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

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

RECORDS

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Vol. 96(1-4) **1998** **Pages 1—250**

CONTENTS

Rec. zool. Surv. India : **96** (1 – 4) : 1 – 5, 1997

MACRO-BENTHIC FAUNA OF LAKE, HUSSAINSAGAR, HYDERABAD WITH REFERENCE TO MOLLUSCS AND CHIRONOMID LARVAE

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INTRODUCTION

There are as many as 4 major lakes (Osmansagar, Himayatsagar, Miralam tank and Hussainsagar) and a number of minor water bodies in the metropolitan limits of the twin cities (Hyderabad and Secunderabad). All these lakes were initially constructed for drinking water and irrigation. Presently Osmansagar and Himayatsagar (oligotrophic) are the main sources of water supply to the twin cities. Miralam tank and Hussainsagar have become eutrophic because of domestic sewage and industrial effluents.

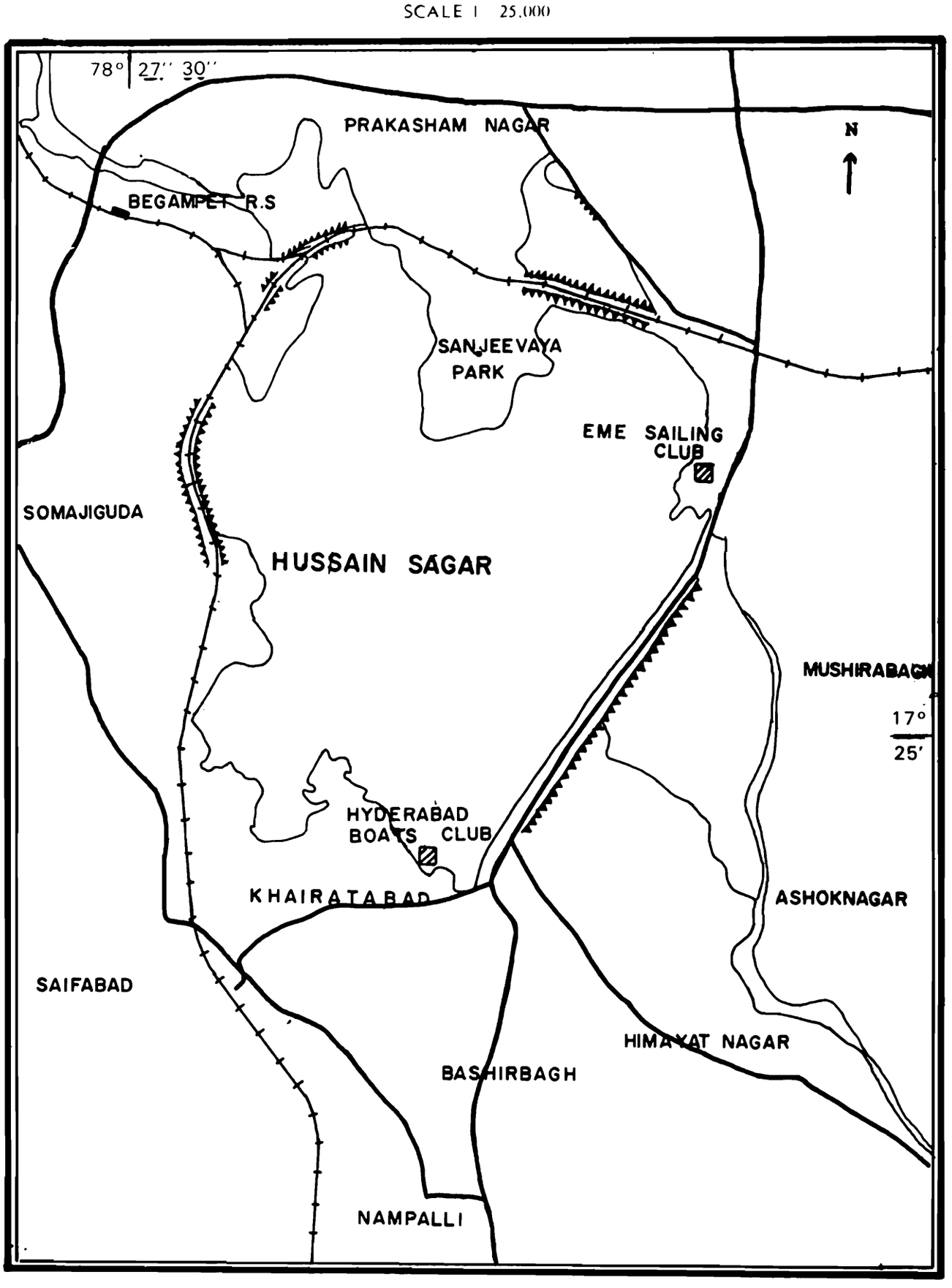
Historically, Butcher (1924) was the first to recognise biological analysis of overall assessment of environment. Hynes (1959, 1960) studied the river pollution using benthic invertebrates as indicators. Patil, S.G. (1984) studied the benthic organisms in lentic and lotic environments. As no attempt was made so far on the benthic fauna of Hussainsagar lake, the author has initiated the study.

Hussainsagar is one of the oldest lakes of 450 hectares, constructed during 1660-70 in the twin cities of Hyderabad and Secunderabad during the regime of Ibrahim Qutub Shah. The lake was initially constructed to store drinking water from Musi river. Since last decade, lot of industrial effluents and domestic sewage from the surroundings are being carried into the lake by Kukatpally stream, which has resulted in eutrophication.

In ecological aspect, Hussainsagar is a habitat not only for fishes but feeding and breeding site for some birds. This lake is an ideal place for water sports. The main feeding channel of this lake is Kukatpally stream which was originated from a tank Parki Cheruvu about 14 km north of Secunderabad — Bombay Highway. Either side of the lake there are about 350 industries of Public and Private sectors (Kodarkar et. al., 1992).

SAMPLING SITES :

HYDERABAD BOAT CLUB (HBC) : This zone is situated towards Hyderabad end of the tank bund where the Budha statue was installed on the rock of Gibraltor. b) KHAIRATABAD COLONY (KBC) : This is situated between Begumpet and Hyderabad Boat Club and here domestic sewage from the surrounding colonies and a lot of silt, paint, plastic, organics and others are entering through the immersion of Ganesh idols every year. c) BEGUMPET RAILWAY LINE



Map of Hussainsagar

Table Showing the Ranges of Physico-Chemical Parameters of the Lake at the Time of Collection

S.No.	Parameter	HBC	KBC	BRL	SJP	EME
1.	Temperature (Air) (°C)	25 – 35	25 – 35	25 – 36	25 – 35	26 – 35
2.	Temperature (Water) (°C)	24 – 30	24 – 30	25 – 29	25 – 30	24 – 31
3.	pH	7.6 – 8.7	7.5 – 8.6	7.4 – 8.2	7.5 – 8.2	8.1 – 8.3
4.	Conductivity (mho's/cm)	1628 – 2250	1639 – 2160	1259 – 2190	1289 – 2210	1623 – 2170
5.	Dissolved Oxygen (DO) (mg/lit)	1.0 – 8.4	2.0 – 8.0	0 – 4.0	0 – 8.8	1.2 – 7.0
6.	Carbonates "	Nil	Nil	Nil	Nil	Nil
7.	Bicarbonates "	336 – 476	336 – 445	305 – 439	311 – 445	229 – 427
8.	Free Carbondioxide "	12 – 14	16 – 18	16 – 18	18 – 20	18 – 20
9.	Chloride "	275 – 348	267 – 348	225 – 370	230 – 395	227 – 338
10.	Total Hardness "	190 – 565	185 – 410	210 – 350	205 – 310	195 – 310
11.	Calcium "	26 – 76	20 – 58	26 – 50	20 – 72	28 – 64
12.	Magnesium "	19.5 – 91	23 – 67	22 – 60	22 – 63	22 – 44

(BRL) This is situtated in the North-eastern direction of the lake, receiving water from Kukatpally stream is the main feeding channel. d) SANJIVAYYA PARK (SJP) : This zone is situated at the end of the lake towards Secunderabad this area of the lake is polluted because of washing activities. e) EME SAILING CLUB (EME) : This zone is situtated at Secunderabad end of Tank bund and is characterised by sports activities.

MATERIALS AND METHODS

About 2 kgs of bottom mud samples were collected with Ekman grab from the lakes transferred to polythene bags. Water samples were also collected alongwith these mud samples. The mud samples were brought to the laboratory and sieved with 500 microns I.S.S. Test sieves. The macro-fauna were collected from the sieves with forceps and brushes and preserved in formalin. The Dissolved Oxygen (DO) water samples were winklerized on the bank of the lake itself and water samples were brought to the laboratory for the rest of analysis. Identification of macro-benthic fauna was done with the help of standard manuals. The above collections were made between August, 1991 to June, 1993.

RESULTS AND DISCUSSION

The Following macro-benthic fauna was observed from the collections made during the study. Chironomid larvae and 6 species of Molluscs were found, details of which are given below.

Phylum : ARTHROPODA
Class : INSECTA
Order : DIPTERA
Family : TENDIPIDAE

1. *Tendepis* sp.

Phylum : MOLLUSCA
Class : GASTROPODA
Order : MESOGASTROPODA
Family : VIVIPARIDAE

2. *Bellamya bengalensis* (Lamarck)

Family : PILIDAE

3. *Pila virens* (Lamarck)

Family : THIARIDAE

4. *Thiara* (*Thiara*) *scabra* (Muller)

5. *Thiara* (*Thiara*) lineata (Gray)

Family : LYMNAEDAE

6. *Lymnaea* (*Pseudosuccinea*) *acuminata Lamarck*

Family PLANORBIDAE

7. *Indoplanorbis exustus* (Deshayes)

Chironomid larvae were found more during the monsoon season and less in summer. Among the 6 species of Molluscs found, *Pila virens* has predominated followed by *Thira* (*Thiara*) *scabra*, *Bellamya bengalensis* and *Indoplanorbis exustus*. Poor diversity was noticed in Post-Monsoon (3 species), but more and equal diversity (5 species) was seen in Pre-monsoon and Monsoons. *Pila virens* has shown its presence in all the seasons, but it was rich in Monsoon and poor in Post-Monsoon *Thiara* (*Thiara*) *lineata* and *Lymnaea* (*Pseudosuccinea*) *acuminata* has got its representations only.

The ranges of physico-chemical parameters of the lake at the time of collection are as in the table.

SUMMARY

A brief study on Macro-Benthic Fauna was undertaken on Hussainsagar, an eutrophic lake in Hyderabad during 1991-93. In all the 5 spots studied, Chironomid larvae and 6 species of Molluscs were observed. Water quality of the lake at the time of collection was also studied.

ACKNOWLEDGEMENTS

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SOME NEW RECORDS OF BATS FROM MIZORAM, INDIA

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INTRODUCTION

Faunistic surveys were conducted in Mizoram, specially for mammals during December, 1993 - January, 1994 and March-May, 1995 by scientists of the Zoological Survey of India. The collections thus obtained contain several species of bats, of which, eight, namely, *Megaerops niphanae* Yenbutra and Felten, *Macroglossus sobrinus sobrinus* Anderson, *Rhinolophus lepidus lepidus* Blyth, *Hipposideros lankadiva* Kelaart, *Hipposideros Cineraceus* Blyth, *Tylonycteris pachypus fulvida* (Blyth), *Barbastella leucomelas darjelingensis* (Hodgson), *Harpiocephalus mordax* Thomas were found to be unrecorded from that state (Blanford 1891, Roonwal 1950, Ellerman and Morrison-Scott 1966, Lekagul and McNeely 1977, Corbet and Hill 1992, Agrawal *et al.* 1992, Wilson and Reeder 1993, Das *et al.* 1995). Since the finalization of a detailed faunal account of mammals of Mizoram will take some more time, it was thought worthwhile to publish the new distributional records of these bats hereunder. In addition, some remarks on their habitat have been given.

External measurements have been taken in the field and the skull-measurements in the laboratory. All measurements are in millimetres and have been taken after Khajuria (1953), except cranial rostrum which has been taken after Sinha (1969).

Following is a list of abbreviations used for various measurements

$c^1 - c^1$ = distance between outer surface of upper canines ;

ccl = condylocanine length ;

cw = cranial width ;

E = length of ear ;

Fa = length of forearm ;

F & Cl = length of foot and claw ;

iw = least interorbital width ;

l = greatest length of skull ;
$m^3 - m^3$ = distance between outer surface of upper molars ;
ml = mandibular length ;
mtr = length of maxillary tooth-row ,
Tb = length of tibia ;
zw = zygomatic width.

SYSTEMATIC ACCOUNT

Order : CHIROPTERA

Family : PTEROPODIDAE

Megaerops niphanae Yenbutra & Felten, 1983
(Niphan's Fruit Bat)

1983. *Megaerops niphanae* Yenbutra & Felten, *Senckenberg Biol.*, **64** : 2 (Thailand).

Material examined : Mizoram : Aizwal district : 1 ♂, 1 ♀, North Khawbang (*c* 1500 m), coll. A.K. Mandal, 16 Dec 1993, in spirit, ZSI Reg. Nos. 24428, 24429. Lunglei district : 1 ♂, 1 ♀, Sairep (*c* 1500 m), coll, T.P. Bhattacharyya, 17 Apr 1995, in spirit, ZSI Reg. Nos. 24430, 24431.

Measurements : External : 2 ♂ : Fa 58.0, 60.7 ; E 17.5, 18.5 ; Tb 23.0, 24.8 ; F & Cl 13.0, 13.7. 2 ♀ : Fa 60.7, 62.3 ; E 17.2, 17.8 ; Tb 25.7, 25.4 ; F & cl 12.8, 12.0. Cranial : 1 ♂, 1 ♀, : *l* 27.9, 28.7 ; *ccl* 24.4, 27.1 ; *mtr* 9.1, 9.1 ; $c^1 - c^1$ 5.4, 5.4 ; *iw* 5.2, 6.0 ; *cw* 12.3, 12.0 ; *zw* 17.7, 18.8 ; $m^3 - m^3$ 8.3, 8.6 ; *ml* 20.4, 20.9.

Distribution : *Megaerops niphanae* was described from Thailand (Yenbutra & Felten 1983). Koopman (1989) confirmed the occurrence of this species in Pashok (Darjiling district, West Bengal, India) and Vietnam. Mandal *et al.* (1993) recorded its occurrence from Manipur. The present specimen, therefore, constitute the first record of this species from Mizoram.

Remarks : The habitats of North Khawbang and Sairep were undulating, hilly terrain, with mixed forests. Specimens were entangled in the uppermost tier of the nylon mist net at a height of about 3.5 m, alongwith *Cynopterus* sp.

Macroglossus sobrinus sobrinus Anderson, 1911
(Greater Long-tongued Fruit Bat)

1911. *Macroglossus minimus sobrinus* Anderson, *Ann. Mag. nat. Hist.*, **7** : 642 (Gunong Igari, 2000' = *c* 610 m, Perak, Peninsular Malaysia).

Material examined : Mizoram : Chimtuipui district : 1 ♂, 1 ♀ : Ngengpui (*c* 200 m), coll. T.P. Bhattacharyya, 8 Apr 1995, dry, skin & skull, ZSI Reg. Nos. 24432, 24433.

Measurements : External : 1 ♂, 1 ♀ : Fa 41.8, 41.7 ; E 15.6, 15.8 ; Tb 19.0, 18.4 ; F & Cl 11.8, 11.4. Cranial : 1 ♂, 1 ♀ : *l* 29.5, 29.1 ; *mtr* 9.6, 9.9 ; $c^1 - c^1$ 5.4, 5.2 ; *iw* 5.3, 5.0 ; *cw* 12.2, 11.8 ; *zw* 16.1, 14.0 ; $m^3 - m^3$ 6.4, 6.1 ; *ml* 22.4, 22.2.

Distribution : *Macroglossus sobrinus sobrinus* is known within Indian limits from West Bengal, Meghalaya, Tripura and Arunachal Pradesh. Hence, the present specimens constitute the first authentic record of this species from Mizoram.

Remarks : The habitat of Ngengpui was undulating, hilly terrain. Mist nets were set up in the valley, having banana plantation. The specimens were collected along with *Cynopterus* sp.

Ellerman & Morrison-Scott (1966) maintained *sobrinus* as a subspecies of *Macroglossus minimus*. Most of recent authors (Lekagul & McNeely 1977, Corbet and Hill 1992), however, considered *minimus* and *sobrinus* as distinct species.

Family : RHINOLOPHIDAE

Rhinolophus lepidus lepidus Blyth, 1844
(Little Indian Horse-shoe Bat)

1844. *Rhinolophus lepidus* Blyth, *J. Asiat. Soc. Beng.*, **13** : 486 (vicinity of Calcutta, Calcutta district, West Bengal).

Material examined : Mizoram : Aizawl district : 3 ♂, Teirei (Dampa) (*c* 250 m), coll. A.K. Mandal 27 Dec 1993, in spirit, ZSI Reg. Nos. 24434-24436.

Measurements : External : 3 ♂ ; Fa 37.7, 38.7, 38.7 ; E 13.5, 13.7, 13.4 ; Tb 15.5, 16.4, 15.7 ; F & cl 7.3, 7.5, 7.7. Cranial : 2 ♂ : *l* 15.9, 16.0 ; *ccl* 13.9, 13.9 ; *mtr* 5.8, 6.0 ; $c^1 - c^1$ 3.9, 3.9 ; *iw* 2.1, 2.2 ; *cw* 6.6, 6.7 ; *zw* (1) 7.7 ; $m^3 - m^3$ 5.2, 5.1 ; *ml* 9.9, 9.9.

Distribution : Within the Indian limits, *Rhinolophus lepidus lepidus* is reported from Delhi, Rajasthan, Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, West Bengal and Meghalaya. The present specimens, thus, constitute the first authentic record of this species from Mizoram.

Remarks : The specimens were collected in mist net along with *Rhinolophus rouxi* by the side of a stream, in deep forest.

Hippsideros lankadiva Kelaart, 1850
(Sri Lanka Gigantic Leaf-nosed Bat
or Kelaart's Leaf-nosed Bat)

1850. *Hipposideros lankadiva* Kelaart, *J. Ceylon Branch R. Asiat. Soc.*, **2** : 216 (Kandy, Ceylon = Sri Lanka).

Material examined : Mizoram : Aizawl district : 1 ♂, Teirei (Dampa) (*c* 250 m), coll. Arun Gupta, 10 May 1995, in spirit, ZSI Reg. No. 24437.

Measurements : External : 1 ♂ : Fa 91.9 ; E 26.3 ; Tb 38.8 ; F & Cl 18.7. Cranial : 1 ♂ : *ccl* 30.0 ; *mtr* 14.3 ; $c^1 - c^1$ 8.6 ; *iw* 3.8 ; *cw* 14.2 ; *zw* 21.2 ; $m^3 - m^3$ 13.0 ; *ml* 25.5.

Distribution : *Hipposideros lankadiva* is known from Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, Orissa, West Bengal, Meghalaya, and Manipur in India. Hence, the present specimen constitutes the first authentic record of this species from Mizoram.

Remarks : The specimen was collected with the help of nylon mist-nets placed on the hill-

top besides bamboo plantation. It was found entangled in the net, at about 10 P.M., 3 m above the ground level along with specimens belonging to the genera *Cynopterus* and *Pipistrellus*.

Brosset (1962) did not consider the variation in colour in the present species as zoogeographically related and he considered this species as monotypic.

Hipposiderus cineraceus Blyth, 1853
(Least Leaf-nosed Bat or
Blyth's Leaf-nosed Bat)

1853. *Hipposideros cineraceus* Blyth, *J. Asiat. Soc. Beng.*, **22** : 410 (Bhera, near Pind Dadan Khan, Punjab Salt Range = Bhera, *c* 32 km Sw of Pind Dadan Khan, Salt Range, The Punjab, Pakistan).

Material examined : Mizoram : Aizawl district : 1 ♂, Terei (Dampa) (*c* 250 m), coll. A.K. Mandal, 25 Dec 1993, in spirit, ZSI Reg. No. 24438 ; Lunglei district : 1 ♂, Sairep (*c* 1500 m), coll. T.P. Bhattacharyya, 18 Apr 1995, in spirit, ZSI Reg. No. 24439.

Measurements : External : 2 ♂ : Fa 34.3, 34.5 ; E 14.5, 15.3 ; Tb 16.5, 16.0 ; F & Cl 5.5, 5.9. Cranial : 2 ♂, : *l* 15.8, 15.2 ; *ccl* 13.4, 13.0 ; *mtr* 5.0, 5.9 ; $c^1 - c^1$ 2.6, 2.5 ; *iw* 2.4, 2.6 ; *cw* 6.8, 7.1 ; *zw* 7.0, 7.2 ; $m^3 - m^3$ 4.8, 4.8 ; *ml* 8.9, 8.7.

Distribution : *Hipposideros cineraceus* is reported from Haryana, Uttar pradesh, West Bengal, Assam, Meghalaya and Arunachal Pradesh in India. These specimens, thus, constitute the first authentic record of this species from Mizoram.

Remarks : The specimens were entangled in nylon mist-net set near a hill stream.

Ellerman & Morrison-Scott (1996) have recognised two subspecies of *Hipposideros cineraceus* but Hill and Francis (1984) considered this species as monotypic.

Family : VESPERTILIONIDAE

Tylonycteris pachypus fulvida (Blyth, 1895)
(Club-footed Bat)

1859. *Scotophilus fulvida* Blyth, *J. Asiat. Soc. Beng.*, **28** : 293 (Schwegyin, Sittang River, southeastern Myanmar).

Material examined : Mizoram : Aizawl district : 1 ♀, Teirei (Dampa) (*c* 250 m), coll. A.K. Mandal, 24 Dec 1993, in spirit, ZSI Reg. No. 24440.

Measurements : External : 1 ♀ : Fa 34.2 ; E 12.5 ; Tb 17.4 ; F & Cl 6.5. Cranial : 1 ♀ : *l* 14.5 ; *ccl* 12.6 ; *mtr* 5.5 ; $c^1 - c^1$ 3.6 ; *iw* 3.1 ; *cw* 7.1 ; *zw* 8.3 ; $m^3 - m^3$ 5.7 ; *ml* 9.7.

Distribution Within the Indian limits, *Tylonycteris pachypus fulvida* is reported from Karnataka, Kerala, West Bengal, Sikkim, Tripura, Meghalaya, Manipur and Andaman Islands. Hence, the present specimen constitutes the first authentic record of this species from Mizoram and also fills the lacunae in its distributional range between Tripura and Manipur.

Remarks : The specimen was collected by setting mist-nets near a hill stream, having bamboo plantation nearby, at about 8 P.M.

Barbastella leucomelas darjelingensis (Hodgson, 1855)
(Eastern Barbastelle)

1855. *Plecotus darjelingensis* Hodgson, in Horsfield, *Ann. Mag. nat. Hist.*, 2(16) : 103 (Darjeeling, North-Eastern India = Darjiling, Darjiling district, West bengal, India).

Material examined : Mizoram : Lunglei district : 2 ♂, Sairep (*c*1500 m), coll. T.P. Bhattacharyya, 26 Apr 1995, in spirit, ZSI Reg. Nos 24441, 24442.

Measurements : External : 2 ♂ : Fa 38.8, 38.4 ; Tb 17.7, 18.6 ; E 16.9, 17.2 ; F & Cl 6.2, 7.6. Cranial : 2 ♂ : *l* 15.0, 15.4 ; *cr* 4.3, 4.4 ; *mtr* 4.7, 4.7 ; $c^1 - c^1$ 3.2, 3.7 ; *iw* 3.8, 4.0 ; *cw* 8.3, 8.2 ; *zw* 6.7, 6.8 ; $m^3 - m^3$ 5.2, 5.3 ; *ml* 8.9, 9.3.

Distribution : *Barbastella leucomelas darjelingensis* is reported from Himachal Pradesh, Jammu & Kashmir, Rajasthan, Uttar Pradesh, Sikkim, Meghalaya and West Bengal in India. Hence, the present specimens constitute the first authentic record of this species from Mizoram.

Remarks : The habitat at Sairep was undulating, hilly terrain with reasonable undergrowth of ferns and shrubs. The specimens were collected between 7 and 7.30 P.M. by placing mist-nets near a water source inside the forests.

Harpiocephalus mordax Thomas,1923
(Broad-skulled Hairy-winged Bat)

1923. *Harpiocephalus mordax* Thomas, *J. Bombay nat. Hist. Soc.*, **29** : 88 (Mogok, northern Mayanmar).

Material examined : Mizoraom : Lunglei district : 1 ♂, Sairep (*c*1500 m), coll. T.P. Bhattacharyya, 25 Apr 1995, dry, skin & skull, ZSI Reg. No. 24443.

Measurements : External : 1 ♂ : Fa 50.5 ; Tl 52.4 ; E 17.7 ; Tb 24.4 ; F & Cl 11.4. Cranial : 1 ♂ : *l* 23.0 ; *ccl* 19.9 ; *mtr* 6.7 ; $c^1 - c^1$ 6.6 ; $m^3 - m^3$ 7.4 ; *iw* 5.6 ; *cw* 9.0 ; *zw* 13.8 ; *ml* 16.7.

Distribution : *Harpiocephalus mordax* is known from West Bengal, Sikkim and Meghalaya, in India. Hence, the present specimen constitutes the first authentic record of this species from Mizoram.

Remarks : Ellerman & Morrison-Scott (1966) considered *Harpiocephalus mordax* as a subspecies of *Harpiocephalus harpia*, with some doubt. But McBee *et al.* (1986) have treated it as a distinct species. The specimen was collected by setting mist-net near a water source down in the valley.

SUMMARY

Megaerops niphanae, Macroglossus sobrinus sobrinus, Rhinolopus lepidus lepidus, Hipposideros lankadiva, Hipposideros cineraceus, Tylonycteris pachypus fulvida, Barbastella leucomelas darjelingensis and *Harpiocephalus mordax* have been recorded for the first time from Mizoram, India. Their collection locality, measurements, distribution in India and some remarks on their habitats have been appended.

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ON A COLLECTION OF BUTTERFLIES (LEPIDOPTERA : RHOPALOCERA) FROM KANHA NATIONAL PARK, MADHYA PRADESH, INDIA

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INTRODUCTION

The present paper deals with the studies on butterflies of Kanha National Park, Mandla and Balaghat district, Madhya Pradesh (fig. 1). The Park extends between latitudes 22°00' and 22°30' N. and longitudes 80°25' and 81°07' E. in the two districts, Mandla and Balaghat of Madhya Pradesh. The heart of the Park, Kanha forest village, is about 54 km. south-east of Mandla town. It was constituted as National Park in the year 1955 and has an area of 1208.15 sq. km. The park is a stretch of wild and hilly country with a broad tableland surrounded in circular manner by range of hills, about 914 m. high in the northern part of the park. The southern part of the park is mainly hilly with chain of hills of varying heights. The top of hills are flat. The main portion of the park is a platean rising up to 893 m. above MSL.

Singh (1995) has reported seven species from the park. This study deals with a collection of butterflies available in the Central Regional Station, Zoological Survey of India, Jabalpur, collected by Dr. H. Khajuria, Dr. R.K. Ghose and Dr. R.K. Singh during different surveys of the park.

Altogether 19 species in 11 genera and 4 families are reported. One species *Neptis soma* Moore, of family Nymphalidae is reported for the first time from Madhya Pradesh and three species viz. *Catopsilia florella gnoma* (Fab.), *C. crocale* (Cramer), *Eurema brigitta rubbella* (Wallace), of family Pieridae ; one species viz. *Melanitis phedima bethami* de Niceville of family Satyridae ; eight species viz. *Neptis soma* Moore, *Hypolimnas misippus* (Linn.), *Precis almana almana* (Linn.), *P. atlites* (Linn.), *P. lemonias vaisya* Fruhstorfer, *P. orithya swinhoei* (Butler), *Euthalia nais* (Forster) and *Cynthia cardui* (Linn.) are reported for the first time from Kanha National Park, district Mandla and Balaghat.

The common names were referred from Varshney (1983) and Evans (1932). The Food plants were referred from Appendix in Wynter-Blyth (1957) and Gupta and Shukla (1987). The classification has been followed after Talbot (1939 & 1947).

ABBREVIATIONS USED

KNP — Kanha National Park, Mandla and Balaghat districts.

Coll. — Name of Collector.

ex. (s) — Number of examples (s).
HK — Dr. H. Khajuria.
RKG — Dr. R.K. Ghose.
RKS — Dr. R.K. Singh.

SYSTEMATIC ACCOUNT

Phylum : ARTHROPODA
Class : INSECTA
Order : Lepidoptera
Sub Order : RHOPALOCERA
Family 1 : PIERIDAE

Genus 1 : ***Valeria*** Horsfield, 1829

1. ***Veleria valeria hippia*** (Fabricius)

1787. *Papilio hippia* Fabricius, *Mantissa Ins.*, **2** : 55.

Common name : The Common Wanderer.

Material examined : 1 ex., KNP, 21.1.1991, Coll. RKG (Reg. No. A/1926).

Distribution : India (Sikkim, Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, West Bengal, Madhya Pradesh) ; Myanmar and Thailand.

Food plants : *Capparis heyneana*, *C. zeylanida.*

Genus 2 : ***Catopsilia*** Hubner, 1819.

2. ***Catopsilia florella gnoma*** (Fabricius)

1775. *Papilio gnoma* Fabricius, *Syst. Ent.*, : 828.

Common name : The African Emigrant.

Material examined : 1 ex., KNP, 2.12.1986, Coll. RKS (Reg. No. A/1958).

Distribution : India (N.W Himalayas, Maharashtra, West Bengal, Karnataka, Uttar Pradesh, Kerala, Madhya Pradesh, Andaman) ; Sri Lanka and Myanmar.

Food plants : *Cassia tora*, *C. auriculata*, *C. occidentalis.*

3. ***Catopsilia crocale crocale*** (Cramer)

1775. *Pipilio crocale* Cramer, *Syst. Ent.*, : 87.

Common name The Lemon Emigrant.

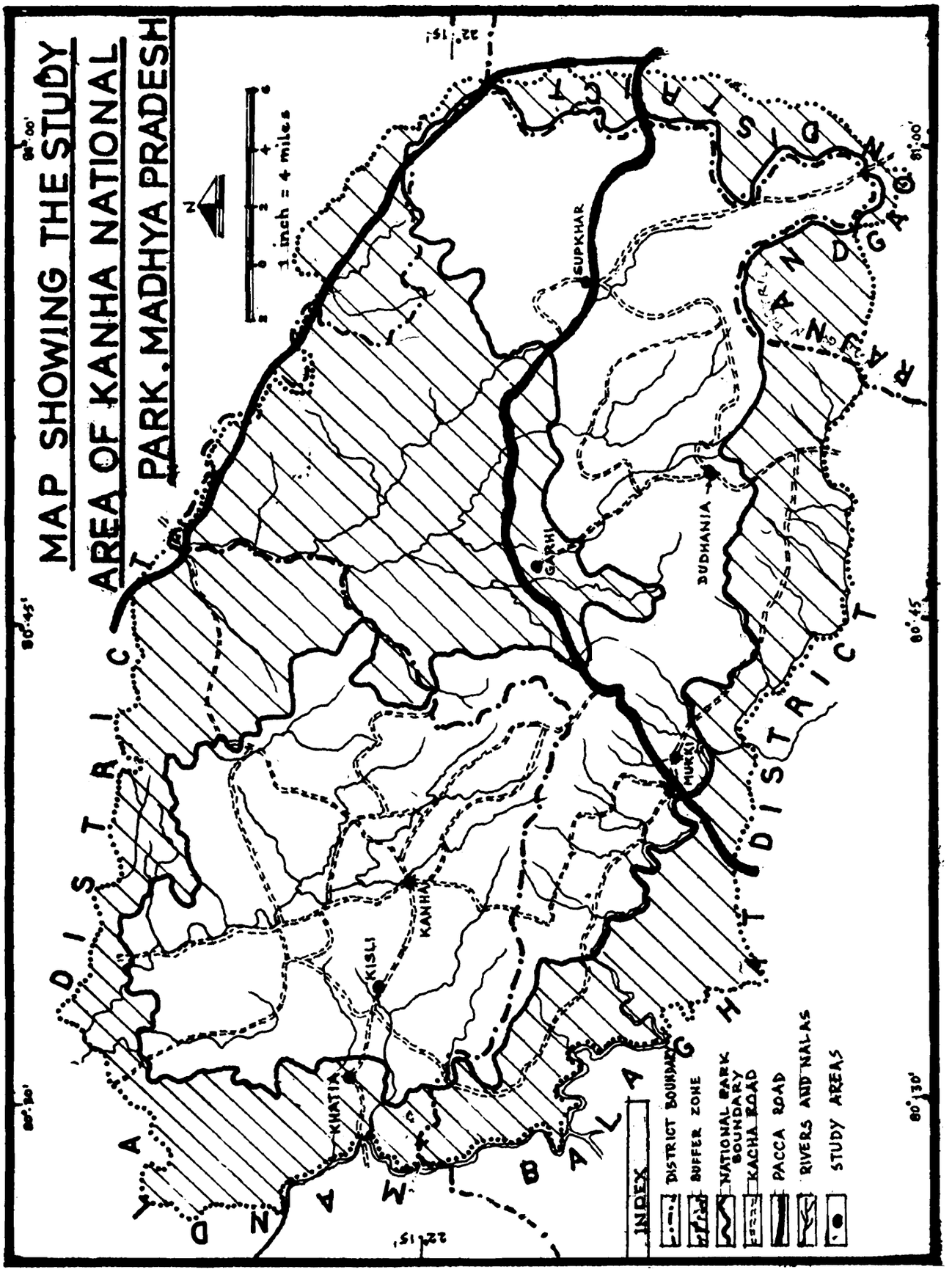

Fig. 1 : Map showing the study area of Kanha National Park, Madhya Pradesh.

Material examined : 5 exs., KNP, 28.5.1964, Coll. HK (Reg. No. A/396 to 400) ; 1 ex., KNP, 21.1.1991. Coll RKG (Reg. No. A/1925).

Distribution : India (Tamil Nadu, Gujarat, Madhya Pradesh, N.W. Himalayas, Andaman & Nicobar, Uttar Pradesh, Kerala, West Bengal, Maharashtra) ; Sri Lanka ; Pakistan ; Myanmar ; S. China ; Indonesia ; the Philippines.

Food plants : *Cassia fistula, C. siamea, C. tora, C. auriculata, C. grandis, C. javanica, C. nodosa, C. occidentalis, Diospyros discolor, Butea frondosa, Bauhinia racemosa.*

4. ***Catopsilia pyranthe pyranthe*** (Linnaeus)

1758. *Papilio pyranthe* Linnaeus, *Syst. Nat.* (ed. X) : 469.

Common name : The Mottled Emigrant.

Material examined : 3 exs., KNP, 28.5.1964. Coll HK (Reg. No. A/733, 734).

Distribution : India (N.W. Himalayas, Gujarat, Madhya Pradesh, Uttar Pradesh, Kerala) ; Sri Lanka ; Pakistan ; Myanmar ; China ; Indonesia ; the Philippines.

Food plants : *Cassia tora, C. auriculata, C. occidentalis, C. nodosa, Sesbania aegyptica.*

5. ***Catopsilia pomona*** (Fabricius)

1775. *Papilio pomona* Fabricius, *Syst. Ent.*, : 479.

Common name : The Lemon Emigrant.

Material examined : 2 exs., KNP, 30.11.1986, Coll. RKS (Reg. No. A/2682).

Distribution : India (Andamans–Nicobars, Tamil Nadu, Gujarat, Madhya Pradesh, N.W. Himalayas, Kerala, Uttar Pradesh, West Bengal, Maharashtra) ; Pakistan ; Sri Lanka ; Myanmar ; Indonesia ; China ; and the Philippines.

Food plants : *Cassia fistula, C. siamea, C. tora, C. auriculata, C. grandis, C. javanica, C. nodosa. C. occidentalis, Diospyros discolor, Butea frondosa, Bauhinia racemosa.*

Genus 3 : ***Eurema*** Hubner, 1819

6. ***Eurema brigitta rubella*** (Wallace)

1867. *Terias rubella Wallace, Trans. ent. Soc. Lond.*, 4(3) : 323.

Common name : The Small Grass Yellow.

Material examined : 1 ex., KNP, 30.11.1986, Coll. RKS (Reg. No. A/1962).

Distribution : India (West Bengal, N.W. Himalayas, Karnataka, Uttar Pradesh, Kerala, Maharashtra, Tamil Nadu, Punjab, Madhya Pradesh, Bihar, and Nicobars) ; Sri Lanka ; Thailand.

Food plants : *Cassia kleinii, C. koenigii, Homonia* sp.

7. ***Eurema hecabe simulata*** (Moore)

1881. *Terias simulata* Moore, *Lep. Ceylon*, **1** : 119.

Common name : The Common Grass Yellow.

Material examined : 3 exs., KNP, 30.11.1986, Coll. RKS (Reg. Nos. A/1959, 1960, 1961) ; 1 ex., KNP, 18.1.1981, Coll. RKG (Reg. No. A/1924) ; 2 exs., KNP, 27.11.1986, Coll RKS (Reg. No. A/2683).

Distribution : India (West Bengal, Madhya Pradesh, Kerala, Maharashtra, Bihar, South India, Central Provinces) ; Sri Lanka ; Pakistan.

Food plants : *Cassia tora*, *C. fistula*, *C. mimosoides*, *Wagatea spicate*, *Pithecolobium dulce*, *Sesbania aculeata*, *Albizzia procera* ; *Caesalpinia* sp., *Albizzia* sp., *Acacia* sp.

Family 2 : DANAIDAE

Genus 4 : ***Danaus*** Kluk, 1780

8. ***Danaus limniace leopardus*** Butler

1866. *Danais limniace* var. *leopardus* Butler, *Proc. zool. Soc. Lond.*, **1886** : 52.

Common name : The Blue Tiger.

Material examined : 1 ex., KNP, 1.2.1991, Coll. RKG (Reg. No. A/1911).

Distribution : India (N. India, Uttar Pradesh, Nocobars, Himachal Pradesh, Madhya Pradesh, West Bengal, Tamil Nadu, Punjab, Orissa, Sikkim, Kerala, Assam, Bihar) ; Myanmar ; Sri Lanka ; Pakistan ; China ; Thailand.

Food plants : *Dregea volubilis*, *Calotropis* sp, *Hoya* Sp., *Marsdenia tenacissima*.

Genus 5 : ***Euploea*** Fabricius, 1807

9. ***Euploea core core*** (Cramer)

1780. *Papilio core* Cramer, *Pap. Exot.*, **3** : 133.

Common name : The Common Indian Crow.

Material examined : 5 exs., KNP, 22.1.1991, Coll. RKG (Reg. Nos. A/1917 to 1921) ; 2 exs. KNP, 2.12.1986 Coll. RKS (Reg. No. A/2679).

Distribution : India (West Bengal, Andamans, Sikkim, Uttar Pradesh, Madhya Pradesh, Tamil Nadu, Orissa, Kerala, Karnataka, Bihar) ; Nepal ; Pakistan ; Myanmar.

Food plants : *Streblus asper*, *Ficus bengalensis*, *F. glomerata*, *F. indica*, *F. religiosa*, *Holarrhena antidysenterica*, *Nerium odorum*, *N. oleander*, *Ichnocarpus frutescens*, *Hemidesmus indicus*, *Cryptolepis elegans*, *Anodendron paniculatum*, *Holigarna arnottiana*, *Cryptostegia grandiflora*.

Family 3 : SATYRIDAE

Genus 6 : ***Melanitis*** Fabricius, 1807

10. ***Melanitis leda ismene*** (Cramer)

1775. *Papilio ismene* Cramer, *Pap. Exot.*, **1** : 26.

Common name : The Common Evening Brown.

Material examined : 1 ex., KNP, 18.1.1991, Coll. RKS (Reg. No. A/1922) ; 1 ex., KNP, 30.11.1986, Coll. RKS (Reg. No. A/1955).

Distribution : India (Andamans and Nicobars, Sikkim, Himachal Pradesh, West Bengal, Madhya Pradesh, Assam, Uttar Pradesh, Orissa, Tamil Nadu) ; Sri Lanka ; Nepal ; Myanmar ; China ; Indonesia.

Food plants : Grasses, *Oryza sativa.*

11. ***Melanitis phedima bethami*** de Niceville

1887. *Melanitis bethami* de Nicéville, *Proc. zool, Soc. Lond.*, **1887** : 451.

Common name : The Dark Evening Brown.

Material examined : 2 exs., KNP, 30.11.1986, Coll. RKS (Reg. Nos. A\1956, 1957).

Distribution : India (Madhya Pradesh).

Food plants : Grasses.

Family 4 : NYMPHALIDAE

Genus 7 : ***Neptis*** Fabricius, 1807

12. ***Neptis soma*** Moore

1858. *Neptis soma* Moore, *Proc, zool. Soc. Lond.*, **1858** : 9.

Common name : The Sullied Sailer.

Material examined : 3 exs., KNP, 30.11.1986. Coll. RKS (Reg. Nos. A/1953, 1954, 1969).

Distribution : India (Uttar Pradesh) ; Myanmar.

Food plants : Not known.

Genus 8 : ***Hypolimnas*** Hubner, 1819

13. ***Hypolimnas misippus*** (Linnaeus)

1764. *Papilio misippus* Linnaeus, *Mus. Ulr.*, : 264.

Common name : The Danaid Eggfly.

Material examined : 1 ex., KNP, 30.1.1991, Coll. RKG (Reg. No. A/1923).

Distribution : India (Andamans and Nicobar, Tamil Nadu, Madhya Pradesh) ; Sri Lanka ; Pakistan ; Myanmar.

Food plants : *Portulaca oleracea*, *P. grandiflora*, *Abutillon sp.*, *Hibiscus* sp.

Genus 9 : ***Precis*** Hubner, 1819

14. ***Precis almana almana*** (Linnaeus)

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

Common name : The Peacock Pansy.

Material examined : 1 ex., KNP, 28.11.1986, Coll. RKS (Reg. No. A/1965).

Distribution : India (Andaman, Madhya Pradesh, Bihar) ; Sri Lanka ; Myanmar.

Food plants : *Asteracantha longifolia*, *Hygrophila* sp., *Barleria* sp., *Osbeckia* sp. *Osbeckia* sp.

15. ***Precis atlites*** (Linnaeus)

1763. *Papilio atlites* Linnaeus, *Cent. Ins.*, : 24.

Common name : The Grey Pansy.

Material examined : 2 exs., KNP, 28.11.1986, Coll. RKS (Reg. Nos. A/1967, 1968).

Distribution : India (Andaman & Nicobar, Madhya Pradesh, NE India. Along the foot of the Himalyas as far as west as Kalka, Peninsular India) ; Sri Lanka, Myanmar.

Food plants : *Asteracantha longifolia*, *Barleria* sp.

16. ***Precis lemonias vaisya*** Fruhstorfer

1912. *Precis vaisya* Fruhstorfer, In Seitz ; *Macrolepidoptera of the World*, 9 : 520.

Common name : The Lemon Pansy.

Material examined : 5 exs., KNP, 28.5.1964, Coll. HK (Reg. Nos. A/672 to 675 and 744) ; 3 exs., KNP, 2.12. 1986, Coll. RKS (Reg. Nos. A/1950 to 1952).

Distribution : India (South and Central India, Madhya Pradesh, Bihar, Jammu & Kashmir, Assam, West Bengal, Gujarat) ; Myanmar, Sri Lanka.

Food plants *Nelsonia campestris*, *Asteracantha longifolia*, *Sida rhombifolia*, *Strobilanthes* sp.

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

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

Common name : The Blue Pansy.

Material examined : 1 ex., KNP, 28.11.1986, Coll, RKS (Reg. No. A/1966).

Distribution : India (Madhya Pradesh, South India, Bihar, recorded from all over the Indian region) ; Sri Lanka, Pakistan.

Food plants : *Justicia procumbens* ; *J. micrantha*, *Lepidagathis prostrata.*

Genus 10 : ***Euthalia*** Hubner, 1819

18. ***Euthalia nais*** (Forster)

1771. *Papilio nais* Forster, *Nov. Spec. Ins. Cent.*, **1** : 73.

Common name : The Baronet.

Material examined : 1 ex., KNP, 1.12.1986, Coll. RKS (Reg. No. A/2681).

Distribution : Imdia (South India, Uttar Pradesh, Sikkim, Madhya Pradesh, Gujarat, Bihar, Karnataka) ; Sri Lanka.

Food plants : *Diospyros melanoxylon*, *Shorea robusta.*

Genus 11 : ***Cynthia*** Fabricius, 1807

19. ***Cynthia cardui*** (Linnaeus)

1758. *Paipilio cardui* Linnaeus, *Syst. Nat.*, (ed. X) : 475.

Common name : The Painted Lady.

Material examined : 1 ex., KNP, 1.12.1986, Coll. RKS (Reg. No. A/2680).

Distribution : India (Andamans, Madhya Pradesh, throughout India) ; Sri Lanka ; Myanmar.

Food plants : *Zornia diphylla*, *Debregeasia bicolor*, *D. hypoleuca*, *Girardinia heterophylla*, *Artemisia* sp., *Blumea* sp.

SUMMARY

The paper dealt herewith the fauna of butterflies, collected from Kanha National Park, districts Mandla and Balagaht of Madhya Pradesh. It reports 19 species in 11 genera and 4 families.

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AN ACCOUNT OF THE MAMMALIAN FAUNA OF CHANDAKA WILDLIFE SANCTUARY, ORISSA

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INTRODUCTION

Chandaka Wildlife Sanctuary (Map-1) is situated in Cuttack and Khurda district of Orissa, covering an area of 193. 39 sq. km. (including the mining area) and lies between latitudes 20° 16' 05" to 20° 26' 03" N and longitudes 85° 34' 42" to 85° 49' 30" E. Chandaka-Dampara forest was declared a Wildlife Sanctuary during 1983-84. It is very close (25 km North-east) to the capital city of Bhubaneswar and can be approached by road via Khandagiri.

In connection with the study of elephants in Chandaka Sanctuary, the authors visited the area many times between January, 1995 to June, 1997. The present paper is an attempt to provide a checklist of the mammalian fauna of the sanctuary as no list of the mammalian species of the Sanctuary is available till date. This paper is based on a series of observations by the authors as well as by enquiring the chandaka forest department staffs.

TOPOGRAPHY & DRAINAGE

The terrain is generally undulating which is broken by small low hills. North-western portions of the reserve are hilly with moderate to steep slopes, whereas the eastern portion is mostly gentle to moderately slopy. The central portion is relatively flat with little undulations. The altitude ranges from 42 m (Chandaka) to 217 m (Pandari Mundia) above mean sea level (Mishra & Sarangi, 1984).

The area is drained by non-perennial streams. Soil is devoid of humus due to excessive grazing by cattles and removal of trees from many areas. Lateritic soil of various types-clay to sandy loam. Soil depth is good.

CLIMATE

The climate is sub-tropical. Rainfall is between 1200-1400 mm. Average rainfall was 1238 mm (1994-96). The temperature varies from 10°-42° C. The area experiences three distinct seasons viz., Rainy (mid June to mid Oct.), Winter (mid Nov. to mid Jan.) and Summer (March to May).

VEGETATION

Chandaka is a mixed tropical dry Semi-evergreen and moist deciduous type of forest where bamboo occupies more than 20% of the area. Other tree species includes *Shorea robusta, Cassia fistula, Tectona grandis, Grewia tiliaefolia, Aegle marmelosa, Terminalia tomentosa, Terminalia belarica, Careya aroborea, Xylia xylocarpa, Dalbergia sisso,* etc. The forest is presently covered

* Nandankanan Biological Park, Bhubaneswar

mostly by shrubby/ bushy vegetation and covers more than 40% of the forest area (Roy, et. al., 1992). *Mimosa pudica* and a wide variety of grasses including *Chrysopogon aciculata, Typha elephantina, Cynodon dactlon* etc. are present which forms the food of elephants, the dominant animal species of this Sanctuary. The species marked with * & ** are included in the Schedule I and Schedule II of the Indian Wildlife Act (1972), respectively. The distribution of the various species have been taken mainly from Ellerman and Morrison-Scott (1951), Pocock (1941) and Prater (1971).

SYSTEMATIC LIST OF MAMMALS REPORTED FROM CHANDAKA WILDLIFE SANCTUARY, ORISSA

The following species of mammals have been dealt with, in this paper.

Order : I. INSECTIVORA

Family : 1. SORICIDAE

1. ***Suncus murinus*** (Linnaeus)

Order : II. SCANDENTIA

Family : 2. TUPAIIDAE

2. ***Anathana ellioti*** (Waterhouse)

Order : III. CHIROPTERA

Suborder : (i) MEGACHIROPTERA

Family : 3. PTEROPODIDAE

3. ***Rousettus leschenaulti leschenaulti*** (Desmarest)
4. ***Pteropus giganteus*** (Brunnich)
5. ***Cynopterus sphinx sphinx*** (Vahl)

Suborder : (ii) MICROCHIROPTERA

Family : 4. VESPERTILIONIDAE

6. ***Pipistrellus coromandra*** (Gray)

Order : IV PHOLIODOTA

Family : 5. MANIDAE

7. ***Manis crassicaudata*** Gray

Order : V. PRIMATES

Family : 6. CERCOPITHECIDAE

8. ***Macaca mulatta mulatta*** (Zimmermann)
9. ***Presbytis entellus*** (Dufresne)

Order : VI. CARNIVORA

Family : 7. CANIDAE

10. ***Vulpes bengalensis*** (Shaw)
11. ***Canis aureus*** Linnaeus
12. ***Cuon alpinus*** Pallas

Family : 8. HYAENIDAE

13. ***Hyaena hyaena hyaena*** (Linnaeus)

Family : 9. URSIDAE

14. ***Melursus ursinus ursinus*** (Shaw)

Family : 10. MUSTELIDAE

15. ***Mellivora capensis indica*** (Kerr)

Family : 11. VIVERRIDAE

16. ***Viverricula indica*** (Desmarest)
17. ***Paradoxurus hermaphroditus*** (Pallas)

Family : 12. HERPESTIDAE

18. ***Herpestes edwardsi*** (Geoffroy)
19. ***Herpestes auropunctatus*** (Hodgson)

Family : 13. FELIDAE

20. ***Felis chaus*** Guldenstaedt
21. ***Panthera pardus*** (Linnaeus)

Order : VII. PROBOSCIDEA

Family : 14. ELEPHANTIDAE

22. ***Elephas maximus indicus*** G. Cuvier

Order : VIII. ARTIODACTYLA

Family : 15. SUIDAE

23. ***Sus scrofa*** Linnaeus.

Family : 16. CERVIDAE

24. ***Muntiacus muntjak*** (Zimmermann)

25. ***Axis axis axis*** (Erxleben)

26. ***Cervus unicolor*** (Kerr)

Family : 17. TRAGULIDAE

27. ***Tragulus meminna*** (Erxleben)

Order : IX. RODENTIA

Family : 18. MURIDAE

28. ***Rattus blanfordi*** (Thomas)

29. ***Rattus rattus*** (Linnaeus)

30. ***Mus booduga*** (Gray)

31 ***Golunda ellioti*** Gray

32. ***Bandicota bengalensis*** (Gray & Hardwicke)

33. ***Bandicota indica*** (Bechstein)

Family : 19. HYSTRICIDAE

34. ***Hystrix indica*** (Kerr)

Family : 20. SCIURIDAE

35. ***Funambulus palmarum*** (Linnaeus)

36. ***Funambulus pennanti*** Wroughton

Order : X. LAGOMORPHA

Family : 21. LEPORIDAE

37. ***Lepus nigricollis*** Cuvier

SYSTEMATIC ACCOUNT

Class : MAMMALIA

Order : I. INSECTIVORA

Family : 1 SORICIDAE

1. ***Suncus murinus*** (Linnaeus)

Common name : House shrew (Eng); Chuchundar (Hindi); Chucho (Beng); Chuchundra (Oriya).

Distribution : India : They have been recorded in West Bengal, Orissa, Bihar, Assam, Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, etc.

Elsewhere : Sri Lanka, Pakistan, Nepal, Bangladesh, Bhutan, China, Burma,

Vietnam, Thailand, Malaysia, Indonesia, Palestine and Egypt.

Remarks : Common species in Chandaka, particularly near Rest houses and Beat offices. Spotted at Jhalara, Ambilo, Godibari, Dahanigarhia and Kumarkhundi.

Order : II. SCANDENTIA

Family : 2. TUPAIIDAE

2. ***Anathana ellioti*** (Waterhouse)

Common name : Indian tree shrew (Eng.); Bana chuchundra (Oriya).

Distribution : India : It is found in both the dry and moist deciduous forests of peninsular India, South of the Ganges.

Elsewhere : Burma.

Remarks : Not common; found in bushes, crevices or under litter in forest, looking for food. Spotted near roadside bushes on way to Nuakua.

Order : III. CHIROPTERA

Suborder : MEGACHIROPTERA

Family : 3. PTEROPODIDAE

3. ***Rousettus leschenaulti leschenaulti*** (Desmarest)

Common name : Indian Fulvous fruit bat (Eng.); Chalta Badur (Beng.); Badudi (Oriya).

Distribution : India : Kumaon, Peninsular India, West Bengal, Western Ghats.

Elsewhere : Nepal, Bhutan, Burma, Bangladesh, Vietnam, Kampuchea, Thailand, Laos and Java.

Remarks : Common. Spotted near Godibari gate, Jhalara, and Ambakhali temple.

4. ***Pteropus giganteus*** (Brunnich)

Common name : Indian flying fox (Eng.); Gadal (Hindi); Badur (Beng.); Badudi (Oriya).

Distribution : India : Widely distributed in peninsular India, northward upto Rajasthan, Punjab, Kumaon, Sikkim, Manipur and Assam.

Elsewhere : Nepal, Bhutan, Bangladesh, Burma, and Sri Lanka.

Remarks : Roosts were noticed on bamboo brakes. Spotted near Bhallumundia, Deras Dam, Jhalara and Nuakua.

5. ***Cynopterus sphinx sphinx*** (Vahl)

Common name : Short-nosed Fruit Bat (Eng.).

Distribution : India : Widely distributed in the Indian Union, north to Jammu and east to Nagaland. Also reported from Andaman Nicobar Island (Das *et al.*, 1991).

Elsewhere : Pakistan, Nepal, Tibet, Bangladesh, Bhutan, Burma and Sri Lanka.

Remarks : Seen in small group (3-4) on trees and rocky caves. Spotted near Bansberna and Bualigarh in the evening hours.

Suborder : MICROCHIROPTERA

Family : 4. VESPERTILIONIDAE

6. ***Pipistrellus coromandra*** (Gray)

Common name : Indian Pipistrelle (Eng.); Chemina (Oriya).

Distribution : India : Peninsular India, north to Jammu and Kashmir, east to Northeastern states, also Car Nicobar Island.

Elsewhere : Southern China, Hainan, Indo-China, Burma, Bhutan Duars and Iran.

Remarks : Very common; seen flying in open air near Ambilo, Jhalara, Godibari, Kochilabarna, Kumarkhundi, Naharthali and Dhobabandh.

Order : IV. PHOLIODOTA

Family : 5. MANIDAE

7. ***Manis crassicaudata*** Gray * (Plate-1)

Common name : Indian Pangolin (Eng.); Bonrui (Beng.); Surajmukhi (Hindi); Bajrakapta (Oriya).

Distribution : India : Indian Pangolin inhabits the plains and lower slopes of the hills of India south of Himalayas, Peninsular India, West Bengal, Lower Assam, Dehradun, Gwalior, Madras and Mysore.

Elsewhere : Pakistan, Bangladesh, China and Sri Lanka (Inskipp & Barzdo).

Remarks : Lives in burrows digged in the ground & in crevices. Ones spotted near Ambakhali on road.

Order : V. PRIMATES

Family : 6. CERCOPITHECIDAE

8. ***Macaca mulatta mulatta*** (Zimmermann) **

Common name : Rhesus macaque (Eng.); Bandar (Hindi and Beng.); Pati mankada (Oriya).

Distribution : India : The Himalayas, Assam and Northern and Central India and in South upto river Tapti in west and Godavari in east.

Elsewhere : Burma, Nepal, Bangladesh, Bhutan, Indo-China, Thailand, Laos, Vietnam, Kampuchea.

Remarks : Very common species in the sanctuary. More than 7 troops have been spotted.

9. ***Presbytis entellus*** (Dufresne) ** (Plate 2)

Common name : Common langur (Eng.); Hanuman (Hindi & Beng.); Hanuman makada (Oriya).

Distribution : India : Whole of India from Himalayas to cape Comorin, except the western deserts.

Elsewhere : Bangladesh, Sri Lanka, southern Tibet.

Remarks : Common. Spotted near Ambilo, Jantarimundia, on way to Jhumka, Barachuria mundia, Kumarkhundi, Naharthali.

Order : VI. CARNIVORA

Family : 7. CANIDAE

10. ***Vulpes bengalensis*** (Shaw)

Common name : Bengal Fox or Indian Fox (Eng.); Lomri (Hindi); Khek-siyal (Beng); Kodisiali (Oriya).

Distribution : India : The whole of India from the foothills of the Himalayas to Cape comorin.

Elsewhere : Nepal, Pakistan and Bangladesh.

Remarks : Common and can be seen on road sides during the evening and morning hours. Spotted near Deras, Jhalara, Nuakua, Behentashi, Kheluachua, Ambakhali temple and Dahanigarhia.

11. ***Canis aureus*** Linnaeus

Common name : Asiatic Jackal (Eng.); Gidhar (Hindi); Shial (Beng); Siali, Bilua (Oriya).

Distribution : India : Throughout the Indian mainland.

Elsewhere : Southwestern, Central and Southern Asia to Thailand including Sri Lanka, Northern and Eastern Africa, south to Senegal, Nigeria and Tanzania, Southeastern Europe.

Remarks : Not very common. Reported by forest staff from Nuakua.

12. ***Cuon alpinus*** Pallas**

Common name : Indian wild Dog (Eng.); Dhole or Jungle Kutha (Hindi); Balia Kukura (Oriya).

Distribution : In India they occur in Himalayan zone and peninsular India.

Elsewhere : Central and Eastern Asia from the Altai mountain and Manchuria southward through the forest regions of India and Malayan countries.

Remarks : A group of 3 animals were spotted near Kheluachua.

Family : 8. HYAENIDAE

13. ***Hyaena hyaena hyaena*** (Linnaeus)

Common name : Stripped hyaena (Eng.); Hundar/Lakkar baghar (Hindi); Heta Bagha, Hunda (Oriya).

Distribution : India : They are reported from Kashmir to Nepal terai, Sind, Cutch, southwards to Nilgiri hills, peninsular India and adjoining areas.

Elsewhere : South Russia, Iran and Iraq.

Remarks : Not very common. Spotted on way to Deras from Jhalara.

Family : 9. URSIDAE

14. ***Melursus ursinus ursinus*** (Shaw) *

Common name : Sloth bear (Eng.); Bhalu (Hindi & Beng.); Bhalu/Bhalluka (Oriya)

Distribution : India : From the base of Himalayas to Assam, Bihar, Orissa, and Peninsular India.

Remarks : Moderately common. Found on hill tops among the bushes and rocks of Bhallumundia. Also reported from Baramundia (Barapita RF), Jantaria mundia and Sanchuria mundia

Family : 10. MUSTELIDAE

15. ***Mellivora capensis indica*** (Kerr) * (Plate 3)

Common name : Ratel or Honey Badger (Eng.); Bejoo (Hindi); Gadabhalu (Oriya).

Distribution : India : From the base of Himalaya to Cape Comorin.

Elsewhere : Southwestern Russia and Turkestan.

Remarks : Moderately common. Spotted in Jhalara and Baramundia (Barapita RF).

Family : 11. VIVERRIDAE

16. ***Viverricula indica*** (Desmarest)

Common name : Small Indian civet (Eng.); Kasturi (Hindi); Gandhogakul (Beng); Saliapatini (Oriya).

Distribution : India : Widely distributed throughout the Indian mainland except deserts of Rajasthan.

Elsewhere : Southern China, Sri Lanka, Bhutan, Burma, Indo-China, Siam, Sumatra, Java and Bali.

Remarks : Seen in the bushes and in the villages at the periphery of the forest. Spotted at Dahanigarhia, Jhalara and near Kalajhar village.

17. ***Paradoxurus hermaphroditus*** (Pallas)

Common name : Common Palm civet or Toddy cat (Eng.); Lakati, Khatus (Hindi); Baghda (Beng); Dali Odha (Oriya).

Distribution : India : Kashmir, the Himalayas and Assam, Southwards through whole of the Peninsular region.

Elsewhere : Southern China, Burma, Indo-China, Siam, Malay States, Sumatra,

Java and Borneo, Philippines and Sri Lanka.

Remarks : Common. Spotted at Jhalara, Deras, Pithakhia, Naharthali, etc.

Family : 12. HERPESTIDAE[3]

18. ***Herpestes edwardsi*** (Geoffroy)

Common name : Common mongoose (Eng.); Newla (Hindi); Hatia Neula, (Oriya); Beji (Beng).

Distribution : India : North-west Frontier, Assam, southwards over Peninsular India to Cape Comorin.

Elsewhere : Iran, Iraq, Afghanistan, Pakistan, Nepal, Sri Lanka.

Remarks : Diurnal and frequently seen on roadside near spring of Jhalara, Ambilo, Deras, Nuakua, Godibari, etc.

19. ***Herpestes auropunctatus*** (Hodgson)

Common name : Small Indian Mongoose (Eng.); Kuji Neula (Oriya).

Distribution : India : Kashmir, south to Gujarat, Madhya Pradesh, Bihar, West Bengal, Orissa and Assam.

Elsewhere : Northern Arabia, Iran, Iraq, Afghanistan, Nepal, Burma, Siam and Malay States.

Remarks : Diurnal and lives in holes; seen near the bushes of Ambilo, Jhalara and Pithakhia.

Family : 13. FELIDAE

20. ***Felis chaus*** Guldenstaedt

Common name : Jungle cat (Eng.); Jangali Billi (Hindi); Bano billar (Beng); Bana Bhuan (Oriya)

Distribution : India : From Himalaya to Cape Comorin.

Elsewhere : Widely distributed from North Africa through South-western Asia to India, Sri Lanka, Burma and Indo-China

Remarks : Seen in the scruby areas of the forest and is not very common. Spotted near Baramundia and Bhallumundia.

21. ***Panthera pardus*** (Linnaeus) * (Plate 4)

Common name : Leopard (Eng.); Chita bagh or sona chita (Hindi); Chita bagh (Beng); Kalara-patria bagh, Pendra (Oriya).

Distribution : India : Occurs throughout the country.

Elsewhere : Southwestern Turkestan, Siberia, China, Tibet, Nepal, Burma, Sri Lanka, Malayan countries, Arab, Iran, Egypt, Algeria, Morocco and Tropical Africa.

Remarks : Few adults and cubs are present, mostly in and around Ambilo, Jhalara, Ambakhali, Kumarkhundi and Sanchuria mundia.

Order : VII. PROBOSCIDEA

Family : 14. ELEPHANTIDAE

22. ***Elephas maximus indicus*** G. Cuvier * (Plate 5)

Common name : Indian Elephant (Eng.); Hathi (Hindi, Beng, Oriya).

Distribution : India : Occurs in the North-east India, foothills of Himalaya in the Terai region of Uttar Pradesh, Orissa, Bihar, West Bengal, Tamil Nadu, Karnataka, Kerala.

Elsewhere : Bangladesh, Burma, Brunei, China, Indonesia, Kamphuchea, Laos, Malaysia, Nepal, Thailand and Vietnam (Sukumar, 1989).

Remarks : It is the most important species of the Sanctuary and its present population is around 70 as estimated from census by the first author and Chandaka Sanctuary staffs. It has been spotted in almost all the areas of the Sacntuary and during the paddy season in the peripheral area of the forest.

Order : VIII. ARTIODACTYLA

Family : 15. SUIDAE

23. ***Sus scrofa*** Linnaeus (Plate 6)

Common name : Indian Wild Boar (Eng.); Jangali Suar (Hindi); Buno Suar (Beng); Barha (Oriya).

Distribution : India : Occurs throughout the country.

Elsewhere : Widely distributed throughout the world; Burma, Tennaserim, Siam, part of Malay Peninsular, Pakistan, Nepal, Bangladesh and Sri Lanka.

Remarks : The sanctuary has a good population of this species. They dig the soil surface in search of food. Seen near Ambilo, Koduamundia, Kheluachua, Ambakhali and Jantari mundia. They are found throughout the Sanctuary.

Family : 16. CERVIDAE

24. ***Muntiacus muntjak*** (Zimmermann) (Plate 7)

Common name : Barking Deer (Eng.); Kakar (Hindi); Kutura (Oriya).

Distribution : India : Peninsular India, Uttar Pradesh, Assam and Malabar coast of South India.

Elsewhere : Southern China, Indo-China, Siam, Malay states, Nepal, Burma, Sri Lanka, Sumatra, Java, Borneo and adjacent Islands.

Remarks : They are quite common, diurnal in habit and distinct male and female call can be heard in night. Spotted at Ambilo, Kumarkhundi and Jantari mundia.

25. ***Axis axis axis*** (Erxleben) (Plate 8)

Common name : Spotted Deer (Eng.); Chital (Hind & Beng); Chitala (male) and Nandi (female) (Oriya).

Distribution : India : Throughout the Indian mainland except the northeastern region, Jammu & Kashmir, Himachal Pradesh.

Elsewhere : Nepal and Bangladesh.

Remarks : Very common throughout the forest and they can be seen in group during early morning and evening. Spotted in almost the entire region of the forest.

26. ***Cervus unicolor*** (Kerr)

Common name : Sambar (Eng., Hindi, Beng., Oriya).

Distribution : India : Forested area of India.

Elsewhere : Sri Lanka, Burma, Malay countries, Indo-China, Siam, Sumatra, Java, Borneo, Celebes and eastward to Philippines and beyond.

Remarks : Very rare. Only one spotted by forest staff.

Family : 17. TRAGULIDAE

27. ***Tragulus meminna*** (Erxleben) *

Common name : Indian Chevrotain, Mouse Deer (Eng.); Pisora (Hindi); Gurundi (Oriya).

Distribution : India : Occurs throughout the Peninsular India, the northern limit being Rajasthan and Bihar (Das et. al., 1991).

Elsewhere : Sri Lanka and Nepal.

Remarks : Moderate. Spotted in and around Ambilo, Godibari, Pandari mundia and Barachudia mundia.

Order : IX. RODENTIA

Family : 18. MURIDAE

28. ***Rattus blanfordi*** (Thomas)

Common name : White tailed wood rat (Eng.).

Distribution : India : Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Orissa, Bihar and West Bengal.

Elsewhere : Sri Lanka.

Remarks : Moderately common. Spotted near bamboo and scruby area of Ambilo.

29. ***Rattus rattus*** (Linnaeus)

Common name : Common House Rat (Eng.); Musa (Oriya).

Distribution : India : Throughout the Indian mainland.

Elsewhere : In almost all part of the world.

Remarks : Common. Spotted near Ambilo tower, Jhalara, Godibari, Dampara Guest House and other fringe areas of the forest.

30. ***Mus booduga*** (Gray)

Common name : Little Indian Field mouse (Eng).

Distribution : India : Throughout the country.

Elsewhere : Nepal, Pakistan, Burma and Sri Lanka.

Remarks : Common. Spotted near Jhalara, Deras, Kalajhar, Behantashi, Dampara, Godibari, Kumarkundi, etc.

31. ***Golunda ellioti*** Gray

Common name : Indian Bush rat (Eng).

Distribution : India : Throughout Indian mainland.

Elsewhere : Nepal, Pakistan, Bhutan and Sri Lanka.

Remarks : Moderate. Spotted mostly in and around Ambilo, Jhalara and Dampara.

32. ***Bandicota bengalensis*** (Gray & Hardwicke)

Common name : Indian mole Rat or Lesser Bandicoot Rat (Eng.); Gatua musa (Oriya).

Distribution : India : Peninsular region, northward to Kathiawar, Sind, Punjab, Kashmir and Assam.

Elsewhere : Sri Lanka, Burma, Nepal, Sumatra and Java.

Remarks : Common and can be seen near Beat Offices and Watch Towers and in fringe areas of the forest.

33. ***Bandicota indica*** (Bechstein)

Common name : Large Bandicoot Rat (Eng.); Musa (Oriya).

Distribution : India : Peninsular India, Uttar Pradesh, Delhi, Gujarat, West Bengal, Assam, Tamil Nadu, Karnataka and Nilgiri Hills.

Elsewhere : Nepal, Burma, Indo-China, Siam, Java, Sumatra and Hong Kong.

Remarks : Common. Generally seen in the fringe areas of the forest near the villages. Also spotted near Nuakua, Pithakhia and Ambakhali temple.

Family : 19. HYSTRICIDAE

34. ***Hystrix indica*** (Kerr)

Common name : Indian crested Porcupine (Eng.); Siyal, Sahi (Hindi); Sajaru (Beng); Jhinka (Oriya).

Distribution : India : Throughout India.

Elsewhere : Sri Lanka, Nepal, Afghanistan, Iran, Iraq, Palestine, Syria, Egypt, Southern and Eastern Russia.

Remarks : Moderately common. Seen on hill top on rocks and in caves. Spotted near Ambakhali temple, Kheluachua and Bhallumundia.

Family : 20. SCIURIDAE

35. ***Funambulus palmarum*** (Linnaeus)

Common name : Three striped palm squirrel (Eng.); Gilheri (Hindi); Kat Berali (Beng); Patta musa (Oriya).

Distribution : India : West Bengal, Bihar, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharashtra.

Elsewhere : Sri Lanka (Das et. al., 1991).

Remarks : Common and can be seen on trees and ground in almost all the areas of the Sanctuary.

36. ***Funambulus pennanti*** Wroughton

Common name : Five striped palm squirrel (Eng.); Gilheri (Hindi); Kat Berali (Beng); Patta musa (Oriya).

Distribution : India : whole of North India, the southern limits being Maharashtra and northern portion of Andhra Pradesh, Orissa.

Elsewhere : Pakistan, Nepal and Bangladesh.

Remarks : Not seen in the dense forest but in the fringe area of the forest near villages. Spotted near Deras and Dahanigarhia village.

Order : X. LAGOMORPHA

Family : 21. LEPORIDAE

37. ***Lepus nigricollis*** Cuvier

Common name : Indian Hare (Eng.); Khargosh (Hindi and Beng); Thekua (Oriya).

Distribution : India : Peninsular India, West Bengal, Sikkim, Assam, Punjab, Sind, Cutch and Kathiawar.

Elsewhere : Sri Lanka, Java, Nepal and Bhutan Duars.

Remarks : Very common and are seen in grasslands and cultivated lands nearby. Spotted on way to Behantasia, Ambakhali and near Bhola village.

SUMMARY

The present paper deals with 10 orders of mammalia, spread over 21 families, 33 genera and 37 species. This is a first attempt to provide a checklist of the Mammalian fauna of this Sanctuary.

Family Muridae is represented by 6 species and Family Pteropodidae, Canidae and Cervidae by 3 species each, but other families have lesser representation.

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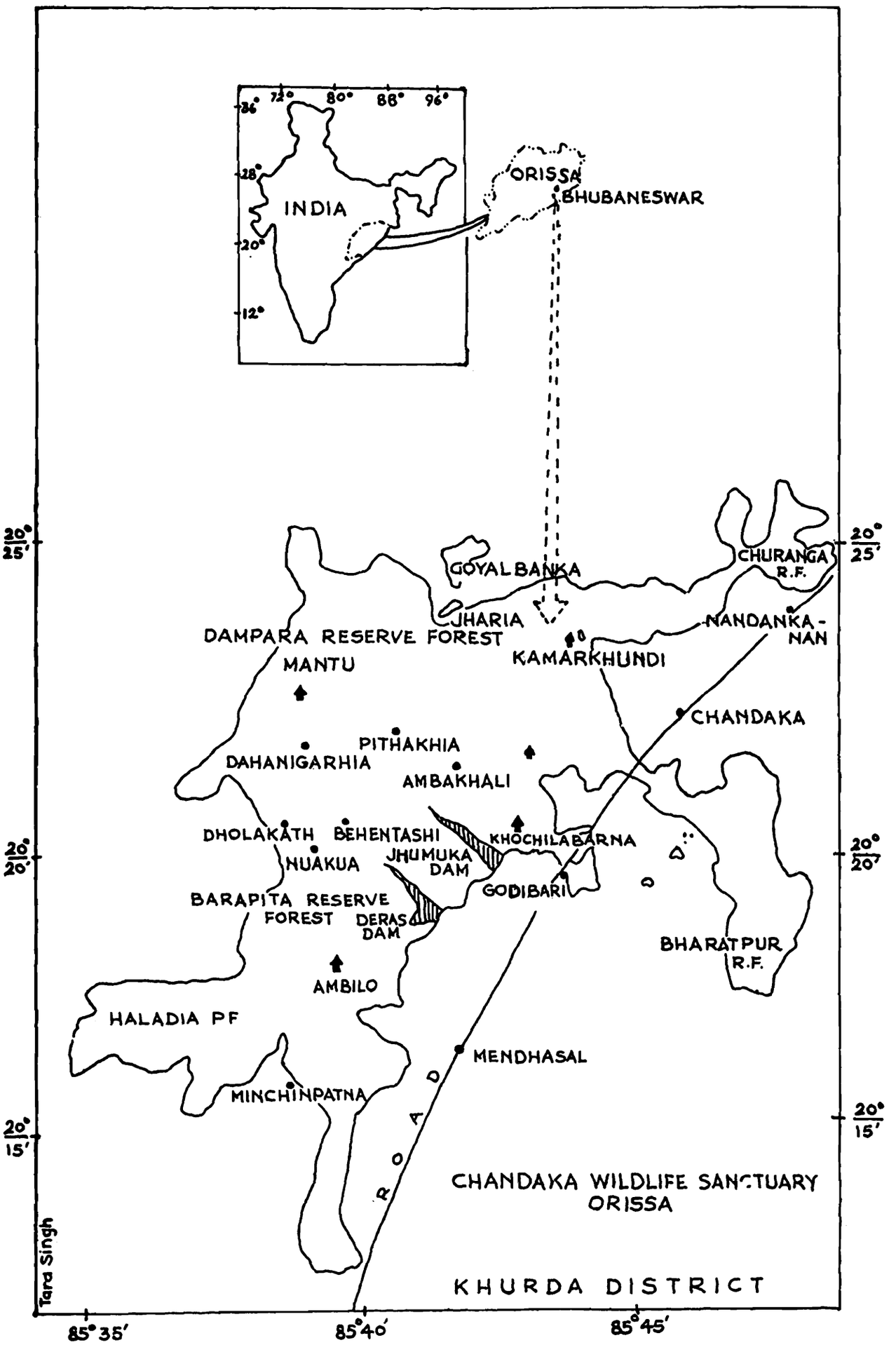
72°
80°
88°
96°
36°
28°
20°
12°
INDIA
ORISSA
BHUBANESWAR
20° 25'
20° 20'
20° 15'
85° 35'
85° 40'
85° 45'
GOYALBANKA
CHURANGA R.F.
JHARIA
DAMPARA RESERVE FOREST
NANDANKA-NAN
KAMARKHUNDI
MANTU
CHANDAKA
PITHAKHIA
DAHANIGARHIA
AMBAKHALI
DHOLAKATH
BEHENTASHI
KHOCHILABARNA
NUAKUA
JHUMUKA DAM
GODIBARI
BARAPITA RESERVE FOREST
DERAS DAM
BHARATPUR R.F.
AMBILO
HALADIA PF
MENDHASAL
MINCHINPATNA
CHANDAKA WILDLIFE SANCTUARY
ORISSA
KHURDA DISTRICT
Tara Singh

Map-1

Plate 1 : Indian Pangolin (*Manis crassicaudata*)

Plate 2 : Common Langur (*Presbytis entellus*)

Plate 3 : Ratel (*Mellivora capensis*)

Plate 4 : Leopard (*Panthera pardus*)

Plate 5 : Indian Elephant (*Elephas maximus indicus*)

Plate 6 : Indian Wild Boar (*Sus scrofa cristatus*)

Plate 7 : Barking Deer (*Muntiacus muntjak)*

Plate 8 : Spotted Deer (*Axis axis axis*)

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STUDIES ON EUGREGARINIDA (APICOMPLEXA : SPOROZOEA : SEPTATINA) OF INDIAN ODONATES (ARTHROPODA : INSECTA : ODONATA). A SYNOPSIS OF THE GENERA AND SPECIES

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INTRODUCTION

Bhatia and Setna (1924) initiated the study on Eugregarinida (Apicomplexa : Septatine) parasitising the midgut of Arthropoda in India. Sarkar and Chakravarty (1969) have first time described *Actinocephalus ceriagrionae*, a septate gregarine from the midgut of the Damselfly *Ceriagrion coromandelianum* (Fabr.) (This host was erroneously written as beetle). Recently, the contributions from Haldar et al. (1985) and Das et al. (1993) have further enhanced the knowledge about the septate gregarines of India. In recent past, Levine (1988) listed various gregarines update a very significant contribution on gregarines. The present study, however, reflects the recent status of 32 species of septate gregarines from 21 species of Indian Odonates.

MATERIAL AND METHODS

Odonates, in most cases, were collected alive, brought back to the laboratory and examined the midguts of the hosts for the septate gregarines. These gregarines were studied in fresh with a drop of Lugol's iodine solution and observed under the microscope after sealing the edges of the coverglass with nail polish or paraffin. The permanent slides were prepared by fixing the smears on glass slides with Schaudinn's fluid and subsequently stained by Heindenhain's Iron-alum Haematoxylin. The cysts obtained from the hindgut as well as faeces of the hosts, were placed in the moist chamber for further development. The sporocysts released from the cysts by simple rupture were observed with a drop of Lugol's iodine under the oil immersion lens of an Olympus microscope. The ratios used here are LP : TL and WP : WD where LP denotes the length of the protomerite, TL the total length, WP the width of the protomerite and WD the width of the deutomerite. All the measurements are given in micrometer (μm). The figures given are not upto the scale. In a few cases, the observations were based on the available literatures.

TAXONOMIC ACCOUNT

Phylum : APICOMPLEXA Levine, 1970

Class : SPOROZOEA Leuckart, 1879

Subclass : GREGARINIA, Dufour, 1828

Order : EUGREGARINIDA Léger, 1900

Suborder : SEPTATINA Lankester, 1885

Family : ACTINOCEPHALIDAE Leger, 1892

Key to the genera

Subfamily : ACANTHOSPORINAE Léger, 1892 emend. Grasse, 1953

1. Epimerite regular, non-appendiculate

2. Epimerite complex, discoid, appendiculate

3(1). Epimerite globular with short or no neck

4(2). Epimerite digitiform with long neck

5(3). Sporocyst with polar and equatorial spines ..... *Acanthospora* Léger 1892

6(4). Sporocyst with polar & meridional spines ..... *Ancyrophora* Léger, 1892

7(6). Epimerite a membranous cup with numerous longitudinal folds ..... *Mukundaella* Sarkar, 1981

8(3). Epimerite with backwardly directed, plate-like longitudinal spines

9(8). Sporocyst biconical with a pair of sharp polar spines ..... *Tetractinospora* Sarkar and Haldar, 1981

10(3). Epimerite a group of upwardly directed conical papillae

11(10). Sporocyst flat, diamond-shaped with a pair of polar and two pairs of mid-lateral spines (one pair on each side) ..... *Tetra-meridionospinispora* Kori & Amoji, 1985

12(2). Epimerite highly complex with ramified spines

13(12). Sporocyst biconical with polar & meridional spines ..... *Ramicephalus* Obata, 1953

Subfamily : MENOSPORINAE Léger, 1892 emed. Grasse, 1953

1. Epimerite complex with short neck

2. Epimerite complex with long neck

3(1). Epimerite cup-like with recurved digitiform processes at the margin

4(2) Epimerite hat-shaped with petaloid spines

5(3) Sporocyst smooth, cylindro-biconical ..... *Menospora* Léger emend. Sarkar, 1995

6(4). Sporocyst smooth, boat-shaped ..... *Odonaticola* Sakar & Haldar, 1981

7(2). Epimerite digitiform, branched ..... bifid & trifid

8(7). Sporocyst smooth, crescentic ..... *Hoplorynchus* Carus, 1863

Subfamily : ACTINOCEPHALINAE Labbe, 1899

1. Epimerite complex with short neck

2(1). Epimerite with hooks or spines

3(2). Sporocyst smooth, ellipsoidal ..... *Actinocephalus* Stein, 1848

Family : DACTYLOPHORIDAE Léger, 1892

1. Epimerite complex with short neck

2(1). Epimerite digitiform, branched (bifid)

3(2). Sporocyst smooth, ellipsoidal with pseudocyst ..... *Dendrorhynchus* Keilin, 1920

SYNOPSIS OF THE GENERA & SPECIES

Family : ACTINOCEPHALIDAE, Léger, 1892

Subfamily : ACANTHOSPORINAE Leger, 1892 emend. Grasse, 1953

Acanthospora Léger, 1892

Epimerite (mucron) regular, non-appendiculate, sessile or stalked, dehiscenece of cyst by simple rupture, sporocyst biconical or spindle-shaped with polar and equatorial spines in both. One species

Acanthospora bengalensis Sarkar & Haldar, 1981

Epimerite globular or bulb-like, 16.90 μm × 21.20 μm, neck short, largest trophozoite 758.0 μm long, largest sporadin 913.70 μm long, LP : TL = 1 :7.0, WP : WD = 1 : 1.0 ; gametocyst spherical, sporocyst spindle-shaped with truncate ends also with polar and equatorial spines ; development intracelluler (Fig. 1 – 4).

Site of infection : Midgut.

Host : *Ceriagrion cerinorubellum* (Brauer).

Locality : Chinsurah, West Bengal, India

Ancyrophora Léger, 1892

Epimerite discoid or globular with 5 – 12 processes (tentacular, recurved digitiform or spinous), sessile or stalked, shape of the gametocys variable, sporocyst biconical with polar and equatorial spines. 2 species.

Key to species

1. Epimerite discoid with digitiform processes
2. Epimerite globular with slightly recurved processes

3(1). Dimension of epimerite 11.0 μm × 12.8 μm

4(2). Dimension of epimerite 27.7 μm × 19.6 μm

5(3). Gametocyst spherical ..... *Ancyrophora ischnurae* Sarkar and Haldar, 1991

6(4). Gametocyst oval ..... *Ancyrophora ovoides* Sarkar & Haldar, 1981

Ancyrophora ischnurae Sarkar and Haldar, 1981

Epimerite discoid with 12 short, recurved, digitiform processes, 11.0 μm × 12.8 μm ; stalked ; largest trophozoite 218.0 μm long ; largest sporadin 748.9 μm long ; LP : TL = 1 : 6.1, WP : WD = 1 : 0.9 ; sporocyst spindle-shaped, hexagonal ; maridional spines longer than polar spines, 6.0 μm × 3.5 μm (Figs. 5 – 8).

Site of infection : Midgut.

Host : *Ischnura senegalensis* (Rambur).

Locality : Hooghly, West Bengal, India.

Ancyrophora ovoides Sarkar and Haldar, 1981

Epimerite globular, 10 – 11 radiating slender digitiform processes. stalked, 22.7 μm × 19.6 μm ; largest trophozoite 542.7 μm long ; largest sporadin 916.8 μm long ; LP : TL = 1 : 5.4, WP : WD = 1 : 1.01 ; gametocyst ovoidal ; sporocyst spindle-shaped, equatorial spines longer than polar spine 6.0 μm × 4.5 μm (Figs. 9 – 12).

Site of infection : Midgut.

Host : *Ischnura aurora aurora* (Brauer).

Locality : Hooghly, West Bengal, India.

Mukundaella Sarkar, 1981

Epimerite a wide cup with numerous vertical undulations on its wall ; neck very short or absent ; gametocyst spherical ; sporocyst diamond-shaped hexagonal, with polar and equatorial spines. 3 species :

Key to species

1. Epimerite a wide cup with vertical undulations
2. Epimerite a bud with vertical undulations

3(1). Broad cup with numerous undulations

4(2). Bud with a few undulations

5(3). No neck between epimerite and protomerite

6(4). Neck very short between epimerite and protomerite

7(5). Epimerite 17.0 μm × 28.4 μm in dimension

8(6). Epimerite 38.5 μm long

9(7). Gametocyst spherical

10(8). Gametocyst spherical to ovate

11(9). Sporocyst diamond-shaped with 2 polar spines ..... *Mukundaella undulatus* Sarkar, 1981

12(10). Sporocyst diamond-shaped with 4 polar spines ..... *Mukundaella agriocnemii* Prema & Janardanan, 1991

13(1). Cup with fewer undulations

14(13). The gregarine from a distantly placed odonate, *Copera* sp. ..... *Mukundaella gurbargaensis* Kori & Amoji, 1984

Mukundaella undulatus Sarkar, 1981

Epimerite a small hemisphere at early stage, wide cup with numerous vertical undulations on its wall when fully differentiated, 17.0 μm × 28.4 μm ; neck almost absent ; largest trophozoite 484.3 μm × 43.4 μm ; largest sporadin 467.6 μm × 83.5 μm ; LP : TL = 1 : 6.36, WP : WD = 1 : 1.2 ; gametocyst spherical ; sporocyst diamond-shaped, hexagonal in polar view, 2 polar and 6 meridional spines, 8.5 μm × 5.0 μm (Figs. 53 – 56).

Site of infection : Midgut.

Host : *Enallagma* sp.

Locality : Hooghly & 24-Parganas(N), West Bengal, India.

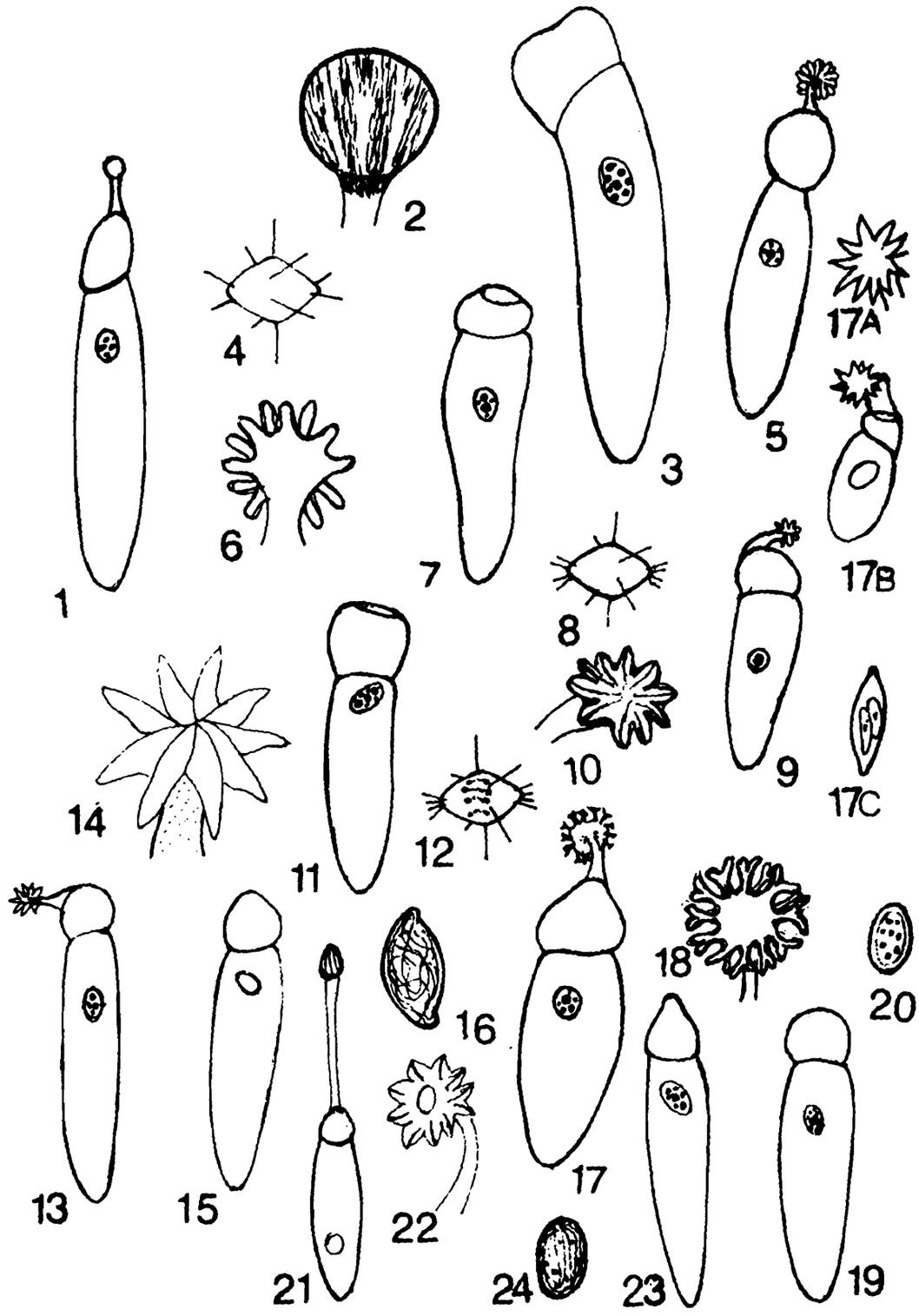
Mukundaella agriocnemii Prema & Janardanan, 1991

Epimerite bud-like with vertical folds to look like a lower, 38.5 μm long, neck very short ; largest trophozoite 1035.4 μm long ; largest sporadine 1108.8 μm long ; gametocyst spherical to ovate ; sporocyst diamond-shaped, hexagonal in polar view, 4 polar and 6 meridioal spines, 6.0 μm – 7.5 μm × 4.5 μm ; LP : TL = 1 : 6.8, WP : WD = 1 : 1.0 ; (Figs. 57 – 59).

Site of infection : Midgut.

Host : *Agriocnemis* sp.

Locality : Calicut University campus, Mallappuram, Kerala, India.



Figs. 1 – 4. *Acanthospora bengalensis*— 1.–Trophozoite, 2.–Epimerite, 3.–Sporadin, 4.–Sporocyst.
Figs. 5 – 8. *Ancyrophora ischnuri*— 5.–Trophozoite, 6.–Epimerite, 7.–Sporadin, 8.–Sporocyst.
Figs. 9 – 12. *Ancyrophora ovoides*— 9.–Trophozoite, 10.–Epimerite, 11.–Sporadin, 12.–Sporocyst.
Figs. 13 – 16. *Actinocephalus ellipsoidus*— 13.–Trophozoite, 14.–Epimerite, 15.–Sporadin, 16.–Sporocyst.
Figs. 17A – 17C. *Actinocephalus ceriagrionae*— 17A.–Epimerite, 17B.–rophozoite, 17C.–Sporocyst.
Figs. 17 – 20. *Dendrorhynchus keilini*— 17.–Trophozoite, 18.–Epimerite, 19.–Sporadin, 20.–sporocyst.
Figs. 21 – 24. *Actinocephalus bradinopygi*— 21.–Trophozoite, 22.–Epimerite, 23.–Sporadin, 24.–Sporocyst.

Remark : It is the only gregarine species where a little variation in the length of the sporocyst is noticed.

Mukundaella gulbargaensis Kori & Amoji, 1984

Epimerite cup or vase-shaped with 12 – 16 vertical undulations or fold on its wall ; very short neck ; largest trophozoite 810.0 μm long ; largest sporadin 1750.0 μm long ; LP : TL = 1 : 3.8 – 8.8, WP : WD = 1 : 0.57 – 1.3 ; gametocyst spherical ; sporocyst diamond-shaped, hexagonal in polar view, 2 polar and 6 maridional spines, 7.5 μm × 5.0 μm (Figs. 60 – 63).

Site of infection : Midgut.

Host : *Copera* sp.

Locality : Gulbarga, Karnataka, India.

Ramicephalus Obata, 1953

Epimerite dish-like, complex with many radially and upwardly directed dendroidal processes ; at the top a cylindrical, longitudinally striated bulb set upon a short neck ; sporocyst diamond-shaped with polar and meridional spines. 1 species :

Ramicephalus olivacus Sarkar and Haldar, 1981

Epimerite complex, cylindro-globular consisting of an upper disc with 15 – 20 ramified spines and lower cylinder with longitudinal striations ; very short neck ; epimerite 28.8 μm × 32.3 μm ; largest trophozoite 411.6 μm long ; largest sporadin 1024.0 μm long ; LP : TL = 1 : 6.1, WP : WD = 1 : 0.96 ; gametocyst spherical with ectocyst ; sporocyst spindle-shaped with shorter polar and longer meridional spines (Figs. 113 – 117).

Site of infection : Midgut.

Host : *Ceriagrion olivaceum* Laidlow.

Locality : Hooghly, West Bengal, India.

*****Tetrameridionospinispora*** Kori and Amoji, 1985

Syn. ***Rodgiella*** Sarkar, 1995

Epimerite a shallow cup, many papilla-like processes on its margin ; sessile ; sporocyst biconical with 2 pairs of polar and 2 pairs of equatorial spines-1 pair on each side at the equatorial region. 1 species :

*****Tetrameridionospinispora ceriagrioni*** (Nazeer Ahamed & Narasimhamurti, 1979) Kori & Amoji, 1985

** cited from Levine (1988)

Syn. ***Ancyrophora ceriagrioni*** Nazeer Ahamed & Narasimhamurti 1979

Rodgiella ceriagrioni Sarkar, 1995

Epimerite a shallow cup ; its margin provided with 17 – 20 papillate processes, sessile ; largest trophozoite 900.0 μm × 200.0 μm ; largest sporadin 825.0 μm × 125.0 μm ; LP : TL = 1 : 9.2, WP : WD = 1 : 0.61 ; gametocyst spherical with an ectocyst of 40.0 μm thick ; sporocyst biconical, 6.5 μm × 5.4 μm, with polar and equatorial spines of equal length, 1 pair on each pole and 1 pair on each side ; each spine 5.0 μm long (Figs. 118 – 121).

Site of infection : Midgut.

Host : *Ceriagrion coromandelianum* (Fabr.).

Locality : Shanti Ashram, Waltair, Andhra Pradesh, India.

Tetractinospora Sarkar & Haldar, 1981

Epimerite globular with several vertical lamellar plates, short neck sporocyst biconical, bent at the middle, with 4 sharp and stout spines a pair at each pole. 1 species :

Tetractinospora victoris Sarkar & Haldar, 1981

Epimerite globular, 16 hyaline plates arranged longitudinally around the globular epimerite, anterior end of each plate round and posterior end sharply truncate, 20.0 μm × 23.2 μm ; short neck ; largest trophozoite 312.5 μm × 54.1 μm ; largest sporadin 466.7 μm × 83.3 μm ; LP : TL = 1 : 5.2, WP : WD = 1 : 0.9 ; gametocyst spherical, dehisces by simple rupture, sporocyst biconical, bent at the middle, a pair of sharply pointed, stout spines a each pole (extention of the sporocyst wall), 9.0 μm × 4.5 μm (excluding the polar spine) ; (Figs. 122 – 125).

Site of infection : Midgut.

Host : *Ceriagrion coromandelianum* (Fabr.).

Locality : Kalyani, West Bengal, India.

Subfamily : MENOSPORINAE Léger, 1892

Menospora Léger, 1892 emend. Sarkar, 1995

Syn. ***Levineia*** Kori & Amoji, 1986

Epimerite cup-like or bell-shaped, bordered with recurved hooks or digitiform processes ; long, slender neck ; gametocyst dehisces by simple rupture ; sporocyst smooth, cylindro-biconical or crescentic ; 4 species :

Key to the species

1. Epimerite cup-like, bordered with digitiform processes.

2. Epimerite bell-shaped with digitiform processes.

3(1). The cup with short neck.

4(2). The bell with long, slender neck.

5(3). Epimerite with more than 30 recurved digitiform processes ... *Menospora enallagmae* Sarkar Haldar, (1980) 1982.

6(5). Sporocyst cylindrobiconical, 10.2 μm × 4.0 μm ..... *Menospora coenagrii* Sarkar & Haldar, (1980) 1982

7(1). Recurved digitiform processes with terminal sucker ..... *Menospora agriocnema* (Kori & Amoji, 1991) Sarkar, 1995

8(3). Sporocyst cylyndrobiconical, 9.0 μm × 3.5 μm ..... *Menospora gulbargaensis* (Amoji & Kori, 1986) Sarkar, 1995

Menospora enallagmae Sarkar & Haldar, (1980) 1982

Epimerite a cup bordered with 32 recurned digitiform processes, long slender neck ; epimerite 21.5 μm in diameter ; largest trophozoite 412.7 μm × 63.7 μm ; largest sporadin 431.0 μm × 68.8 μm ; LP : TL = 1 : 6.1, WP : WD = 1 : 0.9 ; gametocyst spherical ; sporocyst cylindrobiconical, smooth, 10.5 μm × 3.8 μm. (Figs. 36 – 40).

Site of infection : Migut.

Host : *Enallagma parvum* Selys.

Locality : Hooghly, West Bengal, India.

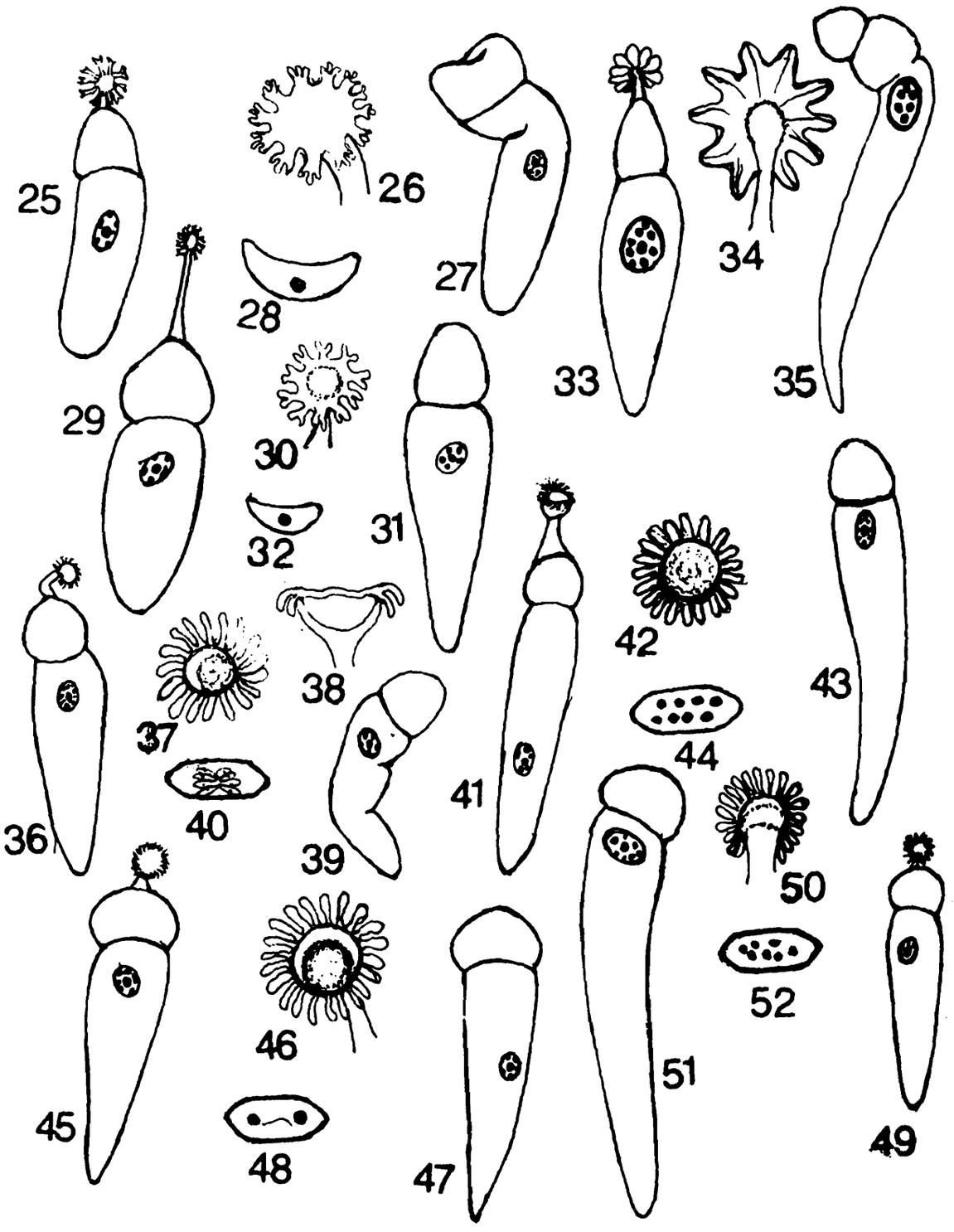
Menospora coenagrii Sarkar & Haldar, (1980) 1982

Epimerite bell-shaped with many recurved digitiform processes, long slender neck, epimerite 24.8 μm × 3.18 μm ; largest trophozoite 350.8 μm × 51.6 μm ; largest sporadin 451.2 μm × 61.2 μm ; LP : TL = 1 : 5.5, WP : WD = 1 : 0.9 ; gametocyst spherical ; sporocyst cylindro-biconical, 9.2 μm × 4.0 μm (Figs. 41 – 44).

Site of infection : Midgut.

Host : *Coenagrion dyeri* Fraster.

Locality : Hooghly, West Bengal, India.



Figs. 25 – 28. *Hoplorhynchus ramidigitus*— 25.–Trophozoite, 26.–Epimerite, 27.–Sporadin, 28.–Sporocyst.
Figs. 29 – 32. *Hoplorhynchus bahamanii*— 29.–Trophozoite, 30.–Epimerite, 31.–Sporadin, 32.–Sporocyst.
Figs. 33 – 35. *Hoplorhynchus carusi*— 33.–Trophozoite, 34.–Epimerite, 35.–Sporadin.
Figs. 36 – 40. *Menospora enallagmae*— 36.–Trophozoite, 37.–Epimerite, 38.–Vertical section through epimerite, 39.–Sporadin, 40.–Sporocyst.
Figs. 41 – 44. *Menospora coenagrii*— 41.–Trophozoite, 42.–Epimerite in frontal view, 43.–Sporadin, 44.–Sporocyst.
Figs. 45 – 48. *Menospora agriocnema*— 45.–Trophozoite, 46.–Epimerite in frontalview, 47.–Sporadin, 48.–Sporocyst.
Figs. 49 – 52. *Menospora gulbargaensis*— 49.–Trophozoite, 50.–Epimerite in side view, 51.–Sporadin, 52.–Sporocyst.

Menospora agriocnema (Kori & Amoji, 1986) Sarkar, 1995

Syn. ***Levineia agriocnema*** Kori & Amoji, 1986

Epimerite a wide cup bordered with 34 – 35 digitiform recurved processes – each with terminal sucker, epimerite 35.0 µm in diameter ; sporadin fusiform ; LP : TL = 1 8.2. WP : WD = 1 : 0.68 – 1.1 ; gametocyst spherical ; sporocyst cylindro-biconical, 10.0 µm × 4.5 µm (Figs. 45 – 48).

Site of infection : Midgut.

Host : *Agriocnemis pygmaea* (Rambur).

Locality : Gulbarga, Karnataka, India.

Menospora gulbargaensis (Amoji & Kori, 1991) Sarkar, 1995

Syn. ***Levinia gulbargaensis*** Amoji & Kori, 1991

Epimerite cup-like, with many digitiform processes ; short, slender neck ; epimertie 12.6 µm long ; largest trophozoite 102.6 µm × 22.3 µm ; largest sporadin 710.0 µm × 160.0 µm ; LP : TL = 1 : 1.3 – 7.8, WP : WD = 1 : 0.4 – 1.1 ; gametocyst spherical ; sporocyst cylindro-biconical, 9.0 µm × 3.5 µm (Figs. 49 – 52).

Site of infection : Midgut.

Host : *Agriocnemis pygmaea* (Rambur).

Locality : Gulbarga, Karnataka, India.

Hoplorhynchus Carus, 1863 emend. Grasse, 1953

Epimerite a flat disc with many digitiform processes at the periphery, processes may be branched or unbranched ; usually a long neck ; gametocyst spherical, dehisces by simple rupture ; sporocyst smooth biconical or crescentic. 3 species :

Key to species

1. Epimerite with long narrow neck
2. Epimerite with short neck

3(1). The disc with radially arranged, unbranched, slightly recurved processes

4(2). The disc with bifid and trifid, short processes

5(3). The processes unbranched, not more than 10 ..... *Hoplorhynchus carasi* Sarkar & Mazumder, 1983

6(4). The processes branched (bifid & trifid) ..... *Hoplorhynchus ramidigitus* Sarkar & Haldar, 1980

7(4). The disc with 10 bifid processes

8(7). Sporocyst largestd, 16.0 µm × 5.0 µm ..... *Hoplorhynchus bahamani* Sailaja & Amoji, 1992

Hoplorhynchus ramidigitus Sarkar & Haldar, 1980

Epimerite a disc with 11 –14 bifid and trifid, stumpy digitiform processes, 16.7 μm in diam., short neck ; largest tropozoite 175.0 μm × 33.3 μm ; Largest sporadin 700.1 μm × 166.7 μm ; LP : TL = 1 : 4.9, WP : WD = 1 : 0.97 ; gametocyst spherical ; sporocyst crescentic, 12.0 μm × 3.5 μm. (Figs. 15 – 28).

Site of infection : Midgut.

Host : *Agriocnemia phygmaea* (Rambur).

Locality Chinsurah, West Bengal, India.

Hoplorhynchus carusi Sarkar & Mazumder, 1983

Epimerite a disc with 10 radially arranged digitiform processes (slightly recurved), long narrow neck ; largest trophozoite 805.0 μm × 60.0 μm ; largest sporadin 650.0 μm × 92.0 μm ; LP : TL = 1 : 9.8, WP : WD = 1 : 1.1 gametocyst and sporocyst unknown (Figs. 33 – 35).

Site of infection : Midgut.

Host : *Pseudagrion decorum* (Rambur).

Locality : Mahananda forest, West Bengal, India.

Hoplorhynchus bahamanii Sailaja & Amoji, 1992

Epimerite disc-like with 10 bifid digitiform processes, 24.5 μm × 13.25 μm long slender neck ; largest trophozoite 210.0 μm × 57.5 μm ; LP : TL = 1 : 3.55, WP : WD = 1 0.95 ; gametocyst spherical ; sporocyst crescentic, 16.0 μm × 5.0 μm (Figs. 29 – 32).

Site of infection : Midgut.

Host Coenagrionid larvae (Odonata).

Locality : Gulbarga, Karnataka, India.

Odonaticola Sarkar & Haldar, 1981

Epimerite hat-shaped with petaloid spines at the margin, long neck ; sporadin solitary ; gametocysts dehisce by simple rupture ; sporocysts boat-shaped, smooth ; development extracellular ; 12 species :

Key to species

1. Epimerite hat-shaped with long neck

2. Epimerite a conical, inverted cup, long neck

3(1). Margin of the hat with with petaloid spines

4(2). Margin of cup with broad spines

5(3). Epimerite with 6 spines ..... *Odonaticola hexacantha* Sarkar & Haldar, 1981

6(4). Epimerite with 7 spines, very long neck ..... *O. longicollara* Sarkar & Haldar, 1981

7(1). Epimerite hat-like, umbrella-shaped margin

8(7). Umbrella-like margin with many sharp spines

9(8). Epimerite 13.7 μm in diameter

10(9). Boat-shaped sporocyst measures 8.5 μm × 3.5 μm ..... *O. orthetri* Sarkar & Haldar, 1981

11(3). Epimerite with 8 petaliod spines

12(11). Epimerite 14.2 μm × 17.4 μm in dimension

13(12). Sporocyst 10.7 μm long ..... *O. rodgii* Sarkar & Haldar, 1981

14(7). Epimerite with many petaloid spines

15(14). Epimerite 12.3 μm × 22.5 μm in dimension ..... *O. brachydiplaxi* Sarkar & Haldar, 1981

16(2). Epimerite with many small recurved spines

17(8). Epimerite 15.8 μm × 20.0 μm in dimension

18(10). Sporocyst 12.0 μm × 5.0 μm in dimension ..... *O. elliptica* Sarkar, 1981

19(2). Epimerite with 9 petaloid spines

20(19). Long slender neck

21(20). Epimerite 24.2 μm × 28.3 μm

22(21). Sporocyst 8.5 μm × 4.5 μm ..... *O. nonacontha* (Devdhar & Despande, 1971) Sarkar, 1981

23(1). Epimerite dome-shaped, 8 downwardly directed petaloid spines

24(23). Gametocyst oval

25(24). Sporocyst boat-like, 13.8 μm × 4.4 μm ..... *O. diplacodi* Kori & Amoji, 1986

26(1). Epimerite hood-shaped, long narrow neck

27(26). Epimerite with several filamentous, curved spines

28(27). Gametocyst oval

28(28). Sporocyst oval, 12.0 μm × 4.0 μm ..... *O. crocothemis* Kori & Amoji, 1983

30(1). Epimerite bell-shaped, long neck

31(30). Epimerite with 8 petaloid spines

32(31). Gametocyst oval

33(32). Sporocyst spindle-like in dorsal view

34(33). Sporocyst 13.0 μm × 5.0 μm ..... *O. haldari* Kori & Amoji, 1984

35(1). Epimerite with 7 – 11 marginal spines

36(35). Epimerite measures 16.0 μm × 6.0 μm

37(36). Gametocyst very large

38(37). Sporoduct cord-like (?)

39(36). Sporocyst small, boat-shaped, 7.5 μm × 4.5 μm ..... *O. pantalae* Prema & Janardanan, 1991

40(1). Epimerite with 6 petaloid spines

41(40). Sporosyst boat-shaped, 9.0 μm × 4.5 μm ..... *O. nurothemisi* Prasadan & Janardanan, 1994

Odonaticola hexacentha Sarkar & Haldar, 1981

Epimerite hat-shaped with 6 petaloid spines at the margin, 9.0 μm × 11.1 μm, long slender neck ; largest trophozoite 273.1 μm long ; largest sporadin 758.5 μm long ; LP : TL = 1: 4.2, WP : WD = 1 : 1.4 ; gametocyst soherical : sporocyst released in the group of three forming a triangle, each one boat-shaped with a very small rectangular projection on each end, 7.5 μm × 3.0 μm. (Figs. 64 – 67).

Site of infection : Midgut.

Host : *Brachythemis contaminata* (Fabr.).

Locality Chinsurah, West Bengal, India.

Odonaticola longicollara Sarkar & Haldar, 1981

Epimerite a conical cup with 7 petaloid spines at its margin, 18.0 μm × 22.9 μm ; very long slender neck ; largest trophozoite 838.1 μm long ; largest sporadin 1467.8 μm long ; LP : TL = 1 : 7.0, WP : WD = 1 : 1.2 ; gametocyst spherical ; sporocyst boat-shaped with short projections on either end, 7.5 μm × 4.1 μm. (Figs. 68 – 71).

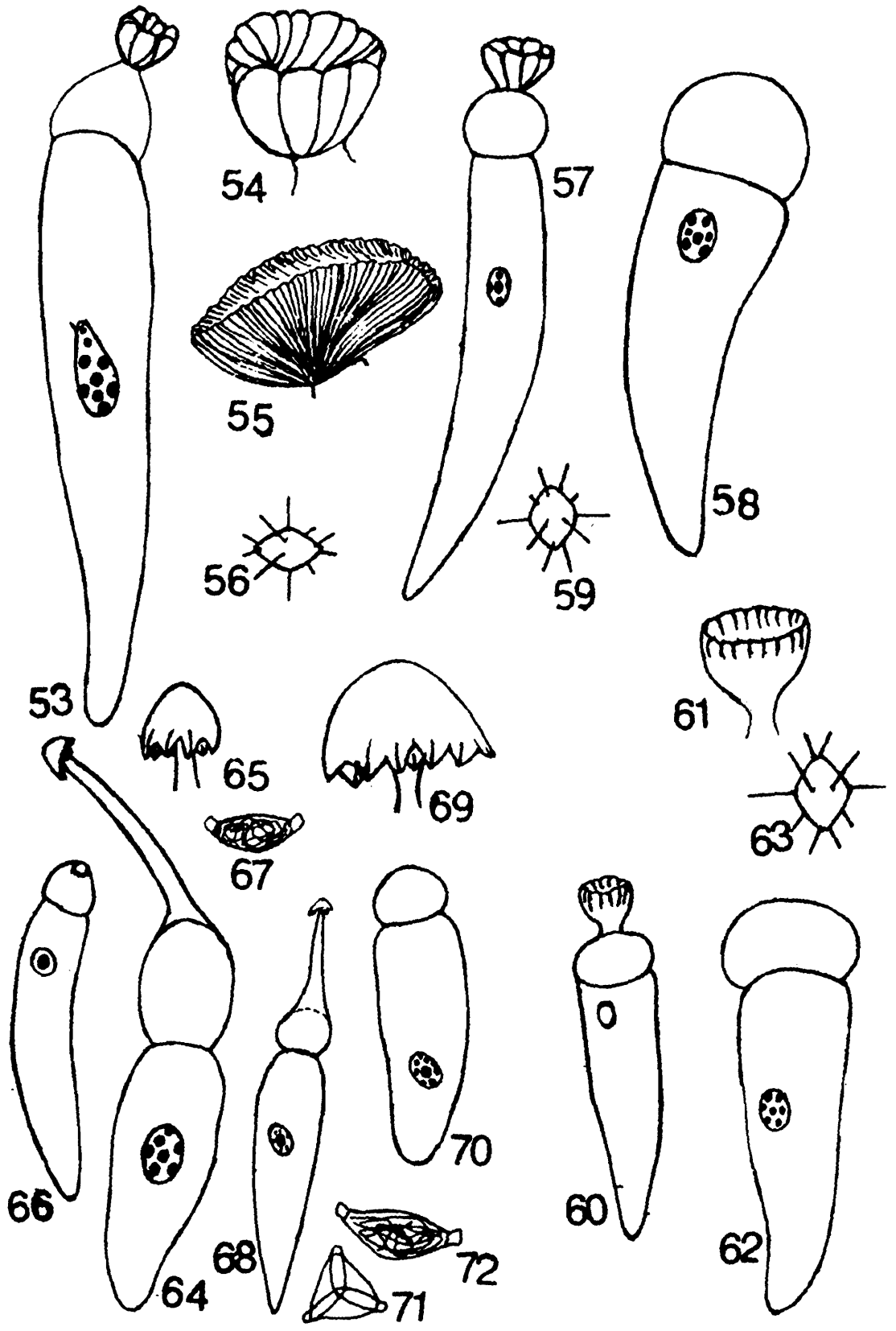
Site of infection : Midgut.

Host : *Diplacodes trivialis* (Rambur).

Locality : Chinsuran, West Bengal, India.

Odonaticola orthetri Sarkar & Haldar, 1981

Epimerite hat-shaped with umbrella-like margin leading to several sharp spines, 13.7 μm in diam. ; moderately long neck ; largest trophozoite 33.70 μm long ; largest sporadin 950.2 μm long ; LP : TL = 1 : 5.4, WP : WD = 1 : 1.3 ; gametocyst spherical ; sporocyst boat-shaped with small rectangular projection on either ends, 8.5 μm × 3.5 μm (Figs. 74 – 77).



Figs. 53 – 56. *Mukunaella undulatus*— 53.–Trophozoite, 54. & 55.–Epimerite, 56.–Sporocyst.
Figs. 57 – 59. *Mukundaella agriocnemii*— 57.–Trophozoite, 58.–Sporadin, 59.–Sporocyst.
Figs. 60 – 63. *Mukandaella gulbargaensis*— 60.–Trophozoite, 61.–Epimerite, 62.–Sporadin, 63.–Sporocyst.
Figs. 64 – 67. *Odonaticola hexacantha*— 64.–Trophozoite, 65.–Epimerite, 66.–Sporadin, 67.–Sporocyst.
Figs. 68 – 72. *Odonaticola longicollara*— 68.–Trophozoite, 69.–Epimerite, 70.–Sporadin, 71.–Aggregation of 3 sporocyst, 72.–Sporocyst.

Site of infection Midgut.

Host *Orthetrum sabina* (Drury).

Locality Chinsurah, West Bengal, India.

Odonaticola rodgii Sarkar & Haldar, 1981

Epimerite hat-shaped with 8 petaloid spines at its margin, 14.2 µm × 17.4 µm ; long slenden neck lartgest trophozoite 268.8 µm × 54.6 µm ; largest sporadin 1624.5 µm long ; LP : TL = 1 : 6.4, WP : WD = 1 : 1.06 ; gametocyst spherical ; sporocyst boat-shaped with small, rectangular, terminal projections, 10.7 µm × 4.0 µm (Figs. 78 – 81).

Site of infection Midgut.

Host *Neurothemis tullia tullia* (Drury).

Locality Kalyani, West Bengal, India.

Odonaticola elliptica Sarkar, 1981

Epimerite conical, umbrella-like with many small curve spines along its margin, 15.8 × 20.0 µm ; very long, slender neck ; largest trophozoite 309.4 µm × 62.5 µm ; largest sporadin 1512.0 µm × 294.6 µm ; PL : TL = 1 : 7.2, WP : WD = 1 : 1.2 ; gametocyst spherical ; sporocyst boat-shaped with a lateral projection on each side, 12.0 µm × 5.0 µm (Figs. 108 – 112).

Site of infection : Midgut.

Host : *Crocothemis servilia servilia* (Drury).

Locality : Chinsurah, West Bengal, India.

Odonaticola nonacontha (Devdhar & Deshpande, 1971) Sarkar, 1981

Syn. : ***Menospora nonacontha*** Devdhar & Deshpande, 1917.

Epimerite conical, umbrella-like with 9 marginal pataloid spines, 24.2 µm × 28.3 µm ; long, slender neck ; LP : TL = 1 : 7.2, WP : WD = 1 : 1.2 ; gametocyst spherical ; sporocyst boat-shaped with lateral projectios, 8.5 µm × 4.5 µm. (Figs. 104 – 107).

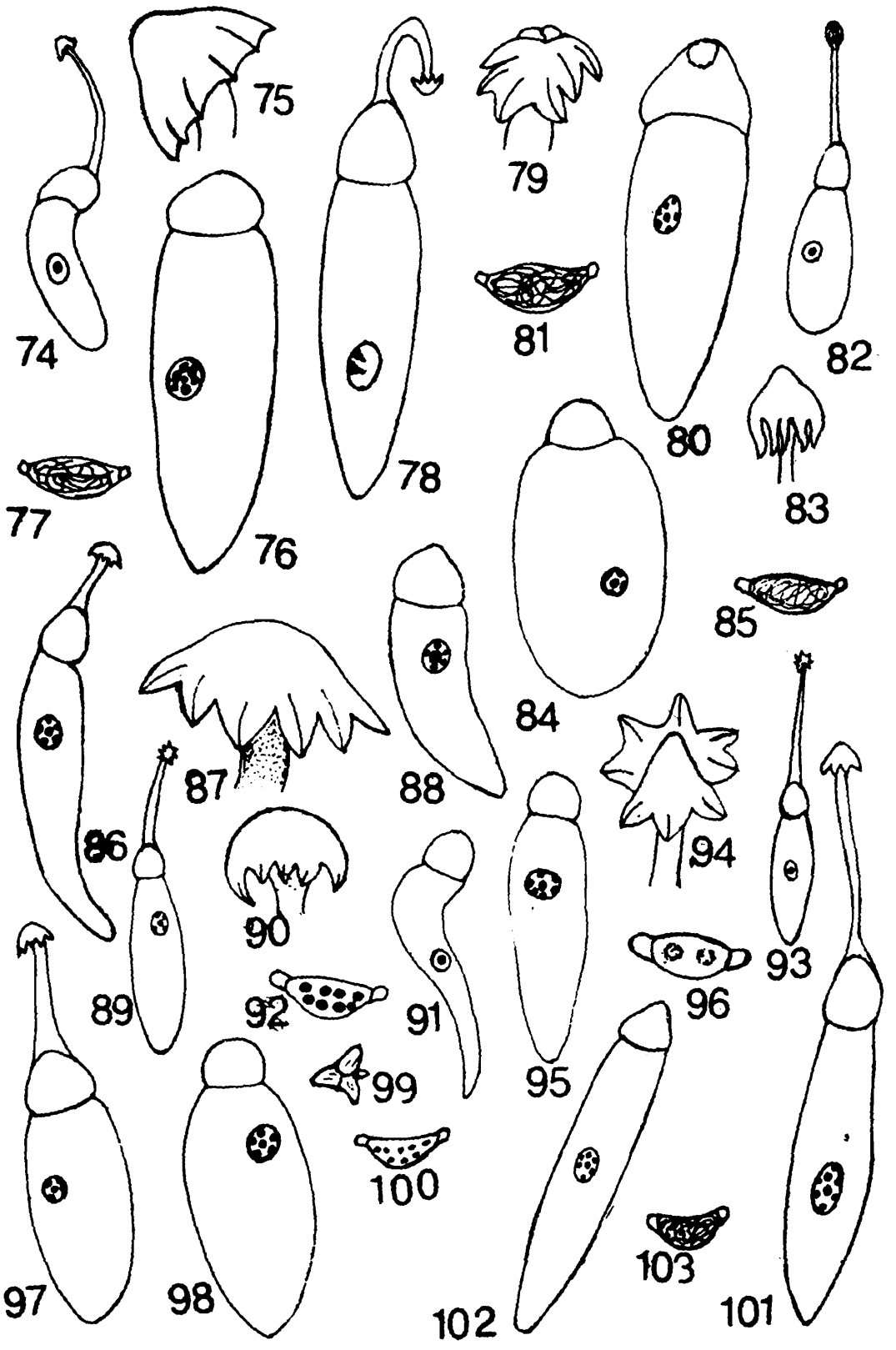
Site of infection : Midgut.

Host : *Urothemis signata signata* (Drury).

Locality Karnataka & West Bengal, India.

Odonaticola brachydiplaxi Sarkar & Mazumder,1983

Epimerite umbrella-shaped with many marginal petaloid spines, 12.5 µm × 22.5 µm ; long neck ; largest trophozoits 382.0 µm × 45.0 µm ; largest sporadin 265.0 µm × 60.0 µm ; LP : TL = 1 : 5.04, WP : WD = 1 : 1.14 ; gametocyst and sporocyst unknown. (Figs. 86 – 88).



Figs. 74 – 77. *Odonaticola orthetri*— 74.–Trophozoite, 75.–Epimerite, 76.–Sporadin, 77.–Sporocyst.
Figs. 78 – 81. *Odonaticola rodgii*— 78.–Trophozoite, 79.–Epimerite, 80.–Sporadin, 81.–Sporocyst.
Figs. 82 – 85. *Odonaticola crocothemis*— 82.–Trophozoite, 83.–Epimerite, 84.–Sporadin, 85.–Sporocyst.
Figs. 86 – 88. *Odonaticila brachydiplaxi*— 86.–Trophozoite, 87.–Epimerite, 88.–Sporadin.
Figs. 89 – 92. *Odonaticola diplacodi*— 89.–Trophozoite, 90.–Epimerite, 91.–Sporadin, 92.–Sporceyst.
Figs. 93 – 96. *Odonaticola haldari*— 93.–Trophozoite, 94.–Epimerite, 95.–Sporadin, 96.–Sporocyst.
Figs. 97 – 100. *Odonaticola pantalae*— 97.–Trophozoite, 98.–Sporadin, 99.–3 sporocyst attached, 100.–Sporocyst.
Figs. 101 – 103. *Odonaticola neurothemisi*— 101.–Trophczoite, 102.–Sporadin, 103.–Sporocyst.

Site of infection : Midgut.

Host : *Brachydiplax farinosa* Kruger.

Locality Mahananda Forest, West Bengal, India.

Odonaticola crocothemis Kori & Amoji, 1983

Epimerite hood-shapped with several filamentous, curved spines ; long neck ; largest trophozoite 540.0 μm long ; largest sporadin 575.0 μm long ; LP : TL = 1 : 5 – 9.5, WP : WD = 1 : 1.8 – 3.6 ; gametocyst oval ; sporocyst boat-shaped with lateral projections, 12.0 μm × 4.0 μm. (Figs. 82 – 85).

Site of infection : Midgut.

Host : *Crocothemis servilia servilia* (Drury).

Locality : Gulbarga, Karnataka, India.

Odonaticola haldari Kori & Amoji, 1984

Epimerite bell-shaped, 8 petaloid spines in the margin ; long neck ; largest trophozoite 770.0 μm long ; largest sporadin 1750.0 μm long ; LP : Tl = 1 : 4.2 – 13.6, WP : WD = 1 : 1.0 – 2.3 ; gametocyst oval ; sporocyst boat-shaped, spindle-like in dorsal view, 13.0 μm × 5.0 μm. (Figs. 93 – 96).

Site of infection : Foregut & Midgut.

Host : *Trithemis aurora* (Burmeister).

Locality : Gulbarga, Karnataka, India.

Odonatocola diplacodi Kori & Amoji, 1986

Epimerite dome-shaped, 8 downwardly directed petaloid spines ; moderately long neck ; largest sporadin 1550.0 μm long ; LP : TL = 1 : 3.5 – 10.75, WP : WD = 1 : 0.6 – 1.75 ; gametocyst oval ; sporocyst boat-shaped, small, terminal projections, 13.8 μm × 4.4 μm. (Figs. 89 – 92).

Site of infection : Midgut.

Host : *Diplacodes trivialis* (Rambur).

Locality : Gulbarga, Karnatak, India.

Odonaticola pantalae Prema & Janardanan, 1991

Epimerite hat-shaped, 7 – 11 petaloid, marginal spines, 16.0 μm × 6.0 μm ; neck long ; lartest trophozoite 880.0 μm long where epimerite is 38.0 μm long ; largest sporadin 1871.0 μm long ; gametocyst spherical ; sporoduct (?) naked ; sporocyst boat-shaped with two short projections at poles, 7.5 μm × 4.5 μm. (Figs. 97 – 100).

Site of infection : Midgut.

Host : *pantala flavescens* (Fabr.).

Locality : Calicut University campus, Kerala, India.

Odonaticola neurothemisi Prasadan & Janardanan, 1994

Epimerite hat-shaped with 6 petaloid spines ; long neck ; largest trophozoite 862.0 μm long ; **largest** sporadin 1778.0 μm long ; gametocyst spherical ; sporocyst released in the form of a naked **sporoduct** (?), sporocyst boat-shaped with a small projection at each pole, 9.0 μm × 4.5 μm. **(Figs.** 101 – 103).

Site of infection : Midgut.

Host : *Neurothemis fulvia* (Drury).

Locality : Calicut University Campus, Kerala, India.

Subfamily : ACTINOCEPHALINAE Labbé, 1899

Actinocphus Stein, 1848

Epimerite with 8 – 10 stout spines or simple digitifor processes ; sessile or with short neck ; **sporocyst** smooth, biconical. 3 species.

Key to species

1. Epimerite a globular crown or a cap
2. Epimerite a discoid plate

3(1). Crown with 16 or more lateral spines

4(2). Disc with 7 to 9 slightly recurved hooks

5(3). Gametocyst spherical

6(4). Gametocyst ellipsoidal

7(5). Sporocyst biconical with rounded ends, 12.40 μm × 4.28 μm .....*Actinocephalus ceriagrionae* Sarkar & Chakravarty, 1969

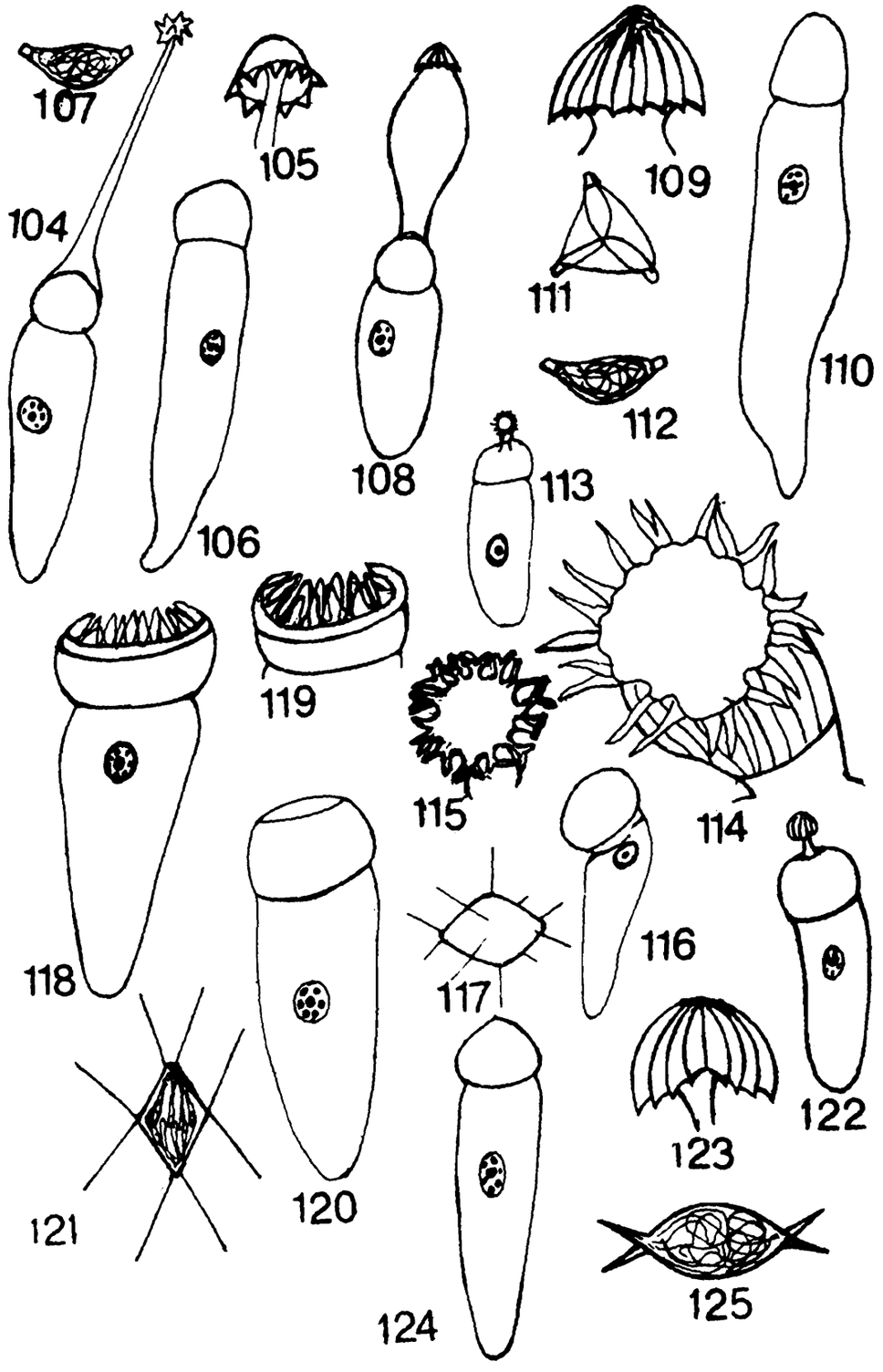
8(6). Sporocyst biconical, 8.0 μm × 4.5 μm .....*Actinocaphalus ellipsoidus* Sarkar & Haldar, 1981.

9(1). Cap with petaloid lobes, long neck

10(9). Gametocyst spherical

11(10). Sporocyst oval, 17.0 μm × 5.0 μm ..... *Actinocephalus bradinopygi* Narasimhamurti & Nazeer Ahamed, 1980

..... *Actinocephalus ceriagrionae* Sarkar & Chakravarty, 1969



Figs. 104 – 107. *Odonaticila nonacontha*— 104.–Trophozoite, 105.–Epimerite, 106.–Sporadin, 107.–Sporocyst.
Figs. 108 – 112. *Odonaticola elliptica*— 108.–Trophozpozoite, 109.–Epimerite, 110.–Sporadin, 111.–Association of 3 sporocyst, 112–Sporocyst.
Figs. 113 – 117. *Ramicephalus olivacus*— 113.–Trophozoite, 114 & 115.–Epimerite, 116.–Sporadin, 117.–Sporocyst.
Figs. 118 – 121. *Tetrameridionospinospora ceriagroni*— 118.–Trophozoite, 119.–Epimerite, 120.–Sporadin, 121.–Sporocyst.
Figs. 122 – 125. *Tetractinospora victoris*— 122.–Trophozoite, 123.–Epimerite, 124.–Sporadin, 125.–Sporocyst.

Epimerite a globular crown with 16 short and stout, lateral, digitiform processes set upon a short, cylindrical neck ; trophozoite (largest) 258.0 μm ; sporadin (largest) 1.0 mm ; LP : TL = 1 : 5.5, WP : WD = 1 : 1.1 ; gametocyst spherical : sporocyst biconical, 12.4 μm × 4.28 μm.

Site of infection : Midgut.

Host : *Ceriagrion coromandelianum* (Fabr.).

Locality : Howrah, West Bengal, India.

Actinocephalus ellipsoidus Sarkar & Haldar, 1981

Epimerite discoid with 7 – 9 slightly recurved, pointed processes, 18.8 μm in diameter ; stalked ; largest trophozoite 458.3 μm long ; largest sporadin 916.8 μm long ; LP : TL = 1 : 7.6, WP : WD = 1 : 1.3 ; Gametocyst ellipsoidal ; Sporocyst biconical, 8.0 μm × 4.5 μm (Figs. 13 – 16).

Site of infection : Midgut.

Host : *Ischnura aurora aurora* (Bramis.).

Locality : Kalyani, West Bengal, India.

Actinocephalus bradinopygi Narasimhamurti & Nazeer Ahamed 1980

Epimerite conical with 9 – 11 petaloid lobes, long neck, largest trophozoite 825.0 μm × 160.0 μm ; largest sporadin 1300.0 μm × 255.0 μm ; Gametocyst spherical ; Sporocyst oval, 17.0 μm × 5.0 μm (Figs. 21 – 24).

Site of infection : Midgut.

Host : *Bradinopyga greminata* Rambur.

Locality : Visakhapatnam, Andhra Pradesh, India.

Remark : The epimarite of this species shows much similarity with that of the *Odonaticola* but its sporocyst does not ; in fact distinctly different from the boat-shaped sporocyst of *Odonaticola*. I, therefore, retain the present status of this species.

Family DACTYLOPHORIDAE

Dendrorhynchus Keilin, 1920 emend. Levine, 1988

Dendrorhynchus Keilin, 1920 emend, Levine, 1988

Epimerite a sucker boardered with ramified lobes (papillae) ; transverse fibrils conspecuous ; gametocyst ellipsoidal ; sporocyst biconical (fusiform). 1 species :

Dendrorhynchus keilini Nazeer Ahmed & Narasimhamurt, 1980

Epimerite a disc (32.0 μm in diam.), the margin produced into 13 – 16 bifid papillae ; very

short neck ; largest trophozoite 400.0 μm long ; largest sporadin 410.0 μm × 156.0 μm ; epicyte with transvrese fibrils in the deutomerite ; gametocyst spherical, dehisces by simple rupture ; sporocyst oval, 12.0 μm × 5.0 μm, sporozoite spindle-like, 7.0 μm × 3.0 μm. LP : TL = 1 : 3.47, WP : WD = 1 : 1.1 (Figs. 17 – 20).

Site of infection : Midgut.

Host : *Ceriagrion coromandelium* (Fabr.).

Locality : Visakhapatnam, Andhra Pradesh, India.

SUMMARY

This study reveals that there are 32 species of Eugregarinida (Apicomplexa : Sporozoea : Septatina) described so far from Indian Odonates (Arthopoda : Insecta : Odonata). These gregarines are referable to 11 genera viz. *Acanthospora* Léger, 1892 ; *Actinocephalus* Stein, 1848 ; *Ancyrophora* Leger, 1892 ; *Dendrorhynchus* Kielin, 1920 ; *Hoplorhynchsu* Carus, 1863 emend. Grasse 1953 ; *Menospora* Léger,1892 ; emend : Sarkar, 1995 ; *Mukundaella* Sarkar, 1981 *Odonaticola* Sarkar & Haldar, 1981 ; *Ramicephalus* Obata, 1953 ; *Tetractinospora* Sarkar & Haldar, 1986 and *Tetrameridionospinispora* Kori & Amoji, 1985. belonging to the family Actinocephalidae Leger, 1892 from 21 species of Odonata.

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ENDEMIC AMPHIBIANS OF INDIA

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INTRODUCTION

205 species of amphibians of 10 families and 33 genera have so far been reported from within the political boundaries of the Republic of India (Inger and Dutta, 1986; Chanda and Ghosh, 1988; Das, 1990; Dutta, 1992; Deuti, 1996). Of these, 123 species (i.e., 60%) under 8 families and 25 genera are considered to be endemic to India. In the present paper an attempt has been made to provide a list of all the endemic Indian amphibians together with their type localities and distribution.

SPECIES LIST

Order : APODA
Family : ICHTHYOPHIIDAE
Genus : ***Ichthyophis*** Fitzinger, 1826

1. ***Ichthyophis beddomei*** Peters, 1879

Type locality : Nilgherrie (Nilgiri), South India.
Distribution : Kerala, Tamil Nadu and Karnataka.

2. ***Ichthyophis bombayensis*** Taylor, 1960

Type locality : Waghai, Surat, Bombay (now in Gujrat).
Distribution : Gujrat, Maharashtra and Karnataka.

3. ***Ichthyophis longicephalus*** Pillai, 1986

Type locality : Silent valley, Kerala.
Distribution : Kerala (known from type locality only).

4. ***Ichthyophis malabarensis*** Taylor, 1960

Type locality : Maduvangard, Travancore, Kerala.
Distribution : Kerala and Karnataka.

5. ***Ichthyophis peninsularis*** Taylor, 1960

Type locality : Malabar, Kerala.
Distribution : Kerala and Tamil Nadu.

6. ***Ichthyophis sikkimensis*** Taylor, 1960

Type locality : Darjeeling, West Bengal.
Distribution : West Bengal and Sikkim.

7. **Ichthyophis subterrestris** Taylor, 1960

Type locality : Travancore, Cochin plains, Kerala.
Distribution : Kerala, Tamil Nadu and Maharashtra

8. ***Ichthyophis tricolor*** Annandale, 1909

Type locality : Maddathora, Cochin, Kerala.
Distribution : Kerala (known from type locality only).

Family : URAEOTYPHLIDAE
Genus : ***Uraeotyphlus*** Peters, 1879

9. ***Uraeotyphlus malabaricus*** (Beddome, 1870)

Type locality : Malabar, Kerala.
Distribution : Kerala and Tamil Nadu.

10. ***Uraeotyphlus menoni*** Annandale, 1913

Type locality : Trichur, Cochin, Kerala.
Distribution : Kerala (known from type locality only).

11. ***Uraeotyphlus narayani*** Seshachar, 1939

Type locality : Kannam, 16 miles from Kottayam, Travancore, Kerala.
Distribution : Kerala and Karnataka.

12. ***Uraeotyphlus oxyurus*** (Dumeril and Bibron, 1841).

Type locality : Cote du Malabar, south India.
Distribution : Kerala and Tamil Nadu.

Family : CAECILIDAE
Genus : ***Gegeneophis*** Peters, 1879

13. ***Gegeneophis carnosus*** (Beddome, 1870).

Type locality : Periah peak at about 500 ft elevation, Wynaad, Kerala.
Distribution : Kerala.

14. ***Gegeneophis fulleri*** (Alcock, 1904).

Type locality : Kuttal, 6 miles south-west of Silchar in Cachar, Assam.
Distribution : Assam (known from type locality only).

15. ***Gegeneophis ramaswami*** Taylor, 1964

Type locality : Tenmalai forest, Pajapura near Trivandrum town, Kerala
Distribution : Kerala (known from type locality only).

Genus : ***Indotyphlus*** Taylor, 1960

16. ***Indotyphlus battersbyi*** Taylor 1960

Type locality : Khandala, Poona district, Maharashtra.
Distribution : Maharashtra.

Order : ANURA
Family : PELOBATIDAE
Genus : ***Megophrys*** Kuhl and Van Hasselt, 1822

17. ***Megophrys robusta*** (Boulenger, 1908).

Type locality : Darjeeling, West Bengal.
Distribution : West Bengal (known from type locality only).

Genus : ***Scutiger*** Theobald, 1868

18. ***Scutiger occidentalis*** Dubois, 1978.

Type locality Shukdhari, Sonamarg, Kashmir
Distribution : Jammu and Kashmir (known from type locality only).

Family : BUFONIDAE
Genus : ***Ansonia*** Stoliczka, 1870

19. ***Ansonia kamblei*** Ravichandran and Pillai, 1990.

Type locality : Jeur, 29 kms north of Tembhurni, Karnala, Sholapur district, Maharashtra
Distribution : Maharashtra (known from type locality only).

20. ***Ansonia ornata*** Gunther, 1875.

Type locality : Brahmagiri hills in Coorg, Mysore, Karnataka
Distribution : Karnataka.

21. ***Ansonia rubigina*** Pillai and Pattabiraman, 1981.

Type locality : Kummattan Thodu, a tributary of river Kunthipuzha, Silent valley, alt 1005 meters, Kerala
Distribution : Kerala (known from type locality only).

Genus : ***Bufo Laurenti,*** 1768

22. ***Bufo abatus*** Ahl, 1925

Type locality : Darjeeling, West Bengal.
Distribution : West Bengal (known from type locality only).

23. ***Bufo beddomei*** Gunther, 1875

Type locality : Travancore hills, between 2500-4500 ft, Kerala.
Distribution : Kerala, Karnataka and Maharashtra

24. ***Bufo brevirostris*** Rao, 1937

Type locality : Kempholey, Hassan, Karnataka
Distribution : Karnataka (known from type locality only).

25. ***Bufo camortensis*** Mansukhani and Sarkar, 1980

Type locality : Compound of Camorta guest house, Camorta, Nicobar
Distribution : Andaman and Nicobar Islands.

26. ***Bufo hololius*** Gunther, 1875

Type locality : Malabar, Kerala
Distribution : Kerala, Karnataka and Andhra Pradesh.

27. ***Bufo koynayensis*** Soman, 1963

Type locality : Hambali village, Koyna, Satara district, Maharashtra
Distribution : Maharashtra (known from type locality only).

28. ***Bufo parietalis*** Boulenger, 1882

Type locality : Malabar, Kerala
Distribution : Kerala, Karnataka and Maharashtra

29. ***Bufo silentavalleyensis*** Pillai, 1981

Type locality : Valiaparai Thodu, Silent valley forests, Kerala
Distribution : Kerala (known from type locality only).

Genus : ***Bufoides*** Pillai and Yazdani, 1973

30. ***Bufoides meghalayana*** (Yazdani and Chanda, 1971)

Type locality : Plateau of a large hill at Mawblang, about 5 kms by road south-east of Cherrapunji town. Meghalaya
Distribution : Meghalaya (known from type locality only).

Genus : ***Pedostibes*** Gunther, 1875

31. ***Pedostibes kempi*** (Boulenger, 1919)

Type locality : Tura, Garo hills, Assam (now in Meghalaya)
Distribution : Meghalaya and Mizoram

32. ***Pedostibes tuberculosus*** Gunther, 1875

Type locality : Malabar, Kerala
Distribution : Kerala (known from type locality only)

Family : MICROHYLIDAE
Genus : ***Melanobatrachus*** Beddome, 1878

33. ***Melanobatrachus indicus*** Beddome, 1878

Type locality : Anamallai hills, 4000 ft, Tamil Nadu
Distribution : Tamil Nadu

Genus : ***Microhyla*** Tschudi, 1838

34. ***Microhyla chakrapani*** Pillai, 1977

Type locality : Mayabunder, east of Burma temple, north Andaman
Distribution : Andaman Islands (known from type locality only)

Genus : ***Ramanella*** Rao and Ramanna, 1925

35. ***Ramanella anamalaiensis*** Rao, 1937

Type locality : Base of Anamallai hills, Coimbatore district, Tamil Nadu
Distribution Tamil Nadu (known from type locality only)

36. ***Ramanella minor*** Rao, 1937

Type locality : Saklespur, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

37. ***Ramanella montana*** (Jerdon, 1854)

Type locality : Mountain streams in Wynaad, Kerala
Distribution : Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujrat

38. ***Ramanella mormorata*** Rao, 1937

Type locality : Saklespur, Hassan, Karnataka
Distribution : Karnataka and Goa

39. ***Ramanella triangularis*** (Gunther, 1875)

Type locality : Hills of Nilgiris and Malabar, Kerala
Distribution : Kerala, Tamil Nadu and Karnataka

Family : RANIDAE
Genus : ***Indirana*** Laurent, 1986

40. ***Indirana beddomii*** (Gunther, 1875)

Type locality : Malabar and Travancore in the Anamallays (Anamallais) and Sevagherry (Sivagiri), Kerala
Distribution : Kerala, Tamil Nadu, Karnataka and Maharashtra

41. ***Indirana brachytarsus*** (Gunther, 1875)

Type locality : Anamallais and Sivagiris, Kerala
Distribution : Kerala and Tamil Nadu

42. ***Indirana diplostictus*** (Gunther, 1875)

Type locality : Malabar, Kerala
Distribution : Kerala and Tamil Nadu

43. ***Indirana gundia*** (Dubois, 1985)

Type locality : Saklespur, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

44. ***Indirana leithii*** (Boulenger, 1888)

Type locality : Matheran, Bombay, Maharashtra
Distribution : Kerala, Tamil Nadu, Karnataka, Maharashtra, Gujrat and Madhya Pradesh

45. ***Indirana leptodactylus*** (Boulenger, 1882)

Type locality : Malabar forests, Kerala
Distribution : Kerala, Tamil Nadu and Karnataka

46. ***Indirana phrynoderma*** (Boulenger, 1882)

Type locality : Anamallays (Anamallais), Kerala
Distribution : Kerala (known from type locality only)

47. ***Indirana semipalmatus*** (Boulenger, 1882)

Type locality : Malabar, Kerala
Distribution : Kerala, Tamil Nadu and Karnataka

48. ***Indirana tenuilingua*** (Rao, 1937)

Type locality : Kempholey Ghats, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

Genus : ***Limnonectes*** Fitzinger, 1843

49. ***Limnonectes andamanensis*** (Stoliczka, 1870)

Type locality : Port Blair, south Andaman Island
Distribution : Andaman Islands

50. ***Limnonectes brevipalmata*** (Peters, 1871)

Type locality : Malabar, Kerala
Distribution : Kerala, Tamil Nadu and Karnataka

51. ***Limnonectes keralensis*** (Dubois, 1980)

Type locality : Malabar, Kerala
Distribution : Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujrat

52. ***Limnonectes khasiensis*** (Anderson, 1871)

Type locality : Khasi hills, Assam (now in Meghalaya)
Distribution : Meghalaya

53. ***Limnonectes mawphlangensis*** (Pillai and Chanda, 1977)

Type locality : Mawphlang, Khasi hills, Meghalaya
Distribution : Meghalaya, West Bengal, Manipur and Mizoram

54. ***Limnonectes murthii*** (Pillai, 1979)

Type locality : Naduvattom forest, 18 kms from Gudallur, Tamil Nadu
Distribution : Tamil Nadu, Kerala and Karnataka

55. ***Limnonectes nilagirica*** (Jerdon, 1853)

Type locality : Marshes in the Wynaad and Neelgherries (Nilgiris), Kerala
Distribution : Kerala and Tamil Nadu

56. ***Limnonectes sauriceps*** (Rao, 1937)

Type locality : Wattekole, Coorg, Karnataka
Distribution : Karnataka

57. ***Limnonectes shompenorum*** Das, 1996

Type locality 2 km east of Kopen heat, ca 14 km on the east-west road, Great Nicobar Island
Distribution : Great Nicobar Island (known from type locality only)

Genus : ***Micrixalus*** Boulenger, 1888

58. ***Micrixalus borealis*** Annandale, 1912

Type locality : Rotung, Abor hills, Arunachal Pradesh
Distribution : Arunachal Pradesh (known from type locality only)

59. ***Micrixalus fuscus*** (Boulenger, 1882)

Type locality : Hills of south-western India
Distribution : Kerala, Tamil Nadu and Karnataka

60. ***Micrixalus gadgili*** Pillai and Pattabiraman, 1990

Type locality : Dynamite house, Pamba, Sabarigiri forest, Kerala
Distribution : Kerala (known from type locality)

61. ***Micrixalus nudis*** Pillai, 1978

Type locality : A small brook inside the Kurichiat reserve forest, 8 kms north of Forest Rest House at Chedleth, Wynaad, Kerala
Distribution : Kerala

62. ***Micrixalus opisthorhodus*** (Gunther, 1868)

Type locality : Nilgiri hills, south India
Distribution : Kerala, Karnataka and Tamil Nadu

63. ***Micrixalus saxicola*** (Jerdon, 1853)

Type locality : Malabar, Kerala
Distribution : Kerala and Karnataka

64. ***Micrixalus silvaticus*** (Boulenger, 1882)

Type locality : Malabar, Kerala
Distribution : Kerala and Tamil Nadu

65. ***Micrixalus thampii*** Pillai, 1981

Type locality : Madari Mavam Thodu, tributary of river Kunthipuzha, Silent valley, alt 900 meters, Kerala
Distribution Kerala (known from type locality only)

Genus : ***Nyctibatrachus*** Boulenger, 1882

66. ***Nyctibatrachus aliciae*** Inger, Shaffer, Koshy and Bakde, 1984

Type locality : Ponmudi, Trivandrum district, Kerala
Distribution : Kerala, Karnataka and Tamil Nadu

67. ***Nyctibatrachus beddomii*** (Boulenger, 1882)

Type locality : Tinnevelly hills, Malabar, Kerala
Distribution : Kerala and Tamil Nadu

68. ***Nyctibatrachus deccanensis*** Dubois, 1984

Type locality : Anamallai hills, south India
Distribution : Kerala and Tamil Nadu

69. ***Nyctibatrachus humayuni*** Bhaduri and Kripalani, 1955

Type locality : Near way side hill stream, Mahabaleshwar, Satara district, Maharashtra
Distribution : Maharashtra, Karnataka and Goa

70. ***Nyctibatrachus kempholeyensis*** Rao, 1937

Type locality : Hills of Kempholey Ghats, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

71. ***Nyctibatrachus major*** Boulenger, 1882

Type locality : Malabar, Kerala
Distribution : Kerala, Tamil Nadu and Karnataka

72. ***Nyctibatrachus minor*** Inger, Shaffer, Koshy and Bakde, 1984

Type locality : Ponmudi, Trivandrum district, Kerala
Distribution : Kerala (known from type locality only)

73. ***Nyctibatrachus sanctipalustris*** Rao, 1920

Type locality : The sacred swamps of the Cauvery, Brahmagiri hills, 4000 ft, Coorg, Karnataka
Distribution : Karnataka (known from type locality only)

74. ***Nyctibatrachus sylvaticus*** Rao, 1937

Type locality : Forests of Kempholey, Saklespur, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

Genus : ***Occidozyga*** Kuhl and Van Hasselt, 1882

75. ***Occidozyga ghoshi*** (Chanda, 1990)

Type locality : Khugairk reserve forest, Manipur
Distribution : Manipur (known from type locality only)

Genus : ***Pterorana*** Kiyasetuo and Khare, 1986

76. ***Pterorana khare*** Kiyasetuo and Khare, 1986

Type locality : Sanuoru and Rukhroma waterfalls, Kohima, Nagaland
Distribution : Nagaland (known from type locality only)

Genus : ***Rana*** Linnaeus, 1758

77. ***Rana bilineata*** Pillai and Chanda, 1981

Type locality : Dianadubi forest, Garo hills, Meghalaya
Distribution : Meghalaya (known from type locality only)

78. ***Rana curtipes*** Jerdon, 1853

Type locality : Malabar, Kerala
Distribution : Kerala, Karnataka and Tamil Nadu

79. ***Rana garoensis*** Boulenger, 1920

Type locality : Tura, Garo hills, alt 3500-3900 ft, Meghalaya
Distribution : Meghalaya (known from type locality only)

80. ***Rana intermedius*** Rao, 1937

Type locality : Saklespur, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

81. ***Rana malabarica*** Tschudi, 1838

Type locality : Malabar hills, Kerala
Distribution : Kerala, Tamil Nadu, Karnataka, Goa, Madhya Pradesh and Gujrat

82. ***Rana mawlyndipi*** Chanda, 1990

Type locality : Mawlyndip, Khasi hills, Meghalaya
Distribution : Meghalaya (known from type locality only)

83. ***Rana senchalensis*** Chanda, 1986

Type locality : Senchal lake, Darjeeling district, West Bengal
Distribution : West Bengal (known from type locality only)

84. ***Rana tuberculata*** Tilak and Ray, 1985

Type locality : Kheel Gad, west of Purari, Chakrata hills, Dehradun, Uttar Pradesh
Distribution : Uttar Pradesh (known from type locality only)

Genus : ***Tomopterna*** Dumeril and Bibron, 1841

85. ***Tomopterna dobsonii*** (Boulenger, 1882)

Type locality : Mangalore, south Kannara, Karnataka
Distribution : Tamil Nadu, Karnataka, Andhra Pradesh and Maharashtra

86. ***Tomopterna leucorhynchus*** (Rao, 1937)

Type locality : Wattakole, Coorg, Karnataka
Distribution : Karnataka (known from type locality only)

87. ***Tomopterna parambikulamana*** (Rao, 1937)

Type locality : Parambikulam forest, Cochin, Kerala
Distribution : Kerala (known from type locality only)

88. ***Tomopterna rufescens*** (Jerdon, 1854)

Type locality : Malabar, Kerala
Distribution : Kerala, Karnataka, Goa and Maharashtra

Family : RHACOPHORIDAE
Genus : ***Chirixalus*** Boulenger, 1893

89. ***Chirixalus simus*** Annandale, 1915

Type locality : Mangaldai, north of Brahmaputra, Assam
Distribution : Assam (known from type locality only)

Genus : ***Philautus*** Gistel, 1848

90. ***Philautus beddomii*** (Gunther, 1875)

Type locality : Atray Mallay, Travancore, 4000 ft, Kerala
Distribution : Kerala and Tamil Nadu

91. ***Philautus bombayensis*** (Annandale, 1919)

Type locality : Castle rock, Bombay, Maharashtra
Distribution : Maharashtra, Karnataka and Goa

92. ***Philautus chalazodes*** (Gunther, 1875)

Type locality : Travancore, Kerala
Distribution : Kerala, Tamil Nadu and Karnataka

93. ***Philautus charius*** Rao, 1937

Type locality : Kottigehar, Kadur, Karnataka
Distribution : Karnataka, Kerala and Tamil Nadu

94. ***Philautus cherrapunjiae*** Roonwal and Kripalani, 1961

Type locality : Near Circuit house, 3 kms from Cherrapunji town, Khasi-Jaintia hill district, alt 1330 metres, Assam (now in Meghalaya)
Distribution : Meghalaya and Arunachal Pradesh

95. ***Philautus crnri*** Dutta, 1985

Type locality : Kempholey, Hassan, Karnataka
Distribution : Karnataka (known form type locality only)

96. ***Philautus elegans*** Rao, 1937

Type locality : Kempholey, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

97. ***Philautus flaviventris*** (Boulenger, 1882)

Type locality : Malabar, Kerala
Distribution : Kerala

98. ***Philautus garo*** (Boulenger, 1919)

Type locality : Tura, Garo hills, Assam (now in Meghalaya)
Distribution : Meghalaya (known from type locality only)

99. ***Philautus glandulosus*** (Jerdon, 1853)

Type locality : Kudra Mukh, south India
Distribution : Tamil Nadu, Kerala and Maharashtra

100. ***Philautus hassanensis*** Dutta, 1985

Type locality : Hills of Kempholey, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

101. ***Philautus kempiae*** (Boulenger, 1919)

Type locality : Tura, Garo hills, Assam (now in Meghalaya)
Distribution : Meghalaya (known from type locality only)

102. ***Philautus kottigeharensis*** Rao, 1937

Type locality : Kottigehar, Kadur, Karnataka
Distribution : Karnataka (known from type locality only)

103. ***Philautus melanensis*** Rao, 1937

Type locality : Kempholey, Hassan, Karnataka
Distribution : Karnataka (known from type locality only)

104. ***Philautus namdaphaensis*** Sarkar and Sanyal, 1985

Type locality : Farmbase camp, Tirap, Changlang district, Arunachal Pradesh
Distribution : Arunachal Pradesh (known from type locality only)

105. ***Philautus narainensis*** Rao, 1937

Type locality : Kottigehar, Kadur, Karnataka
Distribution : Karnataka (known from type locality only)

106. ***Philautus noblei*** (Ahl, 1927)

Type locality : Malabar, Kerala
Distribution : Kerala (known from type locality only)

107. ***Philautus parkeri*** (Ahl, 1927)

Type locality : Malabar, Kerala
Distribution : Kerala (known from type locality only)

108. ***Philautus pulcherrimus*** (Ahl, 1927)

Type locality : Manantoddy, south India
Distribution : Kerala and Tamil Nadu

109. ***Philautus shillongensis*** Pillai and Chanda, 1973

Type locality : Malki forest, Shillong, Meghalaya
Distribution : Meghalaya (known from type locality only)

110. ***Philautus shyamrupus*** Chanda and Ghosh, 1989

Type locality : Hornbill camp, Namdapha biosphere reserve, Arunachal Pradesh
Distribution : Arunachal Pradesh (known from type locality only)

111. ***Philautus signatus*** (Boulenger, 1882)

Type locality : Malabar, Kerala
Distribution : Kerala and Tamil Nadu

112. ***Philautus swamianus*** Rao, 1937

Type locality : Kottigehar, Kadur, Karnataka
Distribution : Karnataka (known from type locality only)

113. ***Philautus travancoricus*** (Boulenger, 1891)

Type locality : Bodanaikanur, Travancore, foot of hills on eastern side, Kerala
Distribution : Kerala (known from type locality only)

Genus : ***Polypedates*** Tschudi, 1838

114. ***Polypedates insularis*** Das, 1995

Type locality : 2 kms east mouth of Galathea river, Galathea National Park, Great Nicobar.
Distribution : Great Nicobar (known from type locality only)

Genus : ***Rhacophorus*** Kuhl and Van Hasselt, 1822

115. ***Rhacophorus calcadensis*** Ahl, 1927

Type locality : Calcad (Kalakkad) hills, Tinnenvelly, Tamil Nadu
Distribution : Tamil Nadu (known from type locality only)

116. ***Rhacophorus dubius*** Boulenger, 1882

Type locality : Darjeeling, West Bengal
Distribution : West Bengal (known from type locality only)

117. ***Rhacophorus jerdonii*** (Gunther, 1875)

Type locality : Darjeeling, West Bengal
Distribution : West Bengal (known from type locality only)

118. ***Rhacophorus lateralis*** Boulenger, 1883

Type locality : Malabar, Kerala
Distribution : Kerala (known from type locality only)

119. ***Rhacophorus malabaricus*** Jerdon, 1870

Type locality : Malabar, Kerala
Distribution : Kerala, Tamil Nadu, Karnataka and Goa

120. ***Rhacophorus namdaphaensis*** Sarkar and Sanyal, 1985

Type locality : Namdapha camp, 58 kms from Miao, Tirap district, Arunachal Pradesh
Distribution : Arunachal Pradesh (known from type locality only)

121. ***Rhacophorus naso*** Annandale, 1912

Type locality : Egar stream, between Renging and Rotung, Arunachal Pradesh
Distribution : Arunachal Pradesh (known from type locality only)

122. ***Rhacophorus pleurostictus*** (Gunther, 1864)

Type locality : Madras, Tamil Nadu
Distribution : Tamil Nadu and Kerala

123. ***Rhacophorus tuberculatus*** (Anderson, 1871)

Type locality : Sibsagar, Assam
Distribution : Assam, West Bengal and Arunachal Pradesh

CONCLUSION

Of the 123 endemic species of amphibians in India, 89 species (72 35%) are endemic to the Western Ghats in south India and 27 species (21 95%) are endemic to North-eastern India. Therefore, these are the two biodiversity hot spots which require immediate conservation measures.

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A RECORD OF THE SAIL FISH, *ISTIOPHORUS PLATYPTERUS* (SHAW & NODDER) (PISCES : ISTIOPHORIDAE) FROM DIGHA COAST, WEST BENGAL, INDIA

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The marine ichthyofauna of Digha coast of West Bengal has been described by Manna & Goswami (1985) and Goswami (1992). In their account, there is no mention of the Pacific sail fish, *Istiophorus platypterus* (Shaw & Nodder), which is reportedly known from tropical watres of Indian Ocean (Talwar & Kacker, 1984 : 827). Talwar (1994) also failed to report this species from West Bengal coast. Recently, in the course of our field investigation at Digha, we found a specimen of *I. platypterus*, 2.95 m. in total length, caught by the fishermen with the help of the fishing launch fitted with longline arrangement from Bay of Bengal, about 25 km off Digha coast on 24.12.93. From the fishermen of Digha, it was learnt that no sail fish was earlier caught from this coast.

Along with the above specimen, three other robust fishes *viz., Pristis microdon* Latham, 4.35 m. in total length; *Stegostoma fasciatum* (Harmann), 3.6 m.; *Rhinobatus granulatus* (Cuvier), 2.08 m. in total length were caught. Capture of such large fishes at a time and sail fish in particular generated curiosity among the residents of Digha, and an exhibition for the same was arranged by Digha Fishermen and Fish Traders Association. Since, the record of the sail fish, *I. platypterus* from Digha Coast is significant, a brief description of the specimen is given below :

Istiophorus platypterus (Shaw & Nodder)

1791 *Xiphias platypterus* Shaw & Nodder, *Natural Misc., 10* : 28, pl 8.

Diagonisis : Body elongate, laterally compressed. Snout long, upper jaw prolonged into a spear. Fine teeth in jaws and palatines. Two dorsal fins, first dorsal fins extremely high, sail like, with 45 rays, second dorsal fin small with 6 rays. Two anal fins with 13 and 16 rays respectively. Pectoral fin falcate, with 19 rays. Pelvic fin with one spine and 2 rays, very long reaching the anus. Caudal fin deeply forked. Fine scales embedded in skin.

Colour : Dark blue dorsally, gradually becoming silvery below, first dorsal fin blackish blue with black spots, other fins blackish brown, about 20 blackish horizontal bars on body.

Material examined : One ex., 2.95 m. in total length, a colour transparancy has been prepared by one the authors (S. T.) which has been depositted at Marine Aquarium & Research Centre under Regd. No. MARC 18.

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THE PREVALENCE, DISTRIBUTION AND CHECKLIST OF AVIAN HAEMATOZOA IN THE INDIAN SUBCONTINENT

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INTRODUCTION

Over the years, there have been a number of small surveys of the haematozoa found in Indian birds, culminating in 1978 with the survey of McClure and his colleagues, representing the largest single survey carried out on birds of the Indian subcontinent. Many of the small surveys were deveoted to noting and describing new species of blood parasites in single individual birds or small samples of them, a situation exemplified by the work of de Mello and his colleagues during the 1930's. This mass of data has never been assembled and patterns of haematozoan distribution both by avian host and geographic region has not been attempted. This present study assembles and analyzes these data about the distribution and prevalence of avian blood parasites and speculates as to why such patterns may have occurred. Although this assemblage of data is small by contemporary standards, it is hoped that the data will illustrate the large gaps in our knowledge concerning the blood parasites of birds of the Indian subcontinent and suggest to future workers fertile fields for further fruitful exploration.

Interest in avian haematozoa in the Indian subcontient began in the 1890's when Ross first elucidated the life cycle of a *Plasmodium* species using a chicken. Since then a large number of widely disparate papers on avian blood parasites appeared in the literature and are listed in the Index Catalogue of Avian Haematozoa in India (Nandi, 1984). However, the literature on this aspect from other countries in the Indian sub-continent (viz. Bangladesh, Bhutan, Nepal, Pakistan, Sri Lanka) have not at yet been summarized either for the country or the Indian subcontinent as a whole. Largely for this reason some relevant papers on avian haematozoan surveys and taxonomic studies in these countries are cited in to provide a complete literature review of such studies for the subcontinent.

Studies on avian haematozoa in India include the earlier important reviews of Stephens and Christophers (1908) and Wenyon's (1926) global overview of bird blood parsites. De Mello (1937) and Bhatia (1938) provided useful summaries on avian haematozoa in India. Later, Nandi (1984) provided a useful summary of the state of the art up to that time with his index-catalogue of Indian avian haematozoa. Following this period, a number of authors presented taxonomic studies or the

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results of small surveys of Indian avian blood parasites. However, the project known as the Migratory Animal Pathological Survey (MAPS) funded by the US Army and conducted by McClure throughout the countries of southeastern Asia, India, Japan and Korea over a 10 year period was by far the single largest survey carried out on avian haematozoa in the Indian subcontinent. The results of this survey was published by McClure, Poonswad, Greiner and Laird in 1978.

Few studies have been carried out in Bangladesh. Laird and Lari (1959) presented the result of their survey of 262 birds of 27 species and Lari (1959) reported on a survey of sparrows and 15 other species of birds from Dacca, Bangladesh. McClure (1978) reported on the blood parasites in 180 birds from Bhutan and two birds from Nepal which highlights the paucity of information from this region. A number of small studies have been carried out in Pakistan following the description of *Haemoproteus handai* by Maqsood (1943) in Lahore. Laird and Lari (1959) re-described *Babesia moshkovskii* from *Corvus splendens* in Pakistan and Lari (1959) reported on *Plasmodium relictum* in 29 of 174 sparrows from Karachi. Mohiuddin and Pal (1967) reported *Haemoproteus* infections in 10 species of birds in Pakistan and *Plasmodium conturnixi* was described by Bano and Abbasi (1983) from quail from the Northwest Frontier Privince of Pakistan.

Several surveys of blood parasites have been carried out in Sri Lanka over the years starting with ones by Castellani and Wiley (1904, 1905). Later on, Dissanaike and his co-workers (1963, 1965, 1965) conducted probably the most extensive of the surveys and studies of life cycles of Sri Lankan avian haematozoa.

MATERIALS AND METHODS

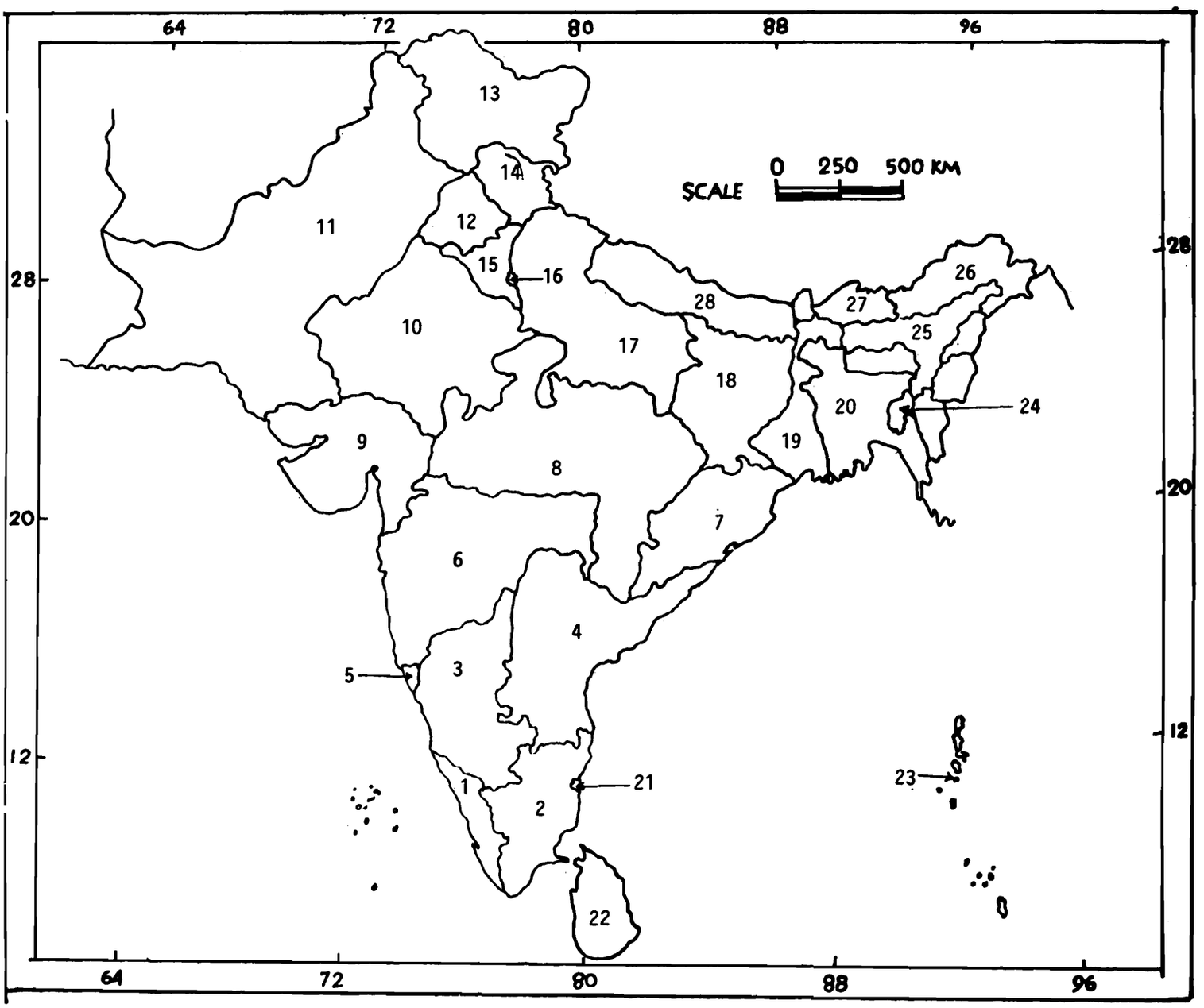
This study is based only on natural infections of blood parasites in birds of the Indian subcontinent, including Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka (Fig. 1). Records on the hosts and species of avian haematozoa recorded in the literature were extracted and the data assembled to present the prevalence and distribution of the blood parasites by avian host family and species (Table 1) and by host family/subfamily (Table 2). The prevalence of avian blood parasites in 21 states, union territories and five other countries of the Indian subcontinent were analyzed (Table 3). A list of the species of *Haemoproteus* and *Leucocytozoon* that are recorded or expected to be encountered in the various avian families of the Indian subcontinent is presented in Table 4 while a list of species of other haematozoa is shown in Table 5. A list of supplanted haematozoan species and their current names is provided in Table 6. Another list of current and supplanted names of avian hosts of the Indian subcontinent is appended in Table 7. The species of the genera *Haemoproteus* and *Leucocytozoon* are according to Bennett, Peirce and Earlé (1993) and the species and hosts of the genus *Plasmodium* are given by Bennett, Bishop and Peirce (1993). The species of the genus *Trypanosoma* are acoording to Bishop and Bennett (1992) but the taxonomy of this group is currently under revision by a number of researchers. The avian species of *Plasmodium* tend to have either a broad host range or very narrow host specificity. Microfilariae can only be identified when the embryos can be associated with the adults found in the tissues of the host ; no attempt has been made to identify these embryo worms. Although reference to species of the genus *Microfilaria* are frequently made, this genus does not exist as the worms involved are only embryos and therefore such names are invalid.

All records of blood parasites in birds from the Indian subcontinent are taken from primary sources which are listed in the References section of this monograph, which can be considered as a bibliography to the Indian subcontinent avian haematozoa. For the sake of brevity and to reduce redundancy, these sources are not listed in this paragraph. Some of references lack the specific data to determine prevalence of parasitism but are included to indicate distribution of the parasites.

RESULTS AND DISCUSSION

The prevalence and distribution of avian haematozoa in 11,900 feral birds (Tables 1,2) show that 277 avian species of 458 (60.4%) representing 53 of the 70 families/subfamilies examined were infected with a variety of species of blood parasites. Members of the genus *Haemoproteus* were the most frequently encountered (11.2%) haematozoan group. In descending order of frequency, species of *Plasmodium* (7.2%), microfilariae (4.1%), *Leucocytozoon* (2.1%) and *Trypansoma* (1.1%) were also encountered. A few birds (0.2%) were also infected with *Atoxoplasma*, *Babesia* and *Lankesterella*, to present an overall prevalence of 23.3% of the sample infected with blood parasites. The impact of these blood parasites on their feral avian hosts is discussed in some detail by Bennett, Peirce and Ashford (1993). The overall prevalence of *Haemoproteus* is considerably higher than the others groups of blood parasites and in fact, the prevalence of *Haemoproteus* is almost equal to all the other genera of praasites combined. All haemoproteids (with the exception of *Haemoproteus columbae* of the Columbidae) for which the life cycles and vectors are known (Bennett and Peirce, 1988) are transmitted by ornithophilic members of the genus *Culicoides* (Diptera : Ceratopogonidae), a genus with widespread distribution and ubiquitous breeding habits (Greiner et al., 1975). Species of *Leucocytozoon* are transmitted by ornithophilic simuliids (Diptera : Simuliidae), a family restricted to breeding in flowing streams or rivers. Avian species of *Plasmodium* are transmitted by culicine (but not anopheline) mosquitoes while species of *Trypanosoma* and microfilariae are transmitted by any of the three groups mentioned above although the microfilariae are probably vector-specific. Thin smear technique is an inadequate method to detect both *Trypanosoma* and microfilaria (Bennett, 1962 ; Woo, 1969) and hence the prevalence recorded for these parasites is undoubtedly low and not a true indication of the frequency of their occurrence. With this in mind, the fact that microfilaria are the third most frequently encountered haematozoan is surprising and suggests that these parasites are indeed common in Indian birds.

Species of *Plasmodium* are the second most frequently occurring group of parasites. The frequency of occurrence of this genus, which usually has low prevalence in avian populations (Bennett et al., 1982), may be due to the studies of Rao and Rao (1980) who recovered *Plasmodium* spp. in 375 of 979 (38%) birds in the Andhra Pradesh, Singh et al. (1951, 1952) who recovered *Plasmodium* spp. in 256 (23.6%) of 869 house sparrows and 214 pigeons and 12.6% of 278 weaver birds. These authors did not report on the presence or absence of other haematozoa so these records bias the overall results. Similarly, the prevalence of microfilaria is biased through the studies of Sen et al. (1965) who recorded only the filarioid nematodes in 161 (72.2%) of 223 jungle crows, *Corvus macrorhynchos*. However, the survey by McClure et al. (1978) represents the largest survey of birds of the Indian subcontinent in which all haematozoa encountered were recorded and the data from this survey probably represents a true picture of the prevalence and distribution of the blood parasites.



Map of the Indian subcontinent showing the various regions and union territories as follows :

1 Kerala ; 2 Tamil Nadhu ; 3 Karnataka ; 4 Andhra Pradesh ; 5 Goa ; 6 Maharashtra ; 7 Orissa ; 8 Madhya Pradesh ; 9 Gujarat ; 10 Rajasthan ; 11 Pakistan ; 12 Punjab ; 13 Jammu and Kasmir ; 14 - Himanchal Pradesh ; 15 Haryana ; 16 - Delhi (Union Territory) ; 17 Uttar Pradesh ; 18 - Bihar ; 19 - West Bengal ; 20 Bangladesh ; 21 Pondicherry (Union Territory) ; 22 Sri Lanka ; 23 Andaman & Nicobar Islands ; 24 Tripura ; 25 Assam ; 26 Arunachal Pradesh ; 27 Bhutan ; 28 Nepal.

The distribution and occurrence of the blood parasites in the various species and families of birds Tables (1, 2) shows that the prevalence of the blood parasites differed markedly from family to family (or subfamily). Of the 52 families/subfamilies of birds with more than 10 individuals sampled (Table 2), only four, the Anhingidae, Caprimulgidae, Hirundinidae and Rostratulidae, were negative for blood parasites. In all these cases (with the exception of Hirundinidae, the sample size was small and it is probable that the lack of blood parasites is more an artifact of small sample size than of host resistance to infection. The most heavily parasitized families (with more than 100 individuals sampled) were the Corvidae, Ploceidae and Capitonidae (Table 2), all of which had more than 50% of the sample infected with one or more genera of haematozoa. A number of families, such as the Charadriidae and Scolopacidae had very low prevalences of parasitism although the sample size was excellent. The low prevalence seen in these two families is typical of these groups throughout the world and probably reflects the behaviour of the birds which some how isolates or removes them from areas of high vector density. This aspect requires further research and elaboration.

In the 21 states and union territories and five other adjacent countries (Fig. 1.) of the Indian subcontinent studied (Table 3 — excluding India unspecified), no blood parasites were found in the birds from Tripura state, a negative finding undoubtedly associated with the small size. Similarly, the survey results from Nepal reflect the lack of sampling activity. Overall prevalence of 30% or higher was found in Bhutan and eight of the 20 remaining specified Indian regions while birds in four Indian regions had a prevalence in the range of 20-29% and birds in the remaining regions with adequate sample size had prevalences in the range of 9-19%.

A comparison between overall prevalence and specific prevalence of parasite genera shows that birds in Bhutan had a greater tendency for multiple infections. The overall prevalence of avian blood parasites in India was found to be 23.3% and species of *Haemoproteus* occurred in all states except Tripura, the only parasite genus to do so. Most of the other genera, however, had a wide distribution throughout India. *Leucocytozoon*, as might be expected, was most prevalent in the mountain states of Bhutan, Uttar Pradesh (Kumaon region) and Jammu and Kashmir (which was environmentally highly suitable for simuliid vectors), and was relatively uncommon in the more flat plains areas of India in which the breeding sites for simuliids is not so optimum.

This analysis of the available data on the distribution and prevalence of avian blood parasites in the Indian subcontinent has shown that blood parasites are quite abundant but that there distribution and prevalence markedly varies from region to region and avian family to family. Much of the variation is attributable to small and unequal sample sizes. However, the data does clearly indicate areas of weakness in which more data must be obtained before any clear conclusions can be drawn. One such area that requires extensive research is the fluctuation over a 12-month period of the prevalence of blood parasites in a population of birds over a time span of 2-3 years to obtain sufficient data. This type of data is required to clearly assess the difference in regional variation of prevalences as comparison of prevalences between various localities not carried out during the same time of year may well give highly erroneous results. The data shows that life cycle studies on species of *Haemoproteus* can be carried out in nearly any region of India with abundant material on hand. Life cycle studies, particularly those involving vector studies, of the other genera of blood parasites should be approached with caution and only undertaken in those regions where it is obvious that both abundant infections occur in the feral avian population, a prevalence that will

indicate the availability of suitable vectors in the area. These data also indicate that the study of the prevalence and distribution of avian haematozoa in the Indian subcontinent can and will provide numerous rewarding research topics for the future that will markedly advance our knowledge in this fascinating area.

SUMMARY

A total of 11,900 birds representing 450 species of 70 families and subfamilies from 21 regions/ States and countries of the Indian subcontinent were examined for blood parasites ; 2776 (23.3%) birds of 277 species belonging to 53 families/subfamilies harboured avian haematozoa. Species of *Haemoproteus* (11.2%) were that most commonly encountered group of blood parasites, followed by *Plasmodium* 7.2%), microfilariae (4.1%), *Leucocytozoon* (2.1%), *Trypanosoma* (1.1 %) and a few *Atoxoplasma* and *Lankesterella* (0.2%) listed as Others. The relatively high prevalence of species of *Haemoproteus* and the marked variation in the prevalence of blood parasites from avian family to family and region to region is discussed. A cheeklist of the avian haematozoa encountered or expected to be found in the Indian subcontinent is appended.

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TABLE 1. Prevalence of haematozoa in the birds of the Indian subcontinent. Abbreviations : ***Haem.*** = ***Haemoproteus*** ; ***Leuc.*** = *Leucocytozoon* ; micro. = microfilaria ; *Plasm.* = *Plasmodium* ; *Tryp.* = *Trypanosoma* ; Others = (***Atoxoplasma***, ***Babesia***, *Lankesterella*, unidentified parasites).

Family and Species	Number of birds		Haematozoa recorded					
	examined	infected	*Haem.*	*Leuc.*	micro.	*Plasm.*	*Tryp.*	Other
ACCIPITRIDAE	66	20	9	11	2		1	1
Accipiter badius (Gmelin)	25	7	3	5	1			
Accipiter nisus (Linnaeus)	4	2	1	1				
Accipiter trivirgatus (Temminck)	1	1		1				
Accipiter virgatus (Temminck)	3	1		1				
Butastur teesa (Franklin)	5	1			1			1
Buteo vulpinus (Gloger)	2	2	1				1	
Elanus caeruleus (Desfontaines)	5	2	1	1				
Gyps bengalensis Gmelin	2	1	1					
Haliastur indus (Boddaert)	3	0						
Ictinaetus malayensis (Temminck)	2	2	1	1				

Milvus migrans (Boddaert)	6	0						
Neophron perenopterus (L.)	3	0						
Spilornis cheela (Latham)	1	0						
Spizaetus cirrhatus (Gmelin)	4	1	1	1				
AEGITHINIDAE	101	21	7	9	5	1		3
Aegithina nigrolutea (Marshall)	12	2		2				
Aegithina tiphia (Linnaeus)	69	12	6	4	3			2
Chloropsis aurifrons (Temminck)	7	3	1	1		1		1
Chloropsis cochinchinensis (Gmelin)	7	4		2	2			
Chloropsis hardwickii (Jardine and Selby)	2	0						
Irena puella (Latham)	4	0						
ALAUDIDAE	65	9	7		1			1
Alauda gulgula Franklin	2	0						
Ammomanes phoenicurus (Franklin)	3	0						

Eremopterix griseus (Scopoli)	16	4	3					1
Gallerida cristata (Linnaeus)	22	2	2					
Gallerida deva (Sykes)	10	2	2					
Galerida malabarica (Scopoli)	5	1			1			
Mirafra assamica Horsfield	5	0						
Mirafra erythroptera Blyth	2	0						
ALCEDINIDAE	124	5	5		1			
Alcedo athis (Linnaeus)	43	0						
Alcedo hercules Laubmann	1	0						
Ceyx erythacus (Linnaeus)	5	0						
Halcyon pileata (Boddaert)	1	0						
Halcyon smyrnensis (Boddaert)	73	5	5		1			
Pelargopsis capensis (Linnaeus)	1	0						
ANATIDAE	511	28	17	10		1		1

Anas acuta Linnaeus	89	5	1	4				
Anas clypeata (Linnaeus)	1	0						
Anas crecca Linnaeus	109	4		4				1
Anas penelope Linnaeus	51	5	5					
Anas platyrhynchos Linnaeus	22	0						
Anas poecilorhyncha Forster	14	0						
Anas querquedula Linnaeus	59	1	1					
Anser anser Linnaeus	28	3	3					
Aythya ferina (Linnaeus)	70	5	5					
Aythya fuligula Linnaeus	28	2		2				
Dendrocygna javanica (Horsfield)	3	0						
Mergus merganser Linnaeus	1	0						
Netta rufina (Pallas)	32	2	1			1		
Nettapus coromandelianus (Gmelin)	2	1	1					

Tadorna ferugina (Pallas)	2	0						
ANHINGIDAE	12	0						
Anhinga rufa (Daudin)	12	0						
APODIDAE	9	0						
Apus affinis (Gray)	9	0						
ARDEIDAE	60	5		2	3		3	
Ardeola bacchus (Bonaparte)	1	0						
Ardeola grayi (Sykes)	32	1		1	1			
Ardea cinerea Linnaeus	6	1		1				
Bubulcus ibis (Linnaeus)	11	0						
Butorides striatus (Linnaeus)	2	0						
Egretta alba (Linnaeus)	1	0						
Egretta gularis Bosc.	1	0						
Egretta intermedia (Wagler)	4	1					1	

Ixobrychus minuta (Linnaeus)	1	1			1		1	
Nycticorax nycticorax (Linnaeus)	1	1			1		1	
ARTAMIDAE	1	0						
Artamus fuscus (Vieillot)	1	0						
BUCEROTIDAE	16	4	3		4		1	
Anthroceros malabaricus (Gmelin)	1	0						
Buceros bicornis Linnaeus	1	0						
Ptilolaemus tickelli (Blyth)	2	1			1			
Tockus birostris (Scopoli)	6	0						
Tockus griseus (Latham)	6	3	3		3		1	
BURHINIDAE	1	0						
Bruhinus oedicnemus (Linnaeus)	1	0						
CAMPEPHAGIDAE	108	22	12	7	1	2		
Coracina melanoptera (Ruppell)	1	0						

Coracina novaehollandiae (Gmelin)	7	1	1					
Hemipus picatus (Sykes)	6	0						
Lalage melaschista (Hodgson)	1	1			1			
Pericrocotus brevirostris (Vigors)	13	5	5					
Pericrocotus cinammomeus (Linnaeus)	7	2				2		
Pericrocotus etholagus (Bangs and Phillips)	1	0						
Pericrocotus flammeus (Forster)	18	0						
Tephrodornis pondicerianus (Gmelin)	52	12	6	7				
Tephrodornis virgatus (Temminck)	2	1						
CAPITONIDAE	114	67	56	12	8	2	1	1
Megalaima asiatica (Latham)	13	11	10		4			1
Megalaima australis (Horsfield)	1	1	1	1	1			
Megalaima franklini (Blyth)	1	1	1	1				
Megalaima haemocephala (Muller)	46	13	10		1	2		

Megalaima rubricapilla (Gmelin)	1	0						
Megalaima virens (Boddaert)	5	3	3	1			1	
Megalaima viridis (Boddaert)	25	25	20	9	1			
Megalaima zeylanica(Gmelin)	22	13	13		1			
CAPRIMULGIDAE	12	0						
Caprimulgus asiaticus Latham	3	0						
Caprimulgus indicus latham	3	0						
Caprimulgus macrurus Horsfield	6	0						
CHARADRIIDAE	179	2	1	1	1		1	
Charadrius alexandrinus Linnaeus	31	0						
Charadrius dubius (Scopoli)	57	0						
Charadrius leschnaulti Lesson	10	0						
Charadrius mongolus Pallas	1	0						
Pluvialis dominica **(Muller)**	**38**	**0**						

Vanellus indicus (Boddaert)	39	2	1	1	1		1	
Venellus malabaricus (Boddaert)	3	0						
CICONIIDAE	2	0						
Anastomus oscitans (Boddaert)	2	0						
CINCLIIDAE	1	0						
Cinclus palasii Temminck	1	0						
COLUMBIDAE	962	314	289	5	8	16	2	
Chalcophaps indica (linnaeus)	20	3			3			
Columba hodgsonii Vigors	1	0						
Columba livia Gmelin	674	267	267		1		2	
Ducula aenea Linnaeus	7	0						
Macropygia rufipennis Blyth	1	0						
Macropygia unchall (Wagler)	1	0						
Streptopellia chinensis (Scopoli)	86	22	6		1	15	1	

Streptopelia decaocto (Frivaldszky)	49	12	11	1			2	
Stretopellia orientalis (Latham)	8	2	1	2				
Streptopelia senegalensis (Linnaeus)	59	2	1	1	1			
Streptopelia tranquebarica (Herman)	1	0						
Treron bicincta (Jerdon)	3	2	2					
Treron curvirostris (Gmelin)	11	0						
Treron phoenicoptera (Latham)	37	1			1			
Treron pompadora (Bonaparte)	1	1			1			
Treron sphenura (Vigors)	3	2	1	1		1		
CORACIIDAE	62	9	9	3	1			
Coracias benghalensis (Linnaeus)	62	9	9	3	1			
CORVIDAE	616	396	30	6	183	193	3	1
Cissa chinesis (Boddaert)	4	3			3			
Cissa flavirostris (Blyth)	1	0						

Corvus macrorhynchus Wagler	243	164	2		162			
Corvus splendens Vieillot	294	190	3		2	189		
Dendrocitta formosa Swinhoe	3	1	1	1				
Dendrocitta frontalis Horsfield	3	2			2			
Dendrocitta vagabunda (Latham)	53	24	20	3	5	4	2	1
Garrulus glandarius (Linnaeus)	4	2	1	1	2			
Garrulus lanceolatus (Vigors)	11	10	3	1	7		1	
CUCULIDAE	143	29	24	5	6	1	2	1
Cacomantis marulinus (Scopoli)	26	0						
Centropus sinesis (Stephens)	46	14	12	1	2	1	1	1
Centropus toulou (Muller)	1	1	1					
Chalcites maculatus (Gmelin)	1	0						
Clamator coromandus (Linnaeus)	1	0						
Clamator jacobinus (Boddaert)	17	10	10	4	1			

Cuculus canorus Linnaeus	1	0						
Cuculus micropterus Gould	1	1					1	
Cuculus poliocephalus Latham	4	1	1		1			
Cuculus varius (Vahl)	1	1			1			
Eudynamys scolopacea (linnaeus)	42	1			1			
Rhopodytes tristis (lesson)	2	0						
DICAEIDAE	19	1	1					
Dicaeum concolor Jerdon	1	0						
Dicaeum cruentatum (Linnaeus)	1	0						
Dicaeum erythrorhynchos (Latham)	17	1	1					
DICRURIDAE	148	23	11		9	5	3	
Dicrurus adsimilis (Bechstein)	93	13	6		3	5	3	
Dicrurus aeneus Vieillot	11	0						
Dicrurus caerulescens (Linnaeus)	13	2	2					

Dicrurus hottentotus (Linnaeus)	2	0						
Dicrurus leucophaeus Vieillot	9	0						
Dicrurus macrocercus (Vieillot)	6	1	1					
Dicrurus paradiseus (linnaeus)	13	7	2		6			
Dicrurus remifer (Temminck)	1	0						
EMBERIZIDAE Emberizinae	22	1		1				
Emberiza cia (Linnaeus)	2	1		1				
Emberiza fucata Pallas	11	0						
Emberiza melanocephala Scopoli	9	0						
ESTRILDIDAE - Poephilinae	745	135	66			26	60	
Amandava amandava (Linnaeus)	32	1	1					
Lonchura kelaarti (Jerdon)	8	5	5					
Lonchura malabarica (Linnaeus)	275	44	16			4	33	
Lonchura malacca (Linnaeus)	243	50	22			22	24	

Lonchura punctulata (Linnaeus)	157	33	20				3	
Lonchura striata (Linnaeus)	30	2	2					
EURYLAIMIDAE	3	1	1					
Serilophus lunatus (Gould)	3	1	1					
FALCONIDAE	9	3	3					
Falco peregrinus Linnaeus	6	0						
Falco tinnunculus Linnaeus	3	3	3					
FRINGILLIDAE - Carduelinae	85	12	4	8	3		1	
Carduelis carduelis (Linnaeus)	8	0						
Carpodacus erythrinus (Pallas)	53	6	2	4	2			
Carpodacus pulcherrimus (Moore)	1	0						
Coccothraustus affinis (Blyth)	1	1		1	1			
Coccothraustus icteroides Vigors	1	1		1				
Leucosticta nemoricola (Hodgson)	1	0						

Melophus lathami (Gray)	14	2	1	1				
Petronia xanthocollis (Burton)	1	1	1					
Pyrrhula aurantiaca Gould	5	1		1				
GLAREOLIDAE	8	0						
Cursorius coramandelicus (Gmelin)	1	0						
Glareola lactea Temminck	1	0						
Glareola pratincola (Linnaeus)	6	0						
GRUIDAE	4	3	3					
Anthropoides virgo (Linnaeus)	3	2	2					
Grus antigone (Linnaeus)	1	1	1					
HIRUNDINIDAE	51	0						
Hirundo daurica Linnaeus	39	0						
Hirundo rustica Linnaeus	11	0						
Hirundo smithi (Leach)	1	0						

LANIIDAE Laniinae	176	77	32		50	13	14	
Lanius cristatus Ruppell	29	9	6		1	2		
Lanius excubitor Linnaeus	4	2	2					
Lanius schach Linnaeus	104	61	19		49	11	14	
Lanius tephronotus (Vigors)	4	0						
Lanius vittatus Valenciennes	34	5	5					
Lanius sp.	1	0						
LARIDAE	7	0						
Geochelidon nilotica (Gmelin)	1	0						
Larus genei (Brehm)	1	0						
Sterna albifrons Pallas	1	0						
Sterna aurantia Gray	1	0						
Sterna bengalensis Lesson	1	0						
Sterna hirundo Linnaeus	2	0						

MEGAPODIDAE	1	1	1					
Megapodius freycinet (Gaimard)	1	1	1					
MEROPIDAE	102	23	20	1	2	1		
Merops leschenaulti Vieillot	4	0						
Merops orientalis Latham	92	22	20		2	1		
Merops philippinus Linnaeus	1	0						
Merops superciliosus Linnaeus	2	0						
Nyctyornis athertoni (Jardine and Selby)	3	1		1				
MOTACILLIDAE	129	28	25		2	2		
Antus hodgsoni Richmond	46	6	5		1			
Anthus novaeseelandiae (Gmelin)	16	2	2		1			
Anthus trivialis (Linnaeus)	1	0						
Dendronanthus indicus (Gmelin)	8	3	3					
Motacilla alba Linnaeus	19	7	6			1		

Motacilla cinerea Tunstall	28	9	9					
Motacilla flava Linnaeus	9	0						
Motacilla madaraspatensis (Gmelin)	2	1				1		
MUSCICAPIDAE - Monarchinae	93	6	4		2	1		
Hypothymis azurea (Boddaert)	47	2	2					
Terpsiphone paradisi Linnaeus	46	4	2		2	1		
Muscicapinae	162	33	28	3	2	3		
Culicicapa ceylonesis Oberholser	14	0						
Muscicapa hyperythra (Blyth)	4	0						
Muscicapa latirostris Raffles	4	2	2					
Muscicapa muttui (Layard)	4	1	1					
Muscicapa parva Bechstein	50	4	4					
Muscicapa sapphira (Blyth)	1	1			1			
Muscicapa sibirica Gmelin	7	3	3					

Muuscicapa striata (Pallas)	6	5	5					
Muscicapa sundara (Hodgson)	10	9	7	2		2		
Muscicapa superciliaris Jerdon	3	1	1					
Muscicapa thalassina Swainson	9	1				1		
Muscicapa tickelliae (Blyth)	50	6	5	1	1			
Rhipidurinae	17	3	2		1	2		
Rhipidura albicollis Vieillot	4	0						
Ripidura albogularis (Lesson)	12	2	2			2		
Ripidura aureola (Lesson)	1	1			1			
Sylviinae	664	108	102	3	2	5	3	1
Acrocephalus agricola Jerdon	23	4	4	1				
Acrocephalus arundinaceous Linnaeus	15	3	3					
Acrocephalus dumetorum Blyth	82	37	37	1			2	
Acrocephalus stentoreus (Hemprich and Ehrenberg)	87	11	11	1				

Hippolais caligata (Lichtenstein)	14	5	5			1		
Locustella certhiola (Pallas)	1	0						
Megaluris palustris Horsfield	18	0						
Orthotomus sutorius (Pennant)	95	3	3					
Phragmaticola aedon (Pallas)	11	8	8					
Phylloscopus colybita (Vieillot)	50	1	1					
Phylloscopus fuscatus (Blyth)	12	1				1		
Phylloscopus inornatus (Blyth)	16	1	1					
Phylloscopus occipitalis (Blyth)	2	1	1					
Phylloscopus subaffinis (Ogilvie-Grant)	1	0						
Phylloscopus tenellipes Swinhoe	4	0						
Phylloscopus trochiloides (Sundevall)	8	1	1					
Prinia buchanani Blyth	7	1						1
Prinia flaviventris (Delessert)	9	0						

Prinia gracilis (Lichtenstein)	3	2	2					
Prinia hodgsoni Blyth	6	1	1					
Prinia socialis Sykes	42	2	1			1	1	
Prinia subflava (Gmelin)	39	5	4			1		
Prinia sylvatica Jerdon	5	2	1		1			
Seicercus affinis Hodgson	2	1			1			
Sylvia communis Latham	1	1	1					
Sylvia curruca (Linnaeus)	90	13	13			1		
Sylvia hortensis (Gmelin)	21	4	4					
Timaliinae	452	91	45	44	12	5	3	3
Actinodura egertoni Gould	2	0						
Actinodura nipalensis (Hodgson)	3	2	2	2				
Alcippe castaneceps (Hodgson)	5	4	2	1				1
Alcippe poioicephala (Jerdon)	34	2	2					

Chrysoma sinense (Gmelin)	49	3		3		1		
Dumetia hyperythra (Franklin)	36	2		2				
Garrulax albogularis (Gould)	5	2		2				
Garrulax caeruleus (Hodgson)	1	1		1	1			
Garrulax erythrocephalus (Vigors)	2	1				1		
Garrulax lineatus (Vigors)	11	3			1	2		
Garrulax monileger (Hodgson)	4	1			1			
Garrulax pectoralis (Gould)	1	0						
Garrulax squamatus (Gould)	3	1			1			
Garrulax striatus (Vigors)	2	0						
Garrulax variegatus (Vigors)	6	2		1	1			
Heterophasia capistrata (Vigors)	16	14	7	13		1		
Leiothrix argentauris (Hodgson)	1	1	1					1
Macronus gularis (Horsfield)	9	0						

Minla cyanouroptera (Hodgson)	5	3	2	3				
Minla ignotincta Hodgson	4	1		1				
Minla strigula (Hodgson)	6	3		2				1
Myzornis pyrrhoura Blyth	4	1		1				
Pellorneum ruficeps Swainsn	53	0						
Pomatorhinus erythrogenys Vigors	1	0						
Pomatorhinus ochraceiceps Walden	1	0						
Pomatorhinus ruficollis Hodgson	3	1		1	1			
Pomatorhinus schisticeps Hodgson	31	0						
Pteruthius flaviscapis (Temminck)	1	0						
Sphenocichla humei (Mandelli)	1	0						
Stachyris nigriceps Blyth	1	0						
Stchyris ruficeps Blyth	5	1					1	
Turdoides caudata (Dumont)	28	7	6	1	1			

Turdoides malcomi (Sykes)	25	4	3	1	1			
Turdoides striatus (Sykes)	84	25	17	7	2		2	
Turdoides subrufa (Jerdon)	2	0						
Yuhina bakeri Rothschild	2	1			1			
Yuhina flavicollis Hodgson	4	3	2	2				
Yuhina xantholeuca (Blyth)	1	1	1					
Turdininae	563	120	64	39	31	4	2	4
Brachypteryx montana Horsfield	1	0						
Copsychus malabaricus (Scopoli)	8	1	1					
Copsychus saularis (Linnaeus)	102	31	27		3	1	1	
Enicurus immaculatus (Hodgson)	1	1	1					
Enicurus shistaceus (Hodgson)	1	0						
Erithacus brunneus (Hodgson)	23	1	1					
Erithacus calliope (Pallas)	20	0						

Luscinia svecicus (Linnaeus)	59	4	3		1			
Monticola cinclorhynchus (Vigors)	23	13	13	6	1			
Monticola solitaria (Linnaeus)	3	0						
Myiophoneus caeruleus (Scopoli)	4	2	2					
Phoenicurus caeruleocephalus Vigors	7	1		1				
Phoenicurus ochrurus Gmelin	37	2	2					
Saxicola caprata (Linnaeus)	24	3	1	1		1		
Saxicola ferrea Gray	1	0						
Saxicola torquata (Linnaeus)	25	1		1				
Saxicoloides fulicata (Linnaeus)	78	14	3	2	9	2		2
Tarsiger cyanurus (Pallas)	8	2		2				
Turdus boulboul (Latham)	2	1	1					
Turdus dissimilis Blyth	1	0						
Turdus merula Linnaeus	33	7	3	4	2			

Turdus ruficollis Pallas	22	6	4	5				1
Turdus unicolor Tickell	16	6	1	5				1
Zoothera citrina (Latham)	63	24	1	12	15		1	
Zoothera dauma (Latham)	1	0						
NECTARINIDAE	130	25	21	2		2		
Aethopyga gouldiae (Vigors)	2	0						
Aethopyga saturata (Hodgson)	1	1	1					
Arachnothera longirostris (Latham)	2	1		1				
Arachnothera magna Blyth	2	1		1				
Nectarina asiatica (Latham)	75	14	12			2		
Nectarina lotenia (Linnaeus)	3	1	1					
Nectarina minima (Sykes)	13	2	2					
Nectarina zeylonica (Linnaeus)	32	5	5					
ORIOLIDAE	41	9	2	3	5		2	

Oriolus oriolus (Linnaeus)	25	3	1	2			1	
Oriolus trailii (Vigors)	1	1	1				1	
Oriolus xanthornus Linnaeus	15	5		1	5			
PARADOXORNITHIDAE	2	0						
Paradoxornis atrosuperciliaris (Godwin-Austen)	2	0						
PARIDAE	49	18	1	15	3	1		
Parus major Linnaeus	24	7		7				
Parus monticolus Vigors	17	6		6	2			
Parus xanthogenys Vigors	8	5	1	2	1	1		
PASSERIDAE	1734	399	85		14	350		3
Passer domesticus (Linnaeus)	1646	380	67		12	350		3
Passer hispaniolensis (Temminck)	20	6	5		1			
Passer montanus Linnaeus	1	0						
Passer rutilans Temminck	5	1	1					

Petronia xanthocollis Burton	62	12	12		1			
PHALACROCORACIDAE	3	0						
Phalacrocorax niger Vieillot	3	0						
PHASIANIDAE - Phasianinae	763	155	2	20	17	108	6	1
Arborophila atrogularis (Blyth)	1	0						
Arborophila rufogularis (Blyth)	1	1	1					
Arborophila torqueola Valenciennes	3	1		1				
Coturnix coramandelica (Gmelin)	118	33		1		32		
Coturnix coturnix (Linnaeus)	109	6				1	5	
Francolinus francolinus (L.)	30	0						
Francolinus pictus (Jardine and Selby)	2	1		1				
Francolinus pondicerianus (Gmelin)	106	27		3	1	22	1	
Gallus gallus Linnaeus	176	13		4	9			
Gallus layfayetti Lesson	39	9		8		1		

Gallus sonnerati Temminck	45	1				1		
Galloperdix spadicea (Gmelin)	2	1		1				
Ithaginis cruentus (Hardwicke)	2	2				2		
Lophura leucomelana (Latham)	2	0						
Perdicula argoondah (Sykes)	21	8		1	7			1
Perdicula asiatica (Latham)	102	50				50		
Perdicula erythroryhncha (Latham)	1	0						
Pavo cristata Linnaeus	1	1	1					
Polyplectron bicalcaratum (Linnaeus)	1	0						
Tragopan satyra (Linnaeus)	1	1				1		
PHOENICOPTERIDAE	8	0						
Phoeniconais minor (Geoffrey)	1	0						
Phoenicopterus roseus Linnaeus	7	0						
PICIDAE	121	22	19	2	5	2		

Blythipicus pyrrhotis (Bonaparte)	1	0						
Chrysocolaptes festivus (Boddaert)	1	0						
Chyrosocolaptes lucidus (Scopoli)	2	0						
Dendrocopos auriceps (Vigors)	5	0						
Dendrocopos himalayensis (Jardine and Selby)	4	0						
Dendrocopos mahrattensis (Latham)	35	7	7			1		
Dendrocopos nanus (Vigors)	1	0						
Dinopium benghalense (Linnaeus)	6	1			1			
Hemicircus canente (Lesson)	1	0						
Jynx torquilla Linnaeus	38	7	7		1			
Micropternus brachyurus (Vieillot)	1	0						
Picoides macei (Vieillot)	1	0						
Picumnus innominatus Burton	1	0						
Picus canus Gmelin	1	1	1					

Picus chlorolophus Vieillot	11	2	1	1	1	1		
Picus flavinucha (Gould)	3	3	3		2			
Picus squamatus (Vigors)	6	1		1				
Picus xanthopygeus (Gray and Gray)	2	0						
Sasia ochracea Hodgson	1	0						
PITTIDAE	41	6		3	4	1	1	
Pitta brachyura (Linnaeus)	39	5		3	3	1	1	
Pitta nipanensis (Hodgson)	2	1			1			
PLOCEIDAE	297	151	102		12	53	1	1
Ploceus benghalense (Linnaeus)	22	9	9			2	1	
Ploceus manyar (Horsfield)	10	4	4					
Ploceus megarhynchus Hume	3	0						
Ploceus philippinus (Linnaeus)	262	138	89		12	51		1
PODICIPEDIDAE	5	0						

Podiceps rufficollis (Pallas)	5	0						
PSITTACIDAE	67	4	4					
Loriculus vernalis (Sparrman)	1	0						
Psittacula alexandri (Linnaeus)	2	0						
Psittacula columboides (Vigors)	2	0						
Psittacula cyanocephala (Linnaeus)	17	3	3					
Psittacula eupatria (Linnaeus)	14	0						
Psittacula krameri (Scopoli)	30	1	1					
Pstittacula longicauda (Boddaert)	1	0						
PTEROCLIDIDAE	22	15				15		
Pterocles indicus (Gmelin)	1	0						
Pterocles exustus Temminck	21	15				15		
PYCNONOTIDAE	421	153	87	32	30	6	19	3
Criniger flaveolus (Gould)	1	1	1					

Hypsipetes flavalus (Blyth)	3	0						
Hypsipetes indicus (Jerdon)	5	3	3					
Hypsipetes madagascariensis (Muller)	33	14	11	2		2	1	
Hysipetes viridiscens (Blyth)	2	0						
Pycnonotus burmanicus Blanf. and Oates	40	33	7	2	27		12	
Pycnonotus cafer (Linnaeus)	125	34	9	24	1	2	1	1
Pycnonotus flavescens (Blyth)	1	0						
Pycnonotus jocosus (Linnaeus)	82	18	12	3	1	1	4	
Pycnonotus leucogenys (Gray)	57	7	2	1		1	1	2
Pycnonotus luteolus Lesson	67	41	40		1			
Pycnonotus melanicterus (Gmelin)	4	2	2					
Pycnonotus striatus (Blyth)	1	0						
RALLIDAE	37	2	2					
Amaurornis phoenicurus (Boddaert)	18	0						

Fulica atra Linnaeus	3	0						
Gallinula chloropus (Linnaeus)	14	2	2					
Porzana pusilla (Pallas)	1	0						
Rallus striatus Linnaeus	1	0						
RECURVIROSTRIDAE	1	0						
Himantopus himantopus (Linnaeus)	1	0						
ROSTRATULIDAE	26	0						
Rostratula benghalense (Linnaeus)	26	0						
SCOLOPACIDAE	545	4	1		1	2		
Actitis hypoleucos Linnaeus	7	0						
Arenaria interpres (Linnaeus)	3	0						
Calidris minutus (Leisler)	22	0						
Calidris testacea (Pallas)	1	0						
Capella gallinago (Linnaeus)	155	0						

Capella megala Swinhoe	3	0						
Capella stenura (Bonaparte)	23	0						
Numenius phaeopus (Bonaparte)	5	0						
Philomax pugnax (Linnaeus)	3	1	1					
Scolopax rusticola Linnaeus	1	1			1			
Tringa glareola Linnaeus	147	0						
Tringa hypoleucos (Linnaeus)	17	2				2		
Tringa nebularia (Gunnerus)	37	0						
Tringa ochropus Linnaeus	26	0						
Tringa stagnitilis (Bechstein)	35	0						
Tringa totanus (Linnaeus)	46	0						
Xenus cinereus (Guldenstaedt)	14	0						
SITTIDAE	25	4	4	1	1		1	
Salpornis spilanotus Franklin	3	0						

Sitta castanea Lesson	16	3	3	1	1		1	
Sitta frontalis Swainson	6	1	1					
STRIGIDAE	69	31	27	4	2	2	3	
Asio flammeus (Pontopiddan)	1	0						
Athene brama (Temminck)	34	9	5	1	1	2		
Bubo coromandus (Latham)	7	4	4					
Glaucidium brodei (Burton)	4	2	2	1			1	
Glaucidium cuculoides (Vigors)	3	2	2	1	1		1	
Glaucidium radiatum (Tickell)	4	3	3					
Ketupa zeylonensis (Gmelin)	1	1	1					
Ninox scutellata (Raffles)	1	1	1					
Otus bakkamoena Pennant	10	7	7	1				
Otus scops Linnaeus	1	1	1				1	
Strix aluco Linnaeus	3	1	1					

STURNIDAE	588	120	63		14	33		2
Acridotheres fuscus (Wagler)	22	4	2		2			
Acridotheres gingianus (Latham)	26	2	2					
Acridotheres tristis Linnaeus	211	23	11		3	9		
Aplonis panavensis (Scopoli)	1	0						
Gracula religiosa Linnaeus	3	1			1			
Mino coronatus (Blyth)	1	0						
Sturna contra Linnaeus	79	20	14		4	17		
Sturnus malabaricus (Gmelin)	78	25	9		2	16		1
Sturnus pagodarum (Gmelin)	98	22	2		1			1
Sturnus roseus (Linnaeus)	43	19	19		1			
Sturnus vulgaris Linnaeus	26	4	4					
THRESKIORNITHIDAE	78	2	2					
Plagadus falcinellus (Linnaeus)	30	0						

Ptaltalea leucorodia Linnaeus	7	1	1					
Pseudibis papillosa (Temminck)	1	1	1					
Threskiornis melanocephalus (Latham)	40	0						
TROGONIDAE	1	1	1					
Harpactes fasciatus (Pennant)	1	1	1					
TURNICIDAE	33	8			8			
Turnix suscitator (Gmelin)	33	8			8			
TYTONIDAE	1	0						
Tyto alba (Scopoli)	1	0						
UPUPIDAE	90	12	1	3	3	4		1
Upupa epops Linnaeus	90	12	1	3	3	4		1
ZOSTEROPIDAE	77	35	29	1	1	4		1
Zosterops palpebrosa (Temminck)	77	35	29	1	1	4		1
GRAND TOTAL	11900	2776	1334	256	490	866	136	29

TABLE 2. Prevalence of haematozoa in avian families and subfamilies of the Indian subcontinent. Abbreviations as in Table 1

Family/subfamily	Number of birds			Haematozoa recorded					
	examined	infected	%infected	*Haem.*	*Leuc.*	micro.	*Plasm.*	*Tryp.*	Other
Accipitridae	66	20	30.3	9	11	2		1	1
Aegithinidae	101	21	20.8	7	9	5	1		3
Alaudidae	65	9	13.9	7		1			1
Alcedinidae	124	5	4.0	5		1			
Anatidae	511	28	5.5	17	10		1		1
Anhingidae	12	0							
Apodidae	9	0							
Ardeidae	60	5	8.3		2	3		3	
Artamidae	1	0							
Bucerotidae	16	4	25.0	3		4		1	
Burhinidae	1	0							

Campephagidae	108	22	20.3	12	7	1	2		
Capitonidae	114	67	58.8	56	12	8	2	1	1
Caprimulgidae	12	0							
Charadriidae	179	2	1.1	1	1	1		1	
Ciconiidae	2	0							
Cinclidae	1	0							
Columbidae	962	314	32.6	289	5	8	16	5	
Coraciidae	62	9	14.5	9	3	1			
Corvidae	616	396	64.3	30	6	183	193	3	1
Cuculidae	143	29	20.3	24	5	6	1	2	1
Dicaeidae	19	1	5.3	1					
Dicruridae	148	23	15.5	11		9	5	3	
Emberizidae-Emberizinae	22	1	4.6		1				
Estrildidae - Poephilinae	745	135	18.1	66			26	60	

Eurylaimidae	3	1		1					
Falconidae	9	3	33.3	3					
Fringillidae Carduelinae	85	12	14.0	4	8	3		1	
Glareolidae	8	0							
Gruidae	4	3		3					
Hirundinidae	51	0							
Laniidae - Laniinae	176	77	43.7	32		50	13	14	
Laridae	7	0							
Megapodidae	1	1		1					
Meropidae	102	23	22.5	20	1	2	1		
Motacillidae	129	28	21.3	25		2	2		
Muscicapidae	1951	361	18.5	245	89	80	20	8	8
Monarchininae	93	6	6.5	4		2	1		
Muscicapinae	162	33	20.4	28	3	2	3		

Rhipidurinae	17	3	17.6	2		1	2		
Sylviinae	664	108	16.2	102	3	2	5	3	1
Timaliinae	452	91	20.1	45	44	12	5	3	3
Turdinae	563	120	21.0	64	39	31	4	2	4
Nectarinidae	130	25	19.2	21	2		2		
Oriolidae	41	9	21.9	2	3	5		2	
Paradoxornithidae	2	0							
Paridae	49	18	36.7	1	15	3	1		
Passeridae	1734	399	24.2	85		14	350		3
Phalacrocoracidae	3	0							
Phasianidae Phasianinae	763	155	20.3	2	20	17	180	6	1
Phoenicopteridae	8	0							
Picidae	121	22	18.1	19	2	5	2		
Pittidae	41	6	14.6	3	4	1	1		

Ploceidae	297	151	50.8	102		12	53	1	1
Podicipedidae	5	0							
Psittacidae	67	4	5.9	4					
Pteroclididae	22	15	68.1				15		
Pycnonotidae	421	153	36.3	87	32	30	6	19	3
Rallidae	37	2	5.4	2					
Recurvirostridae	1	0							
Rostratulidae	26	0							
Scolopacidae	545	4	0.7	1		1	2		
Sittidae	25	4	16.0	4	1	1		1	
Strigidae	69	31	44.9	27	4	2	2	3	
Sturnidae	588	120	20.4	63		14	33		2
Threskiornithidae	78	2	2.6	2					
Trogonidae	1	1		1					

Turniciade	33	8	24.2			8			
Tytonidae	1	0							
Upupidae	90	12	13.3	1	3	3	4		1
Zosteropidae	77	35	45.5	29	1	1	4		1
TOTALS :	11900	2776		1334	256	490	866	136	29
PERCENTAGE :			23.3	11.2	2.1	4.1	7.2	1.1	0.2

TABLE 3. Prevalence of haematozoa in different regions of the Indian subcontinent. Abbreviations as in Table 1. Percentage of infections in parentheses.

Region	Total birds		Haematozoa recorded					
	Examined	Infected	*Haem.*	*Leuc.*	Micro.	*Plasm.*	*Tryp.*	Other
Indian regions	11185	2651 (23.7)	1299 (11.6)	219 (2.0)	480 (4.3)	814 (7.3)	133 (1.2)	23 (0.2)
Andaman & Nicobar	8	2	1		1			
Andhra Pradesh	1125	405 (36.0)	14 (1.2)	3 (0.2)	14 (1.2)	375 (33.3)	1 (0.1)	
Arunachal Pradesh	61	19 (31.1)	5 (8.1)		14 (22.9)			
Assam	41	13 (31.7)	11 (26.8)	1 (2.4)	3 (7.3)	1 (2.4)		
Bihar	8	1	1					
Delhi (U. T.)	1505	431 (28.6)	109 (7.2)			317 (21.0)		
Goa*	419	144 (34.4)	92 (22.0)	15 (3.6)	31 (7.4)	6 (1.4)	34 (8.1)	
Gujarat	372	79 (24.7)	67 (18.0)	12 (3.2)	4 (1.1)	2 (0.4)	1 (0.2)	1 (0.2)
Himachal Pradesh	6	1	1					
India - unspecified	993	153 (15.4)	76 (7.6)	19 (1.9)	84 (8.5)	6 (0.6)	7 (0.7)	5 (0.5)

Jammu and Kashmir	296	54 (18.2)	30 (10.1)	18 (6.1)	4 (1.3)	6 (2.0)		
Kerala	15	9 (60.0)			9 (60.0)			
Maharashtra	1264	295 (23.2)	232 (18.4)	77 (6.1)	30 (2.4)	14 (1.1)	6 (0.05)	8 (0.05)
Madhya Pradesh	6	1		1				
Orissa	353	68 (19.2)	49 (13.9)	10 (2.8)	6 (1.7)	4 (1.1)	6 (1.7)	
Pondicherry (U.T.)	133	18 (13.5)				18 (13.5)		
Punjab	340	157 (46.0)	153 (45.0)		1 (0.3)	7 (2.0)	3 (0.9)	
Rajasthan	1783	175 (9.8)	143 (8.0)	32 (2.0)	7 (0.4)	15 (0.8)	2 (0.1)	4 (0.2)
Tamil Nadu	813	143 (17.6)	115 (14.1)	16 (2.0)	5 (0.6)	4 (0.5)	2 (0.3)	1 (0.1)
Tripura	18	0						
Uttar Pradesh	101	55 (54.4)	16 (15.8)	12 (11.9)	12 (11.9)	35 (34.6)		15 (14.8)
West Bengal	1525	428 (28.0)	184 (12.0)	3 (0.2)	232 (15.2)	39 (2.5)	29 (1.9)	4 (0.2)
Adjacent countries	715	125 (17.5)	35 (4.9)	37 (5.1)	10 (1.4)	52 (7.3)	3 (0.4)	6 (0.8)
Bangladesh	262	23 (8.8)	5 (1.9)			17 (6.5)		19 (0.4)

Bhutan	180	61 (33.9)	28 (15.5)	29 (16.1)	10 (5.5)	4 (2.2)	3 (1.6)	5 (2.7)
Nepal	2	1	1					
Pakistan	232	31 (13.3)	1 (0.4)			30 (12.9)		
Sri Lanka	39	9 (23.0)		8 (20.5)		1 (2.5)		
TOTALS	11900	2776 (23.3)	1334 (11.2)	256 (2.1)	490 (4.1)	866 (7.2)	136 (1.1)	29 (0.2)

**Note* : Goa includes Goa State, Daman and Diu Union territory.

TABLE 4. The species of *Haemoproteus* and *Leucocytozoon* encountered or expected in birds of the Indian subcontinent.

Avian families and subfamilies	Haemoproteus	Leucocytozoon
Accipitridae	*elani* ; *nisi*	*toddi*
Aegithinidae	*aegithinae*	*chloropsidis* ; *irenis*
Alcedinidae	*fusca* ; *halcyonis*	
Anatidae	*nettionis*	*simondi*
Ardeidae	*mathislegeri*	*ardea*
Bucerotidae		*bucerotis*
Capitonidae	*bilobata* ; *cornuata* ; *thereicerycis* ; *xantholamae*	
Charadriidae	*nascimentoi*	*souusadiasi*
Columbidae	*columbae*	*marchouxi*
Coracidae	*coraciae* ; *eurystomae*	*eurystomae*
Corvidae	*danilewskyi* ; *picae*	*sakharoffi*
Cuculidae	*centropi*	*centropi*
Dicaeidae	*dicaeus*	
Dicruridae	*dicruri*	
Estrildidae Poephilinae	*orizivora*	
Eurylainidae	*eurylaimus*	
Falconidae	*tinnunculus* ; *brachiatus*	*toddi*
Fringillidae Carduelinae	*chloris*	*dutoiti*

Gruidae	*antigonis*	
Laniidae - Laniinae	*lanii*	
Megapodiodiae	*megapidius*	
Meropidae	*manwelli, meropis*	*nyctyornis*
Motacillidae	*anthi* ; *motacillae*	
Muscicapidae		
Muscicapinae	*balmorali* ; *pallidus*	
Rhipidurinae	*rhipiduris*	
Sylviinae	*sylvae* ; *wenyoni*	*phylloscopus*
Timallinae	*timalus*	*liothricis*
Turdinae	*fallisi*	*macclurei* ; *shaartusicum*
Nectariniidae	*sequeirae*	*nectariniae*
Oriolidae	*orioli*	*oriolus*
Paridae	*majoris* ; *parus*	*majoris*
Passeridae	*passeris*	
Phasianidae Phasianinae	*rileyi*	*macleani*
Picidae	*bennetti* ; *borgesi* ; *velans*	*squamatus*
Ploceidae	*quelea*	
Psittacidae	*handai*	
Pycnonotidae	*otocompsae* ; *philippensis* ; *sanguinis*	*brimonti* ; *pycnonoti*

Rallidae	*gallinulae*	
Scolopacidae	*contortus*	
Sittidae	*sittae*	
Strigidae	*noctuae* ; *syrnii*	*ziemanni*
Sturnidae	*pastoris*	
Threskiornithidae	*plataleae*	
Trogonidae	*trogonis*	
Upupidae	*upupae*	*communis*
Zosteropidae	*killangoi* ; *zosteropis*	*zosteropis*
Incertae sedis	*asturisdussumieri, herodiadis, himalayanus, moruny, raymundi, tephrodornis*	

TABLE 5. The species of other Haematozoa recorded in birds of the Indian subcontinent

Valid species	Incertae sedis
Genus	Trypanosoma
avium	*centropi*
brimonti bakeri	*cuculi*
corvi	*delhiense*
hannae	*fulicae*
lanii	*gymnorhidis*
	ixobrychi
	knowlesi
	lobivanelli
	milvi
	moruni
	nycticoracis
	turdoides
	urolonchae
Genus	Lankesterella
adiei	
lainsoni	
Genus	Toxoplasma*
	butasturis
	fulicae
Genus	Hepatozoon
adiei	
Genus	Babesia
moshkovskii	
tropicus	
Genus	Plasmodium
circumflexum	*coturnixae***
coturinixi	*herodiadis*
dissanaike	*heroni*
gallinaceum	*polare* (by Ray *et al*, 1933)
juxtanucleare	
nucleophilum	
relictum	
vaughani	

NOTE : * The status of the species of *Toxoplasma* is uncertain. If these two species viz., *T. butasturis* and *T. fulicae* indeed prove to be toxoplasmids, both the parasites may then be referred to as *Toxoplasma gondi.*

** *Plasmodium* (*Garnhamella*) *coturnixae* Sarkar and Ray, 1972 is erroneously referred to as a nomen nudum by Bennett and Bishop (1992). In fact, it is a species incertis sedis as declared by Greiner et al (1975).

TABLE 6. List of supplanted haematozoan parasite species and their current names

Supplanted species	Current name	Supplanted species	Current name
Genus Haemoproteus		*Genus Haemoproteus*	
bramae	*noctuae*	*celli*	*noctuae*
cerchneisi	*tinnunculi*	*danilewskyi* var. *tinnunculus*	*tinnunculi*
fringillae (in *Copsychus*)	*faliisi*	*fulica*	*gallunulae*
galathea	*plataleae*	*garnhami*	*oryzivorae*
glaucidii	*noctuae*	*gymnorhidis*	*passeris*
halcyonis var. *fusca*	*fusca*	*lonchuri*	*oryzivorae*
maclolophi	*majoris*	*morneti*	*pastoris*
oryzivorae (in *Ploceus* spp.)	*quelae*	*oryzivorae* (in timaline brids)	*timalus*
sturni	*pastoris*	*thereicerycis* var. *zeylanicus*	*thereicerycis*
Genus Leucocytozoon		*Genus Leucocytozoon*	
ardeolae	*ardeae*	*coraciae benghalensis*	*eurystomi*
danilewskyi (Nandi & Mandal, 1978)	*ziemanni*	*dubreuli* (Nandi & Mandal, 1978)	*pycnonoti*
enriquesi	*chloropsidis*	*fringillinarum* (Nandi & Mandal, 1978)	*dutoiti*
melloi	*eurystomi*	*molpastis*	*brimonti*
neavei (de Jong, 1971)	*macleani*	*sabrazesi*	*macleani*
Genus Plasmodium		*Genus Plasmodium*	
centropi	*relictum*	*choloropsidi*	*relictum*
gallinulae	*Haemoproteus gallinulae*	*pericrocoti*	*relictum*
ploceii	*relictum*	*praecox* var. *munia*	*relictum*
splendensae	*nemen nudum*	*venkataramiahii*	*nomen nudum*
Genus Trypanosoma		*Genus Trypanosoma*	
avium bakeri	*brimonti bakeri*	*avium bakeri* (in corvids)	*corvi*
bramae	*avium*	*columbae*	*hannae*
garruli	*corvi*	*grewali*	*nomen nudum*

TABLE 7. Current and supplanted generic terminology for avian hosts of the Indian subcontinent, according to Biswas (1952) and Ali and Ripley (1968-74).

Current generic name	Supplanted generic name	Current generic name	Supplanted generic name
Acridotheres	*Aethiospar*	*Accipiter*	*Astur*
Anas	*Nettion, Spatula*	*Anthropoides*	*Antigone*
Calidris	*Erolia*	*Charadrius*	*Leucoptinus*
Coracina	*Grancalus, Lalage*		
Dicrurus	*Chaptia*	*Egretta*	*Demiegretta, Herodias*
Falco	*Cerchneis*	*Grus*	*Antigone*
Lonchura	*Aidemosyne, Munia, Uroloncha*	*Megalaima*	*Thereiceryx, Xantholaema*
Parus	*Maclolophus*	*Perdicula*	*Cryptoplectron*
Pycnonotus	*Dissemerus, Elathea, Molpastes, Otocompsa*	*Sturnus*	*Pastor, Sturnaria, Sturnopastor*
Nectarinia	*Leptocoma*	*Petronia*	*Gymnorhis*
Terpsiphone	*Techitrea*	*Treron*	*Crocopus, Dendrophasa, Sphenocercus*
Vanellus	*Lobivanellus*	*Zoothera*	*Geocichla*

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SEASONAL CHANGES OF BIRD SPECIES IN TWO DIFFERENT ALTITUDINAL LOCATIONS OF SOLAN DISTRICT, HIMACHAL PRADESH

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INTRODUCTION

The Himalaya are most complex folded mountain system in the Indian subcontinent. Altitudinal variations, topographical and climatic conditions have greatly influenced the diversity and distribution of its fauna. The present studies deal with a comparative account of birds occurring in two locations with different altitudes and forest biotopes in Western Himalayan ecosystem of Himachal Pradesh.

STUDY AREA AND METHODS

Observations of birds were carried out at two locations in district Solan, Himachal Pradesh, *viz.* 1) Kotbeja near Kasauli, alt. 715 m. 2) Dumrog near Solan, alt. 1590 m (Fig. 1), covering an area of 3 to 5 sq. km. at each place.

Area of Kotbeja falls in Siwalik Himalaya, a zone of sub-montane and sub-tropical low hills consisting of Siwalik Sal forest. The vegetation comprises *Shorea robusta* with species of *Acacia, Zizyphys, Dalbergia, Bauhinia, Bombax, Ficus* and *Mangifera* : and patches of shrubs and grasses. The area is also under cultivation of maize, wheat, paddy and vegatables. Average annual rainfall is about 1100 mm and temperature varies from 5°C to 28°C. Dumrog are lies in sub-humid and sub-tropical mid hills of lower Himalaya with Himalayan Chir-Pine forest. It is more of less a pure association of *Pinus roxburghii* with Chir *Carissa* grass and dry-evergreen forest. Average annual rainfall is about 1450 mm and temperature range between –4°C and 25°C.

At both locations, observations were made once a month from November 1991 to December 1992 through all seasons : Winter (November-March), Summer or Pre-Monsoon (April-June) and Rainy (July-October). The birds were observed by using a pair of binoculars (8×50 with zoom focussing). They were determined in field with the help of Ali (1949) and Ali & Ripley (1983 a), and finally confirmed by the work of Ali & Ripley (1983 b).

OBSERVATIONS AND DISCUSSION

The data on bird was analysed for their seasonal abundance. A systematic list of 127 species belonging to 37 families alongwith their status and abundance at two locations has been given in Table 1. Of these, 110 species were noticed in Kotbeja area as compared to 96 species at Dumrog.

Relative percentage of all species occurring at Kotbeja and Dumrog are dipicted in Fig. 2. Resident species with a percentage of 62.7 predominated at Kotbeja. Howerver, their percentage declined to 45.8 at Dumrog. The summer and winter visitors were recorded almost in equal numbers at both locations. It is well known that several bird species migrate from the plains of Central India and Himalayan foothills to these ranges during summer, primarily for breeding from March/ April to September. Some species also migrate from Central Asia, Europe and Siberia to this region during the winter particularly from October to March (Ali & Ripley, 1983 b).

Further, a number of high altitude birds endemic to this ecosystem migrate towards lower elevations during winter because of heavy snowfall at Higher ranges and then return back in summer. Birds showing such vertical movements were noticed at both the locations but their percentage was much higher (30.2) in Chir-Pine forest of Dumrog as compared to that of Sal forested area of Kotbeja (17.3).

The resident birds like Whitebacked Vulture, Roseringed Parakeet, Spotted Owlet, Crimsonbreasted Barbet, Yellowfronted Pied Woodpecker, Northwestern Tree Pie, House Crow, Redvented Bulbul and Magpie Robin occurred in fairly good numbers in the Sal forest of Kotbeja (Table 1). On the other hand, the residents like Blossomheaded Parakeet, Jungle Myna and Indian Myna were abundant at Dumrog. Summer visitors *viz.*, Wiretailed Swallow and Golden Oriole were found in higher number at Kotbeja, whereas Brown and Verditor Flycatchers predominated at other locality. Similarly, population of winter visiting birds such as Sooty Flycatcher, Brown Chiffchaff and Pallas's Leaf Warbler was substantial at Dumrog.

Birds endemic to the Himalayan ecosystem (Table 1) such as Slatyheaded Parakeet, Kashmir Woodpecker, Leiothrix, various species of Tits, Wall Creeper, Tree Creeper, etc. occourred in good numbers during winter months in Pine-forested area as compared to Sal-forested area. Further, the population of Himalayan Redbilled Blue Magpie, Himalaya Jungle Crow, Whitecheeked Bulbul, Simla Streaked Laughing Thrush and Himalayan Whistling Thrush was substantial at Dumrog throughout the year. A few common endemic species like West Himalayan Pied Kingfisher, Himalayan Tree Pie, Whitecheeked Bulbul were also found in good numbers at Kotbeja throughout the year.

In general, it can be pointed out that because of varied range of ecological conditions like climate, altitude and associated forest biotopes not only changes the distribution pattern of birds having different status but also changes the seasonal abundance of a species.

SUMMARY

The observations were carried out on the birds occuring in a Siwalik-Sal forest and Himalayan Chir-Pine forest situated in two different altitudinal areas of Solan district, Himachal Pradesh during November, 1991 to December 1992. Altogether 127 species have been recorded. Their status and seasonal abundance at these locations have been compared and discussed.

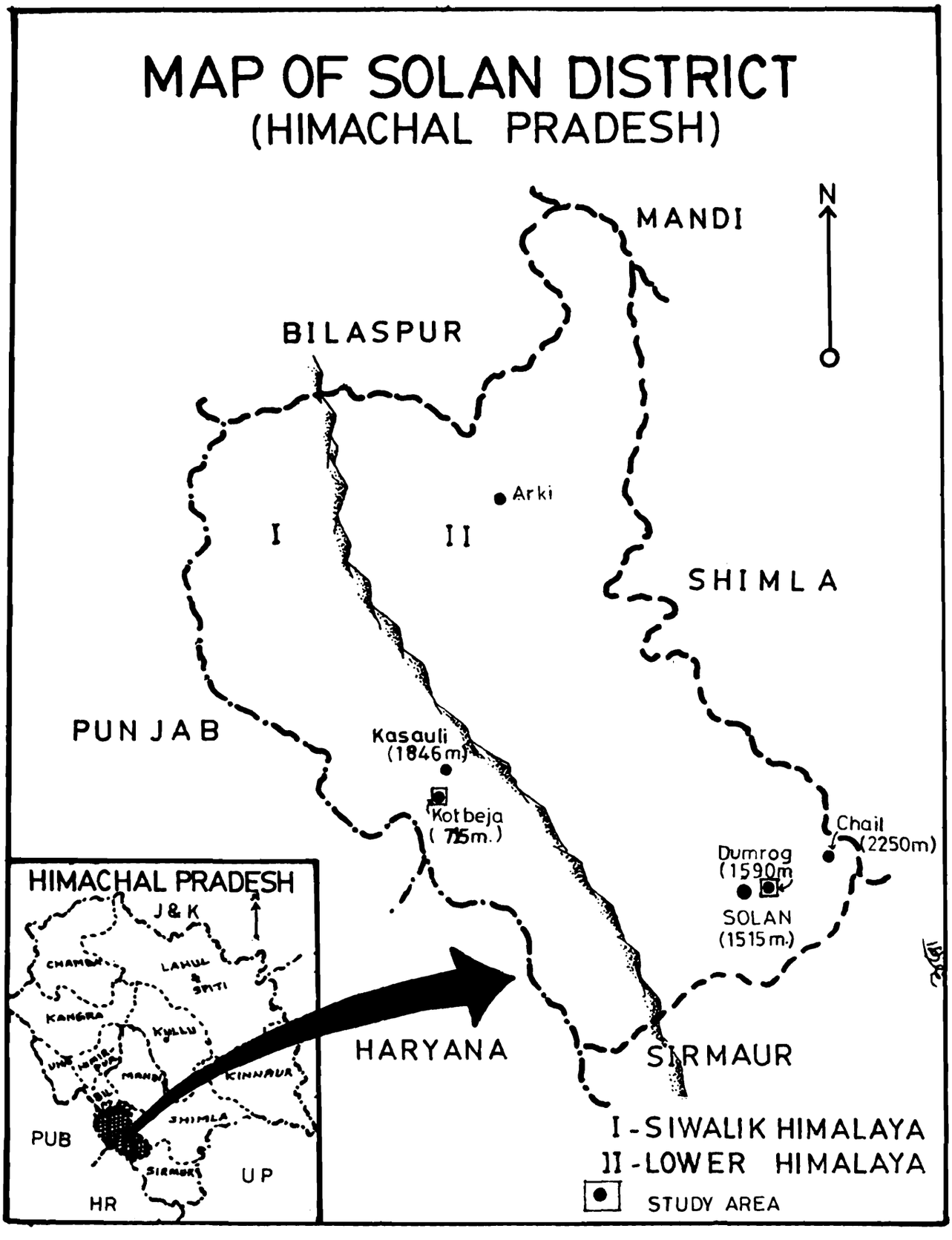

Fig. 1: Map of Solan district (Himachal Pradesh) showing places of study area.

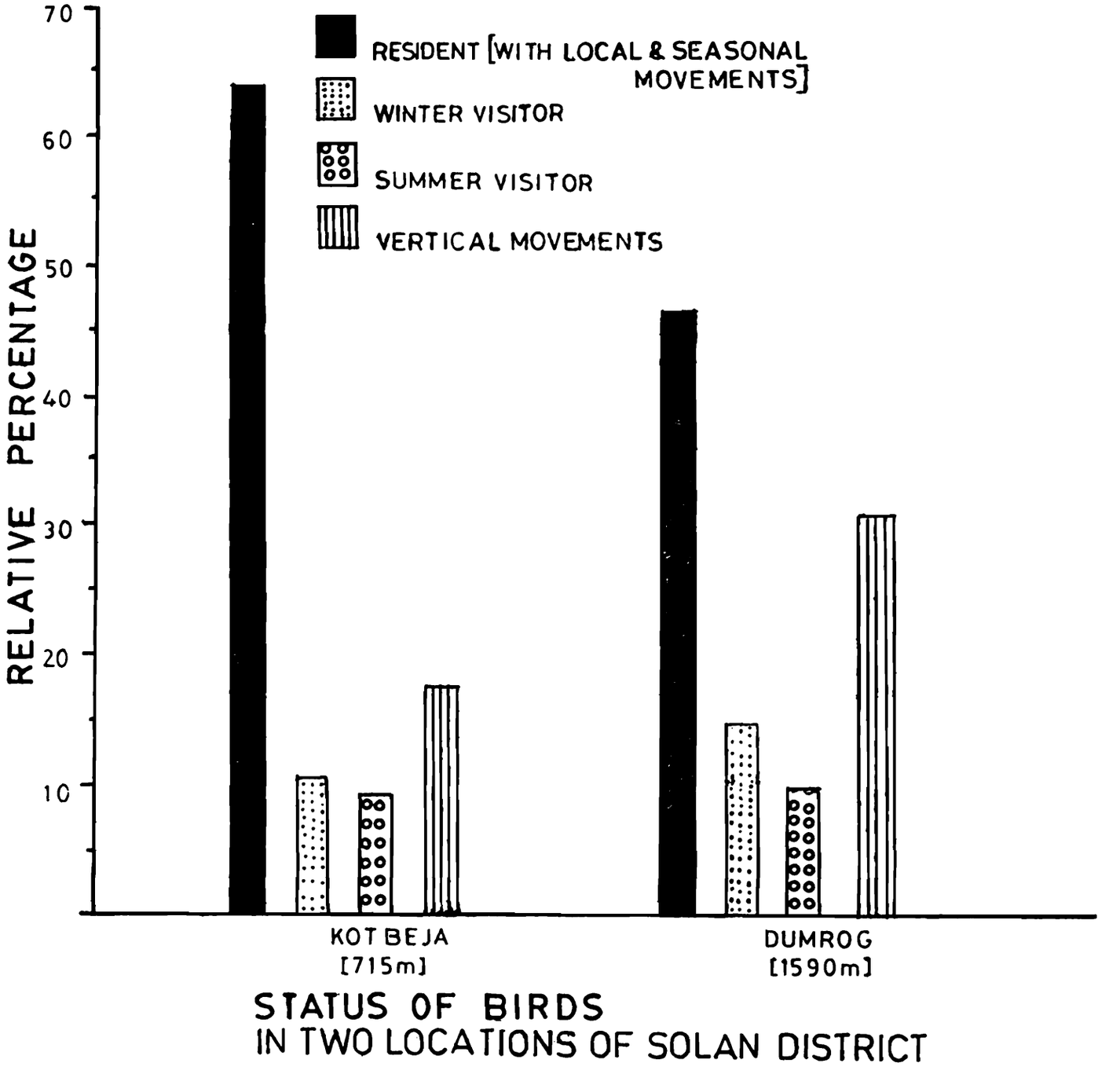

Fig. 2 : Relative percentage of birds having different status in two differnt altitudinal locations of Solan distirct, Himachal Pradesh.

Table-1

A SYSTEMATIC LIST OF BIRDS SHOWING THEIR STATUS AND SEASONAL ABUNDANCE AT TWO DIFFERENT LOCATIONS IN SOLAN DISTRICT DURING 1991-1992.

Sl. No.	Species & Common Name	Status	Seasonla abundance					
			Kotbeja (715 m, Sal Forest)			Dumrog (1590 m, Chir-Pine Forest)		
			Winter	Summer	Rainy	Winter	Summer	Rainy
1	2	3	4	5	6	7	8	9
	Family : ARDEIDAE							
1.	*Egretta alba* (Linnaeus) Eastern Large Egret	R/LM	+	+	–	–	–	–
2.	*Egretta intermedia* (Wagler) Median Egret	R/LM	+	+	–	–	–	–
	Family : ACCIPITRIDAE							
3.	*Elanus caeruleus* (Desfontaines) Blackwinged Kite	R	+	++	++	–	+	+
4.	*Milvus migrans* (Boddaert) Pariah Kite	R/LM	+	++	++	–	++	+
5.	*Butaster teesa* (Franklin) White-eyed Buzzard Eagle	R/LM	–	+	+	–	–	–
6.	*Accipiter badius* (Gmelin) Indian Shikra	R	+	++	++	–	++	+
7.	*Aquila rapax* (Temminck) Tawny Eagle	R/LM	–	+	–	–	–	–
8.	* *Gyps himalayensis* Hume Himalayan Griffon Vulture	VM	–	–	–	+	++	+
9.	*Gyps bengalensis* (Gmelin) Whitebacked Vulture	R	++	+++	++	+	++	++
10.	*Neophron percnopterus* (Linnaeus) Scavenger Vulture	R/LM	++	++	++	–	+	+
11.	*Spilornis cheela* (Latham) Crested Serpent Eagle	R/SM	++	+	–	–	+	–

1	2	3	4	5	6	7	8	9
	Family : FALCONIDAE							
12.	*Falco tinnunculus* Linnaeus European Kestrel	R/LM	+	++	++	–	++	+
	Family : PHASIANIDAE							
13.	*Francolinus francolinus* (Linnaeus) Black Partridge	R	–	–	–	–	+	+
14.	*Francolinus pondicerianus* (Gmelin) North Indian Grey Partridge	R	+	++	++	–	–	–
15.	*Perdicula asiatica* (Latham) Punjab Jungle Bush Quail	R	–	++	++	–	–	–
16.	*Gallus gallus* (Linnaeus) Red Junglefowl	R	–	++	+	–	+	+
	Family : TURNICIDAE							
17.	*Turnix sylvatica* (Desfontaines) Little Bustard-Quail	R/SM	–	+	+	–	–	–
	Family : CHARADRIIDAE							
18.	*Vanellus indicus* (Boddaert) Redwattled Lapwing	R	–	++	++	–	–	–
	Family : COLUMBIDAE							
19.	*Treron phoenicoptera* (Latham) Bengal Green Pigeon	R/LM	–	++	+	–	–	–
20.	*Columba livia* Gmelin Blue Rock Pigeon	R/LM	+	++	++	+	++	++
21.	*Streptopelia orientalis* (Latham) Western Turtle Dove	R/SM	–	–	–	–	+	+
22.	*Streptopelia decaocta* (Frivaldszky) Ring Dove	R/SM	+	++	++	–	+	–
23.	*Streptopelia Chinensis* (Scopoli) Spotted Dove	R/LM	+	++	++	–	++	+
24.	*Chalcophaps indica* (Linnaeus) Indian Emerald Dove	R/LM	–	+	++	–	–	–

1	2	3	4	5	6	7	8	9
	Family : PSITTACIDAE							
25.	*Psittacula eupatria* (Linnaeus) Large Indian Parakeet	R/LM	+	+ +	+	–	–	+
26.	*Psittacula krameri* (Scopoli) Northern Roseringed Parakeet	R	+ + +	+ + +	+ +	–	+ +	+
27.	*Psittacula cyanocephala* (Linnaeus) Northern Blossomheaded Parakeet	R	+	+ +	+	+	+ + +	+ +
28.	**Psittacula himalayana* (Lesson) Himalayan Slatyheaded Parakeet	VM	–	+	–	+ +	+ +	+ +
	Family : CUCULIDAE							
29.	*Clamator jacobinus* (Boddaert) Pied Crested Cuckoo	SV	–	–	+	–	+	+
30.	*Cuculus varius* Vahl Common Hawk Cuckoo	R/LM	–	+	+ +	–	+ +	+
31.	Cuculus micropterus Gould Indian Cuckoo	R/SM	+	–	+	–	–	–
32.	*Cacomantis passerinus* (Vahl) Plaintive Cuckoo	R/LM	–	+	+	–	–	+
33.	*Eudynamys scolopacea* (Linnaeus) Indian Koel	R/LM	+	+ +	+ +	–	+	+
34.	*Taccocua leschenaultii* Lesson Western Sirkeer Cuckoo	R	–	–	+	–	+	+ +
35.	*Centropus sinensis* (Stephens) Common Crow-Pheasant	R	+	+	+ +	–	–	–
	Family : STRIGIDAE							
36.	**Bubo bubo* (Linnaeus) Himalayan Eagle-Owl	VM	–	–	–	+	–	+
37.	*Glaucidium cuculoides* (Vigors) West Himalayan Barred Owlet	WV	+	+	–	+	–	–
38.	*Athene brama* (Temminck) Northern Spotted Owlet	R	+ +	+ +	+ +	–	+	+

1	2	3	4	5	6	7	8	9
	Family APODIDAE							
39.	*Apus melba* (Linnaeus) Indian Alpine Swift	R/LM	–	–	+	–	+ +	+
	Family : ALCEDINIDAE							
40.	**Ceryle lugubris* (Temminck) West Himalayan Pied Kingfisher	VM	+	+ +	+	–	+	–
41.	*Alcedo atthis* (Linnaeus) Small Blue Kingfisher	R/LM	–	+	+	–	+	–
42.	*Halcyon smyrnensis* (Linnaeus) Whitebreasted Kingfisher	R/LM	+	+ +	+ +	–	+	–
	Family : MEROPIDAE							
43.	*Merops orientalis* Latham Small Green Bee-eater	R/SM	+ +	+ +	+	–	+	+
	Family : CORACIIDAE							
44.	*Coracias benghalensis* (Linnaeus) Northern Roller	R/SM	–	+ +	+	–	–	–
	Family : UPUPIDAE							
45.	*Upupa epops* Linnaeus European Hoopoe	SV	–	+ +	–	–	+	–
	Family : BUCEROTIDAE							
46.	*Tockus birostris* (Scopoli) Grey Hornbill	R/LM	+	+ +	+ +	–	–	–
	Family : CAPITONIDAE							
47.	**Megalaima virens* (Boddaert) Himalayan Great Barbet	VM	+	–	–	+ +	+	+ +

1	2	3	4	5	6	7	8	9
48.	*Megalaima asiatica* (Latham) Bluethroated Barbet	R	+	+	–	+	+ +	+
49.	*Megalaima haemacephala* (Müller) Crimsonbreasted Barbet	R	+ +	+ +	+ +	–	+	–
	Family : PICIDAE							
50.	**Picus canus* Gmelin Blacknaped Green Woodpecker	*VM*	+	+	–	+ +	+	+
51.	*Dinopium benghalense* (Linnaeus) Lasser Golden backed Woodpecker	R	–	+	+	–	–	–
52.	**Picoides himalayensis* (Jerdine & Selby) Himalayan Pied Woodpecker	VM	–	–	–	+ +	–	+
53.	*Picoides macei* (Vieillot) Fulvousbreasted Pied Woodpecker	R/LM	–	+	+	–	+	–
54.	*Picoides mahrattensis* (Latham) Yellowfronted Pied Woodpecker	R	+ +	+ +	+ +	–	+	–
55.	**Picoides canicapillus* (Blyth) West Himalayan Greycrowned Pygmy Woodpecker	VM	+	–	–	+ +	+	+
	Family : HIRUDINIDAE							
56.	*Hirundo rustica* Linnaeus Western Swallow	SV	–	–	–	–	+ +	+
57.	*Hirundo smithii* Leach Wiretailed Swallow	SV	–	+ +	+ +	–	+	–
58.	*Hirundo daurica* Linnaeus Himalayan Striated Swallow	SV	–	+	–	–	+ +	+ +
	Family : LANIIDAE							
59.	*Lanius vittatus* Valenciennes Baybacked Shrike	R/SM	+ +	+ +	+	–	–	–

1	2	3	4	5	6	7	8	9
60.	*Lanius schach* Linnaeus Rufousbacked Shrike	SV	+	+ +	+ +	–	+ +	+
	Family : ORIOLIDAE							
61.	*Oriolus orioluus* (Linnaeus) Golden Oriole	SV/SM	–	+ +	+	–	+	+
62.	*Oriolus xanthornus* (Linnaeus) North Indian Blackheaded Oriole	R/LM	–	+	+	–	–	–
	Family : DICRURIDAE							
63.	*Dicrurus adsimilis* (Bechstein) North Indian Black Drongo	R/LM/SM						
64.	*Dicrurus leucophaeus* Vieillot Grey Drongo	SV	+	+	–	+	+	–
65.	*Dicrurus hottentottus* (Linnaeus) Haircrested Drongo	R/SM	–	+ +	–	–	–	–
	Family : STURNIDAE							
66.	*Sturnus malabaricus* (Gmelin) Grey headed Myna	R/SM	–	–	+	–	+	+
67.	*Sturnus pagodarun* (Gmelin) Brahminy Myna	R/SM	+	+ +	+ +	–	+	–
68.	*Acridotheres tristis* (Linnaeus) Indian Myna	R	+ +	+ + +	+ + +	+ +	+ + +	+ +
69.	*Acridotheres fuscus* (Wagler) Northern Jungle Myna	R/LM	+	+ +	+ +	+	+ + +	+ +
	Family : CORVIDAE							
70.	**Cissa erythorhyncha* (Boddaert) Himalayan Redbilled Blue Magpie	VM	+ +	+	+	+ + +	+ +	+ +
71.	*Dendrocitta vagabunda* (Latham) Northwestern Tree Pie	R/SM	+ +	+ +	+ +	+	+	+ +
72.	**Dendrocitta formosae* Swinhoe West Himalayan Tree Pie	VM	+ +	+	+	+	+ +	+ +

1	2	3	4	5	6	7	8	9
73.	*Corvus splendens* Vieillot House Crow	R/SM	+ + +	+ +	+ +	–	–	+
74.	**Corvus macrorhynchos* Wagler Himalayan Jungle Crow	VM	+ +	+	+	+ +	+ +	+ +
	Family : CAMPEPHAGIDAE							
75.	*Coracina melaschistos* (Hodgson) Dark Grey Cuckoo-Shrike	SV	+ +	+	+	–	+ +	+
76.	*Pericrocotus flammeus* (Forster) North Indian Scarlet Minivet	R/SM	+	+	–	–	+ +	+ +
77.	*Pericrocotus roseus* (Vieillot) Rosy Minivet	R/SM	+ +	+	+	–	+	–
	Family : IRENIDAE							
78.	*Aegithina tiphia* (Linnaeus) Northwestern Iora	R	+ +	+ +	–	–	–	–
	Family : PYCNONOTIDAE							
79.	**Pycnonotus leucogenys* (Gray) Whitecheeked Bulbul	VM	+ +	+	+	+ +	+ + +	+ + +
80.	*Pycnonotus cafer* (Linnaeus) Punjab Redvented Bulbul	R	+ +	+ +	+ +	+	+ +	+
81.	**Hypsipetes madagascariensis* (P. L. S. Müller) Himalayan Black Bulbul	VM	+ +	–	–	+ +	+	+ +
	Family : MUSCICAPIDAE							
82.	*Pellorneum ruficeps* Swanson Western Spotted Babbler	R/LM	+	+ +	+	–	–	–
83.	**Pomatorhinus schisticeps* Hodgson West Himalayan Slatyheaded Scimitar Babbler	VM	+	+	+	+	+	+
84.	*Turdoides striatus* (Dumont) Sind Jungle Babbler	R	+	+ +	+ +	–	–	+

1	2	3	4	5	6	7	8	9
85.	**Garrulax leucolophus* (Hardwicke) Himalayan Whitecrested Laughing Thrush	VM	+ +	–	+	+	–	+
86.	**Garrulax lineatus* (Vigors) Simla Streaked Laughing Thrush	VM	–	–	–	+ + +	+ +	+ +
87.	**Leiothrix lutea* (Scopoli) Western Redbilled Leiothrix	VM	–	–	–	+ +	+	+
88.	*Muscicapa sibirica* Gmelin Kashmir Sooty Flycatcher	WV	–	–	–	+ +	–	–
89.	*Muscicapa latirostris* Raffles Brown Flycatcher	SV	–	–	+	–	+ +	+
90.	*Muscicapa thalassina* Swainson Verditer Flycatcher	SV	+	+	–	–	+ +	+ +
91.	*Rhipidura hypoxantha* Blyth Yellowbellied Fantail Flycatcher	WV	+ +	–	–	–	–	–
92.	*Rhipidura albicollis* (Vieillot) Western Whitethroated Fantail Flycatcher	WV	+ +	+	+	–	+	–
93.	*Terpsiphone paradisi* Linnaeus West Himalayan Paradise Flycatcher	SV	–	+ +	+	–	+ +	+ +
94.	*Prinia socialis* Sykes Norhern Ashy Wren-Warbler	R/LM	+	+ +	+ +	–	–	–
95.	*Orthotomus sutorius* (Pennant) Tailor Bird	R	+	+ +	+ +	–	–	–
96.	*Phylloscopus collybita* (Vieillot) Brown Chiffchaff	WV	–	–	–	+ +	–	–
97.	*Phylloscopus proregulus* (Pallas) Western Pallas's Leaf Warbler	WV	+	–	–	+ +	–	–
98.	*Copsychus saularis* (Linnaeus) Magpie-Robin	R	+ +	+ +	+ +	–	+	+ +
99.	*Rhyacornis fuliginosus* (Vigors) Plumbeous Redstrat	R/SM	+	–	–	+ +	–	–
100.	**Enicurus maculatus* Vigors Western Spotted Forktail	VM	+ +	–	–	+ +	–	–
101.	*Saxicola caprata* (Linnaeus) Northern Pied Bush Chat	WV	+ +	+	–	–	–	–
102.	*Saxicola ferrea* Gray Dark-grey Bush Chat	R/SM	+	–	–	+ +	–	–

1	2	3	4	5	6	7	8	9
103.	*Chaimarrornis leucocephalus* (Vigors) Whitecapped Redstart	SM	++	–	–	++	+	–
104.	*Saxicoloides fulicata* (Linnaeus) Brownbacked Indian Robin	R	+	++	++	–	–	–
105.	**Myiophonus caeruleus* (Scopoli) Himalayan Whistling Thrush	VM	++	–	–	++	++	++
	Family : PARIDAE							
106.	**Parus major* Linnaeus Kashmir Grey Tit	VM	+	–	–	++	–	–
107.	**Parus monticolus* Vigors Greenbacked Tit	VM	+	–	–	++	+	–
108.	**Parus xanthogenys* Vigors Northern Yellowcheeked Tit	VM	–	–	–	++	+	–
109.	**Aegihalos concinnus* Gould Western Redheaded Tit	VM	–	–	–	++	+	–
	Family : SITTIDAE							
110.	**Tichodroma muraria* (Linnaeus) Wall Creeper	VM	+	–	–	++	–	–
	Family : CERTHIIDAE							
111.	**Certhia himalayana* Vigors Himalayan Tree Creeper	VM	+	–	–	++	+	–
	Family : MOTACILLIDAE							
112.	**Anthus sylvanus* (Hodgson) Upland Pipit	VM	–	–	–	–	+	++
113.	*Motacilla citreola* Pallas Northern Yellowheaded Wagtail	WV	++	–	–	+	–	–
114.	*Motacilla alba* Linnaeus White Wagtail	WV	+	–	–	–	–	–
115.	*Motacilla maderaspatensis* Gmelin Large Pied Wagtail	R/LM	+	++	+	–	–	–

1	2	3	4	5	6	7	8	9
	Family : NECTARINIDAE							
116.	*Nectarinia asiatica* (Latham) Purple Sunbird	R/LM	–	+	+ +	–	–	–
117.	**Aethopyga siparaja* (Raffles) Yellowbacked Sunbird	VM	+	–	+	+ +	+	+
	Family : ZOSTEROPIDAE							
118.	*Zosterops palpebrosa* (Temminck) White-eye	R/SM	+	+ +	+ +	–	+ +	+
	Family : PLOCEIDAE							
119.	*Passer domesticus* (Linnaeus) House Sparrow	R/SM	+ + +	+ + +	+ + +	+	+ +	+ +
120.	**Passer rutilans* Temminck Himalayan Cinnamon Tree Sparrow	VM	–	–	–	+	+ +	–
121.	*Petronia xanthocollis* (Burton) Yellowthroated Sparrow	SV	–	+	–	–	–	–
122.	*Ploceus philippinus* (Linnaeus) Indian Baya	R/SM	–	+ +	+	–	–	–
123.	*Lonchura punctulata* (Linnaeus) Spotted Munia	R	–	+ +	+	–	+	+
	Family : FRINGILLIDAE							
124.	**Carpodacus rhodochrous* (Vigors) Pinkbrowed Rosefinch	VM		–	–	+	–	–
	Family : EMBERIZIDAE							
125.	*Emberiza stewarti* (Blyth) Whitecapped Bunting	SV	–	–	–	+	+	–
126.	**Emberiza cia* Linnaeus Himalayan Rock Bunting	VM	–	–	–	+ +	–	–
127.	*Melophus lathami* (Gray) Crested Bunting	R/SM	–	+	+	–	–	–

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(R) : Resident,

(LM) : Local Movements,

(SM) : Seasonal Altitudinal Movements,

(SV) : Summer Visitor (For breeding),

(WV) : Winter Visitor,

(VM) : Vertical Movements (Winter-Summer),

(*) : Bird confined to Himalayan Ecosystem,

(–) : Not Observed,

(+) : Rare (1-20 birds),

(+ +) : Common (21-70 birds),

(+ + +) : Abundant (More than 70 birds)

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JUMPING SPIDERS OF BANGLADESH : GENUS *PLEXIPPUS* KOCH (ARANEAE : SALTICIDAE)

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INTRODUCTION

'Salticidae' or 'Jumping spiders' are one of the common predators of insects in different habitats. Among the pioneer workers on this group of spiders Pocock (1900) and Narayan (1915) made excellent contribution from the Indian sub-continent. Afterwards, Bradoo (1980), Tikadar (1966, '67, '73a, b, '74a, b, '75, '76, '77a, b) and Tikadar and Biswas (1981) made a series of contribution on the salticids of India. Recently, Proszynski (1992) and Biswas and Biswas (1992) made a valuable contribution on Salticidae from India.

On the contrary, Chowdhury and Pal (1984), Biswas, *et al.* (1993) and Okuma, *et al.* (1993) recorded a few salticids from Bangladesh. The present paper deals with the genus *Plexippus* Koch represented by two species from Bangladesh. Of these, one *P. wesolowskai* is recognised as new to science and other one, *P. paykulli* (Audouin) is a new record from the area. The new species is described and illustrated.

1. *Plexippus paykulli* (Audouin)

1825. *Attus paykulli* Audouin, *Descr. Egypt.*, 22 : 172.

1850. *Plexippus paykulli* Koch, *Meb. Ar. Syst.* 5 : 51.

1989. *Plexippus paykulli* Chen & Zhang, *Fauna of Zhejiang,* Araneida, 356p.

Specimen examined · 2♀, Harinkhana, Dist. Bagerhat, 18. V. 1991; 4♀, Shikerpur, Dist. Jhenaidah, 12. VIII. 1992; 2♀, 1♂, Dist, Kustia 19. VII. 1993; 1♀, Japhlong, Dist Sylhet, 28. XII. 1993; 2♀, Dist. Rajshahi, 4. III. 1992; 1♀, Tangail, 19. X. 1993. 3♀, Manikganj, 12. V. 1993.

Distribution ; BANGLADESH : Bagerhat, Jhenaidah, Kustia, Manikganj, Sylhet, Rajshahi, Tangail ; AMERICA ; AFRICA; BURMA; CHINA; INDIA; JAPAN; SRILANKA; EUROPE.

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2. Plexippus wesolowskai n. sp.

(Figs. 1 to 5)

General : Cephalothorax dark brown; legs light brown; abdomen brown. Total body length 6.80mm. Carapace 3.40mm long, 2.50mm wide; abdomen 3.20mm long, 2.20mm wide, Legs as in Table-1.

Cephalothorax : broader, longer than wide, postermedially broad, anteriorly narrowing; dorsum decorated with a black band and a posterior longitudinal and transverse white bands. Eyes pearly-white; anterior row recurved, ringed with basal band, anteromedians twice larger than anterolaterals; 2nd row of eyes minute; posterior row straight, placed marginally (Fig. 1), Chelicerae long, cylindrical, inner margin with 2 teeth (Fig. 2). Maxillae anteriorly broad, posteriorly narrowed, scopulate (Fig. 3). Labium wide, apple-shaped, scopulate anteriorly (Fig. 3). Sternum elongate, vase-shaped, posteriorly produced and pointed (Fig. 4). Legs strong and stout; tibiae and metatarsi of I and II with strong spines; leg formula 4312 and the measurements (in mm) in Table-1. Male palp as in Fig. 5.

Table-1 : Measurements (in mm) of different parrs of legs of *Plexippus wesolowskai* n. sp.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.0/1.0	0.3/0.3	0.7/0.7	0.7/0.7	0.4/0.4	3.1//3.1
II	0.9/0.9	0.3/0.3	0.6/0.6	0.6/0.6	0.4/0.4	2.8/2.8
III	1.2/1.2	0.4/0.4	0.8/0.8	0.8/0.8	0.5/0.5	3.7/3.7
IV	1.3/1.3	0.4/0.4	0.9/0.9	0.9/0.9	0.6/0.6	4.1/4.1

Abdomen : Elongately oval, pointed posteriorly, medially wide; dorsum with 2 black and 1 longitudinal white band extending from anterior margin upto the posterior extremity.

Female : Unknown.

Holotype : Male in spirit,

Type-locality : BANGLADESH ; Bangerhat, Khulna; date 12. IV. 1992; Coll. V. Biswas.

This species resembles *Plexippus paykulli* (Audouin) (Tikader, 1967; Yaginuma, 1986) but can be separated by the following characters:

1. Male palp without tibial apophysis.
2. Thoracic fovea absent.
3. Middle row of eyes closer to the anterior row and
4. Sternum elongate and wide in front.

SUMMARY

The jumping spiders of the genus *Plexippus* Koch in Bangladesh is represented by two species *P. paykulli* (Audouin) and *P. wesolowskai* n. sp.

Studies on our collection of spiders, recorded since 1988, has revealed the existence of two species.

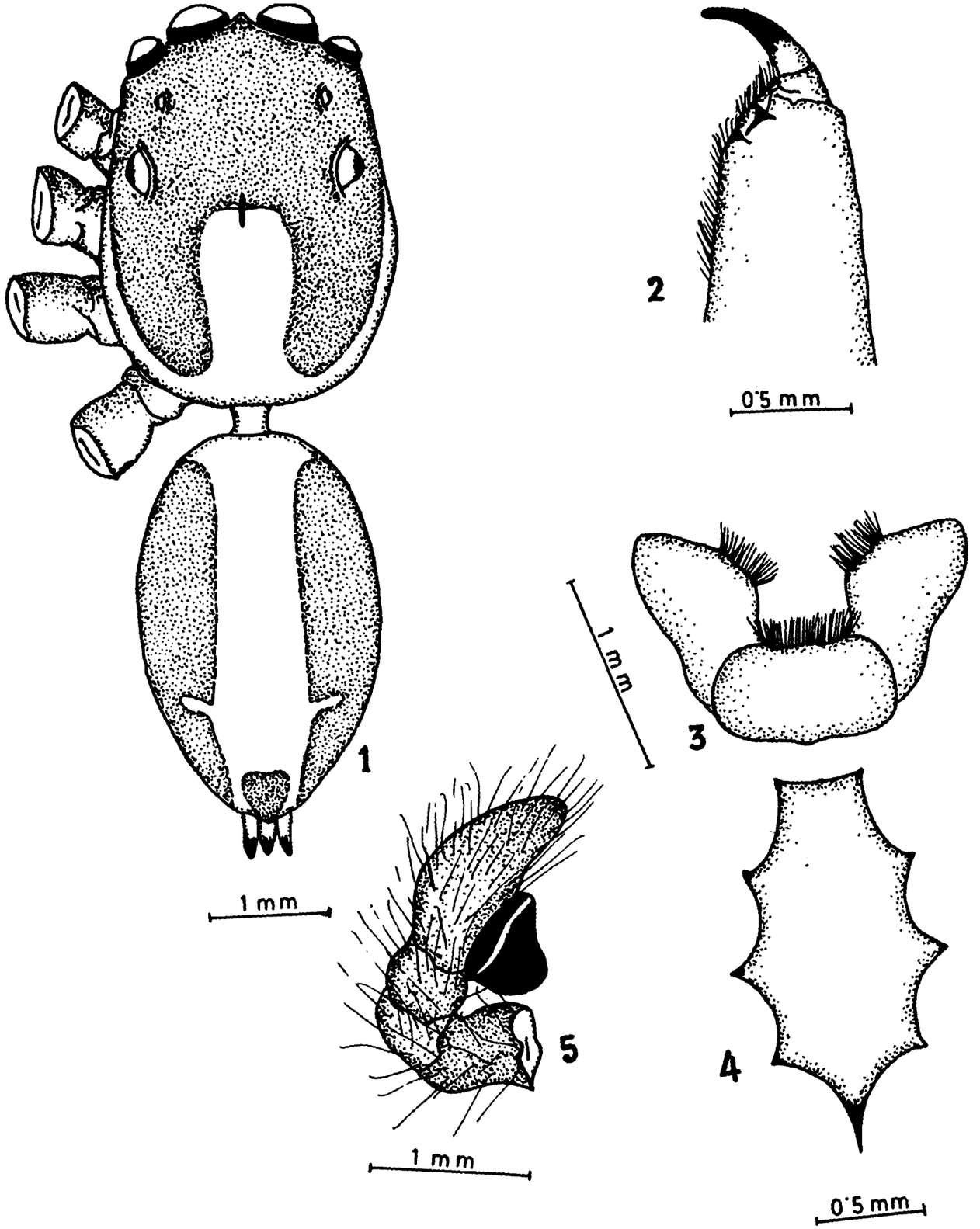

Plate-1 : Figs 1-5, *Plexippus wesolowski* n. sp.

Fig. 1: Whole body (dorsal view); Fig. 2: Chelicerae; Fig. 3: Maxillae and Labium; Fig. 4: Sternum; Fig: 5; Male palp (lateral view)

(indicated above) of *Plexippus* in Bangladesh. Identiy of the species were later confirmed by the Zoological Survey of India, Calcutta.

The types are at present in the collection of the Department of Zoology, Government P. C. College, Bagerhat, but will be deposited to the Museum of the Department of Zoology, University of Dhaka, Dhaka-1000, Bangladesh.

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LIMNOLOGICAL STUDIES OF A FRESHWATER FISH TANK BIBINAGAR, ANDHRA PRADESH PART I, ABIOTIC FACTORS.

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INTRODUCTION

Extensive work on water chemistry of freshwater bodies of India have been carried out by many workers like Ganapati (1940), Alikunni *et al.* (1955). Das and Srivastava, (1956), George (1961, 1966), Zafar (1964) Munawar (1970) Seennaya (1971), Rao (1972), Patil & Sen (1983), Patil *et al.* (1982-85) and others. The present tank was investigated during Jan. 85-Dec. 85, to obtain basic data on abiotic factors for future ecological study of water bodies of this region and to find out the trophic status of this water body.

DESCRIPTION OF THE TANK

The present tank called as Bibinagar tank is situated (lat. 17°38′ N and long. 78°46′E) 40 kms away from Hyderbad on Warangal road near a small town called Bibinagar. The shoreline is wavy with an earthern embankment on one side. The depth of the water varies from 1 to 5 meters. The water of the tank is used for irrigation purpose. The tank water gets polluted due to human activities of the nearby villages. Cattles are also washed here, consequently considerable amount of cowdung & urine are also added in the tank besides the domestic sewage of the nearby town. The tank is not yet under fish cultivation on large scale.

MATERIAL AND METHODS

Collection of surface water samples were made once in a month. D. O. was estimated as per Winkler's method. pH was determined with the help of pH meter. CO_2, total alkalinity, total hardness, calcium, chloride, total Phosphate, Nitrate, Nitrogen and Sulphate was estimated as per Standard Methods for the Examination of water and Waste Water (APHA, 1971). Plankton samples were also collected and preserved in 4% formalin The average annual abiotic data of water of the tank is given in (Table 1).

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RESULTS AND DISCUSSION

Mean transparency value was low throughout the year indicating enrichment of nutrients (Endmondson *et al*) ; 1956. Hickel (1973) related transparency value to density of plankton. The present study corroborate the view of the above authors. Moitra and Bhattacharya (1965), Jana (1973), related a high pH value to heavy bloom of phytoplankton, while low pH indicate the rise in zooplankton, but in the present study this does not seem to be so for zooplanktons of this region. In the present investigation direct correlation was recorded between pH and phenolophthalein alkalinity (Rao, 1955) Reid (1961) reported direct relationship with P and D. O. and while inverse relationship between pH and CO_2. More or less similar observations were made in the present study.

Table 1: Average annual range of various physico chemical factors.

	Average	Range			Standard Deviation
Transparency cm	62.91	30	to	90	5.7873
Temp. water °C	23.62	19	to	28	0.922
Temp. air °C	33.00	27	to	43	1.40
pH	8.7	8.2	to	9.7	0.128
CO_2mg/1.	7.54	0	to	35	3.5037
Carbonate mg/1.	43.33	34	to	80	9.8307
Bicarbonate mg/1.	257.5	170	to	370	22.9775
D. O. mg/1.	5.78	5.1	to	6.3	0.1222
Calcium mg/1.	92.33	65	to	120	5.2166
Mg. mg/1.	42.41	40	to	50	1.01
Total hardness mg/1.	199.58	190	to	220	4.823
Chloride mg/1.	97.0	64	to	130	6.2216
Total PO_4 mg/1.	0.36	0.32	to	0.45	0.0190
Nitrate Nitrogen mg/1.	0.61	0.58	to	0.65	0.0071
Sulphate mg/1.	8.9	8	to	10	0.2203
Sp. conductivity μ ohm/cm	534	468	to	600	11.7118

Total alkalinity was always above 170 mg/L and it was mainly due to the salts of calcium and magnesium. Moyle (1946) hsa given the natural separation point between soft and hard water as 40mg/L. Thus the water of the present tank can be considered as hardwater.

The total alkalinity was of carbonate and bicarbonate type. Chari (1980) observed direct relation -ship between pH and carbonate. Golterman (1970) stated that increased pH means high carbonate, this is true in the present study. pH of the water was usually above 8.2 and varies from 8.2 to 9.7 and the range being 1.5 thus it may be stated that the pH of water has shown only minor seasonal variations throughout one year (George, 1966, Tucker, 1985, Patil, 1976).

Rice (1938), Rao (1955), and Munawar (1970) have observed that the atmospheric temperature and water temperature more or less move hand in hand in the smaller water bodies. Welch (1952) pointed out that the smaller water bodies quickly reacts with the change in temperature. In the present study a well marked direct relation between atmospheric and water temperature could not be established as the water temperature did not follow closely the change in the air temperature due to the large size of the present tank under invesigation.

CO_2 was not detected throughout the period of study except on certain occassion and the maximum of 35 mg/l was recorded. The absence of CO_2 in water can be explained in two ways that the loss of CO_2 during the process of photosynthesis is more than its gain in the process of decay of organic matter. Liberation of CO_2 in the process of decompsition of bottom deposits is not sufficient to convert the carbonate completely into soluble bicarbonate. Further more, the presence of carbonate in the water throughout the year confirms the above statement for this water body.

The D. O. content of the water was found to be varied a less in the summer months and this may be due to high temperature of water. At high temperature, some of the oxygen might have been lost in atmopphere as it is well known that increase in temperature results in decrease in solubility of oxygen. It may be that at high temperature the oxidation of organic matter increases as some of the oxygen in water is also utilized. Thus it may be concluded that these above two processes might have been responsible for the low content of D. O. in the water during summer months. Such relationship have been also described by Munawar (1970), Patil *et al.* (1985).

Though many workers (Ganapati, 1940, Rao, 1955, and Saha *et al.* 1959) showed more or less inverse relationship between CO_2 and D. O. content in the present study well marked inverse relationship between D. O. and CO_2 could not be established in this tank, since CO_2 was rarely present in the present water body.

Calcium content was higher than magnesium content in the present tank. This is in conformity with Zutshi and Khan (1977) and the ratio was 3 : 2 for Ca and Mg. This is not close to the ratio recorded for other valley lakes by Zutshi and Vass (1973). Generally lake with low transparency develops floating flora dominancy (Zutshi *et al.* 1989). Same holds goods in the present study.

Nutrients in natural water often been considered to be limiting to phytoplankton production (Fogg, 1965, Hutchinson 1967). More or less same hold true in the present investigation and will be discussed elsewhere. Phosphate, Nitrate and Sulphates were found in considerable amount indicating moderate fertility of the waterhody, Vollenweider and Frei (1953) stated related increase in electric conductivity to the state of enrichment. In the present study the conductivity value varies between 465 to 600 μ ohms. Water free from contamination of effluents have smaller amount of phosphours (Welch, 1952, and Ruttner, 1953). The present tank water is polluted due to the activities of the nearby human population as a result the tank has considerable quantity of phosphate and nitrate. Increase in phosphate due to sewage pollution is observed (Hutchinson, 1957). Phosphate values were high in winter and lowest in summer, This is in conformity with Zutshi & Vass (1978).

Thus limnological investigation on abiotic factors reveals the hither trophic lavel of the present water body.

SUMMARY

Seasonal variations in abiotic parameters of a fresh water fish tank Bibinagar, Hyderbad have been studied for a period of one year. pH of water has shown minor seasonal variation. The transparancy value was low, CO_2 was detected only once. Direct relationship was observed between pH and phenolphthalein alkalintity. The phosphate and Nitrate (N_2) values were in considerable range. D. O. content was ranged between 5.1-6.3mg/1. The tank is isothermic with no sign of thermal stratification.

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ON A NEW GENUS AND SPECIES OF DERMAPTERA (INSECTA : OPISTHOCOSMIINAE)

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INTRODUCTION

The genus *Cordax* was described by Burr (1910) with *Forficula armata* Haan, 1942 from Burma (Myanmar) as the 'Type' and *Labia ceylonica* Motschulsky, 1863 from Sri Lanka. It appears that the description of the genus was based on the specimens from SE Asia belonging to Type species but in fact belong to some other species as is evident from the figure (Burr, 1910, fig. 67).

Srivastava (1982) examined the Syntype male of *F. armata* and designated it as 'Lectoype male' of the species. The first antennal segment in this specimen is flat above with lateral margin sharp or carinate and convex below.

In the light of this it is proposed that *Cordax* should include only those species that possess antennal segments similar to the Type species.

All other species hitherto include under this genus having basal segment long and cylindrical should be placed under the genus described below.

Paracordax gen. n.

Build slender and form elongated. Head tumid, sutures distinct or obsolete; eyes prominent. Antennal segments long and cylindrical, longer than the distance between antennal bases; 2nd short; 3rd a little shorter than 4th and 5th a little longer than 4th. Pronotum longer than broad, anteriorly a little narrower than head, sides straight and hind margin briefly or strongly convex. Elytra and wings well developed, former without lateral longitudinal ridge. Legs long and slender, femora scarcely thickened; tiviae compressed; 1st tarsal segment longer than the combined length of 2nd and 3rd. Abdomen convex, elongated or spindle shaped. Ultimate tergite, narrowed posteriorly, sloping backwards. Forceps long and slender, remote of contiguous at base, internal margin with several or sometimes one or two teeth only. Forceps in females simple and straight.

Type species : Cordax politus Burr, 1910.

Distribution : Oriental and Ethiopian Regions and New Guinea.

Remarks : Altogether four species *viz., P. ceylonicus* (Motschulsky), *P. politus* (Burr), *P. vandermeermohri* (Menozzi) and *P. cornutu* (Srivastava), are represented from the Oriental Region. A new species from India is described gere. These can be separated by the following key.

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According to Sakai (194, p. 6110), *Cordax goliath* Steinmann, 1982 may be a synonym of *Eparchus burii* (Bormans in Burr, 1903) in having identical forceps which seems to be correct. But the synonymy of *Cordax cornutus* Srivastava, 1991 with *C. golitha* is not possible since former has quite different forceps with branches contiguous in basal one third, not terminating into an internal tooth, afterwards incurved in apical two third (*vs* contiguous in basal two thirds, terminating into an internal sharp tooth, afterwards incurved in apical one third in *C. goliath).*

Taxonomic status of *Labis cylonica* Motshulsky, 1863 is not satisfactorily established. It was originally described on a female and male was subsequently recorded by Dohrn (1865) and described as having the forceps contiguous at base, afterwards broadly arcuate and meeting at apex. Sakai (l.c., p. 6140) has figured a male specimen from BMNH (British Museum of Natural History, London) which has identical forceps. Besides, one male from Sri Lanka, dt. by Brindle (1971) has been examined by me and it possesses forceps contiguous all along its length.

Key to the species (based on males only)

1(4). Forceps remote at the base; pygidium, distinct, vertical, longer than broad, narrowed apically with hind margin concave

2(3). Penultimate sternite with hind margin truncate in middle (fig.1); forceps (fig.2) with branches almost straight, slightly undulated in middle, attenuated with apices gently hooked, internal margin in basal two thirds differentiated in dorsal and ventral borders, with several large and small teeth .....*P. politus* (Burr)

3(2). Penultimate sternite (fig.3) with hind margin rounded; forceps (fig. 4) in basal two thirds broadly arched enclosing an elongated oval space, afterwards contiguous, tips gently hooked, internally at base with fine serations, at basal one third with a vertical triangular tooth directed internally and with another blunt tooth below at apical one third ....*Paracordax julkai* sp. n.

4(1). Forceps with brances contiguous or subcontiguous in basal one third; pygidium small, not as above

5(6). Forceps (fig.7) with a vertical tooth above and two teeth internally....*P. cornutus* (Srivastava)

6(7). Forceps serrated internally, otherwise unarmed

7(8). Forceps contiguous at base only, afterwards arcuate (fig.8) or contiguous all along its length (fig.9), almost straight, tapering apically with tips gently hooked ...*P. ceylonicus* (Motschulsky)

8(7). Forceps (fig.10) subcontiguous and feebly dilated at base for some distance, afterwards incurved, internally with a convexity at about apical one third...*P. vandermeermohri* (Menozzi)

Paracordax julkai sp. n.

Male : General colour shining brownish black with oily lustre, sides of pronotum yellowish, form cylindrical.

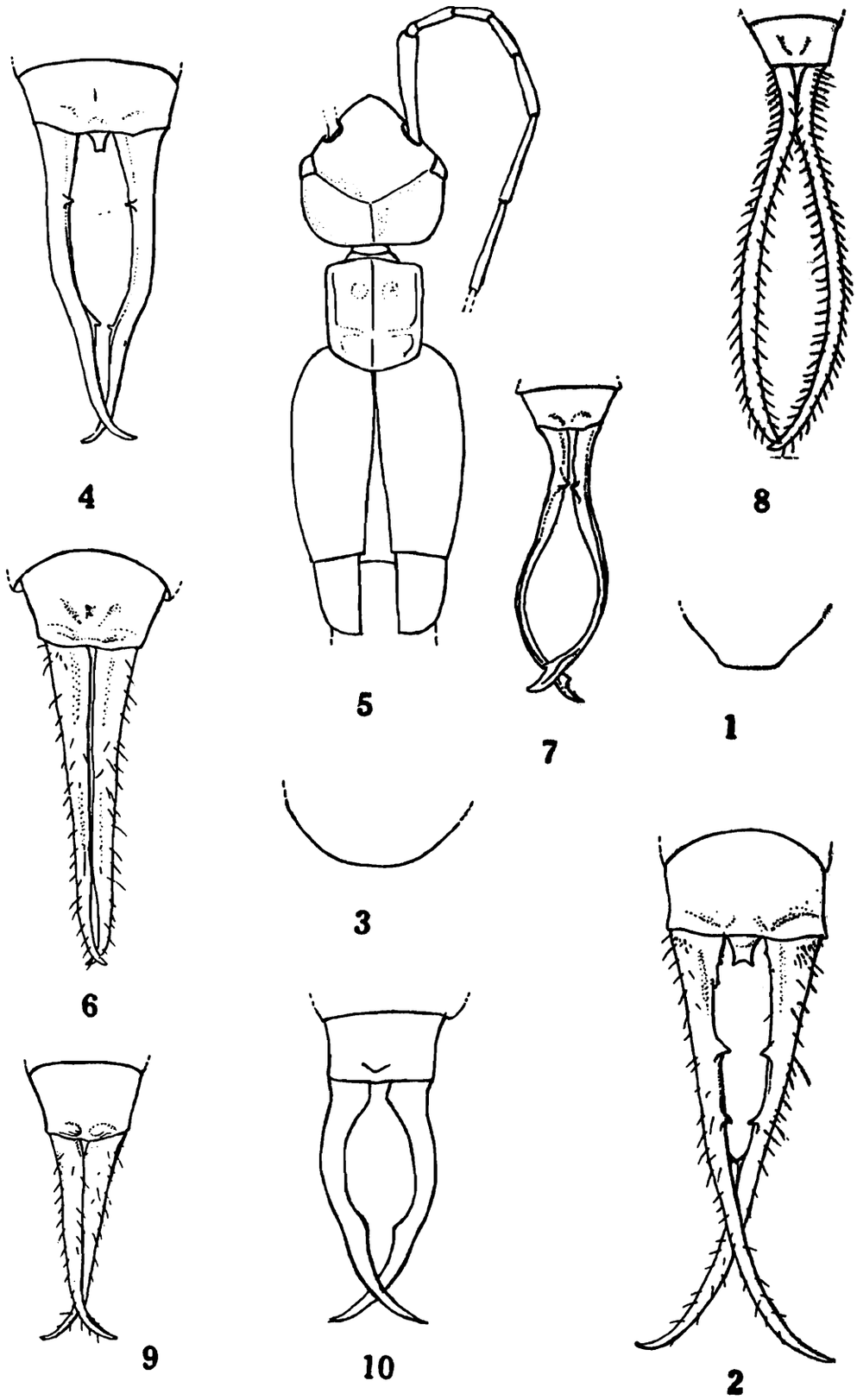
Head about as long as broad, smooth, frons and occiput raised, sutures distinct, hind margin almost straight and angles rounded; eyes prominent but distinctly shorter than post-ocular length. Antennae broken in the Holotype Male, except the left basal segment, long and cylindrical, distinctly longer than the distance between antennal bases. Pronotum smooth, longer than broad, anteriorly narrower than head, sides gently reflexed, parallel, hind margin rounded, median sulcus distinct, prozona weakly raised and well differentiated from depressed metazona. Legs long and slender, femora and tibia compressed, hind tarsi with 1st segment longer than the combined length of 2nd and 3rd; 2nd lobed. Elytra and wings well developed, coriaceous, former obscurely micro-reticulated with hind margin oblique. Abdomen spindle shaped, tergites feebly convex, smooth, lateral folds on 3rd and 4th tergites distinct, sides of segments convex, smooth. Penultimate sternite transverse, posterior margin broadly rounded. Ultimate tergite transverse, narrowed posteriorly, depressed and declivent posteriorly, hind margin weakly trisinuate, oblique above the base of forceps. Pygidium vertical, broader at base, narrowed apically, hind margin feebly concave. Forceps with long and short pubescence, branches cylindrical, remote at base, gently incurved enclosing an elongated space in basal two thirds, afterwards contiguous and straight, apices attenuated and hooked, internal margin with fine serrations at base, a small vertical, triangular tooth above, close to inner margin directed inwards at basal one third and another smaller blunt, ventral tooth at apical one third present. Genitalia with parameres slightly longer than broad, narrowed basally, apical margin rounded.

Female : Agrees with male in most characters except that long pubescence more pronounced on the sides of abdomen and forceps, head orange, legs sometimes clear yellow; antennae broken (maximum number remaining nine only), segments long, thin and cylindrical, 3rd slightly shorter than 4th, narrowed basally; 4th thin, feebly narrowed basally; 5th onwards gradually increasing in length and thinning; penultimate sternite obtusely rounded posteriorly; pygidium indistinct; forceps simple, contiguous and straight.

Measurements (in mm) : Holotype Male : Length : Body -9.2; forceps -3.9; Paratypes 4. Females : Length : Body -8.7 -9.1; forceps -3.1 -4.6.

Material examined: INDIA : Arunachal Pradesh : Subansiri Dist., Galeusiank, 1350m, Holotype Male, 10. XII. 1974; same data, Gemo, 1600m, Paratype 1 Female, 9. XII. 1974; sama data, Damia, 1100m, Paratype 1 Female, 22. XII. 1974 and sama data, Taksing, Surita Top, 3200m, Paratype 1 Female, 22. XII. 1974, all Dr. J. M. Julka Coll. and deposited in the Zoological Survey of India, Calcutta.

Remarks : The described species come close to *P. politus* (Burr) in having long and slender build, long pubescence on abdomen and forceps and somewhat similar pygidium, in males, but differs by the shape of penultimate sternite broadly rounded posteriorly (*vs* truncate in *P. politus*); pygidium more strongly narrowed posteriorly and hind margin feebly emarginate (*vs* broader and hind margin distinctly emarginate and postero-lateral angles produced into minute point), and forceps with branches cylindrical, broadly incurved in basal two thirds, afterwards contiguous and straight, internally armed with fine dentation at base, a dorsal triangular tooth directed inwards present at basal one third and a ventral obtuse tooth at apical one third also (*vs* branches almost straight, at about middle undulated, gently incurved in apical one third, internal margin on ventral and dorsal border with several small or large triangular teeth present in basal two thirds.



Figs. 1-10 : *Paracordax politus* (Burr), ♂ 31, 1. Posterior margin of penultimate sternite, 2. Ultimate tergite, pugidium and forceps; *Paracordax julkai* sp. n., Holotype, ♂, 3. Posterior margin of penultimate sternite 4. Ultimate tergite and forceps, 5. Anterior portion of body, ♀, 6. Ultimate tergite and forceps; *Paracordax cornutus* (Srivastava), ♂, 7. Ultimate tergite and forceps, *Paracordax ceylonicus* (Motschulsky), ♂, 8-9. Ultimate tergite and forceps, *Paracordax vandermeermohri* (Menozzi), ♂, 10. Ultimate tergite and forceps.

SUMMARY

A new genus *Paracordax* is described with *Cordax politus* Burr, 1911 as the type-species and a new species *Paracordax julkai* from India. Besides all other species earlier included under *Cordax* Burr, 1910 which possesses basal antennal segment long and cylindrical will also be included under it. Henceforth, *Cordax* will be characterised by the presence of basal antennal segment deplanate above, laterally faintly raised or carinate and convex below and will include the type species, *Forficula armata* Haan, 1842 and *Timomenus vicinus* Steinmann, 1982, for the present.

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NEW RECORD OF SOME TETRANYCHID MITES (ACARI : TETRANYCHIDAE) FROM CHHINDWARA DISTRICT, MADHYA PRADESH

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INTRODUCTION

A perusal of literature reveals that very little is known about the tetranychid fauna of M. P. Two species of tetranychid mites, *Tetranychus macfarlanei* Baker and Pritchard and *Petrobia latens* (Mullar) were reported by Bindra and Kittur (1961) from Madhya Pradesh, Gupta and Gupta (1978) reported 7 more species from M. P. in addition to this, Gupta (1985) in his Hand Book on Indian plant mites, listed 4 species from Madhya Pradesh. Recently, Gupta and Gupta (1994) reported 8 species from M. P. However, so far nothing has been reported from Chindwara District. The present communication is based on the material collected by the author during a Chhindwara dist. survey and reports 9 species belonging to 5 genera. All these species are reported for the first time from the district and out of these 4 species are reported for the first time from the state. The entire material treated here is deposited in the Central Regional Station, Zoological Survey of India, Jabalpur.

SYSTEMATIC ACCOUNT

Genus I : ***Eutetranychus*** Banks

1. ***Eutetranychus orientalis*** (Klein)

1936. *Anychus orientalis* Klein, *Bull. agric Res. Stn. Rehovoth,* **21** : 3.

1994. *Eutetranychus orientalis,* Gupta and Gupta, *Mem. Zool. Surv. India.* **18** (1) 35-37.

Material examined : 25 ♀♀ (Reg. No. A/1709). M. P. Dist. Chhindwara, Around Rly. Stn., Pandura, ex. Neem plant, 23.11.1989; 14 ♀♀ ♂ 1(Reg. No. A/1822), Pandhurna, ex. Citrus, 22.11.1989; 35 ♀♀ (Reg. No. A/1841), Forested area around Parasia, ex. wild plant, 19.11. 1989; 2 ♀♀ (Reg. No. A/1846), Pandhurna North, ex. wild pant, 24.11.1989.

Distribution in India : Assam, Delhi, Gujrat, Haryana, Jammu and Kashmir, Madhya Pradesh, Karnataka, Punjab, Uttar Pardesh & West Bengal.

Genus II : ***Eotetranychus*** Oudermans

2. ***Eotetranychus hirsti*** Pritchard and Baker

1926. *Tetranychus fici* Hirst. *Proc. zool. Soc. Lond.* 828.

1994. *Eotetranychus hirsti*, Gupta and Gupta. *Mem. zool. Surv. India*, **18** (1) : 67-68.

Material examined : 4♀♀,1♂ (Reg. No. A/1843), M. P. Dist. Chhindwara, Pandhurna North, ex. Grass, 24.11.1989.

Distribution in India : Andhra Pradesh, Bihar, Delhi, Karnataka, Madhya Pradesh, Punjab, Tamil Nadu and West Bengal.

Genus III : ***Oligonychus*** Berlese

3. ***Oligonychus mangiferus*** (Rahman and Sapra)

1940. *Paratetranychus mangiferus* Rahman and Sapra, *Proc. Indian Acad. Sci.* **11** (B) : 192.

1994. *Oligonychus mangiferus*, Gupta and Gupta, *Mem. zool. Surv. India*, **18** (1) : 108.

Material examined : 14 ♀♀ , ♂1(Reg. No. A/1844), M. P. Dist Chhindwara, Imalikhera, ex. Mango, 17.11. 1989.

Distribution in India : Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab and West Bengal.

4. ***Oligonychus punicae*** (Hirst)

1926. *Paratetranychus punicae* Hirst, *Proc. zool. Soc. London*, 830.

1985. *Oligonychus oryzae*, Gupta, *Handbook : Plant Mites of India*, : 88-89.

Material examined : 15 ♀♀ , 1♂(Reg. No. A/1713), M. P. Dist. Chhindwara, Imalikhera, ex. Wild plant, 17.11.1989.

Distribution in India : Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

Remarks : Recorded for the first time from Madhya Pradesh.

5. ***Oligonychus indicus*** (Hirst)

1923. *Paratetranychus indicus* Hirst., : 990.

1985. *Oligonychus indicus*, Gupta, *Handbook : Plant Mites of India*. : **86**.

Material examined : 15♀♀ , 1♂(Reg. No. A/2649), M. P. Chhindwara Dist., Kareaam, Patalkot, ex. unidentified plant, 25.02.1994.

Distribution in India : Andhra Pradesh, Bihar, Delhi, Haryana, Karnataka, Meghalaya, Orissa, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal.

6. *Oligonychus iseilemae* (Hirst)

1924. ***Paratetranychus iseilemae*** Hirst., 524.

1985. ***Oligonychus iseilemae,*** Gupta : *Handbook Plant mites of India* 86-87.

Material examined : 5 ♀♀ , 1♂(Reg. No. A/2651), M. P. Chhindwara Dist., Sangerapot, Patalkot, ex. unidentified plant, 21.02.1944.

Distribution in India : Andaman and Nicobar Islands, Andhra Pradesh and Tamil Nadu.

Remarks : This mite is not known to have any economic importance.

Genus IV : *Schizotetranychus* Tragardh

7. *Schizotetranychus hindustanicus* (Hirst)

1924. ***Tetranychus (Schizotetranychus) hindustanicus Hirst, Ann. Mag. Nat. Hist.,*** **9** (14) 525.

1985. ***Schizotetranychus hindustanicus*** Gupta, *Handbook : Plant mites of India,* : 11.

Material examined : 3 ♀♀ , 1♂ (Reg. No. A/2312), M. P. Dist. Chhindwara, Dhimra Dhara vill. ex. Benyan leaves, 20.11.1989.

Distribution in India : Kerala and Tamil Nadu.

Genus V *Tetranychus* Dufour

8. *Tetranychus urticae* Koch

1867. ***Acarus cinnabarinis*** Boisd., *Ent. Hort.,* 88.

1985. ***Tetranychus cinnabarinus,*** Gupta, *Handbook* : Plant Mites of India, : 106.

1994. ***Tetranychus cinnabarinus,*** Gupta and Gupta, *Mem. zool. Surv, India* : **18** (1) : 131-133.

Material examined 13 ♀♀ 2 ♂♂ (Reg. No. A/1842), M. P. Distt. Chhindwara, Area around forest, Parasia, ex. Rose, 19.11.1989.

Distribution in India : Bihar, Gujrat, Haryana, Karnataka, Kerala, Madhya Pradesh, Meghlaya, Orissa, Punjab, Rajasthan, Tamil Nadu and West Bengal.

9. *Tetranychus neocaledonicus* Andre

1933. ***Tetranychus neocaledonicus,*** Andre, *Bull. Mus. Natn. Hist. nat. Paris,* **42** (5) : 302.

1985. ***Tetranychus neocaledonicus,*** Gupta, *Handbook : Plant Mites of India,* : 113-115.

1994. ***Tetranychus neocaledonicus,*** Gupta and Gupta, *Mem. zool. Surv. India* **18** (1) : 131-133.

Material examined 23 ♀♀ , 2 ♂♂ (Reg. No. A/1778), M. P. Dist. Chindwara, Imalikhera, ex. Cucumber, 17.11.1989.

Distribution in India : Assam, Bihar, Delhi, Gujrat, Haryana, Karnataka, Kerla, Maharashtra, Madhya Pradesh, Meghalaya, Orissa, Punjab, Rajasthan, Uttar Pradesh and West Bengal.

SUMMARY

Nine species of tetranychid mites belonging to 5 genera are reported for the first time from the Chhindwara District. Out of these, four species viz. *Oligonychus punicae* (Hirst), *Oligonychus indicus* (Hirst), *Oligonychus iseilemae* (Hirst) and *Schizotetranychus hindustanicus* (Hirst) are reported for the first time from the State.

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THE GENUS NERTHRA (SAY) FROM INDIA WITH A DESCRIPTION OF A NEW SPECIES FROM ARUNACHAL PRADESH, NORTH EASTERN INDIA (GELASTOCORIDAE : HEMIPTERA : INSECTA)

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Itanagar-791 111, India.

INTRODUCTION

The family Gelastocoridae commonly known as 'Toad Bugs' are short, broad aquatic bugs characterised with protruding eyes. The fore legs are raptorial and abdominal sterna are asymmetrical. There are about 100 species found throughout the world which are divided into two genera, namely, *Gelastocoris* Kirkaldy (subfamily : Gelastocorinae) and the cosmopolitan *Nerthra* Say (Subfamily : Nerthrinae). In India, the genus *Nerthra* is known from North Eastern India and represented by three species, *N. indica,* (Atkinson), *N. asiatica* (Horvath) and *N. spissa,* (Distant) (Distant, 1906 & 1910; Todd, 1955). The genus *Nerthra* can easily be identified by the fused foretarsus to tibia, single foretarsal claw, rostrum appearing to arise on ventral surface of head which is slender. The head is provided with tooth like tubercles on the dorsal side. The ninth abdominal segment of male visible externally with well developed right paramere, left paramere being absent. In the present study, *N. Indica,* hitherto, known from Eastern and North Eastern India, is recorded for the first time from Southern India and a new species of the genus is described from Arunachal Pradesh. A key to all the known Indian species is also given.

Nerthra indica (Atkinson)

1888. *Mononyx indicus* Atkinson, *J. Asiatic Soc. Bengal. LVII :* 345.

1906. *M. indicus* Distant, *Fauna British India, 3 :* 15.

1910. *M. projectus* Distant, *Fauna British India, 5,* : 310.

1955. *N. indica* Tod, *Kans. Sci. Bull, 37 :* 405.

Length 10.0 mm; width of pronotum 7.7 mm; width of abdomen 8.2 mm. The ovipositor lobes are small, less projecting and with lateral submarginal tumescences on the last visible abdominal sternite. The lateral dilation of the embolial margin is not triangular.

Material examined : One female from a jungle stream, near Kodumudi Aru Estate, Kalakad, Tirunelveli Distt, Tamilnadu, alt. 200 metres, Coll. : M. Vasanth; 26. VIII. 1986.

Distritution : Assam, Sikkim, Tamilnadu, (Present recorded), West Bengal.

Remarks : The record of *N. indica* from Kalakad, Western Ghats is the first report of this species from Southern India. Todd (1955) remarked that this species is restricted to India in its distibution.

Nerthra spissa (Distant)

1910. *Mononyx spissus* Distant, *Fauna British India,* 5 : 312.

1955. *Nerthra* Todd, *Kans. Sci. Bull.,* 37 : 412.

Length 9.0 mm; width of pronotum 6.6 mm; width of abdomen 6.7 mm. Body covered with long erect bristles, head with two larger tubercles in front; pronotum almost rectangular with straight lateral margin; scutellum tumescence laterally and apex. Male paramere large, straight, cylindrical and twisted (Fig. 1.F).

Material examined : One male from Julli village, Near Ganga, Itanagar, Arunachal Pradesh, Coll. : D. B. Bastawade, 6. VIII. 91.

Distritution : India : Arunachal Pradesh (present record), Assam.

Remarks : *N. spissa* was first described from Sibasagar, Assam, North Eastern India (Distant, 1910) and subsequently recorded from Misamari, Assam, (Todd, 1955). In the present study, this species is recorded for the first time from Arunachal Pradesh and thus reported after 40 years of gap.

Nerthra arunachalensis sp. nov.

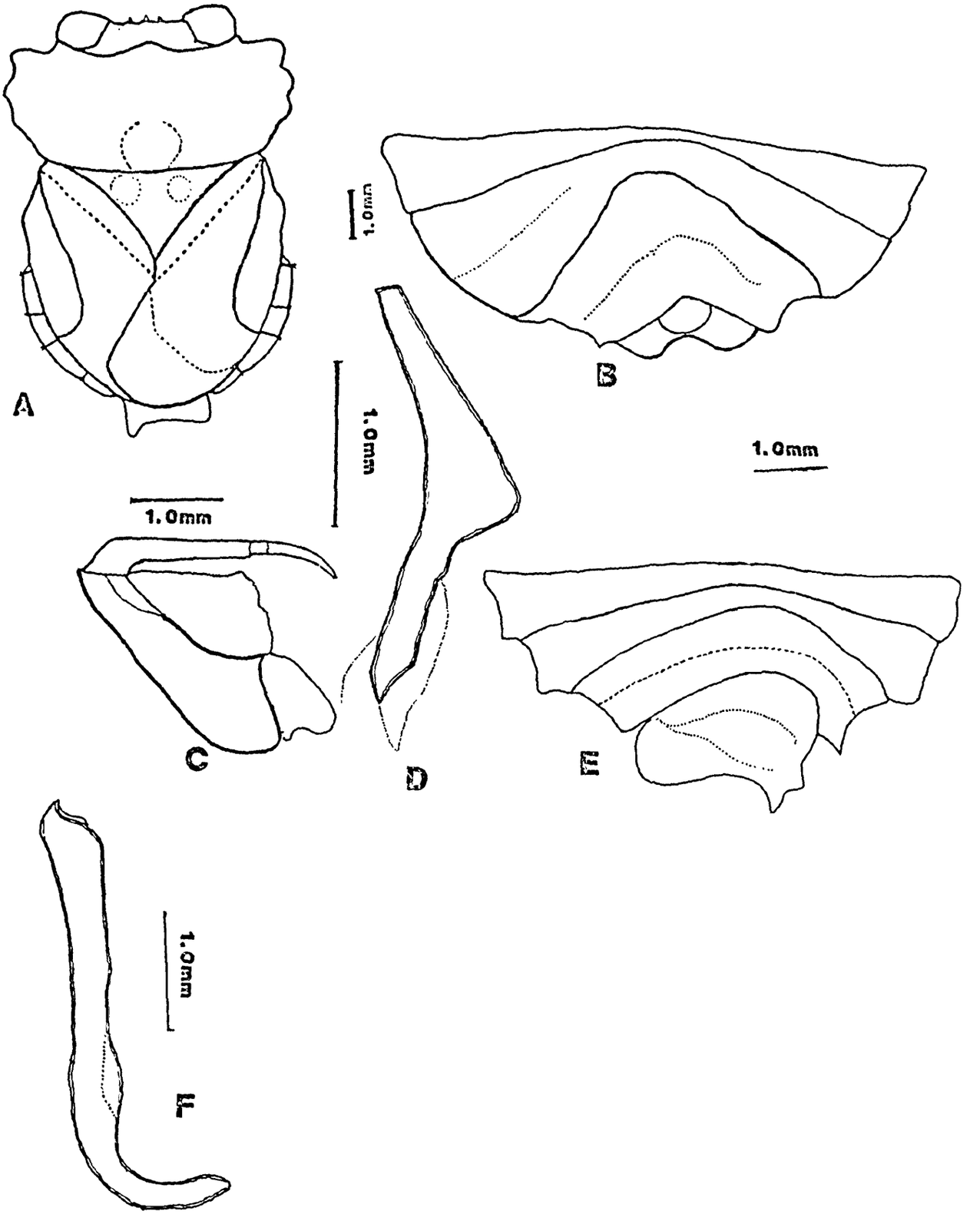
(Fig. 1. A-E)

Size : Male : Length, 8.3 mm., width of the pronotum, 6.2 mm., width of abdomen, 5.9 mm., Female : 9.4 mm., width of the pronotum, 7.1mm., width of abdomen, 6.9 mm.

Colur : Uniformly more or less light brown, scutellum a little darker than rest of dorsal surface. Venter mostly dark brown, all tibiae, tarsi, claws slightly darker.

Structural characteristics : Head with a pair of distinct pointed median tubercles on frons, two pairs indistinct tubercles laterally and in between eyes. Eyes large protruding, pronotum gibbous, carinate, with lateral margin broadly sinuous, greatly ampliate, weakly dentate, forming two distinct furrows projecting beyond the base of the embolium, widest at a level with the transverse furrow. The anterior part converging obliquely towards eyes, where as the posterior part slightly concave, seven distinct longitudinal carination on the disc of posterior part. Scutellum large, moderately elevated laterally, medially tumescent, a pair of two distinct longitudinal carination on either side and a faint tumescence centrally. Hemelytra extending beyond the abdomen almost covering the last genital segment in male, fully covering the ovipositor lobes in female, embolium narrow basally, dialate medially. Body covered with groups of short elevated bristles on pronotum, scutellum and hemelytra. Fore femur broad covered with small black tooth like spines on the anterior margin, foretarsus fused with the tibia, not articulate, one well developed claw. Abdominal sternites in male asymmetrical with ninth abdominal segment visible externally

Fig. 1



A-E Nerthra arunachalensis Sp. nov.

A. Dorsal view of male. B. Abdominal sternites of female. C. Fore leg male. D. Right paramere. E. Abdominal sternites of male. F. *Nerthra spissa* (Distant) : Right paramere.

(Fig. 1.E), wider than long, right paramere well developed, resting in a depression on the right side of the abdomen, simple, swollen medially, bent and tapering to broad tip (Fig. 1.D). The abdominal sternite of female is nearly symmetrical, last visible sternite more or less projecting posteriorly (Fig. 1.B), completely covering the ovipositor lobes.

Materal examined : HOLOTYPE : Male from Julli village, Near Ganga, Itanagar, Arunachal Pradesh, India, Coll. : D. B. Bastawade, 6. VIII. 1991. *PARATYPE* : One female Data same as Holotype.

Remarks : N. arunachalensis is close to *N. indica* (Atkinson) and *N. serrata* (Montandon) in general appearance, but differs distinctly in the nature of pronotum, ventral abdominal segments, and male paramere and other characters mentioned in the text.

Key to the Indian Species of *Nerthra*

1. Lateral margin of pronotum parallel..... *N. asiatica* (Horvath)
   Lateral margin of pronotum straight or irregular with several sinuosities.....2
2. Lateral margin of pronotum straight forming almost right angle with posterior margin.... ..... *N. spissa* (Distant)
   Lateral margin of pronotum broadly sinuous 3
3. Lateral margin of pronotum projecting beyond the base of embolium .... *N. arunachalensis*
   Lateral margin of pronotum projecting not beyond the base of embolium. ....*N. indica* (Atkinson)

The type material is deposited at Arunachal Pradesh Field Station, Zoological Survey of India, Itanagar and will be transfered to National Collections of Zoological Survery of India, Calcutta.

SUMMARY

The present study reports new species of the genus *Nerthra* from Arunachal Predesh (N. Eastern India) and records *N. indica* (Atkinson) for the first time from Southern India and *N. spissa* (Distant) from Arunachal Pradesh after a gap of four decades. A key to the Indian species of the genus is also provided.

ACKNOWLEDGEMENT

Thanks are due to the Director, ZSI, Calcutta and to Officer-in-Charge, Arunachal Pradesh Field Station, Zoological Survey of India, Itanagar for the facilities provided. The author is also grateful to Dr. D. B. Bastawade, Assistant Zoologist of this office for making the new species available for study.

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* Original not seen.

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ILLICIT TRADE IN WILDLIFE SPECIES, PRODUCTS AND DERIVATIVES IN MAHARASHTRA STATE

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Imposition of Wildlife (Protection) Act, 1972, has helped Indian vigilant agencies to hold back, to some extent, the illegal and uncontrolled killing of wildlife and also the trading of its products and derivatives. Wildlife authorities of Maharashtra State Forest Department approached Western Regional Station of Zoological Survey of India, Pune, for the first time in 1981 with a request to issue identification reports of confiscated wildlife skins for filing cases in the court of law under the provisions in the Wildlife (Protection) Act, 1972. Since then a large number of such cases were dealt with by this station. The present article deals with the studies based on the data retrieved from these identification reports since 1981.

ISSUANCE OF IDENTIFICATION REPORTS

Table I shows five-year-wise breakup of number of cases attended to by the Regional Station for issuing identification reports to the various authorities of subordinate offices of Forests, Wildlife, Police, Railways and Custom departments. The table refers to the cases registered within the jurisdiction of Maharashtra State alone.

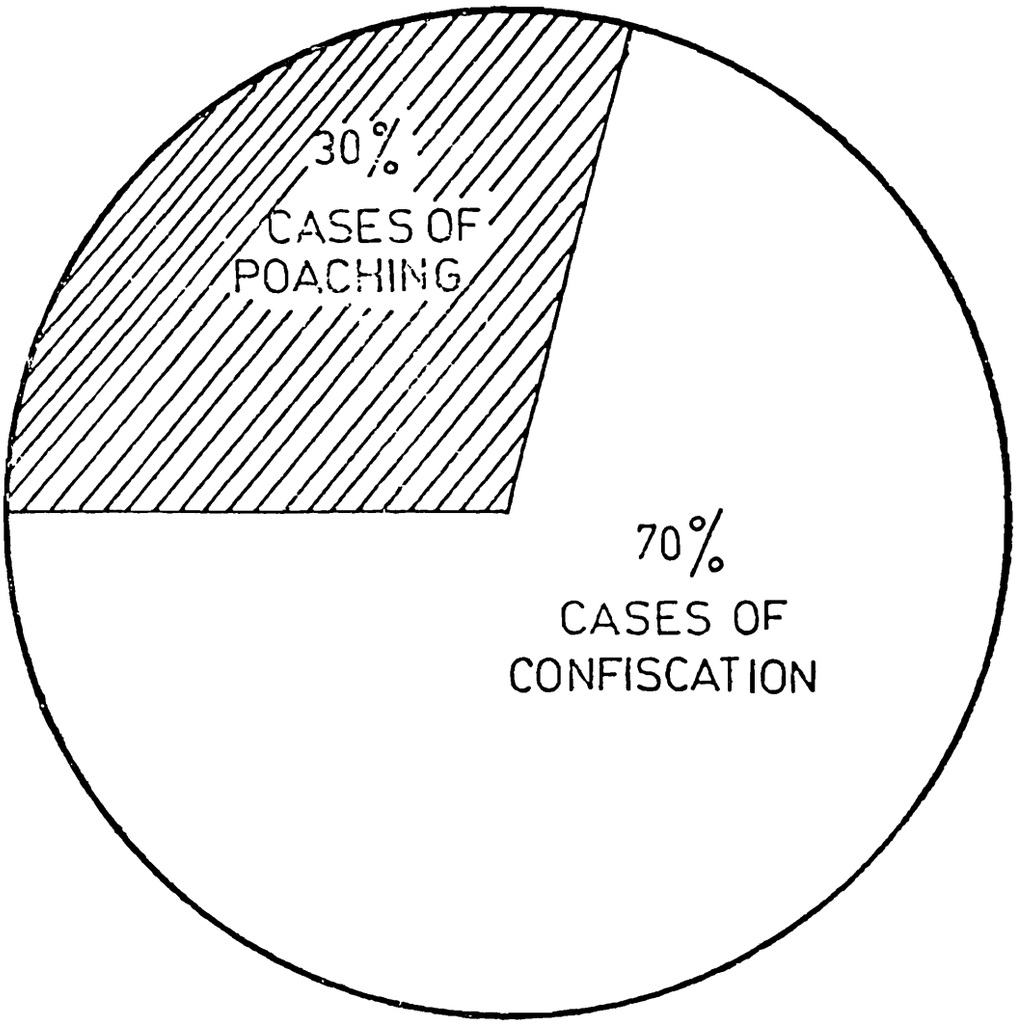
TABLE 1

Number of cases received for issuing identification reports

Sl. No.	Period	Total No. of cases	Cases related with poaching	Cases related with confiscation
1.	1981-85	10	Nil	10
2.	1986-90	24	10	14
3.	1991-95 (March)	50	15	35
	Total	84	25	59

During the period of fifteen years from 1981 to 30th March 1995, eighty four cases were studied. Out of these, 25 cases were related to poaching while 59 with confiscation. That means 30% of instances of poaching have been recorded in the total number of offences registered by the state law enforcement authorities (Fig. 1).

FIG. 1: Percentage of cases registered by the state law enforcement authorities

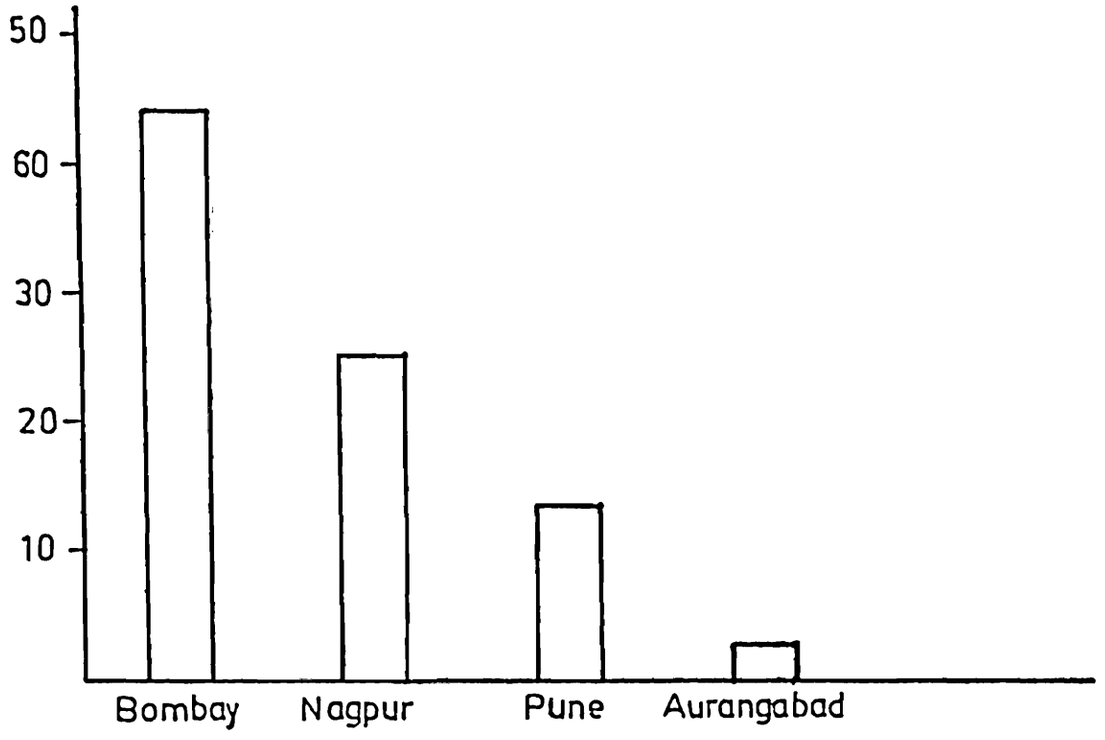


ILLEGAL TRADE ROUTES

Though table No. 1 shows rise in the total number of offences committed, it is because most of the cases were received initially from the Range Forest officer (Bombay

Region), Thane. Later, requests for issuing identification reports in connection with invoking the provisions in the Indian Wildlife (Protection) Act, 1972, started flooding from all the regions of Maharashtra State. However, maximum number of cases were reported from Bombay region only, followed by Nagpur region (Fig. 2).

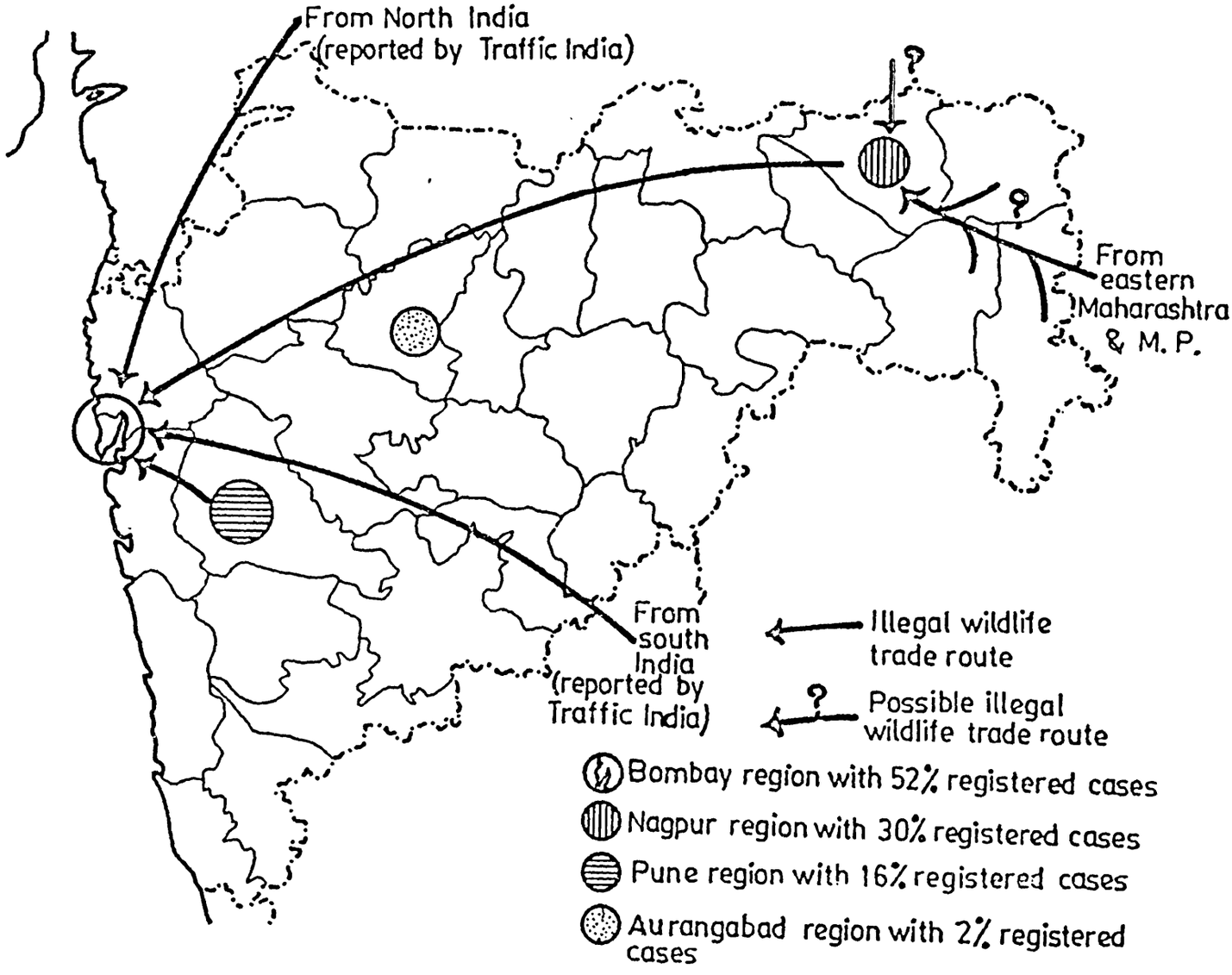
FIG. 2: HISTOGRAM SHOWING NUMBER OF REGION-WISE-REGISTERED CASES IN ILLEGAL WILDLIFE TRADE IN MAHARASHTRA



Bombay city, being the key commercial export point, must have been at the receiving end of the internal illegal wildlife trade routes. Two regions appear to be involved more in the illegal wildlife trade, *viz.* Bombay and Nagpur. Fig. 3 shows possible illegal trade routes of the wildlife specimens, products and derivatives in Maharashtra State. Eastern Maharashtra has an excellent habitat for the growth of rich and diversified biological resources and, hence, it attracts the attention of anti-social elements. Moreover, sale of certain wildlife products like shed deer antlers is totally banned in Madhya Pradesh, while it has been allowed with some restrictions in Maharashtra State. Such disparity in the provisions of the state legislative acts, mostly, encourages illegal movement of the products across the borders. Wildlife products in any form of the finishing stages are being transported to the export points by any means through the available routes by the poachers. Some of these routes are shown in Fig. 3. Records show that wildlife products and derivatives are being illegally transported out of the state as well as exported from the country from Nagpur and Bombay regions (Fig. 4). Routes shown in Figs. 3 & 4

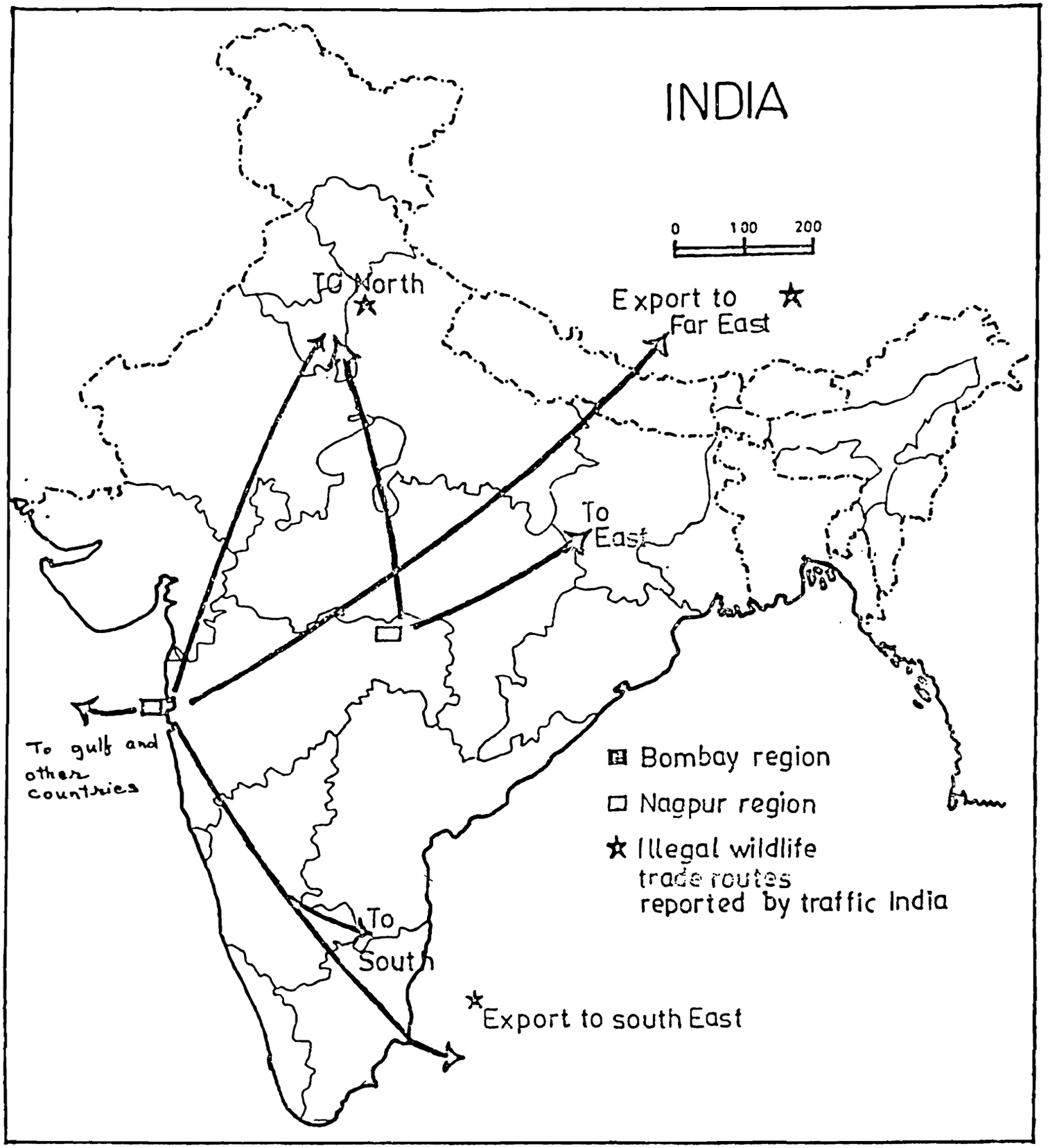
are based on the Traffic-India reports (Menon *et al.* 1994) and the present studies. It seems, therefore, from the present studies that the law enforcement authorities should be more vigilant at these centres, especially at the collection sites in Eastern Maharashtra region which is harbouring one of the finest biological resources. Of course, conservation

FIG. 3: ILLEGAL WILDLIFE TRADE ROUTES IN MAHARASHTRA STATE



measures have already been adopted by the State Govt. authorities by declaring National Parks, Tiger Reserves and Sanctuaries in this area. However, there is a strong need for adopting stringent measures by the vigilant agencies against all those who are involved in poaching activities. There is also equally strong necessity for initiating local public awareness programmes against such heinous acts committed by the poachers.

FIG. 4: NATIONAL AND INTERNATIONAL WILDLIFE TRADE ROUTES FROM MAHARASHTRA



CATEGORISATION OF THE MATERIAL STUDIED

As stated earlier altogether 84 cases were received by us for issuing identification reports. These cases were categorised as detailed in table 2 and figure 5. It will be seen that maximum number of cases were related to the confiscation of wildlife material followed by the cases related to poaching and also with the seizure of fake imitation material. The last two categories indicate consumers' unjust demand for such products in the market which may fulfil their inert desire of exhibition of falsified supremacy above all.

TABLE 2

Categorisation of the registered cases

Total No. of cases	Cases related with confiscation of finished or unfinished products and also of derivatives	Cases related with poaching	Cases related with seizure of fake or imitation material	Cases related with confiscation of live wild animals & birds	Cases related with confiscation of items used in traditional medicines, talismans & occultism
84	30	25	18	6	5

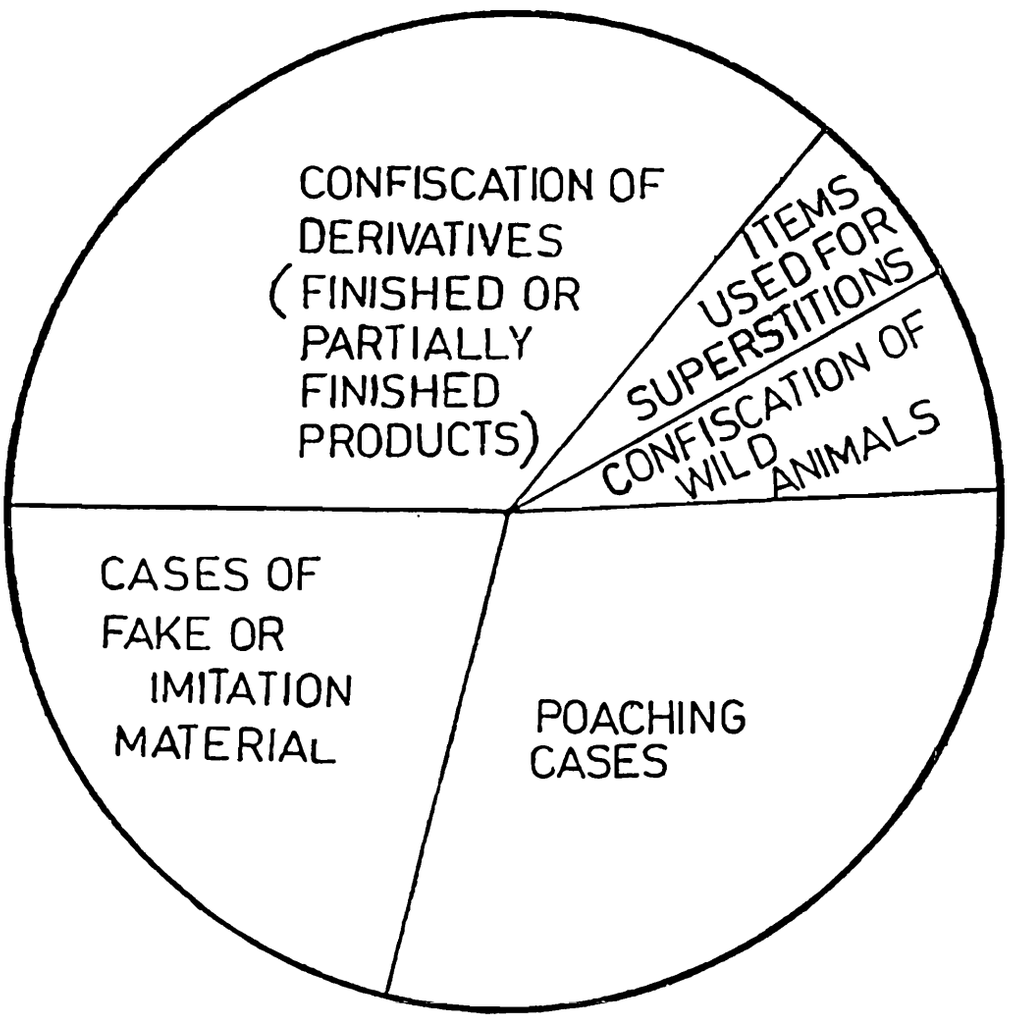
Table 3 gives us some idea about the nature of the material used in the illegal trade. They can be divided mainly into four types *viz.* (1) Fur or skin, (2) Body parts, (3) Derivatives and (4) Artifacts.

Due to strict implementation of Wildlife (Protection) Act, 1972 (as amended up to 1991), Export (Control) Order (1991) and CITES regulations in India, there has been a decline, in recent years, in the number of cases related with confiscation of finished products prepared from wildlife material such as fur coats, belts, shoes, bags, purses, ivory items etc. However, cases related to poaching have increased steadily.

It has been observed that most of the wildlife products involved in poaching consisted of fragmented items like pieces of skins, broken ivory, bone pieces, remains of big cats, shed antlers, horns, claws, musk and other type of pods, hairs, etc. Forest Dept. officials explained that since there was a major demand for parts and derivatives only,

the wild animals were poisoned and killed and then buried underground by the poachers to obtain the desired parts easily from the caracass. Most of these cases were reported from the Nagpur region only where a substantial number of wildlife species is thriving even

FIG.NO.5:- CATEGORIZATION OF THE SEIZED MATERIAL RECEIVED FOR SPECIES IDENTIFICATION



today. The region is situated in Central India and the state border is not very far for the poachers to escape from being arrested and, in turn, punished. Possibility of existence of international links can not be ruled out (Fig. 4). Hence, as stated earlier, the region should be under strict surveillance of the law enforcement authorities to check such offences.

Uncertainty, and shortage in supply of genuine products have led the traders to introduce mixed, fake and imitation products in the market to meet the demand. During last sixteen years six out of 18 such registered cases were brought to our notice. Table 4 gives an idea of some of these articles being sold in the market.

TABLE 3

Categories of material received for species identification

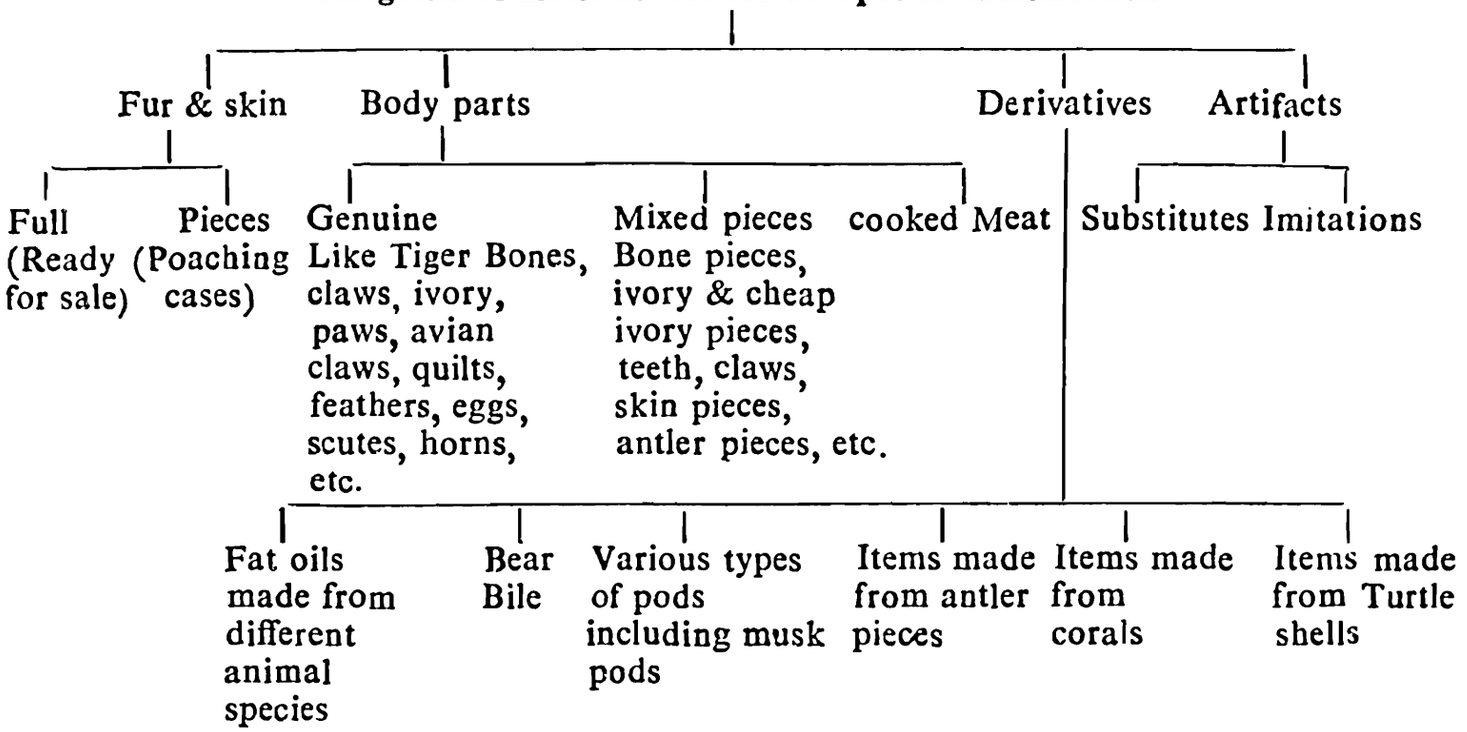


TABLE 4

Imitation, fake and mixed wildlife products being marketed by the traders

Sl. No.	Name of parts	Name of the animal and its parts used for making the products	Commecial Name of the product
1.	Artificially painted skins	Skins of sheep, goat, dog and/or calf	"Tiger" or "Leopard" skins
2.	Flat skins	Skin prepared by stitching together pieces of hyaena skins.	"Tiger" skin
3.	Skull stitched with flat skins	Dog skull	"Tiger" or "Leopard" skull

4.	Claws	Processed and sharpened end pieces of domestic cattle horns	"Tiger" or "Leopard" claws
5.	Canines	Canines of wild boar	"Sloth Bear" Canines
6.	Scented pods	Scented soil pressed in a piece of hairy skin	"Musk" pods
7.	Molars	Fox molars	"Jackal" molars
8.	Bone pieces	Tiger and/or leopard bone pieces mixed with bone pieces of any animal	"Tiger or "Leopard" bone pieces
9.	Bone pieces	Camel bone pieces	Cheap ivory
10.	Gall Bladder	Cow or sheep gall bladder	"Bear Bile"
11.	Horn	Buffalo horn	"Rhino horn"
12.	Claws	Jungle fowl spurs or claws	"Eagle Claws"
13.	Coloured skins	Skins of any non-poisonous snake	"Cobra" skin
14.	Snake skin	Boa skin	"Python" skin
15.	Articles like bags, purses, belts, etc. prepared from reptilian skins	Pressed rexin material	Articles prepared from "reptilian" skins

The list in Table 4 is incomplete in the sense that seller's imaginations have no limitations. The list also indicates that it is not just the scheduled animals that are being killed, but the domestic as well as the wild animals of lesser importance like hyaena, wild boar, jackal, jungle fowl, sand boas, etc. are also not being spared by the poachers to fulfil the whims and fancies of the buyers.

ACCOUNT ON SPECIES-WISE TRADE (MAMMALIA ONLY)

Analysis of the data on the species killed for the illegal trade depicts astonishing results. Table 5 gives a detailed account of the mammalian species which were killed for the trade. Incidently, as per the Export (Control) Order, 1991, there is a complete ban on the export of products and derivatives made from any part of these species.

TABLE 5

List of mammalian species abused in the illegal trade during the period between 1981-March'95

Sl. No.	Common Name	Scientific Name	Total No. of specimens killed in diff. cases	Conservation Status		
				Indian Wildlife (Protection) Act, Schedules (Part).	CITES Appendix	IUCN Status
1.	Panther or Leopard	*Panthera pardus* (Lin.)	32	I	I	VU
2.	Jungle cat	*Felis chaus* (Guld.)	19	II(II)	II	VU
3.	Blackbuck	*Antelope cervicapra*	15	I	III (Nepal)	EN
4.	Fox	*Vulpes* spp.	14	II(II)	III (India)	VU
5.	Tiger	*Panthera tigris*	11	I	I	VU
6.	Desert cat	*Felis sylvastris* = *F. lybica*	11	I	II	EN
7.	Civet	*Paradoxurus hermaphroditus*	6	II(II)	—	—
8.	Indian Civet	*Viverricula indica*	6	II(II)	III (India)	—
9.	Jackal	*Canis aureus*	6	II(II)	III (India)	VU
10.	Hyaena	*H. hyaena*	6	III	—	VU
11.	Hare	*Lepus nigricolis*	6	IV	—	—
12.	Indian Gazelle	*Gazella gazella*	5	I	—	—
13.	Four-horned antelope	*Tetraceros quadricornis*	5	I	III (Nepal)	VU

14.	Spotted Deer	*Axis axis*	5	III	—	—
15.	Barking Deer	*Muntiacus muntjack*	3	III	—	—
16.	Nilgai	*Boselaphus tragocamelus*	2	III	—	—
17.	Sambar	*Cervus unicolor*	2	III	—	—
18.	Sloth Bear	*Melursus ursinus*	2	I	I	VU
19.	Mongoose	*Herpestes edwardsi*	2	IV	III	—
20.	Wild Boar	*Sus scrofa*	1	III	—	—
21.	Ivory	*Elephas maximus*	Three lots	I	I	VU
22.	Horn	*Rhinoceros* sp.	1	I	I	EN
23.	Scutes	*Mains crassicaudata*	Two lots	I	II	VU
24.	Canine teeth	*Panthera leo*	One lot	I	I	EN

Abrevations used :—EN = Endangered ; VU = Vulnerable

Table 5 and Fig. 6 also indicate that about 60% of the mammalian species mentioned in the list fall in the category of "species with highest conservation status". The target species, obviously, are leopard, jungle cat, blackbuck, fox, tiger and desert cat. All these species have attractive fur which can easily fetch good price in the underworld markets. Moreover leopard and tiger lure the poachers most, since their every part is price-worthy in South-East Asia. It is, therefore, really tragic to see that 60% of the large and medium sized mammalian species of this state are being targetted to fulfil the fanatisms of the most selfish species of this planet, *Homo sapiens*.

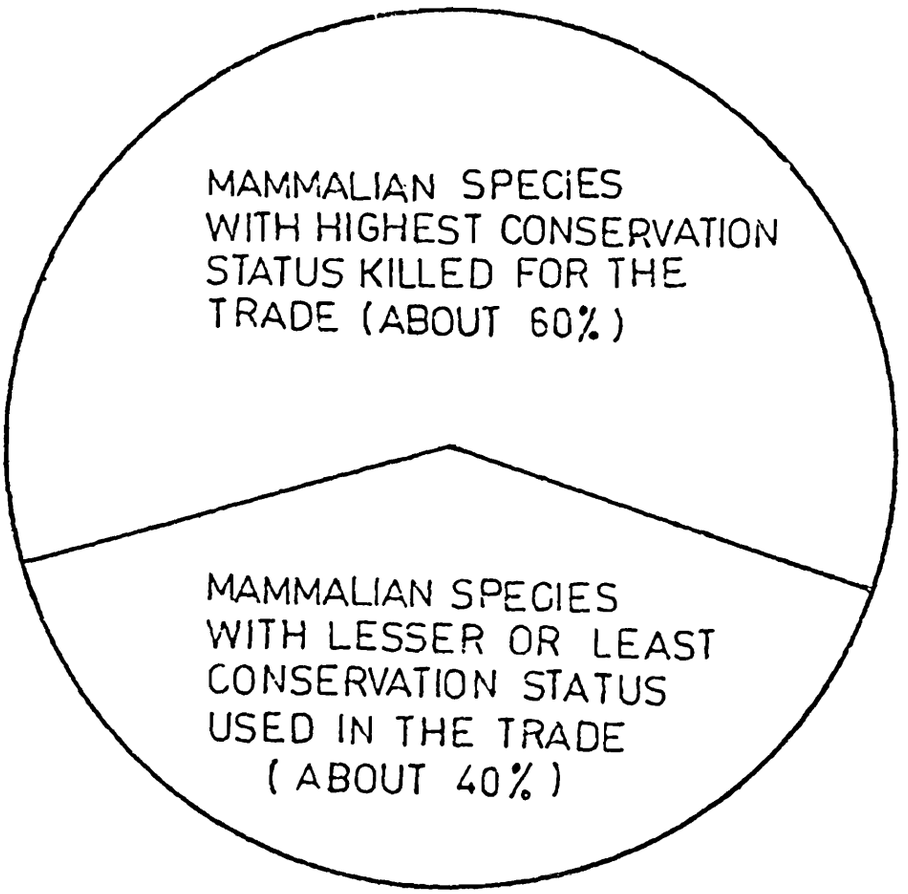
USE OF LIVE WILD ANIMALS FOR ENTERTAINMENT

In recent years another trend appears to have set in. Certain vested interests have started keeping live wild animals in the tourist resorts and starred hotels for the pleasure (!) and entertainment of the tourists. Table 6 shows the list of such live specimens confiscated recently from the commercial establishments in Bombay by the Forest Dept. officials. The list includes species with highest national as well as international conservation status. Some of the names like Golden langur, Hoolock Gibbon, Himalayan

black bear, Mrs. Hume's barred Phaesant, Malabar pied Hornbill etc. are sufficient enough to increase alarmingly the pulse rates of biologists and conservationists.

It was also reported by Forest Dept. authorities that some of the species like Himalayan Black Bear, Golden Langur, Hoolock Gibbon, etc. were illegally trapped

FIG. NO. 6:- MAMMALIAN SPECIES FROM MAHARASHTRA STATE ABUSED IN THE ILLEGAL TRADE



alive by the poachers from the areas across the international borders. That means, not only Indian Wildlife (Protection) Act was violated, but provisions in the international trade legislations (CITES) were also provoked by the illegal trading agencies. If we want to take the conservation efforts seriously, use of wildlife species which are under constant threat of extinction should be strictly banned for any purpose. However, their use in academic studies and research should be legally allowed under close surveillance. Otherwise, the day is not very far for the species like Hoolock Gibbon and Golden Langur when their wild populations will be wiped out from North East India at the cost of tourists' amusement ! If required, amendments in the wildlife Act be considered for heavy punishments against the guilty in such cases.

TABLE 6

List of live specimens confiscated by the Forest Dept. officials from the starred tourist resorts in Bombay

Sl. No.	Name (Scientific Name)	No. of seized animals	Conservation status		
			Indian Wildlife (Protect.) Act, Schedule (Part)	CITES Appendix	IUCN Status
1.	Hyaena (*Hyaena hyaena*)	One	III	—	VU
2.	Four Horned Antelope (*Tetracerus quadricornis*)	Five	I	III (Nepal)	VU
3.	Blue Bull (*Boselaphus tragocamelus*)	One	III	—	—
4.	Spotted Deer (*Axis axis*)	Four	III	—	—
5.	Leopard Cat (*Felis bengalensis*)	One	I	I	VU
6.	Himalayan Black Bear (*Selenarctos thibetanus*)	Four	II(II)	I	—
7.	Capped Langur (*Presbytis pileatus*)	Two	I	I	VU
8.	Golden Langur (*Presbytis geei*)	Three	I	I	VU
9.	Stump-tailed macaque (*Macaca arctoides*)	Two	II(I)	II	VU
10.	Rhesus monkey (*Macaca mulatta*)	Nine	II(I)	II	—
11.	Hoolock Gibbon (*Hylobates hoolock*)	Two	I	I	EN
12.	Indian Giant Squirrel (*Ratufa indica*)	Two	II(II)	II	—

13.	Indian Porcupine (*Hystrix indica*)	Two	IV	—	—
14.	Grey Pelican (*Pelecanus* spp.)	Two	IV	—	—
15.	Pea fowl (*Pavo cristatus*)	One	I	I	VU
16.	Malabar Pied Hornbill (*Anthrococeros malabaricus*)	Two	I	—	VU
17.	Mrs. Hume's barred Phaesant (*Symaticus humiae*)	One	III	—	CR
18.	Demosoille crane (*Anthropoides virgo*)	One	IV	III	—
19.	Sarus crane (*Grus antigone*)	One	IV	II	—
20.	Moorhen (*Porphyria* sp.)	Two	IV	—	—
21.	Crocodyle (*Crocodylus palustris*)	Two	I	I	EN

Adrevations used : EN=Endangered ; VU=Vulnerable ; CR=Critical.

Finally, one can draw following inferences from the present studies :—

1. Confiscation and poaching of wildlife and its products are in practice ever since pre-Wildlife Act era.
2. With introduction of stringent legislation at national and international levels, cases related with confiscation of finished products prepared from wildlife parts declined, while those related with poaching of fragmented items like pieces of skins, bones, ivory, antlers, claws, musk pods, horns, etc. have increased steadily. Chengappa (1993) has also warned about alarming spurt in poaching in past few years.
3. More than 50% of the scheduled mammalian species with highest conservation status inhabit Maharashtra State and they are being used in the illegal trade by the poachers.
4. Interestingly, leopard and not the tiger appears to be the main target species of the poachers.

5. Indian civet species are the victims of myths and have, surprisingly, escaped attention of international organisations like IUCN and CITES. Attempts may be made to study all the species under this category in detail and they can be brought under appropriate international conservation status.

6. Similarly, Indian Four Horned Antelope and Indian Gazelle need a detailed status survey studies for appropriate conservation status under IUCN.

7. Fairly large number of cases have been registered from Nagpur region (Vidharbha in Maharashtra State). Bombay and Nagpur regions appear to be involved more in the illegal wildlife trade. It is, therefore, no wonder if the inter- as well as intra-state illegal willdlife trade routes are in operations. Some of them have been depicted in Figures 3 & 4. This gives the law enforcement authorities an alarm for increasing and concentrating additonal vigilance in these regions.

8. A number of rackets appear to be operating at both national as well as international levels. So, proper implementation of the law with the help of domestic legislation and international trade regulations (like CITES) is, now, a must against such illegal activities. Jackson (1995) has pointed out that only six out of 14 tiger range countries are the signatories of CITES. His suggestion of strict implementation of CITES by all the 14 tiger range countries should not remain unheeded.

9. Table 4 shows that it is not just the scheduled animals that are being killed, but the domestic as well as the wild animals of lesser importance are also not being spared by the poachers. It's quite possible that the genuine products like tiger bone pieces, claws, ivory pieces, musk pods, etc. might have been slipped out, unknowingly alongwith the imitation and fake material in the market. Unless the strong desire to purchase the wildlife products is checked by the buyers, the seller can not limit his imaginations to procure the products by any means and sell them in the market.

10. After looking at Table 6 showing the list of species confiscated alive from the tourist establishments, it is strongly recommended that this kind of use of wildlife for the entertainment of the tourists must be totally banned.

11. The present studies agree with the observations made by Bhattacharya (1984) and Thakur (1985) that possibility of over-exploitation in the licenced trade cannot be ruled out. Hence, there should be proper monitoring and assessment of the situation from time to time.

12. Officials from the law enforcement departments like customs, police, post offices, etc. are not technical experts of wildlife. It is, therefore, recommended that a periodic training of such field staff in preliminary identification of wildlife species, products and derivatives be arranged at the export points by the Scientific Authority of India. Such traininigs have been given in the past by The Zoological Survey of India at Calcutta and New Delhi.

13. For effective check over the illegal wildlife trade, it is essential to have uniform application of wildlife Act in all the states.

14. Lastly, educating the masses is most essential. They should be made aware of the future consequences. Unless the education becomes effective amongst themselves, there can never be fall in the selfish demand for the wildlife articles in the underworld market.

SUMMARY

The article presents analysis of the data for a period of fifteen years (1981-1995) derived from the identification reports of the wildlife material seized by the law enforcement authorities from Maharashtra State.

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The author wishes to express his grateful thanks to the Director, Zoological Survey of India, Calcutta and the Officer-in-Charge, Zoological Survey of India, WRS, Pune, for providing the facilities and encouragements. He is indebted to the Chief wildlife Warden, Conservators and their field staff from Maharashtra State Forest Dept. and also to the authorities of Police, Customs and Railway Depts. for giving him an opportunity to study the material and also for providing valuable information for preparing this note. He is also grateful to Dr. A. M. Bhagwat, Vice Principal, Jhunjhunwala College, Bombay, for reviewing thc article critically.

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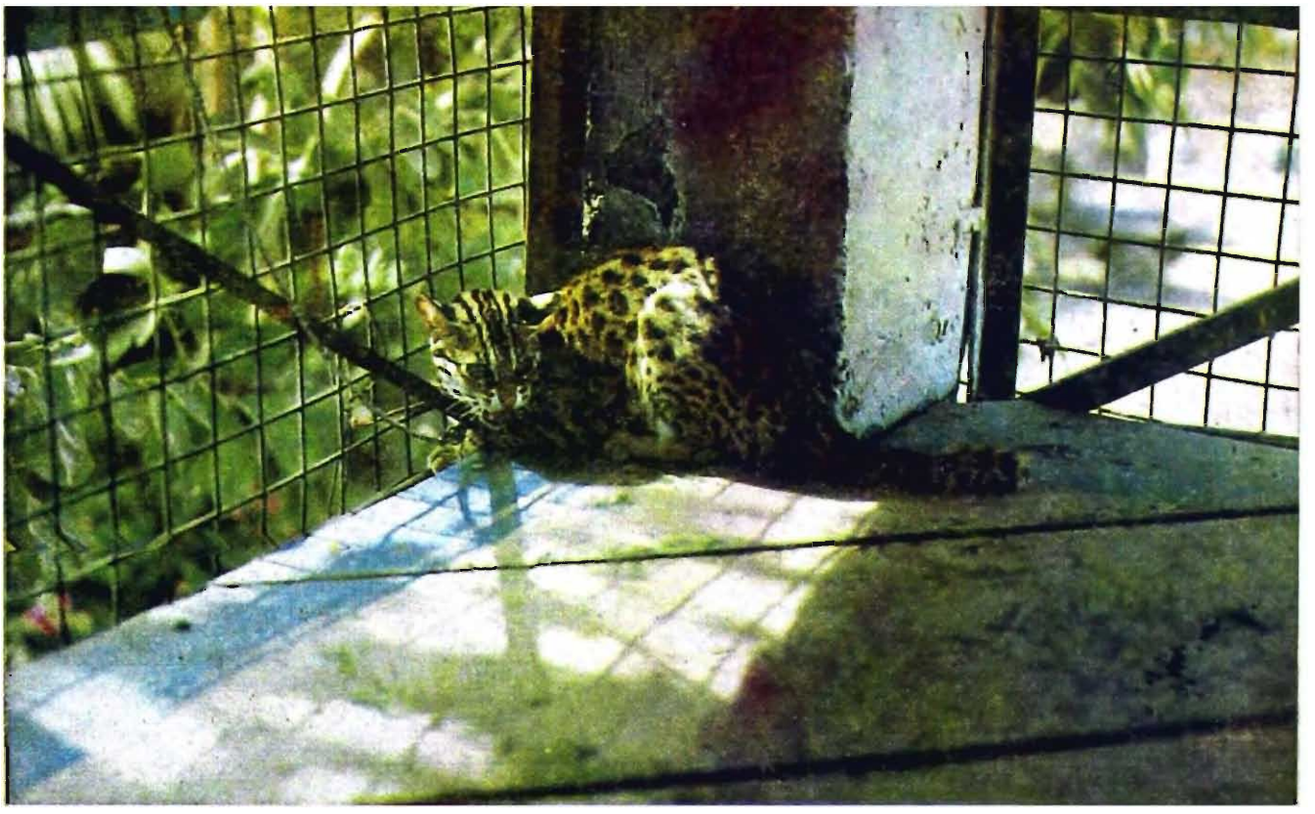
Flat skin of a tiger seized from a poacher by the Forest Dept. authorities from Chandrapur.

Indian Golden Langur seized alive from one of the starred tourist resorts in Bombay by the wildlife authorities.



Some of the lesser known scheduled mammalian species used in the illegal wildlife trade: *Leopard cat* (Art Plate above) and Rhesus monkey (Art Plate below).

Rec. zool. Surv. India, 96 (1-4) : 211-220, 1997

INDIAN SPECIES OF GENUS *SCOLOPENDRA* LINN, (CHILOPODA : SCOLOPENDRIDAE) WITH DESCRIPTION OF A NEW SPECIES

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INTRODUCTION

In India genus *Scolopendra* is, at present, represented by twenty species, including the new species dealt in the present communication. It may be mentioned that Lewis (1986) has synonymised the genus *Trachycormocephalus* Kraepelin with *Scolopendra* Linn. Accordingly the present authors treat the known Indian species of the genus *Trachycormocephalus* as new combinations with the genus *Scolopendra*. Out of the twenty species reported *Scolopendra clypeata* Fabricius, *S. dorsalis* Fabricius and *S. indica* Meinert are *nomen nudum*. While *S. cingulata* and *S. heros* were recorded by Sundara Rajulu (1965, 1967) from South India and by Ahmed (1980) from Andaman. These records remain doubtful since the former is found exclusively in Europe and the latter in America. Therefore, a key to the identification of 15 Indian species, in good standing, has only been presented.

SYSTEMATIC ACCOUNT

1. Scolopendra morsitans Linn., 1758

1758. *S. morsitans*, Linnaeus, *Syst. nat.*, 10 : 638.

Distribution : Assam, Andhra Pradesh, Arunachal Pradesh, A. & N. Is., Bihar, West Bengal, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Maharashtra, Madhya Pradesh, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura and Uttar Pradesh (Attems, 1930 ; Jangi and Dass, 1984 ; Khanna, 1987, 1994 and 1995).

2. Scolopendra subspinipes de haani Brandt, 1840

1840. *S. de haani*, Brandt, *Bull. Ac. Sci.*, 7 : 159.

Distribution : Assam, A. & N. Is., Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and West Bengal (Attems, 1930 ; Jangi and Dass, 1984).

3. Scolopendra hardwickei Newport, 1844

1844. *S. hardwickei* Newport, *Ann. nat. Hist.*, 13 : 97.

Distribution : Andhra Pradesh, A. & N. Is., Karnataka, Maharashtra , Tamil Nadu and West Bengal [Attems, 1930 ; Ahmed, 1980 ; Jangi and Dass, 1984 and Khanna (unpublished record)].

4. Scolopendra amazonica Bücherl, 1946

1946. *Scolopendra morsitans amazonica*, Bücherl, W., *Mem. Inst. Butantan*, 19 : 135-137.

Distribution : A. & N. Is., Madhya Pradesh, Maharashtra, Gujarat and Uttar Pradesh. [Jangi, 1955 ; Jangi and Dass, 1984 ; Ahmed 1980, 1983 ; Khanna and Tripathi, 1985 and Khanna (unpublished record)].

5. Scolopendra valida Lucas, 1840

1840. *S. valida+angusta*, Lucas, *Webb & Berthelot Canar*, 211 ent : 49.

Distribution : Rajasthan (Attems, 1930 and Khanna, 1977).

6. Scolopendra mazbii Gravely, 1912

1912. *S. mazbii* Gravely, *Rec. Indian Mus.*, 7 (4) : 415-417.

Distribution : Himachal Pradesh (Gravely, 1912).

7. Scolopendra clypeata Fabricius, 1793 (Nomen nudum)

1793. *S. clypeata*, Fabricius, *Ent. Syst.*, 2 : 391.

Distribution : Tamil Nadu (Tranquebar) (Attems, 1930).

8. Scolopendra dorsalis Fabricius, 1793 (Nomen nudum)

1793. *S. dorsalis*, Fabricius, *Ent. syst.*, 2 : 390.

Distribution : Tamil Nadu (Tranquebar) (Attems, 1930).

9. Scolopendra cingulata Latreille, 1789

1789. *S. morsitans*, Latreille, *Linn. ent.*, 4 : 1.

Distribution : S. India (?) ; A. & N. Is. (Ahmed, 1980 and Sundara Rajulu 1965).

10. Scolopendra andhrensis Jangi and Dass, 1984

1984. *S. andhrensis*, Jangi and Dass, *J. Scient. Ind. Res.*, 43 : 30-31.

Distribution : Andhra Pradesh, Maharashtra (Jangi and Dass, 1984).

11. Scolopendra heros Girard, 1853

1853. *S. heros*, Girard, *Nat. Hist. Red River*, 27 : 18.

Distribution : South India (?) (Sundara Rajulu, 1965).

12. Scolopendra ellorensis Jangi and Dass, 1984

1984. *S. ellorensis*, Jangi and Dass, *J. Scient. Ind. Res.*, 43 : 31-32.

Distribution : Maharashtra (Jangi and Dass, 1984).

13. Scolopendra punensis Jangi and Dass, 1984

1984. *Scolopendra punensis*, Jangi and Dass, *J. Scient. Ind. Res.*, 43 : 32.

Distribution : Maharashtra (Jangi and Dass, 1984).

14. Scolopendra indica Meincrt, 1886 (Nomen nudum)

1886. *S. Indica*, Meinert, *P. Amer. phil. Soc.*, 23 : 204.

Distribution : Haryana, Himachal Pradesh (Attems, 1930).

15. Scolopendra indiae (Chamberlin) 1914 new comb.

1914. *Trachycormocephalus indiae*, Chamberlin, *Ent. News., Philad.*, 25 : 390.

Distribution : Orissa, Rajasthan and Maharashtra (Attems, 1930 ; Vazirani and Khanna, 1977 ; Khanna, 1977 and Jangi and Dass, 1984).

16. Scolopendra occidentalis (Attems, 1909) new comb.

1909. *Trachycormocephalus occidentalis*, Attems, *Denk. Ges., Jena*, 14 : 14.

Distribution : Bihar (Attems, 1930 and Jangi, 1955).

17. **Scolopendra mirabilis** (Porath), 1876, new comb.

1876. *Cormocephalus mirabilis*, Porath, *Bih. Sevenska Ak.*, 4 (7) : 18.
1903. *Trachycormocephalus mirabilis*, Kraepelin, *Mitt. Mus.*, Hamburg, 20 : 219.

Distribution : Rajasthan and Maharashtra (Khanna, 1977 and Yadav, in press).

18. **Scolopendra nudus** (Jangi and Dass), 1980 new comb.

1980. *Trachycormocephalus nudus*, Jangi and Dass, *Ent. Mon. Mag.* 116 : 67-70.

Distribution : Delhi (Jangi and Dass, 1980 ; Khanna, 1997).

19. **Scolopendra paranudus** (Khanna and Tripathi), 1987, new comb.

1987. *Trachycormocephalus paranudus*, Khanna and Tripathi, *Boll. Soc. ent. ital.*, 119 (2) : 91-93.

Distribution : Haryana (Khanna and Tripathi, 1987).

20. **Scolopendra jangii** sp. nov. (Fig. 1—9)

Description :

Body length : 60 mm. (adult male)

Colour : Antennae, head and tergite olive green with purple tinge. Legs and sternites brownish yellow.

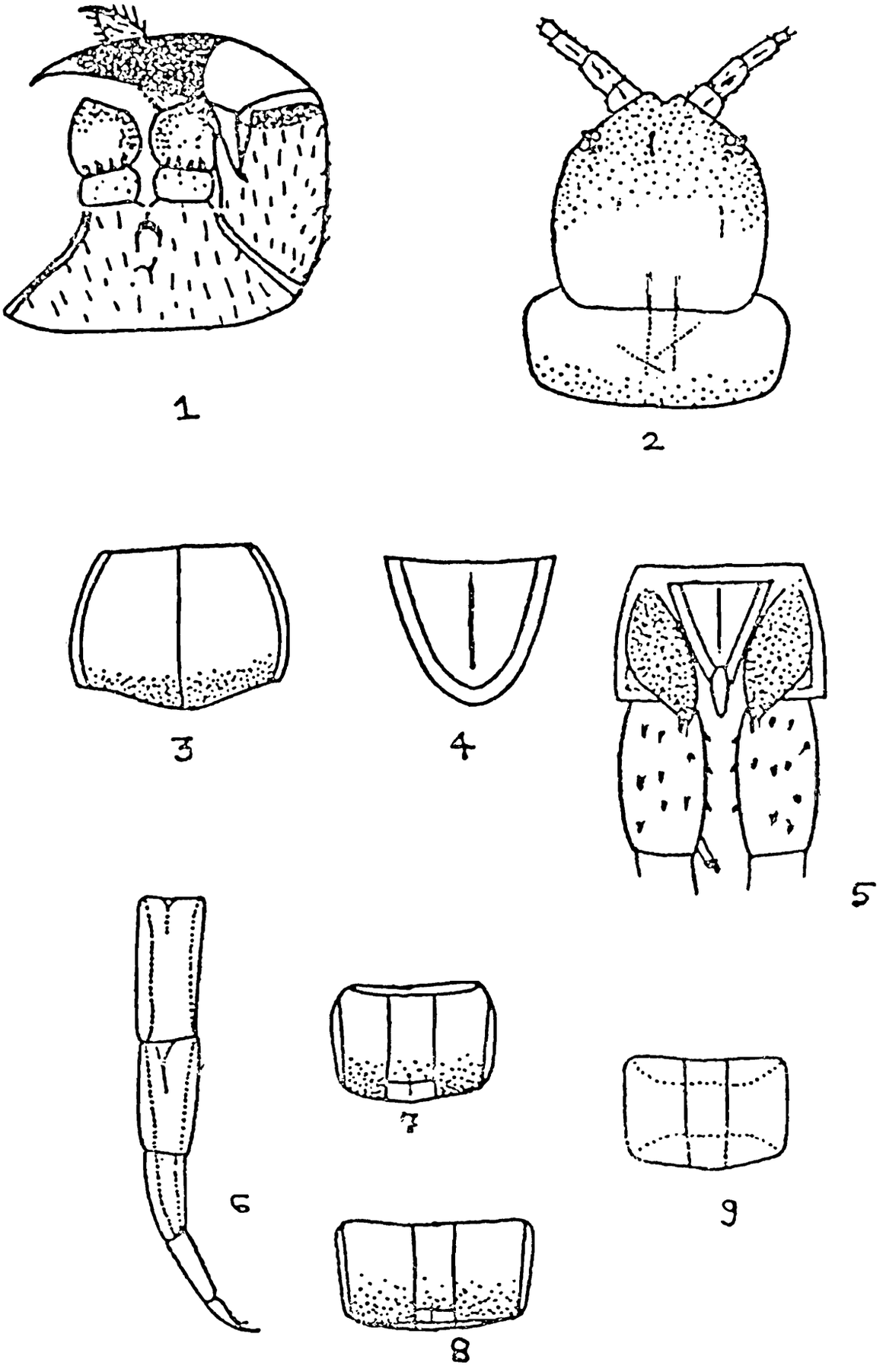
Antennae : Composed of 19 segments with its five basal segments glabrous, flat and wide, remaining pilose and cylindrical. Reflexed antennae reaching back to the IIIrd tergal segment.

Cephalic Plate : Slightly longer than wide and flat ; anteriorly granulose ; feeble median longitudinal furrows visible ; posteriorly the plate bears paramedian longitudinal groove but lacks basal plates. The cephalic plate slightly overlapping Ist tergal segment.

Tergites : Smooth anteriorly but granulose on posterior body segments ; Ist tergite raised with paramedian sutures irregular ; 2-20 with complete sutures, slightly divergent posteriorly on segment 10-14th. Endtergite with a median suture and convexed posteriorly. Emargination of segments begins from 16th tergite.

Sternites : 3-20 with complete paramedian longitudinal furrows ; endsternite longer than wide, triangular in shape ; lateral margins tapering, posteriorly rounded and has a median sulcus also.

Maxillipedes : Coxosternal plate hirsute, broader than long ; prefemur hirsute ; dental plate with 4+4 conical teeth ; median dental plate broader than long ; base of the dental plate with a small median groove ; prefemoral process short and dentate.



Scolopendra jangii sp. nov. Fig. 1 : Coxosternum ; Fig. 2 : Cephalic plate and Ist Tergum-Dorsal View ; Fig. 3 : Endtergite ; Fig. 4 : Endsternite ; Fig. 5 : Endsternite, Coxopleurae and anal legs prefemur ; Fig. 6 : Anal leg—Dorsal View ; Fig. 7 : 17th Tergite ; Fig. 8 : 20th Tergite ; Fig. 9 : Sternal segment showing furrows.

Coxoplurae : Short coxopleural process sparsely punctate with 4 spines at its apex.

Walking legs : 1-20 pair of walking legs with 2 spurs to the claw ; 2-19 with one spur to the Ist tarsal segment ; prefemur of the endlegs ventrally with 3, 3, 2 spines on the left leg and 1, 3, 4, 1 spines on the right leg with 4 dorsal spines. Prefemoral process with 3 spines. Prefemur, femur and tibia flat dorsally and emarginate as in the males of *Scolopendra morsitans.*

Material examined : **Holotype** : India : Maharashtra, Pune Distt., Singhbad Fort, Ca. 20 Kms SW of Pune (Lat. 18°22′ N and 73°46′ E Long.) ; Alt. 1440m above MSL. ; 16.xi.1979, 1 ex., K. Mathew.

The holotype will be deposited in the National Zoological Collection of Zoological Survey of India.

Affinities : *Scolopendra jangii* sp. nov. resembles *S. amazonica* Bücherl in lacking a tarsal spur on 20th pair of legs and also to some extent in the arrangement of spines on the anal leg prefemurs. However, it differs from *amazonica*, in having paramedian longitudinal sutures posteriorly on the cephalic plate, the raised Ist tergal segment with irregular sutures and absence of tarsal spur on Ist pair of legs.

Note : The species has been named after late Dr. B. S. Jangi, a pioneer worker on Indian Myriapodology.

Key to the known Indian species of the genus *Scolopendra Linn*

1. Ist tergite with a deeply dissected curved furrow present anteriorly ... ... *Scolopendra valida* Lucas
   None of the tergite with such furrow ... ... 2.

2. Alternate dark green and brownish yellow tergal segments giving remarkably a banded appearance to the trunk ... *Scolopendra hardwickei* Newport
   No such colour pattern on tergites ... ... 3.

3. Anal leg prefemur, femur and tibia in adult males dorsally flat and emarginate ; prefemur generally bears 9 spines in 3 rows of 3 spines each ... 4.
   No such secondary sexual character visible ... ... 6.

4. 20th pair of walking legs with a tarsal spur ... *Scolopendra morsitans* Linn.
   20th pair or walking legs without tarsal spur ... ... 5.

5. Cephalic plate without any sutures or furrows ... *Scolopendra amazonica* Bücherl
   Cephalic plate with a posterior median sutures ... *Scolopendra jangii* sp. nov.

6. 21st tergite with a median sulcus ... ... 7.
   21st tergite without median sulcus ... ... 11.

7. Emargination of tergites begins earlier than endtergite ... ... 8.
   Only endtergite laterally emarginate ... *Scolopendra indiae* (Chamb.)

8. Cephalic plate without paramedian longitudinal furrows but with a distinctly visible median furrow reaching up to the middle or base of antennae ; Ist pair of legs with 2, 2-19th with 1 tarsal spur ... *Scolopendra occidentalis* (Attems)
   Cephalic plate with or without paramedian longitudinal furrows but never with a median sulcus ; 1-19th pair of legs with 1 tarsal spur ... ... 9.

9. 21st pair of legs without spurs to the terminal claws.... *Scolopendra mirabilis* (Porath)
   21st pair of legs with single spur present laterally ... ... 10.

10. Cephalic plate granulose, without longitudinal furrows ; Ist tarsus of anal legs sparsely plumose ... *Scolopendra paranudus* (Khanna and Tripathi)
    Cephalic plate smooth with a pair of longitudinal furrows ; Ist tarsus of anal legs smooth ... ... *Scolopendra nudus* (Jangi and Dass)

11. Process of coxopleura at the apex with 0-2 spines ; anal leg prefemur with 1-6 spines ... ... 12.
    Process of coxopleura with 5-7 spines ; anal leg prefemur with as many as 26 spines ... ... *Scolopendra ellorensis* Jangi and Dass

12. Process of coxopleura at the apex with 0-1 spine ... .. 13.
    Process of coxopleura at the apex with 2 spines ... ... 14.

13. No spine at the apex of coxopleura ... *Scolopendra mazbii* Gravely
    Only one spine at the apex of coxopleura ... *Scolopendra punensis* Jangi and Dass.

14. Emargination of tergites begins from 18th segment ... ...
    ... ... *Scolopendra andhrensis* Jangi and Dass
    Emargination of tergites begins from 7th segment ; 2-20 sternal segments with complete paramedian longitudinal furrows ... ...
    ... ... *Scolopendra subspinipes dehanni* Brandt

SUMMARY

The present paper deals with a new species, *Scolopendra jangii* sp. nov. collected from Pune, Maharashtra, India. A brief account of the species of genus *Scolopendra* Linnaeus in India has been given, besides a key.

ACKNOWLEDGEMENTS

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Rec. zool. Surv. India, 96 (1-4) : 221-228, 1997

PHYTOPLANKTON ECOLOGY OF A FRESHWATER FISH TANK, BIBINAGAR, HYDERABAD, A.P.

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INTRODUCTION

Extensive work on ecology of phytoplankton of some freshwater bodies of India have been carried out by many workers (Ganapati, 1940, Das and Srivastava, 1956, George, 1962, Lakshminarayana, 1965, Singh 1960, Zafar 1964 and Patil 1976, Trishal 1978, Gopal *et al.* 1982, Patil *et al.* 1935, Singh and Patil 1991, Sharma and Gupta 1994 and others). Such studies are focussed towards understanding the ecology of phytoplankton and their importance as fish food, indicators of pollution and to assess the trophic status of waterbody. In this paper an attempt has been made to investigate seasonal variations in phytoplankton along with physico-chemical parameters.

DESCRIPTION OF THE TANK

The present tank called as Bibinagar tank is situated (lat. 17°38′ N and Long. 78°46′ E) 40 kms away from Hyderabad on Warangal road near a small town called Bibinagar. The shoreline is wavy with an earthern embackment on one side. The depth of the water varies from 1 to 5 meters. The water of the tank is used for irrigation purpose. The tank water gets polluted due to human activities of the nearby villages. Cattles are also washed here, consequently considerable amount of cowdung and urine are also added in the tank besides the domestic sewage of the nearby town. The tank is not yet under fish cultivation on large scale.

MATERIALS AND METHODS

Plankton samples were collected once in a month with the help of nylon plankton net (200 mesh/cm). 40 litres of water was filtered through the net at different sampling

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stations from Bibinagar tank. The quantitative estimation of phytoplankton was made by "Drop Method" under high magnification 400x. Average three counts were made and the mean was calculated. The total count per litre was calculated from the mean value.

RESULTS AND DISCUSTION

The phytoplankton was composed of Myxophyceae, Euglenophyceae, Chlorophyceae and Bacillariophyceae. Chlorophyceae was the dominant group in the phytoplankton population. The average annual percentage composition of chlorophyceae was 39·37%. This percentage is comparatively low as compared to the Mesotrophic tanks studied by Patil (1976).

Considering the Myxophyceae population as an indicator of the trophic status of the water body, the present tank studied at Hyderabad can be judged as one of the "Mesotrophic" system as the Myxophyceae population was comparatively poor (Welch, 1952). Fritsch & Rich (1913), Pearsall (1932), Chu & Tiffany (1951), pointed out that Myxophyceae showed periodicity in summer months. The present study corroborates the above view, as the maxima of Myxophyceae was observed in the month of May when the temperature of water was quite high. The appearance of Euglenophyceae was irregular and that too in certain restricted months of the year.

George (1966) observed that green algae was well represented in Delhi water both qualitatively and quantitatively. Pennak (1949) pointed out that probably the green algae are almost always numerical subordinate and are generally the only minor constituent of pulses of blooms. In the present investigation chlorophyceae was major dominant group. Chlorococales was maximum when pH of water was high. This is in conformity with Gonzalves & Joshi (1946) and Munawar (1970b). However, Kant & Anand (1978) did not find any effect of pH on the growth of Chlorococales.

Pearsall (1932) has observed late winter maxima and early spring maxima of diatoms. George (1966) has noticed maxima of diatoms in winter. In the present study the maxima of diatoms was observed in the month of December, Pennak (1949, 1955) did not find any regular diatom pulse. Singh & Swarup (1979) stated that diatoms prefers to group during warmer part of the year and they have less population during winter.

Vyas and Kumar (1968) observed that the temperature and pH were high when the peaks of phytoplankton were seen in summer, but the pH value was comparatively lower during the monsoon and winter when the peaks of phytoplankton attained a maxima. Lakshminarayana (1965) stated that the pH of the water was high when the phytoplankton

was rich. In the present study the maxima of phytoplankton were seen in the months of May, October aud December when the pH varied between 8·2 to 9·7.

George (1966) stated that diatoms did not form major part of plankton in Delhi tanks. Alikunhi *et al.* (1955) also reported the same thing in freshwater tanks of Cuttuck. George (1963) pointed out that this apparent numerical inferiority of the diatoms appear to be related with food chain and stated that preference of the various planktonic algae to carps was not equal. Diatoms are completely digested, and there is no other chance of appearing again once it is taken inside, whereas most of the blue-green algae and few green algae can appear again through the alimentary canal practically without any harm.

In the present investigation also diatoms did not form a major part of the plankton. This is in conformity with the observation of Alikunhi (1955) and George (1966). In the present study the green algae and the blue green algae are found to be more in the phytoplankton population. This may be due to the preferential feeding on these algae by the fishes of this water body. Further, temperature does not seem to be important factors for the seasonal periodicity of phytoplankton (Jana, 1973) (Chari, 1980, 1985). This is contrary to the observations in temperate zone (Hutchinson 1944, Macombie 1953). The pH of water was between 8·2—9·7. The total phytoplankton was high when the pH was high. This is in agreement with the findings of Jana (1973), Moitra & Bhattacharya (1965). Apparently it seems that CO_2 does not play any role in controlling phytoplankton production and most of the algae utilise CO_2 from bicarbonate (Jana & Sarkar, 1971).

Generally the bloom of green algae was found associated with the low phosphates thereby utilising this nutrient which is essential for the growth of green algae (Pearsall 1932, Komorovasky 1953). This is in contrast to the finding of (Welch, 1952, Chari, 1980). Direct relationship was also observed between nitrate nitrogen and the chlorophyceae as stated by Chari (1980). Phosphates and diatom did not show clear relationship as also reported earlier by Jana, (1973) and Kamorovosky, (1953). Pearsall (1932) opined that diatoms occur when PO_4, NO_3 and silica are rich in water. In the present study the diatom population was poor.

D.O. contents (5·1 to 6·9 mg/L) were more when the phytoplankton was rich (Das and Srivastava, 1956, Biswas, 1966). The occurrence of low total phytoplankton might be due to rich bottom deposit which is continuously drained out for agricultural purposes in this irrigation reservoir. In the present study green algae predominate (Sreenivasan, 1969). Sharma and Durve (1980) stated that the most undesirable features of eutrophication is to change the lake flora from diatom and greens to blue greens which are favoured by increased nutrients.

SUMMARY

Seasonal variations in the population of phytoplankton were studied for a period of one year in a fish tank of Andhra Pradesh. In all 21 genera were recorded of which 4 belongs to Myxophyceae, 2 to Euglenophyceae, 9 to Chlorophyceae and 6 to Bacillariophyceae. The total phytoplankton peak was observed in the month of October with two minor peaks in May and December. Annual percentage distribution data reveal the fact that chlorophyceae population was dominant whereas Myxophyceae and Bacillariophyceae were better represented and Euglenophyceae population was poor.

ACKNOWLEDGEMENTS

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TABLE 1

Average annual range of various physico-chemical parameters.

Transparency Cm	...	30	—	90
Temp. of water °C	...	19	—	28
Temp. of air °C	...	27	—	33
pH	...	8·2	—	9·7
CO_2 mg/L	...	0	—	35
CO_3 mg/L	...	34	—	80
HCO_3 mg/L	...	170	—	370
D. O. mg/L	...	5·1	—	6·9
Total hardness mg/L	...	190	—	220
Ca mg/L	...	65	—	120
Mg mg/L	...	40	—	50
Chloride mg/L	...	64	—	130

Total PO_4 mg/L	...	0·32	—	0·40
Nitrate—Nitrogen mg/L	...	0·58	—	0·65
Sulphate mg/L	...	8	—	10
Sp. conductivity μ mhos/Cm.	...	486	—	600

TABLE 2

Percentage composition data of Phytoplankton

	Jan. 85	Feb. 85	Mar. 85	Apr. 85	May 85	June 85	July 85	Aug. 85	Sept. 85	Oct. 85	Nov. 85	Dec. 85	Average Annual% Composition of
Chlorophyceae	40·00	29·00	42·00	41·60	41·10	56·10	60·15	34·00	32·35	34·88	34·17	25·98	39·27
Myxophyceae	46·64	40·56	34·30	47·20	51·82	28·27	25·20	29·40	42·40	42·61	21·16	19·91	33·60
Bacillariophyceae	9·87	29·00	23·70	11·40	7·08	12·10	11·53	32·30	23·00	21·02	44·20	54·10	25·19
Euglenophyceae	3·40	1·50	—	—	—	3·51	3·10	4·25	2·00	1·55	0·70	—	1·95

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REPORT ON THE MILLIPEDE FAUNA OF SOUTH ARCOT DISTRICT, TAMILNADU

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INTRODUCTION

South Arcot district lies in the northeastern part of Tamilnadu State, between 11°11′ and 12°35′ and 78°38′ 80°E and covers an area of 13355 sq. km. As there is neither a comprehensive account on the Millipede fauna of this district available in the district Gazetteer, nor is the work of Attems (1936) complete, the authors carried out an extensive survey of the district in 1993-94 under the District Survey Programme of Southern Regional Station, Zoological Survey of India, Madras, Tamilnadu to study the Millipedes of this area. Collections were made from 31 different localities (Fig. 1). A total of 1214 specimens belonging to 2 orders, 2 families and 4 species of Millipedes were collected and identified through this study. The present study is of use to improve our knowledge on the Millipede fauna of South Arcot district. These species, the first to be reported from the region undoubtedly represent but a fraction of the millipede fauna occurring there. The identification and classification of species basically are after Hoffman, 1982.

List of Collection Stations :

TINDIVANAM TALUK :

1. Vedur dam
2. Iyyanpuram
3. Kumarapuram reserve forest

VANUR TALUK :

4. Thenkodipakkam
5. Nallavur
6. Ennarpalayam

CUDDALUR TALUK :

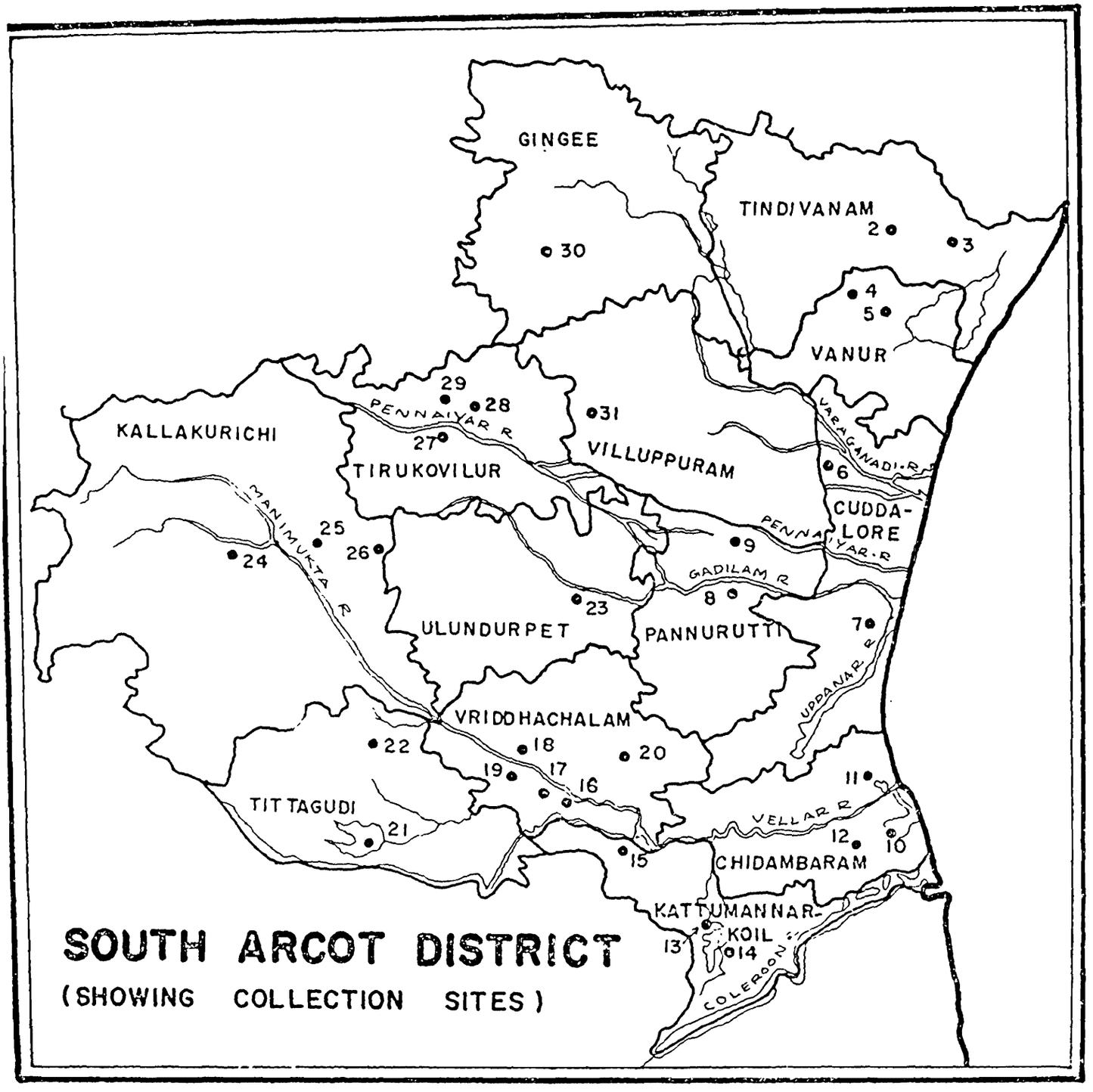
7. Murukespettai

PANNURUTTI TALUK :

8. Gadilam river
9. Pulavunur

CHIDAMBARAM TALUK :

10. Killai
11. Portonova
12. Chidambaram



KATTUMANNARKOVIL TALUK :

13. Veeranam
14. Thiruchinnapuram
15. Anjanakuppam

VRIDDHACHALAM TALUK :

16. Miralur
17. Sukiranur
18. Vridhachalam
19. K. Ilamangalam
20. Old Neyveli

TITTAGUDI TALUK :

21. Wellington reservoir
22. Periyanesalur
23. Sendamangalam

KALLAKURICHI TALUK :

24. Gomuki dam
25. Madur village
26. Rishivandiyam

TIRUKOVILUR TALUK :

27. Thirukkovilur
28. Marudur village
29. Thapovanam

GINGEE TALUK :

30. Kannanakuppam

VILLUPPURAM TALUK :

31. Mambalapattu

SYSTEMATIC ACCOUNT

Order : SPIROBOLIDA

Family : PACHYBOLIDAE

Xenobolus acuticonus Attems

1936. *Xenoboius acuticonus*, Attems, *Mem. Indian, Mus.*, 11 : 133-323.

1959. *Xenobolus acuticonus*, Natarajan, *J. zool. Soc. India*, 11 (2) : 91-101.

Local name : Chikapu Attai, Tamil.

Material examined : 15 exs., Vedur dam, 8.1.94 ; 3 exs., Thenkodipakkam, 10.1.94 ; 5 exs., Nallavur, 10.1.94 ; 10 exs. Ennarpalayam, 12.1.94 ; 2 exs., Murukespettai, 13.1.94 ; 4 exs., Gadilam river bed at Pannuruti, 14.1.94 ; 14 exs., Pulavunur, 14.1.94 ; 1 ex., Killai, 15.1.94 ; 2 exs., Porto Nova, 15.1.94 ; 13 exs., Chidambaram, 17.1.94 ; 6 exs., Veeranam, 17.1.94 ; 6 exs. Thiruchinapuram, 17.1.94 ; 8 exs., Anjanakuppam, 18.1.94 ; 12 exs., Miralur, 18.1.94 ; 18 exs., Sukiranur, 18.1.94 ; 7 exs., Vridhachalam, 19.1.94 ; 18 exs., K. Ilamangalam, 19.1.94 ; 7 exs., Old Neyveli, 19.1.94 ; 9 exs., Wellington Reservoir, 20.1.94 ; 21 exs., Periyanesalur, 22.1.94 ; 4 exs., Gomuki dam, 23.1.94 ; 37 exs., Madur village, 24.1.94 ; 13 exs., Rishivandiyam, 24.1.94 ; 9 exs., Thirukkovilur, 25.1.94 ; 13 exs., Marudur village, 25.1.94 ; 13 exs., Kannanakuppam, 26.1.94 ; 27 exs., Thapovanam, 27.1.94 ; 16 exs., Mambalapattu, 28.1.94. Total : 298 exs.

Diagnostic features : Black, dorsum with a row of hour glass-like reddish spots ; head up to antennae, collum and antennae brown ; anal segment reddish brown.

Length 50 mm., width 4 mm., 50 segments. Sternite of anterior gonopods shorter than telopidite, V-shaped.

Distribution : Karnataka, Tamilnadu, Kerala & Pondicherry.

Remarks : Like *Ommatoiulus moreletti* of Australia (Baker 1978, 1979 a & b), this species is a nuisance pest in South Arcot district (Mary Bai 1995). Fairly large numbers of this species were collected from the roofs and from inside the houses. According to the villagers, these species invade their houses especially during winter and rainy season. They infest the food, stink and stain floors when quashed, spoil drinking water and occupy every crevise in the houses, even beddings. At times, babies and young children devour them accidentally resulting in the development of white patches on their skins, and cause associated health problems.

Order : SPIROSTREPTIDA

Family : HARPAGOPHORIDAE

Phyllogonostreptus nigrolabiatus Newport

1844. *Spirostreptus nigrolabiatus*, Newport, *Ann. Mag. Nat. Hist.*, 13 : 269.

1892. *Spirostreptus nigrolabiatus*, Pocock, *Journ.* Bombay *Nat. Hist. Soc.* I : 159, pl. 1. Fig. 7. pl. 11, Fig. 5.

1918. *Phyllogonostreptus nigrolabiatus*, Carl. *Rev. Suisse.* 26 : 426.

Local name : Peria Attai, Tamil.

Material eaxmined: 10 exs., Vedur dam, 8.1.94 ; 1 ex., Iyyanapuram, 9.1.94 ; 6 exs., Kumarapuram Reserve forests, 9.1.94, 3 exs., Thenkodipakkam, 10.1.94 ; 3 exs. Ennarpalayam, 12.1.94 ; 15 exs., Murukespettai, 13.1.94 ; 8 exs., Gadilam river bed at Pannuruti, 14.1.94 ; 8 exs., Pulavunur, 14.1.94 ; 3 exs., Killai, 15.1.94 ; 4 exs. Porto Nova, 15.1.94 ; 18 exs., Chidambaram, 17.1.94 ; 4 exs., Veeranam, 17.1.94 ; 4 exs., Anjanakuppam, 18.1.94 ; 4 exs. Su Kiranur, 18.1.74 ; 9 exs., Vridhachalam, 19.1.94 ; 4 exs., Old Neyveli, 19.1.94 ; 4 exs., Wellington Reservoir, 20.1.94 ; 17 exs., Sendamangalam, 21.1.94 ; 5 exs., Periyanesalur, 22.1.94 ; 6 exs., Gomuki dam, 23.1.94 ; 9 exs., Madur village 24.1.94 ; 6 exs., Rishivandiyam, 24.1.94 ; 6 exs., Thirukkovilur, 25 1.94 ; 8 exs., Thapovanam, 27.1.94 ; 6 exs., Mambalapattu, 28.1.94. Total : 171 exs.

Diagnostic Features : Body dark brown or bright tan ; tail short curved upwards ; anal scale free ; coxa of gonopods laterally without knob. These are larger species

and a full grown specimen is about 12 to 22 cm. in length and about 1 cm. in breadth ; body has 57-59 segments.

Distribution : South India : Karnataka ; Tamilnadu : Madras, V. O. C. district.

Remarks : These are found mostly in gardens, bunds of fresh water tanks and open fields around villages which the villagers use as open toilet. They were found to feed on faeces and so may be called biodegradators or scavengers (Mary Bai 1995).

Order : SPIROSTREPTIDA

Family : HARPAGOPHORIDAE

Thyropygus poseidon Attems

1936. *Thyropygus posseidon* Attems, *Mem. Indian. Mus.* 11 (4) : 136-323.

Local Name : Karupu—Manjai Attai. Tamil.

Material Examined : 27 exs., Iyyanapuram, 9.1.94 ; 58 exs., Thenkodipakkam, 10.1.94 ; 23 exs., Ennarpalayam, 12.1.94 ; 24 exs., Murukespettai, 13.1.94 ; 20 exs., Gadilam River bed at Pannuruti, 14.1.94 ; 16 exs., Pulavunur, 14.1.94 ; 28 exs., Killai, 15.1.94 ; 15 exs., Chidambaram, 17.1.94 ; 22 exs., Veeranam 17.1.94, 80 exs., Thiruchinnapuram, 17.1.94 ; 15 exs., Miralur, 18.1.94 ; 21 exs., Su Kiranur, 18.1.94 ; 21 exs., Vridhachalam, 19.1.94 ; 13 exs., Old Neyveli, 19.1.94 ; 17 exs., Wellington reservoir, 20.1.94 ; 7 exs., Sendamangalam, 21.1.94 ; 13 exs., Periyanesalur, 22.1.94 ; 7 exs., Gomuki dam, 23.1.94 ; 49 exs., Madur Village, 24.1.94 ; 17 exs., Thirukkovilur, 25.1.94 ; 21 exs., Kannanakuppam, 26.1.94 ; 13 exs., Thapovanam, 27.1.94. Total : 527 exs.

Diagnostic Features : Body black with yellow spots on the sides ; dorsal side curved and shining ; in gonopod, gonocoel opens laterally posterior lamella with a short lobe. 6 cm. length and 1 cm. breadth.

Distribution : Sri Lanka and South India.

Remarks : These were collected mostly from kitchen gardens, around water sources, moist areas like bathrooms and wet areas surrounding the bases of banana trees.

Order : SPIROSTREPTIDA

Family : HARPAGOPHORIDAE

Jonespeltis splendidus Verhoeff

1936. *Jonespeltis splendidus* Verhoeff, *Rec. Indian Mus.* 38 : 103-127, pl. 7.

Material examined : 13 exs., Vedur dam, 8.1.94 ; 10 exs., Iyyanapuram, 9.1.94 ; 8 exs., Kumarapuram reserve forest, 9.1.94 ; 3 exs., Thenkodipakkam, 10.1.94 ; 4 exs., Ennarpalayam, 12.1.94 ; 6 exs., Murukespettai, 13.1.94 ; 22 exs., Pulavunur, 14.1.94 ; 48 exs., Porto Nova, 15.1.94 ; 12 exs., Thiruchinnapuram, 17.1.94 ; 6 exs., Miralur, 18.1.94 ; 21 exs., Su Kiranur, 18.1.94 ; 12 exs., Vridhachalam, 19.1.94 ; 8 exs., Periyanesalur, 22.1.94 ; 21 exs., Thirukkovilur, 25.1.94 ; 17 exs., Kannanakuppam 26.1.94 ; 7 exs., Mambalapattu, 28.1.94. Total : 218 exs.

Diagnostic features : Body brownish black with lateral yellow dots which are not very dark. The tibiotarsus of gonopode is plain at the end and without lobes. Length 32-34 mm., width 2-3 mm.

Distribution : South India : Madras, Kodaikanal, V. O. C. district and Pondicherry.

Remarks : Occurs in large numbers in wet areas near the drainages and plants in kitchen gardens. This species is comparatively smaller in size.

DISCUSSION

All the above mentioned four species studied are being reported for the first time from South Arcot District. When the data on their abundance was analysed, the following results were obtained (Table 1). Out of the four species encountered in South Arcot district, *Thyropygus poseidon* was the most abundant species accounting for 43·41% of the specimens collected from the district. Next to this species, *Xenobolus acuticonus* constituted $\frac{1}{4}$th of the population i.e., 24·54%. *Phyllogonostreptus nigrolabiatus* and *Jonespeltis splendidus* were almost equally represented by 14·08% and 17·95% of the total collections.

TABLE 1

Population abundance of Millipede sp. in S. Arcot district

Name of the species	No. Ex.	%
Thyropygus poseidon	527	43·41
Xenobolus acuticonus	298	24·54
Phyllogonostreptus nigrolabiatus	171	14·08
Jonespeltis splendidus	218	17·95

SUMMARY

The paper presents an account of 4 species belonging to 4 genera under 2 families. All the four species are reported for the first time from South Arcot district, Tamilnadu.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, for facilities and encouragement. We wish to place on record the untiring hard work put in by the supporting staff to collect the specimens from the sites.

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ECOLOGICAL RECONNAISSANCE OF ADULT ODONATA (INSECTA) OF EASTERN INDIA

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INTRODUCTION

Eastern India, in the present context, covers parts of Assam, Bihar, Sikkim and West Bengal mainly, Mizoram, in the east-west direction. Physiographically the states belong to Assam plain, middle and lower ganga plain, and eastern Himalaya respectively. Although there is no physical barrier to divide the area into east and west but the east is more humid and west more dry. The rainfall increases as one moves from west to east. The average rainfall is variable from 200 cm to 400 cm. per year.

HISTORICAL RECORDS

There is no consolidated report on the ecology of dragonflies of eastern India, although Mitra (1994) reported several aspects of habits and habitats of adults and cited the available records on the subject. Besides that Fraser (1933, 1934 & 1936), Asahina (1958), Dasgupta (1988, 1996), Gupta et. al. (1995), Lahiri (1975), Prasad and Ghosh (1982), Ram and Prasad (1978) reported some events on the subject.

MATERIAL AND METHODS

The present report is based on the observations on odonata in the field, mainly in the nearby localities of Calcutta. During the preparations of the report records available from other localities have been added.

OBSERVATIONS

Food habits: Dragonflies feed on both odonates and nonodonates. Six observations on odonate feeding on odonates indicate that *Ischnura senegalensis*, *Ceriagrion coromandelianum* and *Orthetrum sabina* feed on *Agriocnemis pygmaea*. *Orthetrum sabina* alone feed on *Ceriagrion coromandelianume* Regarding non odonate prey a total of seventeen observations indicate that among insects *Pseudagrion rubriceps* feeds on Aphid (*Aphis cracivora*) *Pseudagrion microcephalum* attacks ants (*Paratrachina longicornis*) *Ceriagrion coromandelianum* and *Diplacodes trivialis* attack ant (*Solenopsis geminata*) *Brachythemis contaminata* and *Crocothemis servilia* capture House fly (*Musca domestica*) *Pantala flavescens* and *Tholymis tillarga* feed on mosquitos (? *Anopheles*), *Ischnura senegalensis* and *Crocothemis servilia* capture butterfly, *Trithemis pallidinervis* attack bettles and *Orthetrum sabina* attacks spiders.

It is interesting to note that dragonflies select their food preferably smaller than them and never eat

their own species. Intraspecies fight for food was noticed only once. Mitra (1994) reported a clash between a female and a male *Ischnura senegalensis* on *February, 1967*

Breeding activities : Breeding season, on the basis of observation on tandem and copulations, of the following ten species could be regarded as follows. *A griocnemis pygmea* breed throughout the year; *Pseudagrion rubriceps* and *P. microcephalum, Ceriagrion coromandelianum, Ischnura a. aurora, Crocothemis servilia* breed during the period from June to November; *Ischnura senegalensis* breed from March to December. Depending on the climatic conditions, breeding periods during the twenty four hour cycle are as follows. *Pseudagrion rubriceps, P. microcephalum, Ceriagrion coromandelianum, Ischnura aurora, I. senegalinsis Agriocnemis pygmaea, Crocothemis servilia* breed from the early morning to noon (6.00 to 12.00 hr), while *Brachythemis contaminata* and *Tholymis tillarga* breed from late afternoon to early evening (17.00 to 18.00 hr).

All species form pair and remain near water for oviposition. But *Orthetrum sabina* form pair near water and moves away from water edges to a certain distance probably to avoid disturbances. On three occasions *viz.* on September 15, 1982, September 19, 1982 and August 15, 1983 one pair of *Orthetrum sabina* in each day was found copulate over water even when disturbed by one of us (TRM). Moreover, during the period, November 25 to 30, 1987, in the area of the river Kulik, in the district of West Dinajpur of West Bengal, some specimens of the species (O. sabina) in overcrowded localities, were found to wait on land for partners. Besides this, the copulating pairs were not leaving the area if they felt the wheels were weak, which after sometime got detached and the pair immediately formed wheel again.

Territory formation during the breeding could be noticed in *Tholymis tillarga, Crocothemis servilia Orthetrum sabina.* Intra species competetion as well as inter species competetion for territories could also be noticed. The horizontal dimension of territories depend on the density of the male population, area of the aquatic body and some intrinsic factors.

Emergence of imago : Mass emergence of any species could not be seen, However, emergence of certain species could be recorded, for example, *Orthetrum sabina* could be observed to emerge in the early evening during the summer months at Dum Dum Park, near Calcutta city. *Tholymis tillarga* emerged in the morning of August at the same locality; *Brachythemis contaminata* emerged in the midmorning of December in the Kachugaon forest of Assam; and *Bradinopyga geminata* in the early evening of October-November at Hazaribagh (Bihar). *Pantala flavescens* and *Crocothemis servilia* in the early afternoon of April and midmorning of September of eastern Himalaya.

Migratory flights : Migratory flights could be seen only in *Pantala flavescens.* The flights were noted in September and early October. The directions of the swarms were from the west to the east. The density of the swarm varied from thirty individuals to huge swarm.

Reaction towards moblie objects : Six species. *Pseudagrion microcephalum, Ictionogomphus rapax, Brachythemis contaminata, Diplacodes trivialis, Crocothemis servilia* and *Pantala flavescens* follow mobile objects. All species follow the objects flying parallel to the object but *Diplacodes trivialis* follow the object by moving before the object and then watch and repeat the same for some distance. The cause for this type of behaviour is not clearly known, although it is presumed to be a predatory behaviour.

Thermo-regulation and behaviour during change of weather : The means of thermo-regulation is variable. Sometimes the dragonflies take shelter under leaves or under any shade during the summer. During rain they do the same. But very recently one of us (TRM) noted that a pair of *Neurothemis tullia tullia* (one male and one female) were not moving out to any place while in rain.

During the hot summer *Brachythemis contaminata, Diplacodes trivialis Neurothemis tullia tullia* cover their thorax with wings and the abdomen remain in obelisk position. On the otherhand *Orthetrum sabina Bradinopyga geminata, Lathrecista asiatica* cover their thorax with wings but their abdomen remain in parallel position to the ground. Sometimes Pantala flavescens and *Tholymis tillarga* remain under shade and sometimes the former remain on wings a few metre above the ground. During the cool season (December to February) usually the population become reduced. But during the solar eclipse in October 1995 when the ambient temperature fell to 23°C dragonflies became inactive they were no reacting even when disturbed, although they resumed activities with the rise of temperature as soon as the eclipse was over (Mitra 1996).

Vertical ranges of flight : The usual flight height of eleven species were recorded as follows. *Pseudagrion microcephalum, P.r. rubriceps, Ceriagrion coromandelianum, Ischnura senegalensis, Agriocnemis pygmaea* usually fly within 30 cm above the ground. *Brachythemis contaminata* flies within a height of 50-100 cm; while *Orthetrum sabina, Diplacodes trivialis, Crocothemis servilia* go up to the height of 100-150 cm; *Rhyothemis variegata* and *Pantala flavescens* fly up to 200-300 cm above the ground.

Death in adults : Several dead and dying dragonflies have been collected and their conditions have been reported by Mitra (1977 & 1994). According to the conditions the death of dragonflies may be classified as follows.

(a) *Natural deaths* : One dead male *Onychargia atrocyana*, without having any external injury, has been collected. The cause of death could not be ascertained and it is presumed that it has died a natural death.

(b) *Death due to starvation* : A dead male *Crocothemis servila* and a dead female *Hemianax ephippiger* were collected from the cobwebs. Since there were no spider it is presumed that the specimens died due to starvation.

(c) *Death due to attack of ants :* Sometimes *Camponotus compressus* and *Solenopsis geminata* attack weak and overfed dragonflies and become causes of deaths. For outside India records cf. Kiauta (1971).

(d) *Death due to attack of predators* : Followings have been recorded as predators of dragonflies viz. Birds (*Acridotheres tristis, Corvus splendens, Passer domesticus*), Lizards (*Hemidactylus brookei, Calotes versicolor*) Amphibia (*Tylototriton verrucossus*), Spider (*Plexippus paykulli & Crossopriza lyoni*).

(e) *Death due to accidents* : Sometimes modern vehicles dash or sucked in flying dragonflies in the grille or press the resting insects (Mitra 1994), for records of outside India cf. Kiauta (1965).

(f) *Death due to unknown cause* : Several dead and dying individuals were collected by one of us

(TRM). The apparent reasons for those dead and dying individuals could not be ascertained (Mitra 1994).

Species recorded from houses : Specimen, of certain species have been collected from the house in calcutta and suburban of the city. It is interesting to note that no specimen was collected from the forest rest houses. On the otherhand no mass entry of any species has also been recorded ? although roosting on the walls or verandah have been recorded. The cause for this type of behaviour is presimed to be the shrinkage of habitat.

Species recorded from houses are; *Trithemis pallidinervis, Gynacantha bayacera, G. rammohani, G. dravida, Hemianax ephippiger, Pseudagrion microcephalum, Ceriagrion coromandelianum, C. cernorubellum, Agriocnemis pygmaea, Onychargia atrocyana, Neurothemis tullia, Crocothemis servilia, Brachythemis contaminata, Tholymis tillarga, Orthetrum sabina.*

SUMMARY

The paper reviews ecology of adult dragonflies in eastern India with special reference to the fauna of West Bengal.

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Short Communication

Rec. zool. Surv. India, **96 (1-4)** : 243, 1997

RECENT RECORD OF THE RED-NECKED KEELBACK, *RHABDOPHIS SUBMINIATUS* (SCHIEGEL) FROM ARUNACHAL PRADESH

Recently the senior author was pleasantly surprised to sight a medium-sized Red-necked Keelback(plate I) in the Premises of the residential quarters in Itanagar, Although we could identify it as a freshwater keelback of the Family Colubridae, we did, out of curiosity, take a few snaps of snake and sent them to Shri T. S. N. Murthy, former Scientist-in-charge of Herpetology, Zoological Survey of India, for confirmation of its identity. Mr. Murthy has identified the snake as *Rhabdophis subminiatus* (Schiegel) (Serpentes : Colubridae). Although, the colubrid snakes in general, are considered harmless excepting a few back-fanged snakes with venom that produces haemotological symptomos, it is interesting to know that the bites of the rear-fanged *Rhabdophis miniatus* have been reported to cause systemic poisoning or even death in a few cases according to Murthy (pers. comm.). This is the first authentic report of the occurrence of genus *Rhabdophis* in Arunachal Pradesh and the other species of the genus *Rhabodophis* Known from this part of the state is the Himalayan Keelback *R. himalayana* (Gunther) from Namdapha Biosphere Reserve (Sanyal and Gayen, 1985). The Red-necked Keelback mainly feeds on frogs and toads. The range of this species included North-eastern India, Bangladesh and Nepal.

The authors are grateful to the Director, Zoological Survey of India for the facilities provided. The help of Shri T. S.N. Murthy, Scientist 'SE' (Rtd.) Southern Regional Station, Zoological Survey of India, Madras in confirming the identity and improving the manuscript is gratefully acknowledge. Thanks are due to Mrs. Borah for secretarial assistance.

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Plate I

Rhabdophis subminiatus (Schiegel)

Short Communication

Rec. zool. Surv. India, **96 (1-4)** : 245-248, 1997

NOTE ON THE MILLIPEDE, *PHYLLOGONOSTREPTUS NIGROLABIATUS* NEWPORT A BIODEGRADATOR IN SOUTH ARCOT DISTRICT, TAMILNADU

Information on the faunal diversity of Indian Diplopoda is so far rather inadequate. Data on the role played by them in nature is still more meager. (Kubra Bano and Krishnamoorthy 1979 and Hopkin and Read 1992). Studies carried out by Crawford et al., (1987), Bailey and de Mendonca (1990), Eisenbeis and Wichard (1987) and Hoffman and Payne (1969) in Millipedes revealed that Millipedes consume a variety of food materials. But so far there is no report of their feeding on human faces. During a recent faunistic survey of South Arcot District of Tamil Nadu, apart from collection of different species of millipedes, attempts were made ton study their habitats and food preference. The study lead to observations on food preference of common species, found in the district, *Phyllogonostreptus nigrolabiatus* as a biodegradator.

In Tamil Nadu, in every village a particular portion of field, a little far away from the village is set apart for use as open public toilet by the villager. During a survey in 1994, when the villagers were asked where does the millipede occur? Immediately they responded asking back. Are you asking about the big milipede? and then took us to these open fields. Herewere observed the millipede *Phyllogonostreptus nigrolabiatus* in large numbers, feeding on human faces. The villages from where these millipedes were collected is given in Fig. I and II.

Because of this habit, this species of millipede can be called a partial Biodegradator. This process of biodegradation by these millipedes may help to clean the enviornment and make the soil more fertile. Experimental studies on the propogation of this millipede to other villages, to be used as biodegradator may be undertaken in future. The soil of these fields can be used as natural fertilizer in agriculture.

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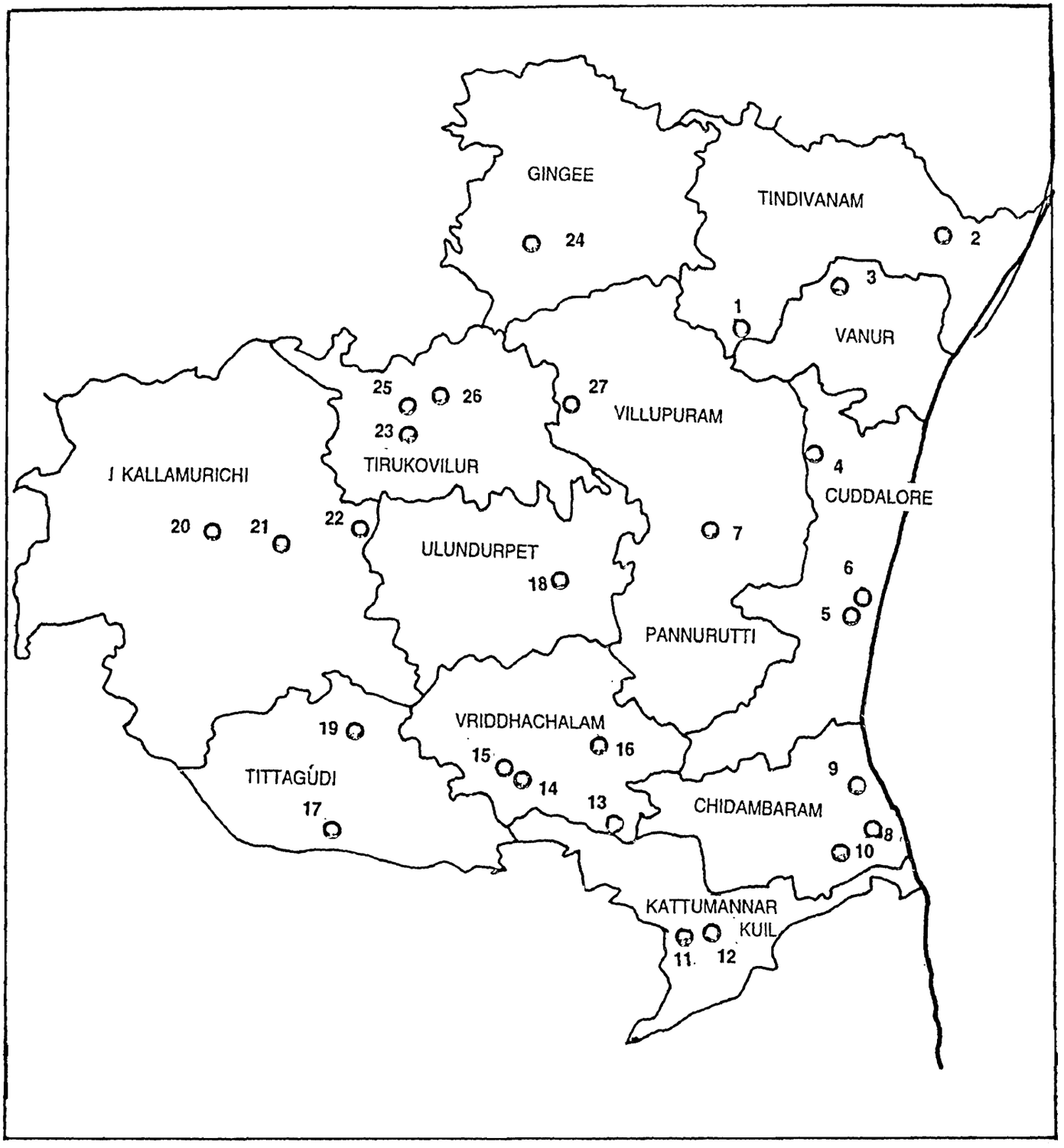

Fig. I

List of collection sites of *Phyllogonostreptus nigrolabiatus* Newport in South Acrot District
1. Vedur, 2. Kumaranpuram, 3. Thenkodipakkam, 4. Ennarpalayam, 5. Murukespettai, 6. Pannurutti, 7. Pulavanur, 8. Killai, 9. Portonova, 10. Chidambaram, 11. Veeranam, 12. Thiruchinnapuram, 13. Anjanakuppam, 14. Sukiranur, 15. Virthachalam, 16. Old Neyveli, 17. Willington Reservoir, 18. Sendamangalam, 19. Periyanesalur, 20. Gomuki Dam, 21. Madur village, 22. Rishivandium, 23. Periya Yeri, 24. Kannanakuppam, 25. Velandai Yeri, 26. Thapovanam, 27. Mambalapattu.

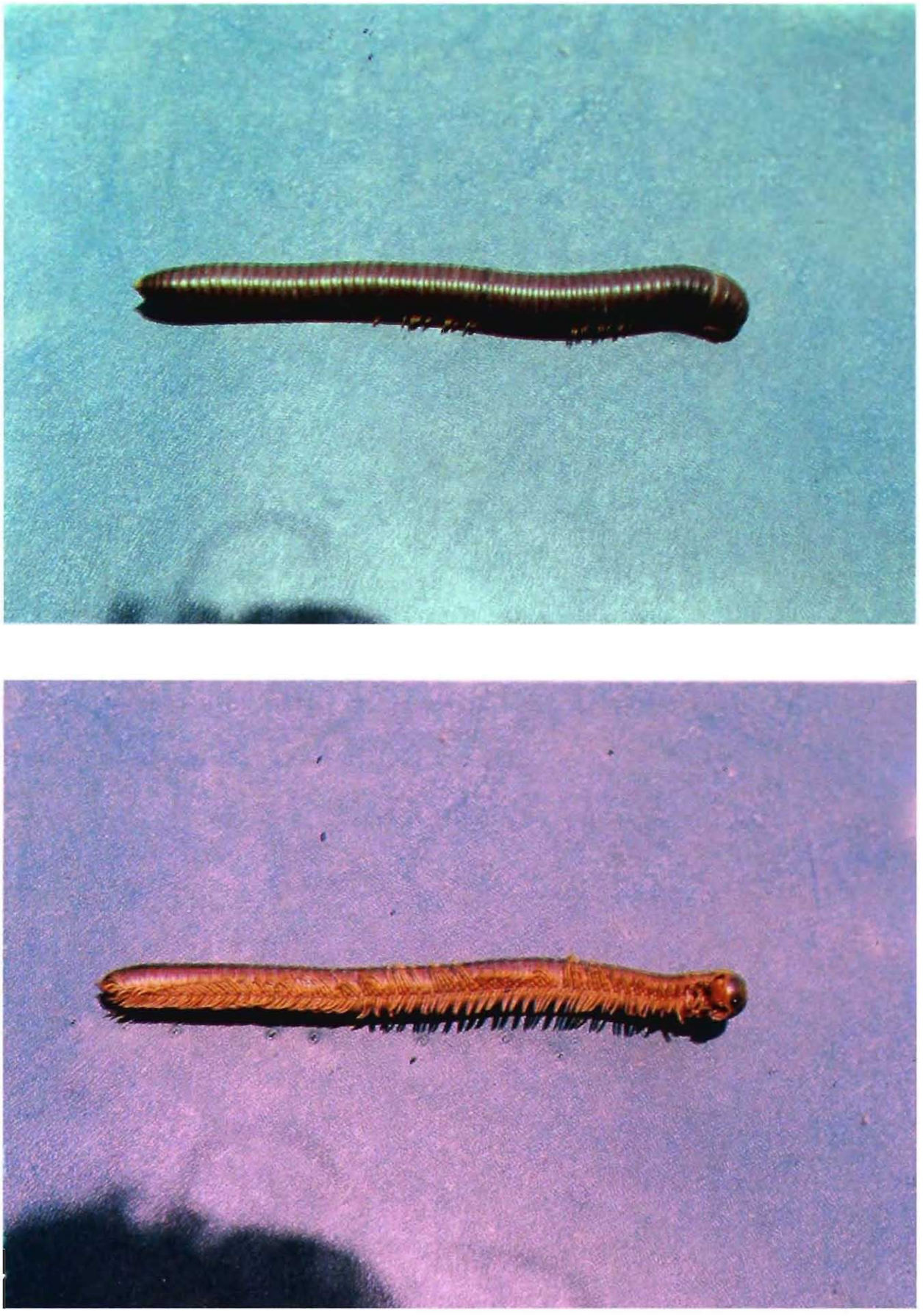

Fig. II

Dorsal and Ventral view of Millipede *Phyllogonostreptus nigrolabiatus* Newport

OBITUARY
IN MEMORY OF PROFESSOR GORDON FRASER BENNETT (1930-1995)

Professor Gordon Fraser Bennett was Indian by birth. He was born in South India in 1930 to Missionary parents. His father, Rev. Reginald Bennett, was a clergyman and his mother, Dr. Ila Bennett, a physician. Professor Bennett had his early schooling in India, but he received his high school education in Ontario. After graduating from Sandwich collegiate Institute in 1949, he elected to study honours zoology and graduated in 1953. He did his masters (1954) and doctorate degrees (1957) under the supervision of Professor A. M. Fallis. During 1957-1962 he was a Research Fellow in the Department of Parasitology at the Ontario Research Foundation where he carried out important studies on the development and transmission of avian blood parasites in collaboration with Professor Fallis. Between 1963-1965 he joined the US National Institute of Health and conducted studies on transmission, development and systematics of simian malaria parasite with Dr. McWilson Warren and others in Malaysia. In 1965, Professor Bennett along with Professors P.C.C. Garnham and A.M. Fallis redefined the genera *Leucocytozoon* and *Haemoproteus*. During 1966-1968, he was Senior Scientist with CSIRO in Brisbane, Australia. In 1969, Professor Bennett returned to Canada to join the Department of Biology, Memorial University of Newfoundland as Associate Professor and in 1974 he became Professor and Head of the World Health Organization's International Reference Centre for Avian Haematozoa (IRCAH). He was the Deputy Head of the Department from 1986 to 1988, and in 1991, he became University Research Professor for 1991-1996. He retired in August 1995.

Professor Gordon F. Bennett authored and co-authored more than 250 research publication in reputed journals. In 1976, he published "Bibliography of the avian blood inhabiting protozoa" with a supplement in 1981. In 1982, his monographic account entitled "A host-parasite catalogue of the avian haematozoa" listed a total of 3,816 bird species representing 152 (84%) of the 175 avian families. It was published as an Occasional Paper in Biology Series No. 5 by the Memorial University and was supplemented in 1992 with bibliography of the group as Occasional paper No. 15 with additional records and references. In 1989, he was awarded theWardle Medal by the parasitology section of the Canadian Society of Zoologists for his outstanding contributions.

During his professoriate he supervised two Ph. D. students, 17 M.Sc. Students and 12 senior undergraduates, He was editor of the Occasional Papers in Biology Series of the Memorial University. He also shared administrative responsibility on various committees in different capacities. Apart from his academic duties, he was voluntary coach of a gymnastics club and was admitted to the Newfoundland and Labrador Gymnastics Sports Hall of Fame in 1988.

Professor Bennett died on Christmas Eve, 1995, after having had a severe mycoplasma infection in April, 1995, which had left him with only 10% lung capacity and a 30 second

oxygen reserve. He leaves behind his wife and two children. Shortly before his death he was relieved to see his collection of type slides, literature, etc., associated with IRCAH shifted safely to the Queensland Museum, Brisbane where Dr. Robert D. Adlard is looking after his great collection and catering information to the interested researchers in the field of avain haematozoa.

He conducted collaborative research with colleagues in about 15 countries around the world on taxonomy and distribution of avian blood parasites and had planned :

- To prepare a monograph on the distribution of avian haematozoa with respect to breeding, nesting etc. habits of birds including their distribution Wallacean life zone-wise;
- To make illustrations of every blood parasite, described or re-described (about 300 species), on computer, and put them on international internet (some 140,000 records) as well as listing of the bibliography;
- To Publish a book giving standardised description of every species of genera *Haemoproteus* and *Leucocytozoon*, based on the original descriptions.

We, his collaborating colleagues all over the world, deeply mourn the death of Prof. Gordon F. Bennett and pray to God that his soul may rest in peace.

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