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Pages 1-186

CONTENTS

	<i>Pages</i>
Venkataraman, K., Jeyabaskaran, R., Ch. Satyanarayana, and Raghuram, K. P. — Status of Coral reefs in Gulf of Mannar Biosphere Reserve	... 1-15
Mukesh Ingle — Ophio-Fauna of Ujjain & certain areas of Malwa region (Madhya Pradesh)	... 17-31
Murmu, A., Chaudhuri, S., Mazumder, P. C. and Talukder, B. — Status of Assamese Macaque, <i>Macaca assamensis</i> in Darjeeling district, West Bengal, India	... 33-41
Bastawade, D. B., Sureshan, P. M. and Radhakrishnan, C. — An illustrated key to the identification of Scorpions (Scorpionida : Arachnida) of Kerala and notes on some interesting new records	... 43-58
Sastry, D. R. K., Paramasivam, S., Manikandan, K. P., Ajmal Khan, S. and Kannan, L. — Additions to the Echinoderm fauna of Great Nicobar Island, Bay of Bengal	... 59-66
Dhriti Banerjee and Bulganin Mitra — Some bee-flies (Bombyliidae : Diptera) from Thar desert	... 67-73
Barman, R. P. — Threatened and endemic fishes of Tripura with comments on their conservation	... 75-81
Barman, R. P. — The fishes of the Kolleru lake, Andhra Pradesh, India with comments on their conservation	... 83-89
Bhattacharyya, A. K. — Two new species of Ascid mites (Acarina : Mesostigmata) from the Thar desert of Rajasthan, India	... 91-98
Chandra Kanta Mandal — <i>Placobdella harasundarai</i> (Hirudinea : Glossiphonidae) a new species of Leech from West Bengal, India	... 99-102
Chandra Kanta Mandal — Endemic Leech fauna of India	... 103-110
Chandra Kanta Mandal — <i>Paraclepsis gardensi</i> (Hirudinea : Glossiphonidae) a new species of Leech from West Bengal, India	... 111-114

Ilango, K. — The Legacy of Dr. Nelson Annandale and his contribution to the Taxonomy of Phlebotomine sandfly species (Diptera : Psychodidae : Phlebotominae) transmitting Leishmaniasis	...	115-121
Pawan Gajbe — Description of three new species of Crab spiders (Araneae : Thomisidae) from Madhya Pradesh, India	...	123-130
Gajbe, U. A. — Studies on some spiders of the families Oecobiidae, Eresidae, Hersiliidae, Urocteidae and Uloboridae (Araneae : Arachnida) from Madhya Pradesh, India	...	131-142
Krishnan, S., Rema Devi, K., Indra, T. J. and Raghunathan, M. B. — On a collection of fish from Bangalore and Kolar districts, Karnataka	...	143-155
Shelley Ghosh — A note on the mites occurring on medicinal plants in Northeast India	...	157-164
Chandrasekhar, S. V. A. — Suitability of water quality for irrigation. A case study of Kondakarla Lake, Andhra Pradesh	...	165-169
Korad, V. S. and Yardi, K. D. — New records of Bats from Central Western India	...	171-177
Short Communication		
Mahabir Kumar — Animals from India in the Caribbean	...	179-183
Prabakar, D. and Radhakrishnan, C. — First record of <i>Madasumma soror</i> Chopard, 1969 (Gryllidae : Orthoptera : Insecta) from Kakkayam Reserve Forest, Kozhikode district, Kerala, India	...	185-186

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Dr. J. R. B. ALFRED
Director
Zoological Survey of India

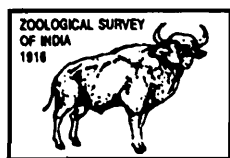
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Dr. J. R. B. ALFRED
Director
Zoological Survey of India



Rec. zool. Surv. India : 103 (Part 1–2) : 1-15, 2004

STATUS OF CORAL REEFS IN GULF OF MANNAR BIOSPHERE RESERVE

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INTRODUCTION

The ever-increasing human pressure on the coastal zone to meet the needs of the growing coastal population has resulted in the rapid decline of biodiversity and biomass of the coastal ecosystems worldwide. “Gulf of Mannar Biosphere Reserve” (GoMBR) situated along the southeast coast of India, comprises of a collection of 21 small islands with fringing reefs built on shallow shores of these islands (Fig. 1). They are arranged in the form of a chain between 8°46' and 9°14' N Latitude and 78°9' and 79°14' E Longitude from Mandapam in the north to Tuticorin in the south. This area is remarkable for its faunal and floral wealth, especially the coral reefs and its associates (Thurston, 1890, 1895, Graveley, 1927 and Pillai, 1996).

Typically, coral reefs contain a number of specialized species representing almost all groups of marine animals. The holes and crevices in the reefs provide abundant shelter for fishes and invertebrates and are important for fish nurseries. The reefs of GoMBR have a variety of seaweeds, plenty of sacred chanks (*Turbinella pyrum*), butterfly chanks, pipefishes, sea horses, pearl oysters, corals and gorgonids, the famous sea cow (*Dugong dugon*) and the balanoglossus (*Ptychodera flauva*).

Of the approximate 600,000 km² of coral reef worldwide, it is estimated that about 10 percent have already been degraded beyond recovery and another 30 percent are likely to decline significantly within the next 20 years (Wilkinson, 2000). Wilkinson (2000) noted that all Indo-Malayan reefs, except those in Australia are in critical or threatened condition – categories applied to reefs that are likely to collapse within the next 40 years, if conservation and management measures are not properly implemented. Only fringing and patch reefs are present in the intertidal regions of GoMBR.

KEY WORDS : Coral reefs, status, Gulf of Mannar Biosphere Reserve.

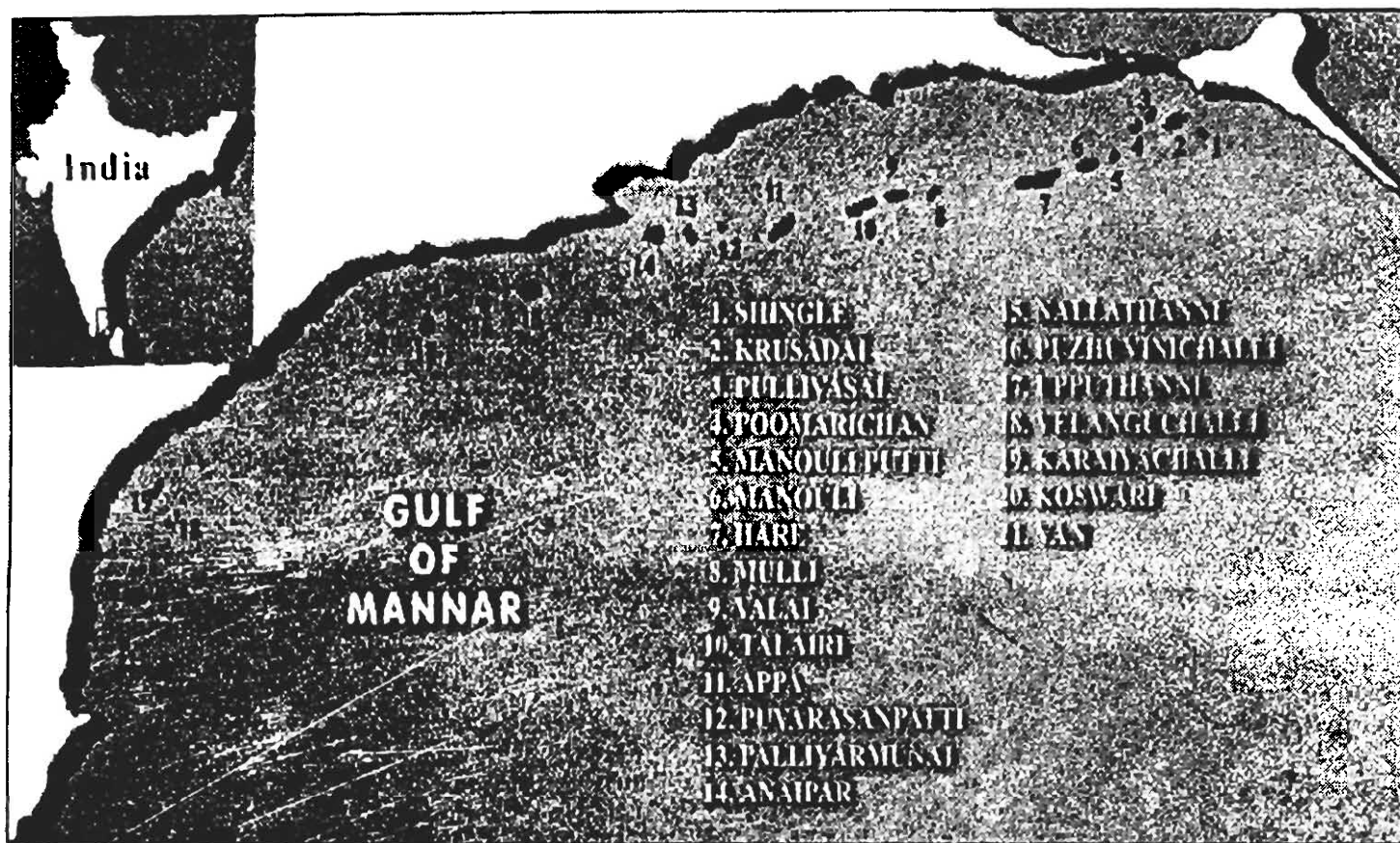


Fig. 1. : Map showing the location of 21 islands of Gulf of Mannar Biosphere Reserve.

The lagoon (the area between the coral reef and the shore) in these islands is shallow, and can be waded during low tides. The intertidal region of Gulf of Mannar islands is sandy and muddy.

Although many have documented the richness of this area qualitatively, the quantitative data on fauna and flora of this region, which is very much needed for effective management of this unique ecosystem, is lacking. Therefore, the present study on the status of the coral reefs was conducted in all the 21 islands of GoMBR.

MATERIAL AND METHODS

Depending upon the proximity to a major town, the 21 islands of GoMBR were divided into three groups (Mandapam, Keelakarai and Tuticorin) (Fig. 1). The present study was carried out in three different phases. In the first phase seven islands of Mandapam group of GoMBR starting from Shingle Island in the north to Hare Island in the south were surveyed in June 1998 initially keeping Mandapam as base camp. In the second phase another seven islands belonging to Keelakarai group from Mulli Island in the north to Anaipar Island in the south were surveyed in October to November 1998 keeping Mandapam and Ramanathapuram as base camps. The remaining seven islands belonging to Tuticorin group starting from Nallathanni Island in the north to Van Island in the south were surveyed in May 1999 keeping Ramanathapuram and Tuticorin as base camps.

Each Island was surveyed using “Manta tow” study method before laying the 50 m Line Intercept Transect (LIT) to find out the location of the coral reef, sea grass bed and general nature of the intertidal region. After confirming the location of the reef area, a 50 m transect (LIT) was laid using a 50 m plastic tape using iron nails as hold. Underwater slates were used to collect data using snorkeling equipment, the intercepts were noted down. The same procedure was repeated in all the 21 islands of GoMBR.

LINE INTERCEPT TRANSECT (LIT)

Line Intercept Transect is used to collect data on the Coelenterata, Mollusca, Crustacea, Echinodermata and other corals and coral reef associated organisms (English *et al.*, 1997). This method is used mainly wherever coral reefs are present and are more than 50 m away from the shore. Coral reefs and the associated fauna are part of the intertidal community, other than the fauna present in the sandy bottom. These communities are characterised by life form categories, which will provide a clear description of the reef community of the intertidal coral reefs and other associated fauna mentioned above.

The LIT is used to estimate the life form cover of the coral reef (present status) and also the reef associated organisms within a specified area by calculating the length of the line that is intercepted by the object (different coral species, Mollusca, Echinodermata and others). This measure of cover is expressed as a percentage, which is considered to be an unbiased estimate of the proportion of the total area covered by that coral reef and associated organisms provided the size of the coral reef fauna is relative to the length of the line and that length of the line is small relative to the area of interest.

LIFE FORM CATEGORIES

The following are the different life form categories used in the present study. These categories and the symbols were much useful in conducting the under water studies. The method used in calculating the life form categories are following English *et al.*, (1997).

DEAD CORALS

DC – recently dead, white or yellow, no algae

DCA – dead coral covered with algae

ACROPORA CORALS

ACB – Secondary branching, axial polyp

ACE – Encrusting with distinct polyp

ACS – Columnar, distinct polyps, sub massive

ACD – finger like, axial polyp, no secondary branching

ACT – looks like a table, flat profile

NON-ACROPORA CORALS

- CB – secondary branching, no axial polyp
- CE – attached to substrate at various points; margin very thin, encrusting
- CF – vertical and/or horizontal plates, foliose
- CM – boulder or mound shape; margin thick, massive
- CSM – with knobs, thickened branches or columns, sub massive
- CMR – free-living solitary, mushroom corals
- CHL – deep brown, smooth, blue colour, blue coral
- CME – mustard yellow, smooth, fuzzy appearance, fire coral
- CTU – polyps look like daisies, stacked pipe skeleton, Organ pipe coral

ALGAE

- AA – a non-distinct mass of algae
- CA – encrusting, red or pink, sometimes like leaves
- HA – hard, green, triangle-shaped, stacked, halimeda
- MA – >5 cm, brown, green, red, macro algae
- TA – <5 cm, >1 cm, forms carpet on substrate, turf algae

OTHER FAUNA

- SC – soft or leathery, brown or colourful, soft coral
- SP – varied shapes, colour and sizes, look out for ostiole, sponges
- ZO – looks like a clump of small anemones with 2 rings of tentacles, Zoanthids
- OT – any other fauna like gorgonians, anemones, octopus, Holothuria, seagrass

ABIOTIC

- S – settles immediately when stirred, sand
- R – broken pieces of coral, <15 cm rubble
- SI – forms a cloud when stirred, silt
- WA – crevice, cracks >50 cm, water
- RCK – non-coral origin like stones, granites

DATA ANALYSIS

Summary of data showing percentage cover and number of occurrences of each life form is calculated using the Line Intercept Transect data. After calculating intercept (length) from the

transition points recorded along the transect, percentage cover of a life form category is calculated as follows.

$$\text{Percent cover} = \frac{\text{Length of category} \times 100}{\text{Length of Transect}}$$

This analysis will provide quantitative information on the community structure of the sample sites. Successive samples can also be compared from different areas of the coral reef.

RESULTS

MANDAPAM GROUP OF ISLANDS

(Figs. 1–3)

The following seven islands, which are located close to Mandapam town, were categorised as Mandapam group of islands *viz.* 1. Shingle, 2. Krusadai, 3. Pullivasal, 4. Poomarichan, 5. Manāliputti, 6. Manāuli and 7. Muyal or Hare Island.

1. Shingle Island : The Shingle Island is situated near Pamban (9°15' N Lat. and 79°14' E Long.) and has an area of 13 ha. This island was composed of coral rubbles on the reef patch. Extensive coral reefs were found on the northeastern side as well as on the eastern side of the island. Two 50 m LIT were laid parallel to the shore, one on the eastern side and other on the northeastern side of the island. The results showed that, the eastern side of the reef contained 19% ACB, 4% CB, 16% CF, 32% CSM and 29% DC. The northeastern side of the reef contained 0.4% CM, 97.6% DC and 2% CSM.

2. Krusadai Island : Krusadai Island (9°14' N Lat. and 79°13' E Long.) is situated near the Mandapam and Pamban of Rameswaram Island. The coral reefs in the island and the shallow lagoon between the reef and the shore formed excellent sites for collection of various kinds of flora and fauna. The southeast side of the Krusadai Island is called “Galaxea Reef” This reef was composed of dead corals with holes and crevices covered with seaweeds and algal growth. The coral reefs on the western part of the southern side contained luxuriant growth of corals and during the study period it was in critical condition. LIT was laid on the southern side of the island reef and the results showed that the reef contained 4% ACB, 1% CF, 23% CM, 17% CSM, 3% R and 52% DC.

3. Pullivasal Island : This Island (9°14' N Lat. and 79°11' E Long.) spreads over an area of 30 ha. The coral reefs were found only in southern shore and it extended to about 300 m from the shore. During low tide, the coral reefs were exposed and the most dominant coral species present was *Montipora* sp. Most of the exposed reefs were dead. The present observation revealed that all the *Montipora* sp. were found to be bleached, and the reef contained mostly dead corals.

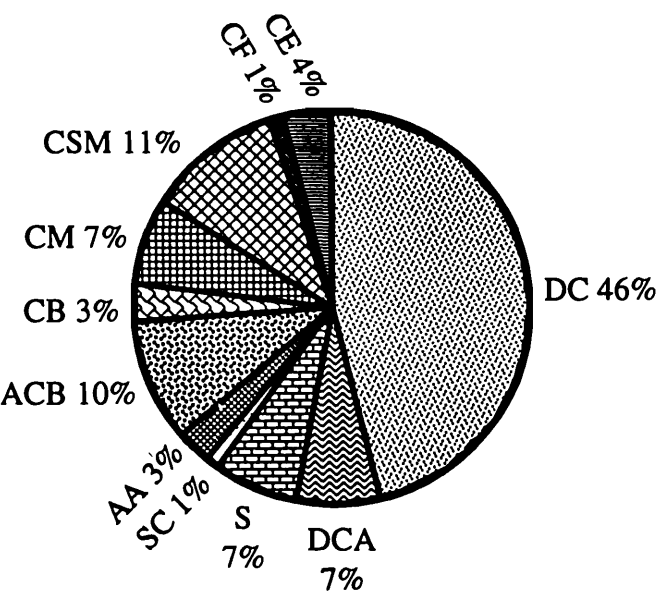
4. Poomarichan Island : The Poomarichan Island is also called as Pulli Island ($9^{\circ}14'$ N Lat. and $79^{\circ}11'$ E Long.) and it covers an area of 17 ha. Coral reefs were found only on the southern, western and northern side of the island. In the southern side dead coral beds were observed and in the northern part of western side different types of live corals were present. The coral reef in the western part of northern side appeared to be good in live coral cover when compared to the other parts of the island.

Three LIT were laid, one on the southern part and the other on the northern part of the island as well as on the western side of the island. The results of the first LIT showed the occurrence of corals in the following percentage; dead coral with algae 53%, CM 16%, DC 1% and CSM 40%. The second LIT showed that the reef contains 33% Dead Coral with Algae, 10% CM, 9% CSM, 17% DC and 31% CB. The western part of northern side of the Poomarichan Island showed the following type of coral distribution 16% ACB, 3% CB, 7% CE, 12% CM, 3% CSM, 18% S and 41% DC. However, these corals were also in stressed condition.

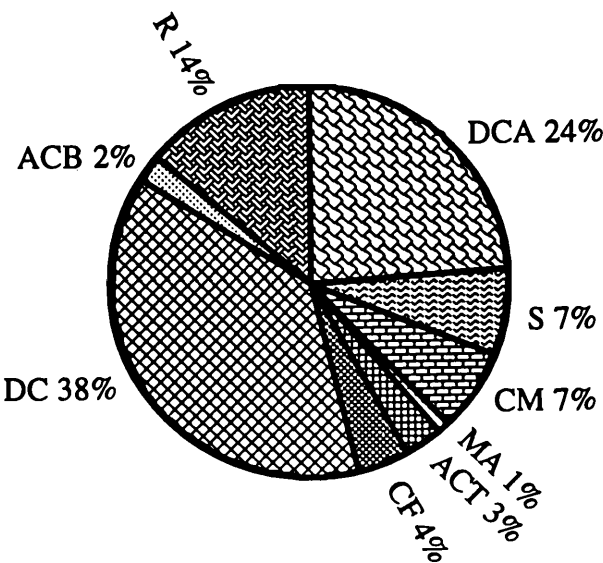
5. Manauliputti Island (New Islets) : This island ($9^{\circ}13'$ N Lat. and $79^{\circ}7'$ E Long.) covers an area of 0.34 ha (Fig. 1). The coral reefs were observed on the eastern side of the island 650 m from the shore to the sea and covered an area of 6 sq km. Two LIT surveys were made on this island. The first LIT showed the 17% CM, 6% CSM, 5% S and 72% DC of coral reef. The second LIT showed the occurrence of 5% ACB, 3% CB, 24% CE, 2% CSM, 5% R, 33% S and 28% DC.

6. Manauli Island : Among all the islands, Manauli Island exhibited maximum diversity among the corals. This island ($9^{\circ}14'$ N Lat. and $79^{\circ}7'$ E Long.) covers an area of 26 ha. Extensive reefs occurred on the northern side of the Manauli Island. It was exposed during low tide and a small stretch of sandy shore formed in between the Manauli Island and Manauliputti Island. Two LIT were laid on northern side of the island. The results showed the presence of 9% ACB, 3% CE, 6% CM, 8% SC, 10% S and 64% DC in the western part of the reef. The LIT on the eastern part of the reef showed the presence of 18% ACB, 1% CE, 4% CM, 73% DC and 4% SC. One more transect was laid on the northern side of the island during Oct.–Nov. '98 and it showed the presence of 1% of live corals dominated by *Pocillopora danae* (4.6%), 83.5% dead corals consisting mostly of *Acropora* branching forms (48.9%) and 9.4% rubble.

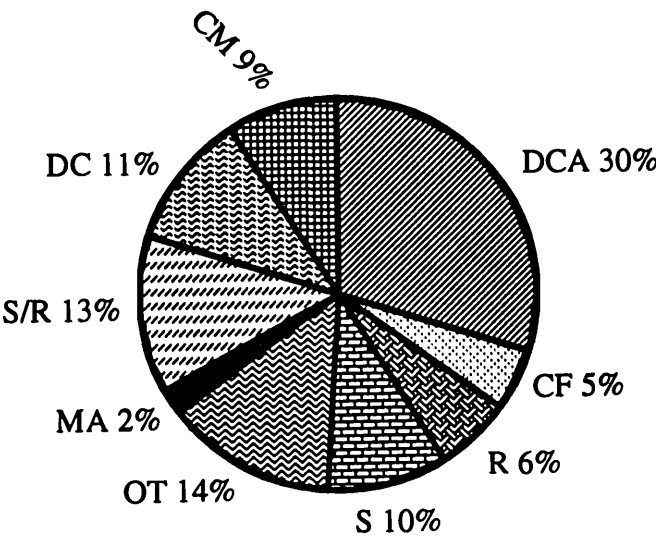
7. Hare Island : Hare Island is the largest island in the Gulf of Mannar and it is also called as "Muyal Tivu" This island ($9^{\circ}12'$ N Lat. and $79^{\circ}5'$ E Long.) spreads over an area of 129 ha. Extensive coral reefs were found in the southern and northern side. The first LIT was laid on the western part and the second on the eastern side. The first LIT showed the presence of 3% ACB, 1% CB, 2% CM, 34% CSM, 18% S and 42% DC. The second LIT showed the presence of 44% ACB, 8% CSM, 10% CE, 5% CM and 33% DC.



Mandapam group



Keelakarai group



Tuticorin group

Fig. 2. : Percentage cover of life forms in three different groups of islands in GoMBR during 2000.

KEELAKARAI GROUP OF ISLANDS

(Figs. 1–3)

The following seven islands, which are situated close to Keelakarai, were categorised as Keelakarai group of islands viz. 1. Mulli, 2. Valai, 3. Thalari, 4. Appa, 5. Poovarasampatti, 6. Palliyarmunai and 7. Anaipar. A patch of coral reefs present close to the Keelakarai coast was also surveyed during the present study.

1. Mulli Island : It is situated 10 km away from Keelakarai (main land) at 9°11' N Lat. and 78°56' E Long., covering an area of 10.2 ha. Extensive reefs were found on the North Eastern side of the island. Two LIT were laid one on the North Eastern side and another on the Southern side of the island. On the North Eastern side not even a single live coral was found. DC (ACT) (32.4%) dominated the reef. Rubble contributed to 35.6%. The only live coral found during the studies was *Coscinaraea monile*. On the southern side of the island good cover of live coral dominated by *Acropora* sp. (20.8%) was found, even though DC formed half of the reef with algae growing over it (DCA 51%). In addition to this, massive corals contributed to 1.2%, rubble 2% and dead coral without algae 25%. *Sargassum* sp. was the most dominant algae.

2. Valai Island : This island is located 10 km away from Keelakarai at 9°11' N Lat. 78°56' E Long. and covers an area of 10.10 hectares. Extensive reefs were found on the Eastern side of the island. Two LIT were laid to measure the coral reef cover in this area. The first transect laid on the south eastern part of the Valai Island revealed a dead reef formed by 15% rubble and the remaining dead coral with a cover of algae (*Caulerpa*, *Sargassum*, *Padina*, *Gelidella*, *Gracilaria* and *Turbinaria*) species. *Halimeda* sp. was also seen growing as pockets. The second transect laid on the eastern side was covered with one fourth sand and almost 65% dead submassive corals. Live coral covers represented by *Pocillopora damicornis*, *Porites solida* and *Montipora digitata* contributed to only 1.2% of the total cover.

3. Thalaiyari Island : Thalaiyari Island is the second largest island in the Keelakarai group of islands. It is situated 10 km away from Keelakarai at 9°11' N Lat. 78°54' E Long. and covers an area of 75.15 ha. Two LIT were laid on the southern side of the island. Although more than half of the reef was covered by dead coral, nearly one fourth was occupied by the massive corals such as *Goniastrea retiformis*, *Goniopora* sp. and *Pavona decussata* (24%) and the other live corals covered in the LIT were *Favites abdita* (0.4%) and *Echinopora lamellosa* (3.8%). Rubble and Sand cover 15%. Second LIT showed the presence of 72% DCA (dead coral with *Caulerpa*, *Padina*, *Sargassum* and *Turbinaria* species), 16% DC, 4.2% CM such as *Goniastrea retiformis*, 3.4% CF (*Echinopora lamellosa*), 0.8% encrusting and the remaining 3.6% Sand.

4. Appa Island : It is situated at 9°09' N Lat. 78°49' E Long., 8 km away from Keelakarai, and covers an area of 28.63 ha. Due to its high elevation and indiscriminate exploitation of weeds around, the northern shore of this island was eroded. Reefs were found on the south eastern part

of the island. Three LIT were laid in the reef area. In the first transect, the dominant life form was DC contributing to 18.4% followed by the sub massive coral (*Montipora digitata*) (11.2%). Other live corals present in this area were *Porites solida* (10%) and *Coscinaraea monile* (1.7%). Sand and rubble occupied more than 30%. In the second transect, *Echinopora lamellosa* was the only live coral available (16.2%), Sand (20.6%), dead massive coral (19.4%), dead coral with algae (19.4%), rubble (15%) and macro algae *Padina* sp. (9.4%) were the other contributors. In the third transect laid further south, sub massive dead corals dominated (66.6%) along with dead branching corals (21.2%). The live corals, contributed to only 4.8% such as *Montipora divaricata*, *Goniastrea retiformis*, *Porites lichen* and *Porites solida*.

4.1. Keelakarai coast : In this coast the coral reef occurred along the shore of Keelakarai (9°14' N Lat. and 78°47' E Long.). The coral reefs in the eastern part (near the custom house) were dead due to the dumping of municipal waste and sewage discharge. The corals in this coast were mostly dead and the dead corals were covered by the dense algal growth. The LIT was laid on the western part of the reef. The results of LIT survey showed 14% ACB, 1% CM, 38% R and 47% DC.

5. Poovarasanpatti Island : This island is situated at 9°09' N Lat. and 78°49' E Long. and 9 km away from Keelakarai. The reefs rarely got exposed at low tide. An observation made on this island revealed the presence of growing weeds and grasses with associated Holothurian and Hermit crab fauna.

6. Palliyarmunai Island : This Island with an area of 6.72 ha is situated at 9°09' N Lat. 78°44' E Long. lies 9 km away from Keelakarai. Extensive reefs were found on the Southern part of the island. Three transects were laid on the Southern part of this island. In the first transect the dead coral (70%) was dominated by branching and digitate forms. Massive corals *Porites solida*, *Porites mannarensis* and *Favia pallida* were the only living forms available in this island. A few sponges (0.2%) were also seen among the reef associates with a few holothurians. Rubble contributing to 30.6% was recorded in the second transect laid. Only 8.3% was the live coral component comprising of *Goniastrea retiformis*, *Porites solida*, *Pavona decussata* and *Pachyseris* sp. *Halimeda* sp. was also seen with *Caulerpa*, *Padina* and *Turbinaria* algae found on the dead corals. The presence of *Porites solida* in the third transect confirmed its wide distribution in this area; along with the other massive coral such as *Goniastrea retiformis* contribute 11.2%. Another live coral was *Echinopora lamellosa* (6.6%). Half of the transect area (51%) was covered with algae (*Sargassum*, *Turbinaria* and *Caulerpa* sps.) over dead coral; another 20.4% of dead coral was without algae. The contribution of sand was 10.8%.

7. Anaipar Island : This island is located 9 km away from Keelakarai at 9°09' N Lat. 78°42' E Long. covers an area of 11 ha. It exhibited more diversity and vast expanse of live corals on its Northern side. Two LIT, one on the Northern side and one on the Eastern side were laid.

Northern side of the island dominated with all other live forms for the first time in the present study. In the first transect, *Acropora* sp. (tabular forms) was 39% of the transect area followed by rubble (35.6%). Other live corals were *Porites solida*, *Goniastrea retiformis*, *Favites abdita* and *Favia pallida* (1.8%). Dead coral covered by algae *Turbinaria* sp. was 2.5% and the dead coral without algae cover 20.4%, sand covered remaining 0.7%. In the second transect of Northern side, live corals dominated with foliose coral *Montipora foliosa* in the front (35.4%) followed by digitate corals *Acropora* spp. (5.3%). *Goniastrea pectinata* (4.4%), *Acropora* sp. (tabular) (2.1%) and *Montipora divaricata* (1%) were the other live corals. Dead corals (21.8%) and dead corals with algae *Turbinaria* sp. (18.4) and rubble (11.6%) were the other components of the reef. Third transect laid on the eastern side showed the dominance of dead coral unlike the dominance of live corals in the northern side. The dominant live coral was *Montipora digitata* (22%). *Pavona decussata*, *Goniastrea pectinata* and *Porites solida* (7%). Dead corals occupied 23.7% area and dead corals with algae 34.7%, rubble 8.6% and sand 5.3%.

TUTICORIN GROUP OF ISLANDS

(Figs. 1–3)

The following seven islands, which are situated close to Tuticorin town, were categorised as Tuticorin group of islands viz. 1. Nallathanni, 2. Puzhuvuinnichalli, 3. Upputhanni, 4. Velanguchalli, 5. Karaichalli, 6. Kasuwar and 7. Van.

1. **Nallathanni Island** : This island is the largest in the Tuticorin group of islands and second largest in the whole of Gulf of Mannar, covering an area of 101 ha. It is situated close to a fishing village called Munthal at 9°06' N Lat. and 78°35' E Long. Big trees of *Tamarind*, *Ficus*, *Thespesia* were found in the island along with papm and coconut trees. Reefs were found all around this island especially on the southern and northern side. Two transects, one on the southern side and another on the northern side were laid during 1998 survey and two more transects on the northern side and another on eastern side of the island were laid during 1999 survey. In the first transect laid on the southern side of the island, dead *Acropora* branching (23%) and dead *Acropora* tabular (13.2%) occupied much of the area. Among the live corals, massive corals *Goniastrea pectinata*, *Goniastrea retiformis*, *Porites solida*, *Favites* sp. and *Hydnophora* sp. occupied 18.6%. Foliose coral *Turbinaria peltata* occupied 2.4%. A branching *Acropora* sp. (1.9%) and Sea anemone (1.9%) was the other living form found in the present study. A major portion (16.7%) of the transect was occupied by sand. In the second transect laid on the Northern side of Nallathanni Island, most of the area was covered by dead coral with algae (63.2%). Massive dead coral recorded in the present study is very less (24.4%). Live corals occupied only a small area (5.4%) with *Goniastrea pectinata*, *Goniastrea retiformis*, *Porites solida*, *Platygyra* sp., and encrusting *Leptoria phrygia* (0.8%). Soft coral occupied 0.8% of the transect area. In the transect laid on the northern side, 53% was occupied by massive corals such as *Porites*, *Goniastrea* sp., *Favia pallida*,

Faiva sp., *Favites* sp. and *Platygyra* sp. In this transect 36% of the area was covered by dead *Acropora* sp. (tabular form) with algae. Recently dead *Porites* occupied 2% of the area and the remaining 9% occupied by sand. Macro algae *Turbinaria* sp. as well as calcareous algae were found in addition to the turf algae grown on corals. In the third transect laid on the Eastern side of the island, dead *Acropora* sp. (branching form) covered by turf algae occupied 43% of the transect area followed by macro algae forms *Caulerpa* sp. and *Turbinaria* sp. (30%). Live corals occupied only 23%, shared by *Montipora foliosa* (15%). Massive *Porites* and *Goniastrea* sp. formed 8% together and sand covered the remaining 4%.

2. Puzhuvunnichalli Island : It is located at 9°06' N Lat. and 78°35' E Long. The area is 6.12 ha and the circumference is 1372 m. It is 18 km from Vembar. This island has a good sandy beach, and thick vegetation. This island was surrounded by live coral reef all around except for a small gap on the eastern side. Two transects, one on the Northern side and another on the Eastern side was laid. On the northern side of the reef the transect area was covered by dead coral with algae (48.4%). The representative dead corals were *Acropora* sp. (branching form), *Acropora* sp. (tabular form), *Porites* sp., *Montipora digitata* and *Montipora foliosa*. Live forms occupied 37.4% of the area, represented by encrusting *Montipora* sp. (2.4%), *Montipora foliosa* (13.4%) and Massive corals *Porites* sp., *Goniastrea* sp., *Favia fava* and *Favia* sp. (21.6%). Sand covered 14.2% area. In the second transect laid on the eastern side of the island nearly half of the area was covered by live corals, 28% by *Montipora foliosa* and 22% by the Massive corals *Goniastrea* sp., *Porites* sp. and *Favia* sp. 32% of the transect area was occupied by dead corals *Montipora digitata*, *Montipora foliosa* and *Porites* sp. covered by algae. Sand occupied 20%. *Gracilaria* sp., *Turbinaria* sp. and turf algae were the macro algae forms found on the dead corals.

3. Upputhanni Island : It is located at 9°05' N Lat. and 78°30' E Long. The area is 22.94 ha and the circumference is 2292 m. It is 8 km from Vembar. It is a big sandy island with plenty of coral rubbles all over. Fringing reefs were found in the mid-eastern portion surrounding south up to the western middle portion at a distance of 150 to 300 m from the island. In the northern side major portion of the area (72%) was covered by dead corals dominated by *Acropora* sp. (tabular forms), followed by *Acropora* sp. (branching forms), other dead corals mostly covered by turf algae were massive *Porites* sp. and *Montipora foliosa*. Other algal forms found on dead corals were *Gracilaria* sp. and *Turbinaria* sp. Live coral cover occupied 27% of the transect area shared by *Montipora foliosa* (16%), massive corals *Goniastrea* sp. (3%) and *Porites* sp. (8%). Soft corals *Lobophytum* sp. occupied 1% of the transect area.

4. Velanguchalli Island : It is located at 8°56' N Lat. and 78°15' E Long. The area is 0.95 ha, and the circumference is 614 m. It is 15 km away from Tuticorin. This island is submerged 2–3 m below water. Isolated patches of thin reef of corals along southeastern side of the island were found.

5. **Karaichalli Island** : It is located at 8°52' N Lat. and 78°13' E Long. The area is 16.46 ha and the circumference is 1610 m. Recently some portion of the island has been eroded and the area has become 12.70 ha. It is 15 km from Tuticorin. It is a sandy island, thickly set with bushes in the center and western side. The whole island is covered with grasses and small shrubs. There was small reef along the island at a distance of 500 m to 1 km from the shore. Two transects, one on the eastern side and the other on the northern side was laid. In the first transect much of the area was occupied by sand with sea grass assemblages comprised of sea grasses such as *Halodule* sp. and *Enhalus* sp. (46%). Dead *Acropora* branching forms, *Acropora* tabular forms and *Montipora foliosa* covered by algae, covered another 45%. Rubble was the next major contributor (6%) and only 4% of the area was covered by live *Goniastrea retiformis*, *Montipora foliosa* and *Montipora digitata*. Poor representation of live coral forms and rubble strewn around the island indicated the major human disturbances happening in this island. Few new young colonies of *Favia fava* and *Acropora* sp., were also seen in the island. On the northeastern side of the island not even a single live coral was found. Sand and rubble covered 92% of the transect area, whereas, only 8% was covered by dead *Acropora* branching and tabular forms.

6. **Kasuwar Island** : It is located at 8°52' N Lat. and 78°13' E Long. The area is 19.50 ha and the circumference is 2160 m. Symptoms of recent erosion were observed and the area of this island has become 15 ha. It is 7 km away from Tuticorin. This island is found with small sand mounds and bushes here and there. The whole island is covered with xerophytic vegetation. Coral reefs were found at the southwest corner of the island at a distance of 500 m. Three transects, one on the eastern side, the second on the northern side and third on the southwestern side were laid. On the first transect laid on the eastern side, 74% was covered by sand, 25.9% sand with grasses *Halodule* sp. and *Enhalus* sp. In the second transect 71% of the area was covered by sand with sea grass and one fourth (25%) of the total area was covered by sand. Dead *Acropora* tabular form occupied 3%. In the third transect 0.4% of the area was covered by two sponges; remaining 99.6% was covered by robust dead *Acropora* sp. (branching forms) covered with turf algae. Close to this area diving up to 4-fathom depth revealed the presence of scattered live corals represented by *Favites abdita*, *Favia fava*, *Goniastrea* sp. and *Goniopora* sp.

7. **Van Island** : It is located at 8°50' N Lat. and 78°13' E Long. The area is 16.0 ha and the circumference is 2015 m. It is 6 km away from Tuticorin. This island is covered with some vegetation of low bushes mostly grasses and xerophytic plants. Fringing reefs were present on the eastern side of the island at a distance of 500 m. Two transects, one on the southern side and the other on the eastern side was laid. The first transect laid on the southern side revealed a mixture of rubble and sand contributing to 82% covered by dead *Acropora* sp. with macro algal forms such as *Caulerpa* sp., *Gracilaria* sp. and *Padina* sp. Dead *Acropora* tabular forms covered by turf algae constituted covered only 4%. The second transect laid on the eastern side revealed that nearly 75% was covered by rubble, 24% covered by sand and 0.6% a mixture of rubble and sand. 0.4% was represented by *Holothuria atra* and a single *Stoichactis* sp.

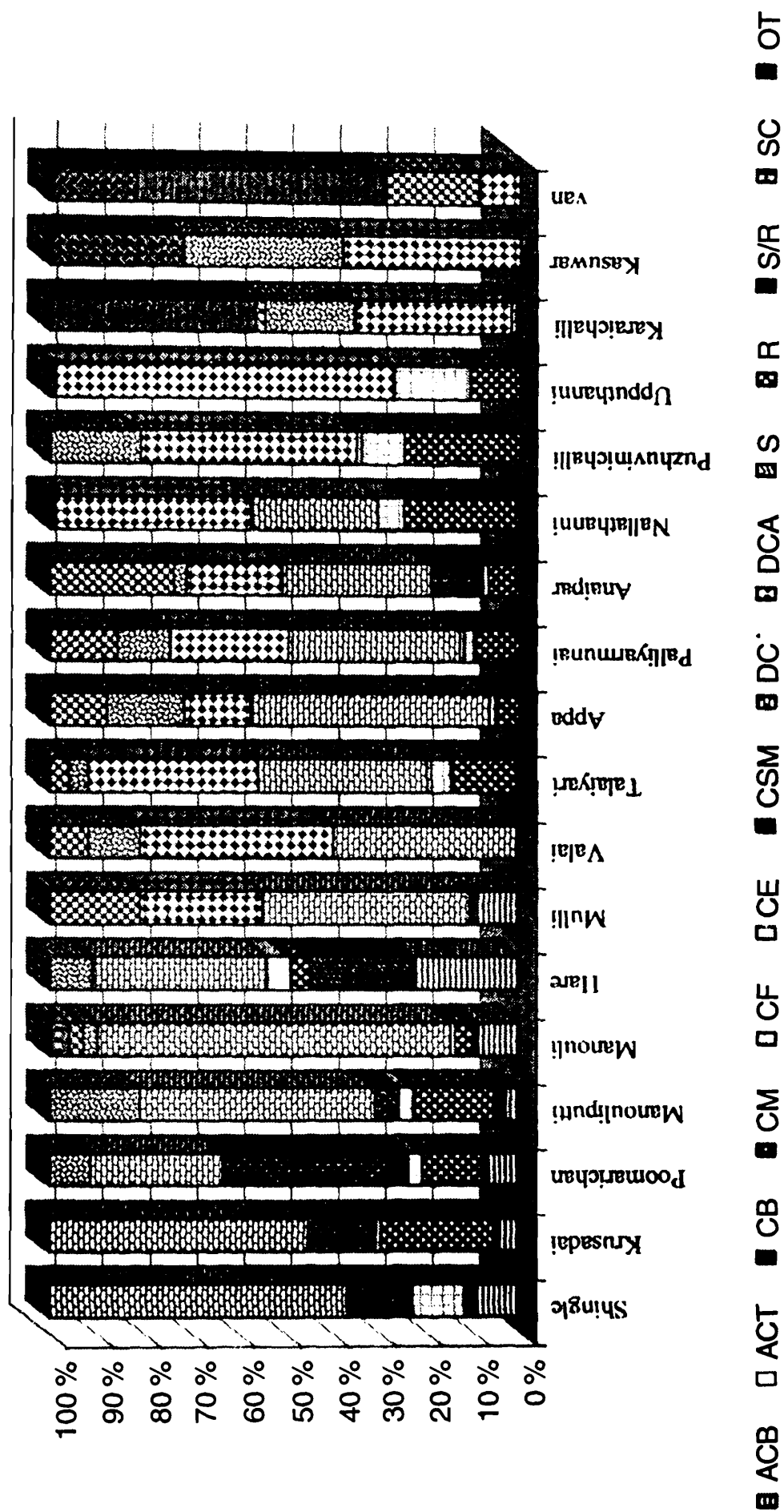


Fig. 3. : Comparison of life form categories in 18 islands of Gulf of Mannar during 1998–2000.

DISCUSSION

The present study revealed 36%, 16%, 11% of live corals; 46%, 38%, 10% of dead corals; 7%, 24%, 28% of dead coral with algae; 7%, 7%, 10% of sand from the Mandapam, Keelakarai and Tuticorin Group of Islands respectively (Figs 2–3). Mandapam group of islands showed rich coral cover when compared to Keelakarai and Tuticorin group of Islands. Species diversity was also more in Mandapam and Keelakarai group than the Tuticorin group. The reduction in coral species diversity in the Tuticorin group may be due to human activities such as over exploitation of reef resources, illegal coral mining, oil spill by fishing boats and lethal chemicals discharged from the coastal industries. Among the Tuticorin group of islands, the Nallathanni and Puzhuvinihalli had good coral reefs, which are away from the Tuticorin town.

The 1998 bleaching event has played a major role in reducing the live coral cover not only in the coral reefs of GoMBR but also in Lakshadweep, Gulf of Kachchh, Andaman and Nicobar reefs (Muley *et al.*, 2000). It has been reported that the 1998 bleaching reduced the live coral cover in the Gulf of Kachchh to 30%, 40% in the Gulf of Mannar, 20% in Lakshadweep and 65–70% in Andaman and Nicobar Islands (Venkataraman, 2000).

Inadequate awareness among the fishermen about coral reefs and their importance, increasing coastal industries and over exploitation is the major causes for coral reef degradation. In order to conserve the coral reefs of Gulf of Mannar Marine Biosphere Reserve, the present status report may help the managers to take proper initiative.

SUMMARY

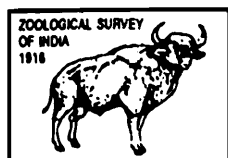
Gulf of Mannar Marine Biosphere Reserve (GoMBR) is the first declared marine Biosphere reserve in the south east Asia. It is endowed with 3600 species of flora and fauna. There is a chain of 21 islands from Mandapam to Tuticorin and these islands are surrounded by fringing reefs. Exploitation of biological resources from these reefs is the only source of income for the coastal village fishermen of this area. For the purpose of the present study, all the 21 islands of GoMBR were divided into three groups, such as Mandapam, Keelakari and Tuticorin, each group with seven islands in their vicinity. The status survey revealed 36%, 16%, 11% of live corals, 46%, 38%, 10% of dead corals, 7%, 24%, 28% of dead coral with algae, 7%, 7%, 10% of sand from the Mandapam, Keelakarai and Tuticorin groups respectively. The present study on status survey of coral reefs of Gulf of Mannar was conducted immediately after the bleaching event (1998–2000). Among the three groups of islands in GoMBR, Mandapam group had the highest percentage of live coral cover than the Keelakarai and Tuticorin group of islands. The reasons for the less percentage of coral cover in other two groups of islands of GoMBR, as well as status of coral reefs of Lakshadweep, Gulf of Kachchh and Andaman Nicobar Islands have been compared in the present paper.

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OPHIO-FAUNA OF UJJAIN & CERTAIN AREAS OF MALWA REGION (MADHYA PRADESH)

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INTRODUCTION

The Ujjain district which was considered as the 'cultural capital' of India in the past, is also carries a significance in Madhya Pradesh for its floral & faunal wealth and the famous 'Mahakal Temple' is located here. The Malwa forms a distinct unit of M.P. (27°70'–25°10' N & 73°45'–79°14' E) with an area of 1,50,000 square kilometre and include the Ujjain district. The climate in general is tropical monsoon-type. This region has got a typical flora; suitable for a plateau and comprises mixed deciduous forest along with grass land and xyrophytes. The soil of Malwa is black loam.

The present paper is mostly based on the study of snakes collected from Ujjain city and its surroundings of Malwa. The present studies are based on 33 species of snakes belong to 6 families. Smith (1943), Gharpurey (1962), Deoras (1965), Whitaker (1978), Daiel (1983) and Murthy (1986) has already focussed our attention on the snakes occurring in Madhya Pradesh. Some of the recent works which deals with the Ophio-fauna of Malwa Region are those of Ingle (1996), Vyas (1998) and Ingle (2001). In the present work, four species have been added and the complete list of snakes known from the Malwa is presented.

SYSTEMETIC ACCOUNT

Order SQUAMATA

Suborder SERPENTES

Family TYPHLOPIDAE

1. *Typhlops braminus* (Daudin)

1803. *Eryx braminus*, *Hist. Nat. Rept.* vii : 279 (based on Russell).

1943. *Typhlops braminus* Smith, *Fauna Brit. Ind.* iii : 46.

Material examined : 20 exs., collected from different areas of Ujjain district as follows : Ujjain city area – 10 exs., collected from KDP, MN, GK, IN, BW & PB. 5.vii.1995, T. Ingle, M. Ingle. Ujjain rural areas – 10 exs., 4 exs. collected from villages NK, JP (BT), 15.viii.1995, M. Ingle. 2 exs. collected from RU, GHI (KT). 13.vi.1995, 19.vii.1996, M. Ingle. 4 exs. collected from DI, PAT, KTH, MKN (TT), 10.ix.1995, M. Ingle.

Distribution : Madhya Pradesh : As mentioned in the material.

Elsewhere : Throughout the orientel region, Arfica, Mexico and New Guinea.

2. *Typhlops diardi diardi* (Smith)

1839. *Typhlops diardi* Schlegel, *Abbie. Amphia.*, : 39.

1923. *Typhlops diardi diardi* Smith, *J.N.H.S. Siam*, vi : 52.

Material examined : 10 exs. collected from Ujjain city areas as follows : KC, HS, DM, RN, PB, 7.vi.1994, 9.vi.1995, 11 & 13.vii.1996, 5.vii.1998, T. Ingle, M. Ingle.

Distribution : Madhya Pradesh : As mentioned in the material, common in West Bengal, Assam, U.P. to Vietnam.

3. *Typhlops acutus* (Dum. & Bib.)

1844. *Ongchocephalus acutus* Dum. & Bib., *Erp. Gen.* vi : 333.

1890. *Typhlops acutus* Boulenger, *Fauna Brit. Ind.*, : 241.

Material examined : 8 exs. collected from city areas of Ujjain as follows : PB, DG, NKH & DM, 17.vii.1995, 15.ix.2000, M. Ingle.

Distribution : Peninsular India, south of Gangetic Plain and south of Rajasthan, west to Gujarat and east to Calcutta (West Bengal).

Family UROPELTIDAE

4. *Uropeltis ocellatus* (Beddome)

1863. *Silybura ocellata* Beddome, *Proc. zool. Soc.*, : 225.

1943. *Uropeltis ocellatus* Smith, *Fauna Brit. Ind.*, iii : 76.

Material examined : 2 exs., 1 ex. collected from Dhamnod (near Narmada river vally) of Dhar district, 1995, M. Vyas. 1 ex. Satvas village of Dewas district, 3.iv.2001, M. Ingle.

Distribution : Madhya Pradesh : As mentioned in the material.

Elsewhere : Western Ghats, Peninsular India.

Family BOIDAE

5. *Python molurus* (Linnaeus)

1758. *Python molurus* Linnaeus, *Syst. Nat. 10th ed.*, : 225.

1943. *Python molurus* Smith, *Fauna Brit. Ind.*, iii : 106.

Material examined : 5 exs., 1 ex. collected from GK–KB area of Ujjain city, 12.xi.1995, M. Ingle. 4 exs. collected from village RV (MT), MKN (TT), PP (BT) of Ujjain district, 3.iv.1996, 15.vii.1999, M. Ingle.

Distribution : Madhya Pradesh.

Elsewhere : Peninsular India to the extreme limit of Sind and Punjab in the north-west and to Bengal in the north-east, also Sri Lanka.

Status : Rare, protected under scheduled I (part-2) of Indian Wild Life Act., 1972 (1992).

6. *Eryx conicus* (Schneider)

1801. *Boa conica* Schneider, *Hist. Amphibia.*, ii : 268.

1943. *Eryx conicus* Smith, *Fauna Brit. Ind.*, iii : 112.

Material examined : 38 exs., 17 exs. Ujjain city areas IAAR, GK, VDCM, GD, DM, 15.xi.1995, 23.vi.1996, 5.vii.1999, M. Ingle. 13 exs. collected from rural areas, DI, PAT, KTH (TT), 10.ix.1995., M. Ingle. 6 exs. from villages NK, GD (BT), 30.ix.1996, M. Ingle. 2 exs. from villages LK, KH (UT), 4.v.1996, M. Ingle.

Distribution : India : from the base of Himalayas to the extreme south of India, in the west to Bihar and Bengal in the east.

Elsewhere : North Sri Lanka, in Pakistan from Sind & Baluchistan.

Status : Common.

7. *Eryx johni johni* (Russell)

1801. *Boa johni* Russell, *Ind. Serp.*, ii : 18 & 20.

1943. *Eryx jonhi johni* Smith, *Fauna Brit. Ind.*, iii : 119.

Material examined : 5 exs. collected from villages DI, PAT (TT), BM, NL, PBR, DH (UT), 13.vi.1993, 15.iv.1995, M. Ingle.

Distribution : Madhya Pradesh : As mentioned in the material; in the plains of Indian subcontinent.

Elsewhere : Sri Lanka, Pakistan, Afghanistan & Iran.

Status : It was common in Ujjain & its surrounding areas in the past but not recorded for last few years. Now became rare in the region.

Family COLUBRIDAE

8. *Lycodon aulicus* (Linnaeus)

1754. *Coluber aulicus* Linnaeus, *Mos. Adolph. Frider.*, i : 29.

1943. *Lycodon aulicus* Smith, *Fauna Brit. Ind.*, iii : 263.

Material examined : 25 exs. collected from Ujjain urban areas : KC, DG, PB, 3.v.1990, 7.vii.1992, 13.ix.1996, 19.viii.2000, T. Ingle, H. Ingle, M. Ingle.

Distribution : Madhya Pradesh : As mentioned in the material.

Elsewhere : Whole of India including Andaman and Nicobar Islands. Sri Lanka, Hongkong, Loss, Malaysia, Nepal, Vietnam, Pakistan, Bangladesh, Philippines, Myanmar, Indonesia and S. China.

Remarks : The species is very common in urban areas of Ujjain city.

9. *Lycodon striatus* (Shaw)

1802. *Coluber striatus* Shaw, *Gen. Zool.*, iii : 527.

1943. *Lycodon striatus* Smith, *Fauna Brit. Ind.*, iii : 261.

Material examined : 8 exs. collected from KC, DG, PB areas of Ujjain city, 14.iv.1995, 20.viii.1997, 31.vii.2000, M. Ingle.

Distribution : India as far east as Chota Nagpur, Peninsular India, Gujarat, Western ghats, Central India.

Elsewhere : Sri Lanka, West ward to Iran, Pakistan, Baluchistan, Sind, N. W. F. Provinces.

10. *Oligodon arnensis* (Shaw)

1802. *Coluber arnensis* Shaw, *Gen. Zool.*, iii : 526.

1943. *Oligodon arnensis* Smith, *Fauna Brit. Ind.*, iii : 225.

Material examined : 6 exs. collected from IN, MN, VUC areas of Ujjain city, 23.vi.1995, 17.vii.1996, 15.vi.2001, M. Ingle.

Distribution : Madhya Pradesh : As mentioned in the material. Gujarat, Peninsular India, Western Himalayas, Bengal.

Elsewhere : Nepal, Pakistan, Sri Lanka.

11. *Oligodon taeniolatus* (Jerdon)

1853. *Coronella taeniolatus* Jerdon, *Jour. Asiat. Soc. Bengal.*, 22 : 528.

1966. *Oligodon taeniolatus* Minton, *Bull. Am. Mus. Nat. Hist.*, 134 : 133-134.

Material examined : 2 exs., 1 ex. collected from a village NK (BT), 3.xi.2000, M. Ingle. 1 ex. collected from IN, 22.vii.2001, M. Ingle.

Distribution : India : Gujarat, Peninsular India and Bihar.

Elsewhere : Sri Lanka, Pakistan.

Remarks : Recorded for the first time from the region.

12. *Sibnyophis subpunctatus* (Dum. & Bib.)

1854. *Oligodon subpunctatus* Dum. & Bib., *Erp. Gen.*, 7 : 58.

1943. *Sibnyophis subpunctatus* Smith, *Fauna Brit. Ind.*, 3 : 279.

Material examined : 1 ex. collected from Dhar district of M.P., 1994, M. Vyas.

Distribution : India : Peninsular India, Gujarat, West Bengal.

Elsewhere : Sri Lanka.

13. *Amphiesma stolata* (Linnaeus)

1758. *Coluber stolata* Linnaeus, *Syst. Nat.*, : 219.

1943. *Natrix stolata* Smith, *Fauna Brit. Ind.*, 3 : 303.

Material examined : 10 exs. collected from DM, RN, HS areas of Ujjain city, 9.vi.1995, 17.vii.1996, 4.v.1997, 27.vii.2001, M. Ingle.

Distribution : Whole of India including Andamans.

Elsewhere : Sri Lanka, Pakistan.

Status : Very common in Ujjain city areas.

14. *Macropisthodon plumbicolor* (Cantor)

1839. *Tropidonotus plumbicolor* Cantor, *Proc. zool. Soc. London* : 54 (type be Malwa, Saugar).

1943. *Macropisthodon plumbicolor* Smith, *Fauna Brit. Ind.*, 3 : 314.

Material examined : 6 exs. collected from villages BM, LK, KH (UT), 2.vi.1994, 11.vii.1996, 20.ix.1999, M. Ingle.

Distribution : Throughout India except the Ganges vally and the extreme north-west.

Elsewhere : Sri Lanka.

15. *Xenochrophis piscator* (Schneider)

1799. *Hydrus piscator* Schneider, *Hist. Amph.*, 1 : 247.

1965. *Xenochrophis piscator* Malanate and Olinton, *Proc. Acad. Sci. Phila.*, 117 : 19-41.

Material examined : 30 exs. collected from RN, NK, BW, VDCM, PB & KC areas of Ujjain city. 11.vii.1995, 17–19.vi.1996, 10,12,15.vii.1999, 3,6,8.vi.2001, M. Ingle.

Distribution : Whole of India.

Elsewhere : Complete Malyan region, S. China, Taiwan, Bangladesh, Bornea, Burma, Sri Lanka, Pakistan & Indochina.

Status : Very common in Ujjain.

16. *Atretium schistosum* (Daudin)

1803. *Coluber schistosum* Daudin, *Hist. Nat. Rept.*, vii : 132 (based on Russell, 1801, Ind).

1943. *Atretium schistosum* Smith, *Fauna Brit. Ind.*, 3 : 319-320.

Material examined : 2 exs. collected from KDP, NG areas of Ujjain, 4.vi.1995, 17.vii.1996, M. Ingle.

Distribution : Throughout India (Anaimalais, Wyanad, Mysore, U. P., Orissa) except the Himalayas.

Elsewhere : Sri Lanka.

17. *Elaphe helena* (Daudin)

1796. Russell, *Ind. Serp.*, 1 : 37, pl. 32.

1943. *Elaphe helena* Smith, *Fauna Brit. Ind.*, 3 : 140.

Material examined : 10 exs. collected from SS, VDCM, BW, NG & HS areas of Ujjain, 23,24.vi.1995, 10,12.ix.1996, 2, 3, 4.vii.1998, M. Ingle.

Distribution : Throughout India : Gujarat : Bharuch, Bhavnagar, Gandhinagar, Kheda, Vadodra, and Dang districts.

Elsewhere : Sri Lanka, West Pakistan.

18. *Ptyas mucosus* (Linnaeus)

1758. *Coluber mucosus* Linnaeus, *Mus. Ad. Erid.*, 1 : 37.

1943. *Ptyas mucosus* Smith, *Fauna Brit. Ind.*, 3 : 159.

Material examined : 30 exs. Ujjain city areas : 17 exs. collected from – RN, DM, UC, VDCM, PB & BW, 3.v.1990, 13.vii.1993, 30.viii.1998, 4.iv.2000, M. Ingle, B Ingle & H. Ingle. 13 exs. collected from villages – NK, GD (BT), LK, KH, HP (UT), KTH (TT), RU, GH, GHI, NGR (KT), RV, IND (MT), BH, JT, 15.vi.1991, 23.vi.1996, 30.vii.1999, 4.viii.2001, M. Ingle, H. Ingle.

Distribution : Throughout India, Gujarat : Rajkot, Jamnagar, Vadodra, Gandhinagar, Bhavnagar, Bharuch, Panchmahals, Sabarkantha, Whole of India, Andaman islands.

Elsewhere : Sri Lanka, Burma.

19. *Argyrogena fasciolatus* (Shaw)

1802. *Coluber fasciolatus* Shaw (based on Russell, 1760 : 26, pl. 21).

1943. *Coluber fasciolatus* Smith, *Fauna Brit. Ind.*, 3 : 170.

1983. *Argyrogena fasciolatus* Daniel, *Indian Reptiles* : 78.

Material examined : 8 exs. collected from PB, DM, RN, VDCM & GD areas of Ujjain, 18.iii.1995, 25&26.v.1997, 14.vi.1999, M. Ingle.

Distribution : Peninsular India, Pakistan North to Himalayas and in the east to West Bengal.

20. *Argyrogena gracillis* (Guenther)

1862. *Zamenis gracilis* Guenther, *Ann. Mag. Nat. Hist.*, (3) ix : 125.

1943. *Coluber gracilis* Smith, *Fauna Brit. Ind.*, 3 : 171.

Material examined : 1 ex. collected from village DI (TT), 13.vi.2001, M. Ingle.

Distribution : Has been found in Bombay, Poona, Satara, Central Provinces & Sindh.

Remarks : The species is recorded for the first time from the region.

21. *Dendrelaphis tristis* (Daudin)

1803. *Coluber tristis* Daudin, *Hist. Nat. Rept.*, 6 : 430.

1943. *Ahaetulla tristis* Smith, *Fauna Brit. Ind.*, 3 : 248.

Material examined : 2 exs. MN area of Ujjain, 3.iv.1995, 15.vii.1999, M. Ingle.

Distribution : India : Gujarat : Rajkot, Junagarh, Vadodra and Bhavnagar districts. Peninsular India, West Bengal, Darjelling.

Elsewhere : Sri Lanka.

22. *Dendrelaphis pictus* (Gmelin)

1789. *Coluber pictus* Gmelin, *Syst. Nat.*, i : 1116.

1871. *Dendrophis pictus andmaniansis* (Anderson) P. Z. S., i : 84.

Material examined : 1 ex. collected from GD area of Ujjain, 17.iv.1995, M. Ingle.

Distribution : Southern India, Eastern Himalayas, Sikkim, the Andamans, Malay, Burma.

23. *Ahaetulla nasutus* (Lacepede)

1789. *Coluber nasuta* Lacepede, *Hist. Nat. Serp.*, i : 100.

1943. *Dryophis nasutus* Smith, *Fauna Brit. Ind.*, 376.

Material examined : 4 exs., 2 exs. collected from villages PBR, HP (UT), 9.iii.1995, M. Ingle. 1 ex. collected from a village Kannod of Dewas district, 14.iv.1999, M. Ingle. 1 ex. collected from Balwara an area of Vindhya hills, Indore district, 22.ii.2001, V. Upadhyay.

Distribution : Peninsular India excluding Ganges valley. West of Patna.

Elsewhere : Complete Indo-Chinese region, Vietnam, Thailand, Cambodia, Sri Lanka, Burma.

24. *Psammophis condanarus* (Merrem)

1820. *Coluber psammophis condanarus* Merrem, *Tent. Syst. Amph.*, : 107.

1966. *Psammophis condanarus* Minton, *Bull. Am. Mus. Nat. Hist.*, **134** : 142-143.

Material examined : 1 ex. collected from a village DI (TT), 15.iii.2001, M. Ingle.

Distribution : India : Gujarat : Kachcha district, Maharashtra (Poona, Jalna, Kurnal, Berar), Punjab, Uttar Pradesh, Orissa, West Bengal.

Elsewhere : Arid and semi arid country in Pakistan, Myanmar, Thailand.

Remarks : The species is recorded for the first time from the Region.

25. *Boiga trigonata* (Schneider)

1802. *Coluber trigonata* Schneider, *Bechst. transl. Lacep.*, **4** : 256, pl. 40, fig. 1.

1966. *Boiga trigonata* Minton, *Bull. Am. Mus. Nat. Hist.*, **134** : 138-139.

Material examined : 8 exs. collected from villages NK, PM, JP (BT), BM (UT), 27.viii.1995, 30.vi.1998, 22.iv.1999, M. Ingle.

Distribution : Throughout India : Gujarat : Vadodra, Panchmahals and Dang districts, Peninsular India, Rajasthan.

Elsewhere : Sri Lanka.

Family ELAPIDAE

26. *Bungarus caeruleus* (Schneider)

1801. *Pseudoboa caeruleus* Schneider, *Hist. amphib.* **2** : 284.

1966. *Bungarus caeruleus* Minton, *Bull. Am. Mus. Nat. Hist.*, **134** : 152-153.

Material examined : 20 exs., 14 exs. collected from IAAR, IN, RN, VDCM of Ujjain city, 25.viii.1995, 15.vii. 1997, 3.vii.1999, 14.vi.2000, 25.vii.2001, M. Ingle. 4 exs. NK, JP, 2.iii.1999. 2 exs. collected from villages NGD, KM (KT), 22.iv.1999, M. Ingle.

Distribution : India : Gujarat : Gandhinagar, Bhavnagar, Dangs, Mehsana, Bharuch districts, West Bengal.

Elsewhere : Pakistan, Sri Lanka.

27. *Callophis melanurus* (Shaw)

1703. *Indian Serp.*, Russell, **1** : 12, pl. 8.

1943. *Callophis melonurus* Smith, *Fauna Brit. Ind.*, **3** : 420.

Material examined : 1 ex. collected from an hilly area on the way of Ujjain–Bhopal road in Bhopal district, 20.iii.2001, M. Ingle.

Distribution : Peninsular India, Gujarat : Bhavnagar, Dangs, West Bengal, Maharashtra (Bombay, Nagpur), Tamil Nadu.

Elsewhere : Ceylon.

Remarks : Recorded for the first time from the region.

28. *Naja naja naja* (Linnaeus)

1758. *Coluber naja* Linnaeus, *Syst. Nat.* : 221.

1966. *Naja naja naja* Minton, *Bull. Am. Mus. Nat. Hist.*, **134** : 153-154.

Material examined : 40 exs., 24 exs. collected from villages RUN, PM, PP, NK (BT), PAT, KTH, MKN, DI (TT), RV, JH (MT), RU, NGR (KT), LK, KH, HP (UT), 26.v.1990, 17.vii.1992, 5.vi.1995, M. Ingle, H. Ingle. 16 exs. collected from RN, DM, HM, VDCM, IN, NG, HS, GK, areas of Ujjain city, 5.vi.1991, 11.iv.1993, 5.vii.1995, 21.v.1998, 24.viii.2000, 28.vi.2001, M. Ingle, B. Ingle, H. Ingle.

Distribution : India : Gujarat : Sanbarkantha, Ahmedabad, Surendra nagar, Surat, Dangs, Junagarh districts, Peninsular India, Kashmir, Punjab, Haryana, Bihar, Orissa, Rajasthan, United Provinces.

Elsewhere : Sri Lanka.

Status : Very common in some areas of Ujjain.

29. *Naja naja kaouthia* Lesson

1831. *Naja kaouthia* Lesson in *Ferussac. Bull. Sci. Nat.*, **25** : 122.

1943. *Naja naja kaouthia* Smith, *Fauna Brit. Ind.*, **3** : 428.

Material examined : 1 ex. collected from Hanuman Mandir near river Kshipra – NG area of Ujjain, 11.ix.1996, M. Ingle.

Distribution : India : Assam, Bengal, Bihar, Eastern Uttar Pradesh & the Himalayas.

Elsewhere : Complete Indo-China.

30. *Naja naja oxiana* (Eichwald)

1943. *Naja naja oxiana* Smith, *Fauna Brit. Ind.*, **3** : 428.

1966. *Naja naja oxiana* Minton, *Bull. Am. Mus. Nat. Hist.*, **134** : 154-155.

Material examined : 25 exs., 16 exs. collected from villages MKN, KTH, BH (TT), IND, JH, RV (MT), NGR, KM, GHI (KT), RUN, NK, JP (BT), DH, BM, LK, KH, HP (UT), 27,28.vi.1990, 17,18.vii.1992, 12.vi.1995, M. Ingle. 9 exs. collected from RN, VUC, NK, DM, IN, GK, KDP, MN areas of Ujjain city. 6,8.vi.1991, 14,15.iv.1993, 6,7.vii.1995, 20,21,22.v.1998, 24,25.viii.2001, M. Ingle, B. Ingle.

Distribution : India : Gujarat, Punjab, Kashmir.

Elsewhere : Transcaspia & Southern Turkmenistan, near the Indian border with Pakistan.

Family VIPERIDAE

31. *Vipera russelli* (Shaw)

1797. *Coluber russelli* Shaw, *Nat. Misc.*, 8 : pl. 291.

1966. *Vipera russelli* Minton, *Bull. Am. Mus. Nat. Hist.*, 134 : 156.

Material examined : 22 exs., 20 exs. collected from villages RUN, PM, NK, PP, JHU (BT), BM, LK, KH, JT, HP (UT), KTH, PAT, DI, MKN (TT), 7,8,9.vi.1994, 7.ix.1995, 16.viii.1998, 23.iv.2000, M. Ingle. 2 exs. collected from HM, RN urban areas of Ujjain, 17.vii.1996, 8.vi.1999, M. Ingle.

Distribution : India : South India, Western Himalayas, Punjab, West coast, lower Bengal.

Elsewhere : Indian sub continent from Baluchistan in the West & Kashmir in the north to the eastern Himalayas & east wards to Burma, Thailand, Indo-china, Formosa, Indo-Australian Archepalegoe and Sri Lanka.

32. *Echis carinatus* (Schneider)

1796. *Ind. Serp.*, Russell, 1 : pl. 2, p. 2 (Arni).

1946. *Echis carinatus* Minton, *Bull. Am. Mus. Nat. Hist.*, 134 : 159-160.

Material examined : 5 exs. collected from villages PBR, NK, RDH, 1.v.1994, 19.iv.1999, M. Ingle.

Distribution : India South & West of Ganges, Middle east, Cochin, Travancore, Kerala.

Elsewhere : Arabia, Ghana, Sri Lanka.

33. *Trimeresurus gramineus* (Shaw)

1802. *Coluber gramineus* Shaw, *Gen. Zool.*, 3 : 420.

1943. *Trimeresurus gramineus* Smith, *Fauna Brit. Ind.*, 3 : 515.

Material examined : 1 ex. collected from Pachmari, Hoshangabad district, 1995, M. Vyas.

Distribution : India : Gujarat : Dangs district, complete Peninsular India South latitude 22°.

SUMMARY

Thirty three species of Snakes occurring in the different urban & rural areas of Ujjain district & surrounding areas of Malwa Region of Madhya Pradesh are discussed.

Table 1. : Species of snakes, area of occurrence & Status in the Ujjain district.
(Urban areas)

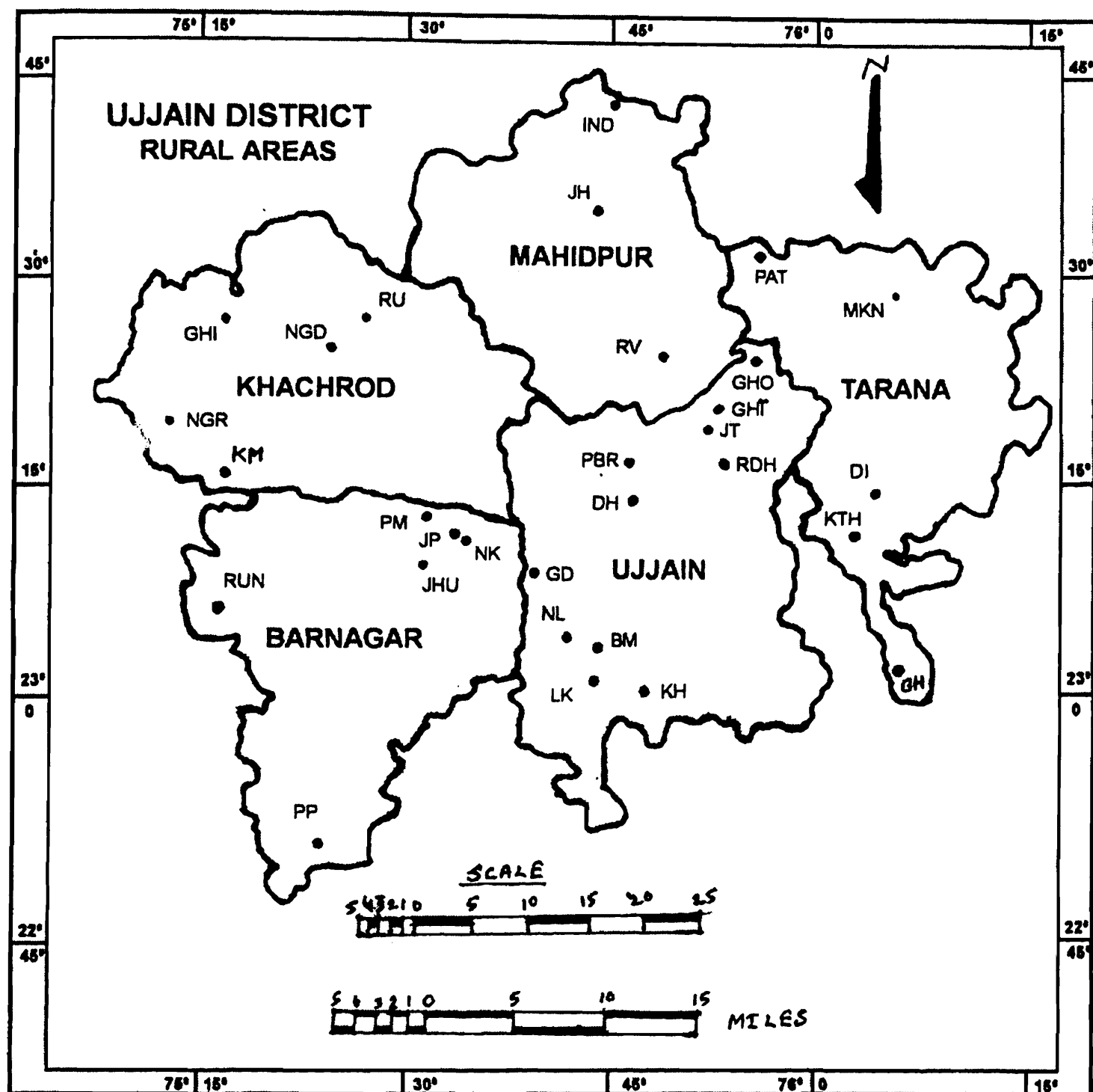
S. No.	Scientific name	Area of occurrence	Status
	Family : TYPHLOPIDAE		
1.	<i>Typhlops braminus</i>	IN, PB, BW, KDP, MN, GK	VC
2.	<i>Typhlops diardi diardi</i>	KC, HS, NG, DM, RN, PB	C
3.	<i>Typhlops acutus</i>	PB, DG, NKH, DM	UC
	Family : BOIDAE		
4.	<i>Python molurus</i>	GK-KB	R
5.	<i>Eryx conicus</i>	IAAR, GK, VDCM, DM	VC
	Family : COLUBRIDAE		
6.	<i>Lycodon aulicus</i>	KC, PB, DG	VC
7.	<i>Lycodon striatus</i>	KC, PB, DG	R
8.	<i>Oligodon arnensis</i>	IN, MN, VUC	C
9.	<i>Amphiesma stolata</i>	DM, RN, HS	VC
10.	<i>Xenochrophis piscator</i>	RN, DM, NKH, BW, VDCM, PB, KC	VC
11.	<i>Atretium schistosum</i>	KDP, NG	UC
12.	<i>Elaphe helena</i>	SS, NG, BW, HS, VDCM	C
13.	<i>Ptyas mucosus</i>	DM, RN, VUC, VDCM, PB, BW	VC
14.	<i>Argyrogena fasciolatus</i>	PB, DM, RN, VDCM	UC
15.	<i>Dendrelaphis tristis</i>	MN	UC
	Family : ELAPIDAE		
16.	<i>Bungarus caeruleus</i>	IAAR, RN, IN, VDCM	C
17.	<i>Naja naja naja</i>	RN, DM, HM, VDCM, IN, NG, HS, GK	VC
18.	<i>Naja naja kaouthia</i>	NG	R
19.	<i>Naja naja oxiana</i>	DM, RN, NKH, IN, GK, KDP, MN, VUC	VC
	Family : VIPERIDAE		
20.	<i>Vipera russelli</i>	HM, RN	C

IN-Indira Nagar, BW-Budhwaria, KDP-Kaliadeh Palace, MN-Mangal nath, GK-Garhkalika, PB-Patni bazar, KC-Kartik chauk, HS-Harsiddhi, NG-Narsingh Ghat, DM-Dashhara Maidan, RN- Rishi Nagar, DG-Danigate, NKH-Nana Kheda, KB-Kal-Bhairav, IAAR-Industrial Area Agar Road, VDCM-Vikramaditya Cloth Market, VUC-Vikram University Campus, SS-Solah Sagar, HM-Hira Mill.

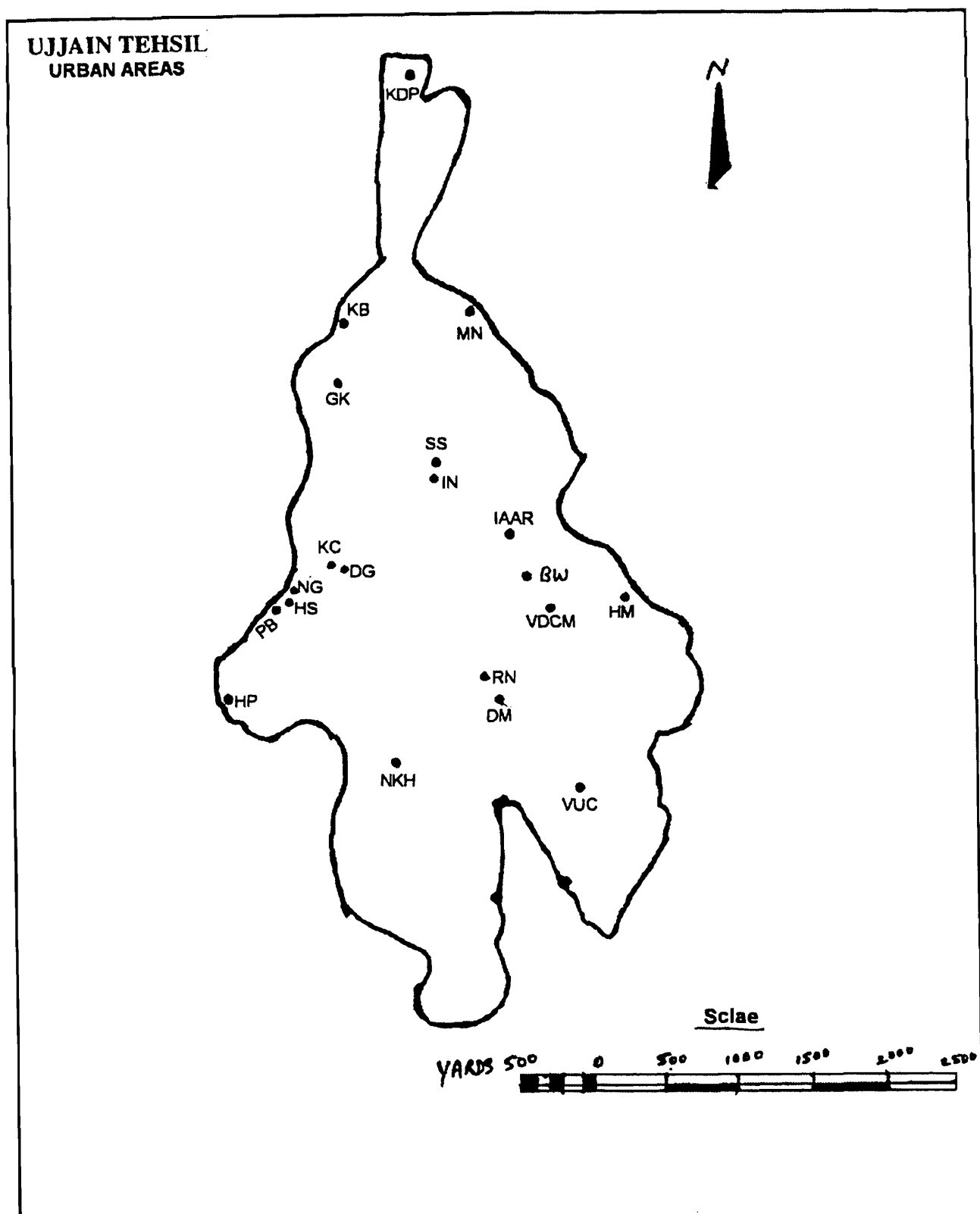
Table 2. : Species of snakes, area of occurrence & Status in the Ujjain district.
(Rural areas)

S. No.	Scientific name	Area of occurrence	Status
1.	Family : TYPHLOPIDAE <i>Typhlops braminus</i>	NK, JP, RU, GHI, DI, PAT, KTH, MKN	VC
2.	Family : BOIDAE <i>Python molurus</i>	RV, MKN, PP	R
3.	<i>Eryx conicus</i>	DI, PAT, KTH, NK, GD, LK, KH	VC
4.	<i>Eryx johani johani</i>	DI, PAT, NL, DH, PBR, BM	R
5.	Family : COLUBRIDAE <i>Oligodon taeniolatus</i>	NK	RFT
6.	<i>Macropisthodon plumbicolor</i>	BM, LK, KH	C
7.	<i>Ptyas mucosus</i>	NK, GD, LK, KH, HP, KTH, GH, GHI, RU, NGR, RV, IND, JT, BH	VC
8.	<i>Argyrogena fasciolatus</i>	GD	UC
9.	<i>Argyrogena gracilis</i>	DI	RFT
10.	<i>Dendrelaphis pictus</i>	GD	R
11.	<i>Ahaetulla nasutus</i>	PBR, HP	R
12.	<i>Psammophis condanarus</i>	DI	RFT
13.	<i>Boiga trigonata</i>	NK, JP, PM, BM	UC
14.	Family : ELAPIDAE <i>Bungarus caeruleus</i>	NK, JP, NGD, KM	C
15.	<i>Naja naja naja</i>	RUN, PM, PP, NK, PAT, MKN, KTH, DI, RV, JH, RU, NGR, LK, KH, HP	VC
16.	<i>Naja naja oxiana</i>	MKN, BH, KTH, IND, JH, RV, NGR, KM, GHI, NK, JP, RUN, DH, LK, KH, HP, BM	VC
17.	Family : VIPERIDAE <i>Vipera russelli</i>	RUN, PM, NK, JHU, PP, BM, LK, KH, HP, JT, MKN, PAT, DI, KTH	C
18.	<i>Echis carinatus</i>	PBR, NK, RDH	UC

NK–Narela Kalan, JP–Jahangir Pur, RU–Rupeta, GHI–Ghinoda, DI–Dubli, KTH–Kaitha, MKN–Makron, RV–Raghvi, PP–Piplu, GD–Gambhir Dam, LK–Lekora, KH–Karohan, NL–Nalwa, DH–Dhabla, PBR–Panbihar, BM–Bamora, HP–Hasam Pura, GH–Ghosala, GHT–Ghatiya, NGR–Narsing Garh, IND–Indokh, JT–Jethal, BH–Bhatuni, PM–Palsoda Makravan, NGD–Nagda, KM–Kamthana, RUN–Runija, JHU–Jhumaki, JH–Jharda, RDH–Rudaheda.



KM-KAMTHANA, NGR-NARSINGH GARH, GHI-GHINODA, RU-RUPETA, NGD-NAGDA, IND-INDOKH, JH-JHARDA, RV-RAGHVI, DI-DUBLI, KTH-KAITHA, BH-BHATUNI, MKN-MAKRON, PM-PALSODA MAKRAVAN, NK-NARELA KALAN, JHU-JHUMKI, PP-PIPLU, GHG-GHOSALA, GHI-GHATIYA, JT-JETHAL, RDH-RUDHAHERA, PBR-PANBIHAR, DH-DHABLA, NL-NALWA, BM-BAMORA, LK-LEKORA, KH-KAROHAN, GD-GAMBHIR DAM, JP-JAHAN GIRPUR, TT-TARANA TENSIL, MT-MAHIDPUR TEHSEL, KT-KHACHROD TEHSIL, BT-BARNAGAR TEHSIL, UT-UJJAIN TEHSIL.



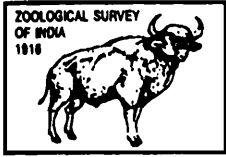
KDP-KALIADEH PALACE, KB-KAL BHAIKAV, GK-GARH KALIKA, MN-MANGAL NATH, IN-INDIRA NAGAR, BW-BUDHWARIA, KC-KARTIC CHAUK, HS-HARSIDDHI, NG-NARSINGH GHAT, DM-DASHHARA MAIDAN, RN-RISHI NAGAR, PB-PATNI BAZAR, DG-DANI GATE, NKH-NANAKHEDA, IAAR-INDUSTRIAL AREA AGAR ROAD, VUC-VIKRAM UNIVERSITY CUMPU, SS-SOLAH SAGAR, VDCM-VIKRAMADITYA CLOTH MARKET, HP-HASAM PURA, HM-HIRA MILL.

ACKNOWLEDGEMENT

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Rec. zool. Surv. India : **103** (Part 1–2) : 33-41, 2004

STATUS OF ASSAMESE MACAQUE, *MACACA ASSAMENSIS* IN DARJEELING DISTRICT, WEST BENGAL, INDIA

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INTRODUCTION

Field studies on the status and ecology of Assamese macaque were carried out earlier by Southwick *et al* (1964), Khajuria (1962), Fooden (1971b), Tiwari and Mukherjee (1992). Mukherjee *et al* (1995) surveyed in some parts of Darjeeling. Recently the Indo-US Primate Project carried out the status and behavior study of this species in northeastern India (Annual Report 05, 1999).

The field surveys of Assamese macaque of Darjeeling district were conducted during May and December 1997. The objective of the study was to survey all habitable areas (except Mahananda Wildlife Sanctuary) of the district to collect information on abundance, distribution, social structure & status of this species. The Assamese macaque (*Macaco assamensis*) allopatrically occupies this hilly district but sympatrically with the rhesus macaque (*Macaca mulatta*) at the lower elevation, below 150 m. This species is relatively larger than rhesus macaque. Its geographical distribution extends over a large area of south and south-east Asia from Nepal, Bhutan, Northeast India, Bangladesh, North Myanmar, South China, Laos, Thailand and Vietnam. It mostly inhabits the Sub-tropical, broad leaf forests and at middle elevation. They are also found in cultivated areas with fringe forests. At places its range of distribution overlaps with *Macaca mulatta*, *M. arctoides*, *M. nemestrina* and *M. thibetana*.

ECOLOGY OF THE STUDY AREA

Darjeeling district lies at the northern part of West Bengal, extending from 26°33' to 27°13' N latitude and between 88°2' and 88°56' E longitude with a geographical area of 3148 sq. km. The major part of the district is in the eastern Himalaya, having the area extending over an elevation of about 200 m at Reang in the Teesta valley to nearly 3800 m elevation near Sandakphu and Phalut.

The climate varies considerably due to altitudinal variation. The mean maximum and minimum temperature during winter are 08.3°C and 1.6°C respectively, while the mean maximum and minimum temperature during summer are 18.9°C and 4.5°C respectively. The district also gets snow in winter. The monsoon extends from the month of June to September and the rainfall is heavy with an average rainfall of about 2812 mm. The major crops are rice, wheat, maize and tea. The district is well connected with other parts of the state by road and rail. The main rivers are Teesta and Mahanada.

The forests are of mixed type from riverine to Oak-Hemlock forests. The vegetation cover of the district is about 46.28% of which 29.63% dense covese, 11.8% open forest and rest are plantations. The configuration of the mountains and winds from the south greatly influence the characters of the vegetation from place to place. In the lower hill forests, Sal (*Shorea robusta*) is the dominant tree with its principal associates being *Schima wallachii*, *Terminalia belerica*, *Terminalia crenulata*, *Sterculia villosa*, *Pinus longifolia*, *Amoora rohituka*, *Michelia campaca* etc. On the upper ridges *Cryptomeria japonica* is the predominant tree with other species like *Michelia excelsa*, *Buchlandia* sp., *Acer campbellii*, *Castnopsis hystrix*, *Alnus nepalensis*, *Michilus gamaniieana*, *Tsuga brunonians*, *Betula utilis* and *Rhododendron* sp.

METHODS

The survey was conducted on roadside and on the forested areas. Three to four observers were involved in the survey. The forest roads and trails were surveyed both on foot and on vehicle. Transect and point methods were applied to locate the monkeys. The transect method in the forest road was accomplished by slowly walking and waiting for 5-6 minutes every 200 m for visual and auditory signals of the presence of monkeys. The point method was adopted at many places of the study area where the range of elevation was 150-400 m. The surveys conducted mainly in the forenoon (0700 to 1100 hr) and afternoon (1500 to 1730 hr) in summer and during the whole day in winter. A total of 220 hours was spent for census work and all the groups were rechecked and the hours logged on recheck was not mentioned here. The groups once located; their social structure, habitat, inter and intra group interaction were recorded. The individuals of a group were classified as adult males, adult females, juveniles and infants. One year of less than three years old individuals were classified as juveniles and individuals carried by their mothers, preweaned and less than one year old were regarded as infants.

RESULTS

Nearly 543-km road was surveyed, including forest road and foot trails, and 42 groups of Assamese macaque were recorded. Areas surveyed and the distributions of monkeys are shown in

Fig. 1. The distribution and social composition are given in Table 1. The 42 groups contained a total of 574 monkeys with an average group size of 13.6 individuals of which 2.3 were adult males, 6.3 adult females, 2.8 juveniles and 2.2 infants. The group size varied from 2 to 43 individuals. Out of 574 monkeys the percentage compositions were 16.6% adult males, 46.3% adult females, 20.7% juveniles and 16.4% infants (Table 2). Assamese macaque in Darjeeling had more juveniles than infants in the population. Ratio of adult male to adult female was 1 : 2.8 and adult female to infant was 1 : 0.35, the ratio of females to combined population of juveniles and infants was 1 : 0.8.

The Darjeeling district has four sub-divisions. The Siliguri sub-division was devoid of Assamese macaque and was replaced by rhesus macaques. The other three sub-divisions viz. Kurseong, Kalimpong and Darjeeling contained the entire population of Assamese macaque.

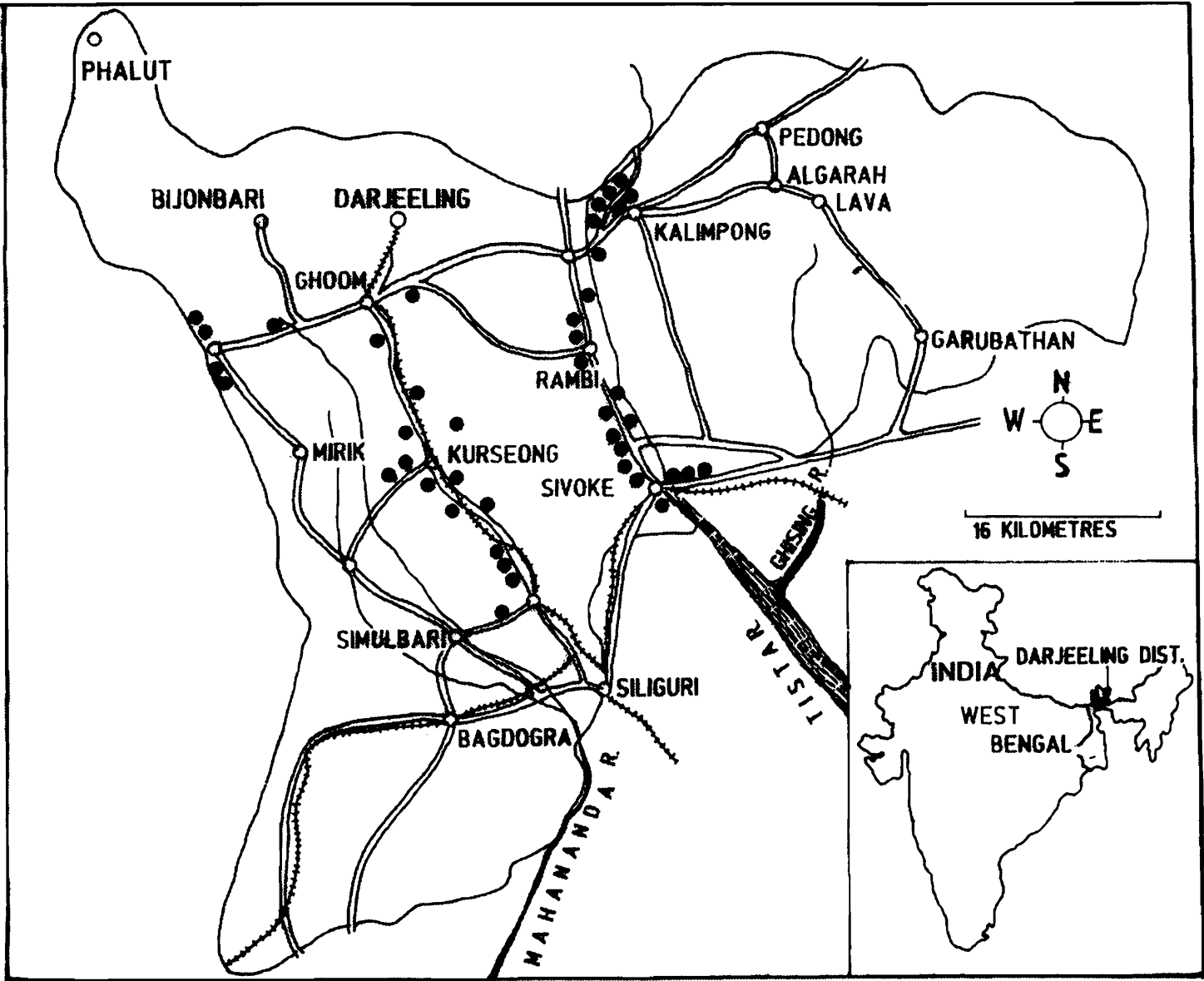


Fig. 1. : Distribution of Assamese macaque in Darjeeling district.

Table 1. Group size and composition of Assamese macaque at Darjeeling district.

Sl. No.	Location	Total Male	Adult Female	Adult	Juvenile	Infant
1	(Kurseong sub-division) 4 km north of Sukna to Rongtong	3	1	1	1	—
2	17 km milestone, 7.5 km north of Sukna to Tindharia	16	2	6	4	4
3	8.5 km north of Sukna	9	2	4	2	1
4	Mahanadi	43	6	19	8	10
5	Lakshmi Jhora, 2.5 km south of Mahanandi	10	1	4	2	3
6	Upper Paglajhora	23	3	10	7	3
7	1 km north of Kurseong	13	2	6	4	1
8	Dow Hill	24	4	12	6	2
9	3 km south of Makaibari T. Estate	5	1	2	2	—
10	Sepahijhora	12	1	6	3	2
11	Near Tung	2	1	1	—	—
12	Dhudhuwa, 2 km from Simulbari	7	1	4	1	1
13	(Kalimpong sub-division) Sevoke	6	1	2	2	1
14	Sevoke	9	2	5	1	1
15	1 km from Rly. Stn. on Sevoke	13	2	6	3	2
16	1 km from Sevoke to Bagrakote	20	3	10	5	2
17	2 km from Sevoke to Bagrakote	3	1	2	—	—
18	9 km north of Sevoke	19	3	8	5	3
19	29th Mile	7	2	2	2	1
20	Jeil Khola	5	1	3	1	—
21	2 km south of Melli, Kurseong beat	25	4	11	6	4
22	Chitrey	32	5	16	8	3
23	2 km from Chitrey to Melli	22	4	11	5	2
24	5 km from Chitrey to Kalimpong	15	3	7	2	3

Table 1. *Cont'd.*

25	Long Depot, Melli	26	4	10	7	5
26	1 km from Chitrey to Melli	8	2	3	1	2
27	Reang (Tarjon Jhora)	16	3	7	3	3
28	2 km south of Lohapul	17	2	8	3	4
29	Hanuman Jhora	3	1	1	–	1
30	2.5 km south of Berrik	16	2	7	2	5
31	Sweti Jhora	8	2	4	1	1
32	Andhrei Jhora	22	4	10	3	5
33	Tasading Beat, 2 km from Chitrey to Kalimpong	2	1	1	–	–
34	27th Mile, Reang to Sevoke	12	2	5	3	2
35	Reang, 7 km north of Reang to Teesata	14	2	7	2	3
36	(Darjeeling sub-division) Simkuna 3rd Mile on Jore Bungalow-Teesta Road, 5 km from Jore Bungalow to Teesta	14	2	8	2	2
37	3 km from Sukhia to Ghoom	10	2	5	1	2
38	2 km from Sukhia to Ghoom Manbhanmgyang road	2	1	1	–	–
39	Parmaiguri, between Khasmahal and FRH	19	3	9	3	4
40	Hima Falls	9	1	6	2	–
41	3.5 km from Ghoom Bhangyang to Bijonbari	11	2	5	2	2
42	6 km from Ghoom Bhangyang to Bijonbari	22	3	11	4	4
	Total	574	95	266	119	94
	Mean	13.6 + 1.38	2.3 + 0.2	6.3 + 0.6	2.8 + 0.3	2.2 + 0.2
	Percentage composition	–	16.6	46.3	20.7	16.4

The number of groups and their composition in the different sub-divisions are shown in Table 2. The other species, viz., rhesus macaque occupied the lower elevation except two groups, one observed at Darjeeling town and other near Ghoom. The two groups now harbouring in Darjeeling and Ghoom might be translocated a few rhesus monkeys by the truck drivers or by road labourers moreover these two areas no assamese monkey was recorded. The Assamese macaque harbours at the higher altitude in the mixed forests of Sukna, Tindharia to Tung, Ghoom to Bijonbari, Sevoke to Teesta, Teesta to Melli on Kalimpong road. We failed to locate any assamese monkey in Takdah and Tarkhola during the survey as reported by Khajuria (1962).

A total of 167 monkeys in 12 groups were found in Kurseong sub-division, of which 25 were adult males, 75 were adult females, 40 were juveniles, and 27 were infants (Table 3). The group size varied from 3 to 43. The average group size was 13.9 individuals. The adult female proportion in the population was three times more than the males. The ratio of female to infant was 1 : 0.36.

Table 2. : Population composition of Assamese macaque and incidence of monkeys in the three Sub-divisions of Darjeeling district.

Sub-division	km. surveyed	No. of groups	Km. per group	No. of monkeys (sample size)	Average group size	Adult Male	Adult Female	%	Sub-adult Juvenile	% Infant
Kurseong	167	12	13.91	167	13.9	14.97	44.91		23.95	16.16
Kalimpong	214	23	9.30	320	13.9	17.50	45.62		20.31	16.56
Darjeeling	162	7	23.14	87	12.4	16.09	51.72		16.09	16.09
Total	543	42	12.92	574	13.6	16.60	46.30		20.70	16.40

Table 3. : Number of groups, composition and percentage variation of Assamese macaque in different sub-divisions.

Sub-division	No. of groups	Total number	Adult males	Adult female	Juvenile	Infant
Kurseong	12	167 (29.1%)	25 (4.35%)	75 (13.1%)	40 (6.96%)	27 (4.7%)
Kalimpong	23	320 (55.75%)	56 (9.75%)	146 (25.43%)	65 (11.32%)	53 (9.23%)
Darjeeling	7	87 (15.15%)	14 (2.44%)	45 (7.84%)	14 (2.44%)	14 (2.44%)
Total	42	574 (100%)	95 (16.54%)	266 (46.37%)	119 (20.72%)	94 (16.37%)

In 167 km road surveyed an equal numbers of monkeys were recorded at Kurseong sub-division with 1 group in each 5.5 sp.km. and 1 monkey per linear km.

In Kalimpong sub-division 214 km road was surveyed which revealed the presence of 320 monkeys in 23 groups consisting of 56 adult males, 146 adult females, 65 juveniles and 53 infants. The group size varied from 2 to 32 monkeys with an average group size of 13.91. The percentage composition was 17.5% adult males, 45.62% adult females, 20.3% juveniles and 16.56% infants. The ratio of adult male to adult female was 1 : 2.6 and adult female and infants and juveniles were 1 : 0.36 and 1 : 0.44 respectively. The distribution of this species in the sub-division was recorded 1 group in every 3.72 sq.km. and 1.5 monkey per linear km.

In Darjeeling sub-division 87 monkeys were recorded in 7 groups at a stretch of 162 km road. These composed of 14 members in each category of adult males, juveniles and infants and the rest 45 were adult females (Table 3), with the average group size of 12.42 monkeys. The adult females in the population was 51.72% and the adult males juveniles and infants were 16.09% each. The adult male to adult female ratio was 1 : 3.21 and adult female to juvenile and infant ratio was 1 : 0.31.

The analysis of data regarding the percentage distribution of different members in each sub-division is presented in Table 3. The data revealed that the number of adult females dominate over-other categories in each group. The adult females were nearly three times the number of adult males and the infants were less than the juveniles. The infants were minimum in number in each sub-division., and the group size varied from 15.15% to 55.75%.

The sex ratio varied from 2.60 to 3.20 between adult males to adult females with a mean of 2.9 (Table 4). The ratio of infants to adult varied from 0.23 to 0.27 with a mean of 0.25 and the proportion of juveniles to adults were from 0.23 to 0.40 with a mean of 0.32.

Table 4. : Sex ratio and proportion of infants and juveniles to adults as also juvenile and infants.

Sub-divisions	Adult male/ Adults females	Infants/Adults	Juveniles/Adults	Juveniles/Infants
Kurseong	3.0	0.27	0.40	0.67
Kalimpong	2.60	0.26	0.32	0.81
Darjeeling	3.21	0.23	0.23	1.0
Mean	2.9	0.25	0.32	0.82

DISCUSSION

The present survey revealed that the Assamese mecaque distributed from 600 m to 2120 m. Mukherjee *et al* (1995) recorded 156 monkeys in 12 groups with an average group size of 13 individuals. Tiwari and Mukherjee (1992) in 1978 census sighted 156 individuals of Assamese macaque from the district. The present study revealed that the population of this species has increased considerably over a period of 15 years but the average group size remains almost the same. Mukherjee (1985) recorded the largest group size was 21 individuals with majority of the groups varied from 11 to 13 monkeys. During the present census, out of 42 groups, 16 groups contained less than 10 monkeys and the largest group was with 43 individuals. The rhesus monkey (*Macaca mulatta*), which was also recorded from the district, but confined in lower elevation from 150 m to 500 m, only 2 groups were noticed at the higher altitude. The Assamese macaque and rhesus macaque both inhabit in lower elevation at Sevoke and adjacent areas but the home range of two species did not overlap.

The Assamese macaque inhabits mostly on the roadside at Darjeeling district (except in Siliguri sub-division). Mukherjee *et al* (1995) recorded an average of 1 group in every 36.42 sq.km in the study area, whereas during the present survey 1 Assamese macaque group was recorded in every 12.9 linear km and 2.6 monkey per sq.km. This indicates that the population of this species has increased at Darjeeling district. Though the monkeys invade the terrace cultivation and vegetable gardens but there is no report of killing. The Nepali people constitute the 90% of the population at Darjeeling and they are more tolerant to monkeys and this may be one of the reason for the viable population in this region.

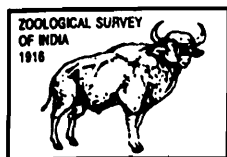
SUMMARY

The Assamese macaque is one of two monkeys species found only in this hilly district of West Bengal. The present data based on the survey conducted during summer and winter months of 1997 at an altitude of 160 m to 2123 m. A total of 42 bisexual groups were located on the roadside and in the forested areas. The 42 groups contained 574 monkeys with an average of 5 monkeys per sq. km. distributed in the district excluding sub-division of Siliguri. The population consisted of 16.6% adult males, 46.3% adult females, 20.7% juveniles and 16.4% infants.

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AN ILLUSTRATED KEY TO THE IDENTIFICATION OF SCORPIONS (SCORPIONIDA : ARACHNIDA) OF KERALA AND NOTES ON SOME INTERESTING NEW RECORDS

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INTRODUCTION

Scorpions are venomous terrestrial arachnids placed under the order Scorpionida. They represent one of the oldest arthropod groups that underwent very little changes during the course of evolution. They are notorious for their poisonous sting, though venom of only a few species is lethal to man. Scorpions are found all over the world except in some cold northern countries and are common in tropical and subtropical areas. Their diversity is more in desert regions of the world. They are strictly nocturnal in habits and hide under stones, barks, thin crevices and burrows and occasionally in dark corners of houses. Scorpions are restricted to carnivorous food habits and feeding mainly on soft-bodied insects.

Pocock (1900) provided a comprehensive account on the scorpion fauna of British India including Sri Lanka and Myanmar. Later, Tikader and Bastawade (1983) updated the knowledge of Indian scorpions by providing detailed taxonomic account of 99 species belonging to 18 genera under 5 families viz. Buthidae, Charilidae, Scorpionsidae, Ischnuridae and Scorpionidae. They also provided information on the origin, habits, habitats, as well as the reproductive and feeding behaviors of scorpions. Three new species were later added to the Indian fauna (Bastawade, 1986a,b, 1992) and currently there are 102 species of scorpions known from India.

The scorpion fauna of Kerala is poorly known. According to Tikader and Bastawade (1983) and Indra (2001) 15 species of scorpions under 7 genera and three families (Buthidae, Ischnuridae and Scorpionidae) are known from Kerala. Based upon the study of the scorpion collections in Zoological Survey of India, Calicut, two interesting records of scorpion species from Kerala are provided here. The species *Chiromachetes fergusoni* Pocock is being reported here again, from

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Kerala, after its original description in 1899 and *Heterometrus* (*Chersonesometrus*) *kanaraensis* (Pocock) for the first time from the state. As an aid to the identification of the 16 scorpion species presently known from Kerala an illustrated key is also prepared.

KEY TO THE SCORPION SPECIES REPORTED FROM KERALA

Key to families

1. Legs furnished with two pedal spurs (Fig. 1); trichobothrial pattern 'A' type (Figs. 3, 4 showing manus and immovable finger of pedipalp); pedipalps with slender hands and chelae comparatively narrow (Figs. 15, 24, 26, 36); pectines generally long and provided with numerous teeth; cephalothoracic sternum triangular and narrowed in front (Figs. 17, 21, 31). Family BUTHIDAE 3
 - Legs furnished with single pedal spur (Fig. 2); trichobothrial pattern 'C' type (Figs. 7, 8); pedipalps with hands not slender and chelae not narrow; pectines short and number of teeth not numerous; sternum pentagonal 2
2. Hands of pedipalp flat (Figs. 38, 41, 46); Tail weak and compressed, telson small with shorter weak aculeus; tarsomere II without ventral spines and lateral distal margins truncate, forming almost a right angle with the base of the claw-lobe and not overlapping the claws on sides (Fig. 9); cutting edges of fingers of chela evenly granular, dentate and not produced into sharp triangular teeth; manus and fingers with strong and complete carina; movable and immovable fingers of chelicera smooth without teeth on ventral surface. Family : ISCHNURIDAE 8
 - Hands of pedipalp not flat; tail powerful and not compressed, telson strong; tarsomere II with short spines on ventral surface, lateral distal margins produced into a rounded lobe, overlapping the base of claw and forming a very acute angle with base of the claw lobe (Fig. 10); cutting edges of fingers of chela armed with strong triangular pointed teeth; manus and fingers with carina not strong and complete, chelicera with three teeth on dorsal fang of movable finger. Family SCORPIONIDAE 11

Famly BUTHIDAE

Key to Subfamilies, genera, subgenera and species

3. III and IV pair of legs always furnished with a tibial spur. Subfamily BUTHINAE 4
 - III and IV pair of legs without tibial spur. Sub family CENTRURINAE (Only one genus known from Kerala : *Isometrus* Hempr. & Ehrenb : Mesosomal tergites monocarinated; interior space of cheliceral fixed finger with one tooth; sternum small, triangular; caudal region slender; vesicle with a strong triangular sub aculear spine at the base of aculeus; tarsomere I not depressed and fringed with setae; trichobothria *d1*, *d3* and *d4* on femur forming β angle (Fig. 37) 7

- 4. Immovable finger of chelicerae furnished below with one minute tooth (Fig. 12); carapace with weak posterior median or lateral carinae (Fig. 13); mesosomal tergites with two or three carinae; cephalothoracic sternum triangular and longer than wide (Fig. 17, 21); metasomal tergites carinated and vesicle elongated with a conspicuous triangular sub aculear spine below the vesicle (Fig. 14); dentition on fingers of pedipalp non imbricated (Fig. 16); trichobothria *d1*, *d3*, and *d4* on femur form β angle (Fig. 20). Genus *Lychas* Koch 5
- Immovable finger of chelicerae always furnished below with two minute teeth (Fig. 11); carapace not carinated; mesosomal tergites monocarinated (Fig. 28); cephalothoracic sternum small, pentagonal and wider than long (Fig. 31); metasomal tergites weakly carinated and vesicle small and round without sub aculear spine (Fig. 29); granular rows of teeth on pedipalp fingers imbricated (Fig. 27); trichobothria *d1*, *d3*, and *d4* on femur form α angle (Fig. 30). Genus *Charmus* Karsch (Only one species known from Kerala : *Charmus indicus* Hirst. : Entire surface of carapace and mesosomal tergites weakly but less sparsely granular on lateral portion; colour dark black (Fig. 26); tergites I–VI with a pair of conspicuous >>–<< shaped yellow marks; pectines 4 times longer than wide; teeth number 17/17. metasomal segment IV short; anal rim smooth).
- 5. Trichobothria *db* is proximal to *et* only (on immovable finger of pedipalp) (Fig. 18). Subgenus *Alterotrichus* (Only on species known from Kerala : *Lychas (Alterotrichus) hendersoni* Pocock : Colour very dark brownish black (Fig. 15); posterior central carinae on carapace weakly developed; pedipalp slender with longer fingers; outer row of teeth on movable finger do not have unpaired teeth; pectines 4 times longer than wide; pectinal teeth, tubular, 17/18 in number, never above 20 (Fig. 17); sternum small, triangular with a median longitudinal depression; metasoma with telson shorter than segment V; aculeus long, slightly shorter than vesicular length, not much curved, sharp and dark on distal portion. (Fig. 14).
- Trichobothria *db* is proximal to *et* and *est* (Fig. 23). sub genus *Endotrichus* 6
- 6. Colour brownish, variegated with yellow patches; entire surface of carapace weakly granular; anterior margin smooth, slightly invaginated; pedipalp slender, blackish brown in colour except yellow manus (Fig. 24); femur as long as carapace, carinae weakly developed; pectines 4 times longer than wide, pectinal teeth 21/21 in number; genital operculum sclerites weak, not pointed on latero median portion (Fig. 25); mesosomal tergites II–IV with one carina; *eb* and *esb* placed at distal from the base of the immovable finger (Fig. 23)
.....*Lychas (Endotrichus) albimanus* Henderson
- Colour brownish yellow; entire surface of carapace coarsely granular; anterior margin crenulated, weakly invaginated; pedipalp different; femur shorter than carapace and carinated; pectines 5 times longer than wide, pectinal teeth 23/23 in number; genital operculum with two sclerites pointed on latero median portion, united in the middle (Fig. 21); mesosomal tergites II–IV with three carinae; *eb* and *esb* placed closer to the base of the immovable finger (Fig. 22) *Lychas (Endotrichus) tricarinatus* Simon

Subfamily CENTRURINAE

Key to subgenera and species

7. *Trichobothria db* placed always proximal to *et* but distal to *est* (Fig. 34); vesicle is not much bulbous. Sub genus *Reddyanus* (Only one species known from Kerala : *Isometrus (Reddyanus) brachycentrus* Pocock : Metasoma 6x as long as carapace; sub aculear spine provided with three pairs of small denticulate granules on inner margin (Fig. 32) ; manus of pedipalp granular and strongly carinated (Fig. 33); (medium size, colour dark brown, dark black in metasoma).
- *Trichobothria db* placed always distal to *et* (Fig. 35); vesicle is more bulbous. Subgenus *Closotrichus* (Only one species known from Kerala : *Isometrus (Closotrichus) sankeriensis* Tikader & Bastawade : Delicate slender white scorpions (Fig. 36); body variegated with black to brown bands and spots; pedipalp slender long, variegated with dark colour; manus with both fingers longer than carapace; vesicle globular, elongate as wide as caudal segment V; aculeus normally curved, sharp, pointed with setations.

Family ISHNURIDAE

Key to Genera, Subgenera, species and sub species

8. Tarsomere II furnished on ventral surface with few delicate spicules on sides and few small median spicules only on proximal portion. Genus *Chiromachetes* Pocock : (Median eye situated anteriorly in the ratio 1 : 2; three lateral eyes, anterior two separated by a very narrow space from the edge but posterior practically in the edge; dentition on fingers of pedipalp of two rows of small granules) (Only one species known from Kerala; *Chiromachetes fergusonii* Pocock : Carapace entirely smooth and finely punctured; anterior margin with deep medial notch (Fig. 38); all tergites smooth and finely punctured; metasomal segments thin and smooth; pedipalp very strong (Fig. 39) with long femur and manus, fingers scalloped at the base; sternum pentagonal, pectines weakly developed with few teeth (Fig. 40))
- Tarsomere II furnished on ventral surface with few long slender bristles on sides and a median row of small spinules or median portion smooth 9
9. Tarsomere II of legs with a median row of spicules on ventral surface; genital operculum narrowed posteriorly and without a median suture in female (Fig. 43); posterior lateral eye above the margin of the carapace (Fig. 44). Genus *Liocheles* Simon : Only one species *Liocheles laeviceps* known from Kerala (Two trichobothria, *dsb* and *dst* present on dorsal surface of immovable finger of manus (Fig. 45) ; trichobothria *esb1* and *esb 2* and *em1* and *em2* on patella placed closer to each other and in the same plane. trichobothria *est 1* placed distal to *est 2* and *est3* on patella (Fig. 42); trichobothria *Est* on manus placed less distally to *Dt* (Fig. 48) (Two sub species known under the species from Kerala 10

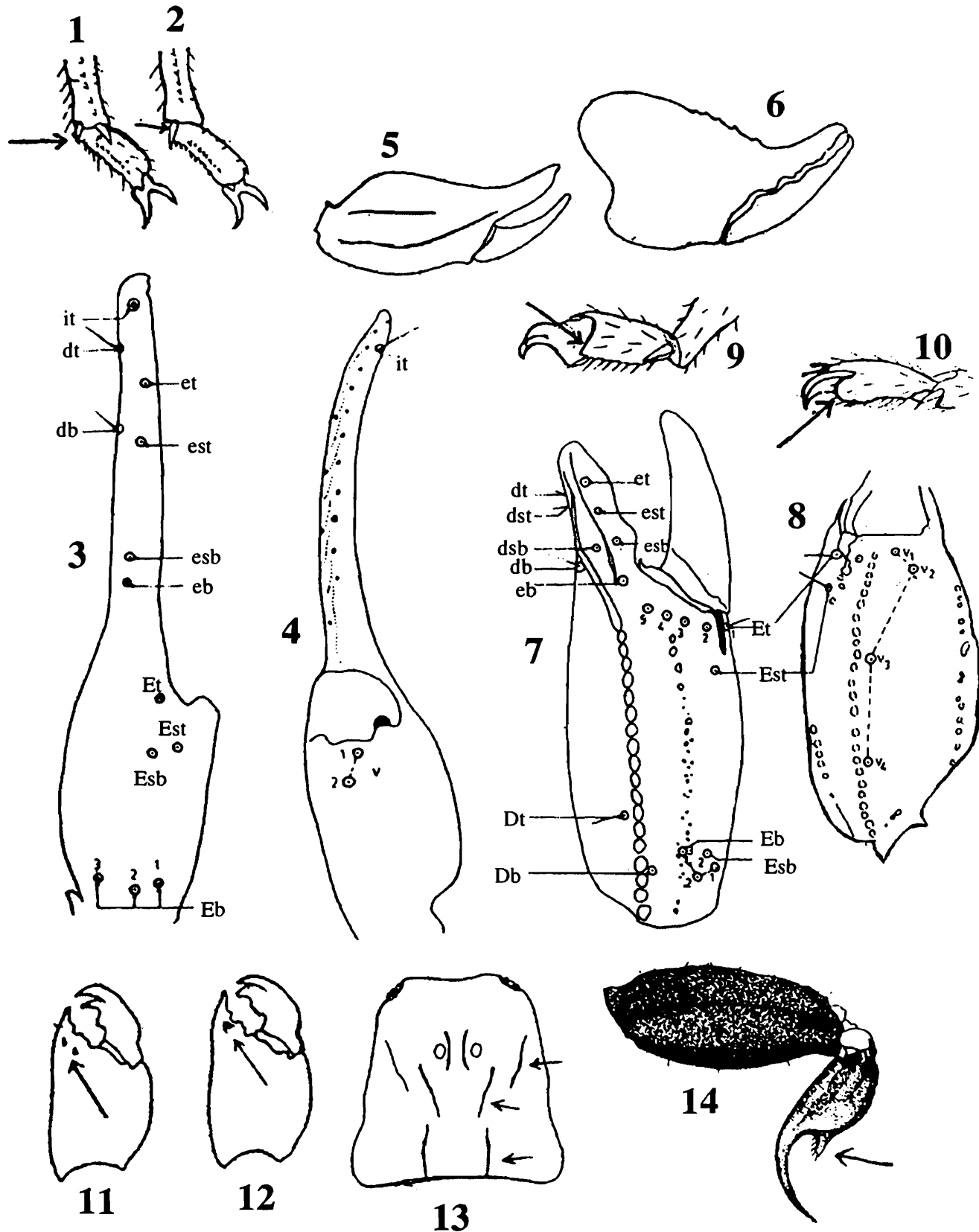
- Tarsomere II without a median row of spicules on ventral surface; genital operculum not narrowed posteriorly and with a median suture in female (Fig. 50). Genus *Hormurus* Thorell (only one species *Hormurus australasiae* (Fabr.) reported from Kerala : Carinae on patella and manus distinct and granular (Fig. 51); anterior or inner surface of patella armed with a strong tuberculate denticle (Fig. 49); trichobothria *Est* on manus placed not much distally to *Dt*; trichobothria *dt* on immovable finger of pedipalp placed closer to *it* (Fig. 53); single inferior median and inferior lateral carinae on metasomal segment regularly crenulate).
- 10. Carinae on patella of pedipalp smooth and obsolete; the trichobothria on patella in the group *eb1–5* placed more closer (Fig. 42) *Liocheles (laeviceps) laeviceps* (Pocock)
- Carinae on patella of pedipalp distinct and weakly crenulated, the trichobothria on patella in the group *eb 1–5* placed more sparsely (Fig. 47)
..... *Liocheles (laeviceps) malabarensis* (Pocock)

Family SCORPIONIDAE

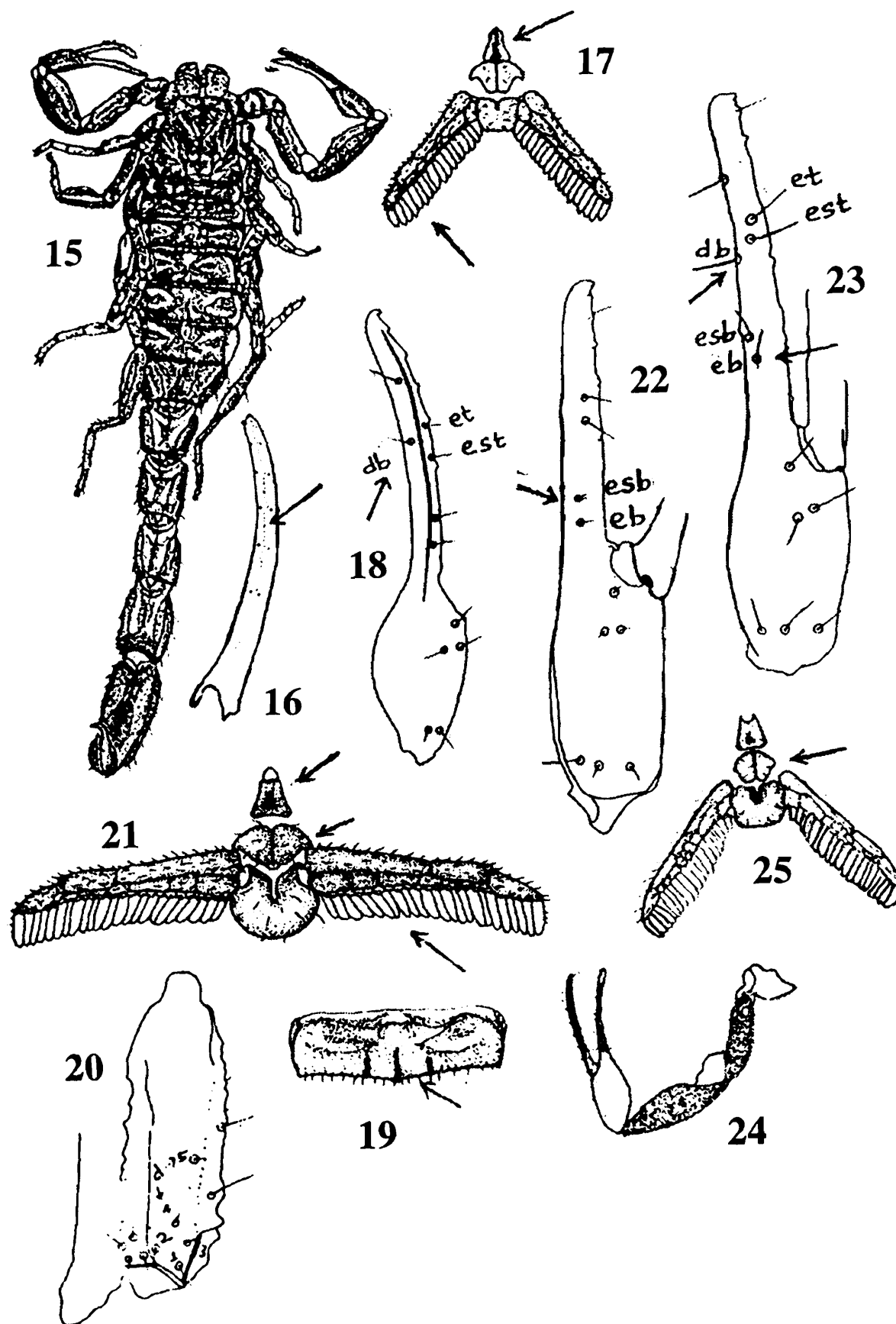
Key to Subgenera and species

- 11. (Only one subfamily Scorpioninae and one genus *Heterometrus* Hemp. & Ehrenb. : Anterior margin of carapace deeply notched in the middle portion; tarsomere II furnished with two rows of stout spines on ventral portion. A stridulatory organ situated between the chela and first leg; ventral surface of patella of pedipalp furnished only with three trichobothria (Fig. 60)
- Rostrolateral margin of carapace with distinct incision next to the posterior lateral eyes; manus of pedipalp longer than wide (Fig. 54) (except species *malapuramensis*) smooth or very poorly granulate on dorsal surface; superciliary crest present, (Subgenus *Heterometrus*) 12
- Rostrolateral margin of carapace continuous, without incision next to the posterior lateral eyes; manus of pedipalp wider than long or as long as wide, granular and carinated on dorsal surface. Superciliary crest may or may not be present 13
- 12. Manus of pedipalp distinctly longer than wide (Fig. 54); patella of pedipalp shorter than femur; metasomal segment V narrowed and almost straight on lateral portion (Fig. 55); femur of pedipalp always longer than carapace; trichobothrial group including *esb*, *em* and *est* on patella placed sparsely (Fig. 57); middle portion of carapace almost smooth but weakly granular on lateral portion; all the lateral eyes are of same size (Fig. 56); pectinal teeth 19/19 *Heterometrus (Heterometrus) keralaensis* Tikader & Bastawade

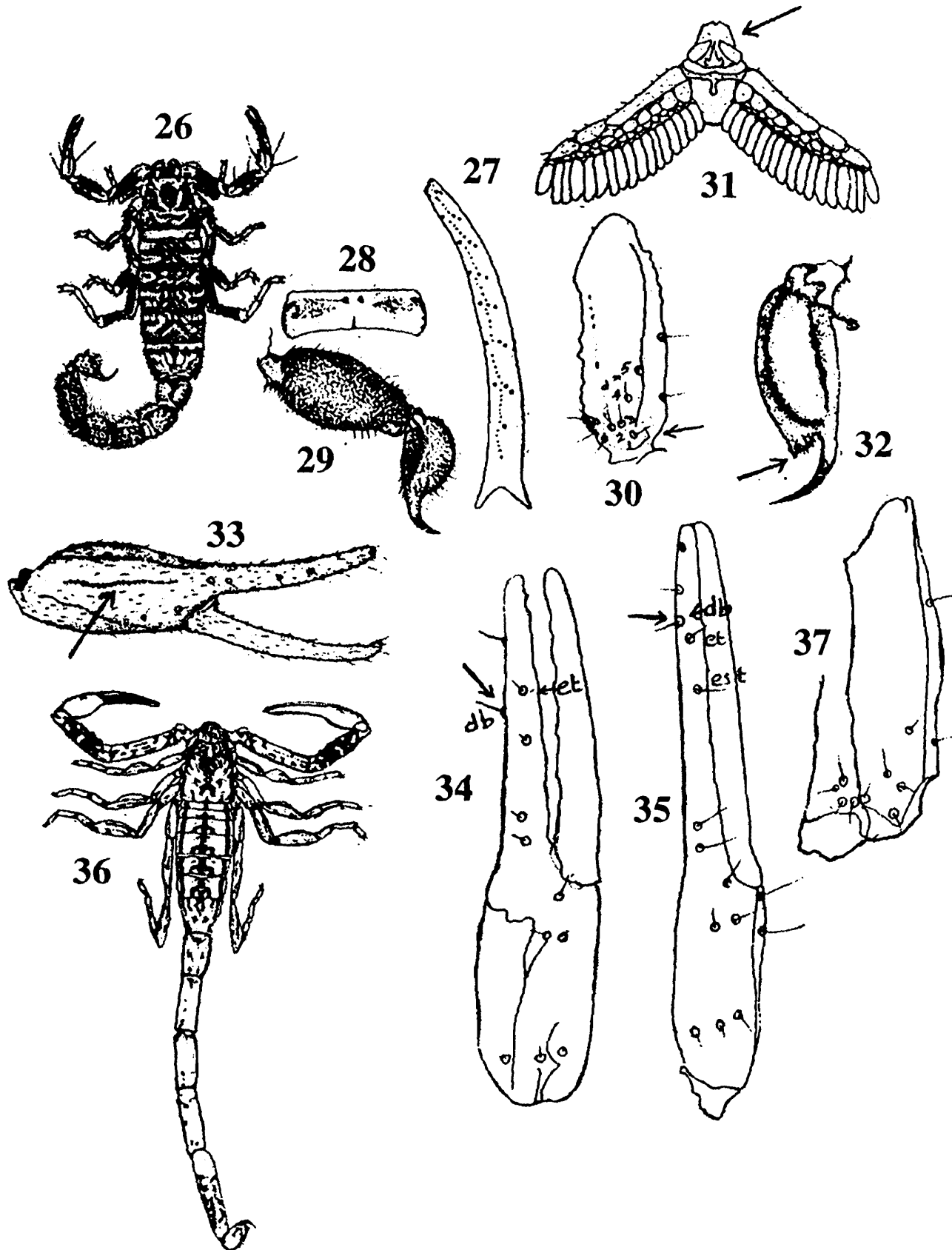
- Manus of pedipalp not distinctly longer than wide (Fig. 58); patella of pedipalp slightly longer than femur; metasomal segment V not much narrowed and lateral sides slightly convex and bulging (Fig. 59); femur of pedipalp always shorter than carapace; trichobothrial group including *esb*, *em* and *est* on patella placed closer to each other (Fig. 62); carapace and mesosomal tergites entirely coarsely granular; first and second lateral eyes larger than the third (Fig. 61); pectinal teeth 11/11 in number
..... *Heterometrus (Heterometrus) malapuramensis* Tikader & Bastawade
- 13. Superciliary crest on carapace almost absent; manus of pedipalp wider than long, almost thickly granular and sometimes with prominent carinae (Figs. 63, 64); immovable finger of pedipalp with smooth distinct carina. Sub genus *Srilankametrus* Only one species known from Kerala : *Heterometrus (Srilankametrus) gravimanus* (Pocock) : Manus of pedipalp fully granular on dorsal surface but granules smooth and obsolete, distal carina distinct but weakly granular and granules not separated, continued on immovable finger; trichobothria V3 and V4 placed closer on manus (Fig. 66); trichobothria *em2* placed distal to *em1* on patella (Fig. 65)
 - Superciliary crest on carapace present; manus of pedipalp as long as wide or wider than long and carinated (Figs. 67, 69, 72), granular and sometimes granular carinae distinct or smooth, short ridges also present; immovable finger of pedipalp with or without carina. Subgenus *Chersonesometrus* (the ratio of ventral length as to maximum width of manus of pedipalp is 0.8–1.00) granulated and carinated on dorsal surface; superciliary crest present, but granular only on anterior portion; the ratio of total length of metasomal segments I–V as to the length of only metasomal segment V is 3.3–3.6) 14
- 14. Dorsal surface of manus entirely coarsely granular (Fig 67); pattella of pedipalp as long as femur; trichobothria V3 & V4 of manus placed away (Fig. 68)
..... *Heterometrus (Chersonesometrus) granulomanus* Couzijn
 - Dorsal surface of manus smooth or very weakly covered with short smooth mosaic ridges; pattella longer than femur; trichobothria V3 & V4 of manus placed closer (Fig. 74) 15
- 15. Femur of pedipalp always longer than carapace (Fig. 71) ; metasomal segments I & II longer than wide; pectinal teeth well developed, not much tapering, 9/9 in number in female and 11/11 in male (Fig. 73) *Heterometerus (Chersonesometrus) kanaraensis* (Pocock)
 - Femur of pedipalp shorter than carapace (Fig. 69) ; metasomal segments I & II wider than long; pectinal teeth weakly developed, much sparsely arranged, tapering on distal portion and 12/12 in number in female (fig. 70)
..... *Heterometerus (Chersonesometrus) scaber* (Thorell)



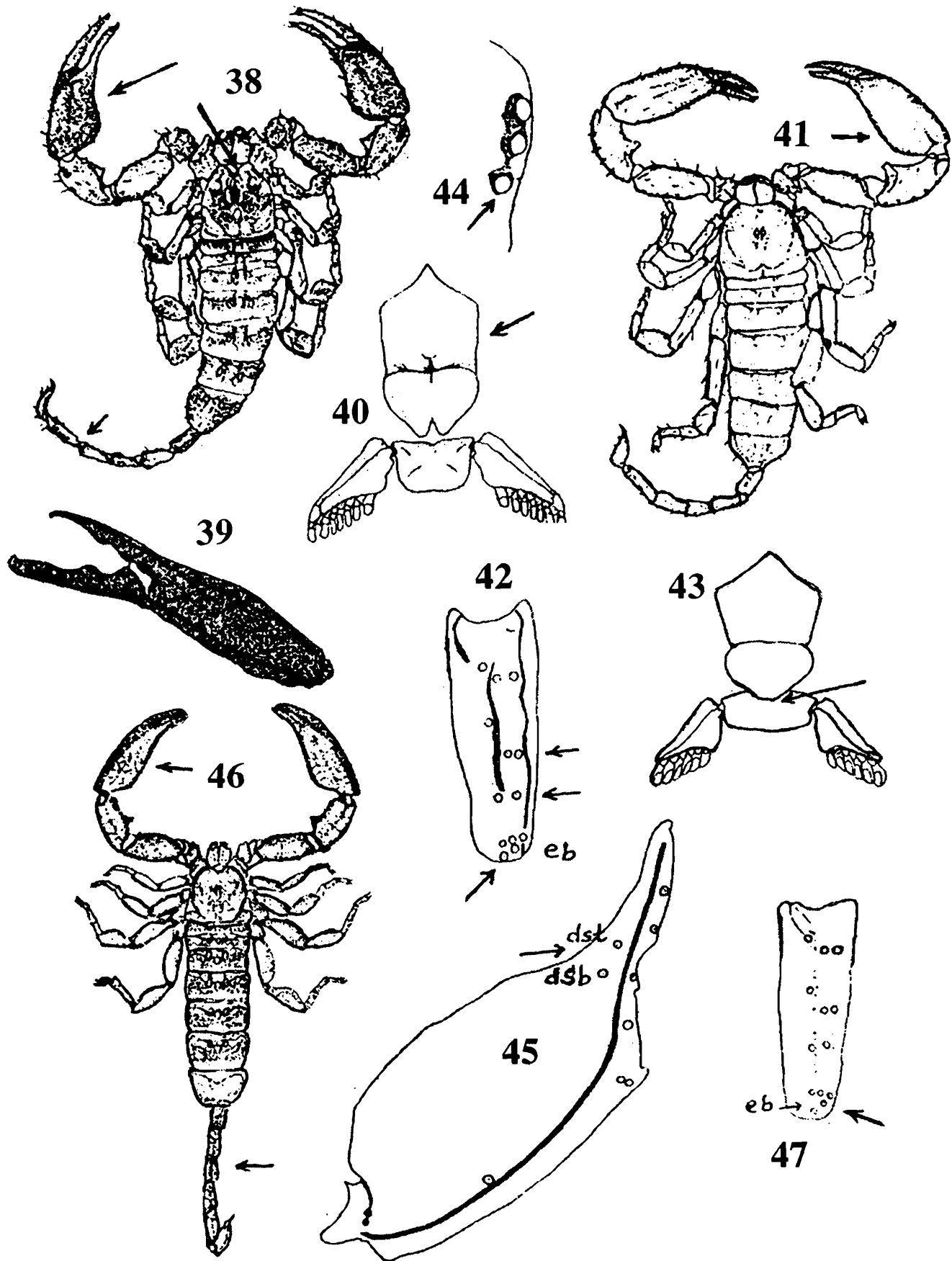
Figs. 1-14. Distal portion of tarsomere I. 1. with a pair of pedal spurs (family Buthidae); 2. with single pedal spur (families Ischnuridae and Scorpionidae). 3-4. Manus and immovable finger of pedipalp with 'A' type trichobothrial pattern (family Buthidae) 3. dorsal view; 4. ventral view. 5-6. Manus and hand of pedipalp : 5. flat, in Ischnuridae 6. not flat in Scorpionidae. 7-8. Manus and immovable finger of pedipalp with 'C' type trichobothrial pattern (families Ischnuridae and Scorpionidae) 7. dorsal view; 8. ventral view. 9-10. Lateral view of tarsomere II of leg : 9. family Ischnuridae, 10. family Scorpionidae. 11-12. Ventral view of chelicera : 11. with two teeth on immovable finger, 12. with single tooth on immovable finger. 13. Carapace of *Lychas* dorsal view 14. *Lychas* (*Alterotrichus*) *hendersoni* : Telson and anal rim of mesosomal segment V lateral view



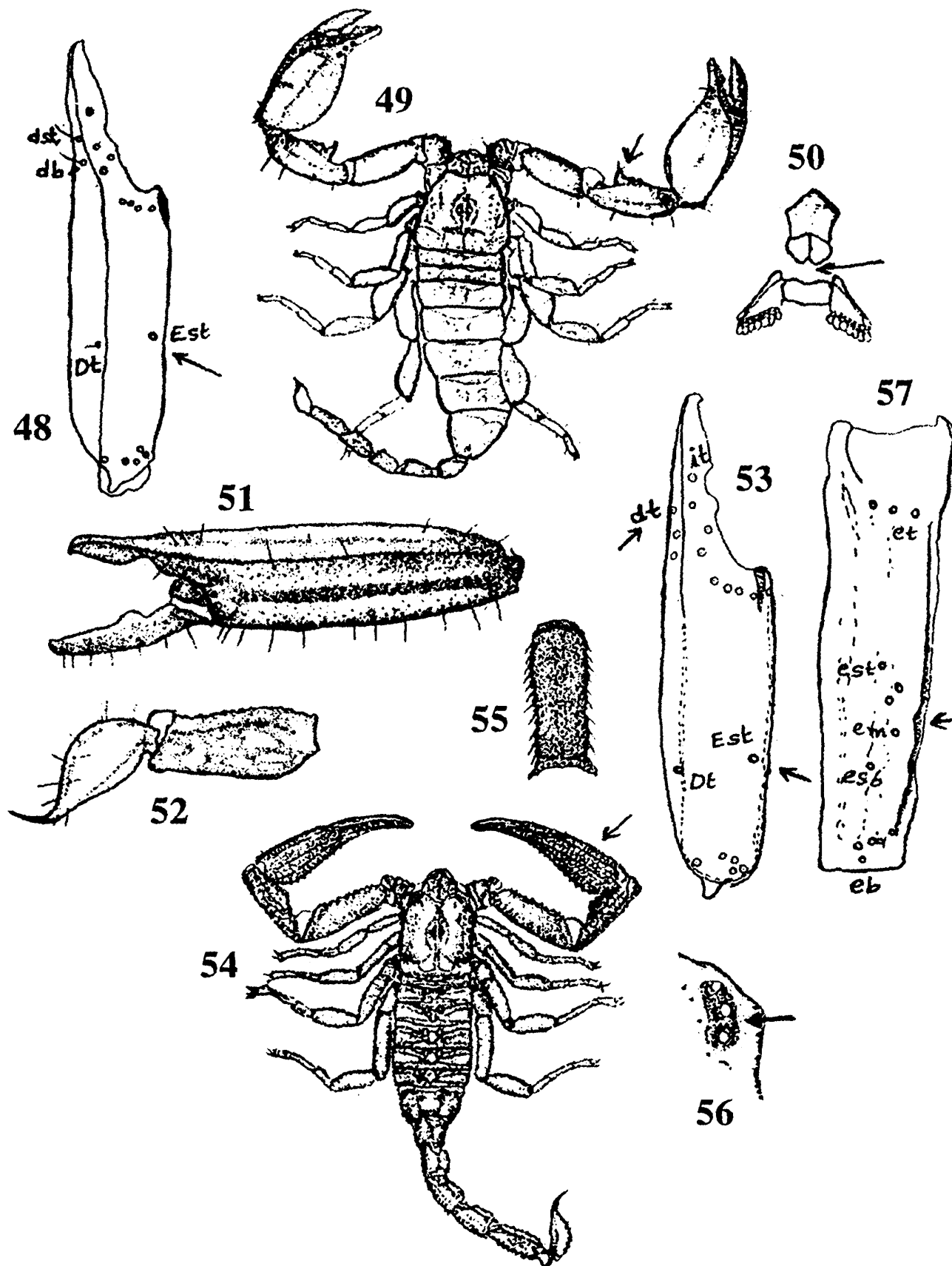
Figs. 15-25. *Lychas (Alterotrichus) hendersoni* female : 15. dorsal view; 16. movable finger of pedipalp dorsal view; 17. pectines, genital operculum and cephalothoracic sternum ventral view, 18. manus and immovable finger of pedipalp dorso-exterior view, showing trichobothria 19-22. *Lychas (Endotrichus) tricarinatus* female; 19. tergite dorsal view; 20. femur of pedipalp dorsal, interior and exterior views showing trichobothria; 21. pectines, genital operculum and sternum ventral view. 23-25. *Lychas (Endotrichus) albimanus* female : 23. manus and immovable finger of pedipalp dorsal view showing trichobothria; 24. pedipalp dorsal view; 25. pectines, genital operculum and sternum ventral view.



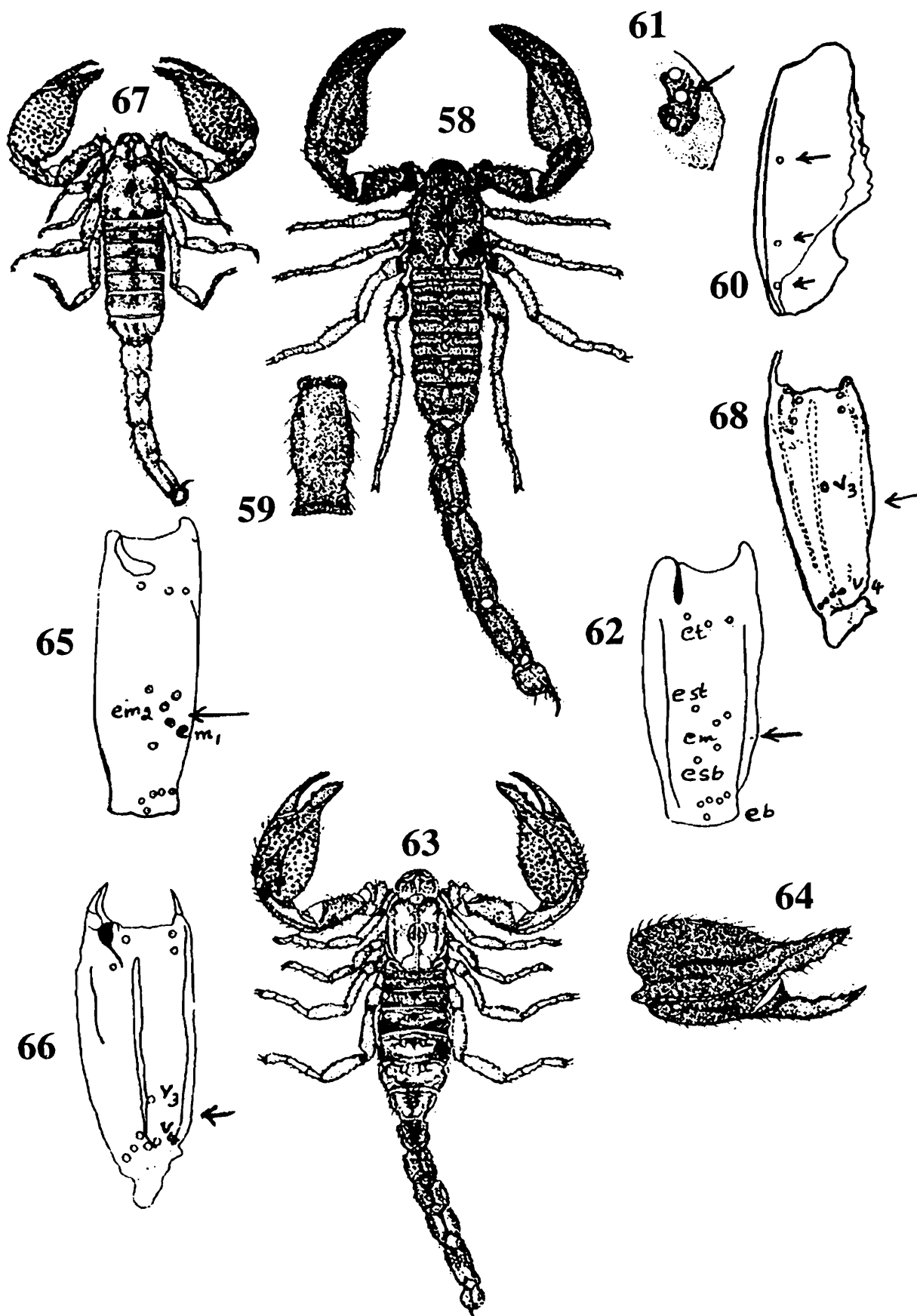
Figs. 26-37. *Charmus indicus* male : 26. dorsal view; 27. movable finger of pedipalp dorsal view; 28. tergite dorsal view; 29. telson and metasomal segment V lateral view; 30. femur of pedipalp dorsal, interior and exterior views showing trichobothria; 31. pectines, genital operculum and sternum, ventral view. 32-34. *Isometrus (Reddyanus) brachycentrus* female : 32. telson and anal rim of metasomal segment V lateral view; 33. manus and fingers of pedipalp exterior view; 34. manus and fingers of pedipalp exterior view showing trichobothria. 35-37. *Isometrus (Closotrichus) sankeriensis* female; 35. manus and fingers of pedipalp exterior view showing trichobothria; 36. body dorsal view; 37. femur of pedipalp dorsal, interior and exterior views showing trichobothria.



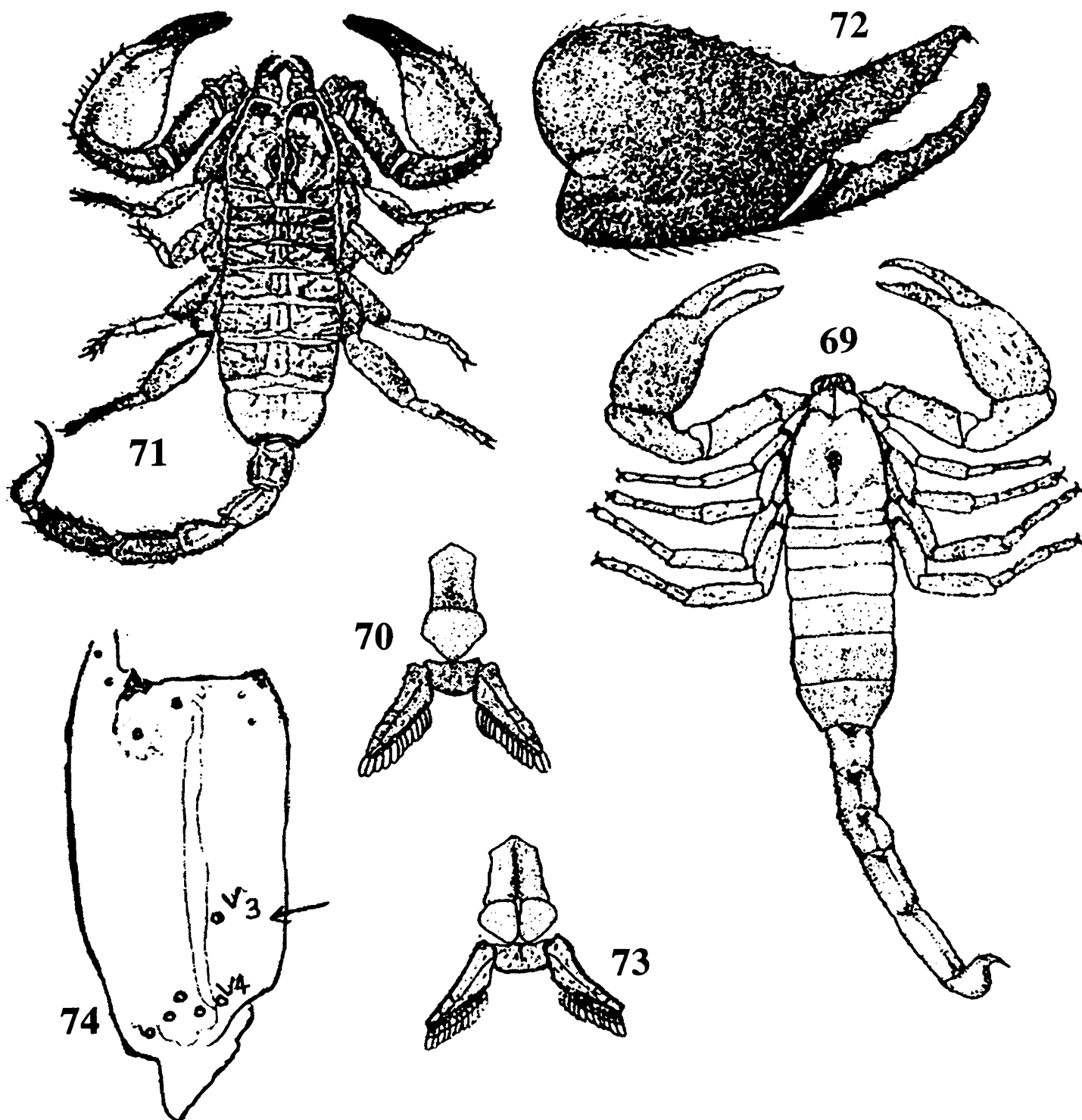
Figs. 38-47. *Chiromachetes fergusonii* female : 38. dorsal view; 39. manus and fingers exterior view; 40. pectines, genital operculum and sternum ventral view. 41-45. *Liacheles laeviceps laeviceps* female : 41. dorsal view; 42. patella of pedipalp exterior view showing trichobothria; 43. pectines, genital operculum and sternum ventral view; 44. lateral eyes lateral view; 45. manus and immovable finger of pedipalp dorsal view showing trichobothria. 46-47. *Liacheles laeviceps malabarensis* female : 46. dorsal view; 47. patella of pedipalp exterior view showing trichobothria.



Figs. 48-57. *Liacheles laeviceps malabarensis* female, manus and immovable finger of pedipalp exterior view. 49-53. *Hormurus australasiae* male : 49. dorsal view; 50. pectines, genital operculum and sternum ventral view; 51. manus and fingers exterior view; 52. telson and metasomal segment V lateral view; 53. manus and immovable finger of pedipalp exterior view showing trichobothria. 54-57. *Heterometrus (Heterometrus) keralaensis* male : 54. dorsal view; 55. metasomal segment V ventral view; 56. lateral eyes lateral view; 57. patella of pedipalp exterior view showing trichobothria.



Figs. 58-68. *Heterometrus (Heterometrus) malapuramensis* male : 58. dorsal view; 59. metasomal segment V ventral view; 60. patella of pedipalp ventral view showing trichobothria; 61. lateral eyes lateral view; 62. patella of pedipalp exterior view showing trichobothria. 63-66. *Heterometrus (Srilankametrus) gravimanus* male : 63. dorsal view; 64. manus and fingers exterior view; 65. patella of pedipalp exterior view showing trichobothria; 66. manus of pedipalp ventral view showing trichobothria. 67-68. *Heterometrus (Chersonesometrus) granulomanus* male : 67. dorsal view; 68. manus of pedipalp ventral view showing trichobothria.



Figs. 69-74. *Heterometrus (Chersonesometrus) scaber* female; 69. dorsal view; 70. pectines, genital operculum and sternum ventral view. 71-74. *Heterometrus (Chersonesometrus) kanaraensis* male : 71. dorsal view; 72. manus and fingers exterior view; 73. pectines, genital operculum and sternum ventral view; 74. manus of pedipalp ventral view showing trichobothria.

INTERESTING SPECIES RECORDS OF SCORPIONS FROM KERALA

Family ISCHNURIDAE

1. *Chiromachetes fergusoni* Pocock

1899. *Chiromachetes fergusoni* Pocock. *J. Bombay nat. Hist. Sioc.* **12** : 744.

Material examined : 1 Female, 5 young ones, Kerala : Quilon district : Thenmala range forest, Kazhuthurutti, 9.viii.1997. Coll. P. M. Sureshan (Reg. No. 10439).

Distribution : India : Kerala : Trivandrum (Type locality), Quilon.

Remarks : The species is endemic to Kerala and reported from the state from a place very near to the type locality after the original description in 1899.

Family SCORPIONIDAE

2. *Heterometrus (Chersonesometrus) kanaraensis* (Pocock)

1900. *Palamnaeus scaber kanaraensis* Pocock, *Fauna Brit. India Arachn.* 93.

1981. *Heterometrus (Chersonesometrus) phipsoni kanaraensis*. *Couzijn. Zool. Verln.* **184** : 151.

Material examined : Kerala : Parambikulam Wildlife Sanctuary : 1 male, Parambikulam, 24.iii.1997, 1 male, Pezhakunnu, 27.iii.1997. Coll. K. C. Gopi (Reg. No. 10664 & 10075); 5 young ones, Kamathalachi, 30.x.1995, 1 female, 1 male, Anchupoolai, 3.ii.1995, 1 female, 1 male, Pulikkal, 1.xi.1995, 3 young ones, Sirkarpathi, 29.x.1995, 1 female, Venkoli, 27.x.1995, Coll. P. M. Sureshan (Reg. Nos. 8450, 8451, 8454, 8456, 8457).

Distribution : India : Karnataka : Kanara (Type locality); Maharashtra : Bombay; Kerala.

Remarks : Though the species is reported for the first time from Kerala it seems commonly distributed in the forested tracts of southern Western Ghats since represented by good numbers in the present collection.

SYSTEMATIC LIST

Famly BUTHIDAE

Subfamily BUTHINAE

1. *Lychas (Alterotrichus) hendersoni* Pocock

1897. *Lychas hendersoni* Pocock. *J. Bombay nat. Hist. Soc.*, **11** : 111.

2. *Lychas (Endotrichus) tricarinatus* Simon

1884. *Lychas tricarinatus* Simon. *Ann. Mus. civ. sto. nat. Genova* **20** : 371.

3. *Lychas (Endotrichus) albimanus* Henderson

1919. *Lychas albimanus* Henderson. *Rec. Indian Mus.* **16**(5) : 379-381.

4. *Charmus indicus* Hirst.

1915. *Charmus indicus* Hirst. *Ann. Mag. nat. Hist.*, **15**(8) : 224-225.

Subfamily CENTRURINAE

5. *Isometrus (Reddyanus) brachycentrus* Pocock

1899. *Isometrus brachycentrus* Pocock. *J. Bombay nat. Hist. Soc.* **12** : 263.

6. *Isometrus (Closotrichus) sankeriensis* Tikader & Bastawade

1983. *Isometrus (Closotrichus) sankeriensis* Tikader & Bastawade. *Fauna India. Scorpions.* III. 311.

Family ISCHNURIDAE

7. *Liocheles laeviceps laeviceps* (Pocock)

1890. *Iomachus laeviceps* Pocock. *Ann. Mag. nat. Hist.*, **5**(6) : 242.

8. *Liocheles laeviceps malabarensis* (Pocock)

1900. *Iomachus laeviceps malabarensis* Pocock. *Fauna Brit. India. Arachn.* : 82.

9. *Hormurus australasiae* (Fabr.)

1775. *Scorpio australasiae* Fabr., *Syst. Ent.*, : 399.

1990. *Hormurus australasiae* : Pocock, *Fauna Brit. India, Arachn.*, : 79.

10. *Chiromachetes fergusonii* Pocock

1899. *Chiromachetes fergusonii* Pocock. *J. Bombay nat. Hist. Soc.* **12** : 744.

Family SCORPIONIDAE

Subfamily SCORPIONINAE

11. *Heterometrus (Heterometrus) keralaensis* Tikader and Bastawade

1983. *Heterometrus (Heterometrus) keralaensis* Tikader and Bastawade. *Fauna of India. Scorpions.* III. 528.

12. *Heterometrus (Heterometrus) malapuramensis* Tikader and Bastawade

1983. *Heterometrus (Heterometrus) malapuramensis* Tikader and Bastawade. *Fauna of India. Scorpions.* III. 533.

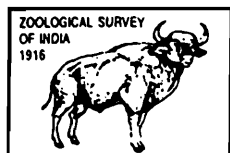
13. ***Heterometrus (Srilankametrus) gravimanus*** (Pocock).
 1894. *Scorpio gravimanus* Pocock. *Ann. Mag. nat. Hist.* **13**(6) : 75
 1900. *Palamnaeus gravimanus* Pocock. *Fauna Brit. India. Arachn.* 90.
 1981. *Heterometrus (Srilankametrus) indus indus* Couzijn. *Zool. Verln.* **184** : 121.
14. ***Heterometrus (Chersonesometrus) granulomanus*** Couzijn
 1981. *Heterometrus (Chersonesometrus) granulomanus* (Couzijn). *Zool. Verln.* **184** : 142.
15. ***Heterometrus (Chersonesometrus) scaber*** (Thorell)
 1877. *Pandinus scaber* Thorell. *Atti. Soc. Ital.* **19** : 202.
 1981. *Heterometrus (Chersonesometrus) scaber scaber* Couzijn. *Zool. Verln.* **184** : 144.
16. ***Heterometrus (Chersonesometrus) kanaraensis*** (Pocock)
 1900. *Palamnaeus scaber kanaraensis* Pocock. *Fauna Brit. India. Arachn.* : 93.
 1981. *Heterometrus (Chersonesometrus) phipsoni kanaraensis* Couzijn. *Zool. Verln.* **184** : 151.

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Rec. zool. Surv. India : **103** (Part 1–2) : 59-66, 2004

ADDITIONS TO THE ECHINODERM FAUNA OF GREAT NICOBAR ISLAND, BAY OF BENGAL

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INTRODUCTION

Great Nicobar is the southernmost island of the Andaman and Nicobar Islands located in the Bay of Bengal. Sastry (1999) gave an account of 18 species of echinoderms known till then from this Island. During the recent intensive explorations one of us (SP) collected material of 33 species of asteroid, ophiuroid, echinoid and holothurian. Of these, only six species namely, *Dactylosaster cylindricus* (Asteroidea), *Ophiocoma dentata*, *Ophiocoma erinaceus*, *Ophiocoma scolopendrina*, *Ophiomastix annulosa* (Ophiuroidea), and *Echinometra mathaei* (Echinoidea), have been reported earlier. The present report adds 27 species to the echinoderm fauna of the Great Nicobar Island. Thus the echinoderm fauna of the Great Nicobar Island comprises of 45 species. Clark and Rowe (1971) gave details of distribution in the Indo-West Pacific region and keys for the identification (up to genus only in case of holothurians). Details of description, distribution and keys for the holothurians reported herein can be found in James (1987a,b,c, 1995a,b). Since all the species are already known from other islands, these have been briefly listed below, with details of localities of collection. The material is deposited in the collections of the Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai-608 502. Though all the species are already known from Andaman and Nicobar Islands, with only a few new to Nicobar group, the present report is considered necessary keeping in view the requirement of faunal diversity of individual islands for declaration and management of Protected Areas.

*Zoological Survey of India, Port Blair-744 102

Phylum ECHINODERMATA

Class ASTEROIDEA

Order PAXILLOSIDA

Family ASTROPECTINIDAE

1. *Astropecten polyacanthus* Mueller and Troschel

Material : Poonam Nalla, 22.02.2002, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

Order VALVATIDA

Family ARCHASTERIDAE

2. *Archaster typicus* (Mueller and Troschel)

Material : Chingen, 02.02.2003, one spec.; Pigeon Island, 12.02.2003, one spec.

Family OPHIDIASTERIDAE

3. *Dactylosaster cylindricus* (Lamarck)

Material : Trinket Choplong Bay, 28.02.2002, one spec.; Indira Point, 03.02.2003, one spec.

4. *Linckia guildingi* Gray

Material : Galathea Bay, 11–13.02.2002, one spec.; Vijaya Nagar, 02.03.2002, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

5. *Linckia laevigata* (Linnaeus)

Material : Trinket Choplong Bay, 28.02.2002, one spec.; Pigeon Island, 17.03.2002, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

6. *Linckia multifora* (Lamarck)

Material : Alexandra Bay, 17.02.2003, one spec.

Family ASTEROPSEIDAE

7. *Asteropsis carinifera* (Lamarck)

Material : Prem Nalla, 20.02.2002, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

Class OPHIUROIDEA

Family OPHIOTHRICIDAE

8. *Macrophiothrix longipeda* (Lamarck)

Material : Swarup Nalla, 27.01.2003, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

Family OPHIOCOMIDAE

9. *Ophiarthrum elegans* Peters

Material : Alexandra Bay, 17.02.2003, one spec.; Inhengloi, 14.02.2003, one spec.; Kopenheat, 17.02.2003, four specs.; Pilo Bet, 16.02.2003, arm bits; Pilo Bhabi, 17.02.2003, one spec.; Sastry Nagar, 27.01.2003, four specs.

Remark : The species is newly recorded from Nicobar group of islands.

10. *Ophiarthrum pictum* Mueller and Troschel

Material : Sastry Nagar, 27.01.2003, one spec.

11. *Ophiocoma dentata* Mueller and Troschel

Material : Poonam Nalla, 26.01.2003, one spec.

12. *Ophiocoma erinaceus* Mueller and Troschel

Material : Chingen, 02.02.2003, arm bits, Indira Point, 03.02.2003, two specs.; Inhengloi, 14.02.2003, one spec.; Keechad Nalla, 16.02.2003, two specs.; Lakshmi Nagar, 07.03.2002, one spec.; Pigeon Island, 17.03.2002, one spec.; Pilo Bet, 16.02.2003, one spec.; Poonam Nalla, 22.02.2002, four specs.; Sastry Nagar, 27.01.2003, three specs.; Vijaya Nagar, 25.01.2003, two specs.

13. *Ophiocoma scolopendrina* (Lamarck)

Material : Alexandra Bay, 17.02.2003, seven specs.; Chingen, 02.02.2003, four spec.; Dongi Nalla, 20.01.2003, one spec.; Galathea Bay, 11–13.02.2002, two specs.; Galathea Bay, 01.02.2003, seven specs.; Indira Point, 03.02.2003, eight specs.; Inhengloi, 14.02.2003, one spec.; Keechad Nalla, 16.02.2003, two specs.; Kopenheat, 17.02.2003, one spec.; Magar Nalla, 21.01.2003, three specs.; Pigeon Island, 17.03.2003, one spec.; Pigeon Island, 12.02.2003, three specs.; Pilo Bet, 16.02.2003, two spec.; Pilo Bhabi, 17.02.2003, three specs.; Poomam Nalla, 26.01.2003, four specs.; Prem Nalla, 20.02.2002, one spec.; Prem Nalla, 23.01.2003, three spec.; Sastry Nagar, 27.01.2003, one spec.; Sippy Nalla, 22.01.2003, three specs.; Swarup Nalla, 27.01.2003, one spec.; Vijaya Nagar, 25.01.2003, three specs.

14. *Ophiomastix annulosa* (Lamarck)

Material : Chingen, 02.02.2003, one spec.; Indira Point, 03.02.2003, two specs.; Inhengloi, 14.02.2003, one spec.; Keechad Nalla, 16.02.2003, one spec.; Kopenheat, 17.02.2003, one spec.; Lakshmi Nagar, 07.03.2002, one spec.; Pigeon Island, 17.03.2002, an arm only; Pilo Bet, 16.02.2003, one spec.; Poonam Nalla, 22.02.2002, one spec.; Prem Nalla, 20.02.2002, one spec.; Prem Nalla, 23.01.2003, arm bits; Sastry Nagar, 27.01.2003, one spec.; Swarup Nalla, 27.01.2003, one spec.; Vijaya Nagar, 02.03.2002, one spec.; Vijaya Nagar, 25.01.2003, one spec.

Family OPHIURIDAE

Subfamily OPHIOLEPIDINAE

15. *Ophioplocus imbricatus* (Mueller and Troschel)

Material : Galathea Bay, 11–13.02.2002, one spec.; Sippy Nalla, 22.01.2003, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

Class ECHINOIDEA

Order DIADEMATOIDA

Family DIADEMATIDAE

16. *Diadema savignyi* Michelin

Material : Galathea Bay, 11–13.02.2002, one spec.; Magar Nalla, 21.01.2003, one spec.; Poonam Nalla, 22.02.2002, one spec.; Prem Nalla, 20.02.2002, one spec.; Vijaya Nagar, 02.03.2002, one spec.; Vijaya Nagar, 25.01.2003, one spec.

Remarks : The defferentiating characters of *Diadema savignyi* and *D. setosum* are not easy to observe in presserved specimens. The tridentate pedicellariae are very few and presence or absence of a red ring around anal region cannot be ascertained in preserved specimens. As such, the material of *D. setosum* reported earlier (Sastry, 1999) could belong to the species reported here or *vice versa*.

17. *Echinothrix calamaris* (Pallas)

Material : Pigeon Island, 17.03.2002, one spec.; Prem Nalla, 20.02.2002, two specs.

Remark : The species is newly recorded from Nicobar group of islands.

18. *Echinothrix diadema* (Linnaeus)

Material : Lakshmi Nagar, 07.03.2002, two specs.; Poonam Nalla, 22.02.2002, one spec.

Order ECHINOIDA

Family ECHINOMETRIDAE

19. *Echinometra mathaei* (de Blainville)

Material : Galathea Bay, 11–13.02.2002, two specs.; Prem Nalla, 20.02.2002, two specs.; Poonam Nalla, 22.02.2003, two specs.; Vijaya Nagar, 02.03.2002, two specs.; Lakshmi Nagar, 07.03.2002, one spec.; Pigeon Island, 17.03.2002, one spec.; Alexandra Bay, 17.02.2003, one spec.; Dongi Nalla, 20.01.2003, one spec.; Keechad Nalla, 16.02.2003, one spec.; Magar Nalla, 21.01.2003, three specs.; Pigeon Island, 12.02.2003, one spec.; Poonam Nalla, 26.01.2003, one spec.; Prem Nalla, 23.01.2003, three specs.; Sippy Nalla, 22.01.2003, one spec.; Swarup Nalla, 27.01.2003, one spec.; Vijaya Nagar, 25.01.2003, two specs.

20. *Echinostrephus molaris* (de Blainville)

Material : Vijaya Nagar, 25.01.2003, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

Order CLYPEASTEROIDA

Family ARACHNOIDIDAE

21. *Arachnoides placenta* (Linnaeus)

Material : Campbell Bay, 12.01.2003, three specs.

Remark : The species is newly recorded from Nicobar group of islands.

Class HOLOTHUROIDEA

Order ASPIDOCHIROTIDA

Family HOLOTHURIIDAE

22. *Actinopyga echinites* (Jaeger)

Material : Sastry Nagar, 31.12.2000, two specs.; Near Dillon Nalla, 06.01.2001, one spec.; Indira Point, 15.01.2001, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

23. *Holothuria (Acanthotrapeza) pyxis* Selenka

Material : Galathea Bay, 12.01.2001, one spec.; Vijaya Nagar, 24.01.2001, three specs.

Remark : The species is newly recorded from Nicobar group of islands.

24. *Holothuria (Lessonothuria) pardalis* Selenka

Material : Near Prem Bahadur Nalla, 04.02.2001, two specs.

25. *Holothuria (Metriatyla) scabra* Jaeger

Material : Sastry Nagar, 31.12.2000, one spec.

Remark : The species is newly recorded from Nicobar group of islands.

26. *Holothuria (Microthele) nobilis* (Selenka)

Material : Vijaya Nagar, 24.01.2001, two specs.

Remark : The species is newly recorded from Nicobar group of islands.

27. *Holothuria (Platyperona) difficilis* Semper

Material : Near Prem Bahadur Nalla, 02.02.2001, two specs.

28. *Holothuria (Thymiosycia) arenicola* Semper

Material : Near Dillon Nalla, 06.01.2001, two specs.

29. *Holothuria (Thymiosycia) hilla* Lesson

Material : Galathea Bay, 14.01.2001, two specs.

Remark : The species is newly recorded from Nicobar group of islands.

Family LABIDODEMATIDAE

30. *Labidodemas rugosum* (Ludwig)

Material : Near Magar Nalla, 05.01.2001, three specs.

Remark : The species is newly recorded from Nicobar group of islands.

Family STICHOPODIDAE

31. *Stichopods variegatus* Semper

Material : Near Magar Nalla, 23.01.2001, two specs.; Vijaya Nagar, 24.01.2001, two specs.; Indira Point, 15.01.2001, three specs.

Order DENDROCHIROTIDA

Family PHYLLOPHORIDAE

32. *Afrocucumis africana* (Semper)

Material : Near Magar Nalla, 23.01.2001, two specs.

Remark : The species is newly recorded from Nicobar group of islands.

Order APODIDA

Family SYNAPTIDAE

33. *Synapta maculata* (Sluiter)

Material : Sastry Nagar, 31.12.2000, one spec.; Near Dillon Nalla, 24.01.2001, one spec.

SUMMARY

Recent collections from the Great Nicobar Island consisted of 33 species of echinoderms including seven species of Asteroidea, eight species of Ophiuroidea, six species of Echinoidea and 12 species of Holothuroidea. Of these, only six species, namely *Dactylosaster cylindricus* (Asteroidea), *Ophiocoma dentata*, *Ophiocoma erinaceus*, *Ophiocoma scolopendrina*, *Ophiomastix annulosa* (Ophiuroidea), and *Echinometra mathaei* (Echinoidea), are among the 18 species known from earlier reports. The total number of echinoderm species is 45. The 33 species collected recently have been briefly reported with details of localities. Some of these are recorded for the first time from Nicobar group of islands.

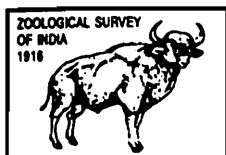
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Rec. zool. Surv. India : **103** (Part 1–2) : 67-73, 2004

SOME BEE-FLIES (BOMBYLIIDAE : DIPTERA) FROM THAR DESERT

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INTRODUCTION

The members of the family Bombyliidae known as, bee-flies are usually dominant in the tropics and subtropics. They are one of those economically important group of the suborder Brachycera, and act as pollinators in forests, and of agricultural crops.

The Great Indian desert popularly known as Thar desert covers part of the four Indian states viz. Punjab, Haryana, Rajasthan and Gujarat. The present account on Bombyliidae fauna pertains to the state of Rajasthan and Gujarat as this is the area which has been best explored and studied faunistically.

Our knowledge of the bee-fly fauna of the Thar desert is limited. Kumar & Kumar (1996) have reported only 2 species under 2 genera from this area, and recently Parui and Mitra (2000) also reported another 3 species under 2 genera.

The present study revealed 10 species of bee-flies under 8 genera of 4 subfamilies. Of them 5 species (* marked) under 4 genera of 4 subfamilies are reported for the first time from the Indian part of Thar desert area. Comprehensive keys to the subfamilies, genera and species of Bombyliidae treated here are given.

LIST OF SPECIES

A. Subfamily TOXOPHORINAE

- *1. *Toxophora javana* Wiedemann

B. Subfamily BOMBYLIINAE

- *2. *Bombylius maculatus* Fabricius

C. Subfamily ANTHRACINAE

3. *Petrorossia albofulva* (Walker)
4. *Petrorossia nigrofemorata* (Brunetti)
5. *Anthrax bipunctatus* Fabricius
- *6. *Argyromoeba duvaucelii* (Macquart)

D. Subfamily EXOPROSOPINAE

7. *Thyridanthrax (Exhylanthrax) absalon* (Wiedemann)
8. *Exoprosopa (Exoprosopa) collaris* (Wiedemann)
- *9. *Ligyra aurantiaca* (Guérin-Méneville)
- *10. *Ligyra oenomaus* (Rondani)

SYSTEMATIC ACCOUNT

Key to the subfamilies

1. Praefurca comparatively long; 2nd longitudinal vein originating (in knee-shaped form) from it approximately opposite anterior cross vein (at almost half way between origin of praefurca and the cross vein, and this only in some species of *Argyromoeba*); antenna widely separated at base; frons in ♂ nearly as wide as in ♀ 2
 - Praefurca comparatively short, 2nd longitudinal vein originating acutely (not in knee-shaped form) always much nearer to origin of praefurca than of anterior cross vein; antennae nearly always approximate at base; eyes in ♂ normally contiguous or nearly so, sometimes distinctively separated; frons in ♂ always much narrower than ♀ 3
2. Antennal style with a pencil of hairs at end; metapleura bare; squamae with a hairy fringe. *Anthracinae*
 - Antennal style devoid of hairs at end; metapleura hairy; squamae with scaly fringe *Exoprosopinae*
3. Head as wide as or a little wider than thorax; abdomen more or less cylindrical, bare or with bristly hairs; antennae very long, especially 1st joint; thorax more or less humped, generally with conspicuous bristle; 2nd longitudinal vein with loop *Toxophorinae*
 - Head generally narrower than thorax; abdomen short and rounded; frequently with dense furry pubescence; antennae approximate at base; thorax generally arched; 2nd longitudinal vein never with a strong loop near tip *Bombyliinae*

A. Subfamily TOXOPHORINAE

Genus *Toxophora* Meigen

Toxophora Meigen, 1803, *Magazin InsektKde.*, 2 : 270. Type-species : *Toxophora maculata* Meigen

***1. *Toxophora javana* Wiedemann**1821. *Toxophora javana* Wiedemann, *Dipt. exot.*, : 179.

Material examined : 1 ♂, Ghata village, Balaram-Ambaji wildlife sanctuary, 13.viii.2000, Coll. P. Parui.

Diagnosis : Antennae very long, prominent, horizontal, approximate at the base; vertex very small, black with a pair of strong ocellar bristles; thorax black, humped with a coating of very small, oblong, brownish scales lying flat on the surface; abdomen black, long narrow, with a layer of small brownish scales as on the thorax; three posterior cells.

Distribution : Gujarat, Tamil Nadu, Uttar Pradesh; Jawa, Krakatau.

Remarks : This is the first report from the Indian part of Thar Desert.

B. Subfamily BOMBYLIINAE**Genus *Bombylius* Linnaeus**

1758. *Bombylius* Linnaeus, *Syst. Nat. Ed.*, **10** : 606. Type-species : *Bombylius major* Linnaeus.

***2. *Bombylius maculatus* Fabricius**1775. *Bombylius maculatus* Fabricius, *Syst. Ent.*, : 803.

Material examined : 1 ♂, 1 ♀, Iswania hill, Balaram-Ambaji wildlife sanctuary, 8.viii.2000, Coll. P. Parui.

Diagnosis : Head in ♂ black; frons with elongate white or yellowish-white scales; antennae black; thorax black, a pair of faint bluish well-separated narrow stripes visible on the denuded surface; abdomen black, black hairs surround the tip of the abdomen; wings clear, costal cell yellowish, whole base of wing as far as humeral cross-vein dark brown.

Distribution : Gujarat, Orissa, Tamil Nadu.

Remarks : This is the first report from the Indian part of Thar Desert.

C. Subfamily ANTHRACINAE**Key to the genera**

1. Body large, hairy; third antennal joint short, onion shaped (sometimes more conical), with styliform prolongation always bisected near tip, and bearing an apical pencil of hairs *Argyromoeba* Schiner
- Body small, less hairy; third antennal joint forming a style-like cone with microscopic apical bristle, no pencil of hairs 2
2. Body hairy; wing almost clear *Anthrax* Scopoli
- Body bare; wing membrane wrinkled, not clear *Petrorossia* Bezzi

Genus *Petrorossia* Bezzi

1909. *Petrorossia* Bezzi, Z. syst. Hymenopt. Dipterol., 8 : 32. Type-species : *Bibio hesperus* Rossi.

Key to the species

1. 2nd vein originating in a knee just beyond half way between base of discal cell and anterior cross vein, upper branch of 2nd vein forming a very distinct downward loop towards its end *nigrofemorata* (Brunetti)
- 2nd longitudinal vein normally with a distinct curve, followed by a distinct downward one just before tip, anterior cross vein at one third of discal cell, placed some distance beyond tip of praefurca *albofulva* (Walker)

3. *Petrorossia albofulva* (Walker)

1852. *Anthrax albofulva* Walker, *Insecta Saundersiana*, 1 : 182.

Material examined : 'Not examined'

Distribution : Gujarat, Uttar Pradesh.

4. *Petrorossia nigrofemorata* (Brunetti)

1909. *Argyromoeba nigrofemorata* Brunetti, *Rec. Indian Mus.*, 3 : 219.

Material examined : 'Not examined'

Distribution : Gujarat, Uttar Pradesh.

Genus *Anthrax* Scopoli

1763. *Anthrax* Scopoli, *Ent. Carniolica* : 358. Type-species : *Musca morio* Linnaeus.

5. *Anthrax bipunctatus* Fabricius

1805. *Anthrax bipunctatus* Fabricius, *Syst. Antliat.*, : 118.

Material examined : 'Not examined'

Diagnosis : Body large; antennae blackish, 3rd joint reddish brown; vertex blackish grey, rather shining, with some brown hairs on hind margin; thorax black, moderately shining, with very sparse pubescence; abdomen black, with short sparse black pubescence and a patch of small elongate snow-white scales towards each side of dorsum of 1st segment; wings very dark, blackish brown at base, the colour diminishing distally and posteriorly, but the lightest part of the wing at least pale brown.

Distribution : Assam, Bihar, Gujarat, Tamil Nadu, West Bengal; Bangladesh, Pakistan.

Genus *Argyromoeba* Schiner

1860. *Argyromoeba* Schiner, *Wien. ent. Monatschr.*, 4 : 51. Type-species : *Anthrax tripunctata* Wiedemann.

*6. *Argyromoeba duvaucelii* (Macquart)

1840. *Anthrax duvaucelii* Macquart, *Dipt. exot.*, 2(1) : 63.

Material examined : 1 ♂, Sambalpani, Balaram-Ambaji Wild life Sanctuary, 10.viii.2000, Coll. P. Parui.

Diagnosis : Body moderate; antennae black, with a slight grayish-white shimmer; vertex with a distinct but short and deep indentation; thorax dark, sides of thorax with long thick grayish-white scaly pubescence; the dorsum with sparse yellowish short hairs round the edges; abdomen blackish grey, 2nd segment distinctly but not greatly longer than the five remaining ones; venter blackish with short white hairs; wings almost clear, costa slightly darker, several isolated spots present, devoid of baso-costal oblique band, anal cell open.

Distribution : Gujarat, Himachal Pradesh, Uttar Pradesh, West Bengal; Pakistan.

Remarks : This is the first report from the Indian part of Thar Desert.

D. Subfamily EXOPROSOPINAE

Key to the genera

1. Ocellar tubercle a long way from vertex; antennal segment 3 like an elongated cone, with a style divided from it by a distinct suture; wing with 3 to 4 submarginal cells; claws usually with along sharp basal tooth 2
- Ocelli more or less close to vertex; antennal style mostly not divided by a suture; wing with 2 submarginal cells only; claws usually without basal tooth, or at most with a small and obtuse tubercle *Thyridanthrax* Osten Sacken
2. Antennal segment 3 with a terminal style bearing a microscopic bristle; 3 submarginal cells in wing *Exoprosopa* (Macquart)
- Antennal segment 3 with a terminal style bearing a minute appendage; 4 submarginal cells in wing *Ligyra* (Newman)

Genus *Thyridanthrax* Osten Sacken

1886. *Thyridanthrax* Osten Sacken, *Biologia cent.-am. (Zool.)*, : 123, Type-species : *Thyridanthrax selene* Osten Sacken.

7. *Thyridanthrax (Exhyalanthrax) absalon* (Wiedemann)

1828. *Anthrax absalon* Wiedemann, *Analecta Ent.*, : 24.

Material examined : 'Not examined'

Diagnosis : Head semicircular; proboscis short; antennae porrect, short, wide apart at base, 1st joint short, cylindrical, 2nd cup shaped, 3rd varying from elongate conical to flat onion-shaped; thorax quadrate, with rounded angles; abdomen flat, oblong; wings brown with more or less hyaline spots.

Distribution : Gujarat, Maharashtra, Orissa, Tamil Nadu; Sri Lanka, Malayasia.

Genus *Exoprosopa* (Macquart)

1840. *Exoprosopa* Macquart, *Dipt. exot.*, 2(1) : 35. Type-species : *Anthrax pandora* Fabricius.

8. *Exoprosopa* (*Exoprosopa*) *collaris* (Wiedemann)

1828. *Anthrax collaris* Wiedemann, *Aussereurop. zweifl. Insekt.*, 1 : 271.

Material examined : 'Not examined'

Diagnosis : Frons distinctly narrower at vertex than above antennae; probosis dark, withdrawn; antennal 1st and 2nd joints ferruginous, 3rd black; thorax black, with sparse black pubescence, covered with very short depressed yellowish brown scale like hairs; abdomen black, the sides often more or less reddish; wings pale grey with the basal third dark brown, a small clear spot at upper corner of 2nd basal cell, with a small yellowish spot immediately above it, and a slight pale yellowish tinge about the middle of the 1st posterior cell.

Distribution : Rajasthan.

Genus *Ligyra* Newman

1841. *Ligyra* Newman, *Entomologist*, 1 : 220. Type-species : *Anthrax bombylifformis* Macleay.

Key to the species

1. Wing dark blackish brown, without any considerable clear or nearly clear part
..... *aurantiaca* (Guérin-Méneville)
- Wing with apical part and considerable portion of posterior half practically clear
..... *oenomaus* (Rondani)

*9. *Ligyra aurantiaca* (Guérin-Méneville)

1844. *Anthrax aurantiaca* Guérin-Méneville, *Icon., du regne anim. Dipt.*, 3 : 539.

Material examined : 1 ♂, Balaram nursery, Balaram-Ambaji wildlife sanctuary, 17.viii.2000, Coil. P. Parui.

Distribution : Gujarat, Arunachal Pradesh, Bihar, West Bengal.

Remarks : This is the first report from the Indian part of Thar Desert.

*10. *Ligyra oenomaus* (Rondani)

1875. *Hyperalonia oenomaus* Rondani, *Annali Mus. Civ Stor. nat. Giacomo Doria*, 7 : 453.

Material examined : 2 ♂, Balaram nursery, Balaram-Ambaji wildlife sanctuary, 17.viii.2000, Coil. P. Parui.

Distribution : Gujarat, Arunachal Pradesh, Assam, Sikkim, West Bengal; Borneo, Malaysia, Philippines.

Remarks : This is the first report from the Indian part of Thar Desert.

SUMMARY

The distribution pattern of 10 species of the family Bombyliidae so far known from the Indian part of Thar desert shows that all the species are predominantly Oriental in distribution. Of them, 8 species (80%) are restricted to the Oriental region, whereas the remaining 2 species (20%) extend beyond the limit of this region. Of the 8 species distributed in the Oriental region, 6 species namely, *B. maculatus*, *P. albofulva*, *P. nigrofemorata*, *E. (E) collaris*, *L. aurantiaca* and *L. oenomaus* are endemic to India, and *E. (E) collaris* is restricted to Rajasthan.

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THREATENED AND ENDEMIC FISHES OF TRIPURA WITH COMMENTS ON THEIR CONSERVATION

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INTRODUCTION

Tripura is a hilly state located in the sub-Himalayan region of the North-East India. It is surrounded on the North, West, South-East by Bangladesh (Erswhile East Pakistan). In the East of this state it has a common boundary with Assam and Mizoram. Physiographically, this state represents the western fringe of the typical ridge and valley structural province of the late Tertiary fold mountain belt, generally known as the Indo-Burmese Ranges or Purbachal Ranges. A perusal of the existing literature, viz., Datta (1977), Nair (1977), Lipton (1983–84), Bhattacharya (1988) and Barman (1988, 1989, 1990, 1991, 1992, 1994 & 2002) on the fish fauna of Tripura shows that this state harbours 129 species of fishes under 78 genera, 33 families and 11 orders. The diagnostic features of all these 129 species of fishes along with a short description of the state with reference to its fisheries aspect, topography and drainage pattern of the river systems of Tripura have been provided by the present author in a separate publication (Barman, 2002). The fishes of this state have been reviewed in respect of its threatened species. The threatened species of this state has been designated as per Molur and Walker (1998) and Menon (1999). Out of these 129 species this state contains 28 vulnerable, 10 endangered and 4 rare species of fishes of India. This state also contains 4 Endemic species of our country. The present paper deals only with the vulnerable, endangered, rare species and endemic species of India found in Tripura. Some comments for protection and conservation of the fish fauna of Tripura are furnished in this communication.

1. NAMES OF THE THREATENED SPECIES

A. Names of the vulnerable species

Order CLUPEIFORMES

Family CLUPEIDAE

1. *Tenuulosa ilisha* (Hamilton)

Order CYPRINIFORMES

Family CYPRINIDAE

2. *Aspidoparia jaya* (Hamilton)
3. *Barilus barila* (Hamilton)
4. *Puntius chola* (Hamilton)
5. *P. conchonius* (Hamilton)
6. *Barbodes sarana sarana* (Hamilton) (= *Puntius sarana sarana*)
7. *Cirrhinus reba* (Hamilton)
8. *Cyprinion semiplotus* (= *Semiplotus semiplotus*) (McClelland)
9. *Labeo pangusia* (Hamilton)
10. *Chagunius chagunio* (Hamilton)
11. *Garra gotyla gotyla* (Gray)

Family COBITIDAE

12. *Botia almorae* Gray (= *Botia rostratra*)

Family BALITORIDAE

13. *Noemacheilus scaturigina* (McClelland)

Order SILURIFORMES

Family BAGRIDAE

14. *Rita rita* (Hamilton)
15. *Mystus bleekeri* (Day)
16. *M. vittatus* (Bloch)
17. *Aorichthys aor* (Hamilton)
18. *Aorichthys seenghala* (Sykes)

Family SCHILBEIDAE

19. *Ailia coila* (Hamilton)
20. *Clupisoma garua* (Hamilton)

Family PANGASIIDAE

21. *Pangasius pangasius* (Hamilton)

Family SISORIDAE

22. *Bagarius bagarius* (Hamilton)

Family CLARIIDAE

23. *Clarias batrachus* (Linnaeus)

Family HETEROPNEUSTIDAE

24. *Heteropneustes fossilis* (Bloch)

Order CHANNIFORMES

Family CHANNIDAE

25. *Channa orientalis* Bloch & Schneider

Order PERCIFORMES

Family MUGILIDAE

26. *Sicamugil cascasia* (Hamilton)

27. *Rhinomugil corsula* (Hamilton)

Family ANABANTIDAE

28. *Anabas testudineus* (Bloch)

B. Names of the Endangered species

Order ANGUILLIFORMES

Family ANGUILLIDAE

1. *Anguilla bengalensis* (Gray)

Order OSTEOGLOSSIFORMES

Family NOTOPTERIDAE

2. *Chitala chitala* (Hamilton) (= *Notopterus chitala*)

Order CYPRINIFORMES

Family CYPRINIDAE

3. *Raiamas bola* (Hamilton)

4. *Tor putitora* (Hamilton)

5. *Tor tor* (Hamilton)

Order SILURIFORMES

Family SILURIDAE

6. *Ompok bimaculatus* (Bloch)

7. *O. pabda* (Hamilton)

Family SCHILBEIDAE

8. *Pseudeutropius atherinoides* (Bloch)
9. *Eutropiichthys vacha* (Hamilton)

Family SISORIDAE

10. *Glyptothorax cavia* (Hamilton)

C. Names of the Rare species

Order CYPRINIFORMES

Family CYPRINIDAE

1. *Barilius nelsoni* Barman
2. *Poropuntius clavatus* McClelland (= *Puntius clavatus clavatus*)
3. *Puntius gelius* (Hamilton)
4. *Schismatorhynchus nukta* (Sykes)

2. NAMES OF THE ENDEMIC SPECIES

Order CYPRINIFORMES

Family CYPRINIDAE

1. *Barilus gatensis* (Valenciennes)* (Found in the Peninsular India and Tripura)
2. *Barilus nelsoni* Barman (Found in Tripura only)
3. *Schismatorhynchus nukta* (Sykes)* (Found in the Peninsular India and Tripura only)

Family COBITIDAE

4. *Botia dario* (Hamilton) (Found in Assam, Tripura, North Bengal, Rajmahal Hills in South Bihar)

*The presence of these two species in Tripura needs more confirmation. These two species were recorded from Tripura by earlier workers.

CONSERVATION

The problems of protection and conservation of the fishes of Tripura are almost common with the rest of our country particularly the North Eastern states. Tripura is small state with only 10,491 sq. km. area accounting 0.32% of the total land area of our country and occupies the 22nd position in terms of the area among the States and Union Territories of India. The maximum length and breadth of this state is 183.5 km. and 112.7 km. respectively. Hilly ranges cover almost

70% of the land area of this state. The altitude of this state varies from 780 m in the North-Eastern part to 15 m or even less in the Western part above the mean sea level. The state with 31,91,186 population (according to the census of 2001) is facing an unprecedented increase in human population since the independence of our country for various reasons. This has resulted a great pressure on the economy of this state. The increase in human population is causing extensive habitat alteration due to vast tracts of forests are cleared for agricultural, industrial and urbanization purposes consequently affecting the aquatic bodies which in turn affecting the fish population in particular. Deforestation, urbanization, water diversion, overexploitation and introduction of the exotic fishes are some of the problems threatening the fish population particularly their endangered, vulnerable and rare species of Tripura. Considering these factors some suggestions for protection and conservation of these fishes of Tripura are furnished in this paper.

Following measures can be adopted to protect and conserve the threatened fishes of Tripura :

- (i) Deforestation is one of the important problems affecting the fish population. Deforestation along the course of the river should be avoided because it causes soil instability that increases the turbidity of the water bodies. It also increases the temperature of the breeding ground of the fishes. Where the vegetation has been destroyed, replantation is desirable to stabilize the soil erosion, to maintain the clear water and to maintain the required temperature of the spawning grounds of the fishes.
- (ii) Pesticides and agricultural fertilizers along the watercourses should be used very carefully. The fishermen or the local people employed in fishing should be told to use only rapidly degradable types of pesticides.
- (iii) Increasing urbanization has led to pollution both by human activities and industrial discharges. Effluents from industrial areas should be released into the river systems after proper treatment to remove toxic materials. If this is not done it will reduce the growth of plankton and will decrease oxygen content of the water body, ultimately affect it will the aquatic animals especially the fish population as a whole.
- (iv) The threatened fish species of the degraded habitats if possible should be transferred to appropriate water bodies keeping in mind that the resident fish of those water bodies would not be adversely affected.
- (v) Water diversion is another factor affecting the fish population adversely. It is well known that if the course of a river system is diverted due to obstruction by damming, the resident fishes will be definitely affected. The Gumti Hydel Project across the river Gumti, therefore is sure to affect the fish population of that locality. Where dams are to be constructed for immediate benefits, the long-term effects have to be kept in consideration. The dams totally change the river ecosystems and causes irreversible damage to the aquatic organisms, primarily due to siltation and aquatic weed growth. It obstructs the migration of the fishes

consequently affecting their growth and reproduction. Since several fish species migrate or move upstream to spawn during the breeding period (early monsoon flood) their reproductive cycle is affected due to the construction of dams resulting the depletion of their multiplication.

- (vi) Overexploitation or indiscriminate harvesting of fishes is another menace to the whole fish population irrespective of the matured or the juvenile fishes. This should be controlled or monitored by imposing closed seasons especially during the spawning period. At the same time the immature specimens should be protected by banning the use of very small mesh sized nets so that juveniles are escaped. The fish resources also to be sustainably utilized otherwise commonly found fishes will also soon disappear from our fish menu meal.
- (vii) Introduction of the exotic fishes has been found in some cases adversely affecting the native fishes due to competition for food, breeding grounds and predation. In view of these types of potential hazards, introduction of exotic fishes should not be done without careful consideration of the ecological and biological impact over the resident fishes.
- (viii) Lastly it may be mentioned since out of the 4 endemic fish species 2 species are already threatened species in Tripura, therefore, all the endemic species should be considered at par the threatened species. Proper care should be taken for their sustainable utilization otherwise in course of time the remaining 2 species will sure to face the problem of their existence like those of the threatened fish species of Tripura.

SUMMARY

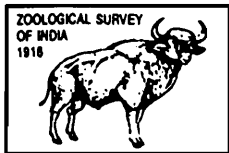
Tripura, one of the states of the North-East India contains several species, which are common to both the Indo-Gangetic and South-East Asian river systems. The presence of these fishes in the sub-Himalayan region of Tripura is of special importance in the Fish Geography of the North Eastern region and that of the Indo-Malayan Archipelago. Generally the North Eastern Region of India is considered as of the Hot Spots of Biodiversity including that of the freshwater fishes of India. Therefore, an attempt was undertaken to estimate Fish Fauna of Tripura. The present author has identified the Fish fauna of this state. It shows that the fish fauna of Tripura contains 129 species belonging to 78 genera, 33 families and 11 orders. Out of these 129 species, 28 species are Vulnerable, 10 species are Endangered and 4 species are Rare species. This state also contains 4 endemic species. As the population in Tripura has been increasing, vast tracts of forests are cleared for agricultural, industrial and urbanization purposes. Several freshwater fish species of India have been described as the threatened species. To conserve and sustainably exploit the fish fauna particularly its threatened species of Tripura, measures should be adopted to protect and conserve this natural resources. Suggestions for conservation of these fishes are discussed in this paper.

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THE FISHES OF THE KOLLERU LAKE, ANDHRA PRADESH, INDIA WITH COMMENTS ON THEIR CONSERVATION

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INTRODUCTION

Kolleru Lake is one of the National wetlands and the largest freshwater lakes of our country. Wetlands are very important productive ecosystems and their socioeconomic values are well established. Moreover, the riverine fishes use wetlands as their breeding grounds. In addition to these, this lake has been found to contain some threatened species of fishes, which needs to be conserved to protect them from extinct in near future. Considering these facts an attempt has been made to estimate the Fish resources of this lake. This work is based primarily on the fish collections from this lake by the author (Barman, 1993) in addition to the fishes recorded from this lake following the works of Chacko *et al.* (1952) and Dutt & Murthy (1971 & 1976). This Lake has been found to contain 51 freshwater fish species belonging to 35 genera, 21 families and 9 orders. A review on the fishes of this lake shows that it contains 4 endangered, 11 vulnerable and 1 rare species following the works of Molur and Walker (1998) and Menon (1999) as per the guidelines and criteria provided by the IUCN for determining the threatened species. Almost all the fishes of this lake are commercially important. Since this lake contains some important commercial fishes and 16 threatened species, it has been suggested for conservation specially to protect the threatened species and to maintain its biodiversity of the fishes as a whole.

TOPOGRAPHY

The Lake Kolleru is a natural depression with an average depth of 1 metre and a maximum depth of 3 metres during the southwest monsoon, in the coastal belt between the deltas of the river Godavari to the east and Krishna to the west. It is located partly in Krishna and West Godavari districts of Andhra Pradesh. The Eluru canal (irrigation canal) connects these two rivers

to the north of this lake and the Bay of Bengal passes to its southwest side. This lake has an area of almost 250 sq. km. Four major streams, viz., Budameru, Thammileru, Ramileni and Gunderu and several irrigation channels open into this lake, carrying a considerable amount of silt in this lake. The Bay of Bengal is 32 km. away and is connected to this lake by one outlet, named Upputeru. This lake is a low-lying swamp type with almost 85% freshwater dominance. Although the lake is connected with the Bay of Bengal through Upputeru, the tidal waters do not enter into the lake proper, so the freshwater fishes can thrive there well.

SYSTEMATIC ACCOUNT OF THE FISHES OF THE KOLLERU LAKE

The classification of Greenwood *et al.*, (1966) and Menon (1999) is followed here in listing the fishes of this lake as follows :

Order I ANGUILLIFORMES

Family 1 ANGUILLIDAE

1. *Anguilla bengalensis* (Gray and Hardwicke) (**Endangered species**)

Order II CLUPEIFORMES

Family 2 CLUPEIDAE

2. *Gudusia chapra* (Hamilton)

Order III OSTEOGLOSSIFORMES

Family 3 NOTOPTERIDAE

3. *Notopterus notopterus* (Pallas)

Order IV CYPRINIFORMES

Family 4 CYPRINIDAE

4. *Salmostoma clupeioides* (Bloch)
5. *Amblypharyngodon mola* (Hamilton)
6. *Chela laubuca* (Hamilton)
7. *Danio devario* (Hamilton)
8. *Esomus danricus* (Hamilton)
9. *E. thermoicos* (Valenciennes)
10. *Parluciosoma daniconius* (Hamilton) (= *Rasbora daniconius*)

11. *Thynnichthys sandkhol* (Sykes) (**Rare & Endemic species**)
12. *Osteobrama cotio cotio* (Hamilton)
13. *Rohtee ogilbii* Sykes (**Vulnerable & Endemic species**)
14. *Barbodes sarana sarana* (Hamilton) (= *Puntius sarana sarana*) (**Vulnerable species**)
15. *Hypselobarbus dobsoni* (Day) (= *Puntius dobsoni*) (**Endangered & Endemic species**)
16. *Puntius chola* (Hamilton) (**Vulnerable species**)
17. *P. sophore* (Hamilton)
18. *P. ticto* (Hamilton)
19. *Catla catla* (Hamilton)
20. *Cirrhinus mrigala* (Hamilton)
21. *C. reba* (Hamilton) (**Vulnerable species**)
22. *Labeo bata* (Hamilton)
23. *L. calbasu* (Hamilton)
24. *L. fimbriatus* (Bloch)
25. *L. rohita* (Hamilton)

Family 5 COBITIDAE

26. *Lepidocephalus guntea* (Hamilton)

Order V SILURIFORMES

Family 6 BAGRIDAE

27. *Mystus bleekeri* (Day) (**Vulnerable species**)
28. *M. cavasius* (Hamilton)
29. *M. gulio* (Hamilton)
30. *M. vittatus* (Bloch) (**Vulnerable species**)

Family 7 SILURIDAE

31. *Ompok bimaculatus* (Bloch) (**Endangered species**)

Family 8 SCHILBEIDAE

32. *Pseudeutropius atherinoides* (Bloch) (**Endangered species**)

Family 9 CLARIIDAE

33. *Clarias batrachus* (Linnaeus) (**Vulnerable species**)

Family 10 HETEROPNEUSTIDAE

34. *Heteropneustes fossilis* (Bloch) (**Vulnerable species**)

Order VI ATHERINIFORMES

Family 11 BELONIDAE

35. *Xenentodon cancila* (Hamilton)

Family 12 CYPRINODONTIDAE

36. *Aplocheilichthys panchax* (Hamilton)

Order VII CHANNIFORMES

Family 13 CHANNIDAE

37. *Channa marulius* (Hamilton)
38. *C. orientalis* Bloch & Schneider (**Vulnerable species**)
39. *C. punctatus* (Bloch)
40. *C. striatus* (Bloch)

Order VIII SYNBRANCHIFORMES

Family 14 SYNBRANCHIDAE

41. *Ophisternon bengalense* McClelland

Order IX PERCIFORMES

Family 15 CENTROPOMIDAE (= CHANDIDAE)

42. *Pseudambassis ranga* (Hamilton) (= *Chanda ranga*)

Family 16 NANDIDAE

43. *Nandus nandus* (Hamilton)

Family 17 CICHLIDAE

44. *Etroplus maculatus* (Bloch)
45. *E. suratensis* (Bloch)

Family 18 GOBIIDAE

46. *Glossogobius giuris* (Hamilton)

Family 19 ANABANTIDAE

47. *Anabas cobojus* (Hamilton) (**Vulnerable species**)
48. *A. testudineus* (Bloch) (**Vulnerable species**)

Family 20 BELONTIDAE

49. *Polycanthus fasciatus* (Bloch & Schneider)

Family 21 MASTACEMBELIDAE

50. *Macrognaathus aral* (Bloch & Schneider)

51. *M. pancalus* (Hamilton)

DISCUSSIONS & CONSERVATION

The Lake Kolleru is one of the very important freshwater lakes and National wetlands of India. Many riverine important edible fishes utilize this wetland for their breeding grounds. The presence of juvenile specimens of almost all the fishes especially the carps in this lake indicates that these fishes use this water body as their spawning grounds. Since this lake is distantly connected with the Bay of Bengal through Upputeru often some marine fishes are also found in the fish fauna of this lake. Among the important commercial fishes of this lake *Anabas testudineus*, *Heteropneustes fossilis* and *Labeo rohita* are abundantly found throughout the year. This lake also has been found to contain 3 endemic species of our country. *Rohtee ogilbii* of this lake is a vulnerable and endemic fish species of our country. This species is found only in the two important south Indian waters of the river Godavari and Krishna. *Hypselobarbus dobsoni* is an endangered and endemic species in India. It has been recorded in the south Indian waters of the Rivers Krishna and Cauvery, and in the Anaimalai Hill drainages. *Thynnichthys sandkhol* is a rare and endemic fish species of India, found in the south Indian waters of the river Gadavari and Krishna only. Since these commercially important vulnerable, endangered and rare fish species are already in danger of extinction due to over exploitation, habitat destruction and other external factors, their protection and conservation measures should be taken immediately to save them from extinction.

To protect and conserve the fish resources along with its vulnerable, endangered and rare fish species of the Lake Kolleru the following measures may be undertaken :

- (1) Indiscriminate fishing by means of fixed engines should be stopped.
- (2) Restrictions on the use of certain nets during the specified times of the year from April to June (*i.e.*, closed season) as well as mesh size (usually the minimum mesh size of the nets permitted is 25 mm. in the Indian waters).
- (3) Restrictions on the capture and sale of legal sizes of fry and fingerlings of major carps to protect the juveniles of the fishes.
- (4) All types of landscapes alterations must be controlled and use of herbicides and insecticides also to be prohibited in and around this lake.

- (5) Mass awareness campaign should be organized to educate about the significance of the conservation of the fishes in their areas. Since the local fishermen and the people surrounding this lake are in constant contact with this wetland, they should be told that they are the real custodian of the flora and fauna of this Kolleru Lake. Destruction, shrinkage and misuses of this wetland will definitely create their socioeconomic problems due to the fact that the degradation of the wetlands with their rich faunal diversity throughout our country is already alarming.

SUMMARY

The fishes of the Lake Kolleru have been reviewed following the works of Molur & Walker (1998) and Menon (1999). This shows that it contains some very important commercial fishes in addition to 11 vulnerable species, viz., *Rohtee ogilbii*, *Barbodes sarana sarana*, *Puntius chola*, *Cirrhinus reba*, *Mystus bleekeri*, *Mystus vittatus*, *Clarias batrachus*, *Heteropneustes fossilis*, *Channa orientalis*, *Anabas cobojius*, and *Anabas testudieus*, 4 endangered species, viz., *Anguilla bengalensis*, *Hypselobarbus dobsoni*, *Ompok bimaculatus* and *Pseudeutropius atherinoides* and 1 rare species, viz., *Thynnichthys sandkhol*. Considering the presence of these vulnerable, endangered and rare species, this Lake has been suggested for conservation measures.

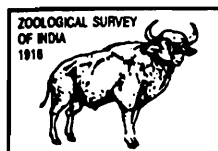
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Rec. zool. Surv. India : 103 (Part 1–2) : 91-98, 2004

TWO NEW SPECIES OF ASCID MITES (ACARINA : MESOSTIGMATA) FROM THE THAR DESERT OF RAJASTHAN, INDIA

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INTRODUCTION

Indian Thar Desert stretching from the west of Aravallis to the Indus basin, is an arid wasteland covered under wind-blown sands. It covers an area of 1,02,400 sq. kms., occupying 12% of the Indian mainland. Considering the huge land area, the invertebrate fauna of this region has been very little explored. Tandon (1996) gave a detailed account of taxonomic researches conducted on different insect groups in the Indian Thar Desert. Literature studies reveal that soil acarine fauna of the Thar Desert is represented by only ten species (Sanyal, 1996). Out of these, seven species belong to the order Cryptostigmata, two species belong to the order Mesostigmata and the remaining one belongs to the order Prostigmata. While working on soil acarine fauna of the Thar Desert, alongwith other acarines two new species of ascid mites belonging to two genera viz., *Lasioseius* Berlese and *Gamasellodes* Athias-Henriot were collected.

Nine species of plant-, soil- and nest-inhabiting *Lasioseius* mites are known from India (Chant, 1960; Menon and Ghai, 1968; Bhattacharyya, 1968; Gupta and Paul, 1985; Bhattacharyya *et al.*, 1997, 2000; Bhattacharyya and Bhattacharyya, 2001). Bhattacharyya (1978), Pramanik and Raychaudhury (1978) reported the occurrence of the *Gamasellodes bicolor* (Berlese, 1918) from West Bengal.

KEY WORDS : *Gamasellodes jodhpurensis* sp. nov., *Lasioseius prakashii* sp. nov., Thar Desert, Rajasthan, India.

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MATERIAL AND METHODS

Mites were cleared in lactic acid before mounting on microscopic slides using Hoyer's medium. Measurement (in micrometer, μm) were taken from slide-mounted specimens with stage-calibrated ocular micrometer. Setae were measured from the base of their insertion to their tips. The system of setal nomenclature for idiosoma and legs follows that of Lindquist and Evans (1965). Type-materials are deposited in the National Zoological Collection, Zoological Survey of India, Calcutta.

Gamasellodes jodhpurensis sp. nov.

(Text-figs. 1-3)

Female : Anterior dorsal shield (126 μm long along midline, 104 μm wide at widest point) with fifteen pairs of simple setae; setae j1, j2 and z1 almost subequal in length (11 μm); posterior dorsal shield (120 μm long, 101 μm wide) with fifteen pairs of simple setae; setae J1–J3 subequal (11 μm), J4 and J5 subequal (9 μm); setae J5 and S5 40 μm and 20 μm long respectively; area between J4 and J5 finely granulated medially; six pairs of short, simple, smooth setae present on lineated lateral membrane; peritreme visible dorsally extending upto setae z1 apically (Fig. 1).

Sternal shield smooth, 62 μm long, 61 μm wide; setae st1 placed on extended anterior portion of sternal shield; bilobed portion containing setae st1 finely granulated; setae st3 longer (13 μm) than subequal st1 and st2 (11 μm); metasternal setae placed on ventral membrane; epigynial shield with a pair of setae; ventral membrane beyond epigynial shield folded to form membrane; ventral membrane around ventri-anal shield with three pairs of ventral setae and platelets as depicted in fig. 2; metapodal platelets narrow, arranged lateral to body margin. Ventri-anal shield (78 μm long along midline, 100 μm wide) coarsely granulated posteriorly, with four pairs of setae, excluding a pair of para- and a post-anal setae. Peritreme narrow, stigma placed on anterior level of coxa IV; post-stigmatal prolongation of peritrematal shield extending posteriorly, encircling coxa IV.

Tectum trispinnate (Fig. 3). Ventrally gnathosoma with five rows of deutosternal denticles; anterior second row widest, with five teeth.

Leg setation normal for the genus *i.e.*, femora I–II–III–IV, 12–10–6–6, and that of tibiae 13–11–8–9; legs I–II–III–IV, 257 μm , 241 μm , 223 μm and 217 μm long respectively.

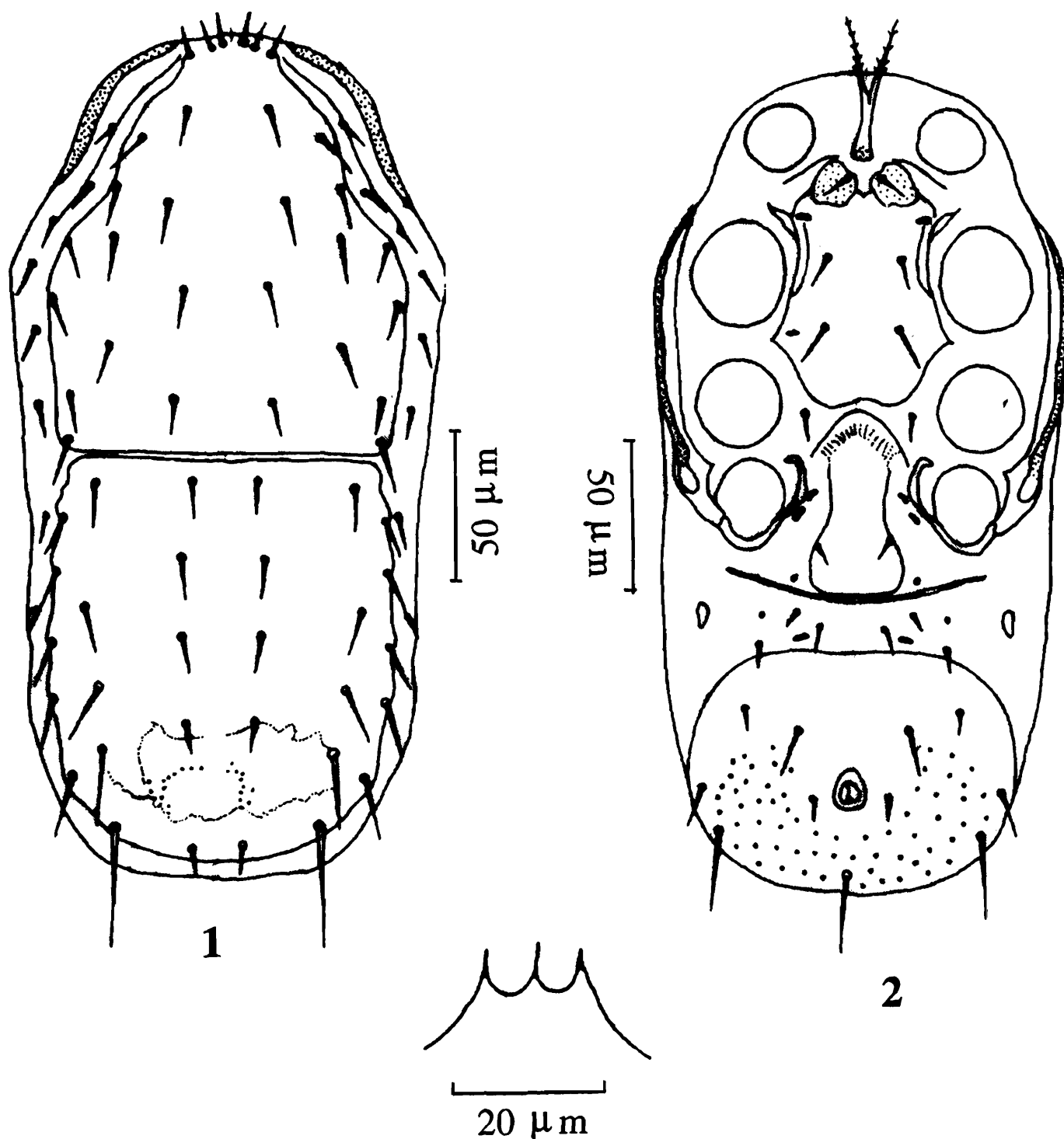
Male : Unknown.

Material examined : HOLOTYPE female, ex. soil; Kharia Mithapur, Jodhpur, Rajasthan; 20.i.2001; A. K. Bhattacharyya coll. PARATYPE : One female, data same as for holotype.

Differential diagnosis : The new species, *Gamasellodes jodhpurensis* shows its similarity with another Indian species *Gamasellodes islandicus* Bhattacharyya and Sanyal, 2002 in having similar shape of sternal and ventri-anal shield and tectum, nature and length of dorsal setae.

However, the new species differ from its allied species in the following aspects : setal disposition of j2, shorter length of j3, longer length of sternal setae st3, punctuated nature of ventri-anal shield and presence of exopodal shield.

Etymology : The specific designation *jodhpurensis* refers to the type-locality.



Figs. 1-3. : *Gamasellodes jodhpurensis* sp. nov., female : 1. Dorsum, 2. Venter, 3. Tectum.

Lasioseius prakashii sp. nov.

(Text-figs. 4–8)

Female : Dorsal shield (390 μm long along midline, 180 μm wide at their widest point) reticulated, with twenty-one pairs of simple to serrated setae; anterior region with twelve pairs of setae, nine pairs of setae on posterior region (Fig. 4); setae j1, r3, S5, Z5 and J5 33 μm , 48 μm , 60 μm , 70 μm and 12 μm long respectively; setae S5 and J5 borne on tubercles; lateral membrane with three pairs of short, simple lateral setae; peritreme visible dorsally, extending beyond apical setae anteriorly.

Tritosternum with long, pilose lacinae. Sternal shield (90 μm long along midline, 117 μm wide between two anterolateral corners) slightly convex posteriorly, with three pairs of setae, st1 longer (23 μm) than subequal st2 and st3 (15 μm); paired platelets flanking the base of tritosternum present anterior to sternal shield; metasternal shield with metasternal seta; genital shield truncate posteriorly, reticulated laterally, with paired genital setae. Peritreme moderately wide, stigma at level of coxa IV; post-stigmatal prolongation of peritrematal shield encircling coxa IV posteriorly. Ventri-anal shield (148 μm long along median line, 165 μm wide at their widest point) large, completely reticulated, with a total of fifteen setae; ventral membrane posterior to ventri-anal shield with two pairs of setae (Fig. 5).

Tectum denticulate, roughly circular in shape (Fig. 6). Ventrally seven rows of deutosternal denticles present in hypognathal groove; anterior second and seventh row with eleven and five teeth respectively.

Chaetotactic formulae of genua and tibiae of legs I–II–III–IV as follows : 13–11–9–9 and 13–10–8–10 respectively; length of legs I–IV, 437 μm , 318 μm , 307 μm and 443 μm respectively.

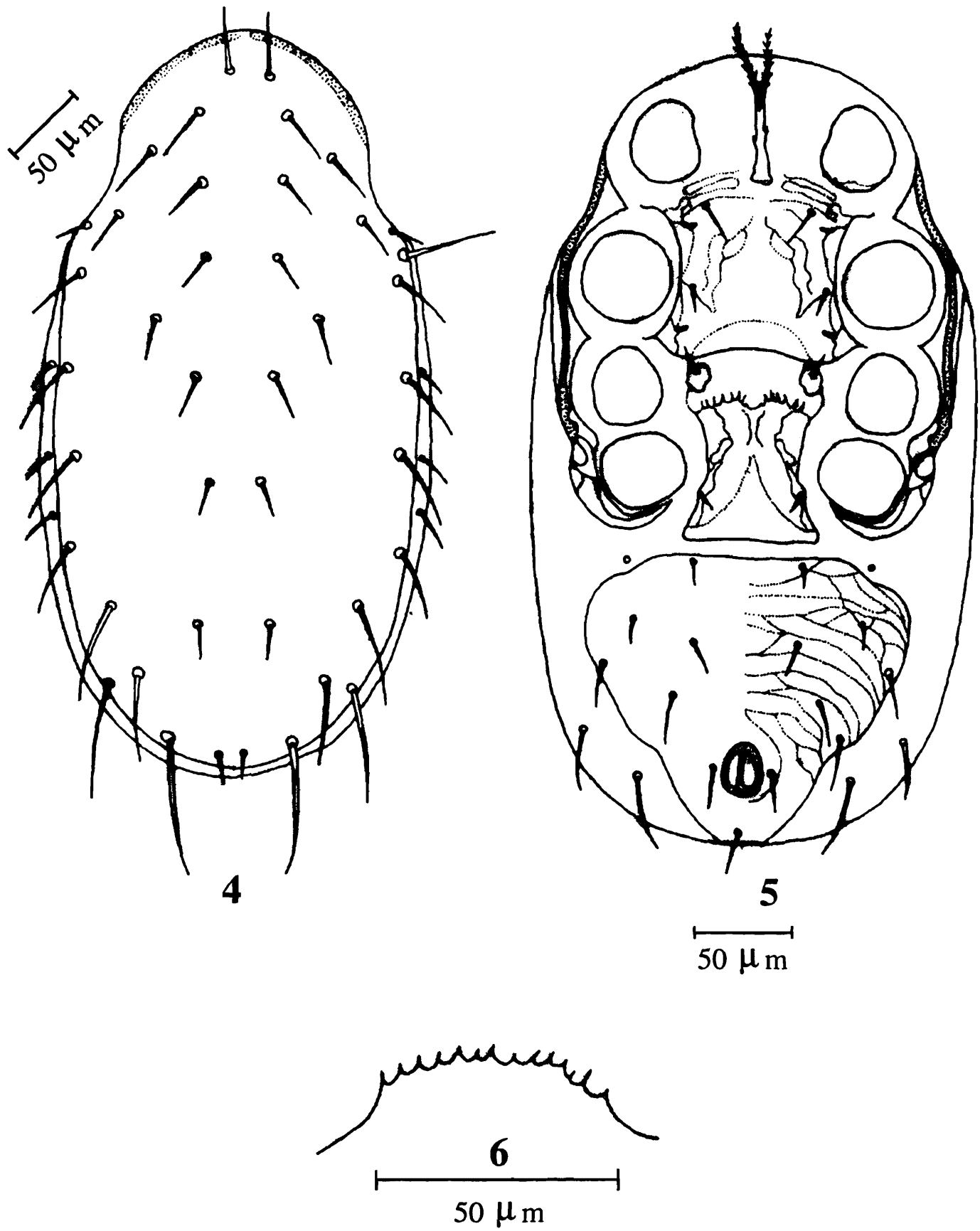
Male : Dorsal shield (278 μm long, 128 μm wide) with twenty pairs of setae, equally divided on anterior and posterior region; setae r3, j2, S5 and J5 32 μm , 28 μm , 51 μm and 9 μm long respectively (Fig. 7); reticulation of dorsal shield same as in female.

Tritosternum same as in female; sterniti-genital shield (117 μm long along midline, 51 μm wide along two anterolateral corners at level of setae st1) with three pairs of setae, st2 longest (11 μm). Peritreme moderately wide, stigma situated at level of upper half of coxa IV. Ventri-anal shield (104 μm long, 148 μm wide) reticulated, with fifteen setae (Fig. 8).

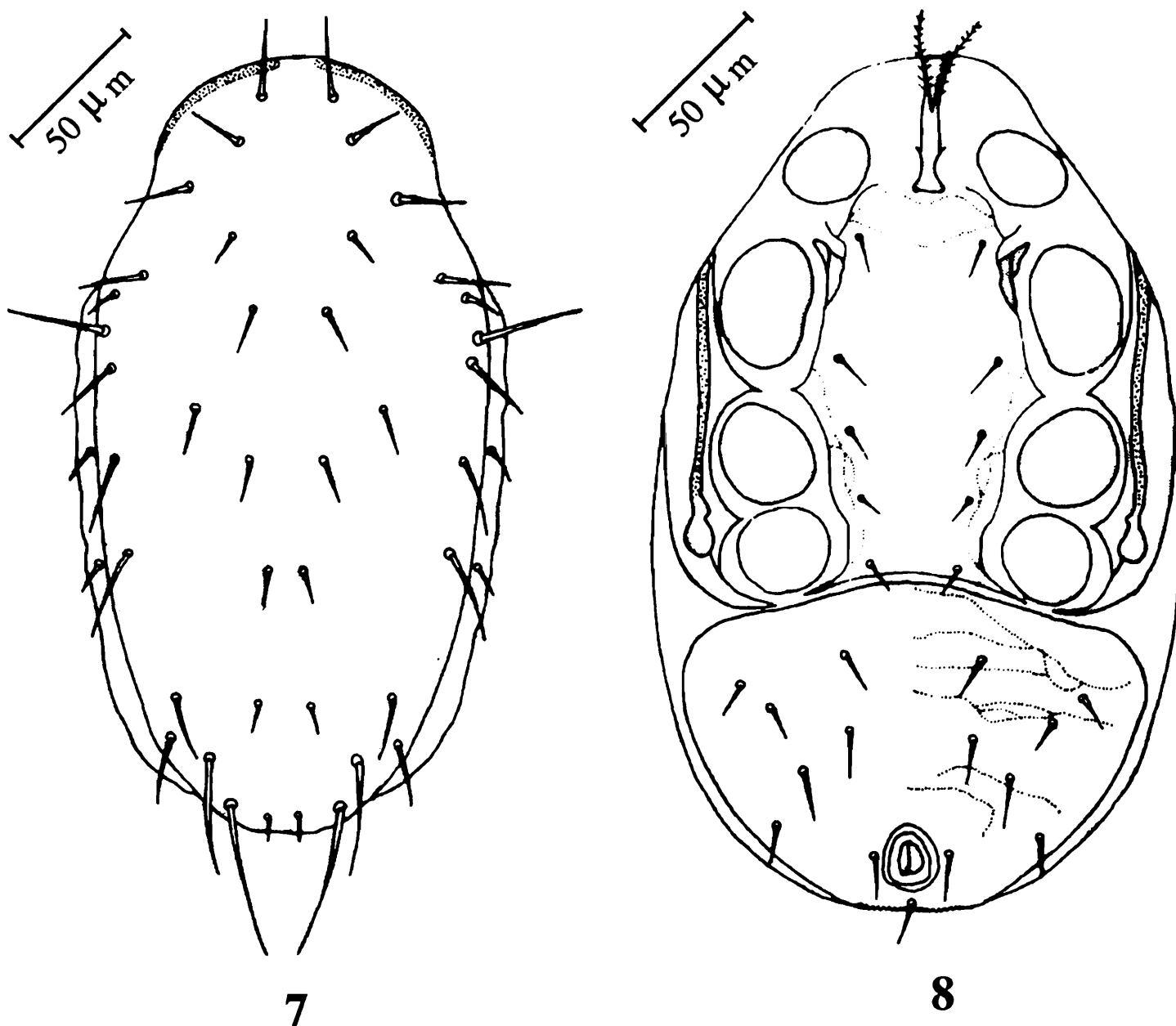
Tectum same as in female. Ventrally gnathosoma with seven rows of deutosternal denticles, with 9–15 teeth in each row, second row widest with fifteen teeth. Fixed cheliceral digit with nine teeth, spermatodactyl process long, movable cheliceral digit unidentate.

Sexual dimorphism absent in legs.

Material examined : HOLOTYPE female, ex. soil; Jaliwada, Jodhpur, Rajasthan; 15.i.2001; A. K. Bhattacharyya coll. PARATYPES : Two females, data same as for holotype. Two females,



Figs. 4-6. : *Lasioseius prakashii* sp. nov., female : 4. Dorsum, 5. Venter, 6. Tectum.



Figs. 7-8. : *Lasioseius prakashii* sp. nov., male : 7. Dorsum, 8. Venter.

ex. soil; Ghaseri, Jalore, Rajasthan; 6.xii.2001; A. K. Bhattacharyya coll. Three females, ex. soil; Kharia Mithapur, Jodhpur, Rajasthan; 20.i.2001; A. K. Bhattacharyya coll. Two females, ex. soil; Sri Vijaynagar, Sri Ganganagar, Rajasthan; 9.ii.2001; A. K. Bhattacharyya coll. One male, ex. soil; Sikwada, Jalore, Rajasthan; 6.xii.2000; A. K. Bhattacharyya coll.

Differential diagnosis : *Lasioseius prakashii* sp. nov. can be differentiated from its nearest congeneric species, *L. lindquisti* Nasr and Abou-Awad, 1987, in the following aspects : total number of setae on dorsal shield, shape of sternal shield, metasternal shield and tectum.

Etymology : The species is named after the name of late Dr. Ishwar Prakash, eminent Indian ecologist, considered an authority on desert ecology.

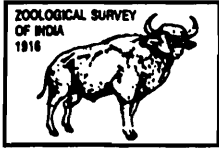
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Rec. zool. Surv. India : 103 (Part 1–2) : 99-102, 2004

***PLACOBDELLA HARASUNDARAI* (HIRUDINEA : GLOSSIPHONIDAE) A NEW SPECIES OF LEECH FROM WEST BENGAL, INDIA**

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INTRODUCTION

A new species of leech *Placobdella harasundarai* is described from West Bengal, and is known by six species of this genus from India. It is distinguished in possessing the following characters. One pair round eyes, Green in colour (in living). Three lines dorsal papilla palpable, others are not so. Breeding season is August to September : Eggs seven to ten in number. One mid ventral line. Anterior sucker triangular in shape. Terminal mouth opening; Posterior sucker almost round in shape. Anterior sucker is one fourth of the posterior sucker.

***Placobdella harasundarai* sp. nov.**

(Fig. 1 & 2)

Holotype : Z.S.I. Reg. No. An 3222/1, 1 ex., Coll. C. K. Mandal, 1.9.2002, Harasundarai pond, Vojerhat, South 24-Parganas, West Bengal, India.

Paratypes : Z.S.I. Reg. No. An 3223/1, Coll. C. K. Mandal, 1.9.2002, 1 ex., Harasundari pond, Vojerhat, South 24-Parganas, West Bengal, India.

Diagnosis : ***Colour*** : Green in colour in living, so beautiful that it is named as Green Queen leech of South 24-Parganas, Harasundari pond. The colour becomes faded in preserved state.

Body : Not transparent, so caeca are not visible. Body bears 60–65 segments.

Sucker : Anterior sucker triangular in shape, posterior sucker almost round in shape.

Length : The total length of *Placobdella harasundarai* 4.5–4.6 mm.

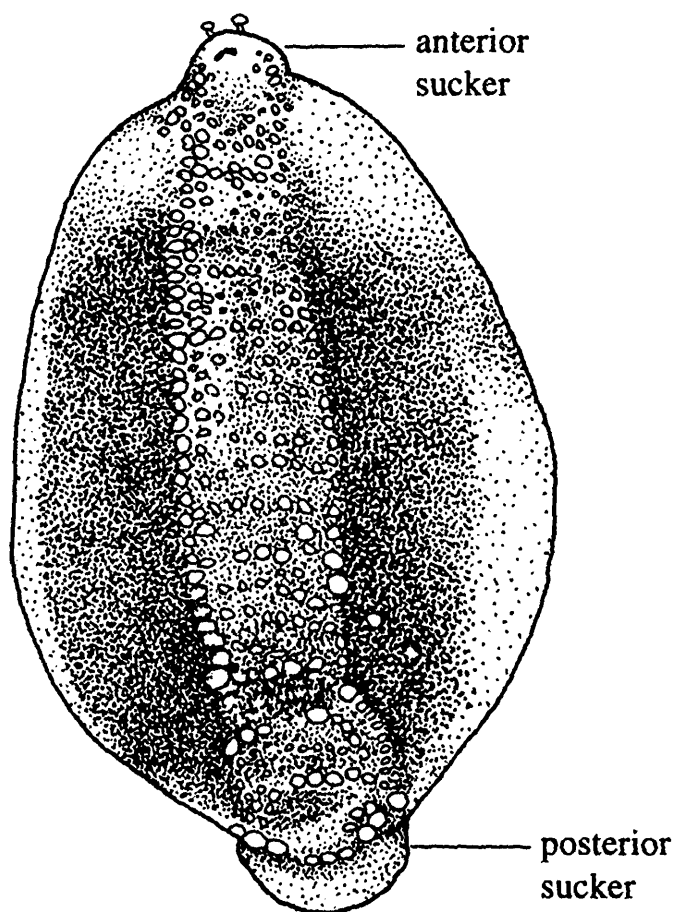


Fig. 1. : Dorsal view of the Leech *Placobdella harasundarai*.

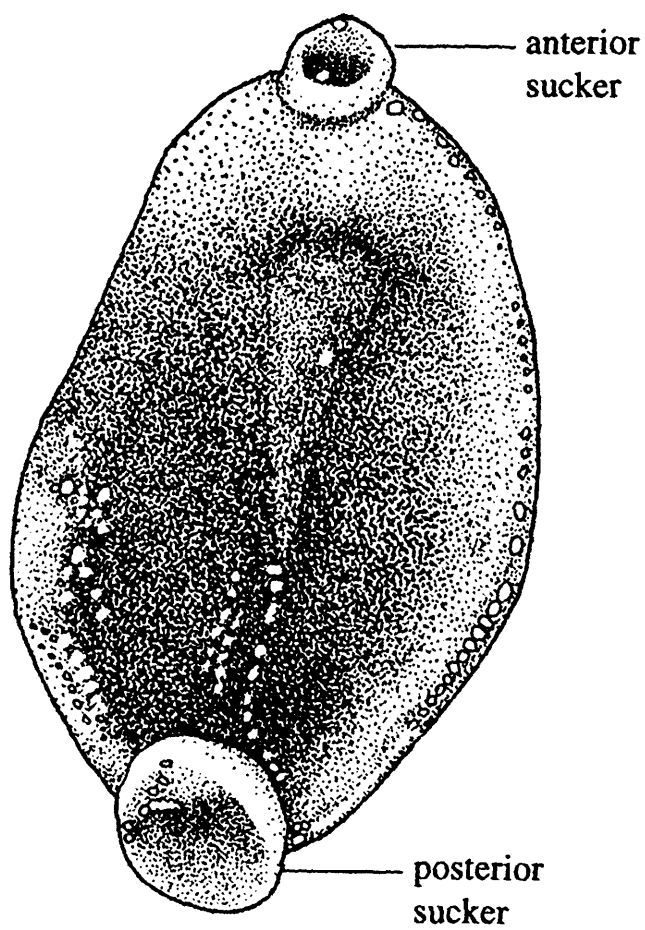


Fig. 2. : Ventral view of the Leech *Placobdella harasundarai*.

Breadth : 2.5 mm. and 3 mm. consecutively.

Distribution : India : West Bengal (Harasundari pond, Vojerhat, South 24-Parganas).

Breeding Season : August to September. During this time they form eggs and bear on the ventral side of the body. They bear 7–10 eggs around the gonopore in jelly like structure.

Remarks : The specific name is proposed according to the name of collection spot.

Comparision : Eyes one pair, round in shape in *Placobdella harasundarai*, coma shaped in *Placobdella emydae*, cup shaped in *Placobdella horai*, *Placobdella indica*, *Placobdella undulata* and three pairs of eyes in *Placobdella ceylanica*. Mouth opening triangular in *Placobdella harasundarai* but almost round in other six species. Posterior sucker is 1/4 of the broadest part of the body in *Placobdella harasundarai* and almost circular in shape. Circular posterior sucker of *Placobdella ceylanica* is 1/2 of the greatest width of the body, in *Placobdella emydae* posterior sucker is narrower than the widest part of the body, less than 1/2 of the body width in *Placobdella fulva*, almost 1/3 in *Placobdella horai* and *Placobdella undulata*. Breeding season in *Placobdella harasundarai* is August to September, May-July in *Placobdella emydae*, June-July in *Placobdella fulva* and *Placobdella horai*, May-July in *Placobdella undulata*. *Placobdella ceylanica* is parasitic on molluscs, frogs and turtles, *Placobdella emydae* on turtles, *Placobdella fulva* on fish and molluscs, *Placobdella horai* on prawn, fishes, *Placobdella undulata* on fishes, *Placobdella indica* on molluscs and *Placobdella harasundarai* on insect larvae and molluscs.

Host and Habitat : It is found in the pond, lakes under the submerged articles at the root of the water hyacinth or on the molluscs shells.

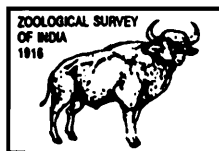
ACKNOWLEDGEMENTS

I am grateful to Dr. J. R. B. Alfred, Director, Zoological Survey of India, for facilities to carry out the work. I am also thankful to Dr. A. Misra, Officer in-charge, General Non-Chordata Section of the same Institution. My sincere thanks are also due to Dr. S. K. Chanda, Scientist SD, Zoological Survey of India (Retired), and Dr. S. K. Dutta, Head, Dept. of Zoology, Utkal University, for critically going through the manuscript.

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Rec. zool. Surv. India : 103 (Part 1–2) : 103-110, 2004

ENDEMIC LEECH FAUNA OF INDIA

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INTRODUCTION

The leeches which are found only in India are called “ENDEMIC LEECHES OF INDIA” The number of endemic leech fauna of India is in remarkable position in the world because of its identical situation and natural diversity. 32 species have been found in India which are not seen anywhere in the world. Out of 32, 21 species being freshwater, 4 species marine and 7 species are terrestrial.

Family PISCICOLIDAE

Genus *Branchellion*

1. *Branchellion plicobranchus* Sanjeeva Raj, 1954.

Type locality : Assumption land, Bay of Bengal, Tamil Nadu.

Type deposition : Z. S. I.

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

Genus *Ozobranchus*

2. *Ozobranchus polybranchus* Sanjeeva Raj, 1951.

Type locality : Porto Novo, Tamil Nadu.

Type deposition : Z. S. I.

Distribution : Tamil Nadu (Porto Novo).

Genus *Piscicola*

3. *Piscicola caeca* Kaburaki, 1921.

Type locality : Orissa (Chilka lake).

Type deposition : Not known.

Distribution : Orissa (Chilka lake).

Genus *Pterobdella*

4. *Pterobdella amara* Kaburaki, 1921.

Type locality : Orissa (Chilka lake).

Type deposition : Not known.

Distribution : Orissa (Chilka lake).

Genus *Batracobdella*

5. *Batracobdella hardingi* Baugh, 1960.

Type locality : Bihar (Monghyr).

Type deposition : Z. S. I.

Distribution : Bihar (Monghyr), Jammu and Kashmir.

6. *Batracobdella lobata* (Bhatia), 1934.

Type locality : Jammu and Kashmir (Srinagar).

Type deposition : Not known.

Distribution : Jammu and Kashmir.

7. *Batracobdella mahabiri* Baugh, 1960.

Type locality : Madhya Pradesh (Rewa).

Type deposition : Z. S. I.

Distribution : Madhya Pradesh (Rewa).

8. *Batracobdella reticulata* (Kaburaki), 1921.

Type locality : Punjab (Jalandhar).

Type deposition : Z. S. I.

Distribution : Punjab (Jalandhar), Himachal Pradesh, Maharashtra, Jammu and Kashmir.

Genus *Glossiphonia*

9. *Glossiphonia cruciata* Bhatia, 1930.

Type locality : Kashmir (Ahabal).

Type deposition : Not known.

Distribution : Jammu and Kashmir.

Genus *Helobdella*

10. *Helobdella nociva* Harding, 1924.

Type locality : Not known.

Type deposition : Not known.

Distribution : Himachal Pradesh, West Bengal, Orissa, Jammu and Kashmir.

Genus *Hemiclepsis*

11. *Hemiclepsis bhatiai* Baugh, 1960.

Type locality : Bihar (Kalipahar, Monghyr).

Type deposition : Z. S. I.

Distribution : Bihar, Jammu and Kashmir.

12. *Hemiclepsis marginata asiatica* Moore, 1924.

Type locality : Srinagar.

Type deposition : Z. S. I.

Distribution : Jammu and Kashmir, Bihar.

13. *Hemiclepsis viridis* Chelladurai, 1934.

Type locality : Kerala (Trivandrum).

Type deposition : Z. S. I.

Distribution : Kerala, Tamil Nadu (Ottacamund).

Genus *Paraclepsis*

14. *Paraclepsis praedatrix* Harding, 1924.

Type locality : Not known.

Type deposition : Not known.

Distribution : Himachal Pradesh, Haryana, Bihar, West Bengal, Assam, Rajasthan, Maharashtra, Jammu and Kashmir.

15. *Paraclepsis vulnifera* Harding, 1924.

Type locality : Tamil Nadu (Tanjore).

Type deposition : Not known.

Distribution : Himachal Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Jammu and Kashmir, West Bengal.

Genus *Placobdella*

16. *Placobdella fulva* Harding, 1924.

Type locality : Not known.

Type deposition : Not known.

Distribution : Bihar, Jammu and Kashmir, West Bengal.

17. *Placobdella horai* Baugh, 1960.

Type locality : West Bengal (Purulia).

Type deposition : Z. S. I.

Distribution : West Bengal, Bihar (Manbhum).

18. *Placobdella indica* Baugh, 1960.

Type locality : Bihar (Sitkundi, Monghyr).

Type deposition : Z. S. I.

Distribution : Bihar, Jammu and Kashmir.

Genus *Theromyzon*

19. *Theromyzon mathaii* Bhatia, 1939.

Type locality : Jammu and Kashmir (Srinagar).

Type deposition : Not known.

Distribution : Jammu and Kashmir.

Family ERPOBDELLIDAE

Genus *Foraminobdella*

20. *Foraminobdella heptamerata* Kaburaki, 1921.

Type locality : Tamil Nadu (Nedurattan).

Type deposition : Z. S. I.

Distribution : Tamil Nadu (Nilgiris).

Genus *Herpobdelloidea*

21. *Herpobdelloidea lateroculata* Kaburaki, 1921.

Type locality : Madhya Pradesh (Saugar).

Type deposition : Z. S. I.

Distribution : Rajasthan, Madhya Pradesh, Maharashtra, Manipur, Jammu and Kashmir, West Bengal, Andhra Pradesh.

Genus *Nematobdella*

22. *Nematobdella indica* Kaburaki, 1921.

Type locality : Himachal Pradesh (Dharampur).

Type deposition : Z. S. I.

Distribution : Rajasthan, Himachal Pradesh, Haryana, Jammu and Kashmir, West Bengal and Andhra Pradesh.

Family HIRUDIDAE

Genus *Dinobdella*

23. *Dinobdella notata* Moore, 1927.

Type locality : Not known.

Type deposition : Not known.

Distribution : Tamil Nadu.

Genus *Haemopsis*

24. *Haemopsis indicus* Bhatia, 1940.

Type locality : Kashmir (Pahalgam).

Type deposition : Not known.

Distribution : Jammu and Kashmir.

Genus *Poecilobdella*

25. *Poecilobdella viridis* Moore, 1927.

Type locality : Kerala (Travancore).

Type deposition : Z. S. I.

Distribution : Himachal Pradesh, Uttar Pradesh, Tamil Nadu, Kerala, Jammu and Kashmir.

Family HAEMADIPSIDAE

Genus *Haemadipsa*26. *Haemadipsa dussumieri* Blanchard, 1917.

Type locality : South India.

Type deposition : Paris Museum.

Distribution : South India (Andhra Pradesh).

27. *Haemadipsa montana* Moore, 1927.

Type locality : Tamil Nadu (Palni Hills).

Type deposition : Z. S. I.

Distribution : West Bengal, Sikkim, Arunachal Pradesh, Tamil Nadu.

28. *Haemadipsa moorei* Sanjeva Raj & Gladstone, 1981.

Type locality : Not known.

Type deposition : Not known.

Distribution : South India, Western ghat.

29. *Haemadipsa ornata* Moore, 1927.

Type locality : West Bengal (Darjeeling).

Type deposition : Z. S. I.

Distribution : West Bengal and Assam.

30. *Haemadipsa zeylanica agilis* Moore, 1927.

Type locality : Not known.

Type deposition : Not known.

Distribution : Himachal Pradesh, Uttar Pradesh, Arunachal Pradesh, Jammu and Kashmir, West Bengal.

31. *Haemadipsa zeylanica cochini* Moore, 1927.

Type locality : Kerala (Cochin).

Type deposition : Z. S. I.

Distribution : Tamil Nadu, Kerala, Maharashtra.

32. *Haemadipsa zeylanica montivindicis* Moore, 1927.

Type locality : West Bengal (Darjeeling).

Type deposition : Z. S. I.

Distribution : West Bengal, Assam, Sikkim and Arunachal Pradesh.

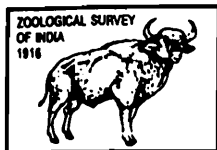
ACKNOWLEDGEMENT

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Rec. zool. Surv. India : 103 (Part 1–2) : 111-114, 2004

***PARACLEPSIS GARDENSI* (HIRUDINEA : GLOSSIPHONIDAE)
A NEW SPECIES OF LEECH FROM WEST BENGAL, INDIA**

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ABSTRACT

A new species of leech *Paraclepsis gardensi* is described from West Bengal, and is known by two species of this genus from India. It is distinguished in possessing the following characters : Eyes three pairs (2nd pair largest) stomach with seven pairs of caeca (Branched), mouth opening almost terminal, a bulb shaped structure on the dorsoventral part of the left anterior portion of the body, 18 greenish brown sub parallel longitudinal lines on the dorsal side 6 mid ventral. Length of a full grown preserved specimen is 10 mm. and width is 4.8 mm. Posterior sucker is 1 mm. in diameter. A living specimen resting in a dish is 28 mm. in length and 3.8 mm. in width.

***Paraclepsis gardensi* sp. nov.**

Holotype : Z.S.I. Reg. No. An 2768/1, 1 ex., Coll. C. K. Mandal, 25.6.1994, King Lake, Botanical Garden, Shibpur, Howrah, West Bengal, India.

Paratypes : Z.S.I. Reg. No. An 2816/1, Coll. C. K. Mandal, 6.6.19-95, 2 exs., Kalikapur field side pond, P.S. Barasat (N), 24-Parganas, West Bengal.

2 exs., Z.S.I. Reg. No. An 2785/1, 2785/2, Coll. C. K. Mandal, 21. 7. 1995, Mechagram, Midnapur District, West Bengal, India.

1 ex., Z.S.I. Reg. No. An 3221/1, Coll. C. K. Mandal, 1.9.2002, Vojerhat, South 24-Parganas, West Bengal.

Diagnosis : ***Colour*** : Raddish brown in living condition and greyish in preserved state.

Body : Ovate, continuous with the head region.

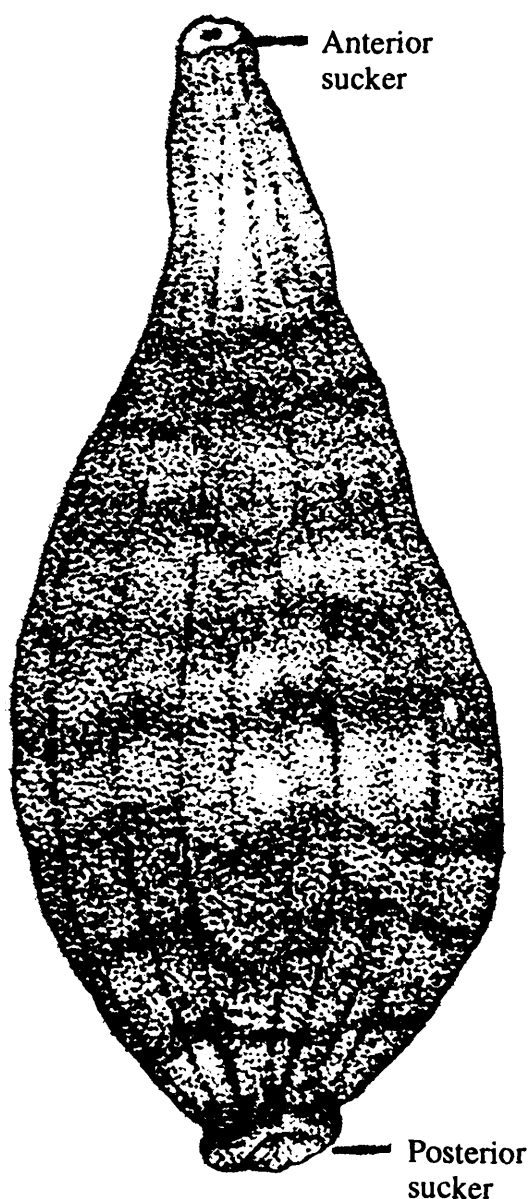
Length : The total length of *Paraclepsis gardensi* 10 mm. (in preserved state), 28 mm. in living.

Distribution : India : West Bengal (Howrah, Midnapur, North and South 24-Parganas).

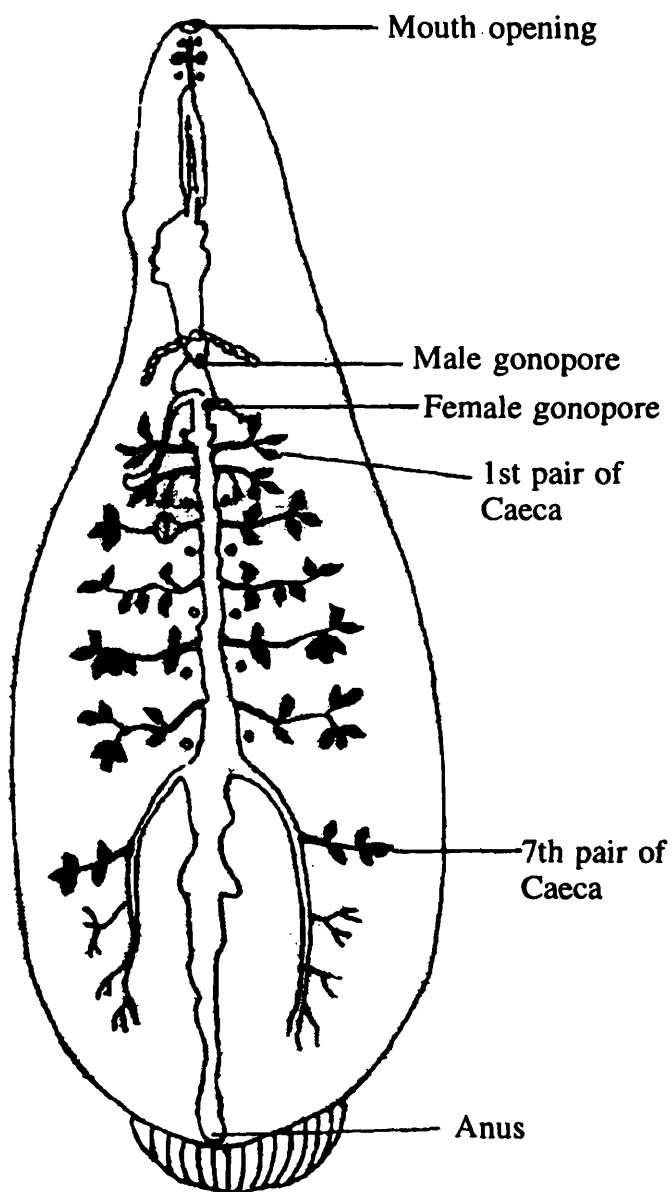
Breeding Season : April to August. During this time they form eggs and bear on the ventral side of the body. 5–7 eggs are found in the jelly like brood, within 20–25 days offsprings came out from the brood, taking rest for few hours leave the mothers body in search of food.

Remarks : The specific name is proposed according to the name of the place where from the first example was collected.

Comparision : *Paraclepsis gardensi* differs from other two species of the genus, so far recorded from Indian region. Dimention of eyes of the *Paraclepsis gardensi* varies from *Paraclepsis praedatrix* and *Paraclepsis vulnifera*. Third pair of eyes are largest in the two species where as in *Paraclepsis gardensi* 2nd pair largest. In *Paraclepsis gardensi* stomach is more branched than



Paraclepsis gardensi sp. nov.



Alimentary canal & caecal arrangement in the sp. nov.
Paraclepsis gardensi

other two species of the genus. In *Paraclepsis gardensi* mouth opening is horse-shoe shaped and terminal in position. In other two species the mouth opening is almost round and sub terminal. Bulb shaped structure is absent in *Paraclepsis praedatrix* and *Paraclepsis vulnifers*. 18 dorsal sub parallel lines and 6 ventral greyish green lines (2 mid ventral) in *Paraclepsis gardensi* but such number of lines are not present in other two species of the genus. Greatest length of *Paraclepsis gardensi* in preserved state is 10 mm. whereas 15.5 mm. in *Paraclepsis praedatrix*, and 14 mm. in *Paraclepsis vulnifera*.

Host and Habitat : It is found in ponds, lakes and canals where tortoises, snakes and frogs abound in.

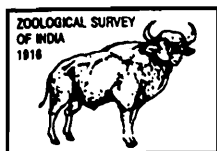
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Rec. zool. Surv. India : 103 (Part 1–2) : 115-121, 2004

THE LEGACY OF DR. NELSON ANNANDALE AND HIS CONTRIBUTION TO THE TAXONOMY OF PHLEBOTOMINE SANDFLY SPECIES (DIPTERA : PSYCHODIDAE : PHLEBOTOMINAE) TRANSMITTING LEISHMANIASIS¹

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INTRODUCTION

Dr. T. N. Annandale was an extraordinary professional zoologist and gifted with administrative foresight. Under the stewardship of Annandale, the Zoological Survey of India was established on 1st July 1916 from the Zoological and Anthropological section of then known Indian Museum. He was primarily instrumental in the activities of Zoological Survey of India and laid the foundation for research on taxonomic zoology in India. This paper presents Annandale's contribution to the taxonomy of phlebotomine sandflies of which some are vectors of bishmaniasis.

BIOGRAPHY OF ANNANDALE

Academic pursuit : Dr. Thomas Nelson Annandale, D.Sc., C.I.E., F.R.S., F.L.S., C.M.Z.S. (Fig. 1) was borne at Edinburgh on 15th June 1876. He was educated at Rugby and at Balliol College, graduating in 1898. In 1899 he joined the Sheat Expedition to Malay Archipelago. From 1902 to 1904 he held a research fellowship in Anthropology in the University of Edinburgh and was awarded the degree of D.Sc. in 1905.

Research and professional excellence : Annandale came to India in 1904 and joined the Indian Museum as Deputy Superintendent and later he was appointed as Superintendent in 1907.

¹Featured in 4th International Symposium on Phlebotomine Sandflies held in Salvador-Bahia, Brazil during August 3–7, 2002, as Entomol. Vect. 9 (Supl. 1) ISOPSIV, 2002 by the Universidade Gama Filho : 145 and abstracted in Zoological Record, Review of Applied Entomology, Quarterly Bibliography of Major Tropical Diseases & other international periodicals.

During this period he was responsible to bring out the Records of Indian Museum and Memoirs of the Indian Museum in 1907. He became the Director of Zoological Survey of India and continued to hold the post until his death in 1924.

Annandale was interested in wide groups of animal taxonomy, their field biology and ecology. He worked on sponges, polyzoa, fresh and brackish water molluscs, termite and termite mounds, true flies, lizards and snakes and published his findings in a series of volumes in the Fauna of British India, Ceylon and Burma, in the Records of Indian Museum and Memoirs of Indian Museum and in the Journals of Asiatic Society of Bengal, Bombay Natural History. For carriers of human disease, his works on the fresh water molluscs suspected vector of schistosomiasis and phlebotomine sand flies transmitting leishmaniasis are worth mentioning.



Fig. 1. Dr. Thomas Nelson Annandale

Annandale was an Honorary Secretary to the Trustee of the Indian Museum for several years, President of Asiatic Society of Bengal in 1923 and twice the Chairman of the Zoology Section of Indian Science Congress and its President in 1924. Dr. Annandale died in Calcutta on 10th April 1924 [sources, ZSI 1990].

ANNANDALE'S CONTRIBUTION TO PUBLIC HEALTH ZOOLOGY

Medical Malacology : When the incidence of schistosomiasis occurred among the Indian troops returning from South Africa during the World War, Dr. Annandale was entrusted to take up the aetiology of the disease and its possible intermediate host. In his search for the intermediate snail host, Annandale travelled as far as Seistan Persia and to several places in India. He provided wealth information about the Indian fresh water molluscs collected from wide range of ecosystems including hill streams, ponds and lakes (Annandale, 1920b).

Taxonomy of Phlebotomine sand fly vectors of leishmaniasis : At the beginning of 20th century, a series of studies was made by the Europeans to explore the Dipterans, among other faunas, of India. Their interest for Indian Dipterans is that they represented not only bewildering diversity but also some of them, a serious pest of agriculture crops and of human diseases. They also extensively travelled across the Indian subcontinent to collect the Dipterans fauna, which were deposited both in their museums and in the Indian Museum.

During this period, Dr. T. N. Annandale joined the Indian Museum in 1904 and laid strong foundation to study the lower Diptera and public health entomology. A special 3 days fever [pappataciefieber, subsequently known popularly as leishmaniasis] being transmitted by the bite of Phlebotomine sand fly species was prevalent in Southern Europe and was believed to occur also in some parts of Northern India (Brunetti, 1912). This public health problem led and inspired Dr. Annandale for studying the natural history and taxonomy of Indian *Phlebotomus* sp. Annandale extensively travelled the entire India and its neighbouring regions to collect sand flies, provided flawless description and deposited them in the National collection of ZSI.

CATALOGUE OF PHLEBOTOMINES DESCRIBED BY ANNANDALE

Annandale described 6 species of phlebotomines, which were subsequently treated under different genera and subgenera by the reviewers for taxonomic stability. Of the 6 taxa, 3 species are known as species complex and 2 species are now considered as major vectors of leishmaniasis. Their current catalogue, taxonomic status, geographical distribution and biology in reference to leishmaniasis are as follows :

Genus *Phlebotomus* Rondani & Berte

Subgenus *Euphlebotomus* Theodor

Phlebotomus argentipes Annandale & Brunetti

Phlebotomua argentipes Annandale & Brunetti in Annandale, 1908 : 101 [male, female]. Lectotype male [designated Quate (1962b : 157)], India : Calcutta, 28.xii.1907; monsoon forest (ZSI Calcutta).

P. argentipes var. *marginatus* Annandale; 1910b : 62 [female]. Holotype female, Sri Lanka : Peradeniya, v. 1909. [Types lost : Quate (1962b : 157).] [Synonymized by Sinton (1932a : 59).]

P. annandalei Sinton, 1923a : 744 [male]. Holotype male, India : Madras, Guindy, 1.ii.1922 (Dep?). [Synonymized by Sinton (1925a : 789).]

P. argentipes var. *glaucus* Mitra & Roy, 1953 : 372 [female]. Syntypes 10 female, India : Maharashtra, Pune (AFMC, Pune). [Synonymized by Lewis (1967a : 24).]

Distribution : Bangladesh, Burma, India, Indonesia, Laos, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam, Malaysia.

Biology : Geographical and biological variation may indicate a species complex; in parts of India it is markedly anthropophilic and an important vector of Visceral Leishmaniasis (Kala-azar) caused by *L. donovani* (Killick-Kendrick, 1990; Lane, 1988; Lewis, 1978, 1982, 1987 cited in Seccombe *et. al.*, 1993; Ilango *et. al.*, 1994). Based on the morphology, especially genital diversity as a source of species isolation and biogeography, *Phlebotonus argentipes* sensu lato has been revised to include 3 sibling species (Ilango, unpublished).

Subgenus *Larroussius* Nitzulescu

Phlebotomus major Annandale

Phlebotomus majo, Annandale, 1910a : 46 [male]. Lectotype male [designated Quate (1962b : 157)], India : Naini Tal; dry tropical scrub and thorn forest (ZSI Calcutta). Female : Sinton (1925b : 107).

P. major var. *grisea* Annandale 1911 : 320 (as var. of *major*). Syntypes, India : Darjiling, Kurseong, 1425 m, vi.1910 & iv.1911. [Types lost : Quate (1962b : 157).]

[Synonymized by Sinton (1932 : 59) & Quate (1962b : 157).]

P. crimicus Shtefko & Minkevich, 1923 : 52 [male, female]. Syntypes 1 male, 1 female, U.S.S.R. (MH, Sinferopol). [Synonymized by Perfil'ev (1966 : 279); poor description, position doubtful; Lewis (1982) suggested this may be *P. sergenti*.]

Distribution : India, Nepal, Pakistan, Thailand.

Biology : *P. major* s.l. has been infected with *L. infantum* (Adler & Theodor, 1957); occurs along Himalayan foot hills in India, where summer rains are heavy (Sinton, 1932a; Lewis, 1982 cited in Seccombe *et. al.*, 1993).

Notes : The *P. major* species complex is reviewed by Artemiev & Neronov (1984), Leger & Pesson (1987) and Lewis (1982). The taxa include *P. krimensis*, *P. major*, *P. neglectus*, *P. syriacus*, *P. wenyoni*, and *P. wui*, most of which have been referred to as *P. major* in the past (Seccombe *et. al.*, 1993).

Genus *Sergentomyia* Franca & Parrot

Subgenus *Neophlebotomus* Franca & Parrot

Sergentomyia malabarica (Annandale)

Phlebotomus malabarica Annandale, 1910a : 48. [male, female]. Lectotype male [designated Quate (1962b : 158)], India : Maddathurai, 16.xi.1908 (ZSI Calcutta).

Distribution : India.

Sergentomyia zeylanica (Annandale)

Phlebotomus zeylanica Annandale, 1910b : 60. [male, female]. Lectotype female [designated Quate (1962b : 158)], Sri Lanka : Peradeniya, 17.v.1910; tropical rainforest (ZSI Calcutta). Male : (as *P. chalami*) Young & Chalam (1927 : 849).

P. chalami Young & Chalam, 1927 : 849. [male, female]. Syntypes, India : Bombay, Colaba, 25.ix-5.x.1926 (BMNH 1 male, 1 female; (CRI.Kas.)).[Synonymized by Sinton (1928c : 319).]

Distribution : India, Sri Lanka.

Notes : Male of the type series of *zeylanica* reidentified as *P. argentipes*.

Subgenus *Parrotomyia* Theodor

Sergentomyia babu (Annandale)

Phlebotomus babu Annandale, 1910a : 49. [male,female]. Lectotype male [designated Quate (1962b : 158)], India : Calcutta, vi.1908; monsoon forest (ZSI Calcutta).

P. niger Annandale, 1911 : 320(as var. of *babu*). Syntypes, India : Bihar, Pusa. [believed lost (Quate, 1962b : 158).[Synonymized by Sinton (1932a : 60).]

P. thapari Mitra & Roy, 1952b : 188 [female]. Holotype female, India : Maharashtra, Pune ('Poona'), Hadapsar (Dep?). [Synonymized by Lewis (1978 : 257).]

Distribution : Afghanistan, Bangladesh, India Mauritius, Pakistan.

Biology : *S. babu* s.l. has been revised as the species complex with inclusion of *Sergentomyia babu* (Annandale) sensu stricto, *S. shorttii* Adler & Theodor, *S. baghdadis* Adler & Theodor, *S. insularis* (Theodor) and *S. yercaudensis* sp. nov. All 5 species are known exclusively from the Oriental Region. Their biology in relation to leishmaniasis, ecological distribution and adaptive radiation were discussed (Ilango, 2003).

Sergentomyia himalayensis Annandale

Phlebotomus himalayensis Annandale, 1910a : 50. [male, female]. Lectotype female [desinated Quate (1962b : 158)], India : Darjiling District, Kurseong, 1500m, 3.vii.1908; mountain vegetation (ZSI Calcutta).

Distribution : India.

SUMMARY

Dr. Thomas Nelson Annandale, the founder Director of Zoological Survey of India, has been widely remembered for his exceptional interest in studying from invertebrates to anthropology. Among the contributions of Annandale, phlebotomine sand fly species transmitting leishmaniasis and fresh water snails as suspected vectors of schistosomiasis are the most important studies relevant to India. Annandale discovered and described 6 species of phlebotomines, of which *Sergentomyia babu*, *Phlebotomus argentipes* and *P. major* are super/or complex of sibling species and the latter

two are important vectors of visceral leishmaniasis. The disease is caused by the protozoan parasite, *Leishmania donovani* being transmitted by the bite of *P. argentipes* prevalent in Bihar, Uttar Pradesh, West Bengal, Tamil Nadu and in Bangladesh and, *L. infantum* by *P. major* from the foot hills of Himalayan Regions in India, Nepal and Pakistan. Among the sand fly species complex, *Sergentomyia babu* and *Phlebotomus major* have been revised while *P. argentipes* needs to be studied at gamma taxonomic level as its varieties stand valid species status and that will have an important bearing on the vector incrimination and control. This paper presents a brief biography of Annandale, his impeccable studies on the taxonomy of phlebotomine sand flies, their current catalogue and status of species known to transmit leishmaniasis.

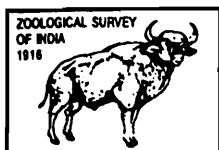
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Rec. zool. Surv. India : **103** (Part 1–2) : 123-130, 2004

DESCRIPTION OF THREE NEW SPECIES OF CRAB SPIDERS (ARANEAE : THOMISIDAE) FROM MADHYA PRADESH, INDIA

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INTRODUCTION

Crab spiders of the genus *Runcinia* Simon, 1875 are not well known from India. Simon (1895) described the species *Runcinia bifrons* and Reimoser (1934) described *Runcinia escheri* from India. Tikader (1965) described *Runcinia roonwali*; Sen and Basu (1972) described *Runcinia chauhani* and Tikader (1980) *Runcinia ghorpadei*. Recently, Gajbe and Gajbe (2000b) described the species *Runcinia yogeshi* from India.

Unlike other crab spider genera, the genus *Thomisus* Walckenaer, 1805 is well represented from India. Stoliczka (1869) described the species *Thomisus elongatus* and *T. pugilis*; Simon (1906) described *Thomisus granulifrons*, *T. leucaspis* and *T. rigoratus*. Dyal (1935) described two species *Thomisus albens* and *T. tuberculatus*. Tikader (1960) described the species *Thomisus bulani*, *T. dhakuriensis* and *T. projectus*. The species *Thomisus sikkimensis* was described by Tikader (1962) and *Thomisus katrajghatus* by Tikader (1963). Basu (1963) described *Thomisus sorajaii*; Sen (1963) described *Thomisus shillongensis*, and Sen and Basu (1963) *Thomisus memae*. Basu (1965) described one species *Thomisus beautifularis*, while Tikader (1965) described three species *Thomisus lobosus*, *T. pooneus* and *T. shivajiensis*. Tikader (1966, 1970) described *Thomisus cherapunjeus* and *T. rishus*, respectively. Tikader (1980) described *Thomisus andamanensis* from the Andaman Islands, Reddy and Patel (1992) described two species *Thomisus godavariae* and *T. krishnae*. Kumari and Mittal (1997) described two species *Thomisus dyali* and *T. ludhianaensis*. Recently, Gajbe and Gajbe (2000a) described the species *Thomisus sundari* and Bhandari and Gajbe (2001) *Thomisus rajani* from Madhya Pradesh, India.

A new species of the genus *Runcinia* Simon and two new species of the genus *Thomisus* Walckenaer are described herein from Madhya Pradesh. The type specimens will in due course be deposited with the National Zoological Collection, Zoological Survey of India, Kolkata.

SYSTEMATIC ACCOUNT

Family THOMISIDAE SUNDEVALL, 1833

Genus I. *Runcinia* Simon, 18751980. *Runcinia* Tikader, *Fauna of India, Spiders*, 1(1) : 58.

Diagnosis : Cephalic region with prominent ocular tubercles, clothed with hairs and spines. Legs long and stout, I and II remarkably longer than others. Abdomen long, spined, narrower behind. Lateral sides with conspicuous muscular corrugation.

Type species : *Runcinia grammica* (C. L. Koch, 1837)

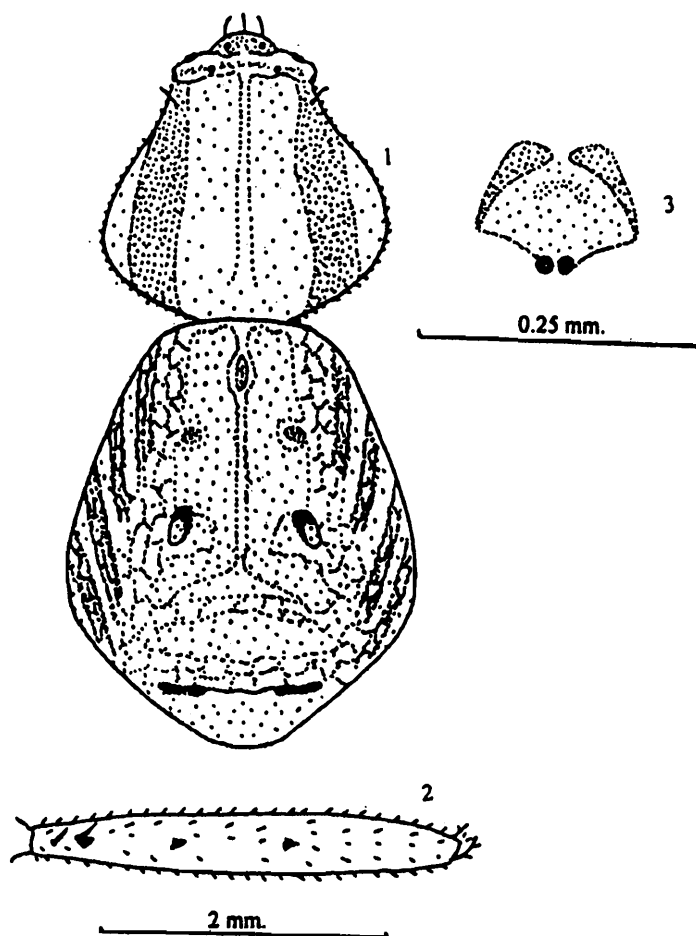
Distribution : Europe, Africa, Asia and Australia.

1. *Runcinia sitadongri* sp. nov.

(Figs. 1-3)

General : Cephalothorax, legs and abdomen brownish in colour. Total length 5.0 mm. Carapace 2.0 mm. long, 2.0 mm. wide; abdomen 3.0 mm. long, 2.5 mm. wide.

Cephalothorax : As long as wide, laterally with two longitudinal broad dark brown stripes, middle region with a longitudinal narrow chalk white stripe as in fig. 1. Eyes eight, black, arranged



Figs. 1-3. *Runcinia sitadongri* sp. nov. 1. Dorsal view of female, legs omitted. 2. Dorsal view of femur. 3. Epigyne.

in two rows; lateral eyes located on protuberance with greenish tinge, antero-lateral eyes largest. Cephalic region and clypeus with few spine-like hair, a spine-like hair present below each postero-lateral eye as in fig. 1. Maxillae dumbbell-shaped; labium slightly darker, as long as wide. Sternum heart-shaped, light brown, clothed with few hair. Legs I and II much longer than III and IV; femur I with two dorsal spines and three tiny dark brown spots as in fig. 2, femur II with one dorsal spine; tibiae and metatarsi I and II with a few long and prominent ventral spines.

Abdomen : Longer than wide, broadest just behind the middle, laterally with dark brown stripes; dorsum with three light brown spots in the anterior region, two oval blackish-brown spots in the middle region and two small black spots in the posterior region as in fig. 1. Ventral side lighter in colour, laterally with brownish stripes, the area between epigynal furrow and spinnerets with a light brown patch. Spinnerets clothed with hair, anterior- and posterior spinnerets equal in size. Epigyne present just above the epigynal furrow, appears as in fig. 3. Male unknown.

Type specimen : Holotype female, in spirit, other details as above.

Type locality : Sitadongri, Delakhari, Pachmarhi Biosphere Reserve, Chhindwara district, Madhya Pradesh, India; coll. Y N. Gupta, 18.x.2002.

Etymology : The specific name is a noun taken in appropriation from the type locality.

This species resembles *Runcinia chauhani* Sen & Basu but can be distinguished from it as follows : (i) A longitudinal narrow chalk white stripe present in the middle region of cephalothorax but absent in *R. chauhani*. (ii) A spine-like hair present below each postero-lateral eye but absent in *R. chauhani*. (iii) Two small black spots present in the posterior region of abdomen but absent in *R. chauhani*. (iv) Femur I with two dorsal spines and three tiny dark brown spots but in *R. chauhani* with four dorsal spines only. (v) Structure of epigyne different in both species.

Genus II. *Thomisus* Walckenaer, 1805

1980. *Thomisus* Tikadar, *Fauna of India, Spiders*, 1(1) : 30.

Diagnosis : Cephalothorax truncated in front, with the upper fore-corners strongly and conically protuberant and divergent, bearing the lateral eyes. Eyes small, black, antero-laterals largest. Abdomen narrow and truncated in front, enlarging to a considerable width behind, where at either corner of the dorsal side is a short blunt conical protuberance. Legs long, I and II much longer than III and IV.

Type species : *Thomisus onustus* Walckenaer, 1805.

Distribution : Europe, Africa, Asia, Australia and America.

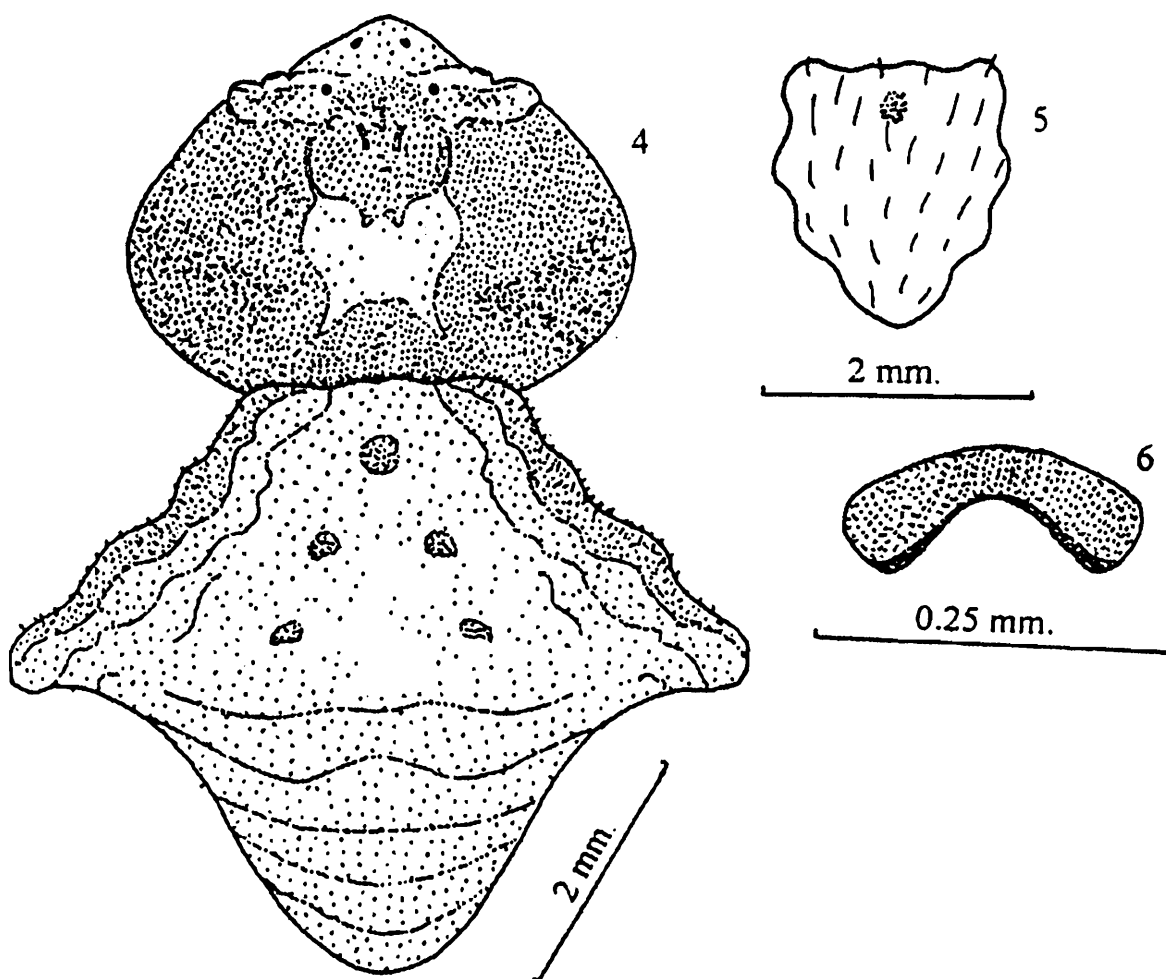
2. *Thomisus baghdeoi* sp. nov.

(Figs. 4-6)

General : Cephalothorax dark brown, legs and abdomen dark brown. Total length 7.5 mm. Cephalothorax 2.5 mm. long, 4.0 mm, wide; abdomen 5.0 mm. long, 6.0 mm. wide.

Cephalothorax : Wider than long, middle region with a heart-shaped light brown patch, postero-lateral region slightly darker as in fig. 4. Ocular protuberance light brown. Maxilla and labium light brown, clothed with hair, labium longer than wide. Sternum light brown, heart-shaped, clothed with hair, a small brownish spot present in the anterior region as in fig. 5. Chelicera light brown, clothed with hair. Legs clothed with hair, provided with some whitish patches, metatarsus I with five pairs of ventral spines.

Abdomen : Pentagonal, wider than long, strongly overlapping cephalothorax, ending in two raised tubercles, antero-lateral region blackish-brown, anterior end and antero-lateral border covered with light brown setae as in fig. 4. Dorsum depressed, with muscular corrugations laterally and posteriorly, provided with five dark brown spots as in fig. 4. Ventral region with transverse muscular corrugations. Spinnerets dark brown, anterior spinnerets thicker than others. Epigyne consisting of a sclerotised plate with an inverted U-shaped dark brown marking as in fig. 6. Male unknown.



Figs. 4-6. *Thomisus baghdeoi* sp. nov. 4. Dorsal view of female, legs omitted. 5. Sternum. 6. Epigyne.

Type specimen : Holotype female, in spirit, other details as above.

Type locality : Baghdeo, Pench Tiger Reserve, Seoni district, Madhya Pradesh, India; coll. M. L. Koshta, 27.vii.2001.

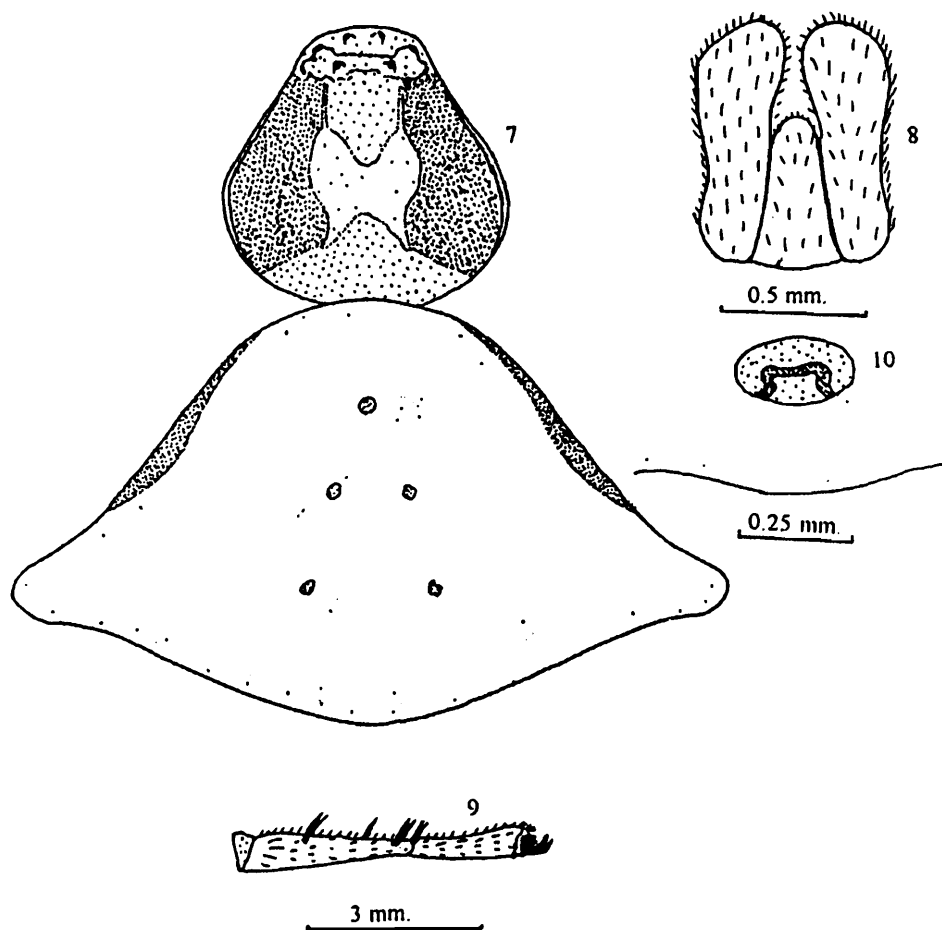
Etymology : The specific name refers to the type locality.

This species resembles *Thomisus projectus* Tikader but can be distinguished from it as follows : (i) Cephalothorax and abdomen dark brown but in *T. projectus* cephalothorax greenish and abdomen chalk white. (ii) Middle region of cephalothorax with a heart-shaped light brown patch, which is absent in *T. projectus*. (iii) Anterior region of sternum with a small brownish spot. (iv) Anterior end and antero-lateral border of abdomen covered with light brown setae. (v) Raised tubercles of abdomen without any spots but in *T. projectus* each tubercle with a black spot. (vi) Structure of epigyne different in both species.

3. *Thomisus kokiwadai* sp. nov.

(Figs. 7-10)

General : Cephalothorax dark brown, legs light brown and abdomen chalk white. Total length 12.0 mm. Carapace 4.5 mm. long, 4.5 mm. wide; abdomen 7.5 mm. long, 12.0 mm. wide.



Figs. 7-10. *Thomisus kokiwadai* sp. nov. 7. Dorsal view of female, legs omitted. 8. Labium and maxillae. 9. Ventral view of I metatarsus. 10. Epigyne.

Cephalothorax : As long as wide, lateral half with a broad dark brown patch and a chalk white patch in the middle region; area below the ocular region and the chalk white patch lighter in colour as in fig. 7. Eyes eight, black, in two recurved rows, lateral eyes on chalk white conical protuberance, antero-lateral eyes largest, ocular quad narrowing in front. Pedipalp clothed with hair and some spines, with one claw. Sternum heart-shaped, clothed with hair, light brown in colour. Maxilla and labium light brown, clothed with hair, labium one and half times longer than wide as in fig. 8. Legs I and II much longer than III and IV, all the legs clothed with hair and provided with some chalk white patches, metatarsi I and II with seven ventral spines each as in fig. 9.

Abdomen : As wide as the entire length of body, pentagonal, globular, widest and sloping in the posterior region, antero-lateral region with narrow dark brown patch, five small dark brown spots on the dorsum as in fig. 7. Ventral region chalk white, area between the epigynal furrow and spinnerets light brown with four pairs of small brownish spots. Spinnerets dark brown, posterior spinnerets longest. Epigyne oval, dark brown, surrounded with hairs, as in fig. 10. Male unknown.

Type specimen : Holotype female, in spirit, other details as above.

Type locality : Kokiwada, Pench Tiger Reserve, Madhya Pradesh, India; coll. K. Chandra, 25.xi.2001.

Etymology : The specific name refers to the type locality.

This species resembles *Thomisus lobosus* Tikader but can be distinguished from it as follows : (i) Lateral half of cephalothorax with a broad dark brown patch but in *T. lobosus* with longitudinal light brown to deep brown patches. (ii) Metatarsi I and II with seven ventral spines but in *T. lobosus* with four pairs of ventral spines. (iii) Anterolateral region of abdomen with narrow dark brown patch but in *T. lobosus* with some black spots. (iv) Structure of epigyne different in both species.

SUMMARY

Three new species of crab spiders, viz., *Runcinia sitadongri* sp. nov., *Thomisus baghdeoi* sp. nov. and *Thomisus kokiwadai* sp. nov. have been described from Madhya Pradesh.

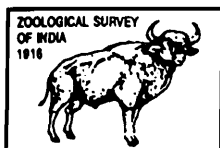
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Rec. zool. Surv. India : **103** (Part 1–2) : 131-142, 2004

STUDIES ON SOME SPIDERS OF THE FAMILIES OECOBIIDAE, ERESIDAE, HERSILIIDAE, UROCTEIDAE AND ULOBORIDAE (ARANEAE : ARACHNIDA) FROM MADHYA PRADESH, INDIA

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INTRODUCTION

The spiders of the families Oecobiidae, Eresidae, Hersiliidae, Urocteidae and Uloboriade are little known from Madhya Pradesh. Pocock (1900) in his Fauna of British India described some species. Gravely (1921) described many species of some families. Sinha (1950) described many species of the family Hersiliidae. Tikader (1962,63,69,70,77) and Tikader & Biswas (1981) described some species of all the families.

Family 1. OECOBIIDAE

Characters : The members of this small family have three claws, both the carapace and sternum wider than long. The spiders live under stones, but are often found in houses, especially in corner angles of walls.

There is a striking similarity between oecobiidae and the ecribellate family Urocteidae of the old world. Some American workers prefer to consider both as sub-families within the same family, in this case, the name Oecobiidae having priority, should be used. Beside the presence or absence of calamistrum and cribellum only minor external differences can be found.

The most common genus is *Oecobius* with four species so far known from India.

Genus 1. *Oecobius* Lucas

1845. *Oecobius* Lucas, *Expt. Alg. Ar.*, : 101.

1981. *Characters* : This is the best known genus of the family. The cephalothorax is convex and moderately elevated. The legs are proportionately long, the metatarsus and tarsus together of

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each of the legs far exceeding the carapace in length. Median ocular quadrangle as long as, or longer than broad.

This spider makes small flat webs on window sills, and over cracks on the walls of buildings.

Type-species : *Oecobius domesticus* Lucas.

Distribution : America, Arabia, Japan and India.

1. *Oecobius putus* O.P. Cambridge

1876. *Oecobius putus* Cambridge, *Proc. zool. Soc.* : 544.

Specimens Examined : 5 ♀♀, office premises of Central Regional Station, Napier Town, Jabalpur, Madhya Pradesh, Coll. U. A. Gajbe, 6.IV.1985 (Reg. No. A/1793). 1 ♀, P.W.D. Rest House Piparia, Hoshangabad dist., Madhya Pradesh Coll. U. A. Gajbe, 7.1.1990 (Reg. No. A/1994). 5 ♀♀, Amanpur, Madan Mahal, Jabalpur, Madhya Pradesh, Coll. U. A. Gajbe, 28.VI.1982. (Reg. No. A/1795).

General : Cephalothorax and abdomen light deep to brown, legs pale green. Total length 2.60 mm. Carapace 0.90 mm long, 1.10 mm wide; abdomen 1.80 mm long, 1.10 mm wide.

Cephalothorax : Wider than long, depressed on the centre but cephalic region slightly high and eyes groups situated on the top, margin encircled by a deep brown line. Eyes unequal in size and dissimilar in form. The anterior medians and posterior lateral eyes dark in colour and others pearly white; posterior medians triangular in size, both rows procurved but anterior row more procurved than posterior. Legs long, clothed with five long hairs and all legs transversely banded with dark brown bands but in male no such bands.

Abdomen : Long, slightly pointed behind, clothed with long hairs, dorsum ornamented by dark and chalk-white irregular patches, middorsally with a spear-shaped black area extending from base to behind the middle. The hind spinnerets long and two joined; the second segment longer than the first and furnished with a comb of long spinning tubes on the inner side.

Distribution : INDIA : Madras, Tamil Nadu; Poona, Maharashtra; Kolkata, West Bengal; Jabalpur, Hoshangabad, Madhya Pradesh; Egypt, Tripoli, Yemen, Tanjanyika, Lahore.

Remarks : This species is being reported here for the first time from Madhya Pradesh.

Family II ERESIDAE

Characters : Cephalothorax very wide in front (resembling at first sight that of Salticidae); cephalic region high; the clypeus low; the four median eyes forming a small quadrangle narrower in front than behind; the posterior lateral far removed from the rest of the eyes and situated high up on the posterior portion of the head. Abdomen very heavy, over hanging, cephalothorax; cribellum thick, transversely divided.

Genus 2. *Stegodyphus* Simon

1873. *Stegodyphus* Simon, *Ann. Soc. Ent. Fr.*, 3(5) : 336.

Characters : Cephalic region large, rounded, high, posterior lateral eyes remote from other eyes; anterior lateral eyes situated at the edge of clypeus; clypeus low, mandibles flat in front, fang groove scarcely toothed; legs strong and stout, spiny. Abdomen oval; anterior spinnerets thick.

The species of the genus occur on bushes or branches of trees, where they spin either large sheet-like webs, accompanied by a tubular retreat, or a large saccular nest, in which many individuals live, gregariously habits among spiders.

Type-species : *Stegodyphus lineatus* Latreille.

Distribution : Asia, Arabia, Africa.

2. *Stegodyphus sarasinorum* Karsch

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

Specimens examined : 5 ♀♀, 1 ♂, Dhaurai village, Narayanpur, Tahsil, Baster dist., Coll. U. A. Gajbe, 24.XII.1983. (Reg. No. A/1782). 43 ♀♀, Forest Rest House, Katwadi, Coll. H. S. Sharma, 22.III.1990. (Reg. No. 1783). 144 ♀♀, Barghat, Seoni dist. Coll. U. A. Gajbe, 7.III.1987. (Reg. 1784). 83 ♀♀, Dokrikhera, Hoshangabad dist., Coll. U. A. Gajbe, 4.I.1990. (Reg. No. A/1785). 29 ♀♀, on the bank of Ramdohu river on way to Chhindwara– Chand road, Chhindwara dist., Coll. H. S. Sharma, 3.IV.1990. (Reg. No. A/1786). 1 ♂, P.W. D. Rest House, Amanganj, Panna dist. Coll. R. K. Singh, 21.II.1987. (Reg. No. A/1787). 125 ♀♀, patch village on way to Katawadi Shahpur road, Betul dist. Coll. H. S. Sharma, 21.III.1990. (Reg. No. A/1788), Kairagad, Rajnandgaon dist., Coll. U. A. Gajbe, 20.XII.1983. (Reg. No. A/1789). 57 ♀♀, Bhesdehi, Betul dist., Coll. H. S. Sharma, 31.III.1990. (Reg. No. A/1790). 1 ♀, Tanhai Village, Panna dist., Coll. R. K. Singh, 17.II.1987. (Reg. No. 1791). 10 ♀♀, 2 ♂, Near Jaon, Ratlam dist., Coll. R. K. Singh, 24.VIII.1990. (Reg. No. A/1803). 78 ♀♀, 2 ♂♂, Near Gandhi Sagar, Mandsaur dist., Coll. R. K. Singh, 17.VIII.1990. (Reg. No. A/1805). 62 ♀♀, 4 ♂♂, Near Tal, Ratlam dist., Coll. R. K. Singh, 25.VIII.1990. (Reg. No. A/1806). 78 ♀♀, 17 ♂♂, Near Bharthari cave, Ujjain dist., Coll. R. K. Singh, 29.VIII.1990. (Reg. No. A/1807). 22 ♀♀, 7 ♂, Mangalnath, Ujjain dist., Coll. R. K. Singh, 11.IX.1990. (Reg. No. A/1808). 29 ♀♀, 4 ♂♂, Bherogarh, Ujjain dist., Coll. R. K. Singh, 1.IX.1990. (Reg. No. A/1808). 45 ♀♀, 2 ♂, Near Rampura, Manasa, Mandsaur dist., Coll. R. K. Singh, 17.VIII.1990. (Reg. No. A/1810). 28 ♀♀, 2 ♂, Near Jaora, Ratlam dist., Coll. R. K. Singh, 26.VIII.1990. (Reg. No. A/1811). 6 ♀♀, 1 ♂, Near Kalladeh, Ujjain dist., Coll. R. K. Singh, 30.VIII.1990. (Reg. No. A/1312). 33 ♀♀, 5 ♂♂, Khachrod, Ujjain dist., Coll. R. K. Singh, 31.VIII.1990. (Reg. No. A/1813). 16 ♀♀, Near Chintamani Ganesh, Ujjain dist., Coll. R. K. Singh, 3.IX.1990. (Reg. No. A/1814). 52 ♀♀, 11 ♂♂, Near Manasa, Mandsaur dist., Coll. R. K. Singh, 15.VIII.1990. (Reg. No. A/1815). 39 ♀♀, 4 ♂, Near Bhanpura, Mandsaur dist., Coll. R. K. Singh,

16.VIII.1990. (Reg. No. A/1816). 20 ♀♀, Near Jaju Dam, Nimach, Mandsaur dist., Coll. R. K. Singh, 13.VIII.1990. (Reg. No. A/1817). 121 ♀♀, 22 ♂, Near Hussain Tekri Jaora, Ratlam dist., Coll. R. K. Singh, 20.VIII.1990. (Reg. No. A/1818). 51 ♀♀, 6 ♂♂, Near Mudali Village, Malhargarh, Mandsaur dist., Coll. R. K. Singh, 20.VIII.1990. (Reg. No. A/1819). 63 ♀♀, 3 ♂♂, Near Nagda, Ujjain dist., Coll. R. K. Singh, 18.VIII.1990. (Reg. No. A/1820). 1 ♀, Near Garod, Mandsaur dist., Coll. R. K. Singh, 18.VIII.1990. (Reg. No. A/1821). 1 ♀, Near Alot, Ratlam dist., Coll. R. K. Singh, 22.VIII.1990. (Reg. No. A/1824). 1 ♀, Ratangarh, Nimach, Mandsaur dist., Coll. H. P. Agrawal, 1.XI.1990.

This spider is gregarious in its habits. It spins a labyrinthine tube, which ends blindly at one end and the other end expands into a broad sheet, which however is smaller than that spun by the genus *Hippasa*. This species does not sting the prey to death, but feeds on the captive alive. All members of the colony sharing the same victim. Spiderlings hatch in the month of October and November and feed on their parents, hibernating in the web tubes in winter.

Distribution : INDIA : Travancore, Bangalore, Chingleput, Bilaspur, Poona, Uran, Calcutta, Barkuda Islands, Punjab and Madhya Pradesh.

3. *Stegodyphus socialis* Pocock

1900. *Stegodyphus socialis* Pocock, *Fauna Brit Indis, Arach.* : 209.

Specimens examined : 1 ♀, Forest Rest House, Hoshangabad, Madhya Pradesh, Coll. U. A. Gajbe, 13.I.1990. (Reg. No. A/1792).

Distribution : INDIA : Bangalore, Karnataka; Ahmednagar, Maharashtra; Hoshangabad, Madhya Pradesh.

Remarks : This species is being reported here for the first time from Madhya Pradesh.

Family III HERSILIIDAE

Characters : The species of the family are very active spiders, living on tree trunks, old walls, or under stones and at most spinning a scanty web of irregular threads. Cephalothorax as wide as long, with cephalic region elevated, narrow and defined by a deep semicircular sulcus; eyes of anterior and posterior row strongly recurved, the anterior laterals standing high up half way between the anterior and posterior. Mandibles weak, at most weakly toothed below : maxillae inclined obliquely on the labium. Legs except III pair, very long and slender armed with three claws. Abdomen short, subpentagonal, posterior spinnerets very long usually longer than the abdomen.

Distribution : Africa, South Asia, Australia, South America.

Genus 3. *Hersilia* Audouin

1826. *Hersilia* Audouin, *Derocr. Egypte Arachn.*, : 114.

Characters : Ocular quadrangle parallel sided; head flat, angular laterally; clypeus usually very high, prominent, protarsi of Ist, IInd and IV legs bisegmented.

Type-species : *Hersilia caudata* Audouin.

Distribution : Africa, Madagascar, Oriental region.

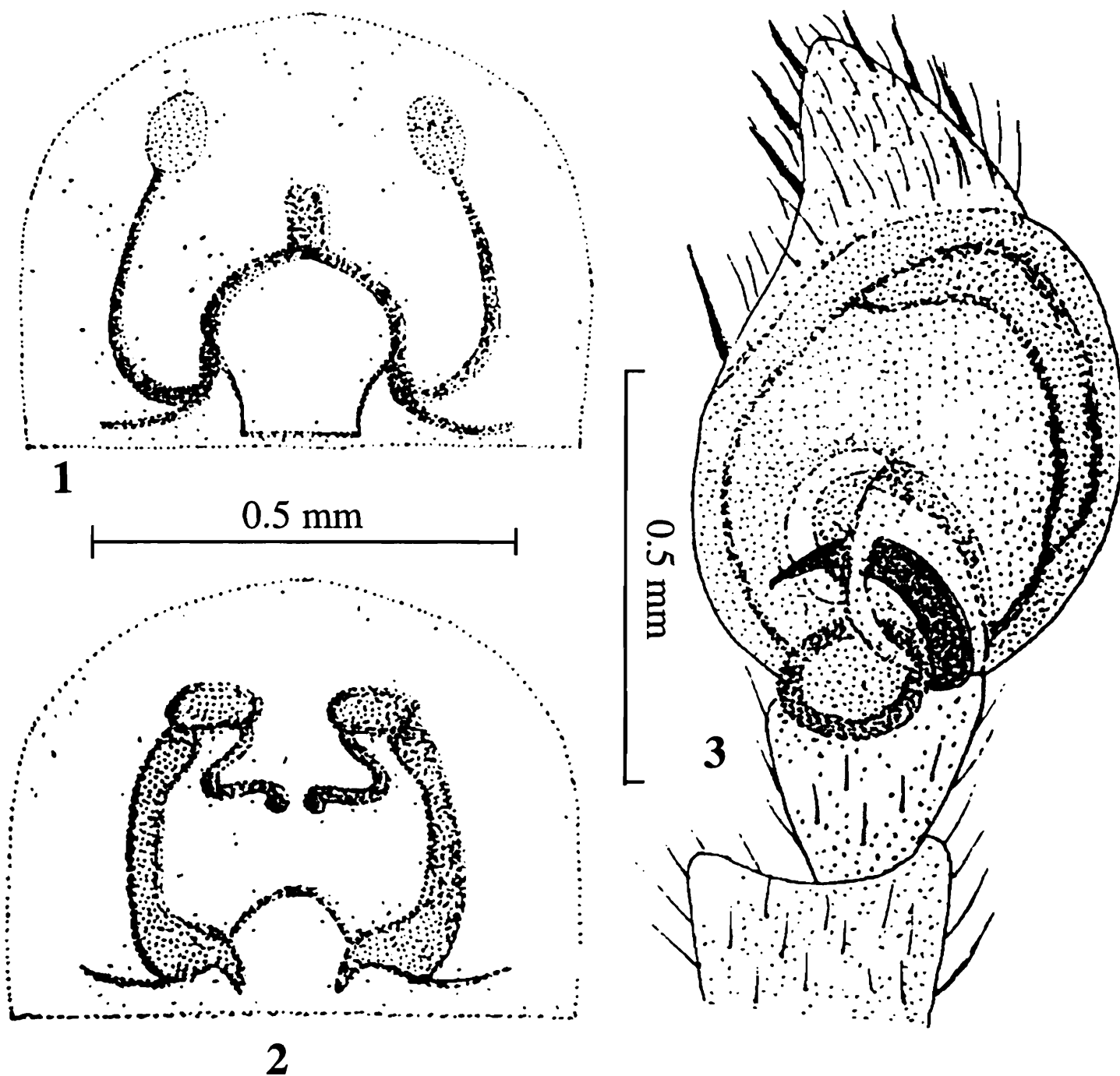
4. *Hersilia savignyi* Lucas

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

Specimens examined : 2 ♀♀, 1 ♂, Around hot water tank on Jabalpur Mandla Road, dist. Mandla, Madhya Pradesh, Coll. U. A. Gajbe, 4.V.1982. (Reg. No. A/1665). 1 ♀, Narayanganj, dist. Mandla, Madhya Pradesh, Coll. U. A. Gajbe, 23.I.1985. (Reg. No. A/1666). 1 ♀, Borla, dist. Rajnandgaon, M.P., Coll. U. A. Gajbe, 1.I.1984. (Reg. 1667). 3 ♂♂, Dhaurai Village, Near Narayanpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 24.XIII.1983. (Reg. No. A/1668). 1 ♀, Chotedonger, dist. Bastar, M.P., Coll. U. A. Gajbe, 28.XII.1983. (Reg. No. 2258). 2 ♀♀, Tondabeda Village Near Orccha, dist. Bastar, M.P., Coll. U. A. Gajbe, 29.XII.1983. (Reg. No. A/2253). 4 ♀♀, 1 ♂, Garhbengal village near Narayanpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 30.XII.1983. (Reg. No. A/2255). 7 ♀♀, 1 ♂, Hatakchora village near Jagdalpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 2.I.1984. (Reg. No. A/2254). 1 ♀, P.W.D. Rest House Compound, Jagdalpur, dist. Bastar, M.P., Coll. U. A. Gajbe, 2.I.1984. (Reg. No. A/1673). 1 ♀, Near Tal, Ratlam dist., M.P., Coll. R. K. Sharma, 25.VIII.1990. (Reg. No. A/1847). 1 ♂, Near Mainpura village, Mandsaur district, M.P., Coll. R. K. Singh, 11.VIII.1990. (Reg. No. A/1848). 7 ♀♀, 4 ♂, Banjar village, Baihar Tahsil, Balaghat district, M.P., Coll. R. K. Ghose, 25.I.1991. (Reg. No. A/1849). 11 ♀♀, 3 ♂, Around Forest Rest House Mukki, Balaghat district, M.P., Coll. R. K. Ghose, 24.I.1991. (Reg. No. A/1851). 1 ♀, Kanha Rest House, Kanha, Mandia district, M.P., Coll. R. K. Ghose, 24.I.1991. (Reg. No. 1852).

General : Cephaloghorax and legs brown, abdomen brownish-black. Total length 6.00 mm. Carapace 2.50 mm. long, 2.00 mm. wide; abdomen 3.50 mm. long, 3.00 mm. wide.

Cephaloghorax : Longer than wide, slightly narrowing in front, clothed with pubescence. Cephalic area very high, black. Both eye row recurved. Anterior median eyes are black, larger than the other eyes, lateral small and oval, equally spaced. Posterior row of eyes slightly recurved, equal in size and equidistant from each other. Median ocular quadrangle longer than wide, widest in front than behind. Clypeal height much greater than the diameter of the anterior median eyes. Chelicerae strong, vertical, narrowing in front, inner margin without tooth, outer margin with one tooth. Labium broad than long, triangular, maxillae oblique, longer than wide and provided with black setae. Sternum heart-shaped, pointed behind, clothed with long black setae. Legs long, clothed with hairs and some spines, protarsi I, II and IV bisegmented.



Figs. 1-3. : *Hersilia savignyi* Lucas. 1. Epigyne; 2. Internal genitalia; 3. Male palp, ventral view.

Abdomen : Longer than wide, subpentagonal, narrowing behind with black rim, transverse stripes, three pairs of sagilla, ventral side very lighter than the dorsal, midventrally provided with brown coloured dots extends upto the spinnerets. Epigyne bilobate, the lobes separated by deep emargination. Spinnerets widely separated, posterior spinnerets very long and longer than the abdomen. Males smaller in size, same in colour as female. The male palp as in fig. 3. Females larger in size, same in colour as male. Epigyne bilobate, the lobes separated by deep emargination as in fig. 1. Internal genitalia as in fig. 2.

This species is active hunting spiders, living on tree trunks and wall of old houses. The body colour varies according to the colour of the substratum and spinning a scanty web of irregular threads.

Distribution : INDIA : Nilgiri Hills, Madras, Tamil Nadu; Bangalore, Karnataka; Poona, Maharashtra; Allahabad, Dehradun, Uttar Pradesh; Kolkata, Serampur, Howrah, West Bengal; Assam; Ranchi, Chota Nagpur, Chakradharpur, Dinapur Siripur, Pusa, Bihar; Puri, Orissa; Mandla, Bastar, Rajnandgaon, Balaghat, Madhya Pradesh.

Remarks : This is a common species found every where in India.

Family IV UROCTEIDAE

Characters : These spiders live under stones where they spin a small saccular tent-like web of about five subradially arranged bands of silk attached to the underside of it. Carapace transversely reuniform widely rounded in front and laterally, posteriorly emarginate, ocular group compact. Legs short and strong, spiny, subequal in length, tarsi armed with three claws. Abdomen large and depressed. Posterior spinnerets much longer than the anterior and anterior spinnerets short, subcylindrical, separated by a colulus; and patella very large and furnished laterally with fringe of long hairs.

Distribution : Mediterranean Region, China, Japan, South Africa, India.

Genus 4. *Uroctea* Dufour

1820. *Uroctea* Dufour, *Ann. Sci. Phys.*, **5** : 198.

Characters : These spiders live under stones, where they spin a small saccular tent-like web attached to the under side of the stone by about five subradially arranged bands of silk.

Type-species : *Uroctea durandi* Latreille.

Distribution : Mediterranean region; China, Japan, South Africa, India.

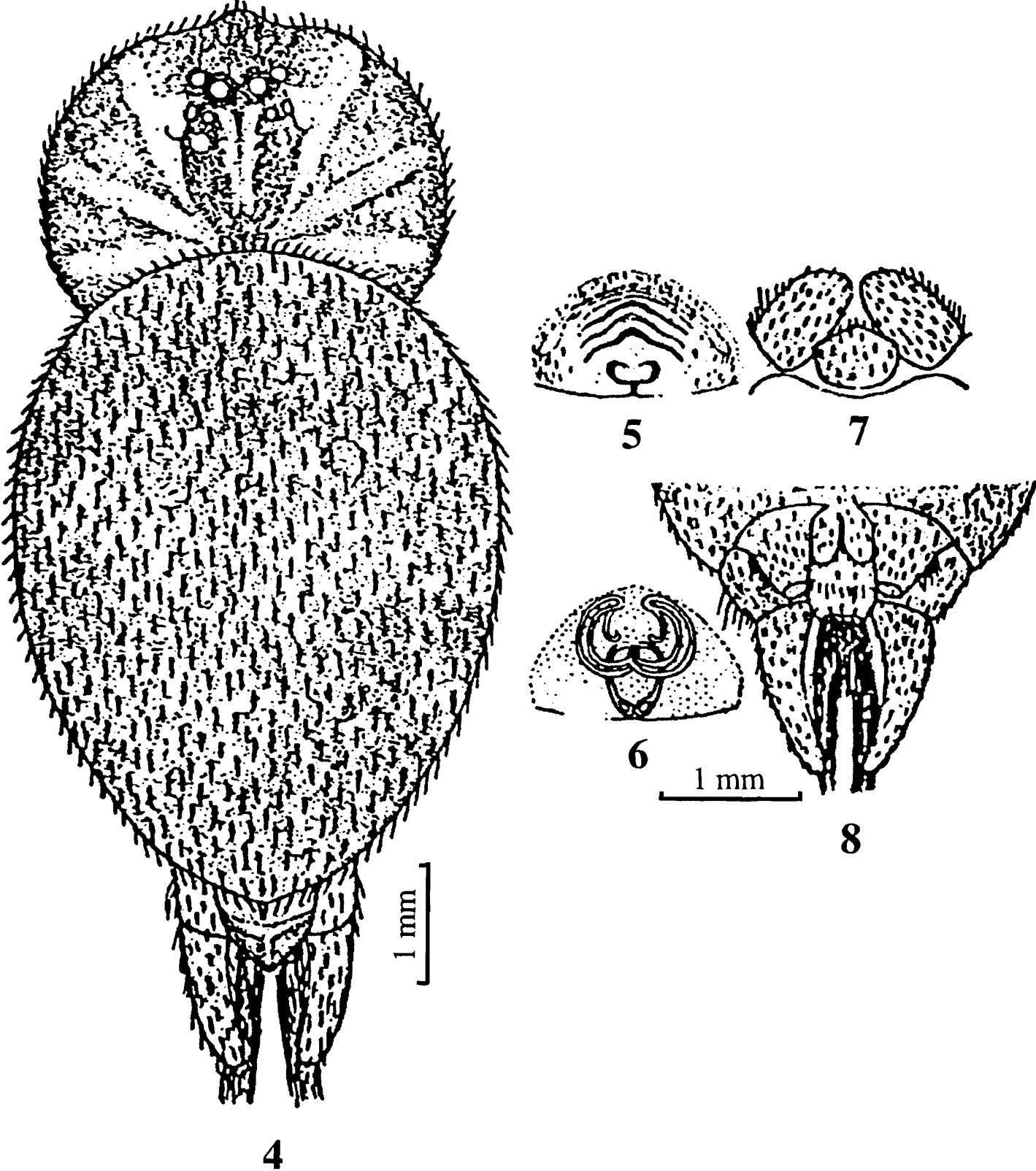
5. *Uroctea indica* Pocock

1900. *Uroctea indica* Pocock, *Fauna Brit. India, Arach.*, : 243.

Specimens examined : 1 ♀, Shelter caves, Hoshangabad dist., Madhya Pradesh, Coll. U. A. Gajbe, 10.I.1990. (Reg. No. A/1796).

General : Cephalothorax and legs reddish-brown, abdomen brownish-black. Total length 8.5 mm. Carapace 2.80 mm. long, 3.70 mm. wide; abdomen 6.30 mm. long, 4.30 mm. wide.

Cephalothorax : Transversely reuniform, strongly rebordered clothed with hairs. Radiating black strips diverges from foveal region to lateral sides of cephalothorax. Eyes compact, pearly white, arranged in two distinct rows. Anterior row of eyes slightly procurved; medians longer than the laterals and closer to laterals than to each other. Posterior row of eyes slightly procurved, medians slightly smaller than the laterals widely separated from each other, closer to the adjacent laterals. Median ocular quadrangle wider than long and wider behind than in front. Chelicerae weak vertical, dorsally clothed with hair, inner and outer margin without tooth. Labium wider than long, pentagonal



Figs. 4-8. : *Uroctea indica* Pocock. 4. Dorsal view of female, legs omitted; 5. Epigyne; 6. Internal genitalia; 7. Labium and maxillae; 8. Spinnerets.

in shape, maxillae convergent, clothed with hair and some spine like hair shape as in fig. 7. Sternum heart-shaped, pointed behind, clothed with long hairs. Legs long, stout, clothed with hairs and spines. Femur of all legs dorsally provided with black and pale patches.

Abdomen : Longer than wide, oval with spine like hair dorsally provided with three pairs of sagitta and some round white spots as in fig. 4. Ventral side slightly lighter than the dorsal, clothed with hairs and provided with four longitudinal white bands starting from epigastric furrow to the anal tubercle. Epigyne consisting of transversely elliptical plate and marked with nearly semi-circular grooves, as in fig. 5. Internal genitalia with oval spermathecae and three spermathecal ducts as in fig. 6. Spinnerets six, clothed with hair, posterior spinnerets longer than others, bisegmented, anterior spinnerets short and cylindrical as in fig. 8. The anal tubercle large thick, bisegmented and clothed with long hair. The apical segment provided with a lateral fringe of long flexible hair.

Distribution : INDIA : Poona, Maharashtra; Nagpur, Rajasthan; Hoshangabad, Madhya Pradesh.

Remarks : This species is reported here for the first time from Madhya Pradesh.

Family V ULOBORIDAE

Characteres : Eyes dark in colour, the lateral eyes on each side farther apart from the median eyes; and the posterior median eyes moderate in size. Chelicerae moderately robust, nearly parallel-sided. Anterior legs longest. Femora with dorsal thichobothria; tarsi with three foot claws. Metatarsus IV bearing the calamistrum, somewhat curved at least along the dorsal edge. Anal tubercle well developed and close to posterior spinners. These spiders spin geometrical orb webs or sectors of webs, similar to those of Araneidae. They are very unique and mostly common in the field, garden old houses and forests. They are a good predators of pest insects in the rice fields.

Genus 5. *Uloborus* Latreille

1806. *Uloborus* Latreille, *Gen. Crust. Ins. etc.*, 1 : 109.

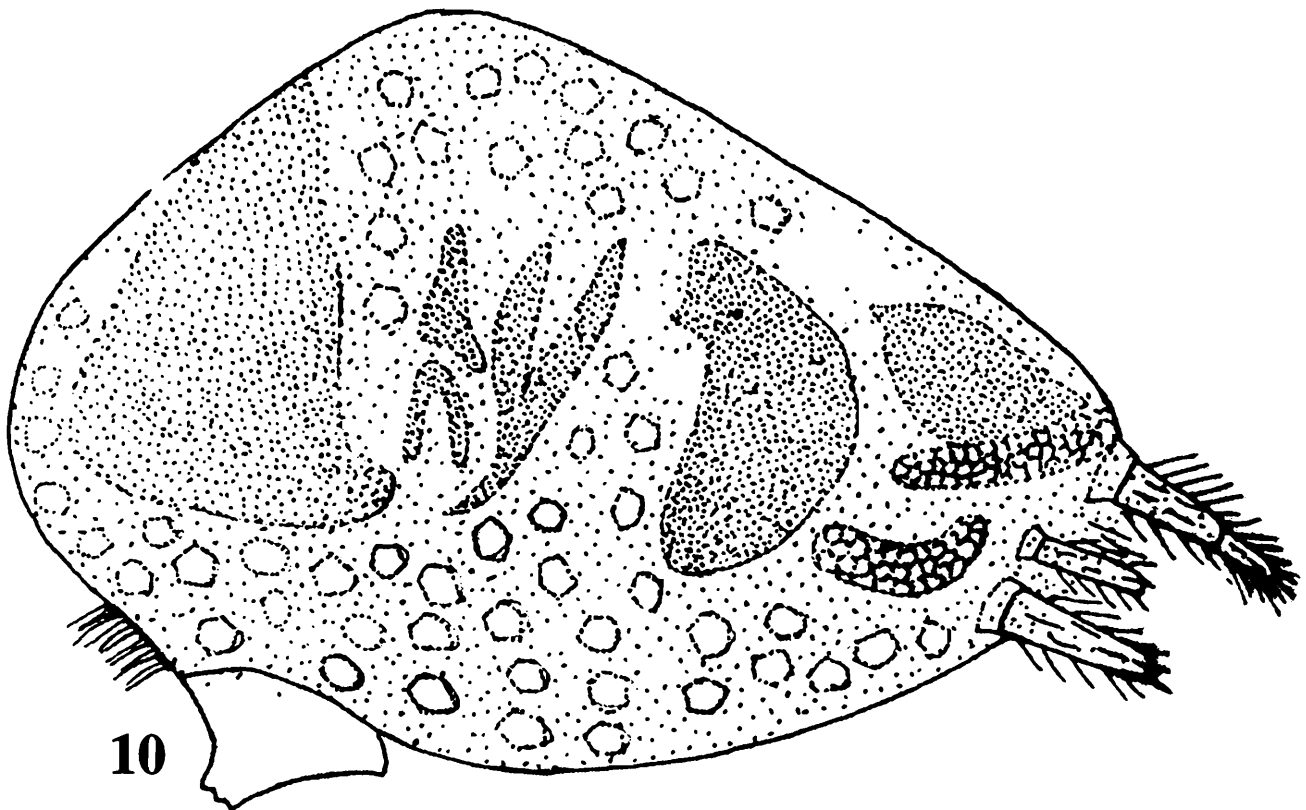
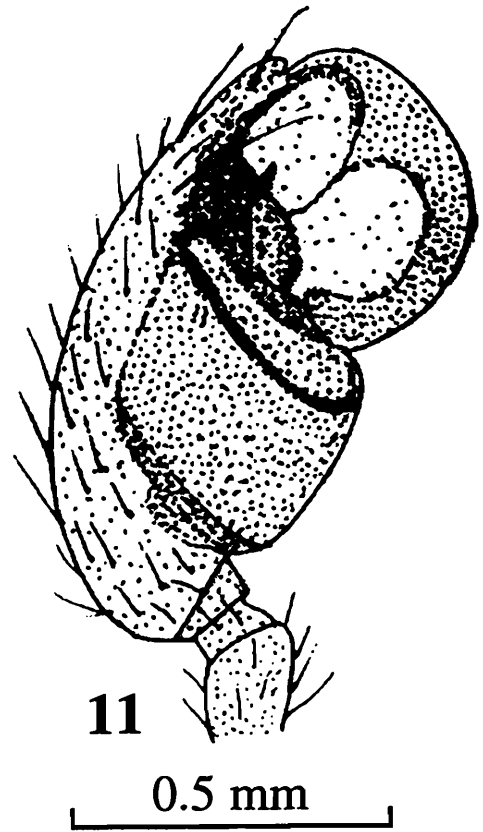
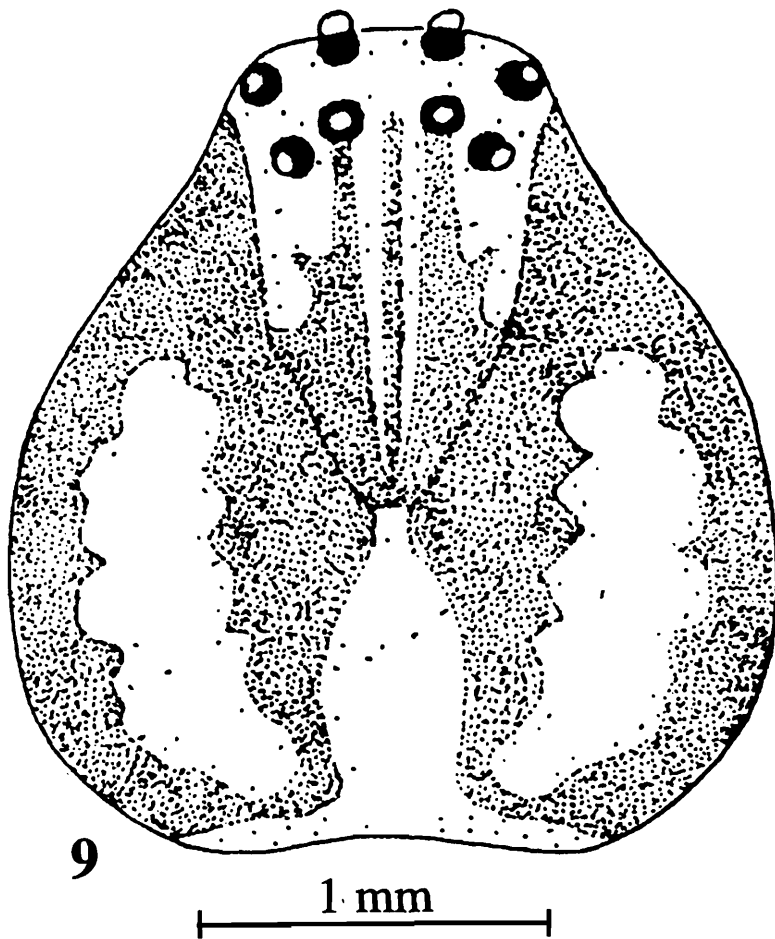
Characters : Anal tubercle prominent in the female, diminished in the male, legs I pair much longer and stronger than the rest. Male tibia of I with six to seven dorsal spines, almost in the form of teeth.

Type-species : *Uloborus walckenaerius* Latreille.

6. *Uloborus danolius* Tikader

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

Specimens examined : 1 ♀, 1 ♂, Vijay Nagar, Jabalpur dist., Madhya Pradesh, Coll. Pawan Gajbe, 30.IV.1995. (Reg. No. 2252).



Figs. 9-11. : *Uloborus danolius* Tikader. 9. Dorsal view of cephalothorax, legs omitted; 10. Lateral view of abdomen; 11. Male palp, ventral view.

General : Cephalothorax and legs light yellowish-green. Abdomen yellowish green. Total length 4.80 mm. Carapace 2.40 mm. long, 2.10 mm. wide; abdomen 3.60 mm. long, 2.30 mm. wide.

Cephalothorax : Slightly longer than wide, narrow in front, two conspicuous longitudinal deep brown broad patches on the cephalothorax as in fig. 9. Eyes black in two rows, anterior row slightly longer than the posterior row. Anterior row of eyes slightly recurved, anterior medians larger than the laterals and closer to each other than to adjacent laterals. Posterior row of eyes almost equal in size, posterior medians slightly closer to adjacent laterals than to each other. Median ocular quadrangle longer than wide and wider behind than in front. Clypeus narrow, length of clypeus is little smaller than the diameter of anterior median eyes. Sternum heart-shaped pointed behind and rebordered at coxae of all legs and deep brown in colour. Legs long and strong, clothed with hairs and conspicuously banded with transverse black patches. Legs I and IV longer than II and III. Male palp as in fig. 11.

Abdomen : Longer than wide, high and broad in front clothed with pubescence and decorated with brownish patches and fine net like structure as in fig. 10. Anterior dorsal side of abdomen provided with a hump, Mid ventral side provided with longitudinal deep brown band extending from epigastric fold to above the calamistrum.

Distribution : INDIA : Maharashtra; Danoli, Dist. Ratnagiri (Type-locality), Poona, Nagpur, West Bengal; Kolkata, Car-Nicobar.

SUMMARY

This paper deals with 6 species under 5 genera of the families, Oecobiidae, Eresidae, Hersiliidae, Urocteidae and Uloboridae.

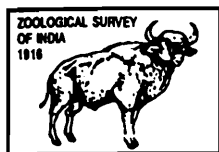
ACKNOWLEDGEMENTS

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Rec. zool. Surv. India : 103 (Part 1–2) : 143-155, 2004

ON A COLLECTION OF FISH FROM BANGALORE AND KOLAR DISTRICTS, KARNATAKA

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INTRODUCTION

In pursuance of the approved annual programme of work, two surveys have been conducted in Bangalore and Kolar districts during December 2001 and March 2002. A total of 2578 specimens under 15 families, 22 genera and allocated to 29 species have been collected and studied. Species have been identified following the guidelines of Day (1875–78), Talwar and Jhingran (1991), Jayaram (1999) and Menon (1999). There is paucity of reliable scientific information on the ichthyofaunal diversity of these districts and hence this work.

The systematic list includes relevant reference, material examined giving details of specimens collected, their length range, locality, date of collection and registration numbers, followed by details of distribution. Sample collections have been done by M. B. Raghunathan from 10.12.2001 to 29.12.2001 and S. Krishnan from 11.03.2002 to 29.03.2002.

LIST OF FISHES

Order OSTEOGLOSSIFORMES

Family NOTOPTERIDAE

1. *Notopterus notopterus* (Pallas)

Order CYPRINIFORMES

Family CYPRINIDAE

Subfamily DANIONINAE

2. *Amblypharyngodon microlepis* (Bleeker)
3. *Danio aequipinnatus* (McCl.)

4. *Esomus danricus* (Hamilton)
5. *Esomus thermoicos* (Val.)
6. *Rasbora caverii* (Jerdon)
7. *Rasbora daniconius* (Hamilton)
8. *Rasbora labiosa* Mukerji

Family CYPRINIDAE

Subfamily CYPRININAE

9. *Cyprinus carpio communis* (Linnaeus)
10. *Cyprinus carpio specularis* (Linnaeus)
11. *Puntius bimaculatus* (Bleeker)
12. *Puntius conchoni* (Hamilton)
13. *Puntius sophore* (Hamilton)

Family COBITIDAE

14. *Lepidocephalus thermalis* (Val.)

Order SILURIFORMES

Family BAGRIDAE

15. *Aorichthys aor* (Hamilton)
16. *Mystus cavasius* (Hamilton)
17. *Mystus montanus* (Jerdon)

Family SILURIDAE

18. *Ompok bimaculatus* (Bleeker)

Family CLARIIDAE

19. *Clarias batrachus* (Linnaeus)

Family HETEROPNEUSTIDAE

20. *Heteropneustes fossilis* (Bloch)

Order CYPRINODONTIFORMES

Family POECILIDAE

21. *Gambusia affinis* (Baird & Girard)
22. *Poecilia (Lebistes) reticulata* (Peters)

Family APLOCHEILIDAE

23. *Aplocheilus panchax* (Hamilton)

Order PERCIFORMES

Suborder GOBIOIDEI

Family GOBIIDAE

24. *Glossogobius giuris* (Hamilton)

Suborder LABROIDEI

Family CICHLIDAE

25. *Eetroplus suratensis* (Bloch)

26. *Oreochromis mossambica* (Peters)

Suborder CHANNOIDEI

Family CHANNIDAE

27. *Channa punctatus* (Bloch)

Suborder MASTACEMBELOIDEI

Family MASTACEMBELIDAE

28. *Mastacembelus armatus* (Lacepede)

Order MUGILIFORMES

Family MUGILIDAE

29. *Rhinomugil corsula* (Hamilton)

SYSTEMATIC ACCOUNT

Order OSTEOGLOSSIFORMES

Family NOTOPTERIDAE

1. *Notopterus notopterus* (Pallas)

1769. *Gymnotus notopterus* Pallas, *Spicil. Zool.*, 7 : 40, Pl. 6, fig. 2 (Type locality : ? Indian Ocean).

1991. *Notopterus notopterus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 64.

Material : 1 ex., 118 mm SL, Suburban Bangalore, 12.3.2002, F.6985.

Distribution : India : Brahmaputra, Cauvery, Ganges, Godavari, Krishna, Mahanadi and other river systems in South India. Java. Malaysia. Myanmar. Sumatra. Thailand.

Order CYPRINIFORMES

Family CYPRINIDAE

Subfamily DANIONINAE

2. *Amblypharyngodon microlepis* (Bleeker)

1853. *Leuciscus microlepis* Bleeker, *Verh. Batav. Genootsch. Kunst. Wet.*, **25** : (Type locality : Ganges river and Brahmaputra River).

1991. *Amblypharyngodon microlepis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 337.

Material : 9 exs., 48–58 mm SL, Uyyampalli, 17.3.2002, F.6890; 11 exs., 36–59 mm SL, BEML Township, 22.3.2002, F.6904; 3 exs., 28–33 mm SL, Holasa Halli, 19.3.2002, F.6930; 28 exs., 38–74 mm SL, Uyyampalli, 17.3.2002, F.6941.

Distribution : India : Eastern and Southern India. Bangladesh. Both Talwar and Jhingran (1991) and Menon (1999) do not include the west face of Western Ghats and limit the distribution of the species to the eastern part of India and Bangladesh.

3. *Danio aequipinnatus* (McCl.)

1839. *Perilampus aequipinnatus* McClelland, *Asiat. Res.*, **19**(2) : 393, pl. 60, fig. 1 (Type locality : Assam).

1991. *Danio aequipinnatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 364.

Material : 1 ex., 49 mm SL, Bangalore, 28.12.2001, F.6864.

Distribution : India : Peninsular India. Bangladesh. Myanmar. Nepal. Sri Lanka. Thailand.

4. *Esomus danricus* (Hamilton)

1822. *Cyprinus danrica* Hamilton, *Fishes of Ganges* : 325, 390, pl. 16, fig. 88 (Type locality : Ponds and ditches of Bengal)

1991. *Esomus danricus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 377.

Material : 12 exs., 40–60 mm SL, Mullagat Highway, 22.3.2002, F.6915; 14 exs., 37–44 mm SL, Kambina Halli, 24.3.2002, F.6921; 1 ex. 38 mm SL, Kombalagodu, 14.3.2002, F.6972; 5 exs., 32–37 mm SL, Kolar-Mulbagal Highway, 22.3.2002, F.6975.

Remarks : This species, probably introduced through aquarium trade has recently been found in several water bodies.

Distribution : Throughout North India and in some parts of South India. Bangladesh. Myanmar. Nepal. Pakistan. Sri Lanka.

5. *Esomus thermoicos* (Val.)

1842. *Nuria thermoicos* Valenciennes, *Hist. nat. Poiss.*, **16** : 238, pl. 472 (Type locality : Hot springs at Kanniya, Sri Lanka)

1991. *Esomus thermoicos*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 378.

Material : 7 exs., 28–33 mm SL, Amerahalli Kere, 690 m, 12.12.2001, F.6872; 2 exs., 30–39 mm SL, Yelahanka, 800 m., 17.12.2001, F.6876; 43 exs., 47–68 mm SL, BEML Township outer, 22.3.2002, F.6903; 4 exs., 49–70 mm SL, BEML Township, 22.3.2002, F.6917; 3 exs., 41–42 mm SL, Jangamkote, 24.3.2002, F.6949.

Distribution : India : Southern India. Sri Lanka.

6. *Rasbora caverii* (Jerdon)

1849. *Leuciscus caverii* Jerdon, *Madras J. Sci., & Lit.*, **15** : 320 (Type locality : Cauvery River, Karnataka).

1991. *Rasbora caverii*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 388.

Material : 28 exs., 25–51 mm SL, Amerahalli kere, 690 m, 12.12.2001, F.6873; 13 exs., 28–29 mm SL, Yelahanka, 17.12.2001, F.6878; 41 exs., 28–52 mm SL, Uyyampalli, 17.3.2002, F.6891; 21 exs., 65–109 mm SL, BEML Township outer, 22.3.2002, F.6919; 350 exs., 17–35 mm SL, Holasa Halli, 19.3.2002, F.6929; 41 exs., 25–51 mm SL, Magadi Tank, 18.3.2002, F.6936; 236 exs., 17–80 mm SL, Narasapura, 15.3.2002, F.6967; 58 exs., 17–31 mm SL, Arabikothanur, 15.3.2002, F.6971; 10 exs., 21–26.5 mm SL, Kumbalagodu, 14.3.2002, F.6973.

Distribution : Southern India, notably Karnataka, especially the Cauvery basin, also Eastern Ghats. Sri Lanka.

7. *Rasbora daniconius* (Hamilton)

1822. *Cyprinus daniconius* Hamilton, *Fishes of Ganges* : 327, 391, pl. 15, Fig-89 (Type locality : Rivers of Southern Bengal).

1999. *Rasbora daniconius*, Jayaram, *The freshwater fishes of the Indian regions* : 82.

Material : 31 exs., 25–40 mm SL, Bangalore Dist., 28.12.2001, F.6865; 26 exs., 25–54 mm SL, Magadi Tank, 18.3.2002, F.6935.

Distribution : Throughout India. Bangladesh. Malay Archipelago. Myanmar. Nepal. Pakistan. Sri Lanka. Zanzibar.

8. *Rasbora labiosa* Mukerji

1935. *Rasbora labiosa* Mukerji, *Rec. Indian Mus.*, **37**(3) : 376, Fig. 1,2 (Type locality : Deolali, Nasik Dist., Maharashtra)

1999. *Rasbora labiosa*, Jayaram, *The freshwater fishes of the Indian regions* : 83.

Material : 36 exs., 17–91 mm SL, BEML Township outer, 22.3.2002, F.6907; 1 ex., 50 mm SL, Magadi Tank, 18.3.2002, F.6937; 108 exs., 34–54 mm SL, Uyyampalli, 17.3.2002, F.6942.

Remarks : This is the first report of the species from Cauvery system in Karnataka. Though the specimens are characterised by hypertrophied labial fold; some differences have been observed from the typical species, details of which are being discussed elsewhere.

Distribution : India : Maharastra, Karnataka.

Family CYPRINIDAE

Subfamily CYPRININAE

9. *Cyprinus carpio communis* (Linnaeus)

1758. *Cyprinus carpio* Linnaeus, *Systema Naturae*, ed. 10, 1 : 320 (Type locality : Europe)

1991. *Cyprinus carpio communis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 185.

Material : 1 ex., 49 mm SL, Khajikalla Halli, Kolar Dist., 15.3.2002, F.6897; 5 exs., 70–196 mm SL, Mungana Halli, 23.3.2002, F.6899; 1 ex., 194 mm SL, BEML Township outer, 22.3.2002, F.6906; 2 exs., 145–166 mm SL, Mungana Halli, 23.3.2002, F.6912; 3 exs., 84–90 mm SL, Mungana Halli, 23.3.2002, F.6927; 6 exs., 46–91 mm SL, Naickarpalya Kere, 18.3.2002, F.6933; 2 exs., 70–80 mm SL, Chintamani, 23.3.2002, F.6957; 1 ex., 37 mm SL, Narasapura, 15.3.2002, F.6969.

Distribution : Central Asia. Introduced into India.

10. *Cyprinus carpio specularis* (Linnaeus)

1758. *Cyprinus carpio* Linnaeus, *Systema Naturae*, ed. 10, 1 : 320 (Type locality : Europe)

1991. *Cyprinus carpio specularis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 185.

Material : 1 ex., 124 mm SL, Mungana Halli, 23.3.2002, F.6900.

Distribution : Central Asia. Introduced into India.

11. *Puntius bimaculatus* (Bleeker)

1864. *Gnathopogon bimaculatus* Bleeker, *Verb. Nat. Holl. Maatsch*, Haarlem, (2)20 : 17, pl. 4, fig. 1 (Type locality : Ceylon)

1991. *Puntius bimaculatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 259.

Material : 10 exs., 16–35 mm SL, Bangalore Dist., 28.12.2001, F.6866; 8 exs., 42–56 mm SL, Mulbagal High way, 22.3.2002, F.6916; 12 exs., 50–56 mm SL, BEML Township, 22.3.2002,

F.6918; 1 ex. 38 mm SL, Magadi Tank, 18.3.2002, F.6838; 1 ex. 35 mm SL, Narasapura, 15.3.2002, F.6968.

Distribution : Southern India. Sri Lanka.

12. *Puntius conchoni* (Hamilton)

1822. *Cyprinus conchoni* Hamilton, *Fishes of Ganges* : 317, 389 (Type locality : Ponds of northeast Bengal, Kosi river and Ami River)

1991. *Puntius conchoni*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 266.

Material : 17 exs., 38–43 mm SL, Kanva Reservoir, 16.3.2002, F.6963.

Distribution : India : Throughout. Bangladesh. Nepal. Pakistan.

13. *Puntius sophore* (Hamilton)

1822. *Cyprinus sophore* Hamilton, *Fishes of Ganges* : 310, 389 (nec. pl. 19, fig. 86) (Type locality : Ponds and rivers in Gangetic Reservoir)

1991. *Puntius sophore*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 288.

Material : 1 ex., 44 mm SL, Uyyampalli, 17.3.2002, F.6892; 6 exs., 72–81 mm SL, Munganahalli, 23.3.2002, F.6898; 2 exs., 28–56 mm SL, BEML Township outer, 22.3.2002, F.6905; 16 exs., 22–49 mm SL, Kambina Halli, 24.3.2002, F.6922; 1 ex., 64 mm SL, Mungana Halli, 23.3.2002, F.6926; 17 exs., 43–57 mm SL, Uyyampalli, 17.3.2002, F.6943; 2 exs., 26–33 mm SL, Jangamkotte, 24.3.2002, F.6950; 3 exs., 46–65 mm SL., Chintamani, 23.3.2002, F.6958; 2 exs., 42 & 43 mm SL, Kanva Reservoir, 16.3.2002, F.6961.

Distribution : India : Throughout. Bangladesh. Myanmar. Nepal. Pakistan. Sri Lanka.

Family COBITIDAE

14. *Lepidocephalus thermalis* (Valenciennes)

1846. *Cobitis thermalis* Valenciennes, *Hist. nat. Poiss.*, 18 : 78 (Type locality : Sri Lanka)

1991. *Lepidocephalus thermalis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. I : 527.

Material : 13 exs., 10–31 mm SL, Amerahalli Kere, 690 m, 12.12.2001, F.6874; 2 exs., 24 & 32 mm SL, Yelahanka, 17.12.2001, F.6879; 13 exs., 38–55 mm SL, BEML Township outer, 22.3.2002, F.6909; 10 exs., 33–41 mm SL, Bagepalli, 28.3.2002, F.6903; 4 exs., 35–41 mm SL, Kambina Halli, 24.3.2002, F.6923; 8 exs., 36–47 mm SL, Holasa Halli, 19.3.2002, F. 6931; 2 exs., 38 & 39 mm SL, Jangamkote, 24.3.2002, F.6951; 2 exs., 32.5–45 mm SL, Kolar-Mulbagal Highway, 22.3.2002, F.6976.

Distribution : India : South India. Sri Lanka.

Order SILURIFORMES

Family BAGRIDAE

15. *Aorichthys aor* (Hamilton)

1822. *Pimelodus aor* Hamilton, *Fishes of Ganges* : 205, 375, pl. 20, fig. 68 (Type locality : Rivers of Bengal and upper parts of Gangetic estuary).

1991. *Aorichthys aor*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 547.

Material : 3 exs., 152–165 mm SL, Suburban Bangalore, 12.3.2002, F.6978.

Distribution : India : Throughout. Bangladesh. Myanmar. Pakistan.

16. *Mystus cavasius* (Hamilton)

1822. *Pimelodus cavasius* Hamilton, *Fishes of Ganges* : 203, 379, pl. 11, fig. 67 (Type locality : Gangetic Provinces).

1991. *Mystus cavasius*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 559.

Material : 2 exs., 119 & 120 mm SL, Suburban Bangalore, 12.3.2002, F.6980.

Distribution : India. Bangladesh. Pakistan. Thailand.

17. *Mystus montanus* (Jerdon)

1849. *Bagrus montanus* Jerdon, *Madras Jour. Lit. & Sci.*, 15(2) : 337 (Type locality : Manantoddy, Wynaad, Kerala State).

1991. *Mystus montanus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 567.

Material : 55 exs., 48–75 mm SL, Bagepalli, 28.3.2002, F.6914; 4 exs., 74–94 mm SL, BEML Township outer, 22.3.2002, F.6920; 5 exs., 45–58 mm SL, Kambina Halli, 24.3.2002, F.6924; 17 exs., 41–61 mm SL, Jangamkote, 24.3.2002, F.6954.

Distribution : India : Kerala, Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh and Assam.

Family SILURIDAE

18. *Ompok bimaculatus* (Bloch)

1797. *Silurus bimaculatus* Bloch, *Ichthyol. Hist. nat. des. Poiss.*, 11 : 17, pl. 364 (Type locality : Malabar).

1991. *Ompok bimaculatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 582.

Material : 6 exs., 135–175 mm SL, Suburban Bangalore, 12.3.2002, F.6981.

Distribution : Throughout India. Bangladesh. Malaya. Nepal. Pakistan. Sri Lanka. Thailand. Vietnam. Yunnan.

Family CLARIIDAE

19. *Clarias batrachus* (Linnaeus)

1758. *Silurus batrachus* Linnaeus, *Systema Naturae*, 1, ed. 10 : 305 (Type locality : Asia and Africa).

1991. *Clarias batrachus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 684.

Material : 1 ex., 325 mm SL, BEML Township outer, 22.3.2002, F.6902; 1 ex., 235 mm SL, Ellamalappa kere, Avalahalli, 15.3.2002, F.6948.

Distribution : India. Bali. Bangladesh. Borneo. Java. Malacca. Malaya. Myanmar. Nepal. Pakistan. Philippines. Singapore. Sri Lanka. Sumatra. Thailand.

Family HETEROPNEUSTIDAE

20. *Heteropneustes fossilis* (Bloch)

1794. *Silurus fossilis* Bloch, *Naturgesch. ausl. Fische*, 8 : 46, pl. 370, fig. 2 (Type locality : Tranquebar, Tamil Nadu).

1991. *Heteropneustes fossilis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 689.

Material : 2 exs., 80 & 89 mm SL, Jangamkote, 24.3.2002, F.6952; 8 exs., 62–100 mm SL, Jangamkote, 24.3.2002, F.6953.

Distribution : India. Bangladesh. Laos. Myanmar. Nepal. Pakistan. Sri Lanka. Thailand.

Order CYPRINODONTIFORMES

Family POECILIDAE

21. *Gambusia affinis* (Baird & Girard)

1853. *Heterandria affinis* Baird and Girard, *Proc. Acad. Nat. Sci. Philad.*, 6 : 390 (Type locality : San Antonio River Drainage, Texas).

1991. *Gambusia affinis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 756.

Material : 76 exs., 11–40 mm SL, 13.12.2001, Kolarkere, Basavantha Halli, F.6868; 4 exs., 30–36 mm SL, BEML Township, 22.3.2002, F.6908; 15 exs., 8.5–32 mm SL, Kambina Halli, 24.3.2002, F.6925; 22 exs., 18–31 mm SL, Holasa Halli, 19.3.2002, F.6932; 6 exs., 18.5–31.5 mm SL, Jangamkote, 24.3.2002, F.6956; 4 exs., 19.5–32 mm SL, Naraspura, 15.3.2002, F.6970; 45 exs., 13.5–30 mm SL, Kumbalagodu, Bangalore Rural, 14.3.2002, F.6974.

Distribution : Throughtout India. Myanmar. Pakistan and Sri Lanka.

22. *Poecilia (Lebistes) reticulata* (Peters)

1859. *Poecilia reticulata* Peters, K. Preussisehem. *Akad. Wiss. Berlin* : 412 (Type locality : Venezuela).

1991. *Poecilia (Lebistes) reticulata*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 756.

Material : 73 exs., 10–24 mm SL, Bangalore Dist., 28.12.2001, F.6867; 188 exs., 8–28 mm SL, near Kondapalli, 750 m, 16.12.2001, F.6870; 290 exs., 9–22 mm SL, Illapallikere, 700 m, 20.12.2001, F.6871; 34 exs., 13–27 mm SL, Amerahallikere, 690 m, 12.12.2001, F.6875; 103 exs., 9–30 mm SL, Yelahanka, 800 m, 17.12.2001, F.6881; 21 exs., 13–22 mm SL, Hosuhuddiahalli pond, 700 m, 20.12.2001, F.6882; 74 exs., 13–33 mm SL, Mallasandrakere, 700 m, 21.12.2001, F.6883; 256 exs., 7.5–29 mm SL, Chintamani, 23.3.2002, F.6960; 18 exs., 18–30 mm SL, Kolar-Mulbagal High way, 22.3.2002, F.6977.

Distribution : Tropical America. Introduced into India.

Family APLOCHEILIDAE

23. *Aplocheilus panchax* (Hamilton)

1822. *Esox panchax* Hamilton, *Fishes of Ganges* : 211, 380, pl. 3, fig. 69 (Type locality : Bengal).

1991. *Aplocheilus panchax*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 752.

Material : 46 exs., 19–41 mm SL, Kanva Reservoir, 16.3.2002, F.6966.

Remarks : This is the first report after Hora (1937) of the species in the wild from Karnataka, Southern India.

Distribution : India (now introduced elsewhere) originally Andaman Is., Orissa & West Bengal (Jayaram, 1991). Bangladesh. Malay Archipelago. Myanmar. Pakistan. Thailand.

Order PERCIFORMES

Suborder GOBIOIDEI

Family GOBIIDAE

24. *Glossogobius giuris* (Hamilton)

1822. *Gobius giuris* Hamilton, *Fishes of Ganges* : 51, pl. 33, fig. 15 (Type locality : Gangetic provinces).

1991. *Glossogobius giuris*, Talwar & Jhingran, *Inland fishes of Indian and Adjacent Countries*, Vol. II : 936.

Material : 3 exs., 50–81 mm SL, Hanumanthnagar (Kanakpura), 17.3.2002, F.6895; 1 ex., 44 mm SL, Uyyampalli, 17.3.2002, F.6944; 1 ex., 79 mm SL, Kanva Reservoir, 16.3.2002, F.6964.

Distribution : Throughout India. Bangladesh. Myanmar. Nepal. Pakistan. Sri Lanka. It has a wide range from the East coast of Africa to Japan, Australia and South Pacific.

Suborder LABROIDEI

Family CICHLIDAE

25. *Etroplus suratensis* (Bloch)

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

1991. *Etroplus suratensis*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 885.

Material : 1 ex., 102 mm SL, Suburban Bangalore, 12.3.2002, F.6979.

Distribution : India : South India. Sri Lanka.

26. *Oreochromis mossambica* (Peters)

1852. *Chromis (Tilapia) mossambicus* Peters, *Montab, Acad. Wiss.*, Berlin : 681 (Type locality : Mozambique).

1991. *Oreochromis mossambica*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 887.

Material : 265 exs., 6–36 mm SL, Kolarkere, Basvanathahalli, 600 m, 13.12.2001, F.6869; 9 exs., 18–27 mm SL, Yelahanka, 800 m, 17.12.2001, F.6880; 5 exs., 50–111 mm SL, Ulsoor tank, 12.3.2002, F.6889; 22 exs., 41–96 mm SL, Uyyampalli, 17.3.2002, F.6893; 44 exs., 30–65 mm SL, Khajikalla Halli, 15.3.2002, F.6896; 8 exs., 45–130 mm SL, Munganahalli, 23.3.2002, F.6901; 52 exs., 20–98 mm SL, BEML Township, 22.3.2002, F.6910; 2 exs., 145 mm SL, Hunganoor, 19.3.2002, F.6911; 6 exs., 46–140 mm SL, Mungana Halli, 23.3.2002, F.6928; 240 exs., 19–113 mm SL, Naickarpalya Kere, 18.3.2002, F.6933; 18 exs., 16–73 mm SL, Magadi Tank, 18.3.2002, F.6940; 22 exs., 35–68 mm SL, Bannerghata, 12.3.2002, F.6946; 4 exs., 124–140 mm SL, Ellamalappa Kere, Avala Halli, F.6947; 73 exs., 7.5–69 mm SL, Chintamani, 23.3.2002, F.6959.

Distribution : East Africa. Introduced in India in 1952.

Suborder CHANNOIDEI

Family CHANNIDAE

27. *Channa punctatus* (Bloch)

1793. *Ophiocephalus punctatus* Bloch, *Naturges, Ausland. Fische.*, (7) : 139, pl. 358 (Type locality : Rivers and Lakes of Coromandal Coast).

1991. *Channa punctatus*, Talwar & Jhingran, *Inland fishes of Indian and Adjacent Countries*, Vol. II : 1020.

Material : 7 exs., 56–110 mm SL, Hanumanthnagar (Kanakpura), 17.3.2002, F.6894; 2 exs., 35 & 56 mm SL, Magadi Tank, 18.3.2002, F.6939; 1 ex., 39 mm SL, Uyyampalli, 17.3.2002, F.6945; 1 ex., 46 mm SL, Jangamkote, 24.3.2002, F.6955; 1 ex., 65 mm SL, Kanva Reservoir, 16.3.2002, F.6965; 1 ex., 178 mm SL, Suburban Bangalore, 12.3.2002, F.6983.

Distribution : Throughout India. Afghanistan. Bangladesh. China. Malaya. Myanmar. Nepal. Pakistan. Polynesia. Sri Lanka.

Suborder MASTACEMBELOIDEI

Family MASTACEMBELIDAE

28. *Mastacembelus armatus* (Lacépède)

1800. *Macrognathus armatus* Lacépède, *Hist. nat. Poiss.*, 2 : 286 (Type locality : Not known).

1991. *Mastacembelus armatus*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 1031.

Material : 1 ex., 315 mm SL, Suburban Bangalore, 12.3.2002, F.6982.

Distribution : Throughout India. Bangladesh. South China. Hainan island. Java. Malaya. Myanmar. Nepal. Pakistan. Sri Lanka. Sumatra. Thailand. Tonkin. Vietnam.

Order MUGILIFORMES

Family MUGILIDAE

29. *Rhinomugil corsula* (Hamilton)

1822. *Mugil corsula* Hamilton, *Fishes of Ganges* : 221, 381, pl. 9, fig. 97 (Type locality : Ganges River).

1991. *Rhinomugil corsula*, Talwar & Jhingran, *Inland fishes of India and Adjacent Countries*, Vol. II : 897.

Material : 3 exs., 150–160 mm SL, Suburban Bangalore, 12.3.2002, F.6984.

Distribution : India. Bangladesh. Nepal. Burma.

DISCUSSION

A comprehensive account of the ichthyofauna of Cauvery River system by Jayaram *et al.*, (1982) reports the presence of 93 species in Karnataka. Recently Chandrashekhariah *et al.*, (2000) have given elaborate version of distributional pattern and status of the ichthyofauna in the different drainages in Karnataka *viz.*, Cauvery, Krishna, Godavari and west flowing rivers in the state. They reported 97 species from Cauvery River including 42 species not reported by Jayaram (*op. cit.*). The ichthyofaunal composition of the Cauvery system draining Karnataka, based on the above cited papers totals to 135.

In the present study from Bangalore and Kolar districts alone 29 species have been collected which includes two new records *viz.*, *Esomus thermoicos* and *Rasbora labiosa* the former new addition to Karnataka fauna and the latter to the Cauvery system. *E. thermoicos* earlier thought to be restricted to Sri Lanka is now found in Southern India. *Rasbora labiosa* restricted to its type locality in Deolali Nasik district, Maharashtra has been reported recently in the Godavary system in Karnataka also (Chandrashekhariah *et al.*, *op. cit.*). Also *Amblypharyngodon microlepis* and *Aplocheilichthys panchax* were collected in the wild after their first report by Hora in 1937.

SUMMARY

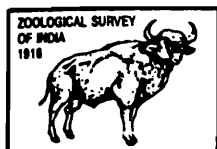
Studies on a collection of fish from Bangalore and Kolar districts, Karnataka have resulted in reliable identification of 29 species, of which *Esomus thermoicos* (Val.) is an addition to Karnataka fauna and *Rasbora labiosa* Mukerji to the Cauvery system. *Amblypharyngodon microlepis* (Bleeker) and *Aplocheilichthys panchax* (Hamilton) are reported from the wild after a span of 65 years.

ACKNOWLEDGEMENTS

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A NOTE ON THE MITES OCCURRING ON MEDICINAL PLANTS IN NORTHEAST INDIA

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INTRODUCTION

Northeast India, due to its interesting geographical location, climatic condition and vegetation shows enormous diversity in the composition of its fauna and flora. It is considered as a unique biological spot which abounds in various interesting species of plants and animals. This region is rich in natural resources of medicinal plants belonging to different families.

In spite of the richness and abundance of fauna in this part of Indian subcontinent the acarine fauna of this region infesting the plants of medicinal importance remained unattended by the acarologists for the reasons best known to them.

A perusal of literature reveals that no such consolidated information on the medicinal plants infested by mites in northeast India is available except the work of Lal and Mukherjee (1977) though the region is sound faunistically. This has prompted the author to undertake the present work chiefly based on published works with a view to get a first hand information. As such, a complete list of mites occurring on medicinal plants in northeast India is provided hereinunder. Consultation of available literature reveals that 45 species of mites infest medicinal plants belonging to 21 species under 14 plant families. In this contribution, the texts are arranged in two sections. In Section–I mite species are arranged according to their families as has been followed by Gupta (1985) and in Section–II, medicinal plants are arranged alphabetically with respective plant family. In Section–I under each family the mite species and their respective host plants are also alphabetically arranged.

The plants considered here as medicinal plants are according to I. C. M. R. publications (1976, 1987) and Chopra *et al.* (1956).

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SECTION-I

Sl No.	Name of Mite	Family	Host Plant	Distribution
1.	<i>Amblyseius (Amblyseius) Channabasavannai</i> Gupta & Daniel	Phytoseiidae	<i>Azadirachta indica</i> <i>Mangifera indica</i>	India : Meghalaya, Kerala, Tamil Nadu, West Bengal.
2.	<i>Amblyseius (Amblyseius) herbicolus</i> (Chant)	Phytoseiidae	<i>Musa paradisiaca</i>	India : Meghalaya, Arunachal Pradesh, Tripura, West Bengal, Elsewhere : Philippines, Taiwan, Thailand, Japan, U.S.A., Madagascar, South America.
3.	<i>Amblyseius (Amblyseius) largoensis</i> (Muma)	Phytoseiidae	<i>Musa paradisiaca</i>	India : Meghalaya, Andaman & Nicobar Isls., Arunachal Pradesh, Assam, Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Kerala, Orissa, Manipur, Karnataka, Nagaland, Pondichery, Punjab, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Elsewhere : Philippines, Taiwan, Thailand, Hong Kong, Israel, Iran, Japan, New Zealand, Kenya, U.S.A., Brazil, Mexico, Jamaica.
4.	<i>Amblyseius (Amblyseius) mcmurtryi</i> Muma	Phytoseiidae	<i>Psidium guajava</i>	India : Meghalaya, Assam, Elsewhere : Northern and Western Iran.
5.	<i>Amblyseius (Paraphytoseius) multidentatus</i> (Swirski & Shechter)	Phytoseiidae	<i>Mangifera indica</i>	India : Meghalaya, Andaman & Nicobar Isls., Andhra Pradesh, Assam, Maharashtra, Karnataka, Tamil Nadu, Bihar, Tripura, Uttar Pradesh, West Bengal.
6.	<i>Amblyseius (Euseius) alstoniae</i> Gupta	Phytoseiidae	<i>Cassia occidentalis</i>	India : Tripura, Jammu & Kashmir, Meghalaya, Bihar, Madhya Pradesh, Punjab, Orissa, Tamil Nadu, Rajasthan.

Sl No.	Name of Mite	Family	Host Plant	Distribution
7.	<i>Amblyseius (Euseius) coccineae</i> Gupta	Phytoseiidae	<i>Psidium guajava</i>	India : Tripura, Andhra Pradesh, Gujarat, Bihar, Tamil Nadu, Jammu & Kashmir, Meghalaya, Madhya Pradesh, Orissa, Pondichery, Uttar Pradesh.
8.	<i>Amblyseius (Euseius) ovalis</i> (Evans)	Phytoseiidae	<i>Luffa acutangula</i> <i>Ficus religiosa</i> <i>Musa paradisiaca</i>	India : Tripura, Gujarat, Andaman & Nicobar Isls., Bihar, Manipur, Tamil Nadu, Meghalaya, Pondichery. Elsewhere : Philippines, Taiwan, Malaysia, Japan, Hong Kong, Indonesia, New Zealand, Mauritius, Hawaii, Mexico.
9.	<i>Amblyseius (Euseius) pruni</i> Gupta	Phytoseiidae	<i>Carica papaya</i>	India : Tripura, Assam, Meghalaya, West Bengal, Himachal Pradesh, Jammu & Kashmir.
10.	<i>Amblyseius (Neoseiulus) longispinosus</i> (Evans)	Phytoseiidae	<i>Luffa acutangula</i>	India : Tripura, West Bengal, Andaman & Nicobar Isls., Karnataka, Bihar, Punjab, Orissa, Pondichery, Tamil Nadu, Uttar Pradesh, Elsewhere : Philippines, Taiwan, Indonesia, Malaysia, Japan, Hong Kong, New Zealand, Jamaica, Hawaii, South Africa.
11.	<i>Amblyseius (Typhlodromips) meghalayensis</i> Gupta	Phytoseiidae	<i>Psidium guajava</i>	India : Meghalaya. Elsewhere : Pakistan, Thailand, Philippines, Madagascar, Malaya, Nigeria, Hong Kong.
12.	<i>Amblyseius (Typhlodromips) suknaensis</i> Gupta	Phytoseiidae	<i>Mangifera indica</i>	India : Meghalaya, Andaman & Nicobar Isls., Assam, Kerala, West Bengal.
13.	<i>Amblyseius (Typhlodromips) syzygii</i> Gupta	Phytoseiidae	<i>Psidium guajava</i>	India : Tripura, West Bengal, Uttar Pradesh, Orissa, Meghalaya, Bihar, Elsewhere : Thailand.

Sl No.	Name of Mite	Family	Host Plant	Distribution
14.	<i>Acarus farris</i> Oudemans	Acari	<i>Cocos nucifera</i> <i>Musa paradisiaca</i>	India : Tripura, Meghalaya, Elsewhere : England, Netherland, Wales, Scotland, U.S.A., Germany, Kenya, Czechoslovakia.
15.	<i>Aponychus baghensis</i> Prasad	Tetranychidae	<i>Musa paradisiaca</i>	India : Meghalaya, Bihar.
16.	<i>Agistemus garrulus</i> Chaudhri, Akbar & Rasool	Stigmaeidae	<i>Morus alba</i>	India : Meghalaya, Elsewhere : Pakistan.
17.	<i>Agistemus gamblei</i> Gupta	Stigmaeidae	<i>Machilus gamblei</i>	India : Arunachal Pradesh.
18.	<i>Agistemus fleschneri</i> Summers	Stigmaeidae	<i>Mangifera indica</i>	India : Arunachal Pradesh, Suji, Assam, Manipur, Tripura, Agartala.
19.	<i>Agistemus macrommatus</i> Gonzalez-Rodriguez	Stigmaeidae	<i>Carica papaya</i>	India : Arunachal Pradesh,
20.	<i>Agistemus edulis</i> Gupta	Stigmaeidae	<i>Macheles edulis</i>	India : Arunachal Pradesh,
21.	<i>Brevipalpus phoenicis</i> (Geij)	Tenuipalpidae	<i>Psidium guajava</i>	India : Meghalaya, Assam, Bihar, Delhi, Himachal Pradesh, Karnataka, Maharashtra, Orissa, Punjab, Tamil Nadu, West Bengal. Elsewhere : Kenya, Tanganayika, Okinawa Isl., Australia, Holland, Spain, Portugal, Syria, Italy, U.S.A, Trinidad, Argentina, Brazil.
22.	<i>Bdellodes grandiflora</i> Gupta	Bdellidae	<i>Thunbergia grandiflora</i>	India : Arunachal Pradesh
23.	<i>Bdella angustifolius</i> Gupta	Bdellidae	<i>Canthium angustifolium</i>	India : Manipur
24.	<i>Bdella khasyana</i> Gupta	Bdellidae	<i>Litsaea khasyana</i>	India : Arunachal Pradesh
25.	<i>Cunaxa anacardae</i> Gupta	Cunaxidae	<i>Mangifera indica</i>	India : Tripura, West Bengal
26.	<i>Cunaxa lambusae</i> Gupta & Ghosh	Cunaxidae	Wood apple (<i>Feronia elephantum</i>)	India : Tripura, West Bengal Andaman & Nicobar Isls.

Sl No.	Name of Mite	Family	Host Plant	Distribution
27.	<i>Cunaxa crista</i> Gupta	Cunaxidae	<i>Caesalpinia crista</i>	India : Arunachal Pradesh.
28.	<i>Cunaxa curassavica</i> Gupta	Cunaxidae	<i>Asclepias curassavica</i>	India : Arunachal Pradesh.
29.	<i>Cheyletus malaccensis</i> Oudemans	Cheyletidae	<i>Michaelia champaca</i>	India : Meghalaya, Kerala, Karnataka, West Bengal.
30.	<i>Eupodes</i> sp.	Eupodidae	<i>Mangifera indica</i>	India : Meghalaya, Songsok, Tripura.
31.	<i>Hemicheyletia indica</i> Gupta	Cheyletidae	<i>Pavetta indica</i>	India : Arunachal Pradesh
32.	<i>Iphiseius andamanicus</i> Gupta	Phytoseiidae	<i>Musa paradisiaca</i>	India : Tripura, Andaman & Nicobar Isls., Karnataka.
33.	<i>Ledermulleria parryorum</i> Gupta	Stigmaeidae	<i>Mussandra parryorum</i>	India : Arunachal Pradesh.
34.	<i>Oligonychus gossypii</i> (Zacher)	Tetranychidae	<i>Mangifera indica</i>	India : Tripura. Elsewhere : Africa (Togo, Senegal, Sierra, Leone, Nigeria, Cameroon, Zaire, Angola).
35.	<i>Oligonychus indicus</i> (Hirst)	Tetranychidae	<i>Musa paradisiaca</i>	India : Meghalaya, Delhi, Andhra Pradesh, Punjab, Haryana, Karnataka, Orissa, Tamil Nadu. Elsewhere : Pakistan.
36.	<i>Oligonychus mangiferus</i> (Rahman & Sapra)	Tetranychidae	<i>Morus alba</i>	India : Meghalaya, Delhi, Gujarat, Haryana, Karnataka. Elsewhere : South Africa, New Zealand, U.S.A.
37.	<i>Oligonychus biharensis</i> (Hirst)	Tetranychidae	<i>Ficus religiosa</i>	India : Tripura, Bihar, Andaman & Nicobar Isls., Gujarat.
38.	<i>Panonychus citri</i> (McGregor)	Tetranychidae	<i>Carica papaya</i> <i>Morus alba</i>	India : Meghalaya, Tripura, Andaman & Nicobar Isls., Assam, Jammu & Kashmir, West Bengal. Elsewhere : Thailand, New Zealand, China, Middle East, Japan, South Africa, U.S.A., Argentina, Cuba, Bermuda.
39.	<i>Panonychus ulmi</i> (Koch)	Tetranychidae	<i>Musa paradisiaca</i>	India : Meghalaya, Himachal Pradesh, Uttar Pradesh, Jammu & Kashmir. Elsewhere : Europe.

Sl No.	Name of Mite	Family	Host Plant	Distribution
40.	<i>Phytoseius (Pennaseius) kapuri</i> (Gupta)	Phytoseiidae	<i>Psidium guajava</i>	India : Tripura, West Bengal, Bihar, Andaman & Nicobar Isls., Orissa, Punjab, Rajasthan, Tamil Nadu, Gujarat, Jammu & Kashmir, Meghalaya, Uttar Pradesh.
41.	<i>Phytoseius (Phytoseius) roseus</i> (Gupta)	Phytoseiidae	<i>Psidium guajava</i>	India : Tripura, Punjab, Gujarat, Tamil Nadu, Jammu & Kashmir, West Bengal, Uttar Pradesh. Elsewhere : Pakistan.
42.	<i>Typhlodromus (Amblydromella) darjeelingensis</i> Gupta	Phytoseiidae	<i>Michaelia champaca</i>	India : Meghalaya, Tamil Nadu, Karnataka, Uttar Pradesh, Punjab, West Bengal, Tripura.
43.	<i>Typhlodromus (Amblydromella) gopali</i> Gupta	Phytoseiidae	Banana (<i>Musa paradisiaca</i>)	India : Tripura, West Bengal, Rajasthan, Punjab, Himachal Pradesh.
44.	<i>Tydeus</i> sp.	Tydeidae	<i>Mallotus philippensis</i>	India : Meghalaya.
45.	<i>Walzia indiana</i> Smith-Meyer & Uckermann	Stigmaeidae	<i>Morus alba</i>	India : Meghalaya, West Bengal

SECTION-II

Sl No.	Name of Plant	Family	Name of Mite
1.	<i>Asclepias curassavica</i>	Asclepiadaceae	<i>Cunaxa curassavica</i>
2.	<i>Azadirachta indica</i>	Meliaceae	<i>Amblyseius (Amblyseius) channabasavannai</i>
3.	<i>Canthium angustifolium</i>	Rubiaceae	<i>Bdella angustifolius</i>
4.	<i>Carica papaya</i>	Caricaceae	<i>Amblyseius (Euseius) pruni</i> , <i>Agistemus macrommatus</i> , <i>Panonychus citri</i>
5.	<i>Cassia occidentalis</i>	Fabaceae	<i>Amblyseius (Euseius) alstoniae</i>
6.	<i>Cocos nucifera</i>	Palmae	<i>Acarus farris</i>
7.	<i>Feronia elephantum</i>	Rutaceae	<i>Cunaxa bambusae</i>
8.	<i>Ficus religiosa</i>	Moraceae	<i>Oligonychus biharensis</i>
9.	<i>Litsaea khasyana</i>	Lauraceae	<i>Amblyseius (Neoseiulus) longispinosus</i> , <i>Bdella khasyana</i>

Sl No.	Name of Plant	Family	Name of Mite
10.	<i>Luffa acutangula</i>	Brassicaceae	<i>Amblyseius (Euseius) ovalis</i>
11.	<i>Macheles edulis</i>	Lauraceae	<i>Agistemus edulis</i>
12.	<i>Machilus gamblei</i>	Lauraceae	<i>Agistemus gamblei</i>
13.	<i>Mallotus philippensis</i>	Euphorbiaceae	<i>Tydeus</i> sp.
14.	<i>Mangifera indica</i>	Anacardiaceae	<i>Amblyseius (Typhlodromips) suknaensis</i> , <i>Amblyseius (Paraphytoseius) multidentatus</i> , <i>Amblyseius (Amblyseius) channabasavannai</i> , <i>Agistemus fleschneri</i> , <i>Oligonychus gossypii</i> , <i>Cunaxa anacardae</i> , <i>Amblyseius (Typhlodromips) syzygii</i>
15.	<i>Michaelia champaca</i>	Magnoliaceae	<i>Typhlodromus (Amblydromella) darjeelingensis</i> , <i>Cheyletus malaccensis</i>
16.	<i>Morus alba</i>	Moraceae	<i>Agistemus garrulus</i> , <i>Panonychus citri</i> , <i>Oligonychus mangiferus</i> , <i>Walzia indiana</i>
17.	<i>Musa paradisiaca</i>	Musaceae	<i>Amblyseius (Amblyseius) herbicolus</i> , <i>Amblyseius (Amblyseius) largoensis</i> , <i>Aponychus baghensis</i> , <i>Panonychus citri</i> , <i>Panonychus ulmi</i> , <i>Oligonychus indicus</i> , <i>Amblyseius (Euseius) ovalis</i> , <i>Typhlodromus (Amblydromella) gopali</i> , <i>Acarus farris</i> , <i>Iphiseius andamanicus</i>
18.	<i>Mussandra parryorum</i>	Rubiaceae	<i>Ledermulleria parryorum</i>
19.	<i>Pavetta indica</i>	Rubiaceae	<i>Hemicheyletia indica</i>
20.	<i>Psidium guajava</i>	Myrtaceae	<i>Amblyseius (Typhlodromips) meghalayensis</i> , <i>Amblyseius (Amblyseius) mcmurtryi</i> , <i>Brevipalpus phoenicis</i> , <i>Amblyseius (Euseius) coccineae</i> , <i>Phytoseius (Pennaseius) kapuri</i> , <i>Phytoseius (Phytoseius) roseus</i>
21.	<i>Thunbergia grandiflora</i>	Acanthaceae	<i>Bdellodes grandiflora</i>

SUMMARY

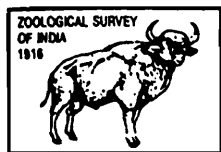
A total of 45 species of mites occurring on 21 species of medicinal plants under 14 families from Northeast India are listed in the paper. It includes distribution of each mite species both in India and elsewhere. Lists of mite-host plant and host plant-mite are also incorporated in the paper under Section-I and II respectively.

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SUITABILITY OF WATER QUALITY FOR IRRIGATION. A CASE STUDY OF KONDAKARLA LAKE, ANDHRA PRADESH

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INTRODUCTION

Water quality refers to the degree of suitability for a specific purpose and it largely depends on the physico-chemical composition of its water. The suitability of water for irrigation purposes should therefore be assessed on the basis of its ability to create favourable conditions for crop growth. Irrigation water contains measurable quantities of dissolved salts originating from different sources. Eaton (1950), Szaboles and Daras (1968), Rhoades (1972), Sreerama Murthy *et al.*, (1995) are some of the attempts made on the water quality for irrigation in general.

Kondakarla Lake is situated at 50 km. south-west of Visakhapatnam in Andhra Pradesh and stretched between latitudes 17°35'30" and 17°36'02" N and longitudes 82°59'27" and 83°01'0" E. Though located at about 20 kms. away from the Bay of Bengal, the lake water is the main source of irrigation to the surrounding agricultural fields, where sugar cane is the major crop (75%) followed by paddy (15%) and vegetables (5%). This paper assumes significance due to its maiden attempt in analysing suitability of the water for irrigation.

MATERIAL AND METHODS

Water samples have been collected on 22.04.2000 from three sites of the lake where the crop density is much in its surroundings, viz., Kondakarla village, Vadrepalle and Haripalem. These samples have been analysed for 13 parameters required for the study. The factors like Sodium Absorption Ratio (SAR), Residual Sodium Carbonate (RSC) and Percent Sodium (PS) have been calculated with the following formula :

$$\text{SAR} = \text{Na} / \sqrt{\left(\frac{\text{Ca} + \text{Mg}}{2} \right)}$$

$$\text{RSC} = (\text{Co}_3 + \text{HCo}_3) - (\text{Ca} + \text{Mg})$$

$$\text{PS} = \frac{100 \text{ Na}}{\text{Na} + \text{Ca} + \text{Mg} + \text{K}}$$

RESULTS AND DISCUSSION

Results of the 13 parameters analysed together with its tolerance limits are given in Table I. Suitability of irrigation water depends primarily upon the silt and salt constituents. The total concentration of soluble salts, the proportion of sodium to other cations, bicarbonate concentration and calcium with magnesium concentration are the important factors for assessing the suitability of water quality for irrigation.

pH : The water is found alkaline with pH value 8.5 at all the three spots of the water body. The tolerance limits of this factor is 6.0 to 8.5. Accordingly, this water is suitable for agricultural purposes.

Electric conductivity : This parameter ranged from 990 (Vadrepalle) to 1450 micro mhos/cm (Kondakarla Village). Waters below the level of 2,250 are found to be suitable for good crop growth with proper management and drainage conditions, but saline conditions may develop if leaching and drainage are inadequate. Irrigational water with electric conductivity between 750–2250 is classified as C3 water and accordingly Kondakarla lake water falls under this class.

Bicarbonates : Abnormal quantity of bicarbonates affects the uptake and metabolism of nutrients by plants and it varies in different species. Calcium and magnesium precipitate as carbonates in waters having more concentration of bicarbonates and also increase the exchangeable sodium percentage. Bicarbonates in the ecosystem was found from 3.6 to 5.2 m.eq/L.

Chloride : Abundance of chlorides may be toxic to fruit crops and injurious to leaves. Maximum tolerable limit of this factor is 17 m.eq/L. and this value in the ecosystem is found between 4–7. The rate of accumulation of this parameter in soil does not have any relation with its concentration in irrigating waters. Silty clay loams accumulate more chlorides in a given time than sandy loams and sands.

Sodicity : Concentration of sodium relative to other cations is called sodicity. Sodium, magnesium, chloride and sulphate are abundantly found in saline waters. Magnesium is one of the important criteria in determining the irrigational waters and high magnesium absorption affects the soil unfavourably. (Szaboles and Daras, 1968).

Table I. : Physico-chemical parameters of Kondakarla Lake.

Sl. No.	Parameters	Kondakarla Village	Haripalem Village	Vadrepalle Village	Tolerance limits (max.)
1.	pH	8.55	8.5	8.6	6.0–8.5
2.	Electric conductivity (Micro mhos/cm)	1450	1320	990	2250
3.	Carbonates (m.eq./L.)	0.8	0.6	1.0	–
4.	Bicarbonates "	5.2	4.2	3.6	–
5.	(Calcium + Magnesium) "	6.0	6.2	3.8	–
6.	Sodium "	8.48	7.04	6.08	–
7.	Potassium "	0.05	0.05	0.1	–
8.	Chloride "	7.0	5.2	4.0	17
9.	Sulphate "	1.4	2.8	1.0	21
10.	Nitrate "	0.13	0.11	0.23	–
11.	Residual Sodium Carbonate "	NIL	NIL	0.6	1.25
12.	Sodium Absorption Ratio –	4.9	4.0	4.41	26
13.	Percent Sodium –	58.36	52.97	60.92	60
14.	Water Quality –	C ₃ S ₁	C ₃ S ₁	C ₃ S ₁	–

m.eq = milli equivalents

The sodium hazard of irrigation waters is measured by the concentration of sodium to calcium and magnesium which is called Sodium Absorption Ratio (SAR). The SAR values in the present study floated from 4.0 to 4.9 and its tolerance limit is 26. The sodium hazard of irrigation waters as expressed by SAR does not take account the effect and anionic composition. The higher SAR values deteriorates the soil texture in irrigation waters. As per the Indian Standards (2296–1982) irrigation water with SAR less than 10 is classified as S_1 and accordingly Kondakarla lake water belongs to this class.

Residual Sodium Carbonate (RSC) during the survey was found 0.6 m.eq/lit. at Vadrepalle and absent in the other two places. According to Eaton (1950), waters with RSC greater than 2.5 m.eq/lit. may be regarded as deleterious while those with less than 1.25 m.eq/lit. are considered safe.

From the water samples the percent sodium ranged from 53 to 61 (rounded of to nearest fraction) and its maximum tolerance limit is 60.

Sulphates : Sensitivity of plants to high sulphate concentration is related to the tendency of high sulphate concentrations to limit the calcium uptake by plants.

The decrease in the uptake of the factor is associated with relative increases in the absorption of sodium and potassium. Sulphate quantity in the lake water during the survey ranged between 1.0 to 2.8 while its tolerance limit is 21.

CONCLUSION

The suitability of irrigation water has to be assessed on the basis of specific conditions like different agroclimatic conditions, different crops (sensitive, semitolerant, tolerant), its varieties and cultural practices. Due to differences in these conditions in different areas, one can treat the above guidelines for evaluating irrigation water quality.

As such the Kondakarla lake irrigation water has been classified as C_3S_1 on the basis of the electric conductivity (750–2250 micro mhos/cm) and SAR (less than 10). All the parameters of Kondakarla lake water are within the limits required for agricultural purpose and thus indicated its suitability for irrigation purposes.

SUMMARY

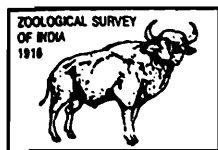
In order to assess the suitability of water quality for irrigation purposes at Kondakarla Lake which is forming one of the major wetlands in Visakhapatnam District of Andhra Pradesh, the author has collected its water samples and analysed the relevant parameters. The positive results obtained have been discussed in the light of its suitability.

ACKNOWLEDGEMENTS

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NEW RECORDS OF BATS FROM CENTRAL WESTERN INDIA

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INTRODUCTION

During ecological study and faunastic survey of bats from Pune city (Maharashtra) performed for two years 1998–2000, three bat species are recorded for the first time from Central Western India. All three bat species belong to genus *Pipistrellus* i.e. *P. pipistrellus* (Schreber, 1774), *P. kuhli* (Kuhl, 1819) and *P. savii* (Bonaparte, 1837).

The occurrence of small evening bats is common in the study area. These bats prefer to live in small groups of 5 to 25 bats, but their consolidated population is large. The bats belonging to genus *Pipistrellus* show species diversity in the city area, about 8 species are recorded in Pune city.

Pipistrellus pipistrellus, *P. kuhli* and *P. savii*, all these species are confirmed by morphological, cranial and dental measurements. Their occurrence in the peninsular India has extended their distribution in the Indian subcontinent.

OBSERVATIONS

TAXONOMY AND ECOLOGICAL DETAILS

(1) COMMON PIPISTRELLE

Class MAMMALIA

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family VESPERTILIONIDAE

*Department of Environment Science, Pune University, Pune.

Genus *Pipistrellus*

Species *Pipistrellus* (Schreber, 1774)

1774. *Vespertilio pipistrellus*, Schreber, 167, pl. 54. Type locality : France.

Diagnosis of the species : Small sized pipistrelle, with forearm length 29–32 mm and head and body length 43–46 mm. The tail is relatively long (32–35 mm). The brain case is moderately high and rounded and interdental palate is longer than wide. Inner upper incisor I² is bicuspidate, outer upper incisor (I³) is similar in crown area to I², but half or slightly more in height. Pm² is similar in crown area to I² and not much intruded from tooth-row. Upper canine is clearly separated from posterior premolar Pm⁴, and Pm² is visible laterally.

Dental formula :
$$i \frac{-2 \ 3}{1 \ 2 \ 3}, \ c \frac{1}{1}, \ pm \frac{-2-4}{-2-4}, \ m \frac{1 \ 2 \ 3}{1 \ 2 \ 3} = 34$$

External, cranial and dental measurements (mm) of *Pipistrellus pipistrellus*

HB	43–46	GTL	11.8–12.2
HF	6–7	CCL	10.6–11.3
T	32–35	ZB	6–6.3
FA	29–32	BB	5.8–6.2
E	10–12	PC	3.4–3.8
5MT	27–30	CM ³	4.2–4.5
4MT	28–31	CM ₃	4.3–4.6
3MT	28–31	M ³ –M ³	5.4–5.6
TIB	10–11	M	8.4–8.7
WSP	190–203	RW	5–5.2

*n = 3 (2 female, 1 male)

HB : Head & body length, HF : Foot length, T : Tail length, FA : Forearm length, E : Ear length, 5MET : Length of 5th metacarpus, 4MET : Length of 4th metacarpus, 3MET : Length of 3rd metacarpus, TIB : Length of tibia, WSP : Wingspan, GTL : Greatest length of skull, CCL : Condylor-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM³ : Maxillary toothrow, CM₃ : Mandibular toothrow, M³–M³ : Posterior palatal width, M : Mandible length, RW : Width of rostrum.

Pelage is soft, dense and silky. Dorsally the pelage colour is blackish brown and slightly paler on the ventral side. Some of the hair tips on the ventral side are grey to buffy brown. Snout, ears and membranes are uniformly dark brown. The ears are held almost horizontally on the head, the

tragus is tall and slightly curved inwardly. The tibiae are short and the soles are small. The dorsal profile of the skull rises gradually from the nasal aperture to lambda. The cranium is bulbous and the rostrum is long and narrow.

Collecting locality : The evening bats of the present species are found hiding behind the wooden notice board at the second floor of Bharati Vidyapeeth, near Katraj lake, on southern border of the city.

Systematic remark : Specimens from India and Pakistan are provisionally referred to the Indian subspecies *P. p. aladdin* (Corbet & Hill, 1992). Those from north of the main massif of the Hindu-Kush Mountains Afghanistan are referred to *P. p. bacrianus* (Gaisler, 1970).

Distribution : The present species of bat is reported from North Pakistan (Gilgit), Kashmir; and to W. Europe, N. Africa and Turkestan.

Ecological note : A group of about 20 bats of adult and subadults were found roosting under the same shelter in early February. This part of city is comparatively cool and humid in monsoon i.e. from June to September but for the remaining season the surrounding is dry, when the bats were located. After trapping and releasing, the disturbed colony left the roosting site and did not turn up to this site till the date. Nothing is known about the reproduction cycle.

(2) KUHLMAN'S PIPISTRELLE

Class MAMMALIA

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family VESPERTILIONIDAE

Genus *Pipistrellus*

Species *kuhlmanni* (Kuhl, 1819)

1819. *Vespertilio kuhlmanni* Kuhl, 1819. Type locality : Trieste, Italy.

Diagnosis of species : The medium sized pipistrelle with forearm length ranging between 34.8–36. The tail length (33–35 mm) is sub equal to the head and body length (46.8–49.4 mm). It differs from other closely related species in dental peculiarities. I^2 is unicuspid, I^3 and pm^2 are small, about one half or less in the crown area of I^2 . The tip of I^3 extends slightly beyond the cingulum of I^2 . The wing membranes are translucent and the most characteristic feature is the presence of distinct white border on the patagium running between the foot and the fifth digit.

External, cranial and dental measurements (mm) of *Pipistrellus khlii*

HB	46.8–49.4	GTL	13–13.6
HF	6–7	CCL	12–13
T	33–35	ZB	8.5–8.8
FA	34.8–36	BB	6.8–7
E	11.1–13	PC	3.4–3.8
5MT	31–33.8	CM ³	4.8–5
4MT	31.8–34.5	CM ₃	5.2–5.6
3MT	32–35	M ³ –M ³	5.7–6
TIB	13–14	M	10–10.6
WSP	233–242	RW	4.9–5

*n = 3 (2 female, 1 male)

HB : Head & body length, HF : Foot length, T : Tail length, FA : Forearm length, E : Ear length, 5MET : Length of 5th metacarpus, 4MET : Length of 4th metacarpus, 3MET : Length of 3rd metacarpus, TIB : Length of tibia, WSP : Wingspan, GTL : Greatest length of skull, CCL : Condylor canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM³ : Maxillary toothrow, CM₃ : Mandibular toothrow, M³–M³ : Posterior palatal width, M : Mandible length, RW : Width of rostrum.

The dorsal pelage is dark brown and slightly paler ventrally. The hair roots on the ventral body surface have darker base. The snout, ears and wing membranes are uniformly brown. The tragus is inwardly curved, but the tip is narrow and the outer border lacks triangular projection, the presence of which is the peculiarity of *P. savii*. The skull is long, its dorsal profile is almost straight and the lambdoid crest in front of the small triangular area is well developed. Pm² is displaced inwardly as a result the upper canine and pm⁴ seem to be in contact. Pm² is smaller, about half of Pm⁴ in height and crown area.

Collection locality : While surveying bat colonies in urban area of Pune city (Maharashtra, India), two colonies of *Pipistrellus kuhlii* were located. In the first case, from the small population of about 6–7 bats, two bats were trapped in early June from the old stony building of St. Hilda's Girls' School premises in Guruwar Peth. The adult males and females live in the crevices of an old stony building at the ground floor verandah covered with old-fashioned clay tiles. The bats of *P. ceylonicus* and *P. savii* were also trapped from the vicinity. Another colony of about four to five bats of *P. kuhlii* was located in early February roosting behind the wooden board again at the ground floor of an old stony building of Fergusson College.

Systematic remark : There is no endemic subspecies in the Indian subcontinent.

Distribution of species : This bat species is reported from southern Europe to India and also from Morocco to Egypt and South Africa (Corbet and Hill, 1992). From India it is reported from Kolkata (West Bengal), Cachar District from Assam and Cherapunji from Meghalaya (Kurup, 1968). The present report is the extension of the species in the central western region of India.

Ecological note : Both these colonies are located in the urban area, where the surrounding is quite green due to indigenous plants and hence cool and humid even in summer.

Like other species of *Pipistrellus*, the bats of the present species come out from their diurnal roost about 10 to 15 minutes after sunset. The bats leave their roost one by one at the interval of about 2 to 3 minutes. The flight is jerky but regular.

Nothing is known about the reproduction. The bats seem to shift the day roosts in response to even slight disturbance in their habitat or due to human interference.

(3) SAVI'S PIPISTRELLE

Class MAMMALIA

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family VESPERTILIONIDAE

Genus *Pipistrellus*

Species *savii* (Bonaparte, 1837)

1837. *Vespertilio savi* Bonaparte : fasc. 20 Type Loc. : Pisa, Italy.

Diagnosis of species : Inner upper incisor I^2 is bicuspid. I^3 is half or more in height to I^2 , but similar in crown area. Pm^2 is little reduced in crown area, about two thirds of that of I^2 . Postorbital region, supraorbital region and rostrum are moderately widened. Supraorbital tubercles are small. Braincase is low, flat and elongate. Basial pits are lacking. Pelage is soft, dense, long and silky.

Dental formula : $i \frac{-2 \ 3}{1 \ 2 \ 3}, c \frac{1}{1}, pm \frac{-2-4}{-2-4}, m \frac{1 \ 2 \ 3}{1 \ 2 \ 3} = 34$

External, cranial and dental measurements (mm) of *Pipistrellus savii*

HB	46–51	GTL	14.4–14.5
HF	6–7	CCL	12.4–13.5
T	29.5–30	ZB	8.3–8.5
FA	35.8–36.7	BB	7–7.2

E	11.6–12.2	PC	3.5–3.7
5MT	31–31.6	CM ³	5.1–5.2
4MT	33.6–34.3	CM ₃	5–5.2
3MT	30.2–33.4	M ³ –M ³	6–6.1
TIB	13.2–14.5	M	9.5–10.5
WSP	235–249	RW	5.5–5.7

*n = 2 male

HB : Head & body length, HF : Foot length, T : Tail length, FA : Forearm length, E : Ear length, 5MET : Length of 5th metacarpus, 4MET : Length of 4th metacarpus, 3rd MET : Length of 3rd metacarpus, TIB : Length of tibia, WSP : Wingspan, GTL : Greatest length of skull, CCL : Condylor-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM³ : Maxillary toothrow, CM₃ : Mandibular toothrow, M³–M³ : Posterior palatal width, M : Mandible length, RW : Width of rostrum.

The medium sized bat with uniformly dark brown long, silky, soft and dense pelage. Ventrally the hair bases are darker, while the tips are pale in colour. The snout, ears and wing membranes are uniformly dark brown. The muzzle is naked and flat. The membranes are translucent. The ear lobes are long and broad at the base. The tip of the ear lobe is rounded. The tragus is long, inwardly curved and with blunt tip. On its outer margin on the lower half, there is a triangular projection. The tail is significantly shorter than the head and body length.

Collecting locality : The bats of the present species *Pipistrellus savii* were trapped, when hiding behind the nameplate fitted on the stony wall of old building in the premises of Fergusson College. Two isolated males were trapped, one in mid March 1999 and the other in mid February next year.

Systematic remark : Specimens from India and Myanmar are provisionally referred to *P. s. austenianus* (Ellerman & Morrison-Scott, 1951 and Hill, 1962) as reported by Corbet & Hill, (1992).

Distribution of the species : *Pipistrellus savii* is reported from Korea, Japan, Arabia, Iran, Afghanistan, India, Myanmar and North Africa. In India Cherapunji (Meghalaya) is the type locality of *P. s. austenianus*. It is a widespread but little studied species. In Indian subcontinent the endemic subspecies *P. s. austenianus* has a restricted range. But its occurrence in the peninsular India has extended its distribution in this subcontinent.

Ecological notes : Nothing is known about the food and feeding habit or reproduction cycle of the present species.

SUMMARY

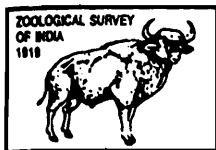
Occurrence of three species of pipistrelles, *Pipistrellus pipistrellus* (Schreber, 1774), *P. kuhlii* (Kuhl, 1819) and *P. savii* (Bonaparte, 1837) in urban area of Pune (Maharashtra, India) has extended the distribution of these species in the Indian subcontinent. The results are based on the morphological, cranial and dental measurements.

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Short Communication

ANIMALS FROM INDIA IN THE CARIBBEAN

No substantial research has been done on the animals and birds that came from India to the West Indies/Caribbean. Historians have instead chosen to focus their studies on Indians (West Indians) in relation to religion, caste, leadership, law and land. Animals were brought on the same ship with labourers who were imported to work on the sugar cane plantations after the abolition of slavery. Large lop-eared goats, for instance, were the survivors of the ship *Lapwing* which was wrecked near Barbados on its way to Guyana (cited in Shannon 1945). As agricultural workers during Indentureship (1838–1917), Indians worked alongside cattle in the fields, and they also kept private animals as property and pets. Indians have an ancient tradition of animal husbandry which continued in the West Indies. Indeed, it must be remembered that the cow (cattle) has always been sacred to Hindus who form a major ethnic group in Trinidad and Guyana. *Until the 1950s every Indian family raised cows to produce dung, milk and manure for subsistence and sale.* The animals were raised on common holdings and fed crop residues, wild grass and cane tops. They, therefore, did not compete with their owners for food and space.

This neglect in research is unfortunate. Researchers Julie Cole, Will Faust and Matt Fleming claim in their work on “The Evolution of Wild Cattle” (1991) that the first known bovid (family of cattle, sheep and goats) in the world was the Aurochs, which is of Indian origin. The breed first evolved in Asia, and then in Europe and Africa at approximately the same time during the Pleistocene Period (1.8 million to 11,000 years ago). The closest resemblance of the Auroches today can be found in the wild Zebu cattle of India, and the Sanga cattle from Africa. Archaeological findings and genetic evidence have proven that farmers in India were the first to capture and tame the humped Zebu cattle which is native to that country (Bradley 2003).

Though domesticated cattle was first brought to the Americas by Columbus on his second voyage, the Zebu cattle (*Bos indicus*) was brought to the West Indies by the British in the 1860's.¹

¹ *Bos indicus* is thought to have originated in India more than 4,000 years ago (RRAT 2002).

Over 30 breeds (including a miniature) came and were named after their province of origin such as the Nellore, Hissar, Mysore and the Gujarat. These have huge curved horns, a massive hump just behind the neck, and thrive in hot humid conditions. Zebus have built-in protection against biting insects in the form of muscles that allow better twitching of the skin. They do not eat when water is unavailable and live off of the fat in their hump. These were later crossed with other breeds in Jamaica and Martinique Chantal *et al.* (1998) in the 1950's to produce more beef (Hoyt 2003; JAS 1961). Several *B. indica* breeds have been developed into the Brahman breed² in the United States, where it was first imported 1849.³

In 1905 and 1908 during indentureship, 30 Jafarabadi Indian water Buffaloes ("bhaisa") were brought to Trinidad in the Tacarigua sugar estate to replace the cattle herds (Zebu and Brahman breeds) which were infected with tuberculosis (L. Rastogi *et al.* 1993; Lidga 1996). Several importations of other breeds like the Murrah, Surti, Nili and Bhadawari, on the advice of Dr. L. Shannon, occurred until 1949.⁴ Crossbreeding by Steve Bennett in the 1960s has produced a Trinidadian type ("Buffalypso") that has been shipped to 19 different countries around the world, especially to Central and South America, Cuba and Barbados. Since 1974, the Food and Agriculture Organization (FAO) has signposted buffalo (*Bubalus carabanesis* and *Bubalus bubalis*) as the most neglected animal for production of milk,⁵ meat (Indian Diary 2002), Cheese, leather (Bennett 2003), and one may add draft power. Buffaloes in Trinidad have been found to be relatively free from cattle diseases and insects, and almost twice as efficient as cows in producing milk. Researcher Leela Restogi and others (1993) argue that their meat is also reported to be superior in quality to beef, and buffaloes have the unique quality to convert poor quality rations into remarkable muscle growth. In 1978, there were 6,000 buffaloes in Trinidad living in environments hostile to other animals (R. Rastogi *et al.* 1978). With the increasing use of tractor power and the imminent death of the sugar cane industry (Caroni 1975 Ltd.), these animals are destined to disappear as drought animals.

The small mongoose was imported from India (sometimes through London) to Jamaica and Trinidad around 1872. It (*Herpestes auropunctatus*) was brought to control rats that infested the sugar cane plantations which caused tremendous losses in revenue (Hinton and Dunn 1967; NHSJ 1949). From these islands they were sent to Cuba, Puerto Rico, Grenada and Barbados. They also kill snakes by inducing them to strike, stepping aside quickly, and then pouncing on their head

² **Brahman cattle** is thought to have originated in India more than 4,000 years ago (RRAT 2002).

³ Henry Koontz was the great grandson of Captain John N. Keeran, who with his friend A. H. "Shanghai" Pierce, imported some of the **first Zebu cattle** to Texas and the **United States** in 1878 (Liar's Lake 1999).

⁴ India has the highest **buffalo population in the world** (IVA 2003).

⁵ India has emerged as the **largest milk producer in the world today** (IVA 2003). About 20 years ago, nearly 60% of milk production came from buffaloes (R. Rastogi *et al.* 1978).

above with a bite that cracks their skull. They are extremely intelligent animals and reliable pets (Sanderson 1953).

Goats are probably the oldest ruminant animal (next to dogs) to be domesticated 8000 years ago. Domestication occurred along the rivers of the ancient civilizations of Nile (Africa), Tigris and Euphrates (Asia), and Indus (India). In 1872, Indian goats were bought from vessels in England, and about the same time they were brought to the West Indies to be milked for the children of immigrant labourers on the ships (Shannon 1945). The original goats imported from Africa, Arabia and India were long-legged and hardy, and were crossed by British breeders.⁶ Goats adapt easily to mountainous and semi-arid environments, and are used for meat, milk and hide production. Goat milk is valued for people suffering with ulcers and matasmus.

Rhesus monkeys (*Macaca mulatta*) were released in islands near Puerto Rico in the 1960s (SZGD 2000, ZOO 2002), and later in Florida (BBC 2003). They have a squat thickset built and are highly intelligent. In India, they are considered sacred and are left unmolested.

Very few birds from India were brought to the Caribbean, and none could have flown over the vast oceans. The most widely distributed is the Peafowl (*Pavo cristatus*). The Peacock is identified by its magnificent huge tail that can be raised into a broad fan. Both male and female emit a loud scream. They are raised as garden and farmyard ornamental birds (Höner 2003; Raffaele *et al.* 1998). Their feathers play an important part in Hindu iconography.

Another bird that is native to India and found in the Caribbean is the Hill Myna (*Gracula religiosa*). It is also called “The Talking Myna” because it has the surprising ability to mimic human speech, bird calls, and other sounds. There are other birds like the Red Avadavat (*Amandava amandava*) (“Strawberry Finch”), Warbling Silverbill (*Lonchura malabarica*) (“Indian Silverbill”), Nutmeg Mannikin (*Lonchura punctulata*) (“Spice Finch”), and the Chestnut Mannikin (*Lonchura malacca*) (“Black-headed Nun”). These birds were introduced to Puerto Rico (in the 1960s) Cuba, Jamaica, Hispaniola, Martinique and Guadeloupe (NFSS 1999; Faffaele *et al.* 1998; Sims 2002). It is likely that they escaped or were released from cages.

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⁶ Shannon (1945) argues that the term **Anglo-Nubian** is a misnomer; Anglo-Indian is a more appropriate and accurate designation.

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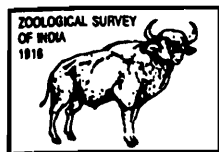
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Short Communication

FIRST RECORD OF *MADASUMMA SOROR* CHOPARD, 1969 (GRYLLIDAE : ORTHOPTERA : INSECTA) FROM KAKKAYAM RESERVE FOREST, KOZHIKODE DISTRICT, KERALA, INDIA

INTRODUCTION

While conducting a faunistic survey of Kakkayam reserve forest located in Kozhikode district, Kerala state, an interesting Orthopteran species was collected and identified as *Madasumma soror* Chopard, 1969 which turned out to be hitherto unreported from the state. Thus, this communication is intended to report the extended distribution of this taxon in the Kerala state.

Kakkayam reserve forest is located between 11°35' N latitude and 75°54' E longitude and about 60 Km. north east of Calicut city, Kerala. Thick evergreen forests and plantations of coffee and cardamom surround the area, at an altitude varying from 600 to 1500 m. above mean sea level. The proximity of Kakkayam reservoir and the forests provide the area with good shelter for many insects and other animals. The specimen of *Madasumma soror* was collected from this locality at night. The literature (Chopard, 1969; Vasanth, 1991) reveals that the species is reported so far in India from Maharashtra only. Chopard (1969) described this as a new species in his work. Details of the specimen presently studied are as follows.

Material examined : *Madasumma soror* Chopard, 1 adult male. Locality : Kakkayam reserve forest, Kozhikode district, Kerala state, India. Date : 22-ii-2003. Collector : M. Jafer Palot. Specimen deposited in Western Ghats Field research Station, Zoological Survey of India, Calicut. Reg. No. 12754.

Diagnostic characters : Head with 3 wide dark brown bands above. Pronotum feebly narrow in front, posterior margin sinuated. Abdomen light brown above, yellow below. Anterior tibiae with an oval tympanum. 5 spines on each margin of the posterior tibiae. Elytra with 2 white, callous spots – one on the external angle of the mirror, the other near its posterior margin and

several dark spots in the anal field; diagonal vein shorter; 3 short and 2 long oblique veins; sub costal vein with 11 branches. Genitalia intricate, presenting a median point and two denticulated lateral projections. Colour, testaceous brown.

Measurements : Length : Body, 18 mm.; body with wings, 28 mm.; pronotum, 2.5 mm.; posterior femora, 12.5 mm.; elytra, 18.5 mm.

Distribution : India : Mumbai, Matheran (Maharashtra); Kakkayam (Kerala) – present record.

Remarks : *Madasumma soror* Chopard belongs to the subfamily Podoscirtinae of the family Gryllidae (Grylloidea : Orthoptera : Insecta). This species comes close to *M. saussureana* (Chopard) and *M. keralensis* (Vasanth). However, the number of oblique veins on elytra in *M. soror* is 5 instead of 7 in *M. saussureana* and 6 in *M. keralensis*.

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