

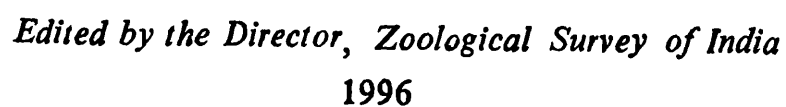
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COMPUTERISED DATA ON NATIONAL ZOOLOGICAL COLLECTION

The National Zoological Collections comprising nearly 15,000 types are housed in the Zoological Survey of India, Calcutta and are properly maintained. All these specimens have Registration numbers and are readily available for study as and when required. Data pertaining to locality, date of collection, name of collector, sex, up to date valid species name, name of the host (for parasite) etc., of each *type of collection* have already been computerised. The computerised data are stored in the computer centre of Zoological Survey of India. Scientists/Naturalists interested for any information on type species present in Zoological Survey of India may contact the Director, Zoological Survey of India, 'M' Block, New Alipur, Calcutta-700 053.

DR. J. R. B. ALFRED
Acting Director
Zoological Survey of India

AN APPEAL

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

Officer-in-Charge, Identification and Advisory Section, Zoological Survey of India, 2nd M. S. Building, Nizam Palace, 234/4, A. J. C. Bose Road, Calcutta-700 020.

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

DR. J. R. B. ALFRED
Acting Director
Zoological Survey of India

RECORDS

OF THE

ZOOLOGICAL SURVEY OF INDIA

Vol. 95 (3-4)

1996

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A NOTE ON THE FEEDING AND OTHER ACTIVITIES OF THE FIVE
STRIPED SQUIRREL (*FUNAMBULUS PENNANTI*) IN THE FRUIT
GARDENS OF WEST BENGAL

A. MURMU, G. D. MUKHERJEE, S. CHAUDHURI and S. K. DUTTA

Zoological Survey of India, Calcutta.

Five striped squirrel (*Funambulus pennanti*) has been briefly studied in the field by Blanford (1888) ; Jerdon (1874) ; Finn (1929) ; Banerjee (1955, 1957) ; Agrawal (1965) and Louch *et. al* (1965).

This report contains the results of a study on the five striped squirrel which is common in many gardens, parks, in and around human habitation. The field study was conducted in the fruit and vegetable gardens at Baruipur, 24 parganas (South) district of West Bengal. Baruipur is situated about 25 km. south of Calcutta and is well known for the production of fruits like guava, lichi, and various types of vegetables. For the study, three fruit/vegetable gardens were selected at Dopagachi area which is about 3 km. west of Baruipur Railway Station. The three fruit gardens were separated from each other by Karamcha hedges (*Carissa carandas*) and by a small pond.

The total area of the three gardens was about 2.5 hectre and in all the three gardens guava in the main fruit tree. The other trees are *Phoenix sylvestris*, *Spondias pinnata* *Zizyphus mauritiana* and *Carrissa carandas*. Seasonal vegetable like *Vigna catang*, *Cucumis sativus*, *Solanum melongena* etc., also occur. A total of 11 months were spent between September 1986 and October 1987, in collecting the data in the field. In every month, 3 continuous days were spent to observe the activities of the squirrels. Observations were conducted from 8 a. m. to 5 p. m. but the activities were recorded from 9 a. m. to 4 p. m. The observations were spread over all the seasons and four observers were deployed for collecting data in the field. Observers were posted in different gardens and hour to hour data were collected. Ten minutes observation in every hour was recorded. Counting of the squirrels were made simultaneously by all the observers in their respective areas at a fixed time to avoid the duplication in counting.

Initially a total of 13 squirrels were identified in the study area which composed of 5 adult males, 5 adult females and 3 juveniles. In addition, 3 other youngs were also encountered during the study period belonging to 3 separate nests, out which 2 died subsequently and the third was living till the termination of the observation. It is

presumed that the mortality in the litters in this area was common, since litter size has been reported to vary from 2 to 3. The common predators here are mongoose, varanus, rat snake, common cobra, domestic cats and hawks.

The squirrels feed mostly on seeds, vegetables and fruits and the consumption of these items varied from season to season depending upon the availability. In the months of May-June, the green vegetables and fruits were not available in these gardens. During this period the squirrels depend much on grass seeds, barks of tress and insects. They were also observed to feed on paddy left out in the field after harvesting. During winter months the squirrels were found licking date-palm juice (*Phoenix sylvestris*). For this food item, the squirrels had to compete with birds like bulbul and common myna. Much of the inter and intra-specific agonistic behaviour was noticed between the squirrels and the birds for this preferred date palm juice. Among the squirrels the fight and chase between the animals were common. Chasing between the squirrels and the birds were common on the palm trees for the palm juice. The other preferred food items of the squirrels were cucumber seeds (*Cucumis sativus*) and seeds of hassk (*Vigna catang*). Cucumber seeds were the preferred food item for the squirrels, as during the sowing time of the seeds the farmer used to engage guards for their field against the squirrels. In one garden, 60 rows of cucumber seeds were sowed, consisting of 40-45 seeds in each row, and it was estimated that the squirrels damaged 90% of the seeds in two days when the guards were not posted. After three days, the cucumber seeds were again sowed to this plot and the guards were deployed, even then 35% of the seeds were eaten up by the squirrels. Not much damage was done to the guava fruits by the squirrels. They took guava-pulp occasionally. They eat seeds, grains of leaves and fruits by holding them with their forelimbs.

The available foods on which the squirrels were observed to feed in different months are shown in table I.

During 10 munites continuous observation it was uoticed that the different animals engage themselves in different activities.

TABLE : I

Food articles consumed in different months by the squirrels

Months	Food matters
June-September	<i>Cucumis sativus</i> , <i>Psidium gugava</i> , grass seeds, bark of trees.
October-November	<i>Spondias pinnata</i> , <i>Cucumis sativus</i> , <i>Spinacia oleracea</i> , grass seeds.
December-February	<i>Zizyphus mauritiana</i> , <i>Dolis lallab</i> , juice of <i>Phoenix sylvestris</i> , <i>Solanum melongena</i> .
March-May	<i>Anona Squamosa</i> , <i>Vigna catang</i> , <i>Solanum melongena</i> , <i>Pisum sativum</i> , <i>Psidium gugava</i> .

The main emphasis was given on the food and feeding activities of the squirrels as they were inhabiting in an agricultural area. The feeding activities of the squirrel is given in Table-II. It was observed that the male and female squirrels were active in

TABLE : II

Average percentage of time spent in feeding activities of squirrel at Baruipur

Time (hours)	Male		Female		Juvenile	
	Feeding	Other activities	Feeding	Other activities	Feeding	Other activities
9-9:59	83.34	16.66	40.00	60.00	33.33	66.67
10-10:59	26.66	73.34	38.33	61.67	53.34	46.66
11-11:59	66.67	33.33	66.67	33.33	66.97	33.33
12-12:59	53.33	46.67	30.00	70.00	28.33	71.67
13-13:59	5.00	95.00	16.66	83.34	5.00	95.00
14-14:59	33.33	66.67	26.67	73.33	6.67	93.33
15-16:00	43.33	56.67	40.00	60.00	3.33	96.67
Range	5.00- 83.34	16.66- 95.00	16.66- 66.67	33.33- 86.34	3.33- 66.67	33.33- 96.67

feeding in the morning hours between 9 and 10 hours and there was a decrease in feeding activity between 10 and 11 hours after which the male spend more time in feeding than the females. Considerable decrease in feeding activities was noticed between the two sexes from 1 to 3 p. m. after which their feeding activities again increased. The juveniles spent much time in feeding between 10 and 12 hours. Thus a marked difference in feeding time was noticed between the adults and sub-adults.

The time spent in travelling mainly in search of food was also studied (Table III). It was noticed that the animals of all age and sex classes spent maximum time in travelling between 9 and 10 a. m. and again between 2 and 3 p. m. In case of juveniles there was again spurt in travelling activity between 3 and 4 p. m. This indicates that the habitat was well stocked with food for the squirrels. Beside the feeding activity, other activities are lumped together in one category as 'other activities'. The other activities include grooming, resting, playing, breeding behaviour etc. These were not much significant in this area as it was mostly an agricultural area.

TABLE—III

Avarage percentage of time spent on travelling by the squirrels at Baruipur

Time	Male		Female		Juvenile	
	Travelling	Other activities	Travelling	Other activities	Travelling	Other activities
9- 9 59	13.33	86.67	13.33	86.67	13.33	86.67
10-10.59	6.67	93.33	5.00	95.00	8.34	91.66
11-11.59	3.33	96.67	5.00	95.00	5.00	95.00
12-12.59	3.33	96.67	3.33	96.67	3.33	96.67
13-13.59	6.67	93.33	3.33	96.67	6.66	93.34
14-14.59	13.33	86.67	13.33	86.67	18.33	71.67
15-16.00	6.67	93.33	10.00	90.00	16.67	83.33
Range	3.33- 13.33	86.76- 96.67	3.33- 13.33	86.67- 96.67	3.33- 28.33	71.67- 96.67

Call of squirrels were common. Harsh call given by the squirrels when they were frightened. The call was heard when they noticed the predators like varanus, mongoose

or domestic cat. Intermittent call of short duration was given during play and before mating behaviour. Banerjee (1955) noticed that this call is given by the females to attract the male. Another long call is emitted by these animals for about 3-4 minutes at a stretch. This shrill call was given with the movement of the tail. The significance of this call could not be ascertained.

Breeding behaviour of squirrel in this area closely resembled the findings of Agrawal (1965). Capulation was observed during March to September. It took place on the branches of the tress mainly in the afternoon period. The male attracted by the call of the female. The duration of the process ranged from 5 to 20 minutes.

At three places in our study area, nests were build by the squirrels. The females were found to construct the nests twice in a year—once in the months of July-August at the height of the Karamch hedge (*Carissa carandus*) and the other in the months of December-January at greater height generally an the palm trees. This support the observation of Agrawal (1965). The materials used to make the nests were jute, cotton, polythene piece, small piece of clothes, threads, dry grass etc. There was no definite shape of nests. It was observed to be oval or of somewhat flattened type.

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ON THE FISH COLLECTIONS FROM KERALA, DEPOSITED IN SOUTHERN
REGIONAL STATION, ZOOLOGICAL SURVEY OF INDIA
BY NRM STOCKHOLM

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Southern Regional Station
Madras 600 028.

INTRODUCTION

In accordance with the request of the Department of Environment, the Scientists of the Swedish Museum Natural History, Erick Ahlander and Suzanne Wejland, working in collaboration with Dr. K. C. Jayaram, then Emeritus Scientist, S. R. S., deposited representative samples of their collections in S. R. S. in two lots made from different parts of Kerala during December, 1987 and March-April, 1990. The areas surveyed include Vembanad Lake, Meenachil River ; Kumarakom and Padiramanal in Kottayam District ; Peermad, and Kallar, Pambar and Deyiyar Rivers in Idukki District ; Achenkoil River in Pattanamthitta and Attingal and Kallar Rivers and Connemara fish market in Trivandrum.

The collections comprise 1018 specimens belonging to 56 species included under 37 genera, 22 families and 9 orders. The systematic list of the species is provided here following Menon (1993). Under each species is included the material examined (including number of specimens, length range, registration number and locality and distribution). The present collections are from southern ranges of the Western Ghats. In his comprehensive check list of the fishes of India Menon (1993) listed 188 species from Western Ghats of which 108 species are endemic to this region.

SYSTEMATIC ACCOUNT

Order : CLUPEIFORMES
Family : CLUPEIDAE
Subfamily : PELLONULINAE

1. *Dayella malabarica* (Day)

4 exs., 40.0-60.0 mm SL, F. 3399, 18.4.90, Vembanad lake at fish landing Kumarakam Dec. 87, ditch near Kottayam Rly. Stn.

Distribution : South Western India.

Order : CYPRINIFORMES
Family : CYPRINIDAE
Subfamily : CULTRINAE

2. *Chela dadyburjori* (Menon)

2 exs., 20.0 & 20.5 mm. SL, F. 3493, 22.3.90, Meenachil River, 1 Km. from Kottayam Railway Station.

Distribution : India : West Coast : Nagercoil to Goa.

3. *Salmostoma boopis* (Day)

1 ex., 87.0 mm, F. 3444, 4. 4.90, Pambar River at border of Chinnar Sanctuary, Idukki ; 12 exs., 13.00-35.0, F. 3481, 28.3.90, Pamba drainage, Kallar river at Vadasserikara bridge, Idukki.

Distribution : Peninsular India : Western Ghats : Karnataka South Canara and Maharashtra & Kerala.

Subfamily : RASBORINAE

4. *Amblypharyngodon melettinus* (Valenciennes)

1 ex., 64.0 mm, F. 3397, 18.4.90, Vembanad lake, from fish landing at

Kumarakom, Kottayam ; 1 ex., 58.0 mm, F. 1253, 6.12.87, Minachil River, N. W. Kottayam.

Distribution : India : Bombay along the west face of Western Ghats to Manavala-kurichi, Kanyakumari Dist., Tamilnadu. Sri Lanka.

5. *Barilius bendelisis* (Hamilton-Buchanan)

70 exs., (54 juveniles), 13.0-59.0 mm, F. 3445, 4.4.90, Pambar river at border of Chinnar sanctuary. Body with 7-10 vertical bands on sides.

Distribution : Throughout India. Pakistan. Nepal and Bangladesh.

6. *Barilius gatensis* (Valenciennes)

84 exs., 19.0-27.0 mm, F. 3426, 10.4.90, Attingal drainage, Kallar river ; 39 exs., 34.00-72.00 mm, F. 3438, 4.4.90, Pambar river at border of Chinnar Sanctuary ; 3 exs., 11.0-15.0, 21.3.90, Meenachil river system, Meenamthara, Kottayam.

Distribution : Peninsular India : Western Ghats, Southern Karnataka, Tamilnadu (Nilgiri Hills) and Kerala.

7. *Danio malabaricus* (Jerdon)

1 ex., 35.0 mm, F. 1250, 9.12.87, stagnant canal adjacent to Minachil river near Kottayam ; 3 exs., 46.0-60.0 mm, F. 3430, 24.3.90, a ditch near Kottayam Rly. Stn. ; 1 ex., 62.0 mm, F. 3421, 25.3.90, Achankoil River, Pathanamthitta ; 7 exs., 27.0-61.0 mm, F. 3489, 26.3.90, Achenkoil River ; 8 exs., 22.0-52.0 mm, F. 3484, 28.3.90, Pambar drainage, Kallar River ; 48 exs., 18.0-65.0, F. 3457, 3.4.90, Karimutty River, Mayoor : 19.0-79.0 mm, F. 3439, 4.4.90, Pambar River at border of Chinnar Sanctuary, 8 exs., 28.0-61.0 mm, F. 3429, 10.4.90, Attingal drainage creek, a tributary of Kallar River ; 2 exs., 17.0-36.0 mm., 12.4.90, Attingal drainage.

Distribution : India : Peninsular India : From headwaters of Krishna river in Maharashtra to Kerala. Sri Lanka.

8. *Horadandia atukorali* Deraniyagala.

3 exs., 13.8-14.0 mm. 17.4.90, Vembanad Lake, artificial lake at Kumarakom tourist complex ; 8 exs., 12.0-14.0 mm, 18.14.90, Vembanad Lake (Padiramanal Island) ; 141 exs., 12.0-17.0 mm, F. 3491, 24.3.90, ditch near paddy field, 3 km. from Kumarakom.

Remarks : Menon (1993) has synonymised *H. atukorali brittani* Rema Devi & Menon with *H. atukorali* Deraniyagala.

Distribution : India : Kerala. Sri Lanka.

9. *Parluciosoma daniconius* (Hamilton-Buchanan)

1 ex., 60.0 mm., F. 1252, 5.12.87, Minachil River and rivelet, N. W. Kottayam ; 7 exs., 56.0-71.0 mm, F. 3432, 24.3.90 a ditch near Kottayam Rly. Stn ; 3 exs. , 56.0-57.0 mm, F. 3419, 25.3.90, Achenkoil River, Pathanamthitta, near valamchizhi temple ; 1 ex., 77.0 mm ; F. 3486, 26.3.90, Achenkoil River ; 4 exs., 30.0-48.0 mm, F. 3482, 28.3.90, Pamba drainage, Kallar River at Vadasseri Kara Bridge ; 1 ex., 25.0 mm., 4.4.90, Pambar River at border of Chinnar Sanctuary ; 5 exs., 59.0-74.0 mm., F. 3434, 6.4.90, Mannam-bandam at Deviyar ; 1 ex., 36.0 mm., 10.4.90, Attingal drainage, Kallar River and 27 exs., 64.0-77.0 mm, F. 3469, Attingal drainage, creek, Kallar River.

Distribution : Throughout India. Sri Lanka. Pakistan. Nepal. Bangladesh. Burma and Thailand.

Subfamily : CYPRININAE

10. *Barbodes sarana subnasutus* (Valenciennes)

1 ex., 115.0 mm, F. 1246, 14.12.87, Vembanad lake, Allepey.

Distribution : India : Krishna and Cauvery river systems, and Kerala, in Peninsular India.

11. *Hypselobarbus kurali* Menon and Rema Devi

7 exs., 36.0-51.0 mm, F. 3427, Attingal drainage, Kallar River, 2 pairs of well developed barbals, L. 1. 41-42 ;

Remarks : A dark band behind opercle and caudal dark tipped. Recently described as a new species and its relationship with *H. curmuca* and *H. kolus* discussed (Paper Menon and Rema Devi, 1995).

Distribution : India : Dakshina Kannada (South Canara) to Travancore hills.

12. *Puntius amphibius* (Valenciennes)

1 ex., 46.0 mm, F. 1260, 6.12.87, Minachil River, N. W. Kottayam ; 2 exs., 55.0-66.0 mm, F. 1261, 14.12.87 Minachil River, 10 km. N. W. from Kottayam ; 2 exs., 55.0-60.0 mm, F. 3454, 16.3.90, Meenamthara River, Kottayam ; 19 exs., 38.0-46.0 mm, F. 3465, 23.3.90, Meenachil River ; 4 exs., 43.0-64.0, F. 3450, 7.4.90, Achenkoil River at Mavelikara canal and river side ; 5 exs., 54.0-63.0 mm, F. 3428, 10.4.90, Attingal drainage, Kallar River.

13. *Puntius arulius arulius* (Jerdon)

1 ex., 23.0 mm, 14.12.87, a ditch near Kottayam Railway Station.

Remarks : One pair of minute barbels ; body with three dark vertical stripes ; dorsal and caudal black tipped.

Distribution : Peninsular India : Tamilnadu : Nilgiri (Cauvery drainage). Kerala : Wynaad, Kottayam, Tenmalai, Kulathupuzha and Periyar Lake.

14. *Puntius chola* (Hamilton)

1 ex., 54.0 mm., F. 1262, 14.12.87, Minachil River, 10 Km. N. W. of Kottayam.

Distribution : Throughout India. Pakistan. Nepal. Bangladesh. Burma and Sri Lanka.

15. *Puntius mahecola* (Valenciennes)

2 exs., 52.0-57.0 mm, F. 1242, 14.12.87, ditch near Kottayam Rly. Stn. ; 2 exs., 65.0 mm., F. 3449, 7.4.90, Achenkoil River, Madikara canal and River side.

Distribution : Peninsular India : Goa, Karnataka, Kerala, Tamilnadu, Andhra Pradesh. Sri Lanka.

16. *Puntius melanampyx melanampyx* (Day)

2 exs., 29.0-33.0 mm, F. 1248, 15.12.87, Pirmad River, close to Kottayam town ; 2 exs., 29.0-47.0 mm, F. 3487, 26.3.90, Achenkoil River ; 8 exs., 31.0-38.0 mm, F. 3480, 1.4.90, Periyar drainage, Kallar River, Munnar ; 2 exs. 25.0-37.0 mm, F. 3442, 4.4.90, Pambar River at border of Chinnar Sanctuary ; 2 exs., 25.00 mm, 10.4.90, Attingal drainage, Kallar River ; 8 exs., 13.0-43.0 mm ; F. 3470, 11.4.90, Attingal drainage.

Distribution : Peninsular India : Western Ghats : South Canara to Travancore hills. Also Nilgiris, Cauvery drainage.

17. *Puntius parrah* Day

2 exs., 111.0-113.0 mm, F. 3407, 14.4.90, Connemara fish market, Trivandrum.

Distribution : India : Kerala, Karnataka, Tamilnadu and Andhra Pradesh.

18. *Puntius punctatus* Day

12 exs., 36.0-47.0 mm. F. 1257, 5.12.87, Minachil River system, N. W. Kottayam ; 1 ex., 34.0 mm., F. 1251, 9.12.87, Canal adjacent to Minachil River, 2 exs., 40.0-46.0 mm, F. 1263, 14.12.87, Minachil River, 10 km. N. W. of Kottayam, 19 exs., 38.0-46.0 mm, F. 3466, 23.3.90, Minachil River, close to Kottayam.

Remarks : Predorsal 8 ; D $3\frac{1}{8}$ strong osseous, no barbel, L, tr. $4\frac{1}{2}/3\frac{1}{2}$; L.1. 22-24, L.1. pores, discontinuous, mostly complete, dorsal in some with 2 rows of spots, a blotch on caudal peduncle, sometimes this is band like encircling the caudal peduncle with blotches in the centre on either sides ; a spot on 3rd or 4th scale behind opercle.

Distribution : Throughout India. Pakistan. Bangladesh. Burma. Thailand. Sri Lanka.

19. *Puntius vittatus* Day

1 ex., 23.0 mm, Dec., 1988, Vembanad lake, Allepey ; 1 ex., 17.0 mm, 17.4.90, Vembanad artificial lake at Kumarakom tourist complex and 1 ex., 17.0 mm ; 18.4.90, Padiramanal island pond.

Distribution : India : Peninsular India : Goa, Cutch, Karnataka, Tamilnadu. Sri Lanka.

20. *Neolissochilus wynaadensis* (Day)

14 exs., 13.0-31.0 mm, 4.4.90, Pambar River at Border of Chinnar Sanctuary.

Remarks : These juveniles collected from the eastern drainage have been tentatively identified as *P. wynaadensis* ; known to attain a size of 25.0 cm TL.

Distribution : India : Kerala.

21. *Garra mullya* (Sykes)

7 exs., 59.0-68.0 mm, F. 3418, 25.3.90, Achenkoil, Pathanamthitta. river near Valamchizhi temple ; 1 ex., 63.0 mm, F. 3485, 26.3.90, Achenkoil River ; 1 ex., 42.0 mm, F. 3458, 3.4.90, Karimutty River, Mayoor ; 9 exs., 23.0-37.0 mm, F. 3443, 4.4.90, Pambar River at border of Chinnar Sanctuary. 9 exs., 36.0-75.0 mm., F. 3433, 6.4.90, Deviyar River, Mannambandam ; 3 exs., 64.0-72.0 mm, F. 3467, 11.4.90, Attingal drainage creek, tributary of kallar River.

Distribution : Throughout Peninsular India.

Family : BALITORIDAE
Subfamily : BALITORINAE

22. *Bhavana australis* (Jerdon)

1 ex., 14.0 mm, 11.4.90, Attingal drainage, tributary of Kallar River.

Distribution : India : Southern Western Ghats : Nilgiris, Karnataka & Kerala.

Subfamily : NOEMACHEILINAE

23. *Noemacheilus pambarensis* Rema Devi and Indra

30 exs., 15.5-45.0 mm, F. 3496 & 4095 : Pambar River, at border of Chinnar Sanctuary, Idukki (Rema Devi & Indra).

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

24. *Noemacheilus triangularis triangularis* Day

5 exs., 24.0-44.0 mm, F. 3425, 10.4.90, Attingal drainage, Kallar River ; 1 ex., 30.0 mm, F. 3492, 12.4.90, Attingal drainage.

Distribution : India : Western Ghats : Kerala.

Family ; COBITIDAE

25. *Lepidocephalus thermalis* (Valenciennes)

1 ex., 46.0 mm., F. 3488, 26.3.90, Achenkoil River ; 1 ex., 37.0 mm, 28.3.90. 7 km. Upstream, Achenkoli River ; 30 exs., 22.0-50.0 mm, F. 3441, 4.4.90, Pambar River at border of Chinnar Sanctuary and 2 exs., 40.0-43.0 mm, F. 3435, 6.4.90, Deviyar River at Mannambandam.

Distribution : Peninsular India and Sri Lanka.

Order : SILURIFORMES

Family : BAGRIDAE

26. *Batasio travancoria* Hora and Law

1 ex., 65.0 mm, F. 3436, 6.4.90, Deviyar River at Mannambandam.

Distribution : India : Western Ghats : Kerala.

27. *Mystus armatus* (Day)

1 ex., 57.0 mm, F. 1258, 5.12.87, Minachil River, N. W. Kottayam ; 1 ex., 70.0 mm, F. 3404, 16.3.90, Meenamthara River, Kottayam ; 1 ex., 56.0 mm, F. 3452, 7.4.90, Achenkoil River at Mavelikara canal.

Distribution : Peninsular India : Kerala, Wynad Hill ranges and Nagaland and probably also lower Burma.

28. *Mystus cavasius* (Hamilton)

1 ex., 38.0 mm, 4.4.90, Pambar River at border of Chinnar Sanctuary.

Distribution ; India. Pakistan. Nepal. Bangladesh. Burma. Malaya. Thailand. Java. Borneo. Sumatra.

29. *Mystus gulio* (Hamilton)

4 exs., 138.0-163.0 mm, F. 3401, 14.4.90, Cannemara fish market, Trivandrum and 2 exs., 116.0-135.0 mm, F. 3392, 18.4.90, Vembanad lake, fish landing centre, Kumarakom.

Distribution : India. Pakistan. Nepal. Bangladesh. Burma. Sri Lanka. Malaya. Thailand. Java. Sumatra, Borneo.

30. *Mystus malabaricus* (Jerdon)

4 exs., 57.0-75.0 mm, F. 1245, Minachil River, 10 km. N. W. of Kottayam.

Distribution : Peninsular India : Western Ghats of Kerala, Karnataka and Maharashtra.

31. *Mystus montanus* (Jerdon)

1 ex., 71.0 mm, F. 3423, 25.3.90, Achenkoil River, Pathanamthitta near Valamchizhi Temple.

Distribution : India : Kerala : Wynaad range of hills, Karnataka, Maharashtra, Madhya Pradesh and Assam.

32. *Mystus oculatus* (Valenciennes)

1 ex., 71.0 mm., F. 3422, 25.3.90. Achenkoil River near Pathanamthitta ; 3 exs., F, 3437, 6.4.90, Deviyar River, Mannambandam ; 1 ex., 62.0 mm, F. 3451, 7.4.90, Achenkoil River, at Mavelikara Canal and 1 ex., 65.0 mm, F. 3393, 18.4.90, Vembanad Lake, at fish landing centre, Kumarakom.

Distribution : India : Kerala and Tamil Nadu.

33. *Pseudobagrus chryseus* Day

2 exs., 148.0-155.0 mm, F. 3390, 18.4.90, Vembanad Lake, at fish landing Centre Kumarakom.

Distribution : India : Western Ghats ; South Canara down along the western face of Western Ghats as far as Southern Kerala.

Family : SILURIDAE

34. *Ompok bimaculatus* (Bloch)

1 ex., 170.0 mm, F. 3391, 18.4.90, Vembanad lake, at fish landing centre, Kumarakom.

Distribution : Throught India. Pakistan. Nepal. Bangladesh. Sri Lanka. Burma Thailand, Java. Sumatra. Borneo. China.

Family : HETEROPNEUSTIDAE

35. *Heteropneustes fossilis* (Bloch)

3 exs., 132.0-185.0, F. 1236, 14.12.87, small ditch near Kottayam Rly. Stn.;
3 exs., 101.0-133.0 mm, 15.12.87, Kottayam.

Distribution : India. Pakistan. Sri Lanka. Nepal. Bangladesh. Burma. Thailand and Laos.

Order : CYPRINODONTIFORMES

Sub Order : EXOCOEATOIDEI

Family : HEMIRAMPHIDAE

36. *Hyporhamphus limbatus* (Valenciennes)

2 exs., 116.0 and 170.0 mm, F. 3396, 18.4.90, Vembanad Lake, fish landing centre, Kumarakom.

Distribution : Persian Gulf. Pakistan. India, Sri Lanka. Burma to Thailand and China.

Family : BELONIDAE

37. *Xenentodon cancila* (Hamilton-Buchanan)

1 ex., 175.0 mm, F. 3456, 24.3.90, Vembanad lake, near Kumarakom.

Distribution : India. Pakistan. Bangladesh. Sri Lanka. Burma and Thailand.

Suborder : CYPRINODONTOIDEI

Family : APLOCHEILIDAE

38. Aplocheilus blocki (Arnold)

1 ex., 17.0 mm., Meenamthara River (Part of Meenachil River), 21.3.90, Kottayam ; 5 exs., 17.0-18.0 mm, 23.3.90 ; Meenachil River, close to Kottayam ; 4 exs., 16.0-17.0 mm, 24.3.90, Ditch near a paddy field, 3 km. from Kumarakom ; 1 ex., 16.0 mm, 28.3.90, 7 km. upstream Meenachil River ; 7 exs., 16.0-22.0 mm., F. 3475, 17.4.90, Vembanad lake, near Kumarakom tourist complex and 3 exs., 14.0-26.0 mm, 18.4.90, Padiramanal Island, pond.

Distribution : Peninsular India : West Coast, from Kutch Southwards along the coast to south Kerala.

39. Aplocheilus lineatus (Valenciennes)

5 exs., 39.0-58.0 mm., F. 1259, 5.12.87, Minachil River and rivulet, N. W. Kottayam ; 4 exs., 16.0-47.0 mm., F. 1249, 9.12.87, Canal-still water, adjacent to Minachil River ; 11 exs., 30.0-54.0 mm, F. 1243, 14.12.87, small ditch near Kottayam Rly Stn., 1 ex., 41.0 mm, F. 1264, 15.12.87, Minachil River, 10 km., N. W. of Kottayam, 3 exs., 26.0-41.0 mm, F. 3478, 21.3.90, Meenamthara River (Part of Meenachil River), Kottayam ; 4 exs., 25.0-30.0 mm, F. 3460, 22.3.90, Meenachil drainage, 1 km. from Kottayam Rly. Stn. ; 9 exs., 23.0-37.0 mm, F. 3464, 23.3.90, Meenachil River, close to Kottayam Rly. Stn. ; 1 ex., 35.0 mm, F. 3483, 28.3.90, Pamba drainage, Kallar River at Vadasserikara Bridge ; 1 ex. 13.0 mm, 10.4.90, Attingal drainage, Kallar River and 5 exs., 16.0-36.0 mm., F. 3474, 17.4.90, Vembanad Lake near Kumarakom tourist complex.

Distribution : Widely distributed in peninsular India.

Family : ORYZIIDAE

40. *Oryzias melastigma* (McClelland)

1 ex., 24.0 mm, 24.3.90, ditch near Kottayam Rly. Stn.,

Distribution : India. Bangladesh. Burma. Sri Lanka.

Family : POECILIDAE

41. *Xiphophorus helleri* Heckel

6 exs., 35.0-47.0 mm, F. 1247, 5.12.87 Peermed River.

Distribution : Eastern Mexico, introduced into India.

Order : CHANNIFORMES

Family : CHANNIDAE

42. *Channa marulius* (Hamilton-Buchanan)

2 exs., 175.0-230.0 mm., F. 3394, 18.4.90, Vembanad lake, fish landing centre at Kumarakom.

Distribution : India. Pakistan. Sri Lanka. Bangladesh. Nepal. Burma. Thailand and China.

43. *Channa orientalis* Bloch and Schneider

1 ex., 46.0 mm, F. 1266, 14.12.87, Minachil River, 10 km. N. W. of Kottayam ;
2 exs., 65.0 mm, F. 3431, 24.3.90, ditch near Kottayam Rly Stn. ; 1 ex., 51.0 mm,
F. 3490, 26.3.90, Achenkoil River and 11 exs., 24.0-62.0 mm, F. 3459, 28.3.90, Pamba
drainage, Kallar River.

Distribution : India. Afghanistan, Iran. Pakistan. Nepal, Sri Lanka. Bangladesh and Burma.

44. *Channa punctatus* (Bloch)

1 ex., 83.0 mm, F. 1240, 14.12.87, near Kottayam Rly. Stn. ; 1 ex., 18.0 mm, F. 3421, 25.3.90, Achenkoil River, Pathanamthitta, near Valamchizhi temple ; 15 exs., 17.0-29.0 mm, F. 3440, 4.4.90, Pambar River at border of Chinnar Sanctuary ; 1 ex., 172.0 mm, F. 3405, 14.4.90, Connemara fish market, Trivandrum.

Distribution : India. Afganistan. Pakistan. Sri Lanka. Nepal. Bangladesh. Burma and Yunnan.

45. *Channa striatus* (Bloch)

4 exs., 111.0-130.0 mm, F. 3403, Apr. '90, fish pond near Paddy field Kumarakom.

Distribution : India. Pakistan. Sri Lanka. Bangladesh. Nepal. Burma. Malay Archipelago. Thailand and South China.

Order : PERCIFORMES

Family : CICHLIDAE

46. *Eetroplus maculatus* (Bloch)

1 ex., 43.0 mm, F. 1256, 5.12.87. Minachil River N. W. Kottayam ; 15 exs., 33.0-57.0 mm, F. 1238, Dec., '87, small ditch near Kottayam Rly. Stn. ; 3 exs., 42.0-51.0 mm, F. 3453, 16.3.90, Meenamthara River, Minachil River system, Kottayam, 2 exs., 41.0-50.0 mm, F. 3477, 21.3.90, Meenamthara River ; 3 exs., 34.0-65.0 mm, F. 3471, 7.4.90, Vembanad lake, Padiramanal Island ; 4 exs., 43.0-54.0 mm, F. 3446, 7.4.90, Achenkoil River at Mavelikara Canal ; 1 ex., 53.0 mm, F. 3409, 14.4.90, Connemara fish market, Trivandrum.

Distribution : Peninsular India : Tamilnadu, Kerala and South Karnataka. Sri Lanka.

47. *Eetroplus suratensis* (Bloch)

4 exs., 53.0-73.0 mm, F. 1237, Dec. '87, small ditch near Kottayam Rly. Station ; 1 ex., 17.0 mm, 22.3.90, Minachil drainage, 1 Km. from Kottayam Rly. Stn. ; 2 exs.

23·0-45·0 mm, F. 3472, 7.4.90, Vembanad Lake, Padiramanal Island and 2 exs., 50·0-55·0 mm, F. 3403, 14.4.90, Connemara fish market, Trivandrum.

Distribution : India : Orissa, Andhra Pradesh, Tamilnadu and Kerala, Sri Lanka.

48. *Oreochromis mossambica* (Peters)

5 exs., 20·0-25·0 mm, 4.4.90, Pambar River at border of Chinnar Sanctuary.

Distribution : East Africa. Introduced in India, Pakistan, Sri Lanka.

Family : AMBASSIDAE

49. *Parambassis thomassi* (Day)

1 ex., 46·0 mm, F. 1241, Dec. '87, small ditch near Kottayam Rly. Stn. ; 1 ex., 75·0 mm, F. 1255, 5.12.87, Minachil River' N. W. Kottayam ; 6 exs., 26·0-41·0 mm, F. 3455, 24.3.90, Vembanad lake near Kumarakom ; 11 exs., 26·0-41·0 mm, F. 3473, 7.4.90, Vembanad lake, Padiramanal Island ; 5 exs., 37·0-96·0 mm, F. 3398, 18.4.90, Vembanad lake, fish landing, Kumarakom.

Family : NANDIDAE

50. *Nandus nandus* (Hamilton-Buchanan)

2 exs., 22·0 & 25·0 mm., F. 1267, 14.12.87, Minachil River, 10 Km. N. W. of Kottayam ; 3 exs., 53·0-65·0 mm, F. 3448, 7.4.90, Achenkoil River, Mavelikara.

Distribution : India. Pakistan. Nepal. Bangladesh. Burma. Thailand.

Family : TERAPONIDAE

51. *Terapon jarbua* (Forsskal)

2 exs., 85·0-91·0 mm, F. 3408, 14.4.90, Connemara fish market, Trivandrum.

Distribution : Indo-west Pacific.

Family : ANABANTIDAE

52. *Anabas testudineus* (Bloch)

1ex., 50.0 mm, F. 1239, Dec. '87, ditch near Kottayam Rly. Stn. ; 3 exs. 60.0-75.0 mm, F. 3447, Achenkoil River at Mavelikara.

Distribution : India. Pakistan. Bangladesh. Sri Lanka. Burma. Malay Archipelago. Singapore. Philippines.

Family : BELONTIIDAE

53. *Pseudosphromenus cupanus* (Valenciennes)

4 exs., 22.0-34.0 mm, Dec., 87, small ditch near Kottayam Rly. Stn. ; 2 exs., 35.0-41.0 mm, F. 3479, 21.3.90, Meenamthara River, Minachil River system, Kottayam ; 2exs., 21.0 & 24.0 mm, F. 3461, 22.3.90, Meenachil River, 1 km. from Kottayam Rly. Stn. ; 1 ex., 30.0 mm, 23.3.90, Meenachil River, close to Kottayam ; 2 exs., 29.0-30.0 mm, F. 3424, 25.3.90, Achenkoil River, Pathanamthitta & 2 exs., 20.0 mm, 17.4.90, Vembanad lake at Kumarakom.

Distribution : India. Sri Lanka. Western Burma. Malay. Peninsular Sumatra.

Order : MASTACEMBELIFORMES

Family : MASTACEMBELIDAE

54. *Macrogathus malabaricus* (Jerdon)

2 exs., 215.0-268.0 mm, F. 3395, 18.4.90, Vembanad Lake, Fish Landing centre at Kumarakom.

Distribution : India : Kerala.

Order : TETRAODONTIFORMES

Family : TETRAODONTIDAE

55. *Tetraodon (Monotretus) travancoricus* Hora & Nair

5 exs., 13.0-15.0 mm, F. 1278, Dec. '87, a ditch near Kottayam Rly. Stn. ; 2 exs., 13.0-15.0 mm, F. 1277, 5.12.87, Minachil River, N. W. Kottayam ; 1 ex., 12.0 mm, 7.4.90, Vembanad Lake, Padiramanal Island.

Distribution : India : Kerala : Pamba River and Vembanad Lake ; Minachil River and Shertallai.

Order : PLEURONECTIFORMES

Family : SOLEIDAE

56. *Euryglossa orientalis* (Bloch & Schneider)

1 ex., 103.0 mm, F. 3400, 18.4.90, Vembanad Lake, from fish landing centre at Kumarakom.

Distribution : Red Sea. Persian Gulf. Pakistan. India. Sri Lanka, through the East Indies to China and Australia.

DISCUSSION

The collections comprise 56 species of which 2 species, *Xiphophorus helleri* Heckel and *Oreochromis mossambica* (Peters) are exotic, and four viz. *Dayella malabarica* (Day) *Hyporhamphus limbatus* (Val.), *Terapon jarbua* (Forsskal) and *Euryglossa orientalis* (Bloch & Schneider) are euryhaline. The remaining 50 are primary freshwater species (Menon, 1993), 24 species are endemic to India of which 23 are endemic to Peninsular India. Among these 15 species are endemic to the Western Ghats and 3 to the Western coastal plains. Nine species are common to India and Sri Lanka and the remaining 21 species are widespread in their distribution.

Though the collections cover the Districts of Kottayam, Idukki, Pathanamthitta and Trivandrum, most of the collections are from Meenachil River and Vembanad

Lake and adjoining water bodies in Kottayam, 18 species from Idukki, 16 spp. from Pathanamthitta and 10 spp. from Trivandrum. The typical hill stream loaches *Bhavana australis* (Jerdon) and the stone loach *Noemacheilus* (t) *triangularis* (Day) are from Kallar River. One new species of *Noemacheilus* was described from the Pamber drainage near Chinnar Sanctuary, Idukki District (Rema Devi and Indra, 1994). *Garra mullya* (Sykes) was identified from Achenkoil River, Pambar River and Kallar River. *Horadandia atukorali* Deraniyagala was represented in good numbers from ditches and ponds near Vembanad Lake and Kumarakom, Kottayam. This Sri Lankan species was only recently reported as a subspecies from Shertallai (Rema Devi and Menon, 1992).

SUMMARY

The fish specimens collected from Kerala by Scientists of the Swedish Museum of Natural History and deposited in the Southern Regional Station, Zoological Survey of India, Madras, have been identified as 56 species and a systematic list of the species is provided. This includes one new species of *Noemacheilus* and a Sri Lankan species *Horadandia atukorali* Deraniyagala reported only recently from Shertallai, Kerala.

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NOTES ON ISOLABOIDINAE (INSECTA : DERMAPTERA : ANISOLABIDIDAE)
FROM THE INDIAN SUBCONTINENT

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INTRODUCTION

Isolaboidinae was erected by Brindle (1978) with *Isolaboides* Hincks (1958) as its type-genus, Hincks (1. C) described this genus for the reception of *Pseudisolabis kosswigi* Burr, 1947 as its type and included two other species viz. *Isolaboides tuberculata* sp. n. and *Pseudisolabis burri* Borelli, 1909. He also hinted that perhaps *Pseudisolabis immsi* Burr, 1913 and *P. renschi* Günther, 1932 may belong to this genus.

Taxonomic position of various species from Indian subcontinent included here is discussed. Following is the list of species recorded or described from the area, is arranged chronologically :

- (i) *Pseudisolabis burri* Borelli, 1909
- (ii) *Pseudisolabis tenera* Burr, 1910
- (iii) *Pseudisolabis immsi* Burr, 1913
- (iv) *Pseudisolabis elegans* Hebard, 1917
- (v) *Pseudisolabis jonathani* Kapoor and Katiyar, 1971
- (vi) *Pseudisolabis santokhi* Kapoor and Katiyar, 1971

All the species are congeneric according to original placement, although referred to different genera by subsequent workers. Male genitalia of all the species is known except for *P. tenera* Burr, 1910 and *P. elegans* Hebard, 1917 and are treated here as uncertain species.

While studying the material of those species known by their male genitalia two different forms, on the basis of external morphology in general and male genital in particular, could be noted.

In one case the male forceps (f. macrolabia) are stout and abruptly curved in posterior half or (in microlabia) straight and gently hooked apically and genitalia with

parameres somewhat broader, anterior margin ablique forming an obtuse angle with external margin and virga spirally coiled but coils short and narrow.

The *P. burri* Borelli, 1909 confirms the above diagnosis. It is further corroborated by the figure of genitalia of the type of this species given by Sakai (1987, p. 2319) and labelled as "BMNH ; Drawer 10 Type SS 65-1050".

In the other form, the forceps (f. macrolabia) are comparatively thin or less stout, regularly incurved or (in microlabia) straight in basal two thirds, afterwards strongly or gently incurved with apices acuminate and hooked. Moreover, the parameres are broader at base, gradually narrowing towards apex, tip acute and the coils of virga are large and loosely arranged. Under this group *P. immsi* Burr, 1913 should be included with *Pseudisolabis jonathani* Kapoor and Katiyar and *Pseudisolabis santokhi* Kapoor and Katiyar as its synonym.

As a result of present study based on a large series of specimens, it is now known that *P. immsi* possesses both microlabic (straight for the most part and hooked apically), and macrolabic (strongly incurved) form of forceps. In view of this it not possible to place accurately *P. tenera* and *P. elegans* since both are known by microlabic form of forceps only and they may belong to either of two groups of species when their genitalia are described. Should *P. tenera* proves to be conspecific with *P. immsi*, the latter will have the priority.

Isolaboides rimosus Steinmann, is quite distinct from other species by its shape of male penultimate sternite and genitalia, the latter appears to represent, immature stage. It is treated here as valid but examination of genitalia and penultimate sternite is desirable.

Steinmann (1990) erected *Paralaboides* with *Pseudisolabis jonathani* Kapoor and Katiyar, 1971 as the type and *Pseudisolabis santokhi* Kapoor and Katiyar, 1971, both from India. These species are treated as synonym of *Pseudisolabis immsi* Burr, 1913 as indicated above. Accordingly *Paralaboides* should be placed as synonym of *Isolaboides*.

The male genitalia of various species included here have right distal lobe (Penis lobe) atrophied with rudimentary virga as stated by different workers but it is difficult to discern in the series of genitalic preparations examined by me. Left distal lobe is enormously developed or when fully flexed forward, covers, in part, the proparameres and parameres, giving false impression of a preputial sac, especially in mounted condition.

Perhaps this has led Steinmann to beleive that proparamere is unpaired and describe a new genus *Paralaboides*.

A careful examination of male genitalia, before mounting, reveals that proparamere is paired and left distal lobe is greatly enlarged with virga spirally coiled. In the light of this it would be justified to place Isolaboidinae under Anisolabididae rather than under Labiidae as has been done by Steinmann (l. c.).

ANISOLABIDIDAE

ISOLABOIDINAE

Isolaboides Hincks

1958. *Isolaboides* Hinks, *EOS*, Madrid, 34 : 131 (Type-species : *Pseudisolabis kosswigi* Hincks, 1947).
 1990. *Paralaboides* Steinmann, *Das Tierreich*, 106 (Part) : 10 (Type-species : *Pseudisolabis jonathani* Kapoor and Katlyar, 1971), Syn. n.

Diagnostic characters : Eyes small, shorter than post ocular length. Antennae 18-22 jointed, 1st shorter than the distance between antennal bases. Apterous. Meso- and metanotum ecarinate laterally. Legs with femora thick, hind tarsi with 1st segment almost equal to combined length of 2nd & 3rd ; 2nd distinctly longer than broad, narrow and slightly shorter than 3rd. Pygidium vertical. Genitalia with proparameres paired but genital lobe of right side atrophied and of left side well developed with virga spirally coiled.

Type species : *Pseudisolabis kosswigi* Hincks, 1947.

Distribution : From Asia Minor to India.

Key to the species (based on males)

- 1 (4). Penultimate sternite with hind margin entire ; virga large and spirally coiled
- 2 (3). Forceps (in forma macrolabia) stout and abruptly curved in apical half ; Parameres broad, anterior margin oblique, forming an obtuse angle with external margin, coils of virga short and narrow...*I. burri* (Borelli)
- 3 (2). Forceps (in forma macrolabia) comparatively thinner, regularly incurved ; Parameres narrower, broadest at base, gradually narrowing towards apex, coils of virga large and loosely arranged...*I. immsi* (Burr)
- 4 (1). Penultimate sternite posterolaterally with a concavity, virga short and coiled ...*I. rimosus* Steinmann

Isolaboides burri (Borelli)

Figs. 1-6

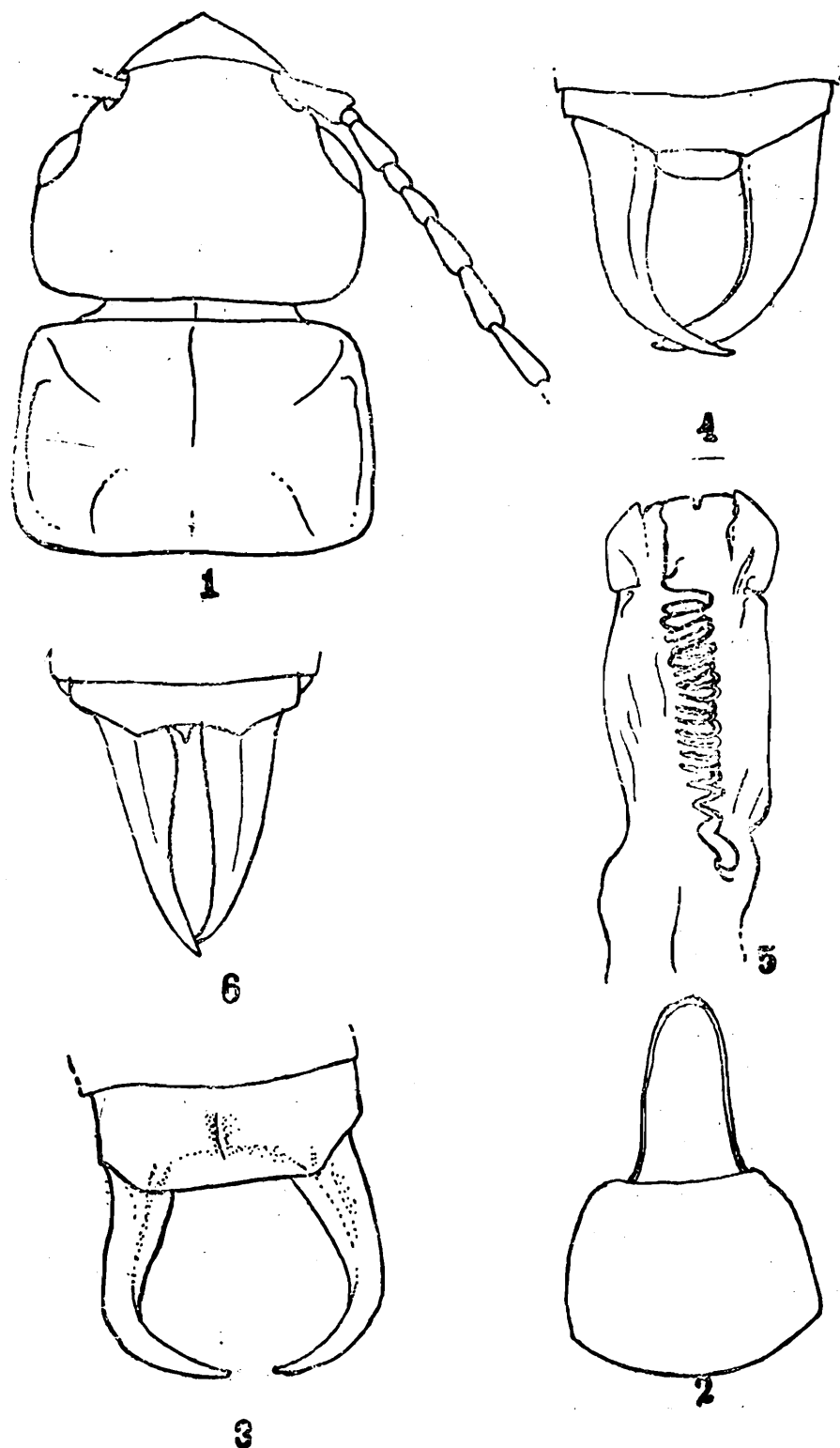
1909. *Pseudisolabis burri* Borelli, *Boll. Musei. zool. Anat. comp. R. Univ. Torino*. 24, No. 603 : 1 (4 male, 3 female ; NE Kashmir—along the road from Gilgit to Srinagar, 2500 m).
1910. *Pseudisolabis burri* ; Burr, *Fauna of British India, Dermaptera* : 103.
1911. *Pseudisolabis burri* : Burr, *Genera Ins.*, 122 : 39, 3, fig. 14 (Head and sternum).
1935. *Pseudisolabis burri* ; Bey-Blenko, *Wiss. Ergebn. Niederl. Exped. Karakorum, zool.* ; 209 (2 Male, 2 Female ; Kashmir, Sonamarg on the river Sind : 5 Male, 2 Female ; valley of the river Sind, 2000-2800 m).
1958. *Isolaboides burri* ; Hinks, *EOS, Madrid*, 34 : 132.
1978. *Isolaboides burri* ; Brindle, *Senckenbergiana biol.*, 58 :

Description : Male : General colour brownish black or black ; head and pronotum shining ; meso- and metanotum and abdomen dull with short and fine pubescence ; legs with femora and tibia black and joints yellow and tarsi slightly lighter in colour.

Head smooth, slightly longer than broad, frons convex, sutures obsolete. Eyes shorter than post-ocular length. Antennae 13-segmented or more, 1st stout, shorter than the distance between antennal bases ; 2nd short ; 3rd long and cylindrical ; 4th short, globular ; 5th subconical, slightly longer than preceding ; 6th stout but equal to 3rd, remaining subconical and gradually increasing in length. Pronotum smooth, transverse, all margins straight, gently widened posteriorly, prozona and metazona little differentiated, median sulcus faint.

Meso and metanotum strongly transverse, former with hind margin straight and in latter emarginate. Apterous. Legs short, femora thickened, tarsi with 1st segment about as long as the combined length of 2nd and 3rd ; 2nd narrow but longer than broad.

Abdomen weakly convex, gently dilated in posterior two thirds, sides of segments 5 to 9 obtuse angulate posteriorly. Penultimate sternite transverse, hind margin in middle convex, manubrium about as long as the sternite and of uniform width throughout. Pygidium vertical, not visible from above, triangular, base almost filling the space between the branches of forceps. Ultimate tergite weakly transverse, gently narrowed posteriorly, hind margin laterally, above the bases of forceps oblique and in middle straight, sloping backwards, faintly depressed in middle posteriorly. Forceps stout, remote at base, branches straight and diverging up to a little beyond middle afterwards abruptly and strongly bowed (f. *macrolabia*) or almost straight and gently incurved a little before apex (f. *microlabia*) with apices gently hooked, branches trigonal in basal one third. Genitalia with parameres longer than broad, narrowed apically, externally



Figs. 1-6 : *Isolaboides burri* (Borelli), Male, 1. Head, pronotum, and a few basal antennal segments of right side ; 2. Penultimate sternite with manubrium ; 3. Ultimate tergite and forceps (f. macrolabia) ; 4. Ultimate tergite and forceps (f. microlabia) ; 5. Genitalia, Female, 6. Ultimate tergite and forceps.

above forming an angle a little before apex, virga of left side spirally coiled but coils narrow and compact.

Female : Agrees with males in most characters except that ultimate tergite narrowed posteriorly and forceps simple and straight.

Measurements : (in mm)

	Male	Female
Length of body :	8.0-9.1	8.0-9.1
Length of forceps :	1.9-2.0	2.0-2.1

Distribution : In the mountains of India (Kashmir) and Pakistan.

Remarks : This species can be easily determined by its strongly transverse pronotum : stout forceps, abruptly curved in apical two thirds or gently incurved a little before apex and genitalia with parameres near apex externally angular and virga of left side with narrow loops and arranged in a compact linear fashion.

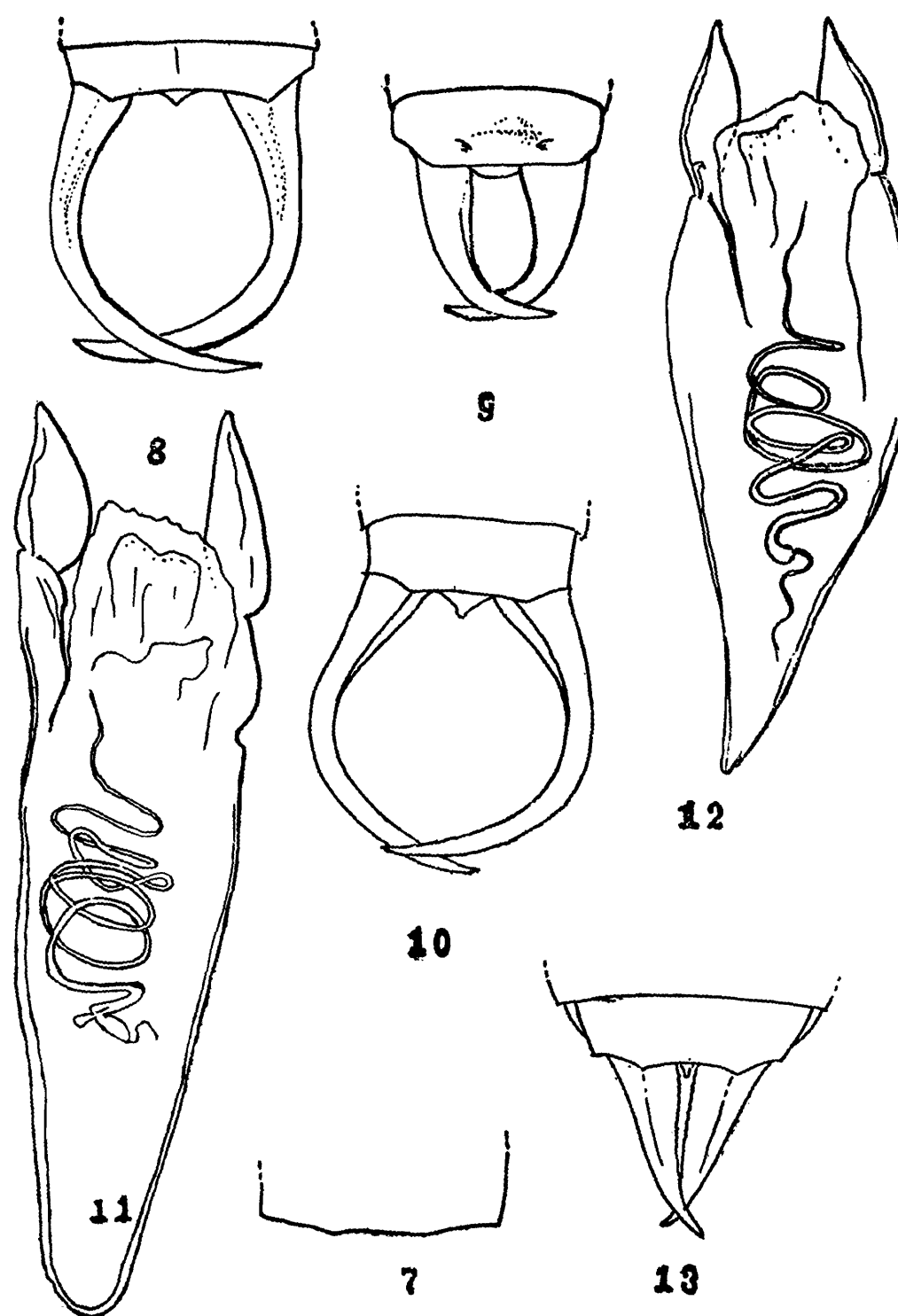
Isolaboides immsi (Burr)

Figs. 7-14

- 1913. *Pseudisolabis immsi* Burr, *J. Asiat. Soc. Beng. (N. S.)*, 9 : 184 (Northern India : Base of Himalayas at Kurdi in Jaunsar).
- 1914. *Pseudisolabis burri* (nec Borelli) : Burr, *Rec. Indian Mus.*, 10(5) : 290 (Female ; Simla Hills, Matiana, 8000 ft.).
- 1966. *Parisolabis immsi* ; Popham and Brindle, *Entomologist*, 99 : 133.
- 1971. *Pseudisolabis jonathani* Kapoor and Katiyar. *J. nat. Hist.*, 5 : 499, figs. 1 and 2 (Male ; Simla Hills, Baghi, Himachal Pradesh—deposited in the Division of Entomology Indian Agricultural Research Institute, New Delhi)—Syn. n.
- 1971. *Pseudisolabis santokhi* Kapoor and Katiyar, *J. nat. Hist.*, 5 : 500, figs. 3 and 4 (Male ; Under stones, Manali, 1930 m, Himachal Pradesh—deposited in the Division of Entomology, Indian Agricultural Research Institute, New Delhi)—Syn. n.
- 1990. *Paralaboides jonathani* ; Steinmann, *Das Tierreich*, 106 : 11
- 1990. *Paralaboides santokhi* ; Steinmann, *Das Tierreich*, 106 : 12.
- 1993. *Isolaboides burri* (nec Borelli) ; Srivastava and Lal, *Rec. zool. Surv. India*, 91 (1) : 116, figs. 11 & 12 (Himachal Pradesh).

Description : Male : General colour brownish black, sides of pronotum, tarsi and antennae somewhat lighter in colour.

Head slightly longer than broad, smooth, frons weakly convex, sutures obsolete hind margin emarginate in middle. Eyes generally black, sometimes whitish, about half as long or slightly less than post-ocular area. Antennae 15-segmented, 1st stout, shorter



Figs. 7-13 : *Isolaboides immsi* (Burr), Male, 7. Posterior margin of penultimate sternite ; 8. Ultimate tergite and forceps (f. *macrolabia*) ; 9. Ultimate tergite and forceps (f. *microlabia*) ; 10. Ultimate tergite and forceps (f. *macrolabia*) ; 11 and 12. Genitalia, Female ; 13. Ultimate tergite and forceps.

(Figs. 8 and 11 from the same specimen ; figs. 9 and 12 from the same specimen and fig. 10 from the Holotype, Male of *Pseudisolabis santokhi* Kapoor and Katlyar).

than the distance between antennal bases ; 2nd short ; 3rd long and cylindrical, gently expanded apically, slightly longer than 4th, remaining slightly increasing in length, one or two apical segments thin and rod shaped. Pronotum slightly wider than long, apical and lateral margin straight, gently widen posteriorly, hind angles rounded and margin almost straight or showing a trace of emargination in middle, smooth, impunctate, prozona weakly raised and scarcely differentiated from depressed metazona, median sulcus faintly marked on prozona. Meso and metanotum transverse, obscurely reticulated, former with hind margin straight and latter broadly emarginate. Legs long and slender, hind tarsi with 1st segment about as long as the combined length of 2nd and 3rd, 2nd slightly longer than broad ; 3rd about twice as long as 2nd ; claw without an arolium. Abdomen spindle shaped, covered with very fine and short pubescence above, on sides a few long and short hairs present, sides of segments broadly convex. Penultimate sternite transverse, slightly depressed posteriorly, hind margin subtruncate. Ultimate tergite transverse, smooth, sloping backwards with a roughly triangular depression in middle posteriorly, sides straight, hind margin in middle between the branches of forceps straight, oblique above the base of forceps, gently narrowed posteriorly in microlabic form. Pygidium vertical, triangular. Forceps with branches remote at base in macrolabic form, strongly arcuate, internally differentiated into dorsal and ventral borders up to middle, afterwards branches circular in cross section, apices pointed and hooked ; in forma microlabia comparatively less stout, straight in basal half ; afterwards gently incurved. Genitalia with parameres broader at base, gradually narrowing apically to pointed apex, external and internal margin convex, distal lobe of left side enormously developed with spirally coiled virga, coils of virga loose and broad, distal lobe of right side atrophied.

Female : Agrees with males in most characters except penultimate sternite obtuse posteriorly ; ultimate tergite narrowed posteriorly ; pygidium vertical, narrow, posteriorly pointed and straight.

Measurements : (in mm)

	Male	Female
Length of body :	6.4-12.0	8.6-8.8
Length of forceps :	1.2-3.0	1.1-1.3

Distribution : Himachal Pradesh (Lahaul and Spiti, Chamba, Kinnaur and Kangra districts).

Remarks : This species can be separated in macrolabic form by its strongly curved and thin forceps and genitalia with parameres narrowed apically, tip pointed and external and internal margin convex and spirally coiled virga with broad and loose coils.

Isolaboides rimosus Steinmann

Figs. 16—18

1983. *Isolaboides rimosus* Steinmann, *Revue Suisse Zool.*, 90 (3) : 251, figs, 748 (Male ; India ; Garhwal, Dhanolti).

Description : Male : General colour dark reddish brown, legs lighter in colour. Head smooth, frons convex, sutures distinct. Eyes small, shorter than post-ocular length. Antennae 17-segmented, 1st stout, shorter than the distance between antennal bases : 2nd short, quadrate ; 3rd long and cylindrical, longer than 4th and 5th. Pronotum weakly transverse, sides parallel, angles rounded, median sulcus distinct. Apterous. Abdomen spindle shaped, finely punctulated, tergites convex. Penultimate sternite postero-laterally with an excised concavity, median lobe broad. Ultimate tergite transverse, posterior margin in middle lightly concave, oblique laterally above the base of forceps. Pygidium vertical, trigonal. Forceps strongly in curved, trigonal in basal half, afterwards cylindrical, very similar to *I. burri*. Genitalia with parameres broad at base, narrowed apically, distal lobes indistinct, virga short & coiled.

Female : Unknown.

Measurements : (in mm)

Male

Length including forceps : 13.00

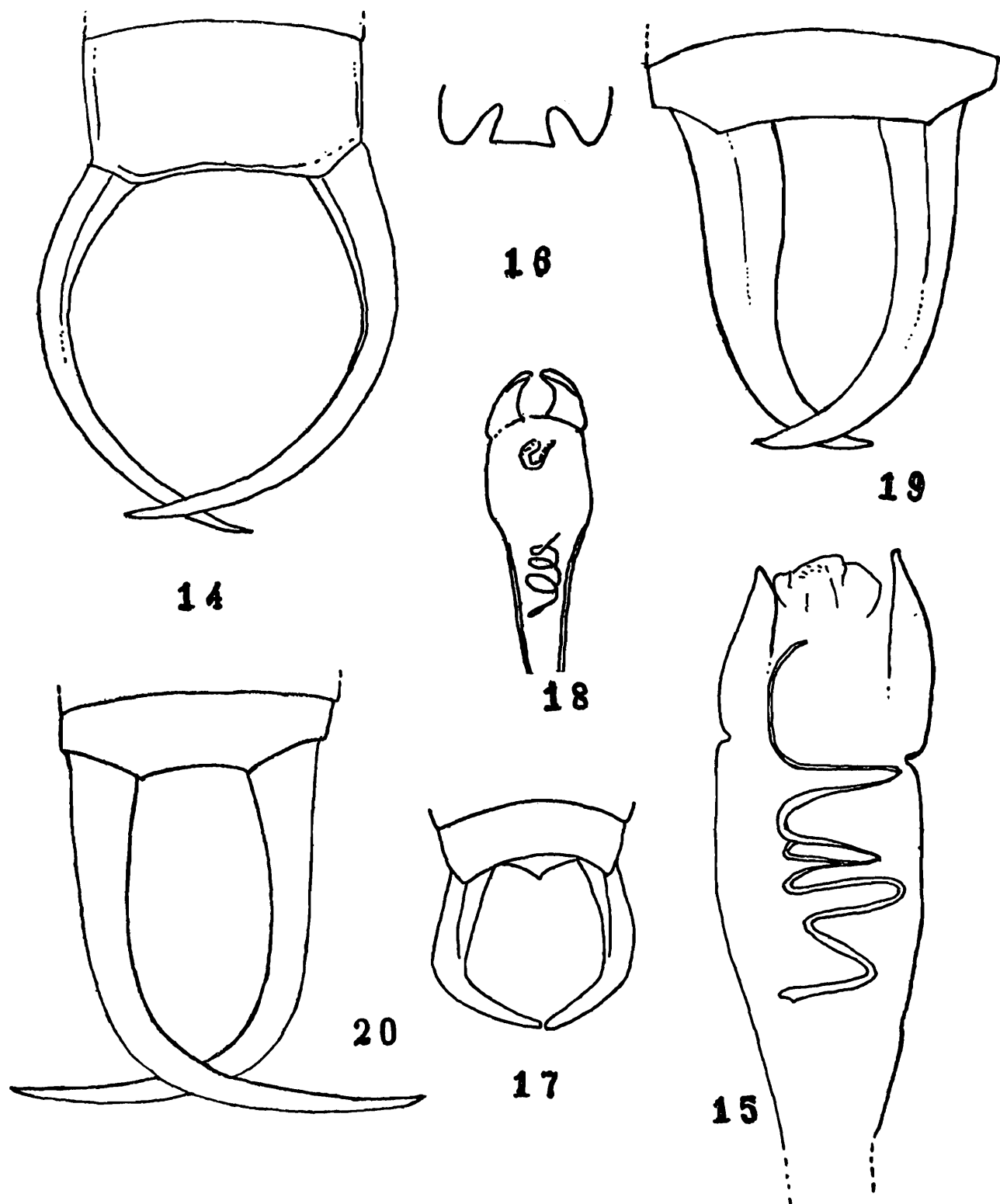
Distribution : India : U.P. (Garhwal Hills).

Remarks : This species differs from all the known species of the genus by its characteristic penultimate sternite.

The male genitalia appears to represent the immature stage.

The coloured photograph of the penultimate sternite given by Sakai (1987, p. 2278) suggests that posterior concavities may not be natural but might be due to damage caused during pulling it off the specimen with forceps for examination of genitalia.

In view of this, it seems necessary to examine the 'Type' for deciding the identity of the species.



Figs. 14-20 : *Isolaboides immsi* (Burr), Male, 14. Ultimate tergite and forceps ; 15. Genitalia ; *Isolaboides rimosus* Steinmann, Holotype, Male, 16. Hind portion of penultimate sternite ; 17. Ultimate tergite and forceps ; 18. Genitalia ; *Isolaboides tenera* (Burr), Male, 19. Ultimate tergite and forceps ; *Isolaboides elegans* (Hebard), Male, 20. Ultimate tergite and forceps. (Figs. 14 & 15 drawn from the Holotype Male of *Pseudisolabis jonathani* Kapoor and Katiyar, figs. 16-18 after Steinmann, 1983 ; fig. 19 after Burr, 1910 and fig. 20 after Hebard, 1917).

DOUBTFUL SPECIES

Isolaboides tenera (Burr)

Fig. 19

1910. *Pseudisolabis tenera* Burr, *Fauna British India, Dermaptera* : 104, fig. 36 (Male : Punjab : Murree).
1911. *Pseudisolabis tenera* ; Burr, *Genera Ins.*, 122 : 39.
1935. *Pseudisolabis burri* (nec Borelli) ; Bey-Bienko, *Wiss. Ergebn. Niederl. Exped. Karakorum, Zool.* : 209 (2 Male, 2 Female ; Kashmir : Sonamarg on river Sind ; 5 Male, 2 Females ; treated *Pseudisolabis tenera* Burr as synonym).

Brief description : Male : General colour dull brown with sparse pubescence.

Head slightly longer than broad, sutures obsolete. Eyes shorter than the post-ocular area. Antennae 17-segmented, 1st stout shorter than the distance between antennal bases ; 3rd long and cylindrical ; 4th short, remaining increasing in length distally. Pronotum rectangular, gently widened posteriorly, sides and hind margin straight. Legs long and slender, hind tarsi with first segment equal to 2nd and 3rd together. Abdomen moderately convex, finely punctulated, contracted posteriorly. Penultimate sternite transverse, hind margin broadly rounded. Pygidium vertical, narrowed posteriorly. Ultimate tergite strongly transverse. Forceps remote at base, almost straight in most part except apices gently incurved.

Female : Not known.

Measurements : (in mm)	Male
Length of body :	11.5
Length of forceps :	1.5

Distribution : Pakistan : Punjab, Murree.

Remarks : This species is so far known by its 'Holotype Male' but genitalia has not been described.

In the original description "...second tarsal segment nearly as long as the first" has been mentioned, which is incorrect. It should be 'first tarsal segment equal to 2nd and 3rd together'.

It is almost certain that this species should be included under *Isolaboides* on the basis of external morphology.

Isolaboides elegans (Hebard)**Fig. 20**

1917. *Pseudisolabis elegans* Hebard, *Proc. Acad. nat. Sci. Philad.*, 69 : 236, pl. 16, figs, 2-3 (Male, Female ; India : Kulu Kangra).
 1923. *Pseudisolabis elegans* ; Hebard, *Mem. Dep. Agric. India ent. Ser.*, 7 : 212.
 1966. *Parisolabis elegans* ; Popham and Brindle, *Entomologist*, 99 : 133.

Brief description : Male : General colour dull brown. Exceedingly finely pubescent.

Head with sutures marked by very feeble impressions. Eyes shorter than post-ocular area. Antennae with 1st segment stout, shorter than the distance between antennal bases. Pronotum rectangular, widened posteriorly, sides and hind margin straight. Legs long and slender, hind tarsi with first segment almost equal to second and third together ; second more than half as long as the third. Abdomen moderately convex, sides of abdominal segments broadly convex posteriorly. Penultimate sternite, transverse, hind margin rounded with slight emargination in middle. Ultimate tergite strongly transverse. Pygidium declivent ; subtrigonal with apex rounded. Forceps with branches remote at base, regularly and strongly incurved, tapering apically with tips strongly hooked, cylindrical but in middle inner surface flattened.

Female : Agrees with males in most characters except that penultimate sternite with hind margin comparatively not so broadly rounded and forceps simple and straight, trigonal above.

Measurements : (in mm)

	Male	Female
Length of body :	9.2-10.2	8.3-9.0
Length of forceps :	1.8-3.0	1.8-2.8

Distribution : India : Himachal Pradesh, Kulu Kangra.

Remarks : On the basis of external morphology it appears to be conspecific with *Isolaboides immsi* (Burr). However, its true identity can be established when the male genitalia is described.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India for providing necessary facilities during the course of this paper.

SUMMARY

Notes on species from Indian subcontinent are provided. Three valid species viz. *Isolaboides burri* (Borelli), *I. immsi* (Burr) and *I. rimosus* Steinmann are recognised and *I. tenera* (Burr) and *I. elegans* (Hebard) are considered as doubtful species since their male genitalia is not described. Besides, *Pseudisolabis jonathani* Kapoor and Katiyar and *Pseudisolahis santokhi* Kapoor and Katiyer are treated as synonym of *Isolaboides immsi* (Burr).

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**EXTENSION OF RANGE OF DISTRIBUTION OF THREE GOBIID FISHES
TO SOUTH ARCOT DISTRICT ON THE EAST T. N. COAST OF INDIA**

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INTRODUCTION

During a recent faunistic survey of South Arcot District by the Scientists of this Station, the inland water bodies yielded several fish species including 6 gobioids and an eleotrid of which, 3 gobiids, viz. *Chiramenu fluviatilis* Visweswara Rao, *Acentrogobius globiceps* (Hora) and *Stigmatogobius javanicus* (Bleeker) were recorded for the first time from this area. The details of the collections are given below.

Suborder : GOBIOIDEI
Family : GOBIIDAE
Subfamily : GOBIINAE

***Acentrogobius globiceps* (Hora)
(Fig. 1)**

1923. *Ctenogobius globiceps* Hora, *Mem. Indian Mus.*, 5 : 744, figs. 24 & 25 (Type locality : Chilka lake, Orissa).

1941. *Acentrogobius globiceps*, Koumans, *Mem. Indian Mus.*, 13 (3) : 234 (Redescription).

Material : 4 exs., 20-24 mm SL, Sankaraparni River, Cuddalore near Vannur Taluk ; 12th Jan 1994, M. Mary Bai.

Diagnostic characters : D. 1. VI ; D. 2. I/10 ; A. I/ 9 ; P. i/16. A small, elongate gobiid with 26-27 large scales in longitudinal series ; 7-8 predorsal scales ; numerous vertical rows of sensory pores below eye, cut across by an horizontal row in middle. Characterised by an oblique white stripe passing through second dorsal and upper caudal fins. Grows to a length of 30 mm SL.

Distribution : India : Gangetic delta, Chilka lake (Orissa) and Ennore backwaters and Vellar basin (Tamil Nadu) ; Java ; Borneo, and probably Singapore.

Remarks : This species was collected for the first time from the inland waters of Cuddalore Taluk from a small stream flowing into the estuary.

***Chiramenu fluviatilis* Visweswara Rao**

(Fig. 2)

1970. *Chiramenu fluviatilis* Visweswara Rao, *J. mar. Biol. Ass. India*, 12 (1 & 2): 183-186. figs. 1 & 2 (Type locality : Godavari estuary, Andhra Pradesh)

Material : 1 ex., 25 mm SL, Killi village, near Porto Novo, Chidambaram Taluk, 12th Jan 1994, M. Mary Bai.

Diagnostic features : D. 1. VI ; D. 2. 1/10 ; A. I/10 ; P. i/15. Body slender and elongate ; mouth inferior, upper jaw prominent with a broad, beak like maxilla, with single row of teeth in upper jaw ; short vertical rows of sensory canal below eye ; scales small, 54-58 ctenoid scales in lateral series ; caudal emarginate ; body with five narrow vertical bands. Grows to 26 mm SL.

Distribution : India : Godavari estuary (Andhra Pradesh), Vellar basin (Tamil Nadu).

Remarks : *Chiramenu fluviatilis* Visweswara Rao was described from Godavary estuary in 1970 and since its original description has not been reported from elsewhere. The genus *Chiramenu* Visweswara Rao is monotypic and as the local name suggests, includes small, translucent gobiids growing to a length of 26 mm SL. These are reported to flood the Godavary estuary from around end of September to mid November, swimming against the flood waters, close to the banks. The occurrence of this fish further south extends its range of distribution in the inland water bodies draining into the Bay of Bengal.

***Stigmatogobius javanicus* (Bleeker)**

(Fig. 3)

1856. *Gobius javanicus* Bleeker, *Natuurk. Tijdschr. Ned. Indie*, 11 : 88 (Type locality : Java).

1941. *Stigmatogobius javanicus*, Koumans, *Mem. Indian Mus.*, 13 (3) : 263 (Redescription),

Material : 4 exs., 21-31 mm SL ; Sankaraparni River near Vannur Taluk, 12th Jan 1994, M. Mary Bai.



FIG. 1

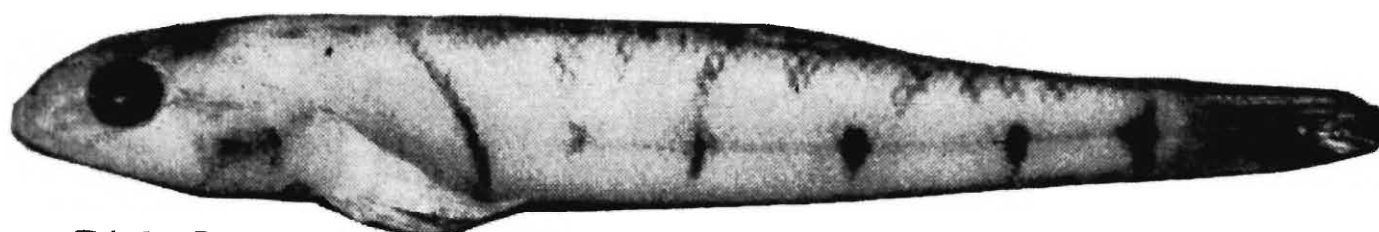


FIG. 2



FIG. 3

Fig. 1 : Lateral view of *Acentrogobius globiceps* (Hora), 24 mm SL

Fig. 2 : Lateral view of *Chiramenu fluviatilis* Visweswara Rao, 25 mm SL.

Fig. 3 : Lateral view of *Stigmatogobius javanicus* (Bleeker), 31 mm SL

Diagnostic features : D. 1. VI ; D. 2. I/6-7 ; A. I/6-7 ; P. i/14. Body elongate and compressed with 25-27 ctenoid scales along lateral series ; predorsal 6-8, the foremost scale is a large unpaired one in the median line ; snout shorter than eye ; upper jaw prominent ; two mucous canals longitudinally over cheek ; caudal obtuse. Head with dark stripe from eye to maxillary and dark oblong spot on cheek ; body with numerous minute spots and two to three longitudinal rows of alternate blotches : first dorsal with a dark spot, second dorsal and caudal spotted.

Distribution : India, through the East Indies, to the Philippines and Australia.

Remarks : This species has a wide range of distribution and in India it is known from Chilka, Godavary and Ennore estuaries. It has recently been collected from the inland water bodies of Pondicherry. This reports its extension of range of distribution to the fresh water streams flowing into the estuary.

Discussion : Gobioid fishes of South Arcot especially Porto Novo have been well studied and reported. Venkateswarlu (1967) listed 30 gobioid species ; Natarajan and Subramanyam (1974) reported on new distributional records of Gobioids from Porto Novo. Recently Lakshminarayana (1994) listed 34 gobioid species in his eco-report on the Vellar estuary. The present report includes 3 gobiids from South Arcot District. The occurrence of *Chiramenu fluviatilis* is of significance since it is known so far only from type locality. The other gobioids in the collection include *Glossogobius giuris* (Ham.) *Oligolepis acutipennis* (Val.) and *Trypauchen vagina* (Bloch & Schneider) and an eleotrid *Prionobutis koilomatodon* (Blkr.).

SUMMARY

Three species of gobiids viz. *Chiramenu fluviatilis* Visweswara Rao, known only from its type locality and two other widely distributed species, *Acentrogobius globiceps* (Hora) and *Stigmatogobius javanicus* (Bleeker) are reported for the first time from the inland waters of South Arcot District, Tamil Nadu.

ACKNOWLEDGEMENT

The authors are grateful to the Director, Zoological Survey of India and Dr. P. T. Cherian, Officer-in-charge, Southern Regional Station, ZSI for providing necessary facilities, and to Dr. A. G. K. Menon, Scientist Emeritus, for going through the manuscript.

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**STUDIES ON THE ODONATA FAUNA OF BASTAR,
MADHYA PRADESH, INDIA**

M. PRASAD

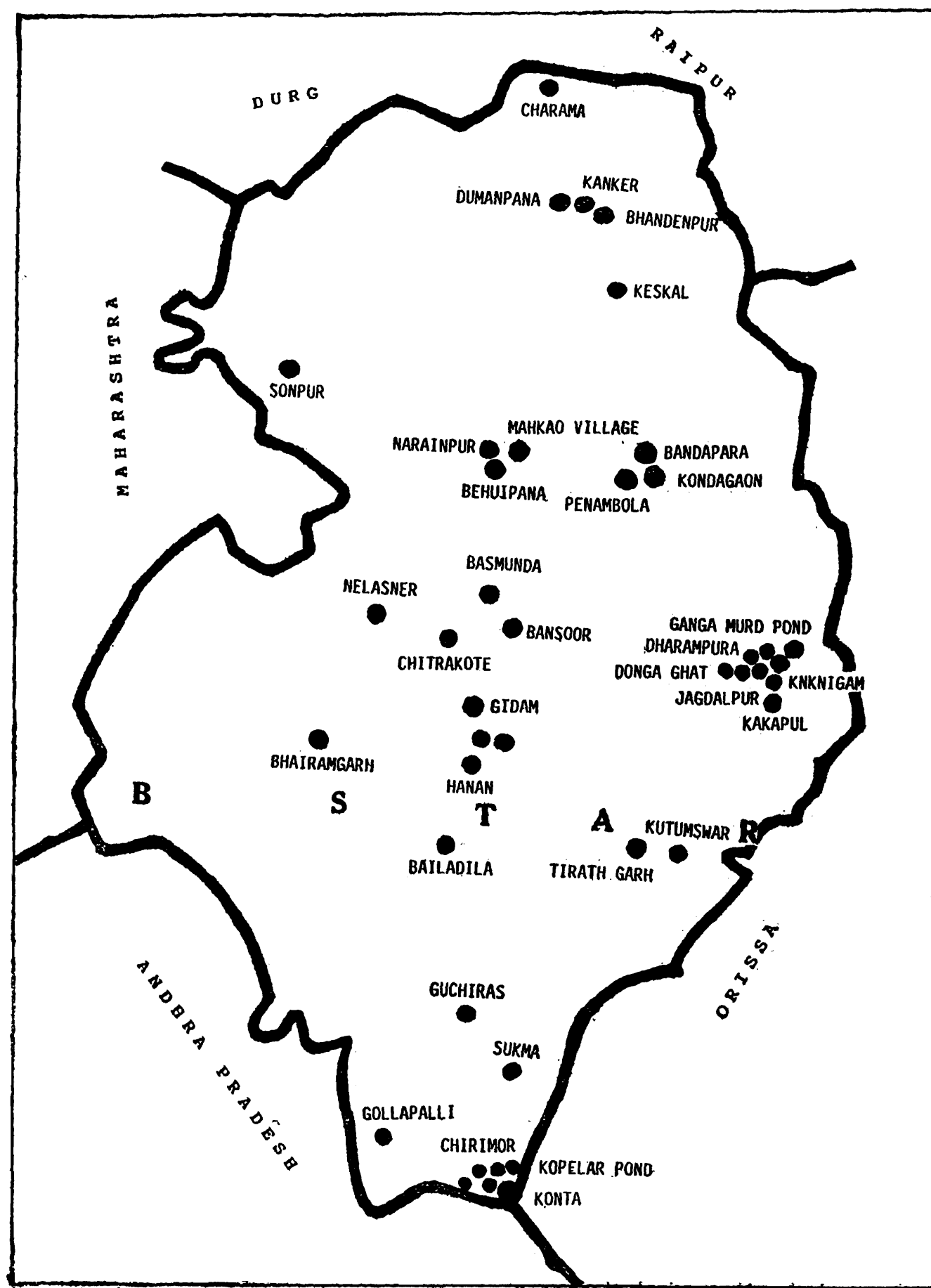
Zoological Survey of India, Calcutta

INTRODUCTION

Bastar is one of the biggest district of Madhya Pradesh, India, situated at the south-east boundary of the State. It lies between 80°15' to 82°15' East longitudes and 17°46' to 20°34' North latitudes. Bastar district is bordered by Maharashtra in the west, Andhra Pradesh in the south and Orissa in the east (see Map). It covers an area of 39,060 sq. kms. and its Administrative Centre is Jagdalpur. Approximately one-third of the district is covered by thick-forests, with hilly tract. It ranges from 49 to 1276 metres in height. Monsoon starts from June and extend up to October. The average annual rain fall amounts to 1,521 mm, and temperature varies in between 19°C to 31°C. The varied ecological conditions provide excellent habitats including rivers, hill-streams and permanent/temporary water-bodies for the breeding of Odonata.

No comprehensive work is available dealing with the Odonata of Madhya Pradesh and Bastar district in particular. Fraser (1933, 1934 and 1936) in the *Fauna of British India*, Odonata, has described 19 species of Odonata from Madhya Pradesh. Bhasin (1953), after a gap of 17 years, has reported 9 species from Madhya Pradesh. Baijal and Agarwal (1955) have also reported 14 species of Odonata from the State. Recently Srivastava and Suribabu (1984, 1985 and 1992), Srivastava *et al.* (1992), Suri Babu (1983) and Suri Babu and Srivastava (1988) and Suri Babu *et al.* (1992) have described the reproductive behaviour and larvae of 13 species of Odonata from Madhya Pradesh State. Mitra (1986 and 1995), while reporting Odonata from Central India, has reported 39 species of Odonata from Madhya Pradesh and in (1995) he has also reported 22 species from the Indravati Tiger Reserve of this district.

To prepare a comprehensive account on the Odonata fauna of Bastar district, the author has made a detailed study of the specimens present in the National Zoological Collections of the Zoological Survey of India, Calcutta. Besides, the author himself conducted a survey trip in Bastar during November, 1988 and collected several



Map of Bastar district, Madhya Pradesh showing the collection sites.

species. This study reveals the occurrence of 66 species and subspecies under 38 genera and 10 families from there. Of these 43 species and subspecies are common with the Western Himalaya (Kumar and Prasad, 1981), and 44 species and subspecies with Bihar (Prasad and Varshney, 1988), which are adjacent to Madhya Pradesh. In the present paper the classification of Davies and Tobin (1984 and 1985) and Tsuda (1991) has been followed, and the nomenclature is in accordance with the Check-list of the Odonata of India (Prasad and Varshney, 1995).

LIST OF SPECIES OF ODONATA FROM BASTAR DISTRICT

I. Family : PLATYCNEMIDIDAE

1. *Copera marginipes* (Rambur)

II. Family : COENAGRIONIDAE

2. *Pseudagrion decorum* (Rambur)
3. *P. rubriceps rubriceps* Selys
4. *P. australasiae* Laidlaw
5. *P. hypermelas* Selys
6. *Ceragrion coromandelianum* (Fabricius)
7. *C. olivaceum* Laidlaw
8. *Aciagrion pallidum* Selys
9. *A. hisopa hisopa* Selys
10. *A. occidentale* Laidlaw
11. *Ischnura senegalensis* (Rambur)
12. *I. aurora aurora* (Brauer)
13. *I. rufostigma rufostigma* Selys
14. *Rhodischnura nursei* (Morton)
15. *Enallagma parvum* Selys
16. *Agriocnemis lacteola* Selys
17. *A. debreui* Fraser
18. *A. splendidissima* Laidlaw
19. *A. pygmaea* (Rambur)
20. *A. pieris* Laidlaw
21. *Onychargia atrocyna* (Selys)

III. Family : LESTIDAE

- 22. *Lestes viridulus* Rambur
- 23. *L. thoracicus* Laidlaw
- 24. *L. umbrinus* Selys
- 25. *L. elatus* Hagen

IV. Family : PROTONEURIDAE

- 26. *Disparoneura quadrimaculata* (Rambur)

V. Family : CHLOROCYPHIDAE

- 27. *Rhinocypha* (*Aristocypha*) *trifasciata* (Selys)
- 28. *Libellago lineata lineata* (Burmeister)

VI. Family : CALOPTERYGIDAE

- 29. *Vestalis gracilis gracilis* (Rambur)
- 30. *V. smaragdina* Selys

VII. Family : GOMPHIDAE

- 31. *Paragomphus lineatus* (Selys)
- 32. *Ictinogomphus rapax* (Rambur)

VIII. Family : AESHNIDAE

- 33. *Anax guttatus* (Burmeister)
- 34. *Gynacantha bayadera* Selys

IX. Family : CORDULIDAE

- 35. *Macromia cingulata* Rambur

X. Family : LIBELLULIDAE

- 36. *Potamarcha congener* (Rambur)
- 37. *Orthetrum taeniolatum* (Schneider)
- 38. *O. sabina sabina* (Drury)
- 39. *O. glaucum* (Brauer)
- 40. *O. luzonicum* (Brauer)
- 41. *O. prunosum neglectum* (Rambur)
- 42. *Palpopleura sexmaculata sexmaculata* (Fabr.)
- 43. *Acisoma panorpoides panorpoides* Rambur

44. *Diplacodes nebulosa* (Fabr.)
45. *D. trivialis* (Rambur)
46. *D. lefebvrei* (Rambur)
47. *Indothemis limbata sita* Campion
48. *Lathrecista asiatica asiatica* (Fabr.)
49. *Cræothemis servilia servilia* (Drury)
50. *Brachythemis contaminata* (Fabr.)
51. *Bradinopyga geminata* (Rambur)
52. *Neurothemis fulvia* (Drury)
53. *N. intermedia intermedia* (Rambur)
54. *N. tullia tullia* (Drury)
55. *Brachydiplax sobrina* (Rambur)
56. *Trithemis aurora* (Burm.)
57. *T. festiva* (Rambur)
58. *T. pallidinervis* (Kirby)
59. *T. kirbyi kirbyi* Selys
60. *Tholymis tillarga* (Fabr.)
61. *Zyxomma petiolatum* Rambur
62. *Pantala flavescens* (Fabricius)
63. *Rhyothemis variegata variegata* (Linnaeus)
64. *Tramea basilaris burmeisteri* Kirby
65. *T. virginia* (Rambur)
66. *Urothemis signata signata* (Rambur)

**KEY TO SPECIES AND SUBSPECIES OF ODONATA IN
BASTAR DISTRICT, MADHYA PRADESH
(Based on adult specimens)**

- Eyes well separated ; forewing and hindwing more or less similar in shape and breadth ; wings petiolated ... 2
- Eyes not well separated, meeting only at a point or broadly confluent ; forewing and hindwing not similar in shape and breadth ; wings never petiolated ... 31

2. More than 5 antenodal nervures ; arc nearer to the base of the wing than the node ; anal vein separated from posterior border of wing ... 28
- Only 2 (rarely 3) antenodal nervures ; arc midway between base of wing and node or nearer to node than the base ; anal vein fused at the base with the posterior border of wing ... 3
3. Veins IRiii + V arising nearer to the node than the arculus ... 4
- Veins IRiii + V arising nearer to the arculus than the node ... 25
4. The anal vein and CUii of normal length ... 5
- The anal vein absent or greatly reduced ; CUii varying from a vein to normal length and may be only one cell or so long ... *D. quadrimaculata*
5. Discoidal cell short ; anal vein separating from wing border either proximal to Ac or distal to Ac ; MA and IRii zigzagged for greater part of their length 6
- Discoidal cell elongate ; anal vein separating from wing border proximal to Ac ; MA and IRii mostly straight only zigzagged apically or not at all ; legs bright orange to dull reddish in colour ... *C. marginipes* (Ramb.)
6. Arc situated at the level of the distal antenodal nervure ... 7
- Arc situated distal to the level of the distal antenodal nervure... *Agriocnemis* Selys 21
7. Vein ab arising from the hind border of the wing at the point where ac meets it ... 8
- Vein ab arising from the hind border of the wing more or less proximal to the point where ac meets it ... 16
8. A prominent ridge on the frons present ; no postocular coloured spot on the head ; head and thorax uniform colour ... *Ceragrion* Selys 9
- No ridge on the frons ; postocular coloured spots always present ; head and thorax not of uniform colour ... 10
9. Abdomen uniform dull olivaceous in colour ... *C. olivaceum* Laid.
- Abdomen bright citron-yellow in colour ... *C. coromandelianum* (Fabricius)
10. Pterostigma in forewing and hindwing of the same size ; abdomen not unduly long and slender ... *Pseudagrion* Selys 11
- Pterostigma in forewing longer than in the hindwing ; abdomen usually very long and slender ... 14
11. Face and vertex reddish orange ... *P. rubriceps rubriceps* Selys

- Face and vertex not reddish orange ... 12
- 12. Face, frons and vertex black *P. hypermelas* Selys
- Face, frons and vertex may be blue or green and marked with black ... 13
- 13. Thorax pale-blue on dorsal side, with three fine black lines on mid-dorsal carinal ridge and a thicker black humeral stripe ... *P. decorum* (Rambur)
- Thorax azure blue on dorsal side, with broad black on mid-dorsum and a narrow black humeral stripe ... *P. australasiae* Laidlaw
- 14. Ground-colour pale brown, without black markings on head and thorax ... *A. pallidum* Selys
- Ground-colour blue, with black markings on head, thorax and abdomen... 15
- 15. Abdomenal segment 8th with a black elongate dorsal triangular marking ... *A. occidentale* Laidlaw
- Abdomenal segment 8th with a short narrow black stripe on each side ... *A. hisopa hisopa* (Selys)
- 16. Pterostigma of the same colour and shape in forewing and hindwing of male ; dorsal apical tubercle on segment 10 of male absent ... 20
- Pterostigma differing in shape and size in forewing and hindwing of male ; dorsal apical tubercle on segment 10 of male present ... 17
- 17. Postocular coloured spot always present in adult stage ; tubercles on apical border of segment 10 closely opposed ... *Ischnura* Charp. 18
- Postocular coloured spot absent in the adult stage ; tubercles on apical border of segment 10 widely separated by a shallow notch ... *R. nursei* (Morton)
- 18. Body colour of male bright orange-red ; abdominal segments 8-10 only black ... *I. rufostigma rufostigma* Selys
- Body colour of male and Isochrome female blue or pale grass-green 19
- 19. Abdominal segments 3-6 lemon-colour on dorsal side ; segment 2 not steely metallic blue on dorsal side ... *I. aurora aurora* (Brauer)
- Abdominal segments 3-6 black on dorsal side ; segment 2 steely metallic blue on dorsal side ... *I. senegalensis* (Rambur)
- 20. Female with a robust ventral apical spine on segment 8 ... *E. parvum* Selys
- Female without a ventral apical spine on segment 8th ; postocular coloured spots absent ... *O. atrocyana* (Selys)

21.	Segment 2 of abdomen with blue eye ...	...	<i>A. dabreui</i> Fraser	
—	Segment 2 of abdomen without blue eye spots	...		22
22.	Labrum non-metallic	...		23
—	Labrum metallic blue	...	<i>A. pygmaea</i> (Rambur)	
23.	Abdomen white in colour	...	<i>A. lacteola</i> Selys	
—	Abdomen blue with black markings	...		24
24.	Abdomen with restricted black markings	...	<i>A. pieris</i> Laidlaw	
—	Abdomen with heavy black markings	...	<i>A. splendidissima</i> Laidlaw	
25.	Thorax without metallic markings	...		26
—	Thorax with green metallic antehumeral stripe	...		27
26.	Vertex of head pale brown	...	<i>L. umbrinus</i> Selys	
—	Vertex of head mat-black	...	<i>L. thoractus</i> Laidlaw	
27.	Thorax with a uniform narrow antehumeral stripe on each side ; vertex pale-brown	...	<i>L. viridulus</i> Rambur	
—	Thorax with narrow antehumeral stripes expanded outwardly at the upper ends ; vertex black	...	<i>L. elatus</i> Hagen	
28.	Sectors of arc arising from a common point	...		29
—	Sectors of arc separated at origin ; Hindwings of male with apical, medial and nodal opaque bands separated	...	<i>R. (Aristocypha) trifasciata</i> (Selys)	
29.	Pterostigma absent in both the sexes	...		30
—	Pterostigma absent in forewings of male only	...	<i>L. lineata lineata</i> (Burm.)	
30.	Wings tinted uniformly with golden yellow	...	<i>V. smaragdina</i> Selys	
—	Wings untinted or partially tinted	...	<i>V. gracilis gracilis</i> (Rambur)	
31.	Discoidal cell approximately of the same size and shape in forewing and situated equal distance from the arc ; Costal and subcostal antenodal nervures not coinciding with the two robust primary antenodals ; middle lobe of the labium large and fissured	...		32
—	Discoidal cell differing in size and shape in forewing and hindwing that of forewing situated for distal of the arc ; middle lobe of labium very small, not fissured broadly overlapped by the lateral lobes ; Costal and subcostal antenodal nervure coinciding the robust primary antenodals absent	...		35

32. Eye separated ... 33
 — Eye broadly confluent above ... 34
33. Discoidal cell, hypertrigone and subtrigone of forewing traversed and reticulated ... *I. rapax* (Rambur)
 — Discoidal cell, hypertrigone and subtrigone of forewing always entire ; anal appendages yellow ... *P. lineatus* (Selys)
34. Base of hindwing without a notch, tornus of hindwing rounded in both the sexes, anal triangle absent, abdomen with orange colour markings ... *A. guttatus* (Burm.)
 — Base of hindwing more or less deeply notched, tornus of hindwing angulated in male, anal triangle always present, abdomen without black or other bright sharply defined markings, 3rd abdominal segment markedly constricted... *G. bayadera* Selys
35. Tibae of males without keels ; base of hindwing rounded in both sexes ; oreillets absent ; body rarely metallic ... 36
 — Tibae of males with an elongate lamina-shaped keel on the flexor surface ; base of hindwing in the male more or less angulated or notched (save in genera *Hemicordulia* and *Procordulia*) ; oreillets present ; body usually coloured metallic ; abdominal segments 4 to 8 ringed with yellow ... *M. cingulata* Rambur
36. Sectors of arc fused at their origin ; primary antenodal nervure absent ... 37
 — Sectors of arc separated from origin ; feebly developed primary antenodal nervure present ; subtrigone in forewing 3 celled ... *U. signata signata* (Rambur)
37. Apex of loop in the wings open ... 38
 — Apex of loop in the wings closed ... 39
38. Abdomen broad at base then tapering gradually to the end ; an opalescent white spot in the centre of hindwing present ... *T. tillarga* (Fabricius)
 — Abdomen tumid at base, then abruptly narrowed and very slim and cylindrical to the end ; an opalescent white spot on the centre of hindwing absent ... *Z. petiolatum* Rambur
39. Distal antenodal nervure in forewing complete ... 40
 — Distal antenodal nervure in forewing incomplete ... 46
40. Frons metallic above ... *B. sobrina* (Rambur)
 — Frons not metallic above ... 41

- | | | | | |
|-----|---|-----|---|----------------------------|
| 41. | Small size specimens ; only 6 antenodal nervures in forewing | ... | <i>A. panorpoides panorpoides</i> Rambur | |
| — | Medium size specimens, not less than 12 antenodal nervures in forewing | ... | ... | <i>Orthetrum</i> Newman 42 |
| 42. | Males coloured brown or black with yellow markings ; often pruinosed | ... | | 43 |
| — | Males coloured some of shade of red, or violaceous red due to a thin overlying pruinescens ; frons blue black anteriorly... | | <i>O. pruinsum neglectum</i> (Rambur) | |
| 43. | Abdomen variable but never very slim nor compressed laterally ; mostly with pruinosed abdomen and thorax | ... | ... | 44 |
| — | Abdomen enormously swollen at base and then abruptly slimmed and compressed laterally to the end ; black marked with greenish yellow ; never pruinosed | ... | <i>O. sabina sabina</i> (Drury) | |
| 44. | Cuii in hindwing arising from the posterior angle of discoidal cell | ... | | 45 |
| — | Cuii in hindwing arising from the distal side of discoidal cell, well away from its posterior angle | ... | <i>O. luzonicum</i> (Brauer) | |
| 45. | Moderately large species with face black or frons blackish anteriorly ; membrane black | ... | <i>O. glaucum</i> (Brauer) | |
| — | Smallest species with face and frons greyish green or bluish ; membrane dark brown bordered with black | ... | <i>O. taeniolatum</i> (Schn.) | |
| 46. | Lobes of prothorax with long hairs | ... | ... | 47 |
| — | Lobes of prothorax without long hairs | ... | ... | 50 |
| 47. | Eyes contiguous for a short space ; discoidal cell in hindwing entire ; costal border of forewing straight ; frons non-metallic above ; discoidal field in forewing beginning with 2 to 3 rows of cells | ... | <i>Diplacodes</i> Kirby | 48 |
| — | Eyes more broadly contiguous ; discoidal cell in hindwing traversed ; costal border of forewing sinuous near base ; frons metallic above ; discoidal field in forewing beginning with 3 rows of cells | ... | <i>P. sexmaculata sexmaculata</i> (Fabricius) | |
| 48. | Apices of wings tipped with black | ... | <i>D. nebulosa</i> (Fabricius) | |
| — | Apices of wings hyaline | ... | ... | 49 |
| 49. | Adults entirely black, with markings ; wings palely enfumed with brown towards apices ; anal appendages black | ... | <i>D. lefebvrei</i> (Rambur) | |
| — | Adult black marked with yellow or pruinosed dark blue throughout ; wings uncoloured except at base ; anal appendages yellow | ... | <i>D. trivialis</i> (Rambur) | |

50. Sectors of arc in forewing separated and divergent at the origin ; black and golden yellow markings present on the wings ... *R. variegata variegata* (Linn.)
- Sectors of arc in forewing arising from common long stalk ; black and golden yellow markings on the wings absent ... 51
51. Discoidal field converging at wing border ... 52
- Discoidal field parallel or divergent at wing border ... 56
52. Nervure IRiii present in between Rii & Riii ... *P. flavescens* (Fabr.)
- Nervure IRiii absent in between Rii and Riii ... *Trithemis* Brauer 53
53. Legs very long and spidery ; pterostigma bicolorous ; body yellow marked with black ... *T. pallidinervis* (Kirby)
- Legs of ordinary length ; pterostigma unicolorous ; body colour variable ... 54
54. Thorax and abdomen bright vermilion red ... *T. kirbyi kirbyi* Selys
- Thorax and abdomen may be violaceous black or violaceous crimson ... 55
55. Base of hindwing with a small dark brown spot ; neuration black ... *T. festiva* (Rambur)
- Base of hindwing with small reddish brown spot ; neuration crimson ... *T. aurora* (Burm.)
56. Discoidal field in in forewing adjacent to discoidal cell, only 2 cells wide, apices of wings clear ... *I. limbata sita* Campion
- Discoidal field in forewing adjacent to discoidal cell, 3 or more cells wide ... 57
57. Pterostigma equal in size in forewing and hindwing ... 59
- Pterostigma unequal in forewing and hindwing ; large blackish brown spot present at the base of wings. ... *Tramea* Hagen 58
58. Hamule with slightly overlapping lobe ; two large black spots at the hindwing surrounded by a golden yellow areola, one in cubital space, the other lying obliquely in anal area of wing ; the two narrowly confluent near base of discoidal cell in the male ... *T. basilaris burmeisteri* Kirby
- Hamule much longer and with greatly overlapping lobe ; only a single black spot of variable size at the base of hindwing ; spot in hindwing reddish brown, very large, extending distally to distal end of discoidal cell and involving nearly whole of anal loop ... *T. virginia* (Rambur)
59. Pterostigma unicoloured ... 60

- Pterostigma bicoloured (black with white end) ... *B. geminata* (Rambur)
60. More than one cubital nervure present in all wings ... *Neurothemis* Brauer 61
- Only one cubital nervure present in all wings ... 63
61. An opalescent white band in the wings present ; base of wings broadly black
... ... *N. tullia tullia* (Drury)
- An opalescent white band in the wings absent ... 62
62. Wings dark reddish brown from base to about middle of pterostigma ; apex of wings
also narrowly opaque brown to partly enclose a clear wings in each wing at apex ;
neuration close *N. fulvia* (Drury)
- Wings pale yellow, area at the base not very sharply defined : costal border of
wings pale yellow up to as far as pterostigma ; reticulation open ...
... *N. intermedia intermedia* (Rambur)
63. Red or yellow specimens ; basal or medial yellow marking present on wing
... ... 64
- Variable coloured specimens ; base of wings rarely marked with pale yellow ... 65
64. Broad reddish yellow medial marking present on the wings *B. contaminata* (Fabricius)
- Small basal yellow marking present at the base of wings ... *C. servilia servilia* (Drury)
65. Arc situated between the second and 3rd antenodal nervures, only one row of cells
between IRiii & RSpl *L. asiatica asiatica* (Fabr.)
- Arc situated between the first and 2nd antenodal nervures 2 rows of cells between
IRiii & RSpl *P. congener* (Rambur)

SYSTEMATIC ACCOUNT

Order	: ODONATA
Suborder	: ZYGOPTERA
Superfamily	: COENAGRIONOIDEA
Family	: PLATYCNEMIDIDAE
Genus	: <i>Copera</i> Kirby

1. *Copera marginipes* (Rambur)

1842. *Platynemis marginipes* Rambur, *Ins. Neurop.*, : 240.

1933. *Copera marginipes*, Fraser, *Fauna Brit. India Odon.*, 1 : 192-197.

Material examined : 2 ♂♂, 2 ♀♀, Konta Basti, 22. 11. 1988, coll. M. Prasad and 1 ♂, Old konta Basti, 24. 11. 1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	31.00 mm	19.00 mm	18.00 mm
Female :	26.50 mm	17.50 mm	17.00 mm

Distribution : India (Assam, Bihar, Himachal Pradesh, Karnataka, Maharashtra, Uttar Pradesh and West Bengal), Indonesia (Sumatra, Java, Sunda Island and Sumba), Malaysia, Myanmar, Nepal, Sri Lanka and Thailand.

Remarks : It is a common species of the genus *Copera* Kirby. Its adults are found near the larval habitats during June to December. Labrum in male is marked with black, but in one specimen it is brownish yellow. Pterostigma covers one cell. Nervure *Ac* nearer to 1st antenodal nervure. 11 postnodal nervures present in forewings and 9 in hind, while in female 12 postnodal in forewings and 10 in hindwings. 9th and 10th abdominal segments in male marked with creamy white. Anal appendages in male are cream-yellow with tips black. Ventral portion of superior anal appendages broadly black.

Family : COENAGRIONIDAE

Genus : *Pseudagrion* Selys

2. *Pseudagrion decorum* (Rambur)

1842. *Agrion decorum* Rambur, *Ins. Newrop.*, : 258.

1933. *Pseudagrion decorum*, Fraser, *Fauna Brit. India Odon.*, 1 : 268-269.

Material examined : 1 ♀, Basmunda Bandh, Dhauroi, 30. 11. 1988, coll. Y. N. Gupta ; 1 ♂, 1 ♀, Chitrakote, 27. 11. 1988, coll. M. Prasad ; 2 ♂♂, Dharampura, Jagdalpur, 30. 11. 1979, coll. S. Ahmed ; 1 ♂, Kakapul, Jagdalpur, 1. 11. 1979, coll. S. Ahmed and 1 ♂, Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	28.00 mm-28.50 mm	19.50 mm-20.50 mm	19.00 mm-19.50 mm
<i>Female</i> :	28.50 mm	20.00 mm-20.50 mm	19.50 mm-20.00 mm

Distribution : India (Himachal Pradesh, Karnataka, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal), Myanmar (Burma), Nepal and Sri Lanka.

Remarks : Nervure *Ac* in females just in the middle of 1st and 2nd antenodal nervures. Pterostigma covers less than a cell. In male there are 10 postnodals in forewings and 8-9 in hindwings, while in females 10 postnodals in forewings and 8 in hindwings.

3. *Pseudagrion rubriceps rubriceps* Selys

1876. *Pseudagrion rubriceps* Selys, *Bull. Acad. Belg.*, (2) 42 : 510.

1933. *Pseudagrion rubriceps*, Fraser, *Fauna Brit. India Odon.*, 1 : 296-299.

1991. *Pseudagrion rubriceps rubriceps*, Tsuda, *A Distributional list of world Odonata* : 46.

Material examined : 2 ♂♂, Chitrakote, Jagdalpur, 2. 11. 1979. coll. S. Ahmed and 1 ♂, Naibasti Konta, 20. 11. 1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	32.00 mm	20.50 mm	20.00 mm

Distribution : Widely distributed throughout continental India, Indonesia, Malaysia, Myanmar (Burma), Nepal and Taiwan.

Remarks : It is one of the most common damselfly of India which occurs throughout the year, Nervure *Ac* present slightly distal to 1st antenodal nervures and pterostigma cover 1 cell 10-11 postnodal nervures present in forewings and 9 in hindwings.

4. *Pseudagrion australasiae* Laidlaw

1876. *Pseudagrion microcephalum* Race ? *australasiae* Selys, *Bull. Acad. Belg. Sci.*, (2) 42 : 506 (pars).

1916. *Pseudagrion australasiae*, Laidlaw, *Rec. Indian Mus.*, 12 : 21.

1954. *Pseudagrion australasiae*, Lieftinck, *Treubia* (Suppl.), 22 : 56.

Material examined : 2 ♂♂, Naibasti Konta, 25. 11. 1988, coll. M. Prasad.

Measurements :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male : 31.50 mm	23.00 mm	22.50 mm

Distribution : India (Assam, Manipur, Meghalaya and West Bengal), Australia, Indonesia, Malaysia, Myanmar (Burma) and Thailand.

5. Pseudagrion hypermelas Selys

1876. *Pseudagrion hypermelas* Selys, *Bull. Acad. Belg.*, (2) 42 : 519.

1933. *Pseudagrion hypermelas*, Fraser, *Fauna Brit. India Odon.*, 1 : 289-292.

Distribution : India (Bihar, Gujarat, Madhya Pradesh (Bastar), Maharashtra, Punjab, West Bengal and Western Ghats).

Genus : Ceriagrion Selys

6. Ceriagrion coromandelianum (Fabricius)
(Figs. 1 & 2)

1798. *Agrion coromandelianum* Fabricius, *Ent. Syst. Suppl.*, : 287.

1933. *Ceriagrion coromandelianum*, Fraser, *Fauna Brit. India Odon.*, 1 : 315-316.

Material examined : 3 ♂♂, Bhandenpur, 18. 10. 1979, coll. S. Ahmed ; 1 ♂, 1 ♀, Chitrakote, Jagdalpur, 27. 11. 1988, coll. M. Prasad ; 5 ♂♂, 2 ♀♀, Naibasti Konta, 25. 11. 1988, coll. M. Prasad ; 4 ♂♂, 1 ♀. Near Ganga Murd pond, Jagdalpur, 28. 11. 1988, coll. M. Prasad and 5 ♂♂, 2 ♀♀, Oldbasti Konta, 24. 11. 1988, coll. M. Prasad.

Measurements :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male : 30.00 mm-31.00 mm	20.00 mm-21.50 mm	19.50 mm-20.50 mm
Female : 29.00 mm-30.00 mm	21.00 mm-22.50 mm	20.00 mm-21.50 mm

Distribution : India (Bihar, Eastern Himalayas, Himachal Pradesh, Uttar Pradesh and West Bengal). China, Malaysia, Myanmar (Burma), Nepal and Sri Lanka.

Remarks : It is most common species of the genus and found almost throughout the year. Anal appendages and male genitalia as shown in figures 1 and 2.

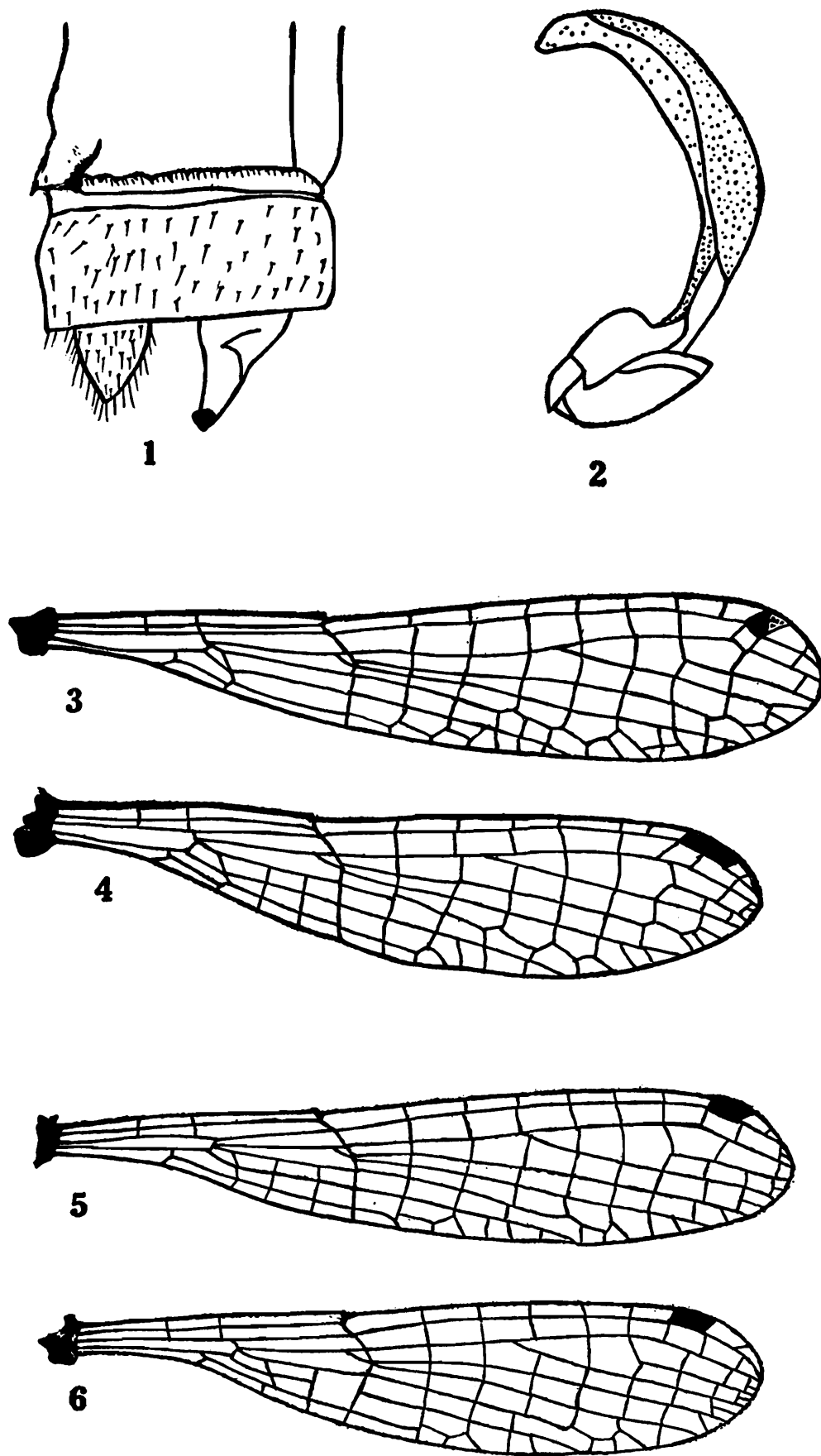


Fig. 1 : Lateral view of anal appendages of *Ceriagrion coromandelianum* (Fabr.)

Fig. 2 : Male genitalia (Prophallus) of *Ceriagrion Coromandelianum* (Fabr.)

Figs. 3 & 4 : *Ischnura aurora aurora* (Brauer)

3. Forewing, 4. Hindwing

Figs. 5 & 6 : *Agriocnemis pygmaea* (Rambur)

5. Forewing, 6. Hindwing

7. *Ceriagrion olivaceum* Laidlaw1914. *Ceriagrion olivaceum* Laidlaw, *Rec. Indian Mus.*, 8 : 345-346.1933. *Ceriagrion olivaceum*, Fraser, *Fauna Brit. India Odon.*, 1 : 324.

Material examined : 1 ♀, Kutumswar, 17. 12. 1980, coll. M. S. Shishodia and 1 ♀, Nelasner, 29. 12. 1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Female</i> :	32.50 mm	22.00 mm	21.00 mm

Distribution : India (Assam, Kerala, Maharashtra, Manipur, Meghalaya, Uttar Pradesh and West Bengal), Cambodia, Laos, Malaysia, Myanmar (Burma), Thailand and Vietnam.

Genus : *Aciagrion* Selys8. *Aciagrion pallidum* Selys1891. *Aciagrion pallidum* Selys, *Ann. Mus. Civ. Genova*, (2) 10 : 512-513.1933. *Aciagrion pallidum*, Fraser, *Fauna Brit. India Odon.*, 1 : 344-345.

Material examined : 8 ♂♂, 3 ♀♀, Benu, 27. 12. 1978, coll. M. S. Shishodia ; 1 ♂, 1 ♀, Dharampura, Jagdalpur, 10. 12. 1978, coll. M. S. Shishodia ; 3 ♀♀, East of Gidam 20. 12. 1978, coll. M. S. Shishodia ; 1 ♀, Hanan, Gidam, 22. 12. 1978, coll. M. S. Shishodia ; 1 ♂, 2 ♀♀, Naibasti Konta, 25.11.88, coll. M. Prasad ; 2 ♂♂, North of Gidam, 29. 12. 1978, coll. M. S. Shishodia ; 1 ♀, Oldbasti Konta, 24. 11. 1988, coll. M. Prasad ; 1 ♀, Saberi beds, Konta, 15. 12. 1978, coll. M. S. Shishodia ; 1 ♂, Sonpur, 1. 1. 1981, coll. M. S. Shishodia ; and 3 ♂♂, Tirathgarh, 17. 12. 1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	30.00 mm-31.00 mm	19.00 mm-20.00 mm	18.00 mm-18.50 mm
<i>Female</i> :	29.50 mm-31.50 mm	18.00 mm-20.00 mm	18.00 mm-18.50 mm

Distribution : India [Assam : (dry zone), Bihar, East Himalaya, Karnataka, Maharashtra, Uttar Pradesh and West Bengal], Myanmar and Nepal.

Remarks : In male specimens there are 12 postnodals in forewings and 11 in

hindwings. In female it varies from 8 to 10 in forewings and 7 to 9 in hindwings. Pterostigma covers approximately one cell.

9. *Aciagrion hisopa hisopa* (Selys)

1876. *Pseudagrion hisopa* Selys, *Bull. Acad. Belg.*, (2) 42 : 509.

1991. *Aciagrion hisopa hisopa*, Tsuda, *A distributional list of Odonata* : 18.

Distribution : India [Karnataka, Kerala, Madhya Pradesh (Bastar), Maharashtra and West Bengal], Bangladesh, Malayasia, Myanmar, Nepal, Pakistan, Singapore, Sri Lanka, Thailand and Vietnam.

10. *Aciagrion occidentale* Laidlaw

1919. *Aciagrion hisopa* (Selys) ? race *occidentalis* Laidlaw, *Rec. Indian Mus.*, 15 : 186.

1933. *Aciagrion occidentale*, Fraser, *Fauna Brit. India Odon.*, 1 : 335-337.

Material examined : 1 ♂, Naibasti Konta, 28. 11. 1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	23.50 mm	16.50 mm	15.50 mm

Distribution : India (Throughout South India) and Sri Lanka.

Remarks : This specimen agrees fairly well with the published description except having Labium and Labrum brown in colour, Legs blackish brown, Pterostigma covers one cell. 11 postnodal nervures in forewings and 10 in hindwings.

Genus : *Ischnura* Charpentier

11. *Ischnura senegalensis* (Rambur)

1842. *Agrion senegalensis* Rambur, *Ins. Neurop.*, : 276.

1933. *Ischnura senegalensis*, Fraser, *Fauna Brit. India Odon.*, 1 : 348-351.

Material examined : 1 ♂, Bandapana, Kondagaon, 30. 12. 1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	22.00 mm	12.50 mm	13.00 mm

Distribution : India (Bihar, Eastern Himalays, Himachal Pradesh, Uttar Pradesh and West Bengal), Africa, France, Indonesia, Japan, Myanmar (Burma), Philippines and Sri Lanka.

12. *Ischnura aurora aurora* (Brauer)

(Figs. 3 & 4)

1858. *Agrion delicatum* Hagen, *Verh. zool.-bot. Ges. Wien.*, 8 : 479.
 1865. *Agrion aurora*, Brauer, *Verh. zool.-bot. Ges. Wien.*, 15 : 510.
 1933. *Ischnura delicata*, Fraser, *Fauna Brit. India Odon.*, 1 : 360-362.
 1954. *Ischnura aurora*, Lieftinck, *Treubia*, 22 : 74.
 1991. *Ischnura aurora aurora*, Tsuda, *A Distributional list of world odonata*, : 34.

Material examined : 1 ♂, Bandapara, Kontagaon, 30.12.1978, coll. M. S. Shishodia ; 2 ♂ ♂, 1 ♀, Basmunda, Bandh Dhuria, 30.11.1988, coll. Y. N. Gupta ; 12 ♂ ♂, 4 ♀ ♀, Chirimor, Konta, 26.11.1988, coll. M. Prasad ; 1 ♂, 1 ♀, Chhotedongu, 1.12.1988, coll. Y. N. Gupta ; 2 ♂ ♂, Chitrakote, 27.11.1988, coll. M. Prasad ; 1 ♂, 1 ♀, Narainpur, 3.12.1988, coll. Y.N. Gupta ; 4 ♂ ♂, 1 ♀, Naibasti Konta, 25.11.1988, coll. M. Prasad ; 2 ♂ ♂, 6 ♀ ♀, Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad ; 1 ♂ Near Kopelar pond, Konda Gaon, 5.12.1988, coll. Y. N. Gupta and 4 ♂ ♂, Oldbasti Konta, 24.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	19.00 mm-20.00 mm	11.00 mm-11.50 mm	10.00 mm-11.00 mm
Female :	19.00 mm-19.50 mm	15.50 mm-16.50 mm	14.50 mm-16.00 mm

Distribution : India (Bihar, Eastern Himalays, Himachal Pradesh, Uttar Pradesh and West Bengal), Australia, Indonesia, Malaysia, Myanmar (Burma), Philippines, Sondaic Archipelago and Sri Lanka.

Remarks : It is most common species of genus *Ischnura* and occurring throughout the year.

13. *Ischnura rufostigma rufostigma* Selys

1876. *Ischnura rufostigma* Selys, *Bull. Acad. Belg.*, (2) 41 : 283.
 1933. *Ischnura rufostigma*, Fraser, *Fauna Brit. India Odon.*, 1 : 362-364.
 1991. *Ischnura rufostigma rufostigma*, Tsuda, *A Distributional list of world Odonata*, : 36.

Material examined : 1 ♂, Mahkao village, Narainpur, 26.10.1979, coll. S. Ahmed.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male :</i>	22.00 mm	15.00 mm	14.50 mm

Distribution : India (Assam, Bihar, Himachal Pradesh, Madhya Pradesh, Uttar Pradesh and West Bengal).

Genus : Rhodischnura Laidlaw

14. Rhodischnura nursei (Morton)

1907. *Ischnura nursei* Morton, *Trans. Ent. Soc. Lond.*, : 306-307.

1933. *Rhodischnura nursei*, Fraser, *Fauna Brit. India Odon.*, 1 : 369-371.

Material examined : 1 ♂, Mahkao, village, Narainpur, 26. 10. 1979, coll. S. Ahmed.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male :</i>	15.50 mm	9.50 mm	9.00 mm

Distribution : India (Bihar, Gujarat, Madhya Pradesh, Uttar Pradesh and West Bengal) and Pakistan.

Genus : Enallagma Charpentier

15. Enallagma parvum Selys

1876. *Enallagma parvum* Selys, *Bull. Acad. Belg.*, (2) 41 : 537.

1933. *Enallagma parvum*, Fraser, *Fauna Brit. India Odon.*, 1 : 376-378.

Material examined : 1 ♀, Bansoor, 26. 12. 1980, coll. M. S. Shishodia ; 2 ♂ ♂, Chhotadangu, 1. 12. 1988, coll. Y. N. Gupta ; 1 ♀, Gidam, 27. 12. 1988, coll. M. S. Shishodia and 2 ♂ ♂, Near Ganga Murd pond, Jagdalpur, 28. 11. 1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male :</i>	17.00 mm-18.00 mm	11.00 mm-11.50 mm	10.00 mm-11.50 mm
<i>Female :</i>	16.50 mm-17.00 mm	11.00 mm	10.00 mm

Distribution : Throughout India, Myanmar (Burma), Nepal and Sri Lanka.

Remarks : Seven postnodal nervures present in forewings and 6 in hindwings.

Genus : *Agriocnemis*

16. *Agriocnemis lacteola* Selys

1877. *Agriocnemis lacteola* Selys, *Bull. Acad. Belg.*, (2) 43 : 144.

1933. *Agriocnemis lacteola*, Fraser, *Fauna Brit. India Odon.*, 1 : 381-383.

Material examined : 1 ♂, Gidam, 7. 11. 1979, coll. S. Ahmed.

Measurements :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male : 16.50 mm	10.00 mm	9.50 mm

Distribution : India (Assam, Bihar, Meghalaya, Sikkim, Tripura and West Bengal).

17. *Agriocnemis dabruei* Fraser

1919. *Agriocnemis dabruei*, Fraser, *Rec. Indian Mus.*, 16 : 454.

1933. *Agriocnemis dabruei*, Fraser, *Fauna Brit. India Odon.*, 1 : 396-398.

Distribution : India [Assam and Madhya Pradesh (Bastar, Balaghat), Malaysia, Myanmar, Thailand and Vietnam.

18. *Agriocnemis splendidissima* Laidlaw

1919. *Agriocnemis splendidissima* Laidlaw, *Rec. Indian Mus.*, 16 : 180-182.

1933. *Agriocnemis splendidissima*, Fraser, *Fauna Brit. India Odon.*, 1 : 392-394.

Material examined : 1 ♀, Bandapara, Konta gaon, 30. 12. 1978, coll. M. S. Shishodia and 2 ♂ ♂, East of Gidam, 30. 12. 1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	17.00 mm	11.00 mm	10.00 mm
Female :	17.00 mm	11.00 mm	10.50 mm

Distribution : India (Bihar, Madhya Pradesh and Western Ghats).

Remarks : Seven postnodal nervures present in forewings and 6 in hindwings. Pterostigma brownish in colour and cover approximately a cell.

19. Agriocnemis pygmaea (Rambur)
(Figs. 5 & 6)

1842. *Agrion pygmaeum* Rambur, *Ins. Neurop.*, 278.

1933. *Agriocnemis pygmaea*, Fraser, *Fauna Brit. India Odon.*, 1 : 398-401.

Material examined : 1 ♂, Barsoor, 26. 12. 1978, coll. M. S. Shishodia ; 12 ♂ ♂, 3 ♀ ♀, Bansmunda Bandh, Dhamai, 30. 11. 1988, coll. Y. N. Gupta ; 6 ♂ ♂, 1 ♀, Chhotadongu, 1. 12. 1988, coll. Y. N. Gupta ; 2 ♂ ♂, Chirimor, Konta, 26. 11. 1988, coll. M. Prasad ; 7 ♂ ♂, 1 ♀, Chitrakote, 27. 11. 1988, coll. M. Prasad ; 1 ♂, Dharampura, 10. 12. 1978, coll. M. S. Shishodia ; 12 ♂ ♂, 2 ♀ ♀, Naibasti, Konta, 25. 11. 1988, coll. M. Prasad ; 11 ♂ ♂, 3 ♀ ♀, Near Ganga murd pond, Jagdalpur, 28. 11. 1988. coll. M. Prasad and 3 ♂ ♂, 1 ♀, Oldbasti Konta, 24. 11. 1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	16.50 mm-17.50 mm	9.50 mm-11.00 mm	9.00 mm-10.00 mm
<i>Female</i> :	17.00 mm-18.50 mm	11.00 mm-12.50 mm	11.00 mm-12.00 mm

Distribution : Throughout India, Australia, China, Indonesia, Myanmar (Burma), Nepal, papua (New Guinea), Philippines, Seycheles (Indian Ocean), Singapore, Sri Lanka and Taiwan.

Remarks : It is most common species of the genus and found throughout the year.

20. Agriocnemis pieris Laidlaw

1919. *Agriocnemis pieris* Laidlaw, *Rec. Indian Mus.*, 16 : 179.

1933. *Agriocnemis pieris*, Fraser, *Fauna Brit. India Odon.*, 1 : 384-385.

Distribution : India [Karnataka, Kerala, Madhya Pradesh (Bastar), Maharashtra and West Bengal].

Genus : Onychargia Selys

21. Onychargia atrocyana (Selys)

1865. *Onychargia atrocyana* Selys, *Bull. Acad. Belg.*, (2) 20 : 416.

1933. *Onychargia atrocyana*, Fraser, *Fauna Brit. India Odon.*, 1 : 417-418.

Material examined : 1 ♀, Dharampura, Jagdalpur, 30. 10. 1979, coll. S. Ahmed.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	22.00 mm	17.00 mm	16.50 mm

Distribution : India (Assam, Anaimalai Hills, Bihar, Karnataka and West Bengal), Myanmar (Burma) and Sri Lanka.

Remarks : Nervure *Ac* situated nearer to proximal antenodal nervure. Nervure *Ab* complete, 11-12 postnodal nervures in forewings and 10 in hindwings.

Superfamily : LESTINOIDEA

Family : LESTIDAE

Genus : *Lestes* Leach

22. *Lestes viridulus* Rambur

1842. *Lestes viridula* Rambur, *Hist. Nat. Ins. Neurop.*, : 252-253.

1933. *Lestes viridula*, Fraser, *Fauna Brit. India Odon.*, 1 : 45-46.

1991. *Lestes viridulus*, Tsuda, *A Distributional list of world Odonata*, : 64.

Material examined : 3 ♂♂, 4 ♀♀, Atagaon 3 kms from Jagdalpur, 31. 10. 1979, coll. S. Ahmed ; 1 ♂, 3 ♀♀, Bhairamgarh, 21. 12. 1978, coll. M. S. Shishodia ; 1 ♀ Bhanpuri, 16. 12. 1980, coll. M. S. Shishodia ; 2 ♂♂, 2 ♀♀, Chhotedongu, 1. 12. 1988, coll. Y. N. Gupta ; 2 ♀♀, Chitrakote, 20. 11. 1979, coll. S. Ahmed ; 2 ♂♂, Donga ghat, 30. 12. 1978, coll. M. S. Shishodia ; 3 ♀♀, East to Gidam, 20. 12. 1978, coll. M. S. Shishodia ; 1 ♂, 2 ♀♀, Gidam, 7. 11. 1979, coll. S. Ahmed ; 3 ♂♂, 2 ♀♀, Kakapul, 2 kms from Jagdalpur, 2. 11. 1979, coll. S. Ahmed ; 1 ♂ Konda gaon, 30. 12. 1978, coll. M. S. Shishodia ; 1 ♂, Kumari, Dhaurai, 2. 12. 1988, coll. Y. N. Gupta ; 2 ♀♀, Kutomswar, 17. 12. 1980, coll. M. S. Shishodia ; 1 ♀, Narainpur, 27. 10. 1979, coll. S. Ahmed ; 3 ♂♂, 4 ♀♀, Narainpur, 3. 12. 1988, coll. Y. N. Gupta ; 2 ♀♀, Naibasti Konta, 25.11. 1988, coll. M. Prasad ; 1 ♂. North of Gidam, 5. 11. 1979, coll. S. Ahmed ; 5 ♂♂, Sonpur, 1. 1. 1981, coll. M. S. Shishodia and 1 ♂, Tirathgarh, 17. 12. 1980. coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	31.00 mm—32.50 mm	22.00 mm—23.50 mm	21.50 mm—22.00 mm
Female :	30.00 mm—33.00 mm	21.50 mm—23.00 mm	21.00 mm—23.00 mm

Distribution : India (Bihar, Himachal Pradesh, Karnataka, Maharashtra, Uttar Pradesh and Western India).

Remarks : A common species occurring within dense dry grasses near water body or away from water body. Sometimes found with the dry grasses in deep forest.

23. *Lestes thoracicus* Laidlaw

1920. *Lestes thoracica* Laidlaw, *Rec. Indian Mus.*, 19 : 152-153.

1933. *Lestes thoracica*, Fraser, *Fauna Brit. India Odon.*, 1 : 56-57.

1991. *Lestes thoracicus*, Tsuda, *A Distributional list of world Odonata.*, : 63.

Material examined : 1♂, Naibasti, Konta, 25. 11. 1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	31.00 mm	21.00 mm	20.00 mm

Distribution : India (Bihar, Gujarat, Orissa, Uttar Pradesh and West Bengal).

Remarks : Prothorax, thorax and 1st abdominal segments are deeply pruinosed. Apical rings present on 3rd to 7th abdominal segments pale-blue. Inferior anal appendages totally black. 12 post nodal in forewings and 10 in hindwings.

24. *Lestes umbrinus* Selys

1891. *Lestes umbrina* Selys, *Ann. Mus. Civ. Genova*, (2) 10 : 497-498.

1933. *Lestes umbrina*, Fraser, *Fauna Brit. India Odon.*, 1 : 53-55.

1991. *Lestes umbrinus*, Tsuda, *A Distributional list of world Odonata.*, : 63.

Material examined : 1♂, 1♀, Gidam, 25. 12. 1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	31.00 mm	20.50 mm	20.00 mm
Female :	30.00 mm	21.00 mm	21.00 mm

Distribution : India (Bihar, Gujarat, Maharashtra, Uttar Pradesh and West Bengal), China and Myanmar.

25. *Lestes elatus* Hagen

1858. *Lestes elata*, Hagen, *Verh. Zool.-bot. Ges. Wien.*, 8 : 478.

1929. *Lestes elata elata*, Fraser, *J. Bombay nat. Hist. Soc.*, 33 : 845-847.

1991. *Lestes elatus*, Tsuda, *A Distributional list of world Odonata*, : 61.

Material examined : 1 ♀, Bennu, 27. 12. 1978, coll. M. S. Shishodia ; 1 ♂, East to Gidam, 20. 12. 1978, coll. M. S. Shishodia ; 1 ♀, Kutumswar, 17. 12. 1980, coll. M. S. Shishodia and 1 ♀, Nelasner, 29. 12. 1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	34.50 mm	24.00 mm	23.50 mm
Female :	34.00 mm—34.50 mm	24.00 mm	23.00 mm—24.00 mm

Distribution : India (Peninsular India) and Sri Lanka.

Family : PROTONEURIDAE

Genus : *Disparoneura* Selys

26. *Disparoneura quadrimaculata* (Rambur)

1842. *Agria quadrimaculata* Rambur, *Ins. Neurop.*, : 255.

1860. *Disparoneura quadrimaculata*, Selys, *Bull. Acad. Belg.*, (2) 10 : 446.

1991. *Disparoneura quadrimaculata*, Tsuda, *A Distributional list of world Odonata*, : 9.

Material examined : 1 ♂, Narainpur, 3. 12. 1988, coll. Y N. Gupta.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	31.00 mm	23.50 mm	23.00 mm

Distribution : India (Karnataka, Madhya Pradesh and Maharashtra).

Remarks : Brown markings on the forewings present in between 1st to 8th post-nodal nervures and in hindwings in between 4th to 13th postnodal nervures. Pterostigma covers more than a cell. 18 postnodals in forewings and 14 in hindwings.

Superfamily : AGROIDEA
 Family : CHLOROCYPHIDAE
 Genus : *Rhinocypha* Rambur
 Subgenus : *Aristocypha* Laidlaw

27. *Rhinocypha (Aristocypha) trifasciata* (Selys)

1853. *Rhinocypha trifasciata* Selys, *Syn. Cat.*, : 61.
 1934. *Rhinocypha trifasciata*, Fraser, *Fauna Brit. India Odon.*, 2 : 31-33.
 1991. *Rhinocypha (Aristocypha) trifasciata*, Tsuda, *A Distributional list of world Odonata*, : 77.

Material examined : 1 ♂, Chitrakote, 14.12.1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	23.00 mm	27.00 mm	26.50 mm

Distribution : India (Assam, Eastern Himalaya, Himachal Pradesh, Uttar Pradesh and West Bengal) and Nepal.

Genus : *Libellago* Selys

28. *Libellago lineata lineata* (Burmeister)

1839. *Calopteryx lineata* Burmeister, *Handb. Ent.*, 2 : 826.
 1934. *Libellago lineata lineata*, Fraser, *Fauna Brit. India Odon.*, 2 : 60-63.

Material examined : 2 ♀ ♀, Chitrakote, 2.11.1979, coll. S. Ahmed and 1 ♂, Chitrakote, 27.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	15.00 mm	16.50 mm	16.50 mm
<i>Female</i> :	14.50 mm—15.00 mm	16.00 mm	15.50 mm—16.00 mm

Distribution : India (Assam, Himachal Pradesh, Kerala, Maharashtra, Meghalaya, Tamil Nadu, Uttar Pradesh and West Bengal), Indonesia, Myanmar, Thailand, throughout Sundaic Archipelago and West Malaysia (Penang).

Remarks : Light yellow markings present at the base of both the wings, expanded

up to node in male specimen. Pterostigma in forewings absent in male but present in hindwings.

Family : CALOPTERYGIDAE

Genus : *Vestalis* Selys

29. *Vestalis gracilis gracilis* (Rambur)

1842. *Calopteryx gracilis* Rambur, *Ins. Neurop.*, : 224.

1934. *Vestalis gracilis gracilis*, Fraser, *Fauna Brit. India Odon.*, 2 : 126-128.

Material examined : 2 ♂♂, East to Gidam, 20.12.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	51.00 mm	36.00 mm	35.50 mm—36.00 mm

Distribution : India (Assam, Bihar, South India and West Bengal), Myanmar, Thailand and Vietnam (Annam and Tonkin).

30. *Vestalis smaragdina* Selys

1879. *Vestalis smaragdina* Selys, *Bull. Acad. Belg.*, (2) 47 : 362.

1934. *Vestalis smaragdina*, Fraser, *Fauna Brit. India Odon.*, 2 : 133-134.

Distribution : India [Madhya Pradesh (Bastar and Meghalaya)], Bangladesh, China, Kampuchea, Laos, Malayasia, Myanmar, Nepal, Thailand and Vietnam.

Suborder : ANISOPTERA

Superfamily : AESHNOIDEA

Family : GOMPHIDAE

Genus : *Paragomphus* Cowley

31. *Paragomphus lineatus* (Selys)

1850. *Gomphus lineatus* Selys, *Rev. Odon.*, : 386.

1934. *Mesogomphus lineatus*, *Fauna Brit. India odon.*, 2 : 230-234.

1991. *Paragomphus lineatus*, Tsuda *A Distributional list of world Odonata* : 107.

Material examined : 1 ♂, Bandapana, Kondagaon, 30.12.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	35.00 mm	26.50 mm	26.00 mm

Distribution : India (Himachal Pradesh, Karnataka, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal), Myanmar and Nepal.

Remarks : Anal triangle 4 celled, Membrane white, only one cubital nervure present. Discoidal cell entire, but in right side of wing, discoidal cell divided into two cells. Pterostigma brownish yellow and covers 5 cells. Nodal index $\frac{7-13/13-8}{8-10/10-8}$.

Genus : *Ictinogomphus* Rambur

32. *Ictinogomphus rapax* (Rambur)

1842. *Diastatoma rapax* Rambur, *Ins. Neurop.*, : 169.

1934. *Ictinus rapax*, Fraser, *Fauna Brit. India Odon.*, 2 : 373-376.

1976. *Ictinogomphus rapax*, Kumar & Juneja, *Newsl. zool. Surv. India*, 2 (2) : 95.

Distribution : India (Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal), Malaysia, Myanmar, Nepal and Sri Lanka.

Remarks : Male of this species was observed by the author at Ganga Murd pond, Jagdalpur in November, 1988, but could not be collected.

Family : AESHNIDAE

Genus : *Anax* Leach

33. *Anax guttatus* (Burmeister)

1839. *Aeschna guttata* Burmeister, *Handb. Ent.*, 2: 840.

1936. *Anax guttatus*, Fraser, *Fauna Brit. India Odon.*, 3 : 140-142.

Material examined : 1 ♂, Chitrakote, 14.12.1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	57.00 mm	52.00 mm	51.00 mm

Distribution : India (Andhra Pradesh, Bihar, Eastern Himalaya, Himachal Pradesh, Karnataka, Kerala, Punjab, Tamil Nadu and Uttar Pradesh), Indonesia, Malaysia, Micronesia, Myanmar, Nepal, North Australia, Samoa Island, Seychelles, Taiwan and Sri Lanka.

Remarks : Bases of both wings marked with yellow, membrane, white anteriorly and black at the posterior end. Discoidal cells 5 celled in forewings and 4 in hindwings, Hypertrigone 4 celled in forewings and 3 celled in hindwings, 4 cubital nervures in forewings and 5 celled in hindwings. Pterostigma brownish in colour and covers $2\frac{1}{2}$ cells. Nodal index $\frac{9-17}{11-14} \mid \frac{18-9}{13-9}$

34. *Gynacantha bayadera* Selys

1891. *Gynacantha bayadera* Selys, *Ann. Mus. Civ. Genova*, 30 : 47.

199 *Gynacantha bayadera*, Tsuda, *A distributional list of world Odonata*, 1991 : 223.

Dis ibution : India [Madhya Pradesh (Bastar), Maharashtra, Meghalaya, Sikkim and West ngal], Bangladesh, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Papua, New Guine Singapore, Thailand and Taiwan.

Superfamily : LIBELLULOIDEA

Family : CORDULIIDAE

Genus : *Macromia* Rambur

35. *Macromia cingulata* Rambur

1842. *Macromia cingulata* Rambur, *Ins. Neurop.*, : 137.

1936. *Macromia cingulata*, Fraser, *Fauna Brit. India, Odon.*, 3 : 179-182.

Material examined : 1 ♂, Chitrakote, 27.11.1988, coll. M. Prasad.

Measurements :

Abdomen	Forewing	Hindwing
Male : 42.00 mm	35.00 mm	34.50 mm

Distribution : India (Assam, Karnataka, Maharashtra, North India, Tamil Nadu and West Bengal).

Remarks : T-shaped black markings on the frons, replaced by two small rounded

yellow spot. Anal triangle 2 celled, membrane long and white in colour. 5 cubital nervures in forewings and 4 in hindwings, Hypertrigone traversed 3 times in forewings and only one in hindwings. Discoidal field begins with 2 rows of cells in left forewing while in right forewing with only one row of cells. Pterostigma small, thick and black in colour and covers $1\frac{1}{2}$ cells. Nodal index $\frac{6-11}{8-8} \mid \frac{13-6}{8-9}$.

Family : LILLLULIDAE

Genus : Potamarcha Karsch

36. Potamarcha congener (Rambur)

1842. *Libellula obscura* Rambur, *Ins. Neurop.*, : 64.
 1890. *Potamarcha obscura*, Karsch, *Berlin Ent. Zeit.*, 33 : 971.
 1891. *Potamarcha congener*, Selys, *Ann. Soc. Espan.*, 20 : 221.
 1842. *Libellula congener*, Rambur, *Ins. Neurop.*, : 70.
 1991. *Potamarcha congener*, Tsuda, *A Distributional list of world Odonata*, : 175.

Material examined : 1 ♀, Knknigam, $4\frac{1}{2}$ kms. South east of Jagdalpur, 29.10.1979 coll. S. Ahmed and 1 ♀, Naibasti Konta, 25.11.1988, Coll. M. Prasad.

Measurements :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Female</i> : 29.00 mm	34.50 mm	34.00 mm

Distribution : India (Andhra Pradesh, Bihar, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal), Indonesia, Malaya Archipelago, Myanmar, Nepal, North Australia, Papua (New Guinea), Philippines, Sri Lanka and Taiwan.

Remarks : It is a common Indian species found near temporary and permanent ponds. Nodal index $\frac{8-14}{11-11} \mid \frac{14-10}{11-11}$.

Genus : Orthetrum Newman

37. Orthetrum taeniolatum (Schneider)

1845. *Libellula taeniolata* Schneider, *Stett. Ent. Zeit.*, 6 : 111.
 1936. *Orthetrum taeniolatum*, Fraser, *Fauna Brit. India Odon.*, 3 : 296-298.

Material examined : 1 ♀, Peuambola, Kondagaon, 28.12.1978, coll. M. S. Shishodia.

Measurements :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Female</i> : 20.00 mm	26.00 mm	25.00 mm

Distribution : India (Bihar, Himachal Pradesh, Madhya Pradesh, Sikkim and West Bengal), Countries bordering Mediterranean and Nepal.

38. *Orthetrum sabina sabina* (Drury)

1770. *Libellula sabina* Drury, *Ill. Exot. Ins.*, 1 : 114.

1936. *Orthetrum sabina*, Fraser, *Fauna Brit. India Odon.*, 3 : 300-302.

1991. *Orthetrum sabina sabina*, Tsuda, *A Distributional list of world Odonata*, : 172.

Material examined : 1 ♂, Barkoor, 26.12.1980, coll. M. S. Shishodia, 1 ♀, Chitrakote, 2.11.1979, coll. S. Ahmed ; 1 ♀, Guchiras, 22.12.1980, coll. M. S. Shishodia ; 1 ♂, Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad ; 1 ♂, Near Kopelar pond, Kondagaon, 5.12.1988, coll. Y. N. Gupta ; and 1 ♀, Oldbasti Konta, 24.11.1988, coll. M. Prasad.

Measurements :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> : 33.00 mm-34.50 mm	32.00 mm-33.00 mm	30.50 mm-32.00 mm
<i>Female</i> : 32.50 mm-33.50 mm	31.00 mm-34.00 mm	30.00 mm-35.50 mm

Distribution : India (Bihar, Eastern Himalaya, Himachal Pradesh, Uttar Pradesh and West Bengal), Angola, Australia, Egypt, Indonesia, Iraq, Iran, Micronesia, most of the African continent, Myanmar, Nepal, Sri Lanka and Thailand.

Remarks : It is one of the most common dragonfly of India and found throughout the year.

39. *Orthetrum glaucum* (Brauer)

1865, *Libellula glauca* Brauer, *Verh. zool.-bot. Ges. wien.*, 15 : 1012.

1936. *Orthetrum glaucum*, Fraser, *Fauna Brit. India Odon.*, 3 : 307-309.

Material examined : 1 ♂, 1 ♀, Dharampura, 10.12.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	33.50 mm	37.00 mm	36.00 mm
<i>Female</i> :	30.00 mm	36.00 mm	35.50 mm

Distribution : Throughout India (except in plains and above altitudes 1200'), Indonesia, Malaya Archipelago, Nepal, Philippines, South China and Sri Lanka.

40. *Orthetrum luzonicum* (Brauer)

1868. *Libella luzonica* Brauer, *Verh. zool.-bot. Ges. Wien.*, 18 : 169.

1890. *Orthetrum luzonicum*, Kirby, *Cat. Odon.* : 380

1991. *Orthetrum luzonicum*, Tsuda, *A Distributional list of world Odonata.* : 171.

Material examined : 1 ♂, Chitrakote, 27.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	27.00 mm	28.50 mm	27.50 mm

Distribution : India (Andhra Pradesh, Assam, Himachal Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal and West coast of India), Indonesia, Myanmar, Nepal, Philippines and Sri Lanka.

Remarks : Only one cubital nervure present in both pairs of wings, 2 rows of cells in between 1Riii & Rspl. Pterostigma brownish yellow and covers 2 cells Membrane brownish-white.

Nodal index $\frac{8-12}{10-9} \mid \frac{11-9}{9-9}$.

41. *Orthetrum pruinosum neglectum* (Rambur)

1842. *Libellula neglecta* Rambur, *Ins. Neurop.*, 86.

1936. *Orthetrum pruinosum neglectum*, Fraser, *Fauna Brit. India Odon.*, 3 : 311-313.

Material examined : 1 ♂, Chitrakote, 14.12.1980, coll. M. S. Shishodia, 1 ♂, Chhotedongu, 1.12.1988, coll. Y. N. Gupta ; 1 ♂, Kanker, 3 kms. East of Rest house, 20.10.1979, coll. S. Ahmed and 1 ♂, Naibasti, Konta, 25.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	28.50 mm—30.00 mm	34.50 mm—36.00 mm	34.00 mm—35.50 mm

Distribution : India (Bihar, Eastern Himalaya, Himachal Pradesh, Uttar Pradesh and West Bengal), Hong Kong, Malaya, Myanmar, Nepal, Sri Lanka and Thailand.

Remarks : Pterostigma covers more than 2 cells, only one cubital nervure in both

the wings, Discoidal field begins with 3 rows of cells in forewings. Nodal index varies from $\frac{8-16}{10-11} \mid \frac{15-10}{10-10}$ to $\frac{10-15}{10-12} \mid \frac{14-11}{11-10}$

Genus : *Palpopleura* Rambur

42. *Palpopleura sexmaculata sexmaculata* (Fabricius)

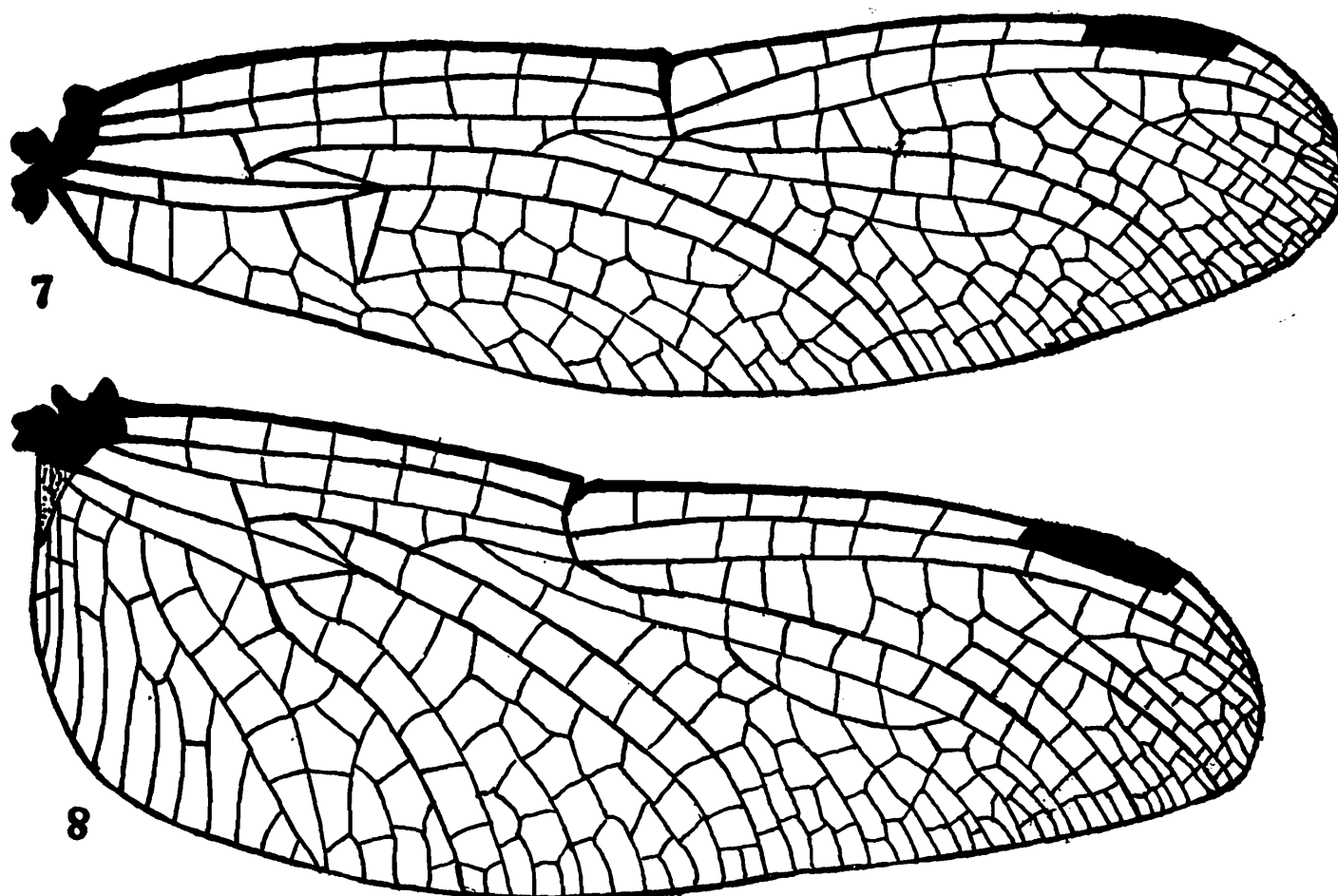
1787. *Libellula sexmaculata* Fabricius, *Mant. Ins.*, 1 : 338.

1936. *Palpopleura sexmaculata sexmaculata*, Fraser, *Fauna Brit. India Odon.*, 3 : 318-320.

Material examined : 1 ♀, Dharampura, 10.12.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Female</i> :	14.00 mm	18.50 mm	18.00 mm



Figs. 7 & 8 : *Acisoma panorpoides panorpoides* Rambur
7. Forewing, 8. Hindwing

Distribution : India (Andhra Pradesh, Assam, Bihar, Eastern Himalaya, Himachal Pradesh, Karnataka, Maharashtra, Meghalaya, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal), China, Malaysia, Myanmar and Nepal.

Genus : *Acisoma* Rambur

43. *Acisoma panorpoides panorpoides* Rambur

(Figs. 7 & 8)

1842. *Acisoma panorpoides* Rambur, *Ins. Neurop.*, : 28.

1936. *Acisoma panorpoides panorpoides*, Fraser, *Fauna Brit. India Odon.*, 3 : 330-331.

Material examined : 1 ♀, Oldbasti Konta, 24.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Female :	18.00 mm	20.50 mm	20.00 mm

Distribution : India (Assam, Bihar, Eastern Himalaya, Himachal Pradesh, Madhya Pradesh, Sikkim, Uttar Pradesh and West Bengal), China, Indonesia, Japan, Malayan Archipelago, Nepal, Philippines, Singapore, Sri Lanka and Thailand.

Remarks : Nodal index $\frac{7-7}{6-7} \mid \frac{7-6}{6-6}$.

Genus : *Diplacodes* Kirby

44. *Diplacodes nebulosa* (Fabricius)

1793. *Libellula nebulosa* Fabricius, *Ent. Syst.*, 2 : 379.

1936. *Diplacodes nebulosa*, Fraser, *Fauna Brit. India Odon.*, 3 : 335-336.

Material examined : 3 ♂♂, 2 ♀♀, Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad.

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	16.00 mm	20.00 mm	19.00 mm
Female :	12.00 mm	16.00 mm	15.00 mm

Distribution : India (Bihar, Eastern Himalaya, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra and Uttar Pradesh), Indonesia, Malacca, Malayasia (West), Myanmar, Nepal, Sri Lanka and Thailand.

Remarks : Only one cubital nervure present in both the wings, one row of cells inbetween 1Riii & Rspl, discoidal cell entire, discoidal field begins with two rows of cells, pterostigma covers more than a cell. Nodal index varies from $\frac{5-7\frac{1}{2}}{5-6} \mid \frac{7\frac{1}{2}-5}{6-6}$ to $\frac{5-7\frac{1}{2}}{5-5} \mid \frac{7\frac{1}{2}-5}{5-5}$

45. *Diplacodes trivialis* (Rambur)

1842. *Libellula trivialis* Rambur, *Ins. Neurop.*, : 115.

1936. *Diplacodes trivialis*, Fraser, *Fauna Brit. India Odon.*, 3 : 336-338.

Material examined : 1 ♀, Bennu, 27.12.1978, coll. M. S. Shishodia ; 3 ♂♂, 1 ♀, Bandapura, 18.10.1979, coll. S. Ahmed ; 2 ♂♂, 2 ♀♀, Behuipana, Narainpur, 26.10.1979, coll. S. Ahmed ; 1 ♀, Donga Ghat, Jagdalpur, 12.12.1978, coll. M. S. Shishodia ; 1 ♂, Dumanpana, Kanker, 3.1.1979, coll. M. S. Shishodia ; 1 ♀, East to Gidam, 20.12.1978, coll. M. S. Shishodia ; 3 ♀♀, Gidam, 7.11.1979, coll. S. Ahmed ; 1 ♂, Golla palli, 20.12.1980 ; coll. M. S. Shishodia ; 1 ♀, Kachauri village, Jagdalpur, 11.12.1978, coll. M. S. Shishodia ; 1 ♂, 2 ♀♀, Kanker, 20.10.1979, coll. S. Ahmed ; 1 ♀, kanker (near Rest House), 19.10.1979, coll. S. Ahmed ; 2 ♂♂, 1 ♀, Kopelar pond, Kondagaon, 5.12.1988, coll. Y N. Gupta ; 1 ♀, Kumchi village, Dhamai, 2.12.1988, coll. Y N. Gupta ; 1 ♀, Mahkao village, Narainpur, 26.10.1979, coll. S. Ahmed ; 1 ♀, Narainpur, 31.12.1980, coll. M. S. Shishodia ; 1 ♀, Narainpur, 3.12.1988, coll. Y. N. Gupta ; 3 ♀♀, Naibasti, Konta, 25.11.1988, coll. M. Prasad ; 1 ♂, 1 ♀ Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad ; 2 ♂♂, Oldbasti, Konta, 24.11.1988, coll. M. Prasad ; 2 ♀♀, Penambola, Kondagaon, 28.12.1978, coll. M. S. Shishodia ; 1 ♂, Sonpur, 1.1.1981, coll. M. S. Shishodia 1 ♀, Sukma, 19.12.1980, coll. M. S. Shishodia and 2 ♂♂, Way to Gollabatto, Konta, 16.12.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i>	19.00 mm-20.50 mm	23.00 mm-24.50 mm	21.00 mm-22.00 mm
<i>Female</i>	18.00 mm-19.50 mm	23.00 mm-24.00 mm	20.50 mm-21.00 mm

Distribution : Throughout India, Indonesia, Myanmar, Nepal, Sri Lanka, Thailand and West Malaysia.

Remarks : It is most common species found throughout the year near the temporary and permanent water bodies, sometime noticed far away from the water bodies.

46. *Diplacodes lefebvrei* (Rambur)1842. *Libellula lefebvrei* Rambur, *Ins. Neurop.*, : 112.1936. *Diplacodes lefebvrei*, Fraser *Fauna Brit. India Odon.*, 3 : 333-335.*Material examined* : 1 ♂, Naibasti Konta, 25.11.1988, coll. M. Prasad.*Measurements* :

<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> : Damaged	22.00 mm	21.00 mm

Distribution : India (Gujarat and West coast of India), Africa and Mesopotamia.

Remarks : Small triangular brownish marking present at the base of hind wings. Only one cubital nervure in both the wings, pterostigma yellowish brown and covers $1\frac{1}{2}$ cells, one row of cells in between IRiii & Rspl. Subtrigone in forewings one celled, membrane brown in colour. Discoidal field begins with two cells in forewings. Nodal index $\frac{6-7\frac{1}{2} \mid 7\frac{1}{2}-6}{5-6 \mid 6-6}$.

47. *Indothemis limbata sita* Champion1923. *Indothemis limbata sita* Champion, *Ann. Mag. Nat. Hist.*, (9): 28.1936. *Indothemis limbata sita*, Fraser, *Fauna Brit. India Odon.*, 3 : 342-343.*Distribution* : India [Karnataka and Madhya Pradesh (Bastar)] and Sri Lanka.48. *Lathrecista asiatica asiatica* (Fabr.)1798. *Libellula asiatica* Fabricius, *Ent. Syst.*, : 283.1936. *Lathrecista asiatica asiatica*, Fraser, *Fauna Brit. India Odon.*, 3 : 281-284

Distribution : India [Assam Kerala, Madhya Pradesh (Bastar), Maharashtra, Orissa and West Bengal], China, Fiji, Indonesia, Japan, Malayasia, Myanmar, Philippines, Papua New Guinea, Singapore, Thailand, Thaiwan, Samoa and Sri Lanka.

Genus : *Crocothemis* Brauer49. *Crocothemis servilia servilia* (Drury)1770. *Libellula servilia* Drury, *Ill. Ex. Ins.*, 1 : 6.1936. *Crocothemis servilia servilia*, Fraser, *Fauna Brit. India Odon.*, 3 : 345-347.

Material examined : 1 ♂, Chitrakote, 14.12.1980, coll. M. S. Shishodia ; 1 ♂, Chitrakote, 27.11.1988, coll. M. Prasad ; 1 ♂, 1 ♀, Dharampura, 10.12.1978, coll. M. S. Shishodia ; 3 ♂ ♂, Dharampura, 30.10.1979, coll. S. Ahmed ; 1 ♂, 1 ♀, Dongaghat, Jagdalpur, 12.12.1978, coll. M. S. Shishodia ; 1 ♂, Kachuri village, 11.12.1978, coll. M. S. Shishodia ; 1 ♂, Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad ; 1 ♂, on way to Gollapalli, Konta, 16.12.1978, coll. M. S. Shishodia ; 1 ♀, Oldbasti, Konta, 24.11.1988, coll. M. Prasad and 1 ♂, Sangipal forest, Jagdalpur, 13.12.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	21.00 mm-22.00 mm	26.00 mm-27.00 mm	25.00-26.00 mm
Female :	21.00 mm-22.00 mm	26.50 mm-27.50 mm	25.00-25.50 mm

Distribution : Throughout India, Australia, Indonesia, Iraq, Japan, Myanmar, Nepal, Philippines, Sundaic Archipelago and Sri Lanka.

Remarks : It is one of the most common Indian dragonfly and found almost throughout the year. Only one row of cells in between IRiii and Rspl.

Genus : *Brachythemis* Brauer50. *Brachythemis contaminata* (Fabricius)1793. *Libellula contaminata* Fabricius, *Ent. Syst.*, 2 : 382.1936. *Brachythemis contaminata*, Fraser, *Fauna Brit. India Odon.*, 3 : 365-366.

Material examined : 2 ♀ ♀, Naibasti Konta, 25.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Female :	16.00 mm	25.00 mm	24.50 mm

Distribution : India (Assam, Bihar, Eastern Himalaya, Himachal Pradesh, Madhya Pradesh, Meghalaya, Orissa, Uttar Pradesh and West Bengal), China, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Taiwan and Thailand.

Genus : Bradinopyga Kirby

51. Bradinopyga geminata (Rambur)

1842. *Libellula geminata* Rambur, *Ins. Neurop.*, : 90.

1936. *Bradinopyga geminata*, Fraser, *Fauna Brit. India Odon.*, 3 : 349-350.

Material examined : 1 ♂, Oldbasti Konta, 24.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	29.50 mm	33.00 mm	32.00 mm

Distribution : India (Bihar, Delhi, Eastern Himalaya, Madhya Pradesh, Peninsular India, Uttar Pradesh and West Bengal) and Sri Lanka.

Remarks : Only one cubital nervure in both the wings. Discoidal field begins with 3 rows of cells. 2 rows of cells in between IRiii & Rspl. Pterostigma covers 2

cells. Nodal index $\frac{9-12\frac{1}{2}}{9-9} \mid \frac{12\frac{1}{2}-9}{9-11}$.

Genus : Neurothemis Brauer

52. Neurothemis fulvia (Drury)

1773. *Libellula fulvia* Drury, *III. Exot. Ins.*, 2 : 84.

1936. *Neurothemis fulvia*, Fraser, *Fauna Brit. India Odon.*, 3 : 353-354.

Material examined : 1 ♂, Chhotedongu, 1.12.1988, coll. Y. N. Gupta and 1 ♂, 1 ♀, East of Gidam, 20.10.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	24.50 mm	31.00 mm	30.00 mm
Female :	24.00 mm	30.50 mm	30.00 mm

Distribution : Throughout India, Australia, Indonesia, Iraq, Japan, Micronesia, Myanmar, Nepal, Philippines, Seychelles, Sri Lanka, Taiwan and Thailand.

53. *Neurothemis intermedia intermedia* (Rambur)

1842. *Libellula intermedia* Rambur, *Ins. Neurop.*, : 91.

1936. *Neurothemis intermedia intermedia*, Fraser *Fauna Brit. India Odon.*, 3 : 357-358.

Material examined : 1 ♀, Bennu, 27.12.1978, coll. M. S. Shishodia ; 1 ♂, Dharampura, 10.12.1978, coll. M. S. Shishodia ; 2 ♂♂, 2 ♀♀, Hanam, Gidam, 22.12.1978, coll. M. S. Shishodia ; 1 ♂, Mahkao, Village, Narainpur, 26.10.1979, coll. S. Ahmed ; 1 ♂, Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad ; 3 ♂♂, 5 ♀♀, North of Gidam, 24.12.1978, coll. M. S. Shishodia and 2 ♀♀, Sonpur, 1.1.1981, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	23.00 mm-24.00 mm	25.00 mm-27.50 mm	24.50 mm-27.00 mm
Female :	22.00 mm-24.00 mm	25.00 mm-28.00 mm	24.00 mm-27.50 mm

Distribution : India (Bihar, Eastern Himalaya, Himachal Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal), China, Myanmar, Nepal, Sri Lanka and West Malaysia.

Remarks : 5 cubital nervures in Forewings and 4 in hindwings. 2 rows of cells in between IRiii & Rspl. Nodal index $\frac{9-10\frac{1}{2}}{9-9} \mid \frac{11\frac{1}{2}-11}{9-9}$.

54. *Neurothemis tullia tullia* (Drury)

1773. *Libellula tullia* Drury III. *Exot. Ins.*, 2 : 85.

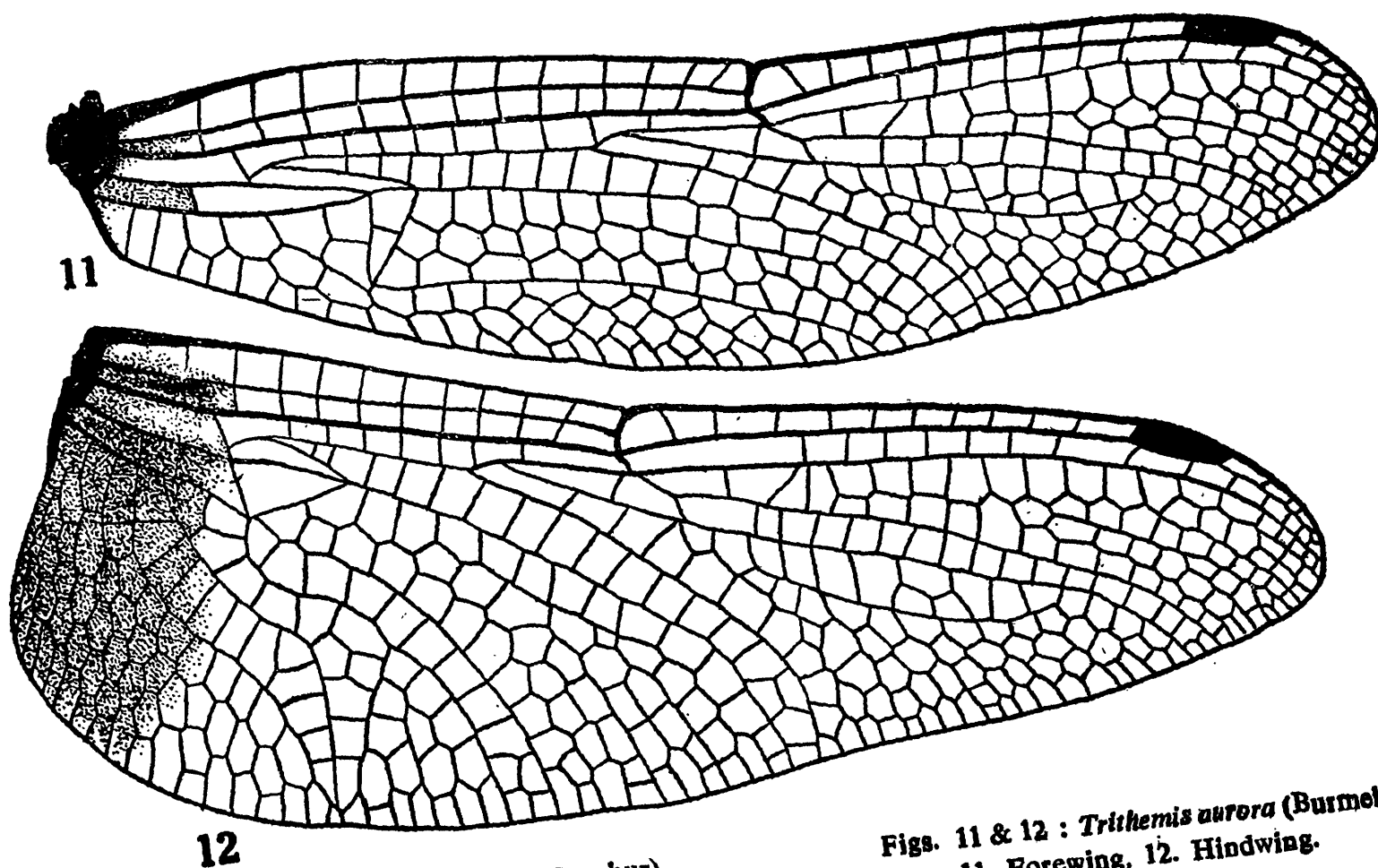
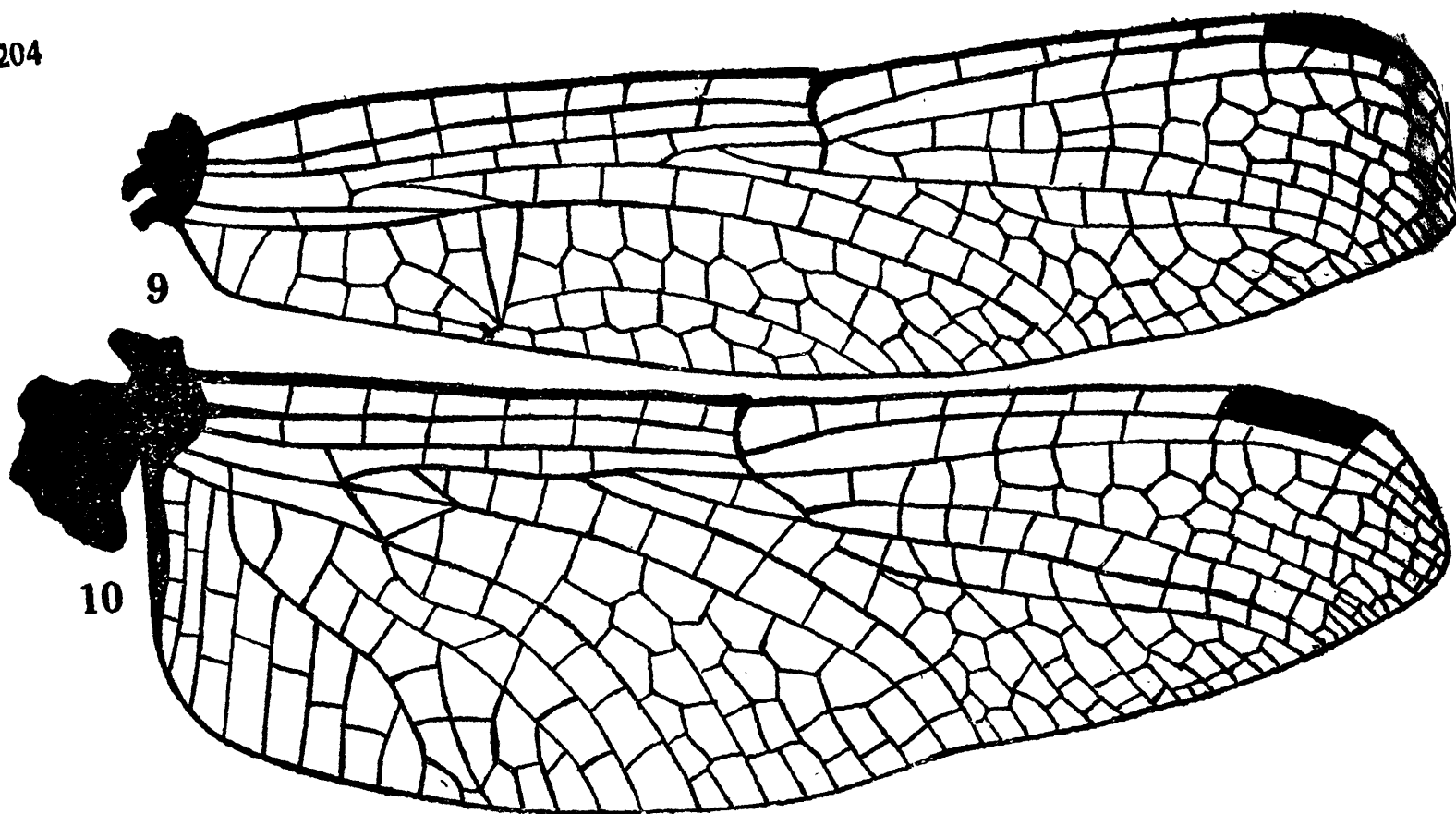
1936. *Neurothemis tullia tullia*, Fraser, *Fauna Brit. India Odon.*, 3 : 360-362.

Material examined : 1 ♂, Naibasti Konta, 25.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	19.50 mm	24.00 mm	23.00 mm

Distribution : India (Bihar, Eastern Himalaya, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and West Coast), China, Thailand and West Malaysia.



Figs. 9 & 10 : *Brachydiplax sobrina* (Rambur)
9. Forewing, 10. Hindwing

Figs. 11 & 12 : *Trithemis aurora* (Burmeister)
11. Forewing, 12. Hindwing.

Genus : **Brachydiplax** Brauer55. **Brachydiplax sobrina** (Rambur)

(Figs. 9 & 10)

1842. *Libellula sobrina* Rambur, *Ins. Neurop.*, : 114.1936. *Brachydiplax sobrina*, Fraser, *Fauna Brit. India Odon.*, 3 : 325-327.

Material examined : 1 ♂, Near Ganga Murd pond, Jagdalpur, 28.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	19.50 mm	26.00 mm	25.00 mm

Distribution : India (Assam, Bihar, Himachal Pradesh, Karnataka, Tamil Nadu, Uttar Pradesh and West Bengal), Myanmar and Sri Lanka.

Remarks : Membrane brownish white, Pterostigma covers $1\frac{1}{2}$ cells. Only one cubital nervure in both the wings, one row of cells in between IRiii & Rspl. Nodal index

$$\frac{6-7}{6-7} \mid \frac{7-6}{6-6}$$

Genus : **Trithemis** Brauer56. **Trithemis aurora** (Burmeister)

(Figs. 11 & 12)

1839. *Libellula aurora* Burmeister, *Handb. Ent.*, 2 : 859.1936. *Trithemis aurora*, Fraser, *Fauna Brit. India Odon.*, 3 : 383-385.

Material examined : 1 ♀, Chirimor, Konta, 26.11.1988, coll. M. Prasad ; 1 ♀, Chitrakote, 14.12.1980, coll. M. S. Shishodia ; 1 ♀, Chitrakote, 27.11.1988, coll. M. Prasad ; 1 ♂, Dharmapura, 18.12.1978, coll. M. S. Shishodia ; 1 ♂, Dongaghat, Jagdalpur 12.12.1978, coll. M. S. Shishodia ; 1 ♂, 1 ♀, Gidam, 7.11.1979, coll. S. Ahmed ; 2 ♂♂, 2 ♀♀, Naibasti Konta, 25.11.1980, coll. M. Prasad ; 1 ♂, Narainpur, 3.12.1988, coll. Y. N. Gupta and 1 ♂, Nelasner, 29.12.1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i>	: 23.00 mm-24.00 mm	24.00 mm-25.50 mm	24.00 mm
<i>Female</i>	: 23.00 mm-26.00 mm	24.00 mm-27.00 mm	24.00 mm-26.50 mm

Distribution ; India (Bihar, Eastern Himalaya, Gujarat, Himachal Pradesh, Karnataka, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal), Indonesia, Myanmar, Nepal, Philippines, Sri Lanka and West Malaysia.

57. *Trithemis festiva* (Rambur)

1842. *Libellula festiva*, Rambur, *Ins. Nurop.*, : 92.

1936. *Trithemis festiva*, Fraser, *Fauna Brit. India Odon.*, 3 : 387-389.

Material examined : 1♂, Chitrakote, 14.12.1980, coll. M. S. Shishodia and 2♀♀, Chitrakote, 27.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i>	: 24.50 mm	28.00 mm	28.00 mm
<i>Female</i>	: 22.00 mm	27.00 mm	26.00 mm

Distribution : India (Assam, Bihar, Eastern Himalaya, Gujarat, Himachal Pradesh, Maharashtra, Meghalaya, Uttar Pradesh and West Bengal), Indonesia, Myanmar, Nepal, Papua, Philippines, Singapore, Sri Lanka, Taiwan and West Malaysia.

58. *Trithemis pallidinervis* (Kirby)

1889. *Sympetrum pallidinervis* Kirby, *Trans. Zool. Soc. Lond.*, : 327.

1936. *Trithemis pallidinervis*, Fraser, *Fauna Brit. India Odon.*, 3 : 389-391.

Material examined : 1♂, 1♀, Chirimor, Konta, 26.11.1988, coll. M. Prasad ; 16♂♂, 2♀♀, Dharmapura, 10.12.1978, coll. M. S. Shishodia ; 1♂, Naibasti, Konta, 25.11.1988, coll. M. Prasad ; 1♂, 2♀♀, Oldbasti Konta, 24.11.1988, coll. M. Prasad and 1♀, Sangi forest, Jagdalpur, 13.12.1978, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i>	: 27.00 mm-32.50 mm	30.00 mm-35.00 mm	30.00 mm-34.50 mm
<i>Femaele</i>	: 26.00 mm-29.00 mm	30.00 mm-34.00 mm	30.00 mm-34.00 mm

Distribution : Throughout India, Malaysia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Thailand and Taiwan.

59. *Trithemis kirbyi kirbyi* Selys

1891. *Trithemis kirbyi* Selys, *Ann. Mus. Civ. Genova*, 30 : 465.

1936. *Trithemis kirbyi kirbyi*, Fraser, *Fauna Brit. India Odon.*, 3 : 385-387.

Material examined : 1♂, Oldbasti Konta, 24.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	24.00 mm	27.50 mm	27.00 mm

Distribution : India (Himachal Pradesh, Karnataka, Maharashtra, Tamil Nadu and Uttar Pradesh) and Sri Lanka.

Remarks : Only one cubital nervure present in both the wings. Membrane dirty white, pterostigma covers $1\frac{1}{2}$ cells. 2 rows of cells present in between IRiii and Rspl.

Nodal index $\frac{8-11\frac{1}{2} \mid 9\frac{1}{2}-8}{12-7 \mid 7-10}$

Genus : *Tholymis* Hagen

60. *Tholymis tillarga* (Fabricius)

1798. *Libellula tillarga* Fabricius, *Ent. Syst. Suppl.*, : 285.

1936. *Tholymis tillarga*, Fraser, *Fauna Brit. India Odon.*, 3 : 411-413.

Material examined : 1♂, Narainpur, 31.12.1980, coll. M. S. Shishodia.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	30.00 mm	34.50 mm	34.00 mm

Distribution : Throughout India, Australia, Indonesia, Malaysia (West), Micronesia, Myanmar, Sri Lanka, Thailand and Tropical Africa.

Genus : *Zyxomma* Rambur

61. *Zyxomma petiolatum* Rambur

1842. *Zyxomma petiolatum* Rambur, *Ins. Neurop.*, : 30.

1936. *Zyxomma petiolatum*, Fraser, *Fauna Brit. India Odon.*, 3 : 409-410.

Distribution : Occurs throughout India, Myanmar and Sri Lanka.

Remarks : It is a common species and was observed in evening nearby Oldkonta village during November, 1988, but could not be collected.

Genus : *Pantala* Hagen

62. *Pantala flavescens* (Fabricius)

1898. *Libellula flavescens* Fabricius, *Ent. Syst. Suppl.*, : 285.

1936. *Pantala flavescens*, Fraser, *Fauna Brit. India Odon.*, 3 : 414-416.

Material examined : 1 ♀, Keskal, 29.12.1978, coll. M. S. Shishodia and 1 ♂, Oldbasti, Konta, 24.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	32.50 mm	42.00 mm	41.50 mm
<i>Female</i> :	32.00 mm	42.00 mm	41.00 mm

Distribution : Circumtropical and Subtropical in distribution.

Genus : *Rhyothemis* Hagen

63. *Rhyothemis variegata variegata* (Linnaeus)

1768. *Libellula variegata* Linnaeus, *Amoenitates Acad.*, 6 : 412.

1936. *Rhyothemis variegata variegata*, Fraser, *Fauna Brit. India Odon.*, 3 : 423-424.

Material examined : 1 ♂, Naibasti, Konta, 25.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	24.50 mm	52.00 mm	32.00 mm

Distribution : India (Bihar, Himachal Pradesh, Karnataka, Orissa, Uttar Pradesh and West Bengal), Malaysia, Myanmar, Nepal and Sri Lanka.

Remarks : Membrane white, 2 rows of cells in between IRiii & Rspl. Nodal index

$$\frac{11-9\frac{1}{2} \mid 9\frac{1}{2}-13}{12-7 \mid 7\frac{1}{2}-13}$$

Genus : Tramea Hagen

64. Tramea basilaris burmeisteri Kirby

1839. *Libellula chinensis* Burmeister, *Hanb. Ent.*, 2 : 852.

1889. *Tramea burmeisteri*, Kirby, *Trans. Zool. Soc. Lond.*, : 316.

1936. *Tramea basilaris burmeisteri*, Fraser, *Fauna Brit. India Odon.*, 3 : 432-434.

Material examined : 2 ♂♂, 3 kms east of Kanker, 20.10.79, coll. S. Ahmed ; 1 ♂, Kanker, 20.10.1979, coll. S. Ahmed and 1 ♂, Oldbasti Konta, 24.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	32.00 mm-33.00 mm	42.00 mm-43.00 mm	41.00 mm-42.00 mm

Distribution : India (Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and West Bengal) and Malaysia.

Remarks : Only one cubital nervure in both the wings. Brown markings present at the base of hindwings and extended up to whole of cubital space, 9th cells of Anal loop and 1st antenodal of subcosta, 2 rows of cells in between IRiii & Rspl. Nodal index

$$\frac{8-12\frac{1}{2} \mid 12\frac{1}{2}-9}{12-7 \mid 7-12}$$

65. Tramea virginia (Rambur)

1773. *Libellula chinensis* De Geer, *Mem. Ins.*, 3 : 556.

1842. *Libellula virginia*, Rambur, *Ins. Neurop.*, 33.

1936. *Tramea virginia*, Fraser, *Fauna Brit. India Odon.*, 3 : 435-436.

Material examined : 2 ♂♂, Oldbasti Konta, 24.11.1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	34.00 mm	43.00 mm	42.50 mm

Distribution : India (Bihar, Himachal Pradesh, Uttar Pradesh and West Bengal), China, Indonesia, Micronesia (Corolina), Myanmar, Taiwan, Thailand and South China.

Remarks : Dark brown marking present in the base of hindwings up to 1st antenodal nervure, half of cubital space, up to outer margin of discoidal cell ; Membrane brownish white, pterostigma brown and covers $1\frac{1}{2}$ cell. Reticulation of the wings black, only one cubital nervure in both the wings. Discoidal cell divided twice in both pairs of wings. 2 rows of cells in between IRiii & Rspl. Nodal index $\frac{10-12\frac{1}{2}}{14-7} \mid \frac{12\frac{1}{2}-11}{7-12}$.

Genus : *Urothemis* Brauer

66. *Urothemis signata signata* (Rambur)

1839. *Libellula sanguinea* Burmeister, *Handb. Ent.*, 2 : 856.

1842. *Libellula signata*, Rambur, *Ins. Neurop.*, : 117.

1936. *Urothemis signata signata*, Fraser, *Fauna Brit. India, Odon.*, 3 : 442-444.

Material examined : 1 ♂, Dharampura, 10. 12. 1978, coll. M. S. Shishodia and 1 ♂, Oldbasti Konta, 24. 11. 1988, coll. M. Prasad.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
Male :	29.00 mm	39.50 mm	39.00 mm

Distribution : India (Bihar, Karnataka, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal), China, Malaysia, Myanmar and Sri Lanka.

Remarks : Only one cubital nervure in both the wings. Only one row of cells in between IRiii & Rspl. Pterostigma covers more than a cell.

SUMMARY

Sixty six species and subspecies of Odonata under 38 genera and 10 families are reported from Bastar district, Madhya Pradesh, India. Fifty four species and subspecies

are recorded for the first time from Bastar. Some field notes and variations observed are given. Key to genera, species and subspecies have been provided. Distribution in India, as well as the entire geographical range of occurrence of all species are shown.

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ON SOME NEW RECORDS OF FRESHWATER OSTRACODS
(CRUSTACEA : ENTOMOSTRACA) FROM INDIA

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INTRODUCTION

Freshwater ostracods are the important little crustaceans and they are very common in India. The systematics of fresh water ostracodes has been studied mainly from South India (Victor and Fernando 1979), Besides, few scattered references were also available from Punjab (Klie 1927), Bengal (Gurney, 1907), Maharashtra (Baird, 1859) and (Deb, 1972, 1984), Rajasthan (Deb, 1972) etc. Practically no work was done on ostracods of Madhya Pradesh. The present paper is the part of extensive, districtwise study of ostracods of M. P. The paper deals with five species under four genera of two families viz. *Strandesia perakensis* Victor and Fernando 1981, *Stenocypris orientalis* Victor and Fernando 1981). *Chrissia formosa* (Klie, 1938), *Cypretta raciborskii* (Grochmalicki), 1915 and *Cypretta seurati* Gauthier, 1929, which are being reported here for the first time from India.

SYSTEMATIC ACCOUNT

Class : CRUSTACEA

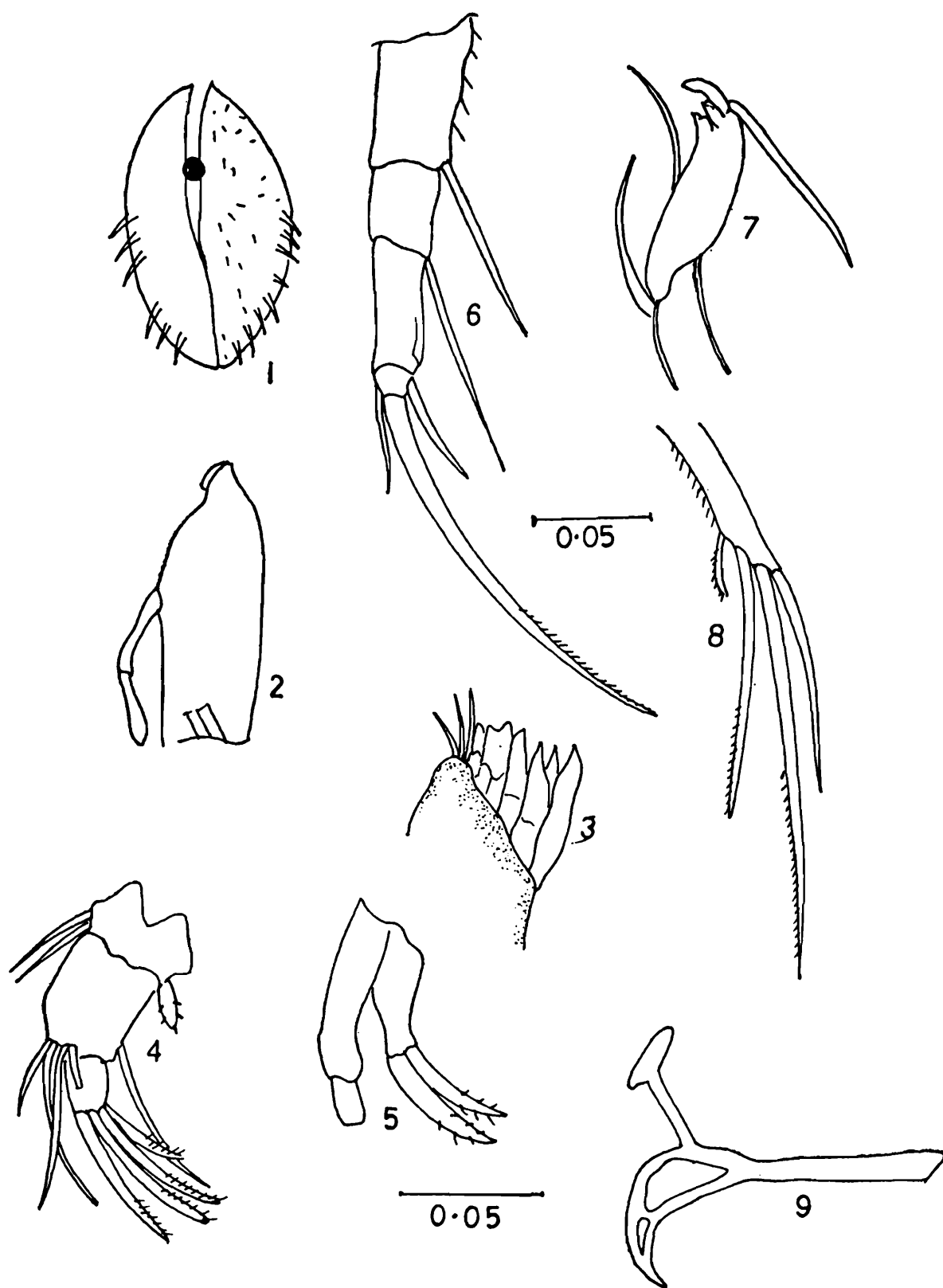
Subclass : OSTRACODA

Family I : CYPRIDIDAE

Genus 1 : *Strandesia* Vavra, 1895

1895. *Cypris* (*Strandesia*) *marcatorum* Vavra, *Jahrbuchder Hambnrgischen Wissenhaltichen Anstalten*. XII : 6.

Diagnosis : Length of valves is up to 2.5 mm-. In lateral view, valves are moderately elongate, subovate or subelliptical, but some times triangular. Left valve overlaps the right. Inner duplicature wide anteriorly and narrow posteriorly. Pore



Figs 1—9: *Strandesia perakensis*, (1) Carapace, dorsal view; (2) First endopodite of antenna showing sensory club; (3) Pars incisiva of the mandible; (4) Mandibular palp, arrow shows B spine; (5) Third and fourth maxillular palps; (6) First thoracic leg; (7) Second thoracic leg; (8) Furcal ramus, distal and magnified; (9) Furcal attachment.

canals are simple, Dorsal, marginal and lateral spines are common for this genus. Natatory setae and sensory club well developed. Furcal rami symmetrical, slender, straight or curved and long.

I. *Strandesia perakensis* Victor & Fernando

1981. *Strandesia perakensis* Victor & Fernando, *Arch. Hydro biol.*, 58 (4) : 469.

Diagnosis : Carapace moderately inflated, valves subovate, left valve larger overlapping the right; 10-12 posteriorly directed spines behind the muscle scar region. Posterior seta of furca setulate in the posterior aspect, smooth terminal seta. Furcal attachment with moderately long central branch.

Female : Carapace moderately inflated, valves unequal, left overlaps right anteriorly and posteriorly. In lateral view valves ovate, dorsum broadly arched, greatest height slightly anterior to the middle. Margins hairy, marginal pore canals simple. 10-12 posteriorly directed spines in the mid dorsal region. Colouration brownish (Fig. 1).

Antenna with five hairy natatory setae, not reaching the tips of terminal claws : four claws, distinctly toothed at the distal end. Sensory club two segmented (Fig. 2). Pars incisiva of the mandible with six teeth (Fig. 3) the β spine present, γ spine absent (Fig. 4). Maxillular spines of the third palp toothed (Fig. 5). First thoracic leg (the walking limb) with a long end claw (Fig. 6). Terminal segment of second thoracic leg (the cleaning limb) with a beak like claw and a reflexed seta (Fig. 7). Furcal rami symmetrical, slender and long; terminal and subterminal claw pectinate. Subterminal claw and posterior seta short; posterior margin of ramus bristled (Fig. 8). Furcal attachment with Tribels loop (Fig. 9).

Male : Unknown.

Measurements :

n(=6)	Length— 0.76 ± 0.03
	Height— 0.46 ± 0.4
	Width — 0.45 ± 0.02

Specimen examined : 6 ♀ ♀, Batsagar dist., Jabalpur, coll. P. D. Rane, 22. 9. 1980 (Reg. No. A/1414).

Distribution : W. Malaysia, E. Malaysia and Indonesia.

Genus 2 : *Stenocypris* Sars, 1889

1889. *Stenocypris* Sars, *Arch. Math. Naturv. Kristiania* 8 : 27

Diagnosis : Valves elongate, equal or unequal, posterior and anterior end rounded or one end pointed. Septa prominent, compact, forming radial band. Surface variable. Dorsal setae absent.

II. *Stenocypris orientalis* Victor & Fernando

1981. *Stenocypris orientalis* Victor and Fernando, *Mitt. Hamburg Zool. Mus. Inst.*, 78 : 151.

Diagnosis : Valves elongate, dorsum almost straight in the middle, posterior margin narrowly rounded, surface punctate and with reticulations, radial band of septa broad and anteriorly with an inwardly building antero-dorsal pattern. Asymmetrical rami, short antero-distal bristles present.

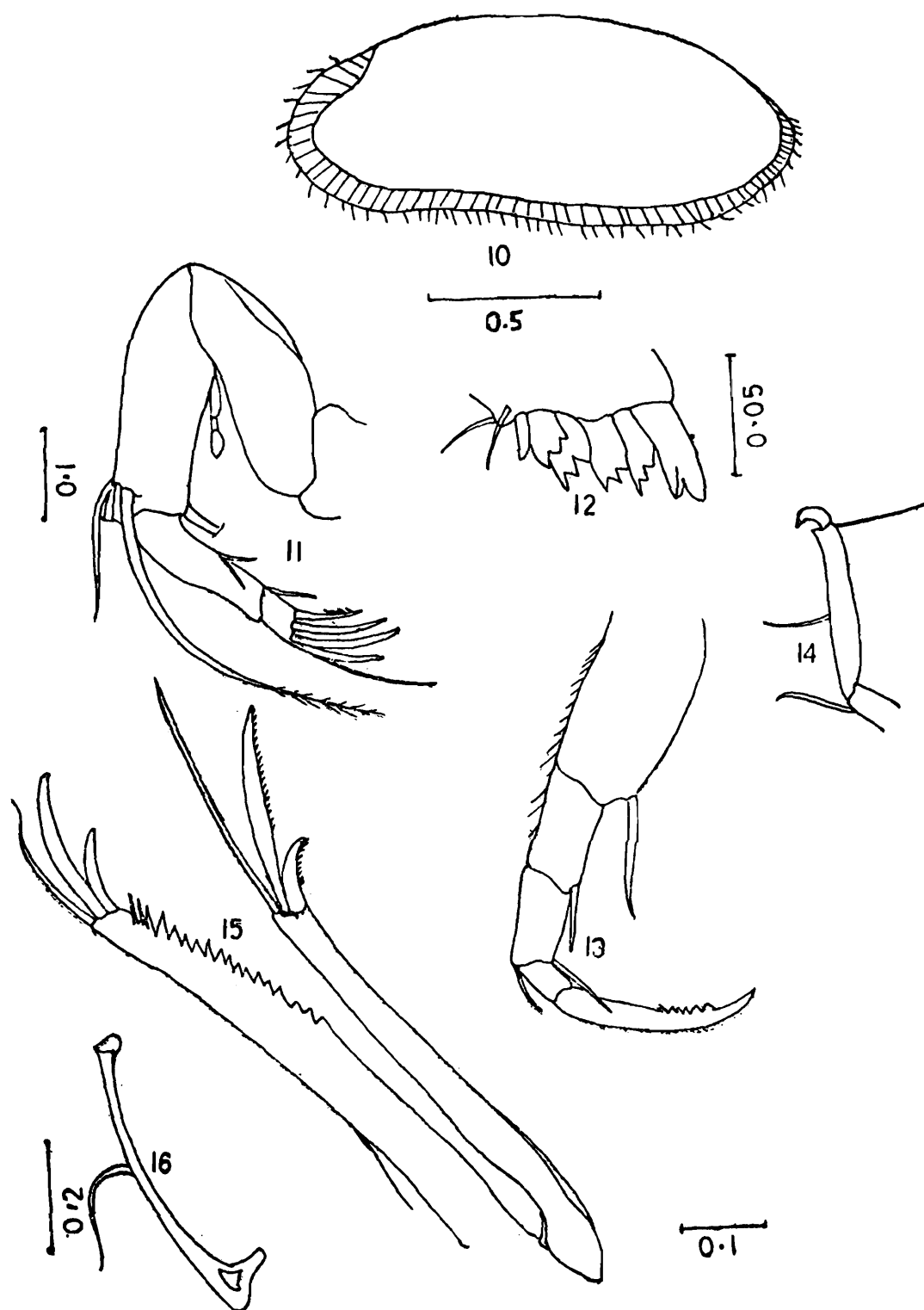
Female : Valves elliptical in dorsal view, laterally compressed, left valve larger than the right. Dorsum almost straight in the middle, smoothly curving anteriorly ; greatest height in the middle. Anterior margin broadly rounded ; posterior margin narrow and bluntly rounded. Radial band of septa distinct, broad in the anterior margin, presence of longer septa in antero-dorsal region thus giving an inwardly bulging appearance ; the septa continues as a narrow band in the ventral and posterior region ; radial band absent in postero-dorsal region (Fig. 10).

Antenna having smooth natatory setae, barely reaching the tips of terminal claws, claws four in number, anterior claws short and toothed, posterior claw smooth, sensory club two segmented (Fig. 11). Gnathobasis of mandible with six teeth (Fig. 12). First thoracic leg (the walking limb) with a long claw pectinate heavily in the middle (Fig. 13). Terminal segment of second thoracic leg (the cleaning limb) with a prominent, curved, bristled claw, pincers and a reflexed seta (Fig. 14). Furcal rami asymmetrical ; right ramus slightly curved, posterior margin strongly toothed ; left ramus nearly straight, posterior margin weakly bristled for half (of) its length ; posterior seta absent, terminal seta of left ramus exceeds the length of terminal claw. Both claws toothed heavily (Fig. 15). Furcal attachment as illustrated (Fig. 16).

Male : unknown.

Measurements : Length— 1.75 ± 0.10 mm.

n(=15) Height— 0.70 ± 0.03 mm.



Figt. 10—16 : *Stenocypris orientalis*, (10) Left valve, external view ; (11) Antenna ; (12) Mandibular teeth ; (13) First thoracic leg ; (14) Second thoracic leg ; (15) Right and left Furcal rami ; (16) Furcal attachment.

Specimen examined : 15 ♀ ♀, Bhartadeo, dist. Chhindwara, M. P., coll. R. K. Singh, 1989-1991 (Reg. No. A/2369).

Distribution : Phillipines and W. Malaysia.

Remarks : The specimens are smaller in size compared to specimens of Phillipines & W. Malaysia but other diagnostic characteristics are similar.

Genus 3 : *Chrissia* Hartmann, 1957

1957. *Chrissia levetzovi* Hartmann. *Osnabruck*, 50.

Diagnosis : The valves with short marginal pore canals distinguishes this genus from *Parastenocypris* which has well developed branching marginal pore canals.

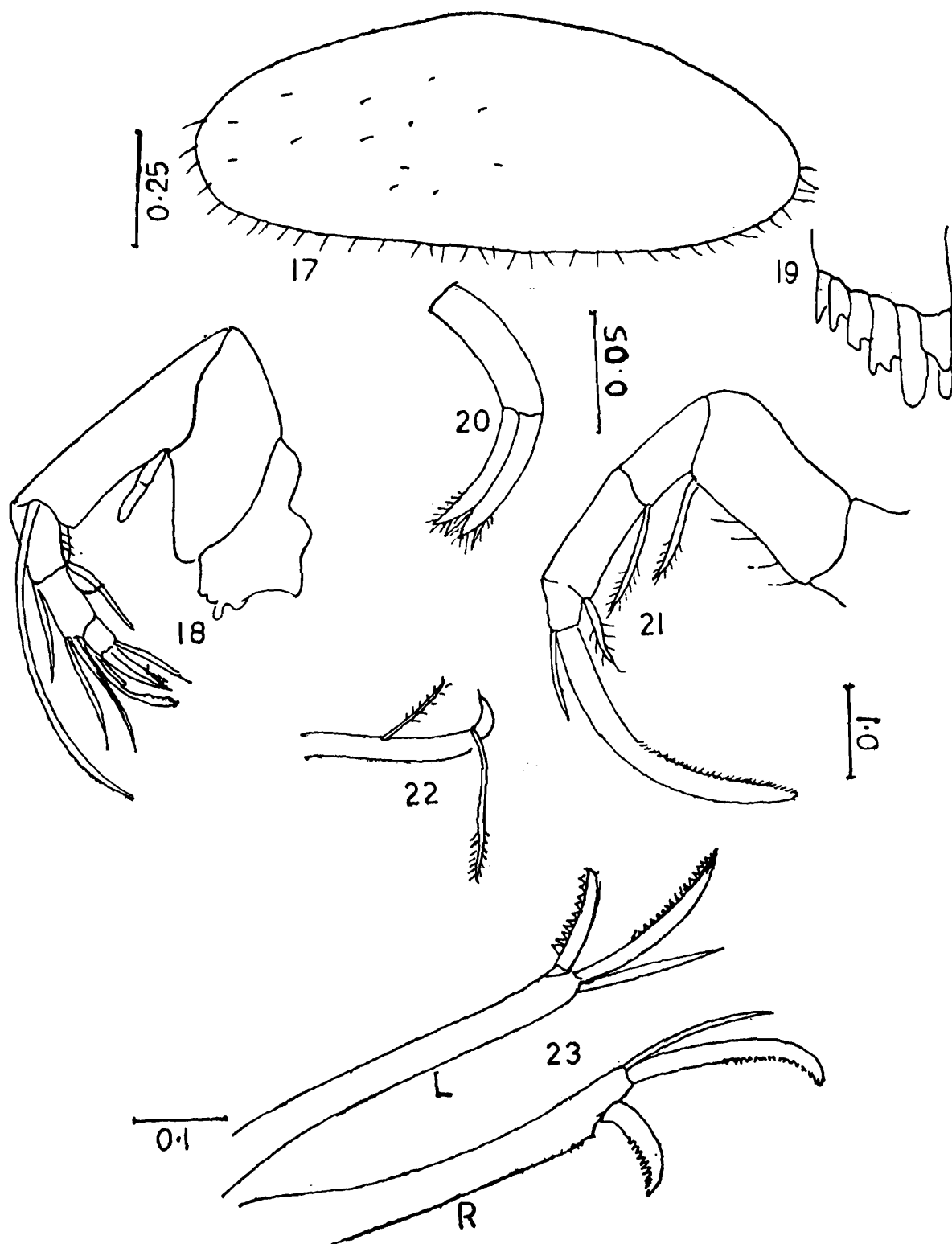
III. *Chrissia formosa* (Klie)

1938. *Stenocypris formosa* Klie, *Bull. biogeogr. Soc. Japan* ; 8 : 21.

1981. *Chrissia formosa* Victor and Fernando, *Mitt. Hamburg. Zool. Mus. Inst.*, 78 : 152.

Diagnosis : Valves elongate in lateral view, greatest height in the middle ; anterior and posterior margin rounded. Antenna with five smooth natatory setae, slightly reaching beyond the tips of terminal claws. Four claws toothed. Furcal ramus asymmetrical, right ramus broader, slightly curved ; anterior margin with three inconspicuous depressions.

Female : Valves elongate in dorsal view, greatest height in the middle, left valve larger than right ; anterior and posterior margins rounded, ventral margin straight ; dorsum smoothly convex, no radial band of septa ; posterior and anterior margins hairy. Surface punctate with a sparse distribution of hairs. Colour whitish (Fig. 17). Second thoracic leg with five smooth natatory setae slightly reaching beyond the tips of terminal claws ; four claws, toothed, seta next to posteriormost claw is claw like and strongly pectinate (Fig. 18). Gnathobasis of the mandible with six teeth (Fig. 19), β and γ spines present. Maxillular spines toothed (Fig. 20). First thoracic leg (the walking limb) with a long end claw, distinctly pectinate up to $1/2$ of its length (Fig. 21). Terminal segment of second thoracic leg (the cleaning limb) with a curved bristled claw, reflexed seta finely setulate (Fig. 22). Furcal rami asymmetrical ; right ramus broader, slightly curved, posterior margin bristled for $3/4$ th of its length ; anterior margin with three inconspicuous depressions ; left ramus narrow and straight, posterior margin smooth ; both claws heavily denticulate (Fig. 23).



Figs. 17-23: *Chrissia formosa*, (17) Right valve, external view; (18) Antenna; (19) Mandibular teeth; (20) Maxillular spines; (21) First thoracic leg; (22) Second thoracic leg; (23) Right and left furcal rami.

Male : Unknown.

Measurements : Length— 1.61 ± 0.02 mm.

n(= 12) Height— 0.65 ± 0.02 mm.

Width— 0.45 ± 0.03 mm.

Specimen examined : 12 ♀ ♀, Bhartadeo, Chhindwara dist., coll. R. K. Singh, 19. 9. 91 (Reg. No. A/2370).

Distribution : West Malaysia and Indonesia.

Family II : CYPRIDOPSIDAE

Genus 4 : *Cypretta* Vavra, 1895

1895. *Cypretta* (*Cypridopsis*) *tenuicauda*, Vavra, *Jahrbuch der Hamburgisches wissenschaftlichen Anstalten XII* : 6,

Diagnosis : Carapace is tumid and in lateral view, the valves subovate, ovates or sub-triangular. Both valves have septa. Valves are unequal and the right valve is larger than left. Furca is leg like, weakly developed with subterminal and terminal claws ; posterior seta present and terminal seta may be present or absent.

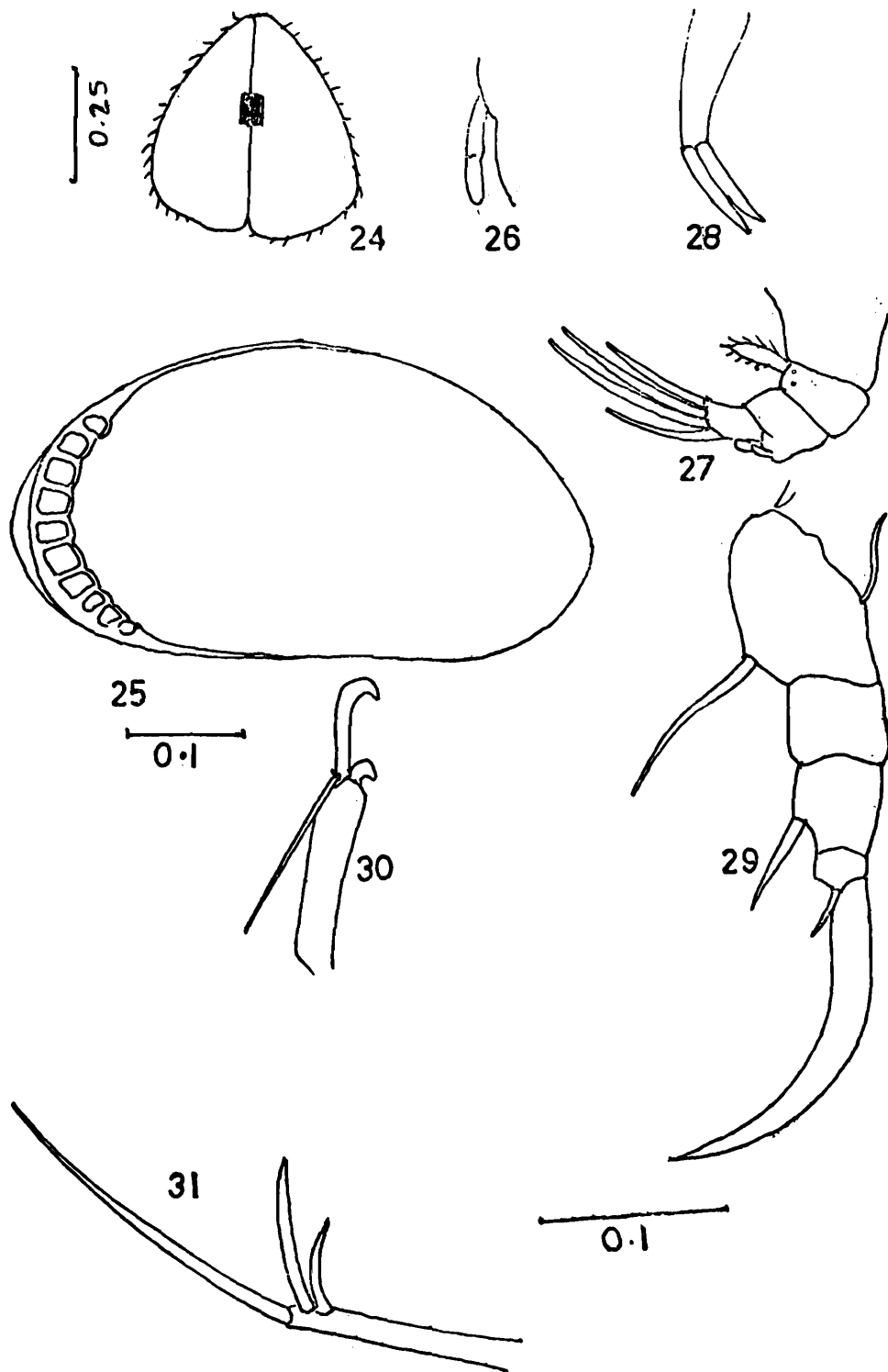
IV. *Cypretta raciborskii* (Grochmalicki)

1915. *Cypridopsis raciborskii* Grochmalicki, *Anz. Akad. Wiss. Krakau, Math. nat. Kl. Reihe* 13 : 235.

1981. *Cypretta raciborskii*, Victor and Fernando, *Int. Revue ges. Hydrobiol.*, 66 (3) : 426.

Diagnosis : Carapace is tumid, with broadly pointed anterior and angular posterior ends. Valves surface punctate and sparsely hairy. Valves unequal, right valve larger overlapping the left anteriorly and posteriorly. Furcal rami weakly developed, terminal seta missing.

Female : Carapace tumid, with broadly pointed anterior end, and angular posterior end. Valves dorsally triangular in shape. Valves unequal, right larger than the left overlapping the later anteriorly and posteriorly. In lateral view valves elongately ovate. Anterior margin of both the valves distinctly septate. Pore canals simple. Valve surface punctate and with few hairs (Fig. 24, 25).



Figs. 24—31 : *Cypretta raciborski*, (24) Carapace dorsal view ; (25) Left valve internal view ; (26) Sensory club ; (27) Mandibular palp ; (28) Maxillular spines ; (29) First thoracic leg ; (30) Second thoracic leg ; (31) Furcal ramus.

Natatory setae of antenna well developed, reaching beyond the tips of terminal claw. Sensory club two segmented (Fig. 26). Gnathobasis of mandible dentate ; β and γ spines present (Fig. 27) ; maxillular spines smooth (Fig. 28). First thoracic leg (the walking limb) with a scythe like end claw, pectinate at the distal end (Fig. 29). Terminal segment of the second thoracic leg (the cleaning limb) with a curved striate end claw, well developed pincers and a reflexed seta exceeding three fourth the length of penultimate segment (Fig. 30). Furcal rami slender, symmetrical, weakly developed, leg like, terminal seta missing (Fig. 31).

Male : Unknown.

Measurements : Length— 0.52 ± 0.02 mm.

n(=15) Height— 0.32 ± 0.03 mm.

Width— 0.04 ± 0.03 mm.

Specimen examined : 15 ♀ ♀, Kutru, dist. Bastar, coll. R. K. Ghose, 28. 1. 1990 (Reg. No. A/2372).

Distribution : West Malaysia and Indonesia.

Remarks : The description of specimens collected from this area more or less identical with the specimens of W. Malaysia and Indonesia, but the sensory club seen in the Indian specimens found to be two segmented instead of three segmented.

V. *Cypretta seurati* Gauthier

1929. *Cypretta seurati* Gauthier ; *Bull. Soc. Hist. Nat AF. N.* 20 : 158.

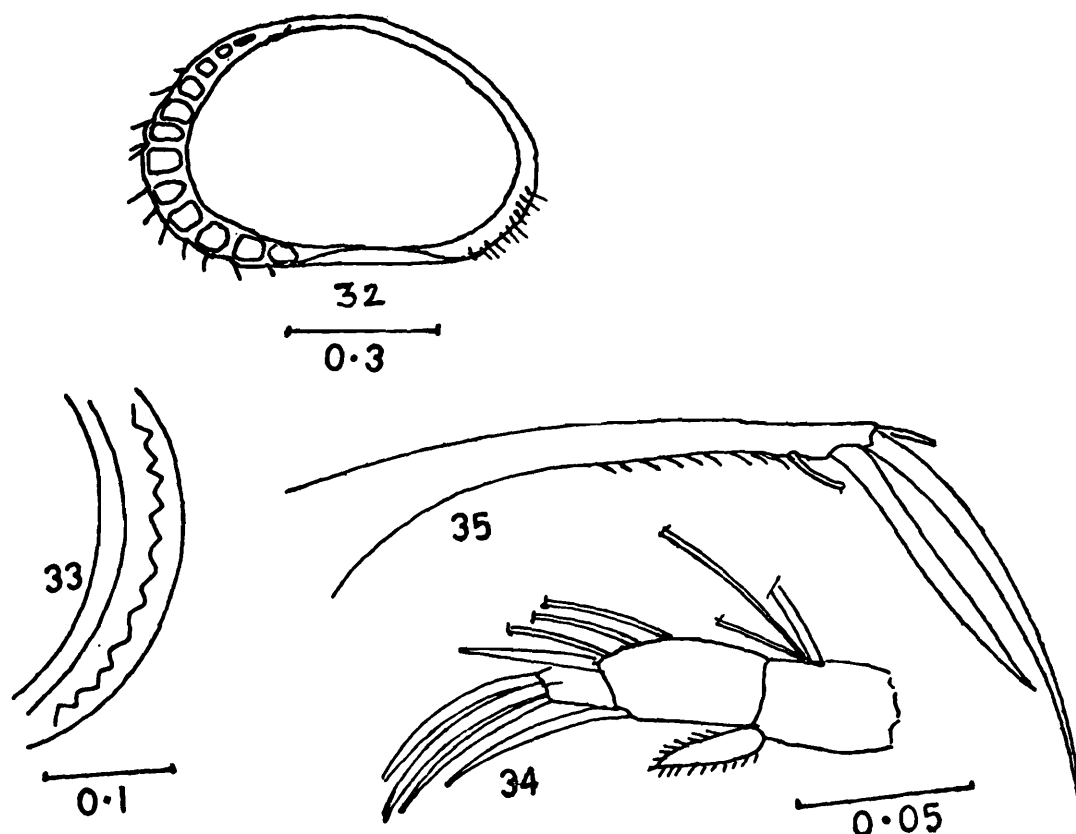
1973. *Cypretta seurati* : Gauthier, *Proc. Jap. Soc. Syst. Zool.*, 9 : 1-6.

Diagnosis : The diagnostic features of this species are the internal view of left and right valves, anterior septa of the left valve and posterior wavy sinuations of the germ septa in the left valve.

Female : Carapace tumid, subovate in lateral view valves unequal ; the right valve is larger than the left and overlapping the left, anteriorly and posteriorly. Valve surface pitted and sparsely pilose. Both valves have septa. Wavy sinuations in germ septa in the left valve (Fig. 32, 33).

Antennule well developed having endopodite five segmented. Natatory setae of the antenna reaching beyond the tips of terminal claws. Sensory club one segmented. Gnathobasis of mandible strongly dentate β and γ spine present (Fig. 34). First tho-

racic leg (the walking limb) with a curved end claw, pectinate at the distal end. Second thoracic leg (the cleaning limb) with a curved beak like claw ; pinness well developed, reflexed seta long. Furcal rami long, slender, symmetrical, weakly developed ; sub-terminal claw more than the half the length of terminal claw ; posterior seta small : terminal seta present but small (Fig. 35).



Figs. 32—35 : *Cypretta seurati*, (32) Right valve, internal view ; (33) Left valve posterior margin ; (34) Mandibular palp ; (35) Furcal ramus.

Male : Unknown.

Measurements : Length— 0.75 ± 0.07 mm.
 n(24) Height— 0.45 ± 0.06 mm.
 Width— 0.50 ± 0.08 mm.

Specimen examined : 24 ♀ ♀, Kanha, dist. Mandla, M. P., coll. R. K. Ghosh 3. 2, 1991, (Reg. No. A/2093) ; 16 ♀ ♀, Bhartadeo, dist. Chhindwara, M. P. coll. R. K. Singh 19. 9. 1991 (Reg. No. A/2371).

Distribution : W. Malaysia, E. Malaysia, Phillipines, S. Europe, N. Africa, Japan,

Remarks : It appears to be a common species in Malaysia, Indonessia and Phillipines. Okubo (1973) redescribed this species from Japan. The southeast Asian specimens reported by Victor and Fernando (1981c) and Indian specimens have sparsely pilos valves but it is not reported in Japanese specimens.

SUMMARY

The paper deals with five species of freshwater ostracoda belonging to four genera of two families namely *Strandesia perakensis* Victor and Fernando, *Stenocypris orientalis* Vtctor and Fernando, *Chrissia formosa* (Klie), *Cypretta raciborskii* (Grochmalicki), *Cypretta seurati* Gauthier. All the species are being reported here for the first time from India. These species are collected from various localities of Jabalpur, Bastar, Chhindwara and Kanha of M. P.

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AN ACCOUNT OF THE MAMMALIAN FAUNA OF
GORUMARA NATIONAL PARK, JALPAIGURI, WEST BENGAL.

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INTRODUCTION

Gorumara National Park (Plate 1A), covering an area of about 70 sq. km, is situated in the Sub-Himalayan Terai region of Jalpaiguri district, West Bengal, India. The park is about 104 km East from Siliguri and can be approached through Sevok Road via Odlabari and Chalsa. From Chalsa, it is only 14 km on way to Lataguri. In connection with the Environment Impact Assessment studies of the Teesta Barrage Project and the ecological studies on the Malayan Giant Squirrel, present authors surveyed the Park during April, 1994, August 1994, February 1995 and August 1995. The core area of the Park (Plate 1B) contains dense mixed forest with thick undergrowth and is mainly composed of large tree species like Sal (*Shorea robusta*), Teak (*Tectona grandis*), Simul (*Bombax malabaricum*), Lali (*Amoora wallichii*), Lasuni (*Dysoxylum* sp.), Sisso (*Delbergia sisso*), Udal (*Sterculia villosa*), Khair (*Acacia catechu*), Tatari (*Dillenia pentagyna*), Bat (*Ficus benglensis*), *Terminalia balarica*, etc. Different species of Orchids and Ferns are also found here. Apart from the dense tree forest, vast stretches of grassland consisting of different species of elephant grasses such as Hudda, Nal, Urudi, Malsa etc., provide totally different ecological conditions sustaining rich faunal diversity. Another interesting grass species of the park is *Citronella* which adds fragrance of Citrus fruit to the air almost throughout the year. A number of perennial rivers like Jaldhaka, Murti, Garatijhora, Indong and their tributaries serve as the water sources of the Park.

Dense forest as well as the array of animal life of Gorumara National Park is very much impressive. So far, about 210 species of birds have been recorded from here by the West Bengal State Forest Department. However, no comprehensive list of the mammalian species of the Park is available. In the present paper, an attempt has been made to provide a checklist of the mammalian species based on authors' observations as well as on reports of the State Forest Department. In the account, species marked with * and ** are included in the Schedule I and Schedule II of the Indian Wildlife (protection) Act, 1972, respectively.

SYSTEMATIC ACCOUNT

Class : MAMMALIA

Order : INSECTIVORA

Family : SORICIDAE

1. *Suncus murinus* (Linnaeus)*Common names* : House Shrew (Eng.) ; Chucho (Beng.) ; Chhuchunder (Hin.).*Remarks* : Very common, particularly near the Forest Rest House and nearby localities.2. *Suncus etruscus* Savi*Common name* : Pygmy Shrew (Eng.).*Remarks* : Not very common. Lives under litter in forest.

Order : PRIMATES

Family : CERCOPI THECIDAE

3. *Macaca mulatta mulatta* (Zimmermann) ***Common names* : Rhesus Macaque (Eng.) ; Markat, Bandar (Beng.) ; Bandar (Hin.).*Remarks* : Most common in the Forest. At least six troops comprising 10 of to 40 animals were observed.4. *Presbytis entellus entellus* (Dufresne) ***Common names* : Hanuman Langur (Eng.) ; Hanuman (Beng.) ; Langur (Hin.).*Remarks* : Rare. Appears to be casual visitor of the Park.

Order : CHIROPTERA

Family : PTEROPODIDAE

5. *Rousettus leschenaulti leschenaulti* (Desmarest)

Common names : Indian Fulvous Fruit Bat (Eng.) ; Chalta Badur (Beng.).

Remarks : Rare.

6. *Pteropus giganteus giganteus* (Brünnich)

Common names : Indian Flying Fox (Eng.) ; Badur (Beng.).

Remarks : No roost was observed in the Park, but quite a large number of them visit the fruiting trees in the night, almost throughout the year. Roosts containing more than 100 animals were noticed in bamboo thickets and Tamarind trees of the neighbouring villages and the tea gardens.

7. *Cynopterus sphinx sphinx* (Vahl)

Common names : Short-nosed Fruit Bat (Eng.) ; Kala Badur (Beng.).

Remarks : Most common. Regularly visits the fruiting trees near Forest Rest House Campus in large numbers.

Family : RHINOLOPHIDAE

8. *Hipposideros lankadiva* Kelaart

Common name : Sri Lankan Gigantic Leaf-nosed Bat (Eng.).

Remarks : No roost was observed. Few specimens used to visit the Varandah of the Forest Rest House at midnight during February, probably for resting a short while.

Family : VESPERTILIONIDAE

9. *Pipistrellus mimus* Wroughton

Common names : Indian Pygmy Pipistrelle (Eng.) ; Chamchika (Beng.).

Remarks : Very common, come out of the roosts during dusk and could be seen flying in the open areas of the forest, particularly over the rivers and swamps.

10. *Scotophilus heathi heathi* (Horsfield)

Common name : Greater yellow Bat (Eng.).

Remarks : Very common. Roosts of 10-20 animals observed in almost all the houses near the Park, as well as in the rest house campus. It comes out of the roost one by one just after the dusk and can easily be seen flying among the trees.

Order : CARNIVORA

Family : CANIDAE

11. *Vulpes bengalensis* (Shaw) **

Common names : Bengal Fox (Eng.) ; Khek-siyal (Beng.) ; Lomri (Hin.).

Remarks : Fairly common and can easily be met within the forest roads after evening.

Family : MUSTELIDAE

12. *Lutra perspicillata* Geoffroy **

Common names : Smooth-coated Indian Otter (Eng.) ; Ud, Bhondar (Beng.) ; Udbilao (Hin.).

Remarks ; Moderately common. Two packs, one of 4, other of 6 animals were observed in the grassland near river banks during August, 1995.

Family : VIVERRIDAE

13. *Viverricula indica indica* (Desmarest) **

Common names : Small Indian Civet (Eng.) ; Gandhagokul (Beng.) ; Khatus (Hin.).

Remarks : Common. Forage in the trees as well as in the ground. Observed both in the deep forest and also in the tea gardens of fringe areas. Scats matters revealed mostly vegetative substances.

14. *Paradoxurus hermaphroditus* (Pallas) **

Common names : Common Palm Civet, Toddy Cat (Eng.) ; Baghda, Bham (Beng.) Khatus (Hin.).

Remarks : Could not be observed in the proper core area. However, they are fairly common in the fringe areas adjacent to localities, causing considerable damage to the poultry. They have also been reported to enter in the store and kitchen rooms.

15. *Herpestes auropunctatus* (Hodgson)

Common names : Small Indian Mongoose (Eng.) ; Beji, Neul (Beng.) ; Neula (Hin.).

Remarks : Diurnal and frequently met in the scrubby fringe areas of the forest.

16. *Herpestes edwardsi nyula* (Hodgson)

Common names : Indian grey Mongoose (Eng.) ; Beji, Neul (Beng.) ; Neula (Hin.).

Remarks : Diurnal, live in family packs, making burrows along the bush-covered ditch or nullah.

Family : FELIDAE

17. *Felis chaus* Gldenstaedt **

Common names : Jungle Cat (Eng.) ; Ban Beral (Beng.) ; Jangli billi (Hin.).

Remarks : Not observed in the Park proper, but have been reported as common in the villages of the fringe areas causing damage to the poultry.

18. *Felis bengalensis* Kerr *

Common names : Leopard Cat (Eng.) ; Ban Biral (Beng.) ; Chita billi (Hin.).

Remarks : Rare, observed only once near a nullah.

19. *Panthera pardus* (Linnaeus) *

Common names : Common Indian Leopard (Eng.) ; Chitabagh (Beng.) ; Tenduwa (Hin.).

Remarks : No specimen, but pugmarks were observed along the river banks. As many as 15-16 leopards have been reported by the Forest Department staff in the Park.

20. *Panthera tigris* Linnaeus *

Common names : Tiger (Eng.) ; Bagh (Beng., Hin.).

Remarks : A couple of tiger have been reported, but during our visits neither the specimen nor the pugmarks could be observed.

Order : PHOLIDOTA

Family : MANIDAE

21. *Manis crassicaudata* Gray *

Common names : Pangolin (Eng.) ; Bajra kit, Bon rui (Beng.) ; Bajra kapta, Silu, Sala (Hin.).

Remarks : According to Forest department and local people's reports Pangolin occurs in the forest. However, we could not observe any specimen and it appears to be very rare. A young of Indian Pangolin has been released in the Park by the Forest Department.

Order : PROBOSCIDEA

Family : ELEPHANTIDAE

22. *Elephas maximus* Linnaeus *

Common names : Indian Elephant (Eng.) ; Hasti, Hathi (Beng.) ; Hanthi (Hin.).

Remarks : Area serves as permanent abode for a herd of about 20 elephants and a solitary bull tusker. Moreover, the Park is used as corridor for many more elephants during migration. During February, a wild bull regularly chased the tame elephant in the campus of Forest Rest House.

Order : PERISSODACTYLA

Family : RHINOCEROTIDAE

23. *Rhinoceros unicornis* Linnaeus *

Common names : Great Indian One horned Rhinoceros (Eng.) ; Gandar (Beng.) ; Gaimda (Hin.).

Remarks : Apart from Jaldapara, Gorumara is the only other area in West Bengal where One-horned Rhinoceros is still surviving. In Gorumara, number of Rhino is estimated as 16 including a new born one. This unique animal can easily be observed in the morning and dusk from the observation spot, during their visit to salt pit. Recently one Rhino from Kaziranga National Park of Assam has been translocated here for genetic improvement of the Stock (Plate 1B). Straying of individual Rhino from the Park is also often reported.

Order : ARTIODACTYLA

Family : SUIDAE

24. *Sus scrofa cristatus* Wagner

Common names : Indian Wild Boar (Eng.) ; Buno suor (Beng.) ; Suar (Hin.).

Remarks : Fairly common. Observed in the grass jungle as well as in tree forest. Living in herds of variable size.

25. *Sus salvanius* (Hodgson) *

Common name : Pygmy Hog (Eng.).

Remarks : One of the most endangered species of Indian Mammals. It has been reported from Gorumara by the Forest Department. However, we could not get any evidence of its occurrence in the Park.

Family : CERVIDAE

26. *Cervus unicolor* Kerr

Common names : Sambar (Eng., Beng., Hin.) ;

Remarks : Rare, Observed only on two occasions in the grassland. On both the occasions the animal was seen foraging.

27. *Axis porcinus* Zimmermann

Common names : Hog deer (Eng.) ; Para (Beng.).

Remarks : Rare, none could be seen during the visits.

28. *Muntiacus muntjak vaginalis* (Boddaert)

Common names : Indian Muntjak, Barking deer (Eng.) ; Kakhar, Kukoo (Beng., Hin.).

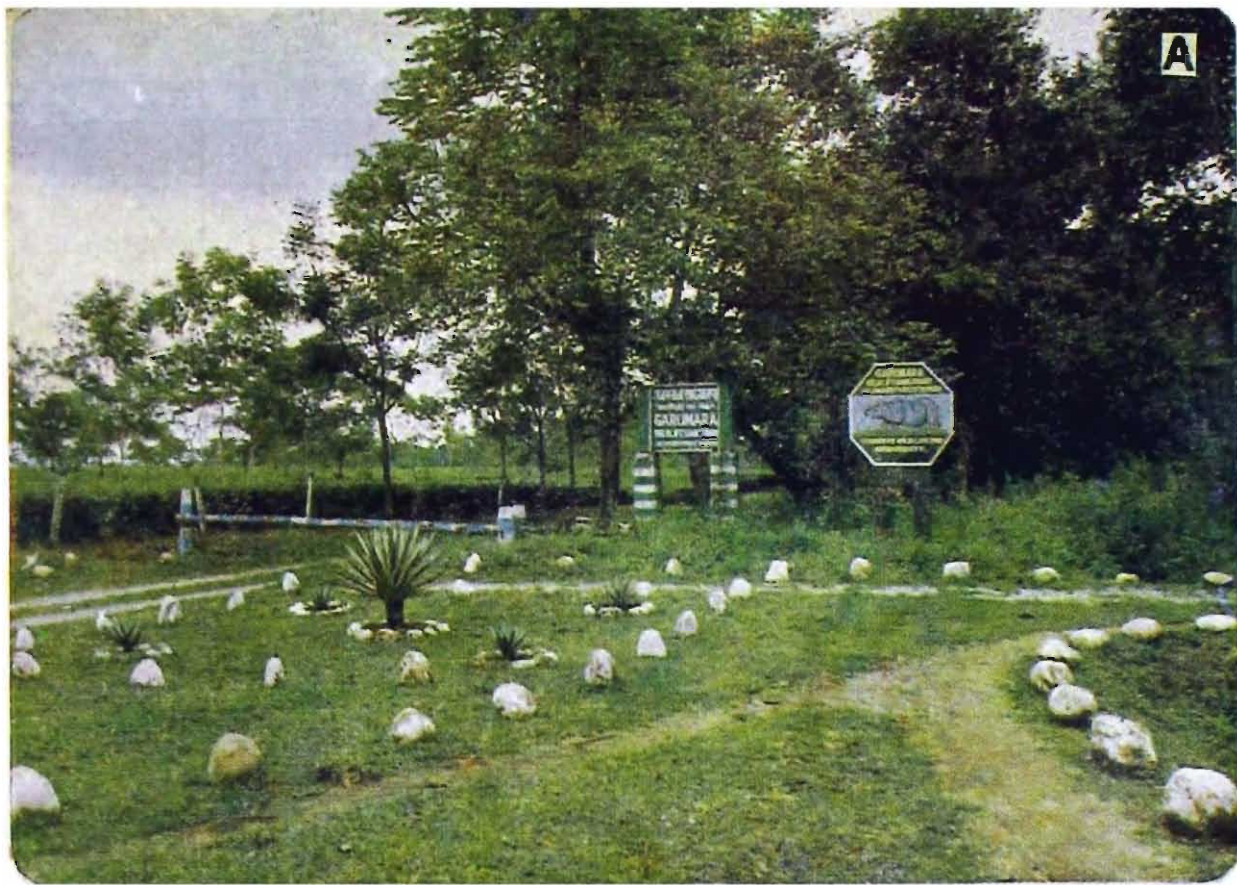
Remarks : Rare. Only one animal could be noticed during August, 95.

Family : BOVIDAE

29. *Bos gaurus* Smith *

Common names : Indian Bison (Eng.) ; Gaur (Beng.) ; Gaur, Janglee Gai (Hin.).

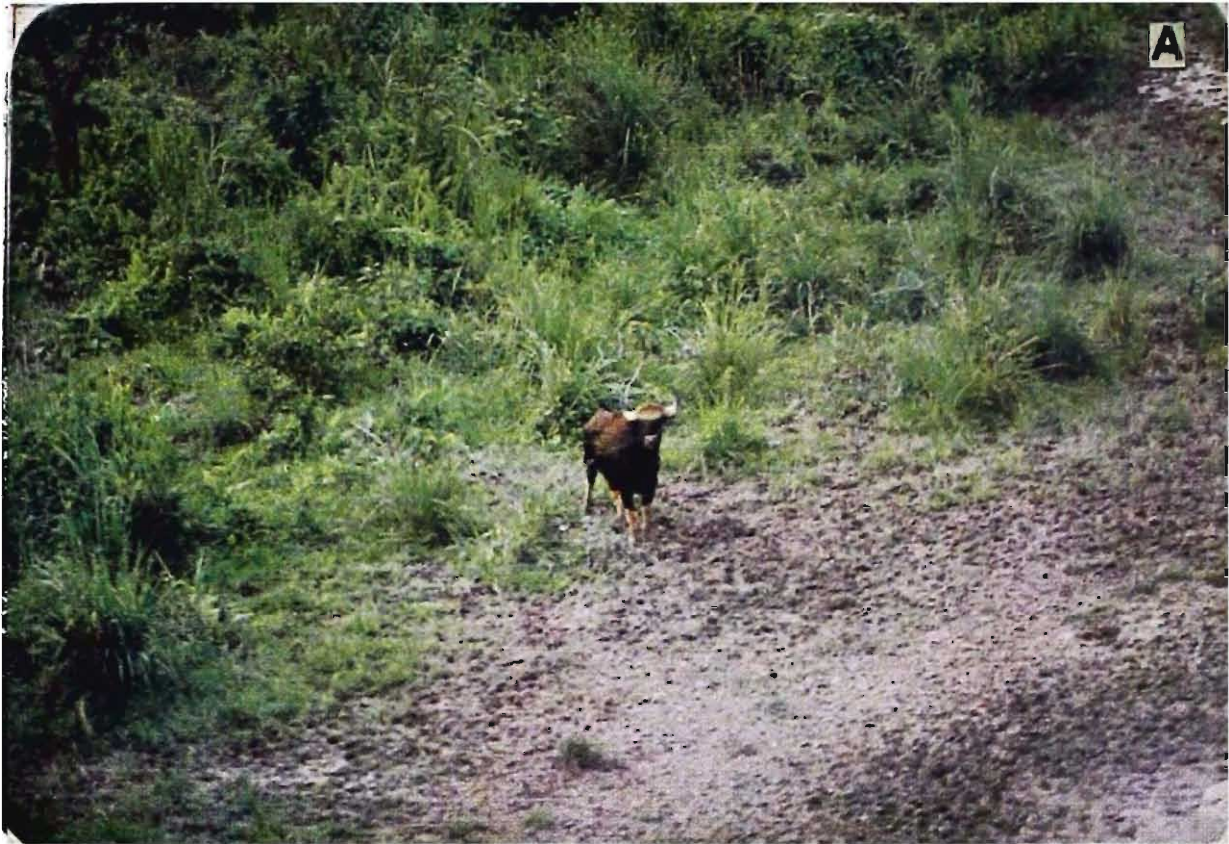
Remarks : Fairly common. Herds of 10-20 animals, including calves, can regularly



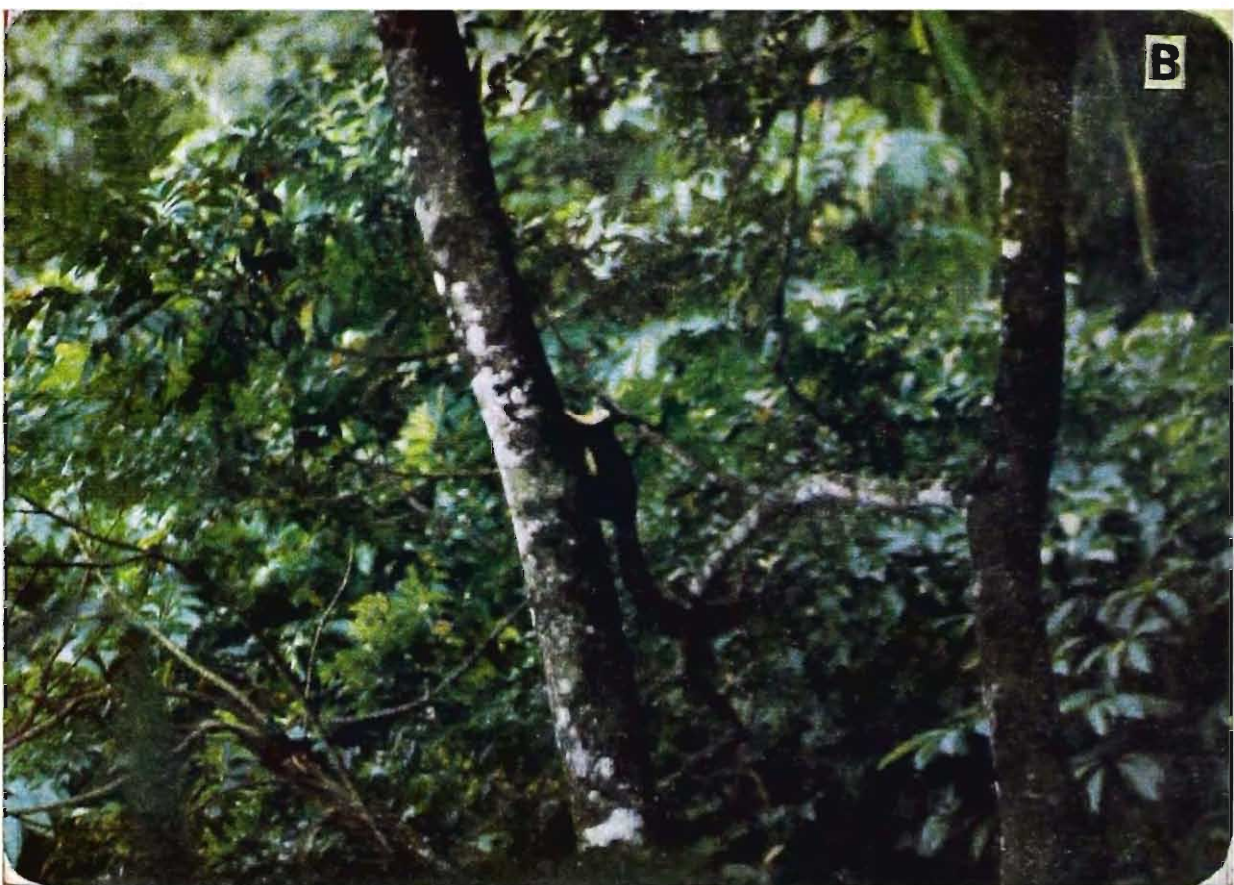
A. Gateway of Gorumara National Park.



B. Introduced specimen of *Rhinoceros unicornis*.



A. A specimen of *Bos gaurus* in the grassland.



B. *Ratufa bicolor gigantea* in the Gorumara National Park.

be seen during elephant ride in the tree forest as well as grassland. Gaur also frequently visits the salt pit (Plate 2A).

Order : LAGOMORPHA

Family : LEPORIDAE

30. *Lepus nigricollis* Cuvier

Common names : Rufous-tailed Hare (Eng.) ; Khargosh (Beng., Hin.).

Remarks : Most common in the grassland. It appears that there is some hunting pressure on this species in areas adjacent to the Park.

Order : RODENTIA

Family : SCIURIDAE

31. *Petaurista* sp. **

Common name : Flying Squirrel (Eng.).

Remarks : Flying Squirrels are fairly common in the tree forest and could easily be marked during their gliding at night. Their characteristic calls can also be heard in the jungle at night.

From the observed size difference during gliding, it appears that at least two species of flying squirrels occur in the Gorumara.

32. *Tamiops maclellandi* (Horsfield)

Common name : Himalayan Striped Squirrel (Eng.).

Remarks : Only a pair was observed in a Sisso tree at about 9-00 A. M. in February. So far, within West Bengal, this species is known to occur in Darjeeling district. Further survey may reveal a well-established population of this species in the Park.

33. Callosciurus pygerythrus lokroides (Hodgson)

Common name : Hoary-bellied Himalayan Squirrel (Eng.).

Remark : Common. Feeds mainly on the lower branches of the trees. Occasionally comes to the ground for passing to the other trees.

34. Ratufa bicolor gigantea (M'Clelland)**

Common names : Malayan Giant Squirrel (Eng.) ; Baro Katbirali (Beng.)

Remarks : A good population of Malayan Giant Squirrel was observed in the core area. However, this squirrel frequently visits the trees at the fringe of open areas for feeding during morning and afternoon hours (Plate 2B). It can easily be marked in the trees due to loud distinctive calls and droppings of fruits, twigs, etc. It feeds mainly on the wide variety of wild seeds, fruits, flowers and leaves. Considerable amount of debarking is also made by these squirrels probably in search of insects. Nests were observed in the high, tender branches of the trees. It was not observed on the ground.

35. Funambulus pennanti Wroughton

Common names : Northern Palm Squirrel, Five striped Squirrel (Eng.) ; Kat birali (Beng.) ; Gilheri (Hin.).

Remarks : Not observed in the Gorumara Proper, but in the nearby villages this squirrel is fairly common,

Family : HYSTRICIDAE

36. Hystrix hodgsoni (Gray)

Common names : Crestless Himalayan porcupine (Eng.) ; Sajaru (Beng.) ; Sahi (Hin.).

Remarks : No specimen or burrow was observed, however, quills indicating its occurrence were found.

Family : MURIDAE

37. *Vandeleuria oleracea dumeticola* (Hodgson)

Common name : Indian Long-tailed Tree mouse (Eng.).

Remarks : Common. Confined mainly on the branches of small trees or in the bush. Small cup-shaped nests of dry leaves and twigs were found in the dense bush.

38. *Rattus rattus* (Linnaeus)

Common names : House Rat (Eng.) ; Indur (Beng.).

Remarks : Common in the forest as well as adjacent localities. Observed in the forest floor and also in the trees.

39. *Mus musculus* Linnaeus

Common names : House Mouse (Eng.) ; Nengti Indur (Beng.).

Remarks : Common in and around Forest Rest House but not in the deep forest.

40. *Mus booduga booduga* (Gray)

Common names : Little Indian Field Mouse (Eng.) ; Nengti Indur (Beng.).

Remarks : Plenty, particularly in the relatively high grass land areas.

41. *Golunda ellioti ellioti* Gray

Common name : Indian Bush Rat (Eng.).

Remarks : A diurnal species of rat. Not very common, observed only on one occasion within the bush in a dry nullah.

42. *Bandicota bengalensis bengalensis* (Gray)

Common names : Lesser Bandicoot Rat (Eng.) ; Metho Indur (Beng.).

Remarks : Though most abundant and serious pest of crops in the entire Jalpaiguri District, but not very common in the Gorumara. During three visits only five live burrows could be noticed in the relatively open grassland.

43. *Bandicota indica nemorivaga* (Hodgson)

Common names : Large bandicoot Rat (Eng.) ; Dhere Indur (Beng.) ; Ghous (Hin.).

Remarks : Fairly common in the grassland particularly in the slopes of swamps and streams. Live burrows can be identified by the presence of fresh molluscan shells at the burrow mouth.

DISCUSSION

In this account, 43 species belonging to 37 genera, 20 families and 9 orders have been reported. Out of these 43 species, 8 are included in Schedule I, and 9 in Schedule II of the Indian Wildlife (Protection) Act, 1972 and 8 species are considered as highly threatened (Z. S. I. 1994).

From our observation and according to the Forest Department, it appears that poaching and grazing, the two major problems of most of the protected areas are practically absent in the Gorumara Park. Moreover, existence of a well established population of the Malayan Giant Squirrel indicates the favourable ecological conditions, along with the quality of forest in positive respect. More species of mammalian fauna of the Park, particularly small/medium sized nocturnal species, may be added if probing is done by trapping and netting methods. As the area of the Park is comparatively small, studies on the carrying capacity and estimate of different populations may help further for the proper management of wildlife.

SUMMARY

Based on the survey works an account of the mammalian fauna of the Gorumara National park was given. Altogether, 43 species have been reported, of which 8 are considered as threatened. No hunting or grazing pressure was noticed in the Park. It appears that few more nocturnal species of mammals occur in the Park in addition to those reported. A detailed survey work along with the study of populations and carrying capacity was recommended.

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HYDROBIOLOGICAL STUDIES ON SOME WATERBODIES ALONG
BOMBAY HIGHWAY AND WARANGAL ROAD
(HYDERABAD, ANDHRA PRADESH)

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INTRODUCTION

Hyderabad is well known for its numerous waterbodies, ponds and lakes. Considering the role played by these waterbodies in the economy of the State, it was thought to undertake a long-term project on hydrobiology of some waterbodies of this area, which are in use for irrigation, fisheries, recreation, source of drinking water etc. Many workers (Zafar, 1964, Venkateshwarlu, 1967, Munawar, 1970, Rao 1972, Seenaya, 1973) studied hydrobiological aspects of some waterbodies of this area, but very little attention has been given to study the waterbodies of this area in reference to pollution and eutrophication. The present work was carried out for three years from April, 1983 to March, 1986 to collect the data on various abiotic and biotic factors for comparative hydrobiological studies of eight waterbodies of this area in reference to pollution status and eutrophication.

TOPOGRAPHY OF THE WATERBODIES STUDIED

In all eight waterbodies were selected of which four were on Warangal Road *Viz.* Raigir, Bhongir, Bibinagar and Narapally, whereas other four were Miyapur,

Gangaram Village tanks, Patan and Komatkunta situated within 70 Kms from Hyderabad on Bombay Highway.

The Komatkunta and Narapally tanks are temporary and usually get dried up in summer whereas Patan tank is perennial and Gangaram, Miyapur, Raigir, Bhongir, Bibinagar waterbodies were under extensive use for irrigation. The Raigir, Bhongir, Bibinagar tanks are situated in Nalgonda District whereas Patan, Komatkunta in the Medak district.

TABLE : I

Topography of Waterbodies

Name of Waterbody	District	Longitude	Latitude	Distance from Hyderabad
Komatkunta	Medak	78°14'E	17°32'N	42 Kms
Patan	Medak	78°16'E	17°02'E	32 Kms
Gangram	Hyderabad	78°17'E	17°31'N	25 Kms
Miyapur	Hyderabad	78°18'E	17°81'N	24 Kms
Narapally	Hyderabad	78°35'E	17°26'N	16 Kms
Raigir	Nalgonda	78°49'E	17°38'N	56 Kms
Bhongir	Nelgonda	78°41'E	17°31'N	52 Kms
Bibinagar	Nalgonda	78°41'E	17°31'N	46 Kms

MORPHOMETRY, DRAINAGE AND CATCHMENT AREA

Majority of the tanks are oval, suboval, or spherical in shape. The ratio between the smallest and largest tanks is 1 : 1500. The two tank, Narapally and Komatkunta are smaller in size and gets water from the nearby Paddy fields during Monsoon. The tanks namely Bhongir, Raigir, Bibinagar and Miyapur receive water from inlet sources like land run off from the surrounding area. The tanks like Bibinagar, Patan, Raigir, Gangaram are under immense impact of suspended silt from the loose soil of surrounding agricultural fields thus making water turbid.

TABLE : II
Some Morphometric Features of the Waterbodies

Waterbody	I	II	III	IV	V	VI	VII	VIII
Altitude M	1685	1680	1680	1678	1675	1680	1685	1630
Max. depth M	1	5	3	3	3	4	5	1.5

CLIMATIC CONDITIONS

There are four seasons in the study area, cold seasons from December to Mid February. Hot period from Mid February to May, the Monsoon season from June to September and the post monsoon from November to December. The maximum summer temperature varies from 28 to 34°C and the minimum was 12 to 15°C, the annual rainfall was very less during the period understudy is shown below.

MATERIALS AND METHODS

The water and plankton samples were collected from the eight waterbodies once in a month for a period of April, 1983 to March, 1986. Visibility was determined by secchi disc. pH, conductivity, were estimated electrometrically. Alkalinity, chloride, D. O., CO₂, Hardness, Phosphate, Nitrate Nitrogen, Sulfate, Calcium and magnesium were determined as per Standard Methods APHA (1971). The plankton in the water was preserved in 5% formaline and counting of plankton was made with the help of Sedgwick Rafter cell. Identification of aquatic macrophytes and zooplankton were made upto species level whereas identification of algae were made upto genera only.

WATER TRANSPARENCY

In majority of these tanks water was turbid due to silting from the nearby agriculture land and urthen bundh. The secchi disc reading was 2 m in Miyapur and lowest reading was 0.5 m in Komatkunta. The transparency of Bibinagar tank was less due to planktonic population besides silting process. All the water bodies under

study were not very deep and most of them dried up due to summer and use of water for irrigation.

CHEMICAL FEATURES OF THE WATERBODIES

pH of all the waterbodies was always above 7 with notable variation in all the water systems. Specific conductivity was the lowest in Bhongir and Miyapur. The water of these reservoirs is moderately hard. Since the total hardness was always above 100 to 150 mg (except Komatkunta) and in some waterbodies it was above 150 mg. The highest chloride content was recorded (185 mg/L) in Patan Cheru. The total alkalinity value was maximum in Bibinagar while the total phosphate, values were relatively more in Bibinagar tank and Patan tank (table III).

The human settlement nearby area of Patan tank has affected the water quality of this tank although previously this tank was used for *Trapa* and fish culture by local people. At present this aquatic system is gradually deteriorating and the thick mat of *Trapa* plants, has been completely vanished likewise other waterbodies Gangaram, Miyapur, Bibinagar are under immense pollution impacts and there is urgent need to protect and save them from death. Further it is necessary to protect these waterbodies from the natural process of filling. The catchment area should be properly planted to prevent soil erosion.

DISCUSSION

During the first year of study it was observed that good aquatic floating vegetation flourishes well in Patan tank followed by Gangaram and Miyapur tank. The list of species recorded from all the waterbodies are given in Table VI, In all 17 Macrophytes have been reported, out of which the Patan tank showed all the plants. The Marshy amphibious plant was dominant in Patan tank besides *Trapa bispinosa*. Among submerged plants *Ceratophyllum demersum* was the most common in Miyapur tank besides *Hydrilla verticillata*. The distribution of *Trapa* plant was quite predominant in first year of study but gradually the thick mat vanished by the end of study period due to increasing pollution by sewage and effluents from the nearby factories. The distribution of macrophytes in other waterbodies was sparse and irregular. In all 20 species of rotifers, 10 species of cladocera and 4 species of Copepods were recorded in all (table IV) the water bodies. Bibinagar tank and Patan tank represent maximum number of species whereas lowest number was recorded in Narapally and Komatkunta. The phytoplankton

TABLE : III
Annual average range of various Physico-chemical Parameters

Lake	Temp. Water °C	pH	CO ₂ mg/L	CO ₃ mg/L	HCO ₃ mg/L	D.O. mg/L	Hard- ness mg/L	Ca mg/L	Mg mg/L	Chlo- ride mg/L	Total PO ₄ mg/L	Sulp. hate mg/L	NO ₃ N mg/L	Sp. conductivity μ Ohm/Cm
I	20- 29	7.3- 8.5	0- 20	0- 24	50- 90	5.6- 8.0	60- 86	40- 52	24- 36	10- 25	0.01- 0.25	1.8- 4.5	0.18- 2.6	10 ³ X.675 X1.0-1.5
II	19- 32	7.2- 8.8	0- 22	18- 64	160- 286	7.2- 8.4	100- 150	40- 80	28- 60	70- 185	3.60- 4.00	1.8- 1.95	10.70- 12.50	10 ³ X.675 X 1.0-2.5
III	20- 30	8.0- 9.3	0- 0	12- 26	36- 170	5.8- 6.2	114- 240	84- 120	36- 100	128- 140	0.01- 0.27	7.2- 15.5	1.5- 7.68	10 ³ X.6.75 X 1.8-2.0
IV	20- 30	7.3- 8.8	0- 0	4- 38	52- 184	4.6- 5.0	142- 180	126- 140	30- 50	20- 102	0.02- 0.136	3.2- 5.6	1.05- 5.51	10 ³ X.675 X 1.0-1.2
V	20- 30	8.0- 8.2	0- 34	0- 0	70- 160	3.2- 4.4	120- 185	85- 135	40- 60	31- 110	0.03- 0.20	6.9- 14.0	0.0- 0.87	10 ³ X.675 X 1.2-1.5
VI	21- 28	8.0- 8.5	0- 24	0- 36	80- 110	6.1- 7.2	180- 224	124- 165	20- 45	50- 92	0.02- 0.22	7.2- 15.5	0.0- 0.58	10 ³ X.675 X 1.0-1.3
VII	19- 28	8.2- 9.7	0- 35	34- 80	170- 370	5.1- 9.7	180- 220	65- 145	50- 60	64- 160	0.30- 2.45	8.2- 10.0	0.58- 0.65	10 ³ X.675 X 1.0-2.0
VIII	10- 30	7- 8.8	0- 0	24- 60	70- 95	7.8- 8.1	180- 240	120 200	60- 80	80- 150	0.40- 0.80	2.8- 7.2	2.6- 8.2	10 ³ X.675 X 1.7-2.5
Komatkunta, II. Patan, III. Gangaram, IV Miryapur, V. Raigir, VI. Bhongir, VII. Bibinagar, VIII. Narapally.														

consisted of Myxophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae of which Myxophyceae was reported by 5 genera and the distribution of other genera is given in Table V.

TABLE : IV
Distribution of Zooplankton Species

	I	II	III	IV	V	VI	VII	VIII
ROTIFERA								
<i>Rotaria rotaria</i> (Pallas)	-	-	-	-	-	-	-	+
<i>Philodina</i> sp.	-	-	-	-	-	-	+	+
<i>Polyarthra vulgaris</i> (Carlin)	+	+	-	-	-	+	+	+
<i>Filinia longiseta</i> (Ehrenberg)	+	++	++	-	+	-	++	+
<i>Filinia terminalis</i> (Plate)	+	+	-	-	+	-	-	-
<i>Keratella Cochlearis</i> (Gosse)	-	+	-	-	-	-	+	-
<i>K. tropica</i> (Apstein)	+	-	++	-	-	-	++	-
<i>Asplanchna intermedia</i> (Hudson)	-	+	-	-	-	+	+	-
<i>Anuraeopsis fissa</i> (Gosse)	+	+	-	-	-	+	+	-
<i>Trichocerca cylindrica</i> (Imhoff)	-	+	-	-	-	-	++	-
<i>Brachionus angularis</i> (Gosse)	-	+	+	-	+	+	+	-
<i>B. calyciflorus</i> (Pallas)	+	+	++	-	+	+	+	-
<i>B. caudatus</i> Barrois & Daday	-	-	-	++	-	+	++	+
<i>B. forficula wierjeski</i>	-	+	-	+	-	-	-	+

	I	II	III	IV	V	VI	VII	VII
<i>B. quadridentatus</i> (Hermann)	—	+	+	—	+	—	+	—
<i>B. falcatus</i> Iacharias	—	—	—	—	+	—	+	—
<i>B. rubens</i> Muller	+	+	—	+	—	—	+	—
<i>Epiphanes macrourus</i> Barrois & Daday	—	+	—	—	—	—	+	—
<i>Lecane bulla</i> Gosse	—	—	+	—	+	—	—	+
<i>Monostyla</i> Sp.								
CLADOCERA								
<i>Diaphanosoma sarsi</i> Richard	+	+	—	—	+	++	—	+
<i>Ceriodaphnia cornuta</i> Richard	—	+	+	—	—	++	—	—
<i>Scapholeberis kingi</i> Sars	—	+	+	—	—	—	+	—
<i>Moina micrura</i> (Jurine)	—	—	—	—	+	—	+	+
<i>Simocephalus vetulus</i> Schodlor	+	+	—	+	—	—	+	—
<i>Pleuroxus adunchus</i>	—	—	—	—	—	+	—	—
<i>Macrothrix spinosa</i> King (E...)	—	—	—	+	+	+	+	—
<i>Chydorus reticulatus</i>	+	+	—	++	++	—	+	+
<i>Chydorus sphaericus</i> Muller	+	—	+	+	+	+	+	—
<i>Alona rectangula</i> Sars	—	+	—	+	—	+	+	—
COPEPODS								
<i>Mesocyclops hyalinus</i> Rehberg	+	+	+	—	+	+	+	—
<i>Cyclops</i> sp.	—	—	—	+	—	+	—	—
<i>Diaptomus</i> sp.	+	+	+	+	+	+	+	+

+ = Present
 ++ = Abundant
 — = Absent

As such the tanks like Narapally and Komatkunta are temporary tanks and usually gets dried up in summer thus affecting annual life cycle whereas the tanks like Gangaram, Miyapur, Raigir, Bhongir. Bibinagar are under immense impact of irrigation. Consequently, the water level gets reduced or sometimes completely dried up in summer. The annual rainfall was very less which also directly affects the water level besides evaporation. The Patan tank is perennial and under impact of sewage and industrial pollution.

The mean transparency value in the Patan, Bibinagar, Narapally and Komatkunta, was low. The low secchi values are due to suspended particles from the erosion of the surrounding area and urthen bundh in Narapally and Komatkunta, whereas in Patan and Bibinagar it is due to density of plankton (Hickel, 1973). Thus these tanks can be judged at the stage of cultural eutrophication on the basis of index of eutrophication (Yoshimura, 1933). The depth of the water in any waterbody does not exceed above 5 meters. According to Crumrine and Beeton (1965) for developing stable summer stratification depth should exceed 8 meters. The present study corroborates this view.

The pH in Patan and Bibinagar reservoirs were high coinciding with heavy bloom of phytoplankton (Moitra and Bhattacharya 1965 and Jana 1973). High pH indicates higher productivity (Davis, 1955 ; Bhatnagar, 1984). The present study supports this view for the waterbodies like Patan and Bibinagar.

Direct relationship between carbonate and pH was observed as has been shown by (Rao, 1955). Comparative study of pH range of all the waterbodies reveal that all the waterbodies are favourable for aquatic life (Das, 1978 ; Robert *et al.* 1940). As such the pH has shown only minor seasonal variations (George, 1966). Free carbon dioxide was not detected except in Komatkunta, Bhongir and Raigir. The absence of CO₂ in the other waterbodies may be due to its utilization by higher plants, evaporation and agitation (Welch, 1952, & Jayangoudar, 1980).

Carbonate was absent in Raigir. The carbonate values in the tanks viz. Bhongir, Komatkunta were not detected on many occasions this may be explained on the basis of the amount of equilibrium CO₂ in water which inhibits conversion of bicarbonate into carbonate as stated by Ruttner (1953) and Munawar (1970), Harshey *et al.* (1982). Bicarbonate content was high in Bibinagar while lowest bicarbonate alkalinity was seen in Komatkunta. Alikunhi *et al.* (1955) pointed out that alkalinity of highly productive waters must be above 100 PPM. Taking into account the 100 PPM as separation point for highly productive and low productive waterbody, the reservoirs Patan, Bibinagar could be grouped as productive.

Freiser and Fernando (1966) opine that when total alkalinity is high, the bicarbonate system prevails and pH is generally on alkaline side. The present study supports this

view. Haarrel and Dorris (1968) pointed out relationship between high alkalinity with high productivity. In the present study the alkalinity of Patan and Bibinagar were high and the tanks are more productive in fauna and flora as compared to other tanks. Das (1978), Patil *et al.* (1983) concluded that high alkalinity indicate pollution. In the present study it holds good in case of tanks like Patan and Bibinagar which are considerably polluted. The former due to sewage and industrial effluents while the later is due to domestic waste and sewage.

D. O. content in all the waterbodies was always above 5.1 mg/L except in Miyapur and Raigir where it was less than 5 mg/L on many occasions. Low oxygen may be due to evaporation at high temperatures and oxydation of organic matter, (Munawar, 1970, Patil *et al.* 1985). It seems that the above tanks except Miyapur and Raigir, are favourable to maintain fish fauna. (Ellis *et al.* 1946, Dimick & Merryfield 1947). Ganapati (1962) stated that higher D. O. during winter can be due to photosynthetic activities at upper level. Total hardness of water was always above 100 mg/L except in Komatkunta. Thus the tanks studied showed water hardness between slightly hard (100-150) and moderately hard (150-250 PPM) (Taylor, 1958 and Jayangouder, 1980). The most dominant cation in these water are calcium and the ratio was 2 : 1 in some cases. The maximum chloride content was found in Bibinagar and Patan and the lowest in Komatkunta. The chloride content was maximum in summer months and it might be due to reduced water level and evaporation at high temperature.

TABLE : V
Distribution of Phytoplankton

	I	II	III	IV	V	VI	VII	VIII
Chlorophyceae								
<i>Ankistrodesmus</i>	—	+	+	++	—	++	+	+
<i>Botryococcus</i>	—	—	—	+	—	++	++	—
<i>Closteriosis</i>	—	—	—	—	++	+	++	—
<i>Coelastrum</i>	—	—	+	—	++	—	—	—
<i>Pediastrum</i>	+	+	—	—	—	+	++	—
<i>Scenedesmus</i>	+	+	—	+	+	+	+	+
<i>Selanastrum</i>	+	+	—	++	—	—	—	+
<i>Tetradesmus</i>	+	—	—	+	—	—	++	—
<i>Olosterium</i>	+	++	—	—	—	++	—	+

	I	II	III	IV	V	VI	VII	VIII
<i>Cosmarium</i>	—	++	—	+	—	—	++	++
<i>Staurastrum</i>	+	—	—	+	+	—	—	+
Cyanophyceae								
<i>Anabaena</i>	—	—	+	—	+	—	++	—
<i>Microcystis</i>	+	++	—	—	—	++	++	—
<i>Oscillatoria</i>	—	+	—	+	+	+	+	+
<i>Spirulina</i>	—	—	—	+	+	+	+	—
<i>Merismopedia</i>	+	+	—	+	—	+	++	—
Bacillariophyceae								
<i>Cyclotella</i>	+	+	—	+	+	—	++	+
<i>Melosira</i>	+	+	—	—	+	—	+	—
<i>Naviculla</i>	+	++	+	+	—	+	++	+
<i>Nitzschia</i>	—	+	+	+	+	—	+	—
<i>Synedra</i>	+	+	+	—	++	++	+	+
<i>Cymbella</i>	—	+	+	—	+	—	—	+
<i>Fragillaria</i>	—	—	+	—	—	+	++	+
Euglenophyceae								
<i>Euglena</i>	—	+	—	—	—	—	++	+
<i>Phacus</i>	+	+	—	+	—	—	+	—

+ = Present

++ = Abundant

— = Absent

The maximum chloride content in both tanks Patan and Bibinagar indicates pollution of animal origin (Keenwood 1923, Ganapati 1962).

Vollenweider and Frei (1953) relate increase in specific conductivity to the state of enrichment. Same holds good in the present study. Specific conductivity values were quite high in Patan, Bibinagar and Narapally but were in favourable range Ellis (1937). Zutshi *et al.* (1980) stated; that generally the water with higher transparency

TABLE VI
Distribution of some Macropytes

	I	II	III	IV	V	VI	VII	VIII
<i>Azolla pinnata</i>	D	P	P	—	P	P	—	—
<i>Ceratophyllum demersum</i>	P	D	P	D	—	P	D	P
<i>Chara</i> sp.	—	P	P	P	P	P	P	—
<i>Elchhornia crassipes</i>	P	D	P	—	—	—	—	—
<i>Hydrilla verticillata</i>	P	P	—P	—P	—	P	—	P
<i>Hygroryza aristata</i>	—	P	—	—	—	—	—	—
<i>Ipomea aquatica</i>	—	P	P	—	—	P	P	—
<i>Jussiaea repens</i>	—	P	P	—	—	—	—	—
<i>Leamna minor</i>	D	P	P	P	P	P	P	P
<i>Najas minor</i>	P	P	P	P	—	—	—	—
<i>Nelumbo nucifera</i>	—P	D	D	P	—	—	—	—
<i>Nymphoides indicum</i>	—	P	—	—	—	—	—	—
<i>Ottelia alismoides</i>	P	P	P	—	—	P	—	—
<i>Pistia</i>	—	P	—	—	—	P	P	P
<i>Potamogeton perfoliatus</i>	—	P	—	—	—	—	P	—
<i>Trapa bispinosa</i>	—	D	P	—	—	—	P	—
<i>Vallisneria spiralis</i>	—	P	P	P	—	—	—	—

D = Dominant

P = Present

— = Absent

develops high density of submerged plants and in turbid water floating forms dominates. The present study support this view. *Ceratophyllum demersum* was dominant in Patan and Bibinagar tanks which indicate beginning of cultural eutrophication. Similar conclusion was also made by Zutshi *et. al.* (1980). The plant *Nelumbo nucifera* was dominant in Gangoram village tank in the first year of study.

Twenty species of Rotifers were recorded from all the water bodies. The tanks which have showed dominance of Rotifers are Patan and Bibinagar and majority of the rotifers were cosmopolitan. No specific pattern was observed throughout the period of study for the peak of rotifers. The rotifer population was poor than cladoceran population. This might be due to forage activities of these large crustaceans. Pennington (1948) concluded that in the presence of cladocera (large crustacean) rotifers population was reduced. Green (1972) and Chengalath *et. al.* (1974) have shown common occurrence of *Brachionus* and the absence or non absence of boreal genus *Notholca*, to be characteristics of many tropical waters. The same holds good in the present study. Komatkunta, Bhongir, Raigir and Narapally tanks have very limited fauna of rotifers thus indicating low fertility. The cladoceran fauna was better presented in Patan, Bibinagar, Bhongir, Raigir in the absence of predator like fish fauna (Harbacek *et. al.* 1961). The cladoceran studied did not show any fixed pattern of abundance and the reduced number of cladocera in the reservoir may be related to vegetation (Shireman and Martin, 1978).

Availability of food affect fertility of females (Comitta and Anderson, 1959; Edmondson, 1965) indirectly affecting birth rate and mortality of zooplankton. It seems reasonable to consider that food is important factors which control zooplankton abundance (Swar and Fernando, 1980.) Copepods were represented by *Cyclops* and *Diaptomus* copepodids and Nauplius showing various peaks in different months of the year.

Seasonal variations in the population of phytoplankton was seen. The phytoplankton consisted of Myxophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae. Considering the Myxophyceae as indicator of trophic status of the waterbody, the tanks Patan and Bibinagar can be judged as eutrophic waterbodies (Welch, 1952). Whereas the tanks like Narapally, Gangaram, Miyapur, Bhongir, Raigir are Mesotrophic since all these waterbodies showed dominance of chlorophyceae.

The phytoplankton was dominant over zooplankton. Temperature does not seem to be important for seasonal periodicity of phytoplankton (Jana 1973, Chari 1980, 1985). The phytoplankton was in peaks when the pH was high (Jana 1963; Moitra and Bhattacharya, 1965). Green algae were found when the phosphate content was low (Komorovsky, 1953), this is in contrast to the study of Chari (1980) and Welch (1952) Diatoms populations was poor in some waterbodies. Pearsall (1932) opines that diatoms occurred when PO_4 , NO^3 and silicate are rich, it seems to be so in the case of tanks like Patan and Bibinagar.

The total phytoplankton was found to be low on many occasions and it might be due to bottom rich deposit which is continuously drawn out for agricultural

purposes in some irrigational reservoirs like Bibinagar, Bhongir, Raigir, Miyapur and Gangaram.

SUMMARY

Eight water bodies were studied for 3 years from 1982-1985 of which four were on Warangal Road, viz, Raigir, Bongir, Bibinagar and Narapalli whereas other four were Miyapur, Gangaram village tanks. Patan and Komatkunta situated within 70 kms. away from Hyderabad on Bombay Highway. Physico-chemical factors like temperature, turbidity, pH, dissolved oxygen, Free CO_2 , total alkalinity, Chloride, total hardness have been studied. Some of these factors have been correlated and discussed. Rotifers, cladocerans, Copepods, were recorded during the period of study. The annual percentage composition of different groups of zooplankton were recorded. 20 species of rotifers, 10 species of cladocera and 4 species of copepods were recorded from waterbodies under study. The phytoplankton consist of Myxophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae.

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OBSERVATIONS ON THE ICHTHYOFAUNAL CONSTITUENTS RESTRICTED TO THE INDIAN SUBCONTINENTAL COASTAL WATERS

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INTRODUCTION

Ichthyofaunal diversity of the Indian subcontinental coastal waters is relatively high and consists of approximately 2000 reliably recorded species (Talwar, 1991). At least 27% of these species contribute to fishery either at a major or minor level. Endemics contribute 10% to the commercially exploited species of India. The one notable feature is the presence of 143 species of fishes belonging to 49 families in the Indian subcontinental coastal and shelf waters (between 60°E and 95°E) and are not found anywhere else in the world. This category of peripherally evolved marine and coastal fishes is very important from several points of view including conservation of biodiversity and optimal development of living resources. Areas of high proportion of narrow endemic species contribute to global diversity more than other areas with similar numbers of species but less endemism. Thus, biological degradation in such areas reduce diversity more than anywhere else. Narrow endemics are perhaps most vulnerable. Natural vulnerability is more for top level carnivores, species with poor colonising ability, those with colonial nesting habits, migratory species and species with little evolutionary experience (Anon., 1988). Limited information is available to the academics and conservationists about non-commercial fish resources. In addition, wherever fishery value exists information does not percolate to the species level. Determining patterns of species richness in areas may be valuable as an adjunct to managing those areas and in detecting centres of biodiversity, "hot spots", centres of endemism, critical faunas and other parameters used to accord conservation priority (Vane-Wright *et al.*, 1991). The majority of publications do not provide comprehensive scientific information, the lacuna remains unfilled for want of precise information on availability or otherwise of fish species found in our area. At this stage in our knowledge, we can perhaps obtain only a very general indication of endemism by examining the results of some recent systematic work on certain groups of fishes (Briggs, 1974). Hence attention is drawn to the fact that this work is not conclusive but with emphasis to know more and to disseminate information.

MATERIALS and METHODS

Fish samples in the holdings of Marine Biological Station, ZSI, Madras have been examined. Taxonomic and systematic information along with fishery details have been gathered from numerous sources including databases from the governmental and non-governmental sectors. They were classified according to habitats, fishery value, IUCN categorisation and other relevant factors. Statistical analysis has been deliberately avoided to (1) exclude skewed landing details and (2) to present the data in simple terms.

RESULTS

The retrieved information about 143 species of fishes belonging to 49 families are presented in Table 1.

TABLE 1

Fishes restricted to Indian coastal waters.
(Arrangement of taxa after Nelson, 1984)

GROUP I : *Commercially valuable fishes*

Taxa	Distribution
Family : CARCHARHINIDAE	
1. <i>Glyphis gangeticus</i> (Muller & Henle, 1891)	: Indus and Ganges riverine and estuarine systems ; possibly in inshore waters.
Family : RHINOBATIDAE	
2. <i>Rhinobatos annandalai</i> Norman, 1926	: Coasts of India ; marine, occasionally enters estuaries.
3. <i>R. lionotus</i> Norman, 1926	: Hooghly ; estuarine.
Family : DASYATIDAE	
4. <i>Dasyatis microps</i> (Annandale, 1908)	: East coast of India, Bangladesh ; inshore waters.
5. <i>Himantura marginata</i> (Blyth, 1861)	: India, Sri Lanka, Myanmar ; Inshore waters, enters estuaries.

Family : MYLIOBATIDAE

6. *Rhinoptera sewelli* Misra, 1946 : Southwest coast (Kerala) of India ; marine.

Family : CLUPEIDAE

7. *Corica soborna* Ham.-Buch., 1822 : Gangetic system ; riverine, frequents coastal inshore waters.
8. *Sardinella dayi* Regan, 1917 : Southern costs of India, Sri Lanka ; marine.
9. *Tenualosa ilisha* (Ham.-Buch., 1822) : Persian Gulf to Myanmar ; marine, pelagic, schooling in coastal waters, entering into rivers during spawning migration.

Family : ENGRAULIDIDAE

10. *Coilia ramcarati* (Ham.-Buch., 1822) : Gangetic delta and Andaman seas : marine, pelagic, entering estuaries.
11. *C. reynaldi* Valenciennes, 1848 : East coast of India to Myanmar ; coastal, entering tidal rivers.
12. *Setipinna phasa* (Ham.-Buch., 1822) : Ganges system, Coastal waters of Orissa ; riverine and estuarine.
13. *Thryssa gautamiensis* Babu Rao, 1971 : East coast of India ; marine, pelagic, inshore, entering estuaries.
14. *T. malabarica* (Bloch, 1795) : Coasts of India, Sri Lanka ; marine, insore waters, pelagic, entering estuaries.
15. *T. purava* (Ham.-Buch., 1822) : Coasts of India, Sri Lanka, Bangladesh ; marine, inshore waters, pelagic, entering estuaries.

Family : ARIIDAE

16. *Arius arius* (Hamilton, 1822) : Pakistan, India, Bangladesh, Myanmar ; Coastal waters, estuaries, tidal rivers and brackish water lakes.
17. *A. jella* Day, 1877 : East coast of India, Sri Lanka, Myanmar ; coastal, inshore, estuaries and brakish waters.
18. *A. platystomus* Day, 1877 : India, Sri Lanka ; coastal waters and estuaries.

19. *A. subrostratus* Valenciennes, 1840 : Pakistan, southern coasts of India, Sri Lanka ; seas, estuaries and tidal rivers.

Family : PLOTOSIDAE

20. *Plotosus limbatus* Valenciennes, 1840 : Southern coast of India, Sri Lanka ; estuaries and inshore waters.

Family : HEMIRAMPHIDAE

21. *Rhynchorhamphus malabaricus* Collette, 1976 : Southern coasts of India, Sri Lanka ; inshore waters.

Family : PLATYCEPHALIDAE

22. *Suggrundus bengalensis* (Rao, (1966) : East coast of India ; marine.

Family : AMBASSIDAE

23. *Parambasis dayi* (Bleeker, 1874) : Western ghats of Kerala & Vembanad lake : freshwater and estuaries.

24. *P. thomasi* (Day, 1870) : Western ghats of Kerala & Karnataka, Vembanad lake ; freshwater, estuaries.

Family : HAEMULIDAE

25. *Plectorhinchus ceylonensis* (Smith, 1956) : Sri Lanka, likely to occur in Indian inshore waters.

26. *P. griseus* (Cuvier, 1830) : West coast of India, Sri Lanka ; coral reefs and inshore waters.

Family : GERREIDAE

27. *Gerres limbatus* Cuvier, 1830 : Seas of India ; marine.

28. *G. setifer* (Ham.-Buch., 1822) : East coast of India, Sri Lanka ; inshore waters and estuaries.

Family : SILLAGINIDAE

29. *Sillago indica* Mc Kay, Dutt & Sujatha, 1985 : Coasts of India ; inshore waters.

30. *S. soringa* Dutt & Sujatha, 1983 : East coast of India, inshore sandy bottom.

31. *S. vincenti* Mc Kay, 1980 : Southern coast of India ; coastal, inshore waters.

Family : SCIAENIDAE

32. *Daysciaena albida* (Cuvier, 1830) : India, Sri Lanka, possibly extending eastward ; coastal waters, estuaries, ascending backwater.

33. *Johnieops aneus* (Bloch, 1793) : West coast of India, Pakistan, Sri Lanka ; marine.
34. *J. macrorhynchus* Mohan, 1976 : India, Sri Lanka, eastward to Singapore ; marine
35. *Johnius carouna* (Cuvier, 1830) : Southern coast of India, Nicobar Island ; coastal inshore waters, estuaries and backwaters.
36. *J. elongatus* Mohan, 1976 : West coast of India ; coastal waters.
37. *J. gangeticus* Talwar, 1991 : Gangetic system (Sunderbans) ; rivers and estuaries.
38. *J. glaucus* (Day, 1876) : West coast of India ; marine.
39. *J. mannarensis* Mohan, 1969 : South-east coast of India, Sri Lanka ; marine.
40. *Kathala axillaris* (Cuvier, 1830) : India, Sri Lanka ; inshore waters.
41. *Macrospinosa cuja* (Ham.-Buch., 1822) : Gangetic estuaries.
42. *Otolithes cuvleri* Trewavas, 1974 : Pakistan, India, Sri Lanka ; inshore and coastal waters.

Family : LEIOGNATHIDAE

43. *Leiognathus jonesi* James, 1971 : South-east coast of India, Andamans ; coastal, marine.

Family : CICHLIDAE

44. *Eetroplus suratensis* (Bloch, 1785) : South-west and east coasts of India, Sri Lanka ; inshore waters and estuaries.

Family : MUGILIDAE

45. *Liza parsia* (Ham.-Buch., 1822) : Pakistan, India (including Andamans), Sri Lanka ; shallow coastal waters.

Family : POLYNEMIDAE

46. *Polydactylus sexfilis* (Val., 1831) : Coasts of India ; marine.
47. *Polynemus paradiseus* Linnaeus, 1758 : Pakistan, India, Sri Lanka ; shallow sandy inshore waters, entering rivers during breeding season.

Family : TRICHIURIDAE

48. *Lepturacanthus pantului* (Gupta, 1966) : East coast of India ; benthopelagic/pelagic, coastal waters, estuaries.

49. *Trichiurus gangeticus* Gupta, 1966 : East coast of India ; coastal waters and estuaries.

Family : BOTHIDAE

50. *Pseudorhombus micrognathus* Norman, 1927 : North-east coast of India ; marine.

Family : CYNOGLOSSIDAE

51. *Cynoglossus dispar* Day, 1877 : Pakistan, West coast of India ; marine.
 52. *C. dubius* Day, 1873 : Pakistan, West coast of India ; inshore waters.
 53. *C. macrostomus* Norman, 1928 : Coasts of India ; shallow sandy bottom of shelf, entering estuaries.
 54. *C. semifasciatus* Day, 1877 : East coast of India ; muddy and sandy bottom of shelf.

Family : SOLEIDAE

55. *Zebrias synapturoides* (Jenkins, 1910) : South-west and East coasts of India ; inshore waters.

GROUP II : Common but non-commercial fishes

Family : SCYLIORHINIDAE

56. *Cephaloscyllium silasi* (Talwar, 1974) : South-west coast of India ; benthic, on the upper most continental slope at a depth of 300 mtrs.
 57. *Halaehurus hispidus* (Alcock, 1891) : Andamans & Gulf of Mannar ; benthic, deep water.

Family : SYNODONTIDAE

58. *Saurida longimanus* Norman, 1939 : Pakistan & north-west coast of India ; marine.

Family : HEMIRAMPHIDAE

59. *Hyporhamphus xanthopterus* (Val., 1846) : South-west coast of India ; estuarine.

Family : SYNGNATHIDAE

60. *Hippocampus branchyrrhynchus* Dunker, 1914, : Chilka lake (India) and Mekran coast (Pakistan) ; brackish waters.

61. *Microphis branchyurus* (Bleeker, 1853) : Southern India, Nicobar Islands, Sri Lanka ; estuaries and freshwater.

62. *M. cuncalus* (Ham.-Buch., 1822) : India, Bangladesh, Sri Lanka ; freshwater, estuaries, low saline habitats.

Family : TRIGLIDAE

63. *Lepidotrigla riggsi* Richards & Saksena, 1977 : Southern coasts of India, Andaman sea ; marine.

Family : SCIAENIDAE

64. *Atrobucca trewavase* Talwar & Sathiarajan, 1974 : South-east coast of India ; deep waters.

Family : LABRIDAE

65. *Xyrichtys cyanifrons* Val. 1840 : Southern coasts of India ; marine.

Family : URANOSCOPIDAE

66. *Ichthyscopus inermis* Cuvier, 1829 : Coasts of India ; marine

67. *Uranoscopus guttatus* Cuvier, 1829 : Coasts of India ; marine

Family : CALLIONYMIDAE

68. *Synchirops lineolatus* (Val., 1837) : India (Madras, Andamans) ; marine.

Family : Gobiidae

69. *Acentrogobius griseus* (Day, 1876) : South-east coast of India ; brackish-waters.

70. *A. madraspatensis* (Day, 1868) : South-east coast of India ; backwaters.

71. *A. masoni* (Day, 1873) : Coasts of India ; marine and backwaters.

72. *Apocryptus bato* (Ham.-Buch., 1822) : India, Bangladesh, Myanmar ; marine to freshwater.

73. *Awaous gutum* (Ham.-Buch., 1822) : India, Bangladesh ; rivers and estuaries.

74. *Bathygobius ostreicola* (Choudhuri, 1916) : East coast of India ; estuaries.

75. *Boleophthalmus dussumieri* Val., 1837 : Iraq, Pakistan, India, Bangladesh ; seas and estuaries.

76. *Callogobius seshaiyai* Jacob & Ranganath, 1960 : South-east coast of India ; estuaries.

77. *Gobiopsis macrostoma* Steindachner, 1860 : India, Thailand ; coastal waters and estuaries.
78. *Mugilogobius valigouva* (Deraniyagala, 1936) : Sri Lanka, India (Goa) ; estuaries.
79. *Oligolepis cylindriceps* (Hora, 1923) : India (Chilka, Ennore estuary, Cochin backwaters) ; brackish waters.
80. *Parachaeturichthys ocellatus* Day, 1873 : Pakistan, North-west coast of India ; marine.
81. *Parapocryptes rictuosus* (Val., 1837) : West coast of India ; marine and brackish waters.
82. *Periophthalmus pearsi* Eggert, 1935 : India (West Bengal), Bangladesh, Myanmar ; marine and brackish waters.
83. *Sicyopterus griseus* (Day, 1876) ; Southern coasts of India ; estuaries and backwaters.

Family : GOBIOIDIDAE

84. *Taenioides buchanani* (Day, 1873) : East coast of India, Myanmar ; estuarine.

Family : SOLEIDAE

85. *Synaptura albomaculatus* Kaup, 1858 : East coast of India, Bangladesh, Myanmar ; shallow coastal waters, estuaries.

GROUP III : *Less frequent ; commercial fishes*

Family : CLUPEIDAE

86. *Dayella malabarica* (Day, 1873) : South-west coast of India ; rivers, estuaries.
87. *Ehirava fluviatilis* Deraniyagala, 1929 : Southern coasts of India, Sri Lanka ; estuaries, lagoons, tidal rivers.

Family : PRISTIGASTERIDAE

88. *Pellona dayi* Wongratana, 1983 : East coast of India, Great Nicobar Island ; marine.

Family : ENGRAULIDIDAE

89. *Thryssa dayi* Wongratana, 1983 : Pakistan, West coast of India, marine, pelagic, inshore waters.
90. *T. polybranchialis* Wongratana, 1983 : Coasts of India, Sri Lanka ; marine pelagic, schooling.
91. *T. spinidens* (Jordan & Seale, 1925) : India (West Bengal) to Thailand ; marine, inshore, pelagic.
92. *T. stenosoma* Wongratana, 1983 : North-east coast of India, Bangladesh, Myanmar ; estuarine, inshore waters.

GROUP IV : *Less frequent, non-commercial fishes*

Family : SQUALIDAE

93. *Centroscyllium ornatum* (Alcock, 1889) : North Arabian Sea and North Bay of Bengal ; deep sea form from upper continental slope.

Family : MURAENIDAE

94. *Lycodontis punctatus* (Bl. & Schn., 1801) : East coast of India ; marine.
95. *L. sathete* (Ham.-Buch., 1822) : Hooghly estuary.

Family : MORINGUIDAE

96. *Moringua arundinacea* (McClelland, 1844) : Gangetic estuaries.
97. *M. raitaborua* (Ham.-Buch., 1822) : Gangetic estuaries.

Family : OPHICHTHIDAE

98. *Caecula pterygea* Vahl, 1794 : Southern coasts of India ; estuaries and inshore waters.
99. *Ophichthus microcephalus* (Day, 1870) : West coast of India ; marine.
100. *O. ornatissimus* (Kaup, 1856) : West coast of India ; marine.

Family : BATRACHOIDIDAE

101. *Austrobatrachus dussumieri* (Val., 1829) : Pakistan, West coast of India, Sri Lanka ; estuaries.

Family : PLATYCEPHALIDAE

102. *Rogadius serratus* (Cuvier, 1829) : India (Minicoy) ; marine.

Family : AMMODYTIDAE

103. *Ammodytus kalollepis* Gunther, 1862 : Coasts of India ; sandy inshore waters.

Family : BLENNIDAE

104. *Alticus andersoni* (Day, 1878) : Andaman Islands ; marine

Family : CALLIONYMIDAE

105. *Callionymus orientalis* Bl. & Schn., 1801 : South-east coast of India ; estuaries, inshore waters.

Family : GOBIIDAE

106. *Boleophthalmus dentatus* Val., 1837 : West coast of India ; marine, estuaries.
 107. *Stigmatogobius minima* (Hora, 1923) : India (Chilka, Godavari estuary) ; brackish waters.

Family : TRYPAUCHENIDAE

108. *Amblytrypauchen arctocephalus* (Alcock, 1890) : Hooghly estuary.

Family : ELEOTRIDAE

109. *Eleotris lutea* Day, 1876 : India (West Bengal, Andamans), Myanmar) ; estuaries.

Family : BOTHIDAE

110. *Cephalopsetta ventrocellatus* Dutt & Rao, 1965 : East coast of India ; marine.

GROUP V : Rare fishes

Family : SCYLIORHINIDAE

111. *Apristurus investigatoris* (Misra, 1962) : Andaman Sea ; deepwater, bottom dwelling.

Family : RHINOBATIDAE

112. *Rhinobatos variegatus* Nair & Mohan, 1973 : Gulf of Mannar ; marine.

Family : MURAENIDAE

113. *Echidna nigra* (Day, 1870) : Andamans ; reef dwelling.

Family : OPHICHTHIDAE

114. *Bascanichthys deraniyagalai* Menon, 1961 : South-east coast of India (Karaikal), Sri Lanka ; estuaries.

Family : SERREVOMERIDAE

115. *Serrevomer microps* (Alcock, 1889) : Andaman Sea ; deep water.

Family : SCORPANEIDAE

116. *Setarches longimanus* (Alcock, 1894) : Andaman Sea ; deep water.

Family : PRISTIGASTERIDAE

117. *Illisha obfuscata* Wongratana, 1983 : India (Pondicherry & Bombay) ; marine.

Family : ENGRAULIDIDAE

118. *Thryssa kammalenoides* Wongratana, 1983 : India (Godavari estuary and nearby inshore waters).

Family : ARIIDAE

119. *Arius gagera* (Hamilton, 1822) : India (West Bengal, Orissa), Bangladesh ; estuaries, tidal rivers.
120. *A. parvipinnis* Day, 1877 : East coast of India ; marine.
121. *Hemipimeladus jattus* (Hamilton, 1822) : India (West Bengal, Orissa), Bangladesh, Myanmar ; estuaries, rivers.

Family : APOGONIDAE

122. *Apogon nigricans* Day, 1875 : East coast of India (Madras) ; marine.

Family : NEMIPTERIDAE

123. *Parascolopsis boesemani* Rao & Rao, 1981 : East coast of India (Waltair) ; marine.

Family : SCIAENIDAE

124. *Bahaba chaptis* (Ham.-Buch., 1822) : Hooghly estuary, Myanmar ; coastal waters, tidal rivers.
125. *Panna heterolepis* Trewavas, 1977 : Hooghly estuary.

Family : LEIOGNATHIDAE

126. *Leiognathus striatus* James & Badruddin, 1991 : Gulf of Mannar ; marine.

Family : BLENNIDAE

127. *Istiblennius dayi* (Whitley, 1929) : Andamans ; coastal.

Family : GOBIIDAE

128. *Bathygobius macrocephalus* (Rao, 1968) : East coast of India ; inter-tidal rock pools.
129. *Boleophthalmus sculptus* Gunther, 1861 : West coast of India (Bombay) ; coastal.
130. *Callogobius andamanensis* Menon & Chatterjee, 1974 : Andaman Islands ; coastal.
131. *Cottogobius kapuri* Rao, 1976 : East coast of India (Godavari estuary).
132. *Chiramenu fluviatilis* Rao, 1970 : East coast of India (Godavari estuary).
133. *Oxyurichthys dasi* Talwar *et al.*, 1982 : Andaman Islands ; coastal.
134. *O. talwari* Mehta *et al.*, 1989 : Andaman Islands ; coastal.
135. *Pogonogobius planifrons* (Day, 1873) : West coast of India (Bombay) ; coastal.
136. *Silhouettea indicus* Rao, 1971 : East coast of India (Godavari estuary).
137. *Scartelaos glaucus* (Day, 1876) : Andaman Islands ; coastal.

Family : ELEOTRIDAE

138. *Incara multisquamatus* Rao, 1971 : East coast of India (Godavari estuary).
139. *Eleotris andamanensis* Herre, 1939 : Andaman Islands ; coastal.
140. *Ptereleotris andamanensis* Herre, 1939 : Andaman Islands ; coastal.

Family : SIGANIDAE

141. *Siganus peulloides* Woodland & Randall, 1979 : Maldives, Similan Islands, isolated islands of west coast of Thailand, possibly Andaman Nicobar Islands.

Family : TETRAODONTIDAE

142. *Arothron leopardus* (Day, 1878) : Coasts of India ; marine.
143. *Canthigaster investigatoris* (Annandale & Jenkins, 1914) : Andaman sea ; marine.

DISCUSSION

The fauna of Indo-west Pacific region is incredibly rich with a species diversity that far exceeds that of the tropical regions. It possesses many families which are not found anywhere else—Pegasidae, Sillaginidae, Kraemeriidae, Siganidae, etc., while other tropical regions possess very few (Briggs, 1974). Indian coastal waters are important

from taxonomic point of view as one of the peripheral areas in the evolution of marine fish species. A numerical analysis of fish species is necessary before having a cursory look at the distribution patterns. A close scrutiny indicates the presence of 143 species of endemics (55 species in the east coast, 25 in the west coast, 48 in both the coasts and 15 enjoying insular distribution).

There are 46 narrow endemic species of fishes found in pockets. The major pockets of occurrence are (i) the Gangetic estuaries (12 species : *Glyphis gangeticus*, *Rhinobates lionotus*, *Lycodontis sathete*, *Moringua arundinacea*, *M. raitaborua*, *Corica soborna*, *Setipinna phasa*, *Bahaba chaptis*, *Johnius gangeticus*, *Macrospinoso cuja*, *Panna heterolepis*, and *Amblytrypauchen arctocephalus*), (ii) Godavari estuaries (6 species : *Thryssa kammalensoides*, *Cottogobius kapuri*, *Callogobius seshaiyai*, *Chiramenu fluviatilis*, *Silhouttea indicus* and *Incara multisquamatus*), (iii) Estuarine systems and coastal belt of Kerala (6 species : *Cephaloscyllium silasi*, *Rhinoptera sewelli*, *Dayella malabarica*, *Hyporhamphus xanthopterus*, *Parambasis dayi* and *P. thomasi*), (iv) the Gulf of Mannar, (3 species : *Halaelurus hispidus*, *Rhinobatos variegatus* and *Leiognathus striatus*) and (v) Seas around Andaman Islands (12 species : *Alticus andersonii*, *Callogobius andamanensis*, *Canthigaster investigatoris*, *Echidna nigra*, *Eleotris undamanensis*, *Istiblennius dayi*, *Oxyurichthys dasi*, *O. talwari*, *Ptereleotris andamanensis*, *Scartelaos glaucus*, *Serrevomer microps* and *Setarches longimanus*). These pockets should be earmarked for conservation purposes with appropriate legislation and enforcement of law. We may even call them as "hot spots" requiring stringent measures to protect the ecosystem as a whole rather than trying to save dwindling species. The other 5 narrow endemics, viz. *Ilisha obfusca* (known from Pondicherry and Bombay) *Hippocampus branchyrrhynchus* (Chilka lake and Pakistan), *Rogadius serratus* (Minicoy Islands), *Apogon nigricans* (Madras coast) and *Parapocryptes rictuosus* (Chilka lake and Ennore estuary) have to be appropriately taken care of.

Out of the 143 species of fishes discussed here, 55 are of common occurrence with fishery value either at a major or minor level, 30 are commonly occurring with no interest to fisheries and passed on as trash fish, 7 are less frequent in commercial catches, 18 are less frequent and non-commercial and 33 species are rare.

In the recent years catch statistics indicate a fluctuating trend qualitatively and quantitatively for common commercial fishes. Especially in the case of *Tenualosa ilisha* catches are fast declining all over the range, more drastically in the Gangetic estuarine system perhaps due to habitat destruction (Talwar and Jhingran, 1991 ; Chandra Ravish, 1994 ; Kotwal, 1994 ; Mukhopadhyay, 1994). It is suspected that individual populations of *T. ilisha* are often isolated and that distinct races exist in the different river systems (Pillay and Rosa, 1963). These races are also susceptible. This species

can be considered vulnerable under IUCN categorisation. For most of the commercial fishes, species specific catch details are not available to arrive at any tangible conclusions. There are many taxonomic hurdles acting as stumbling blocks in the identification of species in the genera *Arius* (Jayaram, 1982), *Ilisha*, *Pellona*, *Sardinella* (Whitehead, 1985; Sivakumaran *et al.*, 1989), *Setipinna*, *Thryssa* (Whitehead *et al.*, 1988) and *Sillago* (Mc Kay, 1992).

In order to avoid destruction of non-commercial but commonly occurring species, it is necessary to evolve suitable methods to reduce the quantum of by-catches. This category needs attention since the germ plasm may be lost in the long run without being noticed by us. The catches of less frequently occurring commercially viable species should be augmented by encouraging replenishment of brood stock in natural environments. Ichthyological and fishery information are needed for *Pellona dayi*, *Thryssa dayi*, *T. polybranchialis*, *T. spinidens* and *T. stenosoma* (Whitehead *et al.*, 1988). The less frequent non-commercial and rare species have to be considered for conservation and to maintain natural biodiversity.

Between 1961 and 1992 occurrence of 17 species (of coastal fishes) as new to science has been reported from India and they are known by types only. Two species (*Apristurus investigatoris* and *Panna heterolepis*) are known by the juveniles only and their adult configuration is not known. Further, *Apogon nigricans*, *Arothron leopardus*, *Bahaba chaptis* (known by 8 specimens only), *Boleophthalmus sculptus*, *Canthigaster investigatoris* (known by 2 specimens only), *Echidna nigra*, *Eleotris andamanensis*, *Istiblennius dayi*, *Pogonogobius planifrons*, *Ptereleotris andamanensis*, *Scartelaos glaucus*, *Serrevoemer microps*, and *Setarches longimanus* do not find a mention in the literature for the past 50 years. More searches have to be made for these species. In the recent years not a single sample of *Arius gagora* and *Hemipimelodus fatus* could be collected even from the locality where they were abundant earlier (Talwar and Jhingran, 1991). Occurrence of *Arius parvipinnis* has also become rare these days. They are thus critically endangered and call for immediate protection measures.

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**DETERMINATION OF OPTIMUM TIME FOR MASS MOUNTING OF
MULTIVOLTINE SILKWORM, *BOMBYX MORI* (L.) [LEPIDOPTERA :
BOMBYCIDAE] UNDER TROPICAL CONDITIONS OF WEST BENGAL.**

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INTRODUCTION

Towards the end of final larval instar, the silkworm starts cleaning its alimentary canal. When the alimentary canal is empty, the worm looks translucent and called mature. Such mature larvae normally crawl towards the periphery of the rearing trays in search of suitable support for building their cocoons. The process of picking the ripe worms and putting them on suitable mountages for the spinning of cocoons is called mounting of worms.

In usual sericultural practices of West Bengal, a farmer rears about 100-200 dfls. of multivoltine silkworm race nistari of *Bombyx mori* (L.) in each commercial crop season. All the worms of a lot do not ripen simultaneously. It is observed that it takes about 24-48 hours for maturation of the entire lot. During this period, the mature worms are picked-up intermittently and mounted for spinning, which involves a great deal of labour and time. Therefore, the present study was undertaken to determine an optimum time for mass mounting of the worms after first appearance of maturation in the lot in order to save labour and time.

MATERIALS and METHODS

The experiment was conducted with 50 dfls. of popular multivoltine race nistari of *Bombyx mori* (L.) reared on S1 variety of mulberry leaves at room temperature and humidity. In 5th larval instar 10,000 worms were taken at random from the mass to initiate the experiment. After the first appearance of maturation in the lot, these worms

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were picked up and put on a separate bamboo mountage. The picking commenced at 6 A. M. and continued at an interval of four hours until the experimental material exhausted. The cocoons were harvested on the 5th day of spinning; subsequently, cocooning percentage, single cocoon weight, single shell weight and silk ratio were recorded. Data of mature worms during each mounting time were taken together for calculating the mean mature value of the concerned parameters. Deviation of premature value from the mean mature one under each parameter at every mounting time is presented in parenthesis. The mean cocooning percentage for mature worms is calculated from the ratio of total number of cocoons resulted from mature worms and total number of mature worms mounted.

The mean values of single cocoon weight and single shell weight for mature worms are actually the mean figures weighted, weight in each case being the ratio of harvest cocoons at different times of mounting and total number of cocoons harvested from mature worms.

The mean of silk ratio is the figure of total shell weight and total cocoon weight expressed in percentage for mature worms. The experiment was conducted in all four commercial seasons, viz., Falgooni (February-March), Jaistha (May), Bhaduri (August-September) and Aগ্রহায়ণ (November) of the year 1984.

RESULTS and DISCUSSION

The data regarding mean performance of mature and premature worms on cocooning percentage, single cocoon weight, single shell weight and silk ratio during the foregone commercial seasons are presented in Tables 1, 2, 3, 4. During the seasons of February-March (Table-1) and November (Table-4). the mounting commenced at 6 A. M. and ended at 10 A. M., whereas in May (Table-2) and August-September Seasons (Table-3), the Mounting started at 6 A. M. and ceased at 6 A. M. of the following day.

During February-March (Table-1) there was no marked difference in cocooning percentage for mature and premature worms at different intervals. However, at 2 P. M. single cocoon weight, single shell weight and shell ratio of premature worms showed no reduction of their mean mature values, as evident by the positive deviation in parenthesis.

In May (Table-2) at 6 P. M. the deviation of the cocooning percentage of premature larvae was found to be minimum (2.37) as compared to that of their mean mature value except 6 A. M. of the following day. Single shell weight and silk ratio of premature larvae at 6 P. M. showed higher grade than their mean mature values, as evident by positive deviation in parenthesis.

TABLE : 1

Mean performance of mature and pre-mature worms mounted at different times
on cocooning, single cocoon weight, single shell weight and silk ratio

Season : February-March, 1984.

Temperature : $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$
Relative humidity : $63\% \pm 2\%$

Time of mounting	Mature (M) Pre-mature (PM)	No of M and PM worms mounted at the time out of 10,000 worms	Cocoons harvested (No.)	Cocooning (%)	Single cocoon weight (g.)	Single shell weight (g.)	Silk Ratio (%)
6 A. M.	M	971	968	99.69	0.880	0.109	12.38
	PM	971	955	98.35(-1.23)	0.831(-0.065)	0.100(-0.012)	12.03(-0.44)
10 A. M.	M	2280	2267	99.42	0.887	0.110	12.40
	PM	2280	2253	99.81(-0.77)	0.836(-0.060)	0.101(-0.011)	12.80(-0.39)
2 P. M.	M	386	384	99.48	0.918	0.115	12.52
	PM	386	382	98.96(-0.62)	0.904(+0.008)	0.113(+0.001)	12.50(+0.03)
6 P. M.	M	799	798	99.87	0.917	0.116	12.64
	PM	799	796	99.62(+0.04)	0.905(+0.009)	0.114(+0.002)	12.59(+0.12)
10 P. M.	M	822	819	99.63	0.910	0.114	12.52
	PM	306	305	99.67(+0.09)	0.906(+0.010)	0.114(+0.002)	12.58(+0.11)
				M* = 99.58	M* = 0.896	M* = 0.112	M* = 12.47

M* = Mean Value of the concerned parameter of worms.

Figures in Paranthesis denotes deviation from mean value of mature worms.

TABLE : 2

Mean performance of mature and pre-mature worms mounted at different times
on cocooning, single cocoon weight, single shell weight and silk ratio

Season : May, 1984
Temperature : $31^{\circ}\text{C} \pm 1^{\circ}\text{C}$
Relative humidity : $80\% \pm 2\%$

Time of Mounting	Mature (M) Pre-nature (PM)	No. of M and PM works mounted at the time out of 10,000 worms	Cocoons harvested (No)	Cocooning (%)	Single cocoon weight (g.)	Single shell weight (g.)	Silk Ratio (%)
6 A. M.	M	702	658	93.73	0.724	0.036	11.89
	PM	702	607	86.46(−8.46)	0.703(−0.029)	0.076(−0.016)	10.81(−1.73)
10 A. M.	M	1214	1129	92.99	0.728	0.090	12.36
	PM	1214	1109	91.35(−3.57)	0.721(−0.012)	0.082(−0.010)	11.37(−1.17)
2 P. M.	M	268	252	94.02	0.732	0.091	12.43
	PM	268	246	91.79(−3.13)	0.730(−0.002)	0.090(−0.002)	12.32(−0.22)
6 P. M.	M	94	89	94.68	0.735	0.094	12.78
	PM	94	87	92.55(−2.37)	0.732(+0.000)	0.093(+0.001)	12.70(+0.16)
10 P. M.	M	214	201	93.92	0.736	0.095	12.90
	PM	214	198	92.52(−2.40)	0.732(−0.001)	0.094(+0.002)	12.84(+0.30)
6 P. M.	M	4558	4363	95.72	0.734	0.093	12.67
(Next day)	PM	458	430	93.88(−1.04)	0.733(+0.001)	0.092(+0.000)	12.55(+0.01)
				M* = 94.92	M* = 0.732	M* = 0.092	M* = 12.54

M* = Mean value of the concerned parameter of worms

Figures in Paranthesis denotes deviation from mean value of mature worms,

TABLE : 3

Mean performance of mature & pre-mature worms mounted at different times
on cocooning, Single cocoon weight, Single shell weight and silk ratio.

Season : August-September, 1984.

Temperature : $31^{\circ}\text{C} \pm 1^{\circ}\text{C}$
Relative humidity : $91\% \pm 2\%$

Time of Mounting	Matural (M) Pre-mature (PM)	No. of M and PM worms mounted at the time out of 10,000 worms	Cocoons harvested (No.)	Cocoonig (%)	Single cocoon weight (g.)	Single shell weight (g.)	Silk Ratio (%)
6 A. M.	M	1388	1289	92.86	0.787	0.085	10.80
	PM	1388	1256	90.48(-3.35)	0.758(-0.044)	0.080(-0.007)	10.55(-0.33)
10 A. M.	M	1749	1629	93.13	0.797	0.086	10.79
	PM	1749	1605	91.76(-2.07)	0.774(-0.028)	0.083(-0.004)	10.72(-0.16)
2 P. M.	M	177	169	95.48	0.812	0.083	10.83
	PM	177	167	94.35(+0.52)	0.787(-0.015)	0.085(-0.002)	10.80(-0.08)
6 P. M.	M	131	125	95.41	0.819	0.090	10.98
	PM	131	124	94.65(+0.82)	0.815(+0.013)	0.089(+0.002)	10.92(+0.04)
10 P. M.	M	116	112	96.55	0.818	0.090	11.00
	PM	116	111	95.68(+1.85)	0.811(+0.009)	0.089(+0.002)	10.97(+0.09)
6 P. M.	M	2739	2287	94.45	0.811	0.089	10.97
{Next day	PM	139	134	96.40(+2.57)	0.810(+0.008)	0.089(+0.002)	10.98(+0.10)
		M* = 93.83		M* = 0.802	M* = 0.087	M* = 10.88	

M* = Mean value of the concerned parameters of worms.

Figures in Paranthesis denote deviation from mean value of mature worms.

TABLE : 4

Mean performance of mature and pre-mature worms mounted at different times on cocooning, single cocoon weight, single shell weight and silk ratio

Season : November, 1984			Temperature $\pm 24^{\circ}\text{C} \pm 1^{\circ}\text{C}$ Relative humidity : $72\% \pm 2\%$				
Time of Mounting	Mature (M) pre-mature (PM)	No. of M and PM works mounted at the time out of 10,000 worms	Cocoons harvested (No.)	Cocooning (%)	Single cocoon weight (g.)	Single Shell weight (g.)	Silk Ratio (%)
6 A. M.	M	766	754	98.43	0.835	0.091	10.89
	PM	766	741	96.73(-2.17)	0.768(-0.084)	0.081(-0.014)	10.54(-0.56)
10 A. M.	M	2426	2391	98.55	0.847	0.093	10.97
	PM	2426	2367	97.56(-1.34)	0.792(-0.060)	0.085(-0.010)	10.73(-0.37)
3 P. M.	M	205	203	99.02	0.868	0.098	11.29
	PM	205	200	97.56(+1.43)	0.858(+0.006)	0.096(+0.001)	11.18(+0.08)
6 P. M.	M	113	112	99.11	0.881	0.099	11.23
	PM	113	110	97.34(-1.56)	0.859(+0.007)	0.096(+0.001)	11.17(+0.07)
10 P. M.	M	2137	2122	99.43	0.860	0.097	11.27
	PM	843	332	98.69(-0.21)	0.859(+0.007)	0.097(+0.002)	11.29(+0.19)
			M*=98.90	M*=0.852	M*=0.095	M*=11.10	

M*=Mean value of the concerned parameter of worms.

Figures in Paranthesis denote deviation from mean value of mature worms.

During the season of August-September (Table-3), it was observed that at 6 P. M. cocooning percentage, single cocoon weight, single shell weight and silk ratio of premature larvae registered a positive deviation from their mean mature values.

During the season of November (Table-4), there was no marked variation in cocooning percentage of mature and premature worms at different intervals. However, single cocoon weight, single shell weight and silk ratio of premature larvae at 2 P. M. showed positive deviation from their mean mature values.

The above results indicate that if all the premature and mature multivoltine silkworms are mounted intermittently for 8 hours (during February-March and November) to 12 hours (during May and August-September) after their first appearance of maturation in the lot, the premature worms result in the formation of normal cocoons without any adverse effect on cocooning and quality of cocoons. Sukcharoen and Akapanathu (1987) reported that in silkworm race $K_1 \times K_{13}$ the mature worms collected after 24 hours of discharging green faeces, were better in cocoon weight and shell weight.

The long duration of ripening of silkworms may be due to many factors, one of which is the formation of egg-cells that do not proceed uniformly within the ovariole (Tazima, 1964). There is conspicuous difference in the rate of growth among egg-cells depending on their location in distal and proximal portions of the ovariole. In general, about seventy eggs are deposited from each tubule. The difference in the growth-rate of egg-cells might reflect in the uneven maturation of the silkworms as well as the hatchability of silkworms, as their hatching usually begins in early morning and ends at about 8-10 A. M. (Tanaka, 1964).

Moulting is a very critical factor in silkworm rearing. The worms normally settle in about 6-8 hours from the time first signs of moulting are noticed. Most of the worms (over 90 %) also come out of moult within 6-8 hours from the time the early moulted worms appear in the bed (Krishnaswami, 1986). This 6-8 hours difference during settling in moult or coming out of moult in a rearing bed is continued till ripening time of the worms, which are then intermittently mounted.

It is well known that temperature and humidity play a vital role in the uniform development of silkworms. Krishnaswami *et al.*, (1971) observed that there is a high degree of climatic fluctuations in West Bengal. Such a condition may lead to variation in maturation of the silkworms. Generally, worms during the ripening time require a temperature around 24°C and 60% to 70% relative humidity (Ullal and Narsimhanna, 1978). High humidity lengthens the ripening period ; this is evident from the fact that during the season of May (Jaistha) and August and September (Bhaduri), total ripening period

required 24 hours, whereas during the seasons of February-March (Falguni) and November (Agrahayani), ripening ended within 18 hours.

The supply of adequate food and proper spacing is necessary for the uniform growth of silkworm (Sengupta and Yusuf, 1974). However, the difference in the assessability of food among the individuals may lead to uneven growth of the silkworms.

All these factors, viz., gradual maturation of egg-cells, hatching duration, irregular moulting, high degree of fluctuations of temperature and relative humidity and difference in the assessability of food, may collectively operate to prolong the ripening period (24-48 hours) of the multivoltine silkworms. During this ripening period, the appetite of silkworms is gradually reduced leading to cessation of feeding at about 8-12 hours after the initiation of ripening, when most of the worms remain busy with cleaning their intestine and prepare themselves for spinning. So, if all the worms are mounted about 8-12 hours after the initiation of ripening, there will be no adverse effect on cocooning economic importance of cocoons. It is useful to reduce labour, cost and time during spinning.

SUMMARY

It was experimentally observed on multivoltine silkworm, *Bombyx mori* (L.) that by intermittent picking and mounting of mature larvae done for 8-12 hours from their first appearance followed by that of all the other mature and premature larvae in the lot mounted at a time, the premature larvae resulted in the formation of normal cocoons without any adverse effect both on the yield and quality of cocoons. Performances of mature and premature larvae, picked-up at different intervals, on cocooning and qualitative characters of cocoons are discussed.

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REPRODUCTIVE CYCLE IN *PARREYSIA FAVIDENS* (BENSON) : A FRESHWATER
BIVALVE OF KOSI RIVER.

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INTRODUCTION

The freshwater bivalve *Parreysia favidens* forms an important shell fisheries of India. The freshwater mussel *Parreysia favidens* (Benson) belong to class Bivalvia, family Unionidae. It is widely distributed in fresh water. They are found in dhars and channels of river Kosi in North Bihar. They live in river bottom on sand, mud, with their ventral part of the shell valves remaining exposed. In the present case a detailed study was done on reproductive cycle, fecundity and development of gonads, particularly ovaries of *Parreysia favidens* collected from Burhi Gandak and dhars of Kosi river of North Bihar.

Sex in bivalves is a subject of great interest. They are either dioecious or monoecious. In some of them change of sex reversal also takes place. A perusal of literature reveals that the work on sex and seasonal gonadal changes has been done mainly with regard to oysters and a few other Pelecypods. There is little information on *Parreysia favidens*. Patil and Bal (1967) have worked on seasonal gonadal changes in adult freshwater mussel, *Parreysia favidens* Var. *marcens* collected from the Mula river, Kirkee (Poona). Patil and Bal (1976) also studied the seasonal changes in chemical composition of the freshwater mussel *Parreysia favidens* Var. *marcens* (Benson). Most of the studies on sex and seasonal gonadal changes have been made in relation to oysters *Venus mercenaria*. Bloomer (1930, 1931, 1934, 1935 and 1939) made observations on *Lamellidens marginalis* and *Anodonta cygnea* in respect of sex and gonadal changes. Agrawal (1980) made some collections from Gwarighat located near Jabalpur and studied the seasonal variation in the gonads of *Indonaia caerulea* (Lea).

Bloomer (1930) made note on the sex of *Anodonta cygnea* collected from

Bracabridge pool, Sutton Park. Healy and Lester (1991) worked on sperm ultrastructure in the Australian oyster *Saccostrea commercialis* (Iredale and Ronglley) collected from rocks and jelly pylons at Donnybrook (Pulmicestone Passage) southern Queensland. Bauer (1987) worked on reproductive strategy of the freshwater pearl mussel *Margaritifera margaritifera*. According to the available literature (Hendelberg 1961, Smith, 1979) the pearl mussel was reported to be dioecious. Morton (1982, 1986) worked on some aspects of the population structure and sexual strategy of *Corbicula fluminalis* (Bivalvia ; Corbiculacea) from pearl river of Peoples Republic of China.

In the present study, the reproductive capacity, fecundity and development of gonads, particularly ovaries of *Parreysia favidens*, collected from Burhi Gandak of Siuri Ghat of Kosi river of North Bihar have been worked out.

MATERIALS AND METHODS

The live specimens of *Parreysia favidens* were collected by Ekamn dredge from the river Burhi Gandak at Siuri Ghat from 3' to 5' depth in water and kept in aquaria containing sand and tap water in the laboratory for a fortnight. They were fed with live Plankton twice in a week. For experimental purpose, the live animals were exposed in normal saline and the ovarian tissue was dissected out and fixed in "aceto-alcohol" overnight and then transferred to 70% alcohol. After fixation a small portion of the gonadal tissue was taken on a slide. If the tissue became hard and stiff the tissue was dipped into N/10 HCl for 20 to 30 seconds. After this the tissue was teased and isolated from the connective tissue and other interstitial substances that might have been present. The tissue was taken and put into the acetocarmine solution.

The macerated tissue was placed on a slide and covered with a thin glass cover-slip and was gently tapped with finger tips. The germ cells of the ovary got segregated. The margins of the cover slip was then sealed by nail polish or sealing wax.

The squash preparation of ovaries was then studied under light microscope, the diameter of ova was measured with the help of ocular and stage micrometers (in μm) under high magnification. There were many ova of different sizes.

Fecundity : The number of ova or eggs present in the ovary of one species or individual is called fecundity. In other words, fecundity implies (i) the power of individual to multiply ; (ii) capacity to form reproductive element ; (iii) the number of eggs produced by an individual or a species.

A total of six live animals were used. The ovaries along with the mesenteries of

each animal were dissected out. The weight of the ovarian mass was taken and discharged into 3ml of distilled water. The suspension was made homogeneous and sieved through a metallic net or mesh (size 160 μm) to exclude the unwanted tissues. A pinch of eosin powder was added to stain the ova present in the suspension. The stained suspension was taken in RBC counting chamber of Neubauer slide with the help of a pipette and the counting was done at 400 fold magnification. For each animal the counting of ova was made in 5 small squares on a diagonal line for 5-times (RBC counting chamber has 25 small squares). The ova gave an average count of ova in 0.1 mm^2 volume (0.1 μl) of media. Mean count was obtained from average counts from 6 animals.

The data generated from these counts were arranged in three groups and then averaged (group average). The average value being the mean count of ova present in 1 ml of preparation whereas the sum of three groups was the total number of ova present in 3ml of suspension of the whole ovary. From the mean values of ova of all animals the average value of mean count of ova/animal was determined.

RESULTS

The sexes are separate in *P. favidens*.

The smallest sized ova were found in the month of August to December, 0.0-75 μm (about 94%). During the months of April to July, the largest size of ova were encountered (Fig. 1). The results were compiled and the percentage frequencies of different size categories were tabulated. The values vary in different months of the year (Table-1).

With gradual increase in temperature of the atmosphere and water during February and March, the ova gained in size and were in the size range of 0.75 and 1.50 to 2.25 μm diameter. During the month of April the smallest size of ova found were ; 0.075 μm 33%, 1.50 μm 43%, 2.25 μm 16% and the 3.00 μm 8%. With gradual increase in temperature of the atmosphere as well as water in the month of May, the ova of different sizes were observed viz. 0.0-75 μm (1.0%), 1.50 μm —(10%), 2.25 μm —(20%), 3.00 μm —(30%) and the 3.75 μm —(19%), 4.50 μm —(11%) and 5.25 μm —(9%) the largest size of ova.

During the months of May and July the ova start increasing in their volume. Therefore, the average frequency of enlarged size ova was evident in May and July. This increase in volume was quite naturally due to the accumulation of yolk, fat, etc. in the

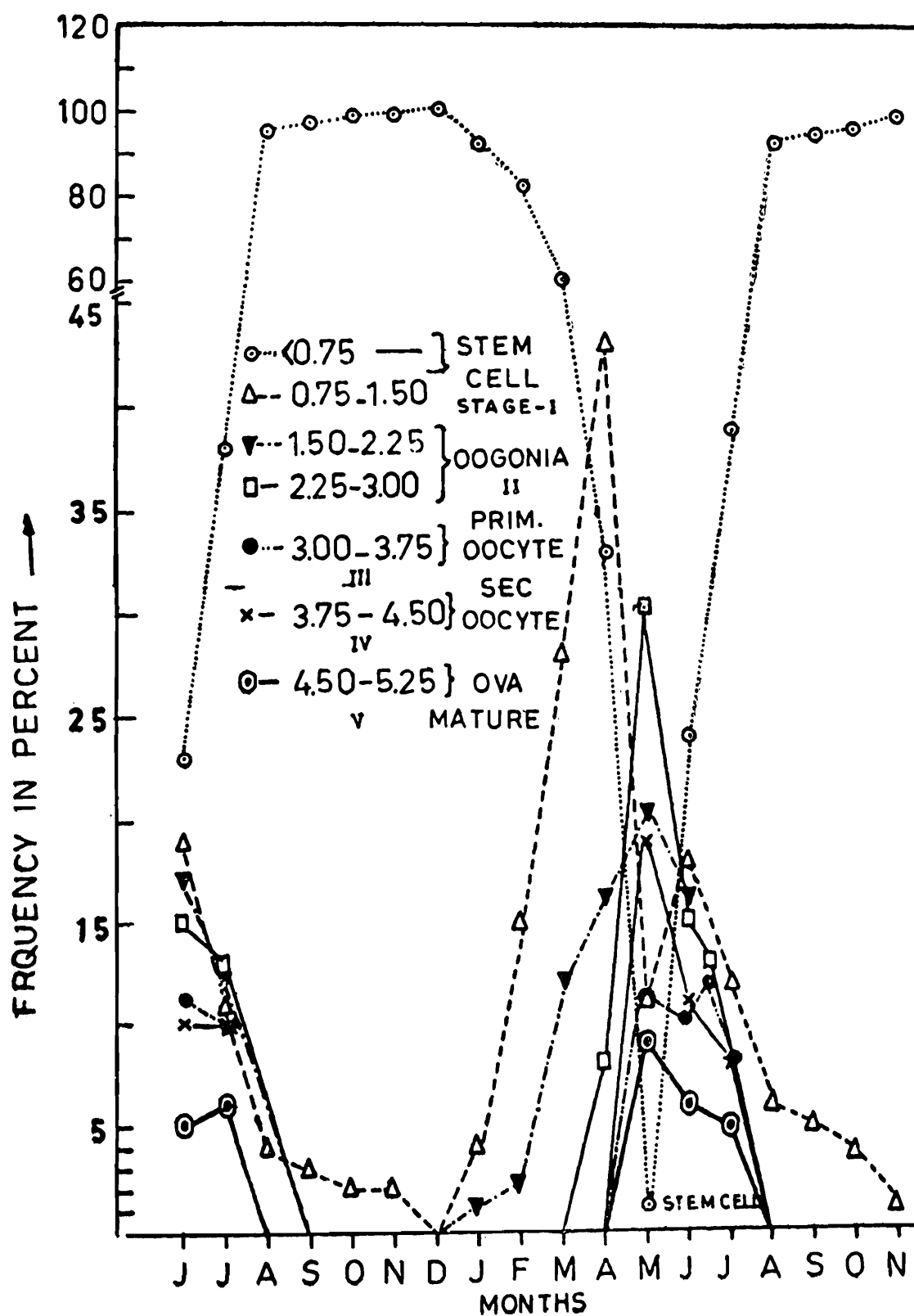


FIG.1

Fig. 1: Graph showing monthly variation in the Frequency of different size groups of *Parreysia favidens* during June'93-November, 1994.

cytoplasm of matured ova. The sizes observed in June were 0.075 μm —(23%), 1.50 μm —(19%), 2.25 μm —(17%), 3.00 μm —(15%), 3.75 μm —(10%), 4.50 μm —(11%) and the 5.25 μm —(5%). In the month of July the ova were observed to be 0.075 μm —(38%), 1.50 μm —(11%), 2.25 μm —(12%), 3.00 μm —(13%), 3.75 μm —(10%), 4.50 μm —(10%) and the 5.25 μm —(6%). After the release of the matured ova by the end of May and July, the ovary was left out with only small sized ova (stem cells). (Table-1).

Like all germ tissues in the present investigation, there as stem cell population which proliferates to produce a new crop of stem cells plus the maturing ova. As such, the smallest sized ova were present during the whole year which represent the stem-cell population. The maturing intermediate cells (Oogonia, primary oocyte, secondary oocyte etc.) were variable during April to July. By the end of July the mature cells were ready to be fertilized (Fig. 1).

DESCRIPTION OF THE MORPHOLOGY OF OVA AT DIFFERENT STAGES OF MATURITY

Five stages of development of ova were observed : PLATE-I (Figs. 1-6)

Stem Cells : The stem cell population is present throughout the year. Upon division it produces two daughter cells, one of which remains as stem cell. The other daughter cell undergoes differentiation to produce mature ova after passing through intermediate stages of oogenesis.

The stem cells were observed as very-minute bodies having poorly distinct nucleus and scanty cytoplasm. Usually circular in outline, but sometimes oval or ellipsoidal stem cells were also observed.

Intermediate I Stage : The ovum of this stage was very small. It is surrounded by vitelline membrane. The cytoplasm is almost clear with small yolk granules and a nucleus.

Intermediate II Stage : The ova of this stage appeared to have an external semi-transparent vitelline membrane of slightly wavy nature. This coat is separated from the egg by perivitelline space. Cytoplasm of the ovum is full of yolk particles. The anterior region of the ovum had a poorly distinct nucleus with chromatin network. Dispersed in the internal "medullary" portion of the ovum were seen a few yolk/fat granules and droplets.

The "cortical region" of the stage II was not traceable. It was quite likely that

the "cortical region" might be temporary stage of the raw materials which was consumed during vitellogenesis.

Intermediate III stage : It represents a dividing stage of ovum with perivitelline membrane. A nucleus was often present in the centre of the cell which was circular in outline. Very small yolk particles in granular form were fairly present. Bifurcation of the shell takes place at this stage.

Intermediate IV stage : In this stage the mature ovum is seen with rod-shaped particles and yolk granules. The egg is surrounded by a semi-transparent gelatinous sheath of slightly fibrous nature.

Stage V : The large sized end cells were encountered in cell population.

A full mature ovum was fairly of large size and was developing into a larva with shell and adductor muscle. A well developed glochidium larva is surrounded by shell valves with adductor muscle and byssus thread.

April to July is the breeding season of *P. favidens*. In the last week of July one to two size groups of the matured ova are discharged. During this period the gills become thickened, hundreds of eggs are discharged in the mantle cavity of the body and are carried through the ostia into water-tubes of the outer and inner gill lamina.

TABLE-2

Distribution of Ova count in the Ovary Suspension (3ml of water) of *Parreysia favidens*

S. No.	Weight of the Ovary (In mg)	Mean Count of Ova (Y) (In 0.1 ul)	$Y \times 10^4$ (in 1 ml)	Total Count in 3 ml	Standard Deviation	Standard Error
1	100	109.6666	1096666	3290000	13.57699	9.60035
2	180	100.0000	1000000	3000000	13.89244	9.82644
3	175	111.3333	1113333	3340000	12.8582	9.09212
4	120	177.6666	1776666	5330000	42.35957	29.95274
5	100	115.3333	1153333	3460000	19.29594	13.64429
6	90	99.6667	996667	2990000	14.74222	10.42433
Grand Total			118944	3568333	294478.1	131694.6

They are held by the mucous secretion of gills and are then fertilized by sperms. The fertilized eggs are retained in the gills which develop into the glochidium larva. The outer and inner gill lamina get greatly enlarged due to the accumulation of a large number of embryos. The gills act as breeding pouches "marsupia". For housing the fertilized eggs remarkable changes take place in the gills structure (Munshi and Pandey, 1991). Females are easily recognized at this stage by the swollen appearance of their outer gill plates.

Glochidia remain entangled by their "byssus thread" and are nourished with the mucous secreted by the gills which act as brood pouches. When sufficiently mature, they come out through exhalant siphon into the water where they slowly sink to the bottom or get scattered by water current.

The data generated from counts were arranged in three groups and then averaged (group averaged); the average value is the mean count of ova present in 1 ml of preparation, whereas the sum of three groups is the total number of ova present in 3 ml of suspension of the whole ovary. Then from the results of combined mean values of all animals the average of ova produced by one individual was computed.

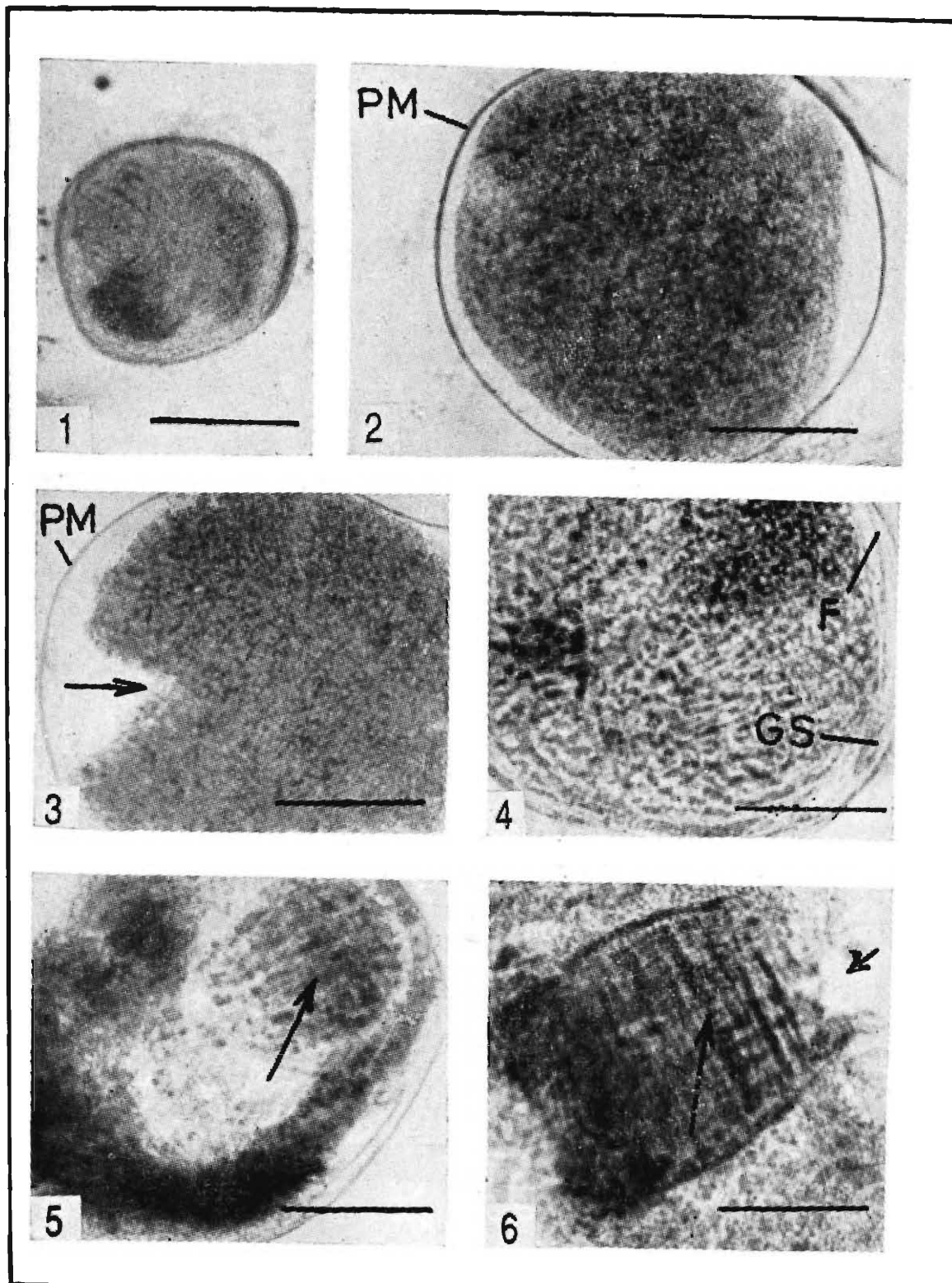
The total count of ova produced per animal was 3568333 S.E. ± 1.31694 . (Table-2).

DISCUSSION

According to Bloomer (1931) the follicles show the presence of globules in *Lamellidens marginalis*. Patil and Bal (1967) observed the seasonal gonadal changes in adult mussels. The spawning starts in the month of March and continues up to October indicating a prolonged breeding period. After the starting of spawning, lipid globules appear in the lumen of the follicles. In the male, spermatid *morulae* appeared in male individuals during the breeding season, no indeterminate sex condition or hermaphroditism was noticed. The sexually inactive stage (resting stage) was very short. In the present work the reproductive capacity and fecundity of *Parreysia favidens* were determined. Patil and Bal (1976) have found seasonal variation of chemical components of ovary of *Parreysia favidens*. Proteins, glycogen and lipid and inorganic constituents vary in different seasons. These variations were correlated with the gonadal changes of the mussel.

Agrawal (1980) observed in the gonads of *Indonaiia caerulea* (Lea) partial spawning in the month of March that gradually rose till July and August. The

PLATE I



Figs. 1 : Fertilised ovum with nucleus, vitelline membrane and very small yolk granules. 2 : Larger stage of ovum with cytoplasm full of yolk particles enclosed within perivitelline membrane (PM). 40×4. 3 : Dividing stage (arrow) of ovum with perivitelline membrane 40×4. 4 : Showing mature ovum with condensed fibrilleae and yolk granules. The egg is surrounded by a semi-transparent gelatinous sheath (GS) of fibrous (F) nature. 40×4. 5 : Small developing larva with arrow shell and adductor muscle. 40×4. 6 : Developing glochidium larva with byssus thread (BT) (arrow) and shell with adductor muscles (arrow). 40×4.

* bar=500 μm

species is considered to be a continuous breeder throughout the year, having a peak of spawning in the months of October and November. After the onset of spawning lipid globules appear in the lumen of the follicles. The spermatocytic *morulae* appeared after the start of the spawning.

Bauer (1987) postulated reproductive strategy of long extended period of reproduction in the freshwater pearl mussel, *Margaritifera margaritifera*. Due to the extended reproductive period populations are less vulnerable to fluctuations of environmental condition. The high fertility was independent of age and absence of a postreproductive period, resulting in a single female producing 200×10^6 glochidia during its reproductive life span of 75 years.

The breeding season of *P. favidens* is similar to the findings of Nagabhushanam and Bidarkar (1990).

The breeding season in *P. favidens* falls between April to July as shown by size frequency study of ovaries. It may be concluded that the months of April to July comprise the breeding season of mussel, *P. favidens*. The spawning takes place during the last week of May and is continued till first week of July.

SUMMARY

The reproductive cycle of a freshwater bivalve *Parreysia favidens* (Benson) of Kosi river has been investigated by determining the frequency percentage of different size ova present in the ovary in different months of the year.

In December the ova were of very small size (0.0-0.75 μ m). They increased in size from February onwards. Three size groups of ova were encountered of which 15% were in the size range of 0.75-1.50 μ m. In April four size groups of ova were encountered of which 6.7% ova were in the range of 2.25-3.00 μ m. In May seven size groups of ova were found of which 13% were in the size range of 2.25-3.00 μ m, and 19.5% were in the size range of 3.00-3.75 μ m. The largest sized ova were in the range of 4.50-5.25 μ m. The small size groups of ova were in the range of 0.0-0.75 μ m.

An individual animal with body weight 30.1g and having ovary mass of 120 mg produces 53,30,000 (Fifty three Lakh and thirty thousand) ova.

April to July is the breeding season of *P. favidens*. In the last week of July the mature ova are discharged. During this period the gills become thickened, thousands of eggs are discharged in the mantle cavity of the body and are carried through

the ostia into water-tubes of the outer and inner gill laminae. The fertilized eggs are held by mucus secreted by gills which develop into the Glochidium larvae.

Key words : Reproductive cycle, *Parreysia favidens*.

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**A NOTE ON SOME OF THE SCHEDULED MAMMALS FROM THE SEMI-ARID
HABITATS ADJACENT TO THE BACKWATERS OF UJANI
WETLAND IN MAHARASHTRA STATE**

Pune district is represented by some of the most interesting and important mammalian fauna like leopard, wolf, blackbuck, gazelle, giant squirrel etc. However, mammalian fauna from the plains of eastern side is different from that of the hilly western tracts of the district. Ujani wetland is on the plains and the mammalian fauna is, naturally, different from that of the western side. Due to importance of the region it was decided to undertake the survey of the mammalian species of this region.

Ujani wetland is formed due to the construction of a dam across Bhima river near Bhimanagar in Pune Dist. The waterspread area of the dam is about 62 sq. kms. The reservoir forms border for Pune, Ahmednagar and Sholapur districts in Maharashtra State. Before construction of the dam, the region was coming under semi-arid zone with very less rainfall. There was no forest cover and it was all dry eariler. After construction of the dam, the surrounding area is being utilized for agricultural purpose with the predominance of sugarcane crop. However, as one goes farther from the dam, one notices the same semi-arid ecology of the past in the adjacent areas of Pune, Ahmednagar and Sholapur districts. Hence, the mammalian fauna of this region has remained the same even after construction of the dam. Some of the important mammalian species reported from the region are given in Table 1.

TABLE 1 : Some of the important mammalian species

Sl. No.	Common Name	Scientific Name
1.	Leopard or Panther	<i>Panthera pardus</i> (Linnaeus)
2.	Desert Cat	<i>Felis silvestris</i> Forster
3.	Common mongoose	<i>Herpestes edwardsi</i> (Geoffroy)
4.	Striped Hyaena	<i>Hyaena hyaena</i> (Linnaeus)

5.	Wolf	<i>Canis lupus</i> Linnaeus
6.	Jackal	<i>Canis aureus</i> Linnaeus
7.	Indian Fox	<i>Vulpes</i> spp.
8.	Smooth Indian Otter	<i>Lutra perspicillata</i> I. Geoff.
9.	Indian porcupine	<i>Hystrix indica</i> Kerr
10.	Indian Hare	<i>Lepus nigricollis</i> F. Cuvier
11.	Indian Gazelle or Chinkara	<i>Gazella bennettii</i> (Sykes)
12.	Indian Antelope or Blackbuck	<i>Antelope cervicapra</i> (Linnaeus)

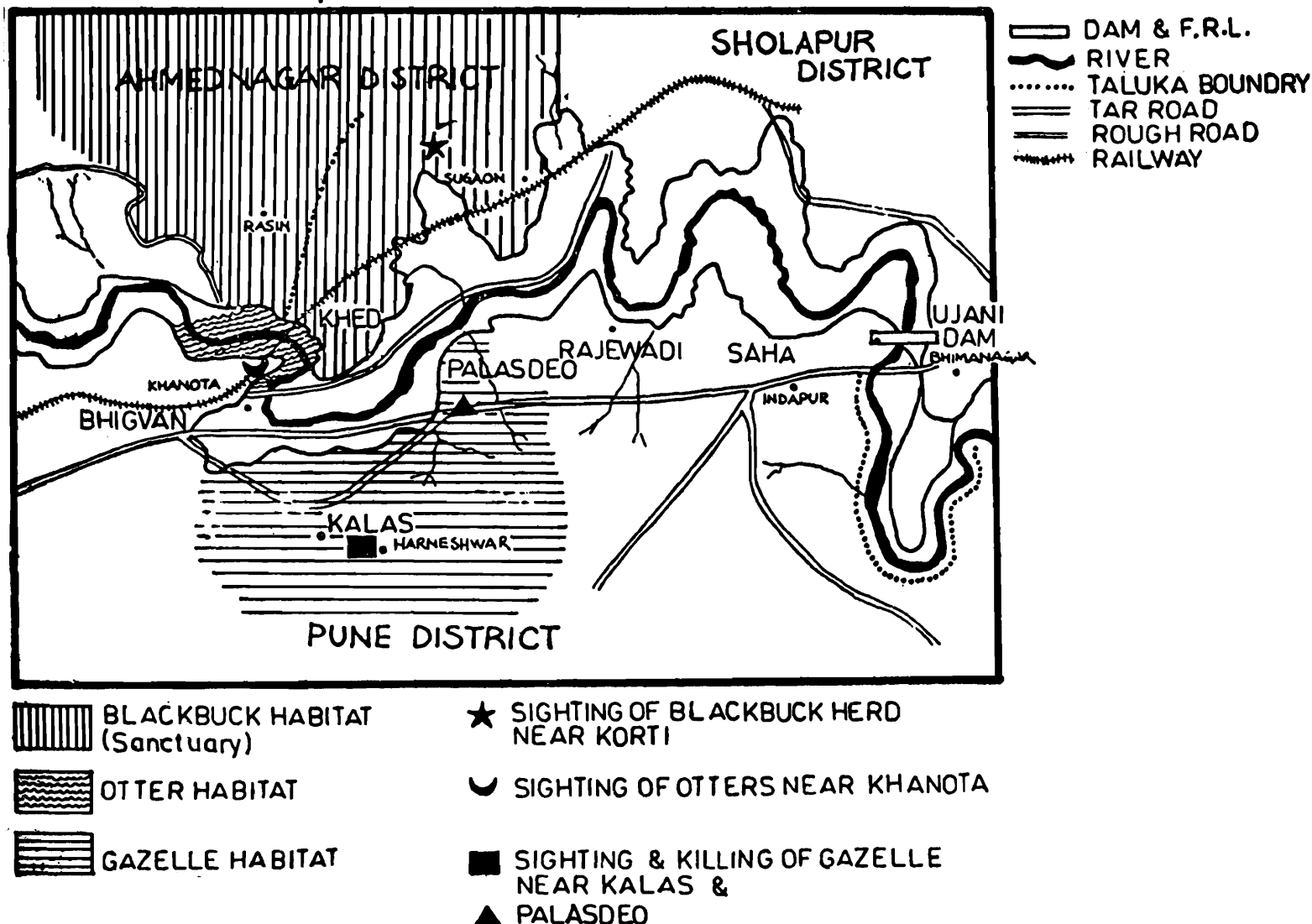
As per the earlier reports, blackbuck, gazelle and otter are the resident species of this region, while most of the other species like leopard, wolf, cat, hyaena, jackal etc. are migratory populations. They undertake migration as per the availability of food. The region is already supposed to be vitally important for 160 avian (Bharucha and Gogte, 1990) and 42 fish (Yazdani and Singh, 1990) species. Apart from preparing the list of important mammalian fauna (Table 1) during the surveys of Ujani wetland, it was also decided to record observations on some of the scheduled mammalian species, namely, blackbuck, gazelle and otter. The species-wise account is as follows,

(A) Smooth Otter (*Lutra Perspicillata* I. Geoffroy) :

Bharucha and Gogte (1990) have reported occurrence of otters in Ujani waters. The otters were, in fact, trapped in the fishing nets set near Khanota. However, they escaped by tearing the nets. Torn nets with damaged fish specimens were shown by the local fishermen during the survey undertaken in Sept. 1990. Snatching of fishes by otters is quite natural as fish forms a delicacy for them. Otter population appears to be taking shelter in the bushy forested and unapproachable areas near Khanota and Khed. (See Map). Fishing is almost impossible due to the wild growth of these bushes. One can easily see large-sized fishes and freshwater turtles in the water under the bridge near Rajegaon Farm. The fish fauna is rich and includes fish species like *Rhinomugil corsula*, *Channa* spp., *Labeo* spp., *Labeo* spp., *Catla* spp., *Mastacembalus* spp. etc. (Pradhan and Singh, 1984 & Yazdani and Singh, 1990). Thus, the habitat around Khanota and Khed is quite appropriate for the growth of the otter population. The otters appear to be undertaking local migrations also, because they have been sighted at different places in different seasons by various authorities. At the time of the survey undertaken by

the ZSI survey party in Sept. 1990 the otter population had shifted to the upper parts of Bhima river near Shirur, since the reservoir was full to its capacity. However, protection and growth of the natural habitat near Khanota may restrict its local migrations and otter population may concentrate in this favourable habitat. Hence, it is strongly recommended that every attempt must be made to restore the habitat and give full protection to the existing otter population.

Map of Bhigwan area of Ujani Wetland showing habitat utilization by some of the scheduled mammalian species



(B) Blackbuck (*Antelope cervicapra* Linnaeus) :

The region between Rasin-Korti-Sugaon belt (See Map) forms a part of Blackbuck and Great Indian Bustard sanctuary in Maharashtra. There were agricultural fields all over the region with predominance of sugarcane crops when the area was surveyed in Sept. 1990. At that time a small herd of blackbucks was observed in the sugarcane fields near Korti. Forest Dept. authorities from Indapur (Pune Dist.) have confirmed recent sighting of a small herd of Blackbucks near Rasin, also, in Oct. 1994. Based on 1989 census the Forest Dept. authorities have reported occurrence of about 3450 blackbucks in the sanctuary area of about 8500 sq. kms. (Indurkar, 1991). The report, however, states that most of the population has concentrated more in a small area near Rehekuri in Ahmednagar Dist. Rehekuri is about seventy five kms. away from the reservoir. The blackbuck populations near Rehekuri are causing serious damage to the standing crops (Indurkar, 1991). In another instance during one of the inspection surveys undertaken earlier in 1987, the author had an opportunity of sighting a small herd of five to six blackbucks in the agricultural fields near Barshi town in Sholapur Dist. Barshi town lies at the distal end of Great Indian Bustard sanctuary. In the light of these observations it appears that the blackbuck populations have started spreading within the sanctuary areas. The spread of blackbuck populations is possibly due to the reduction in the number of its predators like leopard and wolf.

(C) Chinkara or Indian Gazelle *Gazella bennettii* (Sykes) :

At least two gazelles were sighted in June, 1989, on Sholapur highway near Palasdeo by the Zoological Survey of India survey parties. During Sept. 1990 survey local people informed us that there was a population of gazelles in and around Kalas-Harneshwar region which is about ten kms. south of Palasdeo. When surveyed, entire region was found to be semi-arid with patches of scrubby forest spread everywhere. It was an ideal habitat for gazelles. One deer, shot near Harneshwar by a poacher in 1990, was identified as *Gazella bennettii* (Sykes). One more case of a poaching of a gazelle from the same region was registered in Oct. 1994 by the Forest Dept. authorities.

Now, if one takes a careful look at the map, it will be seen that parts of Ujani backwaters and the surrounding landmass serve as an excellent habitat for the most interesting vertebrate fauna which includes scheduled mammalian and reptilian species in addition to the important migratory avian and commercially important fish species. Hence, it is strongly recommended that the entire area should be well protected from habitat destruction and may be declared as a conservation area. Such protection may result in the growth of the multiparous biological diversities in the entire zone.

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AN ACCOUNT OF THE ODONATA OF MAHARASHTRA STATE, INDIA

M. PRASAD

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INTRODUCTION

Order Odonata includes both damsel and dragonflies. Its larvae are aquatic and adults are winged once. Most of the Odonata species are found close to water bodies. Recently Prasad and Varshney (1995) have reported a total of 499 species of Odonata from India. The present paper reports the Odonata of Maharashtra. This study is based on the material present in the National Zoological Collections of the Zoological Survey of India, Calcutta and Pune. Earlier works dealing with Odonata of Maharashtra include Laidlaw (1917, 1919 and 1920), Fraser (1920, 1921, 1924, 1933, 1934 and 1936), Bhasin (1953), Mitra (1986) and Kulkarni and Prasad (In Press).

The present paper reports 46 species and subspecies, belonging to 27 genera under 8 families. The following 10 species/subspecies are reported for the first time here from the Maharashtra State :

1. *Agriocnemis femina* (Brauer)
2. *A. splendidissima* Laidlaw
3. *Lestes elatus* Hagen
4. *Libellago lineata lineata* (Burm.)
5. *Cyclogomphus wilkinsi* Fraser
6. *Cratilla lineata calverti* Foerster
7. *Orthetrum anceps* (Schn.)
8. *Diplacodes lefebvrei* (Rambur)
9. *Tramea limbata similata* (Rambur)
10. *T. virginia* (Rambur)

Taking other earlier reports into account, a total of 83 species and subspecies are thus known from the Maharashtra State. These are listed in an Appendix at the end of paper.

SYSTEMATIC ACCOUNT

Order : ODONATA
Suborder : ZYGOPTERA
Superfamily : COENAGRIONOIDEA
Family : COENAGRIONIDAE
Genus : *Ceriagrion* Selys

1. *Ceriagrion coromandelianum* (Fabricius)

Material examined : 2 ♂♂, Khandala, Pune, 14.12.1980 coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra, Pune (Khandala).

Earlier record : Throughout India, China, Malaysia, Myanmar, Nepal, Pakistan and Sri Lanka.

Genus : *Pseudagrion* Selys

2. *Pseudagrion decorum* (Rambur)

Material examined : 1 ♂, 3 ♀♀, Khanota Village, Indapur, Pune, 5.9.1989, coll. R. M. Sharma.

Distribution :

Present record : Maharashtra ; Pune (Khanota).

Earlier record : Throughout continental India, Myanmar, Nepal and Sri Lanka.

3. *Pseudagrion hypermelas* Selys

Material examined : 1 ♂, 1 ♀, Bordharan, Wardha, 3.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra, Wardha (Bordharan).

Earlier record : India (Bihar, Gujarat, Madhya Pradesh, Maharashtra, Punjab, West Bengal and Western Ghats).

4. *Pseudagrion rubriceps rubriceps* Selys

Material examined : 1 ♀, Noshrapur Village, Pune, 18.11.1965, coll. R. N. Chopra ; 3 ♂ ♂, Pirangut, Pune, 5.8.1966, coll. R. N. Chopra and 2 ♀ ♀, Bordharan, Wardha, 2.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Pune (Noshrapur and Pirangut) and Wardha (Bordharan).

Earlier record : Throughout India, Formosa, Indo-China, Malaysia, Myanmar, Nepal and Taiwan.

Genus : *Aciagrion* Selys

5. *Aciagrion occidentale* Laidlaw

Material examined : 2 ♂ ♂, Saha Village, Pune, 27.8.1988. coll. P. P. Kulkarni.

Distribution :

Present record : Maharashtra, Pune (Saha Village).

Earlier record : South India and Sri Lanka.

Genus : *Ischnura* Charp.

6. *Ischnura aurora aurora* (Brauer)

Material examined : 1 ♂, Khed, Pune, 12.12.1980, coll. G. K. Srivastava ; 2 ♂ ♂, 1 ♀, Warwnad, Buldana, 7.1.1982, coll. A. K. Sanyal ; 1 ♀ ♀ Gondhonkher, Buldana, 10.1.1982, coll. A. K. Sanyal and 6 ♂ ♂, 1 ♀ ♀, Harsul, Aurangabad, 12.1.1982. coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra, Pune (Khed), Buldana (Gondhonkher and Warwand) and Aurangabad (Harsul).

Earlier record : Throughout India, Australia, Indonesia, Malaysia, Myanmar, Nepal, New Guinea, Papua, Philippines, Sri Lanka and Sondaic Archipelago.

7. *Ischnura senegalensis* (Rambur)

Material examined : 1 ♂, 1 ♀, Lone near Mula Mutha River, Pune, 13.12.1980, coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra, Pune (Lone).

Earlier record : Throughout India, Africa, Indonesia, Japan, Malaysia, Myanmar, Philippines and Sri Lanka.

Genus : *Agriocnemis* Selys

8. *Agriocnemis femina* (Brauer)

Material examined : 1 ♂, Shivajinagar, Pune, 14. 5. 1962, coll. B. K. Haldar.

Distribution :

Present record : Maharashtra, Pune (Shivajinagar).

Earlier record : India (Assam, West Bengal and South Andaman Islands), Annam, China, Indonesia Lombok, Myanmar, North Celebes, Philippines, Singapore, and Sri Lanka.

Remarks : It is recorded for the first time from Maharashtra,

9. *Agriocnemis pygmaea* (Rambur)

Material examined : 1 ♀, Colaba, Poddipur, 4. 12. 1980, coll. G. K. Srivastava ; 1 ♂, 2 ♀ ♀, Khed, Pune, 12. 12. 1980, coll. G. K. Srivastava, 5 ♂ ♂, 2 ♀ ♀, Thane, Kalyan, 4. 1. 1981, coll. G. K. Srivastava ; 3 ♂ ♂, 2 ♀ ♀, Thane, Kalyan, 5. 1. 1981, coll. G. K. Srivastava ; 1 ♂, Warwadi, Buldana, 7. 1. 1982, coll. A. K. Sanyal ; 1 ♂, 2 ♀ ♀, Gondhokher, Buldana, 10. 1. 1982, coll. A. K. Sanyal ; 1 ♂, 1 ♀, Harsul, Aurangabad, 12. 1. 1982, coll. A. K. Sanyal and 2 ♂ ♂, Ellora, Aurangabad, 14. 1. 1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Kalyan (Thane) Aurangabad (Ellora and Harsul), Buldana (Gondhonkher and Harsul). Warwnad, Colaba (Polddipur) and Pune (Khed).

Earlier record : Throughout India, Afghanistan, Australia, Bangladesh, China, Hongkong, Indonesia, Japan, Kampuchea, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Papua, Seychelles, Singapore, Sri Lanka, Taiwan and Thailand.

10. Agriocnemis splendidissima Laidlaw

Material examined : 1 ♂, 1 ♀, Thane, Kalyan, 4. 1. 1981, coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra ; Kalyan (Thane).

Earlier record : India (Madhya Pradesh, South India and West Bengal).

Remarks : It is recorded for the first time from Maharashtra.

Family : PLATYCNEMIDIDAE

Genus : Copera Kirby

11. Copera marginipes (Rambur)

Material examined : 2 ♂ ♂, 2 ♀ ♀, Lone, Pune, 13. 12. 1980, coll. G. K. Srivastava ; 3 ♀ ♀, Khandala, Pune, 14. 12. 1980, coll. G. K. Srivastava ; 3 ♂ ♂, Hinghui, Wardha, 4. 1. 1982, coll. A. K. Sanyal ; 2 ♂ ♂, 1 ♀, Wanravira, Wardha, 5. 1. 1982, coll. A. K. Sanyal and 3 ♂ ♂, Gondhonkher, Buldana, 10. 1. 1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra ; Buldana (Gondhonkher), Pune, (Khandala and Lone) and Wardha (Hinghui and Wanravira).

Earlier record : India (Assam, Bihar, Chandigarh, Madhya Pradesh, Maharashtra, Rajasthan, South Andaman Islands, West Bengal, Western Ghats and Western Himalaya), Indonesia, Malaysia, Myanmar, Nepal, Sri Lanka and Thailand.

Family : PROTONEURIDAE

Genus : Disparoneura Selys

12. Disparoneura quadrimaculata (Rambur)

Material examined : 1♂, Ambe Nali near Pratapgarh, Satara, 29. 5. 1976, coll. B. K. Tikader.

Distribution :

Present record : Maharashtra : Satara (Ambe Nali).

Earlier record : India (Central India, Delhi, Uttar Pradesh and Western Ghats).

Superfamily : LESTOIDEA

Family : LESTIDAE

Genus : Lestes Leach

13. Lestes elatus Hagen

Material examined : 1♂, Kaiga near Malhapur, 4. 1. 1972, coll. S. K. Gupta.

Distribution :

Present record : Maharashtra : Malhapur (Kaiga).

Earlier record : India (Karnataka, Orissa and Peninsular India) and Sri Lanka.

14. Lestes Viridulus Rambur

Material examined : 2 ♀ ♀, Chinchani, Satara, 14. 1. 1972, coll. K. S. Pradhan.

Distribution :

Present record : Maharashtra : Satara (Chinchani)

Earlier record : Throughout India and Thailand.

Superfamily : CALOPTERYGOIDEA

Family : CHLOROCYPHIDAE

Genus : *Libellago* Selys

15. *Libellago lineata lineata* (Burmeister)

Material examined : 2♂♂, Lone, Mula Mutha river bank, Pune, 13.12.1980, Coll. G. K. Srivastava ; 2♂♂, Hinghui, Wardha, 4.11.1982, Coll. A. K. Sanyal and 4♂♂, Wanravira, Wardha, 5.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra, Pune (Lone), Wardha (Hinghui and Wanravira).

Earlier record : India (Andaman Islands, Assam, Meghalaya, North India and West Bengal), Indonesia, Penang, Thailand and throughout Sundaic Archipelago.

Remarks : It is recorded for the first time from Maharashtra.

Suborder : ANISOPTERA

Superfamily : AESHNOIDEA

Family : COMPHIDAE

Genus : *Cyclogomphus* Selys

16. *Cyclogomphus wilkinsi* Fraser

Material examined : 1♂, Moshi, Pune, 6.10.1966, coll. B. S. Lamba.

Distribution :

Present record : Maharashtra : Pune (Moshi).

Earlier record : India (Karnataka).

Remarks : It is recorded for the first time from Maharashtra.

Genus : Macrogomphus Selys

17. Macrogomphus annulatus (Selys)

Material examined : 1 ♂, University Campus, Pune, 14.8.1964, coll. B. K. Haldar and 1 ♀ University Campus, Pune, 18.8.1964, coll. B. K. Haldar.

Distribution :

Present record : Maharashtra : Pune (University Campus).

Earlier record : India (Maharashtra).

Genus : Paragomphus Cowley

18. Paragomphus lineatus (Selys)

Material examined : 1 ♂, Kalyan River, Mahabaleshwar, Satara, 19.1.1965, coll. B. S. Lamba and 1 ♂, 2 ♀ ♀, Moshi, Pune, 6.10.1966, coll. B. S. Lamba.

Distribution :

Present record : Maharashtra : Pune (Moshi) and Satara (Kalyan River).

Earlier record : India (Bihar, Haryana, Himachal Pradesh, Maharashtra, Meghalaya, Orissa, Sikkim, South India, Uttar Pradesh, and West Bengal), Myanmar and Nepal.

Genus : Ictinogomphus Cowley

19. Ictinogomphus rapax (Rambur)

Material examined : 1 ♂, Saha Village, Indapur, Pune, 22.8.1988, coll. P. P. Kulkarni, 1 ♂, Khanota Village, Indapur, Pune, 5.9.1989, coll. R. M. Sharma and 1 ♂, Old Bhigwan, Indapur, Pune, 22.9.90, coll. R. M. Sharma.

Distribution :

Present record : Maharashtra : Pune, (Old Bhigwan, Khanota and Saha Village, Indapur).

Earlier record : Throughout India, Malaysia, Myanmar, Nepal and Sri Lanka.

Family : AESHNIDAE

Genus : Anax Leach

20. Anax guttatus (Burmeister)

Material examined : 1 ♀ University Campus Pune, 3.7.1975, coll. C. B. Prasad.

Distribution :

Present record : Maharashtra : Pune (University Campus).

Earlier record : Throughout India, Indonesia, Malaysia, Micronesia, Myanmar, Nepal, North Australia, Samoa Island, Seychelles, Sri Lanka and Taiwan.

21. Anax immaculifrons Rambur

Material examined : 1 ♂, Sinha Gad fort, Pune, 3.6.1965, coll. B. K. Tikader and 1 ♀, old Bhigwan Village, Indapur, Pune, 22.9.1990, coll. M. S. Pradhan.

Distribution :

Present record : Maharashtra : Pune (Bhigwan Village and Sinha Gad).

Earlier record : India (Bihar, Chandigarh, Eastern Ghats, Maharashtra, Sikkim, West Bengal and Western Himalaya), British Isles across to Europe, Central Asia and Southwards to Central Africa and North Morocco,

Family : LIBELLULIDAE

Genus : Cratilla Kirby

22. Cratilla lineata calverti Foerster

Material examined : 1 ♀, Moshi, Nasik, 26.9.1973, coll. M. B. Rao.

Distribution :

Present record : Maharashtra : Nasik (Moshi).

Earlier record : India (Orissa, Uttar Pradesh and Western Ghats), Indonesia, Malaysia, Myanmar, New Guinea, Philippines, Sri Lanka and Sundaic Archipelago,

Remarks : It is recorded for the first time from Maharashtra.

Genus : Orthetrum Newman

23. Orthetrum anceps (Schneider)

Material examined : 1 ♂, Lonewala, Pune, 16.10.1965, coll. B. S. Lamba and 1 ♂, Vadgaon Village, Pune, 11.5.66, coll. B. S. Lamba.

Distribution :

Present record : Maharashtra : Pune (Lonewala and Vadgaon Village).

Earlier record : India (Himachal Pradesh), Asia Minor, North African Coast, Pakistan and Persia.

Remarks : It is recorded for the first time from Maharashtra.

24. Orthetrum glaucum (Brauer)

Material examined : 1 ♂, Lonewala, Pune, 9.11.1963, coll. B. K. Tikader.

Distribution ;

Present record : Maharashtra : Pune (Lonewala).

Earlier record : Throughout India, Indonesia, Malaya Archipelago Nepal, Papua, Philippines, Sri Lanka and South China.

25. Orthetrum pruinosum neglectum (Rambur)

Material examined : 1 ♂, Lone near Mula Mutha River bank, Pune, 13.12.1980, coll. G. K. Srivastava ; 1 ♂, 1 ♀ Matheran, Colaba, 17.12.1980, coll. G. K. Srivastava ; 1 ♀, Ambenali, Satara, 21.12.1980. coll. G. K. Srivastava, and 1 ♂, Hinghui, Wardha, 4.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Colaba (Matheran), Satara (Ambenali), Pune (Lone) and Wardha (Hinghui).

Earlier record : Throughout India, Afghanistan, Bangladesh, China, Hongkong, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam,

26. *Orthetrum sabina sabina* (Drury)

Material examined : 1 ♂, Khed, Pune, 12.12.1980, coll. G. K. Srivastava ; 1 ♂, Lone near Mula Mutha river, Pune, 13.12.1980, coll. G. K. Srivastava and 1 ♂, Osmanabad, 19.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Osmanabad and Pune (Khed and Lone).

Earlier record : Throughout India, Afghanistan, Algeria, Angola, Australia, China, Cyprus, Egypt, Honkong, Indonesia, Iraq, Iran, Israel, Japan, Laos, Malaysia, Micronesia, Myanmar, Nepal, Oman, Papua, Philippines, New Guinea, Qatar, Saudi Arabia, Samoa Islands, Sudan, Singapore, Somalia, Sri Lanka, Taiwan, Thailand, Tunisia, Turkey and Vietnam.

27. *Orthetrum taeniolatum* (Schneider)

Material examined : 1 ♂, Khed, Pune, 12.12.1980, coll. G. K. Srivastava, 1 ♂, Lone near Mula Mutha river, Pune, 13.12.1990, coll. G. K. Srivastava ; 1 ♂, Lingamall Falls, Mahabaleshwar, 23.12.1980, coll. G. K. Srivastava ; 1 ♂, Hinghui, Wardha, 4.1.1982, coll. A. K. Sanyal and 1 ♂, Upla Osmanabad, 19.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Mahabaleswar (Lingamall falls), Osmanabad (Upla), Pune (Khed and Lone) and Wardha (Hinghui).

Earlier record : Throughout India, Nepal and Countries bordering Mediterranean Sea.

Genus : *Potamarcha* Karsch28. *Potamarcha congener* (Rambur)

Material examined : 2 ♀ ♀, Bhokhodhar, Niphod, Nasik, 3.10.1973, coll. M. B. Rao.

Distribution :

Present record : Maharashtra : Nasik (Bhokhodhar).

Earlier record : India (Bihar, Himachal Pradesh, Kerala, Madhya Pradesh,

Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, South Andaman Islands, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal and Western Ghats), Australia, Indonesia, Malaysia, Myanmar, Nepal, Papua, Philippines, Sri Lanka and Taiwan.

Genus : *Acisoma* Rambur

29. *Acisoma panorpoides panorpoides* Rambur

Material examined : 1 ♂, Khandala, Pune, 24. 1. 1966, coll. M. S. Mani.

Distribution :

Present record : Maharashtra : Pune (Khandala).

Earlier record : India (Arunachal Pradesh, Assam, Bihar, Chandigarh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, South India, Uttar Pradesh and West Bengal), China, Indonesia, Japan, Malayan Archipelago, Myanmar, Nepal, Philippines, Singapore, Sri Lanka and Thailand.

Genus : *Brachythemis* Brauer

30. *Brachythemis contaminata* (Fabricius)

Material examined : 1 ♀, Khed, Pune, 12. 12. 1980, coll. G. K. Srivastava ; 2 ♂ ♂, 1 ♀, Lone near Mula Mutha River, Pune, 12. 12. 1980, coll. G. K. Srivastava, 1 ♀, Khandala, Pune, 14. 12. 1980, coll. G. K. Srivastava and 1 ♀, Osmanabad, 17. 1. 1983, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Osmanabad and Pune (Khandala, Khed and Lone).

Earlier record : Throughout India, China, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Taiwan and Thailand.

Genus : *Bradinopyga* Kirby

31. *Bradinopyga geminata* (Rambur)

Material examined : 1 ♂, Ambenali, Satara, 21. 12. 1980, coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra ; Satara (Ambenali).

Earlier record : India (Bihar, Central India, Haryana, Maharashtra, Orissa, Peninsular India, Rajasthan, Uttar Pradesh and West Bengal), Myanmar and Sri Lanka.

Genus : *Crocothemis* Brauer

32. *Crocothemis Servilia Servilia* (Drury)

Material examined : 3 ♂ ♂, Khed, Pune, 12. 12. 1980, coll. G. K. Srivastava ; 1 ♂, Lone, Mulla Mutha River, Pune 13. 12. 1980, coll. G. K. Srivastava, 2 ♀ ♀, Matheran, Colaba, 17. 12. 1980, coll. G. K. Srivastava ; 1 ♂, Lingamall falls, Mahabaleshwar, Satara, 23. 12. 1980, coll. G. K. Srivastava ; 1 ♂, Gondhonkher, Buldana, 10. 1. 1982, coll. A. K. Sanyal and 1 ♀, Upla, Osmanabad, 18. 1. 1982. coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra, : Buldana (Gondhonkher), Colaba (Matheran), Osmanabad (Upla), Pune (Khed and Lone) and Satara (Lingamall falls).

Earlier record : Throughout India, Australia, China, Iraq, Indonesia, Japan, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka and Sundaic Archipelago.

Genus : *Diplacodes* Kirby

33. *Diplacodes lefebvrei* (Rambur)

Material examined : 1 ♀, Hinghui, Wardha, 4. 1. 1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Wardha (Hinghui).

Earlier record : India (Chandigarh, Rajasthan and South India), Africa and Mesopotamia.

Remarks : It is recorded for the first time from Maharashtra.

34. *Diplacodes trivialis* (Rambur)

Material examined : 1 ♀, Lone, Pune, 13. 12. 1980, coll. G. K. Srivastava, 4 ♂♂, Matheran, Colaba, 17. 12. 1980, coll. G. K. Srivastava ; 1 ♂, Old Mahabaleshwar, Satara, 20. 12. 1980, coll. G. K. Srivastava ; 2 ♂♂, Kalyan. Thane, 4. 1. 1981, coll. G. K. Srivastava ; 1 ♂, Thane, 5. 1. 1981, coll. G. K. Srivastava ; 1 ♂, Harsul, Aurangabad, 12. 1. 1982, coll. A. K. Sanyal ; 1 ♀ Chharini, Aurangabad, 12. 1. 1982, coll. A. K. Sanyal ; 3 ♂♂, 1 ♀, Osmanabad, 17. 1. 1982, coll. A. K. Sanyal and 1 ♀, Ellora, Aurangabad, 14. 1. 1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Aurangabad (Chharini, Ellora and Harsul), Colaba (Matheran), Pune (Lone), Satara (Old Mahabaleshwar) and Thane (Kalyan).

Earlier record : Throughout India, Australia, China, Fiji, Hongkong, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Papua, Philippines, New Guinea, Solomon Islands, Seychelis, Sri Lanka, Taiwan, Thailand and Vietnam.

Genus : *Neurothemis* Brauer

35. *Neurothemis fulvia* (Drury)

Material examined : 1 ♂, Law college compound, Pune, 5.10.1961, coll. K. A. Kashid and 1 ♂, Matheran, Colaba, 17.12.1980, coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra : Colaba (Matheran) and Pune (Law college compound).

Earlier record : Throughout India, Australia, China, Hongkong, Indonesia, Iraq, Kampuchia, Laos, Malaysia, Myanmar, Nepal, Philippines, Seychelles, Sri Lanka, Taiwan and Thailand.

36. *Neurothemis intermedia intermedia* (Rambur)

Material examined : 1 ♂, Pune, 5.4.1962, coll. R. N. Chopra.

Distribution :

Present record : Maharashtra : Pune.

Earlier record : Throughout India, Bangladesh, China, Malaysia, Myanmar, Nepal, and Sri Lanka.

37. *Neurothemis tullia tullia* (Drury)

Material examined : 4 ♂ ♂ Kharagvasala, Pune, 17.11.1974, coll. C.B. Prasad.

Distribution :

Present record : Maharashtra : Pune (Kharagvasala).

Earlier record : India (Bihar, Himachal Pradesh, Orissa, South India, Uttar Pradesh and West Bengal), China, Thailand and West Malaysia.

Genus : *Trithemis* Brauer

38. *Trithemis aurora* (Burmeister)

Material examined : 2 ♀ ♀, Khed, Pune, 12.12.1980, coll. G. K. Srivastava ; 1 ♂, Lone, Pune, 13.12.1980, coll. G. K. Srivastava ; 1 ♂, 1 ♀, Ambenali, Satara, 21.12.1980, coll. G. K. Srivastava ; 3 ♀ ♀, Polddipur, Colaba, 21.12.1980, coll. G. K. Srivastava ; 2 ♀ ♀, Bardharan, Wardha, 2.1.1982, coll. A. K. Sanyal ; 2 ♀ ♀, Wanravira, Wardha, 5.1.1982, coll. A. K. Sanyal ; 2 ♂ ♂, 4 ♀ ♀ Rajpur, Buldana, 8.1.1982, coll. A. K. Sanyal and 1 ♂, Upla, Osmanabad, 18.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra : Buldana (Rajpur), Colaba (Polddipur), Osmanabad, (Upla), Pune (Khed and Lone), Satara (Ambenali) and Wardha (Bordharan and Wanravira).

Earlier record : Throughout India, China, Hongkong, Indonesia, Japan, Kampuchea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam.

39. *Trithemis festiva* (Rambur)

Material examined : 1 ♂, Khed, Pune, 12.12.1980, coll. G. K. Srivastava ; 2 ♂ ♂, Khandala, Pune, 14.12.1980, coll. G. K. Srivastava ; 3 ♂ ♂, Matheran, Colaba, 17.12.1980, coll. G. K. Srivastava ; 1 ♂, 1 ♀, Polddipur, Colaba, 21.12.1980, coll. G. K. Srivastava ; 3 ♂ ♂. Lingamall falls, Mahabaleshwar, Satara, 23.12.1980, coll. G. K. Srivastava ; 2 ♂ ♂,

Bordharan, Wardha, 2.1.1982, coll. A. K. Sanyal; 1♂, 1♀, Wanravira, Wardha, 5.1.1982, coll. A. K. Sanyal; 1♂, Rajpur, Buldana, 8.1.1982, coll. A. K. Sanyal and 1♂, Gondhonkher, Buldana, 10.1.1982, coll. A. K. Sanyal.

Distribution :

Present record : Maharashtra, Buldana (Gondhonkher and Rajpur), Colaba (Matheran and Polddipur), Pune (Khandala and Khed), Satara (Lingamall falls) and Wardha (Bordharan and Wanravira).

Earlier record : Throughout India, Afghanistan, China, Cyprus, Hongkong, Indonesia, Iraq, Kampuchea, Laos, Malaysia, Myanmar, Nepal, Papua, Philippines, New Guinea, Singapore, Sri Lanka, Taiwan, Thailand, Turkey and Vietnam.

40. *Trithemis kirbyi kirbyi* Selys

Material examined : 1♂, Pune, 18.11.1961, coll. R. N. Chopra.

Present record : Maharashtra, Pune.

Earlier record : India (Himachal Pradesh, Maharashtra, South India and Uttar Pradesh) and Sri Lanka.

41. *Trithemis Pallidinerivis* (Kirby)

Material examined : 1♂, Sambhaji Park, Pune, 13.5.1961, coll. K. A. Kashid and 1♀, Pune University Campus, Pune, 21.8.1961, Coll. B. K. Haldar.

Distribution :

Present record : Maharashtra : Pune (Shambhaji Park, Pune and Pune University Campus).

Earlier record : Throughout India, Malaysia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Taiwan and Thailand.

Genus : *Rhyothemis* Hagen

42. *Rhyothemis variegata variegata* (Linn.)

Material examined : 1♀, Pune, 23. 11. 1960, coll. M. M. Chatterjee and 1♀, Pune, 5. 4. 1962, coll. R. N. Chopra.

Distribution :

Present record : Maharashtra : Pune.

Earlier record : Throughout India, Malaysia, Myanmar, Nepal and Sri Lanka.

Genus : Pantala Hagen

43. *Pantala flavescens* (Fabricious)

Material examined : 1 ♀, Lane, Mulla Mutha River, Pune, 12. 12. 1980, coll. G. K. Srivastava ; 1 ♀, Khed, Pune, 13. 12. 1980, coll. G. K. Srivastava and 2 ♂ ♂, 1 ♀, Matheran, Colaba, 18. 12. 1980, coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra : Colaba (Matheran) and Pune (Khed and Lone).

Earlier record : Circumtropical and subtropical in distribution : Throughout India, China, Indonesia, Malaysia, Micronesia, Morocco, Myanmar, Sri Lanka and Thailand.

Genus : Tramea Hagen

44. *Tramea basilaris burmeisteri* Kirby

Material examined : 1 ♂, Khandala, Pune, 14. 12. 1980, coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra : Pune (Khandala).

Earlier record : India (Bihar, Central India, Himachal Pradesh, Kerala, Maharashtra, Meghalaya, Nilgiri Hills, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh), Malaysia and Nepal.

45. *Tramea limbata similata* (Rambur)

Material examined : 1 ♂, Kharagvasala, Pune, 18. 9. 1965, coll. R. N. Chopra and 1 ♂, Pune University Campus, Pune, 6. 9. 1967, coll. B. K. Haldar.

Distribution :

Present record : Maharashtra : Pune (Kharagvasala and Pune University Campus).

Earlier record : India (South India), Nepal and Sri Lanka.

Remarks : It is recorded for the first time from Maharashtra.

46. *Tramea virginia* (Rambur)

Material examined : 2 ♂ ♂, Matheran, Colaba, 17. 12. 1980, coll. G. K. Srivastava.

Distribution :

Present record : Maharashtra : Colaba (Matheran).

Earlier record : India (Bihar, Himachal Pradesh, Jammu & Kashmir, Tamil Nadu and Uttar Pradesh), China, Indonesia, Micronesia, Myanmar, South Japan, Taiwan and Thailand.

Remarks : It is recorded for the first time from Maharashtra.

APPENDIX

A CONSOLIDATED LIST OF THE ODONATA OF MAHARASHTRA

Order : ODONATA

Suborder : ZYGOPTERA

Superfamily : COENAGRIONOIDEA

Family : COENAGRIONIDAE

1. *Ceriagrion Cerinorubellum* (Brauer)
2. *Ceriagrion Coromandelianum* (Fabricius)
3. *Ceriagrion Olivaceum* Laidlaw
4. *Pseudagrion decorum* (Rambur)
5. *Pseudagrion hypermelas* Selys
6. *Pseudagrion rubriceps rubriceps* Selys
7. *Cercion malayanum* (Selys)
8. *Aciagrion hisopa-hisopa* Selys
9. *Aciagrion hisopa Krishna* Fraser
10. *Aciagrion occidentale* Laidlaw

11. *Aciagrion pallidum* Selys
12. *Enallagma parvum* Selys
13. *Ischnura senegalensis* (Rambur)
14. *Ischnura aurara aurora* (Brauer)
15. *Agriocnemis femina* (Brauer)
16. *Agriocnemis pieris* Laidlaw
17. *Agriocnemis pygmaea* (Rambur)
18. *Agriocnemis splendidissima* Laidlaw

Family : PLATYCNEMIDIDAE

19. *Copera marginipes* (Rambur)

Family : PLATYSTICTIDAE

20. *Protosticta gravelyi* Laidlaw

Family : PROTONEURIDAE

21. *Disparoneura quadrimaculata* (Rambur)
22. *Elatoneura nigerrima* (Laidlaw)

Superfamily : LESTOIDEA

Family : LESTIDAE

23. *Lestes elatus* Hagen
24. *Lestes umbrinus* Selys
25. *Lestes viridulus* Rambur

Superfamily : CALOPTERYGOIDEA

Family : CALOPTERYGIDAE

26. *Neurobasis chinensis chinensis* (Linn.)

Family : CHLOROCYPHIDAE

27. *Rhinocypha (Heliocypha) bisignata* (Selys)
28. *Libellago lineata indica* (Fraser)
29. *Libellago lineata lineata* (Burmeister)

Suborder : ANISOPTERA

Superfamily : AESHNOIDEA

Family : GOMPHIDAE

30. *Burmagomphus pyramidalis pyramidalis* Laidlaw
31. *Cyclogomphus heterostylus* Selys

- 32. *Cyclogomphus vesiculosus* Selys
- 33. *Cyclogomphus wilkinsi* Fraser
- 34. *Cyclogomphus ypsilon* Selys
- 35. *Macrogomphus annulatus* (Selys)
- 36. *Microgomphus torgatus* (Selys)
- 37. *Microgomphus verticalis* (Selys)
- 38. *Paragomphus lineatus* (Selys)
- 39. *Gomphidia t-nigrum* (Selys)
- 40. *Ictinogomphus rapax* (Rambur)

Family : AESHNIDAE

- 41. *Anax guttatus* (Burmeister)
- 42. *Anax immaculifrons* (Rambur)
- 43. *Hemianax ephippiger* (Burmeister)
- 44. *Gynacantha bayadera* Selys

Superfamily : LIBELLULOLDEA

Family : CORDULIDAE

- 45. *Hemicordulia asiatica* Selys
- 46. *Epothemia frontalis frontalis* Selys
- 47. *Macromia flavicincta* Selys

Family : LIBELLULIDAE

- 48. *Tetrathemis platyptera* Selys
- 49. *Brachydiplax sobrina* (Rambur)
- 50. *Cratilla lineata calverti* Foerster
- 51. *Lathricista asiatica asiatica* (Fobricius)
- 52. *Orthetrum anceps* (Schneider)
- 53. *Orthetrum chrysis* (Selys)
- 54. *Orthetrum glaucum* (Brauer)
- 55. *Orthetrum luzoulcum* (Brauer)
- 56. *Orthetrum pruinsum neglectum* (Rambur)
- 57. *Orthetrum sabina sabina* (Drury)
- 58. *Orthetrum taeniolatum* (Schneider)

59. *Potamarcha congener* (Rambur)
60. *Acisoma panorpoides panorpoides* (Rambur)
61. *Brachythemis contaminata* (Fabr.)
62. *Paopopleura sexmaculata sexmaculata* (Fabricius)
63. *Bradinopyga geminata* (Rambur)
64. *Crocothemis servilia servilia* (Drury)
65. *Diplacodes lefebvrei* (Rambur)
66. *Diplacodes nubulosa* (Fabricius)
67. *Diplacodes trivialis* (Rambur)
68. *Neurothemis fulvia* (Drury)
69. *Neurothemis intermedia intermedia* (Rambur)
70. *Neurothemis tullia tullia* (Drury)
71. *Trithemis aurora* (Burmeister)
72. *Trithemis festiva* (Rambur)
73. *Trithemis kirbyi kirbyi* (Selys)
74. *Trithemis pallidinervis* (Kirby)
75. *Rhyothemis variegata variegata* (Linn.)
76. *Hydrobasileus croceus* (Brauer)
77. *Pantala flavescens* (Fabricius)
78. *Tramea basilaris burmeisteri* Kirby
79. *Tramea limbata similata* (Rambur)
80. *Tramea virginia* (Rambur)
81. *Tholymis tillarga* (Fabricius)
82. *Zyxomma petiolatum* Rambur
83. *Urothemis signata signata* (Rambur)

SUMMARY

A total of 46 species and sub-species of Odonata belonging to 27 genera under 8 families are studied from Maharashtra State, of which 10 are new records for Maharashtra. Notes on the distribution are given under each species and sub-species. An appendix showing a consolidated list of 83 sub-species so far known from Maharashtra is appended.

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NOTES ON THE LARVAL STAGES OF *NEGRITOMYIA ANDAMANENSIS* DAS, SHARMA & DEVROY (DIPTERA, STRATIOMYIDAE)

The present contribution embodies an account of different larval instars (about 7-8) and pupa of *Negritomyia andamanensis* Das, Sharma and Devroy (Diptera, Stratiomyidae) reared on bark of raintree in Andamans. Pupation occurs within the last larval skin and the pupal period lasts 10-15 days.

Recently, Das, Sharma & Devroy (1984) described a new fly *Negritomyia andamanensis* reared from the larvae feeding on the bark of raintree in the Andaman Islands. The communication reports some observations on different larval instars and pupa of this species.

Larval Instars : Though the larvae exhibit considerable diversity of forms, all have a peculiar thick leathery skin, with reticulate texture, impregnated with calcareous matter. The general colour of the larvae is creamy-white. The head is small, exserted and there are 11 trunk segments, none of which bear pseudopods. Peripneustic : only prothoracic and common terminal spiracles are visible in early instars ; the former is brown, conspicuous and located on the dorso-lateral margin (Fig. 2), whereas latter is seen at the middle portion of last abdominal (anal) segment. Sixth instar and onwards four abdominal spiracles are seen on II-V abdominal segments.

The body segments of all the instars bear distinct simple setae. The arrangement of these setae (Fig. 1) is constant on all segments, except the prothoracic and terminal abdominal segments in all the instars. However, as the larvae advance through successive instars the relative sizes and chitinisation of these change progressively and help to identify different instars to some extent. This species possibly passes through 7-8 instars. Differentiation of head structures become significant and prominent in the sixth instar onwards.

The field population of this species shows wide range of instars, present in all seasons. This may be due to lengthy life cycle, the variable rate of development of the larvae and overlapping generations as observed by Hitchcock (1976) in Australian species.

Pupa : Pupation occurs within the last larval skin. It is difficult to distinguish live pupae from larvae. Separation is possible only by observing the specimens closely. Prior to pupation the larvae become immobile, the colour of the larval skin changes from

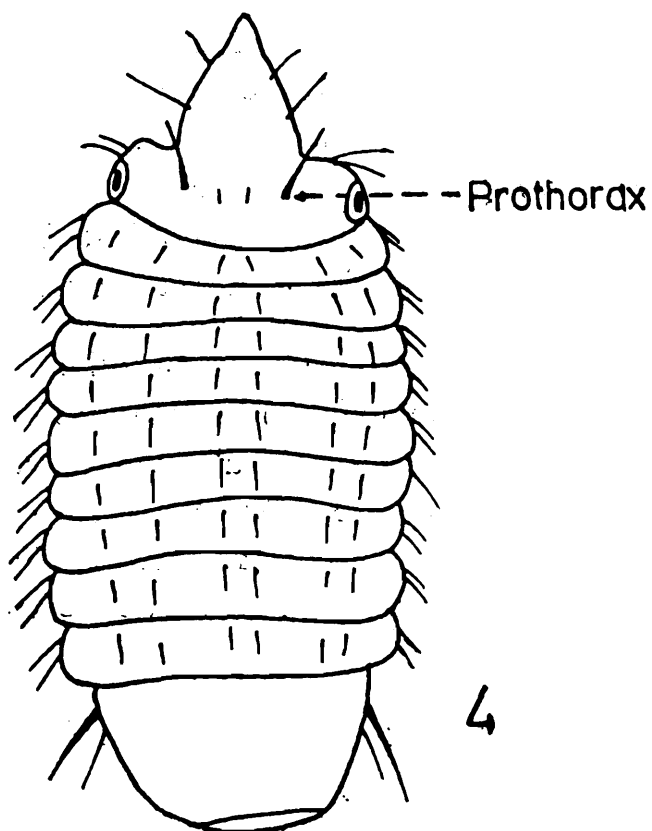
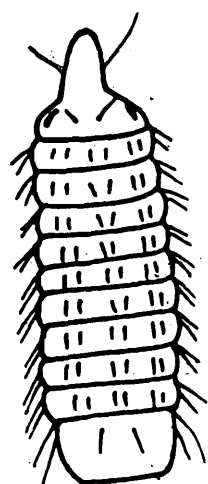
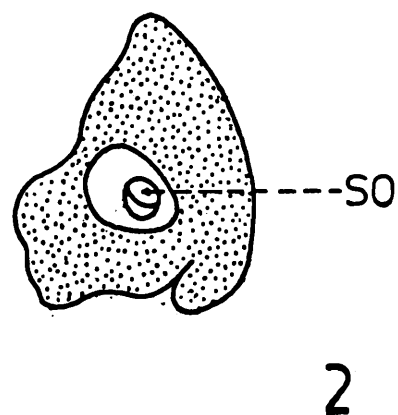
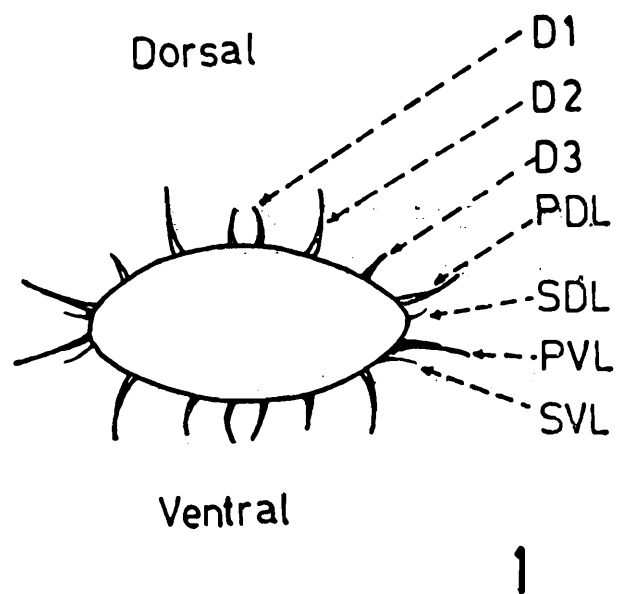


Fig. 1 : Transverse section through a body segment of *Negritomyia* larva showing the arrangement of the setae. (D1, dorsal seta ; D2-D3, medio dorsal setae ; PDL, primary dorso-lateral seta ; PVL, primary ventro-lateral seta ; SDL, secondary dorso-lateral seta ; SVL, secondary ventro-lateral seta).
 Fig. 2 : Prothoracic spiracle, (SO, Spiracular openings) Fig. 3 : Instar I. whole larva (dorsal view)
 Fig. 4 : Instar III. whole larva (dorsal view).

creamy white to light or dark brown. The head and anterior segments become straight, while posterior segments may remain deflected dorsad or ventrad. Pupal period lasted

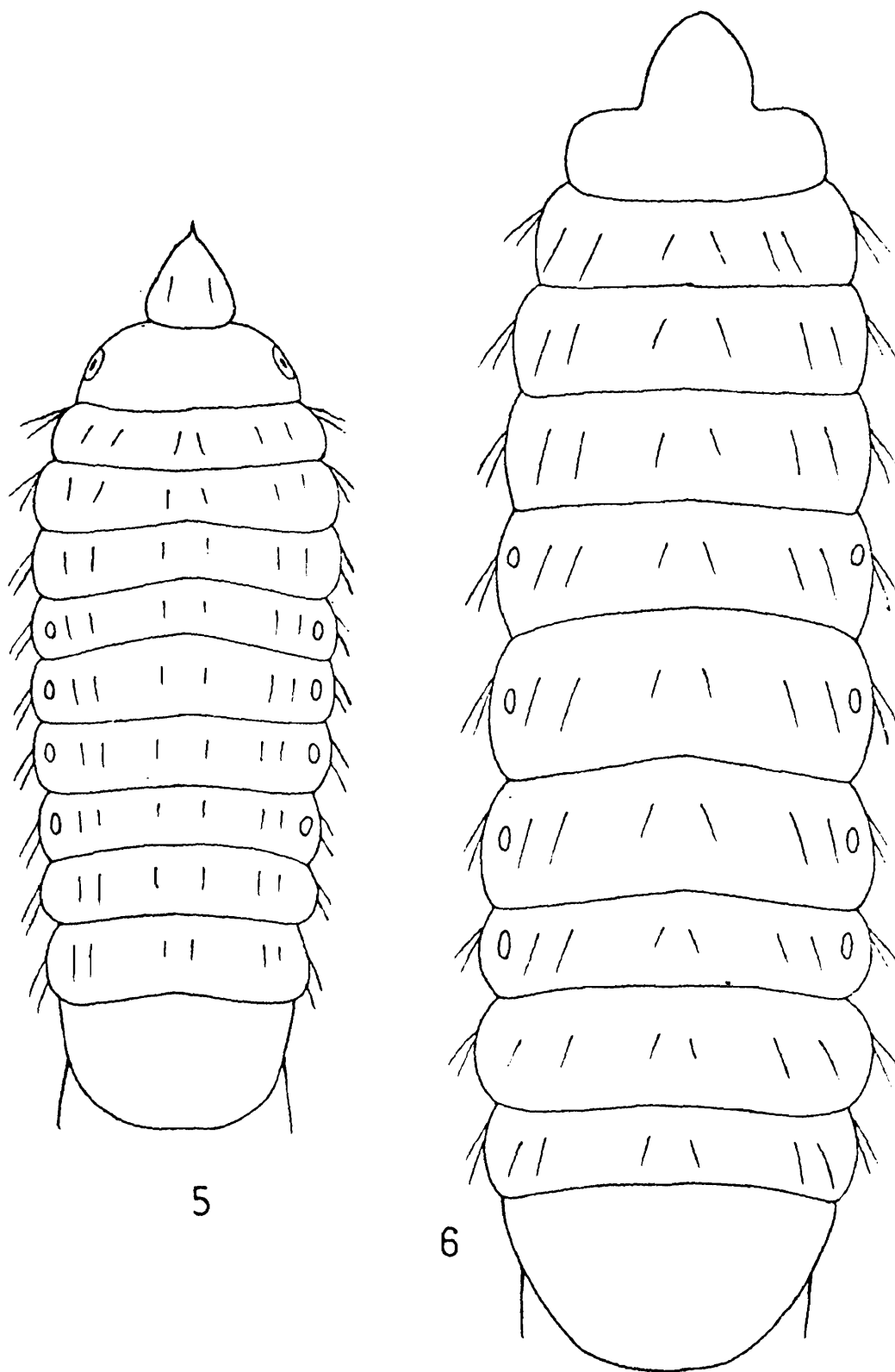


Fig. 5 : Instar VII, whole larva (dorsal view)

Fig. 6 : Puparium (dorsal view).

10-15 days depending on temperature. Adults emerge out by breaking larval skin at mesothoracic region.

Laboratory emergence of adults occurred from October to the middle of February with the main emergence in January. Generally females emerged from smaller pupae and males from larger ones. Emergence of adults usually took place between 14·00 to 16·00 hrs and rarely in the morning between 9·00 to 10·00 hrs.

Observations on sex-ratio at the time of emergence revealed that females outnumber the males. An experiment conducted on longevity of the adults in laboratory conditions showed that the adults remain alive for 14 days when fed on 10% sucrose solution while 5 days without any food.

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