%	No.	%	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	<i>Dayella malabarica</i> (Day)	—	—	2	100	2	—	—	2	100	—	—	Extremely Rare
2.	<i>Chela (Chela) labuca</i> (Ham.)	2	20	8	80	10	10	100	—	—	—	—	Rare
3.	<i>Salmostoma boopsis</i> (Day)	1	100	—	—	1	1	100	—	—	—	—	Rare
4.	<i>Salmostoma clupeoides</i> (Bloch)	1	25.0	3	75.0	4	3	75.0	1	25.0	—	—	Rare
5.	<i>Amblypharyngodon mellitina</i> (Val.)	48	14.95	273	85.05	321	49	15.26	192	59.81	80	24.92	Common
6.	<i>Barilius bendelisis bendelisis</i> (Ham.)	34	94.44	2	5.55	36	36	100	—	—	—	—	Common
7.	<i>Danio aequipinnatus</i> (Mc Cl.)	42	93.33	3	6.67	45	45	100	—	—	—	—	Common
8.	<i>Esomus barbatus</i> (Jerdon)	14	7.91	163	92.09	177	44	24.86	21	11.86	112	63.28	Common (in ponds)
9.	<i>Esomus thermoicos</i> (Val.)	—	—	242	100	242	2	0.83	2	0.83	238	98.35	Common (in ponds)
10.	<i>Rasbora daniconius</i> (Ham.)	16	23.88	51	76.12	67	13	19.40	10	14.92	44	65.67	Common
11.	<i>Rasbora caverii</i> (Jerdon)	—	—	2	100	2	—	—	—	—	—	—	Rare

1.	2	3	4	5	6	7	8	9	10	11	12	13	14
12.	<i>Cirrhinus reba</i> (Ham.)	31	79.49	8	20.51	39	27	69.23	—	—	12	30.77	Common
13.	<i>Labeo boga</i> (Ham.)	1	100	—	—	1	1	100	—	—	—	—	Rare
14.	<i>Labeo dero</i> (Ham.)	2	100	—	—	2	2	100	—	—	—	—	Rare
15.	<i>Labeo pangusia</i> (Ham.)	4	100	—	—	4	4	100	—	—	—	—	Rare
16.	<i>Puntius amphibius</i> (Val.)	3	6.25	45	93.75	48	4	8.33	43	89.58	1	2.08	Fairly common
17.	<i>Puntius chola</i> (Ham.)	30	54.55	25	45.45	55	29	52.73	16	27.27	11	20.0	Fairly common
18.	<i>Puntius dorsalis</i> (Jerdon)	14	24.19	44	75.86	58	55	94.83	1	1.72	2	3.45	Fairly common
19.	<i>Puntius filamentosus</i> (Val.)	14	87.5	2	12.5	16	16	100	—	—	—	—	„
20.	<i>Puntius sarana subnasutus</i> (Val.)	22	84.61	4	15.38	26	26	100	—	—	—	—	„
21.	<i>Puntius sophore</i> (Ham.)	37	39.78	56	60.22	93	41	44.08	37	39.78	15	16.13	„
22.	<i>Puntius ticto ticto</i> (Ham.)	6	37.5	10	62.5	16	7	43.75	—	—	9	56.25	Rare
23.	<i>Puntius vittatus</i> (Day)	—	—	74	100	74	—	—	73	98.65	1	1.35	Common in saline waters
24.	<i>Garra mullya</i> (Sykes)	—	—	3	100	3	3	100	—	—	—	—	Rare (Com- mon in Hill streams)
25.	<i>Lepidocephalus thermalis</i> (Val.)	18	18.18	81	81.81	99	84	84.84	6	6.04	9	9.09	Common
26.	<i>Noemacheilus pulchellus</i> (Day)	—	—	11	100	11	11	100	—	—	—	—	Rare

1	2	3	4	5	6	7	8	9	10	11	12	13	14
27.	<i>Mystus bleekeri</i> (LæD)	4	80	5	20	9	9	100	—	—	—	—	Common
28.	<i>Mystus cavasius</i> (Ham.)	3	33·33	6	66·66	9	9	100	—	—	—	—	„
29.	<i>Mystus montanus</i> (Jerdon)	—	—	8	100	8	2	25	5	62·5	1	12·5	„
30.	<i>Mystus gulio</i> (Ham.)	1	16·67	5	83·33	6	1	16·67	5	66·66	1	16·67	„
31.	<i>Mystus vittatus</i> (Bloch)	21	95·45	1	4·55	22	22	100	—	—	—	—	„
32.	<i>Pseudeutropius athernoides</i> (Blkr.)	—	—	1	100	1	1	100	—	—	—	—	Extremely rare
33.	<i>Channa orientalis</i> (Sch.)	20	90·91	2	9·09	22	11	50	—	—	11	50	Common
34.	<i>Channa punctatus</i> (Bloch)	6	27·27	16	72·73	22	6	27·27	2	9·09	14	63·64	Common
35.	<i>Channa striatus</i> (Bloch)	1	33·33	2	66·67	3	1	33·33	2	66·67	—	—	Rare
36.	<i>Xenentodon cancila</i> (Ham.)	4	40·0	6	60·0	10	4	40·0	—	—	—	—	Common
37.	<i>Aplocheilus blochii</i> (Arnold)	16	33·33	45	72·41	61	16	33·33	41	70·69	1	1·72	Common
38.	<i>Oryzias melanostigma</i> (Mc. Cl.)	2	2·0	70	97·22	72	52	72·22	—	—	20	27·78	Common
39.	<i>Gasia affinis patruelis</i> (Baird and Girand)	—	—	11	100	11	—	—	—	—	11	100	Common
40.	<i>Chanda nama</i> (Ham.)	2	100	—	—	2	2	100	—	—	—	—	Rare

1	2	3	4	5	6	7	8	9	10	11	12	13	14
41.	<i>Etroplus maculatus</i> (Bloch)	25	14.62	146	85.38	171	69	40.35	54	31.58	48	28.07	Fairly common
42.	<i>Oreochromis</i> <i>mossambica</i> (Peters)	120	53.33	105	48.66	225	143	63.55	24	10.67	58	25.77	Fairly common
43.	<i>Glossogobius giuris</i> (Ham.)	5	7.58	61	92.42	66	29	43.94	20	30.30	17	25.76	Fairly common
44.	<i>Liza parsia</i> (Ham.)	—	—	4	100	4	1	25.0	2	50.0	1	25.0	Rare
45.	<i>Rhinomugil corsula</i> (Ham.)	—	—	1	100	1	—	—	1	100	—	—	Rare
46.	<i>Anabas testudineus</i> (Bloch)	—	—	16	100	16	—	—	7	43.75	9	56.25	Common
47.	<i>Macropodus cupanus</i> Val.	—	—	19	100	19	2	10.53	3	15.79	14	73.68	Common
48.	<i>Colisa fasciatus</i> (Schneider)	—	—	4	100	4	—	—	—	—	4	100	Rare
49.	<i>Mastacembelus armatus</i> <i>armatus</i> Lacepede	1	66.66	14	93.33	15	15	100	—	—	—	—	Common
50.	<i>Macragnathus</i> <i>aculeatus</i> (Bloch)	1	100.00	—	—	1	1	100	—	—	—	—	Rare

Table II
QUALITATIVE AND QUANTITATIVE COMPARISON OF FISH FAUNA
COLLECTED FROM TANJAVUR AND TRICHY DISTRICTS

Total number of specimens collected from					
Tanjavur and Trichy Districts		Trichy District		Tanjavur District	
No.	Ex.	No.	Ex.	No.	Ex.
2229		572	25.66	1657	74.34

Total number of species collected from					
Tanjavur and Trichy Districts		Trichy District		Tanjavur District	
		No.	%	No.	%
50		36	72.0	44	88.0

Table III
QUALITATIVE AND QUANTITATIVE COMPARISON OF FISH FAUNA
COLLECTED FROM RIVER CAUVERY, RIVER MULLAIYAR AND
PONDS IN TANJAVUR AND TRICHY DISTRICTS

Total No. of specimens collected from Tanjavur and Trichy Districts	Total No. of specimens collected from					
	River Cauvery		River Mullaiyar		Ponds	
	No.	Ex.	No.	Ex.	No.	%
2229	909	40.78	570	25.57	750	03.65

Total No. of species collected from Tanjavur and Trichy Dists.	Total No. of species collected from					
	River Cauvery		River Mullaiyar		Ponds	
	No.	Species	No.	Species	No.	Species
50	43	86.0	25	51.5	27	52.50

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A STUDY OF HEMISPERMATOPHORES IN INDIAN SCORPIONS OF THE
FAMILIES CHAERILIDAE, VAEJOVIDAE AND ISCHNURIDAE

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INTRODUCTION

Waygoldt (1975) has described the indirect process of sperm transfer through Spermatophore in the six orders of Arachnids namely Scorpionida, Chelonethi (Pseudoscorpionida), Uropygida, Schizomida, Amblypygida and Acarina. He has described the process of formation of glued spermatophores in these different groups. Such spermatophores in scorpions are formed in paraxial organs of male reproductive system. The right paraxial organ produces the right spermatophore (=Hemispermato-phore) and the mirror image, on the left, is produced by the left paraxial organ. It is difficult to obtain a complete glued spermatophore which limits the studies of this structure in this group. So it is generally preferred to study the hemispermato-phore which can be obtained by dissecting the mature males. The present communication deals with the studies of hemispermato-phores in details in one species of each Indian Scorpion families namely Chaerilidae, Vaejovidae (?) and Ischnuridae.

The reports on the glued post-insemination spermatophore of Indian species *Mesobuthus tamulus tamulus* (Fabr.) (family Buthidae) and *Heterometrus (chersonesometrus) scaber* (Pocock) (family Scorpionidae) are available by Bastawade (1992) and by Mathew (1957) respectively. The flagelliform spermatophore in the family Buthidae has been described in details. The lamelliform spermatophore in scorpionidae however, is not much specifically described and needs further studies. The details of the hemispermato-phore for the family chaerilidae in *chaerilus tricostatus* Pocock has been described for the first to the knowledge of Arachnology.

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Family : CHAERILIDAE

Chaerilus tricostatus Pocock

(Figs. 1-3)

Hemispermatothore lamelliform : Total length 4.50 mm, pedicel 0.50 mm, trunk 2.00 mm long and 0.75 mm wide, capsule 1.50 mm long, lamella 1.00 mm long and 0.50 mm wide. Truncal flexure weakly noticed, capsular portion simple and lined with three to four chitinous ridges forming a sperm duct (Fig. 1 & 2). An additional chitinous ridge opposite to the sperm duct is seen (Fig. 2), function is not known.

Family : VAEJOVIDAE (?)

Scorpiops (Scorpiops) hardwickei (Gervias)

(Figs. 4-6)

Hemispermatothore lamelliform, much distinctly curved. Total length 5.30-5.60 mm, pedicel 0.70-1.00 mm long, trunk 2.10 mm long and 0.90 mm wide, lamella 2.50 mm long and 0.50 mm wide. Truncal flexure prominent (Fig. 5), capsular region complicated, lined with more chitinous ridges, some forming sperm duct (Figs. 4-6). Lamella coiled on the distal portion and bent outwardly.

Family : ISCHNURIDAE

Iomachus laeviceps malbarensis Pocock

(Figs. 7-9)

Hemispermatothore lamelliform, curved but not as curved in the *Scorpiops* vaejovids. Total length 6.20 mm long, pedicel 0.50 mm long, trunk 1.70 mm and 0.50 mm wide, lamella 4.00 mm long and 0.30 mm wide. Trunk short and not uniformly wide, truncal flexure prominent. Capsule bulging with more number of chitinous ridges and few soft semichitinized flaps (Figs. 7 & 9). Lamella much more long, almost as long as two and a half times as trunk, little curved on proximal portion and bears an upwardly directed sub-basical hook (Figs. 7 & 9).

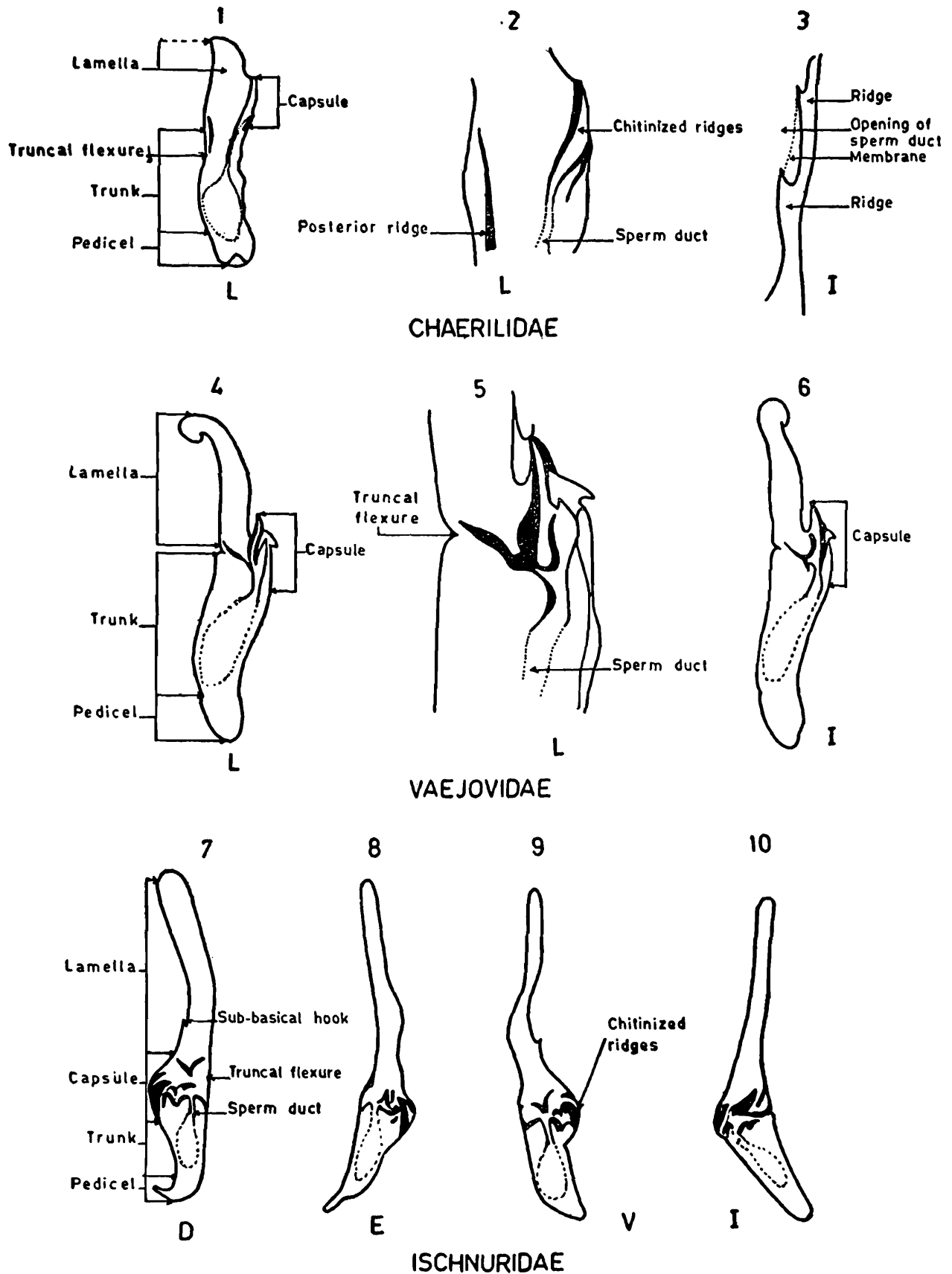


PLATE NO. I :

1. Lateral view, 2. Lateral view of capsular region, 3. Interior view of capsular region of hemispermatothore of *Chaerilus tricostatus* Pocock (Chaerilidae);
4. Lateral view, 5. Lateral view of capsular region, 6. Interior view of hemispermatothore of *Scorpiops (Scorpiops) hardwicki* (Garvias) (Vaejoidea);
7. Dorsal view, 8. Exterior view, 9. Ventral view, 10. Interior view of hemispermatothore of *Iomachus laeviceps malbarensis* Pocock (Ischnuridae).

DISCUSSION

Indian Scorpio-fauna comprises of five families namely Buthidae, Chaerilidae, Vaejovidae (?), Ischnuridae and Scorpionidae. Amongst these only Buthidae possesses

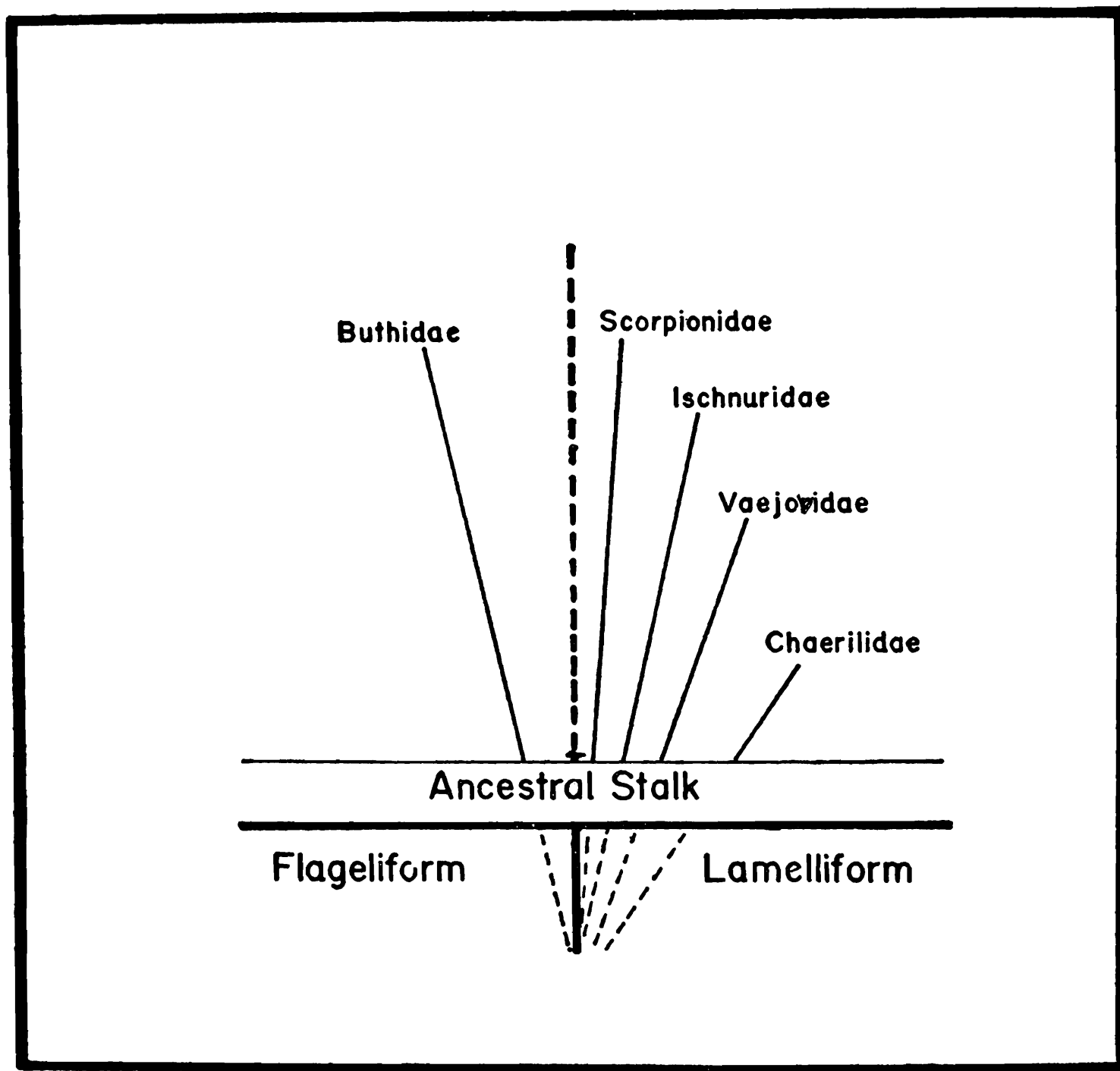


PLATE NO. II

Cladogram showing the phylogeny of different families of Indian Scorpions on the basis of Hemisphermatophores.

a flagelliform spermatophore and the remaining families possess the lamelliform spermatophores. The Chaerilid spermatophore is simple, shorter and not curved or bent in the middle whereas these are curved or bent in the case of Vaejoivid and Ischnurid. The Vaejoivid spermatophore is much more curved than Ischnurid. The spermatophore in case of Ischnurid is longer than remaining two, having longer lamella and shorter trunk and provided with a distinct sub-basal hook. The capsular portion is much simpler in Chaerilid, whereas it much complicated in other two.

The lamelliform spermatophore of chaerilidae shows phylogenetic closeness to remaining chactoid families i. e. Vajeovidae (?), Ischnuridae and Scorpionidae of Indian Scorpions indicating its descendancy from common ancestral stalk. Whereas the flagelliform buthoid spermatophore shows all together different ancestral stalk (Pt. No. II). The Chaerilid spermatophore has been discussed for the first time and it is observed that the chaerilid spermatophore is morphologically primitive among the chactoid scorpion families.

ACKNOWLEDGEMENTS

I most sincerely and thankfully acknowledge Dr. A. K. Ghosh, Director, Zoological Survey of India, Calcutta and Dr. J. R. B. Alfred, Scientist-SG, ZSI, Calcutta, Mr. P. T. Bhutia, Scientist-SE, ZSI, APFS, Itanagar for their keen interest, encouragement and facilities during the work.

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ON A NEW SPECIES OF *NANGRA* DAY
(PISCES : SILURIFORMES : SISORIDAE)
FROM ASSAM, NORTH EAST INDIA WITH A NOTE ON
COMPARATIVE STUDIES OF OTHER KNOWN SPECIES

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INTRODUCTION

While studying some fishes collected from Assam, the authors came across a good number of *Nangra* specimens which on examination proved to be new to science. Three species of *Nangra* namely *N. itchkeea* (Sykes), *N. nangra* (Hamilton-Buchanan) and *N. viridescens* (Hamilton-Buchanan) have so far been reported from India (Talwar and Jhingran, 1991). Out of the three species, *N. nangra* and *N. viridescens* have been so far recorded from Assam.

Though the present specimens show some similarity with these three species in some respects but differences reveal its separate identity.

Material examined: 35 specimens including Holotype ranging from 73 mm to 112 mm TL.

Nangra assamensis Sp. nov.

(Fig. 1, Plate 1)

D. I. 6, P. I. 8-9, V. i. 5, A. iii. 9-10, C. 16-17.

Description: Body elongate, subcylindrical, its depth 6.00-7.90 in standard length: head long, dorsoventrally depressed, its length 3.26-4.27 in standard length,

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Eyes placed high, moderate, oblong, its diameter 5.66-8.40 in head length. Median longitudinal groove extends to almost end of occipital process. Mouth wide, inferior. Barbels four pairs, nasals reaching mostly to hind border of eyes, sometimes a little

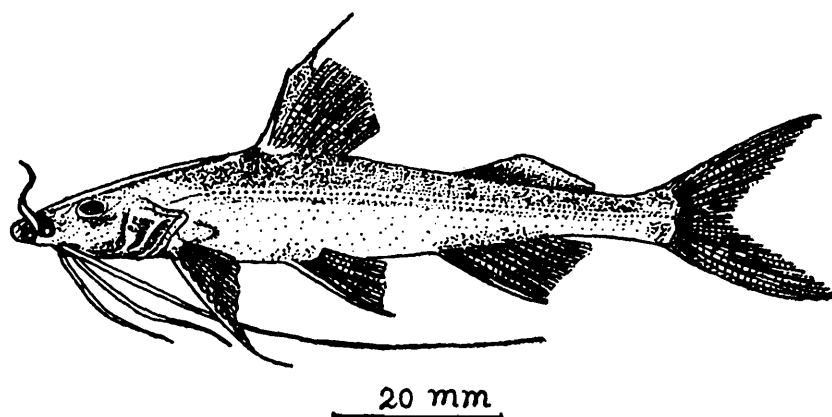


Fig. 1: Lateral view of *Nangra assamensis* sp. nov.

shorter. Outer mandibular generally up to middle of pectoral fin; inner mandibular up to base of pectoral fin or a little beyond; no fingerlike processes present between bases of inner mandibular barbels; maxillary up to middle of anal fin, sometimes a little shorter. Dorsal spine strong and smooth, pectoral spine strong and serrated on its inner edges with 13-16 dentitions. Dorsal and pectoral fins with a filamentous prolongation. The length of dorsal and pectoral fin 3.45-5.57 in standard length. Caudal fin deeply forked, lobes equal, occasionally lower lobe slightly longer than upper. Caudal peduncle narrow. Length of anal fin 5.54-7.15, caudal 4.33-6.27 and caudal peduncle 5.06-6.00 in standard length. Least height of caudal peduncle 18.00-24.00 in standard length.

Muddy, with a faint band along lateral line. Colour above lateral line darker.

Type specimens :

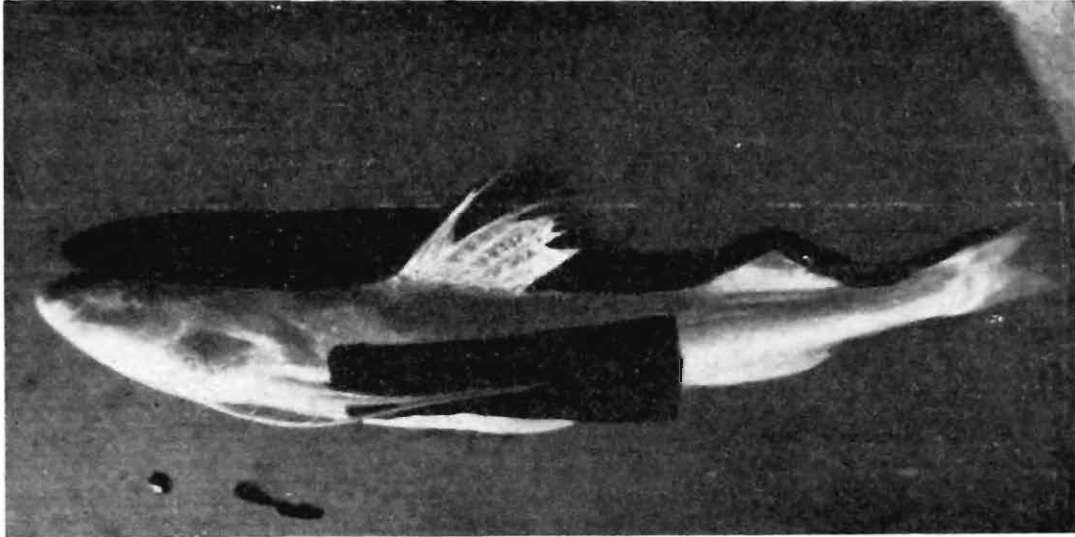
Holotype — 112 mm. TL, locality : Brahmaputra river at Neematighat, 14 Kms from Jorhat, Assam; Collector : B. K. Biswas; date of collection 4.4.91; Reg. no. V/F/ERS/53.

Paratypes — 4 specimens, 78 mm-100 TL, locality : Neematighat, 14 Kms from Jorhat, Assam; collector : B. K. Biswas date of collection : 4.4.91; Reg. no. V/F/ERS/54.

Records of the Zoological Survey of India

SEN & BISWAS

PLATE I



Nangra assamensis sp. nov.

Paratypes — 30 specimens, 73 mm-101 mm TL, locality : Brahmaputra river at Uzan Bazar ghat, Guwahati, Assam ; collector : B. K. Biswas ; date of collection : 26.3.92 ; Reg. no. V/F/ERS/55.

Affinities : In body shape and length of maxillary barbel it is more or less closer to *N. nangra*, but differs in length of nasal barbel (which is very long in *nangra*) and number of unbranched dorsal fin rays (9-10 Vs. 6). In fin formula it is closer to *viridescens* and *itchkeea*, but differs in body shape, colouration and length of barbels.

The species has been named *Nangra assamensis* after the name of the state from where the specimens were collected.

Remarks : Jayaram (1979) & Talwar and Jhingran (1991) described maxillary barbels in *N. nangra* as reaching pectoral fin or slightly beyond. The present authors agree with Hamilton (1822) that maxillary barbels reaching vent.

Key to the species of *Nangra* Day

1. Dorsal fin with 9 or 10 soft rays ; nasal barbels very long, as long as head or slightly beyond *N. nangra*
- Dorsal fin with 6 or 7 soft rays ; nasal barbels shorter than head or rudimentary ... 2.
2. Dorsal and pectoral fins with filamentous prolongation, nasal barbel extends to hind border of eye ; maxillary barbels reaches middle of anal fin ... *N. assamensis* sp. nov.
- Dorsal and pectoral fins without filamentous prolongation, nasal barbel almost as long as or considerably shorter than eye diameter ; maxillary barbels shorter or slightly longer than head 3.
3. A pair of fingerlike processes present between base of inner mandibular barbels ; head greatly depressed, maxillary barbel shorter than head ... *N. viridescens*
- No fingerlike processes present between bases of inner mandibular barbels ; head compressed ; maxillary barbel longer than head ... *N. itchkeea*

Comparative study of different species of *NANGRA*

<i>N. nangra</i>	<i>N. viridescens</i>	<i>N. itchkeea</i>	<i>N. assamensis</i> sp. nov.
1. Dorsal fin with 9-10 soft rays	Dorsal fin with 6 or 7 soft rays.	Dorsal fin with 6 or 7 soft rays.	Dorsal fin with 6 soft rays.
2. Fin formula : D.I.9-10, P.I.9, V.i.5, A.iii.10, C.16-17	D.I.6-7, P.I.8, V.i.5, A.iii-iv.8, C.18-21	D.I.6-7, P.I.8, V.i.5, A.iii-iv.9-10, C.18-21	D.I.6, P.I.8-9, V.i.5, A.iii.9-10, C.16-17
3. Nasal barbel as long as head or slightly longer.	Nasal barbel minute or rudimentary.	Nasal barbel small, shorter than eye diameter.	Nasal barbel reaching mostly to hind border of eye or slightly shorter.
4. Maxillary barbel extends to end of anal fin.	Maxillary barbel much shorter than head	Maxillary barbel longer than head	Maxillary barbel extends to middle of anal fin, occasionally a little shorter.
5. Outer mandibular barbel extends beyond pectoral fin and reaches pelvic fin.	Outer mandibular barbel do not extend beyond pectoral fin.	Outer mandibular barbel shorter than head	Outer mandibular barbel extends to middle of pectoral fin, sometimes crossing a little but never beyond.

- | | | | |
|---|---|--|---|
| 6. Head long, oval. | Head large, broad, greatly depressed. | Head short, globular, rounded anteriorly compressed. | Head long, dorsoventrally depressed. |
| 7. Median longitudinal groove on head extends to almost end of occipital process with two fontanelle. | Median longitudinal groove on head extends to base of occipital process with single fontanelle. | Median longitudinal groove on head extends to base of occipital process with two fontanelle. | Median longitudinal groove on head extends to almost end of occipital process with single fontanelle. |
| 8. No fingerlike process between inner mandibular base. | A pair of fingerlike processes between inner mandibular base. | No fingerlike process between inner mandibular base. | No fingerlike process between mandibular base. |
| 9. Body colour muddy with three indistinct vertical greenish half bands. | Body colour coppery glossed with gold on sides, 3-4 black bands along back descending along sides up to lateral line. A black markings on caudal lobes. | Yellowish bronze, silvery on belly. Body with dark blotches along back descending halfway down side. Black blotches on caudal lobes and on dorsal. | Body colour muddy with a faint band along lateral line. Colour above lateral line darker. |

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NOTES ON A SMALL COLLECTION OF LEAFHOPPERS
(HOMOPTERA : CICADELLIDAE) FROM PERIYAR
AND SALEM DISTRICTS, TAMILNADU

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INTRODUCTION

Our knowledge of leafhoppers of India is mainly based on the works of Distant (1908, 1916, 1918) and Sing-Pruthi (1930, 1934, 1936) and no work is available so far on the group from Periyar and Salem districts.

The present paper lists fifteen species of leafhoppers along with notes on collection data and taxonomical observations. The classification and arrangement of subfamilies followed here is after Nielson (1985) and Rao (1990). Of the species dealt with, four are recorded here for the first time from South India and all are new records from Salem or Periyar districts. The works of Knight (1987), Rao (1990), Ross (1968) and Young (1986) among others were referred for recognition of economically important species.

Subfamily : CICADELLINAE Latreille

1. *Anatikina infecta* (Distant)

1908. *Tettigoniella infecta* Distant, *Fauna Brit. India, Rhynchota*, iv : 210.

1918. *Tettigoniella gemina* Distant, *Fauna Brit. India, Rhynchota*, vii : 2.

1986. *Anatikina infecta* (Distant) : Young, *Tech. Bull. N. C. Agric. Expt. Stn.*, 281 : 46.

Vertex with two discal and two small black spots near ocelli. Pronotum with a central longitudinal carination and two small black spots on anterior margin.

Measurements : Male 7.4 mm long and 1.88 mm wide.

Material examined : Tamilnadu : Periyar dist., Gethesal, 1 ♀, 4.1.1990 ; 1 ♂, 30.12.1989, coll. P.T. Cherian.

Distribution : India : Kodaikanal ; Myanmar.

2. *Atkinsoniella opponens* (Walker)

1858. *Tettigonia opponens* Walker, *List. Hom.* 111 : 757.

1908. *Tettigoniella bellona* Distant,

1908. *Tettigoniella marpessa* Distant,

1914. *Tettigoniella cuprea* Melichar,

1908. *Kolla canidia* Distant,

1911. *Kolla maculifrons* (Schmidt),

1911. *Kolla maculifrons* var *similaris* (Schmidt),

1911. *Kolla trimaculata* Schmidt,

1918. *Kolla tigrina* Distant,

1935. *Kolla melichari* China,

Young, 1986. *Tech. Bull. N. C. agric. Expt. Stn.*, 281 : 97,

Saffron yellow coloured species. Vertex with two transverse black spots near anterior margin; Ocelli testaceous. Face with a large central spot at base partially visible on ventral side. Pronotum with two transverse black fasciae. Forewing ochraceous, clavus and costa marked with three long black streaks.

Measurements : Male 5.12 to 5.20 mm long and 1.2 to 1.28 mm wide. Female 5.8 mm long and 1.26 mm wide.

Material examined : Tamilnadu : Periyar dist., Gethesal, 4 ♂♂ ; 1 ♀ ; 4.1.1990, coll. P.T. Cherian.

Distribution : India : Aiur (Salem), Darjeeling, Dehradun, Fraserpet (Karnataka), Kottur (Vellore), Kumaon, Punjab, Sikkim ; Chap ; China ; Fukien ; Java ; Kangean islands ; Laos ; Malaysia ; Myanmar ; Philippines ; Sarowak ; Sumatra ; Thailand ; Vietnam.

3. *Bothrogonia sclerotica* Young

1986. *Bothrogonia sclerotica* Young, *Tech. Bull. N. C. agric. Expt. Stn.*, 281 : 220.

Vertex with two small apical and one discal spots. Pronotum broader than vertex and with five brown spots. Scutellum with a central brownish spot. Tegmen ochraceous.

Measurements : 13.12 mm long and 2.6 mm wide.

Material examined : Tamilnadu : Salem dist., Kolli Hills, 1 ♀, 30.11.1989, coll. P.T. Cherian.

Distribution : S. India : Anamalai Hills, Coimbatore, Coorg, Gudalur, Malabar, Naliampathi, Nilgiri Hills, Thanjavur, Travancore.

Remarks : Face and clypellus brown ; abdomen greyish ochraceous. Fore tibia entirely black ; intermediate and hind tibiae black at base and apex only.

4. *Cofana spectra* (Distant)

1853. *Tettigoniella albida* (nec Walker) Signoret, *Ann. Soc. Ent. Fr.* Pl. 21, 193 : 663.

1908. *Tettigoniella spectra* Distant, *Fauna Brit. India, Rhynchota*, iv : 211, new name for *Tettigonia albida* Signoret, 1853, not *Tettigonia albida* Walker, 1851.

1979. *Cofana spectra* (Distant) : Young, *Proc. ent. Soc. Wash.*, 81 (1) : 21 ; Rao, 1986. *Rec. zool. Surv. India*, 84 (1-4) : 50.

Specimens less than 10 mm in length. Head with median length less than interocular width. Vertex with median apical and discal spots. Aedeagus without processes, shaft cylindrical. Seventh sternum of female with posterior margin slightly undulating.

Measurements : Male 7.4 to 7.88 mm long and 1.64 to 1.92 mm wide. Female 8.4 to 9.6 mm long and 1.64 to 1.92 mm wide.

Material examined : Tamilnadu : Periyar dist., Dhimbam, 5 ♂♂, 3 ♀♀, 1.1.1990 coll. P. T. Cherian.

Distribution : India : Patacharkuchi, Dibrugarh, Manipur, Silent Valley ; Africa ; Australia ; Japan ; Myanmar ; Philippines ; Sri Lanka.

Remarks : A distinct fovea is seen in some females. This species is known to be a mild pest of rice.

5. *Kolla paulula* (Walker)

1858. *Tettigoniella paulula* Walker, *List. Hom. Suppl.*, 219.

1986. *Kolla paulula*: Young, *Tech. Bull. N. C. agric. Expt. Stn.*, 281 : 135.

Vertex with two large black spots anteriorly and two small spots on disc. Face with a brown spot at apex. Pronotum with basal margin black and produced into a triangle at middle. Fore wings black, costal area broadly stramineous. Scutellum with a brown spot at each basal angle.

Measurements : Male 5.28 to 6.52 mm long and 1.36 to 1.84 mm wide. Female 4.64 to 5.2 mm long and 1.28 to 1.32 mm wide.

Material examined : Tamilnadu : Salem dist., Hair Pin Bend No. 10. Yercaud Road, 2 ♂♂, 2 ♀♀, 29. xii. 1989, coll. P. T. Cherian ; Salem dist., Kolli Hills, 2 ♂♂, 2 ♀♀, 30. xii. 1989, coll. P. T. Cherian ; Periyar dist., Dhimbam, 1 ♀, 1.1.1990, coll. P. T. Cherian ; Periyar dist., Gethesal, 10 ♂♂, 11 ♀♀, 4.1.1990, coll. P. T. Cherian ; Periyar dist., Karpalam, 1 ♀ 6.1.1990, coll. P. T. Cherian.

Distribution : India : Calcutta ; Sri Lanka ; S. E. Asia.

Remarks : Basal marginal band of pronotum not triangularly produced in some specimens.

Subfamily : NIRVANINAE Baker

6. *Nirvana pallida* Melichar

1903. *Nirvana pallida* Melichar, *Hom. Fauna, von Ceylon*, 166 ; Distant. 1908. *Fauna Brit. India, Rhynchota*, iv : 284 ; Sing-Pruthi, 1934. *Indian Forest Rec. ent. ser.*, 19 (4) : 17 ; Ishihara, 1953, *Matsuyama agric. coll. Sci. Rept.*, 11 : 19 ; Viraktamath & Wesley, 1988. *Mem. Great Basin Nat.* No. 12 : 213. Rao, 1990. *Rec. zool. Surv. India, Occ. paper*, 127 : 38.

Vertex less than twice as long as pronotum and marked with a median white line from apex to base and an orange yellow streak on each lateral side. Face medially carinate from basal one third. Fore wing with two large marginal oblique brownish stripes on costa beyond middle.

Measurements : Female 2.4 mm long and 0.8 mm wide.

Material examined : Tamilnadu : Periyar dist., Dhimbam, 1 ♀, 1.1.1990, coll. P. T. Cherian.

Distribution : Throughout India, Sri Lanka ; Indo-Chinese ; Indo-Malayan and Oriental Regions.

Subfamily : HECALINAE Distant

7. *Hecalus arcuatus* (de Motschulsky)

1859. *Acocephalus arcuatus* de Motschulsky, *Etud. Ent.*, 8 : 15.
 1918. *Thomsoniella arcuata* : Distant, *Fauna, Brit. India, Rhynchota*, iv : 280.
 1966. *Linnavuoriella arcuata* (de Motsch.) : Evans, *Mem. Aust. Mus.*, 12 : 134.
 1973. *Hecalus arcuatus* (de Motsch.) Morrison, *Pacif. Insects*, 15 (3-4)
 (= *Linnavuoriella arcuata*) : Rao, 1989. *Hexapoda*, 1 (1) : 66.
 (= *Varta moshiensis* Rao)

Head and Thorax with sanguineous paraboloid fasciae. Pygofer large Apophysis broad and attached to style mid laterally. Connective Y-shaped arms distinct and curved laterally at apex. Aedeagus with two pairs of apical processes.

Measurements : Male 4.52 mm long and 1.2 mm wide.

Material examined : Tamilnadu : Periyar dist., Gethesal, 1 ♂, 4.1.1990, coll. P. T. Cherian.

Distribution : Throughout India ; Flores ; Java ; Sri Lanka ; Queensland.

8. *Hecalus porrectus* (Walker)

1858. *Acocephalus porrectus* (Walker), *List. Hom. Brit. Mus. suppl.*, 362.
 1918. *Parabolocratus porrectus* Distant, *Fauna, Brit. India, Rhynchota*, vii : 31
 (= *Thomsoniella porrecta* Walker)
 1973. *Hecalus porrectus* : Morrison, *Pacif. Insects*, 15 (3-4) : 421.
 (= *Parabolocratus porrectus* Walker. *Thomsoniella albomaculata* Distant) ; Rao, 1990, *Rec. zool. Surv. India, Occ. Paper*, 127 : 50.

Species beautifully marked with orange fasciae—four on vertex, six on pronotum and three or four on scutellum. Fore wing in males with white spots at apex and female without them. Aedeagus with a pair of apical processes directed laterad,

Measurements : Male 4.42 mm long and 1.3 mm wide. Female 6.02 mm long and 1.4 mm wide.

Material examined : Tamilnadu : Periyar dist., Gethesal, 1 ♂, 4.1.1990, coll. P. T. Cherian.

Distribution : Throughout India ; Australia ; Formosa ; Java ; Karatatau ; Maldiv islands ; Myanmar ; Sambawa ; Sri Lanka ; Sunda islands.

Remarks : This insect is known to attack rice, apricot and peach.

Subfamily : DELTOCEPHALINAE Fieber

9. *Aconurella montana* (Distant)

1908. *Deltocephalus montanus* Distant, *Fauna Brit. India, Rhynchota*, iv : 384.

1930. *Cicadula montanus* (Distant) : Sing-Pruthi, *Mem. Indian Mus.*, 11 (1) : 58.

1964. *Aconurella montana* (Distant) : Emeljanov, *Ent. Obozr.*, 43 : 626.

Pale ochraceous. Vertex with a black transverse fascia, medially continued to apex. Pronotum almost as long as vertex. Scutellum with two small spots before transverse impression. Tegmina not covering posterior end of abdomen. Male pygofer large with thick spines at caudal end.

Measurements : Male 2.29 mm long and 9.7 mm wide.

Material examined : Tamilnadu : Periyar dist., Karapalayam, 1 ♂, 6.1.1990, coll. P. T. Cherian.

Distribution : India : Khasi Hills (Meghalaya), Dalhousie Hills, Kahitama, (Assam) ; Muree Hills (Himalayas), Simla.

Remarks : This is reported here for the first time from South India.

10. *Balclutha saltuella* (Kirschbaum)

1868. *Jassus saltuella* Kirsch. *Massau. ver. t. Naturk. Jahrb.*, 21-22 : 86.

1906. *Balclutha saltuella* (Kirsch.) : Oshanin, *Liefereng. Mus. Zoel. St. Petersburg. Ann.*, 11 : 186 (= *Jassus (Thamnotettix) saltuella* Kirsch., = *Gnathodus angustus* (Then),

1987. *Balclutha saltuella* (Kirsch.) : Knight, *J. nat. Hist.*, 21 (*Typhlocyba delicatula* Dist., 1918 ; *Empoanara lineolata* Dist., 1918 ; = *Anomiana longulus* Dist., 1918 ; = *Eugnathodus ocellata* Sing-Pruthi, 1939,

Vertex with a brown spot on each side of median line. Pronotum dull greyish with five linear greyish brown fasciae. Style small. Apophysis finger shaped and directed laterad.

Measurements : Female 2.99 mm long and 0.75 mm wide.

Material examined : Tamilnadu. Periyar dist., Gethesal, 1 ♂, 4.1.1990, coll. P. T. Cherian.

Distribution : Throughout India ; Egypt ; Europe.

11. *Balclutha rubrostriata* (Melichar)

1903. *Gnathodus rubrostriatus* Melichar, *Hom. Fauna, Ceylon*, 208.
 1905. *Gnathodus rubrotinctus* Melichar, Knight, 1987, *J. nat. Hist.* 21 : 1211.
 1906. *Nesosteles sanguinescens* Kirkaldy, Evans, 1977, *Rec. Aus. Mus.*, 31P 120.
 1918. *Typhlocyba rubrostriata* Dist., Knight, 1987, *J. Nat. Hist.*, 21 : 1211.
 1918. *Typhlocyba rufuscula* Dist., Knight, 1987, *Ibid*, 21 : 1211.
 1987. *Balclutha rubrostriata* (Melichar) : Knight, 1987, *J. Nat. Hist.*, 21 : 1211.

Head as wide as pronotum. Pronotum with longitudinal stripes extending to posterior margins of vertex and scutellum. Aedeagus at base with a pair of expansions. Shaft anterior portion recurved.

Measurements : 3.52 mm long and 0.75 mm wide.

Material examined : Tamilnadu : Periyar dist., Gethesal, 4.1.1990, 1 ♂, coll. P. T. Cherian.

Distribution : India : Chikkabalapura, Calcutta, Delhi ; Australia ; Formosa ; Philippines ; Polynesia ; Sri Lanka ; W. Indies.

12. *Changwhania ceylonensis* (Baker)

1903. *Deltocephalus bimaculatus* Melichar, *Hom. Fauna, Ceylon*, 204.
 1825. *Deltocephalus ceylonensis* Baker, *Nom. nov. Proc. Deltocephalus bimaculatus* Melichar (1903) nec. *Deltocephalus bimaculatus* Gillette and Baker, 1855. *Philippine jour. Sci.*, 27 : 537.
 1990. *Changwhania ceylonensis* (Baker) : Webb and Heller, *Stutt. Beltr. Natur. Ser. A. (Biol.)*, 452 : 10 ; Rao (in press). *Rec. zool. Surv. India*.

Vertex with two large round spots at anterior margin of eyes. Face longer

than broad, lateral frontal sutures extending to ocelli. Style broad at base, caudal end produced to form a beak-like structure. Aedeagal shaft long with two asymmetrical processes at apex. The processes notched at middle on outer margin.

Measurements : Female 3.4 mm long and 1 mm wide.

Material examined : Tamilnadu : Salem Dist., 1 ♀, Kolli Hills, 30.xii.1989, coll. P. T. Cherian.

Distribution ; India ; Sri Lanka ; South East Asia. Rao (in press) gave an account of the discontinuous distribution of the species in India.

13. *Exitianus indicus* (Distant)

1863. *Athysanus fusconervosus* de Motschulsky, *Bull. Soc. Nat. Mosc.*, 36 : 97.

1908. *Athysanus indicus* Distant, *Fauna Brit. India, Rhynchota*, iv : 344.

1918. *Phrynomorphus fusconervosus* : Distant, *Fauna Brit. India, Rhynchota*, vi : 51 (= *Athysanus fusconervosus* Dist.).

1968. *Exitianus indicus* : Ross, *Bull. Br. Mus. nat. Hist. (Ent.)*, 22 : 12, Rao, 1990. *Rec. zool. Surv. India, Occ. Paper* : 27 : 97.

Dorsum of head with a single arcuate dark line reaching linear margins of eyes. Anterior margin of pronotum with a series of black spots arranged in an arc. Style large, apophysis pointed but not drawn into a spine.

Measurements : Male 3.92 to 5 mm long and 1.2 to 1.6 mm wide. Female 5.28 to 5.4 mm long and 1.36 to 1.44 mm wide.

Material examined : Tamilnadu : Periyar dist., Dhimbam, 3 ♂ ♂, 2 ♀ ♀, 7.1.1990, coll. P. T. Cherian.

Distribution : Throughout India.

Remarks : The piceous transverse band of vertex is seen interrupted in some specimens.

14. *Recilia intermedia* (Melichar)

1903. *Deltocephalus intermedius* Melichar, *Hom. Fauna, Ceylon*, 205.

1989. *Recilia intermedia* : Rao, *Hexapoda*, 1 (1) : 75, Rao 1990. *Rec. zool. Surv. India, Occ. paper*, 127 : 74.

Pronotum pale ochraceous. Anterior margin rounded, posterior margin truncate. Scutellum broader than long, lateral margin sinuate. Fore wing with four apical and three ante-apical cells and a small appendix. Connective, racket shaped. Aedeagus and connective fused, aedeagal shaft curved in lateral aspect and produced into a spine.

Measurements : Male 2.48 to 2.84 mm long and 0.76 to 0.80 mm wide.

Material examined : Tamilnadu : Periyar dist., Dhimbam, 2 ♂♂, 1.1.1990, coll. P. T. Cherian.

Distribution : This is known from India and Sri Lanka. From India it is known from Khasi Hills.

Subfamily : TYPHLOCYBINAE

15. *Seriana jaina* (Distant)

1908. *Typhlocyba jaina* Distant, *Fauna. Brit. India, Rhynchota*, iv : 413.

1978. *Seriana jaina* (Distant) : Dworakowska, Nagalch and Singh, *Bulletin, Acad. Pol. Sci. (Ser. Sci. biol.)*, 26 : (4) 246-247.

Pale ochraceous. Pronotum medially two and half a times longer than vertex. Vertex anteriorly rounded with a large central apical spot. Scutellum with a large brown central patch at each basal angle.

Measurements : Female 3.32 mm long and 0.64 mm wide.

Material examined : Tamilnadu : Periyar dist., Gethesal, 1 ♂, 4.1.1990, coll. P. T. Cherian.

Distribution : Found throughout India.

SUMMARY

Taxonomical analysis, collection data and distributional records for 15 species of leafhoppers of Periyar and Salem districts are provided in this paper. This study has established two new records to Salem district and nine records to Periyar district.

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CENTIPEDE FAUNA OF NE STATES, INDIA
(CHILOPODA : SCOLOPENDROMORPHA)

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INTRODUCTION

The reconnoitroire of the available references of Pocock (1892/93), Kraepelin (1903), Attems (1906, 1930) Gravely (1910, 1912) and Silvestri (1924) reveal the record of 24 species of Scolopendrid centipedes from NE Region, including part of West Bengal and Sikkim, as also Bhutan, Bangladesh, Myanmar and Nepal. Of these, eleven species represent the present political boundaries of N. E. States, India.

The N. E. (North East) Region, at present, comprises the states of Sikkim, Arunachal Pradesh, Assam, Meghalaya, Nagaland, Manipur, Tripura, Mizoram and part of West Bengal. The region is bounded on North by Tibet and China, East and South-East by Myanmar, on the North-West by Bhutan and Nepal, and on South by Bangladesh. The land of Bangladesh is, in fact, interspersed between West Bengal, Meghalaya, Assam, Tripura and Mizoram.

The present paper deals with the Scolopendrid Centipedes collected from Sikkim, Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram and Tripura States of N. E. Region, India, by the scientists of Eastern Regional Station, Zoological Survey of India, Shillong (Meghalaya) since 1960.

Presently, the author has recorded twenty species from the region. Combining the record of eleven species made prior to 1930 (as referred to above), the total number of species now known from the N. E. Region, India, has been raised to twenty four, which excludes the species recorded from Burma, Bhutan, Bangladesh and Nepal.

Of the present twenty four species, five constitute a new record from India (*viz.*, *Otostigmus spinosus* Porath, *O. oweni* Pocock, *O. oatesi* Kraepelin, *O. proponens* Chamberlin and

Rhysida stuhlmanni stuhlmanni Kraepelin); four a new record from the region (namely, *O. ceylonicus* Haase, *O. ruficeps* Pocock, *O. nudus* Pocock and *Cormocephalus dentipes* Pocock); eleven species are with their distributional ranges extended within the N. E. Region. The author has not come across any material of *Ethmostigmus pygomegas* (Kohlrausch) (previously known from West Bengal, Assam and Myanmar), *Cormocephalus pygmaeus* Pocock (previously known from West Bengal, Assam, Bihar and Lower Myanmar), *Cryptops kempi* Silvestri (Siju cave, Assam) and *Scolopendra subspinipes dehaani* Brandt (from West Bengal, Assam, Myanmar and Bangladesh).

While listing the species from N. E. Region, the author has tried to include all the species hitherto known from N. E. Region. In addition, notes on the species occurring in adjacent countries like Bhutan, Bangladesh, Myanmar and Nepal, have been incorporated under respective genera. Efforts have also been made to re-assign the localities reported by Gravely (1910 and 1912) and earlier workers to their present political boundaries.

SYSTEMATIC ACCOUNT

Phylum : ARTHROPODA

Class : CHILOPODA

Order : SCOLOPENDROMORPHA

Family : CRYPTOPIDAE

Genus : **Paracryptops** Pocock

1. *Paracryptops indicus* Silvestri, 1924

1924. *Paracryptops indicus* Silvestri, *Rec. Indian Mus.*, 26 : 74 (Type locality : Siju Cave, Assam).

Material examined : India : Meghalaya, Shillong, Risa Colony, 1 ex., 15. iv, 1977, M. S. Jyrwa (ERS Reg. No. 14714).

Remarks : Hitherto recorded only from Siju cave (Assam), the present report of the species from Meghalaya state merely extends the range of its distribution in NE Region.

Genus : **Cryptops** Leach

2. **Cryptops** sp. (doubtful)

Material examined : India : Arunachal Pradesh, Basser (Siang), 1 ex., 13. ii. 1973, R. S. Pillai (ERS Reg. No. 6834).

The specimen is badly damaged and can not be assigned to any species.

3. **Cryptops kempi** Silvestri 1924

1924. *Cryptops kempi* Silvestri, *Rec. Indian Mus.*, 26 : 73. (Type locality : Siju cave, Assam).

Remarks : No material of this species was available from the present lot. The species has hitherto been reported by Silvestri (1924) from Siju cave, Assam. The genus is also reported to be represented by *Cryptops feae* Pocock, *Cryptops inermipes* (Pocock) and *Cryptops doriae* Pocock from Myanmar (vide Gravely, 1910). The species *C. doriae* has recently been collected from Nanda Devi Biosphere reserve area (U. P.) and is being dealt with elsewhere by the author. But it may be mentioned here that the record of this species from U. P., hitherto known from Matheran (Maharashtra) and Myanmar, is of great zoo-geographical importance.

Family : SCOLOPENDRIDAE

Subfamily : SCOLOPEDRINAE

Tribe : SCOLOPENDRINI

Genus : **Scolopendra** Linnaeus

4. **Scolopendra morsitans** Linnaeus 1753

1753. *Scolopendra morsitans* Linnaeus, *Syst. nat.*, 10 : 638.

Material examined : India : Meghalaya : Shillong, Motinagar, 1 ex., 14. xii. 1976, 1 ex., 18. iv. 1977, M. S. Jyrwa coll. (ERS Reg. No. 14631 and 14706) ; Risa Colony, 1 ex., 4. iv. 1973, J. K. Prasad (ERS Reg. No. 7004) : Jaintia Hill, Sonapur, 1 ex., 11. ix. 1983, A. R. Lahiri (ERS Reg. No. 9654).

Remarks : The species is cosmopolitan in status with previous report from Dilkush, NE Cachar and Sibsagar (Assam) (vide Gravely 1910). The species is also known to be recorded from Myanmar and Bangladesh.

5. *Scolopendra subspinipes dehaani* Brandt 1840

1840. *Scolopendra de haani* Brandt, *Bull. Ac. St.*, 7 : 159.

Remarks : The author has not come across any example of this species from NE Region, but it is previously known to be recorded from Punkhabari, Darjeeling, Calcutta, Chinsura, Barrackpur, Serampur and Siliguri (West Bengal) ; Dilkush, Jatinga River and North Cachar Hills (Assam) and Lower Myanmar and Bangladesh.

Note : The genus *Scolopendra* is also known to be represented by *Scolopendra pinguis* Pocock, 1891 from Karen Berge (Myanmar) and Buitenzorg (Java).

Genus : *Cormocephalus* Newport

6. *Cormocephalus dentipes* Pocock 1691

1891. *Cormocephalus dentipes* Pocock, *Ann. nat. Hist. Ser. 6*, Vol. 7 : 66-67.

Material examined : India : Meghalaya : Garo Hills, Tura Peak. 2 exs., 27.ii.1966, A. S. Rajagopal (ERS Reg. No. 12850) ; Dainadubi, 1 ex., 8.iv.1971, R. S. Pillai (ERS Reg. No. 1751) ; Selbagiri, 1 ex., 3.viii.1979, K. P. Singh (ERS Reg. No. 16590) : Khasi Hills, Ranikhor, 1 ex., 7.xii.1977, K. R. Rao (ERS Reg. 15193) ; Mizoram, Thingdome, 1 ex., 5.iii.1979, P. T. Cherian (ERS Reg. No. 16540).

Remarks : Originally described as species endemic to West Bengal, *Cormocephalus dentipes* Pocock, is now a well distributed species occurring widely in Meghalaya and Mizoram in NE Region. It has also been recorded from U. P. Terai (Khanna and Tripathi, 1985), Western Himalaya, U. P. (Khanna and Kumar, 1984 and Khanna, 1987), Himachal Pradesh (Khanna, unpublished record).

Distribution elsewhere : Bihar (Chhota Nagpur) and Delhi.

7. Cormocephalus pygmaeus Pocock 1892

1892. *Cormocephalus pygmaeus* Pocock, *J. Bombay nat. Hist. Soc.*, 7 (2) : 140.

Remarks: No material of this species is available in the present lot but it has earlier been recorded from Punkhabari, Darjeeling, Siliguri and Chakradharpur (West Bengal), Chhota Nagpur (Bihar), Cachar (Assam), Western Himalaya, U. P. and Rajasthan and also from Myanmar).

Subfamily : OTOSTIGMINAE
Tribe : OTOSTIGMINI
Genus : *Otostigma* Porath

8. Otostigma ceylonicus Haase, 1887

1887. *Otostigma ceylonicum* Haase, *Abh. Mus.*, Dresden, 5 : 69.

Material examined: India : Meghalaya : Khasi Hills, Pynursula, 1 ex., 23.vi.1966, B. K. Tikader (ERS Reg. No. 280); Umtham, 1ex., 26. ix.1973, S. K. Chanda (ERS Reg. 7947) ; Umphyrna, 1 ex., 26.vii.1974, S. K. Ghosh, (ERS Reg. No. 13489) ; Garo Hills, Resu, 7 exs., 19.ii.1975, S. Biswas (ERS Reg. No. 10686) ; Anbella, 1 ex., 5.iii. 1975, S. Biswas (ERS Reg. No. 10796) ; Jaintia Hills, Umtynagar, 1 ex., 26.vi.1964, S. Biswas (ERS Reg. No. 13478) ; Shillong, 1 ex., 3.v.1965, R. K. Varshney (ERS Reg. No. 12871) ; Risa Colony, 1 ex., 22.iii.1987, M. S. Jyrwa (ERS Reg. No. 19685) ; Lowsotum, 1 ex., 7.ii.1963, V. D. Srivastava (ERS Reg. No. 13521).

Remarks: Previously known from Himachal Pradesh, Myanmar and Sri Lanka, *O. ceylonicus* Haase, is being recorded for the first time, by the author, from Meghalaya states of NE Region, and is, therefore, of zoo-geographical interest.

9. Otostigma insularis Haase, 1887

1887. *Otostigma carinulatum* var. *insulare* Haase, *Abh. Mus.*, Dresden. 5 : 69.

Material examined: India : Meghalaya : Khasi Hills, Ranikhor, 3 exs., 10. xii.1977,

K. R. Rao (ERS Reg. No. 15246) : Umshning, 1 ex., 5.ix.1963, M. R. Rynth (ERS Reg. No. 12872) ; Mizoram : Aizwal, Kolassib, 1 ex., 4.iii.1979, P T. Cherian (ERS Reg. No. 16533).

Remarks : Previously known from Assam and West Bengal, the record of species from Meghalaya and Mizoram is, therefore, extension of range of its distribution in NE Region, The species is also known from Himachal Pradesh (Gravelly, 1912).

Distribution elsewhere : Bhutan, Sri Lanka and Seycelles.

10. *Otostigma nudus* Pocock 1890

1890. *Otostigma nudum* Pocock, *Ann. nat. Hist.*, Ser. (6) 5 : 247.

Material examined : India : Meghalaya : Khasi Hills, Cherrapunji, 2 exs., 15.viii.1965, B. K. Tikader (ERS Reg. No. 13510) ; Shillong, Pynthorumkhroh, 1 ex., 29.x.1959, R. S. Giri (ERS Reg. No. 315 A) ; Risa Colony, 1 ex., 1 .iii.1972, R. S. Giri (ERS Reg. No. :013).

Remarks : The species previously known from Tamilnadu (Pocock 1890) Himachal Pradesh (Khanna and Tripathi, 1986) and Uttar Pradesh (Khanna and Kumar 1984), is being recorded for the first time from NE Region, India.

11. *Otostigma oweni* Pocock, 1892

1892. *Otostigma oweni* Pocock, *J. Linn. Soc.*, London, 24 : 319.

Material examined : India : Arunachal Pradesh : Tirap Dist., Namchik, 1 ex., 21.i.1960, C. B. Srivastava (ERS Reg. No. 1653 A) ; Meghalaya : Umtham, 1 ex., 26.ix.1973, S. K. Chanda (ERS Reg. No. 7947).

Remarks : Previously known from Mergui Archipelago (Myanmar), this is the first record of the species *O. oweni* from Arunachal Pradesh and Meghalaya, in the NE Region, India.

12. *Otostigma oatesi* Kraepelin, 1903

1903. *Otostigma oatesi* Kraepelin, *Mitt. Mus.*, Hamburg. 20 : 120.

Material examined : India : Meghalaya : Shillong, Motinagar, 4 exs., 30.i.1973, M. S. Jyrwa (ERS Reg. No. 6627).

Remarks : Previously known from "British Burma", this is the first record of the species from India, NE Region.

13. *Otostigmus proponens* Chamberlin, 1920

1920. *Otostigmus proponens* Chamberlin, *Bull. Mus., Harvard.* 64 : 15.

Material examined : India : Manipur, Shiroi (Alt. 1926 m), 1 ex., 24.vii.1977, S. G. Patil (ERS Reg. No. 14533).

Remarks : Previously known from Solomon Island (Pacific ocean), this is, interestingly, a first record of the species from India, Manipur in the NE Region.

14. *Otostigmus politus* Karsch, 1881

1881. *Otostigmus politus* Karsch, *Berlin ent. Z.*, 25 : 219.

Material examined : India : Assam : Kamrup, Manas Sanctuary, Sanet, Genda Beel, 1 ex., 9. xii. 1974, K. P. Singh (ERS Reg. No. 10259) ; Meghalaya : Khasi Hills, Old Barrapani, 6 exs., 30. xii. 1981, C. Radhakrishnan (ERS Reg. No. 18012) ; Umtyngar, 1 ex., 20. vi. 1965, B. K. Tikader (ERS Reg. No. 12874) ; Mawphlang, 1 ex., 6. viii. 1963, V. D. Srivastava (ERS Reg. No. 13257) ; 3 exs., 13. iv. 1967, R. K. Varshney (ERS Reg. No. 497) ; 1 ex., 12. iv. 1979, S. K. Chanda (ERS Reg. No. 16256) ; Umshning, 1 ex., 10. ix. 1969, N. Mazumdar (ERS Reg. No. 1189) ; Nongpoh, 1 ex., 22. xii. 1978, P. T. Cherian (ERS Reg. No. 15954) ; Shillong, Tripura castle road, 1 ex., 2. iii. 1973, M. S. Jyrwa (ERS Reg. No. 6911) ; 5 exs., 23. ii. 1976, M. S. Jyrwa (ERS Reg. No. 13585) ; Risa Colony, 1 ex., 1. ii. 1967 (ERS Reg. No. 14421) ; 1 ex., 6. i. 1977 (ERS Reg. No. 14383) ; 1 ex., 15. iv. 1977 (ERS Reg. No. 14714) ; 2 exs., 29. iv. 1982 (ERS Reg. No. 15474) ; 2 exs., 29. iv. 1982 (ERS Reg. No. 18131), all M. S. Jyrwa coll. ; Laitumkhroh, 1 ex., 12. ii. 1973, R. S. Giri (ERS Reg. No. 6646) ; 5 exs., 26. ii. 1973, M. S. Jyrwa (ERS Reg. No. 6903) ; Nongthymmai, 2 exs., 6. iii. 1972, (ERS Reg. No. 2999) ; 5 exs., 20. iii. 1973 (ERS Reg. No. 6957), all R. S. Giri coll. ; 1 ex., 5. vi. 1985, M. S. Jyrwa (ERS Reg. No. 12225) ; Lumparing, 1 ex., 2. xii. 1974 (ERS Reg. No. 10176) ; 5 exs., 1. iii. 1976 (ERS Reg. No. 13636) ; 1 ex., 9. iii. 1976 (ERS Reg. No. 13666), all R. S. giri coll. ; 3 exs., 4. xi. 1975, (ERS Reg. No. 10695), all M. S.

Jyrwa coll. ; Malki Forest, 1 ex., 9. xi. 1971 (ERS Reg. No. 2682) ; 2 exs., 3. iii. 1972, (ERS Reg. No. 2995) ; 3 exs., 13. iii. 1973 (ERS Reg. No. 6936), all R. S. Giri coll. ; 3 exs., 17. iii. 1973 (ERS Reg. No. 6973) ; 2 exs. 18. xii. 1974 (ERS Reg. No. 10204) ; 2 exs., 5. ii. 1974 (ERS Reg. No. 8492) ; 1 ex., 5. x. 1975 (ERS Reg. No. 10993) ; 1 ex., 28. x. 1975 (ERS Reg. No. 12655) ; 1 ex., 15. i. 1976 (ERS Reg. No. 13221) ; 2 exs., 7. ii. 1976 (ERS Reg. No. 13461) ; 1 ex., 2. xi. 1977 (ERS. Reg. No. 15023), all M. S. Jyrwa coll. ; Motinagar, 1 ex., 22. ii. 1972 (ERS Reg. No. 2983) ; 2 exs., 19. xii. 1974 (ERS Reg. No. 10220) ; 2 exs., 16. xii. 1979 (ERS Reg. No. 10207), all R. S. Giri coll. ; 4 exs., 25. i. 1975 (ERS Reg. No. 10461) ; 3 exs., 11. ii. 1976 (ERS Reg. No. 13472) ; 3 exs., 12. i. 1977 (ERS Reg. No. 14377) ; 5 exs., 22. i. 1977, (ERS Reg. No. 14416), all M. S. Jyrwa coll.

Remarks : Previously known from Darjeeling (West Bengal) and Dikrang and Sureil (Assam) in the NE Region, this is considered as further extension of distribution of this species in NE Region.

Distribution elsewhere : India (Himachal Pradesh, Orissa and Uttar Pradesh) ; Myanmar, China, Sumatra, New Guinea and Australia.

15. *Otostigmus rugulosus* Porath, 1876

1876. *Otostigma rugulosum* Porath, *Bih. Svenska Ak.*, 4 (7) : 21.

Material examined : India : Meghalaya : Khasi Hills, Mawsynram, 1 ex., 28. iv. 1978, K. P. Singh (ERS Reg. No. 15440).

Remarks : Previously known from Sadiya and Mangaldai (Assam), this is the first record of this species from Khasi Hills (Meghalaya) after the lapse of about 82 years.

Distribution elsewhere : India (Himachal Pradesh and A & N Islands) and Myanmar (Mergui Archipelago).

16. *Otostigmus ruficeps* Pocock, 1890

1890. *Otostigma ruficeps* Pocock, *Ann. nat. Hist. Ser.* (6) 5 : 247.

Material examined : India : Meghalaya : Khasi Hills, Mawphlang, 1 ex., 12. ix. 1963, S. Biswas (ERS Reg. No. 13505) ; 1 ex., 28. iv. 1978, K. P. Singh (ERS Reg. No. 15440) ; Darugiri, 1 ex., 29. xi. 1977, K. P. Rao (ERS Reg. No. 15093) ; Malki Forest, 2 exs., 24. xi. 1973, R. S. Giri coll, (ERS Reg. No. 8640),

Remarks : Previously known from Tamilnadu (Pocock, 1890) and Lakhimpur Kheri (U. P.) (Khanna and Tripathi, 1985), the present record of this species from Meghalaya State NE Region constitute the first ever record from this part of India, and is of great zoogeographical interest.

17. *Otostigma spinosus* Porath, 1876

1876. *Otostigma spinosum* Porath, *Bih. Svenska Ak.*, 4 (7) : 22.

Material examined : India : Meghalaya : Shillong, Sawsohtum, 2 exs., 28.ii.1967, R. K. Varshney (ERS Reg. No. 447).

Remarks : Previously known from Myanmar (Tennaserrim), Java, Sumatra, Sulawesi and New Guinea, this is the first record of the species from India, Meghalaya State.

Note : In the NE Region the genus *Otostigma* Porath is also represented by species like *faeae* Pocock, *morsitans* Pocock (both from Myanmar) and *scaber* Porath (from Myanmar, China and Thailand).

Genus : *Rhysida* Wood

18. *Rhysida afra cuprea* Kraepallin, 1903

1903. *Rhysida cuprea* Kraepelin, *Mitt. Mus.*, Hamburg, 20 : 154.

Material examined : India : Arunachal Pradesh : Nefa, Tirep Dist. Mainpang, 1 ex., 2. ii. 1962, C. B. Srivastava (ERS Reg. No. 1651A) ; Assam : Kaziranga, Jhapani Bill ; 1 ex., 14. iii 1964, A. K. Mandal (ERS Reg. No. 13506) ; Meghalaya : Garo Hills, Anagiri Forests, 1 ex., 23. ii. 1975, S. Biswas (ERS Reg. No. 10728) ; Jaintia Hills, 1 ex., 13. iii. 1970 (ERS Reg. No. 12858) ; 4 exs., 14. iii. 1970 (ERS Reg. No. 12859), all S. K. Talukdar coll. ; 2 exs., 29. i. 1975, A. K. Ghosh (ERS Reg. No. 10567) ; Khasi Hills, Umran, 1 ex., 28. ii. 1963, V. D. Srivastava (ERS Reg. No. 13511) ; Barapani, 1 ex., 24. vii. 1967, R. K. Varshney (ERS Reg. No. 603) ; Darugiri Road, 1 ex., 29. xi. 1977, K. R. Rao (ERS Reg. No. 15093) ; Shillong, Mawphlang, 1 ex., 12. xi. 1963, S. Biswas (ERS Reg. No. 13505) ; Risa Colony, 4 exs., 27. ii. 1961, S. N. Prasad (ERS Reg. No. 1284 A) ; 1 ex., 28. iii. 1979, K. K. Deb (ERS Reg. No. 7006) ; Motinagar, 1 ex., 19. iii. 1973, M. S. Jyrwa (ERS Reg. No. 6949) ; Lamshing, 1 ex., 4. i. 1972, G. M.

Yazdani, (ERS Reg. No. 2786) ; Tripura Castle Road, 1 ex., 17. ii. 1978, M. S. Jyrwa (ERS Reg. No. 15318) ; Umshning 3 exs., 5. v iii. 1971, V. D. Srivastava (ERS Reg. No. 12502) ; Lalchani Basti, 1 ex., 26. vi. 1975, M. S. Jyrwa (ERS Reg. No. 12208).

Remarks : Previously known from Southern slopes of Bhutan and Sylhet (Bangladesh), *R. afra cuprea* Kraepelin was recorded by Gravely (1910) from Darjeeling and Ghumti (West Bengal) and Assam. The record of this species is, therefore, an extension of range of its distribution in the NE Region. In Western Himalaya, U. P. Khanna and Kumar (1984). and Khanna (1987) recorded this species from Almora and Pithoragarh dists., while Khanna and Tripathi (1985a) from Sirmaur (Himachal Pradesh).

Note : Gravely (1910) also recorded *R. afra petersi* (Porath) from Bhutan.

19. *Rhysida crassispina* Kraepelin, 1903

1903. *Rhysida crassispina* Kraepelin, *Mitt. Mus.*, Hamburg, 20 : 151.

Material examined : India : Meghalaya : Shillong, Malki Forests, 1 ex., 29. vii. 1975, R. S. Giri (ERS Reg. No. 12325) ; Umshning, 1 ex., 4. i. 1972, G. M. Yazdani (ERS Reg. No. 2786).

Remarks : Previously known from Matheran (Nr. Bombay, Maharashtra) the record of *R. crassispina* Kraepelin from Meghalaya, is interesting zoogeographically.

20. *Rhysida longipes longipes* (Newport), 1845

1845. *Branchipstoma longipes* Pocock, *Trans. Linn. Soc.*, 19 : 411.

Material examined : India : Arunachal Pradesh : Nefa, Tirep Dist., Namchik, 1 ex., 17. i. 1962, C. B. Srivastava, (ERS Reg. No. 1628A).

Remarks : Previously known from Lower Myanmar (Moulmein) ; West Bengal (Calcutta and Ranigunge), the finding of species from Arunachal Pradesh is undoubtedly an extension of range of its distribution.

21. *Rhysida nuda immarginata* (Porath), 1876

1876. *Branchiostoma immarginatum* Porath, *Bih. K. svenska Ak.*, 4 (7) : 24.

Material examined : India : Assam : Goalpara, Bhaisi Kuti, 2 exs., 15. i. 1972 (ERS Reg. No. 2664) ; 3 exs., 16. i. 1972, (ERS Reg. No. 2877), all S. Biswas coll. ; E. Khasi Hills, Sericulture garden, 2 exs., 4. i. 1963, M. R. Rynth. (ERS Reg. No. 13256) ; Insectary Building, ZSI, 2 exs., 24. ii. 1967, S. K. Pradhan (ERS Reg. No. 1282A) ; Malki Forests, 1 ex., 8. ix. 1976, M. S. Jyrwa (ERS Reg. No. 13990) ; Garo Hills, Dainadubi, 1 ex., 8. iv. 1967, R. S. Pillai (ERS Reg. No. 1751).

Remarks : Previously recorded from Darjeeling, Punkhabari, Nareil, Jessore, Ranigunge, Tinpahar and Sahibgunge (West Bengal) and Sureil, Samagooting, Dilkush and Cachar (Assam) as also from Chitlong and Little Nepal Valley (Nepal) and Upper Mynmar, the record of this species from Assam and Meghalaya is considered as extension of range of its distribution in NE Region.

22. *Rhysida nuda nuda* (Newport), 1845

1845. *Branchiostoma nudum* Newport, *Trans. Linn. Soc.*, London, 9 : 412.

Material examined ; India : Assam : Goalpara, Dudhnai, 1 ex., 8. iv. 1971, R S. Pillai (ERS Reg. No. 1738) ; Meghalaya : Shillong, Risa Colony, 1 ex., 31. viii. 1960, S. P. Mazumdar (ERS Reg. No. 13482) ; New Colony, 1 ex. 24. iii. 1963, A. S. Rajagopal (ERS Reg. No. 13519).

Remarks : Earlier recorded from Myanmar (Pegu) the species was subsequently recorded by Gravely from Assam (Sadiya and Dibrugarh). This is, therefore, a further extension of range of distribution of this species in the NE Region.

23. *Rhysida stuhlmanni stuhlmanni* Kraepelin, 1903

1903. *Rhysida stuhlmanni* Kraepelin, *Mitt. Mus.*, Hamburg, 20 : 152.

Material examined : India : Meghalaya : Shillong, Tripura Castle Road, 1 ex., iii. 1973, M. S. Jyrwa (ERS Reg. No. 6911).

Remarks : *Rhysida stuhlmanni* Kraepelin is by origin, an Ethiopian species, a subspecies of which has been described by Khanna (in press) from Western Himalaya, U. P., and simultaneously relegated the original species as *Rhysida stuhlmanni stuhlmanni* Kraepelin *forma-typica*.

The author has come across a single specimen of *R. s. stuhlmanni* from Meghalaya, and is, therefore, treated as a first record from India.

Genus : *Ethmostigmus* (Pocock)

The genus *Ethmostigmus* (Pocock) is known to be represented by the following species from NE Region but unfortunately the author has come across none of them in the present lot.

24. *Ethmostigmus pygomegas* (Kohlrausch), 1881

1881. *Heterostoma pygomega* Kohlrausch, *Arch. Naturges.*, 47 : 68.

Remarks : The species is recorded from Darjeeling (West Bengal), Dikrang, Siliguri, Cachar and Sibsagar (Assam) and Myanmar.

In addition, *E. platycephalus* (Newport) and *E. spinosus* (Newport) have also been known from Myanmar.

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SUMMARY

The present paper deals with the Scolopendrid centipedes collected from North Eastern States of India, from Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Sikkim and Tripura. Altogether twenty species have been recorded, five of which, viz., *Otostigmus oatesi* Kraepelin, *O. oweni* Pocock, *O. proponens* Chamberlin, *O. spinosus* Porath and *Rhysida stuhlmanni stuhlmanni* (Kraepelin), constitute a first record from India ; four new record from NE Region, namely, *Otostigmus ceylonicus* Haase, *O. ruficeps* Pocock, *O. nudus* Pocock, and *Cormocephalus dentipes* Pocock ; eleven species are with

their distributional ranges extended within the NE Region. Combining the above records with earlier species known from the region, the number of species now known from NE States has been raised from eleven to twentyfour. *Ethmostigmus pygomegas* (Kohlrausch), *Cormocephalus pygmaeus* Pocock and *Scolopendra subspinipes dehaani* Brandt, known earlier from the region, have not been recorded in the present studies. Notes on the species occurring in the adjoining countries like Bhutan, Bangladesh, Myanmar and Nepal, have been provided.

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