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

RECORDS
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Rec. zool. Surv. India : **102** (Part 1–2) : 1-5, 2004

A NOTE ON THE PRIMATES OF TAWANG DISTRICT, ARUNACHAL PRADESH

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INTRODUCTION

Arunachal Pradesh, the land of dawn-lit mountains with all its forest and wildlife resources sequesters at the farthest point of the north-east region of the country. Tawang, one of the ten districts, appearing just like a speak of the vast stretch of its state's terrain is situated at 90°45' to 92°15' N latitude and 27°22' to 27°45' E longitude with an area of 2085 sq. km. Tawang, the westernmost district of the state; two-third of the area is of high mountaneous region bounded by China (Tibet) in the north, Bhutan in the south-west and West Kameng district (AP) on the east accommodates only 28,287 human population (2001 census). The climate of the district is of temperate nature, moderate in summer and remain much below the freezing point during the winter. Rainfall in the district reasonably high during monsoon (May to September). Steep high mountaneous ranges run elsewhere in the plummer down to the green valleys where they together with other tributaries finally meet the Brahmaputra river. Forest is the main economy in the state, but Tawang depends mainly on agriculture and tourists. The district has only one social forestry division with two forest ranges and five non-account beats. There is no Reserve Forest and no Protected Forest in the district. Recently two Anchal Reserve Forests have been proposed comprising of 405 hec. of land.

No wonder the state has been a dream of naturalists. Many a number of expeditions, surveys have been undertaken by the naturalists of national and international levels. But possibly, no attempt on primates survey have been made in the district of Tawang. Therefore, keeping the view in mind, a preliminary survey to the montane forests and river valleys in the south and north-west parts of the district has been carried out during the month of May, 2002. The monkey groups that were encountered during the survey was Assamese macaque, *Macaca assamensis*. The other primate species which occur at Tawang is capped langur, *Trachypithecus pileatus*, which inhabits in the inaccessible terrain and rarely come in the villages or roadside forests at lower elevation. They are shy but true arboreal in the district. The "Pere Davis" macaque, *Macaca thibetana*, endemic to China to E. Tibet, Szechwan to Kwangtung (Pocock,1939) and the Stump tailed macaque, *Macaca arctoides*, reported to occur at Tawang, could not be located m the present survey even inquires from local people and Forest Department not confirmed its presence in the study area.

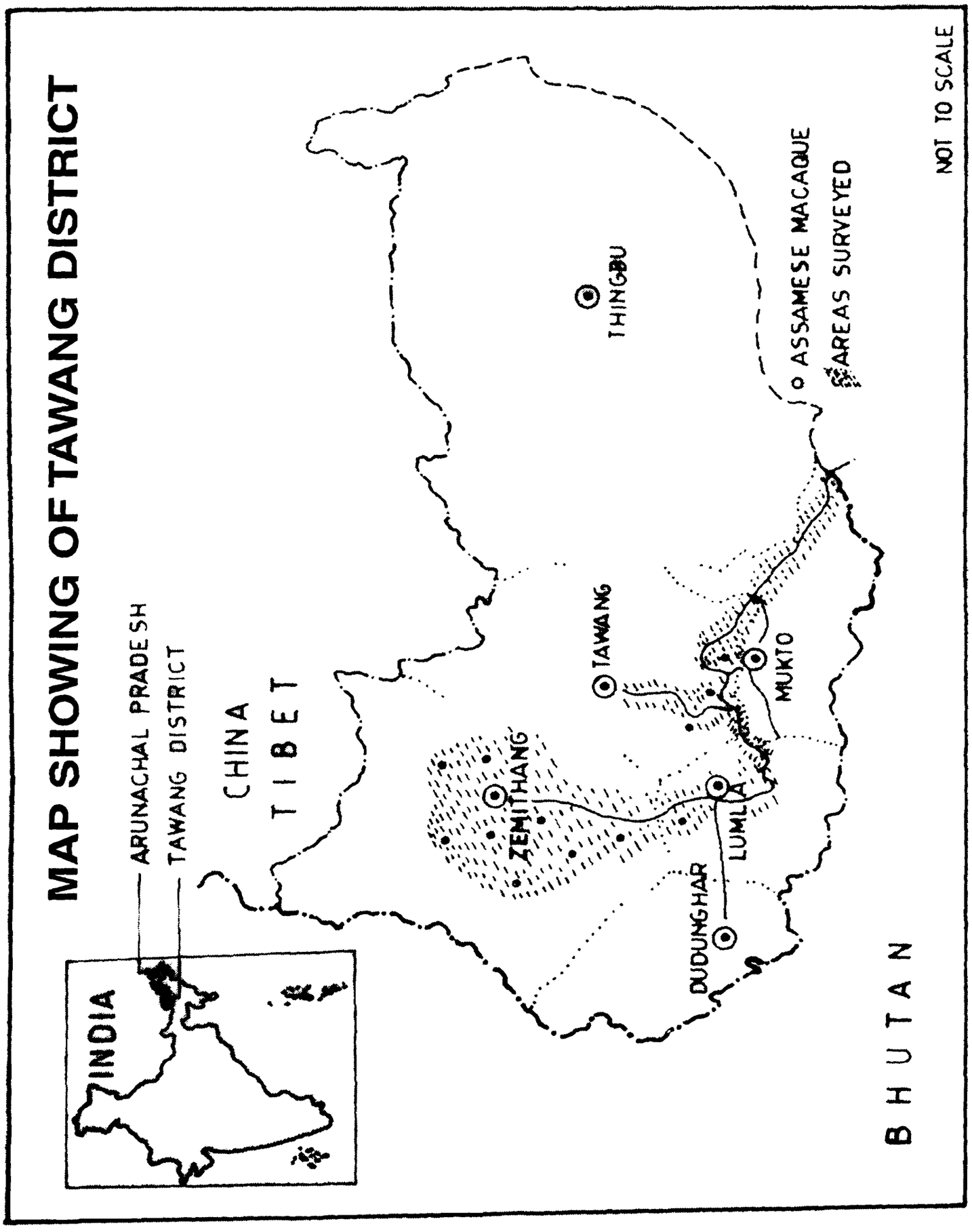
However, the occurence of Pere Davis macaque can not be ruled out at this stage till a detail investigation is made.

The characteristic physical appearance of the Assamese macaque at Tawang was close to description of other authors (Pocock, 1939; Roonwal and Mohnot, 1977). The monkeys were bigger in size and dark coat colour at Tawang as compared to individuals seen at lower elevation might have confused the observers reporting the possible occurence of a new species. A perusal of literature revealed that *Macaca assamensis* inhabits the foothills of the Himalayas and adjoining mountain ranges in south Asia (Hill and Bernstein, 1969; Fooden, 1989). The Assamese macaque belonigs to sinica group of macaque together with *Macaco sinica*, *Macaca radiata* and *Macaco thihetana* (Fooden, 1982).

The present survey revealed that Assamese macaque population is fairly common in the south and north-western parts of Tawang. This monkey inhabits in the montane forests. As the terrain is highly undulating, point method mostly followed for locating monkeys. Transect was not found suitable due to the natiJre of terrain, so that count and sweep sampling method were followed at river valley basins. About 70 sq. km. was searched mostly on foot in roads and walking trails in forbsts and using a slow moving vehicle on roads. Assamese macaque were encountered from Lumla to Zemithang and between Jang and Tawang (Fig. 1). All the groups were bisexual and composed of adult males, adult females, juveniles and infants. Areas surveyed and location of monkeys were shown in fig. 1. The distribution and social structure of this species that were recorded shown in table 1.

During the survey 12 groups of Assamese macaque were sighted in forest habitat and roadside forests. The 12 groups of monkeys composed 320 individuals of which 39 were adult males, 184 adult females, 57 juveniles and 60 infants. The group size varied from 17 to 47 individuals. The average consisted of 3.25 adult males, 13.66 adult females. 4.75 juveniles and 5.0 infants (Table 1). The sex rdtio of adult male to adult female was 1 : 4.2 and adult female to juvenile and infant ware 1 : 0.35 and 1 : 0.37 respectively. Maximum concentration monkeys were recorted in and around Zemithang, the north western part of the district. Out of 12 groups 8 groups were sighted at Zemithang areas with a total 221 monkeys. The percentage composition of the monkeys were 10.86% infants. The sex ratio of adult male to adult female was 1 : 4.67 and female to combined juveniles and infants was 1 : 0.76. The sex ratio of adult male to adult female at Zemithang groups was higher that the groups of other areas. The 320 monkeys counted at Tawang district which consisted of 12.19% adult males, 51.25% adult females, 17.81% and 18.75% were juveniles and infants respectively.

The Assamese macaque of Tawang frequently invaded the cultivated fields causing much damage of the standing crop and vegetables. Due to advantage of valley and river the people of Zemithang areas produce rice. wheat ind vegetables more than other parts of the district.



Figs. 1. Distribution of assamese Macaque in survey areas.

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

Sl./Group No.	Location	Total	Adult Males	Adult Females	Juveniles	Infants
1.	5 km from Gipsu near BTK.	25	4	12	5	4
2.	12 km South of Luma to Zemithang	20+	3	10	4	3
3.	6 km from Jang to Bomdila	35	5	19	7	4
4.	Lhou village 12 km from Tawang to Bomdila	19	3	11	2	3
5.	Muchuk, Zemithang	47	4	20	13	10
6.	Muchuk, Near foot bridge, Zemithang	32	3	15	6	8
7.	Player falls, Zemithang	23	3	12	4	4
8.	Gorsum, Zemithang	17	2	10	2	3
9.	Kharman, Zemithang	26	3	14	4	5
10.	Lumpu, Zemithang	19	2	11	2	4
11.	Umpo, near Zemithang	35	4	18	5	8
12.	Socksant Village, near Zemithang	22	3	12	3	4
	Total	320	39	164	57	60
	Average	26.67	3.25	13.67	4.75	5.0
	%	–	12.19	51.25	17.81	18.75

Ready availability of food and good shelter in the hill forests may be the reasons for more concentration of monkeys in these areas. The people of Tawang are much tolerant towards the monkey menace of the fact, they are Buddhist in faith moreover the 6-th Dalai Lama was born at Urgelling Village near Tawang. Perhaps for these reasons we did not come across any hunter and there was no killing record of monkeys those to be very common in other parts of Aruihachal Pradesh. This preliminary survey in some selected areas of Tawang district revealed that a good number of monkey population still exists there.

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Rec. zool. Surv. India : **102** (Part 1–2) : 7-10, 2004

A REPORT ON THE OCCURRENCE OF THE SEA SKATER, *HALOBATES GALATEA* HERRING (INSECTA : HEMIPTERA : GERRIDAE) IN A MANGROVE HABITAT AT DHARMADAM, KANNUR DISTRICT, KERALA, INDIA

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INTRODUCTION

The Sea skater *Halobates galatea* Herring (Insecta : Hemiptera : Gerridae) was described in 1961 by Herring based on the material procured from an unspecified locality somewhere along the west coast of India. The allotype of the species designated by Herring (1961), collected from Mumbai, India, according to Andersen and Foster (1992) belongs to *H. formidabilis* (Distant) and not *H. galatea* Herring. Based on the material collected at Chorao Island, near Paniji, Goa, India, Andersen and Foster *op. cit.* redefined and redescribed *H. galatea* Herring. The specimens studied by them were collected from the surface of channels and pools amongst mangroves (*Rhizophora*) close to the shore.

During a recent faunistic survey in the Kannur district of Kerala, 7 specimens of *H. galatea* (Plate-I) were collected from a group of 18 specimens observed in a mangrove habitat at Dharmadam, the details of which are presented below. In addition, a check-list of the species of *Halobates* Eschscholtz known so far from the Indian marine habitats is also provided.

MATERIAL EXAMINED

3 males, 4 females (all apterous), Mangroves, Thalassery river mouth 200 m inshore near Koduvally, Dharmadam, Kannur district, Kerala, India, 28-ii-2002. Coll. P. M. Sureshan and Party.

Size : Male : Length 5.2–5.5 mm, width 2.0 mm; Female : Length 5.0 mm, width 2.2–2.5 mm.

Diagnosis : Body blackish with grayish pubescence and yellow markings; head with 2 triangular yellow markings meeting in the midline; ventral part of body in male with yellow markings, not extensive but conspicuous; lateral margin of proctiger of male roundly produced but not pointed;

right styliform process curved outward; in female, the yellow colouration on the ventral part of body more extensive than in male.

Distribution : Arabian Sea along the west coast of India at Chorao Island, near Paniji, Goa; Dharmadam, Kannur district, Kerala (Present record).

Habitat : The present collection has been made from the surface of high tide waters amongst the aerial roots (Pneumatophores) of the mangrove plants, *Avicennia officianalis, A. marina* and *Sonneratia alba.*

A checklist of the species of *Halobates* Eschscholtz reported from India

1. *Halobates elephanta* Andersen & Foster, 1992

   Halobates elephanta Andersen & Foster, 1992. *J. nat. Hist.,* **26** : 537.

   Distribution : (1) Andaman Sea

   (2) Arabian Sea : Maharashtra : Mumbai : Elephanta Island.

2. *Halobates flaviventris* Eschscholtz, 1822

   Halobates flaviventris Eschscholtz, 1822. *Entomographien.,* **1** : 109.

   Distribution : (1) Bay of Bengal : Tamil Nadu : Pamban Pass.

3. *Halobates formidabilis* (Distant, 1910)

   Eurates formidabilis Distant, 1910a. *Ann. Mag. nat. Hist.,* **5**(8) : 146.

   Halobates formidabilis (Distant) : Esaki, 1929. *Ann. Mag. nat. Hist.,* **4**(10) : 417.

   Fabatus servus Distant, 1910b. *Fauna British India,* **5** : 155.

   Halobates galatea Herring, 1961 : Andersen & Foster, 1992. *J. nat. Hist.,* **26** : 542 (Female allotype).

   Distribution : (1) Andaman Sea : Andaman Nicobar : Ross Island.

   (2) Bay of Bengal : Andhra Pradesh; Orissa (Chilika Lake)

   (3) Arabian Sea : Maharashtra : Mumbai.

4. *Halobates galatea* Herring, 1961

   Halobates galatea Herring, 1961. *Pacif. Insects,* **3**(2-3) : 294.

   Distribution : (1) Arabian Sea : Goa : Paniji ; Kerala : Dharmadam.

5. *Halobates germanus* White, 1883

   Halobates germanus White, 1883. *Voy. Challenger Rept. Zool.,* **7**(19) : 50.

   Distribution : (1) Arabian Sea

   (2) Bay of Bengal.

6. *Halobates hayanus* White, 1883

   Halobates hayanus White, 1883. *Voy. Challenger Rept. Zool.*, **7**(19) : 52.

   Distribution : (1) Andaman Sea.

7. *Halobates micans* Eschscholtz, 1822

   Halobates micans Eschscholtz, 1822. *Entomographien.*, **1** : 107.

   Distribution : (1) Andaman Sea

   (2) Bay of Bengal : Tamil Nadu : Gulf of Mannar

   (3) Indian Ocean.

8. *Halobates proavus* White, 1883

   Halobates proavus White, 1883. *Voy. Challenger Rept. Zool.*, **7**(19) : 54.

   Distribution : (1) Andaman Sea : Nicobar Island : Nancovry Harbour.

9. *Halobates trynae* Herring, 1964

   Halobates trynae Herring, 1964. *Proc. ent. Soc. Wash.*, **66** : 85.

   Distribution : (1) Bay of Bengal : Andaman and Nicobar

DISCUSSION

Sea skaters of the genus *Halobates* Eschscholtz comprise the only known true oceanic insects. The genus comprises of 43 species, of which 5 are distributed in all tropical oceans and the remaining 38 have been recorded from the near-shore, sheltered coastal waters of the tropical Indo-Pacific (Andersen and Foster, 1992). Of these, 9 species viz., *Halobates galatea* Herring, *H. flaviventris* Eschscholtz, *H. formidabilis* (Distant), *H. elephanta* Andersen & Foster, *H. germanus* White, *H. hayanus* White, *H. proavus* White, *H. trynae* Herring and *H. micans* Eschscholtz are known to occur in the Indian marine habitats. But for *H. germanus* and *H. micans* which are open ocean species, the remaining species of *Halobates* known from India are apparently near-shore species preferring habitats that are sheltered from winds and wave action.

The present report forms the first record of *Halobates galatea* from the coastal waters of Kerala. It further confirms the observation made by Andersen and Foster (1992) that *H. galatea* inhabits near-shore mangrove habitats. Besides, a recent report on the distribution of *Halobates* in the open oceans around India (Pathak *et al.*, 1998) does not include *H. galatea*, a pointer to the fact that the species in all probability is not an open ocean inhabitant.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. J. R. B. Alfred, Director, Zoological Survey of India, Kolkata for facilities and encouragement.

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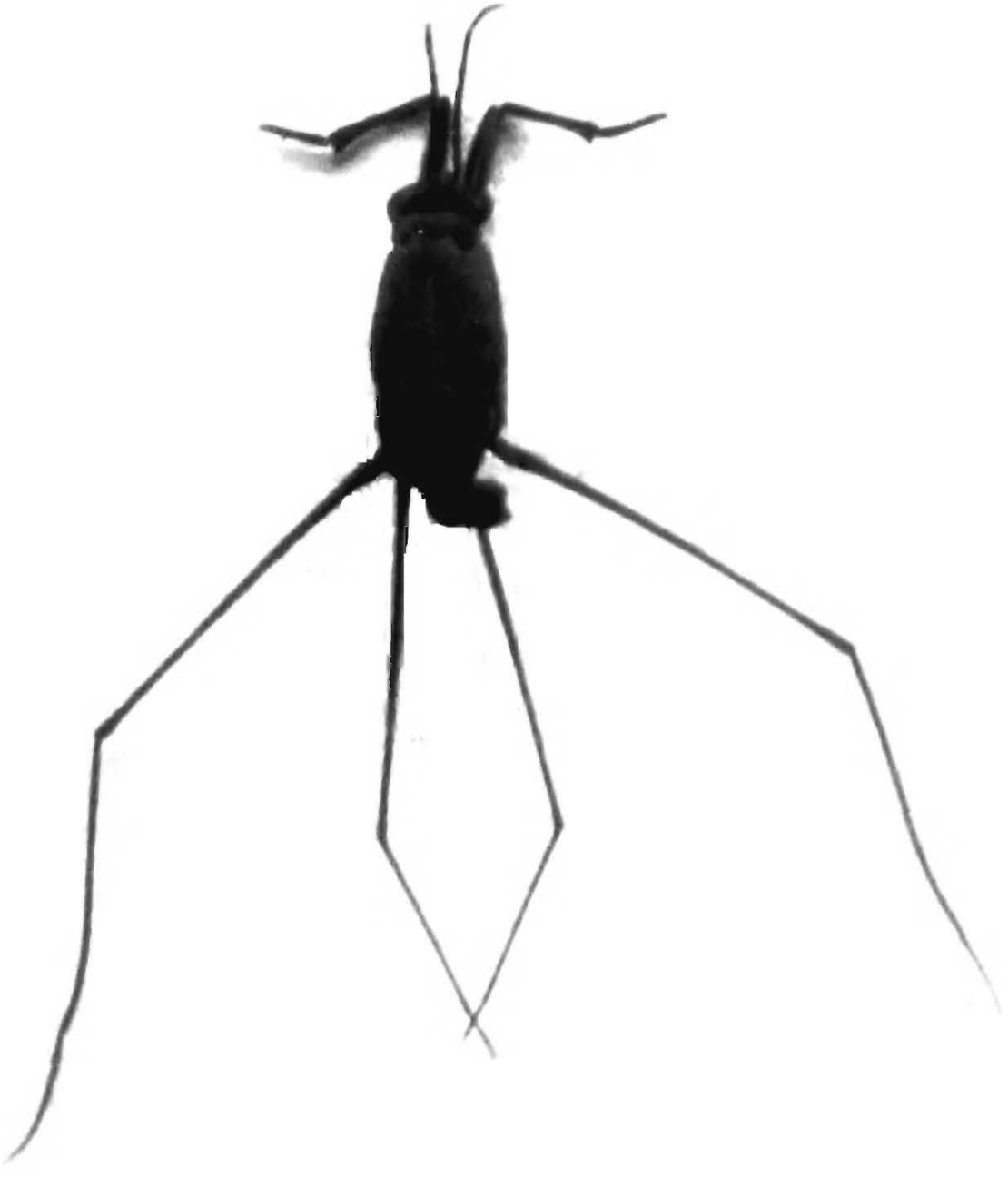
PLATE I

Apterous Male



Halobates galatea Herring

Rec. zool. Surv. India : **102** (Part 1–2) : 11-26, 2004

ON A SMALL COLLECTION OF MUSCID FLIES (DIPTERA : MUSCIDAE) OF SUNDARBANS BIOSPHERE RESERVE, INDIA

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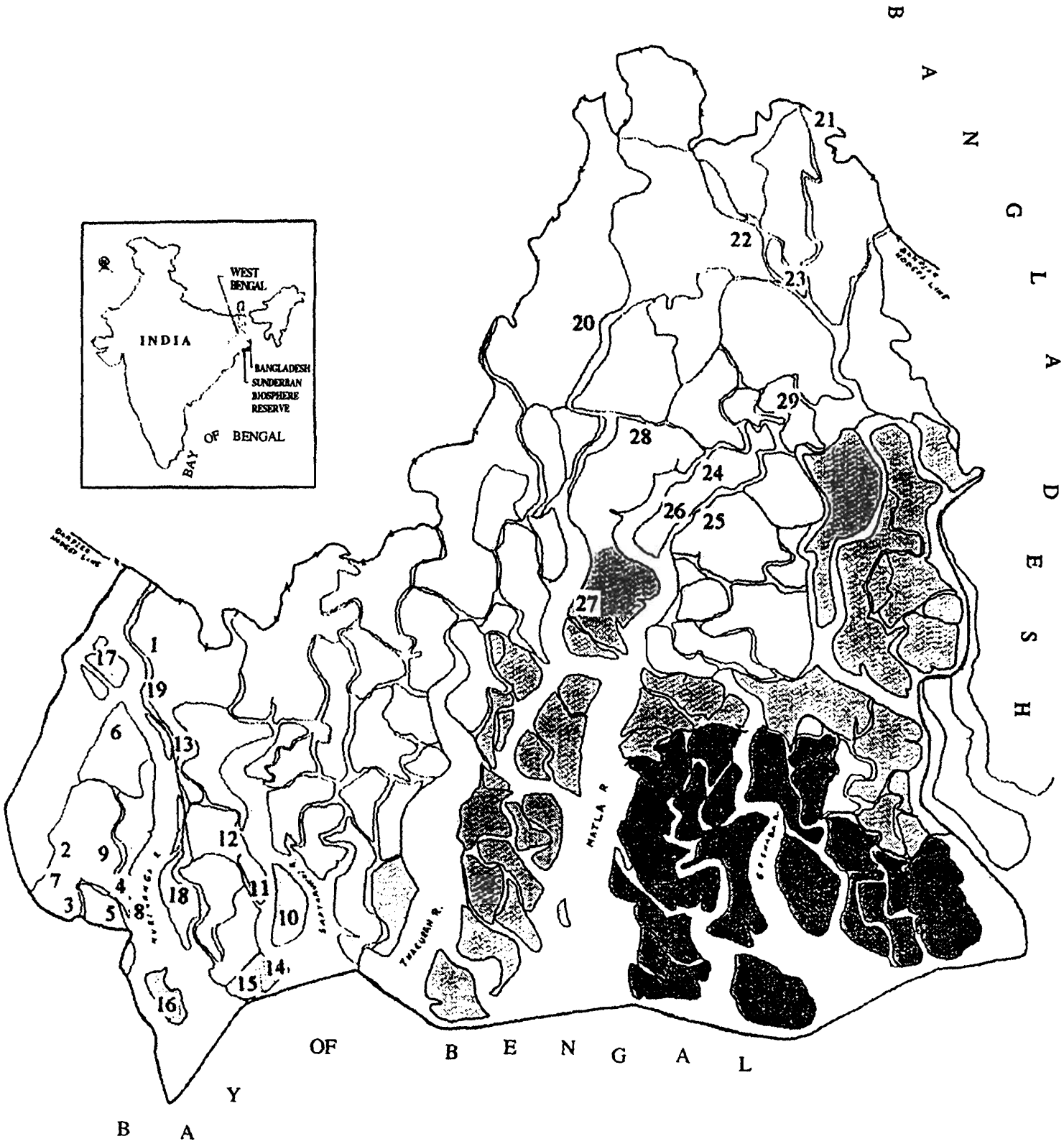
INTRODUCTION

Muscid flies are very little known from Sundarbans Biosphere Reserve except Mazumder and Parui (2001), reported 8 and Sinha and Nandi (2002) 3 species from this Biosphere Reserve. These flies are of great importance in medical, veterinary, forensic and agricultural sciences and are mostly attracted to decaying organic matters, carcasses, dung, privies, salted meat, cheese, dead bodies of different animals and flowering plants. Most of the adult flies are very important because of their relationship with man and dwellings. They carry different types of viruses, bacteria, protozoa and helminthes (Greenberg, 1971; Sinha *et al.*, 2003) and their role in dissemination of gastro enteric diseases are well known. Kettle (1995) reported more than 100 pathogens including the germs of typhoid, paratyphoid, tuberculosis, leprosy and plague which are carried by these flies. Few flies are haematophagous and lick sores of cattle and human and act as vectors of ophthalmic diseases. Some flies also feed on blood and sweat and play an important intermediate host in the cyclical transmission of filarial diseases of domestic stock particularly poultry and also act as potential mechanical vectors of diseases of domestic and wild animals. Some adults are predators and feed on larvae, pupa and adults of Simuliidae and Culicidae (Pont, 1980) and these flies can be used for biological control of some of those vectors. Few species live in the nests of birds and hymenoptera and act as parasites. The larvae of some species produce intestinal, urino-genital, dermal and aural myiasis in man and other domestic and wild vertebrate animals. A few larvae are predator and feed on the larvae of other flies of the genera *Musca, Orthellia, Haematobia* etc. which occur in dung (Shinonaga and Kano, 1971). Larvae of *Atherigona* are plant feeders and bore into the shoots of cereal crops and grasses causing dead hearts and thus they play a significant role in the destruction of crops.

METERIAL AND METHODS

Most of the adult flies were collected by the authors with the help of butterfly net from different habitats, such as dung, carcasses, dead bodies of different animals, sweet and meat shops, fish markets, debris and flowering plants from different parts of Sundarbans Biosphere Reserve (Vide Map 1) in different seasons. In some cases, they were collected with the help of bait traps using

SUNDARBANS BIOSPHERE RESERVE



Map 1. : 1. Kakdwip, 2. Beguakhali, 3. Ganga Sagar, 4. Boatkhali, 5. Bani Jungle, 6. Bamankhali, 7. Krishnagar, 8. Sahara Fish Farm, 9. Shibpur, 10. Lothian Island, 11. Bhagabatpur, 12. Baradrapur, 13. Chandanpiri, 14. Bakkhali, 15. Frasergunj, 16. Jambu Island, 17. Ghoramara Island, 18. Mohisani Island, 19. Namkhana, 20. Canning, 21. Hasnabad, 22. Nayajat, 23. Sandeshkhali, 24. Gosaba, 25. Sajnekhali, 26. Pakhiralaya, 27. Jharkhali, 28. Basanti, 29. Chotta Mollakhali.

dead fish and meat as their baits. After collection, they were killed with the help of benzene vapour putting them in a killing jar. Then they were preserved in small insect envelope mentioning their localities, date of collection and name of the collectors in a small paper and putting them inside the envelope. When they were required to study, they were transferred into a relaxing jar and kept them over night for relaxation. Then they were pinned with entomological pins and later on they were studied throughly under Sterioscopic Dissecting Bionocular and mainly the chaetotaxy were observed. Later on, the male genitalia parts were dissected out with the help of same Bionocular and studied the different parts of genitalia. After dehydration through alcoholic grades, the different parts of genitalia were drawn with the help of camera lucida when required. For preservation, the genitalia parts were placed in a small triangular paper and the paper was attached with gum along the respective specimens. A total of 16 species under 7 genera have been identified. The classification followed here is after Emden (1965) and Pont (1980).

Types will be deposited in the National Collection of Zoological Survey of India, Kolkata, in due course.

SYSTEMATIC ACCOUNT

Subfamily MUSCINAE

Tribe MUSCINI

1. *Musca (Musca) domestica nebulo* Fabricius

1794. *Musca nebulo* Fabricius, *Ent. Syst.*, **4** : 321.

1965. *Musca (Musca) domestica nebulo* : Emden, *Fauna India, Muscidae,* **7**(1) : 55.

Specimens examined : 3♂♂, Canning, 7.ii.2001; 2♂♂, Jambu Island, 16.ii.2001; 1♂, Ganga Sagar, 13.ii.2001; 1♂, Ghoramara Island, 14.ii.2001; 1♂, Frasergunj, 16.ii.2001; 1♂, Boatkhali, 16.ii.2001; 3♂♂, Hasnabad, 12.xii.2001; 2♂♂, Jharkhali, 8.xi.2001; 2♂♂, Basanti, 11.xii.2001.

Bionomics : This is a synanthropic species. They are generally called common bazar- and house fly and the adults were mainly collected from food-stuffs, excrement of different animals and slaughter houses. Greenberg (1971) reported its biological association with *Pseudomonas septica, Herpetomonas muscarum, Leishmania donovani, Leptomonas mirabilis* and *Rhynchoidomonas luciliae.*

Distribution : West Bengal (Basanti, Boatkhali, Canning, Frasergunj, Ganga Sagar, Ghoramara Island, Hasnabad, Jambu Island, Jharkhali); Andhra Pradesh; Assam; Bihar; Goa; Himachal Pradesh; Kashmir; Maharashtra; Mysore; Punjab; Sikkim; Tamil Nadu and Uttar Pradesh.

2. *Musca (Musca) domestica vicina* Macquart

1851. *Musca vicina* Macquart, *Mém. Soc. Sci. Agric. Lille.,* **1850** : 225.

1965. *Musca (Musca) domestica vicina* : Emden, *Fauna India, Muscidae,* **7**(1) : 55.

Specimens examined : 5♂♂, Jambu Island, 16.ii.2001; 5♂♂, Ghoramara Island, 14.ii.2001; 1♂, Canning, 7.ii.2001; 2♂♂, Basanti, 11.xii.2001; 2♂♂, Hasnabad, 12.xii.2001; 4♂♂, Jharkhali, 9.xi.2001; 1♂, Bakkhali, 16.ii.2001; 12♂♂, Ganga Sagar, 20.viii.2000; 1♂, Gosaba, 8.xi.2001; 1♂, Bani Jungle, 31.i.2000; 1♂, Kakdwip, 3.xi.1999.

Bionomics : This is a synanthropic species. They are generally called common bazar- and house fly and the adults were mainly collected from liquefying food-stuffs, sweets, meats, excrement of different animals, decaying vegetables, garbage, slaughter houses and carcasses. They are oviparous and lay eggs on human faeces, cow, poultry and horse dung. They are capable of transmitting a large number of viral diseases (poliomyelitis, coxsackie virus, Q fever) bacterial diseases (many diarrhoea and enteric fevers, infantile summer dysentery, typhoid and paratyphoid fevers, bacillary dysentery, conjunctivitis, tuberculosis, leprosy, plague, streptococci and staphylococci), protozoan parasites (cysts and trophozoites, trypanosomes, amoebic dysentery), tapeworms and nematodes (Smith, 1973). They are found with cattle or domestic animals in the field, irritate them and gather on food and excrement, especially in rural areas. The larvae produce intestinal, urino-genital, traumatic, aural, nasopharyngeal and cuticular myiasis in man and other domestic animals. Cases of ocular myiasis have also been reported by James (1947). They cause a wide loss of dried fishes in dry fish farm (Sinha and Nandi, 2003). Third stage larva was described by Ishijima (1967) and in nature it breeds in animal excrements and cow dung. Greenberg (1971) reported its biological association with Poliovirus, *Pseudomonas* sp., *Alcaligenes faecalis, Escherichia coli, Paracolobactrum* sp., *Proteus vulgaris, Salmonella typhi, Salmonella typhimurium, Shigella dysenteriae, Shigella flexneri, Shigella sonnei, Hemophilus influenzae, Staphylococcus* sp., *Streptococcus* sp., *Lactobacillus* sp., *Corynebacterium* sp., *Bacillus anthracis, Bacillus subtilis, Clostridium* sp., *Treponema pertenue, Herpetomonas muscarum, Chilomastix mesnili, Giardia intestinalis, Trichomonas hominis, Endolimax nana, Entamoeba coli, Entamoeba histolytica, Iodamoeba bütschli, Hymenolepis nana, Taeniarhynchus saginatum, Trichuris trichiura, Ancylostoma* sp., *Enterobius vermicularis, Ascaris lumbricoides, Allantonema muscae* and *Allantonema stricklandi.*

Distribution : West Bengal (Bakkhali, Bani Jungle, Basanti, Canning, Ganga Sagar, Ghoramara Island, Gosaba, Hasnabad, Jambu Island, Jharkhali, Kakdwip); Andhra Pradesh; Arunachal Pradesh; Assam; Bihar; Goa; Himachal Pradesh; Kashmir; Maharashtra; Mysore; Punjab; Sikkim; Tamil Nadu and Uttar Pradesh.

3. ***Musca (Byomya) conducens*** Walker

1859. *Musca conducens* Walker, *J. Proc. Linn. Soc. Lond. Zool.*, **4** : 138.

1965. *Musca (Byomya) conducens* : Emden, *Fauna India, Muscidae*, **7**(1) : 68.

Specimens examined : 1♂, Bamankhali, 21.x.2000; 1♂, Kakdwip, 3,xi,1999; 1♂, Ganga Sagar, 1.ii.2000; 1♂, Bani Jungle, 20.xii.2000; 1♂, Shibpur, 20.xii.2000; 2♂♂, Gosaba, 8.xi.2001.

Bionomics : This is a haematophagous species and the adults were collected from dung of different phytophagous animals. They gather on wounds and sores of cattle and licks from them. Greenberg (1971) reported its biological association with *Stephanofilaria assamensis*. It is also a mechanical vector of stephanofilariasis. It generally feeds on the blood oozing from bites of other insects and acts as intermediate host of *Stephanofilaria* (Shinonaga and Kano, 1971).

Distribution : West Bengal (Bamankhali, Bani Jungle, Kakdwip, Ganga Sagar, Gosaba, Shibpur); Andaman Islands; Andhra Pradesh; Arunachal Pradesh; Assam; Madhya Pradesh; Orissa; Punjab and Uttar Pradesh.

4. ***Musca (Byomya) confiscata*** Speiser

1924. *Musca confiscata* Speiser, *Beitr. Tierk. Konigsberg,* **1924** : 104.

1965. *Musca (Byomya) fasciata* : Emden, *Fauna India, Muscidae*, **7**(1) : 67; 1980. Pont, *Cat. Diptera Afrotropical Region*, 724.

Specimens examined : 1♂, Mohisani Island, 22.xi.2000; 2♂♂, Bamankhali, 4.ii.2001.

Bionomics : This is a haematophagous species and the adults were collected from dead bodies of different animals and nearby the grazing animals. The larvae breed on excrement of cow and buffalo. It licks to suck sweat and may locally become bothersome (Emden, 1965).

Distribution : West Bengal (Bamankhali, Kolkata, Mohisani Island); Andhra Pradesh; Madhya Pradesh; Tamil Nadu and Uttar Pradesh.

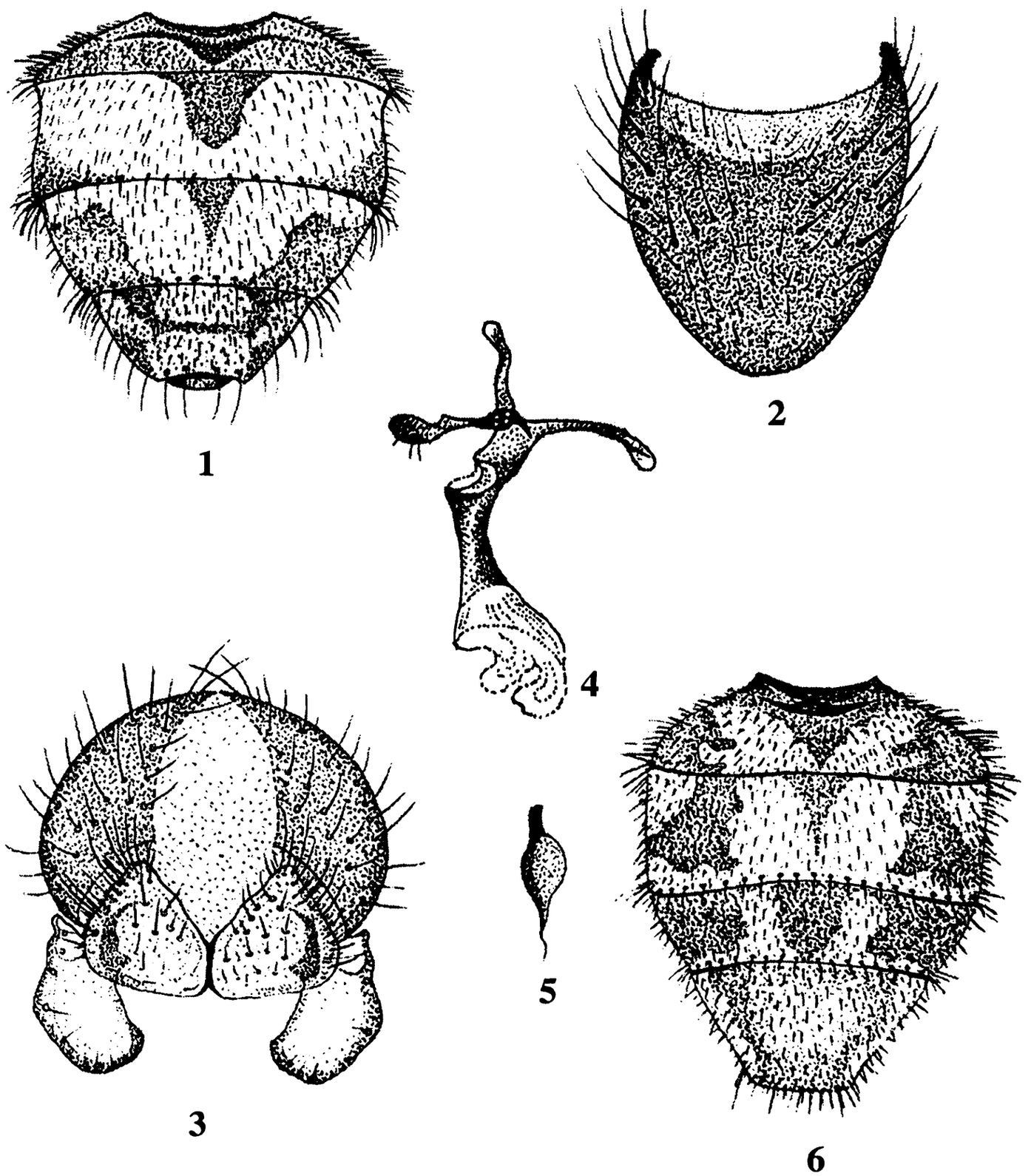
5. ***Musca (Byomya) emdeni*** n. sp.

(Figs. 1–6)

Male : Body length 5.0–5.8 mm.

Head : Eyes bare; frons slightly open and its narrowest part about one-tenth and at the vertex about one-fifth that of head width; frontal vitta brown; face black with grayish pollen; parafrontals and parafacials black with silvery pollen; upper half of parafrontal very narrow; gena and metacephalon black with silvery pollen and numerous black hairs; gena about one-fourth that of eye height; frontal bristles 12–14; antennae blackish, second antennal segment dark-brown, third brown with grayish pollen and its length about two and half times that of the second; arista dark-brown with long plumose and its length about equal to the length of third antennal segment; ocellars very short and only inner vertical moderately long; vibrissae long; palpi dark-brown.

Thorax : Blackish-brown with silvery pollen; scutum grayish appearance and with 4 conspicuous well separated undusted vittae; *ac* 0+1; *dc* 2+3; *ia* 1+2; *h* 3; *ph* 1; *np* 2; *ps* 1; *sa* 2; *pa* 2; *st* 1+2; *mpl* 6; hypopleuron bare; upper part of propleura with tuft of hairs; mesothoracic spiracles slightly



Figs. 1-6 : *Musca (Byomya) emdeni* n. sp.

1. Male abdomen; 2. Fifth sternite of male; 3. Genital tergite with inner and outer forceps; 4. Phallosome (lateral view); 5. Ejaculatory duct of male; 6. Female abdomen.

brown; metathoracic spiracles brown; apicoscutellar, lateroscutellar and discoscutellar bristles 1 pair each.

Wings : Hyaline; R_1 bare; M_{1+2} sharply bending forward; R_5 open; third section of costa about half the length of fifth; basicosta orange; epaulet brown; subcostal scale orange brown and without hairs; squamae light brown; lower squama broad posteriorly; halter orange white.

Legs : Brown; fore femur with a row of short bristles along posterodorsal surface and a row of bristles along posteroventral surface; fore tibia with 2 pre apical bristles on anterodorsal surface; mid femur with 2 bristles on middle portion of anterodorsal surface, a row of bristles along posteroventral surface, a row of sparse bristles along basal half of anterolateral surface, a row of long bristles along distal part of posteroventral surface at about one-third the distance from the distal part and 2 bristles on posteroventral surface medially; mid tibia with 3–4 bristles along distal part; hind femur with a row of long bristles along anterodorsal surface, a row of bristles along distal half of posteroventral surface and 1 long bristle on distal part of anterolateral surface; hind tibia with a row of bristles along posterodorsal surface at about one-third the distance from the distal end and 1 bristle on anterolateral surface.

Abdomen : Silvery grayish checkered pattern with numerous black hairs and dark basal excavation, a median vitta on second segment and the vitta usually more narrow at the third segment, fourth segment without any median vitta; first to fourth sternites light brown with numerous hairs; fifth sternite deep brownish, serrated at terminal projections and with several black hairs; hypopygium dark; genital tergites black with numerous hairs; inner forceps with more hairs than the outer forceps; penis brown; apical part of paraphallus membranous; theca and epiphallus light brown; anterior paramere with three spines of which one long and another two comparatively short; posterior paramere short; apodeme thin and slightly curved; ejaculatory apodeme spindle shaped.

Female : Body length 5.5–6.1 mm.

Head : Frons widely open and about one-third that of width of vertex; frontal vitta light brown; parafrontal with numerous proclinate short hairs along its length and with 8–9 short bristles along frontal ridge; outer vertical bristles well developed.

Thorax and legs : Similar to male.

Abdomen : Narrow and the fourth abdominal segment more darker than that of the male.

Female described here collected in couple.

Specimens examined : *Holotype* : 1♂, South 24-Parganas; Sagar Island (Bamankhali), 18.vi.2001, B. C. Nandi and Shuvra Kanti Sinha; *Paratypes* : 2♂♂, Kakdwip, 3.xi.2001, B. C. Nandi and Shuvra Kanti Sinha; *Allotype* : 1♂, Same data as *Holotype.*

Distribution : West Bengal; South 24-Parganas (Bamankhali and Kakdwip).

Discussion : This species is almost similar to *Musca (Byomya) pattoni* (Austen, 1910) but differs from it by the grayish abdomen with silvery checkered pattern. Moreover, 2+3 dorsocentral bristles present in this species.

This species is named in honour of Emden, F. I. Van of renowned Oriental Dipterologist.

Bionomics : This species was collected from cow-dung and the larvae breed therein.

6. *Musca (Byomya) pattoni* Austen

1910. *Musca pattoni* Austen, *Ann. Mag. Nat. Hist.*, (**8**)5 : 114.

1965. *Musca (Byomya) pattoni* : Emden, *Fauna India, Muscidae*, **7**(1) : 64.

Specimens examined : 1♂, Kakdwip, 3.xi.1999; 2♂♂, Gosaba, 8.xi.2001.

Distribution : India : West Bengal (Canning, Gosaba, Kakdwip); Andhra Pradesh; Assam; Bihar; Tamil Nadu and Uttar Pradesh.

Bionomics : This species is commonly found in bazars and is attracted to sores of living and dead animals. The larvae are generally found on cow-dung.

7. *Musca (Byomya) sorbens* Wiedemann

1830. *Musca sorbens* Wiedemann, *Aussereurop, Zweifl. Insekt.*, **2** : 656.

1994. *Musca (Byomya) sorbens* : Shinonaga and Singh, *Jap. J. sanit. Zool.*, **45** : 106.

Specimens examined : 2♂♂, Baradapur, 19.x.2000; 2♂♂, Ganga Sagar, 21.xi.2000; 1♂, Bani Jungle, 20.xi.2000; 3♂♂, Jharkhali, 8.xi.2000; 1♂, Ghoramara Island, 4.xi.1999; 3♂♂, Pakhiralaya, 6.xi.2001; 1♂, Krishnagar, 4.xi.1999; 1♂, Nayajat, 8.xi.2001; 1♂, Sahara Fish Farm, 5.xi.1999.

Bionomics : This is a synanthropic species and are very common and brothersome in camps and bazars. The adults are attracted to food-stuffs, wounds, eyes on sores, lesions and diseases of human being and poultry. They feed on food-stuffs and the larvae are found in garbage, dumps and dung of different animals including human faeces and the larvae breed therein. Pont (1980) mentioned it as vector of ophthalmic diseases.

Busvine (1980) reported this species swarming over children's faces in the villages and it transmits the germs of trachoma. The larvae can be reared from dung of pig, dog, horse and cow, refuse and carcasses. Adults are frequently attracted to eye and nose and are the principal mechanical vectors of certain eye infections (ophthalmia, blepharitis and corneal ulcers) which may result in permanent damage to the eyes (Smith, 1973). They are associated with cattle or other domestic animals in the field and irritate them. This species is also a vector of hebronemiasis (Shinonaga and Kano, 1971). They can transmit the germs of tuberculosis, leprosy, yaws, streptococci and staphylococci. The larvae cause traumatic myiasis (Smith, 1973). Ishijima (1967) described its third stage larva from Japan. Greenberg (1971) reported its biological association with *Shigella dysenteriae, Shigella flexneri, Haemophilus influenzae, Streptococcus* sp., *Staphylococcus* sp.,

Sarcina sp., *Neisseria gonorrhoeae, Corynebacterium* sp., *Bacillus* sp., *Clostridium* sp., *Mycobacterium leprae, Mycobacterium tuberculosis, Treponema pertenue, Herpetomonas muscarum, Leishmania donovani, Leishmania tropica, Trypanosoma brucei, Trypanosoma congolense, Trypanosma rhodesiense, Trypanosoma suis, Chilomastix mesnili, Giardia intestinalis, Trichomonas hominis, Endolimax nana, Entamoeba coli, Entamoeba histolytica, Iodamoeba bütschlii, Octosporea muscae-domesticae, Taeniarhynchus saginatum, Trichuris trichura, Ancylostoma* sp., *Ascaris lumbricoides, Habronema megastoma* and *Habronema muscae.*

Distribution : West Bengal (Bani Jungle, Baradapur, Ganga Sagar, Ghoramara Island. Jharkhali. Nayajat. Sahara Fish Farm, Pakhiralaya, Krishnagar); Andhra Pradesh; Arunachal Pradesh; Assam; Bihar; Goa; Tamil Nadu and Uttar Pradesh.

8. ***Musca (Byomya) ventrosa*** Wiedemann

1830. *Musca ventrosa* Wiedemann, *Aussereurop. Zweifl. Insekt.*, **2** : 565.

1994. *Musca (Byomya) ventrosa* : Shinonaga and Singh, *Jap. J. sanit, Zool.*, **45** : 107.

Specimens examined : 1♂, Mohisani Island, 22.xi.2000; 4♂♂, Bhagabatpur, 18.x.2000; 1♂, Bamankhali, 21.x.2000; 2♂♂, Sajnekhali, 6.xi.2001; 1♂, Nayajat, 8.xi.2001; 4♂♂, Jharkhali, 9.xi.2001; 6♂♂, Gosaba, 8.xi.2001.

Bionomics : This is a synanthropic and haematophagous species and the adults are available on cattle, horse and human bodies and feed on wounds, sores and tears. They are attracted to dung of different animals and the larvae breed there usually that of cow and buffalo. Ishijima (1967) described its third stage larva from Japan. Greenberg (1971) reported its biological association with *Habronema megastoma* and *Habronema muscae.*

Distribution : West Bengal (Bhagabatpur, Bamankhali, Gosaba, Mohisani Island, Nayajat, Sajnekhali, Jharkhali); Andhra Pradesh; Arunachal Pradesh; Assam; Bihar; Tamil Nadu and Uttar Pradesh.

9. ***Musca (Eumusca) hervei*** Villeneuve

1922. *Musca hervei* Villeneuve, *Ann. Sci. nat. Zool.*, **10**(5) : 335.

1965. *Musca (Eumusca) hervei* : Emden, *Fauna India, Muscidae,* **7**(1) : 75.

Specimens examined : 5♂♂, Sandeshkhali, 11.xi.2001; 2♂♂, Chotta Mollakhali, 7.xi.2001; 1♂, Gosaba, 8.xi.2001.

Bionomics : This is a haematophagous species and is generally found on cattle, horses and cow-dung. It feeds on wounds and tears of cattle. This species is oviparous and the eggs are laid in patches on fresh cow-dung in the field. It was reported as vector of *Thalazia* sp. (Shinonaga and Kano, 1971).

Distribution : West Bengal (Darjeeling, Chotta Mollakhali, Gosaba, Sandeshkhali); Assam; Himachal Pradesh; Punjab; Sikkim and Uttar Pradesh.

Tribe HYDROTAEINI

10. *Orthellia timorensis* (Robineau-Desvoidy)

1830. *Lucilia timorensis* Robineau-Desvoidy, *Essai Myodaires*, 2(2) : 460.

1977. *Orthellia timorensis* : Pont, *Cat. Orient. Diptera*, **3** : 465.

Specimens examined : 1♂, Beguakhali (Sagar Island), 1.xi.2001; 1♂, Gosaba, 8.xi.2001; 2♂♂, Sajnekhali, 6.xi.2001; 1♂, Sandeshkhali, 11.xi.2001; 1♂, Bhagabatpur, 18.x.2001; 1♂, Canning, 7.xi.2001; 1♂, Ganga Sagar, 20.viii.2001; 1♂, Baradapur, 19.x.2000; 9♂♂, Basanti, 12.xii.2001.

Bionomics : This species is generally found on cattle dung, human faeces and also often available on plants and houses.

Distribution : West Bengal (Baradapur, Basanti, Beguakhali, Bhagabatpur, Canning, Ganga Sagar, Gosaba, Sajnekhali, Sandeshkhali); Andhra Pradesh; Arunachal Pradesh; Assam; Bihar; Kerala; Sikkim; Tamil Nadu and Uttar Pradesh.

11. *Neomyia indica* (Robineau-Desvoidy)

1830. *Lucilia indica* Robineau-Desvoidy, *Essai Myodaires*, 2(2) : 453.

1965. *Orthellia indica* : Emden, *Fauna India, Muscidae*, 7(1) : 126.

1994. *Neomyia indica* : Shinonaga and Singh, *Jap. J. sanit. Zool.*, **45** : 115.

Specimens examined : 1♂, Baradapur, 19.x.2000; 1♂, Bhagabatpur, 18.x.2000; 11♂♂, Beguakhali (Sagar Island), 13.ii.2001; 1♂, Ganga Sagar, 20.viii.2000; 2♂♂, Ghoramara Island, 1.ii.2001; 4♂♂, Canning, 7.ii.2001.

Bionomics : The species is generally found on dung of cattle and horse and the larvae breed therein. It is also found on human excrement.

Distribution : West Bengal (Baradapur, Bhagabatpur, Beguakhali, Canning, Ganga Sagar, Ghoramara Island); Andhra Pradesh; Assam; Bihar; Madhya Pradesh; Maharashtra; Tamil Nadu and Uttar Pradesh.

12. *Neomyia lauta* (Wiedemann)

1830. *Musca lauta* Wiedemann, *Aussereurop. Zwiefl. Insekt.*, **2** : 410.

1965. *Orthellia lauta* : Emden, *Fauna Inaia, Muscidae*, 7(1) : 128.

1994. *Neomyia lauta* : Shinonaga and Singh, *Jap. J. sanit. Zool.*, **45** : 116.

Specimen examined : 1♂, Bhagabatpur, 18.x.2000.

Distribution : West Bengal (Bhagabatpur); Andhra Pradesh; Assam; Bihar; Madhya Pradesh; Maharashtra; Tamil Nadu and Uttar Pradesh.

Bionomics : This species is commonly found on cow-dung, dead animals and meat and breed therein.

Subfamily PHAONIINAE

Tribe PHAONIINI

13. ***Synthesiomyia nudiseta*** (van der Wulp)

1883. *Cyrtoneura nudiseta* Wulp, *Tijdschr. Ent.*, **26** : 42.

1965. *Synthesiomyia nudiseta* : Emden, *Fauna India, Muscidae*, **7**(1) : 192.

Specimens examined : 6♂♂, Namkhana, 4.xi.2001.

Bionomics : The species is generally found on decaying vegetables. It is also attracted to carcasses and dead molluscs but rarely enters houses. The larvae breed in various animals and vegetable materials like human and animal cadavers, decaying cotton seeds, dead locusts, faeces and kitchen refuse and generally develop on carrion and human faeces. Greenberg (1971) reported its biological association with Poliovirus, *Escherichia coli* and *Shigella dysenteriae*. This species has been recorded as involved in secondary wound rnyiasis (James, 1947) but has little hygienic significance. The larvae form cocoon gallery on dried grasses, pieces of wood and sands.

Distribution : West Bengal (Bhawanipore, Kolkata, Namkhana).

14. ***Ophyra leucostoma*** (Wiedemann)

1817. *Anthomyia leucostoma* Wiedemann, *Zool. Mag. Keil.*, (1)**1** : 82.

1965. *Ophyra leucostoma* : Emden, *Fauna India, Muscidae*, **7**(1) : 302.

Specimens examined : 3♂♂, Canning, 7.ii.2001; 1♂, Mohisani Island, 22.xi.2001; 4♂♂, Sajnekhali, 6.xi.2001; 7♂♂, Beguakhali (Sagar Island), 13.ii.2001; 1♂, Bhagabatpur, 18.x.2000; 2♂♂, Chotta Mollakhali, 1.ii.2001; 2♂♂, Gosaba, 8.xi.2001; 2♂♂, Jharkhali, 9.xi.2001; 1♂, Basanti, 11.xi.2001; 2♂♂, Chandanpiri, 20.x.2000.

Bionomics : This is a synanthropic species. They are generally available on decaying animals and vegetable matters and the larvae breed in garbages, privies, decaying vegetables and dead animals. The larvae are coprophagous or saprophagous and are found on faeces, carrion, garbages and privies. Ishijima (1967) described its third stage larva from Japan. Greenberg (1971) reported its biological association with Poliovirus, *Alcaligenes faecalis, Flavobacterium devorans, Flavobacterium invisible, Escherichia coli, Aerobacter aerogenes, Klebsiella cloacae, Serratia marcescens, Proteus inconstans, Proteus morganii, Proteus rettgeri, Proteus mirabilis, Proteus vulgaris, Citrobacter freundii, Staphylococcus afermentans, Staphylococcus lactis, Staphylococcus aureus, Staphylococcus saprophyticus, Streptococcus durans* and *Bacillus cereus* var. *mycoides*.

Distribution : West Bengal (Basanti, Beguakhali, Bhagabatpur, Canning, Chandanpiri, Chotta Mollakhali, Gosaba, Jharkhali, Mohisani, Sajnekhali); Kashmir.

15. *Gymnodia tonitrui* (Wiedemann)

1824. *Anthomyia tonitrui* Wiedemann, *Anal. ent.*, 1824 : 52.

1965. *Gymnodia tonitrui* : Emden, *Fauna of India, Muscidae*, 7(1) : 631; 1977. Pont, *Cat. Orient. Diptera*, 3 : 475.

Specimens examined : 2♂♂, Bamankhali, 8.vii.2001.

Bionomics : This species is abundantly available on faeces and in low bush adjacent to native village.

Distribution : West Bengal (Bamankhali); Andhra Pradesh; Assam; Himachal Pradesh; Madhya Pradesh; Maharashtra and Uttar Pradesh.

Subfamily STOMOXYINAE

16. *Stomoxys calcitrans* (Linnaeus)

1758. *Conops calcitrans* Linnaeus, *Syst. Nat.*, **10**(1) : 604.

1965. *Stomoxys calcitrans* : Emden, *Fauna India, Muscidae*, 7(1) : 160; 1994. Shinonaga and Singh, *Jap. J. sanit. Zool.*, **45** : 142.

Specimens examined : 2♂♂, Bamankhali, 8.vii.2001; 2♂♂, Bhagabatpur, 18.xi.2000; 2♂♂, Gosaba, 8.xi.2001.

Bionomics : This species generally bites man and cattle and also on other domestic animals such as dogs, horses and occasionally birds if no other blood source is available. It may reduce milk yield of cattle by 25%, or as much as 40–60% (Greenberg, 1973). The larvae develop on animal faeces or decaying vegetable material and they on rare occasions produce gastric and traumatic myiasis (James, 1947). Greenberg (1971) reported its biological association with Poliovirus, *Pseudomonas aeruginosa, Vibrio comma, Escherichia coli, Escherichia freundii, Escherichia intermedia, Aerobacter aerogenes, Aerobacter cloacae, Serratia marcescens, Proteus vulgaris, Salmonella blockley, Salmonella paratyphi, Salmonella typhi, Shigella dysenteriae, Pasteurella multocida, Pasteurella pestis, Pasteurella tularensis, Brucella abortus, Brucella melitensis, Brucella suis, Bacteroides vulgatus, Staphylococcus aureus, Diplococcus pneumoniae, Streptococcus durans, Streptococcus faecium, Erysipelothrix insidiosa, Bacillus anthracis, Bacillus mesentericus, Bacillus subtilis, Bacillus thuringiensis, Clostridium botulinum, Mycobacterium leprae, Dermatophilus congolensis, Spirochaeta stomoxyae, Borrelia anserina, Borrelia berbera, Borrelia recurrentis, Leptospira conicola, Leptospira grippotyphosa, Colesiota conjunctivae, Anaplasma marginale, Entomophthora muscae, Crithidia haematopotae, Leishmania mexicana, Leishmania tropica, Leptomonas stomoxyae, Trypanosoma brucei, Trypanosoma congolense, Trypanosoma equinum, Trypanosoma evansi, Trypanosoma gambiense, Trypanosoma rhodesiense, Trypanosoma vivax, Entamoeba histolytica, Eimeria irresidua, Eimeria perforans, Toxopolasma gondii, Choanotaenia*

infundibulum, Echinolepis carioca, Rhabditis axei, Habronema megastoma, Habronema microstoma, Habronema muscae and *Setaria cervi.*

Distribution : West Bengal (Bamankhali, Bhagabatpur, Canning, Gosaba); Andhra Pradesh; Arunachal Pradesh; Assam; Bihar; Goa; Kerala; Orissa; Sikkim; Tamil Nadu and Uttar Pradesh.

A BRIEF DISCUSSION ON THE IMPACT OF SPECIES ON MAN AND ANIMALS

Some of the muscid flies are blood sucker and play an important role in the transmission of filarial diseases of poultry and cattle. Few species are pests of cattle due to irritation caused to the animals by the habit of feeding in number in the body. We have observed their restlessness is due to a number of flies in and around the cattle-sheds and in the grazing centers and the species involved for this nuisance are *Musca (Musca) domestica vicina* and *Musca (Byomya) sorbens*. Different types of protozoa and helminthes parasites like *Giardia intestinalis, Trichuris trichura* and *Ancylostoma duodenalis*, etc. are mechanically transmitted from infected persons, excrement, vomiting drops, etc. to human food through their appendages, hairs, bristles which feed on such media and the species involved for dissemination are *Musca (Musca) domestica vicina, Musca (Byomya) sorbens* and *Ophyra leucostoma.* They have also considerable importance as mechanical carriers during epidemic of intestinal diseases like cholera, bacillary and amoebic dysentery and bacterial diseases (diarrhoea and summer dysentery) and the people of this Biosphere Reserve are most sufferers due to non-hygenic conditions of the localities. *Stomoxys calcitrans* is very dangerous causing a wide loss of milk production besides transmitting various types of bacteria, viruses, protozoa and helminthes. Some larvae cause diarrhoea with discharge of blood from the infected persons due to injury of intestinal mucosa and as a result vertigo and less violent pain in the abdomen occur. Few larvae develop in the human digestive tract after being ingested along with contaminated food causing vomiting and fever. A few larvae cause intestinal or wound myiasis in man and domestic animals. A very few larvae are parasite in the mouth, ear, eye and nose causing extensive facial tissue destruction besides the genital organ of man and other animals. We do not come across the larvae of wild animals due to difficulties of examining them on their bodies. A few larvae of the flies develop in dead fishes which are kept for drying up in fish processing centers causing less production of dried fishes. The species involved is *Musca (Musca) domestica vicina* and due to their high density a great loss of dried fishes was observed by Sinha and Nandi (2003). The loss of dried fishes is a great havoc for the people in the fish processing centres of this Biosphere Reserve and careful survey should be conducted for proper maintenance of the dried fish industry. A few larvae can be used for the purpose of medicolegal cases which might help in establishing the approximate time of death of a person in murder case.

ABBREVIATIONS USED IN THE TEXT

ac–acrostichal bristles, *dc*–dorsocentral bristles, *h*–humeral bristles, *ia*–intraalar bristles, *mpl*–mesopleural bristles, *np*–notopleural bristles, *pa*–postalar bristles, *ph*–posthumeral bristles, *ps*–presutural bristles, *sa*–supraalar bristles, *st*–steernopleural bristles.

SUMMARY

Systematic position of 16 species of muscid flies under 7 genera from Sundarbans Biosphere Reserve and their bionomics and distributional records from India are included. One new species *Musca (Byomya) emdeni* is described and illustrated. A note on their impact on man and animals is also added.

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STATUS AND DISTRIBUTION OF TURTLE FAUNA (TESTUDINES : REPTILIA) IN THE MALABAR PART OF KERALA, INDIA

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INTRODUCTION

Turtles, tortoises and terrapins (now usually termed, 'turtles') belong to the reptilian order Testudines. They are mainly amphibious creatures, most of them living in various freshwater and marine habitats. Their body is well protected in a box-like, bony or leathery, shell. The upper portion of the shell is the carapace and the lower, the plastron. In India, about 33 species of turtles are known to inhabit the land and coastal waters. These include 5 species of sea turtles representing two families of Cheloniidae and Dermochelyidae, 5 species of the family Testudinidae and at least 23 species, chiefly freshwater ones, of the families Trionychidae and Bataguridae. In the present report, an attempt has been made to provide a consolidated account on the turtle fauna of the Malabar part of Kerala, with special reference to their status, distribution and some aspects on their conservation.

STUDY AREA

The present study has been conducted in the Malabar part of Kerala. The area comprises of the hilly tracts, from Manjeswaram in Kasaragod district to the southern limits of the Malappuram district, along the western face of the Western Ghats, as well as the midlands and the coastal strip of land washed by the Arabian Sea. The area falls under the 4 districts of Kasaragod, Kannur, Kozhikode and Malappuram in Kerala. Based on physical features, the region can be divided into 3 natural divisions. They are the highlands, the midlands and the lowlands. The Western Ghats which bound the Kerala state on its eastern side dominate the topography of Kerala and constitute the high lands. This division supports different kinds of forest vegetations and plantations. The midlands, an undulating terrain, is dominated by laterite hills cut across by rivers. The lowlands comprise of the long and narrow coastal belt on the west, with stretrches of sand and backwaters. Extensive paddy fields and numerous coconut plantations dominate the landscape in the lowlands. Out of the 41 west flowing rivers of Kerala, 23 originate in the Malabar part of the state. The important rivers are Chandragiri, Kariangode, Kavvayi, Kuppam, Valapattanam, Kuttiadi, Korapuzha, Chaliyar and Bharathapuzha. Besides these rivers, the Malabar region has a long chain

of lagoons and backwaters including Kumbala, Kalanad, Bekkal and Kavvayi. The area receives maximum rainfall of more than 3000 mm., mainly from the south-west monsoon during June–September. Northeast monsoon brings light showers during October–November. Malabar region has a warm, humid tropical climate with a relative humidity ranging between 75 and 92 percent and a comfortable temperature ranging between 16°C in winter to 38°C in summer. Primarily, the vegetation is mostly tropical rain forests in the highlands, and a good growth of mangroves in the coastal areas. The lowlands are also blessed with many patches of sacred groves.

METHODOLOGY

Field surveys were carried out from January 1994 to June 1996 in the northern districts of Kannur and Kasaragod. Later from February 2001 to August, 2002, we concentrated mainly in the Kozhikode and Malappuram districts. Recent records of marine turtle breeding were incorporated in planning the survey. Many less important beaches were also included in the survey to locate further breeding grounds of sea turtles. Numerous interviews were conducted with the local inhabitants closely associated with the sea and the forests. Over a length of 200 km of the coastline was surveyed during the study period to assess the conditions prevailing in the various breeding habitats. A number of terrestrial and fresh water habitats were also surveyed to assess their current status. Besides, literature was reviewed to compare the past and present status and distribution of turtles in Malabar.

RESULTS

A total of 8 species of turtles belonging to 5 families are found to occur in the Malabar part of Kerala, the details of which are presented below. Besides, a key to the identification of the turtle fauna known so far from the area is also provided.

SYSTEMATIC LIST OF TURTLES OCCURRING IN THE MALABAR PART OF KERALA

Class REPTILIA

Order TESTUDINES

Family CHELONIIDAE (Sea Turtles)

1. ***Lepidochelys olivacea*** (Eschscholtz)

   Olive Ridley Sea Turtle

Family DERMOCHELYIDAE (Sea Turtle)

2. ***Dermochelys coriacea*** (Linnaeus)

   Leatherback Sea Turtle

Family BATAGURIDAE (Asian Pond Turtles)

3. ***Melanochelys trijuga trijuga*** (Schweigger)
   Indian Pond Terrapin
4. ***Geoemyda silvatica*** Henderson
   Cochin Forest Cane Turtle

Family TESTUDINIDAE (Land Tortoises)

5. ***Indotestudo forstenii*** (Schlegel and Miller)
   Travancore Tortoise

Family TRIONYCHIDAE (Soft shell Turtles)

6. ***Lissemys punctata granosa*** (Schoepft)
   Indian Flapshell Turtle
7. ***Pelochelys cantorii*** (Gray)
   Asian Giant Softshell Turtle
8. ***Aspideretes leithii*** Gray
   Leith's Soft Shell Turtle.

Key to turtles of Malabar

1. Forelimbs modified into paddle-shaped flippers 2
— Forelimbs not paddle-shaped, at the most semi-paddle shaped only; digits distinct 3
2. Surface of carapace covered with scutes, carapace and plastron without ridges ..... *Lepidochelys olivacea* (Eschscholtz)
— Surface of carapace covered with skin; carapace with seven and plastron with five longitudinal ridges ..... *Dermochelys coriacea* (Linnaeus)
3. Shell covered with soft skin; horny mandibles concealed under fleshy lips; three claws on each limb 4
— Shell covered with scutes; horny mandibles exposed, with no fleshy lips; four or five claws on each limb 6
4. Marginal bones present; cutaneous femoral flaps on plastron ..... *Lissemys punctata granosa* (Schoepft)
— Marginal bones absent; cutaneous femoral flaps on plastron absent 5

5. Anterior of shell poorly-defined, grading smoothly into the skin of the neck; carapace very flat; proboscis very short ..... *Pelochelys cantorii* (Gray)

— Anterior of shell thickened and nodose with patches of wart-like prominences demarcating the division between shell and neck; proboscis well developed ..... *Aspideretes leithii* (Gray)

6. Large, well-defined scales usually evident on snout and between the eyes; hind limbs elephantine with relatively short toes, lacking webbing ..... *Indotestudo forstenii* (Schlegel and Muller)

— Skin on snout and between eyes smooth, lacking large well-defined scales; hind limbs not elephantine; toes prominent with at least slight webbing 7

7. Upper jaw feebly notched at the middle; vertebrals II and III longer than wide ..... *Melanochelys trijuga trijuga* (Schweigger)

— Upper jaws hooked; vertebrals II and III wider than, or as wide as long ..... *Geoemyda silvatica* Henderson

Sea Turtles

Sea turtles which appeared in the late Triassic differed little from those alive today. Having evolved from land based ancestors these large reptiles need to complete their breeding cycle on land. There are seven species of sea turtles living in the world and five of them come ashore to nest in India. They are, the Leatherback (*Dermochelys coriacea*), the Green Sea Turtle (*Chelonia mydas*), the Hawksbill (*Eretmochelys imbricata*), the Loggerhead (*Caretta caretta*) and the Olive Ridley Turtle (*Lepidochelys olivacea*). Of these, Leatherback and Olive Ridley Turtles represent the marine turtle fauna of Kerala. As in the southern part of the Kerala coast, there could be stray visitations of other species of sea turtles in the Malabar coast too that might not have been reported. On some of these beaches, turtle nesting is seasonal, while on others, nesting can be observed throughout the year with a peak season during December.

Family DERMOCHELYIDAE

The family Dermochelyidae is represented by a single species *Dermochelys coriacea*(Linnaeus), commonly called the Leatherback sea turtle. It is the largest known marine turtle species in the world. It is widely distributed in the world's oceans, nesting on tropical beaches and islands. Its carapace is formed of small polygonal bony plates covered with skin. The neck is short and slightly retractile. The limbs are paddle shaped, clawless and feet are scaleless. Nothing is known about the ancestry of this unique family.

Leatherback Sea Turtle

Dermochelys coriacea (Linnaeus)

The Leatherback Sea Turtle or Luth is the largest and the heaviest of all living turtles in the world. Its average weight is about 400 kg with a maximum record of 725 kg. In local Malayalam language, the species is called 'Kolama', due to its elongated body shape. The carapace is smooth-skinned and rubber like, and bears 7 strong nodular longitudinal ridges which provide considerable rigidity. The limbs are paddle-shaped and without claws. It is a circum-global species and nests on the beaches of tropical seas of the Atlantic, Pacific and the Indian oceans. Nesting records for India are scarce, but according to Pritchard (1971), egg bearing females have been observed at Travancore, southern Kerala. Das (1995) reported the species as quite common on the Quilon coast of Kerala, at the end of the nineteenth century, when some 40 turtles were caught annually, either while nesting or in special nets set in the sea. In the early part of the last century only two or three were caught annually, and the species was reported to frequent the outskirts of the Tangasseri Reef, off the Quilon coast (Smith, 1931). Jones' (1959) record of a breeding turtle at Kozhikode (Calicut) beach observed during daytime in July, suggests the prevalence of its breeding once in Malabar. The global decline of Leatherbacks has received much attention in recent times, including prediction of extinction in the near future (Spotila, 2000). The Leatherback is protected under Schedule I of Indian Wildlife (Protection) Act, 1972 and it is included in appendix I of Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), which prohibits trade in turtle products by the signatory countries.

Family CHELONIIDAE

The family comprises of marine turtles whose carapace and plastron are covered with horny epidermal shells. The neck in these turtles is incompletely retractile and bends in a sigmoid curve almost in a vertical plane. Flippers are covered with small scales; claws are reduced to one or two on each limb, and shell is covered with scutes. All living species, except the Green Turtle (*Chelonia mydas*), are carnivorous as their adults feed on marine organisms. The green turtles are herbivorous and mainly feed on marine algae, sea grasses and seaweeds. They lead a perfect aquatic life and visit the sandy coastal areas of the land only for breeding. Five genera and seven species represent the family in the world, of which four species occur in the waters of the Indian subcontinent. So far only one species of cheloniid sea turtle, the Olive Ridley Turtle (*Lepidochelys olivacea*), is represented in the waters of Kerala.

Olive Ridley Turtle

Lepidochelys olivacea (Eschscholtz)

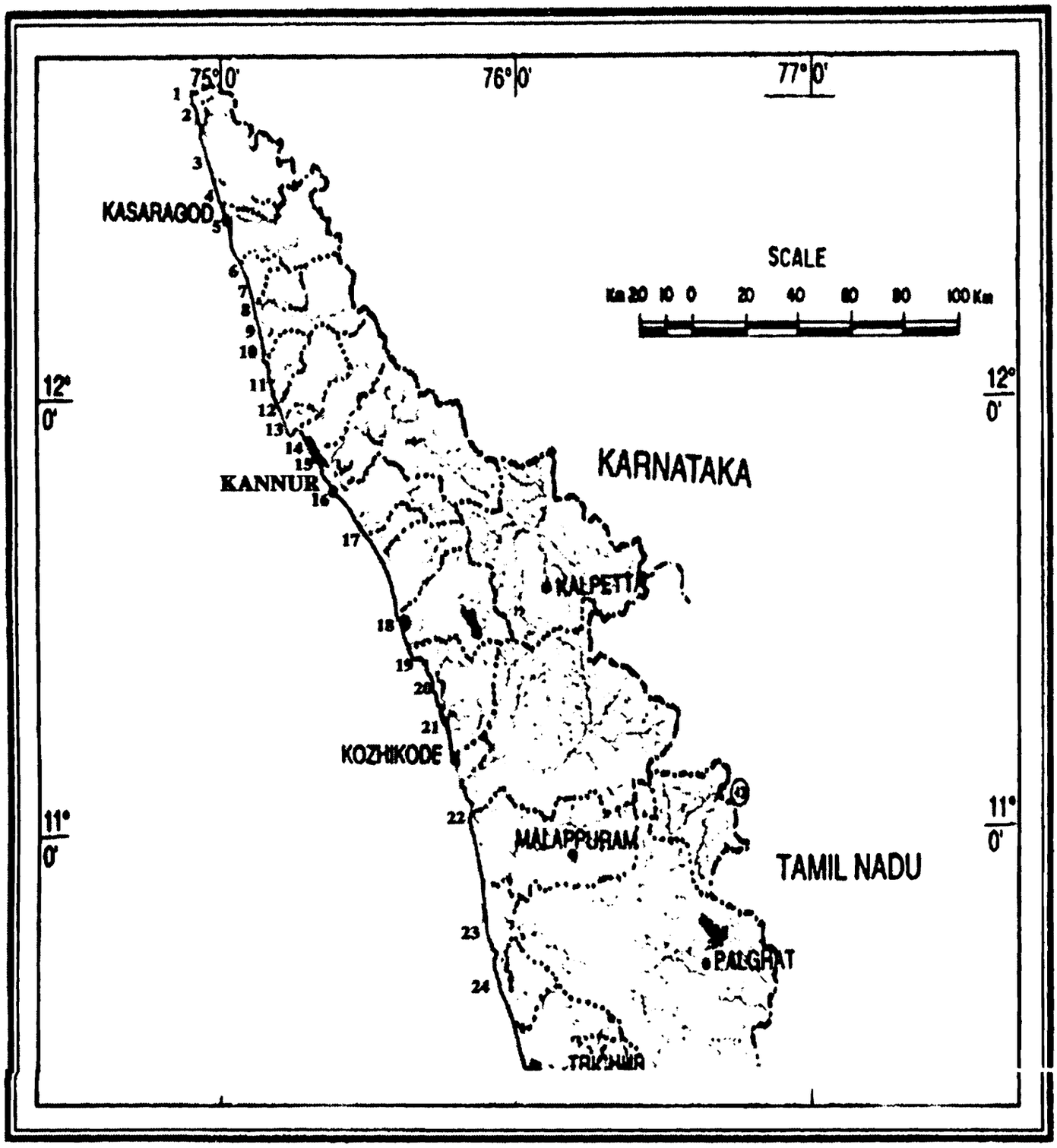
The Olive Ridley turtle is the smallest of the sea turtles of the coast of India and is the one most often found in Kerala coast. The Olive Ridley is one of the high profile species which

has received substantial media coverage and scientific attention in recent years. This is the only turtle that forms massive nesting congregations. The largest nesting population in the Indian subcontinent is at Gahrimatha in Orissa, which has been the subject of several long term studies by many scientists. During our survey along the coastal areas of Malabar, we encountered 24 nesting sites (Map 1) along the 200 km long sea coast. The most abundant nesting areas are found in between Kavvayi and Manjeswaram riverine area in Kasaragod district. Thaikadappuram in Kasaragod district, Kolavipalam in Kozhikode district and Muthiyam beach in Malappuram district are protected by Kerala Forest Department with the help of local Panchayaths and non-governmental organizations by maintaining hatcheries and giving protection to the breeding turtles. In many areas, the local fishermen and villagers reported having seen over 100 nests annually, 20 years before; but in recent years, the number of nestings have reduced considerably. According to the fishermen, sea turtle nests were not seen in the beaches other than in Kolavipalam and Payyoli of the Kozhikode district for the last five years. Jackals (*Canis aureus*), Common mongoose (*Herpestes edwardsi*) and feral dogs were the main primary egg predators at most beaches, and a number of depredated nests were seen in many areas. The turtles visit Malabar beach during September to February, every year, mainly from October to January, with a peak period in November. During 2000–'01, more than 1,600 eggs were collected and most of the hatchlings released in the sea. In 2001–'02, the number was around 5000. In Muthiyam Beach, Vallikunnu Panchayath, Malappuram district, during 1999–2000, about 2500 and in 2000–'01, 2100 hatchlings were released into the sea. The mangrove rich estuarine environment of Kolavipalam (Kozhikode district) and other beaches in Kannur and Kasargod districts attract the marine turtle *en masse* for breeding (Gopi and Radhkrishnan, 2001). The mangrove ecosystem also forms a favourtie habitat for thousands of crabs, prawns and other invertebrates, which Ridley turtles also seem to be fond of. The Olive Ridley Turtle has become endangered on account of commercial exploitation by man for its flesh, skin, leather and eggs. In Kerala alone, approximately 30,000 ridleys are consumed annually (Das, 1995). The species is protected under Schedule I of the Indian Wildlife (Protection) Act of 1972 and Appendix I of CITES.

Asian Pond Turtles

Family BATAGURIDAE

These are smaller, hard-shelled amphibious forms inhabiting the various freshwater bodies. They are closely related to land tortoises, but can be differentiated in not having elephantine hind feet. They are more adapted to freshwater than to terrestrial life. Two species of fresh water turtles are reported from Kerala : the Indian Pond Terrapin (*Melanochelys trijuga*) and the Cochin Forest Cane Turtle (*Geoemyda silvatica).*



Map 1. : Showing the marine turtle nesting sites in the Malabar Part of Kerala.

1. Manjeswaram-Bangava Manjeswar, 2. Uppala, 3. Kumbala, 4. Cherangai Kadappuram-Kasaragod, 5. Keezhur-Kalanad Kadappuram, 6. Chittari Kadappuram, 7. Athiyan Kadappuram, 8. Bhalla Kadappuram, 9. Puthiya valappu, 10. Thaikadappuram, 11. Mavilakadappuram, 12. Kottikadappuram, 13. Kavvayikadappuram, 14. Puthiyangadi Kadappuram, 15. Azhikkal, 16. Thayyil, 17. Thalasseri, 18. Kolavippalam, 19. Kozhilandi, 20. Kappad, 21. Puthiyappa Kadappuram, 22. Muthiyam beach, 23. Ponnani, 24. Koottazhi.

Indian pond Terrapin

Melanochelys trijuga trijuga (Schwiegger)

Of the four subspecies recorded from India, only the *Melanochelys trijuga trijuga* is available in Kerala. It is the most common and widespread species occurring in a variety of habitats from small ponds to wells, rivers and canals. Once, the species was reported to be common in Kerala. Indiscriminate poaching by the nomadic tribals from Tamil Nadu and Andhra Pradesh has caused the population decline in Malabar. At present, the species can only be occasionally sighted. A copulating pair was observed in July 2002, in Parassinikadavu Snake Park, in Kannur district, where more than 10 individuals of this species collected from a surrounding locality were displayed in a small pond. The species is unprotected by legislation. Urgent measures should be taken to protect the species from local extinctions, since their number has declined alarmingly in the recent past.

The Cochin Forest Cane Turtle

Geoemyda silvatica Henderson

This is a small batagurid attaining about 13 cm in shell length. The Cane turtle is entirely terrestrial, inhabiting evergreen, semi-evergreen and moist deciduous forests. The type locality of the species is Kavalai forests near Chalakudi, Ernakulam district, hence the species is also known as Kavalai forest turtle. Vijaya (1982) and Das (1995) provided information on the distribution of the Cane turtle. Accordingly, the species is found in Nadukani, Kothaiyar Reserve Forest, Kavalai, and Wildlife sanctuaries of Peechi-Vazhani, Chimmony, Neyyar, Parambikulam, Peppara and Idukki in Kerala. In Tamilnadu, the species is recorded from the Indira Gandhi Wildlife Sanctuary, Anamalai. It is also reported from Neria and Agumbe forests of Karnataka. The species frequents leaf-littered localities in forests,and is found often in association with the reed *Ochlandra travancorica* at an altitude range of 400–800 m. From the literature available, a record of this species from Calicut district (Groombridge *et al.*, 1983) was noted. The species is threatened mainly by the loss of its natural forest habitats. The tribals collect this turtle mainly for consuming its liver due to its alleged medicinal property in treating piles. The species is protected under Schedule I of Indian Wildlife (Protection) Act of 1972. It is also listed under Action Plan Rating 2 of the IUCN/ SSC Tortoise and Freshwater Turtle Specialist Group.

Land Tortoises

Family TESTUDINIDAE

These are the true terrestrial and herbivorous tortoises having thick shells and completely retractile head and neck. These tortoises are having strong, unwebbed feet with comparatively shorter digits. The hind feet are club-shaped and elephantine. The family testudinidae is represented

in Kerala by two species, *viz.*,the Indian Star Tortoise (*Geochelone elegans*) and the Travancore Tortoise (*Indotestudo forstenii*). The Indian Star Tortoise is distributed over the drier zones of western and southern parts of the Indian subcontinent, and in Kerala, it is mostly found in the Chinnar Wildlife Sanctuary, Idukki district. The Travancore Tortoise is distributed over the forested tracts of Western Ghats, including the Malabar region.

The Travancore Tortoise

Indotestudo forstenii (Schlegel and Muller)

It is endemic to the Western Ghats and known to occur in Kerala, Tamil Nadu and Karnataka states. Bhupathy and Choudhury (1995) provided information on the distribution of this species from various localities. Accordingly, the Travancore Tortoise is recorded from Neyyar, Peppara, Peechi, Parambikulam and Idukki Wildlife Sanctuaries, the Silent Valley National Park, the Periyar Tiger Reserve as well as the Chalakudy and Karulai forests of Kerala. Subsequently, Radhakrishnan (1998) reported the species from Goodrickal range of Ranni forest division in Pathanamthitta district. In Tamil Nadu, the specie is found in Kothaiyar reserve forest and the Indira Gandhi Wildlife Sanctuary. In Karnataka, the species occur in Yellapur, Neriya, Gundia, Chadibiri, Subrahmanya and Agumbe forests, besides the Dandeli, Sharavathi and Mookambika sanctuaries. During the turtle survey, we encountered a pair of specimens, brought from Kudiyanmala Hills of Kannur district, kept in the Parassinikadavu Snake Park. The Kudiyanmala area is on the western slope of Western Ghats adjoining the Coorg district of Karnataka and about 65 km north east of Kannur town. The species is protected under Schedule IV of the Indian Wildlife (Protection) Act of 1972 and listed in Appendix II of CITES. It is listed under the "Insufficiently Known" category in the IUCN Red Data Book and placed under Action Plan Rating 2 of the IUCN/SSC Tortoise and freshwater Turtle Specialist Group.

Soft shell Turtles

Family TRIONYCHIDAE

Trionychidae comprises of the modern, flattened, soft-shelled, carnivorous and highly aquatic turtles. Head and neck are capable of complete retraction within the shell. The neck is quite long, and jaws are markedly sharp and hidden below the soft lips. Being mostly aggressive in nature, it is capable of inflicting serious injury to its handlers. The limbs are clawed and webbed and modified into swimming paddles. Trionychid turtles are represented in India by four genera namely, *Lissemys, Aspideretes, Pelochelys* and *Chitra*. The first three are represented in Kerala by three species as follows.

Indian Flapshell Turtle

Lissemys punctata granosa (Schoepft)

It is one of the most abundant freshwater turtles in the Indian region with a range from Pakistan eastward through India, Nepal, Bangladesh to western Myanmar (Das, 1995). The species is highly adaptable and found in varying aquatic habitats like backwaters, rivers, ponds, ox-bow lakes, streams, paddy fields, canals, *etc.* Locally, the species is called 'Vellaama' or 'Palaama', meaning white turtle or milk turtle respectively, due to its pale colour and soft-shelled appearance. A number of these turtles were kept in a turtle pond for display along with other species of turtles at the Parasinikadavu Snake Park, Kannur, Kerala, where the courtship behaviour was observed once, on 25-th May, 2002. A male was seen chasing the female and mounting it within the shallow pond. During our local faunistic survey, on 5-th May, 2001, we collected an albino Flap-shell Turtle from Kovur, about 9 km from Calicut city. In the albino turtle, the morphological characteristics were observed to be the same as those of normal turtle, except that the colour of the carapace was yellowish with a white tinge.

A good number of Indian Flapshell Turtles are protected with the belief of sanctity in the temple pond of Meloth Kavu near Bedakam in Kasaragod district. Similarly, the temple pond of Meenkulam Srikrishna Temple at Olayambadi in Kannur district also holds hundreds of flapshell turtles. Both these perennial ponds, are situated on a laterite hill. The devotees offer rice and other food items to the turtles for prosperity and good fortune.

The Indian Flapshell turtle is often hunted during rainy season from the paddy fields in Kannur and Kasaragod districts for its flesh by the locals. The Flap-shelled turtle is protected under Schedule I of Indian Wildlife (Protection) Act of 1972.

Asian Giant Softshell Turtle

Pelochelys cantorii (Gray)

The species is a rare and, little known soft-shelled turtle mostly found in the east coast of India. It is characterized by its huge size, depressed shell and unusually smaller head and snout. In India, the species is distributed along the east coast in West Bengal, Orissa and Tamil Nadu. The Asian Giant Softshell Turtle is also known from Bangladesh, Myanmar, Thailand, Malaysia, Indonesia, China and Vietnam (Das, 1995). On the west coast of India, the species is known only from the Thiruvananthapuram district (Nair and Badrudeen, 1975) and Valapattanam river, Kannur district of Kerala (Jafer Palot & Radhakrishnan, 2002). The Valapattanam specimen was caught from Mangadavu region of Valapattanm river (11°57'N and 75°20'E) by a local fisherman. The collection site was about 7 km inland from the sea mouth of Azhikkal estuary. The specimen measured about 90 cm in length, 55 cm in width and weighed about 45 kg. In April, 1999, one more specimen was caught from the same locality and brought to the Parassinikadavu Snake Park,

but it survived only for a few days. The species is protected under Schedule I of Indian Wildlife (Protection) Act of 1972, prohibiting its trade, capture or possession. The species is also listed under Action Plan Rating 3 of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group.

Leith's Softshell Turtle

Aspideretes leithii (Gray)

The species is known from Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh, Orissa and Tamil Nadu (Das, 1995). Recently, the species has been recorded from the Chaliyar river near Nilambur, Malappuram district (Thomas *et al.* 1997). Normally, The Leith's Softshell Turtle is a species of riverine habitat, including the reservoirs. Though widely distributed in Peninsular India, data on its status, distribution and general ecology are rather scarse. The species is protected under Schedule IV of Indian Wildlife (Protection) Act of 1972.

Reasons for the decline of Turtles :

Uncontrolled mechanized fishing in areas of high sea turtle concentrations, illegal near-shore trawling and operating gill nets result in heavy mortality of adult sea turtles. Indiscriminate sand mining along the sandy beaches of coastal Malabar is a great threat to the breeding population of turtles. Developmental activities of man such as construction of buildings in the coastal areas, illuminating the nesting beaches by artificial lights, discharging industrial effluents into the sea, planting of *Casuarina* in some of the beaches, destroying the mangrove vegetation along the estuarine areas *etc* pose great threat to the survival of sea turtles. Besides, collection of eggs and adults for meat and medicine by locals and depredation of eggs and juveniles by jackals, feral dogs, mongooses and crows take heavy toll.

Clearing of lowland evergreen forests and reed beds, illegal fish collection by poisoning and dynamiting, indiscriminate killing for meat and alleged medicinal properties, construction of dams, sluices and weirs and excessive use of pesticides and chemical fertilizers are some of the reasons for the decline of land and freshwater turtles.

CONSERVATION MEASURES

Using Turtle Excluder Devices (TED) by trawlers operating in the coastal waters beyond 5 km of the shore line, strict enforcement of Coastal Regulation Zone Act, guarding the nesting sites to minimize predation, declaring major nesting sites as protected areas and generating awareness among the local communities as well as involving them in conservation programmes are some of the measures required to be implemented to protect the sea turtles.

As far as the land and freshwater turtles are concerned, the protection measures required to be implemented include legislation to upgrade the existing Wildlife Protection Act (since many of the

turtles are currently placed in the lower Schedules of the Act) and preventing further encroachment of man on lowland evergreen and riparian forests.

CONCLUSION

As no systematic survey to assess the status of turtles has been done in Kerala, this should be a priority area of research by those concerned in conserving the turtles. Objectives should be to trace the remnant/fragmented populations of marine and freshwater turtles and to identify the breeding sites of these turtles for undertaking conservation measures. Strict enforcement of the ban on near-shore mechanized trawling, and co-operation from the local Panchayaths and other non-governmental organizations, should be ensured in the conservation programmes. Educational and awareness programmes involving the local people, especially the fishing communities and tribals, are necessary for the effective implementation of turtle conservation efforts. Only through committed and dedicated action, the turtle fauna can be saved from extinction.

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CHECKLIST OF THE HIRUDINEA (LEECHES) OF INDIA

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INTRODUCTION

Although the work of W. A. Harding and J. P. Moore (1927) continues to be the last authoritative word on the Hirudinea in the Fauna of British India series, this fauna has seen a dramatic increase in the number of species in West Bengal and also in India-a result of new species descriptions, revision of several groups, and raising of a number of species.

Preparation work on a checklist of the Hirudinea of India (also the common technical (name of the leeches) shows 62 species in India (25 in West Bengal) which is significantly different from the information generally available. It was this thought that a simple informing working checklist would aid workers on Hirudinea as well as those who require this information for biodiversity assessments.

This work differs from an earlier (Chandra, 1991) in containing names of two new sp., only found within Indian limits. It also incorporates new name changes, includes all new species described and attempts at standerdization of the English several common names of all Indian leeches. Seven new records of Leeches in West Bengal, as well as omissions, have been corrected.

As of the cut off date (June, 1991) the total number of Hirudinean species known from the territory of India was 60, which includes 34 species endemic to the Indian region would increase substantially.

KEY WORDS : Hirudinea, Checklist, English common names, Biodiversity, India.

PISCICOLIDAE

1. *Branchellion plicobranchus* Sanjeeva Raj. 1954 Branchiaeal leeches. (Endemic in India)
2. *Ozobranchus branchiatus* (Baird, 1869) : Chelonial leeches.
3. *Ozobranchus margoi* (Apathy, 1890) : Pseudobranchelion Leeches.
4. *Ozobranchus polybranchus* Sanjeeva Raj, 1951 : Porto Noval leeches. (Endemic in India)
5. *Ozobranchus shipleyi* Harding, 1909 : Sri Lankan turtle leeches.

6. *Piscicola caeca* Kaburaki, 1921 : Eye less leeches. (Endemic in India)
7. *Piscicola olivacea* Harding, 1920 : Blind Shark leeches.
8. *Pontobdellina macrothela* (Schmarda, 1861) : Jamaican leeches.
9. *Pterobdella amara* Kaburaki, 1921 : Fin bearing leeches. (Endemic in India).
10. *Zeylanicobdella arugamensis* De Silva, 1963 : Arugam kalapu leeches or Cylindrical leeches.

GLOSSIPHONIDAE

11. *Batracobdella hardingi* Baugh, 1960 : Coalesed eyed leech. (Endemic in India)
12. *Batracobdella lobata* (Bhatia, 1934) : Leech of Srinagar or Flower vase leech. (Endemic in India)
13. *Batracobdella mahabiri* Baugh, 1960 : Rewal dragger. (Endemic in India)
14. *Batracobdella reticulata* (Kaburaki) 1921 : Anodontal leech. (Endemic in India)
15. *Glossiphonia annandalei* Oka 1921 : Lanceolate leech or Indo-Burman leech.
16. *Glossiphonia complanata complanata* (Linnaeus) 1758 : Ovate elliptical leech.
17. *Glossiphonia cruciata* Bhatia 1930 : Elliptic-claviform leech. (Endemic in India)
18. *Glossiphonia heteroclita* (Linnaeus) 1761 : Ovate acuminate leech.
19. *Glossiphonia weberi weberi* Blanchard, 1897 : Bitten rice or Sumatran leech. (Sumatra, India, Pakistan, Burma, Nepal)
20. *Helobdella nociva* Harding, 1924 : Claviform leeches. (Endemic in India)
21. *Helobdella stagnalis* (Linnaeus), 1758 : Gastropodan leech.
22. *Hemiclepsis bhatiai* Baugh, 1960 : Monghyr leech. (Endemic in India)
23. *Hemiclepsis marginata asiatica* Moore, 1927 : Improportioned eyed leech. (Endemic in India)
24. *Hemiclepsis marginata marginata* Muller, 1774 : Pigmented leech.
25. *Hemiclepsis viridis* Chelladurai, 1934 : Ovate lanceolate leech. (Endemic in India)
26. *Paraclepsis praedatrix* Harding, 1924 : Head constriction bearing leech. (Endemic in India)
27. *Paraclepsis vulnifera* Harding, 1924 : Tanjorean (Tamilnadu) leech. (Endemic in India)
28. *Paraclepsis viridis* (sp.) Mandal, 2002 : Jewel leech of Botanical Garden.
29. *Placobdella ceylanica* (Harding, 1909) : Srilankan type leech of Placobdella genus (Pakistan, Srilanka & India)
30. *Placobdella chandrakantai* (sp) Mandal, 2002 : Green queen of South 24 Parganas. (Endemic in India)

31. *Placobdella emydae* Harding, 1920 : Indo Burman leech.
32. *Placobdella fulva* Harding, 1924 : Leech of undilated head region. (Endemic in India)
33. *Plaeobdella horai* Baugh, 1960 : Purulian type leech. (Endemic in India)
34. *Placobdella indica* Baugh, 1960 : Elliptic lanceolate leech. (Endemic in India)
35. *Placobdella undulata* Harding, 1924 : Leech of undulated head. (India and Srilanka)
36. *Theromyzon mathati* Bhatia, 1939 : Heart leech or Leech of eight eyes. (Endemic in India)
37. *Theromyzon sexoculata* (Moore, 1898) : Enemy leech of water fowls.

ERPOBDELLIDAE

38. *Barbronia weberi* (Blanchard, 1897) : Type leech of Java.
39. *Erpobdella octoculata* (Linnaeus, 1758) : Brown chilli.
40. *Foraminobdella heptamerata* Kaburaki, 1921 : Wrinkled guest leech of amphibia. (Endemic in India)
41. *Herpobdelloidea lateroculata* Kaburaki, 1921 : Worm leech of Saugor, Madhya Pradesh. (Endemic in India)
42. *Nematobdella indica* Kaburaki, 1921 : Worm leech of Dharmapura, Himachal Pradesh. (Endemic in India)

HIRUDIDAE

43. *Dinobdella ferox* (Blanchard,1896) : Parasitic leech of wild domestic animals. (India, Srilanka And Siam)
44. *Dinobdella notata* Moore, 1927 : Freeliving and also parasitic leech of amphibians. (Endemic in India)
45. *Haemopis indicus* Bhatia, 1940 : Burrowing and amphibious leech. (Endemic in India)
46. *Hirudo asiatica* Blanchard, 1896 : Frog parasitic leech. (Afghanistan and India)
47. *Hirudo birmanica* (Blanchard, 1894) : Type leech of Burma. (Burma, India, Pakistan and Srilanka).
48. *Myxobdella annandalei* Oka, 1917 : Less teeth containing type leech of Hong Kong or Tools of Palaeolithic age. (Endemic in India)
49. *Poecilobdella granulosa* (Savigny, 1820) : Medicinal leech of India. (India, Srilanka, Nepal and Burma).
50. *Poecilobdella javanica* (Wahiberg, 1856) : Medicinal leech of Java (Round mouth).

51. *Poecilobdella manillensis* (Lesson, 1842) : Medicinal leech of Philippines or Common medicinal paddy field leech.
52. *Poecilobdella viridis* Moore, 1927 : Medicinal type leech of Kerala. (Endemic in India)
53. *Whitmania laevis* (Baird, 1869) : Sluggish and leafy Type leech of Japan. (Manipur, Burma, China, Formosa and Japan).

HAEMADIPSIDAE

54. *Haemadipsa dussumieri* Blanchard, 1917 : South Indian Type leech. (Endemic in India).
55. *Haemadipsa Montana* Moore, 1927 : Chain striped leech.
56. *Haemadipsa moorei* Sanjeva Raj and Glandstone, 1981 : Painful biting leeches. (Endemic in India).
57. *Haemadipsa ornata* Moore, 1927 : Cream coloured leeches. (Endemic in India).
58. *Haemadipsa sylvestris* Blanchard, 1894 : Largest and robust land leeches of India. (India, Burma, Java and Sumatra).
59. *Haemadipsa zeylanicaagilis* Moore, 1927 : Common land leeches of Western Himalayas. (Endemic in India).
60. *Haemadipsa zeylanica cochiniana* Moore : type leech of Cochin. (Endemic in India).
61. *Haemadipsa zeylanica montivindicis* Moore, 1927 : Type leech of Darjeeling. (Endemic in India).
62. *Haemadipsa zeylanica zeylanica* (Moquin-Tandon) : Srilankan Haemadipsidae. (India and Srilanka).

SUMMARY

An updated checklist of Leeches (Sp. & Subsp.) recorded from the Republic of India is presented along with their authorities (and a suggested common name). The list is significantly larger than those being currently used for biodiversity estimates of this fauna containing 62 species of which 34 are endemic in India.

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NOTES ON MID-WINTER WATERBIRD POPULATION OF SOME SELECTED WETLANDS OF BANKURA AND PURULIYA DISTRICTS, WEST BENGAL

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INTRODUCTION

Knowledge about the composition, population trends and distribution of waterbirds is a fundamental tool for conservation and management of wetlands as well as winged species. Information on these aspects including arrival and departure schedules of overwintering waterfowl is scanty in India (Ali and Ripley, 1983; Ambedkar and Daniel, 1990; Lopez and Mundkar, 1997; Bhupathy *et al.,* 1998) and also in West Bengal (Prakiti Samsad 1999). Due to this reason, mid-winter survey was made at the end of January, 2000, to study the diversity and distribution of waterbirds from eight selected wetlands, four each in Bankura and Puruliya districts, West Bengal. Waterbirds were counted from vantage points using a binocular and also a boat in Saheb bundh, Adra of Puruliya district. Counting was made only once either from 7.30 to 11.30 hrs in the morning or from 14.00 to 17.00 hrs in the afternoon.

RESULTS AND DISCUSSION

The composition and count data of the waterbirds encountered during the course of survey was presented in Table 1, as well as ecological parameters in Table 2. These waterbirds represent a total of 34 species comprising of 11 resident (R), 12 resident migrant (RM) and 9 migrant (M) categories belonging to 24 genera, 7 families and 6 orders. In general, it includes 32 species of waterfowls and 2 species of waders *viz.*, Yellow-wattled Lapwing, *Vanellus malabaricus* and Green Shank, *Tringa nebularia.* Among waterfowls, there were 12 species of ducks and geese, 8 species of herons, egrets and bitterns, 4 species of rails and the rest 6 species comprising of grebes, cormorants, etc. All the 9 migrant avian species were waterfowls (Anatidae) representing ducks and geese from wetlands of Puruliya district only. Amongst the resident anatid ducks, the Lesser Whistling Teal, *Dendrocygna javanica* were found in large flocks in both the districts, namely, Jamuna bundh of Bankura district and Saheb bundh of both Adra and Puruliya town of Puruliya district. The other resident anatids include Comb Duck, *Sarkidiornis melanotos* and Cotton Teal, *Nettapus coromandelianus.* The breeding population of resident ducks could not be observed in

Table 1. Composition and count data of waterbirds in some selected frashwater wetlands of Bankura and Puruliya Districts, West Bengal.

Sl. No.	English name Scientific name	Number of birds counted in wetlands of							
		Bankura district				Puruliya district			
		JB	KB	LB	KJB	SBP	SBA	RB	IB
	A. Waterfowl								
	Order PODICIPEDIFORMES								
	Family PODICIPEDIDAE								
1.	Little Grebe, *Tachybaptus ruficollis* (R)	25	7	31	16	86	48	28	49
	Order PELECANIFORMES								
	Family PHALACROCORACIDAE								
2.	Cormorant, *Phalacrocorax carbo* (RM)	1	–	–	2	–	–	–	–
3.	Indian Shag, *Phalacrocorax fuscicollis* (RM)	1	–	–	–	–	2	–	–
4.	Little Cormorant, *Phalacrocorax niger* (RM)	21	15	18	10	12	32	2	60
5.	Darter, *Anhinga rufa* (RM)	2	1	1	–	–	1	–	1
	Order CICONIFORMES								
	Family ARDEIDAE								
6.	Grey Heron, *Ardea cinerea* (RM)	–	1	–	–	–	–	–	–
7.	Purple Heron, *Ardea purpurea* (RM)	3	4	–	2	1	5	–	6
8.	Pond Heron, *Ardeola grayi* (R)	12	6	2	5	8	3	2	5
9.	Cattle Egret, *Bubulcus ibis* (RM)	18	3	6	2	8	4	9	3
10.	Large Egret, *Ardea alba* (RM)	6	2	–	–	–	2	–	3
11.	Smaller Egret, *Egretta intermedia* (RM)	4	2	2	1	–	–	5	2
12.	Little Egret, *Egretta garzetta* (R)	3	9	5	1	5	16	–	11
13.	Chestnut Bittern, *Ixobrychus cinnamomeus* (RM)	2	1	–	1	18	3	–	–
	Family ANATIDAE								
14.	Greylag Geese, *Anser anser* (M)	–	–	–	–	–	–	–	4
15.	Pintail, *Anas acuta* (M)	–	–	–	–	89	26	–	7
16.	Common Teal, *Anas crecca* (M)	–	–	–	–	74	85	10	6
17.	Gadwall, *Anas strepera* (M)	–	–	–	–	–	11	–	6
18.	Wigeon, *Anas penelope* (M)	–	–	–	–	53	15	–	–

Table 1. *Contd.*

Sl. No.	English name Scientific name	Number of birds counted in wetlands of							
		Bankura district				Puruliya district			
		JB	KB	LB	KJB	SBP	SBA	RB	IB
19.	Garganey, *Anas querquedula* (M)	–	–	–	–	10	7	–	4
20.	Common Pochard, *Aythya ferina* (M)	–	–	–	–	–	14	–	8
21.	Tufted Pochard, *Aythya fuligula* (M)	–	–	–	–	–	–	24	–
22.	Redcrested Pochard, *Netta rufina* (M)	–	–	–	–	55	322*	–	21
23.	Cotton Teal, *Nettapus coromandelianus* (R)	50	27	15	17	69	71	15	13
24.	Lesser Whistling Teal, *Dendrocygna javanica* (R)	1520*	255	–	55	2500*	3504*	67	71
25.	Comb Duck, *Sarkidiornis melanotos* (R)	–	–	–	–	47	–	–	–
	Order GRUIFORMES								
	Family RALLIDAE								
26.	Whitebreasted Waterhen, *Amaurornis phoenicurus* (R)	5	8	–	3	4	2	–	–
27.	Indian Moorhen, *Gallinula chloropus* (RM)	9	8	11	–	103	22	–	–
28.	Purple Moorhen, *Porphyrio porphyria* (R)	16	11	–	–	72	14	–	–
29.	Coot, *Fulica atra* (RM)	–	–	–	4	7	115	–	10
30.	Watercock, *Gallicrex cinerea* (R)	4	7	–	–	–	–	–	–
	Order CHARADRIIFORMES								
	Family JACANIDAE								
31.	Pheasant-tailed Jacana, *Hydrophasianus chirurgus* (R)	2	2	–	–	–	–	–	–
32.	Bronzewinged Jacana, *Metapidius indicus* (R)	75	24	–	–	24	13	6	2
	B. Waders								
	Order CHARADRIIFORMES								
	Family CHARADRIIDAE								
33.	Yellowwattled Lapwing, *Vanellus malabaricus* (R)	–	–	–	–	–	–	1	1
34.	Green Shank, *Tringa nebularia* (M)	–	–	–	–	2	12	–	4
	Total number of species	**20**	**19**	**9**	**13**	**24**	**29**	**12**	**26**

Note : R = Resident, RM = Resident migrant, M = Migrant, * = Not representing total count.
JB = Jamuna bundh, KB = Krishna bandh, LB = Lal bundh, KJB = Kulaijurir bundh,
SBP = Saheb bundh, Purulia, SBA = Saheb bundh, Adra, RB = Rani bundh, IB = Indra beel.

these two districts but Cotton Teal was found to breed happily in Goldighi, an urban artificial reservoir-cum-recreational park complex maintained by the Forest Department, Government of West Bengal in the heart of Rampurhat town in the adjacent district of Birbhum, West Bengal.

Table 2. Salient features of selected wetlands of Bankura and Puruliya districts, West Bengal.

Name of district	**Bankura**				**Puruliya**			
Name of wetland	JB	KB	LB	KJB	SBP	SBA	RB	IB
Date of observation (in 2000)	3 Feb	2 Feb	2 Feb	4 Feb	28 Jan	29 Jan	28 Jan	30 Jan
Time of observation	AM	AM	PM	PM	AM	AM	PM	PM
Nearest town/village	Bish-nupur	Bish-nupur	Bish-nupur	Banka-dah	Puru-liya	Adra	Joy-pur	Indra-bil
Locality type	Semi-urban	Rural	Semi-urban	Rural	Urban	Semi-urban	Rural	Rural
Approximate area (ha)	25	45	12	18	30	50	15	80
Vegetation cover	70%	60%	50%	40%	80%	70%	50%	60%
Wetland use	M	L	M	H	H	H	M	M
Protection	M	L	M	L	H	H	Nil	L
Poaching	Rare	Rare	Rare	Rare	Nil	Nil	Low	High

Abbreviations :

1. Name of wetland : JB = Jamuna Bundh; KB = Krishna Bundh; LB = Lal Bundh; KJB = Kulaijurir Bundh; SBP = Saheb Bundh, Puruliya; SBA = Saheb Bundh, Adra; RB = Rani Bundh; IB = Indra Beel.
2. Time of observation : AM = Morning (7.30 – 11.30 AM); PM = Afternoon (14.00 – 17.00 PM).
3. Wetland use and protection : H = High; M= Medium; L = Low.

In overall, the highest diversity of waterbirds was encountered in Saheb bundh, Adra of Puruliya district and lowest in the Lal bundh, Bishnupur of Bankura district. The richness and diversity of species appears to be associated with the size, availability of food, both macrophytes and macroinvertebrates, and safe refuge of the habitats/wetlands. Migratory waterfowls were recorded from wetlands of Puruliya district only. They were located at rural, semi-urban and urban environments having thick growth of marginal macrophytes. The occurrences of these migratory species in urban (SBP) and semi-urban (SBA) wetlands with recreational boating activities indicate their tolerance to minor man-made noises/disturbances. However, it has been noted that these wetlands of Bankura and Puruliya districts remained ornithologically unexplored (Majumdar *et al.*, 1992; NEWS, 1998) although Prakiti Samsad (1999) surveyed extensively in Southern West Bengal. Mention may be made that NEWS (1998) made an inventory of waterbirds of Saheb Bundh, Puruliya in which a total of 24 species have been listed without any count data of the species. The occurrence and abundance of resident and resident-migrant species *viz.*, Little Grebe,

Jacanas, Rails, etc., which were a common sight in rural wetlands/waterbodies of Lower Bengal even 20 years ago has drastically declined due to habitat destruction, distortion and human impact in these freshwater environments. It is, therefore, urged to the local people and the panchayats to take up appropriate conservation measures for the protection of the wetlands as well as waterfowls offering a safe refuge to both migrant and resident species so that they may merrily overwinter and/or breed undisturbed adding attraction, aesthetic value and beauty to these wetlands.

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Rec. zool. Surv. India : **102** (Part 1–2) : 53-56, 2004

NOTES ON AQUATIC ENTOMOFAUNA OF NARATHALY LAKE OF BUXA TIGER RESERVE, WEST BENGAL

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INTRODUCTION

During the course of investigation on wetland faunal resources of West Bengal, Narathaly Lake of Buxa Tiger Reserve (BTR) which lies between 26°55' N latitude and 89°20' and 89°55' E longitude, under Alipurduar Subdivision of Jalpaiguri district was surveyed twice in September-October 1996 and 1997. BTR covers an area of 760.87 sq. km. of which 385.02 sq. km. area of core zone consists of Buxa Sanctuary and National Park. It is rich in flora and fauna. But, very little work has been done to understand the biodiversity status of this reserve (Banerjee, 1998; Raychaudhuri, 1996; Raychaudhuri and Saha, 2000; Saha and Raychaudhuri, 1998). Since there is no information of wetland fauna of BTR, the present paper on aquatic insect fauna of Narathaly Lake located within the reserve is communicated.

RESULTS AND DISCUSSION

So far, a total of 29 aquatic insect species belonging to 23 genera under 15 families and 5 orders have been identified from the lake and presented in Table 1. Of the 5 insect orders, Hemiptera shows highest diversity (14 species) followed by Coleoptera (8 species). A perusal of literature reveals that Bal and Basu (1994a) reported two species of gerrids (Hemiptera) *viz.*, *Limnogonus parvulus* (Stal) and *Ptilomera laticauda* (Hardwicke) from Alipurduar Subdivision of Jalpaiguri district out of the four families of Hemiptera dealt in the paper. But, Bal and Basu (1994b) in the paper dealing with the other four families could not report a single species of Hemiptera from this district. A single species of 'whirligig beetles' (Family : Gyrinidae), namely *Dineutus spinosus* (Fabricius) was recorded from Jalpaiguri district by Biswas *et al.*, (1995a) from four families of the order Coleoptera adapted to the aquatic life (Biswas *et al.*, 1995a,b,c) indicating ill-exploration from this district. Srivastava (1994) recorded 13 adult/larval ephemeropteran species from Jalpaiguri district including Alipurduar and Buxadaur regions. Srivastava and Sinha (1993) encountered 43 species of adult Odonata from Jalpaiguri district. Chaudhuri and Chattopadhyay (1997) studied chironomid fauna of West Bengal which includes a number of species from Jalpaiguri district. Besides these reports on aquatic and semi-aquatic insects, there are records of 453 species of terrestrial insects (Table 2) compiled in the Newsletter of BTR (Annonymous, 1995).

Afterwards, Raychaudhuri (1996) and Raychaudhuri and Saha (2000) reported 12 species of wood boring cerambycid beetles from Buxa Tiger Reserve, while Saha and Raychaudhuri (1998) contributed on moths of this Tiger Reserve of West Bengal. Thus, the present paper is the first report on insects from wetland/lake habitat of this important protected area of West Bengal.

Table 1. Aquatic entomofaunal diversity of Narathaly Lake, Buxa Tiger Reserve, West Bengal.

A. Order **HEMIPTERA** (Adult)

Family BELSTOMATDAE

1. *Diplonychus annulatum* (Fabricius)
2. *Diplonychus rusticus* (Fabricius)

Family CORIXIDAE

3. *Micronecta* sp.

Family GERRIDAE

4. *Gerris* sp.
5. *Limnogonus parvulus* (Stal)
6. *Limnogonus* sp.

Family HYDROMETRIDAE

7. *Hydrometra* sp.

Family MESOVELLIDAE

8. *Mesovelia vittigera* Horvath

Family NEPIDAE

9. *Laccotrephes griseus* (Guerin)
10. *Laccotrephes ruber* (Linnaeus)
11. *Ranatra filiformis* Fabricius
12. *Ranatra sordidula* Dohrn

Family PLEIDAE

13. & 14. *Plea* spp. (2 species)

B. Order **COLEOPTERA** (Adult)

Family DYTISCIDAE

15. *Canthydrus laetabilis* (Walker)
16. *Canthydrus* sp.
17. *Hydrovatus* sp.
18. *Laccophilus* sp.

Family HYDROPHILIDAE

19. *Amphiops* sp.
20. *Berosus indicus* Mots.
21. *Regimbertia attenuata* (Fabr.)
22. *Sternolophus rufipes* (Fabr.)

C. Order **DIPTERA** (Larvae)

Family CULICIDAE

23. *Anopheles* sp.
24. *Culex* sp.

Family CHIRONOMIDAE

25. Undetermined species (larvae)

D. Order **ODONATA** (Larvae)

Family LIBELLULIDAE

26. *Urothemis* sp.

Family COENAGRIONIDAE

27. *Enallagma* sp.

E. Order **EPHEMEROPTERA** (Larvae)

Family BAETIDAE

28. *Cloen* sp.

Family CAENIDAE

29. *Caenis* sp.

Table 2. Terrestrial insect faunal elements inhabiting Buxa Tiger Reserve.

	Groups / Orders		Number of species
1.	Strepsiptera	(Twisted winged insects)	1
2.	Coleoptera	(Beetles and weevils)	183
3.	Dermoptera	(Earwigs)	6
4.	Dictyoptera	(Roaches)	4
5.	Diptera	(Two winged insects)	10
6.	Heteroptera	(Bugs)	63
7.	Homoptera	(Cicadas, Leaf hoppers, etc.)	20
8.	Hymenoptera	(Bees, Wasps, Ants, etc.)	49
9.	Isoptera	(Termites)	1
10.	Lepidoptera	(Butterflies & Moths)	78
11.	Mantodea	(Preying mantids)	5
12.	Neuroptera	(Lace wing bugs)	2
13.	Odonata	(Dragonflies & Damselflies)	10
14.	Orthoptera	(Grasshoppers, Crickets, etc.)	20
15.	Phasmida	(Stick & Leaf insects)	1
			Total = 453

Source : Annonymous (1995) : *Newsletter* BTR, **2**(1) : 2

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A CHECKLIST OF AQUATIC AND SEMI-AQUATIC HEMIPTERA (INSECTA) OF KARNATAKA

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INTRODUCTION

Aquatic and semi aquatic heteropterans form food in different trophic levels of fresh water ecosystems. Due to their poor dispersal capabilities, these bugs serve as zoogeographical indicators for diverse habitats (Jordon, 1951; Hungerford & Matsuda, 1958). Further, many families of the bugs may be utilized in the biological control of mosquito larvae (Jenkins, 1964). Some corixids are used as indicators of water quality. Studies also indicate that the quality of aquatic environment is partially dependent on the abundance of bugs population (Murdoch *et al*, 1984; Ramakrishna, 2000; Thirumalai & Raghunathan, 1988).

Out of 285 genera and around 3558 species distributed globally, aquatic and semi aquatic heteropteran fauna in India is represented by 78 genera and 269 species accommodated in 16 families (Thirumalai, 1999). The aquatic and semi aquatic bugs of Karnataka received only rather cursory attention largely by foreign scientists limited to taxonomic preliminaries, including recording of species from different parts of the state. However, an attempt to consolidate the information on the group by throwing more light on the present taxonomic status of some families has been made by Thirumalai & Krishnan (2000), Thirumalai (2001 & 2002), Zettel & Thirumalai (2001a & b).

The present checklist includes the collections of aquatic and semi aquatic Heteroptera made by the author from intensive and extensive surveys of Karnataka during the last five years. The study comprises of 40 genera and 67 species under 12 families that are listed in this paper. The study also revealed the rich diversity of aquatic and semi aquatic heteropteran fauna occurring in the state. Under each species citation for the original description and other accompanying work necessary to understand the taxon or its occurrence in India is provided.

AQUATIC AND SEMI AQUATIC HETEROPTERA OF KARNATAKA

Order HEMIPTERA

Suborder HETEROPTERA

INFRAORDER GERROMORPHA

Family GERRIDAE

Subfamily CYLINDROSTETHINAE

Genus ***Cylindrostethus*** Mayr, 1865

1. ***Cylindrostethus productus*** (Spinola, 1840)

Gerris productus Spinola, 1840. Essai *Sur less insectes hemipteres rhynchotes on heteropteres*, 64.

Cylindrostethus productus (Spinola) : Distant, 1903. *Fauna Brit. India*, **2** : 184.

Cylindrostethus productus (Spinola) : Polhemus, 1994. *Bishop Mus. Occ. Pap.*, **38** : 10.

Janias elegantulus Distant, 1910. *Ann. Mag. nat. Hist.*, **5**(8) : 145.

Subfamily EOTRECHINAE

Genus ***Amemboa*** Esaki, 1925

Subgenus ***Amemboa*** Esaki, 1925

2. ***Amemboa (Amemboa) kumari*** (Distant, 1910)

Onychotrechus kumari Distant, 1910. *Ann. Mag. nat. Hist.*, **5**(8) : 145.

Onychotrechus kumari (Distant) : Esaki, 1928. *Ann. Mag. nat. Hist.*, **2**(10) : 509.

Amemboa (Amemboa) kumari (Distant) : Polhemus & Andersen, 1984. *Steenstrupia*, **10**(3) : 85.

Amemboa pervati Pradhan, 1950. *Rec. Indian Mus.*, **48**(3 & 4) : 12.

Subgenus AMEMBOIDES Polhemus & Andersen, 1984

3. ***Amemboa (Amemboides) perlata*** Polhemus & Andersen, 1984

Amemboa (Amemboides) perlata Polhemus & Andersen, 1984. *Steenstrupia*, **10**(3) : 100.

Genus ***Onychotrechus*** Kirkaldy, 1903

4. ***Onychotrechus rhexenor*** Kirkaldy, 1903

Onychotrechus rhexenor Kirkaldy, 1903. *Entomologist*, **36** : 44.

Onychotrechus rhexenor Kirkaldy : Andersen, 1980. *Steenstrupia*, **6**(10) : 128.

5. ***Onychotrechus rupestris*** Andersen, 1980

Onychotrechus rupestris Andersen, 1980. *Steenstrupia*, **6**(10) : 132.

6. ***Oncyhotrechus spinifer*** Andersen, 1980

Onychotrechus spinifer Andersen, 1980. *Steenstrupia*, **6**(10) : 138.

Genus ***Tarsotrechus*** Andersen, 1980

7. ***Tarsotrechus polhemi*** Andersen, 1980

Tarsotrechus polhemi Andersen, 1980. *Steenstrupia*, **6**(10) : 143.

Subfamily GERRINAE

Genus ***Aquarius*** Schellenberg, 1800

8. ***Aquarius adelaidis*** (Dohrn, 1860)

Aquarius adelaidis Dohrn, 1860. *Stettin. ent. Ztg.*, **21** : 408.

Aquarius adelaidis (Dohrn) : Andersen, 1990. *Steenstrupia*, **16**(4) : 61.

Gerris spinolae Leth. & Ser., 1896. *Cat. gen. Hemiptera*, **3** : 63.

Gerris spinolae (Leth. & Ser.) : Distant, 1903. *Fauna Brit. India*, **2** : 180.

Genus ***Limnogonus*** Stål, 1868

Subgenus ***Limnogonus*** Stål, 1868

9. ***Limnogonus (Limnogonus) fossarum fossarum*** (Fabricius, 1775)

Cimex fossarum Fabricius, 1775. *Syst. Ent.*, 727.

Gerris fossarum Fabricius, 1794. *Ent. Syst. emen. aucta*, **IV** : 188.

Limnogonus fossarum Stål, 1868. *K. Svenska Vetensk. Akad.*, **7** : 133.

L. (Limnogonus) fossarum (Fab.) : Hungerford & Matsuda, 1959. *J. Kans. Ent. Soc.*, **32**(1) : 40.

L. (L.) fossarum (Fab.) : Andersen, 1975. *Ent. Scand. Suppl.*, **7** : 30.

10. ***Limnogonus (Limnogonus) nitidus*** (Mayr, 1865)

Hydrometra nitida Mayr, 1865. *Verh. zool. -bot. Ges. Wien*, **15** : 443.

Gerris nitida (Mayr) : Distant, 1903. *Fauna Brit. India*, **2** : 178.

Limnogonus nitidus (Mayr) : Kirkaldy, 1908. *Wissenschafl. Ergebn. der Schwed. zool. Exped. nach dem Kilimandjaro*, **12** : 21.

L. (Limnogonus) nitidus (Mayr) : Matsuda, 1960. *Kans. Univ. Sci. Bull.*, **41** : 198.

L. (Limnogonus) nitidus (Mayr) : Andersen, 1975. *Ent. Scand. Suppl.*, **7** : 62.

Subgenus ***Limnogonoides*** Poisson, 1965

11. ***Limnogonus (Limnogonoides) pectoralis*** (Mayr, 1865)

Hydrometra pectoralis Mayr, 1865. *Verh. zool. bot. Ges. Wien*, **15** : 443.

Gerris pectoralis (Mayr) : Distant, 1903. *Fauna Brit. India*, **2** : 181.

Limnogonus (Limnogonoides) pectoralis (Mayr) : Andersen, 1975. *Ent. Scand. Suppl.*, **7** : 69.

Genus ***Limnometra*** Mayr, 1865

12. ***Limnometra anadyomene*** (Kirkaldy, 1901)

Gerris anadyomene Kirkaldy, 1901. *Entomologist*, **34** : 117.

Tenagogonus anadyomene (Kirkaldy) : Bergroth, 1915. *Zool. Meded. Leiden*, **1**(2) : 122.

Limnometra anadyomene (Kirkaldy) : Lundblad, 1934. *Arch. Hydrobiol. Suppl.*, **12** : 371.

Tenagogonus (Limnometra) anadyomene (Kirkaldy) : Matsuda, 1960. *Kans. Univ. Sci. Bull.*, **41** : 206.

Limnometra anadyomene (Kirkaldy) : Andersen, 1995. *Steenstrupia*, **21** : 117.

Tenagogonus (Limnometra) longispinulus Thirumalai, 1986. *Rec. zool. Surv. India*, **84**(1-4) : 11.

13. ***Limnometra fluviorum*** (Fabricius, 1798)

Cimex fluviorum Fabricius, 1798. *Ent. Syst. Suppl.*, 543.

Gerris fluviorum (Fab.) : Distant, 1903. *Fauna Brit. India*, **2** : 177.

Limnometra fluviorum (Fab.) : Lundblad, 1934. *Arch. Hydrobiol. Suppl.*, **12** : 371.

Tenagogonus(Limnometra) fluviorum (Fab.) : Matsuda, 1960. *Kans. Univ. Sci. Bull.*, **41** : 206.

Limnometra fluviorum (Fab.) : Andersen, 1995. *Steenstrupia*, **21** : 118.

Gerris armata Spinola : Distant, 1903. *Fauna Brit. India*, **2** : 180.

Genus ***Neogerris*** Matsumura, 1913

14. ***Neogerris parvula*** (Stål, 1859)

Gerris parvula Stål, 1859. *Zoology*, **4** : 265.

Limnogonus parvulus (Stål) : Lundblad, 1934. *Arch. Hydrobiol. Suppl.*, **12** : 384.

L. (Limnogonellus) parvulus (Stål) : Hungerford & Matsuda, 1959. *J. Kans. Ent. Soc.*, **32** : 41.

L. (Neogerris) parvulus (Stål) : Hungerford & Matsuda, 1961. *Insecta matsum.*, **24** : 114.

Neogerris parvula (Stål) : Andersen, 1975. *Ent. Scand. Suppl.*, **7** : 86.

Gerris tristan Kirkaldy, 1899. *Revue. Ent.*, **18** : 88.

Genus ***Tenagogonus*** Stål, 1854

15. ***Tenagogonus ceylonensis*** Hungerford & Matsuda, 1962

Tenagogonus ceylonensis Hungerford & Matsuda, 1962. *Bull. Brooklyn ent. Soc.*, **57** : 141.

Subfamily HALOBATINAE

Genus ***Metrocoris*** Mayr, 1865

16. ***Metrocoris communis*** (Distant, 1910)

Euodus communis Distant, 1910. *Ann. Mag. nat. Hist.*, **5**(8) : 151.

Metrocoris communis (Distant) : Esaki, 1929. *Ann. Mag. nat. Hist. Soc.*, **4**(10) : 419.

Metrocoris communis (Distant) : Den Boer, 1965. *Zool. Verh. Leiden.*, **74** : 13.

Metrocoris communis (Distant) : Chen & Nieser, 1993. *Steenstrupia*, **19**(2) : 49.

17. ***Metrocoris indicus*** Chen & Nieser, 1993

Metrocoris indicus Chen & Nieser, 1993. *Steenstrupia*, **19**(2) : 48.

Metrocoris Ståli (Dohrn) : Distant, 1903. *Fauna Brit. India*, **2** : 190.

Metrocoris Ståli (Dohrn) : Den Boer, 1965. *Zool. Verh. Leiden*, **74** : 8.

Metrocoris Ståli (Dohrn) : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 37.

Note : Specimens from Southern India earlier identified as *Metrocoris Ståli* (Dohrn, 1860) refer to *M. indicus*.

18. ***Metrocoris malabaricus*** Thirumalai, 1986

Metrocoris malabaricus Thirumalai, 1986. *Rec. zool. Surv. India*, **84** : 22.

19. ***Metrocoris variegans*** Thirumalai, 1986

Metrocoris variegans Thirumalai, 1986. *Rec. zool. Surv. India*, **84** : 25.

Genus ***Ventidius*** Distant, 1910

Subgenus ***Ventidius*** Distant, 1910

20. ***Ventidius (Ventidius) aquarius*** Distant, 1910

Ventidius aquarius Distant, 1910. *Ann. Mag. nat. Hist.*, **5**(8) : 150.

Ventidius (Ventidius) aquarius Distant : Hungerford & Matsuda, 1960. *Kans. Univ. Sci. Bull.*, **40**(7) : 324.

Subfamily PTILOMERINAE

Genus ***Jucundus*** Distant, 1910

21. ***Jucundus custodiendus*** Distant, 1910

Jucundus costodiendus Distant, 1910. *Ann. Mag. nat. Hist.*, **5**(8) : 143.

Rheumatogonus custodiendus (Distant) : Esaki, 1927. *Eos Revista Espanola Entomologia*, **3** : 267.

Jucundus costodiendus Distant : Zettel & Thirumalai, 2001b. *Ann. Naturhist. Mus. Wien*, **103B** : 276.

Pleciobatus tuberculatus Esaki : Thirumalai, 1992. *Hexapoda*, **4** : 173 (male, misidentification).

Genus ***Ptilomera*** Amyot & Serville, 1843

Subgenus ***Ptilomera*** Amyot & Serville, 1843

22. ***Ptilomera (Ptilomera) agroides*** Schmidt, 1926

Pitlomera agroides Schmidt, 1926. *Ent. Mitt.*, **15**(1) : 63.

Pitlomera (Ptilomera) agroides Schmidt : Matsuda, 1960. *Kans. Univ. Sci. Bull.*, **41**(2) : 269.

Pitlomera (Ptilomera) agroides Schmidt : Thirumalai, 1986. *Rec. zool. Surv. India*, **84**(1-4) : 15.

Ptilomera laticaudata (Hardwicke) : Distant, 1903. *Fauna Brit. India*, **2** : 185 (Fig. 133).

Ptilomera lachne Schmidt, 1926. *Ent. Mitt.*, **15**(1) : 64.

Genus ***Stridulobates*** Zettel & Thirumalai, 2001

23. ***Stridulobates anderseni*** Zettel & Thirumalai, 2001

Stridulobates anderseni Zettel & Thirumalai, 2001a. *Insect Syst. Evol.*, **31**(4) : 434.

Pleciobatus tuberculatus Esaki : Thirumalai, 1992. *Hexapoda*, **4** : 173 (Female, misidentification).

24. ***Stridulobates nostras*** (Thirumalai, 1986)

Pleciobatus nostrus Thirumalai, 1986. *Rec. zool. Surv. India*, **84**(1-4) : 19.

Stridulobates nostras (Thirumalai) : Zettel & Thirumalai, 2001b. *Insect Syst. Evol.*, **31**(4) : 436.

Subfamily RHAGADOTARSINAE

Genus ***Rhagadotarsus*** Breddin, 1905

Subgenus *Rhagadotarsus* Breddin, 1905

25. ***Rhagadotarsus (Rhagadotarsus) kraepelini*** Breddin, 1905

Rhagadotarsus kraepelini Breddin, 1905. *Mitt. Naturhist. Mus. Hamb.*, **22** : 137.

R. (Rhagadotarsus) kraepelini Breddin : Matsuda, 1960. *Kans. Univ. Sci. Bull.*, **41**(2) : 322.

R. (Rhagadotarsus) kraepelini Breddin : Polhemus & Karunaratne, 1993. *Bull. Raffles Mus. (Zoology)*, **41**(1) : 100.

Nacebus dux Distant, 1910. *Ann. Mag. nat. Hist.*, **5**(8) : 152.

Subfamily TREPOBATINAE

Genus ***Gnomobates*** Polhemus & Polhemus, 1995a.

26. ***Gnomobates kuiterti*** (Hungerford & Matsuda, 1958)

Cryptobates kuiterti Hungerford & Matsuda, 1958. *J. Kans. Ent. Soc.*, **31**(4) : 246.

Gnomobates kuiterti (Hungerford & Matsuda) : Polhemus & Polhemus, 1995. *Ent. Scand.*, **26**(1) : 108.

Genus ***Naboandelus*** Distant, 1910

27. ***Naboandelus signatus*** Distant, 1910

Naboandelus signatus Distant, 1910. *Ann. Mag. nat. Hist.*, **5**(8) : 151.

Naboandelus signatus Distant : Thirumalai, 2002. *Rec. zool. Surv. India*, **100** : 71.

Family VELIIDAE

Subfamily HALOVELIINAE

Genus ***Strongylovelia*** Esaki, 1924

28. ****Strongylovelia*** sp.

*Could turn out new to science (Zettel personal Communication)

Subfamily MICROVELIINAE

29. ***Baptisa angulata*** Andersen, 1989

Baptisa angulata Andersen, 1989. *Ent. Scand.*, **19** : 373.

Genus ***Microvelia*** Westwood, 1834

Subgenus ***Microvelia*** Westwood, 1834

30. ***Microvelia (Microvelia) douglasi*** Scott, 1874

Microvelia douglasi Scott, 1874. *Ann. Mag. nat. Hist.*, **14** : 448.

Microvelia (Microvelia) douglasi Distant : Andersen, 1995. *Cat. Het. Palaearctic Region*, **1** : 87.

Microvelia douglasi Scott : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 40.

Microvelia repentiana Distant, 1903. *Fauna Brit. India*, **3** : 174.

M. kumaonensis Distant, 1909. *Ann. Mag. nat. Hist.*, **3**(8) : 500.

Genus ***Pseudovelia*** Hoberlandt, 1950

Subgenus ***Pseudovelia*** Hoberlandt, 1950

31. ***Pseudovelia (Pseudovelia) sexualis*** (Paiva, 1917)

Micronecta (Kirkaldya) sexualis Paiva, 1917. *Mem. Asiatic Soc. Bengal*, **6** : 77.

Pseudovelia (Pseudovelia) sexualis (Paiva) : Andersen, 1983. *Ent. Scand.*, **14** : 256.

Subfamily RHAGOVELIINAE

Genus ***Rhagovelia*** Mayr, 1865

Subgenus ***Neorhagovelia*** Matsuda, 1956

32. ***Rhagovelia (Neorhagovelia) nilgiriensis*** Thirumalai, 1994

Rhagovelia (Neorhagovelia) nilgiriensis Thirumalai, 1994. *Rec. zool. Surv. India*, **94** : 390.

Subgenus ***Rhagovelia*** Mayr, 1865

33. ***Rhagovelia (Rhagovelia) tibialis*** Lundblad, 1936

Rhagovelia tibialis Lundblad, 1936. *Ark. Zool.*, **28**(21) : 31.

R (Rhagovelia) tibialis Lundblad : Thirumalai, 1994. *Rec. zool. Surv. India*, **94** : 382.

Genus ***Tetraripis*** Lundblad, 1936

34. ***Tetraripis asymmetricus*** Polhemus & Karunaratne, 1979

Tetraripis asymmetricus Polhemus & Karunaratne, 1979. *Bull. Fish. Res. Stn., SriLanka*, **29** : 99.

Tetraripis asymmetricus Polhemus & Karunaratne : Thirumalai & Dam, 1996. *Hexapoda*, **8**(2) : 67.

Family HEBRIDAE

Subfamily HEBRINAE

Genus ***Neotimasius*** Andersen, 1981

35. ***Neotimasius orientalis*** Andersen, 1981

Neotimasius orientalis Andersen, 1981. *Syst. Entomol.*, **6** : 405.

Genus ***Timasius*** Distat, 1909

36. ***Timasius splendens*** Distant, 1909

Timasius splendens Distant, 1909. *Ann. Mag. nat. Hist.*, **3**(9) : 499.

Timasius splendens Distant : Andersen, 1981. *Syst. Entomol.*, **6** : 392.

Family MESOVELIIDAE

Subfamily MESOVELIINAE

Genus ***Mesovelia*** Mulsant & Rey, 1852

37. ***Mesovelia vittigera*** Horvath, 1895

Mesovelia vittigera Horvath 1895. *Revue. ent.*, **14** : 160.

Mesovelia vittigera Horvath : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 28.

Mesovelia mulsanti White : Distant, 1903. *Fauna Brit. India*, **2** : 169.

Mesovelia orientalis Kirkaldy, 1901. *Annali Mus. civ. Stor. Nat. Giacomo Doria*, **20** : 808.

Family HYDROMETRIDAE

Subfamily HYDROMETRINAE

Genus ***Hydrometra*** Latreille, 1796

38. ***Hydrometra butleri*** Hungerford and Evans, 1934

Hydrometra butleri Hungerford and Evans, 1934. *Ann. Mag. nat. Hist.*, **28** : 71.

Hydrometra butleri Hungerford and Evans. : Thirumalai, 1994. Misc. Occ. Pap. Rec. zool. Surv. India, **165** : 29.

39. ***Hydrometra greeni*** Kirkaldy, 1898

Hydrometra greeni Kirkaldy, 1898. *Entomologist*, **31** : 2.

Hydrometra greeni Kirkaldy : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 29.

Hydrometra greeni Kirkaldy : Polhemus & Polhemus, 1995. *Bishop. Mus. Occ. Pap.*, **43** : 22.

Hydrometra vittata (Stål) : Distant, 1903. *Fauna Brit. India*, **2** : 170.

INFRAORDER NEPOMORPHA

Family NOTONECTIDAE

Subfamily ANISOPINAE

Genus *Anisops* Spinola, 1837

40. ***Anisops barbatus*** Brooks, 1951

Anisops barbata Brooks, 1951. *Kan. Univ. Sci. Bull.*, **34** : 387.

Anisops barbata Brooks : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 13.

41. ***Anisops bouvieri*** Kirkaldy, 1904

Anisops bouvieri Kirkaldy, 1904. *Wiener Ent. Zeit.*, **23** : 116.

42. ***Anisops campbelli*** Brooks, 1951

Anisops campbelli Brooks : Lansbury, 1964. *Ann. zool. Warszawa*, **22** : 213.

Anisops campbelli Brooks : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 14.

43. ***Anisops cavifrons*** Brooks, 1951

Anisops cavifrons Brooks 1951. *Kans. Univ. Sci. Bull.*, **34** : 418.

Anisops cavifrons Brooks : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 16.

44. ***Anisops nigrolineatus*** Lundblad, 1933

Anisops nigrolineata Lundblad, 1933. *Arch. Hydrobiol. Suppl.*, **12** : 160.

Anisops nigrolineatus Lundblad : Polhemus, 1995. *Cat. Het. Palaerctic region*, **1** : 65.

45. ***Anisops sardeus*** Herrich–Shaffer, 1849

Anisops sardeus Herrich-Shaffer, 1849. *Die wanzenartigen Insecten*, **9** : 41.

Anisops sardeus Herrich-Shaffer : Distant, 1906. *Fauna Brit. India*, **3** : 45.

Anisops sardeus Herrich-Shaffer : Pavia, 1918. *Rec. Indian Mus.*, **14** : 28.

Anisops sardeus Herrich-Shaffer : Distant, 1951. *Univ. Kansas Sci. Bull.*, **34** : 423.

Anisops sardea Herrich-Shaffer : Thirumalai, 1989. *Misc. Occ. Pap. Rec. zool. Surv. India*, **118** : 26.

Subfamily NOTONECTINAE Latreille, 1802

Tribe NOTONECTINI Latreille, 1802

Genus *Enithares* Spinola, 1837

46. ***Enithares ciliata*** (Fabricius), 1798

Notonecta ciliata Fabricius, 1798. *Suppl. Ent. Syst.*, 524.

Enithares indica Spinola : Distant, 1906. *Fauna Brit. India*, **3** : 42.

Enithares paviana Distant, 1910. *Fauna Brit. India*, **5** : 329.

E. lacta Paiva, 1919. *Rec. Indian Mus.*, **19** : 155.

E. abbreviata (Kirby) : Hafiz and Mathai. 1938. *Rec. Indian Mus.*, **40** : 210.

47. ***Enithares fusca*** Brooks, 1948

Enithares fusca Brooks, 1948. *J. Kans. Ent. Soc.*, **21** : 46.

E. fusca Brooks : Lansbury, 1968. *Pacif. Insects*, **10** : 412.

E. fusca Brooks : Thirumalai, 2001. *ZSI. Fauna Conservation area*, **11** : 115.

Family NEPIDAE

Subfamily RANATRINAE

Tribe RANATRINI

Genus ***Cercotmetus*** Amyot & Serville, 1843

48. ***Cercotmetus pilipes*** (Dallas, 1850)

Ranatra (Cercotmetus) pilipes Dallas, 1850. *Trans. R. ent. Soc. Lond.*, **1** : 9.

Cercotmetus pilipes (Dallas) : Montandon, 1903. *Bull. Soc. Sti. Buck.*, **12** : 110.

Cercotmetus pilipes (Dallas) : Distant, 1906. *Fauna Brit. India*, **3** : 23.

C. pilipes (Dallas) : Paiva, 1918. *Rec. Indian Mus.*, **14** : 26.

C. pilipes (Dallas) : Bal & Basu, 1997. *Zool. Surv. India, State Fauna*, **6** : 267.

Genus ***Ranatra*** Fabricius, 1790

49. ***Ranatra elongata*** Fabricius, 1790

Ranatra elongata Fabricius, 1790. *Skrif. Nat. Selesk.*, **1** : 228.

Ranatra elongata Fabricius : Lansbury, 1972. *Trans. R. ent. Soc. Lond.*, **124** : 306.

Ranatra elongata Fabricius : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 22.

50. ***Ranatra filiformis*** Fabricius, 1790

Ranatra filiformis Fabricius, 1790. *Skrit. Nat. Selsk.*, **1** : 228.

Ranatra filiformis Fabricius, : Thirumalai, 1994. *Misc. Occ. Pap. Rec zool. Surv. India*, **165** : 22.

Ranatra filiformis Fabricius, : Bal & Basu, 1997. *Zool. Surv. India, State Fauna*, **6** : 266.

Subfamily NEPINAE

Tribe NEPINI

Genus ***Laccotrephes*** Stål, 1866

51. ***Laccotrephes griseus*** (Guerin-Meneville, 1835)

Nepa griseus Guerin, 1844. *Iconogr. Regne. Anim.*, 352.

Laccotrephus griseus (Guerin) : Distant, 1910. *Fauna Brit. India*, **5** : 314.

Laccotrephus griseus (Guerin) : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 21.

52. ***Laccotrephes ruber*** (Linnaeus, 1764)

Nepa ruber, Linnaeus 1764. *Mus. Lud. Ulr.*, 165.

Laccotrephes ruber (Linn.) : Distant, 1906. *Fauna Brit. India*, **3** : 18.

Laccotrephes ruber (Linn.) : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 22.

Family BELOSTOMATIDAE

Subfamily BELOSTOMATINAE

Genus ***Diplonychus*** Laporte, 1833

53. ***Diplonychus rusticus*** (Fabricius, 1781)

Nepa rustica Fabricius, 1781. *Ent. Sept.*, **4** : 62.

Sphaerodema rusticum (Fab.) : Distant, 1906. *Fauna Brit. India*, **3** : 36.

D. rusticus (Fab.) : Lauck & Menke, 1961. *Ann. Entomol. Soc. Amer.*, **54** : 649.

D. rusticus (Fab.) : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 25.

Diplonychus indicus Venkatesan & Rao, 1980. *J. Bombay nat. Hist. Soc.*, **88** : 299.

Subfamily LETHOCERINAE

Genus ***Lethocerus*** Mayr, 1853

Subgenus ***Lethocerus*** Mayr, 1853

54. ***Lethocerus indicus*** (Lepeletiler & Serville, 1825)

Belostoma indica Lepeletiler & Serville, 1775. *Encycl. Meth.*, **X** : 272.

Belostoma indicum Lepeletiler & Serville, Mayr, 1871. *Verh. zool.-bot. Ges. Wien*, **12** : 426.

B. indicum (Lepeletiler & Serville) : Distant, 1906. *Fauna Brit. India*, **3** : 38.

Lethocerus indicus (Lep. & Serv.) : Buneo, 1927. *Bull. Brooklyn Entomol. Soc.*, **12** : 30.

Lethocerus indicus (Lep. & Serv.) : Lundblad, 1934. *Arch. Hydrobiol. Suppl.*, **12** : 52.

Lethocerus indicus (Lep. & Serv.) : Polhemus, 1995. *Cat. Het. Palaerctic region*, **1** : 23.

Family PLEIDAE

Genus ***Paraplea*** Esaki & China, 1928

55. ***Paraplea frontalis*** (Fieber, 1844)

Plea frontalis Fieber, 1844. *Entomologische Mongraphien, Leipzig*, 18.

P. (Paraplea) frontalis (Fieber) : Hafiz & Pradhan. 1947. *Rec. Indian Mus.*, **45** : 349.

Paraplea frontalis (Fieber, 1844) : Thirumalai. 1999. *IAAB*, **7** : 34.

Plea pelopea Distant, 1910. *Fauna Brit. India*, **5** : 336.

Family HELOTREPHIDAE

Subfamily HELOTREPHINAE

Tribe LIMNOTREPHINI

Genus ***Limnotrephes*** Esaki & China, 1928

56. ***Limnotrephes campbelli*** Esaki & China, 1928

Limnotrephes campbelli Esaki & China, 1928. *Eos. Revta. Esp. Entomol.*, **4** : 161.

Limnotrephes campbelli Esaki & China : Polhemus, 1990. *Acta. Entomol. Bohemoslov*, **87** : 61.

Family CORIXIDAE

Subfamily CORIXINAE

Tribe AGRAPTOCORIXINI

Genus ***Agraptocorixa*** Kirkaldy, 1898

57. ***Agraptocorixa hyalinipennis hyalinipennis*** (Fabricius, 1803)

Sigara hyalinipennis Fabricius, 1803. *Syst. Rhya. Brusvigae*, 105.

Agraptocorixa hyalinipennis (Fab.) : Jaczewski, 1926. *Ann. Zool. Mus. Polon Warsw.*, **5** : 18.

Agraptocorixa hyalinipennis (Fab.) : Thirumalai 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 8.

Corixa unicolor Paiva, 1918. *Rec. Indian Mus.*, **14** : 30.

Corixa paivana Paiva & Dover, 1922. *Rec. Indian Mus.*, **24** : 333.

Tribe CORIXINI

Genus ***Sigara*** Fabricius, 1775

Subgenus ***Tropocorixa*** Hutchinson, 1940

58. ***Sigara promontoria*** Distant, 1910

Corixa promontoria Distant, 1910. *Fauna Brit. India*, **5** : 341.

Corixa (Tropocorixa) promontoria Distant : Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 437.

59. ***Sigara pruthiana*** (Hutchinson, 1940)

Corixa (Tropocorixa) pruthiana Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 447.

C. (T). pruthiana Hutchinson : Thirumalai 1989. *Misc. Occ. Pap. Rec. zool. Surv. India*, **118** : 13.

Subfamily CYMATINAE

Genus ***Cymatia*** Flor, 1860

60. ***Cymatia apparens*** (Distant, 1910)

Corixa apparens Distant, 1910. *Fauna Brit. India*, **5** : 343.

Cymatia apparens (Distant) : Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 405.

Corixa hieroglyphia Distant, 1879. *Rhynchota*, **2** : 13.

Subfamily MICRONECTINAE

Genus ***Micronecta*** Kirkaldy, 1897

Subgenus ***Basilonecta*** Hutchinson, 1940

61. ***Micronecta scutellaris scutellaris*** (Stål, 1858)

Sigara scutellaris Stål, 1858. *Vetens akad. Forh.*, **15** : 339.

M. (Basilonecta) scutellaris scutellaris (Stål, 1858) : Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 365.

M. (Basilonecta) scutellaris scutellaris (Stål, 1858) : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India.*, **165** : 9.

Micronecta dione Distant, 1910. *Fauna Brit. India*, **5** : 348.

Micronecta malabarica Kirkaldy, 1908. *Canad. Ent.*, **40** : 209.

Micronecta malabarica Kirkaldy : Distant, 1910. *Fauna Brit. India*, **5** : 347.

Micronecta proba Distant, 1910. *Fauna Brit. India*, **5** : 348.

M. scutellaris pseudostriata Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 371.

62. ***Micronecta siva*** (Kirkaldy, 1897)

Sigara siva Kirkaldy, 1897. *Entomologist London*, **30** : 240.

Micronecta (Basilonecta) siva (Kirkaldy) : Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 371.

Micronecta striata Fieber : Distant, 1906. *Fauna Brit. India*, **3** : 50.

Subgenus ***Dichaetonecta*** Hutchinson, 1940

63. ***Micronecta desertana dravida*** Hutchinson, 1940

M. (Dichaetonecta) desertana dravida Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 392.

M. (D). desertana dravida Hutchinson : Thirumalai, 2001. *ZSI. Fauna Conservation area*, **11** : 114.

M. (D). desertana dravida conconensis Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 390.

64. ***Micronecta prashadana*** Hutchinson, 1940

Micronecta (Dichaetonecta) prashadana Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 387.

65. ***Micronecta sanctae-catherine*** Hutchinson, 1940

Micronecta (Dichaetonecta) sanctae-catherine Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 384.

Subgenus ***Indonectella*** Hutchinson, 1940

66. ***Micronecta grisea*** (Fieber, 1844)

Sigara grisea Fieber, 1844. *Entomol, Mono. Leipzig*, 14.

Micronecta thyesta Distant, 1910. *Fauna Brit. India*, **5** : 349.

M. (Indonectella) thyesta Distant : Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 363.

M. (I). thyesta Distant : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India.*, **165** : 8.

M. (I). thyesta Distant : Thirumalai, 2001. *ZSI. Fauna Conservation area*, **11** : 115.

Subgenus ***Sigmonecta*** Wroblewski, 1962

67. ***Micronecta quadristrigata*** Breddin, 1905

Micronecta quadristrigata Breddin, 1905. *Soc. Ent. Zurich*, **20** : 57.

Micronecta quadristrigata Breddin : Lundblad, 1933. *Arch. Hydrobiol. Supp.*, **12** : 87.

Micronecta (Basileonecta) quadristrigata Breddin : Hutchinson, 1940. *Trans. Connecticut Acad. Art. Sci.*, **33** : 376.

Micronecta (Sigmonecta) quadristrigata Breddin : Wroblewski, 1962. *Bull. Acad. Pol. Sc. II. Warzawa*, **10** : 176.

M. (S). quadristrigata Breddin : Thirumalai, 1994. *Misc. Occ. Pap. Rec. zool. Surv. India*, **165** : 8.

M. minthe Distant, 1910. *Fauna Brit. India*, **5** : 347.

Note : Jansson (1995) regarded *M. minthe* as a separate species found in SriLanka. However, certain forms of *minthe* are *quadristrigata*.

DISCUSSION

The aquatic and semi-aquatic groups of insects are highly specialised and represent a significant level of diversity (Pennak, 1978; Ghosh, 1996). As checklists of provincial area are of immense value in diversity studies, this account provides baseline information for the assessment of change, to identify key variables and gives a snapshot of the state of biodiversity (Daniels, 1997; Ananthakrishnan, 1999). The present study includes the unique genus, *Stridulobates* Zettel & Thirumalai, 2001a, which possess a mesotrochontrial abdominal stridulation unknown from any other insect, from Karnataka. Extensive collections from Karnataka have resulted in the resurrection of the genus *Rheumatogonus* Kirkaldy, 1909 by removing synonymy with *Jucundus* Distant, 1910.

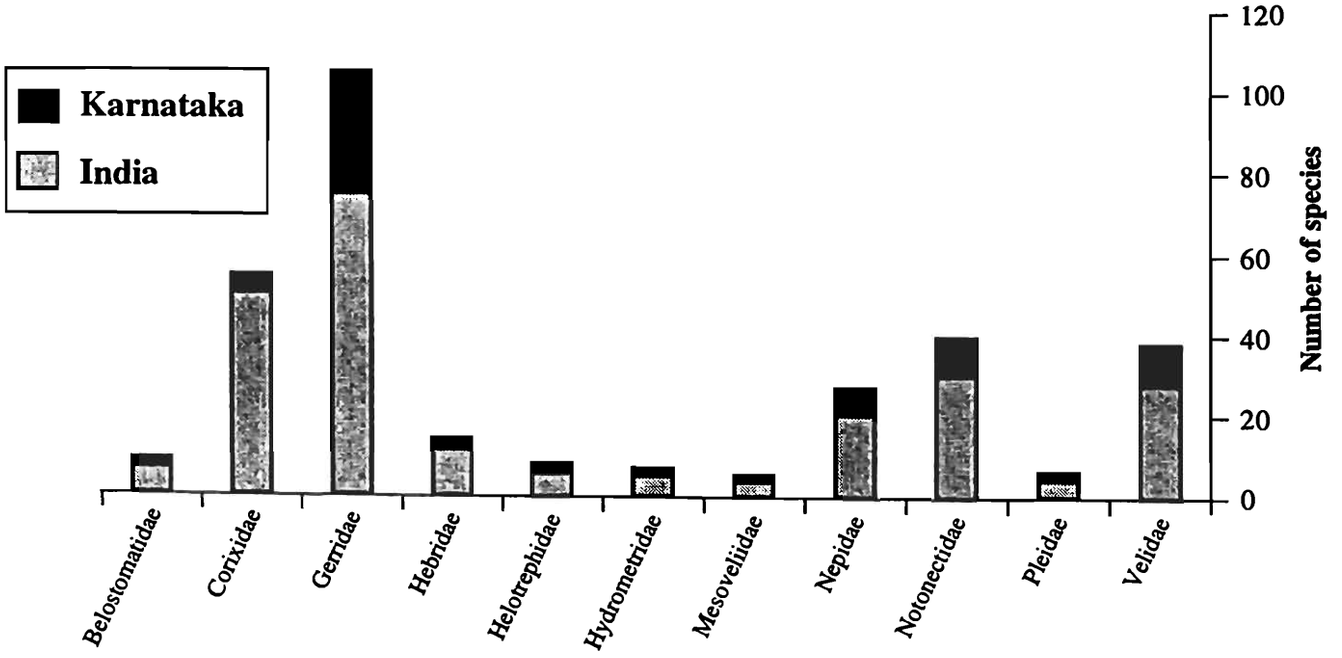

Fig. 1. Distribution of Species of aquatic & semi-aquatic bugs.

Though Karnataka ranks first in total wetland area availability (Anonymous, 1990), the number of species so far reported (67) is less than the neighbouring state, Tamilnadu (95) that ranks 8-th in India. The study forms the authentic report of all the five families of Gerromorpha so far known from India, from this state. Out of 3000 species of insects reported to occur in Indian freshwater habitats (Alfred and Nandi, 2001), the aquatic and semi aquatic bugs constitute 9%. The comparative distribution of aquatic and semi-aquatic bugs is given in the Figure 1. The present report of 67 species of water bugs belonging to 12 families from Karnataka constituting 25% of Indian occurrence reiterates the necessity to explore the group intensively. Since the aquatic and semi aquatic groups of insects are over all indicators of long-term environmental conditions and constitute integral components of almost all freshwater communities, inventorisation of aquatic insect resources forms a high priority area.

SUMMARY

A checklist of Aquatic and semi-aquatic Heteroptera of Karnataka State comprising of 40 genera and 67 species accommodated under 12 families is provided.

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Rec. zool. Surv. India : **102** (Part 1–2) : 73-76, 2004

CHECK-LIST OF MECOPTERA FROM INDIA

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INTRODUCTION

The order Mecoptera includes the insects, which are commonly known as scorpion flies. These insects are recognized on the presence of upturning of terminal abdominal segments like scorpion. They have beak like prolongations of head and often maculated wings. The adults are omnivorous and feed on nectar, pollens, petals, fruits, mosses and small insects. They are also known as hanging flies, because some species of *Bittacus,* which hang from the vegetation with their front legs and catch small insects they prey on in their hind legs.

Today, the order Mecoptera in the world is represented by about 500 species, which is one-hundredth of one % of living species, but in Permian period, they accounted for more than 40% of known fossils. They are among the oldest holometabolous insects dating from the Lower Permian 250 million years ago. All the known species of order Mecoptera belong to nine families, of which, 23 species belonging to 2 genera under two families viz., Bittacidae and Panorpidae are recorded from India (Penny and Byers,1979). They are relatively more paleaerctic in distribution. Out of 23 species, 20 are confined to India and three species i.e. *Bittacus henryi, Neopanorpa effusa* and *N. nipalica* are also distributed in Sri Lanka, Bhutan and Nepal respectively.

Only one suborder Eumecoptera is represented in India, which includes two families. The family Bittacidae has a cosmopolitan distribution in India and five species under genus *Bittacus* are known. The member of this genus are *Tipula* like insects having prehensile tarsi and very prominent bulbous swelling of male abdominal end. However, the family Panorpidae is represented by genus *Neopanorpa*, which includes 18 species from India. The species earlier described under genus *Panorpa* in India have been kept under the genus *Neopanorpa* (Rust and Byers,1976).

This order is poorly studied in India. During early period before 1950, Westwood (1846), Walker (1853), Gerstaecker (1885), Nav'as (1908, 1910, 1914, 1929, 1935), Needham (1909), Erbes-Petersen (1915), Kimmins (1928) and Crampton (1931) described 15 species, whereas after 1950, Cheng (1953), Penny (1969) and Rust and Byers (1976) described 8 species from India. But after 1976, no taxonomic work has been carried out in any region of India. Hence, the check-listing of all the species of the order has been taken up to undertake the detail study on the group subsequently. The list of Indian Mecoptera is given in Table 1.

Table 1. : List of species of Indian Mecoptera.

S.N.	Family / Species / Author / Year	Distribution
	Family : BITTACIDAE	
1	*Bittacus henryi* Kimmins 1928	India; Pondicherry; Tamil Nadu (Coimbatore) : Sri Lanka
2	*B. indicus* Walker 1853	E. India
3	*B. latipennis* Gerstaecker 1885	India; West Bengal (Darjeeling)
4	*B. nodosus* Rust and Byers 1976	India; Gujrat (Deesa)
5	*B. teraiensis* Penny 1969	India; Uttaranchal (Nainital)
	Family : PANORPIDAE	
6	*Neopanorpa appendiculata* (Westwood) 1846 = *Panorpa appendiculata* Westwood 1846	India; Tamil Nadu (Chennai, Nilgiri Hills)
7	*N. benaci* Nav'as 1935	India; West Bengal (Kurseong)
8	*N. contracta* Cheng 1953	India; West Bengal (Darjeeling)
9	*N. cornuta* Esben-Peterson 1915	India; Assam (N. Khasi Hills)
10	*N. denticulata* Rust and Byers 1976	India; Tamil Nadu (Nilgiri Hills); Kerala (Walayar Forests)
11	*N. echinata* Rust and Byers 1976	India; Tamil Nadu (Nilgiri Hills)
12	*N. effusa* (Nav'as) 1914 =*Panorpa effusa* Nav'as 1914	India ; Sikkim : Bhutan (Phuntsholing)
13	*N. fenestrata* (Needham) 1909 =*Panorpa fenestrata* Needham 1909	India; Assam
14	*N. flava* Esben-Peterson 1915	India; Sikkim
15	*N. gibbosa* Rust and Byers 1976	India; Himachal Pradesh (Shimla)
16	*N. hirsuta* (Crampton) 1931	India; Karnataka (Mysore); Kerala; Tamil Nadu (Nilgiri hills)

Table 1. : Cont'd.

S.N.	Family / Species / Author / Year	Distribution
17	*N. indica* Rust and Byers 1976	India; Tamil Nadu (Nilgiri Hills); Maharashtra (Mumbai)
18	*N. nipalica* (Nav'as) 1910	India; Sikkim : Nepal
19	*N. ocellaris* (Nav'as) 1908 =*Panorpa ocellaris* Nav'as 1908	India; Sikkim
20	*N. ochrura* Rust and Byers 1976	India; Himachal Pradesh (Shimla)
21	*N. salai* Nav'as 1929	India; Maharashtra (Khandala, Mumbai); Tamil Nadu (Coimbatore)
22	*N. sordida* (Needham) 1909 =*Panorpa sordida* Needham 1909	India; Assam (Khasi Hills)
23	*N. zebrata* Esben-Peterson 1915	India; Kerala (Periyar Dam)

SUMMARY

The present paper reports the list of scorpion flies and hanging flies (Order-Mecoptera) so far known from India.

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SOME NEW RECORDS OF MITES INFESTING STORED GRAINS IN KOLKATA AND ITS NEIGHBOURHOOD

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INTRODUCTION

Mites infesting stored grains are of twofold importance as not only they feed on the contents of the grains making those useless for human consumption and germination but also often they cause increase in humidity of the granaries, which in turn, invite fungi to infest the grains making those totally or partially un-markatable. In view of this importance, the stored product mites have received worldwide attention of the acarologists. So far as India is concerned, a reasonably good amount of work has been done on diverse aspects from different parts of India, *viz.*, Uttar Pradesh (Girish *et al.*; 1971, 1973; Lal *et al.*, 1973; Maurya & Jamil, 1981; Maurya *et al.*, 1983), Haryana (Mathur, 1979; Mathur & Minocha, 1981; Mathur & Mathur, 1983; Kumud, 1987; Kumud & Mathur, 1989; Mathur & Minocha, 1989), Punjab (Kapil & Bhanot, 1973); Bihar (Nahar & Gupta, 1980) and South India (Pillai, 1955, 1957; Nangia & ChannaBasavanna, 1989). Unfortunately, very little effort was made so far from West Bengal either to explore the stored grain mite fauna or to study their bio-ecological aspects barring Gupta *et al.* (1991) who reported some mites. Hence, it was thought desirable to take up study more intensively on stored product mites of West Bengal w.s.r. to granaires from in and around Kolkata during April 1998 to July 2001 and part of the result thereof reporting occurrence of 36 species representing 13 families, 24 genera under 3 orders infesting stored wheat and rice are presented in this paper. This includes 9 species of mites which are reported here for the first time infesting stored grains in West Bengal.

MATERIALS AND METHODS

Two granaries in two districts of West Bengal *viz.*, 1. F.C.I. godown at Brace Bridge, Kolkata and 2. F.C.I. godown at Dankuni, Hooghly were selected and samples of wheat and rice were collected therefrom at monthly intervals. Extraction of mites was achieved through a battery of Tullgren funnels using 40 W electric bulbs and mites were collected in 70% alcohol kept at collecting tubes fitted with the stems of the funnels. Studies and identification were done after mounting the mites first in 70% lactic acid and later in Heinze's medium.

RESULTS AND DISCUSSION

A total of 36 species belonging to 13 families and 24 genera under 3 orders are reported here and are listed in Table 1, according to their possible food habits.

Out of 36 species reported here, the occurrence of 9 species *viz.*, (1) *Acarus farris* (Oud.) (2) *Caloglyphus berlesei* (Michael), (3) *Tyrophagus longior* (Gervais), (4) *Tarsonemus granarius* Lindquist, (5) *Lepidoglyphus destructor* (Schrank), (6) *Gohieria fusca* (Oudemans), (7) *Blomia freemani* Hughes, (8) *Cunaxa setirostris* (Hermann), (9) *Pyemotes herfsi* Oudemans are reported here for the first time from West Bengal infesting stored grains.

Among these species, *Tyrophagus putrescentiae, Suidasia nesbitti* belong to grain feeding group. *Glycyphagus domesticus, Leiodinychnus krameri, Fuscuropoda marginata* belong to fungivorous group, *Cheyletus eruditus, Cheytetus malaccensis, Blattisocius tarsalis* and *Cunaxa setirostris* in most of the samples belong to predatory group. All these mites were common in both the types of grains.

The other species *viz.*, *Tyrophagus longior, Tyroborus lini, Tarsonemus granarius, Androlaelaps casalis* and *Lasioseius* sp. belong to groups having diverse food habits and their occurrence was rather scarce.

The following is the list of mites arranged as per their possible food habits.

A. Grain feeder

I. Family ACARIDAE

1. *Acarus siro* Linn.
*2. *Acarus farris* (Oudemans)
*3. *Caloglyphus berlesei* (Michael)
4. *Tyrophagus putrescentiae* (Schrank)
*5. *Tyrophagus longior* (Gervais)
6. *Tyrophagus* sp.
7. *Tyroborus lini* Oudemans
8. *Suidasia nesbitti* Hughes
9. *Suidasia medanensis* Oudemans
10. *Rhizoglyphus* sp.

B. Fungivorous

II. Family TARSONEMIDAE

*11. *Tarsonemus granarius* Lindquist
12. *Tarsonemus* sp.

III. Family GLYCYPHAGIDAE

13. *Glycyphagus domesticus* (De Geer)
*14. *Lepidoglyphus destructor* (Schrank)
*15. *Gohieria fusca* (Oudemans)
*16. *Blomia freemani* Hughes

IV Family UROPODIDAE

17. *Leiodinychus krameri* (Canestrini)
18. *Leiodinychus* sp.
19. *Fuscuropoda marginata* (Koch)
20. *Fuscuropoda* sp.

V Family TYDEIDAE

21. *Pronematus fleschneri* Baker

C. Predators

VI. Family CUNAXIDAE

*22. *Cunaxa setirostris* (Hermann)
23. *Cunaxa capreolus* (Berlese)

VII. Family RAPHIGNATHIDAE

24. Raphignathus *sp.*

VIII. Family CHEYLETIDAE

25. *Cheyletus eruditus* (Schrank)
26. *Cheyletus malaccensis* Oudemans
27. *Acaropsis sollers* Kuzin
28. *Cheyletus malayensis* Cunliffe

IX. Family ASCIDAE

29. *Blattisocius tarsalis* (Berlese)
30. *Lasioseius* sp.

X. Family LAELAPIDAE

31. *Androlaelaps casalis* (Berlese)

D. Dust associated mites (Granary dust)

XI. Family PYROGLYPHIDAE

32. *Dermatophagoides farinae* Hughes

33. *Dermatophagoides pteronyssinus* (Trouessart)

E. Granary insect associated mites

XII. Family PYEMOTIDAE

*34. *Pyemotes herfsi* Oudemans

F. Unknown Association

XIII. Family AMEROSEIIDAE

35. *Kleemania plumosus* (Oudemans)

36. *Kleemania bengalensis* Bhattacharya

*New report from stored grains in West Bengal.

The occurrence of mites belonging to Bdellidae, Eupodidae, Carpoglyphidae, though were recorded from other parts of the country but those could not be recorded during the present study.

SUMMARY

The present paper reports occurrence of 36 species of mites representing 13 families and 24 genera under 3 orders *viz.*, Prostigmata, Astigmata and Cryptostigmata, infesting stored wheat and rice in Kolkata and its neighbouring areas, of which the occurrence of 9 species are reported here for the first time infesting stored grains in West Bengal.

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FAUNAL DIVERSITY OF NAYACHAR, A NEWLY EMERGED ISLAND : ORTHOPTERA (ACRIDOIDEA)

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INTRODUCTION

The 'Nayachar Island' lies on the mouth of the river Hooghly near Haldia Port in the district Medinipur of West Bengal. The Island is spindle shaped with an area of about 29.38 sq. km. The Island is flat and only four feet above the river level. During monsoon major portion of the Island remains submerged at high tide for a few hours during full moon and days. The entire Island remains covered with three species of grassess, supporting the major fauna of this Island ecosystem.

Kirby (1914), Willemse (1968), Tandon (1973, 1975), Bhowmik (1984) and Hazra *et. al.*, (1993) contributed to the knowledge of Orthoptera from West Bengal. However, there is no record of grasshopper fauna from newly emerged Island. The present work, therefore, was initiated to make an inventory of Acridoidea of Nayachar Island. The study unravels a wealth of knowledge of grasshopper fauna based on 350 examples collected through different seasons of the year representing 15 species.

SYSTEMATIC ACCOUNT

Order ORTHOPTERA

Superfamily ACRIDOIDEA

Key to the families

1. Foveolae of the vertex contiguous, superior and forming the extremity of the fastigium; stridulatory mechanism absent ..... *Pyrgomorphidae*

— Foveole lateral or inferior, never forming the tip of the fastigium, stridulatory mechanism present ..... *Acrididae*

Family I PYRGOMORPHIDAE

Key to genera

1. Anterior margin of prosternum strongly reflexed and dialated.....*Chrotogonus* Serville, 1839
— Anterior margin of prosternum neither reflexed nor dialated. Tegmina long and narrow, body moderately slender .....*Atractomorpha* Saussure, 1862

Genus *Atractomorpha* Saussure, 1861

1. *Atractomorpha crenulata* (Fabricius)

1793. *Truxalis crenlatus* Fabricius. *Ent. Syst.*, **2** : 28.

1969. *Atractomorpha crenulata* : Kevan and Chen, *Zool. J. Linn. Soc.*, **48** : 187.

Material examined : Rest House site, Nayachar, 1(M), 2(F), 13.v.1992, A. K. Hazra; Hut site, Nayachar, 2(M), 1(F), 13.v.1992, A. K. Hazra; Rest House site, Nayachar, 1(M), 1(F), 19.viii.1993, A. K. Hazra; Meen Dweep 1(M), 16.xii.1992, A. K. Hazra; 1(M), 2(F), MIC site, Nayachar, Haldia, 12.viii.1999, A. K. Hazra.

Diagnosis : Medium size. Lateral pronotal lobe always with a membranous area near posterior margin; pronotal carinae ill defined; lateral margin of pronotal disc well-defined; divergent and somewhat convex in the metazone; tegmina pointed, extending for one-fourth of their length beyond the hind femora.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Bardhaman, Birbhum, Darjeeling, Haora, Hooghly, Jalpaiguri, Maldah, Medinipur, Murshidabad, Nadia, Purulia, 24-Parganas, West Dinajpur), Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Goa, Jammu & Kashmir, Kerala, Lakshadweep, Rajasthan, Orissa; BANGLADESH; BURMA; SUMATRA; PAKISTAN; SOUTH VIETNAM and SRI LANKA.

Remarks : This species is very thickly distributed and dominant in the Island.

Genus *Chrotogonus* Serville, 1892

2. *Chrotogonus (Chrotogonus) t. trachypterus* (Blanchard)

1836. *Ommexecha trachypterus* Blanchard, *Ann. Soc. Ent. France*, **5** : 618.

1959. *Chrotogonus (Ch.) t. trachypterus* : Kevan, *Publcoes Cult. Co. Diam. angola*, no. **43** : 147.

Material examined : 1(M), 2(F), Rest House site, Nayachar, Haldia, 18.xii.1992, A. K. Hazra; 1(M), Mean Dweep, Nayachar, Haldia, 18.xii.1992, A. K. Hazra; 1(F), Rest House, site, Nayachar, Haldia, 24.iii.1993, A. K. Hazra; 1(M), 1(F), Hut site, Nayachar, Haldia, 30.i.1996, A. K. Hazra.

Diagnosis : Hind wings hyaline or occassionally faintly tinged yellowish brown but never infumated or infuscated, apparantly always fairly well developed and always at least two-third as long as tegmina.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Birbhum, Darjeeling, Haora, Jalpaiguri, Kochbihar, Maldah, Medinipur, Purulia, 24-Parganas), Bihar, Madhya Pradesh, Orissa and Rajasthan; BANGLADESH; NEPAL and PAKISTAN.

Remarks : Found in dry condition on a bare sandy ground and we have found in summer seasons.

Family ACRIDIDAE

Key to the subfamilies

1. Prosternal process or tubercle usually absent 2
— Prosternal process or tubercle present 3
2. Stridulatory serration on inner side of hind femur present ..... Truxalinae
— Stridulatory serration on inner side of hind femur absent ..... Acridinae
3. Radial area of tegmen with a series of regular, parallel stridulatory veinlets .... Hemiacridinae
— Stridulatory veinlets of radial area of tegmen absent 4
4. Lower external lobe of hind knee with spine-like apex ..... Oxyinae
— Lower external lobe of hind knee with apex rounded, angular or subacute, but not spine-like 5
5. Mesosternal interspace closed ..... Tropidopolinae
— Mesosternal interspace mostly open 6
6. Dorsum of pronotum flat or weakly tectiform, with medium and lateral carinae linear (Linear carinae some times obliterated); male cercus with strongly compressed, lobiform or subacute, down curved apex ..... Eyprepocnemidinae
— Dorsum of pronotum of variable shape; lateral carinae, if present, not linear; male cercus variable, but not as mentioned above ..... Catantopinae

Subfamily GOMPHOCERINAE

Genus *Leva* Bolivar, 1909

3. *Leva cruciata* Bolivar

1914. *Leva cruciata* Bolivar, *Trab. Mus. Nac. Cienc. Nat. madr.* (ser. Zool.) **20** : 65.

1929. *Leva cruciata* : Uvarov, *Revue Suisse Zool.*, **36** : 450.

Material examined : 1(M), Hut site, Nayachar, Haldia, 17.xiii.1992, A. K. Hazra; 1(F), 2(M), Rest House site, Nayachar, 18.8.1993, A. K. Hazra; 2(M), 2(F), *Accacia* Plantation site, Nayachar, Haldia, 26.vii.1994, A. K. Hazra; 1(M), 1(F), MIC site, 26.vii.1995, A. K. Hazra.

Diagnosis : Pale yellowish, dull reddish brown; fastigium angularly produced, in female subtransverse; inferior foveolae indistinct; frontal costa of fastigium angular; dorsum of pronotum constricted, anteriorly truncate obtusely angulate posteriorly, median carina produced; lateral carinae excurved in prozona and metazona to form 'X' shaped marking.

Distribution : INDIA : West Bengal (Nayachar, Birbhum, Bardhaman, Maldah, Medinipur, Murshidabad, Nadia), Bihar, Karnataka, Tamil Nadu; Oriental region.

Remarks : The species is generally found in open fields amongst short grasses.

Subfamily ACRIDINAE

Key to genera

1. Size large; head long, conically ascending; fastigium of vertex extended much in front of the eyes, broad and truncated at apex; antennae ensiform ..... *Acrida* Linnaeus

— Size medium; head not ascending; fastigium broad or narrow, more or less rounded at the apex; antennae may or may not ensiform 2

2. Antennae always ensiform; lateral carinae at pronotum straight and parallel .... *Phlaeoba* Stål

— Antennae filiform; lateral carinae of pronotum not straight and parallel 3

3. Pronotum constricted in prozona; foveolae of fastigium narrowly trapezoid, visible from avobe ..... *Aiolopus* Fieber

— Pronotum not as above; foveolae of fastigium not visible from above 4

4. Pronotum with raised median crest, Pronotum 'X' marking always with anterior and posterior arms separate rounded usually to rectangular behind and with pale 'X' marks .... *Oedaleus* Fieber

— Pronotum with well marked crest and annulated behind; without 'X' marks.... *Trilophidia* Stål

Genus ***Acrida*** Linnaeus, 1758

4. ***Acrida exaltata*** (Walker)

1859. *Truxalis exaltata* Walker, *Ann. Mag. nat. Hist.*, **4**(3) : 222.

1954. *Acrida exaltata* : Dirsh, *Bull Soc. Faud. Ent.*, **38** : 149.

Material examined : 1(M), 2(F), Rest House site, Nayachar, Haldia, 18.viii.1993, A. K. Hazra; 1(M), 1(F), Hut site, Nayachar, Haldia, 31.x.1996, A. K. Hazra; 1(M), 2(F), Meen Dweep, 12.xii.1997, A. K. Hazra; 2(M), 1(F), MIC site, Nayachar, Haldia, 12.viii.1999, A. K. Hazra.

Diagnosis : Head conically ascending, basal part narrow; fastigium of vertex broad, laminate and truncate at extremity; transverse sulcus of pronotum present about the middle of pronotal disc;

male subgenital plate, in profile, comparatively long, with more elongated part, the upper margin with small projection, tegmen without pointed apex, a little produced beyond the hind knee; and wings slightly shorter than tegmina.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Birbhum, Bardhaman, Haora, Hugli, Jalpaiguri, Maldah, Medinipur, (Murshidabad), Arunachal Pradesh, Jammu & Kashmir, Kerala, Rajasthan, Tamil Nadu, Elsewhere : AFGHANISTAN; BANGLADESH; IRAN; SAUDI ARABIA and PAKISTAN.

Remarks : Found almost throughout West Bengal. It is found in grasses and cultivated fields.

Genus ***Aiolopus*** Fieber, 1853

5. ***Aiolopus thalassinus tamulus*** (Fabricius)

1798. *Gryllus tamulus* Fab. *Ent. Syst. Suppl.*, : 195.

1968. *Aiolopus thalassinus tamulus* : Hollis, *Bull. Br. Mus. nat. Hist.* (Ent.) **22**(1) : 347.

Material examined : 2(M), 3(F), Rest House site, Nayachar, Haldia, 18.viii.1993, A. K. Hazra; 3(M), 1(F), Hut side, Nayachar, Haldia, 25.ii.1999, A. K. Hazra; 1(M), 2(F), Hut site, Nayachar, Haldia, 5.1.1994, A. K. Hazra; 3(M), 4(F), MIC site, Nayachar, Haldia, 12.viii.1999, A. K. Hazra.

Diagnosis : Size medium; antennae as long as head and pronotum together; fastigium with forward angle more acute; foveole narrowly trapezoid, about twice as long as wide; frontal ridge gradually narrowing and almost angular towards fastigial end; sparsely punctured; pronotum somewhat saddle-shaped, posterior margin rounded; tegmina, longer, exceeding hind femur; posterior femur unicolourous, without any oblique fuscia or marking, posterior tibiae usually with red colouration in apical fourth and broadly separated from black band by a wide bluish grey band.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Bardhaman, Darjiling, Haora, Hooghly, Jalpaiguri, Maldah, Medinipur, Nadia, Purulia, 24-Parganas), Andaman & Nicobar Islands, Bihar, Delhi, Himachal Pradesh, Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu. Elsewhere : AUSTRALIA; BORNEO; BURMA; CHINA; JAPAN; MALAYA; PAKISTAN; SINGAPORE; SRI LANKA; SUMATRA and TAIWAN.

Remarks : *A. thalassinus tamulus* is thickly populated in the Island and occur almost all the districts of West Bengal.

Genus ***Oedaleus*** Fieber, 1853

6. ***Oedaleus abruptus*** (Thunberg)

1815. *Gryllus abruptus* Thunberg, *Mem. Aca. Sci. St. Peterb.* **5** : 233.

1981. *Oedaleus abruptus* : Ritchie, *Bull. Br. Mus. nat. Hist.* (Ent.) **42**(3) : 104.

Material examined : 1(M), 1(F), Rest House site, Nayachar, Haldia, 18.viii.1993, A. K. Hazra; 1(M), 2(F), Hut site, Nayachar, Haldia, 25.ii.1999, A. K. Hazra.

Diagnosis : Size small, fastigium of head almost flat; pronotum short, with incomplete, white cruciform marks, strongly carinated, and entire, the median sulcus visible on the sides of the pronotum before the middle, pointed behind; tegmina brown at base; wings hyaline at the base, with a broad black transverse band, curving inwards to the anal angle; hind tibiae red, with a yellow ring at the base.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Bardhaman, Birbhum, Darjeeling, Haora, Hooghly, Jalpaiguri, Kochbihar, Maldah, Medinipur, Murshidabad, Nadia, Purulia), Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh. Elsewhere : BANGLADESH; CHINA; PAKISTAN; SRI LANKA and THAILAND.

Remarks : This is a typical species of the genus with a wide distribution in South Asia and occurs in all type of vegetation cover.

Genus ***Phlaeoba*** Stål, 1860

7. ***Phlaeoba infumata*** Brunner

1893. *Phlaeoba infumata* Brunner, *Annali Mus. Civ. Stor. nat. Giacma Doria Geneva,* **13**(33) : 124.

1914. *Phlaeoba infumata* Kirby, *Fauna British India,* Orthopt. (Acrididae) : 103.

Material examined : 2(M), 1(F), Hut site, Nayachar, Haldia, 13.v.1992, A. K. Hazra; 1(F), 1(M), Rest House site, Nayachar, Haldia, 18.viii.1993, A. K. Hazra; 1(M), MIC site, Nayachar, Haldia, 26.iv.1994, A. K. Hazra; 1(M), 2(F), MIC site, Nayachar, Haldia, 12.viii.1999, A. K. Hazra.

Diagnosis : Uniform brownish testaceous; fastigium above with a continuous median carina extending along the head and pronotum; antennae ensiform, as long as head and pronotum; together; pronotum rugose, with a rudimentary carina on each side between median and lateral carina; tegmina and wings longer than abdomen; wings fusco-hyaline, infuscated towards extremity; hind tarsi reddish.

Distribution : INDIA : West Bengal (Nayachar, Darjeeling, Haora, Hoogly, Jalpaiguri, Kochbihar, Maldah, Murshidabad, Nadia, 24-Parganas, W. Dinajpur), Arunachal Pradesh, Bihar, Delhi, Himachal Pradesh, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu. Elsewhere : BANGLADESH; S. CHINA; MALAYA and YLINAN.

Remarks : This species generally found throughout the year in moist places.

Genus ***Trilophidia*** Stål, 1873

8. ***Trilophidia annulata*** (Thunberg)

1815. *Gryllus annulatus* Thunberg, *Mem. Acad. Sci. St. Petersb.* **5** : 234.

1965. *Trilophidia annulata* : Hollis, *Trans. R. ent. Soc. Lond.,* **117**(8) : 251.

Material examined : 2(M), 1(F), Hut site, Nayachar, Haldia, 13.v.1992, A. K. Hazra; 1(M), Rest House site, Nayachar, Haldiá, 19.viii.1993, A. K. Hazra; 1(M), 2(F), MIC. site, Nayachar, 31.i.1997, A. K. Hazra.

Diagnosis : Brown or grey with black markings, pubescent beneath; pronotum rugose, with a high median carina, forming two teeth in front, and with lateral carinae; tegmina grey, sometimes with two indistinct brown bands; wings yellow at the base, and brown or black beyond; hind tibiae brown with a pale band towards the base, and with a slight pale band beyond the middle.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Birbhum, Darjeeling, Haora, Hooghly, Jalpaiguri, Maldah, Medinipur, Murshidabad, Nadia, Purulia, 24-Parganas, Andhra Pradesh, Arunachal Pradesh, Bihar, Goa, Kerala, Karnataka, Orissa, Rajasthan, Tamil Nadu. Elsewhere : BANGLADESH; HONGKONG; JAPAN; JAVA; KOREA; MALAYA; MONGOLIA; PAKISTAN; SINGAPUR; SRI LANKA; SUMATRA and TAIWAN.

Remarks : It mainly occurs on bare ground adjoining Kuccha rodds.

Subfamily HEMIACRIDINAE

Genus ***Spathosternum*** Krauss, 1877

9. ***Spathosternum prasiniferum prasiniferum*** (Walker)

1871. *Heteracris (?) prasinifera* Walker, *Cat. Derm Salt. Brit. Mus.*, 5 suppl. : 65.

1936. *Spathosternum prasiniferum prasiniferum* : Tinkham, *Lingnan. Sci. J.*, **15** : 51.

Material examined : 1(M), 2(F), Hut site, Nayachar, Haldia, 13.v.1992, A. K. Hazra; 2(M), 3(F), Rest House site, Nayachar, Haldia, 19.viii.1993, A. K. Hazra; 1(M), MIC Site, Nayachar, Haldia, 26.vi.1994, A. K. Hazra; 2(M), (F), MIC site, Nayachar, Haldia, 11.viii.1999, A. K. Hazra.

Diagnosis : Broad blackish or dark green stripe running behind the lower part of the eyes and below the lateral carinae of the pronotum, central area of tegmen with a longitudinal black streak, generally almost obsolete in the male and well marked in the female, but very variable, sometimes being entire; tegmina reaching distal end of hind femora or slightly beyond it; wings well developed.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Bardhaman, Birbhum, Darjeeling, Haora, Hooghly, Jalpaiguri, Kochbihar, Maldah, Medinipur, Murshidabad, Purulia, 24-Parganas), Andhra Pradesh, Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Jammu and Kashmir, Maharashtra, Orissa, Rajasthan, Tamil Nadu. Elsewhere : S. E. CHINA; THAILAND and VIETNAM.

Remarks : It occurs almost throughout India and is associated with most grassy habitats. This species is thickly populated and dominant in the Island.

Subfamily OXYINAE

Genus ***Oxya*** Serville, 1831

Key to the species (male)

1. Cercus laterally compressed, hardly narrowing towards apex, bifurcate at apex .... *fuscovittata* (Marschall)

— Cercus conical narrowing towards apex and obtuse or truncate apically .....*hyla hyla* Serville

Key to the species (female)

1. Ventral surface of subgenital plate almost completely flat or weakly concave, appearing widen posteriorly ..... *fuscovittata* (Marschall)
2. Ventral surface of subgenital plate with two longitudinal ridges extending forwards from posterior margin ..... *hyla hyla* Serville

10. ***Oxya fuscovittata*** (Marschall)

1836. *Gryllus fuscovittatus* Marschall, *Ann. Wien. Mus. Vienna.*, **1** : 211.

1971. *Oxya fuscovittata* : Hollis, *Bull. Br. Mus. nat. Hist.* (Ent.), **26**(7) : 289.

Material examined : 2(M), 1(F), Rest House site, Nayachar, Haldia, 18.viii.1992, A. K. Hazra; 1(M), 1(F), Hut site, Nayachar, Haldia, 31.i.1996, A. K. Hazra; 2(M), 1(F), Rest House site, Nayachar, Haldia, 25.ii.1999, A. K. Hazra.

Diagnosis : Integument finely pitted and shiny; female large in size; cercus of male compressed and bifurcate, and ventral surface of subgenital plate, in female, almost completely that on weakly concave.

Distribution : INDIA : West Bengal (Nayachar, Bardhaman, Birbhum, Darjeeling, Haora, Hooghly, Jalpaiguri, Kochbihar, Maldah, Medinipur, Murshidabad, Nadia, 24-Parganas), Andhra Pradesh, Jammu & Kashmir, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh. Elsewhere : AFGHANISTAN; PAKISTAN.

11. ***Oxya hyla hyla*** Serville

1831. *Oxya hyla* Serville, *Annls Sci. nat.*, **22** : 287.

1971. *Oxya hyla hyla* : Hollis, *Bull. Br. Mus. nat. Hist.* (Ent.), **26**(7) : 282.

Material examined : 1(M), 2(F), Rest House site, Nayachar, Haldia, 18.viii.1993, A. K. Hazra; 1(M), 1(F), Meen Dweep, Nayachar, Haldia, 12.xii.1997, A. K. Hazra; 2(M), 1(F), MIC site, Nayachar, Haldia, 11.viii.1999, A. K. Hazra.

Diagnosis : Body finely regulose, shiny; size small; antennae longer than head and pronotum; supra anal plate trapezoidal with triangular apical projection; on both sides of supra anal plate

small tubercle present; cercus with subacute apex; subgenital plate in female with two longitudinal ridges extending forwords from posterior margin.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Birbhum, Bardhaman, Darjeeling, Haora, Hooghly, Jalpaiguri, Kochbihar, Maldah, Medinipur, Nadia, Purulia, 24-Parganas, W. Dinajpur), Andhra Pradesh, Assam, Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, Meghalaya, Tripura. Elsewhere : AFRICA; MADAGASCAR; NEPAL; SRI LANKA.

Remarks : This species is found in association with cultivated crops, vegetables, grasses etc. specially in moist areas.

Subfamily TROPIDOPOLINAE

12. ***Tristria pulvinata*** (Uvarov)

1921. *Tapinophyma pulvinata* Uvarov, *Ann. Mag. nat. Hist. London,* **7**(6) : 497.

1929. *Tristria pulvinata* : Uvarov, *Revue Suisse Zool.,* **29** : 559.

Material examined : 1(M), 1(F), Rest House site, Nayachar, Haldia, 19.viii.1993, A. K. Hazra; 2(M), Hut site, Nayachar, Haldia, 25.ii.1999, A. K. Hazra.

Diagnosis : Fastigium of vertex. Parabolic, moderately narrow, antennae filiform; prosternal tubercle curved backwards, almost square in cross section, strongly widened apically, with slightly concave surface; tegmen and wings extending upto the apex of subgenital plate or shorter; male cercus in apical third incurved, down curved and laterally flattened posterior margin of last abdominal tergite in male, with a triangular projection on either side of mid-line; female subgenital plate with an angular projection on the posterior margin on either side of mid line; male subgenital plate almost near, compressed knife-like.

Distribution : INDIA : West Bengal (Nayachar, Bardhman, Haora, Jalpaiguri, Nadia, Purulia, 24-Parganas), Assam, Bihar, Maharashtra, Tamil Nadu. Elsewhere : SRI LANKA.

Remarks : This species occurs in limited numbers in the Island.

Subfamily EYPREPOCNEMIDINAE

Genus ***Eyprepocnemis*** Fieber, 1853

13. ***Eyprepocnemis alacris alacris*** (Serville)

1839. *Acridium alacre* Serville, *Hist. nat. Ins. Orth,* 682.

1958. *Eyprepocnemis alacris alacris* : Dirsh, *Proc. R. ent. Soc. Lond,* (B) **27**(3-4) : 40.

Material examined : 2(M), 1(F), Rest House site, Nayachar, Haldia, 19.viii.1993, A. K. Hazra; 1(M), 1(F), MIC site, Nayachar, 25.ii.1999, A. K. Hazra; 1(M), Hut site, Nayachar, Haldia, 12.xii.1997, A. K. Hazra; 1(M), 2(F), MIC site, Nayachar, 12.viii.1999, A. K. Hazra.

Diagnosis : Concavity of fastigium of vertex distinct, with a low apical carinula, separating it from frontal ridge; pronotum above with a characteristic narrow dark spot; lateral carinae of pronotum converging forwards; prozona about as long as metazone; dark spots present on the wings, hind tibiae bluish-grey, with two whitish rings at the base and reddish apex and tarsus; male cercus gradually narrowing towards apex, incurved and downcurved.

Distribution : INDIA : West Bengal (Nayachar, Bardhaman, Birbhum, Darjeeling, Jalpaiguri, Maldah, Medinipur), Rajasthan, Tamil Nadu. Elsewhere : AFGHANISTAN; BANGLADESH; EAST PERSIA; PAKISTAN and SRI LANKA.

Remarks : This species is very thickly distributed in the Island.

Subfamily CATANTOPINAE

Genus ***Catantops*** Schaum

14. ***Catantops pinguis innotabilis*** (Walker)

1870. *Acridium innotabile* Walker, *Cat. Derm. Salt. Brit. Mus.*, **4** : 629.

1956. *Catantops pinguis innotabilis* : Dirsh, *Publcoes Cult. Co. Diam. Angola,* **28** : 1-150.

Material examined : 1(M), 1(F), Rest House site, Nayachar, Haldia, 18.viii.1993, A. K. Hazra; 2(M), 1(F), Hut site, Nayachar, Haldia, 12.xii.1997, A. K. Hazra; 1(M), MIC site, Nayachar, Haldia, 25.ii.1997, A. K. Hazra; MIC site, Nayachar, Haldia, 11.viii.1999, A. K. Hazra.

Diagnosis : Antennae shorter than head and pronotum together; prosternal tubercle thick, cylindrical, at base weakly compressed with rounded apex; lateral lobe of pronotum without coloured pattern; tegmina exceeds the hind knee by more than the length of pronotum; external disc of hind femur without the black median spot below the upper carinula; male cercus more upcurved, with more broadened apex and more projecting upper apical angle.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Darjeeling, Kochbihar, Medinipur, 24-Parganas), Arunachal Pradesh, Assam, Himachal Pradesh, Kerala, Orissa, Tamil Nadu. Elsewhere : JAVA; INDO-CHINA; MALAYA; NEW GUINEA; PHILIPPINES; SRI LANKA; SUMATRA; THAILAND; YUNAN.

Remarks : This species is rather limited in distribution.

Subfamily CYRTACANTHACRIDINAE

Genus ***Cyrtacanthacris*** Walker, 1870

15. ***Cyrtacanthacris tatarica*** (Linnaeus)

1758. *Gryllus locusta tartaricus* Linnaeus, *Syst. nat. (10th ed.)* : 432.

1923. *Cyrtacanthacris tatarica* Uvarov, *Bull. ent. Res.*, **14** : 39.

Material examined : 1(M), 2(F), Rest House site, Nayachar, Haldia, 19.viii.1993, A. K. Hazra; 2(M), Hut site, Nayachar, Haldia, 25.vi.1999, A. K. Hazra.

Diagnosis : Size large; general colouration yellow with brown and white; occiput mostly with on each side a darker coloured stripe, cheeks sometimes with indefinite darker spots or stripes; pronotum above on both sides with a broad velvety blackish brown band; tegmina with dense and thick reticulation and transverse oblique fasciae or irregular spots; wings hyalinous at the base somewhat yellowish, hind tibiae from below yellowish brown or yellowish hind tarsi red or brown.

Distribution : INDIA : West Bengal (Nayachar, Bankura, Maldah, Medinipur, Purulia), Andhra Pradesh, Bihar, Himachal Pradesh, Kerala, Orissa, Tamil Nadu. Elsewhere : AFRICA (except N. AFRICA) and SAHARA; SEYCHELLES; SUMATRA.

Remarks : The species is generally found in thick forest and sometimes also in the cultivated zones especially in mature paddy and maize fields.

SUMMARY

Fifteen species of grasshoppers belonging to 2 families and 14 genera collected from the Nayachar Island, Haldia, are recorded for the first time in this Communication.

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Rec. zool. Surv. India : **102** (Part 1–2) : 97-103, 2004

STUDIES ON SPIDER FAUNA OF COASTAL REGION OF INDIA : DESCRIPTION OF TWO NEW SPECIES OF *PARDOSA* KOCH (ARANEAE : LYCOSIDAE) FROM THE COASTAL REGION OF SUNDARBANS, WEST BENGAL (PART–1)

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INTRODUCTION

Indian coastal region is mainly divisible into three zones *viz.*, Eastern, Western and Southern Zones. The Souther zone includes the coastal areas of Sundarbans, Orissa and Tamil Nadu. The Western Zone includes the coastal areas of Kerala, Karnataka, Maharashtra, Gujarat and Goa. Thirdly Andaman & Nocobar Island is included under Southern Zone.

Although there are several published papers on the spiders of coastal regions of India, (Tikader, 1977 & 1980; Tikader & Malhotra, 1980; Tikader & Biswas, 1981; Tikader, 1982; Sethi & Tikader, 1988; Majumder & Tikader, 1991; Biswas & Biswas, 1992; Biswas, 1995; Biswas & Majumder, (1996) but so far as the spider fauna of Sundarban coastal region is concerned, the published information is indeed scanty. Since wolf spiders are important bio-control agents specially of insect pests of agricultural crops and as this group is not adequately explored from Sundarban region, survey of this group in different crop fields were undertaken. The present paper deals with a description of two new species of *Pardosa* Koch.

SYSTEMATICS

Genus ***Pardosa*** Koch

1848. *Pardosa* Koch, *Die Arachnide,* **14** : 100.

Diagnosis : Cephalic region raised and almost entirely occupied by the two posterior rows of eyes. Chelicerae much smaller than most of the lycosids. Eyes in three rows, anterior row of eyes smaller, posterior row larger. Legs relatively long and are provided with long spines. Metatarsus IV as long as patella plus tibia. Tibia I provided with 3 pairs of ventral spines. Median septum of epigynum almost weakly developed at the anterior end. Median apophysis placed more centrally.

Type species : *Pardosa stristipes* Koch

Distribution : Asia, America and Europe.

Key to the species

1. Posterior end of the carapace wider; inner margin of the chelicera provided with 3 similar teeth and the outer margin with one large tooth ..... *suchismitae.*
– Posterior end of carapace narrower; inner margin of the chelicera provided with one tooth and the outer margin with 3 smaller teeth ..... *debolinae.*

1. ***Pardosa suchismitae*** sp. nov.

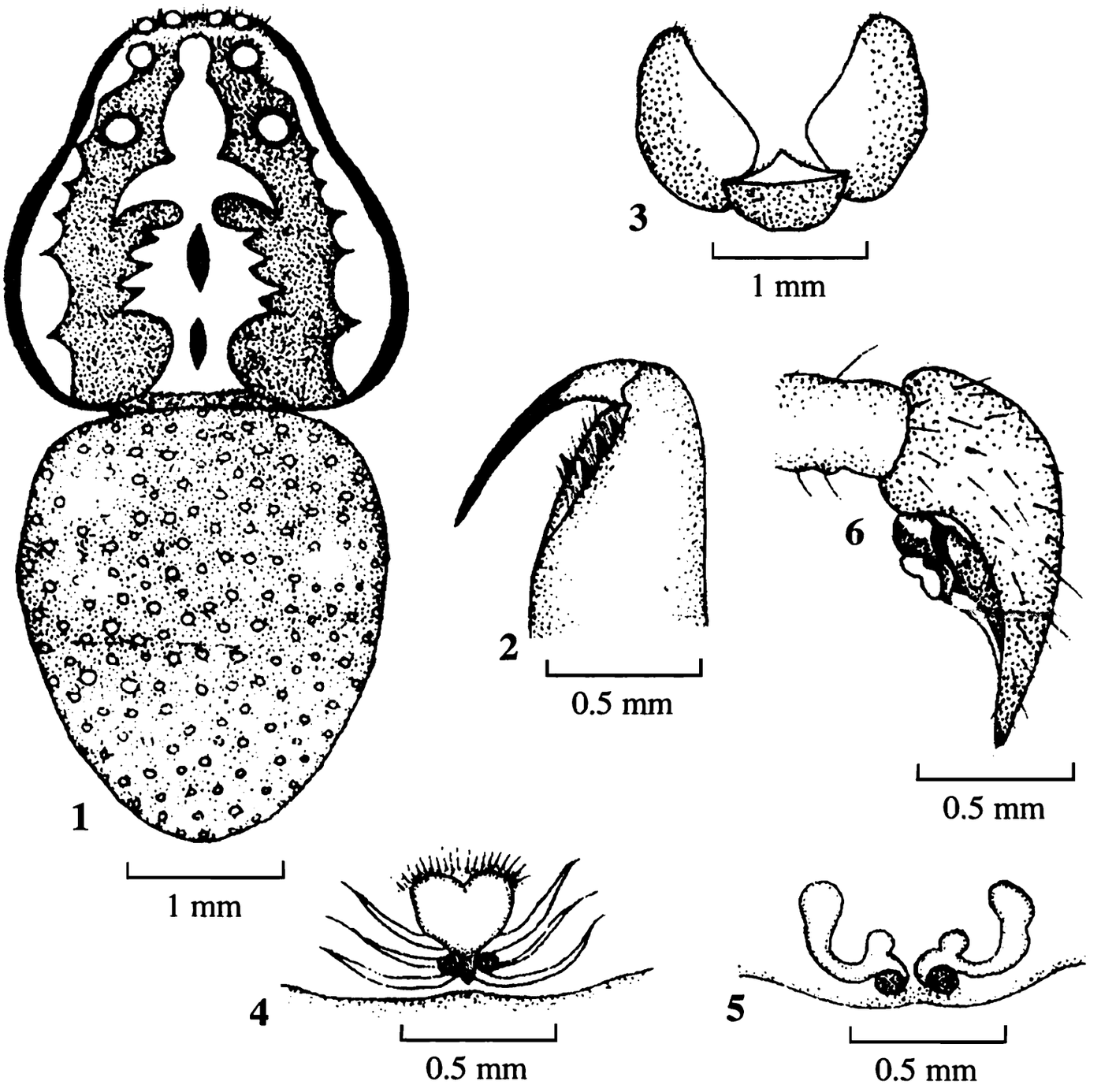
(Figs. 1-6)

General : Chephalothorax and legs redish brown, chelicerae deep brown, chelicerae deep brown; abdomen blackish in colour. Total length 5.30 mm. Carapace 2.60 mm. long and 2.10 mm. wide; abdomen 2.70 mm. long and 2.00 mm. wide.

Cephalothorax : Carapace longer than wide, anteriorly narrowed but wider posteriorly; cephalic region slightly raised. Anterior margin of the cephalothorax straight with anterolateral corner, raised and conical with a few blackish hairs. Thoracic region provided with two deeply distinct longitudinal fovea. Cephalothorax decorated with whitish patches one present mid-longitudinally and other two laterally. Eyes pearly-white encircled by black patches. Anterior row of eyes slightly recurved almost similar in structure; median eyes separated from each other. Eyes of the third row slightly larger than the second row. No prominent black field present in the ocular area (Fig. 1). Ocular quadrate longer than wide; wider posteriorly and narrowed anteriorly. Sternum heart-shaped pointed behind, covered with fine pubescence. Chelicerae not so strong, longer than wide, deep brown in colour. Inner margin provided with 3 similar teeth and outer margin with one tooth (Fig. 1). Maxillae longer than wide, redish brown in colour, anterior end narrowed and scopulated, posterior end wider. Labium wider than long, whitish and pointed anteriorly (Fig. 3). Legs relatively short but strong enough, covered by hair and spines. Tibia with ventral spines; tarsal scopulae distinct. Leg formula 2 1 3 4 and the measurements (in mm) as in Table-1. Tibia of the male palp without retrolateral apophysis, embolus narrowed and elongated. Cymbium long and cylinder without basal spur, tegulum more or less convex, provided with tegular apophysis (Fig. 6).

Table 1. Measurements (in mm) of different parts of legs of *Pardosa suchismitae* sp. nov.

Leg	Femur	Patella & Tibia	Metatarsus	Tarsus	Total
I	2.70/2.70	3.00/3.00	2.10/2.10	1.15/1.15	8.95/8.95
II	3.05/3.05	3.30/3.30	2.20/2.20	1.25/1.25	9.80/9.80
III	2.20/2.20	2.65/2.65	2.00/2.20	1.05/1.05	7.90/8.10
IV	2.05/2.05	2.20/2.20	1.75/1.75	0.90/0.90	6.90/6.90



Figs. 1-6. : Illustration of ***Pardosa suchismitae*** sp. nov. 1. Dorsal view of female, legs emitted. 2. Chelicera showing arrangement of teeth. 3. Maxillae and labium, (ventral view). 4. Epigyne, (ventral view). 5. Internal genitalia, (dorsal view). 6. Male palp, (lateral view).

Abdomen : Oval in shape, slightly longer than wide, conical posteriorly. Dorsum without ornamentatio, provided with a number of white spots, covered by fine pubescence. Venter pale yellow in colour. Epigyne as rounded plate with distinct copulatory openings (Fig. 4). Internal genitalia provided with elongated copulatory tubes bent upwards, divisible into two parts (Fig. 5).

Type locality : HOLOTYPE : I ♀, Reg. No. 5474/18 N.C., Z.S.I. (H.Q) Hasnabad proper (near Rly. Stn.), P. S. Hasnabad, Dist. North 24 Parganas, West Bengal, India, 15.10. 1993, coll. S. C. Majumder. PARATYPES : 6 ♀, Reg. No. 5475/18. N.C., Z.S.I. (H.Q) Chigrikhali, P.S. Hingalgunj,

Dist. North 24 Parganas, West Bengal, India. 14.1.1994, coll. S. C. Majumder. 2 ♀, Bakra, P.S. Hingalgunj, Dist. North 24-Parganas, West Bengal, India. 13.1.1995, coll. S. C. Majumder. 2 ♀, Kalitala, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 21.2.1995, coll. S. C. Majumder. 4 ♀, Katakhali, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 25.2.1995, coll. S. C. Majumder. 2 ♀, Dauthpur, P.S. Sandeshkhali, Dist. North 24 Parganas, West Bengal, India, 18.1.1994, coll. N. P. Debnath. ALLOTYPES : 1 ♀, Reg. No. 5476 18, N. C., Z.S.I. (H.Q) Sibtala, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 26.2.1995, coll. S. C. Majumder. 1 ♂, Kumirmari, P.S. Gosaba, Dist. South 24 Parganas, West Bengal, India. 20.1.1994, coll. D. B. Ranamagor.

Distribution : INDIA : Coastal zone of Sundarban (Hasnabad, Hingalgunj, Sandeshkhali, Dist. North 24 Parganas; Gosaba Dist. South 24 Parganas, West Bengal.

Remarks : This species resembles to *Pardosa sngosa* Tikader and Malhotra in general appearence but differs from it in the following particulars :

(1) Maxilla and labium narrower anteriorly whereas in *Pardosa sangosa* Tikader & Malhotra maxilla and labium broader anteriorly.

(2) Chelicerae not so strong, inner margin provided with 3 similar teeth and the outer margin with one large tooth whereas in *P. sangosa* Tikader & Malhotra chelicera strong enough, inner margin provided with 4 dissimilar teeth and the outer margin with 2 small teeth.

(3) Epigyne and internal genetalia structurally different.

Etymology : The species is named after the name of author's younger daughter Suchismita who helped this study.

2. ***Pardosa debolinae*** sp. nov.

(Figs. 7-12)

General : Cephalothorax and legs redish brown; abdomen dark brown in colour. Total length 5.50 mm. Carapace 2.50 mm long and 1.80 mm wide; abdomen 3.00 mm long and 1.80 mm wide.

Cephalothorax : Carapace longer than wide, anterior and posterior end narrower but wider at the middle portion, covered with fine pubescence. Anterior margin of the cephalothorax straight with the anterolateral corner raised and conical without blackish hair. Cephalothorax decorated with a whitish patch extends from the base of the cephalothorax to the middle of the third eyes. Two distinct fovea present at the middle of the cephalothorax. Eyes pearly white encircled by black patches at the bases. Anterior row of eyes slightly procurved, medians slightly smaller than laterals. The second and third eyes more or less similar in structure. Ocular quadrate wider than long (Fig. 7). Sternum heart-shaped pointed behind, covered with fine pubescence. Chelicerae not

so strong, longer than wide, deep brown in colour. Inner margin provided with one tooth, outer margin with 3 similar teeth (Fig. 8). Maxillae longer than wide redish brown in colour, anterior end narrowed and slightly curved. Labium wider than long, whitish and pointed anteriorly (Fig. 9). Legs relatively short but strong enough, covered with hair and spines. Tibia with ventral spines; tarsal scopulae distinct. Leg formula 4 3 2 1 and the measurements (in mm) as in table-2. Tibia of the male palp without latrolateral apophysis, embolus narrowed not elongated. Cymbium long blunt anteriorly without basal spur, tegulum more or less convex provided with flower like tegular apophysis (Fig. 12).

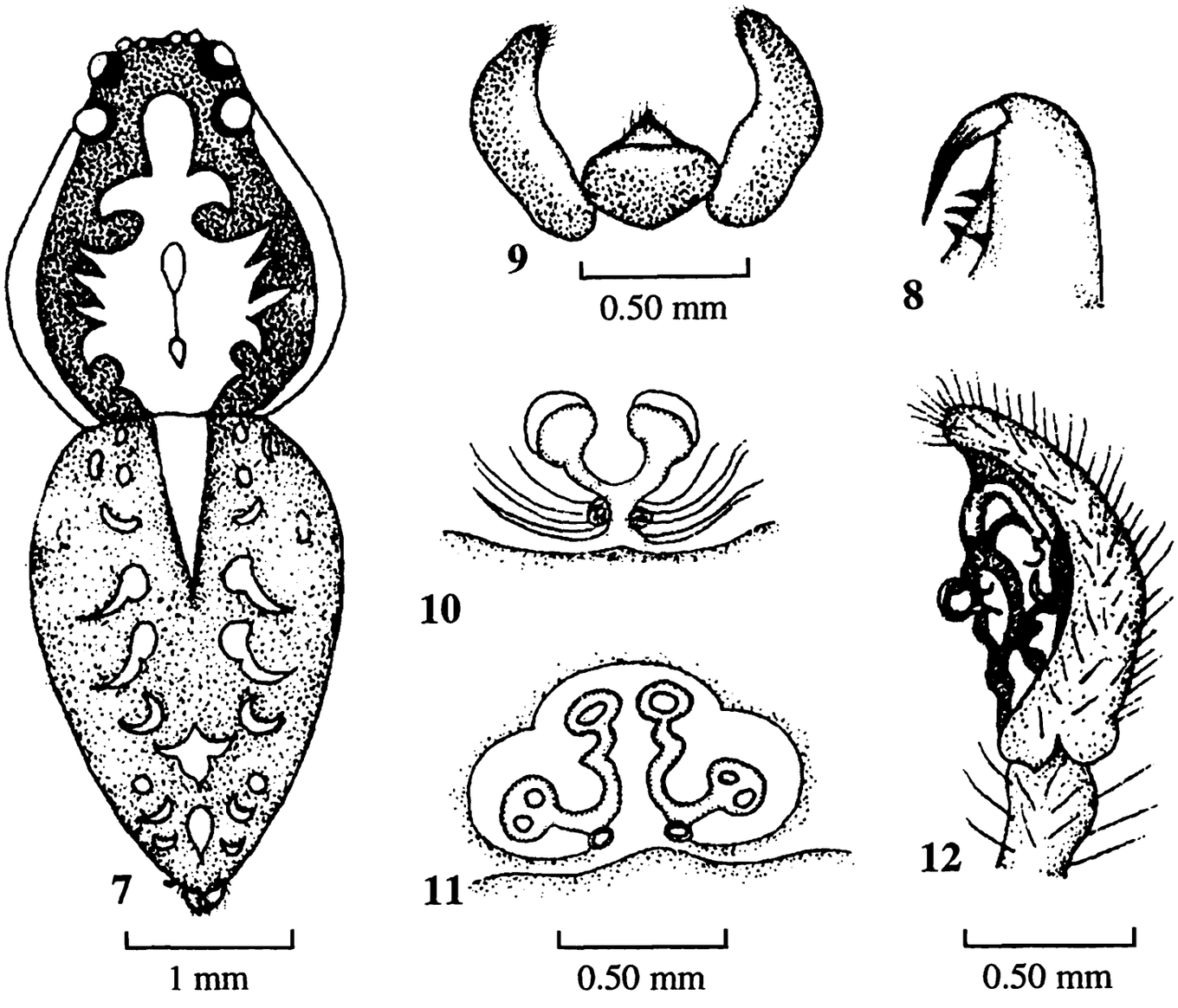
Table 2. Measurements (in mm) of different parts of legs of *Pardosa suchismitae* sp. nov.

Leg	Femur	Patella & Tibia	Metatarsus	Tarsus	Total
I	2.60/2.60	2.75/2.75	2.10/2.10	1.05/1.05	8.50/8.50
II	2.65/2.65	2.80/2.80	2.15/2.15	1.10/1.10	8.70/8.70
III	3.02/3.02	3.35/2.35	2.25/2.25	1.20/1.20	9.82/9.82
IV	3.05/3.02	3.40/3.40	2.30/2.30	0.25/0.25	10.00/9.97

Abdomen : Oval in shape, longer than wide, covered with fine pubescence, narrowed posteriorly but wider anteriorly. Dorsum decorated with a number of white patches arranged laterally (Fig. 7). Venter uniformly coloured. Epigyne as a bifurcated dumble shaped tube with distinct copulatory tubes bent downwards, divisible into two parts (Fig. 11).

Type locality : HOLOTYPE : 1 ♀, Reg. No. 5477/18. N.C., Z.S.I. (H.Q) Bankra, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 13.1.1994, coll. S. C. Majumder. PARATYPES : 1 ♀, Reg. No. 5478/18. N.C., Z.S.I. (H.Q) Chhotomollakhali, P.S. Gosaba, Dist. South 24 Parganas, West Bengal, India. 18.1.1994, coll. D. B. Ranamagor. 1 ♀, Monipur, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 14.1.1994, coll. S. C. Majumder. 1 ♀, Madhabkati, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 22.2.1995, coll. S. C. Majumder. 1 ♀, Sarupkati, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 26.2.1995, coll. S. C. Majumder. ALLOTYPES : 1 ♂, Reg. No. 5479/18, N.C., Z.S.I. (H.Q) Hemnagar, P.S. Hingalgunj, Dist. North 24 Parganas, West Bengal, India. 14.1.1994, coll. S. C. Majumder. 1 ♂, Sandeshkhali Bazar, P.S. Sandeshkhali, Dist. North 24 Parganas, West Bengal, India. 16.1.1994, coll. S. C. Majumder. 1 ♂, Dayapur, P.S. Gosaba, Dist. South 24 Parganas, West Bengal, India. 17.1.1994, coll. N. P. Debnath.

Distribution : INDIA : Coastal zone of Sundarban (Hingalgunj, Sandeshkhali, Dist. North 24 Parganas; Gosaba, Dist. South 24 Parganas), West Bengal.



Figs. 7-12. : Illustration of ***Pardosa debolinae*** sp. nov. 7. Dorsal view, legs emitted. 8. Chelicera showing arrangement of teeth. 9. Maxillae and labium, (ventral view). 10. Epigyne, (ventral view). 11. Internal genitalia, (dorsal view). 12. Male palp, (lateral view).

Remarks : This species resembles to *Pardosa sumatrana* Thorell in general appearence but differs from it in the following particulars :

1) Anterior row of eyes procurved, medians not longer than the laterals whereas in *P. sumatrana* Thorell the anterior row of eyes straight. The medians larger than the laterals.

2) Maxillae and labium longer and narrowed anteriorly, whereas in *P. sumatrana* Thorell maxillae and labium broader anteriorly and not so longer.

3) Epigyne structurally different.

Etymology : This species is named after the name of author's elder daughter Debolina who helped the study.

SUMMARY

The present paper deals with descriptions and illustrations of two new species of *Pardosa* Koch, *viz.*, (i) *Pardosa suchismitae* sp. nov. (2) *Pardosa debolinae* sp. nov. collected from the coastal region of Sundarban, West Bengal, India.

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STUDIES ON SPIDER FAUNA OF COASTAL REGION OF INDIA : OBSERVATIONS ON POPULATION FLUCTUATION OF SPIDERS AND THEIR ROLE IN BIOLOGICAL CONTROL OF INSECT PESTS ON PADDY FIELDS OF SUNDARBAN COASTAL REGION, WEST BENGAL (PART–2)

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INTRODUCTION

Reports on population fluctuation of spiders in Indian coastal regions are very scanty. In Indian sub-continent, various workers *viz.*, Chatterjee & Dutta (1979), Alam *et al.* (1981), Choudhury & Pal (1984), Biswas (1990), Kamal *et al.* 1990, Majumder & Tikader (1991), Kamal *et al.* (1992), Biswas *et al.* (1993) and Biswas *et al.* (1995) worked on the population density of spiders only in the paddy fields.

With a view to enhancing our existing knowledge this field study was undertaken in Sundarban coastal eco-system during 1998 to 1999. Collection and observation of insect pests and spider population were carried out in different eco-systems of Sundarban coastal region.

The present paper deals with the population fluctuation of 30 species of spiders in Sundarban coastal eco-system *viz.*, T. Aman-paddy fields, wild bushes, mangrove vegetation and river beds in relation to their predation on the insect pests in the surrounding areas. Probable impact of the present observations towards biological control of insect pests in T. Aman-paddyfields has been discussed.

MATERIAL AND METHODS

The spider population and their abundance were studied in the paddy fields (T. Aman) associated with wild bushes, mangrove vegetation and river beds of Canning, Gosaba, Basanti and Sagar Island (The study area includes a total of four areas having different host plants and adjacent river beds).

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Spiders were collected from the selected four areas from different host plants simultaneously by hand picking and by standard hand sweeping net (129 cm in diameter). The random sampling was done by making 100 sweeps in each sampling site at bimonthly intervals from 6 A.M. to 9 A.M. during June 1998 to May 1999.

The collected spider specimens were anaesthetised, killed in a killing jar and finally were preserved in Oudman's preservative (90 parts 70% ethyl alcohol, 5 parts glycerine and 5 parts glacial acetic acid) in glass vials. The specimens were identified placing them in a petri dish containing ethyl alcohol under a binocular microscope. Each specimen was preserved in a single vial. The preserved specimens of spiders were identified upto species level.

OBSERVATIONS, RESULTS AND DISCUSSION

The present study includes a total of 30 species available in different hosts/habitats *viz.*, paddy fields, adjacent wild bushes, mangrove vegetation and river beds of Sundarban coastal region. The occurrence of spiders of 574 examples of 16 species were recorded in paddy fields, 394 examples of 16 species on adjacent wild bushes, 194 examples of 11 species on mangrove vegetation and 42 examples of 5 apecies on adjacent river beds during June, 1998 to December, 1998 (Table 1).

In the further study during January 1999 to May 1999, the collection represented 300 examples of 17 species in paddy fields (ratoon), 438 examples of 19 species in adjacent wild bushes, 189 examples of 18 species in mangrove vegetation and 20 examples of 3 species in river beds (Table 2).

The species *viz., Leucauge decorata* (Blackwall), *Pardosa sumatrana* Thorell, *Neoscona mukerjei* Tikadar, *Marpissa mondali* Tikader, *Cheiracanthium himalayensis* Gravely were higher in number in the paddy fields from June 1998 to December 1998 than in the other habitats like adjacent wild bushes, mangrove vegetation and river beds (Table 1). Thereafter, the population gradually decreased in the paddy fields from January 1999 to May 1999 but again increased in the wild bushes and mangrove vegetation (Table 2). The species *viz., Lycosa chaperi* Simon, *Lycosa choudhuryi* Tikader *Pardosa annandelei* Gravely, *Pardosa sumatrana* Thorell and *P. birmanica* Simon were found in the river beds but their occurrence was never found in the mangrove vegetation from June 1998 to December 1998 (Table 1).

The spider population belonging to the genera *viz., Argiope, Neoscona, Leucauge, Larinia, Cyrtophora, Tetragnatha, Oxyopes, Marpissa, Zygoballus, Phidippus* and *Cheiracanthium* were never found in the river beds from June 1998 to May 1999 (Figure 1 and Table 2). The species *Pardosa sumatrana* Thorell was found in good number in paddy fields (rice plants and ratoon) from June 1998 to May 1999 (Table 1 and Table 2). *Marpissa bengalensis* Tikader and *Neoscona elliptica* Tikader and Ball were abundant in wild bushes from June 1998 to December 1998, but scarce in the wild bushes during January 1999 to May 1999 (Table 1 and Table 2).

Table 1. List of the Spiders and their abundance in different host/habitats in Sundarban coastal eco-system during the month of June, 1998 to December, 1998.

Name of the species	Family	Paddy field (Rice plants)	Border weeds/ wild bushes	Adjacent mangrove vegetation	River beds
Argiope pulchella Thorell	Araneidae	12	4	3	0
Argiope sp.	"	18	8	2	0
Neoscona mukerjei Tikader	"	15	10	2	0
Neoscona sp.	"	20	15	17	0
Leucauge decorata (Blackwall)	"	25	5	1	0
L. tessellata (Thorell)	"	5	3	1	0
Leucauge sp.	"	7	4	0	0
Cyrtophora cicatrosa (Stoliczka)	"	12	5	1	0
C.bidenta Tikader	"	10	4	2	0
Cyrtophora sp.	"	21	12	7	0
Larinia sp.	"	10	13	9	0
Tetragnatha sp.	Tetragnathidae	15	12	5	0
Lycosa chaperi Simon	Lycosidae	5	2	0	8
L. choudhuryi Tikader & Malhotra	"	2	1	1	4
Lycosa sp.	"	15	10	2	5
Hippasa sp.	"	11	15	9	2
Pardosa annandalei	"	2	1	0	4
Gravely					
P.birmanica Simon	"	12	1	0	2
P.sumatrana Thorell	"	20	2	0	4
Pardosa sp.	"	40	20	5	10
Arctosa sp.	"	31	17	12	3
Oxyopes shweta Tikader	Oxyopidae	10	6	2	0
O.sunandae Tikader	"	11	5	2	0
Oxyopes sp.	"	45	27	15	0

Table 1. *(Cont'd.).*

Marpissa bengalensis Tikader	Salticidae	10	6	2	0
M. mondali Tikader	"	12	5	2	0
Marpissa sp.	"	41	32	10	0
Plexippus sp.	"	32	27	5	0
Phidippus sp.	"	28	30	13	0
Zygoballus sp.	"	35	21	16	0
Cheiracanthium himalayensis Gravely	Clubionidae	10	4	1	0
Cheiracanthium sp.	"	29	25	8	0
Number of Examples		571	352	154	42
Number of species		16	16	11	5

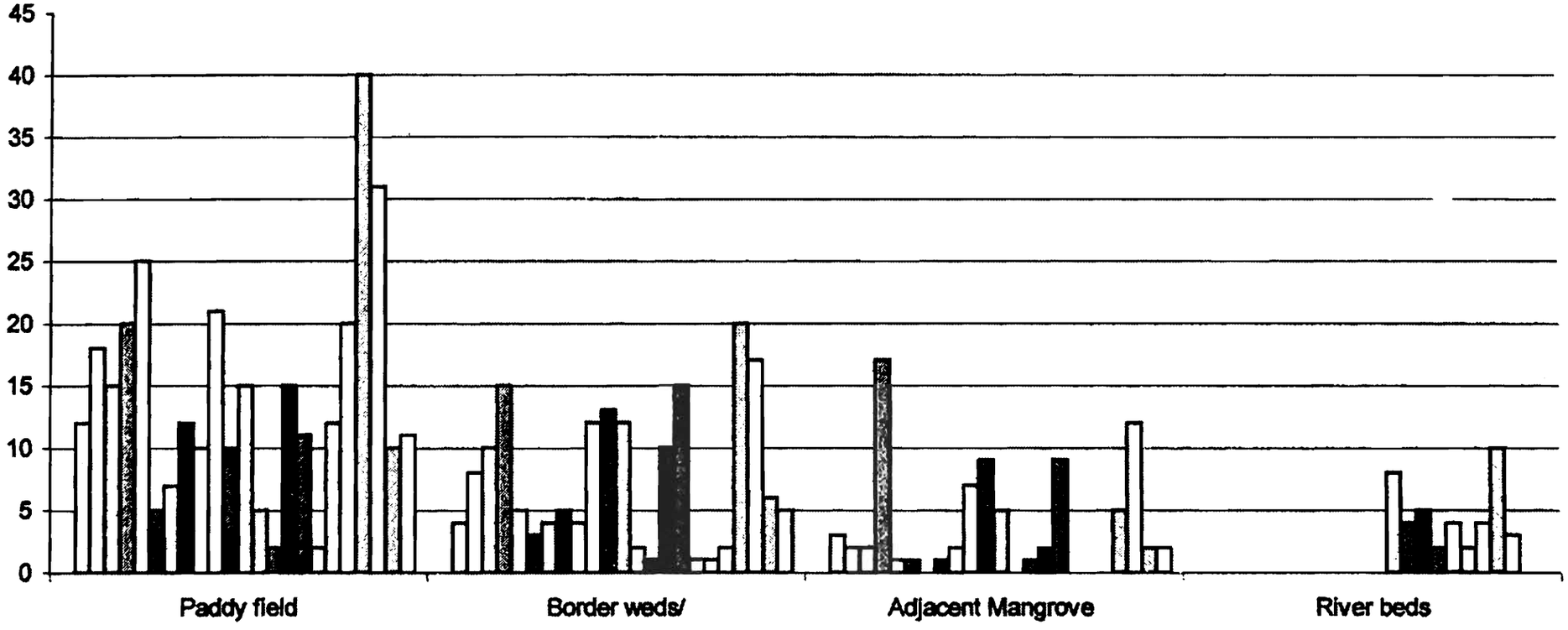
Table 2. List of the spiders and their abundance in different host/habitats in Sundarban coastal eco-system during the month of January 1999 to May 1999.

Name of the species	**Family**	**Paddy field (Rice plants)**	**Border weeds/ wild bushes**	**Adjacent mangrove vegetation**	**River beds**
Argiope pulchella Thorell	Araneidae	0	14	8	0
A.shillongensis Tikader	"	0	12	9	0
A. anasuja Thorell	"	0	10	0	0
Neoscona rumpfi (Thorell)	"	1	13	7	0
N.elliptica Tikader & Bal	"	0	15	10	0
N.mukerjei Tikader	"	0	12	8	0
Neoscona sp.	"	20	25	19	0
Leucauge decorata (Blackwall)	"	6	9	4	0
Leucauge sp.	"	0	12	8	0
Larinia phtisica (L. Koch)	"	0	10	7	0
Larinia sp.	"	0	15	9	0
Cyrtophora cicatrosa (Stoliczka)	"	0	11	6	0
C. bidenta Tikader	"	0	17	7	0
Zygeilla melanocrania (Thorell)	"	0	12	8	0
Zygeilla sp.	"	1	15	10	8

Table 2. *(Cont'd.).*

Lycosa himalayensis Gravely	Lycosidae	15	3	0	0
L.mackenziei Gravely	"	12	4	0	1
L. chaperi Simon	"	10	5	0	0
L.choudhuryi Tikader & Malhotra	"	8	2	0	1
Arctosa indica Tikader & Malhotra	"	13	5	0	0
A.himalayensis Tikader & Malhotra	"	14	0	0	0
A. khudiensis (Sinha)	"	9	0	0	0
Hippasa holmerae Thorell	"	11	0	0	0
P. kupupa (Tikader)	"	13	0	0	0
P. oakleyi Gravely	"	8	0	0	0
Pardosa sumatrana Thorell	"	25	11	7	2
P. birmanica Simon	"	15	12	2	0
P. annandalei Gravely	"	10	7	0	0
Oxyopes sitae Tikader	Oxyopidae	0	13	2	0
O. sunandae Tikader	"	0	10	0	0
O. shweta Tikader	"	0	9	0	0
O. ratnae Tikader	"	0	12	0	0
O. sakuntalae Tikader	"	0	11	0	0
Oxyopes sp.	"	10	25	11	0
Marpissa bengalensis Tikader	Satticidae	0	10	4	0
Marpissa sp.	"	10	15	3	0
Phidippus indicus Tikader	"	0	12	4	0
P. bengalensis Tikader	"	0	15	2	0
Marpissa dhakuriensis Tikader	"	0	10	3	0
Tetragnatha andamanensis Tikader	Tetrag nathidae	0	13	4	0
Cheiracanthium melanostoma Thorell	Clubionidae	0	6	1	0
C. himalayensis Gravely	"	0	3	0	0
C. trivialis Thorell	"	0	2	0	0
Number of examples		216	414	168	4
Number of species		17	19	18	3

Table-1.List of the spiders and their abundance in different host/habitats in Sunderban coastal eco-system during the month of june ,1998to Dec,1998.



Name of the species Family	Argiope pulchella Thorell Araneidae	Argiope sp. Araneidae
Neoscona mukherjei Tikader Araneidae	Neoscona sp. Araneidae	Leucauge decorata (Blackwall) Araneidae
Leucauge tessellata(Threll) Araneidae	Leucauge sp. Araneidae	Cyrtophorasa cicatrosa(Stoliczka) Araneidae
Cyrtophorasa bidentata Tikader Araneidae	Cyrtophora sp. Araneidae	Larinia sp. Tetragnathidae
Tetragnatha sp. Lycosidae	Lycosa chaperi Simon Lycosidae	L.Choudhuryi Tikader&Malhotra Lycosidae
Lycosa sp. Lycosidae	Hippasa sp. Lycosidae	Pardosa annandalei Gravely Lycosidae
P.birmanica Simon Lycosidae	P.sumatrana Thorell Lycosidae	Pardosa sp. Lycosidae
Arctosa sp. Lycosidae	Oxyopes shweta Tikader Oxyopidae	O.sunandae Tikader Oxyopidae

FOOD AND FEEDING HABIT

During the present investigation a number of insect pests were recorded from the fields. Of those *Scirpophaga insertulus, Nilaparvata lugens, Nephottetix virescens, Leptocorisa acuta* and *Orseolia oryzae* were found in the paddy fields during August to October 1998. From this study it was found that the *Lycosa chaperi* Simon fed upon on immature larvae of *Nilaparvata lugens* at the rate of 5 to 15 pest specimens per day. The species *Cheiracanthium himalayensis* Gravely could built nest by rolling up paddy leaves within which they retreated (Majumder & Tikader, 1991).

Table 3. List of the Insect pests available in the paddy fields in the Sundarban coastal region during the year June 1998 to May 1999.

Sl. No. & Scientific name/common name/ local name	Systematic position	Number of insect pests present (from June 1998 to August 1998)	Number of insect pests present (from August 1998 to October 1998)	Number of insect pests (from November 1998 to December 1998)	Insect pests-Nil From January, 1999 to may 1999
1. *Nilaparvata lugens* (Brown plant hoper) Local name : Badami poka	Order : Hemiptera Family : Delphacidae	+	+++	++	0
2. *Nephottetix virescens* (Green leaf hoper) Local name : Shyama poka	Order : Hemiptera Family : Cicadellidae	+	++	+++	0
3. *Scirpophaga incertulus* (White leaf hoper) Local name : Mazra poka	Order : Lepidoptera Family : Pyralidae	+	+++	++	0
4. *Leptocorisa acuta* (Rice bug) Local Name : Gandhi poka	Order : Hemiptera Famaly : Atydidae	++	+++	++	0
5. *Orseolia oryzae* (paddy gall) Local Name : Chungi poka	Order : Diptera Family : Cecidomyiidae	–	++	+++	0

+++ = Maximum; ++ = Optimum; + = Minimum; 0 = Nil.

These spiders were nocturnal in habit and after coming out from the nests they devoured lepidopteran pests at the rate of 5 to 12 prey per day. Observations made in the present study confirmed with those made by Biswas *et al.* (1995). The jumping spiders played an important role in controlling the insect pests in the fields. They consumed 6 to 12 dipteran pests per day and captured the prey by jumping upon them. *Leucauge decorata* Blackwall captured lepidopteran, hemipteran, dipteran and orthopteran pests by trapping them in their beautifully built webs (Biswas *et al.* 1995).

Table 3 indicates that the occurrence of insect pests *viz., Nilaparvata lugens, Scirpophaga incertulus* and *Leptocorisa acuta* were found during August to October 1998. The species *viz., Nephottetix virescens* and *Orseolia oryzae* were found maximum from the month of November to December 1998. No insect pest was found from January 1999 to May 1999.

SUMMARY

In the present study, a total of 30 spider species in 17 genera under 6 families were observed in different hosts/habitats in coastal eco-system of Sundarban *viz.,* paddy fields-plants and ratoon, wild bushes, mongrove vegetation and river beds. Among these species, 587 examples of 30 species were observed in the paddy fields from June 1998 to May 1999; The spider population was rich in wild bushes as evident from the fact that 766 examples of 30 species could be recorded there. The population was lesser in mangrove vegetation and river beds than in the paddy field and wild bushes. A total of 322 examples in 15 species was found in mangrove vegetation and 46 examples in 10 species in river beds. This study also recorded a total of 5 insect pests belonging to Diptera (Cecidomyiidae) Hemiptera (Delphacidae, Cicadellidae) and Lepidoptera (Pyralidae) which were captured and devoured by the spider species indicating that the spiders have a good potentiality as biocontrolling agent in paddy fields of the Sundarban coastal ecosystem.

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ECOLOGICAL STUDY AND FAUNASTIC SURVEY OF BATS FROM PUNE CORPORATION LIMITS, MAHARASHTRA STATE, INDIA

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INTRODUCTION

Bats are grouped under Chiroptera, the second largest order of class Mammalia. It includes two suborders-Megachiroptera and Microchiroptera. The former comprises big bats that are frugivorous and orient by vision and olfaction, the latter are small mostly insectivorous bats that orient by echolocation. Though both these groups are important links of the food web of the terrestrial ecosystem, are not taken seriously by ecologists. Actually these nocturnal and aerial mammals have potential to serve as bioindicators to judge the ecological status of a particular area.

The bats reported from Pune region are few, contribution of Wroughton and Davidson (1920), McCann (1934), Brosset (1962a, 1962b, 1962c, 1963), Bastawde & Mahabal, (1976), Rookmaaker and Bergmans (1981), Shivkumar Swamy *et al.* (1984), Bhat (1994), Bates *et al.* (1994a, 1994b & 1994c) is noteworthy in this regard.

Since the Pune region lies on the fringes of the Western Ghats– one of the biodiversity hotspots of the world, the study of bat fauna in the urban area of Pune city is selected as the first step to know about ecology of this small mammal fauna, which is neglected since many years and not studied for its diversity in a particular area. In the present study two genera from order Megachiroptera and five from Microchiroptera are reported. *Rousettus leschenaulti* the medium sized fulvous fruit bat, *Hesperptenus tickelli,* the Tickell's bat and *Myotis horsfieldii peshwa* the Horsfield's bat previously reported in this region are not found during the recent survey. On the contrary genus *Pipistrellus* the evening bat appeared in a wide range of species diversity.

OBSERVATIONS

In spite of destruction of old buildings and big trees throughout Pune city, the bat fauna is found to be safe to certain extent, but the cave bats in particular are found to be seriously disturbed due to human interference. The green pockets of indigenous plants throughout the city area found to be very important for sustenance of both big as well as small bats.

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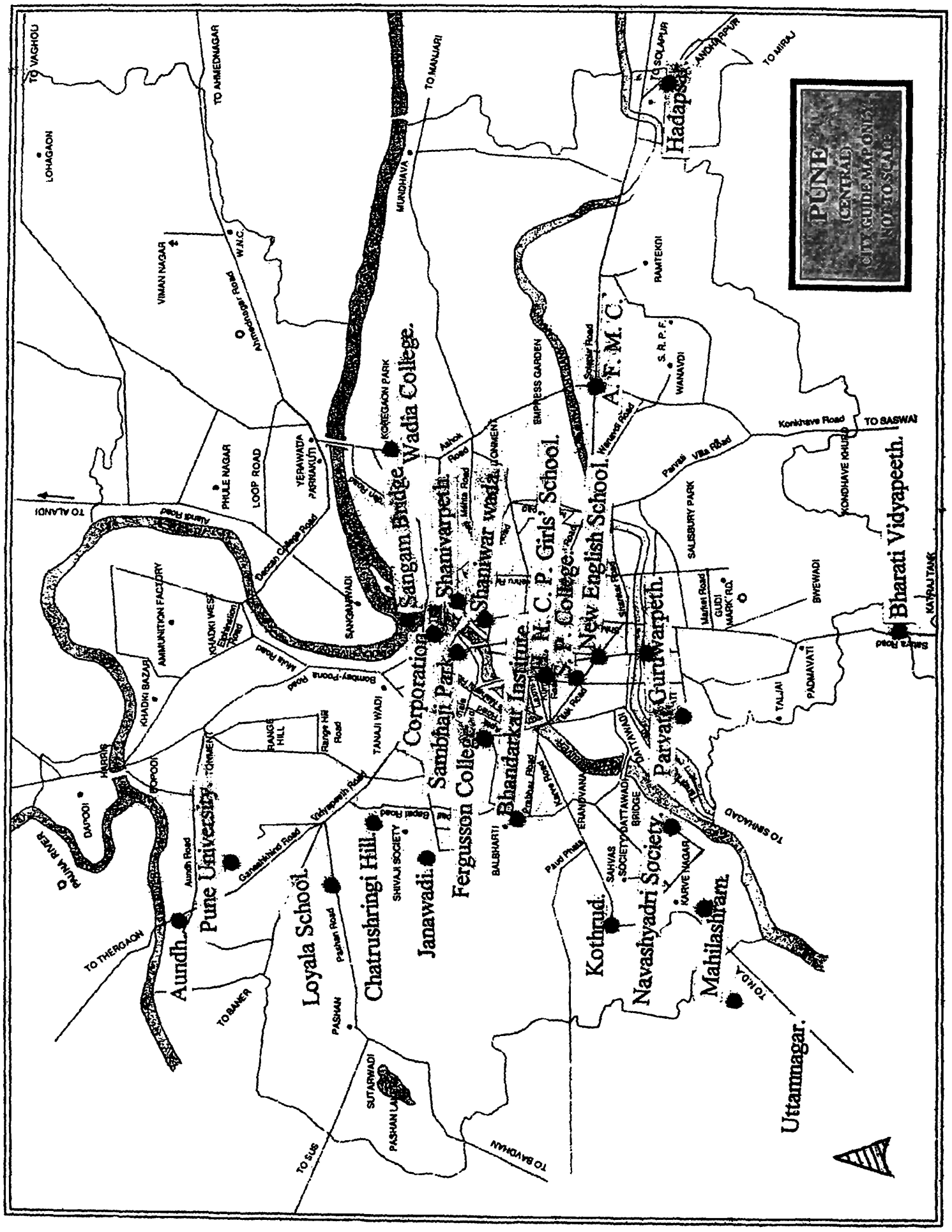

Map 1 : Map of Pune city (not up to scale) showing trapping sites of bats.

TAXONOMY AND ECOLOGICAL DETAILS OF BATS FROM PUNE

Suborder I MEGACHIROPTERA

Family I PTEROPODIDAE

Genus (1) ***Pteropus*** Brisson

1. *Pteropus giganteus* Brunnich, 1782

Indian Flying Fox

Vespertilio gigantean Brunnich, 1782 : Type-loc. : Bengal, India

Diagnosis of species : The tail and nose-leaf are absent. The interfemoral membrane little developed. The wing membranes arise from the sides of dorsum and from the back of the second toe. The wingspan is large (850–1100 mm). The base of the ear completely ringed, tragus and antitragus absent. Inner margin of nostril projecting. Index finger with a powerful claw. Hind neck, shoulder and underside of body generally paler than back. The length of rostrum greatly exceeds the lachrymal breadth. The first upper premolar absent. The crown of molars with longitudinal furrow.

Dental formula : $i\frac{-2\ 3}{1\ 2}$, $c\frac{1}{1}$, $pm\frac{-2\ 3\ 4}{-2\ 3\ 4}$, $m\frac{1\ 2}{1\ 2\ 3} = 34$

Distribution of species : All over India, Sri-Lanka and Burma.

Systematic note : Two subspecies are recognized : *P. g. giganteus* (Brunnich) common in the Indian peninsula excluding Himalayas. Those from Himalayan region are provisionally assigned to *P. g. leucociphalus.*

External, cranial and dental measurements (mm) of *Pteropus giganteus giganteus* from Pune city :

HB	293 – 315	ZB	40.5 – 44
HF	42.5 – 52.6	BB	25.6 – 27
FA	170 – 180	IC	11 – 11.9
WSP	850 – 1050	CM^2	28.6 – 31
E	35 – 40	CM_3	30 – 33
GTL	71 – 75,6	M	57 – 58
CBL	65 – 69.5		

HB : Head & body length, HF : Foot length, FA : Forearm length, WSP : Wingspan, E : Ear length, GTL : Greatest length of skull, CBL : Condylo-basal length, ZB : Zygomatic breadth, BB : Length of braincase, IC : Interorbital constriction, CM^2 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length

*n = 5

All five specimens are male. The head is dark brown to blackish brown in colour, neck and nape uniformly buffy brown to brown, lower shoulder and back blackish brown with some gray hair scattered uniformly, belly vary is colour from brown to light russet brown. The hair roots in this region are darker than the tips, which in particular are paler. The fur around genitalia is dark brown to brownish black in colour.

The baculum though is horseshoe shaped, vary in appearance and dimensions.

Ecological note : The flying fox (*Pteropus sp.*) is the most abundantly found genus in the study area. Four distantly placed colonies are located in the study area and all are in flourishing state. The largest and the oldest colony is at Sangam Bridge in Pune station area and of about 8,000 bats, the other is in Kothrud area in the premises of Kirloskar Kisan Co. Pvt. Ltd. And has about 4,000 bats, the one in Uttamnagar area near National Defense Academy is of about 2,000 and that near Aundh area has about 1,000 plus bats. All these but colonies are conserved by local people as well as owners of the premises. Their flourishing state also indicates abundance of food in the foraging ground. These bats prefer tall trees near river or canal. Trees like mango (*Mongifera indica*), Pipal (*Ficus religiosa*), black plum (*Syzygium cumim*), rain tree (*Albizia labbak*), tamarind (*Tamarindus indica*), cassurina (*Cassurina equisetifolia*) etc. are preferred for day roosting. The actual feeding behavior is not studied, it is noticed that they feed on tender leaves, flowers and ripen fruits of above mentioned plants and many more of wild types from nearby forest.

Genus (2) *Cynopterus* Cuvier, F., 1824

2. ***Cynopterus sphinx*** Vahl, 1797

Short-nosed Fruit bat

Vespertilio sphinx Vahl, 1797. Type-loc : Tranquelar, S. India

Diagnosis of species : The muzzle is shorter and relatively broader than that of *Pteropus* and with a deep emargination between the projecting nostrils. The ears have a well defined pale anterior and posterior border. Tragus and antitragus absent. The tail is short, half porjecting free from the interfemoral membrane. The interfemoral membrane not very extensive. Index finger with claw. Males with neck tufts comprised a semi-rigid ruff of hairs. Colouration varies from light brown to dark brown. The rostrum short and the ventral profile is almost straight. Unlike *Pteropus* the occipital region is not elongated. Skull is smaller than that of *Rousettus leschenaulti.* The upper canine bicuspid and crown of molar marked with longitudinal furrows.

Dental formula : $i\ \frac{-2\ 3}{1\ 2-},\ c\ \frac{1}{1},\ pm\ \frac{-2\ 3\ 4}{-2\ 3\ 4},\ m\ \frac{1-}{1\ 2-} = 30$

Distribution of species : All over India, Pakistan, Bhutan, Nepal Bangladesh, Sri Lanka and Northern Myanmar.

Systematic note : Specimens from northern India tend to be larger than those from the southern peninsula and Sri Lanka. Andersen (1912) provisionally referred the northern specimen under *C. s. gangeticus.* but Agarwal (1973) doubted the validity of this subspecies. The subspecies and their distribution reported in South-East Asia are as follows :

C. S. sphinx (Vahl)-Found in Indian subcontinent except Sumatra, Java, Lombok and Timor.

C. s. tithaecheilus Andersen-Java, Lombok and Timor.

C. s. angulatus Miller-Thiland, Malaya and Sumatra.

C. s. serasani Paradiso-Serasan Island, Indonesia.

C. s. major Miller-Nias Island, off Sumatra.

External, Cranial and dental measurements in mm of *Cynopterus sphinx sphinx* :

HB	95 – 104	GTL	33.8 – 35
T	11 – 15	CBL	28 – 29.5
HF	12.5–16	ZB	18–19
FA	73–75	BB	13–15
WSP	425–438	IC	6–7.7
5MET	43–46	CM^1	12–12.5
4MET	41–44	CM_2	13–13.5
3MET	44–45.6	M	25.5–27.5
E	18–20		

HB : Head & body length, T : Tail length, HF : Foot length, FA : Forearm length, WSP : Wingspan, XMET : Corresponding number of metatarsus, E : Ear length, GTL : Great length of skull, CBL : Condylo-basal length, ZB : Zygomatic breadth, BB : Length of braincase, IC : Interorbital constriction, CM^1 : Maxillary toothrow, CM_2 : Mandibular toothrow, M : Mandible length.

*n = 9.

About nine specimens are trapped from distantly located places in the city area. Of these four are female and five are male. The medium sized fruit bat is dark brown on forehead and neck, the back is grayish brown. In male the chin and chest are slightly orange, while female are tawny brown on neck, grayish on dorsal side and even paler tips on the ventral side. The membranes are uniformly dark brown with characteristically white fingers. The ears are simple with white ring on the margin of the pinna. The nostrils are projected forward on the short, broad and hairy snout.

The moderately long skull has robust and long zygomata. The postorbital processes are well developed. The skull axis is almost straight from nasals to lambda with a weak sagittal crest. The mandible is heavily built.

Ecological note : The short-nosed fruit bat *Cynopterus shinx sphinx* is another fruit bat, which again appears in abundance in small but a number of colonies scattered almost every nook and corner of the city. It prefers to roost in the dark corners of the old buildings roofed in wood and clay tiles, under the dense foliage of drooping ashok (*Polialthia longifolia*), rain tree (*Albizia labbak*) and in the hollow inflorescence of the fishtail palm (*Caryton urens*). The feeding habit of this bat is almost similar to that of flying fox but its range of foraging ground appears naturally smaller and prefers trees of medium height of about 18 plant species.

The isolated young bats of *C. sphinx* observed in the months of December and January as well as in May and June. The single colony comprised 4-5 to 15-20 bats including adults and sub adults. The bats are also noticed to shift their roosting site in the same vicinity as per season. The lactating mothers are observed in November and April.

Suborder MICROCHIROPTERA

Family HIPPOSIDERIDAE

Genus (3) ***Hipposideros*** Gray 1831.

3. ***Hipposideros speoris*** (Schneider, 1800)

Schneider's Leaf-nosed bat

Vespertilio speoris Schneider, 1800. Type-loc : Tranquelar, India.

Diagnosis of Genus : The leaf-nosed bat with ears broad at the base and pointed at the tip. The ears are separate and without tragus. The long tail is included in the interfemoral membrane. The nose-leaf comprises an anterior leaf, central or intermediate leaf and the posterior leaf, all held horizontally and not vertically.

The skull has distinct but low sagittal crest. The tympanic bullae are small but the cochlea are moderately developed. The first upper premolar small, functionless, compressed and displaced from the tooth-row.

Dental formula : $i\ \frac{-2}{1\ 2},\ c\ \frac{1}{1},\ pm\ \frac{-2\ -4}{-2\ -4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 30$

Diagnosis of species : The medium sized leaf-nosed bat with moderately smaller ears. The nose-leaf has three supplementary leaflets; the outer one is inconspicuous. The median emargination of the anterior leaf-nose is not prominent. The upper edge of the intermediate leaf is concave.

The posterior leaf is divided into four cells by vertical three septa and with slightly thickened upper edge.

Distribution : Confined to India and Sri Lanka.

Systematic note : Currently all specimens from the Indian subcontinent are referred to the race *H. s. speoris*.

External, Cranial and dental measurements in mm of *Hipposideros speoris* :

HB	46.6–52	4MT	36–38	GTL	18.5–19.5
T	23-29	3MT	37–40	CCL	16–17
HF	7.5–8	1ph3mt	13.8–15	ZB	10.2–10.5
TIB	19–23.5	2ph3mt	16–18	BB	8–9
FA	51.5–54	1ph4mt	11–12	PC	3–3.2
WSP	277–285	2ph4mt	9–9.8	CM^3	7–7.5
TIB	20–23	E	13.5–14	CM_3	7.5–8
5MT	31.6–34.7			M	13–14

HB : Head & body length, T : Tail length, HF : Foot length, FA : Forearm length, WSP : Wingspan, TIB : Length of tibia, XMET : Corresponding number of metatarsus, YphXmt; Corresponding numbered phalanx of corresponding numbered metatarsus, E : Ear length, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length

*n=9

The medium sized bats vary in pelage colour. Dorsally it is golden brown with grayish tips. The fur is soft and dense. The ventral side is pale with comparatively short fur. The golden tinge differs in shade from dark brown to orange brown. The young bats have dull grayish tinge. The broad funnel like pinna tapers towards the tip and ends into a blunt tip. The supplementary leaflets are three in number, the outer being incomplete and inconspicuous.

The male has a frontal sac just above the posterior leaf-nose, the female lacks this but has a tuft of long hair.

The fifth metacarpal is significantly shorter than fourth and third. The baculum is simple rod like and minute with blunt tip and slightly broad base.

Ecological note : The bats are roosting in a cave located on the slope of a hill among the range of Chatmshringi hills in Ganeshkhind area near Pune University. It is a narrow and deep cave, which is partially divided and each part is interconnected with others. The water tunnels on the floor keep the interior environment cool and moist. The cave is stinking due to the typical unpleasant smell of the urine, excreta and secretion of the frontal sac of males. About 500 bats are roosting, all adults and sub adults together, but separately by means of the curved claws hooked to the rough rocky cliffs. The bats thus hang freely and busy constantly exploring the surroundings with their vibrating big ears. They are used to emerge half an hour after sunset, just before dark.

The bats are observed flourishing for many years. But as the nearby area developed and new buildings came up, the human interference increased to such an extent that the entire colony temporarily shifted in the crevices of the nearby hills. The cave remained almost vacant for about a year or so and recently a small group of about fifty bats have returned to their original cave. The fate of the remaining bats is still doubtful.

The flourishing colony has a regular breeding cycle. Almost all females are conceived from October to November. A single foetus is carried in the left horn of the uterine cornu up to early May. The sucklings are observed from June to mid August clinged to their mother with one of the pelvic teats in their mouth.

Family MOLOSSIDAE

Genus (4) ***Tadarida*** Rafinesque

4. ***Tadarida aegyptiaca*** (E. Geoffroy)

Egyptian Free-tailed bat

Nyctinomus aegyptiacus E. Geoffroy, 1818 Type-loc : Egypt

Diagnosis of genus : Small to medium sized bats with downwardly facing ears and stout tail projecting beyond the interfemoral membrane. The fleshy ears on the forehead either joined or separate. The tragus is rudimentary but antitragus is large. The nostrils open on the pad, the upper lip is often wrinkled. The wings are long but narrow.

Dental formula : $i\ \frac{-2-}{1\ 2(3)},\ c\ \frac{1}{1},\ pm\ \frac{-2\ -4}{-2\ -4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 30/32$

Diagnosis of the species : The medium sized molossid bat with the fleshy ears separated on the forehead. The tragus is squarish with a small angular projection. The antitragus is well developed. The skull is moderately long and the braincase is flattened. The median axis running from nasals to lambda is straight. The premaxillae are not co-ossified with palate.

Systematic note : In Indian subcontinent *T. a. thomasi* is the endemic subspecies and is also very common and not endangered.

External, cranial and dental measurements in mm of *Tadarida aegyptiaca* :

HB	63–69	GTL	19–20
T	35–44	CCL	17–18.5
HF	7–9	ZB	11–12.5
FA	47–49	BB	9–10
WSP	296–330	PC	4.5–5
5MT	28–30	CM^3	7–7.8
4MT	45–48	CM_3	7.9–8.3
3MT	47–50	M^3–M^3	8–9
E	14.5–20	M	13.5–14.2
TIB	13.5–15	RW	7–8

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 5

The pelage colour clove brown on the dorsal side and distinctly pale almost whitish brown on the ventral side. The fur in general is short-and soft, extends on the flanks. The membranes, ears and snout brownish black in colour. Prominent circular pad with middle depression on the sole as well as at the base of the thumb. The fleshy ear almost round but extends in an angle towards the tip. The earlobes erect and are held vertically on the forehead, but do not meet in the center. The trasus short, overlapped by the large rectangular antitragus. The small eyes are just in front of the ears. The foot large, with sharply curved powerful claws, covered with white, long and inwardly directed hair.

Ecological note : These bats are common in the study area. They are used to hide under the metallic signboards, and in the crevices under the roof and walls of old buildings. The night roosting places can easily be marked by the characteristic odour of excreta and urine. The urine marks on the wall, heavily shitted floor and shrilling voice even in day times make their presence sure in the vicinity. They emerge after development of dark, about 45 minutes or even late after sunset.

Immature males are observed in early July. The females in the same months are in early pregnancy with two embryos, one in each comu of the uterus. There is no sexwise segregation during this time.

Genus (4) ***Tadarida*** Rafinesque

5. ***Tadarida (Chaerephon) plicata*** (Buchannan, 1800)

Wrinkle-lipped Free-tailed bat

Vespertilio plicatus Buchannan, 1800

Type-loc. Puttahaut (According to Allen, 1938), Bengal, India.

Diagnosis of species : The smallest species of *Tadarida*. Forearm length averages 46.3mm, apparently similar to *T. aegyptiaca*, but unlike other species the ears are connected by a membrane across the forehead. The soft and dense fur is very short, usually dark clove brown and paler on the ventral side. The premaxillary bones are complete on the palatal side and fused with surrounding bones, leaving two small foramina. The rostrum is narrow and more rounded, distinct supraorbital processes are present. The brain case is more rounded and not flattened above. The dorsal profile has convexities over both the postorbital region and posterior part of the skull. The coronoid process of mandible is weak, but the angular process is robust.

Disribution : This species is reported in India. Sri Lanka, Myanmar, southern China, Vietnam, Philippines and Indonesia.

Systematic note : All specimens from India are referred provisionally to *T. p. plicata.* But those from Sri Lanka are referable to *T. p. insularis* due to dark chocolate brown dorsal pelage (Hill, 1961). In Indian subcontinent the distribution of this species is probably restricted to a few colonies.

External, cranial and dental measurement in mm in *Tadarida plicata* :

HB	69–72	GTL	18.5–19.2
T	34–40	CCL	16–16.5
HF	8–9.5	ZB	11–11.2
FA	46.5–48.5	BB	9.1–9.3
WSP	325–330	PC	3.8–4
5MT	27.5–29	CM^3	6.5–7
4MT	44.5–46	CM_3	7–7.5
3MT	46–48.5	M^3–M^3	7.8–8.5
E	16–17	M	12–12.5
TIB	14–16	RW	6–6.5

HB : Head & body length, T : Tail length, HF : Foot length, FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest

length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : Postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 4

The dorsal pelage is clove brown, while the ventral fur is short, less dense and paler. The snout, ears and wings are blackish brown. The ears are round and facing downward.

Ecological note : A colony of about 70-80 bats are located in a century old building of a night school-Nanawada near well known Shaniwarwada, and is a busy place even during daytime being a famous cultural center in the heart of the city. About 10-11 groups of bats rest behind the wooden frames hanged on the stony wall of an open verandah, about 30-40 feet from the ground level.

The bat colony is flourishing since more than 20-25 years. But recently the building is renovated and the frames are removed from the wall. The disturbed colony is represented by hardly one or two bats in the crevices of the staircase.

Family VESPERTILIONIDAE

Genus (5) ***Scotophilus***

6. ***Scotophilus kuhlii*** Leach, 1821

Asiatic Lesser Yellow House bat

Vespertilio temminckii Horsfield, 1824. Type-loc. Java.

Diagnosis of Genus : Large sized evening bat with small ears. The tragus is crescent shaped and antitragus well formed. The narrow braincase showing prominent and projecting lambda. The second upper incisor is absent, the cheek teeth with outwardly displaced cusps. The third upper molar reduced.

Dental formula : $i\ \frac{-2-}{1\ 2\ 3},\ c\ \frac{1}{1},\ pm\ \frac{--4}{-2-4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 30$

Diagnosis of species : Smaller than *S. heathii.* The pelage is chestnut brown above, yellowish brown below, but not characteristically yellow as found in *S. heathii.*

Distribution : Reported from India, Pakistan, Taiwan, Sri Lanka, Malaysia, Philippines and Indonesia.

Systematic note : In past the small *Scotophilus* was referred variously as *S. temminckii* and *S. wroughtoni*, following Hill and Thonglongya (1972), the tzxon *S. kuhlii* is considered to be correct. Spcimens from Indian subcontinent are provisionally referred to *S. k. wroughtoni.*

External, cranial and dental measurements in mm of *Scotophilus kuhlii* :

HB	60	GTL	20
T	35	CCL	18
HF	10	ZB	13
FA	46.6	BB	9.4
WSP	300	PC	5
5MT	43	CM^3	6.8
4MT	47	CM_3	7.8
3MT	48	M^3–M^3	8.5
E	11.6	M	14
TIB	20	RW	7

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 1

The present specimen of a mature isolated male is trapped in mid April. Though the closely related species of the genus *S. heathii* and *S. kuhlii* exhibit overlapping measurements, the present specimen represents the lower range of parameters and that helps to decide the species. The ventral pelage colour is quite different, brownish yellow in contrast to satin yellow of *S. heathii.*

Ecological note : This species seems to be not very common to the study area, as only one male bat is trapped in the survey of two years. A single mature bat is trapped from the open verandah of the first floor from Wadia College in Pune station area, hiding behind the wooden notice board. Nothing is known about the reproduction cycle or other details.

Genus (6) ***Pipistrellus***

7. ***Pipistrellus javanicus*** (Gray, 1838)

Javan pipistrelle

Scotophilus javanicus Gray, 11S Type-loc. Java.

Diagnosis of Genus : Small vespertilionid bat. The nostrils directed antero-laterally with a distinct inter-narial groove. The muzzle is glandular and nearly naked. The ears short and broad, the tragus about half the height of the ear, its anterior border is slightly concave and antitragus in

form of minute lobular projection. The first upper incisor I^2 is well developed and bicuspid. The second incisor I^3 smaller than the former one. The upper canine is short and usually bicuspid. The upper first premolar (pm^2) is small and usually intruded from the tooth-row. Pm^3 and Pm_3 both are absent.

Dental formula : $i\ \frac{-2\ 3}{1\ 2\ 3},\ c\ \frac{1}{1},\ pm\ \frac{-2-4}{-2-4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 34$

Diagnosis of species : The medium sized bat with snout broad and flattened. The dorsal gland at the root of the tail is absent. There is no white border on the wing membrane running between the foot and the fifth digit. The supra-orbital region is broad and palate is strongly domed. FA < 35, CBL < 13, CM^3 < 5.2 and the cranial profile is almost straight.

Distribution : The species is reported from Afghanistan, Pakistan, India, Myanmar, Indonesia, Philippines. Korea, Japan and New guinea.

Systematic note : Following Corbet and Hill (1992), the taxa *babu, peguensis* and *camortae* have been included in synonym of *javanicus*. Specimens from main land of Indian subcontinent are referred to *P. javanicus babu* and those from Nicobar Islands to *P. j. camortae.*

External, Cranial and dental measurements in mm *Pipistrellus javanicus* :

HB	42.7–52	GTL	14–14.6
T	29–33	CCL	13–13.2
HF	5–8	ZB	8–8.7
FA	34–36	BB	6.7–7.1
WSP	231–250	PC	3.9–4
5MT	30.5–32.8	CM^3	5–5.2
4MT	32–34	CM_3	5.3–55
3MT	32.5–34.6	M^3–M^3	6.5–6.8
E	10–15	M	10.7–11
TIB	13–15	RW	5–6

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull. CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length, RW : Width of rostrum.

*n=3

Pelage colour clove brown to blackish brown dorsally. Ventral paler fur with darker hair roots gives grizzled appearance. Fur in general soft and dense. Ears, membranes and snout uniformly dark brown. The ears are erect, broad at the base and blunt tip is little thick.

Ecological note : Not very common species in the study area, a single colony of about 20 adults and sub adults are located behind the metallic name-plate fitted about 7-8 feet from the ground level in Fergusson College premises. The females in early August have early pregnancy with 2 embryos in the womb.

8. ***Pipistrellus coromandra*** (Gray, 1838)

Coromandel Pipistrelle; Indian Pipistrelle; Little Indian bat.

Scotophilus coromandra Gray, 1838 : Type-loc. Pondecherry, India.

Diagnosis of the species : The small pipistrelle with FA < 35, the braincase is high and rounded. CM^3 < 5.2. The cranial profile is almost straight, the narrow rostrum is not flat, supra orbital region narrow, the hard palate is longer than wide. I^2 is bicuspid, its crown area is equal to that of I^3 & pm^2, I^3 is little more than half the height of I^2. The upper canine is bicuspid.

Distribution : It is found in Afghanistan, Pakistan, India, Southern China, Sri Lanka Nicobar Island, Thailand and Vietnam.

Systematic note : Specimens from throughout the Indian subcontinent are currently referred to the nominate race *P. c. coromandra.* Following Corbet and Hill (1992) those from north-east Pakistan and Afghanistan may be subspecifically distinct.

External, Cranial and dental measurements in mm *Pipistrellus coromandra* :

HB	38.5–42	GTL	12–12.4
T	22–28	CCL	10.5–11
HF	3.5–4.5	ZB	7.6–8
FA	26–30	BB	5.6–6.4
WSP	185–200	PC	3–3.4
5MT	25–27	CM^3	4–4.5
4MT	26–29	CM_3	4.2–4.8
3MT	26.5–28.7	M^3–M^3	5.3–6
E	7.5–8	M	8.2–8.4
TIB	11.5–12.5	RW	4.8–5.4

HB : Head & body length, T : Tail length. HF; Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull. CCL; Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase.

PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibulartoothrow, M : Mandible length RW : Width of rostrum

*n = 3

Small pipistrlle with soft, uniformly clove brown fur. Ventrally the hair roots are dark and tips are pale buffy brown or whitish giving grizzled appearance. The snout, ears and membranes dark brown. Little fur extends over the flanks and the interfemoral membrane on either side of the tail.

Ecological note : Two colonies are located in the study area, one comparatively large colony of about seventeen to twenty bats roosting behind the wooden boards fitted on the wall of open verandah at ground floor of an old building of Mahilashram in Hingane area. It is a mix colony of adults and sub adults observed in early March. The second colony is located behind the electricity board fitted on the wall of the first floor of an old building of S. P. College near Swargate area. The colony of about ten to twelve bats observed in late March includes adults as well as sub adults.

9. ***Pipistrellus tenuis*** (Temminck, 1840)

Least pipistrelle or Indian Pygmy bat

Vespertilio tenuis Temminck, 1840. Type-loc. : Sumatra (Tate,1942)

Diagnosis of Species : This bat shares most of the characteristics with *P. coromandra*, such as FA < 35, supra orbital region not broad, rostrum narrow but not flat dorsally and palate weakly domed. I^2 is equal to I^3 and pm^2 in crown area and the upper canine bicuspid. It differs from *P. corornandra* as the body is tenderly built, CBL and M^3–M^3 are of lower range.

Distribution : It ranges from Afghanistan, India, Sri Lanka to Vietnam and Thailand.

Systematic note : All specimens from Indian subcontinent are referred to *P. t. mimus* (Sinha, 1980).

External, Cranial and dental measurements in mm *Pipistrellus tenuis* :

HB	33.5–40	GTL	11.4–12
T	25–32	CCL	9.8–10.6
HF	4–5	ZB	7.3–7.7
FA	27–30.5	BB	6–6.3
WSP	190–202	PC	3–3.7
5MT	25.2–26	CM^3	3.5–4
4MT	26–29.1	CM_3	4–4.5
3MT	27.5–30	M^3–M^3	4.5–4.8
E	8–9	M	8–8.3
TIB	11–12.5	RW	4.5–4.8

HB; Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, TIB : Length of tibia, XMET : Corresponding numbered metatarsus, E : Ear length, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 3

The pelage colour differed in different groups, and ranged from clove brown to blackish brown. Ventral fur paler with darker hair roots and buffy brown hair tips giving grizzled appearance. Ears, snout and membranes dark brown throughout. The head furry and bulbous, snout and nostrils turned upwards.

Ecological note : It seems to be a common species in the study area. A group of nine females in stage of early pregnancy roost in an open verandah of the first floor of stony old building of Wadia College. The group of bats is thought to be segregated from the mother colony during breeding season, as each female has two embryos in its womb in mid April. Two single adult males are trapped in late April.

The colony of about seven to eight bats in mid January is of mix kind, all adults and sub adults roost under the roof of the first floor of an old stony building of a hostel of Mahilashram, Karve's Institute in Hingane area.

10. ***Pipistrellus ceylonicus*** (Kelaart, 1852)

Kelaart's Pipistrelle

Scotophilus ceylonicus Kelaart, 1852 Type-loc. Trincomalee, Ceylon.

Diagnosis of species : FA > 35, CM^3 > 5.4, cranial profile is raised over frontal region. I^2 bicuspid and its crown area is equal to that of I^3 and pm^2, but I^3 is nearly half the height of I^2. pm^2 intruded and lies in the recess of pm4 and upper canine.

Distribution : It ranges from Pakistan, India and Sri Lanka to Myanmar, China Vietnam and northern Borneo.

Systematic note : According to Lal (1984), all specimens from India should b considered to *P. c. indicus* and those from Sri Lanka as *P. c. ceylonicus*.

External, Cranial and dental measurements in mm *Pipistrellus ceylonicus* :

HB	46–51.4	GTL	13.5–15.5
T	29–38.5	CCL	13–14
HF	6–8.5	ZB	9–10
FA	35–38.2	BB	7.7–8

WSP	227–252	PC	3.8–4.5
5MT	33–34.5	CM^3	5.4–6
4MT	34.4–35.8	CM_3	5.6–6.6
3MT	34.5–36.4	M^3–M^3	6.6–7.8
E	9.5–14	M	10.6–11.6
TIB	13.5–15	RW	5.5–7

HB : Head & body length, T : Tail length. HF : Foot length, , FA : Forearm length, WSP; Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull. CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase. PC : Postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow. M : Mandible length RW : Width of rostrum

*n = 7

The dorsal fur soft, long and silky. It appears clove brown to blackish brow dorsally, but paler with dark hair roots and pale almost gray hair tips. The snout, ears and membranes uniformly dark brown. The triangular ears are broad at the base bt narrowed at the apex into a blunt tip. Tragus inwardly curved with a shallow depression along the length.

Ecological note : It is the most common evening bat in the study area. Usually occurs in the crevices, roofs or behind the wooden shelter in old stony buildings, which are very common in the city area.

The bats collected in January are adult males and females living in the same colony. Segregated pregnant females are observed in mid February as well as in late September. The females carry two embryos in their womb. Isolated males are found in April-May as well as in December.

II. ***Pipisfrellus affinis*** (Dobson, 1871)

Chocolate Pipistrelle

Vesperugo (Pipistrellus) affinis Dobson, 1871. Type-loc. Bhamo, north-eastern Myanmar.

Diagnosis of species : Apparently similar to *P. ceylonicus*, but with larger FA. Braincase comparatively short and rostrum is elongated. Zygomata strongly built with prominent jugal eminence. The dorsal profile of the skull is straight, palate longer than its width. I^2 bicuspid and I^3 is well developed. pm^2 is equal to I^3 in crown area. Upper canine unicuspid and is not in contact with pm^4. pm_2 is situated in tooth row and little smaller than pm_4 in height and crown area.

Distribution : It is found in Sri Lanka, India, Nepal, Tibet and Myanmar.

Systamatic note : Specimens from Sri Lanka are referred to *P. mordax* (Phillips, 1980). According to Corbet and Hill (1992) *affinis* and *mordax* may prove to be conspecific. In this case, all specimens from the Indian subcontinent would be included in *mordax* as this is the prior name.

External, Cranial and dental measurements in mm *Pipistrellus affinis* :

HB	50–54.5	GTL	14.8–15.5
T	30.5–35	CCL	13.5–14
HF	7–8	ZB	9–9.2
FA	38.5–40	BB	7–7.3
WSP	220–243	PC	3.8–4
5MT	34–36.1	CM^3	5.5–5.8
4MT	36–37.3	CM_3	5.5–6
3MT	36.5–38	M^3–M^3	6–6.3
E	12–14	M	10.6–11.6
TIB	14–15.4	RW	5.5–5.9

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic 1 breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length, RW : Width of rostrum.

*n = 4

Pelage colour varies from light brown to dark brown on dorsal side. Ventrally the fur is paler with light buffy brown to whitish tips, and dark hair roots give grizzled appearance. Ears, snout and membranes are uniformly dark brown. Ears short and broad at the base with rounded tip. Tragus long, broad and inwardly curved.

Ecological note : This is the second commonly occurring species of evening bats found in study area, the first being *P. ceylonicus*. Four distantly placed colonies are located roosting in crevices in roof and other shelters in old buildings. Like other Pipistrelles the bats of this species also exhibit sex wise segregation during breeding seasons. The females in September are in stage of mid pregnancy with two embryos in limb bud stage, and those in April are in early pregnancy. The colony in March has both adult males and females living together under the same shelter.

Genus (7) ***Scotozous*** Dobson, 1875.

12. ***Scotozous dormeri*** Dobson, 1875.

Dormer's bat

Pipistrellus dormeri (Dobson, 1875) Type-loc. Bellary Hills, India.

Diagnosis of the Genus : A monospecific genus limited chiefly to India. On occasion referred to *Pipistrellus* as a subgenus on account of an apparent or supposed resemlance to the African

species, *Pipistrellus rueppellii. Scotozous* differs from *Pipistrellus* as its first upper incisor I^2 is large, massive, unicuspid and is in contact with canine, or nearly so. I^3 is minute like a spicule reaching hardly to the cingulum of I^2 and lying nearly laterally to this tooth almost outward to the toothrow. pm^2 intruded and its crown area is greater than half than that of I^2.

Distribution : It is confined to India and Pakistan.

Systematic note : One subspecies *S. d. caurinus* Thomas, 1915 from Gujarat is reported to be different from *S. d. dormeri* on account of the pelage colour, larger skull and longer toothrow. But according to Agarwal (1973), all specimens should be referred to the nominate race *S. d. dormeri.*

External, Cranial and dental measurements in mm *Scotozous dormeri* :

HB	47.7–52.4	GTL	13.7–14.7
T	27–35	CCL	12.8–13.7
HF	6.4–7.7	ZB	9.5–9.6
FA	36–37	BB	7.5–7.8
WSP	227–233	PC	4–4.2
5MT	33.5–34	CM^3	5.2–5.7
4MT	34–35	CM_3	6–6.2
3MT	35–35.7	M^3–M^3	6.4–7
E	10–12	M	10.4–11.4
TIB	14–14.2	RW	5.6–6

HB : Head & body length, T : Tail length. HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillae toothrow, CM_3 : Mandibular toothrow, M : Mandible length, RW : Width of rostrum.

*n = 3

Dorsal pelage uniformly dark brown with some pale tips, ventral fur is even paler. Ears, snout and wings blackish brown. Snout short, broad and thick. Ears short, broad and with rounded tip. Tragus short with slightly curved pointed tip and a projection on subterminal posterior border. Fleshy pads at the base of the first finger and on sole. Dorsal profile of the skull is almost straight with lambda as the highest part, palate concave and zygomata broad.

Ecological note : Three colonies are observed in study area. About 20 adult males and females are living together under the clay tiled roof of an old building at the first floor verandah of hostel in Mahilashram in Hingane area as observed in early June. Another colony of about 8-10 bats is observed living in the crevices of the stony wall of New English School, Tilak Road area roosting about 10m high from the ground level. The females in late September are with two embryos in

womb in late limb-bud stage. Single isolated mature males are observed in the dry days of mid April near the swimming pool of Loyala High School, Pashan Road.

SOME BATS OF PUNE AS REPORTED DURING 1998–2000

Sr. No.	Common Name	Scientific Name	IUCN Status
01	Indian flying fox	*Pteropus giganteus*	LR-nt/N
02	Short-nosed fruit bat	*Cynopterus sphinx*	LR-lc/N
03	Schneider's leaf-nosed bat	*Hipposideros speoris*	LR-nt/N
04	Egyptian free-tailed bat	*Tadarida aegyptiaca*	LR-nt/N
05	Wrinkle lipped free-tailed bat	*Tadarida plicata*	DD/N
06	Asiatic Lesser Yellow House bat	*Scotophilus kuhlii*	LR-nt/N
07	Javan pipistrelle	*Pipistrellus javanicus*	NE
08	Indian pipistrelle	*Pipistrellus coromandra*	DD/N
09	Indian pigmy bat	*Pipistrellus tenuis*	LR-lc/N
10	Kelaart's pipistrelle	*Pipistrellus ceylonicus*	LR-lc/N
11	Chocolate pipistrelle	*Pipistrellus affinis*	DD/N
12	Dormer's bat	*Scotozous dormeri*	LR-nt/N

NOTE

- DD/N—Data deficient nationally, Non-endemic
- LR-nt/N—Lower risk-near threatened nationally
- LR-lc/N—Lower risk-least concerned nationally
- NE—Not evaluated.

DISCUSSION

During the ecological study and faunastic survey of bats in the urban area of Pune city it is clear that the bat diversity is remarkable in. this area. The frugivorous megachiropterans though represented by only two genera, appear in abundance living successfully in their flourishing colonies. The green zones in and around the city are still rich to sustain them in large number.

The microchiropterans have genus and species diversity in the study area, but their existence seems doubtful due to high rate of urbanization. The old residential premises built in stone and wood are disappearing and replaced by cement concrete buildings. which definitely are not suitable to roost as they are dry. Similarly old ficus trees are removed from their original place and are replanted. But it takes years to provide preferable shelter to a large fauna of small animals including bats.

The bridges over the rivers running through the city are century old and the authorities are busy replacing them by constructing the new one. The caves on the slope of the hills are no more safe for colonization of bats.

During intensive study of two years, and occasional visits of the sites for two more years thereafter it is now clear that the deforestation around the city area, most probably have compelled this small mammals to shift from their natural habitats in wild to the urban area, where they might have sustained since some decades and now their existence is quite in danger. The evening bats particularly of genus Pipistrelus appear to exist in form of a number of species. It may be because of their adaptability to survive in form of small groups and feeding on small soft bodied insects, which in particular are abundant in the marshy places and heaps of garbage in the city area

One species of fruit bat *Rousettus leschenaulti* previously reported from Pune (Rookmaaker and Bergmans, 1981) is not reported in the present study. The site at the foot hills of Parvati is visited and found that the subterranean water tanks, where these bats were reported are now sealed by the wire mesh at its entrance. The site again is much disturbed due to human interference.

Two more species of the insectivorous bats *Myotis horsfieldii* and *Hesperoptenus tickelli* reported from the study area (Brosset, 1962c) are not observed in the present study.

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FAUNAL DIVERSITY AND HABITAT PREFERENCE OF HOUSE DUST MITES IN WEST BENGAL IN RELATION TO NASOBRONCHIAL ALLERGIC DISORDERS

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INTRODUCTION

Mites are ubiquitous in distribution and are reported to be present almost in all the habitats. An intricate association between mites and human beings are also noticed from long back. A large number of people are reported to suffer from several nasobronchial allergic complaints due to inhalation of mites present in the house dust. It is well documented that mites of the family Pyroglyphidae, particularly the genus *Dermatophagoides* are considered to be the most potent allergen in house dust responsible for asthma and other allergic manifestations (Voorhorst *et al.*, 1964 and Pepys *et al.*, 1968). Saha (1993, 1994, 1995 and 1997) and Saha *et al.*, (1995 a,b, & c) confirmed that *Dermatophagoides* mites are the main source of allergen in house dust responsible for asthmatic problems in at least 80% of the sensitive patients of Calcutta.

Mites in house dust date back to seventeenth century (Leeuwenhoek, 1694). More than 130 species of mites have so far been isolated from the house dust samples all over the world since 1983 (Zheltikova *et al.*, 1985). The first report on the occurrence of mites in Indian house dust was made by Krishna Rao *et al.*, (1973). Since then studies on the house dust mite fauna have been conducted in different parts of the country from time to time and the presence of varying number of species of mites have been reported (Dixit and Mehta, 1973; Dar and Gupta, 1979; Krishna Rao *et al.*, 1981; Maurya and Jamil, 1982; Tripathi and Parikh, 1983; Kumar *et al.*, 1988; Kumud *et al.*, 1988; Modak *et al.*, 1991, 1995 and Saha *et al.*, 1995b). However, a comprehensive knowledge on the house dust mite fauna of West Bengal is still fragmentary. Earlier, Gupta and Datta Roy (1975) isolated 12 species of mites from mattress dust of patients with respiratory troubles from six different

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districts of the state. In recent past, Modak *et al.*, (1991) in a comparative study reported the presence of 54 species from house dust samples collected from 24 Parganas, Burdwan and Calcutta and highest number of species were encountered from Calcutta metropolis. The present study has been designed to gain an insight into the faunal diversity of house dust mites in 14 different districts of West Bengal and to assess their habitat preference.

MATERIALS AND METHODS

Dust samples from two different habitats namely bed and bedroom floor were collected manually from houses of 85 established cases of bronchial asthma patients residing in 14 different districts of West Bengal, namely, Calcutta, South 24 Parganas, North 24 Parganas, Howrah, Hooghly, Burdwan, Bankura, Birbhum, Purulia, Midnapur, Murshidabad, Malda, Coochbehar and Jalpaiguri. Patients were selected from Asthma Clinic of Calcutta School of Tropical Medicine and District Health Centres of respective districts following the criteria mentioned earlier (Saha, 1993 and 1994).

Dust samples were also collected from the houses of fifty healthy individuals to serve as control. Floor dust samples were collected by sweeping the floors while bed dust samples were obtained by brushing the mattresses, bed covers, pillows on clean sheets of newspapers, kept in separate polythene packets, labeled properly. Extraction of mites were done following the method of Channa Basavanna *et al.*, (1985). Isolated mites were cleared and mounted temporarily in lactic acid and identified following the classification of Hughes (1976).

OBSERVATIONS

A total of about 1,31,531 mites were isolated from 270 samples of dust collected from 14 different districts of West Bengal. As many as 68 species of mites belonging to 44 genera, 25 families and 3 orders namely Astigmata, Prostigmata and Mesostigmata (Table 1) have been isolated. A large number of Cryptostigmatids were also found but they were not identified. Among 68 species of mites, 26 species of mites were reported for the first time from Indian house dust samples, of which 6 species are new to science. Among 14 different districts surveyed, Calcutta holds maximum variety (47) of mites, followed by Burdwan (40) and North 24-Parganas (33) and least number of species was isolated from Birbhum District. *Dermatophagoides pteronyssinus* was the most dominating species comprising 69% of the total number of mites isolated followed by *D. farinae* (14%) and *Hirstia domicola* (13%). It is interesting to note that all the well known allergenic mites *viz. D. pteronyssinus, D. farinae, Euroglyphus maynei, Tyrophagus putrescentiae, Acarus siro* and *Glycyphagus domesticus* (Voorhorst and Spieksma, 1973) were present in large number in the state. Almost all the dust samples collected were positive for the presence of mites and 90% of the samples were positive for *D. pteronyssinus.* It was further noticed that the maximum number

Table 1. Mite fauna isolated from dust samples of different districts of West Bengal.

A. **ASTIGMATA**	
Pyroglyphidae	*Dermatophagoides farinae* Hughes
	D. pteronyssinus (Trouessart)
	Hirstia domicola Fain, Oshima & Bronswijk
	Malayoglyphus intermedius Fain, Cunnington & Spieksma
	Euroglyphus maynei (Cooreman)
Chortoglyphidae	*Chortoglyphus arcuatus* (Troupeau)
Acaridae	*Tyrophagus putrescentiae* (Schrank)
	* *T. tropicus* Robertson
	* *T. brevicrinatus* Robertson
	Tyrophagus sp.
	Rhizoglyphus robini Claparede
	Caloglyphus sp.
	Acarus siro Linnaeus
	Acarus sp.
	Suidasia nesbitti Hughes
	S. medanensis Oudemans
Glycyphagidae	*Glycyphagus domesticus* (De Geer)
	* *G. bicaudatus* Hughes
	** *Austroglycyphagus* sp. nov.
	Blomia tropicalis (Bronswijk, Cook & Oshima)
	B. freemani Hughes
Anoetidae	*Histiostoma* sp.
B. **PROSTIGMATA**	
Tydeidae	* *Pronematus elongates* Baker
	Tydeus sp.
Tarsonemidae	*Tarsonemus granarius* Lindquist
Pyemotidae	*Pyemotes ventricosus* (Newport)
Cheyletidae	*Cheyletus malaccensis* Oudemans
	C. eruditus (Schrank)
	* *C. trouessarti* Oudemans

Table 1. *Cont'd.*

	* *C. malayensis* Cunliffe
	C. fortis Oudemans
	* *Bak deleoni* Yunker
	** *Bak* sp. nov.
	Grallacheles bakeri De Leon
	** *Hemicheyletia* sp. nov.
Raphignathidae	** *Raphignathus* sp. nov.
Tenuipalpidae	* *Raoiella indica* Hirst
	Raoiella. sp.
	* *Brevipalpus phoenicis* (Geijekes)
Tetranychidae	* *Oligonychus indicus* (Hirst)
	Eutetranychus orientalis (Klein)
Cunaxidae	*Cunaxa setirostris* (Hermann)
	Neocunaxoides sp.
Pseudocheyletidae	*Anoplocheylus* sp.
Erythraeidae	* *Leptus giganticus* Khot
Stigmaeidae	** *Zetzellia* sp. nov.
Scutacaridae	** *Imparipes* sp. nov.
	Scutacarus sp.
Trombidiidae	*Trombidium* sp.
C. MESOSTIGMATA	
Ascidae	*Blattisocius mali* (Oudemans)
	* *B. keegani* Fox
	* *B. dentriticus* (Berlese)
	* *B. tarsalis* (Berlese)
	* *Lasioseius quadrisetosus* Chant
Ameroseiidae	*Kleemania plumosus* (Oudemans)
	* *K. plumigera* (Oudemans)
	Kleemania sp.
Dermanyssidae	*Hypoaspis miles* Berlese
	* *H. lubrica* Voigts & Oudemans
	* *H. sardoa* Berlese
	Hypoaspis. sp.

Table 1. *Cont'd.*

Pachylaelapidae	* *Pachylaelaps dorsalis* Bhattacharyya
Phytoseiidae	*Amblyseius largoensis* (Muma)
	A. indicus (Narayanan & Kaur)
	* *A. zwoelferi* Dosse
Uropodidae	*Trichouropoda* sp.
	Leiodinychus sp.
Macrochelidae	*Macrocheles* sp.

* First report from India

** New to science

of mites (13,750/gm of dust) was isolated from a bed dust sample collected from Calcutta during the month of November, while the minimum (2/gm of dust) was reported from one bed room floor dust sample of Bankura during the month of July. Among two different habitats examined, bed and bed room floor, apparently the former contained higher mite densities than the corresponding bed room floor dust samples, though the difference was not statistically significant.

DISCUSSION

Studies on the house dust mite fauna have been explored in other parts of the country from time to time and the presence of varying number of species have been reported by several workers. To the best of our knowledge, other than the state of West Bengal, a maximum of 27 mite species distributed over 21 genera and 10 families have been reported from Punjab and Himachal Pradesh by Kumar *et al.*, (1988). Therefore, it is interesting to note that West Bengal is extremely rich in house dust mite fauna as was also observed in our earlier reports (Modak *et al.*, 1991). This may presumably be attributed to the presence of ideal climatic conditions particularly the temperature and high humidity prevailing in this state as also suggested by Bronswijk and Sinha (1971) and Wharton (1976) in their studies.

Isolation of exceptionally large numbers of *Dermatophagoides* mites is an interesting finding which may be due to extremely favourable conditions to the survival of these mites in respect to temperature, RH and ample supply of food. It has been recognized that temperature and RH are the two most important limiting factors in controlling mite infestations.

Our study further reveals that members of the family Pyroglyphidae predominated in both bed and bedroom floor-dust samples. Predominance of Pyroglyphid mites in house dust was also observed by Dixit and Mehta (1973), Krishna Rao *et al.*, (1981), Modak *et al.*, (1991) and Kumud *et al.*, (1988). Among different species of Pyroglyphidae the most predominant one is

D. pteronyssinus (69%) followed by *D. farinae* (14%) and *Hirstia domicola* (13%). Several authors from different parts of the country also reported the dominance of *D. pteronyssinus* over *D. farinae* (Dixit and Mehta 1973; Nayar *et al.*, 1974; Krishna Rao *et al.*, 1981; Maurya *et al.*, 1983 and Kumud *et al.*, 1988). Similar observations have been reported from different parts of the globe and they constitute 42.32% to 92.61% of the total mite population depending on the grographical location. In contrast, Dar *et al.* (1973), Jamil and Maurya (1981) and Tripathi and Parikh (1983) reported the predominance of *D. farinae* from other parts of the country.

The present study reveals that cent percent dust samples were positive for the presence of mites and the rate of occurrence of *D. pteronyssinus* was 90%, which confirms the earlier observation of Spieksma (1967) and Sesay and Dobson (1972). Dar and Gupta (1979) reported that 64.3% dust samples from Uttar Pradesh, 61% from Punjab, 60% from Chandigarh, 54.9% from Delhi and 45.5% from Haryana were positive for the presence of mites. They further opined that *Dermatophagoides* spp. were present in 100% mite positive dust samples while Tripathi and Parikh (1983) reported 92% positivity among them from Mumbai.

Of the two different habitats examined to study the habitat preference of *Dermatophagoides* mites, it was observed that bed dust contained higher densities of mites than the corresponding bed-room floor dust, though, not statistically significant. Ho and Nadchatram (1984) also did not observe significant difference in mite densities between different niches. In contrast, Sesay and Dobson (1972) and Tripathi and Parikh (1983) observed significant difference between these two habitats. Saha *et al.*, (1995b) also observed that of the two different habitats examined, the bed dust contained significantly higher ($p < 0.01$) mite density than the corresponding bed-room floor dust samples of patients. Higher mite densities in bed dust samples are attributed to the presence of ideal ecological conditions such as favourable temperature, required humidity and available food. Mites usually feed on human skin scales (Spieksma, 1968 and Wharton, 1976), which is present in abundance in the beds. Moreover, since the beds are occupied by human beings for about 1/3 of the day, the required optimum temperature and RH and sufficient amount of human skin scales are automatically provided (Mulla and Medina, 1980). Secondly, the beds provide an undisturbed habitat in comparison to the corresponding bed-room floors which are frequently cleaned and moped (Blythe, 1976 and Mulla and Medina, 1980).

Observations regarding mite densities in house dust samples of individuals, hypersensitive to dust inhalation and control subjects residing in Calcutta metropolis and adjoining suburban areas of West Bengal were made. The study indicates that in the suburbs, the difference in the total number of mites/gm of dust in allergic and control subjects were not significant. However, the difference was significant in Calcutta population. Dixit and Mehta (1973), Nayar *et al.*, (1974), Murten and Madden (1977), Tripathi and Parikh (1983) and Korsgaard (1983) also reported that apparently the mean number of total mites as well as *Dermatophagoides* mites/gm of dust was greater in houses of asthmatics, though such difference was not statistically significant.

Saha *et al.* (1995a & b) was of the opinion that in Calcutta *Dermatophagoides* alone constituted more than 60% of the total mites isolated and patients' bed contained significantly higher ($p < 0.02$) mite population than the control subjects' bed dust.

It is worth mentioning that the maximum and minimum number of mites recorded during the course of present study were 13,750 and 2/gm of dust respectively. Observations in these respects have also been made in other parts of the globe and the maximum and minimum number of the mites recorded so far were between 7000-8000/gm and 5-8/gm of dust respectively (Oshima 1970, Blythe *et al.*, 1975 and Arlian *et al.*, 1983).

In view of increasing trends in the incidence of nasobronchial allergic manifestations due to dust inhalation, the mite fauna of house dust has gained considerable attention throughout the country. Since the house dust mites particularly the genus *Dermatophagoides* present in the house dust are considered as the sole potent allergen responsible for nasobronchial allergic disorders, a detailed knowledge on the diversity and other ecological requirements of this mite species are of urgent need for better understanding of the disease pathogenesis. Saha (1994) further opined that the degree of house dust allergenecity is closely related to the density of mite populations prevalent in patients environment and thus it is reasonable to think that the physical appearance of these mites in higher concentration in the patients' environment may remind us to search for an allergic etiology towards these species of mites.

SUMMARY

House dust mite fauna in the state of West Bengal comprises of 68 species of mites belonging to 44 genera 25 families and 3 orders. Among those 6 species appeared to be new to science and another 20 species are reported for the first time from Indian house dust samples. *Dermatophagoides pteronyssinus* was the most predominating species comprising 69% of the total mite population followed by *D. farinae* (14%) and *Hirstia domicola* (13%). The relative density varies from 13,750/g to 2/g of dust. Interestingly, all the well known allergen producing mites namely, *D. pteronyssinus, D. farinae, Euroglyphus maynei, Tyrophagus putrescentiae, Acarus siro and Glycyphagus domesticus* are present in the house dust collected from different districts of the state. Among two different habitats examined, the bed dust harbour comparatively higher mite population than the corresponding bedroom floor dust samples and their density being higher in dust samples collected from homes of asthmatic patients than non-sensitive control individuals.

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Rec. zool. Surv. India : **102** (Part 1–2) : 147-154, 2004

ORIBATID MITE (ACARINA : CRYPTOSTIGMATA) FAUNA FROM THE THAR DESERT OF RAJASTHAN, INDIA

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INTRODUCTION

Indian Thar Desert covers part of the four Indian states (Gujarat, Punjab, Haryana and Rajasthan) covering an area of 1,02,400 sq. kms. The acarine fauna of the Thar Desert is very little explored. Oribatid mites commonly known as "moss-mites" or "beetle-mites" are the most beneficial soil-dwelling mites. These tiny creatures play an important role in the formation of soil particles as well as in promoting soil fertility. Even then our knowledge on the oribatid mite fauna of Thar is not sufficient. Reddy *et al.* (1978) was the first to mention about the oribatids of the Thar Desert. They reported only one species of oribatid from Rajasthan. Later Sanyal (1996) reported five other species for the first time from this region.

The present account on soil oribatid mites, received from the Desert Regional Station, Zoological Survey of India, Jodhpur, recorded seventeen species belonging to thirteen genera under eleven families. All the species in this study are recorded for the first time from this region. Hence, the total number of oribatid species known from the Indian Thar Desert stands at twenty three.

KEY WORDS : Oribatid mite, Thar, Rajasthan, India.

MATERIAL AND METHODS

Soil and litter samples were mostly collected by shovel from a depth of 10–30 cms. Sometimes samples from deeper layer were also collected. It was found that the most suitable time for collection was post-monsoon period. The samples were extracted with the help of Tullgren funnel extraction apparatus. Before identification the mites were cleared in lactic acid. All the specimens are deposited in the National Zoological Collection, Zoological Survey of India, Kolkata.

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SYSTEMATIC ACCOUNT

I. Family PHTHIRACARIDAE

1. *Atropacarus (Hoplophorella) scapellatus* (Aoki, 1965)

1965. *Hoplophorella scapellata* Aoki, *Nat. Life Southeast Asia*, **4** : 131.

1992. *Atropacarus (Hoplophorella) scapellatus*, Niedbala, In : Phthiracaroidea (Acari, Oribatidae). Systematic Studies, Amsterdam, 226.

Material examined : Dhanpura, Bhinmal, Jalore, ex. soil, 5 exs., 7 December 2000, coll. A. K. Bhattacharyya; Sri Vijaynagar, Sri Ganganagar, ex. soil, 1 ex., 1 November 2001, coll. A. K. Bhattacharyya.

II. Family EUPHTHIRACARIDAE

2. *Rhysotritia peruensis* (Hammer, 1961)

1961. *Oribotritia peruensis* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13**(1) : 133.

1988. *Rhysotritia peruensis*, Perez-Inigo and Baggio, *Acarologia*, **29**(2) : 193.

Material examined : Sri Vijaynagar, Sri Ganganagar, ex. soil, 2 exs., 1 September 2001, coll. A. K. Bhattacharyya; Dhanpura, Bhinmal, Jalore, ex. soil, 4 exs., 12 July 2000, coll. A. K. Bhattacharyya, Sikwara, Jalore, ex. soil, 1 ex., 12 June 2000, coll. A. K. Bhattacharyya.

III. Family LOHMANIIDAE

3. *Heptacarus hirsutus* Wallwork, 1964

1964. *Heptacarus hirsutus* Wallwork, *Rev. zool. Bot. Afr.*, **70** : 358.

Material examined : Sri Vijaynagar, Sri Ganganagar, ex. soil, 1 ex., 1 November 2001, coll. A. K. Bhattacharyya; Dhanpura. Bhinmal, Jalore, ex. soil, 1 ex., 12 July 2000, coll. A. K. Bhattacharyya.

IV. Family EPILOHMANNIIDAE

4. *Epilohmannia pallida indica* Bhattacharya & Banerjee, 1979

1979. *Epilohmannia pallida indica* Bhattacharya & Banerjee, *Indian J. Acar.*, **4**(1) : 19.

Material examined : Paota, Jodhpur, ex. soil under grass, 1 ex., 19 November 2000, coll. A. K. Bhattacaharyya.

V. Family OPPIIDAE

5. *Brachioppia* sp.

Material examined : Dhanpura, Bhinmal, Jalore, ex. soil, 3 exs., 12 July 2000, coll. A. K. Bhattacaharyya.

6. ***Oppia kuhnelti*** Csiszar, 1961

1961. *Oppia kuhnelti* Csiszar, *Acta zool. Hung.*, **8**(13) : 350.

Material examined : Dhanpura, Bhinmal, Jalore, ex. soil, 8 exs., 12 July 2000, coll. A. K. Bhattacaharyya.

VI. Family XYLOBATIDAE

7. ***Paraxylobates imitans*** Balogh & Mahunka, 1969

1969. *Paraxylobates imitans* Balogh & Mahunka, *Acta. Zool. Hung.*, **15** : 20.

Material examined : Dhanpura, Bhinmal, Jalore, ex. soil, 4 exs., 12 July 2000, coll. A. K. Bhattacharyya; Sri Vijaynagar, Ganganagar, ex. soil, 3 exs., 1 September 2001, coll. A. K. Bhattacharyya; Zoological Survey of India compound, Desert Regional Station, Jodhpur, soil under grass, 6 exs., 17 November 2000, coll. A. K. Bhattacharyya; Central State Farm Nursery, Bhagwansar, Sri Ganganagar, ex. soil, 6 exs., 2 November 2001, coll. A.K. Bhattacharyya.

8. ***Xylobates capucinus*** (Berlese, 1908)

1908. *Protoribates capucinus* Berlese, *Redia*, **5** : 2.

1989. *Xylobates capucinus*, Norton & Kethley, *Redia*, **62**(2) : 428.

Material examined : Arid Forest Research Institute Compound, Jodhpur, ex. soil and litter, 5 exs., 13 November 2000, coll. A. K. Bhattacharyya.

VII. Family HAPLOZETIDAE

9. ***Rostrozetes foveolatus*** Sellnick, 1925

1925. *Rostrozetes foveolatus* Sellnick, *Suppl. Ent. Berlin*, **11** : 84.

Material examined : Sri Vijaynagar, Ganganagar, ex. soil, 2 exs., 1 November 2001, coll. A. K. Bhattacaharyya.

VIII. Family SCHELORIBATIDAE

10. ***Scheloribates albialatus*** Hammer, 1961

1961. *Scheloribates albialatus* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13**(1) : 94.

Material examined : Jaliwara, Jodhpur; ex. soil, 6 exs., 18 January 2001, coll. A. K. Bhattacaharyya; Central State Farm Nursery, Bhagwansar, Sri Ganganagar, ex. soil, 9 exs., 2 November 2001, coll. A. K. Bhattacharyya; Gardali, Jalore, ex. soil and litter, 3 exs., 12 August 2000, coll. A. K.

Bhattacharyya; Sikwara, Jalore, ex. soil, 14 exs., 12 June 2000, coll. A. K. Bhattacahryya; Guest House, Ghaseri, Jalore, ex. soil, 9 exs. 12 June 2000, coll. A. K. Bhattacharyya; Dhanpura, Bhinmal, Jalore, ex. soil, 14 exs, 12 July 2000, coll. A. K. Bhattacahryya; Sri Vijaynagar Sri Ganganagar, ex. soil, 1 ex., 1 November 2001, coll. A. K. Bhattacharyya.

11. ***Scheloribates indicus*** Sanyal, 1992

1992. *Scheloribates indicus* Sanyal, *State Fauna Series 3 : Fauna of West Bengal*, Part 3 : 315.

Material examined : Bawri, Jodhpur, ex. soil, 3 exs., 1 January 2001, coll. A. K. Bhattacharyya.

12. ***Scheloribates thermophilus*** Hammer, 1961

1961. *Scheloribates thermophilus* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13**(1) : 95.

Material examined : Dhanpura, Bhinmal, Jalore, ex. soil, 3 exs., 12 July 2000, coll. A. K. Bhattacharyya; Paota, Jodhpur, ex. soil under grass, 1 ex., 11 November 2000, coll. A. K. Bhattacharyya; Guest House, Ghaseri, Jalore, ex., soil & litter, 2 exs., 12 June 2000, coll. A. K. Bhattacharyya.

IX. Family CERATOZETIDAE

13. ***Ceratozetes*** sp.

Material examined : P.W.D. Guest House, Ghaseri, Jalore, ex. soil, 1 ex., 12 June 2000, coll. A. K. Bhattacharyya.

X. Family AUSTRACHIPTERIIDAE

14. ***Lamellobates palustris*** Hammer, 1958

1958. *Lamellobates palustris* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10**(1) : 100.

Material examined : Sri Vijaynagar, Sri Ganganagar, ex. soil, 5 exs., 1 November 2001; coll. A. K. Bhattacharyya; Central State Farm Nursery, Bhagwansar, Sri Ganganagar, ex. soil, 10 exs., 2 November 2001, coll. A. K. Bhattacharyya; Bhinmal Guest House, Jalore, ex. litter, 11 exs., 12 July 2000, coll. A. K. Bhattacharyya.

XI. Family GALUMNIDAE

15. ***Galumna*** sp[1].

Material examined : Bhinmal, Jalore, ex. soil and litter, 2 exs., 12 July 2000, coll. A. K. Bhattacharyya.

16. ***Galumna*** sp[2].

Material examined : Sri Vijaynagar, Sri Ganganagar, ex. soil, 1 ex., 1 September 2001, coll. A. K. Bhattacharyya.

17. ***Galumna*** sp[3].

Material examined : P. W. D. Guest House, Ghaseri, Jalore, ex. soil, 6 exs., 12 June 2000, coll. A. K. Bhattacharyya.

Keys to families, genera and species treated in this paper

1. Ptychoid body, propodosoma can be shut back against the hysterosoma and ventral region like blade of penknife; body generally laterally compressed 2
– Body not ptychoid, propodosoma can not be shut back against the hysterosoma; body not laterally compressed 3

2. Anogenital region wide; body not much compressed laterally ..... Phthiracaridae*
* Genital setae forming a row or almost a row, located near the paraxial margin; distance between g_6 and g_5 greater than that between g_5 and g_4 *Atropacarus (Hoplophorella)***
** Rostral setae directed inwards; interlamellar setae lanceolate; sensillus long, narrow, inflated in the middle ..... *scapellatus*
– Anogenital region narrow; body considerably compressed laterally ..... Euphthiracaridae*
* Longitudinal suture separating ventral plates with a median triangle; genito-aggenital plate with 8–9 genital and 2 aggenital setae; trochanters of legs III and IV with two setae each ..... *Rhysotritia***
** Aspis with two lateral carinae; prodorsal setae erect, distal half finely barbed; lamellar setae shorter than distance between lamellar and dorsal setae; notogastral setae short, erect, apically finely babred ..... *peruensis*

3. Anogenital region macropyline type; no ventral plate; tibia and genu of similar length and shape 4
– Anogenital region brachypyline type; ventral plate present; tibia and genu of different length and shape 5

4. Body dichoid *i.e.*, articulation between legs II and III; preanal plate present .... Lohmaniidae*
* Genital plates with transverse suture, anal and adanal plates fused; 7 pairs of setae on fused ano-adanal plates, two pairs in median, 5 pairs in lateral rows ..... *Heptacarus***
** Notogaster with strong neotrichy, more than 40 pairs of notogastral setae; all notogastral setae heavily ciliate; body minutely punctated ..... *hirsutus*

5. Notogaster pycnonotic *i.e.*, ototaxic organs absent; usually pteromorphae absent 6

– Notogaster poronotic *i.e.*, areae porosae, sacculi or pori present; pteromorphae usually present 7

6. Eight or nine pairs of genital setae; anogenital plate schizogastric type; 14 pairs of notogastral setae; anal setae 3 pairs ..... Epilohmanniidae*

* Protero-hysterosomatic articulation (dichoid); 8 pairs of genital setae arranged in two longitudinal rows (5+3) ..... *Epilohmannia***

** Genital setae 7 pairs placed both in antiaxial and paraxial position; notogastral setae 13 pairs ..... *pallida indica*

– Genital setae 3–6 pairs; ventral plate hologastric type *i.e.*, without transverse suture; notogastral setae 10–14 pairs; prodorsum without true lamellae, either thin crest-shaped lamellae or thin costulae present or both lamellae and costulae absent ..... Oppiidae*

* Sensillus pectinate; notogastral setae 9 pairs; pori *iad* usually placed obliquely to the anal field ..... *Brachioppia*

– Sensillus not pectinate; notogastral setae 10 pairs; pori *iad* usually placed parallel to the anal field ..... *Oppia***

** Sensillus elongated, slightly fusiform apically; prodorsal setae finely ciliated; p_1 and p_2 smooth; 5 pairs of genital setae ..... *kuhnelti*

7. Pteromorphae movable, articulate or semicircular; prodorsum without true projecting lamellae; some chitinous lines present on the prodorsum ..... Galumnidae*

* Lamellar line present; lamellar setae placed between lines *L* and *S* ..... *Galumna*

– Pteromorphae movable or immovable but never articulate, sometimes absent 8

8. Prodorsum with tutorium; usually 6 pairs of genital setae (exceptionally 5 or 4 pairs) 9

– Prodorsum without tutorium; usually 3–5 pairs of genital setae (exceptionally 6 pairs) 10

9. Pteromorphae immovable; lamellae broad, some times synlamella type Austrachipteriidae*

* Interlamellar area small; lamellae without free tips; adanal region with 1 or 2 pairs of setae ..... *Lamellobates***

** Sensillus with long stalk, club-shaped, head beset with fine setae; outer lamellar cuspides not long and narrow ..... *palustris*

– Lamellae broader, lath-shaped, with linear lamellae and without cuspis often connected with well developed translamella ..... Ceratozetidae*

* Larger and broader species; dorsosejugal suture arched; notogaster smooth; rostrum never broadly truncate, with two incisions and three small teeth; genital setae 6 pairs ..... *Ceratozetes*

10. Notogaster with true areae porosae 11
– True areae porosae absent, notogaster with sacculi or pori 12
11. Sensillus long, reclinate, setiform, often slightly lanceolate at its tip ..... Xylobatidae*
* Ten pairs of notogastral setae or alveoli; 6 pairs of genital setae; setae ad_1 and ad_2 long, ad_3 and *ag* minute ..... *Paraxylobates***
** Prodorsal setae long, ciliate; sensillus long with slightly dilated end ..... *imitans*
* Ten pairs of notogastral setae; 4–6 pairs of genital setae; legs monodactylous ..... *Xylobates***
** Rostral and lamellar setae smooth; sensillus with swollen, barbed head; notogastral setae minute, 11 pairs ..... *capucinus*
12. Pteromorphae movable, hinged ..... *Haplozetidae**
* Dorsosejugal suture with three arches; notogastral setae 10 pairs ..... *Rostrozetes***
** Prodorsum and notogaster foveolated ..... *foveolatus*
– Pteromorphae immovable or absent ..... Scheloribatidae*
* Rostral setae placed apart; dorsosejugal suture distinct; genital setae 4 pairs, legs tridactylous ..... *Scheloribates***
** Hysterosoma as broad as long; lamellar setae thiner than rostral setae; sensillus with short stalk and disc-shaped head ..... *albialatus*
* Hysterosoma longer than broad ..... ***
***Sensillus club-shaped; prodorsal setae smooth ..... *indicus*
– Sensillus with lanceolate head; prodorsal setae barbed ..... *thermophilus*

SUMMARY

In an attempt to prepare an account of the soil cryptostigmatid fauna of the Indian Thar Desert, a total of 17 species belonging to 13 genera under 11 families is listed here. One species *viz.*, *Paraxylobates imitans* Balogh & Mahunka, 1969 is the first record from India and all other species reported here are the first record from the Indian Thar Desert.

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A STUDY ON THE CLADOCERAN FAUNA OF HYDERABAD AND ITS ENVIRONS, ANDHRA PRADESH

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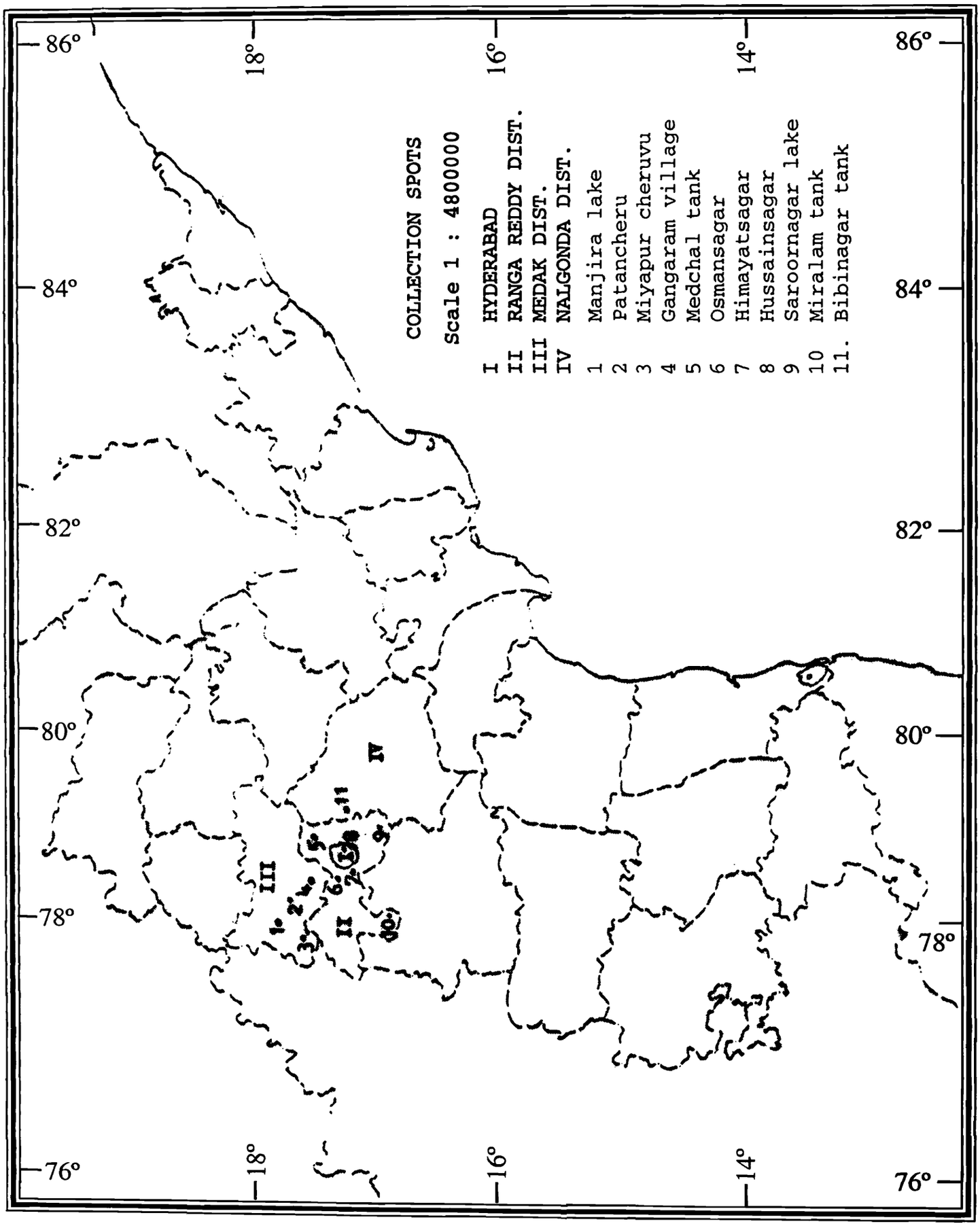
INTRODUCTION

Hyderabad, the historical city of lakes and gardens, can be called as 'Limnological capital of India', due to its sheer number of major and minor water bodies (approximately 170) in its metropolitan limits. The city of Hyderabad was founded on the bank of river Musi in the year 1591 AD by Sultan Mohd. Quli Qutubshah, the 5th ruler of Kutubsahi dynasty and today it is the 5th largest Metropolitan city in India. The Musi river flowing through the city is one of the major tributaries of the Krishna river. River Musi is heavily contaminated with domestic sewage and industrial effluents loaded with toxic chemicals and metals. The river traverses a distance of about 15 km through the heart of Hyderabad and lies between 17°21" to 17°24" N and 78°25" to 78°32" E. There is no regular flow of water in the river from the upstream due to the construction of two reservoirs like Osmansagar and Himayatsagar which are the major sources of supply of drinking water to the city.

Ahson Mohammed (1980), Jaya Devi (1985), Chandrasekhar (1997), Malathi (2002) made some of the major contributions on the ecological studies of the lakes in Hyderabad and its surroundings in which the composition of the cladoceran fauna was emphasized. Some major contributions on the cladoceran fauna in particular, of these water bodies have been confined to Patil (1986), Siddiqi and Chandrasekhar (1993), Chandrasekhar (1995, 1996 and 1998) and Chandrasekhar and Kodarkar (1994). Out of the 111 species available in India and 44 in Andhra Pradesh, 30 species have been reported from water bodies in and around Hyderabad.

Since, no comprehensive report on the cladoceran composition of the water bodies in and around Hyderabad, is available, the author has studied and reported here 30 species (including two subspecies) belonging to 17 genera spread over five families. The study had been carried out by the author from the plankton collections of the water bodies of Hyderabad and its neighborhood and also literature available in Freshwater Biological Station (FBS), Zoological Survey of India (ZSI), Hyderabad. These water bodies include Hussainsagar, Himayatsagar, Osmansagar, Mir Alam tank, Manjira lake, Patancheru tank, Saroornagar lake, Miyapur cheruvu, Gangaram village tank, Bibinagar tank, Medchal tank and some fish farms.

KEY WORDS : Cladocera, Water body, Environment, Hyderabad.


COLLECTION SPOTS
Scale 1 : 4800000
I HYDERABAD
II RANGA REDDY DIST.
III MEDAK DIST.
IV NALGONDA DIST.
1 Manjira lake
2 Patancheru
3 Miyapur cheruvu
4 Gangaram village
5 Medchal tank
6 Osmansagar
7 Himayatsagar
8 Hussainsagar
9 Saroornagar lake
10 Miralam tank
11. Bibinagar tank
86°
84°
82°
80°
78°
76°
18°
16°
14°

Map 1.

Hussainsagar : This lake situated between the twin cities of Hyderabad and Secunderabad, was excavated in 1562 AD mainly to store drinking water brought from Musi river by Balakpur canal. However, with the passage of time the lake lost its importance as a source of potable water. Nevertheless, it was extensively used for washing, bathing and recreation. The lake has got polluted due to industrialisation surrounding its basin and also urbanisation. Its water shed area is 275 sq km., length 3.2 km, width 2.8 km and maximum depth is 12.5m.

Himayatsagar : This water body was constructed in 1926 on the tributary of Musi river and its catchment (1,307 sq km) is made of rocky undulating ground. This water body is 19 km on the south-western side of the city. This is also one of the drinking water sources to the twin cities at present. Its surface area is 21 sq. km, maximum depth 23.9 m., length 7.8 km and width is 4.2 km.

Osmansagar : This reservoir built in 1920 on Musi river system was mainly to control floods and provide drinking water to the twin cities. This ecosystem is about 18 kms on western side of the city. This is one of the drinking water sources to the twin cities even today. This has scrub jungles and the forest of Anantagiri hills at its origin and aerable agricultural land along the course of the water body. Its catchment area is 740 sq km., surface area 22 sq km., maximum depth 31.7 m, length 8.8 km and width 5.1 km.

Mir alam tank : Constructed in 1806, was one of the oldest tanks created on Musi river system and the only multiarch (21 arches) dam of its kind in the world. It is about 7 km south-west of the city. The water body was used as a source of drinking water upto 1960 by the Rajendranagar surroundings. Presently the water has become the main source of water to the Nehru Zoological Park and its surroundings. Its surface area 1.7 sq km., maximum depth 13.41 m, and catchment area 16.5 sq km. The catchment is made of rocky undulating terrain.

Saroornagar lake : Impounded in 1626 AD Saroornagar lake was mainly meant for agricultural and drinking purposes and is one of the major aquatic ecosystems on the Vijayawada Highway in about 8 km on the eastern side of Hyderabad city. Its water spread area is 35 ha., maximum depth 6.1 m. Presently, due to growing urbanisation the catchment has undergone drastic changes with the consequent effects on the ecosystem. Scientifically speaking, the lake has got aquacultural, ecological and recreational potential.

Manjira lake : This water body is situated near the village, Kalabgur near Sangareddy town in Medak District of Andhra Pradesh and is about 58 km North-West side of Hyderabad city. After the construction of a barrage on Manjira lake near Sangareddy town in 1965, this has become a reservoir and one of the main sources of drinking water to the twin cities. Its catchment area is about 1680 sq km., maximum depth is 4.0 m approximately and the catchment area is about 1896 hectares.

Medchal Tank : This is an irrigation tank situated in Medchal Mandal of Ranga Reddy District, about 30 km. from Hyderabad city, on its north-west direction on Nagpur High way.

Patancheru, Miyapur tank and Gangaram Village tanks : These are small water bodies located at about 30–40 km. from Hyderabad city near its Mumbai High Way in Medak District. Bibinagar tank is also a small water body, situated at about 30 km. from Hyderabad city in Nalgonda district near Vijayawada High Way.

MATERIAL AND METHODS

The present study had been undertaken with the help of the plankton samples, collected since 1979 by the scientists of Freshwater Biological Station, Zoological Survey India, Hyderabad, available in the station and also from literature. In order to study the cladoceran fauna of the milieu, the author has limited the study to the collections of the water bodies located approximately with in 60 km. radius from the Centre point of Hyderabad city. These water bodies include Hussainsagar, Himayatsagar, Osmansagar, Mir alam tank, Patancheru tank, Saroornagar lake, Miyapur cheruvu, Gangaram village tank, Bibinagar tank, Medchal tank and some fish farms.

During the course of limnological investigations of water bodies of Hyderabad and its neighborhood, the scientists of Freshwater Biological Station (FBS), Zoological Survey of India (ZSI), Hyderabad, have collected since, 1979, some plankton samples and deposited in the National Zoological Collections of the station. These collections were made by towing the plankton net (No. 25) on the littoral zone of these water bodies and these plankton collections were preserved in 5% formaldehyde solution. The author had studied the cladoceran fauna from these samples with aid of standard literature on the group *viz.*, Michael and Sharma (1983), Battish (1992). A study on the cladoceran fauna of Hyderabad and its surroundings is given here from the results of this study as well as the available literature on the area.

LIST OF CLADOCERA IDENTIFIED

Family SIDIDAE Baird, 1850

Pseudosida bidentata Herrick, 1884

Material examined : Hussainsagar – 23.IV.92; Female; Coll. S. V. A. Chandrasekhar.

Status : Rare.

Length : 0.8 mm.

Distribution : INDIA : Burnihat, Nandalur and Karikal, Rajasthan.

Diaphanosoma sarsi Richard, 1894

Material examined : Patancheru – 9.III.1983; Female; Coll. S. G. Patil.

Osmansagar – 4.III.1992; Female; Coll. S. V. A. Chandrasekhar.

Status : Common.

Length : 0.33–0.9 mm.

Distribution : INDIA : Bihar, Rajasthan, Meghalaya and West Bengal.

Diaphanosoma excism Sars, 1885

Material examined : Manjira lake – Female; 26.XI,1981; Coll. M. B. Rao.
Hussainsagar – Female; 30.IV.1992; Coll. S. G. Patil.
Osmansagar – Female; 12.XI.1992; Coll. S. V. A. Chandrasekhar.

Status : Common.

Length : 0.27–0.79 mm.

Distribution : INDIA : West Bengal, Rajasthan and Bihar.

Family DAPHNIIDAE Straus, 1820

Ceriodaphnia cornuta Sars, 1885

Material examined : Manjira lake – Female; 4.VI.1981; Coll. M. B. Rao.
Patancheru – Female; 9.III.1983; Coll. S. G. Patil.
Osmansagar – Female; 12.XI.1992; Coll. S. V. A. Chandrasekhar.

Status : Abundant.

Length : 0.32–0.38 mm.

Distribution : Widely distributed species.

Ceriodaphnia reticulata (Jurine, 1820)

Material examined : Osmansagar – Female; 4.III.1992; Coll. S. V. A. Chandrasekhar.

Status : Uncommon.

Length : 0.75 mm.

Distribution : INDIA : Rajasthan and Bihar.

Ceriodaphnia laticaudata P. E. Muller, 1867

Material examined : Saroornagar lake – Female; 4.V.1995; Coll. S. V. A. Chandrasekhar.

Status : Rare.

Length : 0.65 mm.

Distribution : INDIA : Pune, Simla, Rajasthan.

Daphnia carinata King, 1853

Material examined : This species had not been observed in the collections of the station, but collected by Dr. Bhimachar on 20.X.1970 from Hyderabad fish farm (Michael and Sharma, 1988, p. 60).

Status : Rare.

Length : ?

Distribution : INDIA : Simla, Mysore, Banaras, Meerut and Surat, Rajasthan, Tamilnadu, Bihar and West Bengal.

Daphnia lumholtzi Sars, 1885.

Material examined : This species had not been observed in the collections of the station, but collected by Fisheries Extension Unit from Hyderabad fish seed farm and Brehm, 1953 found from Hyderabad (Michael and Sharma, 1988, p. 64-66); Date ?

Status : Uncommon.

Length : ?

Distribution : INDIA : West Bengal, Cuttack (Orissa), Hyderabad and Golconda (A. P.), Rajasthan, Tamilnadu.

Scapholeberis kingi Sars, 1903b

Material examined : This species had not been observed in the collections of the station, but found by Jaya Devi (1985) from Himayatsagar and Osmansagar lakes; Date ?

Status : Uncommon.

Length : ?

Distribution : INDIA : West Bengal, Kashmir & Nilgiri Hills, Rajasthan, Meghalaya and Assam.

Simocephalus vetulus (O. F. Muller, 1776)

Material examined : Manjira lake – Female; 4.VI.1981; Coll. M. B. Rao.

Hussainsagar – Female; 23.IV.92; Coll. S. V. A. Chandrasekhar

Status : Common.

Length : 0. 75–1.3 mm.

Distribution : INDIA : Punjab, Kashmir, Mysore, Bihar and West Bengal.

Family MOINIDAE

Moina micrura Kurz, 1874

Material examined : Manjira lake – Female; 13.I.1982; Coll. M. B. Rao.
Saroornagar lake – Female; 23.IV.1994; Coll. S. V. A. Chandrasekhar.

Status : Common.

Length : 0. 6–0.9 mm.

Distribution : INDIA : Nilgiri Hills, Bijapur, Rajasthan, Punjab, Bihar and West Bengal.

Moina brachiata (Jurine, 1820)

Material examined : Hussainsagar – Female; 23.IV.1992; Coll. S. V. A. Chandrasekhar.
Osmansagar – Female; 12.XI.1992; Coll. S. V. A. Chandrasekhar.
Saroornagar lake – Female; 23.IV.1994; Coll. S. V. A. Chandrasekhar.

Status : Common.

Length : 0.29–0.75 mm.

Distribution : INDIA : Kashmir, Rajasthan and Meghalaya.

Moinodaphnia macleayi (King, 1853)

Material examined : Osmansagar – Female; 4.III.1992; Coll. S. V. A. Chandrasekhar.
Hussainsagar – Female; 23.IV.1992; Coll. S. V. A. Chandrasekhar.

Status : Rare.

Length : 0.3–0.8 mm.

Distribution : INDIA : South India and West Bengal.

Family MACROTHRICIDAE Norman and Brady, 1867

Macrothrix spinosa King, 1853

Material examined : Miyapur cheruvu and Gangaram village – Females; 2.III.1983; Coll. S. G. Patil.
Hussainsagar – Females; 23.IV.1992; Coll. S. V. A. Chandrasekhar.

Status : Uncommon.

Length : 0.45–0.9 mm.

Distribution : INDIA : Rajasthan and Manipur.

Streblocerus serricaudatus (Fischer, 1849)

Material examined : Mir alam tank – Female; 18.IX.1982; Coll. S. G. Patil.

Osmansagar – Female; 4.III.1992; Coll. S. V. A. Chandrasekhar.

Status : Uncommon.

Length : 0.5–0.8 mm.

Distribution : INDIA : Rajasthan and Manipur.

Family CHYDORIDAE Stebbing, 1902

Subfamily CHYDORINAE Stebbing, 1902

Pleuroxus aduncus (Jurine, 1820)

Material examined : Manjira lake – Female; 13.I.1982; Coll. S. G. Patil.

Jaya Devi (1985) collected from Himayatsagar and Osmansagar lakes.

Status : Uncommon.

Length : 0.24 mm.

Distribution : INDIA : Punjab and Rajasthan.

Alonella excisa (Fischer, 1854)

Material examined : Himayatsagar – Female; 10.VIII.1990; Coll. A. K. Pandey.

Status : Rare.

Length : 0.39 mm.

Distribution : INDIA : Madhya Pradesh and Kashmir.

Alonella nana (Baird, 1843)

Material examined : Himayatsagar – Female; 10.VIII.1990; Coll. A. K. Pandey.

Status : Rare.

Length : 0.45 mm.

Distribution : INDIA : Kashmir.

Chydorus sphaericus (O. F. Muller, 1776)

Material examined : Manjira lake – Female; 26.XI.1981; Coll. M. B. Rao.

Osmansagar – Female; 4.III.1992; Coll. S. V. A. Chandrasekhar.

Status : Common.

Length : 0.2–0.45 mm.

Distribution : INDIA : Kashmir.

Chydorus parvus (Daday, 1898)

Material examined : Himayatsagar – Female; 10.VIII.1990; Coll. A. K. Pandey.

Status : Uncommon.

Length : 0.45 mm.

Distribution : INDIA : Irinjalayakuda, Kerala; Chennai and Kolleru lake from Andhra Pradesh.

Chydorus reticulatus Daday, 1898

Material examined : Bibinagar tank – Female; 10.III.1983; S. G. Patil.
Jaya Devi (1985) collected from Himayatsagar and Osmansagar lakes.

Status : Rare.

Length : 0.28 mm.

Distribution : INDIA : Rajasthan and Hyderabad.

Subfamily ALONINAE

Alona quadrangularis (O. F. Muller, 1776)

Material examined : Medchal tank – Female; 12.I.1990; Coll. Ramakrishna.

Status : Rare.

Length : 0.72 mm.

Distribution : INDIA : Kali Pokhri, West Bengal and South India.

Alona rectangula rectangula Sars, 1862

Material examined : Mir alam tank – Female; 18.X.1982; Coll. S. G. Patil.
Osmansagar – Female; 4.III.1992; Coll. S. V. A. Chandrasekhar.

Status : Uncommon.

Length : 0.31–0.36 mm.

Distribution : INDIA : Ladakh, Gujarat, Rajasthan, Meghalaya, Kashmir and West Bengal.

Alona rectangula richardi (Stingelin, 1895)

Material examined : Manjira lake – Female; 4.VI.1981; Coll. M. B. Rao.
Saroornagar lake – Female; 27.XI.1994; Coll. S. V. A. Chandrasekhar.

Status : Common.

Length : 0.24–4.0 mm.

Distribution : INDIA : West Bengal.

Alona davidi davidi (Richard, 1895)

Material examined : Manjira lake – Female; 26.XI.1981; Coll. M. B. Rao.

Status : Rare.

Length : 0.2 mm.

Distribution : INDIA : West Bengal.

Alona davidi punctata (Day, 1898)

Material examined : Manjira lake – Female; 4.VI.1981; Coll. S. V A. Chandrasekhar.

Status : Uncommon.

Length : 0.23 mm.

Distribution : INDIA : West Bengal.

Alona pulchella King, 1853

Material examined : Saroornagar lake – Female; 20.XII.1984; Coll. Uday Vaikunth.

Status : Rare.

Length : 0.36 mm.

Distribution : INDIA : West Bengal.

Graptolebris testudinaria (Fischer, 1851)

Material examined : Himayatsagar – Female; 10.VIII.1990; Coll. A. K. Pandey.

Status : Rare.

Length : 0.72 mm.

Distribution : INDIA : Kashmir and Kumaon (Western Himalaya).

Biapertura affinis (Leydig, 1860)

Material examined : Manjira lake – Female; 13.I.1982; Coll. M. B. Rao.

Status : Uncommon.

Length : 0.23 mm.

Distribution : INDIA : Kashmir, Gujarat and West Bengal.

Kurzia longirostris (Daday, 1898)

Material examined : Medchal tank – Female; 12.I.1990; Coll. Ramakrishna.

Status : Rare.

Length : 0.4 mm.

Distribution : INDIA : West Bengal.

Among the above 30 species, Brehm (1953) first recorded *Moinodaphnia macleayi* as rare species in India. *Streblocerus serricaudatus, Alonella excisa, A. nana, Alona rectangula rectangula, A. rectangula richardi, A. davidi davidi, A. davidi punctata, A. pulchella* and *Graptolebris testudinaria* have extended their distribution to South India. The relative abundance of cladocerans, particularly the members of Chydoridae indicates the eutrophic conditions of a water body, resulting from organic pollution (Khan and Seshagiri Rao, 1981). According to Das (1989) *Chydorus sphaericus* and *Simocephalus* sp., are the chief representatives of Oligotrophic lakes and the presence of genera *viz.*, *Daphnia, Moinadaphnia, Ceriodaphnia* and *Diaphanosoma* indicates eutrophic state. By going through the cladoceran composition, most of these lakes can be classified as eutrophic.

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SUMMARY

The author has made studies on the cladoceran fauna of Hyderabad and its environs with the aid of plankton collections from the water bodies (Hussainsagar, Himayatsagar, Osmansagar, Mir alam tank, Patancheru tank, Saroornagar lake, Miyapur cheruvu, Gangaram village tank, Bibinagar

tank, Medchal tank and some fish farms) and also from the literature available. The study revealed 30 species (including two subspecies) belonging to 17 genera spread over five families of Cladocera from the environment, available at FBS, ZSI, Hyderabad. Details of material examined, status, Distribution ... *etc.*, have been discussed.

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APHIDS ON MEDICINAL PLANTS IN NORTH EAST INDIA (INSECTA : HOMOPTERA : APHIDIDAE)

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INTRODUCTION

India, one of the 12 Megadiversity countries, has an estimated plant species of over 45,000 out of which about 15,000 + 2000 constitute the flowering plants distributed in phyto zones ranging from Alpine Himalayas to deserts of Thar, "Hot spots" of Northeast India and Western Ghats, the sweet and saline water plants, the plants of plains and plateaus, hills and hillocks, valleys and vantages etc. (Hazra and Chakravorty, 1997).

The present paper provides a complete list of Aphids infesting the medicinal plants of Northeast India where aphids are represented by 414 species and subspecies (Ghosh and Singh, 2000). 90 species/subspecies of aphids infest medicinal plants belonging to 95 species under 50 plant families. The present communication also includes the list of medicinal plants (arranged alphabetically with family name) infested by the aphids in the target area. In this work, the texts are arranged in two sections. In Section I, aphids are arranged according to their subfamilies as has been followed by Remaudiere and Remaudiere (1997) and in Section II, medicinal plants are arranged alphabetically with respective plant family. In Section I, under each subfamily the aphid 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 also after Chopra *et al.* (1956).

SYSTEMATIC ACCOUNT

SECTION-1

Aphid-Medicinal Plant List

Subfamily ANOECIINAE

1. *Aiceona retipennis* David

   Buddleja asiatica (Buddlejaceae)

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Subfamily APHIDINAE

2. *Acyrthosiphon pisum* (Harris)

   Pisum sativam (Fabaceae)

3. *Akkaia bengalensis* Basu

   Polygonum glabrum (Polygonaceae)

4. *Akkaia sikkimensis* Agarwala & Raychaudhuri

   Raphanus sativus (Cruciferae)

5. *Aphis achyranthi* Theobald

   Punica granatum (Punicaceae)

6. *Aphis asclepiadis* Fitch

   Cryptostegia grandiflora (Periplocaceae)

7. *Aphis (Protaphis) carthami* (Das)

   Veronia cinerea (Asteraceae)

8. *Aphis craccivora* Koch

   Achyranthes aspera (Amaranthaceae), *Alstonia scholaris* (Apocynaceae), *Boerhavia diffusa* (Nyctaginaceae), *Carican papaya* (Caricaceae), *Hibiscus rosasinensis* (Malvaceae), *Holoptelea integrifolia* (Ulmaceae), *Mangifera indica* (Anacardiaceae), *Mimosa pudica* (Fabaceae), *Phaseolus vulgaris* (Fabaceae), *Pisum sativum* (Fabaceae), *Plumbago zeylanica* (Plumbaginaceae), *Raphanus sativus* (Cruciferae), *Sesamum indicum* (Pedaliaceae), *Solanum melongena* (Solanaceae), *Solanum nigrum* (Solanaceae), *Tephrosia purpurea* (Fabaceae), *Tinospora cordifolia* (Menispermaceae), *Tribulus terrestris* (Zygophylaceae), *Veronia cinerea* (Scrophulariaceae), *Zea mays* (Poaceae)

9. *Aphis fabae* Complex

   Eclipta alba (Asteraceae), *Hibiscus rosasinensis* (Malvaceae), *Michelia champaka* (Magnoliaceae), *Momordica charantia* (Cruciferae), *Punica granatum* (Punicaceae), *Rubia cordifolia* (Rubiaceae), *Solanum melongena* (Solanaceae), *Solanum nigrum* (Solanaceae)

10. *Aphis gossypii* Glover

    Achyranthes aspera (Amaranthaceae), *Allium cepa* (Alliaceae), *Argemone mexicana* (Papaveraceae), *Abroma augusta* (Sterculiaceae), *Buddleja asiatica* (Buddlejaceae), *Calicarpa macrophylla* (Verbenaceae), *Carican papaya* (Caricaceae), *Cryptostegia grandiflora* (Periplocaceae), *Clerodendron serratum* (Verbenaceae), *Cuscuta reflexa* (Cuscutaceae), *Cyperus rotundus* (Cyperaceae), *Eclipta alba* (Asteraceae), *Eleusine coracana* (Poaceae), *Ficus bengalensis* (Moraceae), *Gossypium arboreum* (Malvaceae),

Hibiscus sabdariffa (Malvaceae), *Holoptelea integrifolia* (Ulmaceae), *Ichnocarpus frutescens* (Apocynaceae), *Ixora coccinea* (Rubiaceae), *Impatiens balsamina* (Balsaminaceae), *Lawsonia innermis* (Lythraceae), *Luffa acutangula* (Cruciferae), *Mangifera indica* (Anacardiaceae), *Mentha arvensis* (Lamiaceae), *Mimosa pudica* (Fabaceae), *Michelia champaka* (Magnoliaceae), *Momordica charantia* (Cruciferae), *Morus alba* (Moraceae), *Musa paradisiaca* (Musaceae), *Ocimum basilicum* (Lamiaceae), *Ocimum sanctum* (Lamiaceae), *Psidium guajava* (Myrtaceae), *Paederia foetida* (Rubiaceae), *Piper betle* (Piperaceae), *Punica granatum* (Punicaceae), *Raphanus sativus* (Cruciferae), *Rosa alba* (Rosaceae), *Rubia cordifolia* (Rubiaceae), *Saccharum officinarum* (Poaceae), *Solanum melongena* (Solanaceae), *Solanum nigrum* (Solanaceae), *Solanum xanthocarpum* (Solanaceae), *Tagetes erecta* (Asteraceae), *Veronia cinerea* (Asteraceae), *Verbena officinalis* (Verbenaceae), *Vitex negundo* (Verbenaceae), *Vitis vinifera* (Vitaceae), *Zingiber officinale* (Zingiberaceae)

11. *Aphis nasturtii* (Kaltenbach)

Achyranthes aspera (Amaranthaceae), *Hibiscus rosasinensis* (Malvaceae), *Impatiens balsamina* (Balsaminaceae), *Mentha arvensis* (Lamiaceae), *Michelia champaka* (Magnoliaceae), *Momordica charantia* (Cruciferae), *Solanum melongena* (Solanaceae), *Woodfordia fruiticosa* (Lythraceae)

12. *Aphis nerii* (Boyer de Fonscolombe)

Cryptostegia grandiflora (Periplocaceae), *Daemia extensa* (Asclepiadaceae), *Dregea volubulis* (Asclepiadaceae), *Gymnema sylvestre* (Asclepiadaceae)

13. *Aphis spiraecola* Patch

Adhatoda vasica (Acanthaceae), *Alstonia scholaris* (Apocynaceae), *Boerhavia diffusa* (Nyctaginaceae), *Eleusine coracana* (Poaceae), *Hibiscus rosasinensis* (Malvaceae), *Hibiscus sabdariffa* (Malvaceae), *Ichnocarpus frutescens* (Apocynaceae), *Impatiens balsamina* (Balsaminaceae), *Melia azedarach* (Meliaceae), *Momordica charantia* (Cruciferae), *Morus alba* (Moraceae), *Psidium guajava* (Myrtaceae), *Paederia foetida* (Rubiaceae), *Punica granatum* (Punicaceae), *Raphanus sativus* (Cruciferae), *Rubia cordifolia* (Rubiaceae), *Solanum melongena* (Solanaceae), *Solanum nigrum* (Solanaceae), *Terminalia arjuna* (Combretaceae), *Woodfordia fruticosa* (Lythraceae)

14. *Aphis umbrella* (Börner)

Hibiscus rosasinensis (Malvaceae), *Momordica charantia* (Cruciferae), *Solanum nigrum* (Solanaceae), *Withania somonifera* (Solanaceae)

15. *Aphis verbasci* (Schrank)

Cedrus deodara (Pinaceae)

16. *Aulacorthum circumflexum* (Buckton)

    Achyranthes aspera (Amaranthaceae), *Hibiscus rosasinensis* (Malvaceae), *Polygonum glabrum* (Polygonaceae), *Solanum melongena* (Solanaceae), *Solanum nigrum* (Solanaceae)

17. *Aulacorthum magnoliae* (Essig and Kuwana)

    Luffa acutangula (Cruciferae)

18. *Aulacorthum nipponicum* (Essig and Kuwana)

    Paederia foetida (Rubiaceae)

19. *Aulacorthum solani* (Kaltenbach)

    Hibiscus rosasinensis (Malvaceae), *Solanum melongena* (Solanaceae)

20. *Brachycaudus helichrysi* (Kaltenbach)

    Eleusine coracana (Poaceae), *Mangifera indica* (Anacardiaceae), *Punica granatum* (Punicaceae), *Rubia cordifolia* (Rubiaceae), *Solanum melongena* (Solanaceae), *Solanum xanthocarpum* (Solanaceae)

21. *Capitophorus hippophaes javanicus* H.R.L.

    Polygonum glabrum (Polygonaceae)

22. *Capitophorus mitegoni* Eastop

    Polygonum glabrum (Polygonaceae)

23. *Cavariella aegopodii* (Scopoli)

    Zingiber officinale (Zingiberaceae)

24. *Coloradoa artemisicola* Takahashi

    Adhatoda vasica (Acanthaceae)

25. *Dysaphis foeniculus* (Theobald)

    Foeniculum vulgare (Umbelliferae)

26. *Hyalopterus pruni* (Geoffroy)

    Phaseolus vulgaris (Fabaceae)

27. *Hyadaphis coriandri* (Das)

    Daucus carota (Umbelliferae), *Foeniculum vulgare* (Umbelliferae)

28. *Hysteroneura setariae* (Thomas)

    Eleusine coracana (Poaceae), *Paspalum scrobiculatum* (Poaceae), *Cyperus rotundus* (Cyperaceae), *Plumbago zeylanica* (Plumbaginaceae), *Punica granatum* (Punicaceae), *Saccharum officinarum* (Poaceae), *Triticum aestivum* (Poaceae), *Zea mays* (Poaceae)

29. *Impatientinum asiaticum dahousiensis* Verma

    Impatiens balsamina (Balsaminaceae)

30. *Lipaphis erysimi* (Kaltenbach)

    Foeniculum vulgare (Umbelliferae), *Lepidium sativum* (Cruciferae), *Raphanus sativus* (Cruciferae), *Sesamum indicum* (Pedaliaceae), *Solanum melongena* (Solanaceae), *Withania somonifera* (Solanaceae)

31. *Liosomaphis himalayensis* Basu

    Raphanus sativus (Cruciferae)

32. *Macrosiphum centranthi* Theobald

    Mangifera indica (Anacardiaceae), *Pisum sativum* (Fabaceae)

33. *Macrosiphum euphorbiae* (Thomas)

    Mangifera indica (Anacardiaceae)

34. *Macrosiphum pachysiphon* H.R.L.

    Triticum aestivum (Poaceae)

35. *Megoura dooarsis* (Ghosh & Raychaudhuri)

    Tephrosia purpurea (Fabaceae)

36. *Melanaphis sacchari* (Zehntner)

    Eleusine coracana (Poaceae)

37. *Micromyzodium filicium* David

    Punica granatum (Punicaceae)

38. *Myzus ornatus* Laing

    Hibiscus mutabilis (Malvaceae), *Hibiscus rosasinensis* (Malvaceae), *Ocimum sanctum* (Lamiaceae), *Punica granatum* (Punicaceae), *Raphanus sativus* (Cruciferae), *Solanum melongena* (Solanaceae), *Solanum nigrum* (Solanaceae), *Urena lobata* (Malvaceae)

39. *Myzus persicae* (Sulzer)

    Boerhavia diffusa (Nyctaginaceae), *Carican papaya* (Caricaceae), *Cuscuta reflexa* (Cuscutaceae), *Datura metel* (Solanaceae), *Daucus carota* (Umbelliferae), *Hibiscus mutabilis* (Malvaceae), *Hibiscus rosasinensis* (Malvaceae), *Lepidium sativum* (Cruciferae), *Momordica charantia* (Cruciferae), *Musa paradisiaca* (Musaceae), *Phaseolus vulgaris* (Fabaceae), *Pisum sativum* (Fabaceae), *Psidium guajava* (Myrtaceae), *Punica granatum* (Punicaceae), *Raphanus sativus* (Cruciferae), *Sesamum indicum* (Pedaliaceae), *Solanum melongena* (Solanaceae), *Solanum nigrum* (Solanaceae), *Withania somonifera* (Solanaceae)

40. *Myzus dycei* Carver

    Raphanus sativus (Cruciferae)

41. *Myzakkaia verbasci* (Chowdhuri *et al.*)

    Rubia cordifolia (Rubiaceae)

42. *Neomasonaphis anaphalidis* (Basu)

    Morus alba (Moraceae)

43. *Ovatus crataegarius* (Walker)

    Mentha arvensis (Labiatae)

44. *Pentalonia nigronervosa* Coquerel

    Musa paradisiaca (Musaceae), *Psidium guajava* (Myrtaceae)

45. *Rhopalosiphum maidis* (Fitch)

    Cyperus rotundus (Cyperaceae), *Paspalum scrobiculatum* (Poaceae), *Saccharum officinarum* (Poaceae), *Setaria italica* (Poaceae), *Terminalia arjuna* (Combretaceae), *Triticum aestivum* (Poaceae), *Zea mays* (Poaceae)

46. *Rhopalosiphum nymphaeae* (Linnaeus)

    Canna indica (Cannaceae), *Trapa bispinosa* (Trapaceae), *Vallisneria spiralis* (Hydrocharitaceae)

47. *Rhopalosiphum padi* (Linnaeus)

    Canna indica (Cannaceae), *Eleusine coracana* (Poaceae), *Triticum aestivum* (Poaceae), *Veronia cinerea* (Compositae), *Zea mays* (Poaceae)

48. *Rhopalosiphum rufiabdominalis* (Sasaki)

    Allium sativum (Alliaceae), *Cyperus rotundus* (Cyperaceae), *Eleusine coracana* (Poaceae), *Hibiscus rosasinensis* (Malvaceae), *Hibiscus sabdariffa* (Malvaceae), *Psidium guajava* (Myrtaceae), *Saccharum officinarum* (Poaceae), *Triticum aestivum* (Poaceae)

49. *Schizaphis rotundiventris* (Signoret)

    Cyperus rotundus (Cyperaceae)

50. *Schizaphis graminum* (Rondani)

    Triticum aestivum (Poaceae)

51. *Semiaphis heraclei* (Takahashi)

    Foeniculum vulgare (Umbelliferae)

52. *Sinomegoura citricola* (van der Goot)

Piper nigrum (Piperaceae)

53. *Sitobion leelamaniae* (David)

Eleusine coracana (Poaceae)

54. *Sitobion mimosae* (Ghosh *et al.*)

Mimosa pudica (Mimosae)

55. *Sitobion miscanthi* (Takahashi)

Cyperus rotundus (Cyperaceae), *Eleusine coracana* (Poaceae), *Saccharum officinarum* (Poaceae), *Triticum aestivum* (Poaceae), *Zea mays* (Poaceae)

56. *Sitobion rosaeformis* (Das)

Allium sativum (Alliaceae) (Vagrant), *Hibiscus rosasinensis* (Malvaceae) (Vagrant), *Pisum sativum* (Fabaceae) (Vagrant), *Rosa centifolia* (Rosaceae)

57. *Sitobion takahashii* (Eastop)

Mimosa pudica (Fabaceae)

58. *Subovatomyzus leucosceptri* (Basu)

Calicarpa macrophylla (Verbenaceae)

59. *Toxoptera aurantii* (Boyer de Fonscolombe)

Adhatoda vasica (Acanthaceae), *Aegle marmelos* (Rutaceae), *Carissa carandas* (Apocynaceae), *Eucalyptus globulus* (Myrtaceae), *Hibiscus rosasinensis* (Malvaceae), *Mangifera indica* (Anacardiaceae), *Momordica charantia* (Cruciferae), *Psidium guajava* (Myrtaceae), *Piper nigrum* (Piperaceae), *Saccharum officinarum* (Poaceae), *Tamarindus indica* (Fabaceae), *Veronia cinerea* (Asteraceae)

60. *Toxoptera citricidus* (Kirkaldy)

Mangifera indica (Anacardiaceae)

61. *Toxoptera odinae* (van der Goot)

Erythrina indica (Fabaceae), *Hibiscus rosasinensis* (Malvaceae), *Momordica charantia* (Cruciferae)

62. *Uroleucon compositae* (Theobald)

Veronia roxburghii (Asteraceae)

63. *Uroleucon (Uroleucon) jaceae* (Linnaeus)

Ficus religiosa (Moraceae)

64. *Uroleucon (Uromelan) minutum* (van der Goot)

Veronia cinerea (Asteraceae)

65. *Uvoleucon (Uromelan) pachysiphon* (Börner)

Triticum aestivum (Poaceae)

66. *Vesiculaphis caricis* (Fullaway)

Cyperus rotundus (Cyperaceae)

Subfamily DREPANOSIPHINAE

67. *Sipha maydis* (Passerini)

Saccharum officinarum (Poaceae)

68. *Taiwanaphis kalipadi* (Raychaudhuri & Ghosh)

Annona squamosa (Annonaceae)

69. *Therioaphis trifolii* (Monell)

Cyperus rotundus (Cyperaceae)

70. *Tinocallis kahawaluokalani* (Kirkaldy)

Woodfordia fruticosa (Lythraceae)

Subfamily GREENIDEINAE

71. *Eutrichosiphum pseudopassaniae* Szelegiewicz

Hibiscus rosasinensis (Malvaceae)

72. *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri

Syzigium jambos (Myrtaceae)

73. *Greenidea (Trichosiphum) formosana heeri* Raychaudhuri *et al.*

Syzigium jambos (Myrtaceae), *Psidium guajava* (Myrtaceae)

74. *Greenidea ficicola* Takahashi

Ficus bengalensis (Moraceae)

75. *Mollitrichosiphum (Metatrichosiphon) nandii* Basu

Clerodendron serratum (Verbenaceae)

76. *Schoutedenia ralumensis* Rubsaamen

Musa paradisiaca (Musaceae)

Subfamily HORMAPHIDINAE

77. *Ceratovacuna lanigera* Zehntner

Saccharum officinarum (Gramineae)

78. *Ceratovacuna perglandulosa* (Basu *et al.*)

Saccharum officinarum (Poaceae)

79. *Ceratovacuna silvestrii* (Takahashi)

Saccharum officinarum (Poaceae)

80. *Cerataphis fransseni* (Hille Ris Lambers)

Cocos nucifera (Palmae)

Subfamily LACHNINAE

81. *Cinara curvipes* (Patch)

Cedrus deodara (Pinaceae)

82. *Cinara indica* Verma

Cedrus deodara (Pinaceae)

83. *Paoliella nirmalae* (David)

Terminalia arjuna (Combretaceae)

84. *Formosaphis micheliae* (Takahashi)

Michelia champaka (Magnoliaceae)

85. *Geoica lucifuga* (Zehntner)

Cyperus rotundus (Cyperaceae)

86. *Tetraneura (Indotetraneura) basui* H. R. L.

Eleusine coracana (Poaceae)

87. *Tetraneura javensis* (v. d. Goot)

Eleusine coracana (Poaceae), *Saccharum officinarum* (Poaceae), *Setaria italica* (Poaceae)

88. *Tetraneura kalimpongensis* (Raychaudhuri *et al.*)

Saccharum officinarum (Poaceae)

89. *Tetraneura nigriabdominalis* (Sasaki)

Cyperus rotundus (Cyperaceae), *Eleusine coracana* (Poaceae), *Musa paradisiaca* (Musaceae), *Pisum sativum* (Fabaceae), *Saccharum officinarum* (Poaceae), *Setaria italica* (Poaceae), *Zea mays* (Poaceae)

90. *Tetraneura radicicola* (Strand)

Eleusine coracana (Poaceae)

SECTION-2

Medicinal plant – Aphid List :

Name of Plant	Plant Family	Aphid
1. *Achyranthes aspera*	Amaranthaceae	*Aphis craccivora* Koch, *A. gossypii* Complex, *A. nasturtii* Kaltenbach, *Aulacorthum (Neomyzus) circumflexum* (Buckton)
2. *Adhatoda vasica*	Acanthaceae	*Aphis spiraecola* Patch, *Coloradoa artemisicola* Takahashi, *Toxoptera aurantii* (B. d. Fonscolombe)
3. *Aegle marmelos*	Rutaceae	*Toxoptera aurantii* (B. d. Fonscolombe)
4. *Allium cepa*	Alliaceae	*Aphis gossypii* Complex, *Rhopalosiphum rufiabdominalis* (Sasaki)
5. *Allium sativum*	Alliaceae	*Macrosiphum* sp., *Rhopalosiphum rufiabdominalis* (Sasaki), *Sitobion rosaeformis* (Das) (Vagrant)
6. *Alstonia scholaris*	Apocynaceae	*Aphis craccivora* Koch, *A. spiraecola* Patch
7. *Argemone mexicana*	Papaveraceae	*Aphis gossypii* Complex
8. *Abroma augusta*	Sterculiaceae	*Aphis gossypii* Complex
9. *Boerhavia diffusa*	Nyctaginaceae	*Aphis craccivora* Koch, *Aphis spiraecola* Patch, *Myzus persicae* (Sulzer)
10. *Buddleja asiatica*	Buddlejaceae	*Aiceona retipennis* David, Narayanan and Rajasingh, *Aphis gossypii* Glover
11. *Calicarpa macrophylla*	Verbenaceae	*Aphis gossypii* Glover, *Subovatomyzus leucosceptri* Basu
12. *Canna indica*	Cannaceae	*Rhopalosiphum nymphaeae* (Linnaeus), *Rhopalosiphum padi* (Linnaeus)
13. *Carican papaya*	Caricaceae	*Aphis craccivora* Koch, *Aphis gossypii* Glover, *Myzus persicae* (Sulzer)
14. *Carissa carandas*	Apocynaceae	*Taxoptera aurantii* (B. d. F.)
15. *Cedrus deodara*	Pinaceae	*Aphis spiraecola* Patch, *Aphis verbasci* Schrank, *Cinara curvipes* (Patch), *Cinara indica* Verma

16. *Cocos nucifera*	Palmae	*Cerataphis fransseni* (Hille Ris Lambers)
17. *Cryptostegia grandiflora*	Periplocaceae	*Aphis asclepiadis* Fitch, *Aphis gossypii* Glover, *Aphis nerii* B. d. Fonscolombe
18. *Clerodendron serratum*	Verbenaceae	*Aphis gossypii* Complex, *Mollitrichosiphum (Metatrichosiphon) nandii* Basu
19. *Cuscuta reflexa*	Cuscutaceae	*Aphis gossypii* Complex, *Myzus persicae* (Sulzer)
20. *Cyperus rotundus*	Cyperaceae	*Aphis gossypii* Complex, *Geoica lucifuga* (Zehntner), *Hysteroneura setariae* (Thomas), *Rhopalosiphum maidis* (Fitch), *Rhopalosiphum rufiabdominalis* (Sasaki), *Schizaphis rotundiventris* (Signoret), *S. graminum* (Rondani), *Sitobion miscanthi* (Takahashi), *Tetraneura nigriabdominalis* (Sasaki), *Therioaphis trifolii* (Monell), *Therioaphis ononidis* (Kaltenbach), *Vesiculaphis caricis* (Fullaway)
21. *Daemia extensa*	Asclepiadaceae	*Aphis asclepiadis* Fitch, *Aphis nerii* B.d.F.
22. *Datura metel*	Solanaceae	*Myzus persicae* (Sulzer)
23. *Daucus carota*	Umbelliferae	*Hyadaphis coriandri* (Das), *Myzus persicae* (Sulzer)
24. *Dregea volubulis*	Asclepiadaceae	*Aphis nerii* B.d. Fonscolombe
25. *Eclipta alba*	Asteraceae	*Aphis fabae* Complex, *Aphis gossypii* Complex
26. *Eleusine coracana*	Poaceae	*Aphis gossypii* Glover, *A. spiraecola* Patch, *Brachycaudus helichrysi* (Kalt.), *Geoica lucifuga* (Zehntner), *Hysteroneura setariae* (Thomas), *Melanaphis sacchari* (Zehntner), *Rhopalosiphum padi* (Linnaeus), *R. rufiabdominalis* (Sasaki), *Schizaphis graminum* (Rondani), *Sitobion leelamaniae* (David), *Sitobion miscanthi* (Takahashi), *Tetraneura (Indotetraneura) basui* H.R.L, *Tetraneura (Indotetraneura) javensis* v.d. Goot, *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki), *T radicicola* Strand

27. *Erythrina indica*	Fabaceae	*Toxoptera odinae* (van der Goot)
28. *Eucalyptus globulus*	Myrtaceae	*Aphis nasturtii* Kaltenbach, *Toxoptera aurantii* (B.d. Fonscolombe)
29. *Syzygium jambos*	Myrtaceae	*Greenidea (Trichosiphum) formosana heeri* Raychaudhuri *et al.*, *Greenidea (Trichosiphum) bucktonis* Ghosh, Basu and Raychaudhuri
30. *Ficus bengalensis*	Moraceae	*Aphis gossypii* Complex, *Greenidea ficicola* Takahashi
31. *Ficus religiosa*	Moraceae	*Uroleucon (Uromelan) jaceae* (Linnaeus)
32. *Foeniculum vulgare*	Umbelliferae	*Dysaphis foeniculus* (Theobald), *Hyadaphis coriandri* Das, *Lipaphis erysimi* (Kaltenbach), *Semiaphis heraclei* (Takahashi)
33. *Gossypium arboreum*	Malvaceae	*Aphis gossypii* Glover
34. *Gymnema sylvestre*	Asclepiadaceae	*Aphis nerii* B.d. Fonscolombe
35. *Hibiscus mutabilis*	Malvaceae	*Myzus ornatus* Laing, *Myzus persicae* (Sulzer)
36. *Hibiscus rosasinensis*	Malvaceae	*Aphis craccivora* Koch, *Aphis fabae* Complex, *Aphis gossypii* Complex, *Aphis nasturtii* Kaltenbach, *Aphis spiraecola* Patch, *A. umbrella* (Borner), *Aulacorthum solani* (Kaltenbach), *Eutrichosiphum pseudopassaniae* Szelegicwicz, *Sitobion rosaeformis* (Das) (vagrant), *Myzus ornatus* Laing, *Myzus persicae* (Sulzer), *Aulacorthum (Neomyzus) circumflexum* (Buckton), *Rhopalosiphum rufiabdominalis* (Sasaki), *Toxoptera aurantii* (B.d. F.), *Toxoptera odinae* (van der Goot)
37. *Hibiscus sabdariffa*	Malvaceae	*Aphis gossypii* Complex, *Aphis spiraecola* Patch, *Rhopalosiphum rufiabdominalis* (Sasaki)
38. *Holoptelea integrifolia*	Ulmaceae	*Aphis craccivora* Koch, *Aphis gossypii* Complex

39. *Ichnocarpus frutescens*	Apocynaceae	*Aphis gossypii* Complex, *Aphis spiraecola* Patch
40. *Ixora coccinea*	Rubiaceae	*Aphis gossypii* Complex
41. *Impatiens balsamina*	Balsaminaceae	*Aphis gossypii* Complex, *Aphis nasturtii* Kaltenbach, *Aphis spiraecola* Patch, *Impatientinum asiaticum dahousiensis* Verma
42. *Lawsonia innermis*	Lythraceae	*Aphis gossypii* Complex
43. *Lepidium sativum*	Cruciferae	*Lipaphis erysimi* Kaltenbach *Myzus persicae* (Sulzer)
44. *Luffa acutangula*	-do-	*Aphis gossypii* Complex, *Aphis umbrella* (Börner), *Aulacorthum magnoliae* (Essig and Kuwana)
45. *Mangifera indica*	Anacardiaceae	*Aphis craccivora* Koch, *Aphis gossypii* Complex, *Brachycaudus helichrysi* (Kaltenbach), *Macrosiphum centranthi* Theobald, *Macrosiphum euphorbiae* (Thomas), *Toxoptera aurantii* B.d. F., *Toxoptera citricidus* Kirkaldy
46. *Melia azedarach*	Meliaceae	*Aphis spiraecola* Patch
47. *Mentha arvensis*	Lamiaceae	*Aphis gossypii* Complex, *Aphis nasturtii* Kaltenbach, *Ovatus crataegarius* (Walker)
48. *Mimosa pudica*	Fabaceae	*Aphis craccivora* Koch, *Aphis gossypii* Glover, *Sitobion mimosae* (Ghosh *et al.*), *Sitobion takahashii* (Eastop)
49. *Michelia champaka*	Magnoliaceae	*Aphis fabae* Complex, *Aphis gossypii* Complex, *Aphis nasturtii* Kalt., *Formosaphis micheliae* Takahashi
50. *Momordica charantia*	Cruciferae	*Aphis fabae* Complex, *Aphis gossypii* Complex, *Aphis nasturtii* Kaltenbach, *Aphis spiraecola* Patch, *Aphis umbrella* (Börner), *Myzus persicae* (Sulzer), *Toxoptera aurantii* B.d. F., *Toxoptera odinae* (van der Goot)

51. *Morus alba*	Moraceae	*Aphis spiraecola* Patch, *Aphis gossypii* Complex, *Neomasonaphis anaphalidis* (Basu)
52. *Musa paradisiaca*	Musaceae	*Aphis gossypii* Glover, *Myzus persicae* (Sulzer), *Pentalonia nigronervosa* Coquerel, *Schoutedenis ralumensis* Rubsaamen, *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki)
53. *Ocimum basilicum*	Lamiaceae	*Aphis gossypii* Complex
54. *Ocimum sanctum*	Lamiaceae	*Aphis gossypii* Complex, *Myzus ornatus* Laing
55. *Paspalum scrobiculatum*	Poaceae	*Hysteroneura setariae* (Thomas) *Rhopalosiphum maidis* (Fitch)
56. *Phaseolus trilobus*	Fabaceae	*Aphis craccivora* Koch
57. *Phaseolus vulgaris*	Fabaceae	*Aphis craccivora* Koch, *Hyalopterus pruni* (Geoffroy), *Myzus persicae* (Sulzer), *Smynthurodes betae* Westwood
58. *Pisum sativum*	Fabaceae	*Acyrthosiphon pisum* (Harris), *Aphis craccivora* Koch, *Aphis spiraecola* Patch, *Macrosiphum centranthi* Theobald, *Myzus persicae* (Sulzer), *Sitobion rosaeformis* (Das) (vagrant), *Tetraneura nigriabdominalis* (Sasaki)
59. *Psidium guajava*	Myrtaceae	*Aphis gossypii* Glover, *Aphis spiraecola* Patch, *Greendidea (Trichosiphum) formosana heeri* Raychaudhuri *et al.*, *Myzus persicae* (Sulzer), *Pentalonia nigronervosa* Coquerel, *Rhopalosiphum rufiabdominalis* (Sasaki), *Toxoptera aurantii* (B.d. F)
60. *Paederia foetida*	Rubiaceae	*Aphis gossypii* Complex, *Aphis spiraecola* Patch, *Aulacrothum nipponicum* (Essig and Kuwana)
61. *Piper betle*	Piperaceae	*Aphis gossypii* Complex
62. *Piper longum*	Piperaceae	*Sinomegoura citricola* (van der Goot)

63. *Piper nigrum*	Piperaceae	*Toxoptera aurantii* (B.d. F.)
64. *Plumbago zeylanica*	Plumbaginaceae	*Aphis craccivora* Koch *Hysteroneura setariae* (Thomas)
65. *Polygonum goabrum*	Polygonaceae	*Akkaia bengalensis* Basu, *Capitophorus hippophaes javanicus* H.R.L., *Capitophorus mitegoni* Eastop, *Aulacorthum (Neomyzus) circumflexum* (Buckton)
66. *Punica granatum*	Punicaceae	*Aphis achyranthi* Theobald, *Aphis fabae* Complex, *Aphis gossypii* Complex, *Aphis punicae* Passerini, *Aphis spiraecola* Patch, *Brachycaudus helichrysi* (Kaltenbach), *Hysteroneura setariae* (Thomas), *Micromyzodium filicium* David, *Myzus ornatus* Laing, *Myzus persicae* (Sulzer)
67. *Raphanus sativus*	Cruciferae	*Akkaia bengalensis* Basu, *Akkaia sikkimensis* Agarwala & Raychaudhuri, *Aphis craccivora* Koch, *Aphis gossypii* Glover, *Aphis spiraecola* Patch, *Brevicoryne brassicae* Linn., *Liosomaphis himalayensis* Basu, *Lipaphis erysimi* (Kalt.), *Myzus dycei* Carver, *Myzus ornatus* Laing, *Myzus persicae* (Sulzer)
68. *Rosa alba*	Rosaceae	*Aphis gossypii* Complex
69. *Rosa centifolia*	Rosaceae	*Sitobion rosaeformis* (Das)
70. *Rubia cordifolia*	Rubiaceae	*Aphis fabae* Complex, *Aphis gossypii* Complex, *Aphis spiraecola* Patch, *Brachycaudus helichrysi* Kaltenbach, *Melanaphis sacchari* (Zehntner), *Myzakkaia verbasci* (Chowdhuri *et al.*)
71. *Saccharum officinarum*	Poaceae	*Aphis gossypii* Complex, *Ceratovacuna lanigera* Zehntner, *Ceratovacuna perglandulosa* Basu *et al.*, *Ceratovacuna silvestrii* (Takahashi), *Geoica lucifuga* (Zehntner), *Hysteroneura setariae* (Thomas), *Melanaphis sacchari* (Zehtner), *Rhopalosiphum maidis* (Fitch),

		Rhopalosiphum rufiabdominalis (Sasaki), *Sipha maydis* Passerini, *Sitobion miscanthi* (Takahashi), *Tetraneura (Indoteraneura) javensis* van der Goot, *Tetraneura kalimpongensis* Raychaudhuri *et al.*, *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki), *Toxoptera aurantii* (B.d. F.)
72. *Setaria italica*	Poaceae	*Melanaphis sacchari* (Zehntner), *Rhopalosiphum maidis* (Fitch), *Tetraneura (Indotetraneura) javensis* van der Goot, *Tetraneura (Tetraneurella) nigriabdominalis* (Sasaki)
73. *Sesamum indicum*	Pedaliaceae	*Aphis craccivora* Koch, *Aphis nasturtii* Kaltenbach, *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer)
74. *Solanum melangena*	Solanaceae	*Aphis craccivora* Koch, *Aphis fabae* Complex, *Aphis gossypii* Complex, *Aphis nasturtii* Kaltenbach, *Aphis spiraecola* Patch, *Aulacorthum solani* (Kalt.), *Brachycaudus helichrysi* (Kalt.), *Lipaphis erysimi* (Kalt.), *Myzus ornatus* Laing, *Myzus persicae* (Sulzer), *Aulacorthum (Neomyzus) circumflexus* (Buckton)
75. *Solanum nigrum*	-do-	*Aphis craccivora* Koch, *Aphis fabae* Complex, *Aphis gossypii* Complex, *Aphis spiraecola* Patch, *Aphis umbrella* (Börner), *Myzus ornatus* Laing, *Myzus persicae* (Sulzer), *Aulacorthum (Neomyzus) circumflexum* (Buckton)
76. *Solanum xanthocarpum*	-do-	*Aphis gossypii* Complex, *Brachycaudus helichrysi* (Kalt.), *Brevicoryne brassicae* (Linnaeus)
77. *Trapa bispinosa*	Trapaceae	*Rhopalosiphum nymphaeae* (Linn.)
78. *Tagetes erecta*	Asteraceae	*Aphis gossypii* Complex
79. *Tamarindus indica*	Fabaceae	*Toxoptera aurantii* (B.d. F.)
80. *Terminalia arjuna*	Combretaceae	*Aphis spiraecola* Patch, *Rhopalosiphum maidis* (Fitch), *Paoliella nirmalae* (David)

81. *Tephrosia purpurea*	Fabaceae	*Aphis craccivora* Koch, *Megoura dooarsis* (Ghosh and Raychaudhuri)
82. *Tinospora cordifolia*	Menispermaceae	*Aphis craccivora* Koch
83. *Tribulus terrestris*	Zygophylaceae	*Aphis craccivora* Koch
84. *Triticum aestivum*	Poaceae	*Hysteroneura setariae* (Thomas), *Macrosiphon pachysiphon* Hille Ris Lambers, *Rhopalosiphum maidis* (Fitch), *Rhopalosiphum padi* (Linn.), *Rhopalosiphum rufiabdominalis* (Sasaki), *Schizaphis graminum* (Rondani), *Sitobion miscanthi* (Takahashi)
85. *Urena lobata*	Malavaceae	*Myzus ornatus* Laing
86. *Vallisneria spiralis*	Hydrocharitaceae	*Rhopalosiphum nymphaeae* (Linn.)
87. *Veronia cinerea*	Asteraceae	*Aphis craccivora* Koch, *Aphis gossypii* Complex, *Aphis (Protaphis) carthami* (Das), *Rhopalosiphum padi* (Linn.), *Toxoptera aurantii* (B.d. F.), *Uroleucon (Uromelan) minutum* (van der Goot)
88. *Veronia roxburghii*	Asteraceae	*Uroleucon compositae* (Theobald)
89. *Verbena officinalis*	Verbenaceae	*Aphis gossypii* Glover
90. *Vitex negundo*	-do-	*Aphis gossypii* Complex, *Aphis punicae* Passerini
91. *Vitis vinifera*	Vitaceae	*Aphis gossypii* Glover
92. *Withania somonifera*	Solanaceae	*Aphis umberlla* (Borner), *Lipaphis erysimi* (Kalt.), *Myzus persicae* (Sulzer)
93. *Woodfordia furticosa*	Lyhthraceae	*Aphis nasturtii* Kaltenbach, *Aphis spiraecola* Patch, *Tinocallis kahawaluokalani* (Kirkaldy)
94. *Zea mays*	Poaceae	*Aphis craccivora* Koch, *Brevicoryne brassicae* (Linn.), *Hysteroneura setariae* (Thomas), *Melanaphis sacchari* (Zehntner), *Rhopalosiphum maidis* (Fitch), *Rhopalosiphum padi* (Linn.), *Rhopalosiphum rufiabdominalis* (Sasaki), *Sitobion miscanthi* (Takahashi), *Tetraneura (Tetraneurella) nigri-abdominalis* (Sasaki)
95. *Zingiber officinale*	Zingiberaceae	*Aphis gossypii* Complex, *Cavariella aegopodii* (Scopoli)

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