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CONTENTS

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Vol. 86(3&4) 1990 Pages 407-521

CONTENTS

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CYTOTAXONOMY OF THREE SPECIES OF THE FAMILY CHIRONOMIDAE (DIPTERA)

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INTRODUCTION

While morphological characters and life history stages still remain important in the division of the Family Chironomidae into sub-families and lower taxa, the usefulness of other criteria is being increasingly recognised as such an approach is being directed to a better understanding of the classical systematics. Besides the search for better morphological tools, current trends include the ideas crystallizing from studies on cytological and biochemical aspects. However, the introduction of novel techniques and the ever new characters utilized by resourceful taxonomists merely supplant those of classical workers rather than replace them.

It was Steffan (1966) during the First International Symposium on Chironomidae who presented the salient aspects of earlier cytotaxonomic investigations of this group. Within the genus *Chironomus*, Keyl (1962) employed methods which had advantages, although certain difficulties and limitations were encountered. Those methods were based on investigations in giant chromosomes as they were known to be 'primary' species characteristics, which are known to be not directly influenced by changes in the environment. The banding pattern of these giant chromosomes proved very ideal for such studies. These structures were extensively used in cytotaxonomic studies since they are subject only to heritable variation and unlikely to show convergence. Furthermore, the complexity of banding patterns almost entirely excludes the likelihood of any similarity between species. Differences between species are hence based only on the translocation of complete chromosome arms and inversions. These inversion patterns in many cases have proved as efficient as classical morphological methods, since they show clear chromosomal differences, even while external differences of adults, pupae and larvae were minimal. However, cytotaxonomy is no 'clue all' for the many problems that beset chironomid systematics and would certainly be insufficient by itself.

MATERIALS AND METHODS

The three species studied were *Chironomus costatus* Johannsen, *Nilodorum stupidus* (Johannsen) and *Stictochironomus affinis* (Johannsen).

The chromosome material for the present study came from larvae collected from the field or reared from eggs. Salivary gland squashes were prepared following the technique given by Wulker *et al* (1971) modified slightly by us. The glands were transferred to a clean microscope slide and covered with a drop of 50% acetic acid. The individual cells of the salivary gland were dissected out of the surrounding mass of saliva to ensure a proper squash. (Sublette, personal communication). The dissected salivary glands were subsequently stained and mounted in Lacto-Aceto-Orcein. The detailed banding patterns and their location with reference to the arms in the respective chromosomes (I-IV) along with their puffs, Balbiani rings and the nucleolar regions have been studied employing standardized procedures (Keyl, 1962; Martin, 1968).

RESULTS AND DISCUSSION

Chironomus costatus Johannsen : This has three long and one short salivary gland chromosomes similar to most species of the genus. The three large pairs are metacentric and the small pair is acrocentric. Only 2 inversions have been recorded in the present study. Chromosomes were numbered I–IV in order of length and in each, the right and the left ends were arbitrarily fixed. These ends were later fixed accurately by identifying the bands A-G, corresponding to those recognised by Keyl (1962).

Arm A is usually polymorphic for the genus *Chironomus* and in the present species *C. costatus* a relatively large inversion is seen in the distal half in nearly 50% of the individuals examined. Arm A is heterozygous for inversion, by the presence of a small loop configuration near the distal end.

Chromosome IV is heterozygous for a small terminal inversion as seen near the left end of the arms. Based on the above characters of the I, II, III and IV chromosomes, this species probably belongs cytologically to the *psuedothummi* group, as it has the chromosome arm combinations AE, BF, CD and G. (Keyl, 1962).

Nilodorum stupidus (Johannsen) : This has three pairs of chromosomes which are revealed by the meiotic chromosomes to be meta or submeta-centric. One chromosome was homozygous in all specimens examined, while another had an inversion (which occurred either together or singly) at each end. The third chromosome was heterozygous in males for a very complex inversion, involving much of the chromosome indicating that this polymorphism is sex-linked. However, all the females studied were homozygous for this chromosome. As standard maps do not exist for this genus, the arm could not be designated.

Stictochironomus affinis (Johannsen) : This species also had three pairs of

chromosomes. One of these was heterozygous for an inversion at one end. The other two were homozygous, of which one appeared to have had two inversions recorded in a single specimen only. Once again the lack of standard maps for this genus made the identification of the various arms difficult.

The cytotaxonomic studies on the three species of larvae of Chironomini show that characters in *Chironomus costatus* Johannsen resemble closely the standard map of Genus *Chironomus* (Keyl, 1962). the same number of chromosomes, three pairs metacentric and one pair acrocentric were present in this species also. However, the present species in having only two inversions differs from the otherwise highly polymorphic species of the Genus *Chironomus* found in other parts of the world (Martin, 1966; Keyl, 1962). Further, the arm combinations of AE, BF, CD and G, observed here (Martin, personal communication) places the present species in the *psuedothummi* group (Keyl, 1962) known to be cosmopolitan in distribution (Martin, 1966). The karyotypes of the other two species show three pairs of chromosomes in each of them. Although a number of inversions are visible in both these species, the want of standard maps excludes the possibility of placing them in definite cytotaxonomic groups. These interesting preliminary results clearly indicate the need for more detailed work on the cytotaxonomy of Indian Chironomidae.

SUMMARY

Karyotypes of three species, *Chironomus costatus, Nilodorum stupidus* and *Stictochironomus affinis* all belonging to the tribe Chironomini were examined for cytoxonomic studies. Karyotype of *C. costatus* closely resembles the standard map of the genus, except in having only two inversions, while the genus *Chironomus* is highly polymorphic. The arm combinations observed in the present study places the species in *pseudothummi* group. The other two species could not be placed in definite groups for want of standard maps.

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NEMATODES FROM WEST BENGAL (INDIA). XIX. QUALITATIVE AND QUANTITATIVE STUDIES OF PLANT AND SOIL INHABITING NEMATODES ASSOCIATED WITH PADDY CROP IN WEST DINAJPUR DISTRICT

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INTRODUCTION

During May 1982, a random survey was conducted to make the qualitative and quantitative studies of parasitic nematodes associated with paddy crop in West Dinajpur district of West Bengal. Sixtyfive soil sample were collected from the following developmental blocks of West Dinajpur : Balurghat, Islampur, Hilli and Kumarganj.

MATERIAL AND METHODS

The sampling was made at random. For the quantitative study, the samples were processed and the nematode populations were estimated as described by Baqri *et. al.*, (1983).

RESULTS

A. Qualitative Study :

Upon analysis, the samples yielded 16 stylet bearing nematode species belonging to 12 genera of the order Tylenchida. In addition to this, 19 soil inhabiting or predacious species of the orders Dorylaimida and Mononchida have also been identified. The identified species are listed below:

Order TYLENCHIDA Thorne, 1949

1. *Tylenchus goodeyi* Das, 1960
2. *Ditylenchus* spp.
3. *Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959
4. *Hoplolaimus indicus* Sher, 1963
5. *Helicotylenchus indicus* Siddiqi, 1963
6. *H. egyptiensis* Tarjan, 1964
7. *H. retusus* Siddiqi & Brown, 1964
8. *H. microcephalus* Sher, 1966
9. *Pratylenchus scribneri* Steiner, 1943

10. *Hirschmanniella gracilis* (de Man, 1880) Luc & Goodey, 1963
11. *Rotylenchulus reniformis* Lindford & Oliveira, 1940
12. *Nothotylenchus acutus* Husain & Khan, 1968
13. *Meloidogyne graminicola* Golden & Birchfield, 1965
14. *Macroposthonia ornata* (Raski, 1958) De Grisse & Loof, 1965
15. *M. crenata* (Loof, 1964) De Grisse & Loof, 1965
16. *Aphelenchoides subtenuis* (Cobb, 1926) Steiner & Buhrer, 1932

Order DORYLAIMIDA (de Man, 1876) Pearse, 1942

17. *Dorylaimus thornei* Andrassy, 1969
18. *Laimydorus baldus* Baqri & Jana, 1982
19. *Discolaimium andrassyi* Baqri & Khera, 1976
20. *Discolaimoides bulbiferous* (Cobb, 1906) Heyns, 1963
21. *Lenonchium oryzae* Siddiqi, 1965
22. *Jairajpuria shamimi* Baqri & Jana, 1980
23. *Aporcelaimollus heynsi* Baqri & Jairajpuri, 1968
24. *A. chauhani* Baqri & Khera, 1975
25. *Dorylaimellus indicus* Siddiqi, 1964
26. *Paraoxydirus gigas* (Jairajpuri, 1964) Jairajpuri & Ahmad, 1979
27. *Discomyctus elongatus* Dhanachand & Jairajpuri, 1980
28. *Tylencholaimus pakistanensis* Timm, 1964
29. *Proleptonchus indicus* Siddiqi & Khan, 1964
30. *Tyleptus variablis* Jairajpuri & Loof, 1964
31. *Dorylaimoides teres* Thorne & Swanger, 1936
32. *D. arcuatus* Siddiqi, 1964
33. *D. leptura* Siddiqi, 1965
34. *Laevides imphalus* Ahmad & Jairajpuri, 1980

Order MONONCHIDA Jairajpuri, 1969

35. *Mononchus aguaticus* Coetzae, 1968

B. Quantitative Study :

The results of the quantitative estimation of different parasitic nematode genera and other nematodes (dorylaims, rehabditids and mononchs) have been analysed in TABLE I. The details of the sampling and localities have also been given in the same table. Sixtyfive samples were collected from 14 village centres and their surroundings in four developmental blocks of West Dinajpur district.

TABLE – I

Results of the survey of *Paddy crop in West Dinajpur district of West Bengal State*
Range of Nematode number with its average per 200 of soil
Figures as parenthesis indicate percent frequency of occurrence

		V I L L A G E S				
		Dolla	Tikaderpara	Mamna	Chakkhasi	Mahadevpur
No. of samples collected		4	4	3	7	6
	Nematode associated					
1.	*Ditylenchus*	30-60:50 (75)	20-20:20 (50)	10-20:15 (66.67)	10-30:23 (42.86)	10-50:35 (66.67)
2.	*Helicotylenchus*	10-160:70 (75)	20-30:25 (50)	20-80:40 (100)	10-50:37 (85.17)	20-210:68 (83.33)
3.	*Hirschmanniella*	140-1470:668 (100)	50-710:303 (75)	10-310:160 (66.67)	130-740:434 (100)	450-1150:785 (66.67)
4.	*Hoplolaimus*	—	—	—	—	—
5.	*Macroposthonia*	—	—	—	—	—
6.	*Meloidogyne*	30-2030:810 (75)	—	10-70:40 (66.67)	30-120:75 (23)	10-50:27 (50)
7.	*Tylenchorhynchus*	30-70:48 (100)	30-50:206 (75)	20-30:27 (100)	10-30:18 (85.17)	10-120:77 (50)
8.	Saprophagous	40-480:218 (100)	30-70:53 (100)	40-210:117 (100)	10-770:173 (100)	10-950:302 (100)

Table – I. Contd.

		VILLAGES			
		Saronbadi	Uzal Moza	Barckum	Gopalgaunj
No. of samples collected		3	3	3	3
	Nematode associated				
1.	*Ditylenchus*	30-30:30 (66.67)	20-50:35 (66.67)	10-10:10 (66.67)	10-90:55 (100)
2.	*Helicotylenchus*	20-80:50 (67)	40-110:73 (100)	10-60:43 (100)	210:210 (33.33)
3.	*Hirschmanniella*	110-360:230 (100)	10-60:35 (66.67)	80-260:160 (100)	70-410:193 (100)
4.	*Hoplolaimus*	—	20:20 (33.33)	—	—
5.	*Macroposthonia*	—	20:20 (33.33)	—	—
6.	*Meloidogyne*	20:20 (33.33)	110-450:257 (100)	—	520:520 (33.33)
7.	*Tylenchorhynchus*	10-30:23 (100)	20-690:260 (100)	20-50:33 (100)	10-100:60 (100)
8.	Saprophagous	40-200:106 (100)	120-430:290 (100)	50-200:125 (66.67)	10-570:290 (66.67)

Table – I Contd.

		V I L L A G E S				
		Iluabari	Phoolbari	Khokobasti	Ramgaunj	Taringibari
No. of samples collected		6	5	6	8	4
	Nematode associated					
1.	*Ditylenchus*	10-50:22 (83.33)	30-30:30 (40)	10-50:34 (83.33)	10-20:15 (50)	10-20:15 (50)
2.	*Helicotylenchus*	30-350:132 (83.33)	30-190:98 (100)	40-450:185 (66.67)	10-50:24 (100)	20-270:90 (100)
3.	*Hirschmanniella*	10-110:37 (100)	10-130:66 (100)	20-20:20 (33.33)	10-130:60 (75)	10-70:43 (100)
4.	*Hoplolaimus*	—	—	—	—	170:170 (25)
5.	*Macroposthonia*	10-90:23 (100)	10-170:70 (60)	30-180:85 (66.67)	10-50:25 (50)	10-50:27 (75)
6.	*Meloidoqyne*	40-270:205 (33.33)	20-660:257 (60)	10-30:20 (83.33)	10-20:13 (37.5)	10-150:60 (100)
7.	*Tylenchorhynchus*	10-110:48 (100)	10-190:70 (100)	30-150:77 (50)	10-40:26 (62.5)	10-440:130 (100)
8.	Saprophagous	70-750:366 (100)	150-240:190 (100)	30-1090:320 (100)	50-210:114 (87.5)	60-1200:445 (100)

The quantitative study reveals that among the plant parasitic nematodes in West Dinajpur district, the species of the following four genera are most abundant: *Hirschmanniella* Luc & Goodey, 1963; *Tylenchorhynchus* Cobb, 1913; *Helicotylenchus* Steiner, 1945; and *Meloidogyne* Goeldi, 1887. Upon analysis, the frequency of occurrence of *Hirschmanniella gracilis* has been noted in 83% and was found dominating over other plant parasitic nematodes in 48% samples. The occurrence of *Tylenchorhynchus mashhoodi* and *Helicotylenchus* spp. has been noted in 85% and 82% samples but dominated only in 14% and 20% soil samples respectively *Meloidoqyne graminicola* has been recorded from 45%, samples but the dominance was noticed only in 12% samples. The other potential nematode pests in the area are *Ditylenchus* spp. Though the frequency of their occurrence was noted in 58% soil samples but were found dominating only in 5% samples. *Hoplolaimus indicus* and *Macroposthonia ornata* were also encountered but always in small numbers.

The present study concludes that *Hirachmanniella gracilia* is the key nematode pests in the area surveyed. The other important nematode pest of paddy in West Dinajpur district are *Meloidogyne graminicola, Tylenchorhynchus mashhoodi* and *Helicotylenchus* spp.

SUMMARY

During May 1982, a random survey was conducted at 14 villages under four developmental blocks (Balurghat, Hilli, Islampur and Kumarganj) of West Dinajpur district (W. Bengal) to make the qualitative and quantitative studies of plant and soil inhabiting nematodes associated with paddy crop. Sixtyfive soil samples were collected. In all 35 species belonging to the orders Tylenchida, Dorylaimida and Mononchida have been identified, of which 16 belong to the parasitic group of the order Tylenchida. The quantitative study reveals that *Hirschmanniella gracilis, Tylenchorhynchus mashhoodi* and *Helicotylenchus* spp. are most abundant in the area surveyed. The other important parasitic nematodes are *Meloidogyne graminicola* and *Ditylenchus* spp.

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THE RELEVANCE OF TRADITIONAL BIRD DRUGS IN RELATION TO MODERN PRIMARY HEALTH CARE IN MADHYA PRADESH, INDIA

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INTRODUCTION

If one looks back over a few centuries, one can see that in every household, it was mostly the older people who used to administer medicines for many of the diseases. Of course, in very complicated cases more experienced people who later on came to be known as physicians were consulted. This class later turned professional and the system was perpetuated hereditarily. Traditional medicine then formed part of the culture. But with the advent of allopathy there has been a great set-back for traditional medicines all over the world. In the ethno-zoological studies undertaken recently in Madhya Pradesh, I have come upon a host of facts pertaining to the use of animal drugs by the tribals in the treatment of a variety of diseases. Of these, the data pertaining to birds is dealt with in this paper.

Madhya Pradesh, a central state of India, contains the largest tribal population in the country. It is scattered over forty-one of the forty-five districts constituting this state. According to the latest census (1981), the population of this state is 52,178,844 and that of tribals is 11,987,031. During a five month ethnozoological survey (form 4th November 1982 to 4th April 1983), all the forty-one districts containing sizeable tribal population were covered. They are Balaghat, Bastar, Betul, Bhind, Bilaspur, Chatarpur, Chindwara, Datia, Dewas, Dhar, Durg, Guna, Gwalior, Hoshangabad, Indore, Jabalpur, Jhabua, E. Nimar, W. Nimar, Mandsaur, Mandla, Morena, Narasimhapur, Panna, Raigarh, Raipur, Raisen, Rajgarh, Ratlam, Rewa, Satna, Sehore, Seoni, Shahdol, Shajapur, Shivpuri, Sidhi, Surguja, Tikamgarh, Ujjain and Vidisha. According to Ali (1973) there are fifty-eight classified tribes in Madhya Pradesh. These include sub-groups of some of the larger tribes. Thirty-nine of them were covered in the survey, which include all the larger tribes and majority of the smaller tribes. They are Agaria, Baiga, Biar, Badigar, Bhumiya, Bhil, Bhand, Bhattra, Bhilalas, Binjhwar, Dhurwa, Dewar, Dhanwar, Gond, Halba, Kamar, Kawar, Khairwar, Keer, Kol, Kondh, Korku, Korwa, Madia, Mawasi, Meena, Mudia, Muria, Nagesia, Nat, Oraon, Panika, Pao, Pardhan, Pardhi, Patillah, Saur, Seharia, and Sonr.

METHODOLOGY

An exhaustive data sheet was prepared to ascertain the role of animals in the following: food, drugs, aphrodisiac value, family planning, age stabilizers, experimental

uses, mechanical uses, industrial uses, fuel, fertilizers, ornamental and decorative purposes, bioaesthetics, costume, jewellery, perfume, entertainment/games, pets/hobbies, baits, dowry/gifts, religious purpose, omen, astrology, witchcraft, harmful animals, pests, vectors, totems, taboos, etc. Along with it, the impact of animals on aboriginal cultures as well as folklores and myths about them were also studied. In the field work the tribal map of India prepared by Gohan (1971) helped us much in getting a general idea of the district-wise distribution of various tribes. Details of methodology and survey are given in an earlier paper by the author (1988).

OBSERVATIONS

Detailed uses of the birds as drugs in Madhya Pradesh are appended in tabular form. The names of birds as well as the tribes are arranged alphabetically.

Name of bird	Mode of application	Disease (s)	Name of tribe(s); the district (s) they belong to are given in bracket
1	2	3	4
Crow *Corvus* sp.	Liver roasted, dried and given for 3-4 days, once daily	Cough, cold	Gond (Chatarpur)
Crow *Corvus* sp.	Liver dried, powdered, dissolved in milk and given to children for 2 days, once a day	Most of the chronic diseases	Gond (Panna)
Crow *Corvus* sp.	Liver cooked and taken for 6-7 days, or dried, powdered and dissolved in milk and given for 6-7 days, once a day	Rickets	Khairwar (Chatarpur); Sonr (Panna)
Crow *Corvus* sp.	Liver or flesh fried in mustard oil and taken 3 times	Eye trouble (red eyes)	Panika (Shahdol)
Crow *Corvus* sp.	Flesh cooked and taken once	Red eyes	Baiga (Sidhi)
Crow *Corvus* sp.	Egg shell roasted, powdered and applied in eyes, 2-3 times	Eye trouble (general)	Halba (Balaghat)
Drongo *Dicrurus adsimilis* (Bechstein)	Liver dried, powdered, dissolved in honey and taken for 4-5 days, twice daily	Whooping cough	Pardhan (Seoni)
Hen *Gallus gallus* (L.)	A hole is made on the shell of the egg, some quantity of opium and certain herbs pushed into the yolk, then the shell completely covered with cowdung and roasted in fire, the egg orally given for 15 days, twice daily	Breathing trouble	Gond (Raipur)

1	2	3	4
Hen *Gallus gallus* (L.)	Eggs orally taken and applied externally on ribs for 5-6 days	Breathing trouble	Bhumiya (Jabalpur); Kol (Jabalpur and Narasimhapur)
Hen *Gallus gallus* (L.)	Egg massaged on body for 4-5 days, once in a day	Swelling of body	Dhanwar (Bilaspur); Khairwar (Bilaspur)
Hen *Gallus gallus* (L.)	Yolk of egg applied externally on ribs for 2-3 times only	Pneumonia, bronchial complaints	Gond (Raisen, Rewa and Shahdol); Halba (Balaghat); Keer (Raisen); Kol (Shahdol); Pao (Shahdol)
Hen *Gallus gallus* (L.)	Yolk from egg warmed, applied externally and put bandage	Internal injury, bronchial trouble	Gond (Rewa)
Hen *Gallus gallus* (L.)	Egg yolk massaged on ribs for 2-3 times	Ribs pain	Bhil (Khandawa); Gond (Betul and Jabalpur); Korku (Betul); Mawasi (Hoshangabad); Mudia (Narasimhapur); Pardhan (Jabalpur)
Hen *Gallus gallus* (L.)	Egg yolk applied externally and fomented for two times	Ribs pain	Gond (Chindwara; Hoshangabad and Mandla); Pardhan (Chindwara)
Hen *Gallus gallus* (L.)	Egg mixed with honey, applied externally on ribs and then fomented for 2-3 days, once daily	Ribs pain	Kol (Mandla)
Hen *Gallus gallus* (L.)	Egg mixed with vermilion or sugar and lime and applied on ribs for 1-2 times	Ribs pain	Gond (Seoni)
Hen *Gallus gallus* (L.)	Egg massaged on chest for 2 times	Chest pain	Korku (Sehore)
Hen *Gallus gallus* (L.)	Egg yolk applied on ribs for 3-5 times only	Cough, cold, ribs pain	Gond (Sehore)
Hen *Gallus gallus* (L.)	Egg massaged on affected part till cured	Chest pain, ribs pain	Gond (Bilaspur); Halba (Durg); Oraon (Bilaspur and Raigarh)
Hen *Gallus gallus* (L.)	Egg applied externally on ribs and joints for 2-3 days, once daily	Ribs pain, pneumonia	Baiga (Shahdol); Kol (Shahdol); Mudia (Narasimhapur); Panika (Shahdol)

1	2	3	4
Hen *Gallus gallus* (L.)	Egg yolk applied on ribs and fomented for 2-3 times	Ribs pain, pneumonia	Korku (Raisen)
Hen *Gallus gallus* (L.)	Egg yolk applied for 10-30 days, once daily	Burns, boils	Bhil (Jhabua); Panika (Shahdol)
Hen *Gallus gallus* (L.)	A hole is made into egg, the swollen apex of finger where pus is formed inserted into it and kept for 3-4 hours, for 2-4 days, once daily	Swelling of finger	Gond (Balaghat and Bilaspur) Kondh (Raigarh); Nagesia (Surguja); Oraon (Bilaspur & Surguja)
Hen *Gallus gallus* (L.)	Egg yolk orally given to children for 2-3 times	Cold	Kawar (Shahdol)
Hen *Gallus gallus* (L.)	Egg mixed with vermilion and applied on boil on neck till cured	Boil on neck	Halba (Durg)
Hen *Gallus gallus* (L.)	Egg yolk applied on finger for 5-7 days	Pus in fingers	Gond (Bastar)
Hen *Gallus gallus* (L.)	Hole made into egg and finger inserted into it and kept for 1-2 hours	Boils with pus and pain	Bhumia (Jabalpur); Dhanwar (Bilaspur); Gond (Jabalpur, Shahdol) Halba (Balaghat); Kol (Jabalpur); Pardhan (Jabalpur)
Hen *Gallus gallus* (L.)	Egg yolk applied for 2-3 days, once daily	Burns	Dewar (Raipur); Dhurwa (Bastar); Korwa (Raigarh); Muria (Bastar); Nagesia (Surguja); Oraon (Surguja)
Hen *Gallus gallus* (L.)	Shell of egg roasted, mixed with 'Alsia' *(Brasica nigram)* oil and then applied externally on piles for 3-5 days, twice in a day	Piles	Gond (Balaghat)
Hen *Gallus gallus* (L.)	Egg orally taken for 3-4 days, once daily	Pneumonia	Baiga (Balaghat)
Hen *Gallus gallus* (L.)	Egg broken open, content stirred and orally taken for 5-8 days, once daily	Rickets	Korku (Khandawā)
Hen *Gallus gallus* (L.)	Egg orally given to patient for 10-12 days, once daily	Tuberculosis	Baiga (Balaghat); Bhil (Khandawa); Gond (Bilaspur and Durg); Pardhi (Raipur); Saur (Bilaspur)

1	2	3	4
Hen *Gallus gallus* (L.)	Egg yolk used as ear drops for one or two days, once daily	Feeble mindedness	Bhilala (Dhar)
Hen *Gallus gallus* (L.)	Egg yolk mixed with vermilion and applied externally on the swollen glands of neck for 2 times	Tonsillitis	Bhilala (Dewas)
Hen *Gallus gallus* (L.)	Egg orally given for 2-3 days once daily	General weakness	Bhûmiya (Jabalpur); Binjhwar (Raigarh); Dhanwar (Bilaspur); Gond (Bilaspur and Surguja); Khairwar (Bilaspur); Kondh (Raigarh); Oraon (Bilaspur); Pardhan (Seoni)
Hen *Gallus gallus* (L.)	Egg orally given for 3-4 days, once daily	Sexual weakness in male	Gond (Surguja)
Hen *Gallus gallus* (L.)	Two raw eggs mixed in a glass of cow's urine and given in pregnancy between 4-5 months	Abortion	Khairwar (Panna)
Hen *Gallus gallus* (L.)	Two raw eggs taken by males before intercourse	Prevention of pregnancy	Khairwar (Panna)
Hen *Gallus gallus* (L.)	Egg orally taken for 3-4 days, twice daily	Lethargy, weakness	Baiga (Surguja)
Hen *Gallus gallus* (L.)	Egg yolk, orally taken as well as applied externally and put bandages for 3-4 days	Cold in children	Korku (Dewas)
Hen *Gallus gallus* (L.)	Egg yolk applied externally on the testicles for 3-4 times	Swelling and pain in testicles	Gond (Durg); Halba (Durg)
Hen *Gallus gallus* (L.)	Egg yolk applied externally at the sight of snake bite, once or twice	Snake bite	Gond (Durg)
Hen *Gallus gallus* (L.)	Egg placed on a blanket and the child make to sit on it with his anal reigion above the egg once daily, for 3-4 days (worms get attached to the blanket)	Roundworms, tapeworms	Gond (Seoni)
Hen *Gallus gallus* (L.)	Shell of egg powdered, dissolved in water and used as ear drops for 2-3 days, once daily	For pus in ears	Gond (Durg)
Hen *Gallus gallus* (L.)	Flesh cooked and given to impotent males	Impotency	Bhil (Dhar)

1	2	3	4
Hornbill (Not specific)	Fat mixed with mustard oil and massaged for 6-8 days, once daily	Rheumatic complaints	Gond (Satna)
Kite *Milvus migraus* (Boddaert)	Oil extracted, warmed and applied externally for 2-4 days, once daily	Rheumatic pain	Pardhi (Raipur)
Myna (Not specific)	Flesh cooked and given for children for 1-2 days, once daily	Less talk	Baiga (Sidhi)
Owl (Not specific)	Liver squashed, dissolved in water and given for 2-3 days, twice daily	Tuberculosis, fits	Seharia (Gwalior)
Owl (Not specific)	Liver squashed, mixed wih breast milk and given to children for 2-3 times	Rickets	Gond (Jabalpur)
Owl (Not specific)	Liver dried, powdered and dissolved in milk or liver and milk given to children for 2-4 days, once daily	Rickets	Kol (Narasimhapur); Nat (Panna); Saur (Tikamgarh)
Owl (Not specific)	Liver fried in oil and taken 1-2 times	Rheumatic pain	Panika (Shahdol)
Owl (Not specific)	Liver boiled and taken for 5-6 days, once daily	Rickets	Bhil (Dhar)
Owl (Not specific)	Flesh rubbed on muscles for 2-3 times	Fever	Bhilalas (Jhabua)
Owl (Not specific)	Flesh cooked and taken for 5-6 days, once daily	Rickets	Bhil (Dhar)
Owl (Not specific)	Fat massaged for 4-5 days, once daily	Rheumatic pain	Panika (Shahdol)
Owl (Not specific)	Feather burnt over bone fire and fumes emitting out passed over the body	High temperature	Bhil (Jhabua)
Peacock *Pavo cristatus* L.	Feather roasted, mixed with cane jaggery and taken for 3-4 times	Stomach pain	Saur (Bilaspur)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in mustard oil and applied externally twice	Body ache	Kondh (Raigarh)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, mixed in honey and ghee, and taken for 2-3 times	Vomiting	Kondh (Raigarh)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in mustard oil and used as ear drops, 2-3 times	Ear trouble	Panika (Shahdol)

1	2	3	4
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in honey and taken for 3-4 days, twice daily	Smallpox, chickenpox	Halba (Balaghat)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in honey and taken for 3-4 times	Ear trouble	Gond (Durg)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, mixed with cane jaggery and taken for 2-3 days, twice daily	Fever	Kol (Mandla)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in honey and taken for 3-4 days, once daily	Stomach pain	Gond (Balaghat)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in water and given to children for one or two times	Vomiting	Gond (Shahdol); Halba (Bastar); Pardhan (Chindwara); Pardhi (Bastar)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, mixed with powdered pepper and dissolved in honey and taken 2-3 times	Neurotic complaints	Gond (Mandla)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in honey and onion added to it, taken 2 or 3 times	Vomiting	Keer (Raisen)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in honey and taken once	Scorpion bite, delirium	Gond (Mandla); Khairwar and Kol (Shahdol)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, mixed with cardamom powder and dissolved in honey, taken once	Vomiting	Bhumiya (Jabalpur)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in honey and orally administered for 2 times	Vomiting	Gond (Chindwara, Durg, Jabalpur and Seoni); Halba (Durg); Panika (Shahdol); Pardhan (Seoni)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in honey and orally administered for about 15 days, twice daily	Cough, whooping cough	Gond (Jabalpur and Narasimhapur); Kol (Jabalpur)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in milk and taken for 2-3 days, twice daily	Vomiting	Pao (Shahdol)
Peacock *Pavo cristatus* L.	Feather roasted, powdered, dissolved in cow's urine and taken by the patient for 4-5 days, once daily	Breathing trouble	Gond (Chindwara)

1	2	3	4
Peacock *Pavo cristatus* L.	Feather roasted, powdered and dissolved in water and taken by ladies on the first day of mensus, the same day cow's milk also consumed, subsequent day again cow's milk taken, third day 'kheir' (rice, sugar and milk boiled together) also given	For bearing male child	Mudia (Narasimhapur)
Peacock *Pavo cristatus* L.	Feather and peduncle of maize roasted, powdered, dissolved in water and given to children for 2-3 days, thrice daily	Cough, cold, vomiting	Baiga (Shahdol)
Peacock *Pavo cristatus* L.	Feather burnt to ash and dissolved in honey, taken once or twice	Vomiting	Binjhwar (Raigarh); Dewar (Raipur); Gond (Bilaspur); Kamar (Raipur); Khairwar (Bilaspur); Korwa (Raigarh); Nagesia (Surguja); Oraon (Surguja)
Peacock *Pavo cristatus* L.	Feather burnt to ash and dissolved in honey, taken once or twice	Cough	Pardhi (Raipur)
Peacock *Pavo cristatus* L.	Feather ground, dissolved in water and used as ear drops, 2-3 times	Ear trouble	Dhanwar (Bilaspur)
Peacock *Pavo cristatus* L.	Lower part of foot powdered, dissolved in water and used as ear drops, applied for 2-3 times	Ear trouble	Baiga (Sidhi and Surguja); Bhil (Dhar); Bhilalas (Dhar); Bhilalas (Guna); Binjhwar (Raigarh); Bhumiya (Jabalpur); Dewar (Raipur); Dhanwar (Bilaspur); Gond (Balaghat, Bilaspur, Jabalpur, Surguja and Vidisha); Kamar (Raipur); Korku (Dewas); Kawar (Shahdol and Surguja); Korwa (Raigarh); Meena (Vidisha); Nagesia (Surguja); Pardhan (Seoni); Pardhi (Raipur); Oraon (Raigarh and Surguja); Sur (Bilaspur); Seharia (Guna, Morena and Vidisha)

1	2	3	4
Peacock *Pavo cristatus* L.	Lower part of foot ground, dissolved in water or breast milk and used as ear drops for 1-3 days, once daily	For ear trouble in children	Keer (Raisen)
Peacock *Pavo cristatus* L.	Lower part of foot ground in water, mixed with vermilion and used as ear drops	Ear trouble	Gond (Mandla)
Peacock *Pavo cristatus* L.	Lower part of foot ground in water and applied externally on ribs for 1-2 days, once daily	Ribs pain	Gond (Raisen)
Peacock *Pavo cristatus* L.	Lower part of foot boiled in oil and massaged externally on joints till pain subsides	Rheumatic pain	Mudia (Narasimhapur)
Peacock *Pavo cristatus* L.	Lower part of foot framed in copper and hung below backbone till pain subsides	Schiatic pain	Biar (Sidhi)
Peacock *Pavo cristatus* L.	Bone of foot boiled in mustard oil and the oil used as ear drops	Ear trouble	Gond (Durg); Halba (Balaghat and Durg)
Peacock *Pavo cristatus* L.	Bone of foot powdered, mixed with oil and used as ear drops, for 1 day, 2-3 times	Ear trouble	Bhilalas (Dewas and Sehore); Gond (Chindwara); Kondh (Raigarh); Pardhan (Chindwara)
Peacock *Pavo cristatus* L.	Bone of foot ground in oil and applied externally on ribs till pain persists	Ribs pain	Pardhan (Chindwara)
Peacock *Pavo cristatus* L.	Bone of foot ground, dissolved in water at room temperature or sometimes slightly warmed and used as ear drops for 1-3 days, once a day	Ear trouble	Baiga (Balaghat); Bhattra (Bastar and Indore); Bhil (Ratlam); Bhilalas (Rajgarh); Dhurwa (Bastar); Gond (Betul, Hoshangabad, Khandawa, Narasimhapur, Raipur, Raisen, Sehore and Sidhi); Korku (Betul, Hoshangabad, Raisen and Sehore); Mawasi (Hoshangabad)
Peacock *Pavo cristatus* L.	Bone of foot powdered and dropped in ears for 2-3 times, once daily	Ear trouble	Bhil (Jhabua & Ratlam); Bhilalas (Ujjain); Seharia

1	2	3	4
			(Rajgarh); Baiga (Shahdol); Bhumiya (Jabalpur); Gond (Seoni and Shahdol); Kol (Jabalpur, Mandla and Shahdol); Mudia (Narasimhapur); Panika (Shahdol); Pardhan (Jabalpur)
Peacock *Pavo cristatus* L.	Bone of foot ground in oil and massaged externally for 2-3 days, thrice a day	Body swelling	Baiga (Shahdol)
Peacock *Pavo cristatus* L.	Generally bone of foot or any other bone powdered, dissolved in oil (preferably in mustard oil) and used as ear drops, 2-3 days, once a day	Ear trouble	Bhand (Satna); Bhumiya (Panna and Satna); Gond (Bhind, Chatarpur, Satna and Tikaamgarh); Khairwar (Chatarpur and Panna); Kol (Narasimhapur and Panna); Pao (Satna); Saur (Tikamgarh); Seharia (Gwalior); Sonr (Panna)
Peacock *Pavo cristatus* L.	Bone powdered and administered to children for 3-4 days, once a day	Breathing trouble	Bhilalas (Shajapur)
Peacock *Pavo cristatus* L.	Bone powdered and applied over wounds of bulls for 2-3 days, once a day	Cuts, severe wounds	Bhil (Jhabua)
Peacock *Pavo cristatus* L.	Bone hung on lower part of feet till pain subsides	Severe muscular pain	Kol and Pao (Satna)
Peacock *Pavo cristatus* L.	Bone powdered, dissolved in water and used as ear drops, 2-3 days, once daily	Ear trouble	Korku (Bhind); Mawasi and Pahalwan or Nat (Satna); Seharia (Datia and Shivpuri)
Peacock *Pavo cristatus* L.	Bone powdered, mixed with mustard oil and garlic and used as ear drops, applied 2-3 times	Ear trouble	Gond (Panna)
Peacock *Pavo cristatus* L.	Bone powdered and applied in eyes for a few times	Eye trouble	Sonr (Panna)
Peacock *Pavo cristatus* L.	Bone roasted, dissolved in lemon juice and used as ear drops for 2-3 times	Ear trouble	Nat (Panna)

1	2	3	4
Peacock *Pavo cristatus* L.	Nail roasted, powdered and dissolved in mustard oil and used as ear drops for 4-5 days, once daily	Ear trouble	Kol (Satna)
Peacock *Pavo cristatus* L.	Fat massaged at the broken bone for 6-10 days, once daily	To join the broken bone	Keer (Raisen)
Pigeon *Columba livia* Gmelin (Wild)	Blood orally administered for 6-7 days, once a day	Asthma	Oraon (Raigarh)
Pigeon *Columba livia* Gmelin (Wild)	Blood consumed for about a week, once daily	Paralysis	Gond (Jabalpur and Shahdol); Halba (Bastar); Kol (Narasimhapur)
Pigeon *Columba livia* Gmelin (Wild)	Blood taken for 10-15 days, once daily	Tuberculosis	Gond (Chindwara)
Pigeon *Columba livia* Gmelin (Wild) (Black)	Fresh blood orally given and massaged externally till cured from disease	Paralysis	Gond (Durg)
Pigeon *Columba livia* Gmelin (Wild) (Black)	Blood massaged on affected part for 2-4 days, once a day	Rheumatic and muscular pains	Bhilalas (Jhabua)
Pigeon *Columba livia* Gmelin (Wild) (Black)	Blood massaged externally on the affected part for 15-20 days or more	Paralysis	Bhil (Dhar, Jhabua and Ratlam); Bhilalas (Dhar and Ujjain)
Pigeon *Columba livia* Gmelin (Wild) (Black)	Blood massaged on affected part for 10-15 days, once a day	Paralysis	Baiga (Shahdol); Bhil (Khandawa); Bhilalas (Dewas and Khandawa); Bhumiya (Chatarpur); Binjhwar (Raigarh); Dhanwar (Bilaspur); Gond (Balaghat, Bastar, Betul, Bilaspur, Chindwara, Khandawa, Narasimhapur, Raipur, Raisen and Sehore); Halba (Durg); Kawar (Raipur and Shahdol); Keer (Raisen); Khairwar (Bilaspur);

1	2	3	4
			Kol (Jabalpur, Mandla and Shahdol); Korku (Betul, Dewas, Hoshangabad, Khandawa, Raisen and Sehore); Korwa (Raigarh); Mawasi (Hoshangabad); Mudia (Narasimhapur); Oraon (Bilaspur and Raigarh); Pardhan (Chindwara and Narasimhapur); Pardhi (Bastar and Raipur); Saur (Bilaspur); Seharia (Satna)
Pigeon *Columba livia* Gmelin (Wild)	Blood orally administered for 6-7 days, once daily	Breathing trouble, paralysis	Saur (Bilaspur)
Pigeon Columba livia Gemlin (Wild)	Blood massaged and flesh consumed for 10-15 days, once a day	Rheumatic complaints, paralysis	Gond (Bhind)
Pigeon *Columba livia* Gemlin (Wild)	Blood and flesh boiled and consumed for 1-2 days, once a day	Paralysis, to reduce heart beat	Panika (Shahdol)
Pigeon *Columba livia* Gemlin (Wild)	Blood and flesh mixed with hen's eggs and taken for 10-15 days, once daily	Tuberculosis	Korku (Bhind)
Pigeon *Columba livia* Gemlin (Wild)	Blood mixed with soil and massaged on affected part till cured, once daily	Paralysis	Gond (Panna)
Pigeon *Columba livia* Gemlin (Wild)	Flesh cooked and consumed for 3 days, once daily	Cough, breathing trouble	Mudia (Narasimhapur)
Pigeon *Columba livia* Gemlin (Wild)	Flesh boiled and consumed for 8-10 days, twice daily	Tuberculosis	Gond (Bastar, Mandla and Narasimhapur)
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Flesh boiled or cooked and consumed for 10-15 days, twice daily	Paralysis	Bhil (Dhar, Jhabua and Ratlam); Bhilalas (Dhar and Ujjain); Halba (Bastar)

1	2	3	4
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Flesh boiled and consumed for 2-3 days or more, twice daily	Breathing trouble	Gond (Tikamgarh); Oraon (Surguja)
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Flesh cooked and consumed for 2-3 weeks, once a day	Paralysis	Baiga (Shahdol); Bhil (Khandawa); Bhilalas (Khandawa and Ujjain); Gond (Balaghat, Bastar, Betul, Bilaspur, Chindwara, Durg, Jabalpur, Khandawa, Mandla, Narasimhapur, Raipur, Raisen, Sehore and Shahdol); Halba (Bastar and Durg); Kawar (Raipur); Keer (Raisen); Khairwar (Shahdol); Kol (Jabalpur, Narasimhapur, Mandla and Shahdol); Korku (Betul, Dewas, Hoshangabad, Khandawa, Raisen and Sehore); Mawasi (Hoshangabad); Mudia (Narasimhapur); Oraon (Bilaspur and Raigarh); Pardhan (Chindwara, Narasimhapur and Seoni); Pardhi (Bastar and Raipur)
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Flesh and blood cooked and consumed for 3-4 days, twice daily	Breathing trouble	Dewar (Raipur)
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Small quantity of flesh or blood orally administered for 10-15 days, once a day	Rheumatic pain	Mawasi (Chindwara)

1	2	3	4
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Flesh burnt, mixed in hare's blood and given for 2-3 days, twice a day	Paralysis, breathing trouble	Seharia (Gwalior)
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Flesh burnt to ash, dissolved in honey and given for 9-10 days, thrice daily	Breathing trouble	Saur (Tikamgarh)
Pigeon *Columba livia* Gemlin (Wild) (Preferably caught from wild)	Juice of flesh extracted, mixed with blood and consumed for 10-15 days, twice a day	Paralysis	Bhattra (Bastar)
Pigeon *Columba livia* Gemlin (Wild)	Flesh warmed and juice extracted, consumed for 4-5 days or more, twice daily	Paralysis	Binjhwar (Raigarh); Dhanwar (Bilaspur); Halba (Balaghat); Khairwar (Bilaspur); Korwa (Raigarh)
Pigeon *Columba livia* Gemlin (Wild)	One entire pigeon boiled in about one litre of water and the juice consumed, meat cooked and consumed in two or three times	Paralysis	Gond (Seoni)
Pigeon *Columba livia* Gemlin (Wild)	Flesh cooked, consumed and blood massaged over the affected region for 10-15 days, once or twice daily	Paralysis	Bhil (Indore and W. Nimar); Bhilalas (Rajgarh, Seoni and Shajapur); Gond (Chatarpur); Khairwar (Chatarpur and Panna); Meena (Vidisha); Nat (Panna); Saur (Chatarpur); Seharia (Shivpuri and Vidisha)
Pigeon *Columba livia* Gemlin (Wild)	Fat massaged till disease cured	Rheumatic complaints	Gond (Satna)
Pigeon *Columba livia* Gemlin (Wild)	A pigeon boiled and the patient exposed to the vapour emitting from it in a closed room for about an hour	Paralysis	Gond (Chindwara)

1	2	3	4
Pigeon *Columba livia* Gemlin (Wild)	A globule of excreta mixed with a little cane jaggery and consumed by ladies for one or two days, once a day	Menstrual complaints (in case of stoppage of menstruation, for normal menstruation)	Mudia (Narasimhapur)
Pigeon *Columba livia* Gemlin (Wild)	A little excreta dissolved in curd and consumed by the patient for 4-5 days, twice daily	Breathing trouble, asthma	Oraon and Saur (Bilaspur)
Pigeon *Columba livia* Gemlin (Wild)	Bits of excreta applied on the belly of children for 2-3 times	Rickets	Bhilalas (Shajapur)
Pigeon *Columba livia* Gemlin (Wild)	Feathers used to fan wind at the affected part for 15-30 days, thrice daily	Paralysis	Baiga (Shahdol); Bhil (Ratlam); Bhilalas (Dewas, Khandawa, Sehore, Shajapur and Ujjain); Gond (Betul, Balaghat, Bilaspur, Jabalpur, Narasimhapur, Raipur, Raisen, Sehore, Seoni, shahdol and Vidisha); Kawar (Shahdol); Keer (Raisen); Khairwar (Bilaspur); Kol (Shahdol); Korku (Dewas, Hoshangabad, Khandawa, Raisen and Sehore); Mawasi (Hoshangabad); Mudia (Harasimhapur); Oraon (Bilaspur); Pao (Shahdol); Pardhan (Chindwara and Narasimhapur); Pardhi (Bastar); Saur (Bilaspur)
Pigeon *Columba livia* Gemlin (Wild)	Live pigeon tied to the hands or kept in underarm and the heat released from the body of pigeon is believed to be absorbed by the paralysed muscles	Paralysis	Pardhan (Seoni)

1	2	3	4
Pigeon *Columba livia* Gemlin (Wild)	A bird cut into 2 pieces and tied on the ear lobes covering them and left for 1-2 hours, then cooked and consumed	Paralysis	Panika (Shahdol)
Vulture *Gyps sp.*	Blood applied externally for 4-5 times	Boils	Kol (Panna)
Vulture *Gyps sp.*	Fat warmed and applied externally for 3-4 days, once daily	Rheumatic complaints	Seharia (Morena)

SUMMARY

Analysis of data collected shows that there are altogether 136 medical applications of birds or their derivatives among 39 tribes belonging to 41 districts of Madhya Pradesh. Group-wise breakup of applications is: peacock 44, hen 38, pigeon 33, owl 9, crow 6, vulture 2, drongo 1, hornbill 1, kite 1 and myna 1. The hen's egg has the maximum number of applications as a single derivative. There are 37 of them used in curing a variety of diseases: breathing trouble, swelling of body, pneumonia, bronchial trouble, ribs pain, chest pain, joint pain, swelling and pain in testicles, cough, cold, burns, boil, swelling of finger, boil on neck, pus in ears, piles, rickets, tuberculosis, feeble mindedness, general weakness, sexual weakness in male, abortion, tonsillitis, prevention of pregnancy, snake bite, round worms and tapeworms. It may be because of hen's close association with human beings. This is followed by the feather of peacock having 22 applications; curing stomach complaints, body ache, ear trouble, small pox, chicken pox, fever, vomiting, neurotic complaints, scorpion bite, delirium, cold, cough, whooping cough, breathing troubles and for bearing male child. No wonder that in ancient times peacock was one of the most sought after export items from India. Similarly, the maximum number of applications of a single derivative for curing a particular disease is the blood of pigeon. It is massaged for cure of paralysis by 21 tribes in 19 districts. Some of the other widely applied drugs are the lower part of foot of peacock for ear trouble (by 19 tribes in 14 districts); feather of pigeon for paralysis (by 16 tribes in 19 districts); and flesh of pigeon for paralysis (by 15 tribes in 19 districts). It is interesting to note that pigeon plays an important role in the treatment of paralysis. There are as many as 19 applications, the parts made use of in majority of cases are blood/flesh.

The bones, feet and claws of peacock have 13 modes of applications for curing ear trouble. These parts contain abundant calcium. It is, threrfore, probable that calcium plays a significant role in curing ear complaints. This view is further supported by the fact that tribals often use the shells of cowrie for the same purpose.

DISCUSSION

From the above account it can be deduced that the traditional animal drugs are much more relevant today than any other time because the great majority of people in developing countries cannot afford allopathic treatments, especially in complicated and serious cases, owing to the prohibitive cost. This system has an added advantage when compared to the allopathic system. Its efficacy has been proved by the generations and it has practically no side effects. So it is high time that every modern primary health care centre should have a physician well versed in traditional drugs. It is also required to open training and research centres to bring traditional drugs on firmer scientific footing. If researches show that some of these organs used in curing have no pharmaceutical value, except as a source of rich protein and vitamin, then the tribals must be educated properly. Those birds which possess special curative qualities should be cultured and must be made available in large numbers which will not only help in curing diseases but also will give employment opportunities. This will also prevent the extinction of many of the dwindling species of birds. The tribals normally kill the birds for curing a particular disease at a time making use of only one or two organs, while discarding most of the other parts. But in a bird farm all the useful derivatives can be preserved and be utilised as and when required.

The scanty knowledge of traditional animal drugs is obvious from the fact that there is not much literature available on the subject except for the occasional notings in the writings of Verrier Elwin and other eminent anthropoligists and in reports of different forest departments, travelogues and gazetteers. Even in 'Materia Medica' by Kent (1970) mention is made only about a dozen animals that are being utilised; curiously enough not a single one of them is a bird. Much general information is available in 'A Dictionary of Indian Raw Materials and Industrial Products : The Wealth of India Raw Materials' published by the Indian Council of Scientific and Industrial Research, New Delhi (1948-1976). In conclusion it may be stated that this being a new concept, the study needs many years of painstaking research for its proper development.

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It is with pleasure I acknowledge my deep gratitude to Dr B.K. Tikader, ex Director, Zoological Survey of India, Calcutta, for assigning the problem to me. Thanks are due to Dr Asket Singh, Joint Director-in-Charge of the same department for encouragements. I am also indebted to the Department of Environment, Government of India, New Delhi, for funding the project and to my colleagues Dr V.P. Sharma, Sri H.K. Azmi, Sri S.K. Mondal and Sri S.K. Das, for helping me to collect the data presented in this paper.

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ON SOME FRESHWATER GASTROTRICHA FROM NORTH-EASTERN REGION, WITH REMARKS ON INDIAN TAXA.

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INTRODUCTION

Our knowledge of Indian freshwater Gastrotricha is scanty and scattered. The various earlier contributions are by Annandale (1907), Stewart (1908), Vanamala Naidu (1962), Visveswara (1963,1964), Dhanapathi (1976), Rao & Mohan (1977) and Sharma (1980).

The present report deals with five species of freshwater Gastrotricha from Meghalaya State, North-Eastern India. All the studied species are new to this region while only one species comprises a new record from India. Comments are made on the nature and composition of Gastrotrich fauna of India.

MATERIAL AND METHODS

The material for this study was collected from some freshwater bodies in Meghalaya State (Fig. 1). Methods of collection and preservation are detailed by Sharma (1980). The drawings are made using a camera lucida and measurments are given in micrometers (μm).

TAXONOMIC NOTES

Chaetonotus similis Zelinka 1889
(Fig. 2)

Present specimens of *C. similis* are identical with those examined from West Bengal (Sharma 1980). This species has also been reported previously from this country from Andhra Pradesh (Vanamala Naidu 1962, Dhanapathi 1976, Rao & Mohan 1977). Total length : 170-176.

Chaetonotus anomalus Brunson 1959
(Fig. 3)

Forms agree with those reported from West—(Sharma *loc. cit*) in that the long spines do not project beyond the body. The only earlier report of this species from India is from Andhra Pradesh (Dhanapathi 1976). Total length : 150-156.

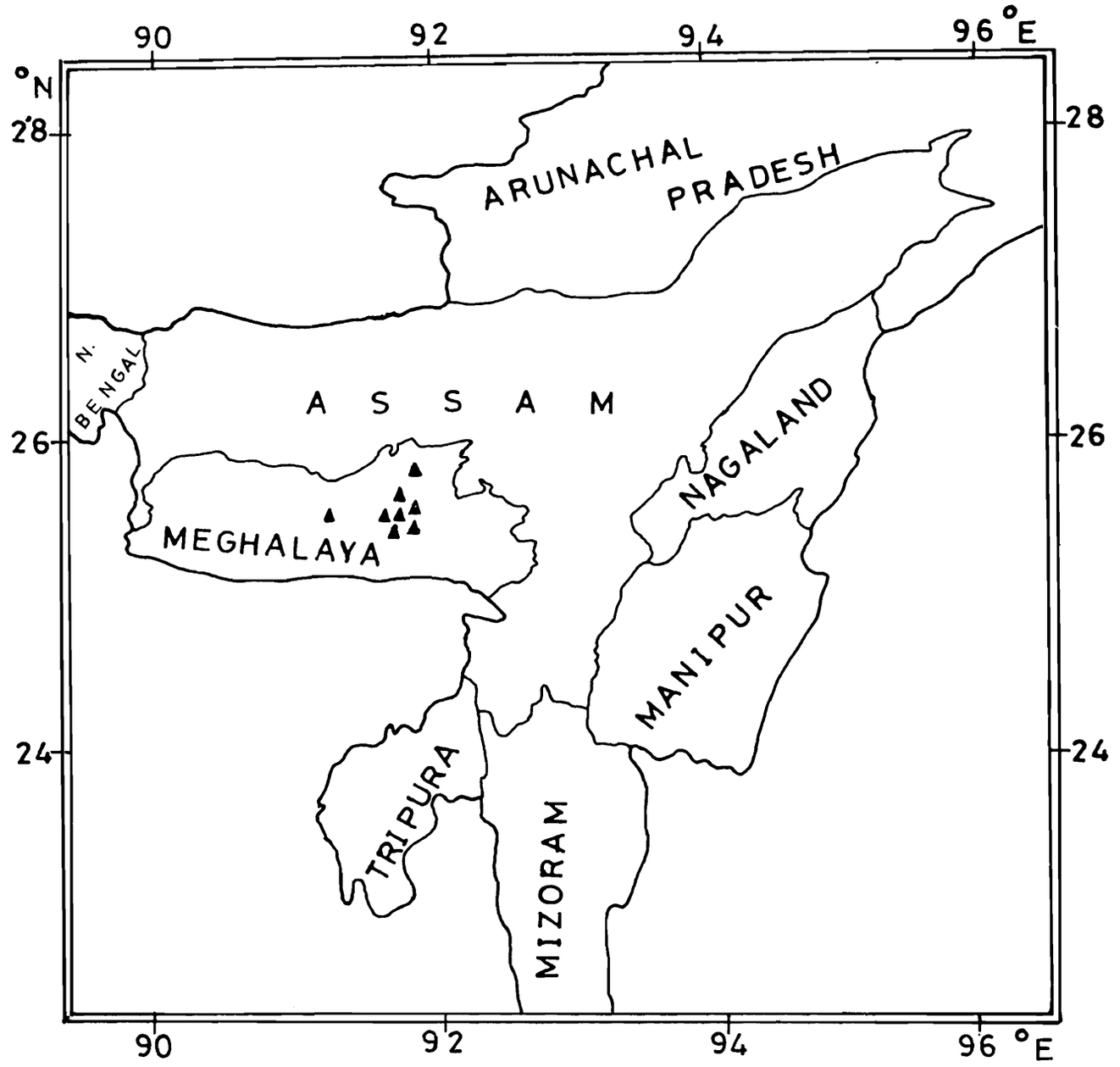

Fig. 1. Map of North-Eastern India showing sites of collection.

Chaetonotus spinulosus Stokes 1887
(Fig. 4)

Head five-lobed. Anterior and posterior tectile bristles present. Body with seven long and bifurcate spines, arranged in two rows. It differs from *C. octonarious* in the arrangement of its long spines. This species represents a new record from India. Total length 62.

Lepidodermella squamatum (Dujardin 1841)
(Fig. 5)

Head five-lobed. Body covered with scales arranged in alternate rows and projecting beyond the body surface. Reported previously from India from Andhra Pradesh (Rao & Mohan 1977) and West Bengal (Sharma 1980). Total length : 162.

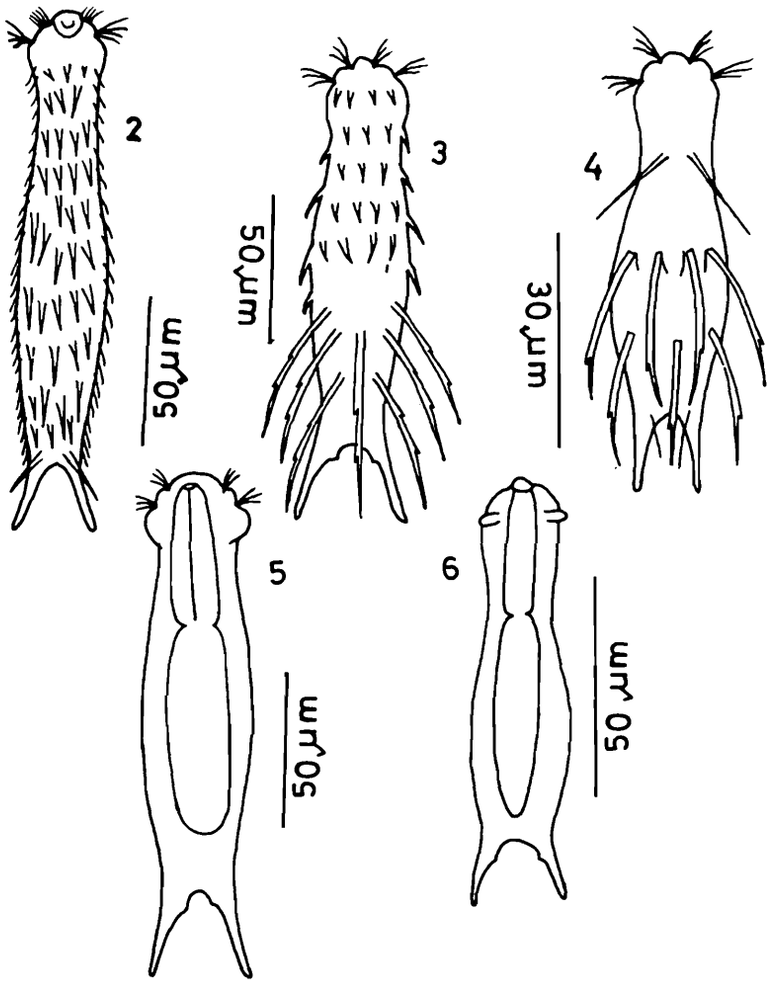

Fig. 2. *Chaetonotus similis* Zelinka 1889, dorsal view; Fig. 3. *Chaetonotus anomalus* Brunson 1959, dorsal view; Fig. 4. *Chaetonotus spinulosus* Stokes 1887, dorsal view; Fig. 5. *Lepidodermella squamatum* (Dujardin 1841), dorsal view; Fig. 6. *Icthydum auritum* Brunson 1950, dorsal view.

Icthydium auritum Brunson 1950
(Fig. 6)

Head three-lobed; posterior lobes as earlike flaps. No tectile bristle present. Recorded earlier from this country only from West Bengal (Sharma 1980). Total length : 90.

REMARKS

Five species of freshwater gastrotrichs are presently documented from the state of Meghalaya in North-Eastern India. While only *Chaetonotus spinulosus* represents a new report from India, all the reported species are new to this region. Further, all the examined taxa were rare in the present material. Agreeing with Sharma (1980), most of the studied species were associated with habitats rich in detritus and decaying organic matter; with some localities having dissolved oxygen values even below 1.0 mg/l *Chaetonotus* spp. also showed affinity with filamentous algae and various macrophytes.

Twenty-four species of freshwater Gastrotricha (including the present study) have so

far been reported from India (APPENDIX I); this comprises about 10% of the world's fauna. The Indian taxa belong to six genera and are spread over three families. Genus *Chaetonotus* comprises a dominant fraction of the reported species. *C. similis* appears to be relatively common in its occurrence. Certain other species i.e., *C. techyneusticus, C. formosus* and *C. anomalus* have been collected from various localities in Eastern India. On the other hand, *Chaetonotus novenarius, Icthydium minimum, I. monolobum, Polymerurus nodicaudis* and *Neogossea antennigera* are known only from Central India. The endemic forms i.e., *Stylochaeta abarbita, Chaetonotus trianguliformis, C. monobarbatus, C. laterospinosus, C. sextospinosus, C. caudalspinosus* and *Polymerurus magnus* comprise a significant component (34.3%) of the gastrotrich fauna of this country and are apprently restricted to Central India.

The studies so far conducted reflect that Gastrotrich fauna of India is rich and varied eventhough a majority of previous works are from Eastern India. It shall be still interesting to examine further extensive collections from different latitudes and longitudes of this subcontinent.

SUMMARY

Five species of freshwater Gastrotricha are collected from Meghalaya State in North-Eastern India. Of these, *Chaetonotus spinulosus* represents a new record from India while all the examined taxa are new to this region. Remarks are made on the composition of Gastrotrich fauna of this country and a list of Indian taxa is presented.

APPENDIX – I

List of freshwater Gastrotricha reported from India

Class GASTROTRICHA

Family CHAETONOTIDAE

Chaetonotus anomalus Brunson 1950; *Chaetonotus brevispinosus* Zelinka 1889; *Chaetonotus caudalspinosus* Visveswara 1964; *Chaetonotus formosus* Stokes 1887; *Chaetonotus laterospinosus* Visveswara 1964; *Chaetonotus longipinosus* Stokes 1887; *Chaetonotus monobarbatus* Visveswara 1964; *Chaetonotus novenarius* Greuter 1917; *Chaetonotus octonarius* Stokes 1887; *Chaetonotus schulzei* Zelinka 1889; *Chaetonotus sextospinosus* Visveswara 1964; *Chaetonotus similis* Stokes 1887; *Chaetonotus spinulosus* Stokes 1887; *Chaetonotus tachyneusticus* Brunson 1948; *Chaetonotus trianguliformis* Visveswara 1964; *Chaetonotus vulgaris* Brunson 1950; *Icthydium auritum* Brunson 1950; *Icthydium minimum* Brunson 1950; *Icthydium monolobum* Brunson 1950; *Lepidodermella squamatum* (Dujardin 1841); *Polymerurus magnus* Visveswara 1963; *Polymerurus nodicaudus* Voigt 1901.

Family DASYDYTIDAE

Stylochaeta abarbita Visveswara 1963.

Family NEOGOSSEIDAE

Neogossea antennigera (Goose 1857).

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CONTRIBUTION TO THE ACRIDID FAUNA (ORTHOPTERA) OF NORTH-EASTERN STATES OF INDIA

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INTRODUCTION

The grasshopper fauna of the North-eastern states of India is meagrely known. However, stray contributions have been made by Serville (1839), Stal (1878), Kirby (1914), Uvarov (1927a, 1927b, 1930, 1942), Willemse (1925), Ramme (1941), Bhowmik (1965) and more recently Shishodia and Hazra (1985). As a result of these studies, inter alia, 13 interesting new species were described from the areas (vide appendix).

The present communication contains records of localities of the relatively well known species, comprising of 33 species or subspecies belonging to 27 genera under 9 sub-families, and most of these, have been recently dealt with elsewhere (Bhowmik, 1986). Of these, 17 species are new records from some of the states of north-eastern India. Some of the species not recorded earlier by Bhowmik (op. cit.) are also included. The total number of species from north-eastern states of India, is now 57 species under 42 genera (vide appendix)

SYSTEMATIC ACCOUNT

Order ORTHOPTERA

Family ACRIDIDAE

Subfamily ACRIDINAE

1. ***Acrida exaltata*** (Walker, 1859)

Material : 1 ♂ and 2 advanced ♀ nymphs; Noa Dhihing river, Namsai, Lohit district; 10.9.86; R.N. Bhargava coll. 1 ♀; Foothill, W. Kameng; 4.1.86; R.N. Bhargava coll.

Remarks : A very common species of the region.

2. ***Phalaeoba antennata*** Brunner, 1893

Material : 2 ♂♂, 1 ♀; Kamlong, Lohit district; Nov. 1986; R.N. Bhargava coll. 1 ♀; Kheram, Lohit district; 25.9.86; R.N. Bhargava coll. 1 ♂, 2 ♀♀; Kalaktank, W. Kameng; 26.12.85; R.N. Bhargava coll. 4 ♂♂, 6 ♀♀; (and 1 nymph); Foot Hill,

Tipi, W. Kameng; 8.9.84; R.N. Bhargava coll. 4 ♀♀; Sepai Jala, Agartala; 10.11.83; P. Halder coll. 1 ♀; Motinagar, Silchar, Assam; 6.11.83; B.C. Saha coll. 1 ♂; Sultana vill., Lohit district; Arunachal Pradesh; 9.9.86; R.N. Bhargava coll.

Remarks : In India the species is common in Darjeeling district (Bhowmik and Rui, 1984). It is recorded here for the first time from Tripura.

3. ***Phlaeoba infumata*** Brunner, 1893

Material : 1 ♂, 1 ♀; Rydak forest, Jalpaiguri, West Bengal; 9.9.75; H.K. Bhowmik coll.

Remarks : The species was so far recorded from Arunachal Pradesh and Burma. It is recorded here from West Bengal for the first time.

4. ***Phlaeoba panteli*** Bolivar, 1902

Material : 1 ♀; Nilpara (Hasimara) Jalpaiguri; 31.8.75; H.K. Bhowmik coll. 1 (nymph); Sepai Jala, Agartala; 10.12.83; P. Halder coll. 1 ♀; Kheram Lohit district, Arunachal Pradesh; 26.9.86; R.N. Bhargava coll. 2 ♂♂; 119 miles point, Paya, Lohit district; 15.9.86; R.N. Bhargava coll. 1 ♂, 1 ♀; Mankao, Chowkhan, Lohit district; 19.9.86; R.N. Bhargava coll. 1 ♀, Kheram vill. Bordumsa, Lohit district; 8.9.86. R.N. Bhargava coll. 1 ♂, 4 ♀♀; Paya, Lohit district; Arunachal Pradesh; R.N. Bhargava coll.

Remarks : Previously known from Bihar, Tamil Nadu, Himachal Pradesh, Arunachal Pradesh, West Bengal and Afganistan, the species is a new record from Tripura.

5. ***Gonista sagitta*** (Uvarov, 1912)

1912. *Gelastorrhinus sagitta* Uvarov, *Horae Soc. Ent. Rose.*, **40**(3) : 10.

1933. *Gonista sagitta* : Uvarov; 1933 *Trans.Inst. Zool. Acad. Sci URSS* **1** : 189.

Material : 1 ♀, Churachandpur, Manipur; 20.11.83; S.K. Gupta coll.

Remarks : The species was previously known from Karnatak, Sikkim, Tamil Nadu, Burma and SriLanka. It is a new record from north-eastern India.

It is a little known species and some observation on its morphology are given below:

Antenna as long ss combined length of head and pronotum, 21-segmented, 3rd to 10th segments somewhat ensiform, apical segments tapering, whiplike towards tip. Prozona one and a half times longer than metazona; 2nd sulcus indented on prozona but does not cross median carina. Tegmen about 8mm. longer than abdomen, acuminate at apex. Posterior femur shorter than abdomen; posterior tibia shorter than femur, with 13 external and 14 internal short spines; dull yellowish. Mesosternum long, its lobes small, almost touching in middle line; metasternum separated by a distinct suture.

Measurement (one female in mm.); Body 39; antenna 15; prozona 4.5; metazona 3; tegmen 35; posterior femur 17; posterior tibia 14.

6. ***Ceracris nigricornis laeta*** (Bolivar, 1914)

Material : 2 ♀♀; Khellong, West Kameng; 7.1.86; R.N. Bhargava coll.

Remarks : The specimens (30-32) agree well with known accounts (Bhowmik, 1986). It is, however, a new record from Arunachal Pradesh.

7. ***Ceracris nigricornis nigricornis*** (Walker, 1870)

Material : 2 ♂♂, 1 ♀, Lamka, Manipur; 21.11.83; B.C. Saha coll. 2 ♀♀; East Kameng; 13.12.85; R.N. Bhargava coll. 3 ♂♂, 1 ♀; Kellong, West Kameng, 8.1.86 and also (80 nymphs-probably 3rd stage instars): Tawang, West Kameng; 22.9.84; R.N. Bhargava coll.

Remarks : This subspecies has a restricted distribution ranging over the Himalayas and Karen Hills (Burma). In the plains, it is only known from Pusa (Bihar) and Tripura. The availability of a large series of nymphs during September indicate postmonsoon breeding.

8. ***Ceracris deflorata*** (Brunner, 1893)

Material : 1 ♀; Moreh, Manipur; 25.11.83; B.C. Saha coll.

Remarks : The species was previously known from Pusa and Chapra (Bihar) and Burma. Its present record is the eastern most limit of its distributional range in India.

9. ***Holopercna darjeelingensis*** (Bolivar, 1914)

Material : 1 ♂; Tenga, West Kemeng; 24.9.84; R.N. Bhargava coll.

Remarks : The species seems to be distributed throughout the Eastern and Western Himalayas. Arunachal Pradesh is, however, a new record for it.

II. Sub-family GOMPHOCERINAE

10. ***Aulacobothrus decisus*** Walker, 1871

Material : 1 ♂; 1 ♀; Churachandpur, Manipur; 20.11.83; B.C. Saha coll.

Remarks : Previously recorded from Bombay and Tamil Nadu, the species is recorded here for the first time from Manipur.

III. Sub-family OEDIPODINAE

11. ***Aiolopus thalassinus tamulus*** (Fabricius, 1798)

Material : 1 ♀; Dirang, W. kameng; 19.9.84 and 1 ♀; Tenga, W. Kameng; 24.9.84; R.N. Bhargava coll. 4 ♀♀; Raipasa, Ambasa, Tripura; 20.2.83; A.K. Sanyal & party coll. 1 ♀; Lembuchera, Agartala; 7.2.83; A.K. Sanyal and party coll.

Remarks : A common rice-pest of oriental regions sand Australia.

12. ***Acrotylus humbertianus*** (Saussure, 1884)

Material : 1 ♂, 1 ♀; Lalchhuri, Ambasa, Tripura; 22.2.83; A.K. Sanyal & party coll.

13. ***Heteropternis respondens*** (Walker, 1859)

Material : 4 ♂♂, 1 ♀; Fatikchara, Agartala; 26.2.83. 1 ♀; Raipasa, Ambasa, Tripura; 20.2.83. 1 ♂; Hatipocha, Tripura; 11.2.83. All by A.K. Sanyal and party coll. Also from - 2 ♂♂; Adderly, Nilgiri, Tamil Nadu; 28.2.83; S. Sur coll.

Remarks : Though a common species, it is reported here for the first time from Tripura.

14. ***Oedaleus abruptus*** (Thunberg, 1815)

Material : 1 ♂, 3 ♀♀; Fatichara, Agartala; 26.2.83; A.K. Sanyal & party coll. 1 ♂; Subhasnagar, Agartala; 5.2.83; A.K. Sanyal & party cool.

15. ***Gastrimargus africanus africanus*** (Saussure, 1884)

Material : 1 ♂; Solari, W Kameng; 26.9.84; R.N. Bhargava coll. 1 ♀; Motinagar, Silchar, Assam; 6.11.83; B.C. Saha coll.

Remarks : A very common sub-species.

16. ***Trilophidia annulata*** (Thunberg, 1815)

Material : 2 ♀♀; Kalak tang. W. Kameng; 27.12.85 and (2 nymphs); foothills, W. Kameng; 4.1.86; R.N. Bhargava coll. 1 ♀; Sepahi jala, Agartala; 6.2.83. 3 ♂♂; 1 ♀; Subhas Nagar, Agartala; 5.2.83; A.K. Sanyal & party coll.

IV Sub-family HEMIACRIDINAE

17. ***Spathosternum prasiniferum prasiniferum*** (Walker, 1871)

Material : 4 ♀♀, (and 1 nymph); Foothills, W. Kameng; 4.1.86. 2 ♂♂, 4 ♀♀; Kellong, W. Kameng; 7.1.86. 3 ♂♂, 4 ♀♀; Tipi, W. Kameng; 15.12.85. All by R.N. Bhargava coll. 3 ♂♂, 5 ♀♀; and numerous nymphs. Noadihing river, Namsai, Lohit district; 10.9.86; R.N. Bhargava coll. 1 ♂; Lembuchera, Agartala; 7.2.83; A.K. Sanyal & party coll.

18. ***Hieroglyphus banian*** (Fabricius, 1798)

Material : 1 ♂; Medo, Lohit district, Arunachal Pradesh; 26.9.86; R.N. Bhargava coll.

Remarks : A widespread species of India and a rice-pest.

V Sub-family OXYINAE

19. ***Oxya velox*** (Fabricius, 1787)

Material : 1 ♂, 1 ♀; Sunpura, Paya, Lohit district, Arunachal Pradesh; 17.9.86; R.N. Bhargava coll. 1 ♂, 3 ♀♀; Kheram, Lohit district; 25.9.86; R.N. Bhargava coll.

Remarks A common species.

20. ***Oxya paravicina*** Willemse, 1925

Material : 1 ♂, 1 ♀; Paya, Lohit district, Arunachal Pradesh; 14.9.86; R.N. Bhargava coll.

Remarks : The species was described in 1925 from India and it was revised by Hollis (1971) from 10 specimens of North-east India. The present *material* agrees to known account, and is a topotype (plate 1, figs. 1-2).

21. ***Oxya hyla hyla*** (Serville, 1831)

Material : 8 ♂♂, 9 ♀♀; E. Kameng; 13.12.85; R.N. Bhargava coll. 2 ♂♂; Subhasnagar, Agartala; 8.2.83. 2 ♂♂; Lembacherra, Agartala; 7.2.83. 2 ♂♂; Raipasa, Ambasa, Tripura; 20.2.83.

Remarks : A common subspecies, but recorded from Arunachal Pradesh for the first time.

VI. Sub-family COPTACRIDINAE

22. ***Eucoptacra praemorsa*** (Stal, 1860)

Material : 2 nymphs; Sutanlu, Namsai, Lohit district; 9.9.86. 2 ♂♂, 3 ♀♀; Kellong, W Kameng; 7-8.1.86 and 1 ♂; Forest Rest House, Tipi; W Kameng; 8.9.84; R.N. Bhargava coll. 3 ♂♂, 3 ♀♀; Moreh, Manipur; 24.11.83; B.C. Saha coll. 1 ♂, 1 ♀; Fatikchera, Agartala; 26.2.83. 2 ♂♂, 1 ♀; Khemsia Mangal, Teliamura, Tripura; 18.2.83. 1 ♂, 1 ♀; Raipasa, Ambasa, Tripura; 20.2.83.

Remarks : The species is common in Arunachal Pradesh and Tripura.

23. ***Apalacris varicornis*** Walker, 1870

Material : 1 ♂; Boisa, Nagaland; 20.11.83; S.K. Gupta coll.

Remarks : Previously known from "North India", Kurseong and Lebong, West Bengal, it is a new record for Nagaland.

24. *Circocephalus indica* Bhowmik & Haldar, 1982

Material : 1 ♂; Khellon, W Kameng; 7.1.86. 1 ♀; Pakni Ssanctuary, E. Kameng; 14.12.85. All R.N. Bhargava coll. 1 ♀; Cachar district, Assam; B.C. Saha coll. 1 ♂, 2 ♀♀; Ukhrúl, Manipur; 16-17.11.83; S.K. Gupta coll. 1 ♀; Bhutanghat, Jalpaiguri, West Bengal.

Remarks : The species was described from Darjeeling and Jalpaiguri districts of West Bengal. It is newly recorded here from Arunachal and Assam.

VII. Sub-family EYPREPOCNEMIDINAE

25. ***Choroedocus robustus*** (Serville, 1839)

Material : 1 ♀; Forest Rest House, Tipi, W. Kameng; 8.9.84; R.N. Bhargava coll.

Remarks : First described from Sylhet, the species is now known form Darjeeling and Jalpaiguri districts as well as from Calcutta (old collection) (Bhowmik and Halder, 1984). It is an endemic species of eastern India including Bangladesh.

26. ***Eyprepocnemis alacris alacris*** (Serville, 1839)

Material : 1 ♂, Kheram, Lohit district; 25.9.86; R.N. Bhargava coll. 1 ♂, (and 50 nymphs); Fatichara, Agartala; A.K. Sanyal & party coll. 26.2.83.

Remarks : This variable subspecies seems to be widespread throughout India. It is a new record from Arunachal Pradesh. The occurrence of 3-staged instars in February indicated postwinter breeding.

VIII. Sub-family CYRTACANTHACRIDINAE

27. ***Chondracris rosea*** (de Deer, 1773)

Material : 2 ♂♂, 3 ♀♀; Salari, W. Kameng; 26.9.84; R.N. Bhargava coll. 1 ♂; Churachandpur, Manipur; 20.11.83; S.K. Gupta coll.

Remarks : This species is common throughout India.

28. ***Patanga (Patanga) succincta*** (Fisher de Waldheim, 1870)

Material : 1 ♂; Churachandpur, Manipur; 20.11.83; B.C. Saha coll.

Remarks : The species, popularly known as the 'Bombay Locust', is rare in eastern India regions. Jago (1981) has proposed a new subgenric status for it. This is a new record for Manipur.

29. ***Pachyacris vinosa*** (Walker, 1870)

Material : 3 ♂♂, 2 ♀♀; Moreh, Manipur; 25.11.83. 1 ♀; Tamu, Burma; 24.11.83. All B.C. Saha coll.

Remarks : Distributed fairly widely in the woods of India, Burma and China. It is, however, a new record for Manipur.

IX. Sub-family CATANTOPINAE

30. ***Stenocatantops splendens*** (Thunberg, 1815)

Material : 1 ♀; Medo, Lohit district, Arunachal Pradesh; 26.9.86; R.N. Bhargava coll. 1 ♀; Forest Rest House, Tipi, W. Kameng; 8.9.84; R.N. Bhargava coll. 3 ♂♂;

Churachandpur, Manipur; 20.11.83; B.C. Saha coll. 2 ♂♂, 1 ♀; Sepahi Jala, Agartala; 6.2.83; A.K. Sanyal & party coll.

Remarks : Rather commonly distributed in India; this is a new record for Arunachal Pradesh and Manipur.

31. ***Xenocatantops humilis*** (Serville, 1839)

Material : 1 ♂, 3 ♀♀; Khellong, W. Kameng; 8.1.86. 1 ♂; Kalaktang; 27.12.85. 1 ♀; Kamlang, Lohit district, 23.9.86. All R.N. Bhargava coll. 1 ♂, 1 ♀; Harinchara, Ambasa, Tripura; 21.2.83; A.K. Sanyal & party coll.

Remarks : This is a very common species.

32. ***Catantops innotabilis*** (Walker, 1870)

Material : 2 ♂♂; Noa Dhihing river, Namsai, Lohit district, Arunachal Pradesh; 18.9.86; R.N. Bhargava coll. 2 ♂♂; Fatikchara, Agartala; 26.3.83; A.K. Sanyal & party coll.

Remarks : A very common species.

33. ***Cingalia dubia*** (Walker, 1870)

1941 (1940). *Cingalia (Mesambria) dubia* : Ramme, *Mitt.zool.Mus.Berlin*, 25(1) : 147

Material : 1 ♂, 4 ♀♀; Ukhrul, Manipur; 17.11.83; S.K. Gupta coll. 1 ♂, 1 ♀; Boisa, Nagaland; 30.11.83. S.K. Gupta coll.

Remarks : Previously known from SriLanka and Darjeeling (Bhowmik, 1986). Recorded here for the first time from the north-eastern Himalayas.

SUMMARY

33 species or subspecies of grasshoppers (Order Orthoptera : Family acrididae) belonging to 27 genera are recorded here from the north-eastern states of India. This including the discovery of 17 new records, has increasd the no. of species to 57 under 42 genera form the region. A complete list of species from the areas is provided in the appendix.

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APPENDIX

List of species of grasshoppers so far known from north - eastern states of India

(with inter - states distributions)

Name of species	*Distribution*
Sub family ACRIDINAE	
Acrida exaltata (Walk. 1859)	(Common)
Phlaeoba antennata Brunner, 1893	(Assam; Arunchal P; Tripura)
P. infumata Brunner 1983	(Arunachal Pradesh; West Bengal)
P. panteli Bolivar, 1902	(A.P. Tripura; West Bengal)
**P. assama* Ramme, 1941	(Assam; Arunachal Pradesh)
Ceracris nigricornis nigricornis (Walk. 1870)	(Arunachal Pradesh; Manipur)
C. n. laeta (Bolivar, 1914)	(Arunachal Pradesh)
C. deflorata (Brunner, 1893)	(Manipur)
Holopercna darjeelingenisis (Bolivar, 1914)	(Assam; Arunachal Pradesh)
H. sukhadae Bhowmik, 1965	(Assam)
Sub family GOMPHOCERINAE	
Aulacobothrus luteipes (W. 1871)	(Assam)
A. decisus Walk. 1871	(Manipur)
Aiolopus thal. tamulus (Fabr. 1793)	(Arunachal Pradesh)
Sub familiy OEDIPODINAE	
Trilophidia annulata (Th. 1815)	(Arunachal Pradesh)
Gastrimargus af. africanus (Sauss. 1884)	(Common)
Pternocirta cinctifemur (W. 1859)	(Meghalaya)
Acrotylus humbertianus (Sauss. 1884)	(Tripura)
Oedaleus abruptus (Th. 1815)	(Tripura)
Heteropternis respondens (W. 1859)	(Tripura)
Sphingonotus longipennis Saussure, 1888	(Assam; Arunachal Pradesh)
Sub family HEMIACRIDINAE	
Apalacris varicornis Walk., 1870	(Arunachal Pradesh; Nagaland)
Gesonula punctifrons (Stal, 1861)	(Arunachal Pradesh)
Spathosternum pr. prasiniferum (W. 1871)	(Common)
**Hieroglyphodes assamacris* Uvarov 1922	(Assam)
Hieroglyphus banian (Fabr. 1798)	(Arunachal Pradesh)
H. concolor (Walk 1870)	(Assam)
Sub family OXYINAE	
**Oxya grandis* Willamse, 1925	(Assam)
**Oxya paravicina* Willamse, 1925	(Assam; Arunachal Pradesh)

Name of species	*Distribution*
O. diminuta Walk. 1871	(Assam)
O. fuscovittata Marschall, 1836	(Assam)
O. velox·(Fab. 1787)	(Common)
Oxya japonica japonica (Thunberg, 1824)	(Assam)
O. hyla (Serville, 1839)	(Arunachal Pradesh; Tripura)
Hygracris palustris Uvarov, 1921	(Assam)
Sub - family COPTACRIDINAE	
Circocephalus indica Bhowmik & Halder 1982	(Assam; Arunachal Pradesh)
Eucoptacra praemorsa (Stal, 1860)	(Arunachal Pradesh; Tripura)
E. saturata (W. 1870)	(Assam)
**Traulia cachara* Kirby, 1914	(Assam)
Oxyrrhepes obtusa (de Haan,1842)	(Arunachal Pradesh)
Pseudocarsula tarsalis (Walker, 1870)	(Assam)
Tristria pulvinata (Uvarov, 1921)	(Assam)
Sub - family CALLIPTAMINAE	
**Peripolus pedarius* (Stal, 1878)	(Assam)
Sub - family EYPREPOCNEMIDINAE	
**Eyprepocnemis rosea* Uv. 1942	(Meghalaya)
E. al. alacris (Serville 1839)	(Arunachal Pradesh; Tripura)
**Choroedocus robustus* (Serville, 1839)	(Asssm; Arunachal Pradesh)
**Shirakiacris shirakii* (Bolivar, 1902)	(Assam)
Sub - family CATANTOPINAE	
Cingala dubia (Walk. 1870)	(Manipur; Nagaland)
**Assamacris striata* Uv. 1942	(Meghalaya)
**Indopodisma kingdoni* (Uvarov, 1930)	(Assam)
**Rhinopodisma assam* (Uvarov, 1930)	(Assam)
Catantops innotabilis (W. 1870)	(Arunachal Pradesh; Tripura)
Xenocatantops humilis (Serville, 1839)	(Assam; Tripura and Arunachal Pradesh)
Stenocatanops splendens (Th. 1815)	(Arunachal Pradesh; Manipur and Tripura)
Sub - family CRYTACANTHACRIDINAE	
Chondracris rosea (de Geer, 1773)	(Assam; Arunachal Pradesh)
Patanga (Patanga) succincta (Fisher de Waldheim 1870)	(Manipur)
Pachyacris vinosa (W. 1870)	(Mizoram; Manipur)
Cyrtacanthacris tatarica (Linn. 1758)	(Assam)

* Indicates type locality

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LEPIDOPTEROUS FAUNA OF GUJARAT, INDIA

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Butterflies have been reported earlier from Gujarat State by Nurse (1899), Aldrich (1946), Shull (1963, 1964), Shull and Nadkerny (1967), Nadkerny and Shull (1968), moths by Shull and Nadkerny (1964) and both butterflies and moths by Mosse (1929). Presently, 30 species and subspecies in 26 genera belonging to 11 families of butterflies and moths are dealt with from this area along with their common name, measurement of fore wing and geographical distribution. Of these, 11 species and subspecies constitute new locality records from seven Districts namely, Banas Kantha, Bharuch, Dangs, Mahesna, Panch Mahal, Rajkot and Sabar Kantha.

Family PAPILIONIDAE

1. *Atrophaneura aristolochiae aristolochiae* (Fabricius)

1775. *Papilio aristolochiae* Fabricius, *Syst. Ent.*, : 433.

1929. *Byasa aristolochiae*, Mosse, *J. Bombay nat. Hist. Soc.*, **33** (4) : 888.

1939. *Polydorus aristolochiae aristolochiae*, Talbot, *Fauna of British India (Butterflies)*, **1** : 86.

1946. *Tros aristolochiae aristolochiae*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 375.

1963. *Polydorus aristolochiae aristolochaie*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 593.

1981. *Pachliopta aristolochiae aristolochiae*, Arora and Mandal, *Rec. zool. Surv. India*, Occ. paper, No. **29** : 54-58.

1981. *Atrophaneura aristolochiae aristolochiae*, Varshney et al. *Rec. zool. Surv. India* Occ. Paper, No. **31** : 24-25.

1983. *Pachliopta aristolochiae aristolochiae*, Mandal and Nandi, *Rec. zool. Surv. India*, **81** : 367-368.

Material examined : Sabar Kantha District, Himatnagar, 1 ex., 5.xi.1964 (*R. N. Bhargava leg.*); Bharuch District, Rajpipla, 1 ex., 31.i.1975, Dangs District, Ahwa, 1 ex., 5.ii.1975 (*T G. Vazirani leg.*); Dangs District, Ahwa, 4 exs., 28.ix.1976 (*Y P Sinha leg.*). *Fore wing length.* - 42-53 mm.

Distribution : India.

Remarks : The butterfly, popularly called 'The Common Rose' was recorded from

Kathiawar (Mosse, 1929), as fairly common from Kheda District (Aldrich, 1946) and common throughout the year in South Gujarat (Shull, 1963). It is a new record for Sabar Kantha District.

2. ***Graphium agamemnon menides*** (Fruhstorfer)

1904. *Papilio agamemnon menides* Fruhstorfer, *Insektenk.* **21**(no. 23) : 181.
1929. *Zetides agamemnon*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 888.
1939. *Graphium agamemnon menides*, Talbot, *Fauna of British India (Butterflies)*, 1 : 232.
1945. *Zetides agammemnon menides* (Sic), Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 375.
1963. *Graphium agamemnon agamemnon*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 594.

Material examined : Bharuch District, 1 ex., 16.ix.1976 (*Y P. Sinha leg.*). *Fore wing length.* - 46 mm.

Distribution : Peninsular India and Sri Lanka.

Remarks : The butterfly, popularly known as 'The Tailed Jay' was reported from Kathiawar (Mosse, 1929), as rare from Kheda District (Aldrich, 1946) and as very common throughout the year in South Gujarat (Shull, 1963).

Family PIERIDAE

Subfamily PIERINAE

3. ***Delias eucharis*** (Drury)

1773. *Papilio eucharis* Drury, *Ill. exot. Ent.*, **2** : 16, pl. 10, figs. 5, 6, (♂).
1929. *Delias eucharis*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 889.

Material examined : Bharuch District, 9 exs., 10.ix.1976; Dangs District, Ahwa, 1 ex., 28.ix.1976 (*Y P. Sinha leg.*). *Fore wing length.* - 36-40 mm.

Distribution : India (Lower slopes of the Himalayas, Peninsular belts) and Sri Lanka.

Remarks : The butterfly, commonly known as 'The Common Jezebel' occurs in Kathiawar (Mosse, 1929), as fairly common in Kheda District (Aldrich, 1946) and common throughout the year (abundant from November to February) in South Gujarat (Shull, 1963).

4. ***Cepora nerissa phryne*** (Fabricius)

1775. *Papilio phryne* Fabricius, Syst. Ent., : 473.
1929. *Huphina nerissa*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 889.
1939. *Cepora nerissa phryne*, Talbot, *Fauna of British India (Butterflies)*, **1** 362.
1946. *Huphina nerissa evagete*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 375.
1967. *Huphina (Cepora) nerissa*, Shull and Nadkerny, *J. Bombay nat. Hist. Soc.*, **64**(2) : 264.

Material examined : Bharuch District, Rajpipla, 1 ex., 31.i.1975; Dangs District, Ahwa, 1 ex., 5.ii.1975 (*T G. Vazirani leg.*). *Fore wing length.* - 24-26 mm.

Distribution : India, Nepal and Sri Lanka.

Remarks : The butterfly, popularly called 'The Common Gull', occurs in Kathiawar (Mosse, 1929). This subspecies is common in Kheda District during October, November and December (Aldrich, 1946) and throughout the year in South Gujarat (Shull, 1963). Shull and nadkerny (1967) reported it from Surat and Dangs Districts.

5. ***Ixias marianne*** (Cramer)

1779. *Papilio marianne* Cramer, *Pap. Exot.*, **3** : 41, pl. 217, figs. C-E.
1929. *Ixias marianne*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 889.

Material examined : Bharuch District, 1 ex., 10.ix.1976 (*Y P Sinha leg.*). *Fore wing length.* - 26 mm.

Distribution : India and Sri Lanka.

Remarks : The butterfly, commonly known as 'The White Orange Tip' was reported from Kathiawar (Mosse, 1929), as common in Kheda District (Aldrich, 1946) and fairly common in south Gujarat (Shull, 1963).

6. ***Colotis danae dulcis*** (Butler)

1876. *Teracolus dulcis* Butler, *Proc. zool. Soc. Lond.*, : 157, pl. 7, fig. 13 (♂, ♀).
1929. *Colotis danae*, Mosse, *J. Bombay nat. Hist. Soc.* **33**(4) : 889.
1939. *Colotis danae dulcis*, Talbot, *Fauna of British India*(Butterflies), **1** : 472.
1946. *Colotis danae danae*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 375.
1963. *Colotis danae danae*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 595.

Material examined : Bharuch District, Rajpipla, 1 ex., 31.i.1975 (*T G. Vazirani leg.*). *Fore wing length.* - 23 mm.

Distribution : Pakistan (Sind to Baluchistan) and India (Kathiawar).

Remarks : The butterfly, commonly known as 'The Crimson Tip', was recorded from Kathiawar by Mosse (1929) and its common occurrence in Kheda District by Aldrich (1946). According to Talbot (1939) the nominate subspecies occurs in Peninsular India and Sril Lanka whereas *C. danae dulcis* (Butler) is distributed from Kathiawar and Sind to Baluchistan. Shull (1963) referred to this subspecies being uncommon in the Dangs District but common elsewhere in South Gujarat from October to April.

7. ***Catopsilia crocale crocale*** (Cramer)

1775. *Papilio crocale* Cramer, *Pap. Exot.*, **1** : 87, pl. 55, figs. C, D, ♀
1929. *Catopsilia crocale*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 889.
1939. *Catopsilia crocale crocale*, Talbot, *J. Bombay nat. Hist. Soc.*, **60**(3) : 596.

Material examined : Dangs District, Ahwa, 2 exs., 28.ix. 1976 (*Y P. Sinha leg.*). *Fore wing length.* - 28-30 mm.

Distribution : South China, India, Burma, Sri Lanka, the Philippines, Borneo, Sumatra and Java.

Remarks : The butterfly, popularly known as 'The Common Emigrant', was recorded from Kathiawar (Mosse, 1929), Surat and Dangs Districts (Shull and Nadkerny, 1967). The nominate subspecies is common in Kheda District (Aldrich, 1946) and abundant throughout the year having two distinct female forms, one white and the other yellow (Shull, 1963).

8. *Catopsilia florella gnoma* (Fabricius)

1775. *Papilio gnoma* Fabricius, *Syst. Ent. App.*, 828.
1929. *Catopsilia florella*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(2).
1939. *Catopsilia florella gnoma*, Talbot, *Fauna of British India* (*Butterflies*), **1** : 500-501.
1946. *Catopsilia florella gnoma*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 375.
1963. *Catopsilia florella gnoma*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 596.

Material examined : Banas Kantha District, 3 kms. west of Disa, Palanpur, 1 ex., 15.x.1964 (*V. C. Agarwal leg.*). *Fore wing length.* - 31 mm.

Distribution : India, Burma and Sri Lanka.

Remarks : The butterfly, popularly known as 'The African Emigrant' occurs in Kathiawar (Mosse, 1929), as common in Kheda District (Aldrich, 1946) and South Gujarat (Shull, 1963). Now, it is a new record for Banas Kantha District.

9. *Eurema hecabe simulata* (Moore)

1758. *Terias simulata* Moore, *Lep. Ceylon*, **1** :119.
1899. *Terias hecabe*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 511.
1929. *Terias hecabe*, *Mosse*, *J. Bombay nat. Hist. Soc.*, **33**(4) : 889.
1939. *Eurema hecabe simulata*, Talbot, *Fauna of British India* (*Butterflies*), **1** : 530.
1946. *Terias hecabe simulata*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 375.

Material examined : Banas Kantha District, Palanpur, Mansarovar tank, 4 exs., 10.x.1964, Disa, Palanpur, 1 ex., 14.ix. 1964, Kachchh District, Bhuj, Jakhawara tank, 1ex., 15.x.1964; Mahesna District, Anwar Talab, Patan, 3 exs., 30.x.1964; Sabar Kantha District, Himatnagar, 6 exs., 6.xi.1964 (*V C. Agarwal leg.*). Dangs District, Ahwa, 1 ex., 5.vii. 1975 (*T G. Vazirani leg.*). Bharuch District, 1 ex., 16.ix.1976 (*Y. P. Sinha leg.*). *Fore wing length.* 21-24 mm.

Distribution : India, Burma and Sri Lanka.

Remarks : The butterfly, popularly known as 'The Common Grass Yellow', was reported from Kachchh (Nurse, 1899), Kathiawar (Mosse, 1929) and as very common from Kheda District (Aldrich, 1946). Shull (1963) referred that it is abundant throughout

the year sometimes crepuscular and occasionally captured at mercury vapour lamp in Ahwa. Shull and Nadkerny (1967) also collected it by mercury vapour lamp from Surat and Dangs Districts. This subspecies is a new record for Districts of Banas Kantha, Sabar Kantha and Mahesna.

Family DANAIDAE

10. *Danaus chrysippus chrysippus* (Linnaeus)

1758. *Papilio chrysippus* Linnaeus, *Syst. Nat.*, (ed. 10), **1** : 471.
1899. *Danais chrysippus*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 511.
1929. *Danais chrysippus*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.
1946. *Danais chrysippus*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 376.
1947. *Danaus chrysippus chrysippus*, Talbot, *Fauna of British India (Butterflies)*, **2** : 19-23.
1963. *Danaus chrysippus*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 586.

Material examined : Dangs District, Ahwa, 2 exs., 7.ii.1975 (T G. Vazirani leg.); Bharuch District, Rajpipla, 7 exs., 10.ix.1976 (*Y P. Sinha leg.*). *Fore wing length.* - 33-35 mm.

Distribution : Extreme south-east Europe eastwards to India, Burma, Sri Lanka, Malaya, Sumatra, Borneo, the Philippines, Japan, China to Asia Minor.

Remarks : The butterfly is popularly known as 'The Plain Tiger' This nominate subspecies occurs in Kachchh (Nurse, 1899), Kathiawar (Mosse, 1929), as very common in Kheda District (Aldrich, 1946) and South Gujarat (Shull, 1963).

11. *Danaus genutia* (Cramer)

1779. *Papilio genutia* Cramer, *Pap. Exot.*, **3** : 23, pl. 203.
1899. *Danais genutia*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 511.
1929. *Danais plexippus*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.
1946. *Danais plexippus*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 376.
1947 *Danaus plexippus*, Talbot, *Fauna of British India (Butterflies)*, **2** : 25.
1960. *Danaus genutia*, Editors, *J. Bombay nat. Hist. Soc.*, **57**(1) : 230-231.
1963. *Danaus genutia*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 586.
1981. *Danaus genutia*, Varshney *et al.*, *Rec. zool. Surv. India Occ. Paper*, No. 31 : 13.

Material examined : Bharuch District, Rajpipla, 1 ex., 30.i.1975; Dangs District, Ahwa, 1 ex., 5.ii.1975 *(T G. Vazirani leg.)*, Dangs District, Ahwa, 6 exs., 28.ix.1976 *(Y P Sinha leg.). Fore wing length.* - 38-43 mm.

Distribution : Afghanistan, Pakistan (Baluchistan), India, Burma, Yunnan to South China and the Riu-Kiu Islands, Tongkong, Annam, Thailand, Wetar, Timor and Australia.

Remarks : The butterfly, commonly known as 'The Common Tiger' was recorded

from Kachchh (Nurse, 1899) , Kathiawar (Mosse, 1929), as rare in Kheda District (Aldrich, 1946) and common throughout the year in South Gujarat (Shull, 1963).

12. *Danaus limniace leopardus* Butler

1866. *Danais leopardus* Butler, *Proc. zool. Soc., Lond.*, : 52.
1899. *Danais liminiace* (Sic), Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 511.
1929. *Danais limniace*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.
1946. *Danais limniace mutina*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 376.
1947. *Danaus limniace leopardus*, Talbot, *Fauna of British India* (Butterflies), **2** : 31.
1963. *Danaus limniace mutina*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 585.

Material examined : Bharuch District, 4 exs., 31.i.1975 *(T G. Vazirani leg.). Fore wing length.* - 46-48 mm.

Distribution : South China, Pakistan (Chitral), India, Burma, Sri Lanka, and Thailand.

Remarks : The butterfly, popularly called 'The Blue Tiger', occurs in Kachchh (Nurse, 1899), Kathiawar (Mosse, 1929), Kheda District (Aldrich, 1946) and is common throughout the year in South Gujarat (Shull, 1963).

13. *Euploea core core* (Cramer)

1780. *Papilio core* Cramer, *Pap. exot.*, **3** : pl. 266, figs. E,F, ♂
1899. *Euploea core*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 511.
1929. *Euploea core*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.
1946. *Euploea core core*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 376.

Material examined : Dangs District, Ahwa, II exs., 28.ix.1976 *(Y P. Sinha leg.). Fore wing length.* - 43-46 mm.

Distribution : India.

Remarks : The butterfly, popularly known as 'The Common Indian Crow', was recorded from Kachchh (Nurse, 1899), Kathiawar (Mosse, 1929), Kheda District (Aldrich, 1946) and as very common throughout the year in South Gujarat (Shull, 1963).

Family ACRAEIDAE

14. *Acraea violae* (Fabricius)

1775. *Papilio violae* Fabricius, *Syst. Ent.*, : 460.
1929. *Telchinia violae*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.
1946. *Telchinia violae*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 376.
1947. *Acraea violae*, Talbot, *Fauna of British India (Butterflies)*, **2** : 466-469.
1963. *Telchinia violae*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 589.

Material examined : Sabar Kantha District, Himatnagar, 1 ex., 6.xi.1964 *(R. N.*

Bhargava leg.); Panch Mahal District, Godhra, 1 ex., 25.i.1975 *(T G. Vazirani leg.)*. *Fore wing length* - 18-20 mm.

Distribution : Peninsular India and Indo-gangetic plains upto the lower hills of Himalaya, and Sri Lanka.

Remarks : The butterfly, popularly known as 'The Tawny Coster', was recorded from Kathiawar by Mosse (1929), and from Kheda District by Aldrich (1946). Both of them them included this species in the family Nymphalidae. Aldrich *(loc. cit.)* remarked that this species listed to the south-west and south of Kheda, but not to the west or north. The Kheda record may, therefore, represent its north-western costal limit. Shull (1963) referred to this species being common throughout the year in the Surat and Dangs Districts and fairly common at Bharuch. This species is a new record for the Districts of Sabar Kantha and Panch Mahal.

Family NYMPHALIDAE

15. *Euthalia nais* (Forster)

1771. *Papilio nais* Forster, *Nov. Spec. Ins. Cent.*, **1** : 73.
1929. *Euthalia nais*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 590.

Material examined : Dangs District, Ahwa, 1 ex., 8.ii.1975 *(T G. Vazirani leg.)*. *Fore wing length.* - 32 mm.

Distribution : India and Sri Lanka.

Remarks : The butterfly, commonly called 'The Baronet', was recorded as rare from Bhavnagar by Mosse (1929) and as common throughout the year in South Gujarat (Shull, 1963).

16. *Hypolimnas bolina* (Linnaeus)

1758. *Papilio bolina* Linnaeus, *Syst. Nat.*, (ed. 10), **1** : 479.
1899. *Hypolimnas bolina*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 512.

Material examined : Dangs District, Ahwa, 5 exs., 28.ix.1975 *(Y P. Sinha leg.)*. *Fore wing length.* - 36-45 mm.

Distribution : Almost throughout the Oriental and Australian Regions.

Remarks : The butterfly, commonly called 'The Great Eggfly', occurs in Kachchh (Nurse, 1899), Kathiawar (Mosse, 1929), Kheda District (Aldrich, 1946) and as common throughout the year in South Gujarat (Shull, 1963).

17. *Neptis hylas astola* Moore

1872. *Neptis astola* Moore, *Proc. zool. Soc. Lond.*, : 560.
1932. *Neptis hylas astola*, Evans, *The Identification of Indian Butterflies* : 166.
1946. *Neptis hylas varmona*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 376.
1963. *Neptis hylas*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 587.

Material examined : Dangs District, Ahwa, 1 ex., 8.ii.1975, 2 exs., 11.ii.1975 *(T G. Vazirani leg.). Fore wing length.* - 26-29 mm.

Distribution : India, Burma and Sri Lanka.

Remarks : The butterfly, popularly known as 'The Common Sailer' was reported as rare in Kheda District by Aldrich (1946) who also remarked that it has not been recorded to the south-west of Bhavnagar, nor to the west or north of Kheda District.

18. ***Precis orithya swinhoei*** (Butler)

1885. *Junonia orithyia (sic) swinhoei* Butler, Ann. Mag. nat. *Hist. London*, (5) **16** : 309.

1899. *Junonia orithyia*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 511.

1929. *Precis orithya*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.

1946. *Precis orithya swinhoei*, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 376.

1963. *Precis orithyia* (sic), Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 588.

Material examined : Banas Kantha, Palanpur 7 exs., 12.x.1964 *(V. C. Agarwal leg.). Fore wing length.* - 21-23 mm.

Distribution : Pakistan (Baluchistan), India and Sri Lanka.

Remarks : The butterfly, commonly called 'The Blue Pansy' occurs in Kachchh (Nurse, 1899), and was recorded as very common in Kathiawar (Mosse, 1929), Kheda District (Aldrich, 1946) and as very common throughout the year in South Gujarat (Shull, 1963). It is a new record for Banas Kantha District.

19. ***Precis almana almana***, (Linnaeus)

1758. *Papilio almana* Linnaeus, *Syst. Nat.* (ed.10) **1** : 472.

1929. *Precis amana*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.

1946. *Precis almana almana*, Aldrich, *J. Bombay nat. Hist.* **46**(2) : 376.

Material examined : Banas Kantha District, 1 ex., 10.x.1964 *(V. C. Agarwal leg.)*, Dangs District, Ahwa, 1 ex., 8.ii.1975 *(T G. Vazirani leg.)*, Dangs District, 11 exs., 7.x.1976 *(Y P. Sinha. leg.). Fore wing length.* - 30-32 mm.

Distribution : Japan, China, India, Burma, Sri Lanka and Malayan subregion.

Remarks : The butterfly, popularly known as 'The Peacock Pansy' was recorded from Kathiawar by Mosse (1929), Kheda District by Aldrich (1946). This nominate subspecies is common throughout the year in South Gujarat (Shull, 1963). It is a new record for Banas Kantha District.

20. ***Cynthia cardui*** (Linnaeus)

1758. *Papilio cardui* Linnaeus, *Syst. Nat.*, (ed. 10), **1** : 475.

1899. *Pyrameis cardui*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 512.

1929. *Vanessa cardui*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 890.

1946. *Vanessa cardui*, Aldrich, *J. Bombay nat. Hist.* Soc., **46**(2) : 376.

1963. *Vanessa cardui*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 588.

1967. *Vanessa cardui*, Shull and Nadkerny, *J. Bombay nat. Hist. Soc.*, **64**(2) : 264.
1971. *Cynthia cardui*, Field, *Smithsonian Contributions to Zoology*, **84** : 37.
1977. *Cynthia cardui*, Varshney, *Newsl. zool. Surv. India*, **3**(1) : 13-14.

Material examined : Dangs District, Ahwa, 1 ex., 28.ix.1976 *(Y P. Sinha leg.). Fore wing length.* - 30 mm.

Distribution : Almost Worldwide.

Remarks : The butterfly, commonly known as 'The Painted Lady' occurs in Kachchh (Nurse, 1899), Kathiawar (Mosse, 1929) Kheda District (Aldrich, 1946), Surat and Dangs Districts (Shull and Nadkerny, 1967). It is found as very common throughout the year in South Gujarat (Shull, 1963).

Family LYCAENIDAE

Subfamily LYCAENINAE

21. ***Jamides celeno aelianus*** (Fabricius)

1793. *Hesperia aelianus* Fabricius, *Ent. Syst.*, **3**(1) : 280, no. 79.
1869. *Lampides aelianus*, Butler, *Cat. Fabr. Lep.*, : **166**, no. 16.
1907. *Lampides celeno*, Bingham, *Fauna of British India* (Butterflies), **2** : 404.
1962. *Jamides celeno aelianus*, Cantlie, *The Lycaenidae portion (except the Arhopala Group)* of Brigadier Evans' *The Identification of Indian Butterflies*, 1932 : 71.
1963. *Jamides celeno celeno*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 591.

Material examined : Panch Mahal, Godhra, 7 exs., 15.i.1975 (*T G. Vazirani leg.*). *Fore wing length.* - 14-18 mm.

Distribution : Pakistan, India and Burma.

Remarks : The butterfly, popularly called 'The Common Cerulean' is common throughout the year in South Gujarat (Shull, 1963). It is a new record for Panch Mahal District.

Subfamily THECLINAE

22. ***Curetis dentata dentata*** Moore

1874. *Curetis dentata* Moore, *Proc. zool. Soc.* Lond., : 137, 139.
1962. *Curetis dentata dentata*, Cantlie, *The Lycaenidae portion (except the Arhopala Group) of Brigadier Evans' The Identification of Indian butterflies*, 1932 : 104.
1963. *Curetis acuta dentata*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 592.

Material examined : Dangs District, Ahwa, 3 exs., 8.ii.1975 *(T G. Vazirani leg.). Fore wing length.* - 18-20 mm.

Distribution : India (Himalayas from Kulu to Assam; Madhya Pradesh, Pachmarhi; South India), and Burma.

Remarks : The butterfly, commonly known as 'The Toothed Sunbeam' was reported as fairly common throughout the year in South Gujarat (Shull, 1963).

Family HESPERIIDAE

23. ***Telicota augias augias*** (Linnaeus)

1763. *Papilio augias* Linnaeus, *Amoen. acad.*, **6** : 410.
1881. *Telicota augias*, Moore, *Lep. Ceylon*, **1**(4) : 169.
1949. *Telicota augias augias*, Evans, *A Catalogue of the Hesperiidae from Europe, Asia and Australia in the British Museum* : 394-395.
1963. *Telicota ancilla*, Shull, *J. Bombay nat. Hist. Soc.*, **60**(3) : 598.
1964. *Telicota ancilla*, Shull and Nadkerny, *J. Bombay nat. Hist. Soc.*, **61**(2) : 466.

Material examined : Dangs District, Ahwa, 4 exs., 5.ii.1975, 4 exs., 7.ii.1975 *(T G. Vazirani leg.). Fore wing length.* - 16-18 mm.

Distribution : India, Burma, Sri Lanka, Saigon, Malaya, Java, Banka and Borneo.

Remarks : The butterfly is commonly known as 'The Pale palm Dart.' Shull (1963) referred to this nominate subspecies (especially the dark brown) as being common from November to May in South Gujarat. Shull and Nadkerny (1964) also reported its occurrence in South Gujarat.

24. ***Pelopidas mathias mathias*** (Fabricius)

1798. *Hesperia mathias* Fabricius, *Suppl. Ent. Syst.* , : 443.
1899. *Chapra mathias*, Nurse, *J. Bombay nat. Hist. Soc.*, **12** : 513.
1929. *Baoris mathias*, Mosse, *J. Bombay nat. Hist. Soc.*, **33**(4) : 891.
1946. Baoris mathias mathias, Aldrich, *J. Bombay nat. Hist. Soc.*, **46**(2) : 377.
1949. *Pelopidas mathias mathias*, Evans, *A Catalogue of the Hesperiidae from the Europe, Asia and Australia in the British Museum* : 411-442.

Material examined : Kachchh District, Bhuj, Amisar tank, 5 exs., 19.x.1964, Rajrani tank, 1 ex., 25.x.1964 *(V. C. Agarwal leg.). Fore wing length.* - 16-18 mm.

Distribution : India, Sri Lanka, Burma, Siam (Thailand), malaya, Sumatra, Java, Batoe Is., Siberut, Mindoro, Celebes, Djampea, Lombok, Engano, Timor and Tenimber.

Remarks : The butterfly, popularly known as 'The Small Branded Swift' occurs in Kachchh (Nurse, 1899), Kathiawar (Mosse, 1929) and Kheda District (Aldrich, 1946). According to Shull (1963) the nominate subspecies is common throughout the year in South Gujarat.

Family SATURNIIDAE

Subfamily SATURNIINAE

25. ***Antheraea paphia*** (Linnaeus)

1758. *Phalaena bombyx paphia* Linnaeus, *Syst. Nat.*, Ed. **10**(1) : 496.
1964. *Antheraea paphia*, Shull and Nadkerny, *J. Bombay nat. Hist. Soc.*, **61**(2) : 284.
1979. *Antheraea paphia*, Arora and Gupta, *Mem. zool. Surv. India*, **16**(1) : 25.

Material examined : Dangs District, Ahwa, 2 exs. 8.ii.1964 *(T G. Vazirani leg.). Fore wing length.* - 62-70 mm.

Distribution : South China, India, Bangladesh, Nepal, Bhutan, Burma and Sri Lanka.

Remarks : The moth, popularly called 'The Indian Tasar Moth', was recorded from Surat and Dangs Districts by Shull and Nadkerny (1964). The cocoon of this moth is a source of the economically important tasar silk.

Family ARCTIIDAE

26. ***Creatonotus gangis*** (Linnaeus)

1764. *Phalaena gangis* Linnaeus, *Amoen. Acad.*, 6 : 410.
1822. Creatonotus interrupta, Huebner, Verz. bekannt. Schmett : 170.
1892. *Creatonotus interruptus*, Hampson, *Fauna of British India (Moths)*, **2** : 26.
1901. *Creatonotus gangis*, Hampson, *Cat. Lep. Phal. Brit. Mus.*, **3** : 333.
1914. *Creatonotus gangis*, Rothschild, In Seitz (1933) : *The Macrolepidoptera of the World*, **10** : 253.

Material examined : Sabar Kantha District, Himatnagar, Berna Village, 3 exs. 6.xi.1975 *(R. N. Bhargava leg.). Fore wing length.* - 20-22 mm.

Distribution : India, Burma, Sri Lanka to China and Australia.

Remarks : This species represents a new locality record from Sabar Kantha District in Gujarat State.

Family NOCTUIDAE

Subfamily AGROTINAE

27. ***Agrotis spinifera*** (Huebner)

1826. *Noctua spinifera* Huebner, *Eur. Schmett. Noct.*, : 83.
1894. *Agrotis biconica*, Hampson, *Fauna Brit. India, (Moths)*, **2** : 182.
1903. *Euxoa spinifera*, Hampson, *Cat. Lep. Phal. Brit. Mus.*, **4** : 177.
1971. *Agrotis spinifera*, Kapur and Arora, *Rec. zool. Surv. India*, **65**(1-4) : 107.

Material examined : Rajkot District, Okha, Suraj Karari tank, 2 exs., 13.iii.1966 *(V. C. agarwal leg.). Fore wing length.* - 15 mm.

Distribution : Persia, India, Bhutan, Burma and Sri Lanka.

Remarks : This species is a new record for Rajkot District in Gujarat.

Subfamily CATOCALINAE

28. ***Chalciope hyppasia*** (Cramer)

1779. *Phalaena (Noctua) hyppasia* Cramer, *Pap. Exot.*, **3** : 250.
1894. *Trigonodes hyppasia*, Hampson, *Fauna of British India (Moths)*, **2** : 527.
1899. *Trigonodes hyppasia*, Nurse, *J. Bombay nat. Hist. Soc.*, **12**(3) : 514.
1913. *Chalciope hyppasia*, Hampson, *Cat. Lep. Phal. Brit. Mus.*, **13** : 27.

1964. *Trigonodes hyppasia*, Shull and Nadkerny, *J. Bombay nat. Hist. Soc.*, **61**(2) : 292.

Material examined : Banas Kantha District, Palanpur (Dak bungalow), 8 exs., 11.x.1964 *(V. C. Agarwal leg.). Fore wing length.* - 23-25 mm.

Distribution : Africa, Mauritius, Aden, China, India, Burma, Sri Lanka, Java and Thailand.

Remarks : Shull and Nadkerny (1964) reported this species from Surat and Dangs Districts. It is a new record for Banas Kantha District.

29. ***Fodina stola*** Guenee

1852. *Fodina stola* Guenee, *Noct.*, **3** : 275, 1715.

1894. *Fodina stola*, Hampson, *Fauna of British India* (Moths), **2** : 530.

Material examined : Dangs District, Ahwa, 6 exs., 6.ii.1975 *(T G. Vazirani leg.). Fore wing length.* - 20-22 mm.

Distribution : India, Bhutan, Burma and Sri Lanka.

Remakrs : This species was recorded from Surat and Dangs Districts by Shull and Nadkerny (1964).

Family PYRALIDAE

30. ***Diaphania laticostalis*** (Guenee)

1854. *Nargarodes laticostalis* Guenee, *Delt. & Pyral.*, : 303, no. 315, ♂

1895. *Glyphodes laticostalis*, Hampson, *Fauna of British India* (Moths), **4** : 346.

1980. *Diaphania laticostalis*, Mandal and Bhattacharya, *Rec. zool. Surv. India*, **77** : Table I, no. 61.

Material examined : Dangs District, Ahwa, 3 exs., 7.ii.1975 *(T G. Vazirani leg.). Fore wing length.* - 41-43 mm.

Distribution : India, Burma, Sri Lanka, Pulo Laut; Sumbawa, Ceram and New Hebrides.

Remarks : This species is a new record from the Dangs District in Gujarat State.

SUMMARY

The paper incorporates the account of thirty species and subspecies distributed over twenty six genera belonging to eleven families of Lepidoptera from Gujarat along with their common name, fore wing length and geographical distribution. Of these, eleven are new locality records from seven Districts of the State.

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Nurse, C. G. 1899. Lepidoptera taken in Cutch. *J. Bombay nat. Hist. Soc.*, **12**(3) : 511-514.

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Talbot, G. 1939. The Fauna of British India including Ceylon and Burma (Butterflies), 1 : xxix + 600 pp., 2 pls., 1 map (Published by Taylor and Francis, London).

Rec. zool. Surv. India, 86(2) : 243-252, 1990

LARVIVOROUS FISHES OF MADRAS AND ADJOINING AREAS

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INTRODUCTION

Several references (Chacko and Rajagopal, 1962; Day, 1889; Evangeline and Subbiah, 1969, Misra, 1959; and Jayaram, 1981) to the fish fauna of Madras and its vicinity are available. But publications, on larvivorous fishes are few with the exception of Chacko (1950), Job (1940) and Menon (1977). The Corporation of Madras spends considerable amount of money every year on chemical control of mosquitoes. Ichthyologists (Bay, 1972; Hass and Pal, 1984; Hora, 1938; Job, 1940; Menon, 1977; Menon and Rajgopalan, 1977 and 1978), the report of the WHO, Travelling seminar on the use of Larvivorous Fish (WHO, 1980) and the WHO Informal Consultation on the use of fish for mosquito control (WHO, 1982) have, however, emphasised the importance of control of mosquitoes through the indigenous larvivorous fish. With a view to introduce extensive use of larvivorous fish for antimalarial measures and to make an assessment of the availability of indigenous larvivorous fishes in and around Madras, surveys were undertaken from February 1982 to July 1983 the results of which are embodied in this paper.

MATERIAL AND METHODS

Areas Surveyed : The following water bodies in and around Madras city were surveyed and material collected: Pillaipakkam Pond, Kovour Tank and Paddy fields, Vengampakkam Pond and Agaram lake, Thinnanur Tank and lake, Navalur Lake, and Chemmencheri Pond. For the purpose of collection, two types of minnow nets of two sizes were made from fine blue nylon netting of approximately 3mm. mesh. The smaller one was half meter in diameter ring net and another larger 3 × 1.5 sqm. seine. The fishes were presserved in 5% formaldehyde solution immediately after collection. The specimens are deposited in the Southern Reginal Station, Zooligical Survey of India, Madras.

RESULT

The specimens examined during the Present study comprised 13 species belonging to 10 genera. 3 of the species belong to the genus *Puntius* while the other 10 species belong to 9 different genera. The classification followed is after Jayaram (1981).

SYSTEMATIC ACCOUNT

Order CYPRINIFORMES

Family CYPRINIDAE

Subfamily CULTRINAE

Genus	*Chela* Hamilton
	Chela laubuca (Hamilton)
Subfamily	RASBORINAE
Genus	*Esomus* Swanson
	Esomus danricus (Hamilton)
Genus	*Danio* Hamilton
	Danio aequipinnatus Mc clelland
Genus	*Rasbora* Bleeker
	Rasbora daniconius (Hamilton)
Subfamily	CYPRININAE
Genus	*Puntius* Hamilton
	Puntius amphibius (Valenciennes)
	Puntius arenatus (Day)
	Puntius filamentosus (Valenciennes)
Order	ATHERINIFORMES
Family	CYPRINODONTIDAE
Genus	*Aplocheilus* Mc Clelland
	Aplocheilus blochii (Arnold)
	Aplocheilus lineatus (Valenciennes)
Genus	*Oryzias* Jerdon and Snyder
	Oryzias melanostigma (Mc Clelland)
Family	POECILLIDAE
Genus	*Gambusia* Poey
	Gambusia affi nis (Baird & Girad)
Genus	*Poecilia*
	Peocilia reticulatus (Peters)
Order	PERCIFORMES
Family	CICHILIDAE
Genus	*Etroplus* Cuvier
	Etroplus maculatus (Bloch)

The following account gives the valid names accompanied by outline sketches of the individual species, their distribution and particulars of material examined including the locality, date of collection, name of collector, number of examples and range of length in mm. in that order. Under remarks, the utility value of fishes for mosquito control is also discussed.

Chela laubuca (Hamilton)

(Fig. 1)

1822. *Cyprinus laubuca* Hamilton, *Fish Ganges*, pp. 260, 380 (type locality : Ponds of the northern parts of the Bengal).

1889. *Perlambus lubuca Day, Fauna Brit. India,* Fish., 1, p. 360.

Material : Kovur Tank, dt. 26.5.1982, K.I., 11 exs., 65-84 mm.; Navalur Lake, dt. 14.7.1983, K.I., 7 exs., 64-82mm.

Distribution : India: Andhra Pradesh, Madras, Orissa, West Bengal, Madhya Pradesh, Assam, Pakistan, Nepal, Bangladesh, Burma, Sri Lanka.

Remarks : This fish has upturned mouth and feeds at the surface and should, therefore, be useful in larvicidal measures (Hora, 1938).

Esomus danricus (Hamilton)
(Fig. 2)

1822. *Cyprinus danrica,* Ham. *Fish. Ganges,* pp. 325, 390, Pl. xvi. 886 type locality : Ponds & ditches of Bengal).

1889. *Nuria danrica,* Day, *Fauna Brit. India,* Fish; 1 p. 334.

Material : Kovur Tank and Paddy fields, dt. 24.4.82, K.I., 5 exs., 41-68mm.; Navalur lake, dt. 14.7.82; K.I., 18 exs., 40-78mm.

Distribution : India: Tamilnadu, Karnataka.

Remarks : This species is of larvicidal value and also used as an aquarium pet. This fish is gregarious and spends much of its time at the water surface, it lives in the shallow water of Ponds, tanks, pools, paddy fields, ditches etc., where, it breeds freely (Jayaram, 1981).

Danio aequipinnatus (Mc Clelland)
(Fig. 3)

1839. *Perilampus aequipinnatus* Mc Clelland, *Asiat. Res.,* 19, P. 393, Pl. 60, fig. 1 (type locality: Assam).

1889. *Danio aequippinnatus* Day, *Fauna Brit. India,* Fish; 1, P. 356.

Material : Thinnanur Tank and irrigation canals, dt. 27.7.83, K.I., 7 examples.

Distribution : Throughout India, Pakistan, Nepal, Bangladesh, China, Sri Lanka, Burma, Thailand, Sumartra, Yunnan Province.

Remarks : Several species of this genus *Danio* have been reported to have used as good larvicidal fishes (Hora, 1938 and WHO 1977).

Rasbora daniconius (Hamolton)
(Fig. 4)

1822. *Cyprinus daniconius* Hamilton, *Fish Ganges,* pp. 327-391, Pl. 15, fig. 89 (type locality : river of Southern Bengal).

1889. *Rasbora daniconius* Day, *Fauna Brit. India,* Fish, 1,

Material : Thinnaur Tank, dt. 28.7.82, K.I., 13 exs., 54-78mm.; Navalur Lake, dt. 14.7.82, K.I., 10 exs., 50-72mm; Agaram lake and Vengampakkam Pond, dt. 25.11.82, K.I., 13 exs. 58-78mm.

Distribution : Throughout India, Pakistan, Nepal, Bangladesh, Srilanka, Thailand, Vietnam, South China and Malaysia.

Remarks : This species may be used for mosquito contol in place where it occurs in great abundance. (Hora, 1938).

Puntius amphibius (Valenciennes)
(Fig. 5)

1842. *Capoeta amphibia* Valenciennes, *Hist. nat. Poiss.*, 16, p. 282, Pl. 478 (type location : Bombay).

1889. *Barbus amphibius* Day, *Fauna Brit. India,* Fish. 1, p. 322.

Material : Chemmancherry Pond dt. 22.7.82, K.I., 23 exs., 50-88mm.

Distribution : India : Freshwaters of U.P., Orissa, Madras, Central India, Deccan, Karnataka, M.P., Kerala, Bombay, and Sri Lanka.

Puntius arenatus (Day)
(Fig. 6)

1889. *Barbus arenatus* Day, *Fauna Brit. India,* Fish. 1, p. 321.

Material : Pillaipakkam Pond, dt. 30.4.82, M.B.R., 5 exs: Kovur Tank, dt. 14.7.82, K.I., 1 ex., 48mm., Thinnanur Tank, dt. 28.7.82 & 15.2.82, K.I., 24 exs. 35-82mm.

Distribution : India: Madras.

Puntius filamentosus (Valenciennes)
(Fig. 7)

1844. *Leucius filamentosus* valenciennes, *Hist. nat. Poiss.* 17, p. 96, Pl.492 (Type locality : Alypey).

1889. *Barbus filmentosus* Day, *Fauna Brit. India,* Fish; 1, p. 333.

Material : Kovur Tank, dt. 26.5.82, K.I., 1 ex., 47 mm.

Distribution : India: South India: Sri Lanka.

Remarks : Puntius spp. are very common in our country. There is hardly any body of fresh water where one cannot encounter some species or other of these "garden fishes" They are small, hardy forms of practically little value as food for human beings. They are able to stand transportation well and can breed freely in confined waters. Several workers have experimented with different species of this genus and have found them effective as larvicidal forms, (Hass, 1984; Hora, 1938).

Aplocheilus blochii (Arnold)
(Fig. 8)

1911. *Haplocheilus panchax* Var. blochii Arnold, *Wschv. Terrar. -u,* Terrerienk, 8, p. 672.

1916. *Panchax parvus* Raj, *Rec. Indian Musseum,* 12, p. 268. (rivers and tanks of Madras city).

Material : Kovur Pond and Paddy fields, dt. 27.7.83 K.I., 25, 32-40mm.

Distribution : India: Fresh and brackish water of Kutch, Ahemedabad, Madras; Pakistan and Sri Lanka.

Aplocheilus lineatus (Valenciennes)

1846. *Panchax lineatus* Valenciennes, *Hist. nat. Poiss.* 18, p; 381 (type locality : Bombay).

1889. *Haplocheilus lineatus*, Day, *Fauna Brit. India*, Fish, 1 p. 416.

Material : Pillaippakkam Pond, dt. 12.2.84, M.B.R. 3 adult exs. and 13 juvenile exs., 35-38 mm.

Distribution : India: Fresh and brackish waters along the coast of Bombay, Wynaad, Malabar, Travancore, Cochin, Coorg, Madras, Coromandel; Sri Lanka.

Remarks : *Aplocheilus* "the Indian top minnow", is the most suitable indigenous fish for destroying mosquito larvae. It is a perennial breeder and is hardy in nature, it can withstand transportation well, and live both in fresh and moderately brackish waters. Its life history by Job (1940) and its use for controlling the mosquitoes by Menon and Rajagopalan (1977 and 1978) have been studied in detail.

Oryzias melanostigma (Mc Clelland)
(Fig. 9)

1839. *Aplocheilus melanostigma* Mc Clelland, *Asiat, Res.;* 1 p. 301. 427, Pl.42, fig.3 (type locality: Tanks in Calcutta).

1889. *Haplocheilus melanostigma*, Day, *Fauna Brit. India*, Fish. 1, P. 415.

Material : Kovur Pond, irrigation cannals and paddy fields, dt. 24.4.82, 14.5.82 and 26.5.83, K.I., 58 exs., 32-38mm; Thainnanur Tank and Paddy field irrigation canals, dt. 15.2.83, K.I., 21 exs. 33-38mm.

Distribution : India: West Bengal, Orissa, Tamil Nadu; Kerala; Bangladesh, Burma, Thailand.

Remarks : This species is a perennial and rice-field breeder found in great abundance in the Paddy fields and irrigation canals of Kovur and Thinnanur and its utility for mosquito control was highly commended by Job (1940). The Prime vector of the Japanese encephalitis virus, the mosquito *Culex tritaeniorhynchus*, breeds in Paddy fields. From this, it would follow that the disease might occur in places wherever rice is cultivated. In fact, it has been found both in endemic and epidemic form in the ricegrowing areas of Tamil Nadu, Andhra Pradesh, West Bengal, Assam and Uttar Pradesh, and as expected, the distribution of cases has been predominately rural (Banerjee, 1979). It is important to mention here that the introduction of *Oryzias melanostigma* in such areas for anti-larval measures in the rice fields would be a boon for rural community to control the vector.

Gambusia affinis patruelis (Baird and Girard)
(Figs. 10 & 11)

1853. *Heterandria patruelis* Baird and Girard, *Proc. Acad. nat. Sci. Philad.*, 6. p. 390 (type locality: Rio Sabinal, Texas).

Material : Occurring in all the habitats during this survey.

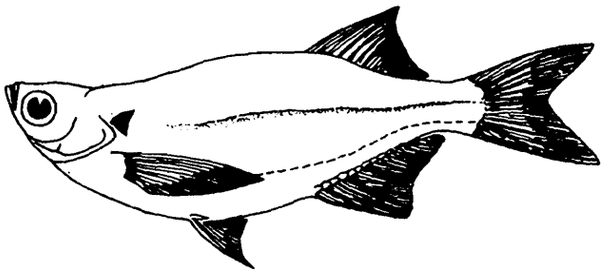

Fig. 1.

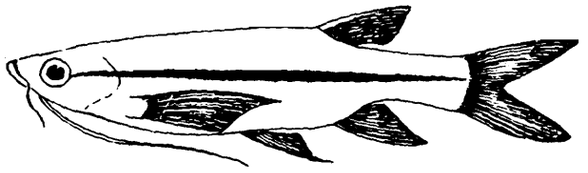

Fig. 2.

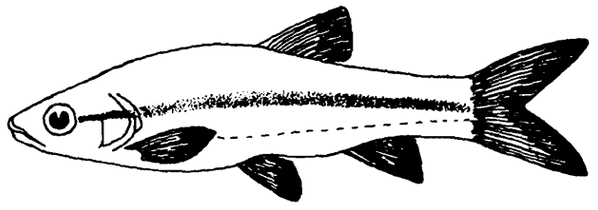

Fig. 3.

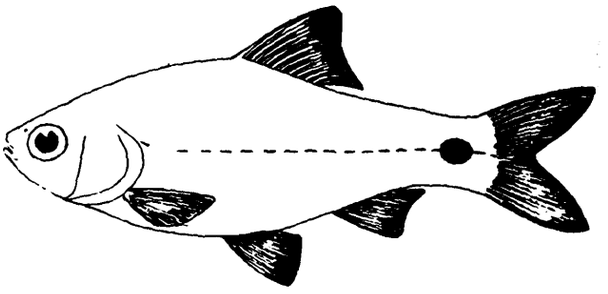

Fig. 4.

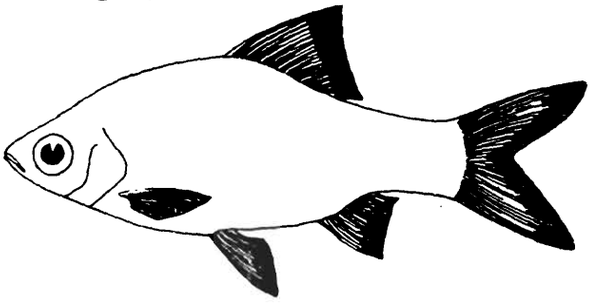

Fig. 5.

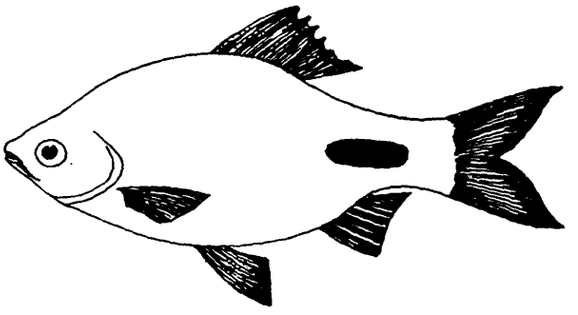

Fig. 6.

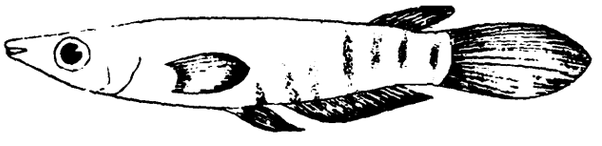

Fig. 7.

Fig. 1. *Chela laubuca* (Hamilton); Fig. 2. *Esomus danricus* (Hamilton); Fig. 3. *Danio aequipinnatus* Mc Clelland; Fig. 4. *Rasbora daniconius* (Hamilton); Fig. 5. *Puntius amphibius* (Valenciennes); Fig. 6. *Puntius filamentosus* (Valenciennes); Fig. 7. *Puntius arenatus* (Day)

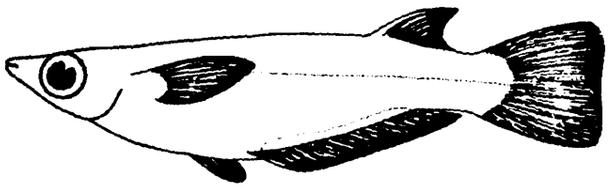

Fig. 8.

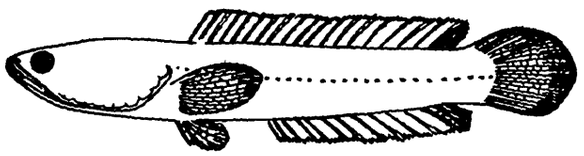

Fig. 9.

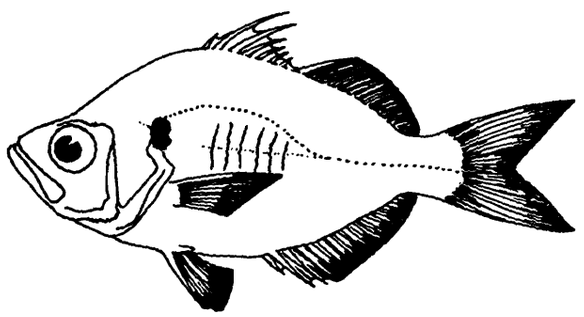

Fig. 10.

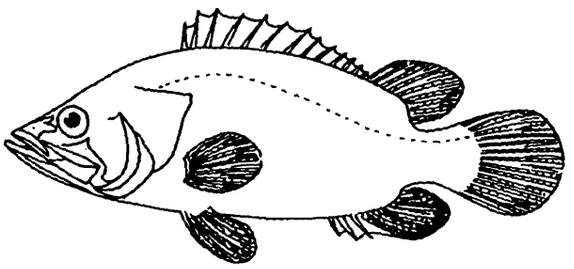

Fig. 11.

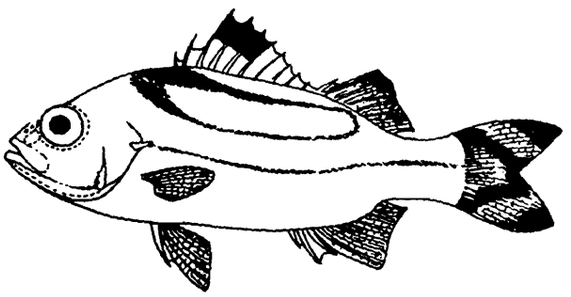

Fig. 12.

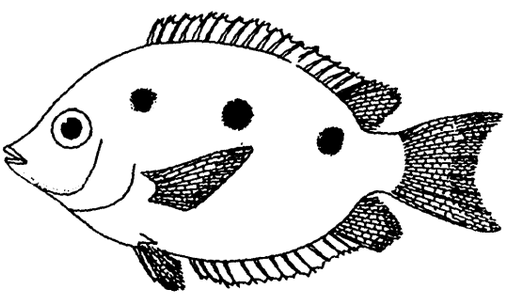

Fig. 13.

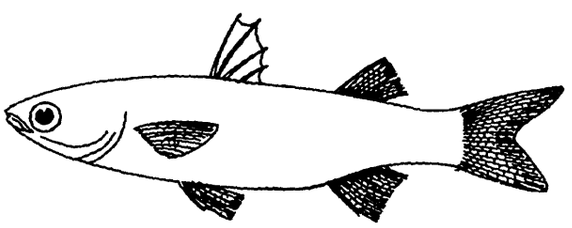

Fig. 14.

Fig. 8. *Aplocheilus blochii* (Arnold); Fig. 9. *Oryzias melanostigma* (Mc Clelland); Fig. 10. *Gambusia affinis* (Baird & Giard): Male; Fig. 11. *Gambusia affinis* (Baird & Giard): Female; Fig. 12. *Poecillia reticulatus* (Peters) Male. Fig. 13. *Poecillia reticulatus* (Peters) Female; Fig. 14. *Etroplus maculatus* (Bloch)

Distribution : Native to the Southern United states northward to Illinois an introduced in many parts of the world include India, Pakistan, Burma, Sri Lanka, Philippines Hawaii, Formosa and Italy.

Remarks : Gambusia has been and continues to be widely used for mosquito control. But considering its impact on the other aquatic animal life, its use for larval control has been controversial.

Poecilia reticulatus (Peters)
(Figs. 12 & 13)

1859. *Poecilia reticulatus* Peters, *Monatsber. AK. Wiss.* Berl. p. 412 (type : Caraccas, Brazil).

Material : Except in Navalur Pond this has also been found in all habitats during this survey.

Distribution : Originally from tropical America. Introduced into India, particularly well established in South India.

Remarks : *Poecilia* has been used for the control of *Anopheles tessellatus* whih breeds exclusively in wells and *A. sulepictus and Culex quinquefaciatus* (vector for filariasis) which breed in brackish water. (Haas and Pal 1984).

Etroplus maculatus (Bloch)
(Fig. 14)

1785. *Chaetodon maculatus*, Bloch. *Syst. Ichth.* p. 427 fig. 2. (type locality : not given).

1889. *Etroplus maculatus* Day. *Fauna Brit. India* Fish 2. p. 529.

Material : Pillaipakkam Pond, dt. 12.2.82, M.B.R., 2 exs., 35-65mm; Chemmancherry Pond, dt. 22.7.82 K.I. 15 exs. 32-60mm.

Distribution : India particularly in South India and Sri Lanka.

Remarks : A natural inhabitant of Brackish or sea Water, and it is easily acclimatised to the fresh water bodies like lakes and ponds. It thrives where luxuariant growth of acquatic vegetation is available. Since this fish is deep bodied and armed with spines it does not easily fall a prey to murrels. As such it can be cultivated safely along with murrels. Hora (1938) reported that young ones are active predator on mosquito-larvae.

DISCUSSION

Madras city continues to be favourite haunt of the malarial mosquito *Anopheles stephensi*. It was reported that it accounted for 60 per cent of the 67,912 malaria cases recorded in the State in 1983. In the last four years, the city did not give up its prime place even once. In 1980, 36, 196 cases were recorded in the city, while the entire State reported only 73,381 cases. The figures for 1981 was 44951 (71,517), for 1982 it was 44,981 (66,133) and for 1983 it was 44,817 (47, 912).

Recent studies have shown that the mosquitoes are devloping resistance not only to DDT, BHC and Malathion but also to the latest generation of synthetic Pyrethroid chemicals. The Indian Council of Medical Research (ICMR) has developed integrated environmental control methods to combat insecticide resistant malria carrying

mosquitoes and it used naturalistic methods and encouraged community participation to combat the menace. As it reported, after the application of larvivorous fishes in the Union territory of Pondicherry and Khera district of Gujarat, mosquito breeding in the ponds has been considerably reduced, and in many ponds, completely eliminated.

Poecillids such as *Gambusia* and *Peocilia* have got higher reproductive rate better protection from natural enemies which damage or eliminate indigenous species. The harmful effects of introduced exotic fish can include: reduction or elimination of local fish, reduction or elimination of plants which play a vital role in food chains of fish or necessary for the breeing of local fish or production of alterations favouring growth of other vectors of human diseases - e.g., it is conceivable that through the effects on other fish, *Gambusia* may favour filharziasis vectors. Therefore new introductions of exotic fishes should be considered with the almost care. (Haas and Pal 1984).

The Indian top minnows such as *Aplochilus blochii, A. lineatus, A. panchax, and Oryzias melanostigma* were long back in use, although *G. affinis and P. reticulatus* had been introduced into India about 1928 for controlling *Anopheles stephensi* and other amospheline mosquitoes. Menon and Rajagopalan (1977) carried out laboratory and field trials in Pondicherry with *A. blochii and O. melanostigma.* They were more effective against the well inhabiting mosquitoes *A. stephensi* and *A. subpictus* than was *Gambusia.* In particualar the species *O. melanostigma* has got a high growth rate, high reproductive capacity and shorter incubation period (Personal observations). The above factors would substantially provide better understanding for choosing them as good larvivorous fishes than the exotic ones.

In view of the above facts, Madras and its vicinity could also be brought under large scale mosquito control with the use of indigenous larvivorous fishes and community participation. A scheme, which may be called "Social Forestry" scheme, so that people can select and exploit the locally available larvorous fishes to control the mosquito. For example in areas like Kovur Pond, Paddy fields and Thinnanur pond and neighbouring irrigation canals, *Oryzias melanostigma,* and *Aplocheilus blochii* were noticed in abundance and these could be extensively used for anti-malarial measures.

SUMMARY

The distribution of larvivorous fishes with reference to mosquito control collected from Madras and its vicinity during 1982 and 1983 is reported. The availability of the species *Oryzias melangostigma* (Mc Clelland) in abundance and its significance for controlling the vector, *C. tritaeniorhynchus* of the Japanese encephalitis virus are discussed and the suggestion of "Social Fisheries" is also.

ACKNOWLEDGEMENT

The author is thankful to the Officer-in-Charge, Southern Regional Station, Zooligical Survey of India, Madras and the Director, Zoological Survey of India, Calcutta for providing facilities. Suggestion of this work by late Prof. M. Anantaraman, Professor Emeritus and confirmation of certain fishes and critically going through this paper by Dr. A.G.K. Menon, Emeritus Scientist of Zooligical Survey of India, Madras are gratefully acknowledged.

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SEASONAL STUDIES ON FRESHWATER CLADOCERA OF CHINGLEPUT TANK, TAMILNADU

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INTRODUCTION

Very little is known regarding the distribution of different species of Cladocera in Tamil Nadu. Earlier Sumithra Vijayaragavan (1970) studied on a natural population of *Daphnia carinata* King. Michael (1973) reported about Cladocera of Madurai area. Further Navaneethakrishnan and Michael (1971), Murugan and Sivaramkrishnan (1973,1976), Murugan (1975a,b,1977), Murugan and Venkataraman (1977) and Venkataraman and Job (1980) worked out the biology of certain cladocerans from Madurai. Polymorphism and predation of *Daphnia carinata* were dealt by JohnoBrien and Vinyard (1978). Murugan (1981) made observations on the natural history of cladocerans from a small pond in Madurai. Further studies on planktonic cladocerans were made by Raghunathan (1983,1985a,b,c,1986). Recently Venkataraman and Krishnaswamy recorded (1984a,b) two new records from TamilNadu. Further laboratory culture studies on *Diaphanosoma senegal* Gauthier were made by Venkataraman and Krishnaswamy (1985). Regarding cyclomorphosis further studies were made by Venkataraman and Krishnaswamy (1986) and Manimegalai *et.al* (1986). There appears to be a paucity on studies of the natural populations of Cladocera. Hence a long term study on the Cladocera of Tamilnadu was undertaken and here the study pertaining to Chingleput tank is discussed.

CHINGLEPUT TANK

Chingleput tank is 3.3 km. long and 1.6 km. wide and situated in Chingleput town, 58 km south of Madras. The average depth was 1.5 m. The tank has well developed boat club and regular fishing activities are undertaken. The following fishes were noted in the collections namely *Puntius dorsalis, Puntius sarana, Puntius parrah, Channa punctatus, Etroplus maculatus, Etroplus suratensis, Danio equipinnatus* and *Rasbora daniconius* indicating the availablity of more number of plankton feeding species. It is a perennial tank irrigating about 2000 ha. in fifteen villages and rain water is the major source of the tank.

MATERIAL AND METHODS

A 0.25 m(diameter) nylon net (0.3mm. mesh size) was operated (Length 1.0 m.) so that the attached rope (2.55m.) was in the water and in this manner plankton samples

were collected from a wooden boat. From April 1979 to June 1980 regular samples were collected. The samples were preserved in 5% formalin and made up to 250 ml. From this subsample of 2ml. was examined in a Sedgewick-rafter cell for counting purposes. Total number of specimens collected are given for 500 litres of water filtered assuming the filtration efficiency of the net is 100% (Rawson, 1956). Cladocerans were separated individually and indentified.

Surface water samples collected from two stations along with the plankton were analysed for dissolved oxygen (Winkler's method with azide modification) and pH. Other paramcters like depth, transparency, air temperature and water temperature were also recorded.

RESULTS
(Table 1 & 2)

From the results of two stations, the average was taken for each month. The air temperature fluctuated from a minimum of 26.5°C to a maximum of 32.5°C. The water temperature fluctuated between 26.5°C and 32.0°C. The maximum water temperature was recorded during April and May and the minimum in December.

TABLE 1

Physico-Chemical Parameters of Chingleput Tank

Month	Air Temp. C	Water C	Depth M	Transp. M	pH.	D.O. mg/1.
April 1979	32.5	32.0	1.50	0.75	7.10	1.20
May 1979	32.0	32.0	1.30	0.60	7.30	1.40
June 1979	29.0	28.0	1.40	0.60	7.65	0.90
July 1979	29.0	29.0	2.00	0.60	7.80	1.50
Aug. 1979	32.0	30.5	2.20	0.30	8.50	4.10
Sept. 1979	30.0	29.0	2.25	0.30	8.4	4.0
Oct. 1979	29.5	30.0	2.00	0.30	8.50	7.14
Nov. 1979	28.0	27.5	2.00	0.60	7.5	7.0
Dec. 1979	27.0	26.5	2.10	0.80	8.5	8.0
Jan. 1980	27.0	27.0	2.0	0.60	8.50	8.0
Feb. 1980	27.0	28.0	1.25	0.45	8.25	8.1
March 1980	29.0	29.5	1.30	0.50	8.2	8.4
April 1980	30.0	32.0	1.20	0.45	8.10	7.70
May 1980	32.0	32.o	1.10	0.30	8.00	15.60
June 1980	29.5	28.5	1.0	0.35	7.90	9.90

TABLE 2

Chingleput Tank - Plankton

Month	C. cornuta	M. micrura	D. excisum	Chy reti culatus	A. guttata	D.lum holtzi	Cal. cope pods	Cycl. cope pods	Cop. epo dite	Brac hio nus	Testu dinella
Apr. 1979	875	—	—	—	—	—	625	3500	—	—	—
May 1979	500	250	375	—	—	—	625	2875	90000	—	—
Jun. 1979	7625	2750	9500	—	—	—	1250	6625	875	—	—
Jul. 1979	2750	1500	1125	—	—	—	750	3000	1750	—	—
Aug. 1979	4750	1625	2250	875	375	—	2625	3375	6125	—	—
Sep. 1979	41750	5250	1875	22125	125	—	1125	3625	7125	1000	875
Oct. 1979	42750	5625	2125	—	—	—	1125	2125	1375	2875	3375
Nov. 1979	4750	3625	1125	1875	—	—	2750	750	3625	—	—
Dec. 1979	1750	125	—	1000	125	—	500	375	625	—	—
Jan. 1980	6125	625	2000	—	375	125	250	1375	2375	—	—
Feb. 1980	14125	125	4000	125	—	375	6500	—	3250	—	—
Mar. 1980	3125	—	2000	1000	—	—	3500	14750	16125	—	250
Apr. 1980	875	500	22625	—	—	—	1375	5875	7750	—	—
May 1980	375	—	5250	—	—	—	39875	6000	6750	—	—
Jun. 1980	—	—	875	48125	—	—	4250	6125	—	—	—

The maximum depth recorded was 2.25 m. during September 1979 and the minimum depth was 1.0 m. in June 1980. The transparency values ranged between 0.30 m. And 0.80. with maximum in December 1979 and minimum in August, September, October 1979 and May 1980.

The variation in pH accounted to 1.4 units between the highest value of 8.5 and the lowest value of 7.1. Higher values were recorded during August, October, December 1979 and January 1980. Dissolved oxygen content varied from a minimum of 0.9 mg/1. to a maximum of 15.6 mg/1. The maximum value (185%) was recorded in May 1980, perhaps because of good sunshine and more amount of primary production. Except between April and July 1979, the dissolved oxygen values were above 4 mg/1.

From the view point of the volume of plankton, the maximum of 10 ml. was noted in June 1979 and the minimum of 1.5 ml. in January 1980.

The species of Cladocerans encountered in the samples were *Ceriodaphnia cornuta* Sars; *Diaphanosoma excisum* Sars; *Moina micrura* Kurz; *Chydorus reticulatus* Daday; *Daphnia lumholtzi* Kurz and *Alona guttata* Sars.

Ceriodaphina cornuta was represented in almost all the samples except in June 1980, with maximum during October 1979 (42750) and more numbers in September 1979 (41750) and February 1980 (14125). *Diaphanosoma excisum* was noted in most of the samples except during April and Decempber 1979 with maximum in April 1980 (22625). On the other hand *Moina micrura* was represented from May 1979 to February 1980 with maximum in October 1979. Like *Ceriodaphinia cornuta. Chydorus resticulatus* was recorded from August 1979 with maximum during June 1980. *Daphnia lumholtzi* and *Alona guttata* were recorded only in very few numbers.

Among the other constituents, calanoid copepods were present in almost all samples with maximum during May 1980. Cyclopoid copepods were also present in the samples with maximum in March 1980. Rotifers namely *Brachionus* sp. and *Testudinella* sp. were present in September and October 1979.

DISCUSSION

During the present study the most dominant species were *Ceriodaphnia cornuta, Diaphanosoma excisum and Moina micrura. Ceriodaphnia cornuta* occurs in most of the freshwaters near Madras (Raghunathan, 1983). A major peak was noted in September and October 1979 and a minor peak in February 1980. During these periods increase in plankton volume was mainly due to the abundance of this species. During September, October 1979 and February 1980, the dissolved oxygen values were from 4.0 mg/1 to 8.1 mg/1. (52%to 102%) and the pH was on the alkaline side with 8.25 to 8.50. Michael (1962) has recorded *C. cornuta* from a pond during certain periods of the year with a rapid increase from January to March resulting in swarming conditions which was attributed to the abundance of flagellates and ciliates.

Moina micrura was also recorded in greater numbers during the same months namely September and October 1979. Parabrahmam et al (1967) have observed that an optimal pH of 7.5 to 8.2 and a temperature of 28°C to 31°C were suitable for the growth of *Moina micrura*. During the present investigation it was seen that the same temperature range accompanied by a pH range of 8.4 to 8.5 and dissolved oxygen values from 4.0 to 7.14 mg/1. were equally suitable for this species. Krishnamuthy (1967) however observed that dissolved oxygen values so low as 0 to 2.0 mg/1 were more suitable for the increase of *Moina* sp.

For *Diaphanosoma excisum* only one major peak was seen during April 1980. The dissolved oxygen values were higher namely 7.7 mg/1. (105%) with pH 8.1 during the peak period. A fair abundance of *Chydorus reticulatus* was noted in September 1979 with maximum in June 1980. During these months the dissolved oxygen values were between 4.0 to9.9 mg/1. and the pH from 7.9 to 8.4. The other forms namely *Daphnia lumholtzi* and *Alona guttata* were noted only in very few numbers and no comparable conclusions could be drawn. But *D. lumholtzi* is a rare species in the lower altitudes in Tamilnadu while it is not so rare in higher altitudes (Raghunathan, 1983). Here in Chingleput tank, out of thirty periodical collections only four samples contained *D. lumholtzi* and that too in fewer numbers.

SUMMARY

Studies on Cladocera of Chingleput tank were undertaken from April 1979 to June 1980. Six species of Cladocera namely *Ceriodaphnia cornuta* Sars; *Diaphanosoma excisum* Sars; *Moina micrura* Kurz; *Chydorus reticulatus* Daday; *Daphnia lumholtzi* Kurz and *Alona guttata* Sars, were encountered in the samples. The seasonal periodicity of cladocerans is correlated with ecological parameters namely temperature, pH, dissolved oxygen, depth and transparency.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, Calcutta; to Dr. R.S. Pillai, Joint Director, Southern Regional Station, Zoological Survey of India, Madras and to Dr. G.U. Kurup, Officer-in-Charge, Western Ghat Regional Station, Zoological Survey of India, Calicut for encouragement and facilities.

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ON SOME ASILIDAE (DIPTERA) PRESENT IN THE B. P. BISHOP MUSEUM, HONOLULU II

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INTRODUCTION

Through the courtesy of Dr. Neal L. Evenhuis, Associate Entomologist, B. P. Bishop Museum, Honolulu, Hawaii 96819, we have received a second lot of robber flies from India and Nepal and the result of the study is presented in this paper. The arrangement of genera followed in this paper is based on that given in "A Review of the Asilidae (Diptera) from the Oriental Region" by Joseph and Parui (1984a).

Types are deposited in the B. P. Bishop Museum, Honolulu and the Zoological Survey of India, Calcutta.

Laphria Meigen

1803. *Laphria* Meigen, *Magazin insektkde*, **2** : 270.

1. *Laphria frommeri* Joseph and Parui

1981. *Laphria frommeri* Joseph and Parui, *Ent. Scand.*, **12**(2) : 219.

Material examined : 1 ♂ (tip of abdomen lost), India. Tamil Nadu, Anamalai Hills, 1050 m., iv. 1956, Coll. P. S. Nathan; 1 ♂, 1067 m., v. 1956, other details as in preceding specimen.

Remarks : This is the second record of this species from the type locality. It has not been recorded elsewhere.

Cyrtopogon Loew

1847 *Cyrtopogon* Loew, *Linn. Ent.*, **2** : 516.

2. *Cyrtopogon laphrides* Walker

1851. *Cyrptogon laphrides* Walker, *Insecta Saundersiana*, **1** : 99.

Material examined : 2 ♂, 1 ♀, Nepal, Langtang Valley, 60 km. N. of Katmandu, 2700 - 3400 m., 12-23. x. 1965, Coll. L. V Quate.

Remarks : It is reported here for the first time from outside India.

Microstylum Macquart

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

3. *Microstylum bhattacharyai* Joseph and Parui

1984. *Microstylum bhattacharyai* Joseph and Parui, *Ent. Scand.*, **15** (4) : 450 451.

Material examined : 1 ♀, Tamil Nadu, Coimbatore, 420 m., iv. 1960, Coll. P. S. Nathan. 1 ♀, Pondicherry, Karikal, viii. 1970, Coll. P. S. Nathan.

Remarks : The species is described from Tamil Nadu and Kerala. The present report is the first from Pondicherry.

4. *Microstylum varshneyi* Joseph and Parui

1984. *Microstylum varshneyi* Joseph and Parui, *Ent. Scand.*, **15** (4) : 452 - 453.

Material examined : 2 ♂, Tamil Nadu, Coimbatore, 420 m., ix. 1962, Coll. P. S. Nathan.

Remarks : The species is only known from type locality.

Saropogon Loew

1847. *Saropogon* Loew, *Linn. Ent.*, **2** : 439.

5. *Saropogon hulli* Joseph and Parui

1981. *Saropogon hulli* Joseph and Parui, *Oriental Ins.*, **15** (1) : 27-28.

Material examined : 1 ♀, Kerala, Anamalai Hills, Cinchona, 1067 m., v. 1959, Coll. P. S. Nathan. 1 ♂, Tamil Nadu, Coimbatore, 420 m., xii. 1969, Coll. P. S. Nathan.

Remarks : So far the species is recorded from Kerala and Karnataka. It is recorded here for the first time from Tamil Nadu.

Stenopogon Loew

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

6. *Stenopogon kherai* Joseph and Parui

1976. *Stenopogon kherai* Joseph and Parui, *Ent. Scand.*, **7** : 105 - 106.

Material examined : 1 ♀, 1 ex. (abdomen lost), Kerala, Anamalai Hills, Cinchona, 1067 m., v. 1959, Coll. P. S. Nathan.

Remarks : The species was described from Bihar. This is the second record of the species and the first from Tamil Nadu.

7. *Stenopogon manii* Joseph and Parui

1981. *Stenopogon manii* Joseph and Parui, *Oriental Ins.*, **15** (1) : 106 - 107.

Material examined : 1 ♂, Kerala, Anamalai Hills, Cinchona, 1050 m., iv. 1956, Coll. P. S. Nathan.

Remarks : The species is only known from Kerala.

Trigonomima Enderlein

1914. *Trigonomima* Enderlein, *Wien, ent. ztg.*, **33** : 164.

8. *Trigonomima anamaliensis* Joseph and Parui

1980. *Trigonomima anamaliensis* Joseph and Parui, *Bull. zool. Surv. India*, **2** (2 & 3) : 197 - 199.

Material examined : 2 ♂ , Kerala, Anamalai Hills, Cinchona, 1067 m., v. 1956, Coll. P. S. Nathan. 10 ♀, v. 1967, other data as in preceding.

Remarks : The species is only known from Tamil Nadu.

Damalis Fabricius

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

9. *Damalis calicutensis* sp. nov.
(Fig. 1)

A small black species with yellowish-brown legs, and hyaline wings.with brown costal and subcostal cells. Male : length 11 mm, wing 9 mm; female : length 13 mm, wing 10 mm.

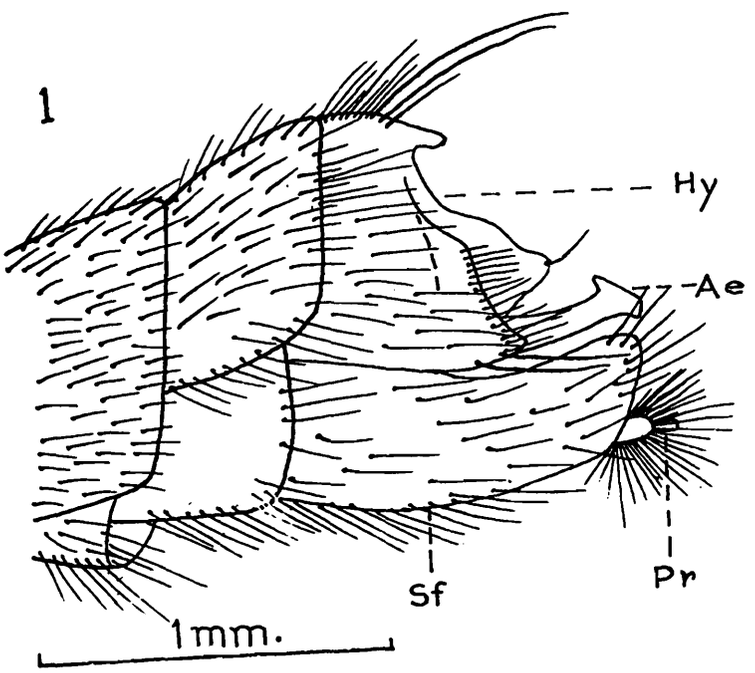

Fig. 1. *Damalis calicutensis* sp. nov., lateral view of male genitalia.

♂ : *Head* broader than thorax, black, tomentum grey or greyish-yellow, sparse; mystax a transverse row of four black bristles; fronto-orbital and ocellar bristles absent; postcranium sparsely grey tomentose with sparse white haris, a few hairs above black. Antenna black with distal half of style white, scape short, about one-fourth length of pedicel and ventrally bearing an elongate bristle, pedicel globular, bristles of both segments black, style elongate. Palpus and proboscis black, former with black and pale yellow hair, latter with a pair of elongate black hairs.

Thorax black, sparsely grey and greyish-yellow tomentum; pronotum with white hair; mesonotum medially black, laterally and posteriorly grey or greyish-yellow tomentose, humerus brown, vestiture medially black and the remainder white, scutellum with a ridge on hind border which bears a few elongate white hairs; pleuron sparsely grey tomentose. Haltere yellowish-brown, head marked with dark brown.

Leg mostly yellowish-brown, coxa black, remainder yellowish-brown except apices of all femora and apices of all tarsal segments being dark brown, vestiture predominantly black with a few pale yellow hairs, bristles black; apex of hind trochanter with a cluster of black spines apically, hind femur with an anteroventral row of black spines extending the complete length and a posteroventral row of 5-6 black spines on the distal half.

Wing hyaline with costal and subcostal cells brown.

Abdomen black, sparsely grey tomentose; terga 1 and 2 laterally with a few elongate white hairs, vestiture black. Genitalia (Fig. 1) black with black and a few white hairs. Hypandrium with a pair of long black hairs dorsally and one short and two long bristly hairs at apical corners.

♀ : Differs from male as follows: head rather densely grey tomentose; scape long, slightly longer than half the length of pedicel; hairs on proboscis pale yellow. Thorax densely grey tomentose; mesonotum with a broad, mediolongitudinal black stripe extending from anterior border to midway between transverse suture and hind border, remainder grey and greyish-yellow tomentose with two mediolateral black areas on each side. Haltere pale yellow, head marked black. Wing with brown colour extending along border into the 1st posterior cell. From abdominal tergum 3 to hind terga with white hairs.

It is very similar to *Damalis indica* (Joseph and Parui) but differs in the details of male genitalia : hypandrium devoid of spine medially and with one short and two long spiny bristles in the apical corner, and in the shapes of the aedeagus and of superior forceps.

Holytype : ♂, South India : Kerala State : Calicut District : Chembra Peak Area, 1067 m, coll. T. R. S. Nathan.

10. ***Damalis cederholmi*** (Joseph and Parui) new combination

1984. *Xenomyza cederholmi* Joseph and Parui, *Ent. Scand.*, **15** (4) : 448 449.

Material examined : 1 ♂, Kerala, Trivandrum District, Poonmudi Range, 900 m., iv - v. 1971, Coll. P. S. Nathan.

Remarks : This is the second record of the species from the type locality.

11. ***Damalis indica*** (Joseph and Parui) new combination

1984. *Xenomyza indica* Joseph and Parui, *Ent. Scand.*, **15** (4) : 444.

Material examined : 1 ♂ , 1 ♀, Kerala, Anamalai Hills, Cinchona, 1050 m., i. 1967, Coll. P. S. Nathan.

Remarks : The species was described from Kerala, Karnataka and Tamil Nadu. This is the second record of the species.

12. ***Damalis rufoabdominalis*** (Joseph and Parui) new combination

1984. *Xenomyza rufoabdominalis* Joseph and Parui, *Ent. Scand.*, **15** (4) : 445 447.

Material examined : 1 ♀, Kerala, Calicut District, Chembra Peak Area, v. 1970. Coll. T. R. S. Nathan. 1 ♂, Tamil Nadu, 420 m., iii - iv. 1971, Coll. P. S. Nathan.

Remarks : It was described from Kerala and Karnataka and subsequently reported from Tamil Nadu (Joseph and Parui, in press).

Cophinopoda Hull

1958. *Cophinopoda* Hull, *Proc. Ent. Soc.* Washington, **60** : 251.

13. ***Cophinopoda chinensis*** (Febricius)

1794. *Asilus chinensis* Fabricius, *Ent. Syst.*, **4** : 383.

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

Material examined : 1 ♀, Tamil Nadu, Coimbatore, 420 m., x. 1962, Coll. P. S. Nathan.

Remarks : It is a cosmopolitan species. Its detailed distribution in India is given by Joseph and Parui (in press).

Michotamia Macquart

1838. *Michotamia* Macquart, *Dipt. Expt.*, **1** (2) : 72.

14. ***Michotamia aurata*** (Fabricius)

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

1975. *Michotamia aurata* (Fabricius) : Oldroyd, *A Catalog of Diptera of the Oriental Region*, **2** : 130.

Material examined : 2 ♂, 2 ♀, Madhya Pradesh, Jabalpur, 480 m., x. 1957, Coll. P. S. Nathan. 1 ♀, Tamil Nadu, Coimbatore, 420 m., x. 1962, Coll. P. S. Nathan.

Remarks : It is widely distributed in India.

Ommatius Wiedemann

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

15. *Ommatius minor* Doleschall

1857. *Ommatius minor* Doleschall, Natuurk. *Tijdschr. Ned. Indie*, **14** : 394.

Material examined : 2 ♂ , 2 ♀, Kerala : Anamalai Hills, Cinchona, 1050 m., i. 1967, Coll. P. S. Nathan.

Remarks : The type locality of this species is Moluccas and subsequently recorded from Borneo, India, and New Guinea (Oldroyd, 1975). The species is only known from Kerala and Tamil Nadu (Joseph and Parui, 1984 d).

16. *Ommatius tuberculatus* Joseph and Parui

1983. *Ommatius tuberculatus* Joseph and Parui, *Ent. Scand.*, **14** (1) ; 87.

Material examined : 3 ♂, 1050 m., iv. 1956; 1 ♂, 1967 m., v. 1956; and 4 ♂ ♂, 1 ♀, v. 1970; all from Kerala, Anamalai Hills, Cinchona, Coll. P. S. Nathan.

Remarks : The species is only known from Kerala and Tamil Nadu.

Astochia Becker

1913. *Astochia* Becker, *Ann. Mus. Zool. Acad. St. Petersbourg*, **17** : 538.

17. *Astochia indica* Joseph and Parui

1984. *Astochia indica* Joseph and Parui, *Rec. zool. Surv. India*, Occ. paper No. **66** : 30 - 31.

Material examined : 1 ♂, Pondicherry, Karikal, xi. 1961, Coll. P. S. Nathan.

Remarks : The species was described from Karnataka. This is the second record of the species and for the first time from Pondicherry.

18. *Astochia karikalensis* sp. nov.

(Fig. 2)

A medium sized black species with yellowish-brown and dark brown legs and apically fuscous wings. Male : length 16 mm, wing 9 mm.

♂ : *Head* as broad as throx, black with dense greyish-white and greyish-yellow tomentum; mystax white, fronto-orbital plate bearing white and black hairs, ocellar bristles black, postcranium white haired, postocular bristles black or pale yellow and four on each side, postgena densely white haired. Antenna black, bristles black and present on basal two segments both dorsally and ventrally, bristles on segment 1 ventrally dense and a few of them elongate, segment 2 subequal to length of segment 1, segment 3 subequal to combined length of segments 1 and 2, style subequal in length to flagellum. Palpus and proboscis black, their hairs white.

Thorax black with grey tomentum; pronotum white haired with a median transverse row of pale yellow bristles; mesonotum with a mediolongitudinal black stripe divided by a narrow greyish-yellow stripe, stripe extending from anterior border to transverse suture, laterally with two large and one small black spots in a longitudinal row, vestiture black with a few white hairs anterolaterally and posterolaterally, bristles black; scutellum densely grey tomentose with long white hairs, hind border with a pair of black bristles; pleura grey tomentose with white hairs. Haltere pale yellow with dark brown mark on head.

Leg yellowish-brown and dark brown; coxa black with dense grey tomentum, trochanter black, femora yellowish-brown and dark brown, fore femur yellowish-brown with basal one-third and apex dark brown, mid femur similar but basal dark brown colour a little more extended, hind femur dark brown leaving a yellowish-brown subapical ring, tibiae yellowish-brown with dark brown tip, in hind tibia dark brown colour more extensive, tarsi dark brown, fore tibia with a ventral row of six, long black hairs, vestiture predominantly white with some black hairs, bristles black.

Wing infuscated distally, which continues posteriorly into the 5th posterior cell, remainder hyaline.

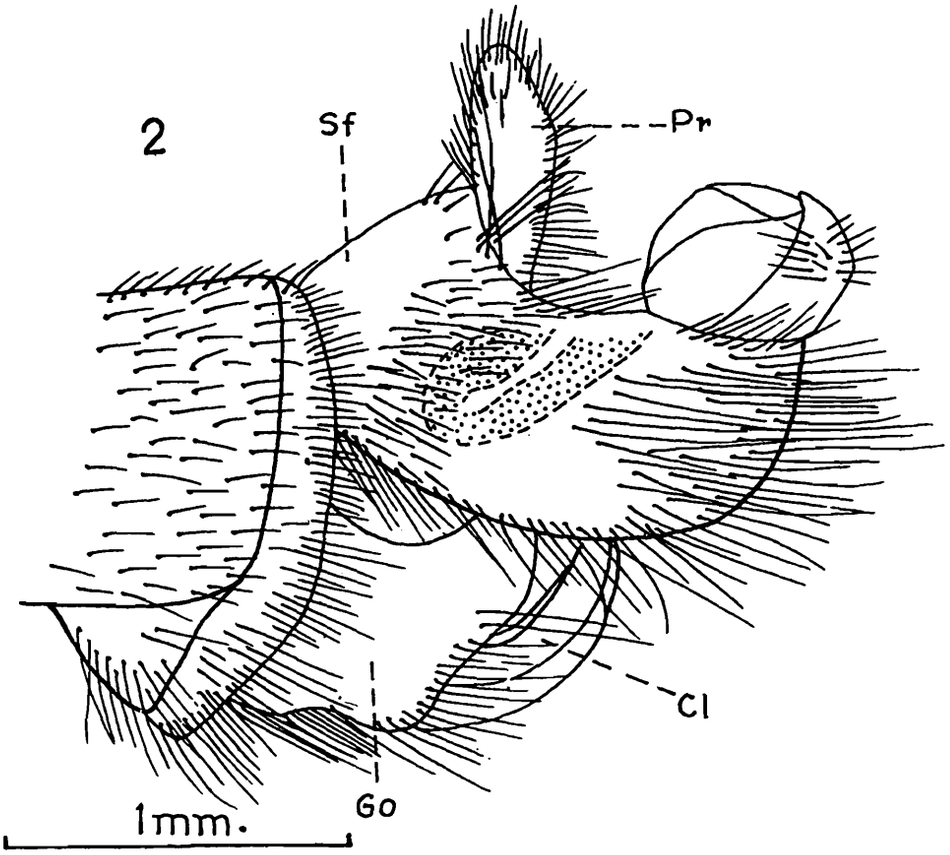

Fig. 2. *Astochia karikalensis* sp. nov., lateral view of male genitalia.

Abdomen black with grey tomentum, tergum 1 wholly grey tomentose, tergum 2 and beyond grey laterally and posteriorly leaving an anterior black area, terga 2 and 3 with posterior grey band abruptly narrows near middle leaving a small, median, triangular black area at posterior border, terga 1 and 2 and to some extent 3 laterally with long, white hairs, tergum 1 also bears a few black and white bristles, vestiture white. Genitalia (Fig. 2) black with black and white hairs.

Of all the known Indian species of the genus *Astochia*, *A. karikalensis* n. sp. is close to *A. bromleyi* Joseph and Parui from which the former can be readily separated by the leg colouration and the shape of superior forceps.

Holotype : ♂, South India : Pondicherry : Karikal, xi. 1962, Coll. P. S. Nathan.

Clephydroneura Becker

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

19. *Clephydroneura karnatakaensis* Joseph and Parui

1984. *Clepydroneura karnatakaensis* Joseph and Parui, *Rec. zool. Surv. India*, Occ. paper No.66 : 9 10.

Material examined : 1 ♂, Pondicherry, Karikal, xi. 1962, Coll. P. S. Nathan.

Remarks : This is the second record of the species and first time from Pondicherry.

Heligmoneura Bigot

1858. *Heligmoneura* Bigot, in Thomson, *Arch. ent.*, **2** : 356.

20. *Heligmoneura cheriani* Joseph and Parui

1980. *Heligmoneura cheriani* Joseph and Parui, *Ent. Scand.*, **11** (3) : 286 - 287.

Material examined : 1 ♀, Kerala, Anamalai Hills, Cinchona, 1067 m., v. 1956, Coll. P. S. Nathan.

Remarks : So far this species is recorded only from Kerala.

Machimus Loew

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

21. *Machimus angularis* (Ricardo)

1923. *Tolmerus angularis* Ricardo, *Ann. Mag. nat. Hist.*, (9) **10** : 64.

1975. *Machimus angularis* (Ricardo) : Olyroyd, *A Catalog of Diptera of the Oriental Region*, **2** : 144.

Material examined : 4 ♂, 1 ♀, Nepal, Langtang valley, 60 Km. N. of Katmandu, 2700 - 3400., 13 - 25, x. 1965, Coll. L. W. Quate.

Remarks : This Indian species was recorded earlier from Nepal by Joseph and Parui (in press).

22. *Machimus smithi* Joseph and Parui

1986. *Machimus smithi* Joseph and Parui, *Rec. zool. Surv. India.* Occasional paper No.96 : 51.

Material examined : 1 ♂, Kerala, Anamalai Hills, Cinchona, 1067 m., v. 1956, Coll. P. S. Nathan. 1 ♂, Kerala Calicut District, Chembra Peak Area, 1067 m., v. 1970, Coll. T. R. S. Nathan.

Remarks : This is the first record from Kerala. It was described from Tamil Nadu.

Philodicus Loew

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

23. *Philodicus ceylanicus* Schiner

1868. *Philodicus ceylanicus* Schiner, *Diptera Novara Reise*, : 179.

Material examined : 1 ♂, Kerala, Calicut District, Chembra Peak Area, 1067 m., Coll. T. R. S. Nathan. 1 ♂, Pondicherry, Karikal, ii - iv. 1971, Coll. P. S. Nathan.

Remarks : The species was described from Sri Lanka. Subsequently it has been recorded from Andaman Islands (Lal, 1960) and Nepal (Joseph and Parui 1984 d). It is recorded here for the first time from Kerala and Pondicherry.

24. *Philodicus pruthii* Bromley

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

Material examined : 1 ♀, Tamil Nadu, Coimbatore, 420 m., x. 1962, Coll. P. S. Nathan; 2 ♂, 1 ♀, xi. 1967, rest of data as in preceding.

Remarks : The species was described from Tamil Nadu and subsequently has been recorded from Andhra Pradesh, Karnataka and Madhya Pradesh.

25. *Philodicus raoi* sp. nov.
(Fig. 3)

A medium sized dark brown and yellowish-brown fly with grey or greyish-yellow tomentum or black with grey, greyish-white or greyish-yellow tomentum, yellowish-brown with varying infuscated or black legs, and distally light brown wings with closed first posterior cell. Male : length 16-19 mm, wing 10-12 mm; female : length 17-20 mm, wing 9-11 mm.

♂ : *Head* narrower than thorax, black, heavily greyish-yellow to greyish-white tomentose; mystax white, fronto-orbital plate white haired, ocellar bristles white, postocular bristles white, occipital hairs white, postgena densely white haired. Antenna yellowish-brown with dark brown style but in some specimens segment 3 also distally or wholly dark brown, segments 1 and 2 with white bristles both ventrally and dorsally, segment 2 two-thirds to three-fourths length of segment 1, length of segment 3 variable, from subequal to segment 1 to the combined length of segments 1 and 2. Palpus dark brown or black, proboscis black, their hairs white.

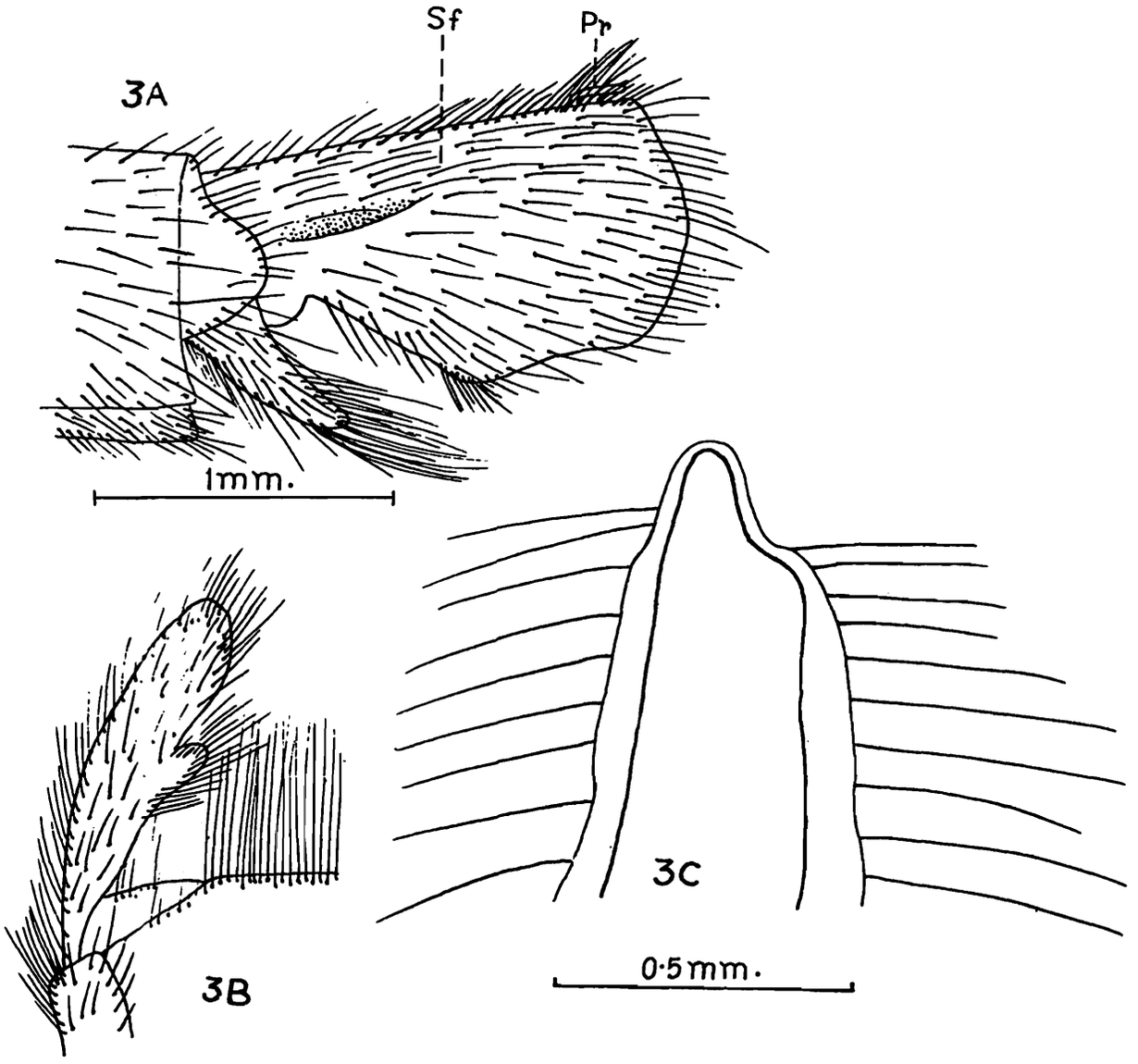

Fig. 3. *Philodicus raoi* sp. nov., A lateral view of male genitalia; B, ventral view of male genitalia; C, ventral view of eighth sternum of female.

Thorax dark brown and black with dense greyish-yellow tomentum or black with sparse grey tomentum; pronotum with a transverse row of white bristles, densely white haired laterally; mesonotum with a mediolongitudinal black stripe extending entire length which is divided by a median greyish-yellow or grey stripe extending from anterior border to midway between transverse suture and hind border, in black specimens the mediolongitudinal dividing stripe faint, laterally with two indistinct dark brown or black spots, vestiture black with some white hairs anterolaterally and posterolaterally, bristles white with some black ones on either side of mediolongitudinal stripe behind transverse suture, in black specimens all bristles white; scutellum greyish-yellow or grey tomentose with a median dark brown marking, disc white haired, hind borders with

two or four white bristles; metapleuron with a tuf of white hairs and bristles. Haltere completely pale yellow or to a varyig extent dark brown.

Leg yellowish-brown with varying extent of infuscaiion or black on femora and tibiae; in holotype fore femur anteriorly infuscated but for some distance basally and at apex yellowish-brown, mid femur similarly coloured but the infuscation lighter and smaller, hind femur infuscated for distal one-third length, fore tibia uniformly yellowish-brown, mid and hind tibiae apically infuscated, infuscation more distinct and occupying larger area on the latter, hairs and bristles white except for a few black bristles on tarsus; in paratypes fore and mid femora black anteriorly, dorsally and posteriorly but in one example extreme base yellowish-brown, basal one-fourth of hind femur or more yellowish-brown with the remainder black anteriorly, dorsally and posteriorly, fore tibia also infuscated, hairs and bristles similar to that of holotype.

Wing hyaline, distally light brown; 1st posterior cell closed.

Abdomen heavily greyish-yellow tomentose or black, tergum 1 laterally with a tuft of white hairs and bristles, tergum 2 laterally with two anterior and three posterior white bristles, terga 3-5 or beyond with three to four posterior white bristles, vestiture white. Male genitalia (Fig. 3) dark brown or black with white hairs.

♀ : Similar but with the following differences: in two examples even though mesonotum is black, it is with some black bristles on either side of the mediolongitudinal black stripe posterior to the transverse suture; leg colouration quite variable, one specimen with apex of fore tibia infuscated, another female with all legs yellowish-brown with apex of tibiae infuscated, the remaining paratypes like those of paratype males but showing much variation in the extent of infuscation or black colouration; one female with abdomen laterally yellowish-brown.

Genital black, spines on tergum 9 arranged more or less in two rows, anterior row with 8-12 large spines and posterior row with 4-7 small spines along with additional 1-4 still smaller spine in some cases.

Of all the known species in the genus *Philiodicus*, it is similar to *P grandissimus* Ricardo from which it differs in the closed 1st posterior cell and the shape of superior forceps. *P. jagannathi* Rao is the only other known Indian species with a closed 1st posterior cell but P. raoi differs from it in the mixed black and yellowish brown legs and presence of two rows of spines on the ninth tergum. The species is named in honour of Dr. K. R. Rao, our colleague and the well known worker on cicadellids.

Holotype : ♂, India : Thar Desert : Banmuel, 1.viii.1955, Coll. P. S. Nathan.

Paratypes 2 ♂♂, 1 ♀, data as in holotype; 1 ♂ and 6 ♀♀, India Thar Desert : Balmer, viii.1955, Coll. P. S. Nathan.

Promachus Loew

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

26. *Promachus jabalpurensis* Joseph and Parui

1981. *Promachus jabalpurensis* Joseph and Parui, *Oriental Ins.*, **15** (1) : 25-26.

Material examined : 2 ♂, 1 ♀, Madhya Pradesh, Jabalpur, 480 m., x.1957, Coll. P. S. Nathan.

Remarks : It is the third report from the type locality, Jabalpur. It is not known from any other locality.

SUMMARY

The paper deals with 26 species of 16 genera of Asilidae from India and Nepal. Of these, three are new species, i.e., *Damalis calicutensis* sp. nov., *Astochia karikalensis* sp. nov. and *Philodicus raoi* sp. nov.

ACKNOWLEDGEMENTS

We are indebted to Dr. Neal L. Evenhuis, Associate Entomologist of B. P. Bishop Museum, Honolulu, Hawaii, for giving on loan the robberflies dealt with in this paper. Our thanks are also due to Direction, Zoological Survey of India, Calcutta, for according the permission to study the material.

Abbreviations used in text figures

Ae, aedeagus; Cl, Clasper; Go, Gonopod (gonocoxite); Hy, hypandrium; Pr. proctiger; Sf, superior forceps (enandrium).

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DIGENETIC TREMATODES OF MARINE FISHES OF INDIA (SUPERFAMILY HEMIUROIDEA : FAMILY HEMIURIDAE)

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INTRODUCTION

The present study is based on 60 specimens mounted on 43 slides of digenetic trematodes of marine fishes of the bay of Bengal and Arabian Sea. The material will be deposited with the National Collections of the Zoological survey of India, Calcutta. The references marked with an asterisk (*) have not been seen by the author. The classification of Hemiuroidea Looss, 1899 as given by Gibson and Bray (1979) has been adopted here.

MATERIAL AND METHODS

The specimens were first studied alive after they were recovered from the fish hosts. They were allowed to relax in normal saline in cavity blocks. After the muscular body movement was slowed down, they were kept on clean slide one by one and covered with a cover glass and flattened gently with the tip of a needle under a binocular. They were then killed and fixed in A.F.A. using gentle pressure with the tip of the needle in order to avoid contraction of the body. They were allowed to remain in this condition covered with a petridish in order to avoid chances of drying. When fully fixed, they were removed in 70% alcohol and preserved in the same in air-tight small glass vials.

In the laboratory, they were overstained with alcoholoic borax carmine, treated with acid alcohol to remove excess of the stain, placed in ammonia alcohol to remove traces of acid and then washed thrice with 70% alcohol to remove any trace of the alkali. The specimens were then dehydrated in higher grades of alcohol, given a touch in xylol, cleared in clove oil and finally mounted in Canada balsam and dried.

All measurements in descriptions are in micrometres unless otherwise stated. Diagrams have been made with the aid of a camera lucida.

SYSTEMATIC ACCOUNT

Superfamily HEMIUROIDEA Looss, 1899

Family HEMIURIDAE Looss, 1899

Subfamily ELLYTROPHALLINAE Skrjabin and Guschanskaja, 1954

Genus 1. ***Lecithocladium*** Lühe, 1901

Syn. *Clupenurus* Srivastava, 1935

Magnapharyngium Bilqees, 1971

Colletostomum Sahai and Srivastava, 1978

Cleftocolleta Sahai and Srivastava, 1978

The genus *Clupenurus* Srivastava, 1935 has always been disputed one in the family Hemiuridae and has not been reported since it was erected. Its validity *vis-a-vis Lecithcladium* has always been doubted. Manter (1940) indicated that *Clupenurus* may be a synonym of *Tubulovesicula* Yamaguti, 1934. Later on, he (1947) revised his opinion and differentiated the two genera in the extent of glandular part of pars prostatica and in the absence or presence of cuticular plications on the body proper. He further suggested that *Clupenurus* should stand as a genus closely related to *Lecithocladium*, and Manter and Pritchard (1960) considered the former as a synonym of the latter. Fischthal and Kuntz (1963) also considered *Clupenurus* a synonym of *Lecithocladium* and emended the diagnosis of the latter genus. But Yamaguti (1971) considered it as a distinct genus. Gibson and Bray (1979) accept the validity of *Clupenurus* with a question mark. Probably they doubt that it has been adequately and correctly studied and described. They differentiated it from *Lecithocladium* on the basis of a glandular region of the pars prostatica largely in the forebody and a bulbous sinus-sac. In *Lecithocladium* the glandular region of pars prostatica is largely in the hindbody and the sinus sac is mainly tubular, narrow and usually situated in the forebody. But Gibson and Bray (1986) seem to have revised their opinion by considering *Clupenurus piscicola* Srivastava, 1935 as a synonym of *Lecithocladium harpodontis* Srivastava, 1937 with a question mark. However, they did not list *Clupenurus* as a synonym of *Lecithocladium.*

Clupenurus was described to have a plicated soma, a pharnyx which is longer thatn wide (if not cylindrical), a spindle-shaped or pyriform seminal vesicle with a muscular wall, a sinuous pars prostatica with a recurved proximal part surrounded by gland cells and a tubular vitellarium. These vital characters are also present in *Lecithocladium.* Therefore the synonymy of *Clupenurus* with *Lecithocladium* may be taken beyond doubt. Srivastava's *Clupenurus* must possibly be the result of erroneous study from badly processed specimens. I have examined hundreds of specimens of the fish *Hilsa ilisha* from various places along the Indian sea coasts and have found the trematode specimens recovered from them to be the same as *Lecithocladium ilishae* Mamaev, 1970, *L. ilishae* Bashirullh and D'Silva, 1973, *L. chauhani* Hafeezullah, 1975 and *Lecithocladium* sp. of Soota and Ghosh, 1977.

1. ***Lecithocladium piscicola*** (Srivastava, 1935)

Syn. *Clupinurus piscicola* Srivastava, 1935

Lecithocladium ilishae of Mamaev, 1970

L. ilishae of Bashirullah and D'Silva, 1973

L. chuhani Hafeezullah, 1975

Lecithocladium sp. Soota and Ghosh, 1977 (n.syn.)

Discussion : Gibson and Bray (1979) have doubted the validity of some other species (listed above) reported in *Lecithocladium* from *Hilss ilisha*. They (1986), however, finally considered them as synonyms.

The specimens of *Lecithoclaium* sp. of Soota and Ghsoh, 1977 mounted on two slides (Z.S.I. Reg. Nos.W 7249/1 and W 7250/1) were examined by the author, and they were found to be identical to *L.chauhani*. While sending the paper containing the description of *L. chauhani* to press, the descriptions of *L. ilishae* of Mamaev, 1970 and *L.ilishae* of Bashirullah and D'Silva, 1973 had not become available to the author. Presuming that the original description of *Clupenurus piscicola* is inaccurate, the author concurs with Gibson and Bray (1986) that the other four species of *Lecithocladium* reported from *Hilsa ilisha* are synonymous with it, but it is hard to share their (1986) opinion that all these species are in their turn synonyms of *L. harpodontis* Srivastava, 1937.

Colletostomum Sahai and Srivastava, 1978 has been described from the fish host *Pseudosciaena diacanthus* from Bombay coast. It comes well within the concept of *Lecithocladium*. The reported presence of "an everted, circular, appreciably broad collar around the oral sucker" may be a fixation artifact and needs corroboration after rechecking *Colletostomum muthiai* Sahai and Srivastava, 1978, the type species of the genus.

Cletftocolleta Sahai and Srivastava, 1978 (type species *C.magnum*) from the stomach of *Scomberoides tala* from the Madras coast is nothing but a *Lecithocladium*. The reported presence of a muscular collar around the oral sucker of the type species may also be a fixation artifact and requires confirmation.

2. ***Lecithocladium apolecti*** Velasquez, 1962

Syn. *L. exisiforme* of Gupta and Sehgal (1971)

L. annulatum of Gupta and Sehgal (1971)

L. annulatum of Gupta and Sehgal (1971)

L. hexavitellarii (Bilqees, 1971)

L. excisiforme of Radhakrishnan and Nair (1979) (n. syn)

L. stromatei Farooq and Khanum, 1980

(Figs. 1-7)

Host : *Formio niger* (Bloch), black pomfret. (Family Formionidae)

Syn. *Parastromateus niger* (Bloch)

Apolectus niger (Bloch)

Location : Stomach.

Localities : Veraval, Okha (Arabian Sea).

Number of Specimens : 6, on 6 slides (from Veraval); collected on 16.11.1965; 2, on 1 slide (from Okha); collected on 8.11.1978

Description : Body 10.09 - 15.37 mm long, 0.89 - 1.19 mm wide at junction of soma and ecsoma, elongate, attenuated posterior to acetabulum; ecsoma 3.82-6.91 mm long, 0.73-1.04 mm wide, tapering to a rounded posterior end. Tegument thin, feeble rings at places discernible in some specimens, otherwise smooth, 'Kraüselung' absent. Acetabulum 364-418 long, 378-459 wide, spherical, at 0.76-1.12 mm from anterior end. Oral sucker 397-451 wide, funnel-shaped, terminal, ventral lip having two notches. Muscular protrusion ('Nacken-buckel') dorsal to oral sucker not sen. Preoral lobe absent. Sucker width ratio 1 : 0.91-0.99. Pharynx 378-391 long, 195-243 wide, muscular, cylindrical; oesophagus short, oval, followed by intestinal bifurcation; 'Drüsenmagen' formed, then turning back and reaching almost posterior end of body.

Tests two, 378-999 long, 270-378 wide, entire, globular or oval, tandem, in middle or hind region of soma, preovarian. Seminal vesicle 715-970 long, saccular or elliptical, elongate, with thick muscular walls, in hind body; pars prostatica long, slightly convoluted,weekly developed, with prostate gland cells (which are also weakly developed) surrounding it along its full length but becoming faint anteriorly, joining metraterm postero-dorsal or antero-dorsal to acetabulum (Figs. 6-7) to form hermaphroditic duct, in one specimen even joining posterior to pharynx. Hermaphroditic duct very long, slender, enclosed in long tubular sinus-sac, occasionally projecting out of genital pore. Genital atrium probably shallow.

Ovary 222-378 long, 289-357 wide, subglobular, entire, median, situated in middle of hind region of body near junction of body proper and ecsoma or descending into tail near junction (Fig. 5). Juel's organ present attached to ovary posteriorly. Shell gland present. Vitellarium 7 long winding tubules, extending or not into ecsoma depending upon position of ovary, or entirely into ecsoma in cases where ovary descends into it (Fig. 5). Uterus voluminous, descending up to middle of ecsoma; metraterm differentiated, very long, winding. Eggs small, 14 × 7 µm, very numerous, dark.

Excretory vesicle Y-shaped, arms uniting dorsal to oral sucker; excretory pore terminal.

Discussion : The chief characteristics of these specimens are: tegument feebly ringed and discernible with difficulty in a few places only, otherwise it is smooth. The gonas are situated normally in the middle third of the soma but the ovarian complex may also be found to occur in various positions in its posterior third, or it may even descend into the ecsoma near the junction (Figs. 2-5). With the gradual posterior displacement of the ovary, the testes also move posteriorly. The vitelline tubules are distributed in a particular fashion posterior to ovary, a few of them entering ecsoma. In some specimens a few tubules extended anteriorly to the ovary (Figs. 2-3). The pars

prostatica is not very tortuous and is surrounded by feebly developed prostatic gland cells. The eggs are very minute measuring 14 × 7 μm.

L. stromatei Farooq and Khanum, 1980 and *L. hexavitellarii* (Bilqees, 1971) do look identidal to *L. apolecti*, but, contrary to Bray and Gibson (1986), *L. anteroporus* (Bilqees, 1971), *L. tetravitellarii* (Bilqees, 1971), *L. microductus* (Bilqees, 1971), *L. arabiana* (Bilquees, 1971), *L. octovitellarii* (Bilquees, 1971) and *L. microcaudum* (Bilqees, 1971) differ from *L. apolecti* in certain respects.

3. *Lecithocladium megalaspis* Yamaguti, 1953
(Fig. 8)

Host : *Megalaspis cordyla* (Linn.), torpedo (Family Carangidae).

Location : Stomach.

Locality : Bombay (Arabian Sea).

Number of Specimens : 5, on 5 slides; collected on in May 1964.

Discussion : The posterior limit of the hermaphroditic duct, as studied in five specimens, extends to various distances between the pharynx and the anterior border of the acetabulum. It seems to be a variable character, at least in *Lecithocladium*, and care should be exercised in using it as a diagnostic character.

4. *Lecithocladium glandulum* Chauhan, 1945
(Fig. 9)

Host : *Caranx carangus* (Bloch), black tailed trevally, (Family Carangidae).

Location : Stomach.

Locality : Madras (Bay of Bengal).

No. of Specimens : 3, on 3 slides; collected on 9.11.1964.

Discussion : Originally, Chaunan (1945) described this species from *Lutianus johnii* (type host) and *Mugil speigleri* from the Bombay coast. *Caranx carangus* is a new host record for this species.

Subfamily DINURINAE Looss, 1905

Genus 2. *Tubulovesicula* Yamaguti, 1934

Syn. *Transversolecitha* Sahai and Srivastava, 1978 (n. syn.)

5. *Tubulovesicula angusticauda* (Nicoll, 1915)
Transversolecitha scaberi Sahai and Srivastava, 1978 (n. syn.)
(Figs. 10, 11)

Host : *Platycephalus scaber* (Linn.), Rough flathead, (Family Platyecphalidae).

Location Stomach.

Locality : Karwar (Arabian Sea).

No. of Specimens : 2, on 2 slides; collected on 20.5.1965.

Discussion : The two specimens agree well with the description as provided by Manter and Pritchard (1960) except for the sucker ratio (1: 2.39 in the present material, as against 1 : 1.7-1.8). Only in one of them does the seminal vesicle not extend posterior to the acetabulum.

Transversolecitha scaberi Sahai and Srivastava, 1978, described from the same species of host from Madras (Bay of Bengal) is considered a synonym of *Tubulovesicula angusticauda*. Sahai and Srivastava (1978) have reported their genus and species from improperly preserved specimens in which the tubular seminal vesicle is coiled and the tubules of vitellarium could have been extended.

Tubulovesicula angusticauda has also been reported from Australia, New Zealand, the Celebes and Hawaii.

Genus 3. ***Uterovesiculurus*** Skrjabin and Gushanskaja, 1954

Syn. *Exoticotyle* Sahai and Srivastava, 1978 (n. syn.)

6. ***Uterovesiculurus lemiriensis*** (Tubangui and Masilungan, 1935) (Fig. 12)

Host : *Scomberoides lysan* (Forskal), doubledotted queenfish, (Family Carangidae), and *Caranx melampyqus* Cuvier, Bluefin jack, (Family Carangidae).

Location : Stomach.

Localities : Viskhapatnam (Bay of Bengal) and Karwar (Arabina Sea).

No.of Specimens : 3 + 7, total 10 on 3 + 7 slides; collected on 17.10.1964 and in 1965 respectively.

Discussion : Hafeezullah (1975) commented at length on this species. Velasquez (1962) redescribed it from the same species of fish from the Philippine. The redescription agrees fairly well with the original in general morphology except for slight differences in certain body measurements and egg size. *Exotycotyle* Sahai and Srivastava, 1978 (type species *E. labiatus*) is beyond any shadow of doubt a synonym of *Uterovesiculurus*.

7. ***Uterovesiculurus paralichthydis*** (Yamaguti, 1934)

Syn. *U. platycephali* (Yamaguti, 1934)

U. indicus Sahai and Srivastava, 1978 (n.syn.) (Fig. 13)

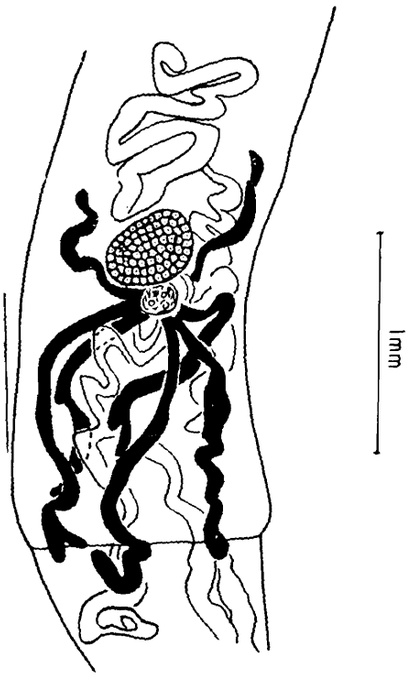
Host : *Platycephalus indicus* (Linn), Indian flathead, (Family Platycephalidae).

Location : Stomach.

Locality : Tuticorin (Gulf of Mannar); Madras.

No. of Specimens : 5 + 2, on 7 slides; collected on 8.1.1965 and 27.11.1964 respectively.

Fig.1



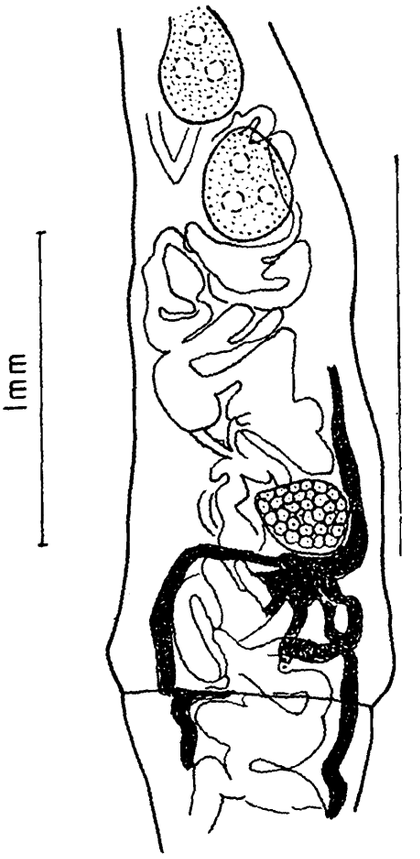


Fig.3

Fig. 1. *Lecithocladium apolecti*. Entire worm. Fig. 2. Part of body as in normal position of gonads. Fig. 3. Part of body of another specimen. Ovarian complex and vitellariam removed posteriorly.

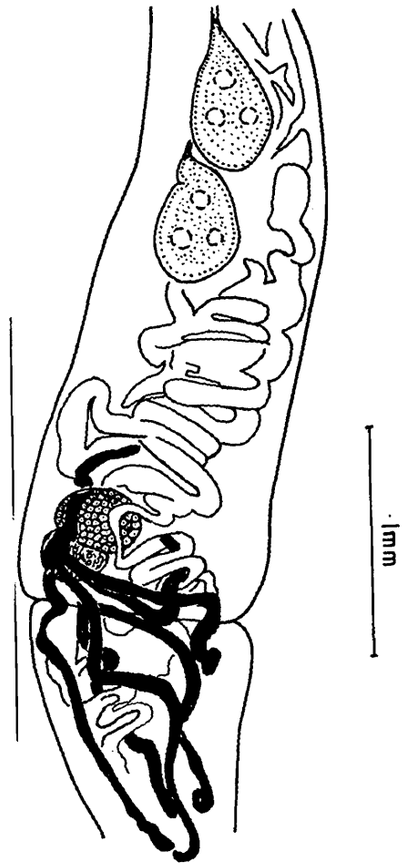


Fig.4

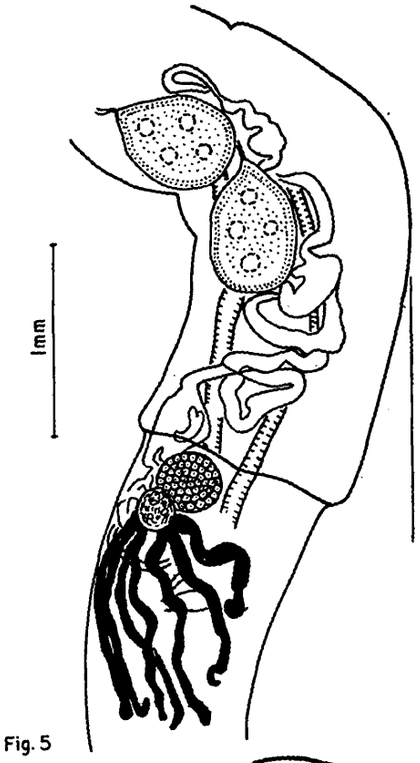


Fig. 5

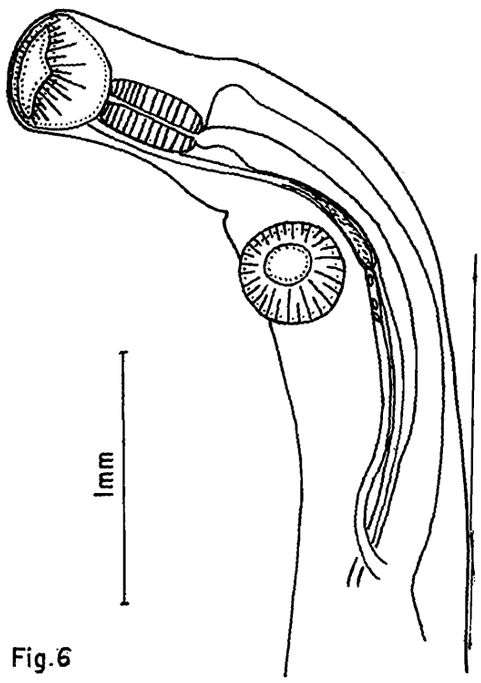


Fig.6

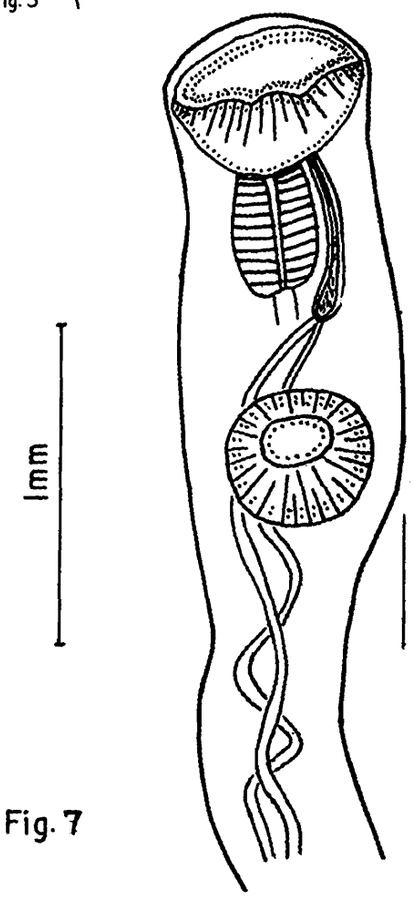


Fig. 7

Fig. 4. Part of body of still another specimen. Ovarian complex and vitelleriam come near junction of body proper and ecsoma. Fig. 5. Part of body of the specimen in which ovarian complex and vitellariam descended into ecsoma. Fig. 6. Anterior part of body. Sinus-sac reaching acetabulum posteriorly. Fig. 7. Anterior part of another specimen. Sinus- scc not reaching acetabulum posteriorly.

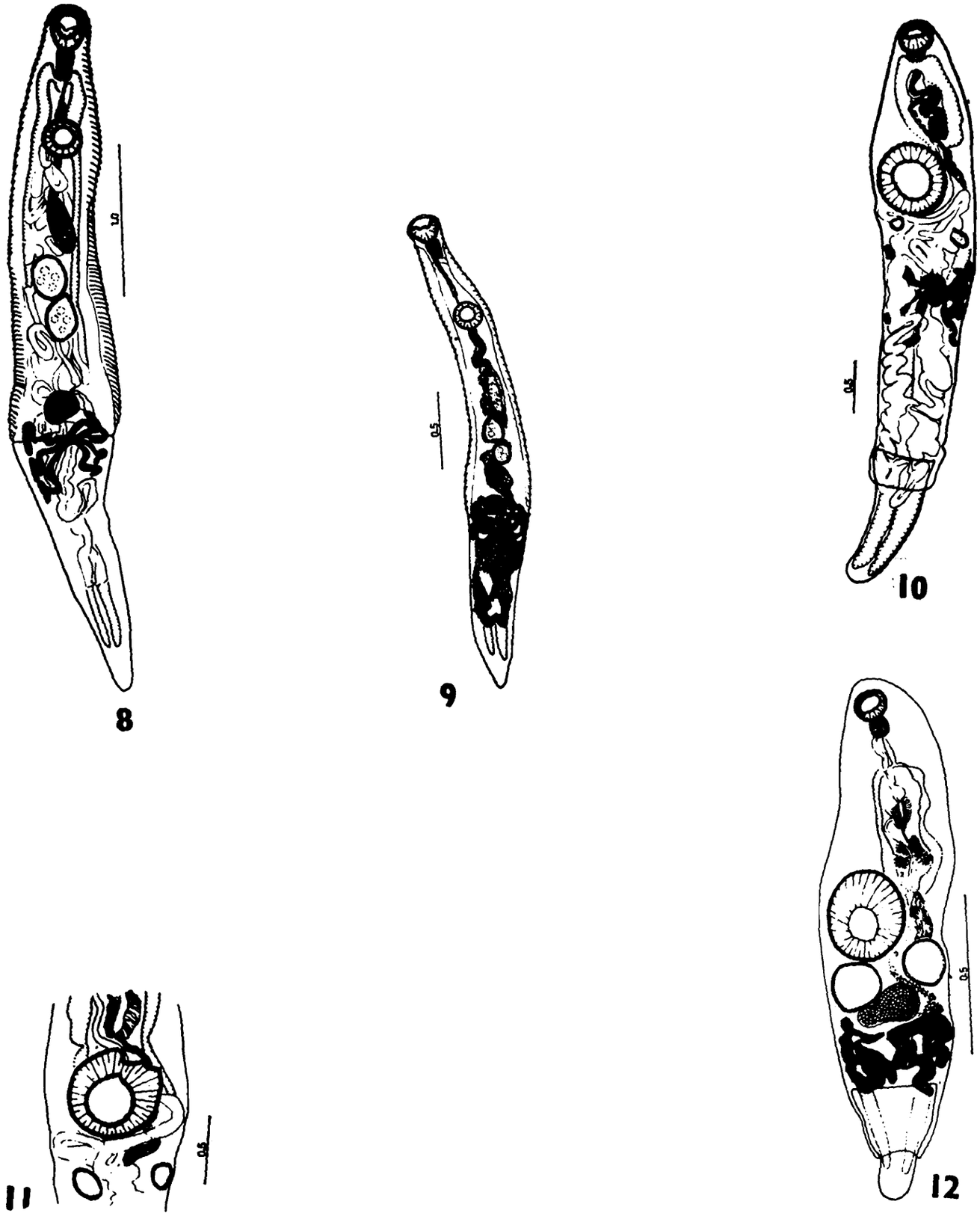


Fig. 8. *Lecithocladium megalaspis*. Entire worm. Fig. 9. *Lecithocladium glandulum*. Entire worm. Fig. 10. *Tubulovesicula angusticauda*. Entire worm. Fig. 11. *Tubulovesicula angusticauda*. Acetabular region. Fig. 12.*Uterovesiculurus lemiriensis*. Entire worm.

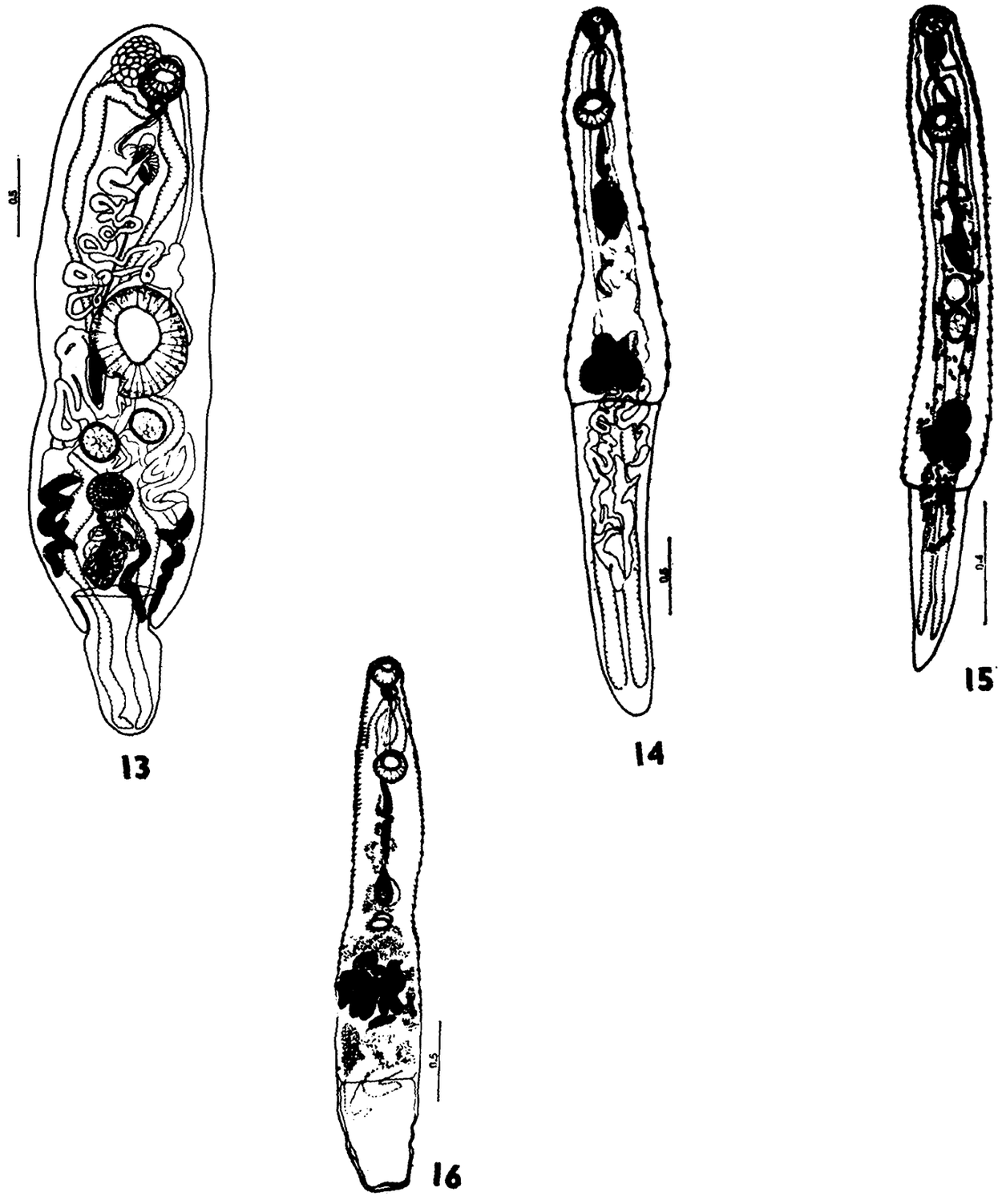


Fig. 13. *Uterovesiculurus paralichthydis*. Entire worm. Fig. 14. *Parahemiurus gastricus*. Entire worm. Fig. 15. *Parahemiurus dussumieri*. Entire worm. Fig. 16. *Parahemiurus engraulisi*. Entire worm.

Discussion : The differences between *U. paralichthydis* and *U. platycephali* seem to be meagre and therefore, I agree with Sahai and Srivastava (1978) in considering the latter a synonym of the former. By the same reasoning *U. indicus* reported from the fish *Platycephalus indicus* should also be taken as a synonym of *U. paralichthydis.*

Subfamily HEMIURINAE Looss, 1899

Genus 4. ***Parahemiurus*** Vaz and Pereira, 1930

Syn. *Dentiacetabulum* Sahai and Srivastava, 1977 (n.syn.)

Daniella Sahai and Srivastava, 1977 (n.syn.)

8. ***Parahemiurus gastricus*** (Sahai and Srivastava, 1977) n.comb. (Fig. 14)

Host : *Sardinella sirm* (Walbaum), spotted Sardinella, (Family Clupeidae).

Location : Stomach.

Locality : Tuticorin (Gulf of Mannar).

No. of Specimens : 2, on 2 slides; collected on 1.2.1965.

Discussion : Sahai and Srivastava (1977) described their species *Dentacetabulum gastricus* in the fish *Dussumieria acuta* from Madras (Bay of Bengal). The present material is similar to the description for *D. gastricus*, and I consider it a species of the genus *Parahemiurus* Vaz and Pereira, 1930. Consequently, *Dentacetabulum* is considered here as a synonym of *Parahemiurus.*

In having a short and saccular sinus-sac close to the pharynx, it comes close to *Parahemiurus yanamense* Hafeezullah, 1980, but the latter has a small ecsoma in comparison with the size of the soma, whereas in the former the ecsoma is only slightly shorter than the body proper, Secondly, the sides of the body in the latter are almost parallel whereas in the forme this is not the casee, being widest at the junction of the body proper and the ecsoma.

9. ***Parahemiurus dussumieri*** Hafeezullah, 1981

Syn. *Parahemiurus indicus* Ahmad, 1981 (n. syn.)
(Fig. 15)

Host : *Dussumieria acuta* Valenciennes, Rainbow sardine, (Family Clupeidae).

Location : Stomach.

Locality : Madras (Bay of Bengal).

No. of Specimens : 8, of two slides; Collected on 28.11.1964.

Discussion : *Parahemiurus dussumieri* Hafeezullah, 1981 (Published: October 31, 1981) and *Parahemiurus indicus* Ahmad, 1981 were separately described from the same species of fish host and from the same stretch of water. The descriptions broadly agree with each other, except that the tegument in the latter has been described to be smooth,

and the pars prostatica only partly glandular. According to the present material, the tegument has ventral plications all over body proper and the extent of dorsal plications is not constant. Moreover, pars prostatica is completely glandular. *P. indicus* Ahmad, 1981 becomes a junior synonym to *P. dussumieri*, as the former has been published in December, 1981.

10. ***Parahemiurus engraulisi*** Gupta and Jahan, 1977

Syn. *P. cameroni* Gupta and Ahmad, 1979 (n.syn.)

P. simhai Gupta and Gupta, 1978 (n.syn.)

P. puriensis Ahmad, 1981 (n.syn.)

(Fig. 16)

Host : *Ilisha filigera* (Valenciennes) Jwelled shad, (Family Clupeidae), *Thrissocles hamiltoni* (Gray), Hamilton's anchovy, Englaulidae), and *Thrissocles mystax* (Schneider) Moustached anchovy, (Family Engraulidae).

Location : Stomach.

Localities : Visakhapatnam (Bay of Bengal), Tuticorin (Gulf of Mannar), and Madras (Bay of Bengal) respectively.

No. of Specimens : 3+1+1, on 5 slides; collected on 30.9.1964, 3.1.1965 & 10.11.1964 respectively.

Discussion : The details of the above specimens overlap with the descriptions of *P. engraulisi, P. simhai, P. cameroni* and *P. puriensis*. Hence the identification of the present material and synonymy of *P. simhai, P. cameroni* and *P. puriensis* with *P. engraulisi.*

SUMMARY

Ten hemiurid species from marine fishes of the Bay of Bengal and Arabian Sea belonging to four genera under three subfamilies are reported with comments and additional information including synonymies. Four species, *viz., Lecithocladium piscicola* (Srivastava, 1935), *L. apolecti* Velasquez, 1962, *L. megalaspis* Yamaguti, 1953 and *L. glandulum* Chauhan, 1945 in the subfamily Elytrophallinae Skrjabin and Guschanskaja, 1954; three species, *viz., Tubulovesicula angusticauda* (Nicoll, 1915), *Utervesiculurus lemeriensis* (Tubangui and Masilungan, 1935) and *U. paralichthydis* (Yamaguti, 1934) in the subfamily Dinurinae Looss, 1905; and three species, *viz., Parahemiurus gastricus* (Sahai and Srivastava, 1977), *P. dussumieri* Hafeezullah, 1981 and *P. engraulisi* Gupta and Jahan, 1977 in the subfamily Hemiurinae Looss, 1899 are reported. The new synonymies suggested are: *Colletostomum* Sahai and Srivastava, 1978 and *Cleftocolleta* Sahai and Srivastava, 1978 with *Lecithocladium* Lühe, 1901; *Lecithocladium* sp. of Soota and Ghosh, 1977 with *Lecithocladium piscicola*

(Srivastava, 1935); *Lecithocladium excisiforme* of Radhakrishnan and Nair (1979) with *L. apolecti* Velasquez, 1962; *Transversolecitha* Sahai and Srivastava, 1978 with *Tubulovesicula* Yamaguti, 1934 and *Transversolecitha scaberi* Sahai and Srivastava, 1978 with *Tubulovesicula angusticauda* (Nicoll, 1915); *Exoticotyle* Sahai and Srivastava, 1978 with *Uterovesiculurus* Skrijabin and Guschanskaja, 1954 and *Uterovisiculurus indicus* Sahai and Srivastava, 1978 with *U. paralichthydis; Dentiacetabulum* Sahai and Srivastava, 1977 and *Daniella* Sahai and Srivastava, 1977 with *Parahemiurus* Vaz and Pereira, 1930; *Parahemiurus dussumieri* Hafeezullah, 1981; and *P. simhai* Gupta and Gupta, 1978, *P cameroni* Gupta and Ahmad, 1979 and *P puriensis* Ahmad, 1981 with *P. engraulisi* Gupta and Jahan, 1977.

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BIRDS OF DHARMAPURI DISTRICT, TAMILNADU, INDIA

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INTRODUCTION

There is practically no information on the avifauna of Dharmapuri district of Tamil Nadu. As a matter of fact, it was realised that the district had been faunistically ignored, even with respect to several lower groups of animals. With this in mind, the Southern Regional Station of the Zoological Survey of India at Madras sent two parties during 1985 and 1986 to survey the district intensively and collect various animal groups (except mammals and brids), with a view to building up a faunal inventory of the district. The present author, who was associated with both the surveys utilised the opportunity to make a field study of the birds of the district, and list them. A total of 105 species of birds were identified on the basis of field sighting, and these are listed in this paper. No bird specimen was examined in the hand. No claim is made that the list presented is complete or near complete. Only the northwestern, western, southwestern, southern and southeastern rigions of the district were surveyed. The duration of study was of only 19 days in April, 1985, and 17 days in February-March, 1986. Since most of the major forest areas were surveyed, it is felt that the present list comprises a substantial number of bird species which are actually to be found in the district.

The present study has revealed that the majority of the birds sighted are resident species. Only nine species (*c* 8.5% of the total sighting) are winter visitors to the whole or most of India, while two more are winter visitors to Tamil Nadu. The Chestnutbellied Nuthatch, *Sitta castanea* Lesson, is recorded for the first time from the district; it has been previously recorded in Tamil Nadu from the Nilgiri Hills. The flock of over 25 Whitenecked Stork, *Ciconia episcopus* (Boddaert), is perhaps the largest ever recorded. The present study has also shown that in the Dharmapuri district, the Streaked Weaver Bird, *Ploceus manyar* (Horsfield), breeds in the period between the NE and SW monsoons. This raises the question whether its breeding season is as dependent on the monsoons, in this district, as it has been stated to be in the Himalayan foothills. Further, the Ashy Wren-Warbler, *Prinia socialis* Sykes, was also found breeding a little earlier than previously recorded in Tamil Nadu. The Franklin's Ashy-Grey Wren-Warbler, *Prinia hodgsoni* Blyth, was also observed breeding much earlier than known so far. A single dubious sighting of the Grey Shrike, *Lanius excubitor* Linnaeus, would make it the first record of this species from Tamil Nadu. However, this would require confirmation by further investigation.

There is a view, and a sound one too, that restricting the study of any group of animals, especially one with as great a mobility as the birds, to a small political region with no distinctive geographical features, is artificial and undesirable. But, such a study has a two-fold significance. First, it tells us about the wealth and variety of a particular group of animal in the district. This aspect, apart from being of academic interest, is of importance when one takes a long-range view; a similar study conducted twenty or thirty years hence will, on comparison with the present one, show us the status, abundance and intra-district distribution of the animal in question. The second aspect of studies such as the present one, is that these aid the state governments concerned to formulate methods to conserve their faunal wealth. This aspect is of paramount importance today when environmental degradation is rapid and rampant and unless we know what we have, we will never know what we lost.

Admittedly, there is ample scope for further studies, and this paper would have served a very useful purpose, even if it were only to arouse other ornithologists to make more intensive efforts to study the birds of the district.

LOCATION AND AREA

Dharmapuri district is situated between 11° 45' and 12° 55' North, and 77° 28' and 78° 50' East in the state of Tamil Nadu. On the north, it shares its borders with Andhra Pradesh and Karanataka, and on the west with Karnataka and Coimbatore district, Tamil Nadu. On the south, it is bounded by Salem district, Tamil Nadu, and its eastern borders are shared by South and North Arcot districts, Tamil Nadu. The district has a total area of about 9615.89 Km^2, and comprises four taluks, viz., Hosur, Krishnagiri, Dharmapuri and Harur.

TOPOGRAPHY

Topographically, Dharmapuri district could be distinguished into two parts: (1) a poorly wooded, rocky, undulating plateau on the north and east, with denser forests in the south and west. Its average elevation is about 915 m above m.s.1., dipping to the southwest towards the Cauvery river; (2) a basin intermediate between the Karnataka table-land and the plains. The general elevation is about 395m above m.s.1. This basin is bounded on the north and west by the Karnataka plateau, on the south and east by the hill ranges of Javadi, Teertamalai, Chitteris, Shevroys and Manukondamalai.

RIVER SYSTEMS

Two major rivers, the Ponnaiyar and the Cauvery, and their, tributaries, drain the northern and eastern portion of Dharmapuri and Harur taluks. Although they are perenniel rivers, the flow is scanty during the dry season.

The Cauvery and its tributaries drain the southern portion of Hosur and Dharmapuri

taluks. The Cauvery receives the Chinnar river at Hogenekal. The falls at Hogenekal are *c* 585m above m.s.l.

RAINFALL

The northern plateau, comprising the Hosur taluk and a part of Krishnagiri taluk, depends on the southwest monsoon, while the rest of the district depends mostly on the northeast monsoon. Annual rainfall varies from 680mm to 980mm.

VEGETATION AND FOREST

About a fifth of the total area of the district is under forest cover. Due to scant fainfall, over-grazing, human interference and impoverished soil, trees are of poor quality. The chief forest type in the district is the Tropical Dry Deciduous Forest. Further details of the major features of vegetation are given below against the various localities where field study was conducted.

LOCALITIES
(Fig. 1)

1. *Hosur Cattle Farm campus* : Located at Mathigiri, about 6 Km from Hosur town, the area is full of grassy pastures with scattered trees. Some large shady trees are found in the Farm Guest House compound.

2. *Perandapalli* : Located on the Hosur-Krishnagiri road, just outside the boundary of the industrial area. Vegetation is mainly thorny scrub.

3. *Berikai Reserve Forest* : Thorny scrub vegetation, with large boulders and rocks.

4. *Denkanikotta Forest Rest House compound* : Fairly wooded area - chiefly planted trees.

5. *Sameri, Aiyur Reserve Forest* : Mixed dry deciduous and thorny scrub, with abundant *Lantana* thickets; a muddy *jheel*; area supporting elephants (one was sighted in the distance).

6. *Noganoor Reserve Forest* : Dry deciduous scrub, with *Lantana*, Bamboo.

7. *Namaleri* : Paddy fields; *jheel* on roadside.

8. *Dadikal Dam* : Shallow muddy reservoir with scattered shrubs in its vicinity; paddy fields not far away.

9. *Tali Reserve Forest* : Bordering Karnataka; very dry, predominantly scrub.

10. *Keesan Kuppam* : On way to Tail Reserve Forest ; *Jheel* on roadside with grassy surroundings.

11. *Panai Reserve Forest* : Mixed dry deciduous and scrub.

12. *Anchetty Forest Rest House compound and vicinity* : Some garden trees, with open uncultivated fields down to Toddahalla river on eastern side; *jheel* on western side.

13. *Anchetty Reserve Forest, c 5 Km on Natrapalayam Road* : Mixed dry deciduous and scrub.

14. *Kulumuru pallam* : WSW of Anchetty; predominantly dry thorny scrub, with some open uncultivated fields.

15. *Hogenekal Forest Rest House compound and vicinity* : Dry deciduous forest.

16. *Bevanurmalai Reserve Forest, on east bank of Cauvery river* : Rocky area; mixed dry deciduous and scrub.

17. *Forest around Chinnar river* : Deciduous forest - denser close to the river, with abundant leaf litter.

18. *Forest along Hogenekal - Pennagaram road* : Mixed dry deciduous and thorny scrub.

19. *Kottapatti Forest Rest House compound* : Planted trees, some very large and shady.

20. *Vannathipaarai, along Chinnar river* : Dry diciduous forest, well-wooded in some portions.

21. *Kottapatti-Sittilingi road* : Open cultivated and uncultivated fields.

22. *Malaithaangi, c 1-2 Km ahead of Sittilingi* : Partly dry scrub, with *Lantana* shrubs and thorny thickets, and partly deciduous with tall trees (near stream).

23. *Chettigutta (Ammapetta Aru)* : Deciduous forest.

24. *Naagamarathu pallam (Eluvani Aru)* : River at the foot of a hill and at the forest edge. Forest is deciduous and scrub with a good number of tamarind trees, bamboo, and thick undergrowth of thorny plants.

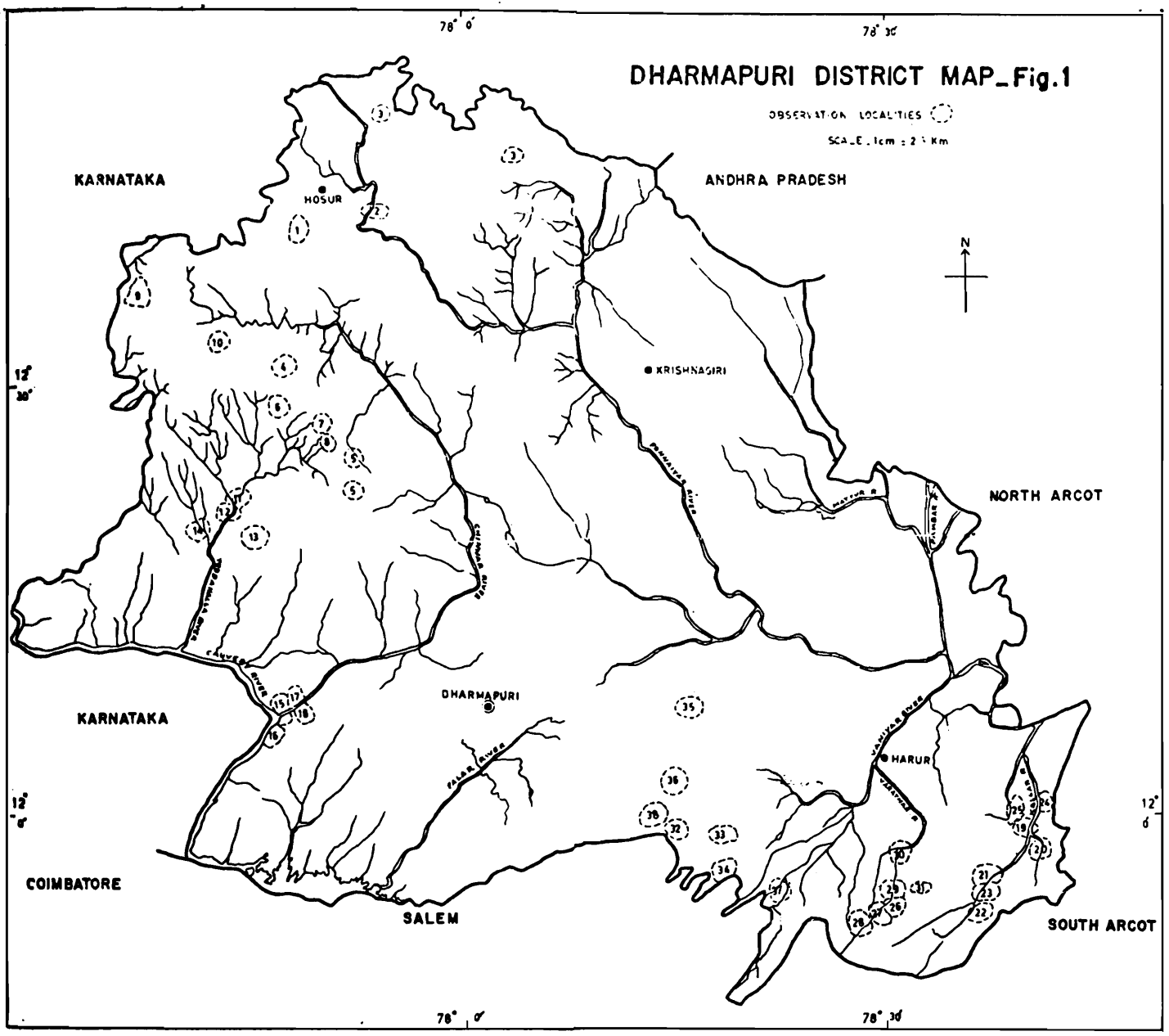
25. *Singleri* : A *jheel* with a bund made of large stones on one side. some parts of the *jheel* edge with rotting vegetation emanating a pungent foul odour. Surrounding areas with scattered thorny plants.

26. *Sitteri Forest Rest House and vicinity* : Sandalwood and *Eucalyptus* trees (both planted) in front of the Rest House. Surrounding area with deciduous forest. Abundant *Lantana* thickets.

27. *Forest between Sitteri and Thombakkal aru* : Deciduous forest with abundant *Lantana* thickets and leaf litter.

28. *Nochikuttai* : Deciduous forest - quite dense.

29. *Maamarathu odai* : Rocky stream with a little water here and there, in deciduous forest with plenty of *Lantana* shrubs, *Bryophyllum*.



Map indicating observation location

30. *Sitteri-Harur road, c 12 Km from Sitteri* : Scattered light deciduous forest, with a large number of tamarind trees and *Calotropis.*

31. *Pereri/Pudur* : No forest worth the name. Large areas under cultivation, with human habitation here and there. Scattered groves of tamarind, mango and coconut trees.

32. *Bommidi Forest Rest House and vicinity* : Rest house close to railway line. Other than planted trees in the garden of the Rest house, surrounding areas open with fewer trees. Hillock behind Rest house with scrub vegetation.

33. *Kavaramalai* Typical open, dry, rocky, thorny scrub.

34. *Shevroy hills (foothills area)* : Dense deciduous forest.

35. *Mookanur Reserve Forest, ahead of Kadathur on Bommidi-Dharmapuri Road* : Dry, rocky, thorny scrub.

36. *Mookanur Panchayat Forest, off Bommidi-Dharmapuri road, near Kadathur* : Paddy and uncultivated field, giving way to stony, thorny scrub towards base of hillocks.

37. *Papireddipatti, Vaniyaru Dam* : A large irrigation reservoir. Forest in the vicinity dense in places with plenty of *Lantana*, Cactus and other thorny plants.

38. *Gajakulam* : Open uncultivated and cultivated fields, the latter with castor, cotton, paddy and *ragi* crops. As one proceeded towards the hills, the fields gave way to *Lantana* shrubs and a surfeit of *Babool*, and farther ahead to tamarind and other trees, with thick undergrowth.

The serial number given for the various localities are used within parentheses, in the notes under each bird species, so as to facilitate easy reference.

Abbreviations used is the paper are as follows: FRH: Forest Rest House; GH: Guest House, RF: Reserve Forest.

SYSTEMATIC LIST

Order PELECANIFORMES

Family PHALACROCORACIDAE

1. ***Phalacrocorax carbo*** (Linnaeus)
LARGE CORMORANT

A lone bird was sighted sitting still on a dry branch of a submerged leafless tree in the middle of the shallow reservoir on 8.iv.1985 at Dadikal Dam (8). Judging by its colouration, it appeared to be an immature bird.

Order CICONIIFORMES

Family ARDEIDAE

2. *Ardea cinerea* Linnaeus
GREY HERON

Only two sightings were made: one was of a small, scattered group of three birds in the Cauvery river at Hogenekal on 16.iv.1985. One of these birds flew away, apparently disturbed by the author's presence, although it appeared to be at least 300 m away. The second record was of a single bird in the middle of the reservoir at Vaniyaru Dam, Papireddipatti (37) on 11.iii.1986.

3. *Ardeola grayii* (Sykes)
POND HERON

A common bird in the slushy banks of ponds and tanks; sighted at various places. It

was conspicuously absent in the Cauvery river at Hogenekal although the Little and Cattle Egrets and the Grey Heron were recorded there.

4. ***Bubulcus ibis*** (Linnaeus)
CATTLE EGRET

Commonly found in association with grazing cattle. At Hogenekal, one bird was seen in the Cauvery river close to the bank near three buffaloes which were also wallowing in the shallow awater.

5. ***Egretta garzetta*** (Linnaeus)
LITTLE EGRET

A common resident seen near many water bodies. One bird was seen in the company of three buffaloes and a Cattle Egret in the shallow water near the bank of the Cauvery river at Hogenekal. Another was seen in a drying reservoir between Berikai and Bagalur in the company of a Pond Heron and a White Stork.

Family CICONIIDAE

6. ***Ciconia episcopus*** (Boddaert)
WHITENECKED STORK

This bird was recorded on only two occasions, feeding in meadows in the cattle farm campus at Hosur (1). On the first occasion (3.iv.1985) only four birds were seen, while a flock of over 25 birds was sighted on the second occasion (4.iv.1985). Ali and Ripely (1983) state that a flock of 15 birds is the largest recorded by them.

7. ***Ciconia ciconia*** (Linnaeus)
WHITE STORK

A single bird was recorded in a dry reservoir between Berikai and Bagalur on 4.iv.1985. According to Ali and Ripley (1983) this winter visitor to India is less common in the Deccan than in the northern parts of India, and it returns to its summer breeding grounds by March/April.

Order FALCONIFORMES

Family ACCIPITRIDAE

8. ***Elanus caeruleus*** (Desfontaines)
BLACKWINGED KITE

One solitary bird recorded at about 8 AM on 1.iii.1986 perched on a telegraph pole on the Kottapatti-Theertamalai road.

9. ***Milvus migrans*** (Boddaert)
PARIAH KITE

A common kite especially near human habitation. A nest of this bird was seen in a

tree at a height of about 10m in the Anchetty FRH compound (12). An adult (possibly female), and a young one, which were constantly found in the vicinity of the FRH, were seen occupying the nest, separately, on one or two occasions. The young one was fairly advanced, and was found frequently on the wing uttering a shrill cry. On a couple of occasions it was also found perching in a *Eucalyptus* tree very close to the FRH, and it was not easy to chase it away by disturbance. The adult was observed perching on a telegraph pole for long durations.

10. ***Haliastur indus*** (Boddaert)
BRAHMINY KITE

Although not as commonly met with as the Pariah Kite, this kite was also not very difficult to find. At Bommidi (32), on 6.iii.1986, a Brahiminy Kite was sighted being chased by a Pariah Kite. Two Brahminy Kites were recorded sitting on the bank of the Cauvery river at Hogenekal on 16.iv.1985. One of them was also observed swooping down over the surface of the river occasionally, thereby frightening the numerous fish *(Periophthalmus)* which were found in the river. The kite was not observed catching any fish.

11. ***Accipiter badius*** (Gmelin)
SHIKRA

Recorded on six occasions between 25.ii.1986 and 5.iii.1986, always solitarily, except on the latter date at Bommidi (32), when an adult and an immature bird were observed flying in circles over the FRH area.

12. ***Spizaetus cirrhatus*** (Gmelin)
CRESTED HAWK-EAGLE

Only one record in the deciduous forest on the way to Thombakkal river from Sitteri FRH (27). The bird was probably a subadult, and it was seen perched in the top canopy overlooking an area with abundant shrubs, but few trees.

13. ***Neophron percnopterus*** (Linnaeus)
SCAVENGER VULTURE

Recorded only once at Gajakulam (38). The bird was observed soaring high above the hills which were rocky and had abundant scrub vegetation.

Order CHARADRIIFORMES
Family CHARADRIIDAE
Subfamily CHARADRIINAE

14. ***Vanellus indicus*** (Boddaert)
REDWATTLED LAPWING

One bird was sighted sitting near a small embankment in an open uncultivated field,

about 150m from a streamlet, at Kulumuru pallam (14). It later took to wing uttering its distinctive call. Another was seen in a similar situation at Vannathipaarai (20). A third one was sighted at the margin of the *jheel* at Singleri (25).

15. ***Charadrius dubius*** Scopoli ?
LITTLE RINGED PLOVER

A single bird, almost certainly of this species, was seen on the shingly bank of the Cauvery river at Hogenekal. As the bird flew away after a moment's observation, an element of doubt remains as to its exact specific identity.

Subfamily SCOLOPACINAE

16. ***Tringa ochropus*** Linaaeus
GREEN SANDPIPER

Two birds were seen on 11.iii.1986 towards the far end of the reservoir at Vaniyaru Dam (Papireddipatti) (37), in the company of Common Sandpiper.

17. ***Tringa glareola*** Linnaeus
WOOD SANDPIPER

About eight of these birds were seen feeding at the *jheel* at Singleri (25) on 28.ii.1986. No other sandpiper could be observed at this place. Other waders found in that location were Pond Heron, Little Egret and Blackwinged Stilt.

18. ***Tringa hypoleucos*** Linnaeus
COMMON SANDPIPER

At Papireddipatti (37) three birds were sighted on the same date and in the same situation as described for *T ochropus* Linn. One bird was also recorded at Namaleri (7) where it was seen flying low in a wide circle around a paddy field, all the while uttering its characteristic call, finally coming to settle on the margin of a slushy, grassy *jheel* in the company of Pond Heron and Yellow Wagtail.

Family RECURVIROSTRIDAE

19. ***Himantopus himantopus*** (Linnaeus)
BLACKWINGED STILT

Four of these distinctive pied black and white birds with disproportionately long legs were recorded at the *jheel* at Singleri (25).

Order COLUMBIFORMES

Family COLUMBIDAE

20. ***Streptopelia chinensis*** (Scopoli)

SPOTTED DOVE

The bird was heard and seen in the Bevanurmalai R.F. (16) adjacent to the Cauvery river at Hogenekal, and also close to the Vaniyaru Dam (37), and in the deciduous forest at Vannathipaarai (20).

21. ***Streptopelia senegalensis*** (Linnaeus)

LITTLE BROWN DOVE

This dove was sighted at four localities, *viz.*, Kavaramalai (33), Mookanur RF (35), Vaniyaru Dam (37) and Gajakulam (38). It was always associated with scrub forest.

Order PSITTACIFORMES

Family PSITTACIDAE

22. ***Psittacula krameri*** (Scopoli)

ROSERINGED PARAKEET

This parakeet was found in the vicinity of villages and light deciduous forest. It was not seen in Sitteri where *Psittacula cyanocephala* (Linn aeus) was the common species.

23. ***Psittacula cyanocephala*** (Linnaeus)

BLOSSOMHEADED PARAKEET

Three to four of these parakeets were seen frequenting the tall *Eucalyptus* trees in the Sitteri FRH compound (c 920m) (26) around 7.00 to 7.30 AM. This parakeet was also recorded at Nochikuttai (910m) (28). At the latter locality, a nesting pair was seen at a hole in a tree trunk.

Order CUCULIFORMES

Family CUCULIDAE

24. ***Clamator jacobinus*** (Boddaert)

PIED CRESTED CUCKOO

This black and white cuckoo was found in considerable numbers in a fairly large clearing with sparsely distributed trees about 5 Km from Anchetty on the Natrapalayam road (13). This clearing was surrounded by scrub and dry diciduous forest.

25. ***Cuculus varius*** Vahl.

COMMON HAWK-CUCKOO

The call of this bird was heard almost incessantly at Hogenekal (15) from 16-18.iv.1985, but not even once could the bird be sighted here. A solitary bird was,

however, sighted perched high up on a tree in the dry deciduous forest near Natrapalayam on the Anchetty-Hogenekal road.

26. ***Eudynamys scolopacea*** (Linnaeus)
KOEL

The Koel was sighted at the Hosur cattle farm GH compound (1), Pereri (31), Kottapatti FRH compound (19) and Vannathipaarai (20). Of these localities, the first three had human habitation, and gardens and groves of large, leafy trees to which the Koel is attracted. At the first locality, the Koel was seen in association with Golden Oriole, Jungle Crow and Indian Myna, all three of which have been recorded as fosterers of the Koel, although the Jungle Crow and the House Crow are the principal fosterers (All and Ripley, 1983).

27. ***Rhopodytes viridirostris*** (Jerdon)
SMALL GREEN-BILLED MALKOHA

Three of these shy birds were located within Cactus and *Lantana* thickets close to the road skirting the reservoir of Vaniyaru dam at Papireddipatti (37). Another was seen inside thorny scrub at Malaithaangi (22) near Sittilingi.

28. ***Centropus sinensis*** (Stephens)
COUCAL OR CROW-PHEASANT

One bird was seen at each of the following places - Kulumuru pallam (14) deep within the scrub, Vaniyaru dam (37) within *Lantana* bushes, and Pereri (31) close to human habitation.

Order STRIGIFORMES
Family STRIGIDAE
Subfamily STRIGINAE

29. ***Bubo zeylonensis*** (Gmelin)
BROWN FISH OWL

The of these owls were seen in the daytime, perched on a high bough of a large tree just overlooking a stream in a wooded area at Malaithaangi (22). Both the birds flew away when approached.

30. ***Athene brama*** (Temminck)
SPOTTED OWLET

A pair was seen on a mango tree very close to the Cattle farm GH at Hosur (1), regularly between 3 & 5.iv.1985, and another pair was found at the entrance of a hollow in a tree trunk in the FRH compound at Anchetty (12).

Order APODIFORMES

Family APODIDAE

Subfamily APODINAE

31. ***Cypsiurus parvus*** (Lichtenstein)
PALM SWIFT

A bird commonly sighted in open country with palm trees of the genus ***Borassus***.

Subfamily HEMIPROCNINAE

32. ***Hemiprocne longipennis*** (Tickell)
CRESTED TREE SWIFT

Sighted only in one locality, *viz*., Sameri (5) in the deciduous and scrub Aiyur RF, where several of these swifts were observed flying in small loose parties over the *jheel (eri)*. They were noticed diving occasionally at great speed and sipping water from the surface of the *jheel* before flying away. The crest was clearly visible when the birds settled on the trees.

Order CORACIIFORMES

Family ALCEDINIDAE

33. ***Ceryle rudis*** (Linnaeus)
PIED KINGFISHER

This kingfisher was always found associated with a body of water such as a *jheel* or river. It was sighted at a *jheel* near Anchetty FRH (12), near a bund on a river (Eluvani aru), at Naagamarathu pallam (24), at the reservoir at Papireddipatti (37) and at the Cauvery river at Hogenekal. At the last locality one bird was frequently seen perched on a wooden pole jutting out of the middle of the swift-flowing waters of the river. These birds were also seen hunting fish in the river. They would hover about 7-10m above the water surface, and dive vertically down to catch the fish. Every bout of hovering was not followed by a dive.

34. ***Alcedo atthis*** (Linnaeus)
SMALL BLUE KINGFISHER

Only two records during the present study - one at Chettigutta (23), and the other at the foothills of Shevroy Hills (34) - both in forested areas, near a stream. At the latter locality, this kingfisher was seen with a fish in its biil.

35. ***Halcyon smyrnensis*** (Linnaeus)
WHITEBREASTED KINGFISHER

Very common bird, sighted at several places, singly, often far away from water.

Family MEROPIDAE

36. ***Merops philippinus*** Linnaeus
BLUETAILED BEE-EATER

This bee-eater was seen at two places only - one bird at Mookanur Panchayat forest (36) off the Bommidi-Dharmapuri road where it was perched on a telegraph wire in a paddy field, and a pair at Hogenekal. This pair was seen sitting on the sandy bank of the Cauvery river. Every now and then, either of them, or both, would rise to catch an insect and come gliding down very gracefully.

37. ***Merops leschenaulti*** Vieillot
CHESTNUTHEADED BEE-EATER

Only one bird was seen at the roadside at Vaniyaru dam reservoir (37).

38. ***Merops orientalis*** Latham
SMALL GREEN BEE-EATER

The most common of the three species of bee-eaters observed. Very often met with, perched on telegraph wires in open fields, every now and again flying out to capture an insect and returning to its perch. At the Hosur Cattle farm (1) a bee-eater was seen on an earth mound from where it was noticed making aerial sorties and returning to the mound. It was not possible to approach the mound, but as it was the breeding season (3.iv.1985), it is possible that the bird had a nest in the mound.

Family CORACIIDAE

39. ***Coracias benghalensis*** (Linnaeus)
INDIAN ROLLER

A very common bird met with in several localities. It appeared to show a preference for sparse human habitation and open cultivated and uncultivated fields, where it could be seen perched on telegraph poles and wires, or on some tall tree, uttering its monosyllablic raucous call once in a way. It was, nevertheless, sighted in deciduous forest too. At Singleri (25), 2-3 birds were seen on rocks on the ground at the edge of the *jheel*. The bird appeared to avoid congested village areas. Near the Anchetty FRH (12), one bird - apparently a male - was observed indulging in aerial displays for extended periods. No female could be located nearby.

Family UPUPIDAE

40. ***Upupa epops*** Linnaeus
HOOPOE

A pair was observed building its nest on 5 & 6.iv.1985 in a hole in an earthern wall of a house near the Denkanikotta FRH (4); the pair was seen bringing rubbish to the nest every now and then. Not recorded elsewhere.

Family BUCEROTIDAE

41. ***Tockus birostris*** (Scopoli)

GREY HORNBILL

One bird was recorded in an isolated tree in the middle of a meadow in the cattle farm campus at Hosur (1), one in flight over an open field at Naagamarathu pallam (24), and three in the Bevanurmalai RF (16) at Hogenekal, close to the Cauvery river.

Order PICIFORMES

Family CAPITONIDAE

42. ***Megalaima viridis*** (Boddaert)

SMALL GREEN BARBET

The call of this bird was abundantly heard in several places, especially in the Chitteri Hills where the forest resounded with its call. It was sighted at three places *viz.*, Hosur cattle farm campus (1), Denkanikotta (4) and Shevroy Hills (34). One bird (or, perhaps a pair) was seen visiting a nest in the trunk of a tree about 4m from the ground in the grove of trees in front of the Denkanikotta FRH (4).

43. ***Megalaima haemacephala*** (P.L.S. Müller)

CRIMSONBREASTED BARBET

A common resident bird, much more easily heard only during the breeding season. One bird was observed for a few minutes from fairly close range (c 8m) at Perandapalli (2).

Family PICIDAE

Subfamily PICINAE

44. ***Dinopium benghalense*** (Linnaeus)

GOLDENBACKED WOODPECKER

Not very commonly seen. Sighted in four localities - Hogenekal FRH compound (15), Hogenekal-Pennagaram road (18), near Singleri (25) and Vaniyaru dam (37).

45. ***Picoides mahrattensis*** (Latham)

YELLOWFRONTED PIED OR MAHRATTA WOODPECKER

Although this is supposed to be one of our commonest woodpeckers, it was sighted only in two localities during the present study — in the forest on the Anchetty - Natrapalayam road (13), and on a tall tree at the edge of the reservoir at Vaniyaru dam (37). At the latter locality a nesting pair was seen, the female tapping out a hole about 15-20m from the ground, while the male watched from nearby. Ali and Ripley (1983) state that the nest hole is one to 10m from the ground, usually under 4m.

Order PASSERIFORMES

Family PITTIDAE

46. ***Pitta brachyura*** (Linnaeus)
INDIAN PITTA

This colourful bird was spotted only once for a few seconds on the ground close to a barbed wire fence enclosing a grove of trees in front of the FRH at Denkanikotta (4). On sensing that it was being observed, it flew away.

Family ALAUDIDAE

47a. ***Mirafra assamica*** Horsfield
MADRAS BUSH LARK

OR

47b. ***Mirafra erythroptera*** Blyth
REDWINGED BUSH LARK

As no bird could be examined in the hand, it was not possible to ascertain the exact specific identity of the birds sighted. This is why both the species have been taken together.

The birds appeared to show a distinct liking for stony scrub and bush jungle, and open dry deciduous forest. As it was the breeding season of these birds, all the males sighted showed the characteristic display-flight almost tirelessly.

48. ***Eremopterix grisea*** (Scopoli)
ASHYCROWNED FINCH-LARK

This finch-lark was common in the vicinity of open fields, and also dry stony scrub jungle. In a couple of localities, the males were observed indulging in aerial display.

49. ***Ammomanes phoenicurus*** (Franklin)
RUFOUTAILED FINCH-LARK

Only one bird was seen at Mookanur RF (35) - typical dry stony scrub and bush country.

Family HIRUNDINIDAE

50. ***Hirundo rustica*** Linnaeus
COMMON SWALLOW

This swallow was sighted hawking insects on the wing in several localities.

51. ***Hirundo daurica*** Linnaeus
REDRUMPED SWALLOW

The Redrumped Swallow was seen at Tali RF (9), Keesan kuppam (10) and Panai

RF (11) along Toddahalla river. At the first site a single bird was observed for over five minutes flying in a small restricted area. Once in a while, it would descend and go below some large over-hanging rocks only to emerge again withing seconds. At Keesam kuppam these birds were sighted perched on small thick-stemmed plants, about 3 m - 4 m above the ground level, not far from a *jheel*. Now and then, the birds would take off and return to the same perch, possibly after capturing some insect.

Family LANIIDAE

52. ***Lanius excubitor*** Linnaeus ?
GREY SHRIKE

Only one bird, presumably belonging to this species, was sighted in the dry stony scrub jungle at Kavaramalai (33). This species has not been recorded so far from Tamil Nadu; the two records mentioned by Ali and Ripley (1983) as being from this state are actually from Cuddsapah district, which is in Andhra Pradesh.

53. ***Lanius vittatus*** Valenciennes
BAYBACKED SHRIKE

A pair was sighted in the mixed dry deciduous and thorny scrub jungle along the Hogenekal-Pennagaram road (18), about 2 Km from Hogenekal.

54. ***Lanius schach*** Linnaeus
GREYBACKED SHRIKE

One bird was spotted perched on an electric wire in an open field not far from a river and diciduous forest at Naagamarathu pallam (24).

Family ORIOLIDAE

55. ***Oriolus oriolus*** (Linnaeus)
GOLDEN ORIOLE

This bird appeared to be preferentially attached to gardens with large trees; it was seen around rest houses *viz.*, at Hosur cattle farm (1), Denkanikotta (4), Kottapatti (19) and Bommidi (32), all of which were surrounded by gardens with large trees. Not seen after 6 April.

56. ***Oriolus xanthornus*** (Linnaeus)
BLACKHEADED ORIOLE

A pair was noticed flying across the Toddahalla river in the Panai RF (11), and a single male was seen in a tree in the deciduous forest in the Shevroy hills (foothills) (34).

Family DICRURIDAE

57. ***Dricrurus adsimilis*** (Bechstein)
BLACK DRONGO

A very common resident met with in gardens, uncultivated and cultivated fields, scrub and light deciduous forests.

58. ***Dicrurus caerulescens*** (Linnaeus)
WHITEBELLIED DRONGO

Although not as commonly seen as the Black Drongo, the present species was very common. It was sighted in dry deciduous forest in several locatities. At one place a bird was seen eating an insect.

59. ***Dicrurus aeneus*** Vicillot
BRONZED DRONGO

Sighted only where the forest was quite dense, *viz.*, Nochikuttai (28) in the Chitteri hills, and in the foothills of the Shevroy hills (34). In the former locality, two of these birds were sighted perched on the branch of a tree, every now and then making sorties to catch insects.

60. ***Dicrurus paradiseus*** (Linnaeus)
LARGE RACKET-TAILED DRONGO

One bird was seen in flight in the light deciduous forest by the side of the Sitteri-Harur road (c 500 m) (30). Another was seen in the heavier forest in the foothills of the Shevroy hills (34).

Family STURNIDAE

61. ***Sturnus pagodarum*** (Gmelin)
BRAHMINY MYNA

Although sighted in several places, this myna was never seen in such great numbers as the Common myna.

62. ***Acridotheres tristis*** (Linnaeus)
COMMON MYNA

A very common myna. A resident encountered both near and away from human settlement, in gardens, open fields and in scrub and wooded scrub jungles.

63. ***Acridotheres fuscus*** (Wagler)
JUNGLE MYNA

Much less common than the Common Myna. In the large trees near the Hosur cattle farm GH (1), this myna was seen in the company of the Common Myna, Koel, Golden

Oriole and Black Drongo. One pair was found nesting in a hole in a tree trunk about 10 m above the ground near the Denkanikotta FRH (4). On one occasion, one of the birds was seen taking a piece of polythene sheet about 15cm x 10cm into the hole. This species of myna was also seen at Nochikuttai (28) in the Chitteri hills.

Family CORVIDAE

64. ***Dendrocitta vagabunda*** (Latham)
INDIAN TREE PIE

Met with in several localities, but not in any great numbers.

65. ***Corvus splendens*** Vicillot
INDIAN HOUSE CROW

Common near human settlements only. It was conpicuously absent in localities removed from human hibitation. This crow was found in larger numbers where filth resulting from human dwellings was greater. At Anchetty, House Crows were not seen in the vicinity of the FRH which is located about 1 Km to the south of the village. At the latter location these crows were found in plenty. At about 4 or 4.30 PM the crows were noticed flying very high, in flocks, from the direction of the village northwards over the FRH. The return trip took place around 6 or 6.15AM. It is possible that many of the crows made this daily journey to and from their communal roosts.

66. ***Corvus macrorhynchos*** Wagler
JUNGLE CROW

More commonly met with than the House Crow in places with less human interference. Around the Anchetty FRH (12) the Jungle Crow was found, while it was absent in the Anchetty village.

Family CAMPEPHAGIDAE

67. ***Coracina novaehollandiae*** (Gmelin)
LARGE CUCKOO-SHRIKE

Only one sighting from a moving jeep, of a solitary male on a tree by the side of the road form Bommidi to Vaniyaru dam.

68. ***Coracina melanoptera*** (Ruppell)
BLACKHEADED CUCKOO-SHRIKE

Both sexes recorded in trees in gardens, thorny scrub and deciduous forest.

69. ***Pericrocotus cinnamomeus*** (Linnaeus)
SMALL MINIVET

This species was always sighted in parties of 4-8 birds. These birds appeared to show a preference for dry scrub forests.

Family IRENIDAE

70. ***Aegithina tiphia*** (Linnaeus)
IORA

A bird which was not uncommonly seen, usually in pairs. It was generally located by its pleasant sweet whistles. A bird was once seen clinging to a branch upside down with its tail pressed to the branch as if for support.

71. ***Chloropsis aurifrons*** (Temminck)
GOLDFRONTED CHLOROPSIS

Only one bird of this species was seen in the foothills of the Shevroy hills (34). It was seen in the upper canopy of a tree in the forest, sipping nectar from flowers.

72. ***Chloropsis cochinchinensis*** (Gmelin)
JERDON'S CHLOROPSIS

This chloropsis was sighted in only two places, *viz.*, in the open area surrounded by dry deciduous forest on the Anchetty-Natrapalayam road (13) and in the tall *Eucalyptus* trees in the Sitteri FRH compound (26). The birds were very noisy.

Family PYCNONOTIDAE

73. ***Pycnonotus jocosus*** (Linnaeus)
REDWHISKERED BULBUL

This bulbul was much less common than either the Redvented Bulbul or the Whitebrowed Bulbul. It was found in several localities in the Chitteri hills. On the whole, it appeared to show a preference for denser, more shady forests.

74. ***Pycnonotus cafer*** (Linnaeus)
REDVENTED BULBUL

By far, the most commonly seen bird along with the Whitebrowed Bulbul, the Redvented Bulbul was abundantly found in gardens, scrub, light and denser deciduous forests.

75. ***Pycnonotus luteolus*** (Lesson)
WHITEBROWED BULBUL

An abundantly-present bird, this bulbul was more easily heard than seen. It showed less preference for gardens than the previous species of bulbul.

Family MUSCICAPIDAE
Subfamily TIMALIINAE

76. ***Dumetia hyperythra*** (Franklin)
WHITERHROATED BABBLER

A group of about five birds was seen rummaging for insects in the masses of dry

leaves accumulated in the dry sandy bed of a stream in the deciduous scrub forest close to the Anchetty-Natrapalayam road (13). On being approached, they disappeared into the undergrowth, only to reappear after a while. Another flock of a larger number of these babblers was found deep within dense scrub undergrowth at Gajakulam (38).

77. ***Turdoides malcolmi*** (Sykes)

LARGE GREY BABBLER

Sisterhoods of this babbler were seen in four localities, *viz.*, Anchetty FRH compound (12), Vannathipaarai (20), Maamarathu Odai (29) and Sitteri-Harur road (30).

78. ***Turdoides affinis*** (Jerdon)

WHITEHEADED BABBLER

A common resident found in several localities.

Subfamily MUSCICAPINAE

79. ***Muscicapa tickelliae*** (Blyth)

TICKELL'S BLUE FLYCATCHER

Single males were seen on two instances, once deep inside the thickets in an overgrown dry *nallah* at Nochikutaai (28), and at another time in a shady area near a stream in the foothills of the Shevroy hills (34).

80. ***Terpsiphone paradisi*** Linnaeus

PARADISE FLYCATCHER

Although males under three years and females were seen in quite a few localities, no adult male was sighted.

81. ***Monarcha azurea*** (Boddaert)

BLACKNAPED MONARCH FLYCATCHER

One female of this species was seen on a tamarind tree in light deciduous and scrub forest not far from open fields and a dry stream at Kulumuru pallam (14). It flew away from its perch every now and then to catch an insect only to return to it soon after.

Subfamily SYLVIINAE

82. ***Prinia hodgsoni*** Blyth

FRANKLIN'S ASHY-GREY WREN-WARBLER

This species was found in the thorny bushes in scrub jungle in several localities. Almost all the males were noticed indulging in the breeding song. All observations

were between 7 March and 13 April, suggesting that this might be a part of the breeding season of this species in Dharmapuri district. Ali and Ripley (1983) state its breeding season as from middle of June to October, chiefly July and August. Dharmakumarsinhji's observation in Gujrat, as quoted by Ali and Ripley (*op.cit.*) is that the season is February-March.

83. ***Prinia socialis*** Sykes
ASHY WREN-WARBLER

This wren-warbler was found in several localities in bushes and shrubs. On 9.iii.1986 one bird was seen nesting in an inundated paddy field. This was evidenced by the fact that the bird was seen to hop into the paddy at a certain specific spot, flying away on sensing danger, returning to the same spot every time. Ali and Ripley (1983) describe three types of nests which these birds are known to build. As it was impossible to approach the nest in the present study, its shape, size, location, constituent materials and contents could not be ascertained.

84. ***Orthotomus sutorius*** (Pennant)
TAILOR BIRD

A common resident, which was sighted in gardens and in light deciduous and thorny scrub forests.

85. ***Acrocephalus dumetorum*** Blyth
BLYTH'S REED WARBLER

A winter visitor that was met with widely in th e district.

86. ***Phylloscopus trochiloides*** (Sundevall)
GREENISH LEAF-WARBLER

This leaf-warbler, which winters in peninsular India, was found in several places, affecting gardens, light and a little denser deciduous forests. It appeared to be more abundant in the southeastern part of the district between 25.ii.1986 and 11.iii.1986 than in the western and southwestern part between 3.iv.1985 and 16.iv.1985.

Subfamily TURDINAE

87. ***Copsychus saularis*** (Linnaeus)
MAGPIE-ROBIN

Sighted in many places, the Magpie-Robin was also frequently seen perched on top of some tall exposed branch of a tree, or some similar vantage point, and pouring forth its song.

88. ***Copsychus malabaricus*** (Scopoli)
SHAMA

The Shama is a beautiful songster which was sighted only on one occasion in the wooded Panai RF (11) on the banks of the Toddahalla river near Anchetty. This bird, a male, allowed the present author to observe it for an extended period of time from a distance of about 20m, and also treated him to a wonderful repertoire of rich, melodious song. Only when the author attempted to get closer to the singing bird did the latter exhibit shyness by flying away.

89. ***Saxicola caprata*** (Linnaeus)
PIED BUSH CHAT

This bush chat was seen on only two occasions - once on 4.iv.1985 at Berikai RF (3), and again on 12.iv.1985 at Kulumuru pallam (14). On both occasions, only a male was sighted, and it was found close to a stream. In the first-mentioned locality, the male was seen exhibiting the characteristic 'display' flight.

90. ***Saxicoloides fulicata*** (Linnaeus)
INDIAN ROBIN

An extremely common resident species, seen almost everywhere, usually in pairs. The present author stumbled upon a nest of this bird on 11.iv.1985 (around 7.30 AM) in one of the numerous little "islands" in the Toddahalla river in the Panai RF (11). The nest from which the sitting female was accidentally disturbed was cup-shaped and made of grass. It was built on the side of a boulder about 50 cm from the ground, shielded on the other side by tall grass. The nest contained a single egg. After about an a hour, during which period no observation was made, the nest revealed a second egg, which must have been laid in the interim period. Ali and Ripley (1983) state that the eggs are laid in the early morning at 24-hour intervals. In that case, the first egg had, perhaps, been laid the previous day. The nesting birds were not sighted anywhere, although they were perhaps keeping watch from a safe distance.

Family PARIDAE

Subfamily PARINAE

91. ***Parus major*** Linnaeus
GREY TIT

A pair of these birds was found, apparently nesting, in a hollow in a stump of a tree *c* 5m above the ground on the bank of the Toddahalla river. The birds flew away on disturbance, and did not return during the 10-minute duration when the tree was watched.

Family SITTIDAE

Subfamily SITTINAE

92. ***Sitta castanea*** Lesson

CHESTNUTBELLIED NUTHATCH

This nuthatch was seen only in one locality *viz.*, Sameri (5) in deciduous forest mixed with thorny plants and *Lantana*. It appears to be unrecorded so far from Tamil Nadu except from the Nilgiri Hills.

A pair of these birds was found nesting in a hollow in a tree trunk about 10m above the ground, not far from the *jheel*. The female was observed bringing into the nest mud balls, blob by bolb, from the margin of a puddle about 70m away. On her return journey with the mud balls, she stopped once or twice in some nearby trees, as though it was difficult for her to fly directly to her nest with her burden. The male was observed bringing some bark-like material to the nest.

93. ***Sitta frontalis*** Swainson

VELVETFRONTED NUTHATCH

Seen only in the deciduous forest at Nochikuttai (28) in the Chitteri hills.

Family MOTACILLIDAE

94. ***Motacilla flava*** Linnaeus

YELLOW WAGTAIL

Two to three of these winter visitors to India were seen feeding on the moist grassy margin of the *jheel* at Namaleri (7) in the company of Pond Heron and Common Sandpiper.

95. ***Motacilla caspica*** (Gmelin)

GREY WAGTAIL

This wagtail, which winters in the Indian Peninsula, was sighted singly in a few localities, generally among rocks in streams. On 16.iv.1985 one male was seen in the Hogenekal FRH compound (15), which showed a darkening chin, throat and upper breast that were not entirely black, as in the summer plumage.

96. ***Motacilla maderaspatensis*** Gmelin

LARGE PIED WAGTAIL

The most common of the three species of wagtail seen in Dharmapuri district. It was sighted very often in the vicinity of water bodies, wading in shallow water, feeding in the damp grassy river bed, and in the banks of rivers, streams and *jheels*. One bird was seen perched atop a large tamarind tree on the bank Toddahalla river at a height of 20-25m. In Madras, the present author has never seen this wagtail (which is quite common) on a tree top, the bird appearing to prefer, as a perch, some tall "man-made" object, which offers a good view, like a water tank, or TV antenna, to trees.

Family DICAEIDAE

97. ***Dicaeum erythrorhynchos*** (Latham)
TICKELL'S FLOWERPECKER

Only three records in the present study - one at Denkanikotta, and two in the Chitteri hills.

Family NECTARINIIDAE

98. ***Nectarinia zeylonica*** (Linnaeus)
PURPLERUMPED SUNDIRD

A common resident species of sunbird, met with not infrequently. At the Denkanikotta FRH compound, on 6.iv.1985, a male was observed feeding a young one which had left the nest.

99. ***Nectarinia asiatica*** (Latham)
PURPLE SUNBIRD

Another common sunbird. All males sighted were in breeding plumage. On 16.iv.1985, a male was seen perched on a barbed wire fence in the Hogenekal FRH compound, singing with raised head, and fluttering his partially opened wings, displaying his bright yellow pectoral tufts in the process. But, in contrast to this kind of 'display' described by Ali and Ripley (1983), no female could be sighted near the displaying male.

Family ZOSTEROPIDAE

100. ***Zosterops palpebrosa*** (Temminck)
WHITE-EYE

A party of 10-12 of these birds was sighted in the open light deciduous forest at Noganoor near Denkanikotta. White-eyes were also seen in the Chitteri hills.

Family PLOCEIDAE

Subfamily PASSERINAE

101. ***Passer domesticus*** (Linnaeus)
HOUSE SPARROW

A sparrow which was commonly found near human settlements, especially in villages and towns. It showed a preference for grain godowns. This species of sparrow was not encountered in the scrub or deciduous forests in the district.

102. ***Petronia xanthocollis*** (Burton)
YELLOWTHROATED SPARROW

The present author did not come across this species in the southeastern part of the

district between 25.ii.1986 and 13.iii.1986. The bird was sighted in three localities in the southwestern part of the district between 10.iv.1985 and 16.iv.1985. In one of the localities, *viz.*, Anchetty FRH compound (12), a solitary male was observed during the hotter part of the day for four days, chirruping monotonously for long periods, perhaps indicating the presence of a nest nearby, but this was not possible to confirm because dense thorny thickets barred approach to the vicinity of the tree where the sparrow perched and sang.

Subfamily PLOCEINAE

103. ***Ploceus manyar*** (Horsfield)
STREAKED WEAVER BIRD

A noisy colony of more than 60-80 males and females was found one evening (12.iv.1985) among reeds in a marshy pool which was close to paddy fields and a large *jheel*. Some nests in the "helmet" stage, were seen. On disturbance, the birds flew away, *en masse*, only to settle among other similar reeds at a distance, thus disappearing from view. After sometime, they returned. No copulation was witnessed.

Crook (1983) has stated that all weavers breed in the monsoon. Ambedkar (1972) has identified the breeding season of this weaver bird in the Kumaon terai as coinciding with the SW monsoon, usually between June and September. It appears from the present study that in Dharmapuri district *P. manyar* completes its breeding cycle by about the middle or the third week of May. So, perhaps in this region it is not as dependent on the monsoon as it is in the Himalayan foothills.

Subfamily ESTRILDINAE

104. ***Lonchura malabarica*** (Linnaeus)
WHITETHROATED MUNIA

Four birds of this species were sighted perched on electric wire over open fields at Naagamarathu pallam (24) on 27.ii.1986. This was the only sighting of this munia during the course of the present study.

Family FRINGILLIDAE

Sub family CARDUELINAE

105. ***Carpodacus erythrinus*** (Pallas)
ROSEFINCH

The Rosefinch was recorded only at Nochikuttai (28) in the Chitteri hills; a pair was seen perched on a tree at the edge of the dense deciduous forest on 3.iii.1986.

SUMMARY

105 species of birds identified by field sighting are listed from Dharmapuri District of Tamil Nadu. Brief field notes are given for each species.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta, for giving him an opportunity to carry out this work. He is indebted to Dr R.S. Pillai, Scientist 'D' and Officer-in-Charge, Southern Regional Station, Zoological Survey of India, Madras, for permitting him to associate himself with both the survey tours to Dharmapuri distict, for reviewing the MS critically and suggesting valuable improvements, and for his help in various other ways. The author is grateful to the Tamil Nadu Forest Department for help and co-operation.

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Rec. zool. Surv. India, 86(2) : 315-318, 1990

EXTENSION OF RANGE OF DISTRIBUTION OF *ACCROSSOCHEILUS HEXAGONOLEPIS* (McCLELLAND) (PISCES : CYPRINIDAE) FROM MADURAI DISTRICT, TAMIL NADU - NEW RECORD FOR THE SOUTH INDIA.

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Accrossocheilus hexagonolepis (McClelland) is so far known only from India (restricted in northern parts only), Bangladesh, Nepal, Pakistan, Burma, Thailand, Vietnam, China, Malaya and Sumatra (Jayaram,1981). *A. hexagonolepis* was described by McClelland (1839) from Upper Assam and has been subsequently reported from other localities, in Kalimpong Duars and Siliguri Terai by Hora and Gupta (1941), in North Bengal by Shaw and Shebbeare (1937), in Abor Hills, Assam by Chaudhuri (1913), in Naga Hills and Manipur valley by Hora (1921), in Garo Hills, Assam by Hora (1924) and in Arunachal Pradesh by Barman (in Datta and Barman, 1985).

The faunistic survey of the freshwater fishes of Madurai (78°E to 78.5°E Longitude and 9.5°N to 10°N Latitude), Tamil Nadu shows the presence of 13 specimens of *A. hexagonolepis*. A perusal of the existing literature on the fish fauna of Tamil Nadu also indicate that this species has not been earlier represented from Tamil Nadu and other states of the southern India also. The occurrence of *A. hexagonolepis* in Tamil Nadu establishes the continuity of the geographical distribution of this species, which extends from the Nothern India to the Southern India.

A brief description of this species along with other relevant information is provided in this note.

Accrossocheilus hexagonolepis (McClelland)

(Text–Fig. 1)

Barbus hexagonolepis McClelland,1839, *Asiat. Res.*, **19** : 270, 271, 336, pl.41, fig.3 (type-locality : Upper Assam); Day, 1878, *Fish. India*, : 564, pl.137, fig.4 ; Day, 1889, *Fauna Brit. Ind. Fish*, **1** : 305.

Accrossocheilus hexagonolepis, Jayaram, 1981, *Handbk. Freshw. Fish. India*, : 122, fig.59 (genus description and distribution)

Materials examined : 13 exs., 19mm. - 147mm. in standard length. Reg. No. ZSIFF2529. Locality : from the Vanathiparai hill stream of Madurai district, Tamil Nadu. Name of coll. : S. S. Saha and date of collection : 19. 2. 1986.

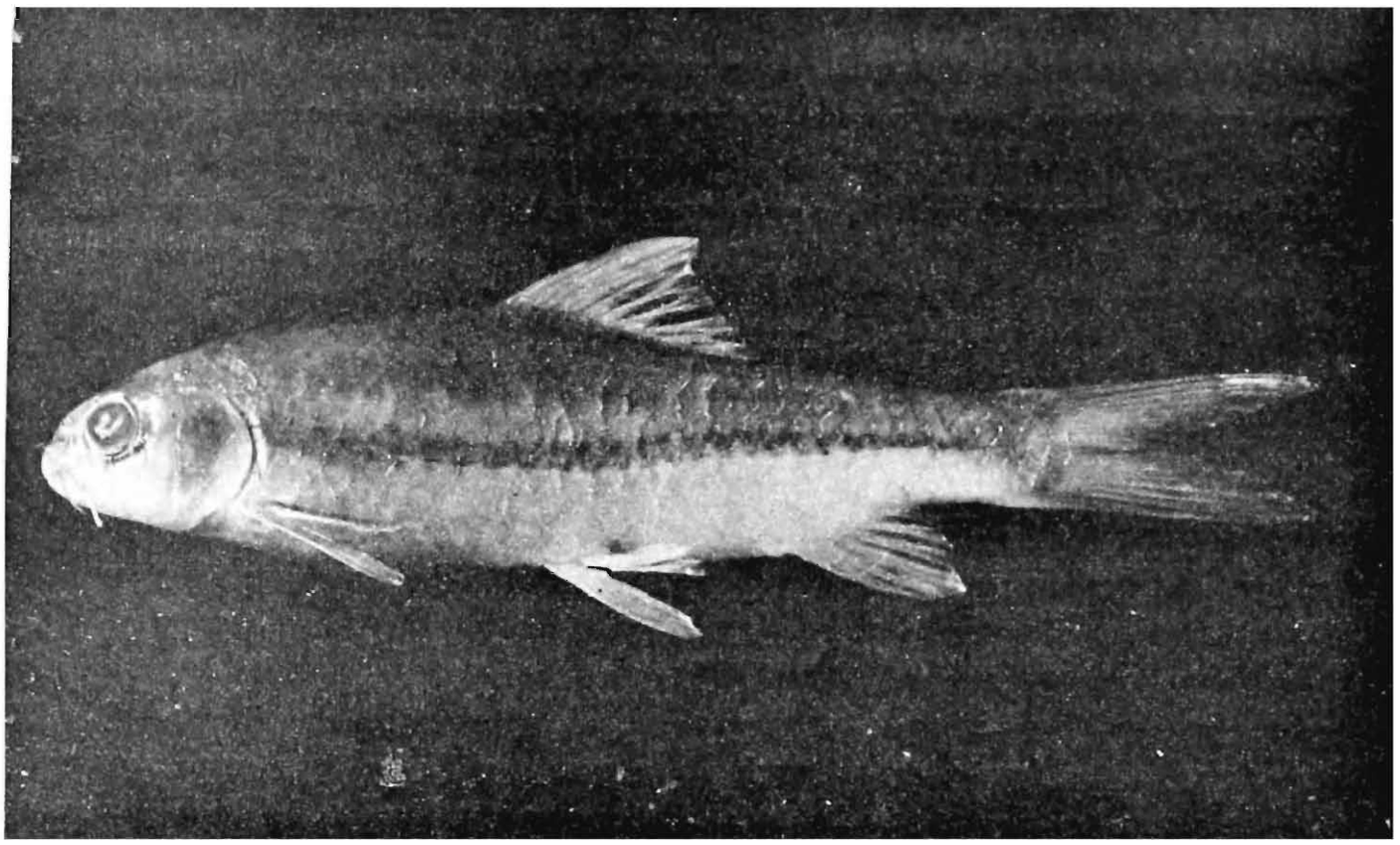

Fig. 1. Lateral view of *Accrossocheilus hexagonolepis* (McClelland) from Madurai district, Tamil Nadu, 107mm.SL.

DESCRIPTION

Head length 3.82 - 4.04 and body depth 3.45 - 3.73 in standard length. Eye diameter 3.05 -4.10 in head length, 1.66 - 1.77 in interorbital width. Eyes, anterior, lateral in position, not visible from ventral surface. Snout length 2.84 – 3.00 in head length, 1.23 – 1.26 in interorbital width. Dorsal profile more convex than ventral profile. Interorbital space convex. Upper jaw longer and lower labial fold interrupted. Several rows of horny tubercles on sides and in front of the snout. Barbels two pairs, the maxillary pair longer extending up to below the posterior margin of the preopercles and rostral pair slightly shorter. Gape of mouth reaching anterior margin of the orbit and is subterminal in position. Lower lip conspicuously separated from lower jaw which has horny covering. Upper lip separated from the snout by a groove.

Scales : Lateral line complete covering 30 – 32 scales. Lateral transverse row of scales 9, scales between base of pelvic fin and lateral line is $3^1/_2$. Predorsal scales 11 and circumpeduncular scales 14.

Fins : D.III/9, A.II/5, P.17, V.9, C.19.

Dorsal fin originates slightly ahead of pelvic fin origin, midway between the tip of the snout and base of caudal fin. Pectoral fins not extending pelvic fin. Pelvic fin also not reaching anal fin which in turn not reaches base of caudal fin. A scaly flap or appendage is present before each pelvic fin. Caudal fin deeply forked with pointed lobes.

Colour in alcohol : Dorsal surface up to lateral line is darker, ventral surface below lateral line bluish grey. A conspicuous dark longitudinal stripe extending from opercular end to base of caudal fin. Fins slightly darker.

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The authors are grateful to the Director, Zoological Survey of India, Calcutta for laboratory facilities and to Dr. P. K. Talwar, Deputy Director, Zoological Survey of India Calcutta for encouragement. Thanks are also due to Shri S. S. Saha, Assistant Zoologist, Zoological Survey of India, Calcutta for the collection of the specimens and to Shri S. Sen, Photographer of the Photopgraphy section of the Zoological Survey of India, Calcutta for taking the photograph of the specimen.

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Rec. zool. Surv. India, 86(2) : 319-327, 1990

NEMATODES FROM WEST BENGAL (INDIA). XXII. MORPHOMETRIC AND ALLOMETRIC VARIATIONS IN HIRSCHMANNIELLA ORYZAE (V. BREDA DE HAAN, 1902) LUC & GOODEY, 1963 (PRATYLENCHIDAE : TYLENCHIDA)

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INTRODUCTION

Though *Hirschmanniella gracilis* (de Man, 1880) Luc & Goodey, 1963 has been found a key pest of paddy by Baqri et. al (1983) in West Bengal, *H. oryzae* (V Breda de Haan, 1902) Luc & Goodey 1963 has also been encountered as a potential pest of paddy in some localities of North Bengal Districts of West Bengal. Since *H. gracilis* has been confused with *H. oryzae* in West Bengal, it was felt necessary to study the intra-specific variations with special reference to allometric and morphometric characters of the two species so that these may be identified correctly. Dey & Baqri (1985) have already discussed the allometric and morphometric variations in *H. gracilis*. Waliullah (1985) has also studied allometric variations in *H. oryzae* from Indonesia. However, he has taken into consideration only the linear relationships of a few sets of characters by using the logerithmic regression equation. This paper reports the variations in single population of *H. oryzae* from West Bengal, India.

MATERIAL AND METHOD

The nematodes were fixed in hot 4% formalin, dehydrated in the descicator and mounted in anhydrous glycerine. The specimens have been registered and deposited with the National Zoological Collection, Zoological Survey of India, Calcutta.

Hirschmanniella oryzae (V Breda de Haan, 1902) Luc & Goodey, 1963 (Figs. 1 - 3)

Dimensions : TABLE I.

Description :

Female : Body slightly curved upon fixation. Body annules 1.2-2.0 µm apart in the middle region. Lateral fields 5-7 µm or 1/4th-1/3rd of body-width near middle, marked with four incisures of which the outer ones are crenate. In some specimens incomplete aerolations have been found in the posterior region of the body. Head continuous with body, flat at apex, marked with 3-4 annules, with well developed cephalic framework. Stylet robust, 17-19 µm or about 1.8-2.2 times the head-width. The metanchium (anterior part of the stylet) 7-8 µm long or 41-42 % of the stylet length. The stylet knobs are rounded, 3.5-4.2 µm wide.

TABLE 1

Morphometric and Allometric Variations in Adults in *Hirschmanniella Oryzae* (V. Breda de Haan, 1902) Luc & Goodey, 1963 (40 Females, 40 Males)

Characters	♀ Range	♀ Mean ± S. D.	♀ S. E.	♀ C.V.(%)	♂ Range	♂ Mean ± S. D.	♂ S. E.	♂ C.V.(%)
Length (mm)	1.20 – 1.58	1.40 ± 0.09	0.02	6.83	1.09 – 1.44	1.28 ± 0.09	0.01	7.0
a	59.30 – 75	68.05 ± 3.38	0.53	4.97	55.50 – 73.94	63.71 ± 5.05	0.80	7.92
b	10.50 – 12.70	11.53 ± 0.60	0.09	5.20	9.01 – 11.68	10.53 ± 0.67	0.11	6.39
b'	3.9 – 5.0	4.32 ± 0.24	0.04	5.55	3.57 – 5.02	4.19 ± 0.25	0.04	6.03
c	14.30 – 18.30	16.29 ± 0.98	0.15	6.02	14.34 – 18.21	16.60 ± 1.01	0.16	6.11
c'	5.20 – 7.0	5.82 ± 0.47	0.07	8.07	4.5 – 6.15	5.31 ± 0.35	0.06	6.64
V/T	51 – 57	53.42 ± 1.41	0.22	2.64	23 – 35	28.97 ± 3.35	0.53	11.55
G_1	18 – 23	20.02 ± 1.73	0.27	8.64	–	–	–	–
G_2	15 – 25	18.85 ± 1.98	0.31	10.5	–	–	–	–
O	13.51 – 18.42	15.57 ± 1.13	0.17	7.26	11.11 – 17.65	15.06 ± 1.12	0.17	7.44
m	55.30 – 66.10	61.82 ± 2.80	0.44	4.53	56.0 – 66.94	62.82 ± 2.12	0.34	3.38
Cut. at mid body (µm)	0.80 – 1.20	0.95 ± 0.10	0.02	10.50	0.8 – 1.2	0.94 ± 0.11	0.02	11.68
Annules (µm)	1.20 – 2.0	1.56 ± 0.23	0.04	14.68	1.1 – 1.7	1.47 ± 0.16	0.03	10.77
Lateral fields (µm)	5 – 7	5.87 ± 0.85	0.13	14.47	5 – 7	5.47 ± 0.60	0.09	10.92
Head width (µm)	7 – 9	8.47 ± 0.55	0.09	6.49	8 – 9	8.42 ± 0.50	0.08	5.93
Stylet (µm)	17 – 19	17.78 ± 0.48	0.08	2.69	17 – 19	17.50 ± 0.52	0.08	2.96
Head height (µm)	3 – 5	3.87 ± 0.40	0.06	10.32	3 – 5	3.75 ± 0.44	0.07	11.68
Stylet knobs (µm)	3.5 – 4.2	3.81 ± 0.10	0.01	2.62	3 – 4	3.51 ± 0.09	0.01	2.56
Metenchium (µm)	7 – 8	7.47 ± 0.19	0.02	2.54	7 – 8	7.52 ± 0.21	0.03	2.79

Characters	♀ Range	♀ Mean ± S. D.	♀ S. E.	♀ C.V.(%)	♂ Range	♂ Mean ± S. D.	♂ S. E.	♂ C.V.(%)
D. Oesc.gl.opening (µm)	2.5 – 3.5	3.14 ± 0.23	0.03	7.32	2 – 3	2.84 ± 0.20	0.03	7.04
Oesophagus* (µm)	116 – 136	124.90 ± 4.34	0.69	3.47	113 – 135	123.35 ± 4.85	0.77	3.93
Oeso. overlap** (µm)	150 – 240	203.27 ± 19.78	3.13	9.73	140 – 205	185.20 ± 21.27	3.36	11.48
Median bulb (µm)	16-20 × 9-12	18.07× ± 1.11×	0.18×	6.19×	17-20 × 8-11	18.10× ± 1.17×	0.19×	6.48×
		10.97 ± 0.89	0.14	8.12		9.87	0.65	0.10 6.55
Median bulb* (µm)	70 – 81	75.20 ± 2.32	0.37	3.09	70 – 84	76.50 ± 3.49	0.55	4.57
Nerve ring* (µm)	89 – 102	96.42 ± 3.07	0.49	3.18	90 – 104	97.62 ± 3.58	0.57	3.67
Excretory pore* (µm)	112 – 131	121.45 ± 4.92	0.78	4.05	109 – 129	120.52 ± 5.01	0.79	4.16
Hemizonid (from excr.pore)	0 – 5 annules.							
Hemizonid width	2 – 4 annules.							
Vulva* (µm)	668 – 830	751.07 ± 46.0	7.27	6.12	–	–	–	– –
Vagina (µm)	8 – 10	8.82 ± 0.81	0.13	9.18	–	–	–	– –
Vulva body width (µm)	17 – 25	20.70 ± 1.80	0.28	8.7	–	–	–	– –
Anterior gonad (µm)	222 – 380	279.15 ± 37.32	5.90	13.37	–	–	–	– –
Posterior gonad (µm)	210 – 358	266.32 ± 37.34	5.90	14.02	–	–	–	– –
Anal body width (µm)	12 – 18	14.87 ± 1.53	0.24	10.35	13 – 17	14.53 ± 2.54	0.40	17.78
Rectum (µm)	8 – 15	10.32 ± 2.16	0.34	20.96	–	–	–	– –
Tail annules (no.)	54 – 75	65.27 ± 6.10	0.96	9.35	–	–	–	– –
Tail length (µm)	70 – 105	86.47 ± 6.98	1.10	8.08	63 – 90	77.67 ± 5.34	0.84	6.88
Spicules (µm)	–	–	–	–	20 – 28	23.8 ± 1.65	0.26	6.94
Gubernaculum (µm)	–	–	–	–	5 – 10	7.7 ± 1.24	0.20	16.16
Phasmids (µm)	20 – 45	28.65 ± 5.65	0.89	9.72	21 – 35	27.67 ± 2.90	0.46	10.49

* Distance from anterior end.

** Distance from Oesophagos-intestinal junction.

Oesophagus typical of the genus. Median oesophageal bulb at 56-60 % of the oesophageal length from anterior end, 16-20 × 9-12 µm. Oesophageal glands lobed, overlapping intestine ventrally. Orifice of the dorsal oesophageal gland 2.5-3.5 µm below the base of the stylet. The nerve ring situated at 89-102 µm or 72-80 % of the oesophageal length from anterior extremity. Excretory pore at 112-131 µm or 91-94 % of the oesophageal length from anterior end, located slightly anterior to the oesophago-intestinal junction (Fig. 1). Hemizonid 2-4 annules long, situated 0-5 annules anterior to the excretory pore. Vulva post-equatorial in position. Vagina about 1/2 of the corresponding body-width. Reproductive system amphidelphic. Each sexual branch consists of an uterus, a spermatheca, an oviduct and an ovary. Spermatheca filled with sperms. Oocytes arranged in a single row except in the growth region. Tail cylindrical,with mucronate terminus, 70-105 µm or 5.5-6.5 anal body-widths long. Phasmids located in posterior half of the tail, 26.4-42.8 % of the tail length from tail terminus.

♂ : Similar to female in general shape and morphology except the reproductive system and the tail shape. Bursa subterminal (Fig. 1. I, J). Gubernaculum slightly curved. Spicules 20-28 µm long when measured along the median line. Tail slightly curved, 63-90 µm or 4.5-6 anal body-widths long, with a pointed ventral mucro.

MORPHOMETRIC AND ALLOMETRIC CHARACTERS

The measurements and statistical analyses of various morphometric and allometric characters of adult females and males have been furnished in Table-I. The position of the vulva and the length of the tail are significantly correlated with the body length, the correlation of which are 0.922 and 0.629 respectively (fig. 2). The position of the excretory pore has moderate correlation with body-length as its 'r' value is 0.502. The length of oesophagus and the position of the median bulb from anterior end is less correlated with the body-length, the 'r' value are 0.268 and 0.159 respectively. The length of the stylet and gonads have no correlation with the body-length.

The statistical analysis shows that the stylet length and the 'V' value are the least variable characters (CV ≥ 3). Though the 'V' value is least variable, the length of anterior and posterior sexual branches exhibit high degree of variability (CV = 8.64 and 10.5 respectively). The length of body, tail and oesophagus; distance of dorsal oesophageal gland opening from the base of stylet; position of median bulb, nerve ring, and excretory pore from anterior end; and the value of a, b, b', c, 0, and m are moderately variable characters (CV = 4-8). In case of male, the length of the spicules varies moderately (CV = 6.94) while the length of the gubernaculum and the position of phasmids show a high degree of variability (CV = 10.49 - 16.16).

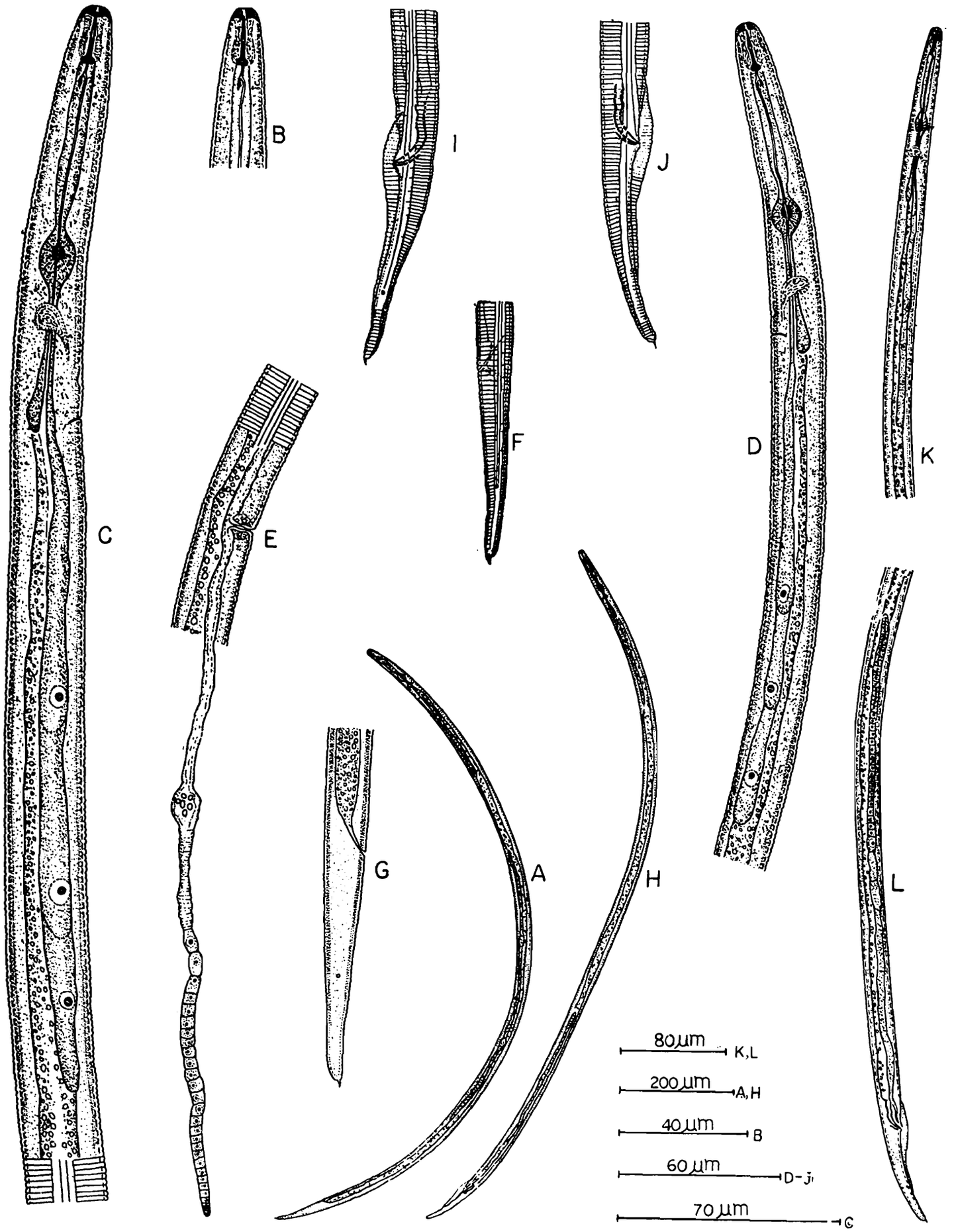

Fig. 1. *Hirchmanniella oryzae* (V. Breda de Haan, 1902) Luc & Goodey, 1963. A-G : Female. A-Entire Female, B-D-Anterior region, E-Female reproductive system, F & G-Female tails. H-L Male. H-Entire male, I & J-Male tails, K-Anterior region, L-Posterior region.

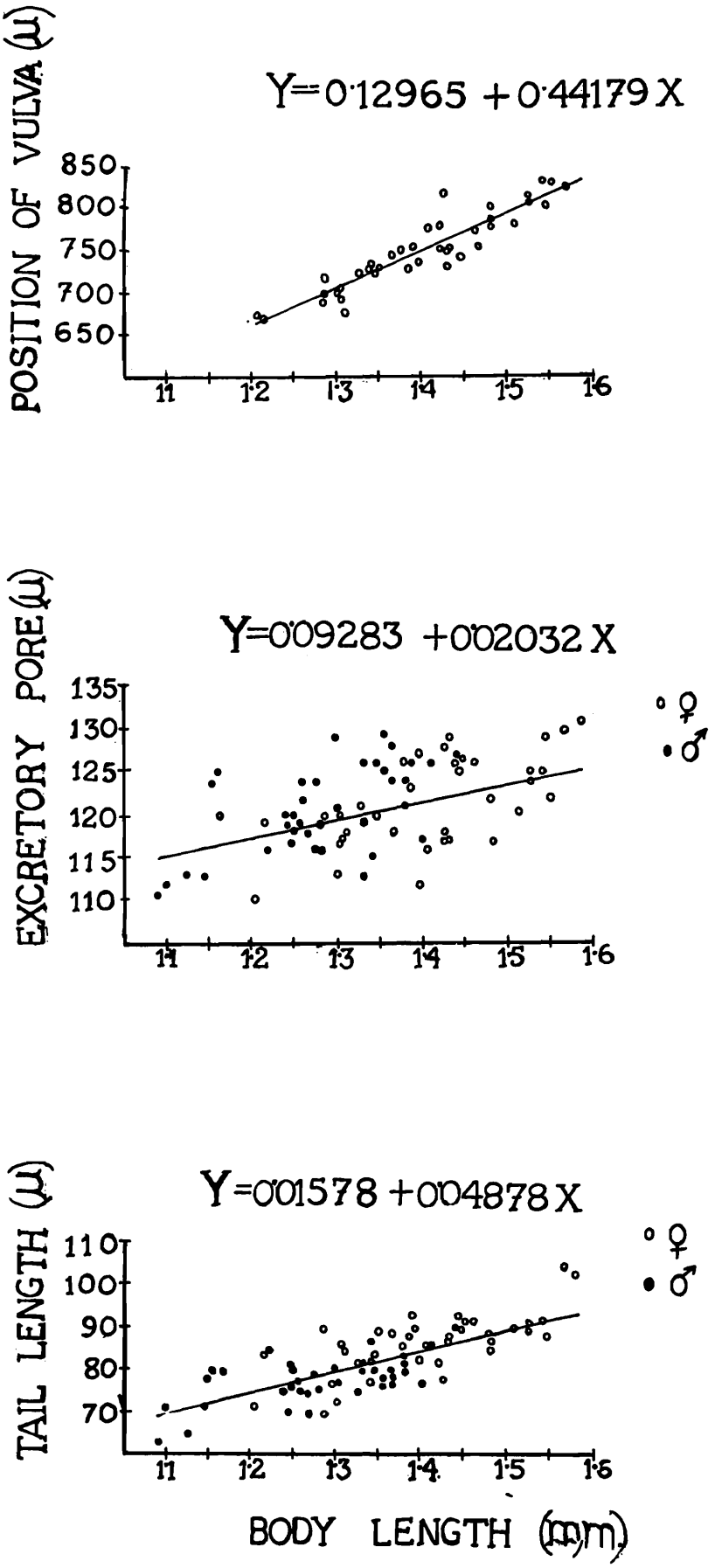

Fig. 2. Correlation between body length versus vulva, excretory pore and tail length respectively with regression lines.

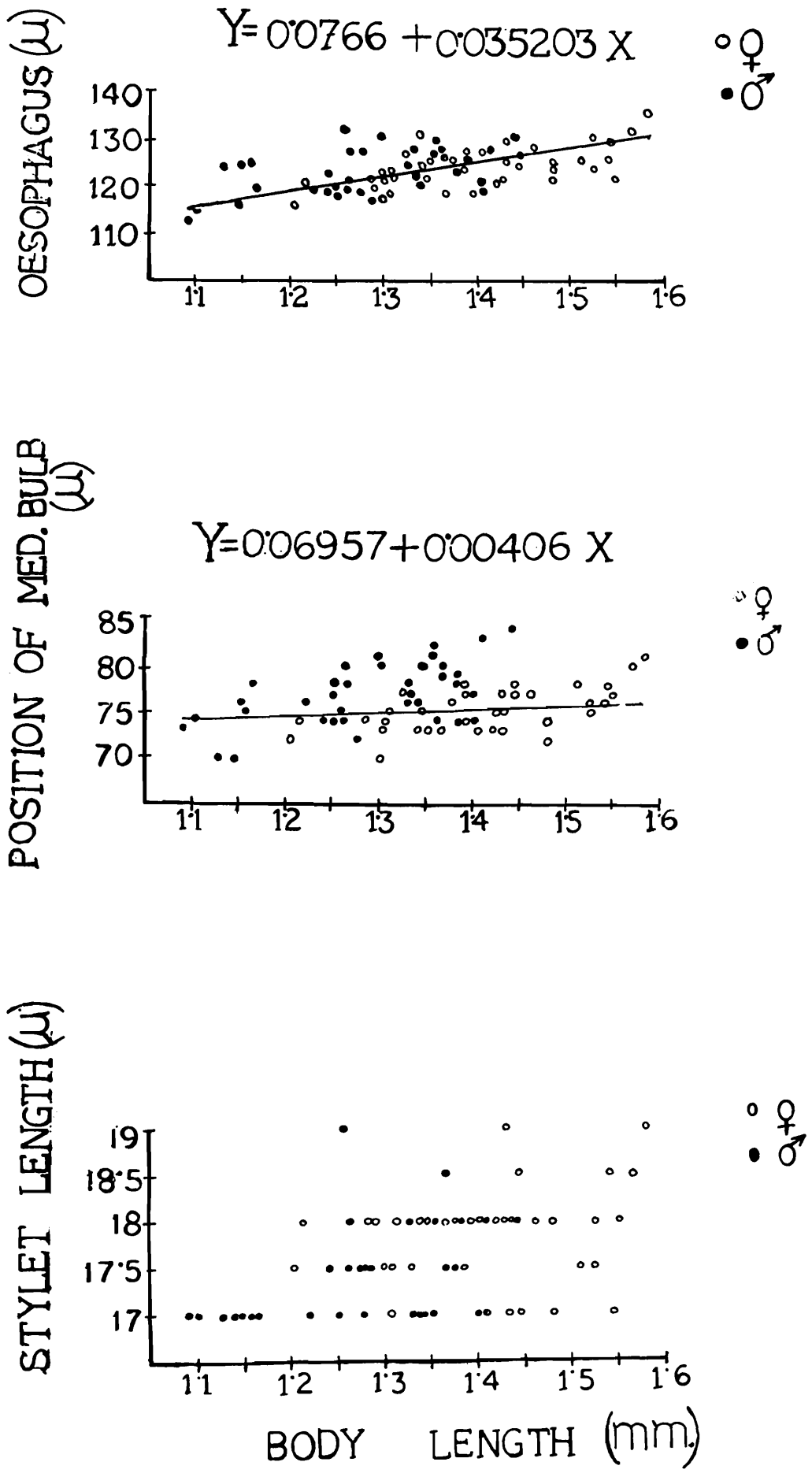

Fig. 3. Correlation between body length versus oesophagus, position of median bulb and stylet length respectively with regression lines.

In some respects these results have been found similar to Waliullah's (1985) findings on *H. oryzae, viz.*, total oesophageal length, position of vulva and spicule length show consistent positive correlation with body length. Our observations are similar to Bird and Mai (1967) who found that the stylet length and the position of vulva were least variable than other allometric characters in *Trichodorus christei* Allen, 1957. Azmi and Jairajpuri (1976) also found that the position of vulva and the length of the stylet are least variable characters in *Helicotylenchus indicus* Siddiqi, 1963. Similar results have been found by Baqri & Ahmad (1981, 1984) in *Tylrnchorhynchus nudus* Allen, 1955 and *Helicotylenchus crenacauda* Sher, 1966.

Remarks : Dey and Baqri (1985) while discussing the distinguishing characters of *H. gracilis* and *H. oryzae* have already reported that the length of the stylet and spicules can be used to differentiate these two species (stylet and spicules = 21-23 µm and 28-35 µm in *H. gracilis* against 17-19 µm and 20-28 µm respectively in *H. oryzae*).

Sher (1968) in his illustrations (fig. 3,A) and Shivakumar & Khan (1982) in their key to species of *Hirschmanniella* have reported that the excretory pore in *H. oryzae* is situated posterior to oesophago-intestinal junction. However, the West Bengal population shows that the position of excretory pore varies from opposite to slightly anterior to the oesophago intestinal junction.

Locality and habitat : From soil around roots of paddy, *Oryza sativa* at Salbari, District Darjeeling, West Bengal.

SUMMARY

The statistical analysis of the measurements of a single population of *Hirschmanniella oryzae* (V. Breda de Haan, 1902) Luc & Goodey, 1963 reveals that the length of the stylet and the position of vulva are the least variable characters (CV ≥ 3). The length of the body, oesophagus, tail and spicules; the position of the dorsal oesophageal gland opening, median oesophageal bulb, nerve ring, excretory pore and the values of a, b, b', c, 0 and m are moderately variable characters (CV ≥ 8). The values of G1 and G2, length of the oesophageal overlap and the position of the phasmids show a high degree of variability (CV < 8).

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CONTRIBUTION TO THE TAXONOMICAL STUDIES OF NEUROPTERA (SUBORDER PLANIPENNIA) FROM EASTERN INDIA III. FAMILY CHRYSOPIDAE

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INTRODUCTION

The Chrysopids, popularly known as green lacewings, are predators on various insect pests of agriculture and other plantations. The group thus attracted the attention of systematics for a long time.

The taxonomic study of the group has received so far less attention from the Indian subregion. No consolidated work on the fauna particularly from Eastern India has been published excepting for a few stray papers. Therefore, an attempt has been made to provide a comprehensive account of the fauna on the basis of named and also unnamed collections, collected by different Survey parties including the author, of Zoological Survey of India. The paper deals with a brief review on earlier investigations, general distribution, review on taxonomy, external morphology and terminology related to the group, taxonomic studies coupled with keys to taxa, redescription wherever necessary, description of a new species and biogeographical account. Besides, the description of an unknown female, morpho-variations and new locality records have been incorporated. Over and above, the text has been suitably illustrated and the literature review of those species, marked asterisk (*), has been made due to the lack of material for study. It may be mentioned here that five species placed under *Chrysopa* are doubtful concerning their generic identity. Because *C. virgestes* and *C. ignobilis* are represented only by females and relevant material for the study of *C. notata* Navas, *C. guttata* Navas and *C. madestes* Banks are not available. However, altogether 24 species in 11 genera and 2 subfamilies have been reported in this paper.

EARLIER INVESTIGATION

The Chrysopid fauna from India is not well known. The work, whatever known, is mainly based on the scattered account rendered by various workers including Walker (1853, 1859), Needham (1909), Navas (1910, 1912 - 1914, 1928-1932,) Banks (1911, 1933 & 1939), Kimmins (1938 & 1955) and Ghosh (1976 a, 1976 b, 1977 a - d, 1980, 1981 & 1983). Amongst a total of 52 species reported by these workers only 16 are so far known to occur in the Eastern Peninsular and Himalayan sectors of India.

GEOGRAPHICAL DISTRIBUTION

The *distribution* of the Chrysopid fauna highlights certain important aspects.

Amongst a total of twentyfour species from Eastern India, *Anisochrysa boninensis* (Okamoto) is represented from the Ethiopian, Palaearctic and Oriental regions and other two species, namely, *Anisochrysa alcestes* (Banks) and also *Brinckochrysa scelestes* Banks are represented from both the Palaearctic and Oriental regions. Of the remaining species, all are endemic in India except *Ankylopterv x octopunctata* (Fabricius) which extends from Oriental region to the Papuan region of the globe.

The material from Eastern India constitute about 50% of the entire Indian fauna and they occur in the north-eastern Himalayas particularly Sikkim, Assam and Darjeeling of West Bengal and also in Peninsular India with special reference to Bihar, Orissa and West Bengal. It is interesting to note that five species constitute new locality records for the different states of India, one species and the female of another species are for the first time recorded from India.

REVIEW ON THE TAXONOMY

A lot of confusion exists in the taxonomy of the group specially on the placement of the species in proper genera. Quite a large number of species have been placed in the genus *Chrysopa* though they belong to different genera erected by the modern taxonomists. Tjeder (1966) on the basis of male genitalia considered eight subgenera of *Chrysopa*. Subsequent workers raised the status of some of the genera namely, *Chrysoperla*, *Anisochrvysa* etc. to the generic level. In this context, it may be pointed out that several Indian species of *Chrysopa* viz., *C. orestes* Banks, *C. alcestes* Banks, *C. boninensis* Okamoto, *C. scelestes* Banks and *C. lacciperda* Kimmins also are not true *Chrysopa* but belong to different genera as substantiated by the study of wings and male genitalia of the species. Similarly, eight species of *Nothochrysa* described by different authors are not true *Nothochrysa* but some of them belong to the genus *Italochrysa*. Two *type species* namely, *N. indigena* Needham and *N. robusta* Needham examined by the author led him to conclude that species *indigena* is a true *Nothochrysa* but the species *robusta* belongs to the genus *Italochrysa*.

EXTERNAL MORPHOLOGY AND TERMINOLOGY

Adults medium-sized with a length of forewing 6.5-35 mm.; head: with prominent compound eyes; ocelli absent; antenna : multisegmented and filiform; maxillary palpi : 5-segmented and second segment always short; labial palpi : 3-segmented; mandibles well-developed; pronotum: either transverse or longer than wide at base and without lateral projection; meso - and metathorax: prescutum of mesothorax large, divided by a suture longitudinally into two halves; meso- and metascutum constricted at middle forming thereby narrowly separated lobes; legs : slender, hind pair longer than other two pairs; tarsi 5-segmented with a pair of curved claws; wings: large, usually subequal, pterostigma present but sometimes indistinct, microtrichiae only on a short area in anal

angle of forewing and margin with dense fringes but without trichosors; usually without wing-coupling apparatus; humeral veinlet not recurrent; subcostal area of forewing usually with a single basal crossvein and a few apical ones in the pterostigmatic region; Sc long reaching wing margin beyond pterostigma; radius (R) long, parallel and close to Sc; radial sector (Rs) single; media (M) usually forked; intramedian cell (im) of different shapes usually present; two cells (m_1 & m_2) between M and Cu_1; pseudomedia (psm) formed by the fusion of M beyond im with the branches of Rs usually straight; cubitus 1 and Cubitus 2 (Cu_1 & Cu_2) arising from a common stem; Cu_1 & Cu_2 enclosing three cells; beyond the cell m_2, Cu_1 fused with the branches from median to form pseudocubitus (psc); abdomen: usually cylindrical or nearly so; 8 pairs of spiracles; cercal callus and trichobothria present; gonarcus and hypandrium internum in male genitalia and spermatheca in female always present.

SYSTEMATIC ACCOUNT

Key to the Subfamilies of the family CHRYSOPIDAE

psm of forewing merges with inner gradate series; jugal lobe of forewing large and tympanal organ absent; frenulum on hindwing present..... ..... Nothochrysinae Navas

psm of forewing merges with outer gradate series; jugal lobe of forewing absent; frenulum of hindwing if present, reduced .... Chrysopinae Esben-Petersen

Subfamily A. CHRYSOPINAE Esben-Petersen

Forewing : Tympanum absent; R dilated underside near base; one crossvein near base of subcostal area; M forked; an intra-median cell (of different shapes) usually present; Rs arising distally to furcation of M; second medio-cubital crossvein located distally or near to the furcation of M; psm straight and usually merging with outer gradate; psc never merges with outer gradate series; jugal lobe of forewing lacking; hindwing: frenulum if present, reduced.

Key to the genera of Subfamily CHRYSOPINAE

1. Costal area at first narrow, then gradually widening 2

   Costa steep at base..... *Ankylopteryx* Brauer

2. Forewing with only two rows of gradate..... 3

   Forewing with more than two rows or irregular gradates..... 9

3. Small to medium-sized insects; cell im usually subtriangular; basal subcostal crossvein beyond first medio-cubital crossvein..... 4

Robust species, usually large to very large; cell im usually subquadrangular; basal subcostal crossvein located about midway between first medio-cubital crossvein and furcation of M..... 7

4. Sternite 8 & 9 completely fused..... 5

Sternite 8 & 9 separated by intersegmental membrane..... ....***Chrysopa*** Leach

5. Genitalia in male with tignum..... 6

Genitalia in male without tignum .....***Glenochrysa*** Esben-Petersen

6. Genitalia in male with gonapsis.....***Anisochrysa*** Nakahara

Genitalia in male without gonapsis .....***Chrysoperla*** Steinmann

7. Gonarcus in male with entoprocessus..... 8

Gonarcus without entoprocessus .....***Italochrysa*** Principi

8. Male with pseudopennis.....***Ceratochrysa*** Tjeder

Male without pseudopennis.....***Brinckochrysa*** Tjeder

9. Forewing with three rows of gradate veinlets.....***Chrysopidia*** Navas

Forewing with irregularly distributed gradate venilets over the disc .... Tumeochrysa Needham

Genus I. *Italochrysa* Principi

1946. *Italochrysa* Principi, *Boll. Lst. Ent. Univ.* Bologna, **15** : 86.

Diagnostic characters : Usually large-sized robust species; antenna : stout and flagellum with four concentric rings of short setae; forewing : jugal lobe lacking; cell im usually subquadrangular; basal crossvein in subcostal area located about midway between first mediocubital crossvein and furcation of M; Cell m_2 longer than m_1; psm merges with outer gradate series; abdomen: sternite 8 and 9 fused; male genitalia: gonarcus without entoprocessus; arcessus large and toothed at apex; paramere long and united at base; hypandrium internum with large comes; female genitalia: subgenital long, weak tube with a pair of apical lobes and ventral ridge; spermatheca large with large vela and usually deep ventral impression.

Type species : *Hemerobius italicus* Rossi.

Distribution : Abyssinia, Central and South Africa, Japan, Palestine, Iran, India, the Sunda Islands, China and Australia.

Remarks : Principi (1946) erected this genus. Ghosh (1981) described a species in this genus. So, only two species including the present one are so far reported from India.

1. ***Italochrysa robusta*** (Needham), comb. nov.

1909. *Nothochrysa robusta* Needham, *Rec. Indian Mus.*, **3** : 202.

Redescription : Head (Fig. 1) without spot, brownish; clypeus and frons: brownish; palpi and labrum: dark brown; antenna: flagellum brown with four concentric rings of short setae; other parts discoloured; pronotum : (Fig. 1) broader than long with front angles broadly eroded and hind angles squared; brown in colour with both fore–and hind borders darker; with darso-median longitudinal groove; meso–and metanotum: brown; wings: hyaline, without spot; pterostigma elongated, pale-yellowish; longitudinal veins yellow; forewing (fig. 2): cell im long, sub-rectangular; costal crossveins pale yellow with several basal crossveins with black ends; crossveins between R & Rs, two radio–medial crossveins, 1st crossvein between psm & m_2 and psc & m_2, three cubital crossveins and both inner and outer gradates black; branches of Rs basally black; cross veins between psm and psc black at each end; marginal forks black: inner gradates with 18 and outer gradates with 15 crossveins; hindwing: both inner and outer gradates yellow; leg: brownish yellow; abdomen: discoloured and all but two basal segments missing.

Measurements : 1 ex: length of forewing, 30 mm, hind wing, 25 mm.

Material examined : *Female* : India, Assam, Sibsagar (Coll. S. E. Peal) Reg. No. 9899/15.

Distribution : India (Assam).

Remarks : Amongst a couple of specimens referred to by Needham (1909), a single flood damaged specimen bearing registered no. referred to above was available for study. After a careful examination of the wings of this largest chrysopid species so far known, the present author considers the species *robusta* Needham under the genus *Italochrysa* Principi as psm merges with outer gradate series and also other characters related to the wing agree will with this genus. However, the genitalic studies were not possible due to the missing apical abdominal segments.

2. ***Italochrysa*** sp.

Description : Head: yellow including vertex; clypeus, labrum and palpi : yellow; labium : longer than maxillae; antenna : yellow; flagellum with four concentric rows of setae at the middle and apical parts and 3 rows basad; pronotum : yellow, broader than long and with a rounded black spot on either side; with short hairs but moderately long hairs at the region of the spot; wings (figs. 3 & 4): hyaline, without spot; pterostigma pale; all longitudinal veins pale yellow; several crossveins between R & Rs brown but with yellowish ends; cell im much narrower distally and subrectangular; 1st radio-medial crossvein, crossvein between m_1 & m_2 and m_2 & im brown; outer gradates black and merges with psm; inner gradates with 6 and outer gradates with 7 crossveins; apical crossveins between psm & psc black; hindwing: all longitudinal and crossveins but a few partially brownish; apical cross veins between R & Rs pale yellow; both inner and outer

gradates with 5 crossveins; legs: yellow with brown tarsi; abdomen : brownish with short white hairs.

Measurements : 1 ex : length of forewing, 15 mm, hindwing, 14 mm.

Material examined : India, West Bengal, Darjeeling, Singla, 16.iv.1973 (Coll. H. S. Sharma & party).

Distribution : India (West Bengal).

Remarks : Due to the paucity and damaged condition of the material the specimens, though interesting, could not be identified upto species level. However, the species is not agreeing with any of the species so far known from India.

Genus II. *Chrysoperla* Steinmann

1964. *Chrysoperla* Steinmann, *Ann. Hist. -nat. Mus. Nation. Hung., Zool.*, **56** : 260.

Diagnostic characters : Small to medium sized insects; forewing costal area of moderate width; single crossvein in basal part of subscostal area located above the basal part of cell m_2; cell im usually ovate and small; usually with two pairs of gradates; hindwing: M & Rs fused for a short distance near base; abdomen: sternites 8 and 9 completely fused in males; male genitalia: tignum present; gonarcus with a pair of entoprocessus and an arcessus; pseudopennis and gonapsis absent.

Type species : *Chrysopa* carnea Stephens.

Distribution : All major regions of the globe.

Remarks : The following Indian species is included in the genus *Chrysoperla* erected by Steinman (1964).

3. *Chrysoperla orestes* (Banks), Comb. nov.

1911. *Chrysopa orestes* Bank, *Proc. ent. Soc. Wash*, **13** : 102.

Redescription : Labrum, clypeus and frons: whitish, a narrow red fascia on lateral margins of frons and red suffusion on either side at the basal portion of clypeus; a narrow black stripe under each eye; vertex : bright yellow; antenna: yellow to fuscous; with a black on outer side of basal joint; pronotum:broad but narrowed in front; with transverse groove and ridge; antero-lateral corners with red fascia; meso- and metanotum: greenish-yellow; forewing: short and broad with tip subacute; venation pale; gradate veinlets, the ends of costal veinlets and a few other crossveins brown; divisory veinlet ending beyond first radio-medial crossvein; gradate veinlets 3/6; inner gradates plainly nearer to outer than to radial sector; pterostigma yellowish; hindwing: slender, gradate veinlets 3/2; leg: pale yellow; tarsi brown; abdomen: brownish; male genitalia: gonarcus arch-shaped; entoprocessus small with more or less acute apex; arcessus elongated with curved tip; tignum arched and with long acumen; female genitalia: spermatheca with high vella.

Measurements : ♂♂ : length of forwing, 9-12 mm, hindwing, 7-10 mm; ♀♀ : length of forewing, 12-13 mm. hindwing, 10 - 11 mm.

Material examined : 42 exs. (♂♂, ♀♀) : 17 exs, India, Nadia, Ranaghat, Purnanagar, 24-27.vi.1982, 1 ex, loc. Ibid., 9.ii.1982, 2 exs., loc. Ibid., 10.vii.1982; 8 exs., 24-Prgs., Kumra, 24-26.iv.1982, 1 ex., loc. Ibid., 11.ii.1982; 3 exs., 24-Prgs., Kuthipara, 12.v.1982 (Coll. D. R. Maulik); 7 exs., Burdwan, Panagarh, Kanksa forest, 9.ii.1984 (Coll. S. K. Ghosh); 2 exs., 24-Prgs., Kakdwip, 18.ii.1984 (Coll. S. K. Ghosh); 1 ex., Orissa, Balasore, Khantapara, 28.ix.1974 (Coll. B. C. Saha).

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

Remarks : The species was originally described under the genus *Chrysopa* by Banks (1911). But the genitalia specially of males is very characteristics to place the species under the genus *Chrysoperla*. However, the species is for the first time recorded from Orissa and West Bengal.

Genus III. *Anisochrysa* Nakahara

1955. *Anisochrysa* Nakahara, *Kontyu*, **23** (4) : 145.

Diagnostic characters : Small to medium sized insects; antenna: usually shorter but sometimes equal to or longer than forewing; wings: venation similar to *Chrysoperla*; abdomen: 8th and 9th sternites completly fused; male genitalia: tignum, gonarcus and gonapsis present; gonarcus with or without entoprocessus; pseudopennis absent.

Type species : *Anisochrysa paradoxa* Nakahara.

Distribution : Africa, Europe, Asia including India, Australia and Islands in the Pacific.

Remarks : Nakahara (1955) though erected the genus but Tjeder (1966) gave it a subgeneric status. Presently, *Anisochrysa* is considered as genus to accomodate two Indian species.

Key to the species of the genus **Anisochrysa** Nakahara

Gradates of forewing black and all other cross veins dark at each end; gena with red mark..... *alcestes* (Banks)

Gradates of forewing and most other crossveins pale; gena with black mark..... *boninensis* Okamoto

4. *Anisochrysa boninensis* Okamoto, Comb. nov.

1914. *Chrysopa boninensis* Okamota, Jour. Coll. Agr. Tohoku Univ., 6 : 62; 1919, *Rep. Hokkaido Agric. Exper. Sta.;* **9** : 61.

1924. *Chrysopa* boninensis, Kuwayama, *Trans. Nat. Hist. Soc. Formosa*, **13** : 12; 1956, Trans. Shikoku ent. Soc., **5** : 29; 1962, *Pacif. Insects*, 4(2) : 365.

1959. *Chrysopa* boninensis, Adams, Insects of Micronesia, 8, no. 2 : 28.

1927. *Chrysopa rutila* Esben-Petersen, *Ann. Mag. nat. Hist.*, (9) **19** : 453.

1929. *Chrysopa obliqua* Navas, *Ann. Mus. Civ. Storia Nat. Giacomo Doria*, **53** : 362.

1966. *Chrysopa (Anisochrysa) boninensis*, Tjeder, *South Afr. Anim. Life*, **12** : 476.

Measurements : ♂♂ : Length of forewing, 12-13 mm, hindwing, 11-11.5 mm; ♀♀ : length of forewing, 13-14.4 mm, hind wing, 12-13.5 mm.

Material examined : 15 exs (♂♂, ♀♀), India, West Bengal, 24-Prgs., Kumra, 24-26.iv.1982 (Coll. D. R, Maulik).

Distribution : Japan, Ryukyu Is., Bonin Is., Chagos Is., Central and South Africa, Cape Verde Is., Taiwan, India (West Bengal).

Remarks : Adams (1959), while studying the Micronesian chrysopids, redescribed the species under the genus *Chrysopa* along with the figures of male genitalia. Tjeder (1966) examined the species from Bonin Island, African continent and cape Verde Island and recorded his observations by describing the species under *Chrysopa (Anisochrysa)* in details from different places along with illustration of wings and genitalia. However, the author in course of his study of the material of Chrysopids from north-east India encountered the aforesaid species from West Bengal and considered it under the genus *Anisochrysa* on the basis of male genitalic structures. All the specimens are agreeing with the specimens from Bonin Island in having black genal spot, pronotum with mid-dorsal stripe, inner gradate with six and outer gradate with seven crossveins and characteristics genital elements in males e.g., narrowly arched gonarcus alongwith ovate side-pieces but without entoprocessus, long arcessus, flattened gonapsis splitting distally into two prongs, left one being narrower and also with long and narrow lateral arms and angularly arched tignum with indistinct acumen. So, with the first record of the species from India the distributional range has further been extended.

5. ***Anisochrysa alcestes*** (Banks), comb. nov.

1911. *Chrysopa alcestes* Banks, *Proc. ent. Soc. Wash*, **13** : 102.

1959. *Chrysopa alcestes*, Adams, *Insects of Micronesia*, **8**, no. 2: 32.

Measurements : ♂♂ : length of forewing, 11-12 mm, hindwing, 9-10 mm; ♀♀ : length of forewing, 12-13 mm, hindwing, 10-11 mm.

Material examined : 20 exs. (♂♂, ♀♀) : India, West Bengal, Burdwan, Panagarh, Kanksa forest, 9.ii.1984 (Coll. S.K. Ghosh).

Distribution : Bonin Is., India (West Bengal).

Remarks : Adams (1959) redescribed the species under the genus *Chrysopa* along with suitable illustrations while studying the type described by Banks (1911) and also a few Micronesian specimens. Presently, the author has collected quite a large number of specimens from a forest locality of West Bengal. The specimens agree with the descriptions given by Adams *(loc. cit.)* and Banks *(loc. cit.)* except the red suffusion on the frontal suture. Considering the genital armature the species is now being placed in the genus *Anisochrysa* which was considered by Tjeder (1966) as subgenus. The species constitutes new locality record for West Bengal.

Genus IV ***Brinckochrysa*** Tjeder

1966. *Brinckochrysa* Tjeder, *South Afr. Anim. Life*, **12** : 360.

Diagnostic characters : Antenna : little longer than forewing; wing venation: *Chrysoperla* - pattern; abdomen: ectoproct distinctly separated dorsally but completely fused with tergite 9 laterally and forming a lappet-like structure with the enlargement of ventral margin proximally; male genitalia: without tignum, pseudopennis and gonapsis; gonarcus with a pair of entoprocessus and a spine-like arcessus.

Type species : *Chrysopa (Brinckochrysa) peri* Tjeder.

Distribution : Micronesia, South Africa, Congo, Cape Verde Islands and India.

Remarks : Tjeder (1966) erected the subgenus under the genus *Chrysopa* But the male genitalia is quite significant to raise the status to generic level. Only one species is so far recorded from India which is dealt with here.

6. ***Brinckochrysa scelestes*** (Banks), comb. nov.

1911. *Chrysopa scelestes* Banks, *Proc. ent. Soc. Wash*, **13** : 103.

1959. *Chrysopa* scelestes, Adams, *Insects of Micronesia*, **8**, no. 2 : 28.

1966. *Chrysopa (Brinckochrysa) scelestes*, Tjeder, *South Afr. Anim. Life*, **12** : 361.

Measurement : ♀♀ : length of forewing, 13.5 mm, hindwing, 11.5 mm.

Material examined : 1 ♀ : India, West Bengal, Darjeeling, Rangia forest Rest house, 5.iv.1973 (Coll. H. S. Sharma).

Distribution : India (Bihar & West Bengal); Micronesia.

Remarks : Adams (1959) redescribed the species under the genus *Chrysopa* on the basis of type described by Banks (1911) and also the sepcimens available to him from Micronesia. Later, Tjeder (1966) referred to this species under *Chrysopa* (Brinckochrysa). Presently, the author on the basis of male genitalic structures as described and figured by both Adams & Tjeder (*loc. cit.*) raised the status of the subgenus to the generic level to accomodate the concerned species. However, the species is a new record for West Bengal.

Genus V ***Ceratochrysa*** Tjeder

1966. *Ceratochrysa* Tjeder, *South Afr. Anim. life.* **12** : 352.

Diagnostic characters : Antenna : very long, longer than forewing; forewing : inner gradates few in number in comparison to outer gradate; abdomen: ectoprocts not fused with each other dorsally and a distinct suture present between them; sternites 8 and 9 fused in males; male genitalia: without tignum and gonapsis; gonarcus without arcessus; pseudopennis present; female genitalia: subgenital sternite-like and hairy.

Type species : *Chrysopa ceratina* Navas.

Distribution : South Africa, Katanga; "Guinea" and India.

Remarks : Tjeder (1966) treated this as a subgenus of *Chrysopa* But the distinctive male and female genitalia are sufficient to raise the status to a generic level. Only a single species from India may be considered under the genus.

7. ***Ceratochrysa lacciperda*** (Kimmins) comb. nov.

1955. *Chrysopa lacciperda* Kimmins, *Indian J. Ent.*, **17**, pt. 2 : 217.

Measurements : ♀ : Length of forewing, 17 mm, of hindwing, 14 mm.

Material examined : 1 ♀ : India, BIhar, Ranchi, Namkum, 8.iii.1972 (Coll. A. K. Sen).

Distribution : India (Bihar).

Remarks : Kimmins (1955) described the species from India (Bihar). Although a single female specimen was available to the author for study from the same locality but the genitalia in male described and figured by Kimmins (*loc. cit.*) led him to place this species under the genus Ceratochrysa which was considered by Tjeder as a subgenus of *Chrysopa*

Genus 7. ***Glenochrysa*** Esben - Petersen

1920. *Glenochrysa* Esben-Petersen, *Ann. South Afr. Mus.*, **17** : 520.

Diagnostic characters :*Wings* : with brilliant irridescence and strongly marked; crosseveins in pterostigmatic area; venation: *Chrysoperla*-type; abdomen: spiracles in male small but with large atria; male genitalia: tignum absent; gonarcus with a pair of entoprocessus and an arcessus; with gonapsis.

Type species : *Glenochrysa typica* Esben-Petersen.

Distribution : Africa, Sunda Islands, India, Australia, North America, West Indies.

Remarks : The genus *Glenochrysa* described by Esben-Petersen (1920) as a subgenus under the genus *Chrysopa* The author after studying the wings and genitalia has considered *Glenochrysa* as a genus and a single species hitherto recorded from India has been dealt with under this taxon.

9. ***Glenochrysa marmorata*** (Needham)

1909. *Eremochrysa marmorata* Needham, *Rec. Indian Mus.*, **3** : 205.

1940. *Glenochrysa marmorata* Kimmins, *Ann. Mag. nat. Hist.*, **11**(5) : 449.

1980. *Chrysopa (Glenochrysa) marmorata*, Ghosh, *Rec. zool. Suve. India*, **77** : 249.

Measurements : 2 exs: length of forewing; 10-12 mm; hindwing, 8-10 mm.

Material examined : 2 exs: India, Nadia, Ranaghat, Purnanagar, 10.vii.1982 (Coll. D. R. Maulik).

Distribution : India (Assam, West Bengal, South Andaman).

Remarks : Though the wings of the species closely resemble the specimens described by Needham (1909) and redescribed by Ghosh but the morphovariations observed by the author while examining the fresh specimens from West Bengal may be referred to as follows: body green in colour; vertex with a rounded red spot; scape, pedicel and prescutum of mesothorax dark red; pronotum with two reddish spots anteriorly; without milk white spots between the branches of Rs as observed in the specimens from Andaman; wings with red suffusion at the extreme base. As the abdominal tips of both the specimens have been lost so on the basis of wing characters the specimens have been kept under the species *G. marmorata* (Needham) at the moment. However, the species is a new record for West Bengal.

Genus VII. *Chrysopa* Leach

1815. *Chrysopa* Leach, Artikel entomology-Brewster, *Edinburgh Encyclopaedia*, **9** (1) : 138.

Diagnostic characters : Wing venation : chrysoperla-type; male abdomen : tergite 9 and ectoprocts dorsally fused above the anus; 8 and 9 sternites separated by an intersegmental membrane; male genitalia: gonarcus with a pair of entoprocessus but without arcessus; pseudopennis lying in gonosaccus and situated below the gonarcus; gonosaccus paired.

Type species : *Chrysopa* perla (Linnaeus) sensu Schneider, 1851 (i.e. *Hemerobius chrysops* Linnaeus, 1758, sensu Tjeder, 1952).

Distribution : Palaearctic, Oriental (India) and Nearctic regions.

Remarks A subgenus *Chrysopa* (*s. str.*) was erected by Tjeder (1966). The species, *Chrysopa septempunctata* Wesmael recorded by Tjeder (*loc. cit.*) is known from India. So, only one species is so far recorded under this genus in strict sense. However, other four species mentioned below are kept under this genus at the moment due to the paucity of material specially that of males at hand.

9. *Chrysopa virgestes* Banks

1911. *Chrysopa virgestes* Banks, *Proc. ent. Soc. Wash*, **13** : 103.
1914. *Chrysopa virgestes*, Banks. *Rec. Indian Mus.*, **8** : 103.
1933. *Chrysopa virgestes*, Banks, *Indian Forest Rec.*, **18**(6) : 3.

Redescription : Female : Head : face pale yellow; yellowish white dorsal vittata on vertex continued over thorax and abdomen; pronotum: slightly broader than long; strong ridge at middle; wing: venation pale; forewing: rather slender, acute at tip; gradates dark; a few costals, radials and medio-cubital crossveins dark; four inner and five to six outer gradate veinlets present; pterostigma inconspicuous; inner row nearer to outer than to Rs; hindwing with 3-4 inner and 4-5 outer gradates; leg: slender, pale; tarsi pale brown; abdomen yellow with white hairs and bristles; female genitalia: targite 9 and ectoproct, a rather elongated structure; subgenital weak, its distal lobes separated broadly by incision and ventral lobes short; spermatheca with triangular vella and with narrow duct.

Measurment : 5 ♀♀ : length of forewing, 10.5 to 11 mm; hindwing. 9 to 9.5 mm.

Material examined : 1 ♀ : India, West Bengal, Darjeeling, Rangia rest house, 5.iv.1973 (Coll. H. S. Sharma & party); 1 ♀ : West Bengal, Panagarh, Burdwan, Soai forest, 9.ii.1984 & 3 ♀♀ : Kanksa forest, 9. ii. 1984 (Coll. S. K. Ghosh).

Distribution : India (Bihar & West Bengal).

Remarks : Banks (1911) described the species from Pusa, Bihar. Presently, only five female secimens from West Bengal were available for study and these constitute new locality records for the state. It may be mentioned here that without examining the male genitalia it is not possible to change the generic status of the species. Therefore, the concerned species is retained for the time being under the genus *Chrysopa*

10. *Chrysopa ignobilis* Walker

1859. *Chrysopa ignobilis* Walker, *Trans. R. ent. Soc. Lond.*, **5** : 183.

Redescription : Labrum, clypeus and gena : dark brown; frons and vertex: yellowish; antenna: basal segments brown; pronotum: yellowish with two narrow black stripes on either side and a distinct ridge at middle; mesonotum: blackish; forewing : cell im ending beyond the first radio-medial crossvein; 2nd cubital cell about as long as 3rd and the latter broadened at apex; outer gradate with 8 and inner gradate with 6 crossveins; inner row at nearly equal distance from both outer row and radial sector; hindwing : missing; legs : brownish.

Measurements : length of forewing, 13 mm.

Material examined : 1 ex., India, Calcutta, West Bengal.

Distribution : India (West Bengal).

Remarks : Walker (1859) described the species from 'Hindostan' without specifying the exact locality. However, the present author while working out the collection of the chrysopidae, a flood damaged specimen from Calcutta, West Bengal is available in the National Zoological collections. So, an account of the species on the basis of the intact parts of the damaged specimen has been provided. But it is not possible at the moment to make any comment on the generic status of the species without studying the male genitalia. Therefore, the author has no other alternative than to retain its position in *Chrysopa*

*11. *Chrysopa notata* Navas

1910. *Chrysopa notata* Navas, *Broteria S. Fiel.* **9** : 55.

Distribution : India (West Bengal).

Remarks : Navas (1910) described the species from Darjeeling, West Bengal. The literature and material being inaccessable it is not possible to provide comment on it.

*12. ***Chrysopa guttata*** Navas

1929. *Cintameva guttata* Navas, *Rev. Acad. Sci.*, **13** : 42.

Distribution : India (West Bengal).

Remarks : Banks (1940) and Tjeder (1966) synonymized the genus *Cintameva* with *Chrysopa* In that event *guttata* should fall under *Chrysopa* But as the species is not available for study it is not possible to make any comment whether the species really belongs to *Chrysopa* s. str. or not.

*13. ***Chrysopa madestes*** Banks

1911. *Chrysopa madestes* Banks, *Proc. ent. Soc. Wash.*, **13** : 119.

Distribution : India (Bihar).

Remarks : Though Banks (1911) did not consider the structure of male genitalia while describing the species, the characters of the wings as stated by him appears to be convincing to consider the species as a distinct one.

Genus VIII. ***Ankylopteryx*** Brauer

1864. *Ankylopteryx* Brauer, Verh. *Zool. Bot. Ges. Wien*, **14** : 889.
1866. *Ankylopteryx* , Brauer, *Zool. Theil.* 2. Neuropteren : 34.
1866. *Ankylopteryx* , Hagen, *Stettin Ent.* Ztg., **27** : 377.
1940. *Ankylopteryx* , Banks, *Proc. U.S. natn. Mus.*, **88**, no. 3079 : 187.
1952. *Ankylopteryx* , Kimmins, *Ann. Mag. nat. Hist.*, (12) **5** : 80.
1909. *Ankylopteryx* , Weele, in : *Y SJOSTEDT'S Kilimandjaro Meru Expedition*, **2**(3) : 18.
1910. *Ankylopteryx* , Navas, *Broteria*, **9** : 57.
1954. *Leucochrysa* Fraser, *Nat. Malgache*, **3** : 16.
1966. *Ankylopteryx* , Tjeder, *South Afr. Anim. Life*. **12** : 493.

Diagnastic Characters : Forewing : very broad especially at base, from where costa originating very steeply; Sc and R very close upto pterostigmatic region and then suddenly diverging; radial cross vein placed near base of wing; Rs arising at level with or beyond the fork of M; im ovate or elongate and in oblique position; second medio-cubital crossvein located distad of the furcation of M; two series of gradate crossveins; psm merges with outer gradates; hindwing; narrow; costal area narrow; frenulum present as a small lobe with some stiff hairs; legs : very short and slender; abdomen: male with sternite 8 and 9 and also tergite 9 and ectoprocts fused; male genitalia: gonarcus arch-shaped; entoprocessus present; gonosaccus very long; hypandrium internum and comes present; tignum and gonapsis lacking; female: tergite 8 not prolongted downwards laterally; tergite 9 and ectoproct fused; subgenitale bilobed, spermatheca flattened with indistinct vela and without ventral impression.

Type species : *Chrysopa venusta* Hagen.

Distribution : Africa, China, Cambodia, India, Malagasy, Malaysia, the Philippines, Singapore, Taiwan.

Remarks : Amongst a total of three species recorded so far from India only two are dealt with hereunder.

Key to the species of the Genus **Ankylopteryx** Brauer

Pronotum with antero-lateral spot; presence of black points at the end of both marginal and costal cross veins of forewing.....
.....
.....*octopunctata* (Fabricius)

Pronotum without antero-lateral spot; absence of black points at the end of both marginal and costal cross veins of forewing... *tessalatus* Needham

14. ***Ankylopteryx octopunctata*** (Fabricius)

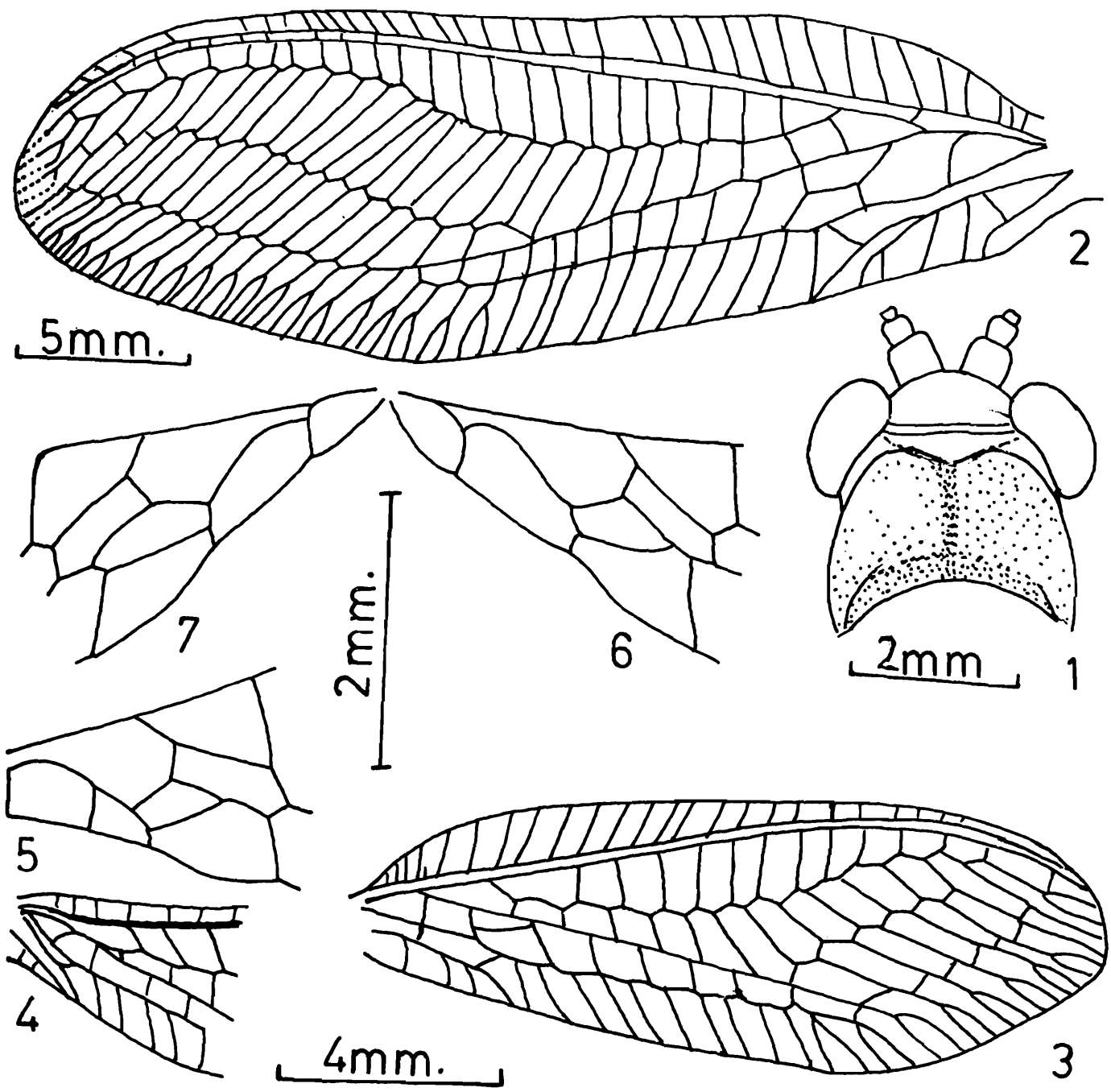
1793. *Hemerobius octopunctatus* Fabricius, *Ent. Syst.*, **2** : 85.
1798. *Hemerobius candidus* Fabricius, *Ent. suppl.* : 202.
1851. *Chrysopa candida* Schneider, *Mon. Chrysop* : 161.
1864. *Ankylopteryx candida*, Brauer, Verh. *Zool. bot. Ges.* Wien, **14** : 901.
1858. *Chrysopa punctata* Hagen, *Syn. Neur. Ceyl.*, **1** : 483.
1864. *Ankylopteryx punctata*, Brauer, *Verh. zool. bot. Ges.* Wien, **14** : 901.
1853. *Hemerobius trimaculata* Girard, *Ann. Soc. Ent. Fr.*, (3) **87** : 163.
1864. *Ankylopteryx trimaculata*, Brauer, *Verh. zool. bot. Ges. Wien*, **14** : 901.
1864. *Ankylopteryx anomala* Brauer, *Novara Exp. Zool.* **2** : 35.
1893. *Ankylopteryx sigillaris* Gerstaecker, *Mitt. naturw. Ver. Neu-vorpomm. u. Rugen*, **25** : 162.
1909. *Ankylopteryx octopunctata*, Weele, *Notes Leyden Mus.*, **31** : 57.
1935. *Ankylopteryx octopunctata*, Handschin, *Revue Suisse Zool.*, **42** : 695.
1980. *Ankylopteryx octopunctata*, Ghosh, *Rec. zool. Surv. India*, **77** : 251.

Measurements : ♂♂ : length of forewing, 11 mm; hindwing, 10 mm; ♀♀ : length of forewing, 12 mm, hindwing, 11 mm.

Material examined : 63 exs (♂♂, ♀♀) : 46 exs : India, West Bengal 24-Prgs., Kumra, 22-24-vi.1982; 4 exs : Nadia, Ranaghat, 26.vi.1982 & 10.vii.1982 (Coll. D. R. Maulik); 12 exs : West Bengal, Burdwan, Panagarh Kanksa forest, 9.ii.1984 (Coll. S. K. Ghosh) and 1 ex : West Bengal, Dum Dum Park, 13.ix.1971 (Coll. T. R. Mitra).

Distribution : China, India (West Bengal, South India, Western Himalayas; Andamans), Insulinde.

Remarks : The species originally described by Fabricius has been redescribed by Weele (1909). The author, in course of his study of the material collected during West Bengal Survey, observed an interesting morphovariation of the forewing. Intramedian cell dividing the third cubital cell of the forewing shows a gradual transition from incomplete division of the cubital cell to a complete division (Figs. 5-7).



Figs. 1-2. *Italochrysa robusta* (Needham). (1) Head & pronotum, dorsal; (2) forewing. Figs. 3-4. *Italochrysa* sp. (3) forewing; (4) part of hindwing. Figs. 5-7. *Ankylopteryx octopunctata* (Fabricius). (5) general disposition of intramedian cell of forewing; (6) further extension of intramedian cell; (7) intra-median cell dividing the third cubital cell completely.

15. ***Ankylopteryx tesselatus*** Needham

1909. *Ankylopteryx tesselatus* Needham, *Rec. Indian Mus.* **3** : 205.

1980. *Ankylopteryx tesselatus*, Ghosh, *Rec. zool. Surv. India*, **77** : 252.

Measurement : 1 ex : Length of forewing, 12 mm.

Material examined : 1 ex : India, Assam, date - nil, Reg. no. 1275/9.

Distribution : India (Assam).

Remarks : Needham (1909) described the species from Assam. A flood-damaged specimen in National Zoological collections is available for study bearing the same registered no. of Needham's type. However, the specimen is very badly damaged and it is not possible by the author to study the material in details excepting for noting down certain characters of the forewing along with measurment and of pronotum. Presence of large and conspicuous pterostigma, absence of black points at the end of both marginal and costal crossveins of forewing and also the pronotum without antero-lateral spot are the salient featues for distinguishing the species from *A. octopunctata* (Fabricius).

Genus IX. ***Chrysopidia*** Navas

1910. *Chrysopidia* Navas, *Broteria*, **9** : 54.

1971. *Chrysopidia*, Holzel, *Zeitschr. Arbeitsgem Ost. Entom.* **23** : 57.

Diagnostic characters : Mandibles asymmetricle; forewing : 12 to 20 mm; without jugal lobe; costal field broad; only a sigle basal crossvein between Sc and R; apex of im ending beyond the 1st r - m crossvein; three rows of gradate crossveins; hindwing : with feebly developed frenulum; M and R occasionally fused; 3 rows of gradates; abdomen : tergite 9 and ectoproct in both sexes fused; sternite 8 and 9 in males completely fused, elongated and small; gonarcus and areessus attached together.

Type species : *Chrysopidia* nigrata Navas.

Distribution : India and Nepal.

Remarks : Only two species are so far reported from India. At present a new species is described below.

16. ***Chrysopidia manipurensis***, sp. nov.

♂ : Labrum, clypeus and frons : pale yellowish; gena : pale brownish; antenna: basal segment yellow; a red line on the outer side of the basal segment of each antenna; vertex : yellow : pro-meso-and metanotum : yellow but laterally somewhat greyish; wings : membrane unspotted; longitudinal veins and Rs pale; fore wing (fig.8) : costals pale but partially black; radials partially black; gradates black; some of the marginal forks black; pterostigma yellowish, about 22 costals before it; a single basal crossvein between Sc and R; intramedian cell ending beyond 1st r-m crossvein; 3 rows of gradate crossveins; number of gradates 8-4-8 in the left and 10-3-9 in the right wing; inner gradates extending

basally; hindwing (Fig. 9) : narrower than forewing; all veins and crossveins pale except a few costals partially dark; number of gradates 6-1-8 in left wing but in right one the intermediate gradate absent; inner gradates extending basally; leg; pale but the tarsal segments and the claws brown; abdomen (Fig.10): yellow with short hairs; apex of the abdomen as in fig. 10; male genitalia (Fig.11) : gonarcus with expanded side pieces, with almost 'y' - shaped entoprocessus and relatively short arcessus which is narrowed at base and expanded at apex with three distinct dents.

Measurement : 1 ♂ : length of forewing, 16 mm; of hindwing, 13 mm.

Material examined : 1 ♂ (Holotype : Reg. no. 1180/H_{12}) : India, Manipur, Mao, Inspection Bungalow, 12.iv.1975 (Coll. M.S. Shishodia).

Distribution : India (Manipur).

Rrmarks : The present species comes closer to *C. fuscata* Navas by the presence of more or less distinct red mark on the outer side of the basal joint of antennae but it can be easily differentiated by the basal extension of inner gradates, number of crossveins in gradate series and by the absence of crossveins in the pterostigmatic area.

*17. *Chrysopidia nigrata* Navas

1910. *Chrysopidia nigrata* Navas, *Broteria*, **9** : 55.

1971. *Chrysopidia nigrata*, Holzel, *Wien. Z. Arabgem. Ost. Ent.*, **23** (2) : 57.

Distribution : India (West Bengal).

Remarks : Holzel (1971) redescribed a male of the species along with illustrations. The internal genital structures as well as the shape of the atrium of the abdominal tracheae distinguish this species from its close allies.

*18. *Chrysopidia numerosa* Navas

1914. *Chrysopidia numerosa* Navas, Russk. Ent. Obozr. 14 : 11.

Distribution : India (West Bengal).

Remarks : Navas (1914) described ths species from Darjeeling, West Bengal. Holzel (1971) while redescribing the species, *Chrysopidia migrata* Navas referred to the species, *C. numerosa* in the discussion and considered this species as Nomina dubia due to the imperfect description.

Genus X. *Tumeochrysa* Needham

1909. *Tumeochrysa* Needham, *Rec. Indian Mus.*, **3** : 204.

1910. *Chrysoplecta* Navas, *Broteria*, **9** : 55.

1940. *Tumeochrysa*, Banks, *Proc. U. S. natn. Mus.*, **88**(3079) : 187.

Diagnostic characters Antenna : about as long as the body, shorter than wings; with huge, erect basal segments; wings: costal area very narrow at base, then gradually widening; forewing Cu bending down to hind margin before apical third of the wing; 3rd cubital cell obliquely divided with the vein ending on its upper margin; more than

two rows of irregular gradates which are many; leg : hind tibia more than three times as long as hind tarsus.

Type species : *Tumeochrysa indica* Needham.

Distribution : China and India.

Remarks : Only two species hitherto recorded from India of which one is dealt with hereunder.

19. *Tumeochrysa indica* Needham

1909. *Tumeochrysa indica* Needham, *Rec. Indian Mus.*, 3 : 204.

Redescription : Remale : Frons, clypeus, labrum and maxillary palpi : yellow; vertex : yellow, somewhat elevated and rounded posteriorly and with a narrow triangular dilatation anteriorly which extends between the basal segment of antenna; antenna : yellowish brown; basal segment erect, swollen and approximated to each other and as long as following 6 subequal segments taken together; each antenna reaching almost base of pterostigma of forewing; thorax: yellow ventrally and darker dorsally; tinged with reddish on the principal convex areas; pronotum : elongated and with short black hairs; Wings : elongate, subacute at tip; veins and crossveins mainly yellow; crossveins in gradate series mostly black, forewing : 31 costal veinlets before yellowish pterostigma; 21 cross veins between R and Rs; 3rd cubital cell almost equal in length to 2nd and broadened apically; first intramedian cell ending beyond 1st cross vein of Rs; leg : slender mainly yellow with short black hairs; each claw dark brown with a dent at base; abdomen : (Fig. 12). blackish brown dorsally and yellowish ventrally; abdominal segments with yellow pubescence and apical segment with moderately long hairs; lamina superior large and lamina lateralis with almost straight margin; coxite narrow; subgenital plate (fig. 13) small; its distal margin deeply emarginate; spermatheca (fig. 14) large, strongly chitinished with its dorsal sail acute at lip.

Measurement : ♀♀; Length of forewing, 21-24 mm, hindwing, 19-22 mm.

Material examined : 2 ♀♀ : India, Manipur, Ukhrul, alt. 6200 ft., Inspection Bungalow, 3.x.1975 (Coll. M.S. Shishodia).

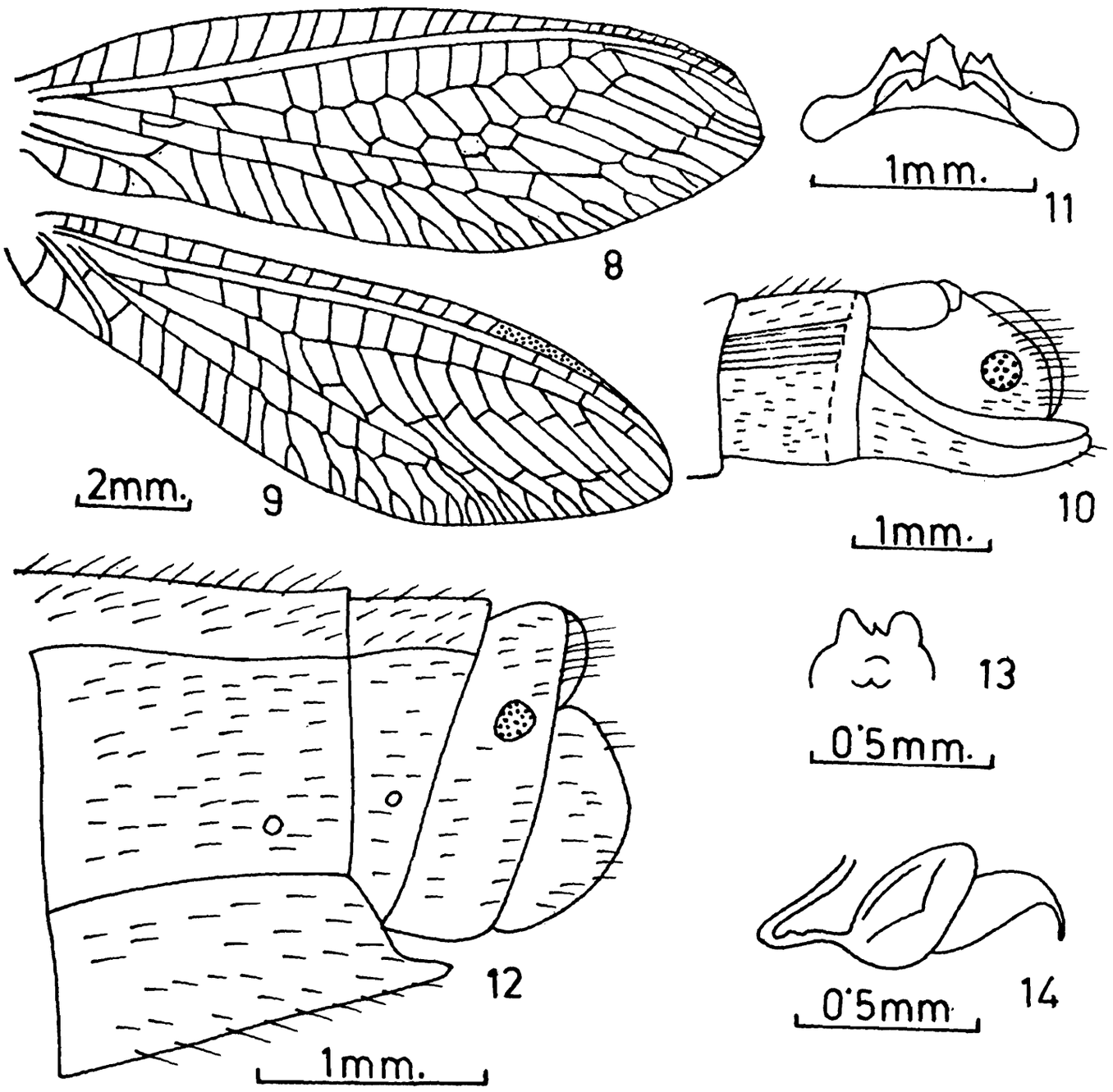
Distribution : India (Manipur and Western Himalayas).

Remarks : The species was described by Needham (1909) from a male collected in Western Himalayas. So, the female is recorded for the first time from India. However, the range of distribution is now known to extend from Western Himalayas to Eastern Region.

20. *Tumeochrysa cirerai* Navas
(= Chrysoplecta cirerai Navas)

1930. *Chrysoplecta cirerai* Navas, Rev. Acad. Sci., 13 : 43.

Distribution : India (West Bengal).



Figs. 8-11. *Chrysopidia manipurensis*, sp. nov., male. (8) forewing; (9) hindwing; (10) tip of abdomen, lateral; (11) male genitalia, dorsal. Figs. 12-14. *Tumeochrysa indica* Needham. (12) tip of abdomen, lateral; (13) subgenital plate, ventral; (14) Spermatheca, lateral.

Remarks : Banks (1940) synonymised *Chrysoplecta* Navas with *Tumeochrysa* Needham without assigning any reason. At this stage it is not possible to state how far such synonymisation has been justified.

Subfamily B. NOTHOCHRYSINAE Navas

Wings : Veins nearly uniform in diameter at base but evenly tapering apically; posterior media not fused with R; forewing : tympanal organ absent on ventral side of R; jugal lobe large and conspicuously produced; psm merging with inner gradate series specially in *Nothochrysa*; prosternum: area largely membranous; colour: usually non-green.

Genus XI. *Nothochrysa* MacLachlan

1868. *Nothochrysa* MacLachlan, *Trans. Ent. Soc. Lond.*, (1868) : 195.
1903. *Nothochrysa* , Banks, *Trans. Am. ent. Soc.*, **29** : 142
1909. *Nothochrysa* , Vander Weele, *Notes Leyden Mus.*, **31** : 75.
1919. *Nothochrysa* , Okamoto, *Hokkaido Agr. Exp. Sta. Rep.*, **9** : 26.
1924. *Nothochrysa* , Kuwayama, *Trans. Nat. Hist. Soc. Formosa*, **13** : 8.
1941. *Nothochrysa* , Tjeder, *Ent. Tidskr.*, p. 30-31.
1946. *Nothochrysa* , Principi, *Bol. Inst. Entomol. Univ.*, Bolgona, **15** : 86.
1913. *Nathanica* Navas, *Trans. 2nd Intern. Congr. Entomol.*, **2** : 181. Oxford.
1937. *Nathanica* , Killington, *A monograph of British Neuroptera*, **2** : 235. Ray Society, London.
1941. *Nathanica* , Tjeder, *Ent. Tidskr.*, p. 30.
1967. *Nothochrysa*, Adams. *Bull. Mus. comp. zool.*, Harvard, *135*(no. 4) : 222.

Diagnostic characters : Antenna : about as long as forewing; forewing : basal subcostal crossvein lying between first medial crossvein and medial fork; Rs originating basad of medial fork; two rows of gradates; psm formed by overlapping longitudinal veins may extend beyond basal inner gradates; pseudomedial fold present; upper and lower prongs of im parallel to each other; second medial crossvein intersecting lower prong of im parallel to each other; second medial crossvein intersecting lower prong of im midway between M and Cu_1; psc parallels psm and passing to outer gradate series; jugal lobe prominent; hindwing : frenulum well developed; M coalescent with Rs for moderate distance; two rows of gradates; psm well developed; veins between psm and psc lying exactly opposite the basal branches of Rs; pseudomedial fold present; abdomen: male: 9th abdominal tergite fused with ectoproct and gonarcus with wide triangular mediuncus; gonocoxites small; female: no hooked hairs on 9th gonocoxites; 8th sternum bilobed and lobes fitting into cup-like 9th valvulae.

Type-species : *Chrysopa fulviceps* Stephens.

Distribution : Owing to the confusion with *Italochrysa* it is not possible to furnish a reliable account of the distribution of this genus. However, the distribution of four true *Nothochrysa* species, viz., *N. fulviceps* (Stephens), *N. capitata* (Fabricius), *N.*

californica Banks and *N. indigena*. Needham is Great Britain for the first two, North America and India for the last two species respectively.

Remarks : Adams (1967) & Tjeder (1966) mentioned in their papers the existence of only three true *Nothochrysa* species. The present author after studying the diagnostic characters of *indigena* adds one more species in the genus concerned.

21. *Nothochrysa indigena* Needham

1909. *Nothochrysa indigena* Needham, *Rec. Indian mus.*, **3** : 203.

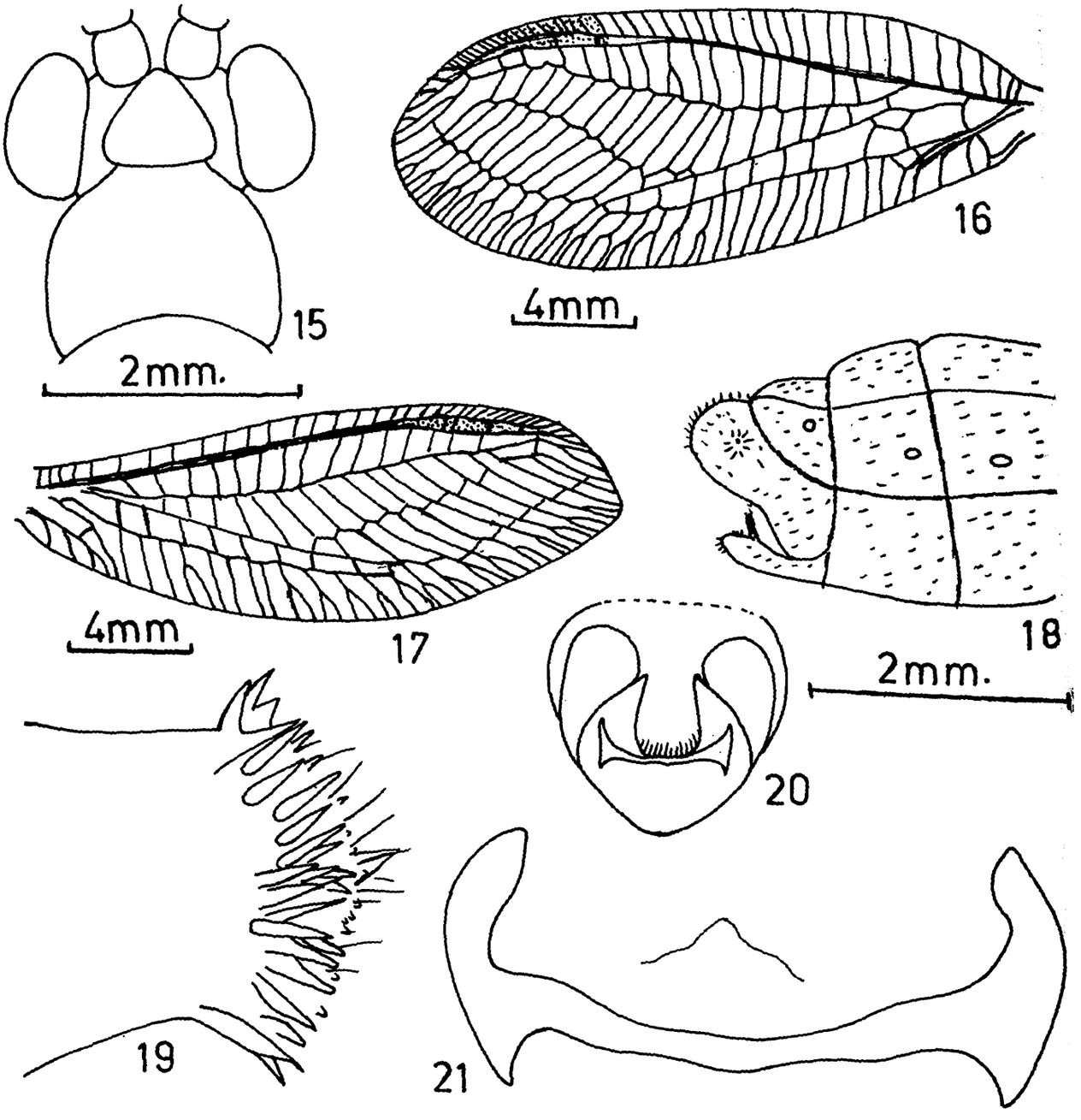
Redescription : ♂ : Head and mouth parts: discoloured; antenna: flagellum with four concentric rows of setae; thorax: discoloured; pronotum (fig. 15) broader than long with front angles broadly eroded; wings : hyaline, without spot; wing roots specially in the forewing black; pterostigma elongated, brown; longitudinal veins yellow; forewing (fig. 16) costal crossveins yellow; two basal and 5 apical crossveins between R and Rs black; gradates blackish with 12 crossveins in both outer and inner rows; 3 apical crossveins between psm & psc and the crossvein between 1A and posterior margin and between 2A & 3A black; hindwing (fig. 17) : both longitudinal and crossveins yellow; inner gradate with 9 and outer row with 11 crossveins; abdomen (fig. 18) : discoloured but tip and sternite yellow; tip of 8th and 9th sternite (fig. 19) rounded with a row of stout bristles and hairs; male genitalia (figs. 20 & 21); gonarcus transverse, almost straight and with lateral pieces; mediuucus as shown in fig. 21.

Measurement : ♂ : length of forewing, 22 mm, hindwing, 19 mm, abdomen, 8 mm.

Material examined : 1 ♂ : India, West Bengal, Calcutta, Reg. no. 9595/7, Indian Museum premises, (Coll. R. Hodgart).

Distribution : India (West Bengal).

Remarks : Needham (1909) described the species from West Bengal. A flood-damaged specimen is available from National Zoological collections bearing the aforesaid registered no. which was referred to by Needham (loc. cit.) in the text. So, the present author unhesitatingly thinks it as a type and redescribes it along with drawings of wings and genitalia. After a thorough study it is confirmed that the species *indigena* Needham has been rightly placed by its author in *Nothochrysa* as it lacks tympanum and psm merges with inner gradate series. Thus the comments made by Tjeder (1966), "We know for the present only three *Nothochrysa* species", viz., *N. fulviceps* (Stephens), *N. capitata* (Fabricius) and *N. californica* Banks and also by Adams (1967), "It appears that the great majority of old world species formerly included in Nothochrysa belong instead to *Italochrysa*" may be revised in the light of present work and present species under report may be added to the aforesaid three species.



Figs. 15-21. *Nothochrysa indigena* Needham. (15) pronotum, dorsal; (16) forewing; (17) hindwing; (18) tip of abdomen, lateral; (19) tip of 8th & 9th sternite, lateral; (20) male genitalia, caudal; (21) gonarcus and mediuncus, dorsal.

*22. ***Nothochrysa carletoni*** Banks

1939. *Nothochrysa carletoni* Banks, *Bull. Mus. comp. Zool. Harv.*, **85**(7) : 472.

Distribution : India (Sikkim).

Remarks : Tjeder (1966) while giving synonymical notes of the genus *Italochrysa* commented on the genus *Nothochrysa* as "A great many species have been described under the genus name *Nothochrysa*, most of which apparently have to be transferred to *Italochrysa*. Though similar in general appearance the species may easily be distinguished in the following way; psm merges with inner gradate series - *Nothochrysa*; with outer gradate series - *Italochrysa*. *Nothochrysa* lacks tympanium and belongs to the subfamily Distyochrysinae. We know for the present only three true *Nothochrysa* species, namely, *Chrysopa fulviceps* Stephens, *Chrysopa capitata* (Fabricius) and *Chrysopa californica* Banks". The description of *Nothochrysa carletoni* Banks (1939) reads, "The outer gradates very pale as a continuation of the medius" Consideration of Bank's description vis-a-vis Tjeder's opinion leads one to include the species *carletoni* under the genus *Italochrysa*.

*23. ***Nothochrysa lefroi*** Needham

1909. *Nothochrysa lefroi* Needham, *Rec. Indian Mus.*, **3** : 203.

Distribution : India (Assam, Bihar, Meghalaya, Punjab and Western Himalayas).

Remarks : Needham (1909) while describing the species laid emphasis only on colouration. From the description no definite comment can be made on the identity of the species.

*24. ***Nothochrysa talaverae*** Navas

1928. *Nothochrysa talaverae* Nevas, *Bol. Soc. Ent. Eso.*, **11** : 133.

Distribution : India (Sikkim).

Remarks : Neither the literature nor the specimen has been available for making a definite comment.

SUMMARY

The paper incorporates the taxonomic account along with earlier investigations, geographical distribution, review on the taxonomy, external morphology and terminology of the family Chrysopidae from eastern India. Amongst a total of twenty four species, fifteen species have been examined and nine other species have been reviewed from literature. From the examined material, one species has been described new to science, six species including two type-species described by Needham (1909) have been redescribed, one indetermined species and an unknown female of a species have been described. One species has been recorded for the first time from India and three species from West Bengal and also another species from both West Bengal and Orissa have been established as new locality records for the area under consideration. Besides, six species

have been newly combined. The distribution of the said fauna is quite interesting, since four species are hitherto known to be exotic, while the remaining twenty species are endemic in India. Running keys to all the taxa examined, literature review of nine species, references, and relevant illustrations have been provided. Thus, an account of twentyfour species distributed over eleven genera and two subfamilies of Chrysopidae has been furnished in the paper.

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PRELIMINARY OBSERVATIONS ON THE ECOLOGY OF SOME GRASSHOPPERS IN TRIPURA WITH SPECIAL REFERENCE TO *OXYA HYLA HYLA* SERV. (ORTHOPTERA : ACRIDIDAE)

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INTRODUCTION

Grasshoppers are polyphagous in nature and cause varying amount of damage all over the world in agriculture and grassland ecosystems. Their populations are affected by a host of factors, both external and internal. In case of few species of grasshoppers and locusts ecological relationships have been worked out. Katiyar (1960) reported the effect of soil on the population structure of *Schistocerca gregaria*. Pradhan and Peswani (1961) studied the ecological aspects of *Hieroglyphus nigrorepletus*. Anderson (1964) showed that the vegetation exerts a definite influence on the selection of areas of occupancy by grasshoppers. Hazra *et al.* (1981, 1984) studied population ecology of grasshoppers inhabiting cultivated and natural grassland ecosystems.

In recent times, the seasonal incidence and biology have assumed much importance due to the fact that these provide information on population dynamics, nature and extent of damage, and relationship with various biotic and abiotic factors which facilitate in formulating sound pest management programmes.

In Tripura, a State adjoining Bangaldesh, an ecological survey revealed that there are a number of species of grasshoppers which cause economic damage to several crops and at times the damage caused by them is alarming. Practically nothing is knwon about this group of insects in North-Eastern Region of India in general and of Tripura in particular. A study was therefore undertaken on the seasonal abundance of five commonly available species, *viz., Oxya hyla hyla, O. fuscovittata, Xiphidiopsis straminula, Atractomorpha crenulata and Euconocephalus pallidus*. An attempt was also made to include biological observations on some of them. The essential results of the study are presented here.

MATERIAL AND METHODS

Five sites included in the present study were located in the vicinity of Agartala. In each site paddy cultivated area of 50 × 50 m was chosen and fortnightly observations were undertaken to count the nymphs of all the species together and species-wise adults. The population was counted by sampling, using 1 m^2 field cage which was bottomless

and the top covered with muslin cloth, expansible half metre. Each observation comprised 3 samples in each locality and thus 15 m^2 area was examined early in the morning during August, 1984 - July, 1985. The data on biological studies are based both on field observations and laboratory rearing in cages.

RESULTS AND DISCUSSION

Seasonal incidence

All the five species of grasshoppers included in the present study showed strong seasonal population fluctuations and the trend was almost similar in all the species (Table 1). The most abundant species was *O. hyla hyla* followed by *A. crenulata* and *O. fuscovittata*. Genus *Oxya* accounted for 42.6% of the total grasshopper population. During December-June the population of grasshoppers remained at a low level. It

TABLE 1

Multiple correlation among population of various species of grasshoppers, average temperature and total rainfall.

Month	Average population/m^2						Av. Temp. (°C)	Total rainfall (mm)
	O. hyla hyla	O. fusco-vittata	A. cre-nulata	E. palli-dus	X. stra-minula	Nymphs		
1984								
August	23.3	17.0	14.5	2.5	11.83	3.16	29.7	278.2
September	26.0	16.3	10.83	1.16	8.5	7.0	29.0	292.0
October	47.0	28.0	19.0	3.83	14.83	9.0	28.6	85.0
November	20.33	18.16	22.0	4.16	14.0	17.83	26.2	0
December	3.5	15.0	16.0	6.5	16.83	10.66	22.2	3.8
1985								
January	0	0	9.0	1.0	5.0	9.16	21.12	2.0
February	0	0	3.33	0.33	6.33	8.5	23.33	26.9
March	2.83	2.5	0.66	0.66	4.16	6.6	27.9	49.8
April	1.33	1.0	1.0	0.66	1.16	1.8	29.2	396.9
May	1:0	0	0.66	1.5	0.83	0.7	29.1	301.7
June	0	0.3	0.33	0.0	0.5	0.6	29.6	461.8
July	0.1	0	6.66	1.0	10.66	5.8	30.2	129.8
Calculated 'F'	1.178	0.729	2.026	4.5*	3.089	9.004*		

* Significant at 5% level.

started increasing after June when 'aman' crop was transplanted and touched its peak in October. Thereafter it started declining and with the approach of maturity of the crop in December it touched a low level. The nymphal population comprised much less (15.4%) as compared to adults. This low number is because nymphal duration is of much shorter duration than the adult stage. A multiple correlation analysis revealed a significant relationship between the numphal population and the prevailing temperature and rainfall. This relationship, barring *E. pallidus* could not prove true in the adult stage. However, the adult population of *E. pallidus* remained low throughout the year and, therefore, much importance cannot be attached to this significance. It is, therefore, reasonable to put forward that the food is more important than the abiotic factors to the adults which are stout and long-lived than the nymphs which are weak physically and remain in this stage for only few weeks.

Damage

The hoppers and adults damaged the foliage and in 1985 the damage was widespread and so conspicuous that almost the entire foliage of the crop was eaten up in certain fields. 'Aman' crop was attacked more as compared to 'aus' and 'boro' crops. The ripening ears of paddy were also severely damaged which impaired the grain formation to a great extent. The crop in nursery stage received very light infestation of grasshoppers.

Alternate hosts

When paddy was harvested, grasshoppers migrated to nearby bushes and grasses but their population remained at a low level. Water hyacinth *(Eichhornia crassipes)*, a very common aquatic weed in the region, was recorded to be an alternate host. In laboratory, when paddy was not available, culture was maintained on water hyacinth.

Biological enemies

Under field conditions mynah *(Acridotheres tristis)*, squirrel *(Funambulus pennanti)* and toad *(Bufo melanostictus)* were recorded to be common predators but were able to reduce the grasshopper population to a minor extent only. In the laboratory ant *(Oligosita brevicilice)*, spider *(Heteropoda venatoria)*, lizard *(Hemidactylus sp.)*, fungus *(Aspergillus sp.)* and an unidentified mite species caused mortality to the hoppers and adults. Cannibalism was noted, under stress conditions, in case of *X. straminula* which fed on *A. crenulata* and *Oxya* spp.

Oviposition

In field, eggs were generally laid in moderately hard soil about 3 cm deep, preferably along the areas nearer to the boundaries of the paddy fields. In laboratory, moist soil was the preferred site although some egg-pods were also found on mesh of the cages. Oviposition was more during March and October.

Eggs of *O. hyla hyla* were cylindrical, light whitish or foggy in colour with a dark blue spot on the lateral side of the anterior portion. An egg-pod measured, on an average, 4.5 mm in length, 1.1 mm in width and 2.5 mg in weight. The egg stage varied from 8 to 12 days.

Developmental stages

The duration of various nymphal instars are presented in Table 2. The development was comparatively faster in the males as compared to the females.

TABLE 2

The duration of developmental stages (mean ± S.D. days) of *O. hyla hyla*.

Developmental stage	Female	Male
First instar	3.9 ± 0.4	3.7 ± 0.42
Second instar	4.9 ± 0.3	4.5 ± 0.35
Third instar	4.4 ± 0.24	3.8 ± 0.25
Fourth instar	6.6 ± 0.27	5.9 ± 0.26
Fifth instar	8.1 ± 0.46	7.5 ± 0.35
Wing development	20.1 ± 1.04	18.1 ± 0.18

TABLE 3

Effect of various feeding and non-feeding conditions on the longevity (based on 10 replications for each treatment) of *O. hyla hyla*.

Treatment	Longevity in days	
	Female	Male
With food and water	138.7 ± 1.82	125.6 ± 2.87
With food and without water	102.5 ± 2.65	98.8 ± 0.38
Without food and with water	55.4 ± 1.12	56.4 ± 0.66
Without food and water	32.0 ± 1.22	38.4 ± 1.65
SEm ±	1.82	2.88
CD at 5%	65.78	4.43
CD at 1%	88.83	5.98

Ratio of male and female and their longevity

Regular collection of the adults of *O. hyla hyla* all over the year revealed that the

females always outnumbered the males and the overall ratio between male ane female was worked out to be 1:1.4. The females outlived the males when food and water was available under laboratory conditions while the reverse was true when they were devoid of food and water (Table 3).

The maximum population of grasshoppers recorded in the month of October more or less confirms the earlier findings of Dwivedi (1977) and Hazra *et al.*, (1981) who reported peak in August and November. The seasonal population fulctuations according to the present investigation is more influenced by food than the abiotic factors is in conformity with the earlier findings of Hazra *et al.*, (1984) who reported that the quality and distribution of grasshoppers are dependent upon vegetation. Oviposition details recorded here are consistent with the observations of a number of earlier workers (Katiyar, 1960; Pradhan and Peswani, 1961; Chapman, 1960; Kushwaha and Bharadwaj, 1977). Observations on the sex ratio and longevity of male and female recorded here are more or less similar to those reported earlier by Hazra *et al.* (1981).

SUMMARY

Observations on the seasonal incidence of five species of grasshoppers, *viz.*, *Oxya hyla hyla*, *O. fuscovittata*, *Xiphidiopsis straminula*, *Atractomorpha crenulata* and *Euconocephalus pallidus*, recorded during 1984-85 in Tripura revealed *O. hyla hyla* to be the most common species followed by *A. crenulata* and *O. fuscovittata*. In general, grasshoppers were more abundant during July-December with a peak in October. A positive significant correlation was established between nymphal stage of grasshoppers and prevailing temperature and total rainfall. This relationship did not, however, prove significant in the adults except in case of *E. pallidus*. Notes on the biology of some species are presented.

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DISTRIBUTION, SEASONAL ACTIVITY AND DISEASE RELATIONSHIP OF IXODID TICKS (ACARINA : IXODIDAE) PARASITISING LIVE-STOCK IN ZAMBIA

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INTRODUCTION

Ticks are known vectors of agents that cause many economically important diseases in domestic live-stock causing heavy economic losses to animal industry. As a number of Ixodid tick species are a matter of concern to cattle, sheep and goat farmers in Zambia; therefore, faunistic and ecological work on these parasites is of considerable significance. The continued threat of acaricidal resistance and the ever increasing price of these compounds are further factors which stimulates concerted efforts in tick ecology and indeed entire tick ecosystem. Recent studies on ticks in Zambia were carried out by MacLeod, 1970; MacLeod and Colbo 1976, MacLeod et al, 1977 and MacLeod and Mwanaumo, 1978. These mainly deal with infestation pattern of ticks.

MATERIAL AND METHODS

In planning effective dip management a sound knowledge of distribution and population density of target species in relation to season is a pre-requisite in an efforts to plan more efficient control programmes. To achieve this objective the Livestock and Pest Research Centre of National Council for Scientific Research during the past decade carried out the systematic surveys throughout the country for the collection of ticks in different season. Tick samples though obtained in a random manner from most areas but in sufficient numbers to give an accurate indication of distribution, abundance, hosts and seasonal occurrence of the majority of tick species, especially those parasitic on domestic hosts. Most of these collections were made by trained staff during field trips designed to cover particular areas during a national survey of tick infestation patterns and during the long-term studies on tick and tick-borne diseases chiefly *Theileriosis* in Zambia. The collections were usually made by deticking both domestic and wild animals; or by flagging; cone swooping; and blanket sweeping in pastures.

RESULTS

The available data on ticks parasitising livestock in Zambia reveals the presence of 30 species on cattle (Table 1), with varying degree of infestation.

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TABLE 1

Ixodid tick species found on livestock in Zambia.

Amblyomma eburneum	*Rhipicephalus hurti*
Amblyomma hebraeum	*Rhipicephalus masseyi*
Amblyomma lepidum	*Rhipicephalus muehlensi*
Amblyomma variegatum	*Rhipicephalus neavei*
Boophilus decoloratus	*Rhipicephalus punctatus*
Boophilus microplus	*Rhipicephalus reichenowi*
Haemaphysalis aciculifer	*Rhipicephalus sanguineus*
Haemaphysalis (Rhipistoma) leachii	*Rhipicephalus sculptus*
Hyalomma rufipes	*Rhipicephalus simus*
Hyalomma truncatum	*Rhipicephalus sulcatus*
Ixodes cavipalus	*Rhipicephalus simus*
Rhipicephalus appendiculatus	*Rhipicephalus sulcatus*
Rhipicephalus capensis	*Rhipicephalus supertritus*
Rhipicephalus compositus	*Rhipicephalus tricuspis*
Rhipicephalus evertsi evertsi	*Rhipicehpalus turanicus*
Rhipicephalus longus	*Rhipicephalus zambeziensis*

The subject of this paper is limited to the most common ticks of cattle and commonly referred to as cattle ticks. Gross total of adult specimens taken from cattle are shown in Table 2, rounded to the nearest hundred for clarity and they are arranged in

TABLE 2

Approximate total number of adults (both sexes) of the most common species of ticks collected from cattle during the survey.

Sl.No.	*Tick species*	*Nos.*
1	*Boophilus microplus*	1,60,000
2.	*Boophilus decoloratus*	70,600
3.	*Amblyomma variegatum*	47,400
4.	*Rhipicephalus appendiculatus*	28,000
5.	*Rhipicephalus evertsi evertsi*	12,800
6.	*Rhipicephalus compositus*	11,900
7	*Rhipicephalus tricuspis*	10,300
8.	*Hyalomma truncatum*	7,400
9.	*Rhipicephalus simus*	6,000
10.	*Rhipicephalus sanguineus*	3,700
11.	*Rhipicephalus punctatus*	3,200
12.	*Hyalomma rufipes*	1,600

order of total number of specimens which have been collected and identified. Each specimens without exception, has been critically studied under the stereomicroscope.

DISTRIBUTION, SEASONAL ACTIVITY AND DISEASE RELATIONSHIP OF CATTLE TICKS IN ZAMBIA BOOPHILUS MICROPLUS

Distribution : *Boophilus micorplus* is confined to the elevated plateau region of greatly reduced relief, shallow Chambeshi valley, Bangweulu depression and on elongated plateau strip of northern and eastern regions (Fig.1). This is a one host tick and a primary parasite of cattle.

Seasonal Activity : *Boophilus microplus* is a one host tick and breeds continually throughout the year; the engorged adult, larvae and nymph can be collected at any time of the year but in varying numbers. A summary of collection data shows (Fig.2) that it has an active period during the cold dry season i.e., April to July. In the hot and humid season i.e. from the beginning of August there is a sudden decline in population, followed by a secondary rise in September and a high incidence in January which is the peak of rainy season. *Boophilus microplus* has more than two generations in a year.

Disease Relationships : These have not been studied in detail in Africa but *Boophilus microplus* is important as the vector of red water or texas fever (*Babesia bigemina*) and anaplosmosis or gall sickness (*Anaplasma marginale*) in relation to cattle.

Boophilus decoloratus

Distribution : *Boophilus decoloratus* is widely distributed in country (Fig.3) and has been collected in large numbers. In northern-eastern region of the country this tick has been replaced by *Boophilus microplus* to a great extent on domestic cattle. However, this tick has been found on wild animals in South Luangwa National Park. This is also a one-host tick and a primary parasite of cattle.

Seasonal Activity : Like *Boophilus microplus* this tick also breeds continuously throughout the year. The population starts building up towards the end of the rainy season and reaches its peak in May, then it shows gradual decline till October (Fig.4). There is a slight increase in population at the beginning of rainy season in November but then there is a sudden decline till the end of rainy season. It has more than two generations in a year.

Disease Relationship : *Boophilus decoloratus* is known to transmit agents of *Anaplasmosis* and *Babesiosis*.

Amblyomma variegatum

Distribution : *Amblyomma variegatum* is the commonest and most important tick in Zambia and is found in almost every type of the country from faulted valleys of

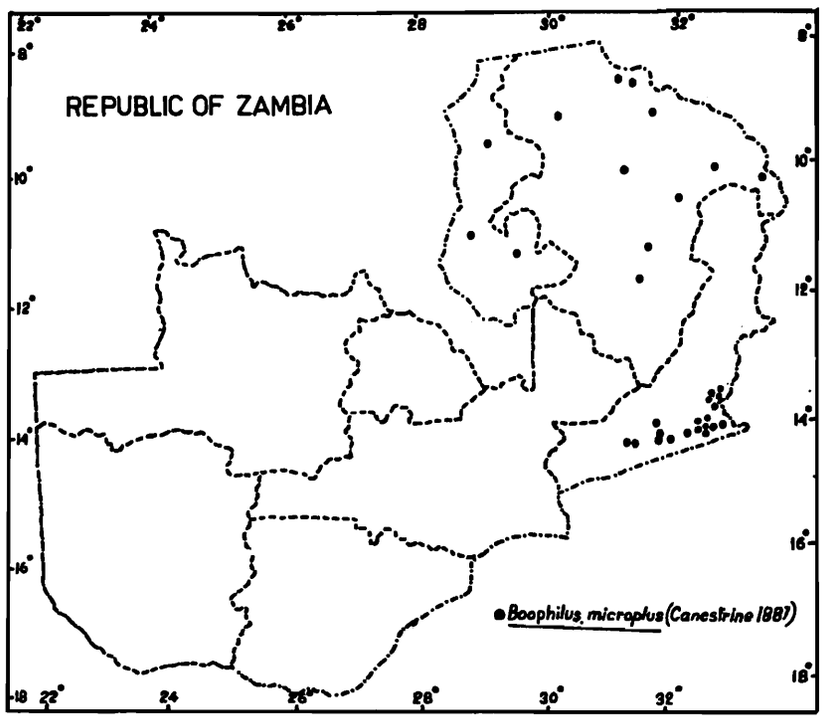

Fig. 1. Distribution of Boophilus microplus in Zambia

Fig. 1. Distribution of *Boophilus microplus* in Zambia.

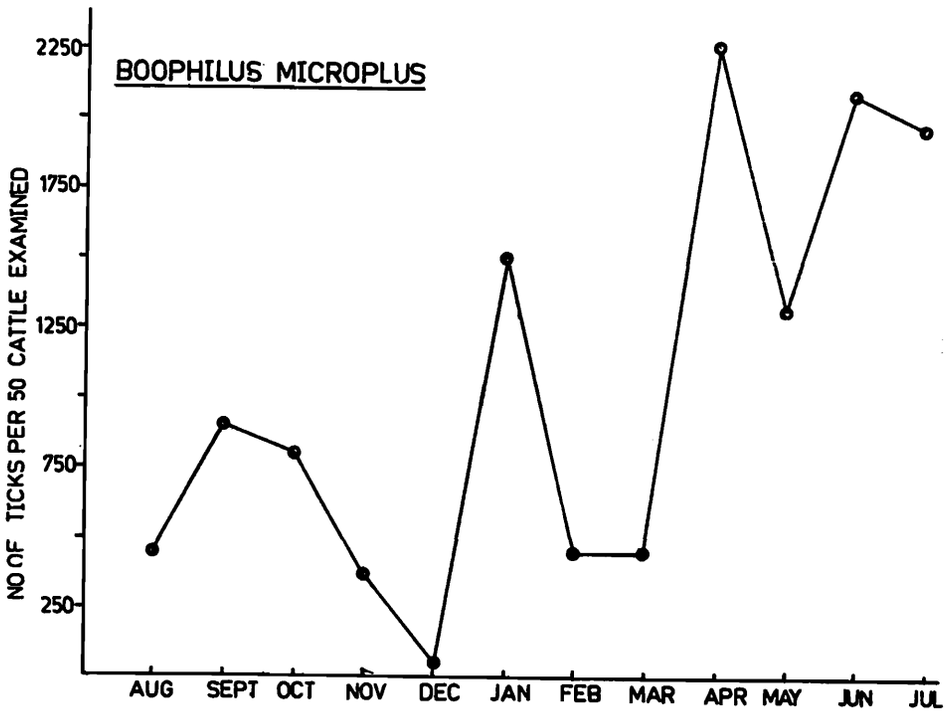

Fig. 2. The seasonal incidence curve of adult of Boophilus microplus in Zambia on cattle.

Fig. 2. The seasonal incidence curve of adut of *Boophilus microplus* in Zambia on cattle.

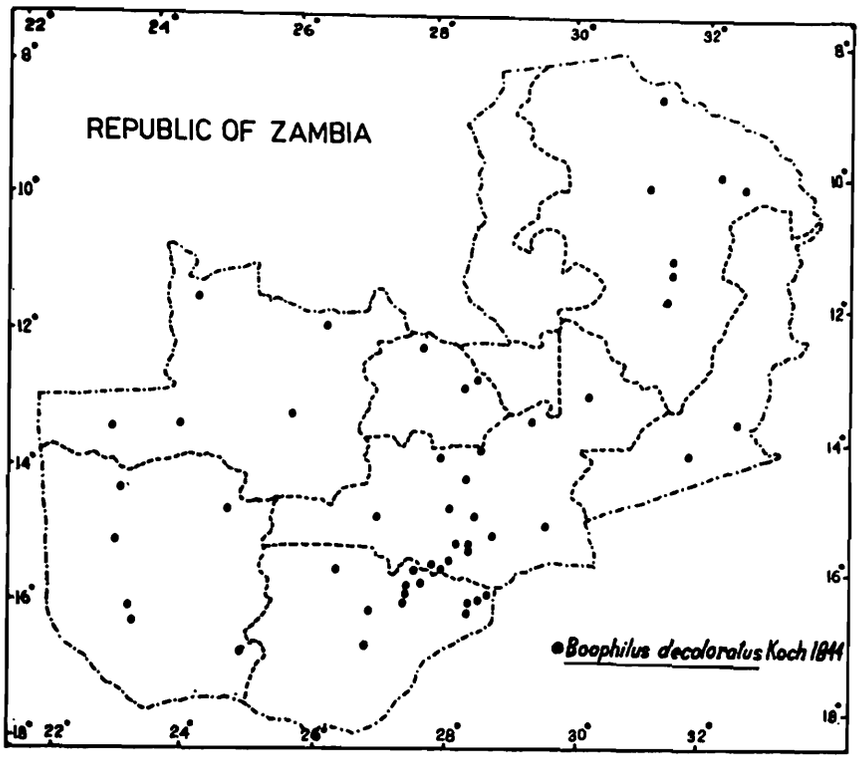

Fig. 3. Distribution of Boophilus decoloratus in Zambia.

Fig. 3. Distribution of *Boophilus decolratus* in Zambia.

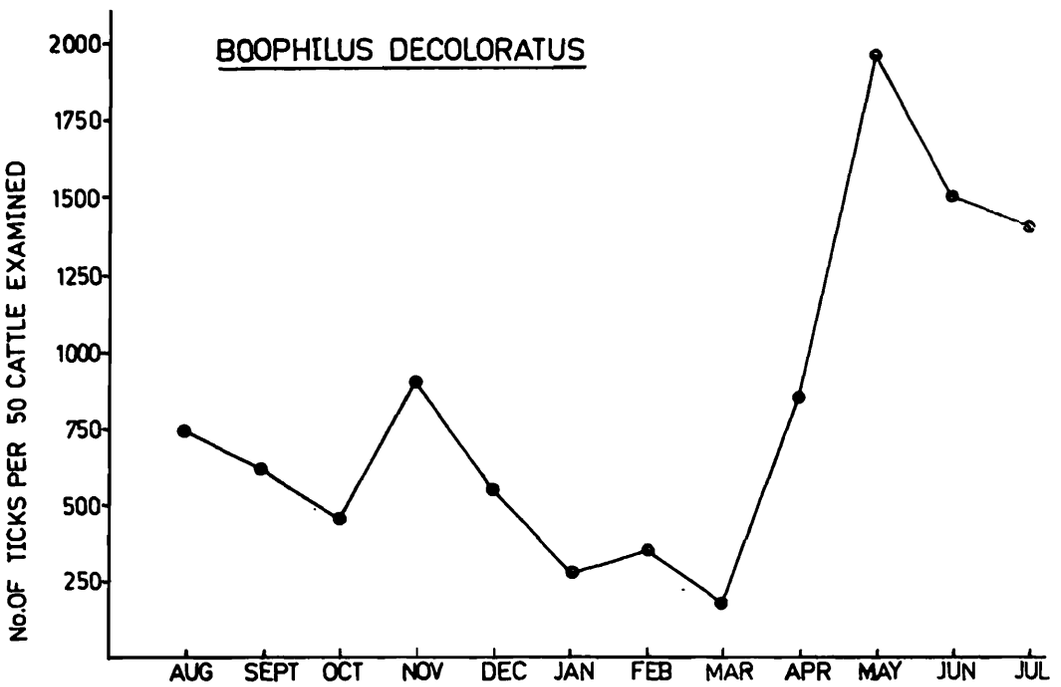

Fig. 4. The seasonal incidence curve of adult of Boophilus decoloratus in Zambia on cattle.

Fig. 4. The seasonal incidence curve of adut of *Boophilus decoloratus* in Zambia on cattle.

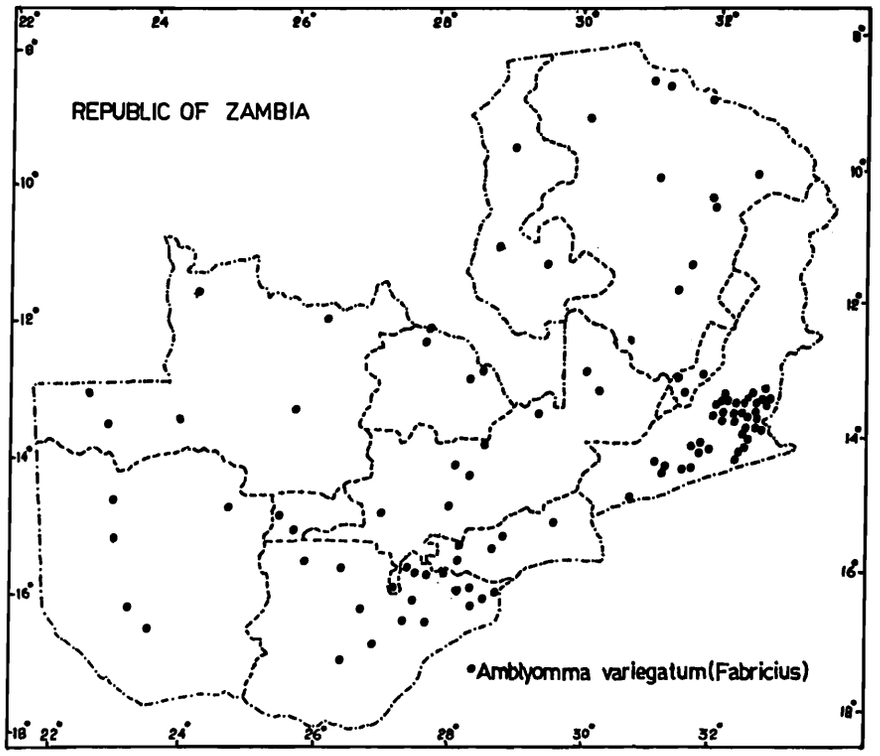

Fig. 5. Distribution of Amblyomma variegatum in Zambia.

Fig. 5. Distribution of *Amblyomma variegatim* in Zambia.

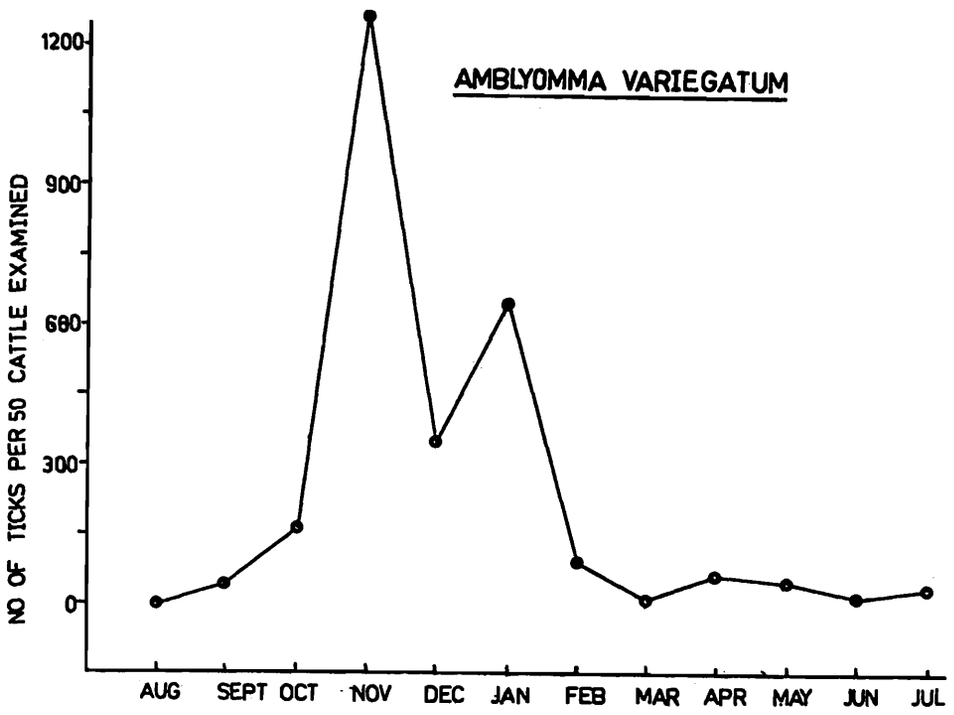

Fig. 6. The seasonal incidence curve of adult of Amblyomma variegatum in Zambia on cattle.

Fig. 6. The seasonal incidence curve of adut of *Amblyomma variegatim* in Zambia on cattle.

Zambezi, Luangwa and Kafue rivers and the basin of Lake Tanganyika in the north to Mafinga Mountains and Mbala-highlands (Fig.5). It occurs throughout the mountain ranges, massifs, rift valleys wherever there are cattle and is almost ubiquitous in the plains.

Seasonal Activity : The adults of this tick have been found on cattle in Zambia almost throughout the year in varying numbers (Fig.6). They start appearing in collection towards the end of dry season, especially in late September and early October. The population gradually starts building up and reaches a peak in the month of November. A large number of engorged females start appearing from late October. There is a sudden decline in population in the month of December due to large number of engorged females leaving the host for egg-laying. The population than increases in January. Adult population show a rapid downward trend in the dry season reaching a minimum in the month of August. This tick has a single generation in Zambia.

Disease Relationship : *A. variegatum* is known to transmit heartwater of ruminants, caused by *Cowdria ruminantium*. In Eastern Province of Zambia this tick also transmits chronic theileriosis throughout the year.

Rhipicephalus appendiculatus

Distribution : *R. appendiculatus* is the most important species of ticks in Zambia. Generally it is found in almost all the provinces in the country (Fig.7). It occurs in altitude ranging from 300 m in the faulted valley of Luangwa and Zambezi to 1820 m in Mafinga and Mbala highlands. It has also been found uniformly throughout the main plateau region on either side of the main Congo-Zambezi watershed from Kabwe to Isoka which ranges in altitude from 1,230 m to 1535 m; and on southern plateau around Choma and Kalomo in the Southern Province at about 1,200 m; and the eastern plateau at about 1,075 m; there is also a focus of infestation in the upper valley region ranging in altitude from 900 m to 1200 m. On Barotse plain and northern plateau region of North-Western province, the occurrence of this tick is very irregular.

Seasonal Activity : The adult of *Rhipicephalus appendiculatus* generally makes their first appearance towards the beginning of rainy season i.e. in November and attains a maximum during January i.e. the peak of rainy season. Thereafter they decrease in number towards the end of rainy season (Fig.8). The larvae are found in cold-dry season and nymph in hot-dried season and adults in rainy season, due to its requirement of high humidity optimum, about 75% and above. This clearly indicates that this tick passes through only one generation per annum.

Disease Relationships : *R. appendiculatus* is the chief field vector of the protozoan parasite *Theileria parva*, causative agent of East Coast Fever. It is also capable of transmitting Redwater *(Babesia bigemina)*, Pseudo East Coast Fever *(Theileria mutans)*, Boutonneuse Fever *(Rickettsia conorii)*, and louping ill (virus) experimentally.

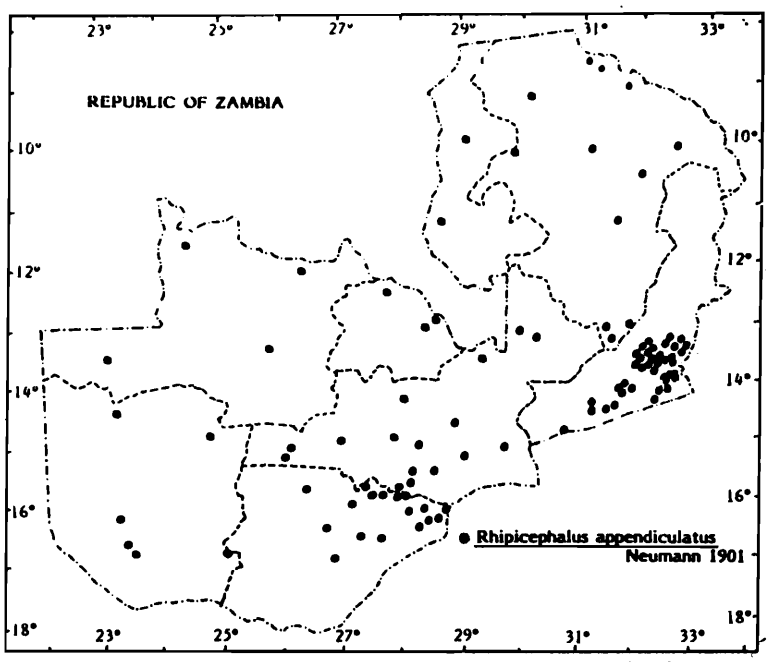

Fig. 7. Distribution of Rhipicephalus appendiculatus in Zambia.

Fig. 7. Distribution of *Rhipicephalus appendiculatus* in Zambia.

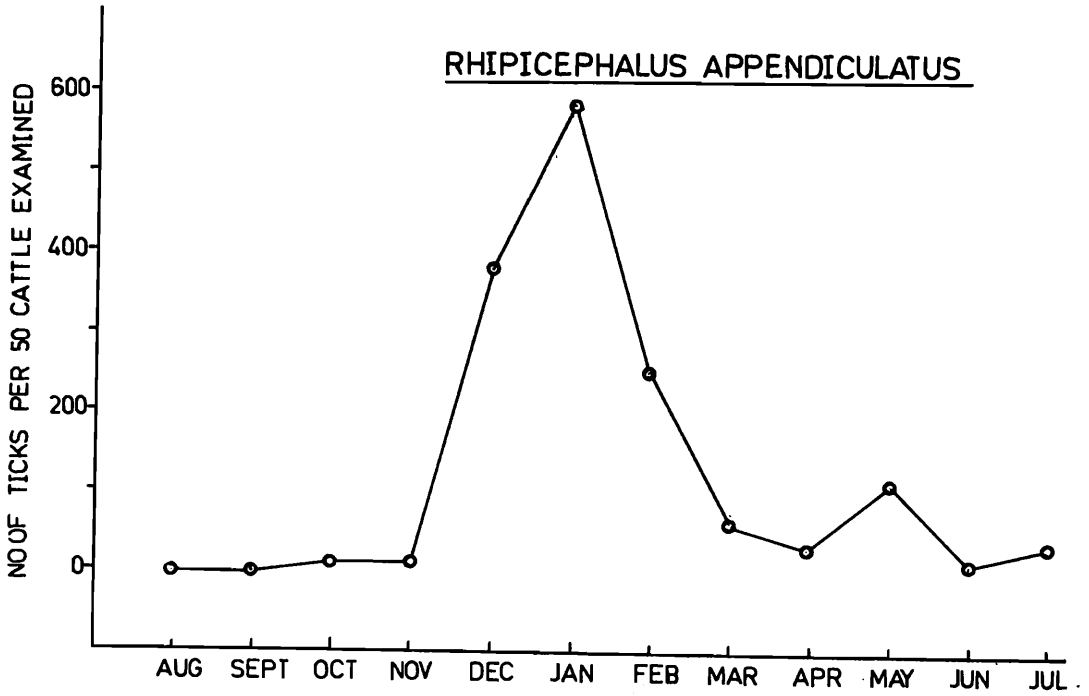

Fig. 8. The seasonal incidence curve of adult of Rhipicephalus appendiculatus in Zambia on cattle.

Fig. 8. The seasonal incidence curve of adut of *Rhipicephalus appendiculatus* in Zambia on cattle.

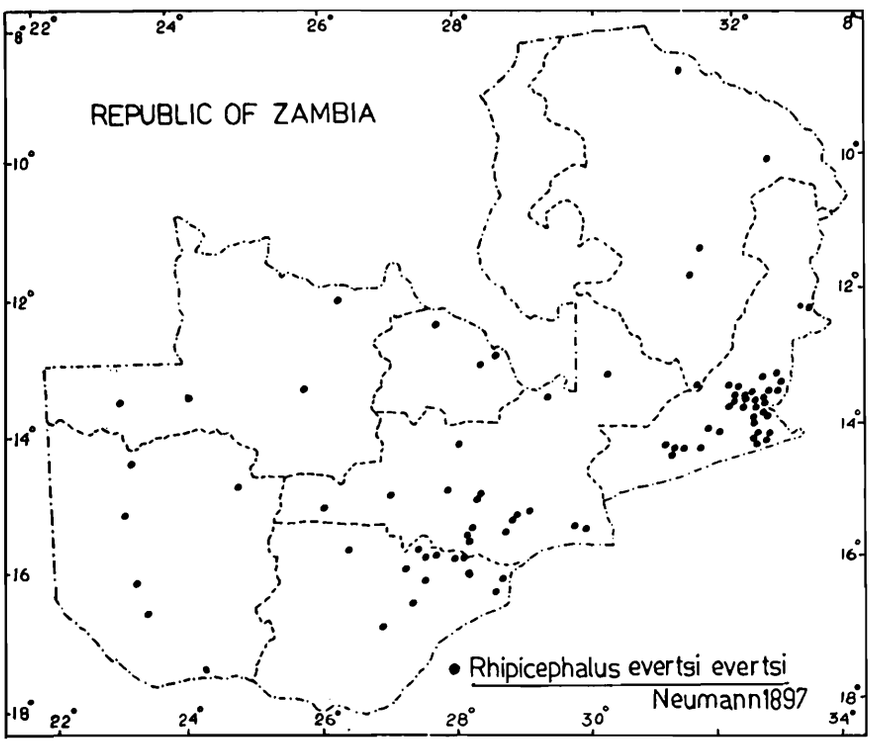

Fig. 9. Distribution of Rhipicephalus evertsi evertsi in Zambia.

Fig. 9. Distribution of *Rhipicephalus evertsi evertsi* in Zambia.

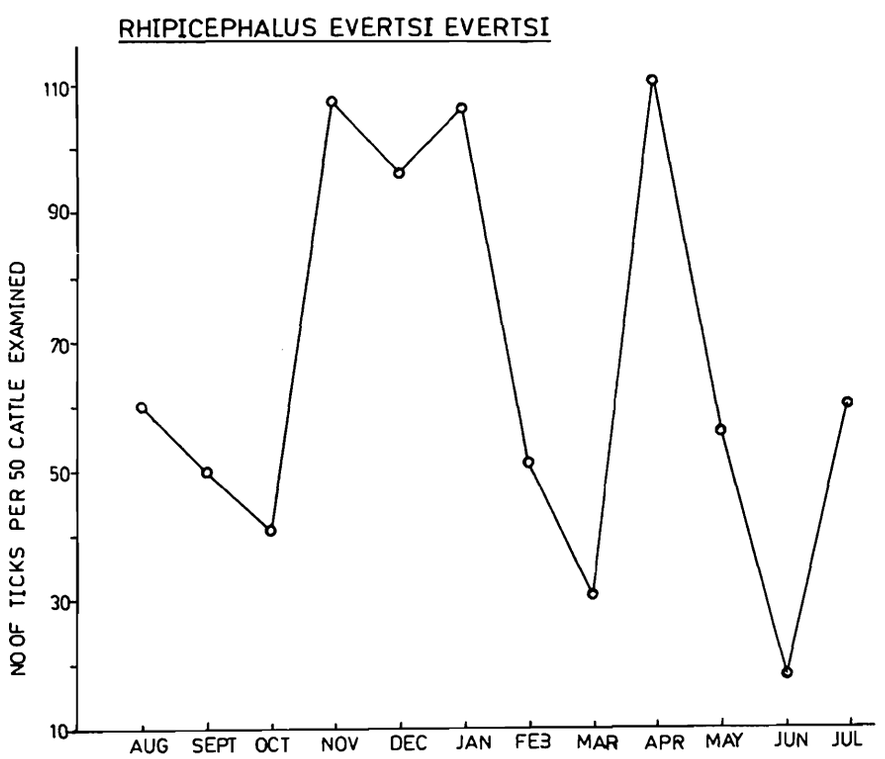

Fig. 10. The seasonal incidence curve of adult of Rhipicephalus evertsi evertsi in Zambia on cattle.

Fig. 10. The seasonal incidence curve of adut of *Rhipicephalus evertsi evertsi* in Zambia on cattle.

Rhipicephalus evertsi evertsi

Distribution : *R. evertsi evertsi* is present almost throughout the country although not equally distributed in all the provinces (Fig.9). This tick seems to be able to withstand varying conditions and may well be found in many other areas from where it has not yet been reported. This tick is found widely in eastern, central, southern plateau systems and western Barotse plains with some extensions into river valleys and northern highlands.

Seasonal Activity : *R. evertsi evertsi* occurred throughout the year, often in substantial numbers. The infestation of this tick occurs in waves (Fig.10). The seasonal cycle in Zambia showed that adults begin to appear in cold-dry season in June and then population slowly builds up and reaches its peak in November and peak of infestation is maintained in the rainy season. There is a sudden decline towards the end of rainy season in March. This decline is due to the dropping off engorged females for egg-laying. The secondary peak of activity, occurs at the beginning of cool-dry season in the month of April. This suggests that *R. evertsi* passes through more than two generations per annum. This tick can withstand both high and low humidity and temperature.

Disease Relationship : *R. evertsi evertsi* has been proved to transmit *Theileria parva*, the agent of East Coast Fever, *Theileria mutans* agent of Pseudo East Coast Fever, and *Babesia bigemina*, red water of cattle. Besides these, it is also capable of transmitting the causative agents of biliary fever of horses and of both bovine and equine spirochaetosis.

Rhipicephalus compositus

Distribution : There are records of *R. compositus* throughout the whole range of Zambia's physiography from flat plateau at about 600 m in altitude to elevated uplands country, intensely dissected escarpment zones to highlands over 1800 m in altitude (Fig.11). This tick is very rare in southern plateau region and absent in our collections from Choma-Kalomo plateau region.

Seasonal Activity : The activity period of *Rhipicephalus compositus* differs from *R. appendiculatus* and *R. Simus* in, that peak infestations occur before the rains, during the hot months of September and October. There is a gradual decline with the onset of rains and gradually diminishes in the cold-dry season (Fig.12). This suggests that this species also pass through only a single generation per annum.

Disease Relationship : This tick is known to transmit pathogens of East Coast Fever experimentally.

Rhipicephalus tricuspis

Distribution : *R. tricuspis* is almost ubiquitous in Zambia and occurs throughout the main physiographical zones of the country from faulted valleys of Zambezi to Mbala-highlands and Nyika plateau ranging in altitude from 600 m to 1820 m (Fig.13).

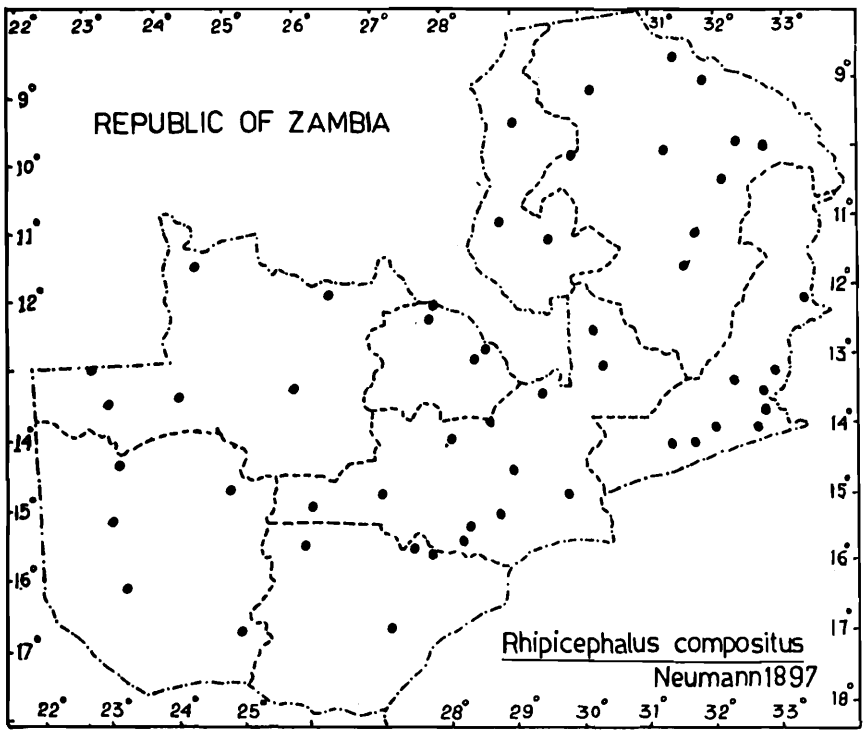

Fig. 11. Distribution of Rhipicephalus compositus in Zambia.

Fig. 11. Distribution of *Rhipicephalus compositus* in Zambia.

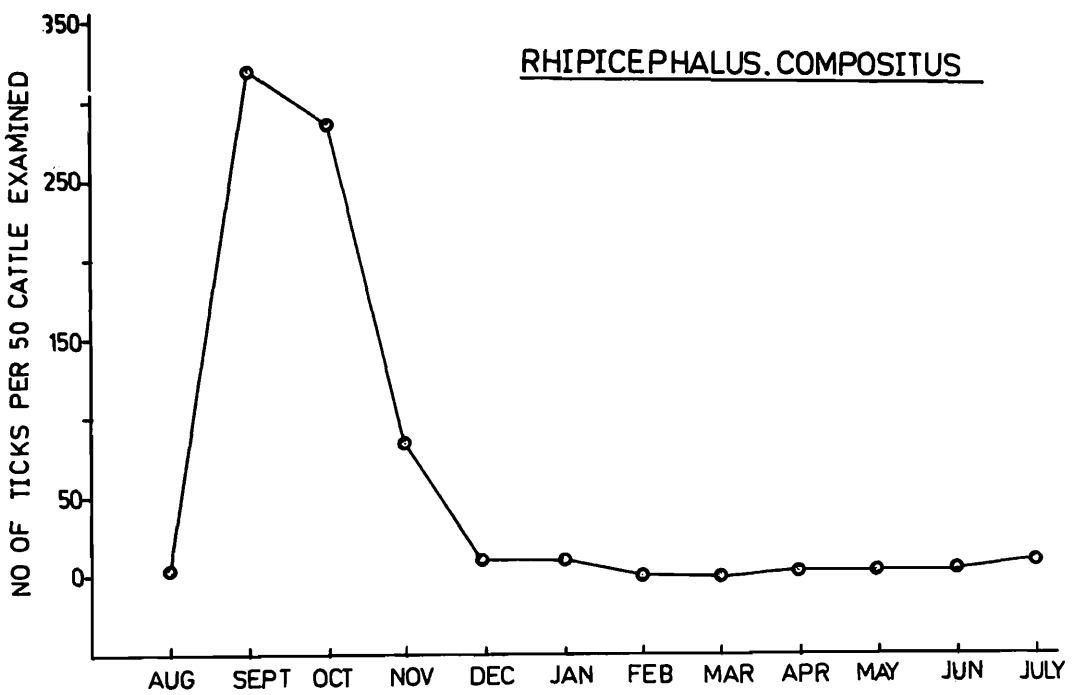

Fig. 12. The seasonal incidence curve of adult of Rhipicephalus compositus in Zambia on cattle.

Fig. 12. The seasonal incidence curve of adut of *Rhipicephalus compositus* in Zambia on cattle.

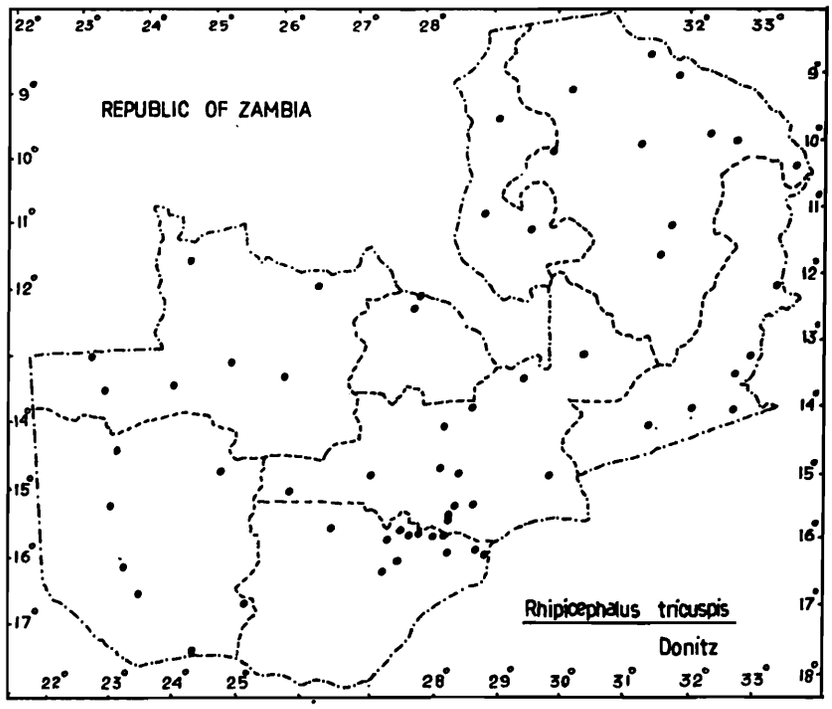

Fig. 13. Distribution of Rhipicephalus tricuspis in Zambia.

Fig. 13. Distribution of *Rhipicephalus tricuspis* in Zambia.

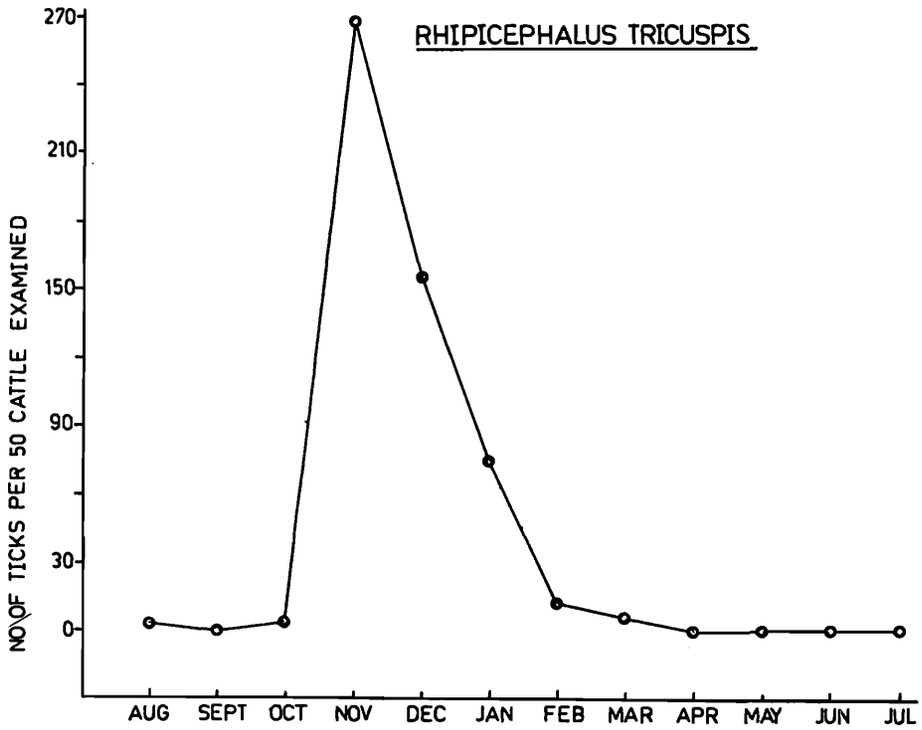

Fig. 14. The seasonal incidence curve of adult of Rhipicephalus tricuspis in Zambia on cattle.

Fig. 14. The seasonal incidence curve of adut of *Rhipicephalus tricuspis* in Zambia on cattle.

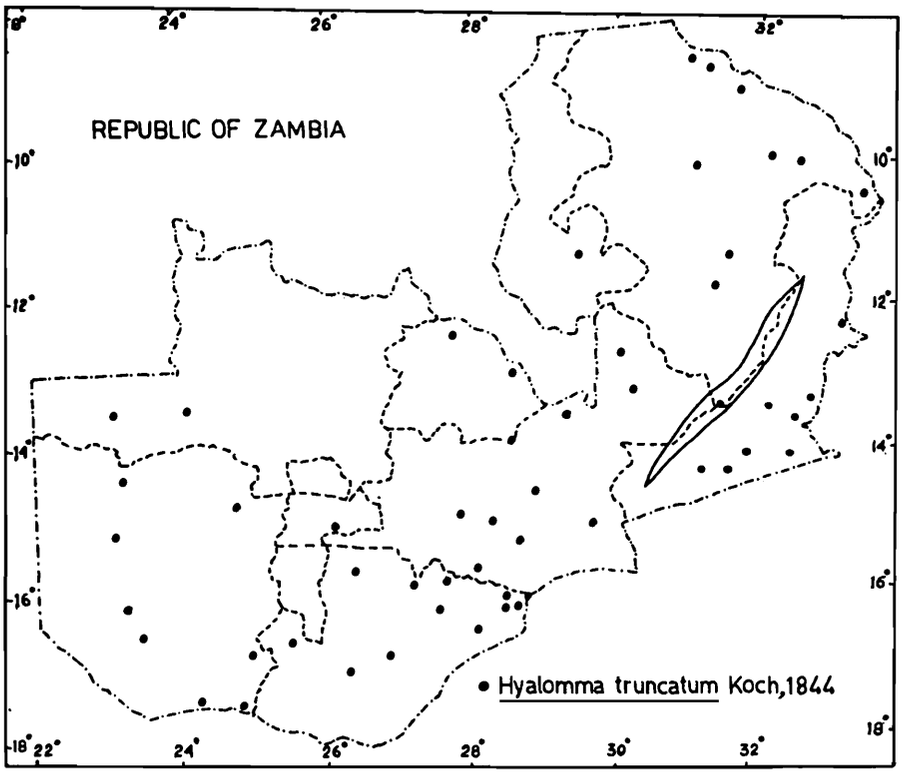

Fig. 15. Distribution of Hyalomma truncatum in Zambia.

Fig. 15. Distribution of *Hyalomma truncatum* in Zambia.

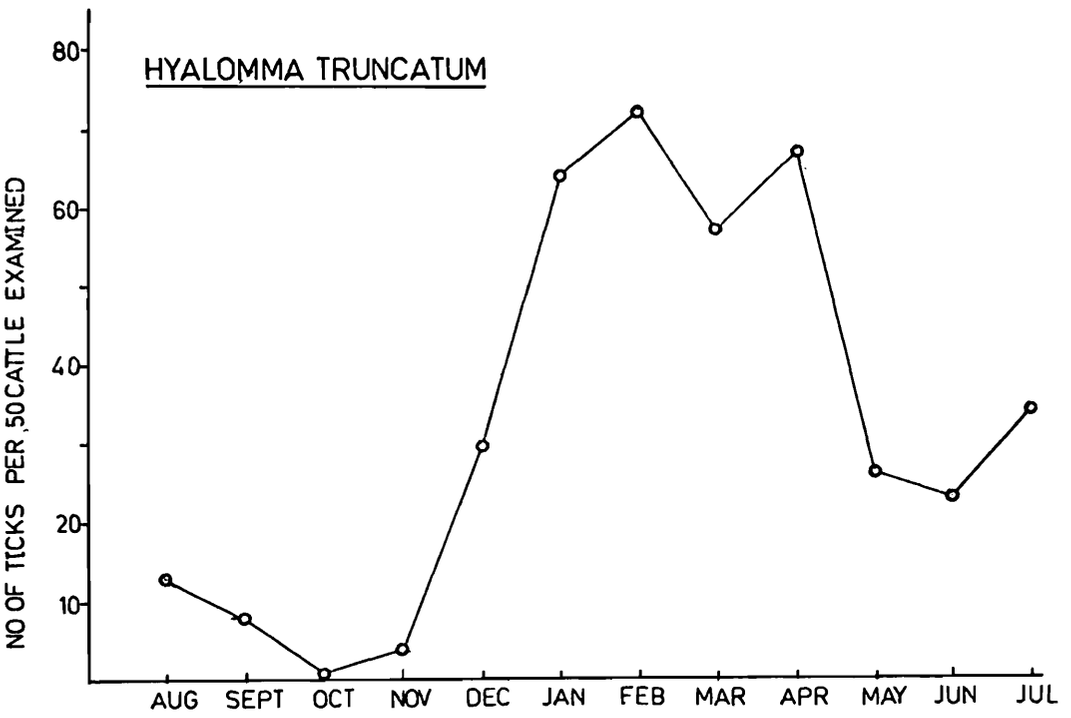

Fig. 16. The seasonal incidence curve of adult of Hyalomma truncatum in Zambia on cattle.

Fig. 16. The seasonal incidence curve of adut of *Hyalomma truncatum* in Zambia on cattle.

Seasonal Activity : The adults of *R. tricuspis* starts appearing in the hot months and the population reaches its peak on or about the onset of rains. The activity is maintained during the early part of the rainy season but then there is a gradual decline till March and no adults of this tick are usually found till August. This pattern also suggests a single generation of this species per annum (Fig. 14).

Disease Relationship : *R. trcuspis* has been proved to transmit agents of *Q fever* and is also known to cause paralysis in sheep and lamb.

Hyalomma truncatum

Distribution : *H. truncatum* has been collected frequently between 900 m to 1200 m in altitude in low to moderate infestation. It has also been found at Mbala-highlands and Mafinga mountains in the north eastern plateau region of the country where the altitude is over 1500 m. The foci of infestation of this tick is mainly from Kalahari region in the west to Kafue flats, central plateau, broken hill country and lesser eastern plateau of the country (Fig. 15).

Seasonal Activity : The adult of *Hyalomma truncatum* are found in substantial numbers from the beginning of rainy season till the end of cold-dry season (Fig. 16). The peak of activity is from middle of rainy season to the beginning of cold-dry season. The population gradually declines from May with a slight build up in July then there is a sudden decline till September. In view of the activity pattern there is a possibility of more than one generation of tick per annum.

Disease Relationship : *Hyalomma truncatum* is known to transmit the virus of sweating sickness, a disease that affects cattle, sheep, goats and pigs. It is also known to transmit causative agents of east coast fever of cattle under laboratory conditions.

Rhipicephalus simus

Distribution : *R. simus* almost ubiquitous in Zambia and has been recorded from most parts of the country (Fig. 17). It is distributed throughout the whole range of Zambia's physiography, from faulted valley of Zambezi and Luangwa river a tributory of Zambezi-Zaire Divide; Luangwa-Lake-Malawi divide, Bangweulu depression, Mbala highlands and Barotse plains. These area range in altitude from 310 m to 1820 m.

Seasonal Activity : The adults of *Rhipicephalus simus* starts appearing during hot-dry months of September and October and gradually population builds up throughout November at the onset of rains, reaches its peak by middle of rainy season, thereafter the size of infestation decreases gradually through the end of rainy season (Fig.18). Numbers occurring during cool months are negligible. The activity pattern of this tick suggests only one generation per annum.

Disease Relationship : *R. simus* has been proved to transmit East Coast Fever of Cattle and gall sickness *(Anaplasma marginale).*

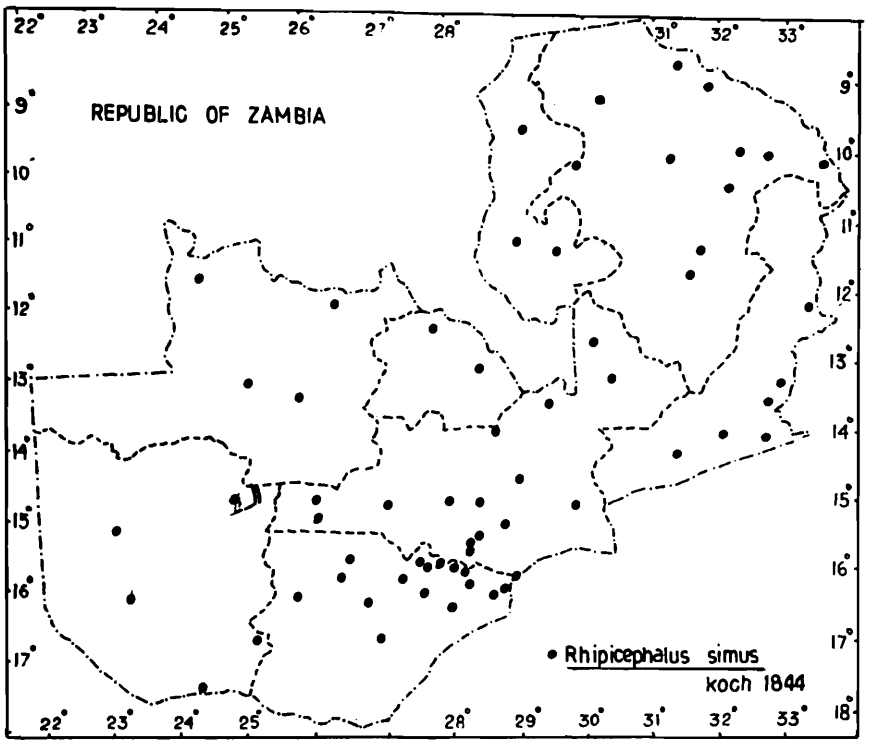

Fig. 17. Distribution of Rhipicephalus simus in Zambia.

Fig. 17. Distribution of *Rhipicephalus simus* in Zambia.

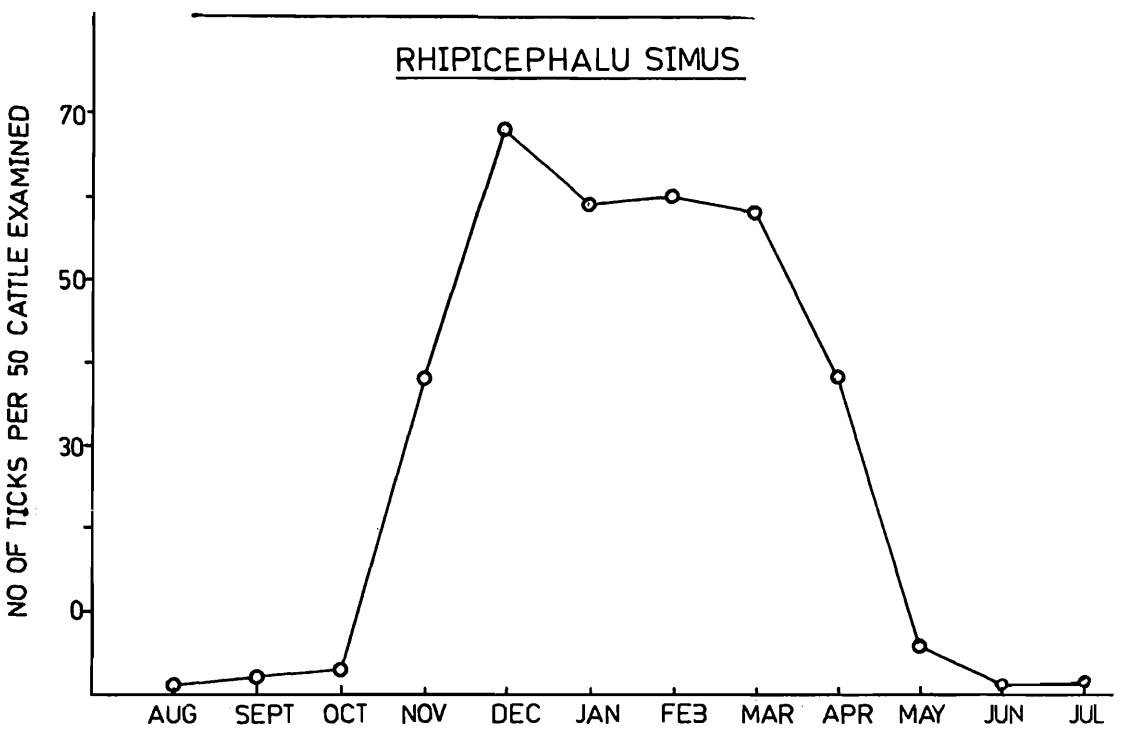

Fig. 18. The seasonal incidence curve of adult of Rhipicephalus simus in Zambia on cattle.

Fig. 18. The seasonal incidence curve of adut of *Rhipicephalus simus* in Zambia on cattle.

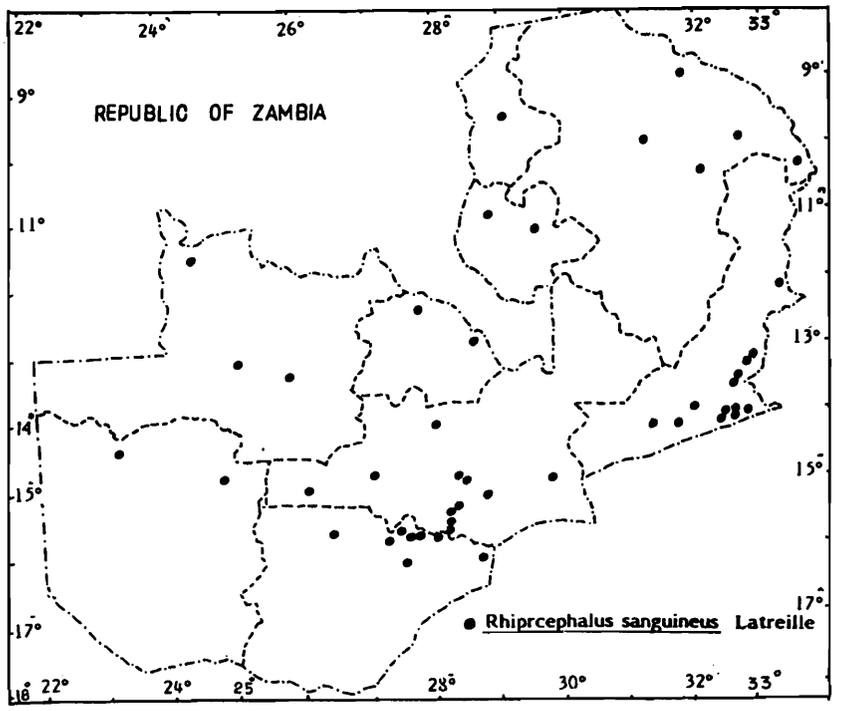

Fig. 19. Distribution of Rhipicephalus sanguineus in Zambia.

Fig. 19. Distribution of *Rhipicephalus sanguineus* in Zambia.

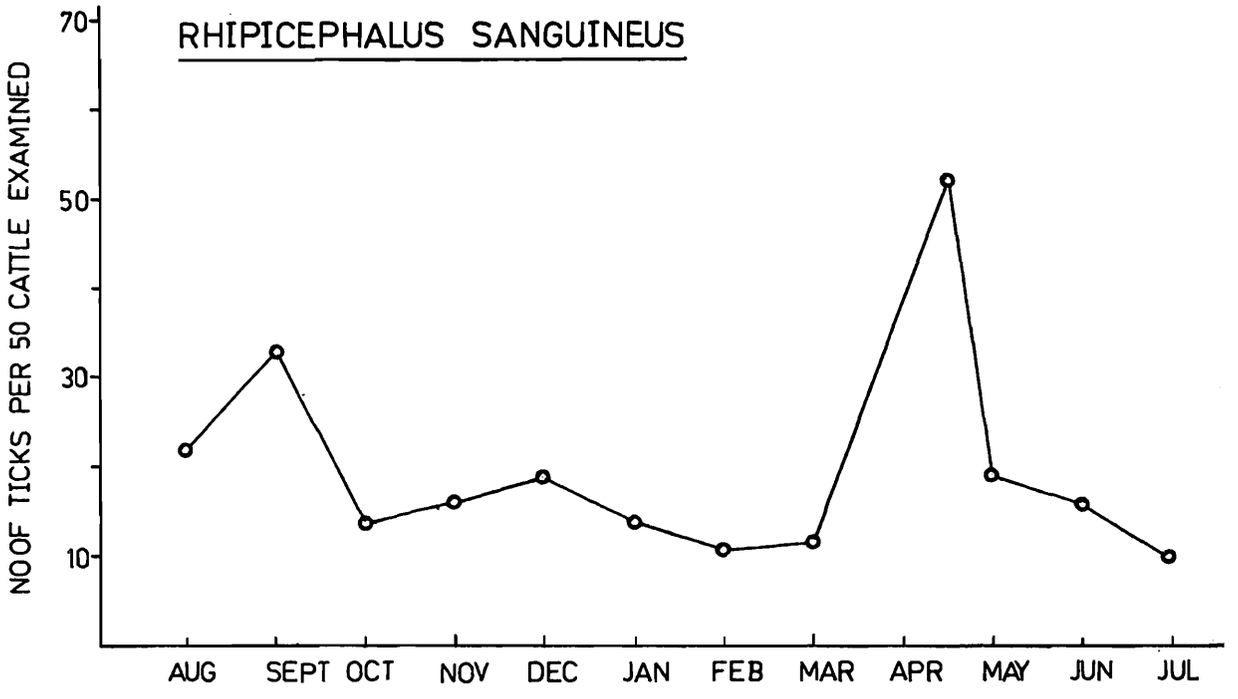

Fig. 20. The seasonal incidence curve of adult of Rhipicephalus sanguineus in Zambia on cattle.

Fig. 20. The seasonal incidence curve of adut of *Rhipicephalus sanguineus* in Zambia on cattle.

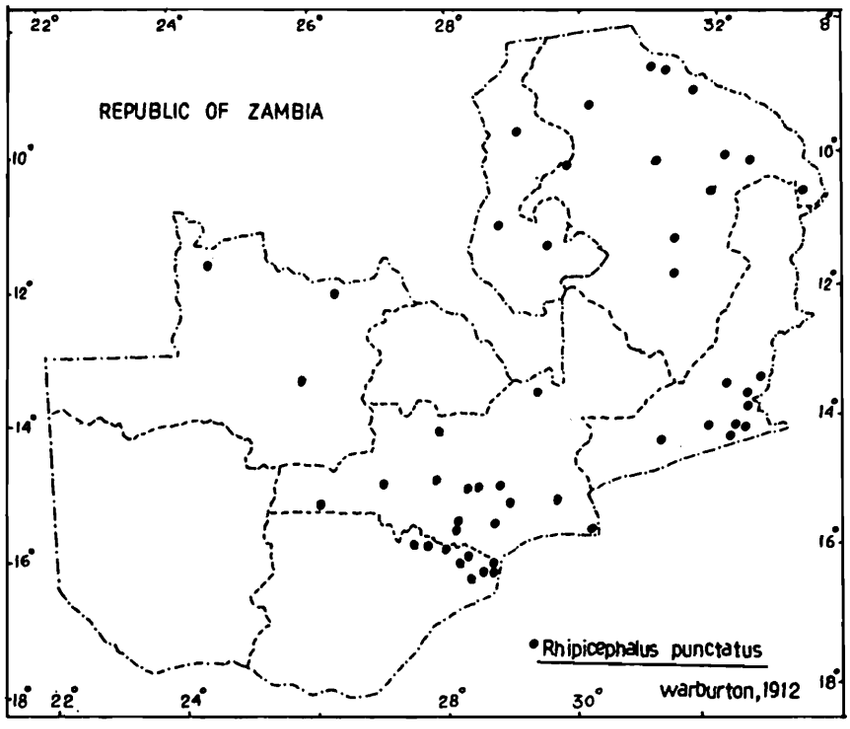

Fig. 21. Distribution of Rhipicephalus punctatus in Zambia.

Fig. 21. Distribution of *Rhipicephalus punctatus* in Zambia.

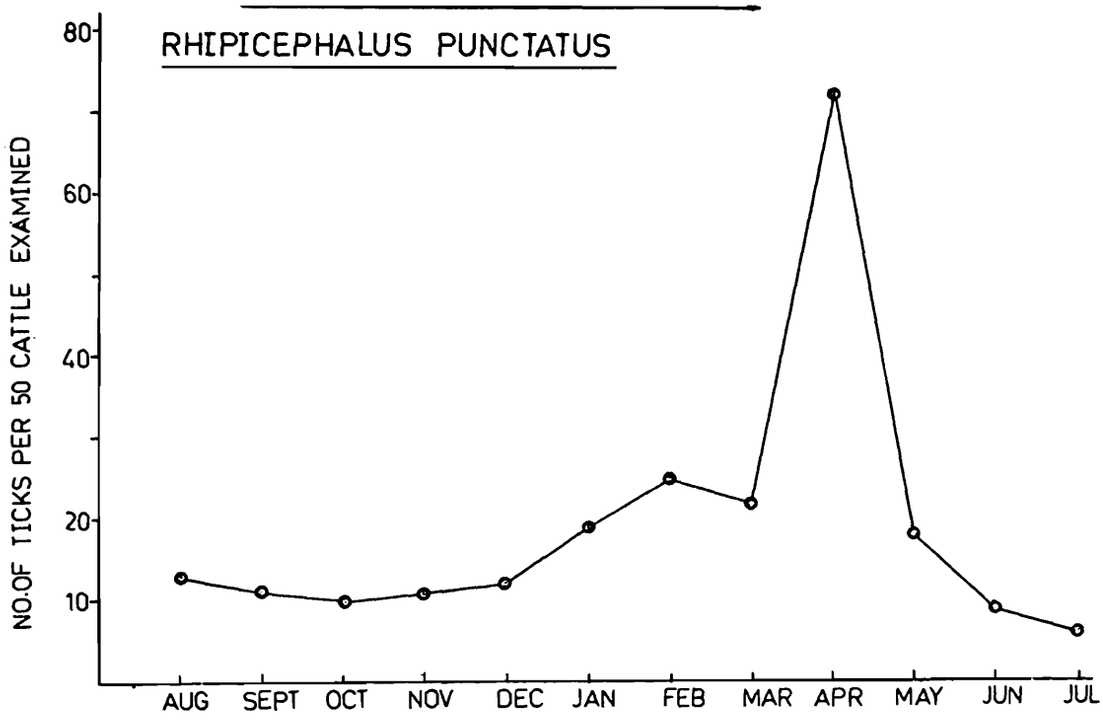

Fig. 22. The seasonal incidence curve of adult of Rhipicephalus punctatus in Zambia on cattle.

Fig. 22. The seasonal incidence curve of adut of *Rhipicephalus punctatus* in Zambia on cattle.

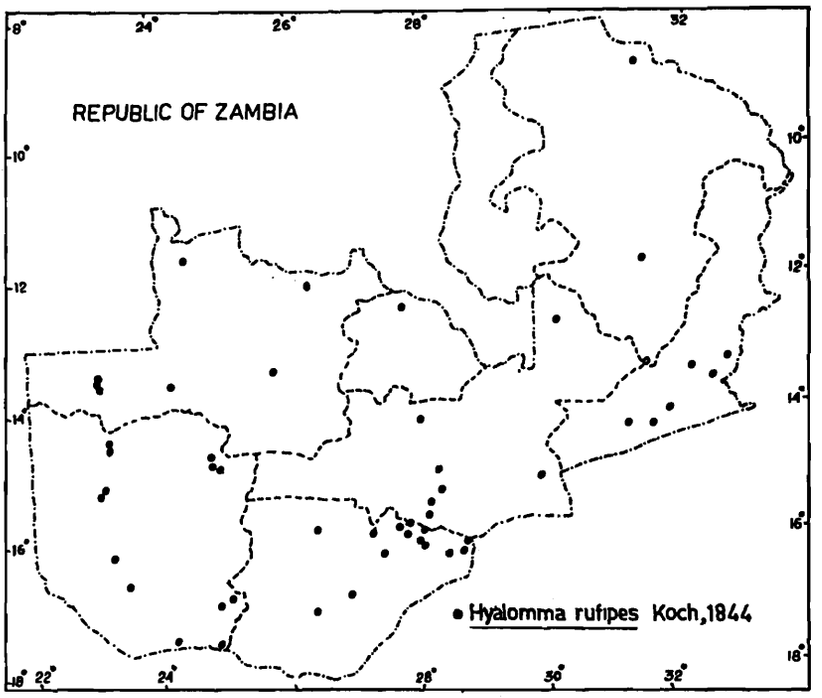

Fig. 23. Distribution of Hyalomma rufipes in Zambia.

Fig. 23. Distribution of *Hyalomma rufipes* in Zambia.

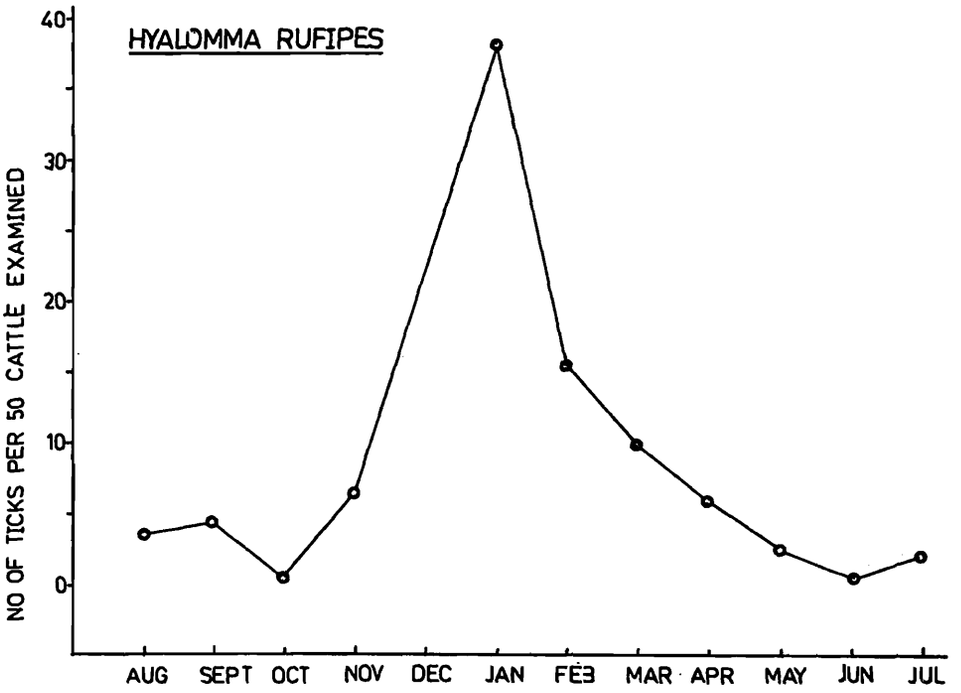

Fig. 24. The seasonal incidence curve of adult of Hyalomma rufipes in Zambia on cattle.

Fig. 24. The seasonal incidence curve of adut of *Hyalomma rufipes* in Zambia on cattle.

Rhipicephalus sanguineus

Distribution : *Rhipicephalus sanguineus* is fairly well distributed in the country (Fig.19). It has been found in most of the physiographic zones from the faulted river valleys to highlands in the north eastern plateau region. It ranges in altitude from about 300 m to 1800 m. It seems to be more common between altitude 900 m to 1200 m. It appeared very rarely in collection from Barotse plains.

Seasonal Activity : The adults of *R. sanguineus* are active initially on stock about the beginning of hot and humid moniths and the population gradually decline with the onset of rains and remains at very low ebb almost throughout the rainy season. The population reaches peak in April at the beginning of cold-dry season and then there is a sudden decline throughout the cold-dry season (Fig.20). This pattern suggests that probably there is more than one generation per annum.

Disease Relationship : *Rhipicephalus sanguineus* is a cosmopolitan species and serves as a principal vector of Boutonneuse Fever, "Indian Tick Typhus" caused by *Rickettsia conori*. It is also a vector of Rocky-Mountain spotted fever in warmer north of America.

Rhipicephalus punctatus

Distribution : *R. punctatus* is widely distributed in the country (Fig.21). It is mainly confined on main plateau region on either side of Congo-Zambezi water-shed; on eastern plateau in Eastern Province and faulted valleys of lower Zambezi ranging in altitude from 300 m to 1800 m. It is very rare in Barotse plain and have been collected so far towards the border of Kalahari sands in Sesheke plains at an altitude of about 600 m. It has also been found in lake basin area of Lake Tanganyika.

Seasonal Activity : The adults of *R. punctatus* are active initially with the onset of rains, and the population rise steadily through the rainy season and reaches its peak in April towards the end of rainy season, there after declining sharply in May and remaining at low level till the next season (Fig. 22). The activity pattern suggests one generation of this species per annum.

Disease Relationship : These have not been studied.

Hyalomma rufipes

Distribution : *Hyalomma rufipes* is fairly well distributed in Zambia except in Luapula Province where it has not yet been found. This tick occurs throughout the central plateau, broken hill country, lesser eastern plateau, kafue flats and Kalahari region (Fig. 23). It is essentially a tick of the central plateau and medium altitude.

Seasonal Activity *Hyalomma rufipes* occurred in substantial numbers throughout the rainy season and in lower number throughout the cool and hot months (Fig. 24). The single peak activity of this tick shows that it passes through one generation per annum in contrast to *H. truncatum* in which infestation occurs in two waves.

Disease Relationship : These have not been studied but the close association of this tick with vector species during rainy season calls for investigations.

DISCUSSION

The life-cycles of an Ixodid tick may be either uninterrupted or co-ordinated with seasonal climatic changes (Balashov, 1968). The life-cycle of ixodid species found in the present study fall into two broad categories. The one-host tick *B. decoloratus* and *B. microplus* and the two host tick *R. evertsi* passes through more than two generations per annum. The two host-tick *Hyalomma truncatum* apparently passes through more than one generation. The other two host-tick *H. rufipes*, appears to have a seasonally regulated life-cycle and passes through only one generation per annum. The same is true with three-host ticks *R. appendiculatus*, *R. compositus*, *R. punctatus*, *R. simus*, *R. tricuspis* and *A. variegatum*. The minimum duration of the life-cycle usually increases from one to three-host ticks, as a result of the increased part of the life-cycle spent off the host (non-parasitic phase). The advantage of the short duration, uninterrupted-one and two host-life-cycles is that populations are able to build up rapidly under favourable conditions. A disadvantage is that under adverse, dry season conditions mortality in the dessication sensitive egg and unfed larval stages is likely to be high. Multi-host ticks which pass through only one generation per annum are able to over-come the high egg and larval mortality by ensuring that these stages are present in the environment when conditions are most suitable for their survival. The adult activity of Ixodid ticks is regulated in some cases by day length while in others temperature, rainfall and high humidity in others. In number of species probably the adults and nymphs are able to pass unfavourable period by diapause or quiscence. The period of quiescence undoubtedly plays an important role in many tick-cycles, in allowing both survival under adverse conditions and seasonal regulation of the life-cycle. The ticks do seek residence on host during the hot and dry period in order to survive on cattle to produce the next generation.

This would then be a most suitable strategic period to control tick population in pastures and on animals.

SUMMARY

Thirty species of Ixodid ticks were found on cattle of which 12 are most common and are known as cattle ticks and are cause of concern to domestic live stock industry in Zambia. The *Seasonal Activity* of the adults of 12 Ixodid tick species was studied on cattle herds in the country with notes on their *Distribution* and *Disease Relationships*. Species studied were *Boophilus microplus*, *Boophilus decoloratus*, *Amblyomma variegatum*, *Rhipicephalus appendiculatus*, *Rhipicephalus evertsi evertsi*, *Rhipicephalus compositus*, *Rhipicephalus tricuspis*, *Hyalomma truncatum*, *Rhipicephalus simus*, *Rhipicephalus sanguineus*, *Rhipicephalus punctatus*, *Hyalomma rufipes*. It has been observed that ticks do seek residence on host during the hot and dry period in order to

survive on cattle to produce the next generation. This would then be a most suitable period to control tick population in pastures and on animals.

ACKNOWLEDGEMENTS

I am thankful to Dr. S.M. Silangwa, Secretary General, National Council for Scientific Research, Lusaka, Zambia, for encouragement and facilities during the course of this work. The final draft of the paper has been prepared at Zoological Survey of India, Calcutta, and I am grateful to Dr. B.S. Lamba, Joint Director-in-Charge, Zoological Survey of India, for facilities and encouragements. Thanks are also due to Dr.S.K.Bhattacharya, Deputy Director, Zoological Survey of India, for useful suggestions. I am also thankful to Mr. M. Seemani and M. Chilapatisha of Livestock and Pest Research Centre, NCSR, Chilanga for technical assistance during the course of this work.

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AMPHIBIANS FROM SABARIGIRI FOREST, WESTERN GHATS, KERALA, INCLUDING A NEW SPECIES OF *MICRIXALUS*

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INTRODUCTION

The Amphibia reported in this paper were collected during the course of two field survey trips to Sabarigiri with the primary objective of comparing its faunal wealth with that of Silent Valley where faunal studies were made to assess the possible impacts of the proposed hydel project. The first one was from 23.4.1981 to 10.5.1981. The second survey was from 7th to 12th December 1981 when the senior author accompanied Dr. Madhav Gadgil and other scientists who were deputed to assess the extent of well preserved natural vegetation in the Peermede plateau. Some material of Amphibia was collected during the overnight trek from Pamba Reservoir to Thannikudy in the Periyar Tiger Reserve.

In all 265 examples of Amphibia belonging to 4 families, 7 genera and 14 species were collected out of which one species of *Micrixalus* turned out to belong to a new taxon. This is being named in honour of Dr. Gadgil.

No systematic account is available in literature on the Amphibia of Sabarigiri where a hydel project has been commissioned about one and a half decades ago. Neither has any serious study been undertaken to assess the impact of the hydel project on this forest ecosystem.

The authors are thankful to the Director, Zoological Survey of India, Calcutta for all the facilities and to Dr. Gadgil for inviting the senior author to participate in the field work including the exciting footmarch from Pamba to Thannikudy.

LIST OF AMPHIBIANS FROM SABARIGIRI

The following orders, families, genera and species are represented in the material studied.

Class AMPHIBIA

Order SALIENTIA

Family RANIDAE

Genus (1) ***Rana*** Linnaeus

1. *Rana limnocharis* Boie
2. *Rana keralensis* Dubois

3. *Rana beddomii* Gunther
4. *Rana diplosticta* (Gunther)
5. *Rana temporalis* Gunther
6. *Rana curtipes* Jerdon

Genus (2) ***Micrixalus*** Boulenger

7. *Micrixalus fuscus* Boulenger
8. *Micrixalus gadgili* sp. nov.

Genus (3) ***Nyctibatrachus*** Boulenger

9. *Nyctibatrachus major* Boulenger

Genus (4) ***Nannobatrachus*** Boulenger

10. *Nannobatrachus beddomii* Boulenger

Family BUFONIDAE
Genus (5) ***Bufo*** Laurenti

11. *Bufo melanostictus* Schneider
12. *Bufo parietalis* Boulenger

Family RHACOPHORIDAE
Genus (6) ***Philautus*** Gistel

13. *Philautus nasutus* (Gunther)

Order GYMNOPHIONA
Family ICHTHYOPHIDAE
Genus (7) ***Ichthyophis*** Fitzinger

14. *Ichthyophis tricolor* Annandale

SYSTEMATIC ACCOUNT

1. *Rana limnocharis* Boie 1835

1920. *Rana limnocharis*: Boulenger, *Rec.Indian Mus*:28
1923. *Rana limnocharis*:V.Kampen, *Amph.Indo-Austr.Arch*:167

Twenty five specimens ranging from 12 mm to 36 mm in head and body, collected from five localities in and around Pamba are available.

Although agreeing with the description of this species, the following notes are offered. Tibio-tarsal articulation exceeds eye and in some almost touches tip of snout. Tibia is as long as or slightly shorter than foot. In one-third of the examples, dorsum presents three reddish spots. Coupled with the small size of the specimens it is

tempting to include them under the variety *syhadrensis* proposed by Annandale (1919) to those individuals from comparatively high altitutdes of the Himalaya, Burma and Western Ghats. However, no differences with reference to dorsal warts or webbing or in the comparative lengths of the first and second fingers are discernible.

2. ***Rana keralensis*** Dubois 1980

1920. *Rana verrucosa*:Boulenger, *Rec.Indian Mus*: 26.

A total of 72 juveniles and adults collected from five localities at Moozhiar are available. The largest of these measure 65 mm from vent to snout. However, most of them fall under the 15-25 mm range.

They seem to prefer rainwater or other stagnant pools in grassy areas. Some were taken from grassy banks of streams.

3. ***Rana beddomii*** Gunther 1875

1920. *Rana beddomii*: Boulenger, *Rec. Indian Mus*: 114.

Seven localities both from Pamba and Moozhiar have yielded 20 adults and 2 juveniles. The largest example measures 33 mm in head and body; the smallest is 21 mm. In characters and colouration they agree well with published accounts. Some males exhibit well developed nuptial pads on the first finger.

4. ***Rana diplosticta*** (Gunther 1875)

1882. *Rana diplosticta* : Boulenger, *Cat. Batr.Sal.Brit.Mus* : 58.

1920. *Rana diplosticta* : Boulenger, *Rec. Indian Mus*: 120.

To this species we assign a single stout example measuring 27 mm in head and body. The tympanum is only moderately distinct. The characteristic black spot above the loin is very clear.

Dorsum greyish, snout not lighter. A broad temporal streak extending forwards as canthal streak right upto the tip of snout. Base of arms with a clear, long black stripe. Limbs barred, lower side of foot darker. Belly and lower parts of limbs white.

5. ***Rana temporalis*** Gunther 1864

1920. *Rana temporalis*:Boulenger, *Rec.Indian Mus*: 159.

64 adults and five juveniles belonging to this species were collected from eight localities from both Pamba and Moozhiar. They were more common along the banks of rocky streams in Pamba. Although the largest example measures 80 mm in head and body, about half of them belongs to 12 to 25 mm range.

Yellowish brown above with small dark or grey spots in between the dorso-lateral glandular folds. Ventrally white, throat and chest mottled with brown.

6. ***Rana curtipes*** Jerdon 1853

1920. *Rana curtipes*: Boulenger, *Rec. Indian Mus*: 131.

A single example of this frog was taken during the trek from Pamba to Thannikudy on 11.12.1981 from a spot about 8 km from Pamba. Measuring 59 mm dfrom tip of snot to vent, it agrees well with the descriptions in literature. An outer metatarsal tubercle, however, is present for this species although Boulenger (1920) states that it is absent.

7. ***Micrixalus fuscus*** (Boul. 1882)

1882. *Ixalus fuscus*: Boulenger, *Cat. Batr.Sal.Brit.Mus*: 96.

1890. *Micrixalus fuscus*: Boulenger, *Fauna Brit.India* 466.

Thirty adults, six juveniles and a few tadpoles were collected from 11 localities both from Pamba and Moozhiar, the size ranging from 12 to 28 mm. The tail, in tadpoles is $1^1/_2$ times longer than body.

8. ***Micrixalus gadgili*** sp. nov.

Material : The material consists totally of six examples, two from Pamba and four from Moozhiar forests of Sabarigiri. One of them is a male.

Diagnosis : Small frogs with tympanum fairly distinct, dorsolateral glandular folds and lingual papilla absent, digits with small discs bearing circum-marginal groove, feet sparsely webbed and both inner and outer metatarsal tubercles present.

Description : *Head*: Not depressed, about as broad as long, width at angle of jaws equal to distance to tip of snout. Snout subacuminate, as long as diameter of eye, protruding beyond mouth. Canthus rostralis rounded, lores almost vertical, slightly concave, nostril lateral, half way between eye and tip of snout. Interorbital space half times broader than upper eyelid. Tympanum small, its rim fairly distinct through the enveloping skin, its diameter half that of eye. Pupil horizontally oval;vomerines absent, tongue free, bifid, devoid of papilla.

Forelimbs : Short, moderately slender and about half the total length from tip of snout of vent. Fingers free, tips dilated into small discs with circular groove. First finger a little shorter than second which is as long as fourth. Subarticular tubercles prominent.

Hindlimbs : About 1 1/2 times the total length from tip of snout to vent; heels not touching when limbs are folded at right angles to the body; tibio-tarsal articulation of adpressed limb reaching mid-eye. Tibia half of body length, about 3 1/2 to 4 times as long as broad, toes with discs larger than that of fingers, with circum-marginal gooves. Web rudimentary, not extending beyond basal phalanges and without fringes extending to discs. No intercalary ossicles, subarticular tubercles fairly prominent. An elongated inner metatarsal tubercle and a much smaller nodule-like outer metatarsal tubercle present.

Skin : Shagreened above, with a few scattered granules on flank. Dorsolateral glandular folds absent, a weak supratympanic fold.

Colour : Dorsum light greyish to dark with irregular darker markings, occasionally spotted or marbled with lighter hue. A dark band on either side backwards from eye tapering to groin. Originating above this is a short longitudinal band terminating sharply at about the middle of the body. Arms and legs with darker patches and bars dorsally. Throat and breast marbled with sepia in four examples while it is mottled or immaculate in the other two.

The smallest example (15 mm) collected on 6.5.1981 from Moozhiar is a male with nuptial pads on the upper side of first finger. This specimen is palest of the lot.

Measurements See Table

Holotype : An adult female, loc. Dynamite House, Pamba, Sabarigiri, S. India, Alt. 990 metres, coll. R.S. Pillai, 29 April, 1981.

Paratypes : 1) One male, loc. 3 km by road to Moozhiar from I.B.,Sabarigiri, S. India, Alt. 440 metres, coll. R.S. Pillai, 6 May, 1981 2) Three adult females, loc. Vettayar. Sabrigiri, Alt. 520 metres, coll. R.S. Pillai, 9 May, 1981. 3) One adult female, loc. western side of (Eighteen five), Pamba, Sabarigiri, S. India, Alt. 1100 metres, coll. R.S. Pillai, 3 May, 1981.

Field notes : All the specimens were collected from damp litter of the forest floor. They resembled *Microhyla ornata* (Dum. & Bibr.) in their movements and tried to take shelter under decaying leaves to avoid detection. Although many other species of Amphibia were collected from streams nearby, not a single example of *Micrixalus gadgili* was picked up from water. Their rudimentary webs not being of much use in water, the species appears to be terrestrial in habit.

Affinities : A comparison with eight species of Indian and Ceylonese frogs of the genus *Micrixalus*, a key for which was presented by Pillai (1978) and with *Micrixalus thampii* described subsequently by Pillai (1981) from Silent Valley, Kerala, shows that the present species is closely related to *Micrixalus nudis* Pillai known from Wynad, S.India. However, the erection of a new taxon to accommodate the present species has been necessitated in consideration of some stable differences, the most important of which are the much briefer webbing on toes and presence of a distinct outer metatarsal tubercle. A better defined tympanum, a much thinner tibia and colour pattern are the other characters which distinguish *Micrixalus gadgili* from *Micrixalus nudis*. While the presence of a lingual papilla distinguishes *M. saxicola* (Jerdon) and *M. sarasinorum* (Muller) from the present species, the absence of dorsolateral glandular folds in *M gadgili* separates it from the rest of the Indian species viz. *M. opisthorhodus* (Gunther), *M. herrei* Myers, *M. fuscus* (Boul.) *M. sylvaticus* (Boul.) *M. borealis* Annandale and *M. thampii* Pillai.

TABLE I

Body measurements in mm of *Micrixalus gadgili* Pillai & Pattabiraman

	Body parts	Holotype	Paratypes				
		1	2	3	4	5	6
1	Total length (from tip of snout vent)	19	19	19	18.8	19.2	15
2.	Length of head (from tip of snout to angle of jaws)	6	6	6.2	5.9	6	5
3.	Width head (at angle of jaw)	6	6	6.2	5.9	6	5
4.	Length of snout (from tip of snout to anterior corner of eye)	2.6	2.6	2.6	2.6	2.7	2.4
5.	Diameter of eye	2.5	2.5	2.5	2.5	2.5	2.3
6.	Minimum inter-orbital distance	2.1	2.1	2.1	2.1	2.2	1.8
7	Maximum diameter of tympanum	1.2	1.2	1.3	1.3	1.2	1.1
8.	Length of forelimb (upto tip of finger)	12	12	11.5	11.5	12	9.5
9.	Length of hindlimb	29.5	29.5	30	29.3	31	24
10.	Length of Tibia	9.5	9.5	9.5	9.2	9.8	7.5
11.	Width of tibia (Maximum)	2.5	2.8	2.9	2.7	2.5	2.0

9. *Nyctibatrachus major* Boul. 1882

1890. *Nyctibatrachus major*: Boulenger, *Fauna Brit. India* : 468.

1978. *Nyctibatrachus major*: Pillai, *Bull. zool. Surv. Inaia* 135.

Thirty adults and two tailed juveniles have been collected from seven localities mostly from understones in stream beds or from muddy debris in shallow side pools. They agree well with the descriptions of the species available in literature.

10. *Nannobatrachus beddomii* Boul. 1882

1882. *Nannobatrachus beddomii*: Boulenger, *Cat.Batr. Sal.Brit. Mus*: 470.

A single example of this rare frog was collected at a point 12 km from Pamba I.B. towards Thannikudy on 11.12.1981. It measures 15.2 mm from tip of snout to vent.

Pupil rhomboidal although Boulenger (1882) has indicated the vertical condition of the pupil as a generic character to distinguish it from *Nannophrys* which has horizontal pupil. The non-utility of this character has already been pointed out by Rao (1937). Habit stout, head depressed, with indistinct canthus rostralis. Inter-orbital space in our example is broader than upper eyelid. Toes with slight rudiment of web, skin smooth above. Dorsum light brown, variegated with darker colour. An ill-defined lighter band on either side of body and a dark stripe connecting the two eyes. Limbs cross barred. Ventrally whitish.

Nannobatrachus beddomii is a very rare frog endemic to Western Ghats. Subsequent to its description by Boulenger in 1882, Sabarigiri is the second place from where we have collected this species, the first being Silent Valley. Boulenger's material came from Malabar and Tinnevelly hills.

11. *Bufo melanostictus* Schneider 1799

1890. *Bufo melanostictus*: Boulenger, *Fauna Brit. India* 505.
1963. *Bufo melanostictus*: Daniel, *J. Bombay nat. Hist. Soc*: 435.

Two examples measuring 41 mm and 47 mm were collected from the forest floor, one from decaying timber.

12. *Bufo parietalis* Boulenger 1882

1890. *Bufo parietalis*: Boulenger, *Fauna Brit. India* 507.

Two examples measuring 60 mm and 70 mm were collected. The first one was seen resting well exposed on a large boulder by the side of a stream. Lemon-colored and totally inactive, it was collected easily. The bright yellow dorsum had a few brown spots mid-dorsally. Flanks brownish and ventrally white with a few dark dots.

13. *Philautus nasutus* (Gunther 1868)

1882. *Ixalus nasutus*: Boulenger, *Cat. Batr. Sal.Brit.Mus*:100.
1957. *Philautus nasutus*: Kirtisinghe, *Amph.Ceylon*: 73.

A single example measuring 25 mm in total length was collected from within a fallen, decaying stem along with a specimen of *Bufo melanostictus* near the Kakki dam.

Brownish with a raised median vertebral glandular line from tip of snout to vent. The tibio-tarsal articulation in our example reaches only upto the middle of eye. Being a male, the first finger has a basal pad. Throat speckled with brown. This species is known from Southern India and Ceylon.

14. *Ichthyophis tricolor* Annandale 1909

1909. *Ichthyophis glutinosus tricolor*: Annandale, *Rec. Indian Mus*: 286.
1968. *Ichthyophis tricolor*: Taylor, *Caecilians of the World:* 148.

A single example of *Ichthyophis tricolor* measuring 170 mm in length was collected on 9.5.1981 from Vettayar (Moozhiar) at an altitude of 520 metres. The first nuchal groove crosses the throat and passes up on the head but does not reach the mid-dorsal line. The second nuchal groove passing on the side of the neck stops at mouth level. The third groove is clear below but indistinct dorsally. There are about 265 annuli behind these.

Slaty brown with a narrow yellowish lateral stripe from head to tip of tail. A narrow dark stripe borders the lower part of this yellow stripe; a broad whitish ventral stripe.

The specimen was collected from under a rotting piece of wood, far away from the stream.

SUMMARY

The paper deals with the Amphibia of Sabarigiri forest (Western Ghats, Kerala) based on two surveys. 14 species belonging to 4 families and 7 genera are recorded out of which one species, viz. *Micrixalus gadgili* is described as new to science. A single example of the rare frog, *Nannobatrachus beddomii*, originally described by Boulenger in 1882 has been recorded.

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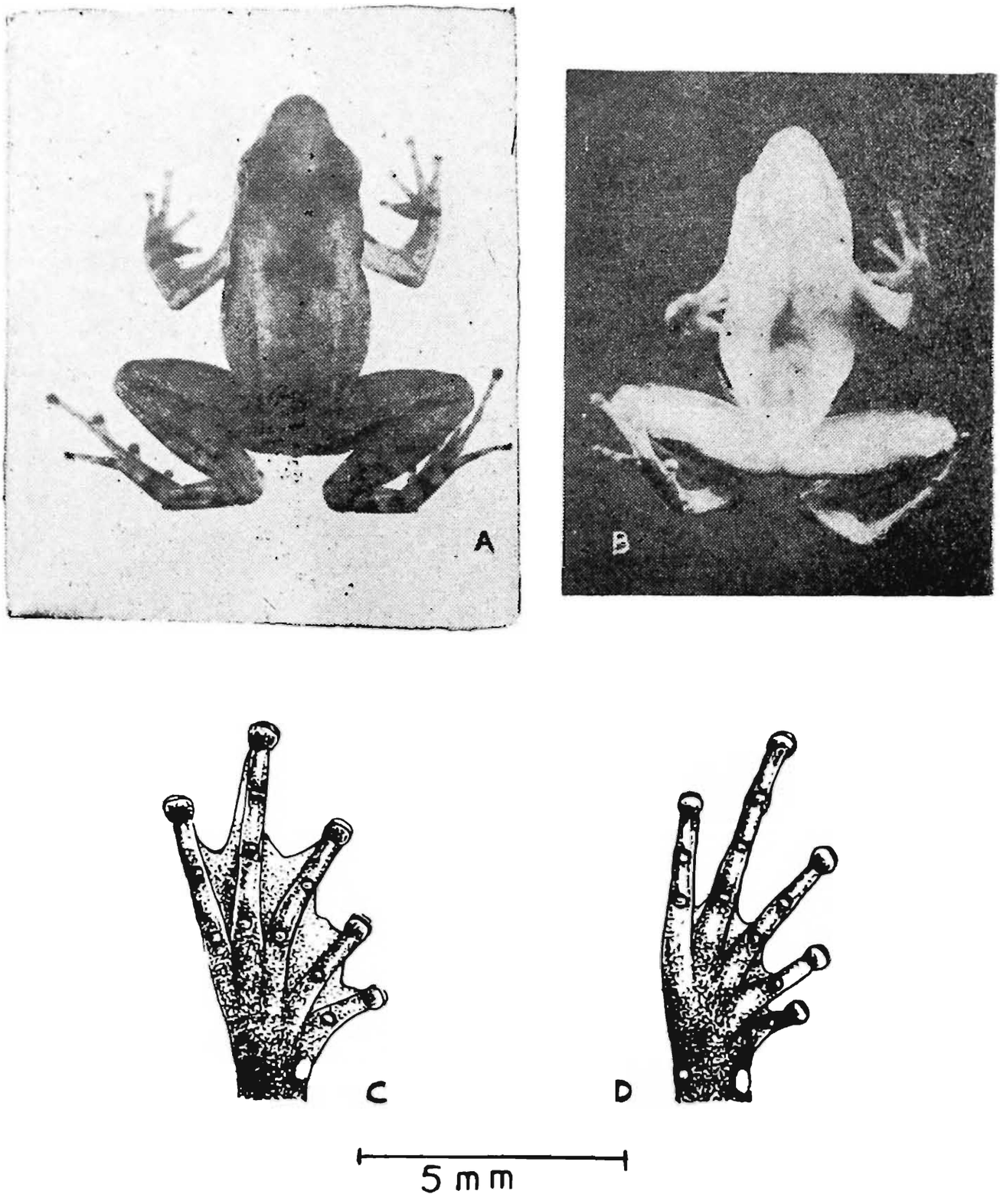

Figs. A, B & D—*Micrixalus gadgili* sp. nov. Male. A. Dorsal view, B. Ventral view, D. Ventral view of foot.

Fig. C. Ventral view of foot of *Micrixalus nudis* Pillai.

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INSECTA : COLEOPTERA : LANGURIIDAE IN WEST BENGAL, INDIA

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INTRODUCTION

Arrow (1925) in Fauna of British India described one hundred and ten species under two sub families – Languriinae and Cladoxeninae of the family Languriidae. Sengupta & Crowson (1971) made several changes in classificatory system of the family Languriidae and transferred a number of genera from the family Cryptophagidae to Languriidae. The present paper deals with the species of the tribe Languriini and Cladoxenini from West Bengal. Arrow (1925) included thirteen species from West Bengal and recently Sengupta and Mukherjee (1977) added one more species *Basulanguria lavanica* Sengupta and Mukherjee from Lava, Darjeeling District of West Bengal. So far known, the chief habitat of Languriidae are bushes and foliages, and mostly occur in the foot hills of Himalaya, Eastern ghat and Nilgiri hills.

SYSTEMATIC ACCOUNT

Class	INSECTA
Order	COLEOPTERA
Superfamily	CUCUJOIDEA
Section	CLAVICORNIA
Family	LANGURIIDAE
Tribe	LANGURIINI (= Languriinae Arrow)

1. *Pachylanguria elongata* (F.)

1801. *Trogosita elongata* F. Syst. Eleuth, **1** : 152.

1925. *Pachylanguria elongata* (F.) : Arrow *Fn. Brit. India, Coleoptera, Clavicornia : Erot., Lang., & Endom.* : 173 74.

Material studied : 1 ex., Rangpu, Darjeeling Dist., 28.v.1974, J. K. Jonathan.

Distribution in West Bengal : Rangpu, Darjeeling Dist., (- Sengupta & Mukherjee, 1979).

Remarks : It can be recognised by its lower surface red, with the terminal segment dark (Arrow, 1925). ZSI reference collection possess eleven examples from different localities in India.

2. ***Petralanguria variiventris*** Kraatz

1899. *Tetralanguria variiventris* Kraatz, *Deutsche Ent. Zeitschr.* : 348.

1925. *Pachylanguria variiventris* Arrow, *Fn. Brit., India, Coleoptera, Clavicornia.: Erot. Lang. & Endom.* : 174 75.

Material studied : 2 exs. Pashok, Darjeeling Dist., 3.vi.1930, S. L. Hora.

Distribution in West Bengal : Nurbong and Pashok, Darjeeling.

Remarks : It can be recognised by its lower surface without entirely red segments (Arrow, 1925). ZSI reference collection possess sixteen exs. collected from different localities in India.

3. ***Pachylanguria collaris*** Crotch

1876. *Pachylanguria collaris* Crotch. *Cist. Ent.* 1 : 377.

1925. *Pachylanguria collaris* Crotch : Arrow, *Fn. Brit. India, Coleoptera, Clavicornia : Erot., Lang., & Endom.* : 178.

Material studied : 17 exs., Mahanuddi valley, Nurbong, Darjeeling Dist., H. Stevens.

Distribution in West Bengal : Mahanuddi valley, Nurbong, Darjeeling dist.

Remarks : It can be recornised by its pronotum strongly transverse not narrowing from base to front margin (Arrow, 1925). ZSI reference collection possess seventeen examples collected from different localities in India.

4. ***Doubledaya viator*** White

1850. *Doubledaya viator* White, *Proc. Ent. Soc. Lond.*, : 13.

1925. *Doubledaya viator* White : Arrow, *Fn, Brit. India, Coleoptera, Clavicornia : Erot. Lang. & Endom.* : 187 88.

Material studied : 13 exs. Nurbong, Darjeeling, H. Stevens.

Distribution in West Bengal : Nurbong, Darjeeling.

Remarks : It can be recognised by its legs being very long, elytra strongly punctured (Arrow, 1925). ZSI reference collection possess thirteen examples collected from different localities in India.

5. ***Doubledaya atripennis*** Arrow

1925. *Doubledaya atripennis* Arrow, *Fn. Brit. India, Coleoptera; Clavicornia : Erot. Lang. & Endom* : 189-90.

Material studied : None represented in the reference collection.

Distribution in West Bengal : Darjeeling.

Remarks : It can be recognised by its elytra and abdomen black (Arrow, 1925). ZSI collection possess none.

6. ***Doubledaya severini*** Fowler

1893. *Doubledaya severini* Fowl. *Ann. Soc. Ent. Belg.* XXXVII : 74.

1925. *Doubledaya severini* Fowl. : *Arrow, Fn. Brit. India, Coleoptera; Clavicornia; Erot. Lang. & Endom.* 190 - 91.

Material studied : 1 ex., Kurseong, P. Braet.

Distribution West Bengal : Kurseong; Nurbong, Mahanadi Valley, Darjeeling.

Remarks : It can be recognised by its elytra being blue & abdomen red (Arrow, 1925). ZSI collection possess one example from Darjeeling in India.

7. ***Doubledaya ustulata*** Arrow

1925. *Doubledaya ustulata* Arrow, *Fn. Birt. India, Coleoptera; Clavicornia : Erot. Lang. & Endom,* : 191 - 92.

Material studied : None represented in the collection.

Distribution in West Bengal : Nurbong, Darjeeling.

Remarks : It can be recognised by its red, with the extremities of the elytra black (Arrow, 1925). ZSI collection possess none.

8. ***Doubledaya ruficollis*** (Kr.)

1899. *Cosmolanguria ruficollis* Kr., *Dautsche Ent. Zeitschr.* : 351.

1925. *Doubledaya ruficollis*, Arrow, *Fn. Brit. India Coleoptera, Clavicornia : Erot. Lang. & Endom.* : 196 - 97.

Material studied : 2 exs., Nurbong, Darjeeling, H. Stevens.

Distribution in West Bengal : Burbong, Darjeeling.

Remarks : It can be recognised by its club of the antennae being 3 - jointed and head dark (Arrow, 1925). ZSI reference collection possess two examples from Darjeeling in India.

9. ***Doubledaya forcipata*** Arrow

1925. *Doubledaya forcipata* Arrow, *Fn. Brit. India. Coleoptera, Clavicornia : Erot. Lang. & Endom.* : 201 - 202.

Material studied : None represented in the reference collection.

Distribution in West Bengal : Darjeeling.

Remarks : It can be recognised by its antennal club being with 4 - jointed (Arrow, 1925). ZSI collection possess none.

10. ***Doubledaya mouhoti*** (Crotch)

1876. *Languriosoma mouhoti, Crotch, Cist.* Ent. I : 379.

1925. *Doubledaya mouhoti* (Crotch) : Arrow, *Fn. Brit. India, Coleoptera, Clavicornia : Erot. Lang. & Endom.* : 202 203.

Material studied : 1 ex., Pedong, Darjeeling, A Dosgodinus.

Distribution in West Bengal : Pedong, Darjeeling.

Remarks : It can be recognised by its red, with the legs & tips of the elytra black (Arrow, 1925). ZSI collection possess one example collected from Pedong in India.

11. *Basulanguria lavanica* Sengupta & Mukherjee

1977. *Basulanguria lavanica* Sengupta & Mukherjee *Orient. Ins.* **11**(1) : 1 - 4.

Material examined : 2 exs., Lava, Darjeeling, J. K. Jonathan.

Distribution in West Bengal : Lava, Darjeeling.

Remarks : It can be recognised by its small size, and slender, somewhat parallel-sided body and 15.00 mm. in length (Sengupta & Mukherjee, 1977). ZSI reference collection possess one Holotype & one Paratype.

12. *Anadastus longior* Arrow

1925. *Anadastus longior* Arrow, *Fn. Brit. India, Coleoptera, Clavicornia : Erot. Lang., & Endom.* : 214.

Material studied : None represented in the collection.

Distribution in West Bengal : Gopaldhara, Darjeeling.

Remarks : It can be recognised by its abdominal lines being divergent (Arrow, 1925). ZSI collection possess none.

13. *Anadastus bifasciatus* (Motsch.)

1860. *Languria bifasciata* Motsch, *Schrent's Reisen im Amrul.* II : 241.

1925. *Anadastus bifasciatus*, Arrow : *Fn. Brit. India, Coeloptera, Clavicornia, Erot., Lang., & Endom.* : 230 - 31.

Material studied : 2 exs., Suravisthan, Badkulla, 10 kms. away from Krishnagar, Nadia, on grass, 14.3.1982, D. N. Biswas.

Distribution in West Bengal : Bengal : Barway (Pere Cardon) – Arrow 1925, now in Bihar. But author recorded two examples from Suravisthan, Badkulla, Krishnagar in Nadia in West Bengal (Mukherjee & Biswas, in press).

Remarks : It can be recognised by its head being black & elytra not truncate (-Arrow, 1925). ZSI collection possess two examples from Badkulla in West Bengal in India.

14. *Caenolanguria birmanica* (Har.)

1879. *Languria birmanica* Har., *Mitth. Munch. Ent. ver.* III : 74.

1925. *Caenolanguria birmanica*, Arrow : *Fn. Brit. India. Coleoptera, Clavicornia : Erot. Lang. & Endom.* : 241 42.

Material studied : 4 exs., Gopaldhara, Darjeeling, 4720 ft., H. Stevens.

Distribution in West Bengal : Gopaldhara, Darjeeling.

Remarks : It can be recognised by its elytra being brown, with legs closely punctured lines (Arrow, 1925). ZSI collection possess four examples collected from Darjeeling in India.

Tribe ***Cladoxenini*** Sengupta & Crowson (= Cladoxininae, Arrow)

15. ***Bolerus lateralis*** (Arrow)

1925. *Thellisellodes lateralis* Arrow, *Fn. Brit. India, Coleoptera, Clavicornia : Erot. Lang. & Endom.* : 247 - 58.

1968. *Bolerus ateralis*, (Arrow) : Sengupta, *J. nat. Hist.*, **2** : 463 - 475.

Material studied : None represented in collection.

Distribution in West Bengal : Gopaldhara, Darjeeling.

Remarks : It can be recognised by its body being very narrow, pronotum scarcely transverse (Arrow, 1925). ZSI collection possess none.

SUMMARY

The paper deals with the fifteen species of Languriidae from West Bengal.

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SHORT COMMUNICATIONS

RECENT RECORD OF THE ROCK GECKO, *HEMIDACTYLUS MACULATUS* DUMERIL AND BIBRON (REPTILIA : GEKKONIDAE), FROM LONAVALA, PUNE.

Recently we had the opportunity to pick up a large gekkonid lizard, slightly injured by a vehicle, on Tungarli road, Lonavala, on 21 September 1986. The lizard was found in a moribund state. At the time of capture, the yellowish-orange and yellowish-brown bands, with rows of dark spots on the back and tail were conspicuous. The underside was dirty white in colour. The digits, dilated at the base, the divided subdigital lamellae, and the clawed toes place the gecko in the genus *Hemidactylus*. Detailed observations of the gecko revealed following morphological characters :

Sex	Male
Total length	236 mm
Snout-vent length	104 mm
Tail	132 mm
Eye to eye	12 mm
Ext. nare to eye	10 mm
Eye to ear	9 mm
Eye diameter	8.5 mm
Ear opening(oval)	5 mm
Lamellae under inner toe	9
Lamellae under 4 th toe	11
Femoral pores on each side of the thigh	19

DESCRIPTION

Head large with convex small scales on the snout; hinder part of the head with tubercles along with small granular scales. Upper labials 12 and 10 lower labials. Entire back covered with about 22 longitudinal rows of large, trihedral tubercles intermixed with small juxtaposed scales. Belly covered with small imbricate scales. Digits free and dilated at the base, with divided, perfectly straight, transverse lamellae. Tail oval in section, depressed, with 6 longitudinal rows of large keeled tubercles and with alternate broad orange and yellowish-brown bands with dark lining (see Figs. 1-4).

On the basis of the above characters the lizard was determined as *Hemidactylus maculatus* following the key by Smith (1935 : 83). As far as the colour is concerned,

soon after death and now in preserved state (in alcohol), the lizard appears uniformly grey with dark spots, matching the description given by Daniel (1983). This species was recently reported from Pune and Bombay area by Murthy (1985) and prior to that by Tiwari and Sharma (1970).

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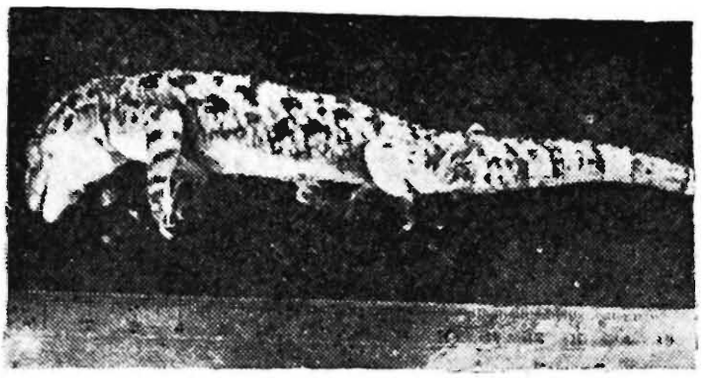

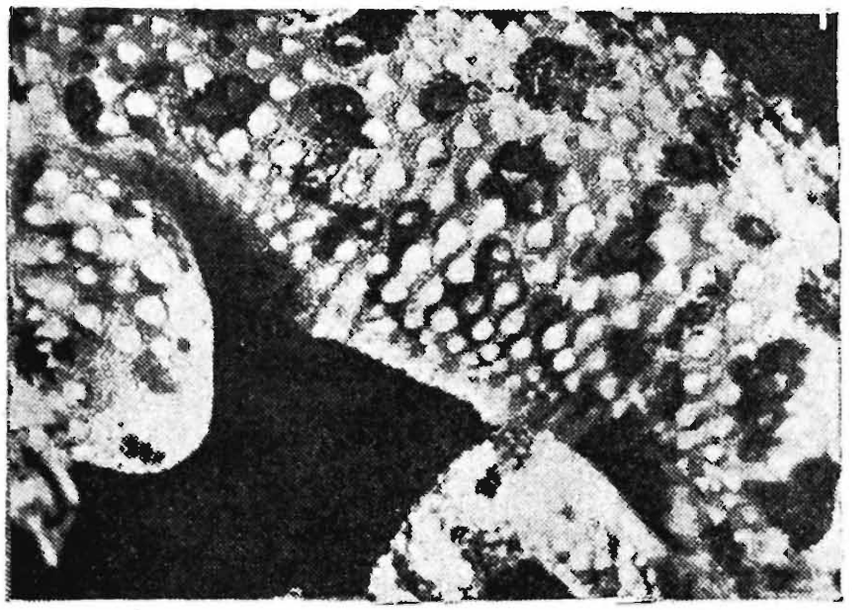

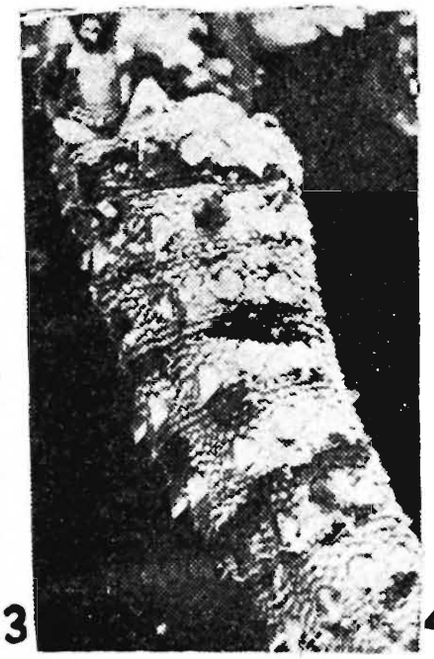

Fig. 1. *Hemidactylus maculatus* lateral view ; Fig. 2. Dorsolateral view of the lizard showing large trihedral tubercles. Fig. 3. Ventral view of the toe showing straight, divided subdigital lamellae and well developed claws ; Fig. 4. Dorsal view of the part of the tail. Note 6 rows of large tubercles.

Rec. zool. Surv. India, 86(2) : 399-403, 1990

SHORT COMMUNICATIONS

NEW RECORDS OF LEPIDOPTERA FROM ARUNACHAL PRADESH, INDIA

The present communication is based on the study of material collected from Arunachal Pradesh by Mr. C. B. Prasad, Museum and Taxidermy section of Zoological Suvey of India, Calcutta. As a result of this study 15 species in 15 genera and nine families belonging to suborder Heterocera have been recorded for the first time from Arunachal Pradesh.

Betts (1950), Mandal & Ghosh (1967), Varshney & Chanda (1971), Arora & Chaudhury (1976), Gupta & Shukla (1977a,b), Arora & Mandal (1981), Arora & Chaudhury (1980, 1982) and Bhattacharya (1985) have reported earlier a large number of species of butterflies and moths from Arunachal Pradesh. With new locality records reported in this note, the distribution of the included species has been extended.

Family SATURNIIDAE

1. *Actias selene* (Hübner)

Material examined : 1 ♂, Arunachal Pradesh, Indira Park, 24.iv.1987. Wing expanse: 93 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Assam, Manipur, Meghalaya, Bihar, West Bengal, Orissa, Tamil nadu, Karnataka, Maharashtra, Uttar Pradesh, Himachal Pradesh and Andamans); Nepal; Bhutan; Burma; Bangladesh; Sri Lanka; Borneo; Tibet; USSR; and Japan.

Remark : The wing expanse of the examined material is much shorter than hitherto recorded (132 - 166 mm.).

Family SPHINGIDAE

2. *Acherontia lachesis* (Fabricius)

Material examined : 1 ♀, Arunachal Pradesh, Rajbhawan, 26.iv.1987. Wing expanse : 118 mm.

Distribution : India (Sikkim, Arunachal pradesh, Assam, Meghalaya, West Bengal, Orissa, Maharashtra and Andaman Islands); Bangladesh; Sri Lanka; Java; and Hongkong.

3. *Theretra nessus* (Drury)

Material examined : 1 ♀, Arunachal Pradesh, Chief Minister's Bungalow, 27.iv.1987. Wing expanse : 115 mm.

Distribution : 1 ♀, India (Sikkim, Arunachal Pradesh, Assam, Meghalaya, Karnataka and Maharashtra); Bangladesh; Pakistan; Sri Lanka; Java; and Hongkong.

4. ***Rhyncoloba acteus*** (Cramer)

Material examined : 1 ♀, Arunachal Pradesh; Chief Minister's Bungalow, 29.iv.1987. Wing expanse : 72 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Assam, West Bengal, Maharashtra, Himachal Pradesh (Kulu), and Andaman Islands); Sri Lanka; Burma; Borneo and Java.

Family ZYGAENIDAE

5. ***Heterusia magnifica*** (Butler)

Material examined : 1 ♂, Arunachal Pradesh, Chief Minister's Bungalow, 27.iv.1987. Wing expanse : 55mm.

Distribution : India (Sikkim, Arunachal Pradesh, Assam and Meghalaya) and Bangladesh.

Family COSSIDAE

6. ***Xyleutes persona*** (Le Guillou)

Material examined : 1 ♂, Arunachal Pradesh, Chief Minister's Bungalow, 27.iv.1987. Wing expanse : 128 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Nagaland, West Bengal, Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir and South India). Bangladesh; Burma; Sri Lanka; Indonesia and China.

Family LYMANTRIIDAE

7. ***Numenes siletti*** Walker

Material examined : 1 ♂, Arunachal Pradesh, Chief Minister's Bungalow, 27.iv.1987. Wing expanse : 52 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Assam and Meghalaya) and Burma.

8. ***Imaus mundus*** (Walker)

Material examined : 1 ♀, Arunachal Pradesh, Rajbhawan, 24.iv.1987. Wing expanse : 72 mm.

Distribution : India (West Bengal, Assam and Arunachal Pradesh); Bhutan; Bangladesh and Java.

Family HYPSIDAE

9. ***Hypsa complana*** Walker

Material examined : 1 ♀, Arunachal Pradesh, Chief Minister's Bungalow, 29.iv.1987. Wing expanse : 63 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Assam, Orissa and Nilgiris); Sri Lanka; Burma; Singapore; Timor.

Remarks : The wing expanse is smaller than recorded earlier (74 mm.).

Family ARCTIIDAE

10. ***Chionaema bellissima*** (Moore)

Material examined : 1 ♂, Arunachal Pradesh, Chief Minister's Bungalow, 27.iv.1987. Wing expanse : 48 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Uttar Pradesh (Mussooree) and North-West Himalayas) and Burma.

Family AGARISTIDAE

11. ***Eusemia adulatrix*** Kollar

Material examined : 1 ♀, Arunachal Pradesh, Indira Park, 24.vi.1987. Wing expanse : 65 mm.

Distribution Throughout India and Burma.

Family NOCTUIDAE

12. ***Apsarasa radians*** (Westwood)

Material examined : 1 ♂, Arunachal Pradesh, Chief Minister's Bungalow, 28.iv.1987. Wing expanse : 44 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Assam and Andaman Islands).

13. ***Phyllodes eyndhovii*** Voll.

Material examined : 1 ♂, Arunachal Pradesh, Chief Minister's Bungalow, 28.iv.1987. Wing expanse : 112 mm.

Distribution : India (Sikkim, Arunachal Pradesh and Assam) and Borneo.

Remarks : The wing expanse of the material examined is much shorter than the earlier recorded (136 mm.).

14. ***Maenas salaminia*** (Fabricius)

Material examined : 1 ♂, Arunachal Pradesh, Chief Minister's Bungalow, 28.iv.1987. Wing expanse : 86 mm.

Distribution : India (Sikkim, Arunachal Pradesh, Assam, Meghalaya and Nicobar Is.); Bangladesh; Singapore; China; Taiwan; Java; Australia and Japan.

Family URANIIDAE

15. ***Nyctelemon patroclus*** (Linnaeus)

Material examined : 1 ♀, Arunachal Pradesh, Rajbhawan, 24.iv.1987. Wing expanse : 112 mm.

Distribution : India (Arunachal Pradesh and Andamans); Bangladesh; Burma; China; the Philippines; Malaya and Burma.

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SHORT COMMUNICATIONS

FURTHER RECORDS OF MASKED BOOBY *SULA DACTYLATRA MELANOPS* HEUGLIN (PELICANIFORMES : SULIDAE) FROM KERALA

There have been occasional reports of encountering the sea bird Masked Booby *Sula dactylatra melanops* Heuglin along the Western seaboard of India, pakistan and also in the adjacent islands of Sri Lanka (Ali and Ripley, 1983) and Maldives (Phillips, 1947). Masked booby is a pelagic bird normally ranging in the south-western Indian Ocean, and having its easterly distributional limit in the seas off Sind and Makran(Baluchistan) coasts. Birds reported from India and elsewhere outside the normal range are believed to be stray individuals which have been carried away by monsoon gales and winds. Among such records of masked booby occurrences in the west cost of India, the only record so far from the Kerala coast is that of one from Cannanore mentioned by Ali and Ripley (1983). However, these authors have not given the specific reference of the published report of this record, and a literature search for it falied to find any.

Being so, it is of interest to report that two masked booby birds were caught recently from near Calicut, one in the last week of July and the other in the middle of August, 1987. The former was caught at sea about 10 km offshore from Kadalundi river estuary and the latter from inland at Beypore, ca 5 km from sea shore. The one that was caught the first time landed on a mechanised boat engaged in fishing in the open sea and behaved very tamely. The second bird captured inland also did not offer any resistance when caught. Infact, boobies are said to lack any sense of fear of man and they not only fly alongside ships to catch fish which shoot up from the wake of the ships, but also land on the vessels and sit quietly, lending themselves to be grabbed by the sailors (Adley, 1979). The first bird was released back into the sea, and the other whose flight muscles were slightly injured was kept for a few days at the Western Ghat Regional Station of Zoological Survey of India and later sent to Trichur Zoological Gardens. So far as is known, this is the southernmost record of occurrence of this species in the Indian mainland.

The bird in captivity consumed large amount of fish. In the fist few days about a kilogram of fish per day was eaten, but obviously it could do with more. Sardines and similar fishes of even about 15 cm in length were snapped up and swallowed wholly. Like in pelicans and allied species, the great digestive power of the bird for dissolving even the bones was evident in the liquid nature of the excreta which was ejected in a jet-stream to a distance of about half-a-metre behind. In a short time, the bird plasters the floor of the cage with this whitish sticky excreta. It is no wonder that a small island off the coast of Peru is said to be entirely made up of the casting from huge colonies of this bird (Murphy, 1936).

The only sound produced by the bird is similar to that of ducks, but was heard only in context of some alarm. Jackals which either sensed the presence or heard its call used to visit the campus during nights and seeing them the bird called even more.

The first bird was perhaps slightly immature as it had dark-brownish blotches on the back of the neck and on the outer white upper half of the wings, whereas the other one was uniformly whitish on these parts. Bills and legs including the web were blue-grey. Accompanying photograph is that of the second bird observed in captivity and now kept in Trichur Zoological Gardens.

As a postscript it may be added here that subsequent to the preparation to this note and while it was under publication, another masked booby bird was caught at nearly the same area in Beypore during August, 1988.

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