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COMPUTERISED DATA ON NATIONAL ZOOLOGICAL COLLECTION

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

Dr. RAMAKRISHNA
Director-in-charge
Zoological Survey of India

AN APPEAL

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

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

Dr. RAMAKRISHNA
Director-in-charge
Zoological Survey of India

Rec. zool. Surv. India : **108**(Part–3) : 1-8, 2008

DESCRIPTION OF TWO NEW SPECIES OF TERMITES (ISOPTERA : INSECTA) FROM THE HIMALAYA

P. MUKHERJEE AND P. K. MAITI*

T.M.-5/31, Nishikanan, Tegharia, P.O. Hatiara, Kolkata-700 059

INTRODUCTION

While studying a fairly large collection of termites from the Himalaya, two new species, namely *Angulitermes nepalensis* and *Ahmaditermes sikkimensis* have been recognized. These two species have been described here with comparison with their respective related species and proper illustrations. The genus *Angulitermes* Sjöstedt easily recognized by its frontal projection of the soldier caste, is so far only known from the new world. The Indian subregion contains18 species distributed in India, Myanmar, Pakistan and Bangladesh (Snyder, 1949; Chatterjee & Thakur, 1964 and Chhotani, 1997). As such, this is the first record of the species and genus from Nepal where termites are extremely poorly studied so far (Weidner, 1976). *Ahmaditermes* Akhtar, a nasute Oriental genus, is represented by 12 species from Hong Kong, South China, Thailand and India. Only two species, namely *A. emersoni* (Maiti) (described as *Bulbitermes*, Maiti, 1979) from North Bengal and *A. pyricephalus* Akhtar (1975) from Bangladesh are so far known from Indian subregion.

However, these two species are described here.

MATERIAL AND METHOD

The study is based on the collections preserved in 70 percent alcohol at the Zoological Survey of India, Kolkata. These collections were made mostly by the staff-members of the same Institute. The study was made under a Binocular Microscope and the diagrams were drawn with help of a Camera Lucida.

**32/A, Dover Place, Kolkata-700 019*

SYSTEMATIC ACCOUNTS

Family TERMITIDAE

Subfamily TERMITINAE

Genus ***Angulitermes*** Sjöstedt

Angulitermes nepalensis sp. nov.

Material studied : 2S., 10 miles NE of Tanakpur, Nepal forest, Nepal, *coll. K. Krishna*, 31.01.1953, ex. "under stone in soil"

Description : *(i) Imago*-unknown.

(ii) Soldier : Head-capsule straw yellow; antennae and labrum as same as head-capsule; mandibles dark reddish brown; body and legs whitish yellow. Head-capsule moderately and body fairly densely pilose. Body length: 4.00-4.10 mm.

Head-capsule subrectangular; broadest just behind antero-lateral corners, whence gradually converging behind and somewhat incurved a little above posterior margin; posterior margin convex; antero-lateral corners somewhat prominent and comparatively chitinised; frontal projection fairly large, prominent with rounded anterior margin, apex pilose, somewhat rounded and turned upwards, reaching upto or sometimes beyond the median depression of labrum. Fontanelle lying below the frontal projection, prominent and less hairy than head; fontanelle gland large and prominent. Eyes and ocelli absent. Antennae broken (last segment); segment 1 and 2 sparsely and remainder fairly densely pilose; 2 slightly and 4 much smaller than 3, 5-8 club-shaped and increasing gradually in length, 9 to the penultimate one subequal or shorter than 8. Postclypeus weakly swollen and pilose. Anteclypeus whitish and apilose. Labrum a little longer than broad; antero-lateral corners with horn-like projections; anterior margin deeply and angularly concave and with hairs; lateral margins narrowing posteriorly. Mandibles of snapping-type, long and slender, pointed out weakly and incurved at distal end, slightly longer than head-length. Postmentum short, club-shaped, widest a little below the anterior margin, with transverse weak striations and apilose, lateral margin weakly incurved basally, anterior margin substraight and posterior margin weakly incurved.

Pronotum strongly saddle-shaped, anterior margin considerably raised; broader than long and much narrower than head capsule, anterior margin without any median notch, fairly pilose. Legs thin, short and pilose. Tibial spur formula 3:2:2, tarsi 4-segmented, claws weak. Abdomen oblong, short, fairly densely pilose. Cerci short with 2-segments and hairy. Styli absent.

Measurements (in mm) :

		Holotype Soldier
1.	Body-length	3.50
2.	Length of head to lateral base of mandibles	1.12
3.	Length of head to tip of frontal projection	1.20
4.	Maximum width of head	1.00
5.	Maximum height of head	0.60
6.	Maximum height of frontal projection	0.27
7.	Head Index I (width/length)	0.72
8.	Head Index II (height/width)	0.69
9.	Head Index III (height/length)	0.55
10.	Maximum length of labrum	0.22
11.	Maximum length of labrum (without tip)	0.19
12.	Maximum width of labrum	0.20
13.	Maximum length of mandibles-left	1.30
14.	Head mandibular Index (left mandible-length/head length)	1.08
15.	Min (median) length of postmentum	0.38
16.	Maximum width of postmentum	0.27
17.	Minimum width of postmentum	0.20
18.	Postmentum contraction Index	0.68
19.	Maximum length of pronotum	0.12
20.	Maximum width of prototum	0.35
21.	Pronotum index (length/width)	0.34
22.	Head-pronotum width Index (Pronotum-width/head-width)	0.35
23.	No. of antennal segments	Broken

Type-specimens : All specimens, in spirit and from a single source (vide, Material) in separate vials, deposited as follows :

Holotype Soldier (Z.S.I. Reg. No. 3763/H_{11}) and PARATYPE Soldier (Z.S.I. Reg. No. 3764/H_{11}) deposited in Z.S.I., Kolkata.

Type-locality and distribution : Type-locality–10 miles NE of Tanakpur, Nepal Forest, Nepal, *coll. K.Krishna.* Distribution: Known only from the type-locality.

Comparison : The species, *Anguliternes nepalensis* n. sp. can easily be separated by its shape, size and characters of rostrum and labrum from all other species known from India. However, the species is very close to *A.dehraensis* from Dehra Dun, (Gardner, 1945) but it can be separated from this species by the following characters :

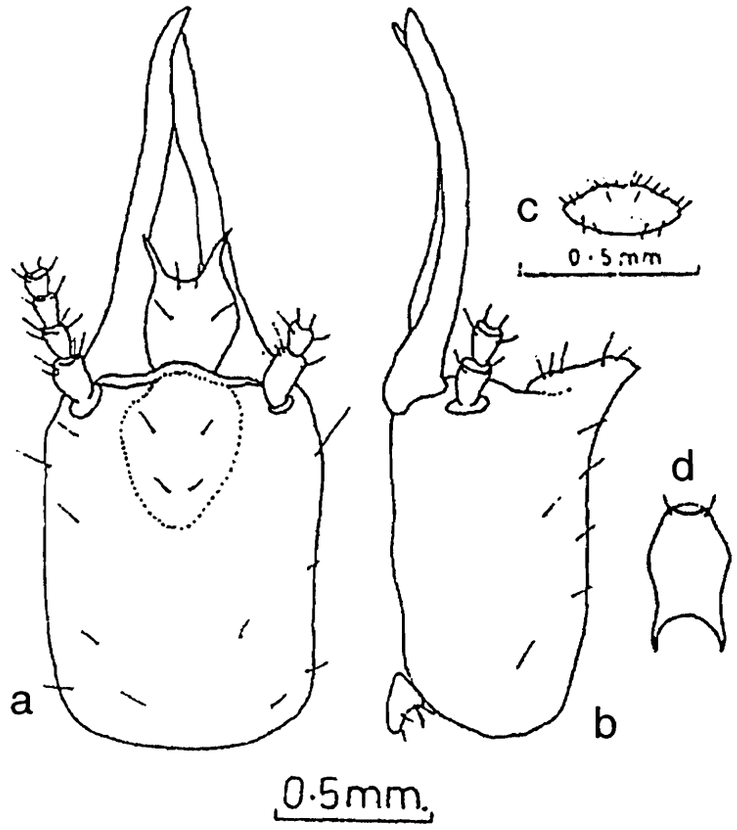

Fig. 1 : *Angulitermes nepalensis*; a-b, Soldier. a. Head, dorsal view; b. Head and pronotum, side view; c. Pronotum; d. Postmentum

From A. dehraensis : Soldier – (i) Antero-lateral corners of head below antennal socket very much prominent and angular (vs., not so prominent in *A. dehraensis)*; (ii) Frontal projection very much prominent, tip raised and directed slightly backward (vs., frontal projection not so prominent, tip not so raised and directed backward rather forward), (iii) Anterior margin of labrum with deep, angular median notch (vs., anterior margin deeply incurved with rounded median emargination); (iv) Tip of labrum very sharply pointed (vs., anterior tip not so pointed); (v) Mandible slightly longer than head-length, head-mandible index (mandible length/head-length) 1.08 (vs., mandible distinctly longer than head-length, head-mandibular index:1.12-1.26).

Subfamily NASUTITERMITINAE

Genus ***Ahmaditermes*** Akhtar

Ahmaditermes sikkimenses sp. nov.

Material studied : 1S. and sev. W., Ranipool, near Gangtok, East Sikkim, *coll. G. K. Srivastava and G. S. Arora*, 20.xii. 1973.

Description : (i) *Imago* : Unknown.

(ii) *Soldier :* Head pale brown; rostrum yellowish brown, darker at the apex. Antennae; pronotum and abdominal tergites pale brown. Head and pronotum with sparse minute hairs; abdomen with more erect hairs.

Head excluding antennae almost pear-shaped with distinct constriction behind the base of the antennae; head slightly longer than broad, broadest posteriorly and slightly smaller than the double the width of constriction below the antennae; lateral margin strongly bulging out. Posterior margin broadly rounded with distinct median emargination; head in dorsal profile almost straight with a feeble hump on rostrum-base; posterior bulge of head moderate (0.42 mm.) Rostrum short almost sub-cylindrical, slightly more than half the head-length with few minute hairs at the tip. Fontanelle gland and its tube prominent. Antennae broken, 2nd segment somewhat thicker than 3rd, 3 smaller than 2nd and double the 4th and 5th onwards increasing in length and width with profuse hairs. Labrum small, broader than long. Anteclypeus whitish, much broader than long, anterior margin convex; postclypeus distinct with convex anterior margin. Mandibles reduce, small and devoid of any denticle or any spine like process. Molar plates with irregular margin. Postmentum broader than long, broadest in the middle, anterior and posterior margin substraight.

Pronotum strongly saddle-shaped, anterior margin with a median feeble emargination, posterior margin weakly convex.

Measurements (in mm) :

		Holotype Soldier
1.	Length of head with rostrum	1.57
2.	Length of head without rostrum	1.00
3.	Maximum width of head	1.00
4.	Head constriction width	0.61
5.	Posterior head bulge	0.42
6.	Head index (width/length)	1.00
7.	Maximum length of labrum	–
8.	Maximum width of labrum	–
9.	Length of left rostrum (Upper base of condyle to tip)	0.57
10.	Nasute-head length Index (nasute-length/head-length without rostrum)	–
11.	Minimum median length of postmentum	–
12.	Maximum width of postmentum	–
13.	Width of postmentum at waist	–
14.	Maximum length of pronotum	0.15
15.	Maximum width of pronotum	0.45
16.	Pronotum index (length/width)	0.33
17.	Number of antennal segments	–

(iii) *Worker* : Head pale to fuscous brown, slighter anteriorly, antennae paler than head; legs and rest of the body pale white. Head, pronotum and abdomen fairly pilose.

Head elongately oval, both lateral and posterior sides weakly outcurved. Anteclypeus whitish, apilose and postclypeus feebly brown with some hairs especially on anterior margin. Epicranial suture faintly marked. Antennae with 14 segments, 2 and 3 subequal, rest comparatively longer. Mandibles of typical *Ahmaditermes*–type.

Measurements (in mm) :

		Worker
1.	Length of head	0.80-0.83
2.	Width of head	0.92-0.98
3.	Length of Postclypeus	0.19-0.21
4.	Width of Postclypeus	0.38-0.41
5.	Length of Pronotum	0.22-0.24
6.	Width of Pronotum	0.52-0.54
7.	No. of antennal segments	14

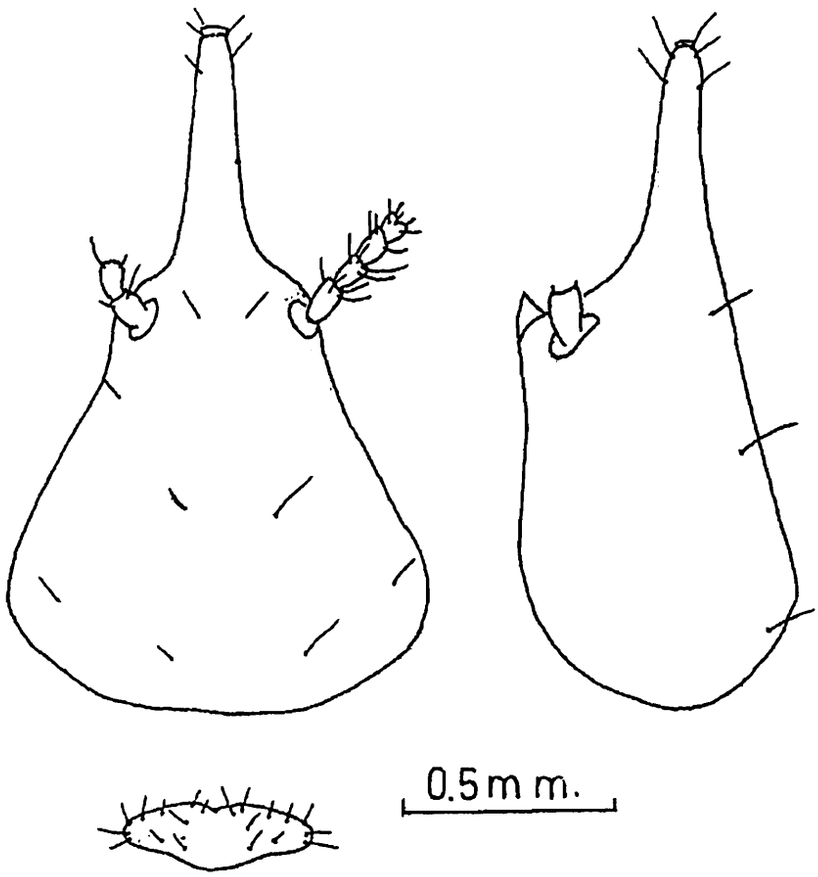

Fig. 2 : *Ahmaditermes sikkimensis*; a-b, Soldier. a. Head and pronotum, dorsal view; b. Head, side view.

Pronotum saddle–shaped, weakly emarginate on anterior–median and postero-median margins.

Type specimens : All specimens, in spirit and from a single source (vide, Material), deposited as follows :

Holotype Soldier (Z.S.I. Reg. No. 3765/H_{11}) and Paramorphotype Workers (Z.S.I. Reg. No. 3766/H_{11}) deposited in Z.S.I. Kolkata.

Type-locality and distribution : Type-locality: Ranipool, near Gangtok, East Sikkim. Known only from the type locality.

Comparison : Of the two species known so far from the Indian subregion, *A. pyricephalus* Akhtar from Bangladesh and Southern China has the dimorphic soldiers, whereas the new species is monomorphic one. However, the species comes close to *A. emersoni* (Maiti) from the Eastern Himalaya, (Maiti, 1979) but differs as follows:

From *A. emersoni* : Soldier : (i) Head-wider, head-width 1.00 mm (vs. head narrower, 0.83-0.93 mm in *A. emersoni*); (ii) Posterior margin of head distinctly emarginate (vs. substraight in *A. emersoni*); (iii) Head in dorsal profile almost straight with a very weak rostral (basal) hump (vs. head in dorsal profile incurved and devoid of any distinct hump in *A. emersoni*).

SUMMARY

The paper deals with the illustrated description of two new species of termites namely, *Angulitermes nepalensis* sp.nov. from Nepal and *Ahmaditermes sikkimensis* sp. nov. from Sikkim, India based on the characters of soldier caste.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to the Director, Zoological Survey of India, Kolkata for extending all facilities for the work. Thanks are also due to Dr. (Mrs.) N. Saha, Officer-in-charge of Isoptera Section, for free access for studying the termite material.

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STATUS OF FOUR ARBOREAL SPECIES OF MAMMALS IN DARJEELING DISTRICT, WEST BENGAL, INDIA

T. P. BHATTACHARYYA, A. MURMU, S. CHAUDHURI AND P. C. MAZUMDER
Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

INTRODUCTION

To ascertain the present status of four arboreal species of mammals *viz.*, Rhesus Macaque, *Macaca mulatta* (Zimmermann), Assamese Macaque, *Macaca assamensis* (M'Clelland), Common Langur, *Semnopithecus entellus* (Dufresne) and Malayan Giant Squirrel, *Ratufa bicolor gigantea* (M'Clelland) in North Bengal, a project was undertaken by the Zoological Survey of India. The project was taken up for the following reasons (i) to ascertain their abundance, (ii) to add information at National level about their population and lastly, (iii) to collect data to built up comparative behavioural and demographic studies. The knowledge about the population status of primates is a prerequisite to formulate any management plan or to carry out meaningful long-term behavioural studies. Therefore, this population survey may add some information to primate resources in India.

The distribution of these four arboreal species of mammals in India has been given below (vide Alfred *et al.*, 2000).

Species	Distribution
Macaca mulatta	Whole of North and Northeast India to south up to 15° 46' N Latitude near Bay of Bengal.
Macaca assamensis	Arunachal Pradesh, Assam, Manipur, Mizoram, Nagaland, Sikkim, Tripura, Uttar Pradesh, West Bengal.
Semnopithecus entellus	Throughout India except North East India and western part of Gujarat.
Ratufa bicolor gigantea	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and West Bengal.

STATUS OF NON-HUMAN PRIMATES

Amongst non-human primates Rhesus Macaque, *Macaca mulatta,* Assamese Macaque, *Macaca assamensis* and Common Langur, *Semnopithecus entellus* are the more common species. Rhesus Macaque and Hanuman Langurs are widely distributed in Indian subcontinent but the Assamese Macaque is restricted in its distribution in the northeastern states. They are found living in feral condition and also as commensal around human settlements, in the towns and villages as opposed to their forest dwelling populations that were quite sizeable in our country. The people treated these rural and urban populations with tolerance on religious and ethical grounds. However, under increased economic pressure the traditional tolerance of the people tend to become eroded and in turn resulted in confrontation, which put the population under severe stress of survival. In addition to this the commercial trade of Rhesus and Assamese Macaque for use in biomedical research especially in developed countries, and similar but relatively recent usage of Hanuman Langur for such purposes within the country resulted in their general population decline. In order to ensure proper conservation of these species it soon became necessary to collect baseline data on several aspects. So, the present status of the population of these species, their major habitat use, the significant ecological factors affecting their survival, needed to be studied for their conservation.

One of the earliest population surveys of non-human primates was done in the country (Southwick and Siddiqui, 1966) which was mainly for the Rhesus Macaque in northern Indian states. Khajuria (1966) published a brief account of the distribution of Assamese Macaque in certain parts of Darjeeling district. Mukherjee and Mukherjee (1972) also conducted surveys for some of the same states and for the same species. Dolhinow and Lindburg (1980) surveyed the forest populations of Rhesus Macaque and Hanuman Langur in the same region. Kurup (1984) recorded the survey findings of Andhra Pradesh, Karnataka, Tamil Nadu and Kerala. Zoological Survey of India conducted survey of non-human primates from 1977 to 1981, particularly of the Rhesus Macaque and Hanuman Langur of India and recorded the distribution, abundance and present status of these two species in different states of India (Tiwari and Mukherjee, 1992). Field studies of non-human primates were also made by Mukherjee *et al.* (1995), Murmu *et al.* (2004) and reported the entire range of distribution of Rhesus and Assamese Macaque of Darjeeling district. Chaudhuri *et. al.* (2006) reported the distribution of Rhesus Macaque in three districts of Northern West Bengal.

This report presents the result of three census surveys conducted on Rhesus Macaque, *Macaca mulatta* (Zimmermann), Assamese Macaque, *Macaca assamensis* (M'Clelland) and Hanuman Langur, *Semnopithecus entellus* (Dufresne) during the period from January 2002 to November 2003.

METHODOLOGY

In order to do this, initially, contact was made with the forest officials to inquire about the availability of these primates. However, most of the staff and officers of the forest department and forest labourers were found to be keen observers of these primates. In addition to above, knowledgeable villagers were also contacted to have further information available, if any. On receipt of the information counting by direct count method of different troops living by roadsides and adjacent forests was adopted. Utmost care was taken to count them but as some of the groups were wild there might be some chances of missing a few members in some groups. Driving a vehicle at slow speed (20–30 km per hour) made the roadside surveys with four observers keeping a constant watch for monkeys and langurs along the road and roadside forests. In forest different ecological areas were selected for census and transect and point methods were applied to locate them. Surveys were conducted during dry periods only to obtain quite clear visibility to scan a long distance as far as clearly visible through a 7 × 50 binocular. At Takdah due to dense fog the visibility was too poor and it was not possible to make an extensive survey. Selected groups in each sub-division were observed to estimate population growth and birth rate.

The individuals of a group were classified as adult males, adult females, juveniles and infants. Juveniles were identified as those, which were independent of their mothers. Infants were identified as those that were carried by their mothers.

ECOLOGY OF THE STUDY AREA

Darjeeling district lies in the northern part of West Bengal, extending between 26° 33' to 27° 13' N latitude and 88° 2' to 88° 56' E longitude with a geographical area of about 3148 sq. km. The major part of it lies in the eastern Himalayas ranging at an elevation between 200 m at Reang in the Teesta Valley to about 3800 m near Sandakphu and Phalut. The climate of the area also varies considerably due to altitudinal variations. The major crops of the area are rice, wheat, maize and tea. The area also experiences a few winter shower and snowfalls in many places during winter months. The main rivers are Teesta and Mahananda, which with their numerous affluence form the drainage system.

The forests are of mixed type from riverine to Oak-Hemlock forests. In the lower altitude in many places Sal (*Shorea robusta)* is the predominant species with principal associates being *Schimia wallachii, Terminalia belerica, Terminalia crenulata, Sterculia villosa, Pinus longifolia, Amoora rohituka, Michelia champaca,* etc. On the upper ridges *Cryptomeria japonica* is the predominant species with other species like *Michelia excelsa, Bucklandia populnea, Acer combelii, Alnus nepalensis, Nysa javanica, Prunus nepalensis, Michilus gamaniieana,* etc.

Nearly 550 km. road was surveyed including forest road and foot trails and 46 groups of *Macaca assamensis*, 27 groups of *Macaca mulatta* and 2 groups of *Semnopithecus entellus* were seen in the forested habitat and roadsides (Fig. 1).

The Darjeeling district has four sub-divisions. The Siliguri sub-division was devoid of Assamese Macaque and was replaced by Rhesus Macaque. The other three sub-divisions *viz.* Kurseong, Kalimpong and Darjeeling were found to contain the entire population of Assamese Macaque. The distribution and social composition of Assamese Macaque is given in Table 1, of Rhesus Macaque in Table 2 and of Hanuman Langur in Table 3.

Table 1 : *Macaca assamensis* (M'Clelland) [Status IUCN–VU].

Area	Total no. of Troops	Total no. of Individuals	Male	Female	Juvenile	Infant
Kurseong sub-division	14	182	30	110	32	10
Kalimpong sub-division	24	340	70	210	40	20
Darjeeling sub-division	8	100	18	65	10	7
Total	**46**	**622**	**118**	**385**	**82**	**37**
Percentage composition	–		**19**	**61.9**	**13.2**	**5.9**

Table 2 : *Macaca mulatta* (Zimmermann) [Status IUCN–L Rnt].

Area	Total no. of Troops	Total no. of Individuals	Male	Female	Juvenile	Infant
Kurseong sub-division	1	31	4	19	5	3
Kalimpong sub-division	15	201	32	102	40	27
Darjeeling sub-division	2	81	15	35	15	16
Siliguri sub-division	9	108	18	56	20	14
Total	**27**	**421**	**69**	**212**	**80**	**60**
Percentage composition			**16.4**	**50.4**	**19.0**	**14.2**

Table 3 : *Semnopithecus entellus* (Dufresne) [Status IUCN–L Rnt].

Area	Total no. of Troops	Total no. of Individuals	Male	Female	Juvenile	Infant
Kurseong sub-division	2	45	7	20	10	8
Total	**2**	**45**	**7**	**20**	**10**	**8**
Percentage composition			**15.6**	**44.4**	**22.2**	**17.8**

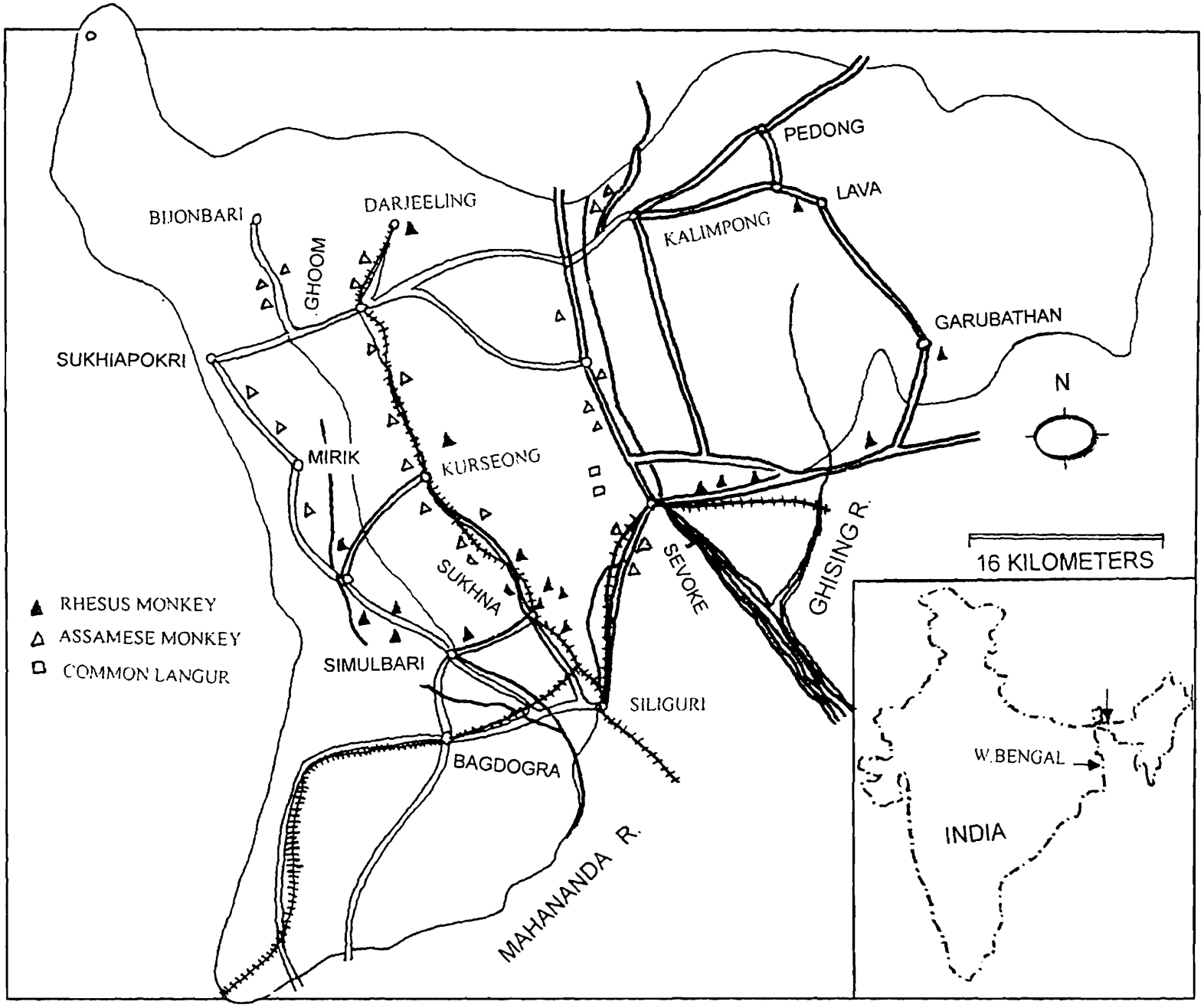

Fig. 1 : Distribution of non-human primates of Darjeeling district, West Bengal.

The 46 groups of Assamese Macaque contained a total of 622 monkeys with an average group size of 13.6 individuals of which 2.6 were adult males, 8.4 adult females, 1.8 juveniles and 0.8 infants. The group size varied from 5 to 40 individuals. Out of 622 monkeys the percentage composition were 19.0% adult males, 61.9% adult females, 13.2% juveniles and 5.9% infants. Ratio of adult male to adult female was 1 : 3.3; adult female to infant was 1 : 0.2 and ratio of females to combined population of juvenile and infant was 1 : 0.3.

The 27 groups of Rhesus Macaque contained a total of 421 monkeys with an average group size of 15.6 individuals of which 2.6 were adult males, 7.8 was adult females, 3.0 juveniles and 2.2 infants. The group size varied from 6 to 25 individuals. Out of 421 monkeys percentage composition was 16.4% adult males, 50.4% adult females, 19.0% juveniles and 14.2% infants. Ratio of adult male to adult female was 1 : 3.2, adult female to infant was 1 : 0.3 and ratio of females to combined population of juvenile and infant was 1 : 0.7.

The two groups of Hanuman Langur contained a total of 45 Langurs with an average group size of 22.5 individuals of which 3.5 was adult males, 10.0 adult females, 5.0 juveniles and 4.0 infants. The group size was of 20 and 25 individuals. Out of 45 Langurs the percentage composition was 15.6% adult males, 44.4% adult females, 22.2% juveniles and 17.8% infants. Ratio of adult male to adult female was 1 : 2.9; adult female to infant was 1 : 0.5 and ratio of females to combined population of juvenile and infant was 1 : 0.9. Moreover, a third group was observed in the top canopy of the same area, which could not be counted due to poor visibility. Population composition and incidence of monkeys is detailed in Table 4.

Table 4 : Population composition and incidence of monkeys in Darjeeling district.

Species	Km surveyed	No. of groups	Groups/ Km	No. of monkeys	Average group size	Adult %		Sub-adult %	
						Male	Fe-male	Juve-nile	In-fant
Macaca mulatta	550	27	20.37	421	15.6	16.4	50.4	19.0	14.2
Macaca assamensis	550	46	11.96	622	13.52	19.0	61.9	13.2	5.9
Semnopithecus entellus	550	2	–	45	22.5	15.6	44.4	22.2	17.8

DISCUSSION

The present survey revealed that the Rhesus Macaques are confined to lower altitude, between 100 m and 550 m whereas the Assamese Macaques are mostly restricted to higher altitudes except three groups of Rhesus Macaque-one at Darjeeling town (*c* 2123), one at Dowhill (*c* 1880 m) near Kurseong and one at Lava (*c* 2184 m) region were found inhabiting at higher altitudes. In spite of

local enquiries it could not be confirmed whether it was a natural group or introduced or group formed by the escaped monkeys. The Assamese Macaque and Rhesus Macaque both inhabit in lower elevation at Sevoke and adjacent areas but the home range of these two species was found not to overlap. Mukherjee *et. al.* (1995) conducted survey in the same area during 1985 and found 188 Rhesus Macaque, 156 Assamese Macaque and 19 Hanuman Langur, with an average of 1 group in every 36.4 sq. km. in the study area. Murmu *et. al.* (2004) surveyed the said area during 1997 and found 574 Assamese Macaque inhabiting there and recorded 1 Assamese Macaque in every 12.9 linear km. and 2.6 monkeys per sq. km. During present survey it was recorded 0.08 groups of Assamese Macaque per linear km and 1 Assamese Macaque group in every 21.7 sq. km. So, the population of Rhesus Macaque has increased by 133 monkeys during the last 20 years and that of Assamese Macaque by 48 monkeys during the last 8 years. The Nepali people constitute the major population in this district and they are more tolerant to these monkeys. This may be one of the reasons for having the viable population in this district. The two troops of Langur observed near Coronation Bridge on Sevoke-Teesta Road have also increased by 26 Langurs during the last 20 years. The increase of Langur population should have shown a higher figure if the third troop was possible to count.

A number of Assamese Macaques were found to have lost their forelimbs due to shock from high tension electric wire placed in the roadside forests at Andheri Jhora, 27th mile, 29th mile on Sevoke-Teesta road. They were also found carrying their infants on back and showing erect bipedal movement on hind limbs.

The monkeys have been found living with human beings and have influenced each other. It has been amply emphasized that human disturbance to habitat has important consequences on the demography, behaviour, and ultimately the survival of non-human primates, specially of the Indian subcontinent (Bishop *et al.,* 1981). During present investigation it was observed that, as the provisioning was highest at temples and tourist areas the population of Assamese Macaque has shown considerable increase in their population. On the other hand as the provisioning was low in the forest areas the population of Rhesus Macaque did not show much increase.

It is evident from the present surveys that Rhesus Macaque population has increased considerably than that of Assamese Macaque at Darjeeling district. The Assamese Macaque was at present found inhabiting only at Darjeeling district in Bengal. The Rhesus Macaque is a highly adaptive species among the Macaques and now it is invading the territory of Assamese Macaque in the district. The Assamese Macaque is a broad-leaf, evergreen species but due to shrinkage of forest habitat and scarcity of preferred food this species is forced to harbour in the roadside forest predominantly of monoculture habitat at Darjeeling. If the Rhesus Macaque proceed on invading the higher elevation of Darjeeling district then there is a possibility of decline in Assamese Macaque population. So, regular monitoring is needed to formulate a strategy for survival of Assamese

Macaque in this montane region of West Bengal. Hanuman Langur was found to live in top canopy to avoid territorial fight with other primate species.

For better conservation attention needed to be given on the following points :

1. Study of communicable diseases especially of Assamese Macaque.
2. Group wise capture, translocation and release in suitable habitats.
3. Systematic analysis of attitude of people towards monkeys.
4. Grow more trees in newly constructed housing colonies to provide food and shelter.
5. Continue density estimate to gather more information on population trends.

STATUS OF MALAYAN GIANT SQUIRREL

Within the Indian limit, the Malayan Giant Squirrel, *Ratufa bicolor gigantea* (M'Clelland) [Status IUCN L Rnt] is restricted to the mixed semi evergreen or evergreen forests of Northeast India. Ecological requirements of this squirrel are very different from most of the diurnal vertebrates. At present, rapid destruction of its habitat in northeast is adversely affecting their population and no detailed information about the population size of this taxon recurring in Indian range is available. However, for adopting an appropriate conservation programme, it is much necessary to have detail conservation programme. It is much necessary to have detail information of this species in respect of distribution, ecology, hebaviour, population etc. Unfortunately, very little information is available about this significant species occurring in the North Bengal. This species can be used as an indicator species for making assessment of the quality of habitats. To fill up this lacunae this research project has been taken up by the Zoological Survey of India. In connection with this project, seasonal surveys were conducted in the different forests of Darjeeling district, North Bengal. Survey was done on foot by a four-member team along the jungle roads but occasional entry was also made deep inside the forest to locate the animal. Survey was conducted from early morning to noon and again from afternoon to evening.

Date and timing of each sighting is detailed below :

Date	Place of sighting	No. of animals
20.01.2002	Chitri, 2 km from Dowhill	4
26.01.2002	Near F.R.H., Takdah	3
29.01.2002	Riyang	1
04.02.2002	Near F.R.H., Sukna	6
21.09.2002	Kalijhora	2
23.09.2002	5 km from Kalijhora towards Sevoke	4

Date	Place of sighting	No. of animals
24.09.2002	8 km from Kalijhora towards Sevoke	5
11.11.2003	Reshap	3
12.11.2003	4 km on way to Lolegaon from Lava	4
14.11.2003	Near Coronation Bridge	4
15.11.2003	Dalim Forest, 4 km from Gorubathan	4
16.11.2003	Samsing	2
17.11.2003	Suntalyekhola	1

DISCUSSION

Most of the sighting records were made during feeding. If not disturbed, it was found to feed on a single tree for more than 40 minutes. However, none of the animals were found to feed on the trees of the forest village.

Chakraborty and Chakraborty (1991) reported on the activity pattern and population of this squirrel in Jalpaiguri district of North Bengal. Pratihar *et al.*, (1995) reported about the status of this squirrel in different forests of North Bengal. They also reported about their feeding habits.

During survey it was observed that their feeding activity continues almost throughout the day. Feeding activity starts within an hour of sunrise and continues till dusk with a lean period from about 1.00 p.m. to 3.30 p.m. For feeding, it comes out of the dense forested part to somewhat open areas and is restricted to a selected tree species within as small area. In the morning activity is related to feeding and interspecific territorial chasing. During noon it takes rest lying flat on the shaded branches of tree. Wide varieties of foods are taken depending upon the availability within the foraging ground. It was also observed that the animal debarks the trees in search of insect food. From the sighting frequency and number of animals sighted it appears that it lives in pairs or sometime singly. But at certain times even five to six animals were also found foraging in the same area. It was also found that different species of birds, Macaques and Langurs sharing the food items with this species at certain areas. Due to very nice matching colour with the back ground forests, this species can easily be located for its frequent characteristic loud call and dropping of leaves, fruits, seeds etc. The forests of Darjeeling district supports and carries a good population of this squirrel. Chakraborty and Chakraborty (1991) reported that this squirrel is strictly arboreal and never descends below 5 metre. But during survey work a pair was found feeding on seeds on ground inside forest at Lava-Lolegaon road and a pair was found crossing the road running to reach the other side forest on the same road.

SUMMARY

The present status survey conducted in the Darjeeling district, West Bengal revealed that the populations of Assamese Macaque, *Macaca assamensis;* Rhesus Macaque, *Macaca mulatta* and Hanuman Langur, *Semnopithecus enlellus* have increased considerably in that area. The area also carries a good and viable population of Malayan Giant Squirrel *Ratufa bicolor gigantea.*

ACKNOWLEDGEMENT

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EARTHWORMS OF NORTH 24 PARGANAS, WEST BENGAL

PROBIR K. BANDYOPADHYAY*, C. K. MANDAL** AND AMLAN K. MITRA*

**Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani-741 235, West Bengal, India*

INTRODUCTION

Soil animals may play a range of roles in vineyards. Decomposers (some of which are opportunistic herbivores) are important in nutrient dynamics, because by reducing organic matter to its constituents, they liberate nutrients usable by grapevines. Earthworms are only part of the complex of organisms termed "decomposers" in agroecology. As noted by Charles Darwin in his 1882 classic, *The Formation of Vegetable Mould Through the Action of Earthworms with Observations on Their Habits* (Werner, 1990), earthworms process huge quantities of plant litter and help to convert it into rich topsoil, liberating nutrients for renewed plant growth. More recent studies show that earthworms can help to reduce soil compaction, improving permeability and aeration. Earthworms do this through burrowing activities, ingestion of soil along with plant debris, and subsequent excretion of casts. Upon drying, these casts form water-stable soil aggregates. These aggregates are clumps of soil particles bound together by organic compounds, and their presence helps to improve soil structure, retain nutrients that might otherwise be leached, and reduce the threat of erosion (Lee, 1985). Earthworms are increasingly recognized as indicators of agro-ecosystem health and as important tools for ensuring soil improvement and efficient nutrient cycling.

In India, due to continuous biodiversity surveys of earthworms number of new species is increasing day by day, although in comparison to more than 3000 global species (Stephenson, 1923), the number of Indian species is far less (only 390). In an attemp to enhance the knowledge on biodiversity of Indian earthworms, the present authors explored 11 earthworm species in the district of North 24 Parganas of West Bengal, of which 6 have been identified as new to the district.

***Zoological Assistant, Zoological Survey of India, Kolkata, India*

SYSTEMATIC ACCOUNT

Phylum ANNELIDA

Class OLIGOCHAETA

Order HAPLOTAXIDA

Family MEGASCOLECIDAE

1. ***Gtnus-Lampito*** Kingberg

(a) ***Lampito manrilii*** Kingberg, *Ofvers. K. Vetens. Akad. Forhandl. Stockholm*, **23** : 103.

1998. *Lampito manritii,* Halder, *Fauna of West Bengal, State Fauna Series,* **3**(Part-10) : 17-93.

Material : 4 exs., Vivekananda Nagar, Madhyamgram, North 24 Parganas, West Bengal, 15.VIII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Andaman and Nicobar islands, Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Laccadeep and Minicoy islands, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh.

Outside India : Zanziber, Comoro Isl., Madagascar, Seychelles Isl., Mauritus, Pakistan, China, Maldives, Sri Lanka, Bangaladesh, Myanmar, Thailand, Malay Peninsula, Indonesia, Philippines, Hong Kong, New Caledonia.

2. Genus ***Meiaphire*** Siams and Easton

(b) ***Metaphire houlleti*** (Perrier)

1872. *Prerichaeta houlleti* Perrier, *Nouv. Arch. Mus. Hist. Nat. Paris*, **8** : 99.

1982. *Melaphire houletti* Julka, *Rec. zool. Surv. India*, **80** : 142.

Material : 2 exs., Sarada Pally, Madhyamgram, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Andaman and Nicobar islands, Meghalaya.

Outside India : Nepal, Bangladesh, Myanmar, Malay Peninsula, Philippines, Java, Fizi islands, Farmosa, Indonesia, Thailand, U.S.A., Central America, Cuba.

(c) ***Metaphire posthuma*** (Vaillant)

1868. *Prerichaeta posthuma* Vaillant, *Annl. Sci. Nat., (Ser. 5)*, **10** : 228.

1972. *Melaphire posthutma* Siams and Easton, *Biol. J. Linn. Soc.*, **4**(3) : 239.

Material : 2 exs., Sarada Pally, Madhyamgram, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Maghalaya, Andaman islands, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan and Uttar Pradesh.

Outside India : Pakistan, Bangladesh, Myanmar, Thailand, Vietnam, Malay Peninsula, Indonesia, Philippines and U.S.A.

3. Genus ***Perionyux*** Perrier

(d) ***Perionyx excavatus*** Perrier

1872. *Perionyx excavatus* Perrier, *Nouv. Arch. Mus. Hist. Nat. Paris*, **8** : 126.

1998. *Perionyx excavatus* Halder, *Fauna of West Bengal, State Fauna Series,* **3**(Part-10) : 17-93.

Material : 6 exs., Vivekananda Nagar, Madhyamgra, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Meghalaya, Andaman island, Arunachal Pradesh, Assam, Himachal Pradesh, Maharashtra, Manipur, Orissa, Sikkim, Tamil Nadu and Uttar Pradesh

Outside India : Madagascar and its adjacent islands, Sri Lanka, Myanmar, Thailand, Vietnam, Malay Peninsula, Indonesia, Philippines, Taiwan and West Indies.

4. Genus ***Eutyphoeus*** Michaelsen

(e) ***Eutyphoeus orientalis*** (Beddard)

1833. *Typhoeus orientalis* Beddard, *Ann. Mag. Nat. Hist., (Ser. 5)*, **12** : 219.

1938. *Eutyphoeus orientalis* Gates, *Rec. Indian Mus.*, **40** : 98.

Material : 1 ex., Sarada Pally, Madhyamgram, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Bihar and Uttar Pradesh.

Outside India : Bangladesh.

*(f) ***Eutyphoeus nicholsoni*** (Beddard)

1901. *Typhoeus nicolsoni* Beddard, *Proc. Zool. Soc. Lond.*, **1901** : 195.

1903. *Eutyphoeus nicolsoni*, Michaelsen, *Geogr. Verbr.*, 109.

Material : 2 exs., Madhyamgram, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Bihar and Uttar Pradesh.

Outside India : Not recorded.

*(g) ***Eutyphoeus incommodus*** (Beddard)

1901. *Typhoeus incommodus* Beddard, *Proc. Zool. Soc. Lond.*, **1901** : 200.

1903. *Eutyphoeus incommodus* Michaelsen, *Geogr. Verbr.*, 109.

Material : 1 ex., Sarada Pally, Madhyamgram, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Bihar, Hariyana, Himachal Pradesh, Orissa, Punjab, Rajasthan and Uttar Pradesh.

Outside India : Pakistan.

*(h) ***Eutyphoeus waltoni*** Michaelsen

1907. *Eutyphoeus waltoni* Michaelsen, *Mitt. Naturh. Hamb.*, **24** : 179.

1966. *Eutyphoeus waltoni* Soota, *Rec. zool. Surv. India*, **64** : 179.

Material : 1 ex., Vivekananda Nagar, Madhyamgram, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Bihar, Gujarat, Madhya Pradesh, Punjab and Uttar Pradesh.

Outside India : Bangladesh.

5. Genus ***Amynthas*** Kingberg

(i) ***Amynthas diffringens*** (Baird)

1809. *Megascolex diffringens* Baird, *Proc. Zool. Soc. Lond.*, **1869** : 40.

1972. *Amynthas diffringens* Sims and Easton, *Biol. J. Linn. Soc.*, **4**(3) : 235.

Material : 2 exs., Ramakrishna Pally, Madhyamgram, North 24 Parganas, West Bengal, 15.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal : Darjeeling; Jalpaiguri; Hooghly and North 24 Parganas, Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Karnataka, Manipur, Meghalaya, Sikkim, Tamil Nadu and Uttar Pradesh.

Outside India : Africa, Madagascar and its adjacent islands, Europe, China, Eorea, Japan, Sri Lanka, Nepal, Bhutan, Bangladesh, Myanmar, Indonesia, Philippines, Hainan, Hong Kong, Taiwan, Australia, New Zealand, some islands in the Pacific Ocean, U.S.A., Central America, West Indies and South America.

Family MONILIGASTRIDAE

6. Genus ***Drawida*** Michaelsen

*(g) ***Drawida nepalensis*** Michaelsen

1907. *Drawida nepalensis* Michaelsen, *Mitt. Naturh. Mus. Hamb.*, **24** : 146.

1961. *Drawida nepalensis* Gates, *Burma Res. Soc. 50th Anniv. Pub. No.* **1** : 57.

Material : 2 exs., Abdalpur, North 24 Parganas, West Bengal, 5.VI.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Andaman and Nicobar islands, Assam, Bihar, Himachal Pradesh, Meghalaya, Sikkim and Uttar Pradesh.

Outside India : Pakistan, Nepal, Bangladesh, Myanmar and Indonesia.

Family ALMIDAE

7. Genus ***Glyphidrilus*** Horst

*(h) ***Glyphidrilus tuberosus*** Stephenson

1916. *Glyphidrilus tuberosus* Stephenson, *Rec. Indian Mus.*, **12** : 349.

1987. *Glyphidrilus tuberosus* Julka and Senapati, *Rec. zool. Surv. India, Occ. Paper No.*, **92** : 6.

Material : 6 exs., Uttar Beel, Sonapukur, Haroa, North 24 Parganas, West Bengal, 21.VII.2005, Coll. C.K. Mandal.

Distribution : INDIA : West Bengal, Orissa and Tamil Nadu.

Outside India : Not recorded.

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*New place record.

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Julka, J.M. 1988. Fauna of India and the adjacent countries : Megadrile Oligochaeta (earthwarms); Haplotaxida : Lumbricina : Megascolecoidea : Octochaetidae, XIV+400 pp. *Zool. Surv. Ind.*, Calcutta.

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DIVERSIFIED FEEDING BEHAVIOR OF A TRUE WEAVING ARANEID SPIDER FROM TINDHARIA, DARJEELING DISTRICT, WEST BENGAL

S. TALUKDAR AND S. C. MAJUMDER

Zoological Survey of India, 13th floor, Nizam Palace, 234/4, Acharya J. C. Bose Road, Kolkata-700 020

INTRODUCTION

Information on feeding behavior of araneid spiders is lacking from Darjeeling Hills of West Bengal. Tikader (1961) made an observation on spider weavers as a trap hunter in their orb-web. Tikader (1982) in his observation on nest building behavior of araneid spider from India mentioned the prey capturing purpose also. Majumder (2001) recorded some important notes on spider nest by which odonates were caught. Talukdar and Majumder (2006) studied some interesting observations on web-building, food and feeding behavior of four araneid species of the genus *Argiope* and *Neoscona.*

During early monsoon of the year 2006 while carrying out an extensive behavioral studies on spiders of Darjeeling hills the authors came across an araeneid spider *Argiope pulchella* Thoerll was displaying its feeding behavior on its orb web built near a hill stream of Tindharia. The present paper deals with the details of the sites where the spider builds it's web for trapping insects as their prey is also included the food and the diverse pattern of feeding habits of *Argiope,* the places it stays near the web while retract, the morphological structure and measurements of the spider and its prey, the time span it needs to capture the prey and digestive mechanism along with the biological significance regarding the advancement of predatory behaviour.

MATERIALS AND METHOD

Study area : The camp site of Tindharia situated at the grid between 88.00 degree east and 26.38 degree north of West Bengal, a vibrant pteridophytic hill walls steeped in splendour on the western ravine of Darjeeling hills about 856 meters of altitude and is about 32 kms away from

siliguri and about 52 kms from Darjeeling town. The place where we performed our observation is very green, vegitation of this area is remarkable with very dense population of ferns and bryophytes under dense canopy of different varieties of trees. Spiders of almost all group like such habitat. It was a narrow upward path along the hill towards the forest. Beside this path there was a jhora, a sharp hill stream. One of the place left less green may be due to land sliding the settled vegetation was disturbed. We took the area as special interest keeping in mind that "this might be a habitat of clubioneid spiders" But suddenly we saw an Argiope female on its web acting on a lepidopteran victim.

Climate : Monsoon prevails for about four months from early of June to mid of October with high humidity. Annual range of humidity is between 90–95%. July-August are the heavy rainfall months with precipitations as high as 500 mm. Annual rainfall is about 320 cms. Occasional rains are often encountered throughout the rainy season. Pre-monsoon is dry and warm with versatile climatic conditions within a single day. Clouds from mild to most dense accumulation and precipitation thereon following sunny sky wormness are very common Post-monsoon is apparently cold with negligible rainfall. Maximum temperature reaches up to 14.89 degree celcious in May while the mean maximum temperature is 8.59 degree celcious observed in June. On the other hand the minimum temperature drops up to 1.2 degree celcious in January and the mean minimum temperature is about 3 degree celcious observed during early December every year.

Collections : Spiders were collected from the study areas directly from the webs by hand picking method, by the sweeping net and by dusting the nearby bushes in to an inverted umbrella. More we concentrated ourselves in collection of the data about the behaviors of the spiders than we collected the specimens.

Preservation : Collected spider specimens were anaesthetized, killed in a killing jar and finally preserved in Oudman's preservative (90 parts 70% ethanol, 1.5 parts glycerol and 5 parts glacial acetic acid) in glass vials.

Identification : Well-preserved spider specimens were sorted transferred in ethyl alcohol and studied under binocular microscope in a Petri dish. The specimens were identified up to species level.

OBSERVATION

Two different process of feeding observed in same species.

In first case : On 10th July' 06 at 3 p.m. we saw an *Argiope pulchella* female measuring about 12 mm of it's body length is waiting at the hub of its orb-web hanging vertically from the fern and weeds of the slant decorated with the stabilimentum near a hill stream beside our trake. After a while during return from the same way back at about 4.30 p.m. we saw one large lepidopteran

moth is entrapped into the web and trying to escape. But the predator (*A. pulchella)* rushed at the insect which is at least 5 times larger than the spider and pierces it with repeated actions of biting. This process lingers at least 5 minutes till the victim become completely immobilized at about 4.35 p.m. Then the spider approached towards the victim and finally confirmed itself about the immobilization process with 3–4 attempts At about 4.40 p.m the spider pulled out a sheet of silk from its spinnerets with its right hind leg first then the second and thursts the sheet against the moth keeping a distance about 2 cm away from the victim. The silk sheet then fussed with the moth's body by 2–3 trials. At about 4.50 p.m. we saw the spider rolling the insect on to the sheet to swathe it and simultaneously pulling out the same from the spinnerets with the help of the right and left hind legs alternately. This process continued upto 5 p.m. with some intervals and ended when the victim was completely covered with the silk.

After a while the spider readjusted the swathed victim on to the hub of it's web and set itself very close to the body in search of a soft area in it from which juices can be sucked. It took about 5–10 minutes. Finally the predator sat on a grand dinner and keeping a half an hour watch further we left the spot for evening tea at about 5.40 p.m. We returned there again after 45 minutes and saw no new thing other than the direction of the prey-predator composition is rotated just 180 degree. The spider is now sucking juice keeping it's head vertically upward which is just opposite to the previous position. We had to return to the camp for other activities and for arrangement of light at about 7.10 p.m. in between we saw the spider rotated another 180 degree and changed its position in continuation of its dinner.

After finishing dinner we came back along with our camp host at about 9 p.m. and saw that the spider is also about to finish it's dinner and very actively moving with the prey composition but never sucking more. Switching off the light we awaited there for about half an hour and observed no new thing other than the detachment of prey-predator complex. After more 30 minutes while we departed the study area we saw the spider started repairing its web which was torn during feeding.

In second case : On 11th July, 06 the day was very dark but no rain, with extra interest we visited the same spider in same web and the observation was really very interesting. At 9 a.m. we reached the spot and saw a complete different picture. That time the spider was feeding upon a jet black coleopteran beetle most probably a species of the genus *Apogonia* measuring about 9 mm in length. The feeding process was almost direct unlike yesterday's pattern, the spider first immobilized the prey by repeated biting from different angles by injecting venom which took about 15 minutes and no silk swathing to the victim. During this process, the spider was using the first two legs little folded keeping the body away with a keen watch on the victim. After confirmation of the immobilization process the predator started feeding by piercing its sucking instrument through a soft area near the joint of head and thorax of the prey. Searching a soft area took about 15 minutes, in between stray sucking was done by the spider during search through the joining areas of the

hard crust of the insect. Like yesterday whole the feeding process occurred at the hub where the predator dragged down the prey for nourishment. After completion of the sucking the spider detached from the residue of the victim's body within 5 minutes. The total process took about 3.5 hours and before we left the place at 12.45 noon the spider started repairing its web.

DISCUSSION AND SIGNIFICANCE

It is revealed from this study that *Argiope pulchalla* of Tindharia have a two dimensional food capturing behavior in one of which it displayed a similar type of prey-predator interaction like the wandering spiders by direct attack for immobilization and then suck the juice. The only difference is that they perform their feeding like all biological activities on the web. Here *Argiope* displayed it's feeding behavior on a coleopteran beetle by sucking it's body fluid directly just after immobilizing it while in other case it swathed the prey (a lepidopteran moth) after immobilization and then sucked the body fluid.

Thus it can be concluded that in the way of evolution the majority of sedentary spiders develop the art of building orb-webs as traps to capture the prey to satisfy their carnivorous and predatory habit. Unlike all other web-building spider species *Argiope pulchella* Thorell simultaneously display the method of capturing prey like the wandering spiders and like the true web hunters both by the primitive attack procedure of using the chelicerae to immobilize prey while in other case first immobilize the victim by using a silk swath following an injection of venom after the prey has been encountered. Prey caught by the Argiope differs in size, from large grass hopper, beetle, moths, butterflies to small insects such as leaf hopper, gall wasps, fruit flies and small moths. According to the post captured behavior and the external morphology of the prey particularly the size and active repercussion which might have been cause of fear to the predator.

The diverse mechanism regarding feeding habit in light of evolutionary significance is note worthy. This might have happen due to the diversity of the morphology of the prey insects. Here the lepidopteran prey was larger in size and about 5 times volume of the spider thus needed extra security and protection for defense and conveniences during feeding (during the sucking action). On the other hand the coleopteran prey was smaller in size and easy manageable thus might not need swathing but more venom injection was also needed three fold time to immobilize than the swathed prey. The development of swathing before feeding is definitely an advancement in feeding behavior by conservation of bimolecule (Less use of venom) towards the savings of biological energy and highly significant.

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AN ACCOUNT SMALL TRAVANCORE FLYING SQUIRREL, *PETINOMYS FUSCOCAPILLUS FUSCOCAPILLUS* (JERDON)

RINA CHAKRABORTY

Zoological Survey of India, 27, J. L. Nehru Road, Kolkata-700 016

e-mail : sujitrinazsi@yahoo.co.in

INTRODUCTION

The flying squirrels (Rodentia : Sciuridae : Petauristinae) are nocturnal gliding mammals, comprising of 43 species under 12 genera of which one species is found in Europe and North Asia, two in North America and all other species are confined to Asia. The species richness reaches its peak in the Southeast Asian countries (Lee and Liao 1998). Thirteen species of flying squirrel (Alfred *et al.* 2002), are so far known from India of which most of the species are concentrated in the stretches of Himalayas, and only two species are found along the Western Ghats. The Small Travancore Flying Squirrel, *Petinomys fuscocapillus fuscocapillus* (Jerdon) is one of them (Prater 1980, Ashraf *et al.* 1993).

There are two subspecies of *Petinomys fuscocapillus* of which nominate subspecies *fuscocapillus* is found in Thiruvananthapuram, Pathanamthitta and Thrissur districts of Kerala (Alfred *et al.* 2002, 2006) while the other race *layardi* is distributed in Sri Lanka (Ellerman 1961). Though 40 species of flying squirrels are distributed in the Oriental region yet there exists a significant gap of knowledge of species distribution and ecology (Lee *et al.* 1986). The Small Travancore Flying Squirrel is one of the least known species among the 13 species of flying squirrels of India and practically there is no detail account of its ecology, behaviour and taxonomy. Some stray works have been carried out by different scientists (Ashraf *et al.* 1993, Kumara and Singh 2005, Kurup 1989, Rajamani (unpublished), Xavier *et al.* 1996, 1998, Zacharias and Bhardwaj 1997). Thus, an attempt has been made here to study the status, ecology, taxonomy and behaviour of *Petinomys fuscocapillus fuscocapillus* (Jerdon).

Key Words : *Small Travancore Flying Squirrel, Kerala.*

PHYSIOGRAPHY

The State Kerala, occupies an area of 38,855 km^2 with a long 550 km coastal line along the southwestern extremity of Peninsular India. It is endowed with the best remaining rain forests in the whole of Peninsular India supporting rich and diverse fauna. Physiographically, the land is divisible into three divisions, the lowlands of coastal areas, undulating midlands of small or medium hills and the highlands occupying forested tracts of southern Western Ghats. Thick rain forests of Western Ghats are now very much destroyed and have become fragmented.

Western Ghats is a 1400 km long chain of hills that runs parallel to the west coast of Peninsular India from river Tapi in the north to Kanyakumari in the south, covering an area of 1,32,606 km^2 which is approximately 4.03% land area of India (Rodgers *et al.* 2000). The Western Ghats stretching over five states *viz.* Kerala, Tamil Nadu, Karnataka, Goa and Maharashtra lies between 8°0' to 12°30' N latitude and 75°0' to 78°30' E longitude.

The hills rise up to an average elevation of 900–1500 m, sometimes rising upto height of more than 2000 m at few places. The southern western slopes receive an average of 2000–6000 mm rainfall, and the same decreases from the north and to the east (Nair 1991).The diversity of rainfall regimes and topography have resulted in a variety of vegetation types in the Western Ghats (Champion and Seth 1968). The region possesses one of the richest biological resources forming a distinct ecological and biogeographical region of India and is considered as an extremely important life supporting system in the Peninsular India.

STUDY AREA

The Small Travancore Flying Squirrel is a denizen of rain forest (Fig. 16) and known so far from the southern most stretches of Western Ghats, so the coastal belt of Kerala was not considered during the field study. The surveys were confined in the low hill forest tracts as well as in adjacent orchards and plantations. Study was carried out in certain protected areas *viz.* Periyar Tiger Reserve, Idukki Wildlife Sanctuary, Salim Ali Bird Sanctuary, Chinnar Wildlife Sanctuary, Silent Valley National Park and Wynad Wildlife Sanctuary as well as along the forest tracts of non protected areas of Pathanamthitta, Kottayam, Idukki, Thrissur (eastern part), Palakkad or Palghat and Wynad districts and in the adjacent plantation areas (Fig. M1).

METHODOLOGY

For assessing the population and abundance of the Small Travancore Flying Squirrel, 10 to 15 plots of approximately covering 500 m^2 area were marked in each selected study area. The plots were selected inside the forest, along the peripheral region of the forest, in plantations adjacent to the forest cover and also in the plantations in the villages. The plots were hypothetically divided

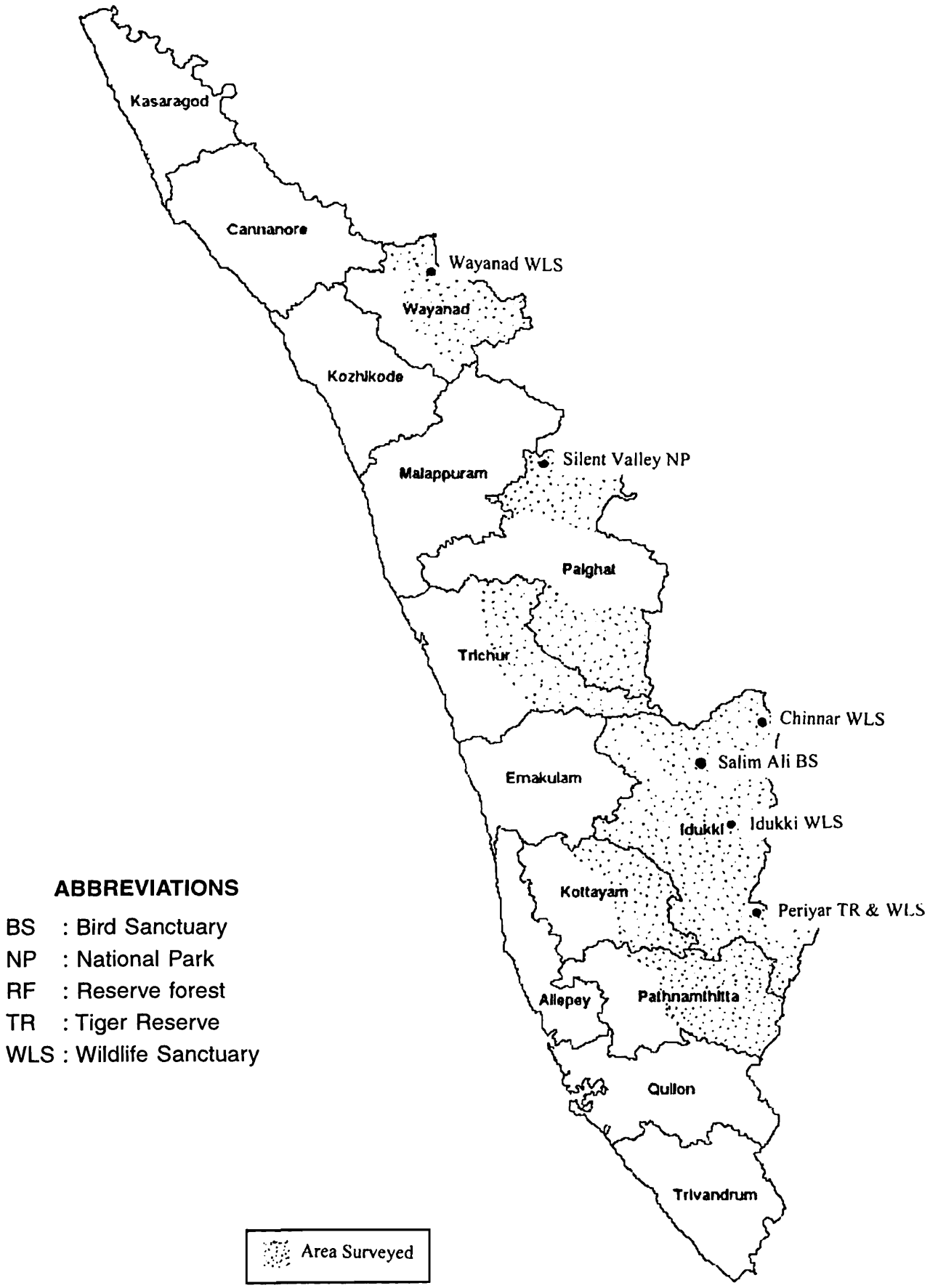

Fig. M1. : Map of Kerala.

into 25 small blocks on two or four different transects in each study area (Chakraborty and Kar 2004). The plots were set randomly according to the area surveyed. But due to certain natural obstacles, it was not possible to study each and every quadrate. In India, line transect (Burnham *et al.* 1974) and vehicle census methods are mostly adapted. But in the dense rain forest, vehicle sensus method is not possible to apply due to obvious reasons. Thus a method, walk (km)/hour was followed through the transects. Apart from the direct sighting other indirect evidences like calls, remains of non-consumed part of the food materials, people's knowledge *etc.* were also considered. As the animal is nocturnal and seldom seen, so before setting up a quadrate, opinion of the local people was also taken into consideration.

For data collection, walk through the accessible quadrates as well as trails was undertaken in every study site approximately between 18.30 to 23.30 hrs. in the evening and 4.30 to 7.30 hrs in the morning. The spotlight was used for locating the animals at night. This method is widely used in the study of other nocturnal arboreal mammals (Lee *et al.* 1993, Goldingay 1990) and has been established as effective in detecting arboreal mammals (Laurence and Laurence 1995). It is very difficult to locate or search this small sized squirrel at night within the dense high canopy forest until or unless it gives calls or glides from one canopy to other. Number of times, hours were spent under the expected roosting trees in the evening for counting the number of animals emerged from the tree holes. The Western Ghats is the home of elephants. During study the elephant corridors were avoided, as the spot lights create much disturbance to the moving heards of the elephants. Sometimes it was difficult to enter into the Protected Areas before and after the usual permissible time. In such cases much emphasis was given on the adjacent reserve forest or fringe areas.

All strata of the canopy were scanned from different angles for searching the presence of the Small Travancore Flying Squirrel. At night there were so many doubtful calls and sounds. Only after confirming the calls of the Small Travancore Flying squirrel, the animal was taken into consideration for the present analysis. For each sighting, following observations were recorded : time of sighting, approximate height at which the animal was detected, height of the tree, tree species *etc.* As the species is very rare to see, its behavioral characteristics were also recorded after confirming its presence. In forest area, number of tall trees ($\pm$20 mts) in each quadrate were counted, even where there was no encounter with the species. But in the plantation area, the trees were planted as per need and hence, counting of trees was not undertaken in such areas. The habitat comparison in between the study areas was also made, wherever it is possible. The sight areas were recorded through GPS.

The status survey was carried out during premonsoon and postmonsoon periods of 2003-2005. In addition to field survey, interactions with local people with some definite questionnaire were carried out.

OBSERVATIONS

The Small Travancore Flying Squirrel was observed only seven times during the two years surveys. It was seen four times in its feeding ground in the plantation areas. During the present survey, first sight record of this squirrel was in Salim Ali Bird Sanctuary during a walk through the trail between 18.30–19.00 hrs, on 19th December, 2003. It was observed to sit silently within the canopy approximately at a height of 15 to 20 mts. The area was within 400 m from the Range office.

On 20th December, 2003 on second occasion, it was observed in the evening at about 20.30 hrs on a very tall (approximately 20–25 m) *Hydnocarpus pentandra* tree (Local name : *marooti*) in a forest near Kotamara village, Idukki district, approximately 5 km east to Salim Ali Bird Sanctuary. It was observed that the Small Travancore Flying Squirrel, roosts in the holes of the said tree, approximately at a height of 15 mts. The fruit of the said tree is a delicacy to them and partly consumed fruit of *H. pentandra* (Figs. 17 & 18) was also found under the tree. It was also observed that, there were numbers of good, tall, old, foliaged *H. pentandra* trees in the reserve forest adjacent to the village but only a single tree was being used by a pair of the Small Travancore Flying Squirrel as their hide. The squirrels were observed to enter into the hole and coming out from the same. But unfortunately on the successive days no trace of these flying squirrels could be noticed. In third occasion the only sighting was occurred at Nemmara, Nelliyampally, Palakkad district, at about 20.15 hrs in a coco plantation on 21st December, 2003.

The fourth individual was observed on 7th May, 2005 at Njayapilly, Idukki district (10° 08' 04" N and 76° 42' 7.21" E) in a coco plantation (Fig. 12) at about 21.00 hrs. It was reported by the local people that the smaller flying squirrel lived in the nearby forest and used to come to the coco plantation when the fruits were ripe and feeds on ripen coco seeds (Figs. 13 & 14).

Fifth individual was seen at Sathrapady, Idukki district at about 21.30 hrs. on 9th May, 2005 in a coco plantation near the forest area. When the spot light was focused, it suddenly jumped from one canopy to other and ultimately was missed in a nearby forest area.

The next incidence of observation of this flying squirrel on 11th May, 2005 at Kallipara forest (10° 08' 46.1" N and 76° 43' 6.18" E), Thattekad Forest Division, Idukki district, at about 21.30 hrs when it was spotted on a *Terminalia paniculata* tree, locally called *anjili*. It was seen feeding on ripen *anjili* (Figs.19 & 20) fruits which is very much alike to small jack fruit or bread fruit. On the same night almost about a kilometer away from the earlier location, another animal was seen in coco plantation adjacent to the forest little late in the night at about 23.00 hrs. It was probably engaged in feeding on ripe coco. When the spot light was focused on it, one partly fed coco fruit was dropped down on the ground and the squirrel was seen to hide behind the canopy. In the same plantation there were nutmeg trees with ripe fruits, which were probably not relished by the squirrel as no damage fruit was observed on the tree even. From coco plantation the animal was seen to move to a nearby rubber plantation and probably very quickly moved to a nearby forest.

Last incidence occurred at Athirampally forest region of Thrissur district, while the survey party was moving through the forest road during evening time. Successive calls of squirrel were heard from the road side trees. But when the canopies searched with spot lights no animal could be identified and rather it is better to say, it hided itself either inside a tree hole or within the canopy.

The observations made by the present author or reported in past from the survey area by scientists, forest personals or local people have been tabulated in Table 1.

Table 1 : Sight record of Small Travancore Flying Squirrel, *Petinomys fuscocapillus fuscocapillus* (Jerdon).

Sl. No.	No. of sighting	Location	Time (hrs.)	Date	Place	Seen(S)/ Reported®/ Collected©
1.	One	Salim Ali Bird Sanctuary, Idukki district	18.30–19.00	19th Dec. 2003	Within canopy (not identified)	S
2.	One	Kotamara village, Idukki district	20.30	20th Dec. 2003	On *H. pentandra*	S
3.	One	Nemmara, Nelliyampally, Palakkad district	20.15	21st Dec. 2003	In coco plantation	S
4.	One	Njayapilly, Idukki district	21.00	7th May 2005	In coco plantation	S
5.	Two	Sathrapady, Idukki district	21.30	9th May 2005 and 22nd March 2005	In coco plantation	S & C
6.	Two	Kallipara forest, Idukki district	21.30 & 23.00	11th May 2005	On *T. paniculata* & coco plantation	S
7.	One	Periyar WLS, Idukki district	–	June 2004	On *H. pentandra* & *M. indica*	R
8.	One	Kokara Beat, Idukki district	–	Sept 2004	–	R
9.	One	Salim Ali Bird Sanctuary	–	–	–	R
10.	One	Ranni Forest Divn. Pathanamthitta Dist.	–	1998	–	R
11.	One	Mepaddy Range, Wynad district	–	1993	–	R

Further, the account given below is based on the observations made by other workers at different times. It was reported by Sreejish, B., a staff of Aranya Nivas of Periyar WLS (09° 34' 52" N & 77° 9' 7.03" E), Idukki district, that the squirrel was last seen in June 2004 on *H. pentandra* and *Magnifera indica* (Fig. 21) trees, when the mango fruits were ripe. It was also reported by the forest personals of Kokara Beat, Thekkady, Idukki district that the squirrel was last observed in September 2004. One specimen was accidentally found on the forest road of Salim Ali Bird Sanctuary, Thattekadu in the year 2003 and kept in a cage in the sanctuary zoo (Fig. 11). The animal was died of starvation within few days as reported by the forest personals.

So far, one specimen (Fig. 6) was collected by Dr. Kurup, ex-scientist of Zoological Survey of India from Venniculum, Pathanamthitta district on 5th May, 1987 and deposited in National Zoological collection of ZSI, Kozhikode, Kerala. It was collected from the crown of a coconut tree while it was roosting within the foliage at about 8.30 am. It was probably an accidental catch. The actual location is approximately 7 km from Sabrimala temple and 24 km away from Ranni forest Division. In the Ranni Forest Division of Pathanamthitta district, it was last seen in 1998 as stated by the forest personals.

The species was also reported from the Munnar-Kuttampuzha of Idukki district (Johnsingh 2001), Munnar, Knacherry Forest, Neriyamangalam Range (10° 07' N & 76° 46' E), Idukki district and Kuttampuzha, Pooyankutty (10° 07" N & 76° 50' E) (Rajamani, unpublished). This squirrel was not observed in Marayoor or Chinnar WLS of the same district during the present survey and there was no previous record also from this region.

Though it was reported from Nemmara, Nelliyampathy of Palakkad district but the species was not found in the Protected Areas surveyed or in Silent Valley National Park and its adjacent areas. It was last reported from Meppady Range, Wynad Forest Division of Wynad district in 1993 by Sri N.K. Sashidharan, the then DFO and another incidence was in 1989, which was reported as subjudice by the forest department. No smaller flying squirrel was observed or reported from the Wynad Wildlife Sanctuary during the current survey of that region.

One specimen was shot and collected by local police in Chalakudy Forest Division and thought it was a strange animal and ultimately handed over to the College of Veterinary and Animal Sciences, Thrissur district for further forensic study (Xavier *et al.* 1998) but the skin was not preserved. Zacharias and Bhardwaj (1997) reported the species from Periyar Tiger Reserve.

It was also reported from the Shendurney WLS, Pepara WLS and Achankovil Reserve Forest (Rajamani, unpublished) but the areas were not surveyed by the present survey party.

BEHAVIOUR

Only once, it was observed that the squirrels came out from their hide late in the evening very silently, moved towards the high canopy and glided to the feeding ground. The animal is very shy

and if not provoked, it is not heard to make any sound. The sound was heard only once from the roosting place in *H. pentandra* tree which was disturbed for observing the squirrel near Kotamara village. It is not sure the call heard at Athirampally was of Small Travancore Flying Squirrel. The call heard at Kotamara was chik-k, chik-k which ended with a grawl. In all the five instances it was noticed that the animal prefers to live in the forests with a good number of old *H. pentandra* trees. It was only seen to come out from the hide for feeding in the nearby plantation or inside the forest. In the dark night it is really difficult to locate and identify the squirrel in the thick canopy of Rain Forest even after searching with the help of a good search light. Except once, during the walk through the forest tracks either at dawn or dusk no sign of the smaller flying squirrel was observed. It is comparatively easy to locate in the moonlit night when it glides from one canopy to other. While gliding, it's size is little bigger than a full plate which tapers towards posterior end with rather flat tail may be the only identifying character in the field. It can float in the air for more distance, than that of a larger flying squirrel of the same region. When observed within the canopy, it's round, dark, bright eyes and chestnut tinge of fur may be the only sign of its presence.

It was observed that during feeding it holds the fruit with the forehands and make hole in the middle of the fruit (Figs.14 & 15) and take out the seeds. It is capable of taking seed without detaching (Fig. 15) the fruit from the stalk. As per present observation, the most preferred food of this squirrel is fruit of *H. pentandra* (Fig. 17) in wild and coco and mango in plantation (Figs. 13, 15, 21). Other than these, it takes fruits of *Artocarpus hirsutus, Syzygium cumini, Grewia tillifolia, Ziziphus rugosa, Pisidium guajava, Lantana camara, Caryca arborea and Olea dioiea* (Xavier *et al.* 1996) and also flowers and barks of certain other plants. It also takes fruits of *Anjili* (Figs. 19 & 20). It is also reported by the local people that it also consumes fruits of Mangostin and Rumbestem. Nothing is known about its reproductive biology except a report that female gives birth to two youngs (Alfred *et al.* 2006).

TAXONOMY

Genus ***Petinomys*** Thomas

1908. *Petinomys* Thomas, *Ann. Mag. Nat. Hist.*, **1** : 6.

1847. *Sciuropterus fuscocapillus* Jerdon in Blyth, *J. Asiat. Soc. Beng.*, **16** : 867.

1850. *Sciuropterus layardi* Kelaart, *J. Ceylon Br. Asiat. Soc.*, **2** : 215 (328 of 1887 reprint)–Ceylon Race.

Key to the races of *Petinomys fuscocapillus*

1(2). Cheeks and sides of belly white ..... *P. f. fuscocapillus*

2(1). Cheeks and belly gray ..... *P. f. layardi*

N. B. : Wroughton (1915) stated 'The type of *layardi* Kelaart is in the National collection-the type of *fuscocapillus* is apparently lost, and the only thing I have to represent is a mutilated flat skin collected by Mr. Bourdillon in Travancore. Kelaart in his description of *layardi* says "beneath gray" while Blyth writes of *fuscocapillus* "underparts rufous white extending to the cheeks and under-lip, the lateral fur margining the membrane rufofulvous" (Ellerman 1961).

Only three damaged skins of *P. f. fuscocapillus* are present in different museums of the world. The specimen present in the Natural History Museum, London, U.K. is presumably, the one collected by Bourdillon from Travancore (Wroughton 1915). Hutton (1949) included the subspecies in his account of the mammals of high wavy mountains in Madurai district, Tamil Nadu. It is now understood, the Bombay Natural History Society has one specimen collected by him, whose locality labeled merely as Travancore (Kurup 1989). The third specimen was collected by Kurup in 1987 from Vennikulum (76° 37' E and 9° 23' N), Pathanamthitta district, Kerala.

Other than the above mentioned three specimens (flat skin) one stuffed specimen is present in Thekkady Nature Education and Interpretation Centre, Periyar WLS and another in Zoological Survey of India, Kolkata.

Description of the Holotype (after Jerdon 1847)

Petinomys fuscocapillus (Jerdon, 1847)

1847. *Sciuropterus fuscocapillus* Jerdon in Blyth, *J. Asiat. Soc. Beng.*, **16** : 867.

"This is an undescribed species, from S. India, a notice of which may be introduced here : Length 7½" (190.5 mm), of tail (vertebrae) 6" (152 mm), the hair reaching 3/4" (19 mm) further; fore-foot proportionally large, measuring with claws $1\frac{1}{8}$" (28.5 mm); hind feet wanting in the only specimen examined. Ears small, and almost wholly naked, of an ovate form, and measuring ½" (13 mm) long posteriorly. Tail very bushy, and but indistinctly distichous. Moustaches long and black. Fur rather long (the hairs measuring fully 3/4" on the back), porrect, of extremely fine texture, the individual piles sinuous, and those of the upper parts fuscous to near the tips, which are of a rufescent-fulvous hue, or dark brownish-isabelline, forming the surface colour; on the croup the fur is shorter and more dense; and upon the head it is much shorter, and the basal dusky hue predominates over the grayish brown tips; above the volar membrane also the blackish hue is chiefly apparent. Under-parts rufous-white, extending to the cheeks and under-lip; the lateral fur margining the membrane rufo-fulvous. The hairs of the tail measure 1" (25.4 mm) and upwards, for its basal half or more, becoming gradually rather shorter towards the tip; their colour pale at base, then darker, producing an *ensemble* nearly of the colour of the back; but underneath, the tail is fuscous or blackish-brown, and the extreme tip is whitish."

Description of the specimen present in
Thekkady Nature Education and Interpretation Centre
(Figs. 1 & 2)

Specimen : Stuffed (Damaged).

Locality : Periyar Wildlife Sanctuary.

Colour : Head cinnamon-brown, hairs speckled with white at tip; ears small, roundish; whiskers black; neck same as head but little darker; back cinnamon-brown speckled with black; a dark ashy-grey patch on rump; sides of the patagium blackish-brown or dark, the inner side (attached with body) of the patagium cinnamon-brown speckled with black hair tip; the colour of the lower legs nearer to rump area is little darker than rump; proximal $\frac{1}{3}$ of tail is creamy buff (may be due to shading of top hairs) and the rest is light cinnamon-brown; a central black line under the tail; underparts yellowish white or creamy buff; underparts of patagium light cinnamon; patagium not extended beyond hind leg.

Measurements : (Taken from dry stuffed specimen) HB : ±323 mm; TL : ±270 mm; HF : ±40 mm; E : ±15 mm. Maximum length of whiskers 52 mm; free tip of tail 17 mm.

Details of the specimens present in the Zoological Survey of India, Kozhikode, Kerala
(Figs. 6, 7 & 8)

Specimen : Skin (Damaged), skull attached with the skin.

Locality : Venniculum, Pathanamthitta district, Kerala (9°23' N and 76°37' E).

Date of collection : 05.05.1987.

Sex : Female.

Colour : Reddish brown; tail, little lighter than body.

Measurements : HB 280 mm; TL 240 mm; Skull 50.1 mm; Diastema 9 mm; Length of tooth row 8 mm; Bullae 8 mm (Not much flattened).

Description of a specimen after Xavier *et al.* (1996)

Colour : Dorsum dark brown, tail long and bushy, lighter in shade; eyes large and round; whiskers dark in colour; parachute translucent having a brown hair cover.

Sex : Female.

Measurements : Total length 530 mm (from head to tail tip); TL : 270 mm; tip of nostril to base of ear 40 mm; width of forehead 40 mm; length of parachute 300 mm; width of parachute near forelimb 125 m and near hindlimb 100 mm.

Remark : Skin not preserved.

Description of a specimen present in the Bombay Natural History Society

(Figs. 4 & 5)

Specimen : Skin (Damaged) : Reg. No. 7106; Collector : A.F. Hutton.

Locality : Travancore.

Colour : Dorsal rufous brown; head and sides of body rather dark; tail lighter; cheek and throat light yellow or whitish yellow; hind foot damaged.

Remark : Kurup (1989) stated that the specimen was from high wavy mountains of Madurai district, Tamil Nadu.

N.B. : Description based on a photograph received from BNHS by courtesy.

Description of a specimen present in the Natural History Museum, London, U.K.

(Fig. 3)

BM(NH) 1880.8.23. 1 skin, Travancore, Collector-F.W. Bourdillon.

Colour : Dorsal rufous brown; sides of the body dark; right hindfoot wanting; tail damaged, except a little proximal part distal part wanting.

N.B. : Based on a photograph received from BM(NH) by courtesy.

Description of a specimen present in Zoological Survey of India, Kolkata

(Figs. 9 & 10)

The specimen was received from Dr. R. Sugathan for depositing in the National zoological collection of ZSI, Kolkata. As the report received, the specimen was collected dead and damaged during forest fire from Sathrapady on 22.03.2005.

Measurements : Measurements were taken from a dry, stuffed specimen. HB : ± 185 mm; Tail, wanting; HF : ±35 mm; E : ± 12 mm, roundish and naked.

Colour : Almost same as the specimen present in the Nature Education and Interpretation Centre of Thekkady. Upperparts more grayish with rufous wash; a dark ashy grey patch is present on the back just above the tail; underparts whitish extending up to cheeks; sides of the patagium dark.

Remark : Likely to be sub-adult.

ABBREVIATIONS : HB. Head and body length; TL. Tail length; E. Ear length; HF. Hind foot length.

RESULT AND DISCUSSION

There are eight species of the genus *Petinomys* (Walker *et al.*1983) distributed throughout the southeastern Asia of which only *P. fuscocapillus* is distributed in Sri Lanka and southern part of

Western Ghats. Among the two subspecies only the nominate subspecies *fuscocapillus* is distributed in certain pockets like Anamalais, Chalakudy Forest Division, Periyar Tiger Reserve (Zacharias and Bhardwaj 1997), Pathanamthitta district (Kurup 1989), Shendurney WLS and Achankovil RF (Rajamani, unpublished), Peppara WLS, Srivilliputhur, Kodayar, Peechi (Molur and Walker 1998) of southern Western Ghats of India. Other than these the species is reported from certain parts of Idukki, Palakkad, Wynad, Thrissur and Kollam districts also. Kumara and Singh (2005) reported the species from Karnataka. Menon (2003) mentioned that the species is found along the Western Ghats of Tamil Nadu, Kerala, Karnataka and possibly Goa but so far no such authentic record is available from Goa. As per direct and indirect evidence this smaller flying squirrel is distributed only in certain pockets and the population is so thin and fragmented, that the animal is seldom seen.

The species is an inhabitant of moist-deciduous, semi-evergreen and evergreen forests (Molur and Walker 1998). However, present study reveals that it prefers to live in the peripheral region of the forest from where it usually comes out at night to the neighbouring orchards or plantation for feeding. In fact, it was never met in the dense forest during the study period, though in the Indira Gandhi National Park of Tamil Nadu and Periyar Tiger Reserve, it is reported to live in the dense forest area (Kumar *et al.* 2002; Zacharias and Bhardwaj 1997). Xavier *et al.* (1996) also reported the species from a village adjacent to Vazhachal Forest Division of Thrissur district, Kerala. Probably that was the first record of this species from central Kerala between 70° 10' and 76° 40' E and 10° 15' and 10° 30' N. Kurup (1989) also collected one specimen (Fig. 6) far from the Ranni Forest Division from a coconut plantation. One specimen (Fig. 11) was accidentally collected from the forest road of Salim Ali Bird Sanctuary of Thattekad by the forest staff and kept in the zoo of the same sanctuary. It was reported that, the specimen died due to starvation and shock. The skin and skull of the specimen was not preserved. The specimen collected from Sathrapady was also from a rubber plantation. From the history of the collection of this smaller Flying Squirrel, it is clear that the catches reported so far are accidental.

It was noticed that the dorsal colouration of the preserved specimens present in BNHS, BM(NH) and ZSI, Kozhikode are more rufous than the specimens of the Thekkady, Thattekad and ZSI, Kolkata. It may be due to seasonal and/or age variation. At the same time ashy rump patch is not clear in three individuals (Figs. 3, 4, 6) but whitish venter and cheeks are predominant in all the specimens.

On every night a walk of approximately 2-4 km was undertaken at the rate of 0.5-1.2 km/hour both through the quadrates in forest and plantation as well as through the forest trails. Though quadrate was tried for population study yet in practice this method was not found to be useful. From the study, it reveals that, distribution of the species even in a selected forest area is more patchy than other arboreal rodents and, thus at the time of population estimation most of the quadrates were found to be without any individual and resulted nil. Moreover, the animal was never seen twice in the same site.

Call of the squirrel is not uncommon in the forests of Western Ghats but call of the Small Travancore Flying Squirrel was heard and identified only once in Kotamara village. However, successive attempts to record or confirm the calls failed. It is obvious that it sounds very rarely and at the same time the population is also very thin which ultimately prevented for catching the call of the animal to be identified independently.

It was also attempted to collect and identify the non-consumed food parts of the smaller flying squirrel during day time. As the food items may be shared by other squirrels like *Petaurista, Ratufa etc.*, the same could not be detected for this species. Only some damaged fruits was under the roosting or feeding trees were collected (Figs. 13-15, 17-21), during its feeding time at night and identified.

Except one *H. pentandra* tree in Kotamara village, no other tree was identified as its roosting tree and at the same time sighting of emergence of two individuals was experienced only once. Time of sighting was usually in between 20.00 to 23.00 hrs. except once in Salim Ali Bird Sanctuary, where it commenced at dusk. It was never mate with during dawn. In wild, preference for the tree species of this flying squirrel was mostly identified as *H. pentandra* and the animal was observed mostly in plantation of coco. Hence, preference towards other wild plants was not studied. In the typical forest, there were at least 10-15 large trees in each smaller quadrate of which any one might be the roosting tree for that squirrel. As the squirrel was seen only once in a tree hole of *H. pentandra* tree, thus, it is not wise to conclude anything about its roosting preference.

The presence of the species was confirmed both by direct sighting and indirect evidence. Practically, information received from the local people was more fruitful than any other indirect evidence. Except one from Palakkad, in the present study all the sighting records were from Idukki district only (Table 1). There was no sighting record from the other districts except a very recent record by Rajamani (unpublished). Moreover, there was no report of regular sighting of this species from any area.

The main threat of survival of this species is habitat loss and fragmented distribution. Probably the pressure of persecution by local people is minimum and at the same time less important in trade due to its smaller size, very soft skin and rarity.

The status of *Petinomys fuscocapillus* as per IUCN (2006) is LR/lc. However, after the present study of *P. fuscocapillus fuscocapillus*, it is hereby suggested to include the Indian sub-species in 'Vulnerable' category as it was proposed earlier in 1998 and 2000 based on the IUCN version 2.3 (1994). This species is already protected under Indian Wildlife (Protection) Act. 1972 (as ammended upto 2004) in Schedule I, Part I. Moreover, according to Red Data Book (1994) the status of the Indian race has been declared as 'Endangered'

SUMMARY

The Small Travancore Flying Squirrel, *Petinomys fuscocapillus fuscocapillus* (Jerdon) is distributed only in the southern region of Western Ghats. The study reveals that, the population of this smaller flying squirrel is very thin. As per sight record, the population density of the species is rather better in Idukki district than other districts of Kerala. It is fond of fruits of *Hydnocarpus pentandra*, (local name *: marooti*), *Terminalia paniculata* (local name : *anjili*), coco, mango *etc.* The status of the Indian sub-species may be recommended here as 'Vulnerable'

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Web site : http://www.iucnredlist.org

PLATE I

Fig. 1 : Specimen in Thekkady NEI Centre (Dorsal view).

Fig. 2 : Specimen in Thekkady NEI Centre (Ventral View).

PLATE II

Fig. 3 : Specimen in BM(NH) (By Courtesy, The Natural History Museum, U.K., London).

PLATE III

Fig. 4 : Specimen in BNHS (By Courtesy, The Bombay Natural History Society, Mumbai).

PLATE IV

Fig. 5 : Specimen in BNHS (By courtesy, The Bombay Natural History Society, Mumbai).

PLATE V

Fig. 6 : Specimen in ZSI, Kozhikode, Kerala (Dorsal view).

Fig. 7 : Specimen in ZSI, Kozhikode, Kerala (Ventral view of skull).

Fig. 8 : Specimen in ZSI, Kozhikode, Kerala (Lower jaw).

PLATE VI

Fig. 9 : Specimen in ZSI, Kolkata (Dorsal view).

Fig. 10 : Specimen in ZSI, Kolkata (Ventral View).

PLATE VII

Fig. 11 : Specimen in the zoo of Thattekad WLS (By courtesy, Sri K.K. Swan, Asst. Wildlife Warden, Thattekad Bird Sanctuary, Kerala).

PLATE VIII

Fig. 12 : Survey party in a coco plantation at Njayapilly.

PLATE IX

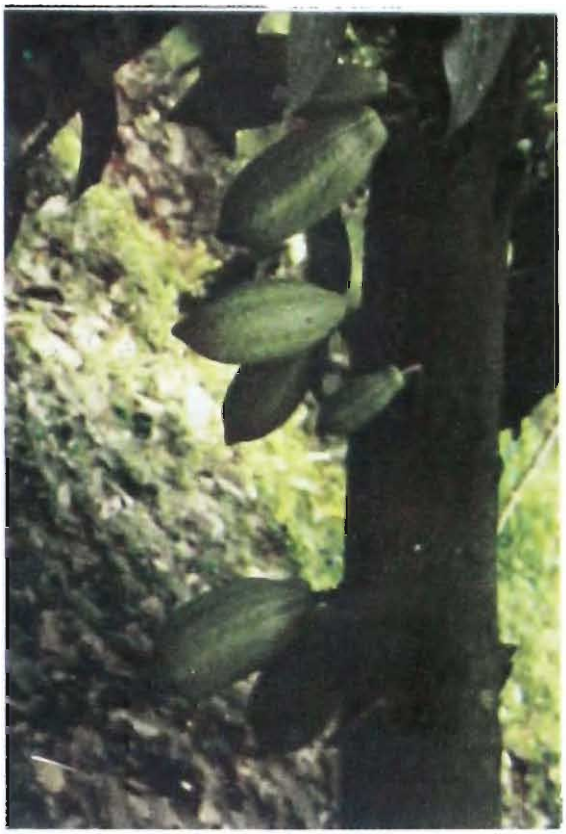

Fig. 13 : Mature coco fruits in coco plantation.

Fig. 14 : Fully damaged coco fruit.

PLATE X

Fig. 15 : Damaged coco fruit hanging on the stem.

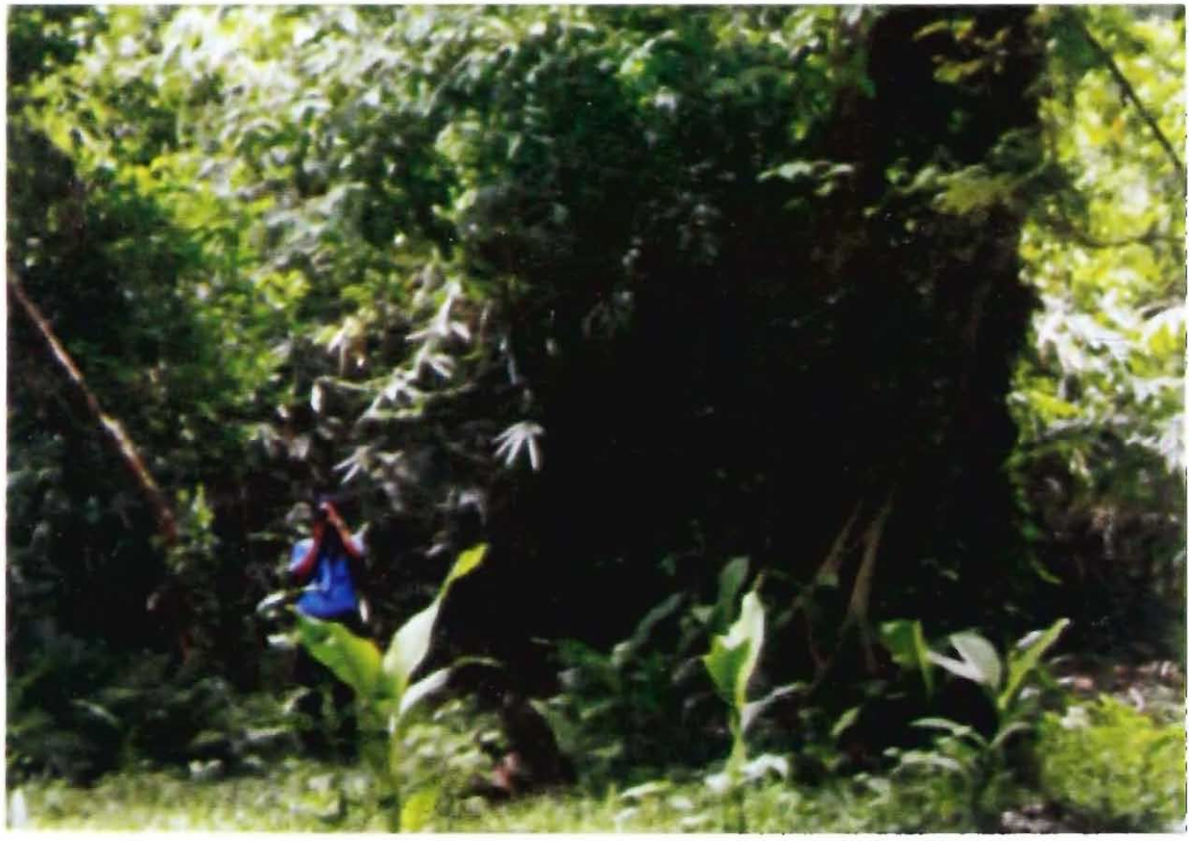

Fig. 16 : Ideal habitat of *P. f. fuscocapillus* at S.A. Bird Sanctuary.

PLATE XI

Fig. 17 : Fruit of *H. Pentandra.*

Fig. 18 : Damaged fruit of *H. Pentandra.*

PLATE XII

Fig. 19 : Fruit and seeds of *Terminalia paniculata.*

Fig. 20 : Damaged fruit of *Terminalia paniculata.*

Fig. 21 : Damaged fruit of *Magnifera indica* with epicarp.

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STUDIES ON EARTHWORM POPULATION IN SALINE AND NON-SALINE SOILS OF MIDNAPORE AND BARDDHAMAN DISTRICTS OF WEST BENGAL

R. N. SHARMA, J. K. MAZUMDER, G. C. DE AND C. K. MANDAL
Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

INTRODUCTION

Earthworms are found in all types of soil provided there is sufficient moisture and food. Organic materials like municipal dumps, cow dung dumps, forest litter, humus and kitchen drainage are attractive sites to some species. They are much less frequent in acidic soil. The feeding activities of these soil inhabiting worms have a considerable effect on the fertility of the soil. Burrowing earthworm species transport a huge quantities of organic materials from the soil surface to deeper parts of the soil profile through their burrows and thus play a profound role in agriculture and crop productivity.

Several research works in the form of review papers, books and monographs have been published by the European workers like Satchell (1967), Edwards and Lofty (1972), Bouche (1972), Atlavinyte (1975) and Lavelle (1978). In India Ali *et al.*, (1973), Dash *et al.*, (1974), Dash and Patra (1977) are the pioneer workers who studied the earthworm dynamics in grassland ecosystem. Several papers have been published on seasonal activity, population density and biomass of earthworms in many Indian ecosystem by Kale and Krishnamoorthy (1978 a & b), Senapati *et al.*, (1979), Dash and Senapati (1980, 1986, 1991), Chouhan (1980), Sahu and Senapati (1986), Pani (1987), Julka and Senapati (1987), Krishnamoorthy and Ramchandra (1988), Sahu *et al.*, (1988), Ismail *et al.*, (1990). But no works have been done on the population dynamics of earthworm in different soil types. So the present work was undertaken to acertain the population structure of earthworm in alluvial soil of Barddhaman district and coastal soil of Midnapore district, West Bengal.

MATERIALS AND METHODS

The present study was under taken during June 2003 to January 2006 and the collections were made in 10 different localities of Barddhaman and Midnapore districts of West Bengal. The

collection of earthworm was made by digging soil with spade. For the comprehensive survey, the earthworms were collected from different ecological niches like paddy field, understraw stack, near cow dung stack and from grassy fields. For the collection and counting of the earthworm one m^2 plot was selected in a 10 m^2 plot and was digged with a spade and the earthworms were sorted out. From a 10 m^2 plot the average number of five one m^2 plot was taken. Collected specimens were narcotized and fixed in 70% alcohol or 4% formaline solution for taxonomic studies using a hand lens and by dissecting the specimens.

Apart from the collection of earthworms from soil, the soil samples of the collection sites were also analysed to determine the pH and soil moisture. The soil temperature was also recorded in the field by inserting a soil thermometer in the soil.

RESULT AND DISCUSSION

The seasonal average population along with edaphic factors of different habitat types in alluvial soil of Barddhaman district and in saline coastal soils of Midnapore district is presented in Table 1. It has been observed that the range of soil temperature in different seasons in both the districts were more or less same varying from 30°C to 33°C in summer, 28°C to 31°C in monsson and 20°C to 24°C in winter (Table 1). As regards the moisture contents of the soil it was found that in summer the moisture content was high in the coastal soil (7.8% to 17.5%) than the alluvial one (3.8% to 8.5%) and in winter and monsoon it was slightly high (13% to 22%, 19.8% to 26.2%) in alluvial soil than the coastal soil (7.2% to 19.2%, 14.6% to 22.7%). In both the districts the soil was acidic in nature.

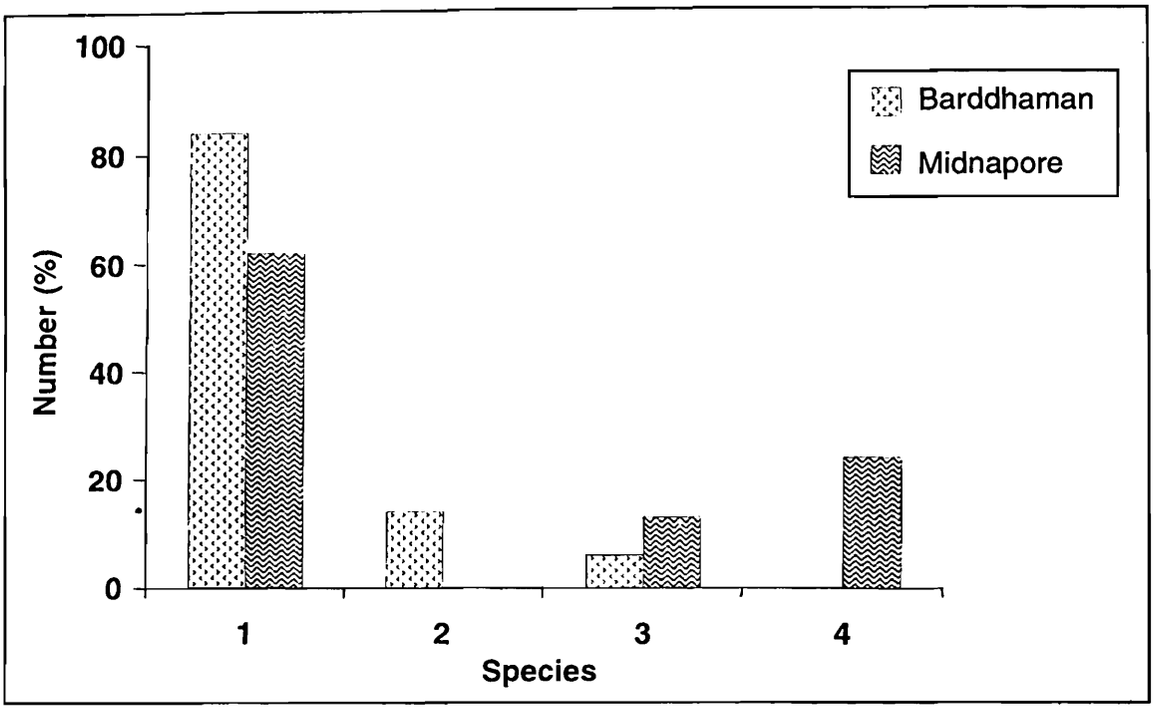
Table 1. : Shows the different edaphic factors, vegetation and average earthworm population in different seasons of the collecting spots in Barddhaman and Midnapore districts.

District	Season	Soil temperature (Range)	Soil moisture (Range)	Soil pH (Range)	Vegetation	Average population
Barddhaman	Summer	30°C–33°C	3.8%–8.5%	5.25–5.45	Rotton straw Grass	54.7 45.6
Midnapore	Summer	30°C–33°C	7.8%–17.5%	6.3–7.42	Grass	26.5
Barddhaman	Monsoon	28°C–31°C	19.8%–26.2%	5.25–5.45	Rotton straw Grass	31.3 51.5
Midnapore	Monsoon	28°C–31°C	14.6%–27.2%	6.3–7.42	Grass	34.7
Barddhaman	Winter	20°C–24°C	13%–22%	5.25–5.45	Rotton straw Grass	33.5 25
Midnapore	Winter	20°C–24°C	7.2%–19.2%	6.3–7.42	Grass	31.3

The collections of the earthworm were mainly made from the uncultivated land, paddy field after harvest, under straw hips and from the boarder line of the paddy fields. As regards the total population it was observed that under the straw hips the earthworm population was higher in summer than in the grassy field of Barddhaman district. In the grassy field the average earthworm population was higher in the soil of Barddhaman district than that of Midnapore district (Table 1). In Barddhaman district the grassland population was much higher. In monsoon low population under straw hips may be due to low porocity and bad drainage of the soil which was apparently better in the grassyfield than the earthworm population of under the straw hips and also from the grassland population of Midnapore district in monsoon. In winter the grassland population was lower than the population of straw hips in Barddhaman district while in Midnapore district the grassland population was higher than the grassland population of Barddhaman district but it was lower than that of under straw hips of Barddhaman district. Some collections had also been made from the cultivated paddy field after harvesting the paddy and it was found that in summer not only the population was very poor but also the population migrated vertically below one ft. from the surface and at the same time the earthworms were found in the upper surface in the adjacent grassland in the border line of the paddy field.

Seven species of earthworm have been identified from the collection sites namely, *Lampito mauritii, Perionyx excavatus, Polypheretima elongata, Metaphire posthuma, Drawida nepalensis, Eutyphoeus orientalis* and *Glyphidrilus tuberosus*. These species occurred in different frequency in different seasons and in both the districts. Among the seven species four species namely *Lampito mauritii, Polypheritima elongata, Perionyx excavatus* and *Metaphire posthuma* were very frequent in occurrence in three collecting samples. Of the four frequently occurring species *Lampito mauritii* showed dominance in both the districts in summer, occupying 84% and 62% of the total population in Barddhaman and Midnapore districts respectively (Fig. 1). As regards the frequency of this species it occurred in every habitat type in every seasons in the Barddhaman district, while in Midnapore district, it was present in 50% to 90% sampling plots in different seasons. In Midnapore district *Metaphire posthuma* showed the dominance, occupying about 48% and 47% of the total population in monsoon and winter seasons respectively and the *Lampito mauritii* occuyping the second position. *Perionyx excavatus* occurred in both the districts but very few in numbers and the *Polypheritima elongata* was not found in Midnapore district but it was occupying the second position in Barddhaman district and occurring in 12%, 23% and 19% of total population in summer, monsoon and winter seasons respectively. Higher population of earthworms under straw hips in summer than the grassland in Barddhaman district was due to low soil temperature and unexposed condition of the soil to the direct sunlight which enable the soil to keep more moisture than that of the grassyfield and the winter also showed the same trend. In the monsoon low population under straw hips may be due to the low porosity and bad drainage of the soil which was apparently better in the grassyfield (Raw, 1967).

The higher population of the grassland soil in Barddhaman district than that of the Midnapore district might be due to the salinity of the soil as the collection was made in the coastal region. Low population in the upper layer of the paddy field may probably be due to the effect of the different agricultural practices for the cultivation and the earthworms were migrated to the lower layer to avoid the hazards (Satchell, 1967; Hunter, 1966; Wallwork, 1970).



A = *Lampito mouritii*, B = *Polypheritima elongata*, C = *Perionyx excavatus*, D = *Metaphire posthuma*

Fig. 1. : Relative abundance of four species of earthworm in Barddhaman and Midnapore districts in summer

SUMMARY

1. The earthworm populations of saline and non-saline (alluvial) soil of Midnapore and Barddhaman districts were studied based on seasonal surveys from cultivated and uncultivated grassland.
2. Seven species were found in different frequency in different seasons in both the districts.
3. Among the seven species namely *Lampito mauritii, Perionyx excavatus, Polypheretima elongata, Metaphire posthuma, Drawida nepalensis, Eutyphoeus orientalis* and *Glyphidrilus tuberosus* the species *Lampito mauritii* showed the dominance.

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ROTATORIAN FAUNA AS INDICATOR OF TROPHY IN ADRA LAKE, PURULIA DISTRICT, WEST BENGAL, INDIA

S. V. A. CHANDRASEKHAR AND S. Z. SIDDIQI*

Freshwater Biological Station, Zoological Survey of India, Plot 366/1, Attapur (V), Ring Road, Hyderguda P.O., Hyderabad-500 020

INTRODUCTION

Adra lake (also known as Saheb Bandh), is a relatively small, oligotrophic raw water reservoir (*Ca.* 2.5 ha.) located at about 5 km north of Adra, a railway town in Purulia district, West Bengal [latitude 23°42'N and longitude 87°01'E]. Detailed limnological investigations were initiated covering three main seasons between October, 1995–April, 1996, to assess/evaluate its raw water characteristics and *trophic* status. Pending in depth analysis of the physico-chemical *milieu* and inorganic plant nutrients [various forms of Phosphorus (P) and Nitrogen (N)] in lake's ecology, the rotifer component of the net zooplankton in the lake were identified, for possible biological evaluation of its ecological status. In past, occurrence/abundance of rotifer population and their distribution have been successfully used as indicator of lake's trophy (Sladecek, 1983 and Kuezensky 1987). Nearer home, Arora, 1966, Chaurasia and Adoni, 1987 and Sharma and Dudani, 1992 have used presence of these organisms as ecological indicators.

Further to listing the overall species composition of rotifer community in the lake, observations have been made on ecological indicator values of the respective taxa as indicator of environment. Of the ten species reported hereunder, genus *Keratella* predominates the rotifer population though its two species *viz.*, *K. quadrata* (Muller, 1788) and *K. cochlearis* (Gosse, 1851) and the species rich genus *Lecane* represented by three species.

Rotifer fauna of West Bengal, save for some pioneering studies by Anderson, 1989 and later exhaustive studies by Sharma, 1998, have otherwise failed to attract much scientific attention as ecological indicators of lakes environment. Therefore this humble attempt to document rotifer fauna in the oligotrophic lake as an indicator of ecological status. Present study records ten species

**Estuarine Biological Station, Zoological Survey of India, Gopalpur-on-Sea-761 002, (Ganjam, Orissa).*

under six genera, quite a few of which serve as good biological indicator of lakes oligotrophic status, including few transitional forms (Table-I).

MATERIAL AND METHODS

The relatively small raw water reservoir (*Ca.* 2.0 ha.) caters to the potable water needs of the railway township, Headquarters of Adra Railway Division on the South-Eastern Railways. A masonary wall bandh with a pucca road on it separates the reservoir upstream from the filter beds and pump house below. An irregular shaped lake and its water spread area is otherwise surrounded by fields and small forest on western, northern and north-western edges/sides. Over five limnologically sampling sites where selected for random sampling of plankton/other wetland fauna.

Plankton samples were collected in addition to subsurface samples of lakes waters using plankton net (No. 25) with a 50 ml capacity plastic container tied at its end, on the sub-surface waters during the course of limnological studies in October, 1995 and April, 1996. Samples were preserved in 4% formaldehyde solution, were deposited in the National Zoological Collections of Freshwater Biological Station, Zoological Survey of India, Hyderabad after registration (Nos. FBS/ZSI/4417 to 4440, 4443 to 4461 and 4491 to 4504). The rotifer fauna was identified using standard taxonomic manual (Smith, 2001) and other Indian literature (Battish, 1992 and Dhanapathi, 2000).

DISCUSSION

The plankton community in relatively small oligotrophic, Adra lake plays host to a wide array of zooplankton communities *viz.*, Cladocera, Rotifera, Copepoda and Ostracoda *etc.* of which cladocera predominates, both in terms species and numbers, followed by rotifera, in the stated order of abundance. Of the Rotifers, the ubiquitous Lecanid genera is represented by three species while the other equally cosmopolitan Brachionid genera is represented by a single species—*B. patulus*, and *Keratella* by two species *viz., K. quadrata* and *K. cochlearis,* the former predominating the later in terms of species number and abundance. A brief taxonomic account of the ten rotifer species encountered, with ecological notes is furnished in tabulated form (Table 1). A categorical number of the taxa, over two three species, inhabit oligotrophic, often acidic waters (acidophilic).

In view of established ecological criterion of the ubiquitous genus *Brachionus* and its few cosmopolitan species as eutrophic forms and that of the genus, *Trchocerca* as indicator of purely oligotrophic waters, an interesting ratio of the two genera *viz., Brachionus, Trichocerca* quotient or Q = *Brachionus* spp. / *Trichocerca* spp. (Sladecek, 1983) has been used for biological evaluation of lakes trophic status. Sladecek's quotient revealed a value of 0.5 and corroborates the oligotrophic status of Adra raw water reservoir.

Table 1. Listing over all species composition of rotifers in the zooplankton community in Adra lake. Sladecek, 1983 quantitative quotient Q = B/T using the presence of number of species of *Brachionus* to number of species of *Trichocerca* indicates oligotrophic status.

ROTIFERA / EUROTATORIA / MONOGONONTA / PLOIMIDA
Brachionidae Wisenberg-Lund 1851. 1. *Brachionus* Pallas 1766 *Brachionus patulus* (Muller, 1776). Lorica length 0.135-0.15; maximum width 0.11-0.13; antero-lateral spine 0.03-0.04; antero-median spine 0.029-0.04; postero-lateral spine; 0.05-0.06; postero-median spine 0.015-0.016; postero-intermediate spine 0.01-0.015 mm. Commonly occurring, ubiquitous, transitional species. Invariably inhabits acidic waters (acidophilus).
Keratella Bory de Vincent, 1822 (a) *Keratella cochlearis* (Gosse, 1851) Lorica length 0.1-0.13; Maximum width 0.66-0.7; anterior spine 0.012-0.014; posterior spine 0.055-0.06 mm. Commonly observed in eutrophic, soft and often acidic waters or waters with neutral pH (< > 7). (b) *K. quadrata* (Muller, 1786) Lorica length 0.18-0.2; maximum width : 0.085-0.09; Posterior spine 0.057-0.06 mm.
Mytilinidae Bortos, 1969. 3. *Mytilina* Bory de., Vincent, 1826 *Mytilina ventralis ventralis* (Ehrenberg, 1832), Lorica length 0.38-0.4; maximum width 0.22-0.25; toes 0.084-0.088 mm. Relatively uncommon, but widely, distributed in oligo-meso-eutrophic lake series. A transitional form, restricted to clean, clear waters.
Lecanidae Bartos 1959 4. *Lecane* Nitzsch, 1827 (a) *Lecane bulla* (Gosse, 1851), Lorica length 0.16-0.18; maximum width 0.075-0.085, toe 0.04-0.048 mm. Cosmopolitan, ubiquitous in all types of waters but less abundant, (b) *L. hamata* (Stokes, 1896), Lorica length 0.12-0.145; maximum width 0.057-0.07; toe length 0.05-0.06 mm. Commonly observed, transitional form, occurring in both nutrient poor to nutrient rich or polluted waters. © *L. lunaris* (Ehrenberg, 1832), Lorica length 0.065-0.075; maximum width 0.045-0.06; toe length 0.04-0.05 mm. Ubiquitous, most commonly occurring, littoral species, inhabits both oligo-and eutrophic waters.
Trichocercidae Remane, 1933, *Trichocerca* (Lamarck, 1801). Sub-genus : *Trichocerca (Diurella)* Bory de St. Vincent, 1824 *(a) Trichocerca (Diurella) similes* (Wierzejski, 1893), Lorica length 0.15-0.2, right toe 0.065-0.075; left toe 0.046-0.055 mm. Cosmopolitan but less commonly occurring, prefers purely oligotrophic, clean, clear waters. Sub-genus *Trichocerca (Trichocerca)* Lamarck, 1801. (b) *Trichocerca (Trichocerca) pusilla* (Lauterborn, 1898), Lorica length 0.2-0.25, body width : 0.1-0.15, left toe 0.15-0.16, right toe 0.075-0.08 mm., Less commonly observed/distributed, prefers clear, clean oligotrophic, nutrient poor waters.
Gastropidae Remane, 1933. *Ascomorpha* Perty, 1850. *A. ovalis* (Bergendal, 1892), Lorica length : 0.57-0.6 mm., Less commonly observed, rather rare in nutrient rich meso-trophic waters, inhabits oligotrophic waters.

SUMMARY

Limnologic investigations, including range of pH values (6.8-7.0), high Sacchi disc transparency, extremely low turbidity and nutrients various forms-Phosphates and Nitrates, initiated on a relatively small raw water reservoir *ca* 2.5 *ha.*, as also associated lacustrine fauna-littroral, planktonic, neuston and nekton, predominantly fishes and crustacean decapods (prawns) revealed oligotrophic nature of the lake. Of the various zooplankton groups, rotifers in view of their ubiquitous nature, and wide use as indicator of environment were taken up for identification. 10 species, including a few transitional forms, serve as categorical indicator of oligotrophic environment.

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MAMMALIAN AND AVIAN FAUNA OF SOME SELECTED AREAS OF PURULIA DISTRICT, WEST BENGAL

K. K. Biswas, P. C. Saren and Dipankar Basu

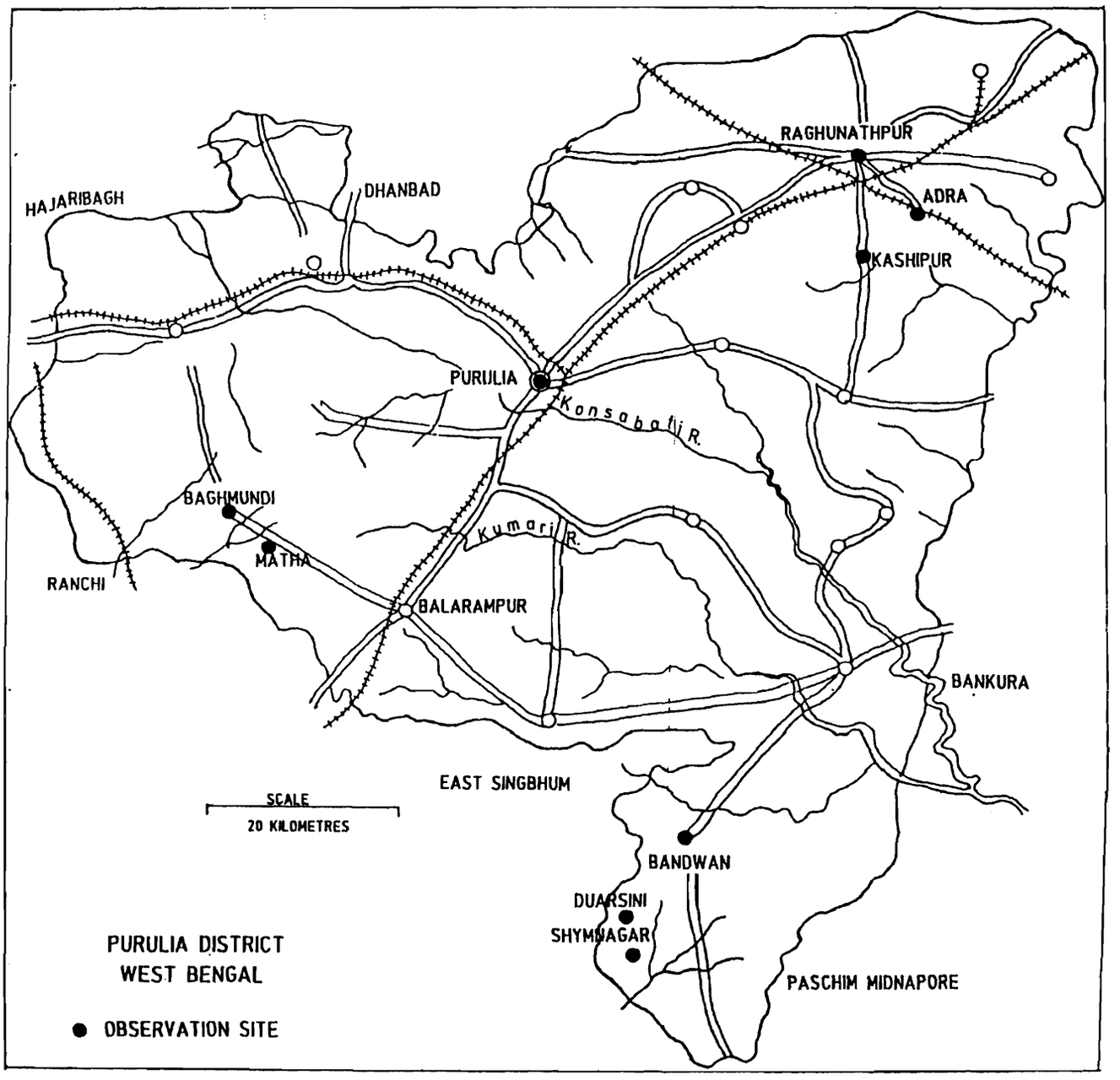
Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

INTRODUCTION

Surveys on mammalian and avianfauna of Raghunathpur, Banduan and Baghmundi areas of Purulia district were undertaken in the year 2001 and 2002. The Geographical area of the district is 6,259 sq. km. and the total forest area is 876 sq. km., the net-cropped area is 294.9 thousand hector. The rest is either wasteland or converted into plantation from wasteland. Presently, the forest Department of West Bengal has started intensive plantation in the degraded areas and for that Wildlife may be little assured for their extended home range (Chakraborty & Kar, 2004). The forests dealt within the district are scattered more or less all over the area with main concentration in south, south-western and southern sides. So far literature concern no extensive work has been done in the study areas. So special efforts were made to survey the wildlife with special reference to mammals and birds of the areas. The systematic lists of mammals and birds have been treated after Ellerman & Morrison-Scott (1951) and Ripley (1982) respectively. The species of both mammals and birds belonging to schedules of Indian wildlife (Protection) Act, have been followed by Alfred *et al.*, (2002) and Anon (1995).

TOPOGRAPHY, CLIMATE AND VEGETATION

District Purulia is the westernmost district of West Bengal (Map-I) and lies between 22°43' and 24°4' North Latitude and 85°49' and 86°54' East Latitude. It is bounded in the north by Damodar river, western and southern sides by Dhanbad, Giridi, Hazaribag and Singhbhum district respectively. Most of the eastern side is bounded by Bankura district while in the south-east lies Midnapore and Bardwan districts respectively. The district as a whole has a feature of gently undulating topography with occasional hillocks of hard rocks. The soil is an infertile laterite and alluvial type.



Map 1 : Map of Purulia district (West Bengal).

In Raghunathpur most of the areas are plain land like Koshipore, Sadiah, Motizeel and only a few hilly areas are present like Joychandi and Eksira hill etc. with more cultivation and fallow lands. There is more planted forest and less natural forest land in comparison to Banduan and Baghmundi areas. The Banduan area comprises of both hilly areas like Duarsini, Bhalopahar, Shyamnagar, Chirudi, Ghagrakeshira, Kuilapal with comparatively less plain lands i.e. cultivations and fallow lands. These areas are enriched with large natural forest in comparison to Raghunathpore areas. The Baghmundi areas are also hilly zones and less plain lands and the vegetations are more or less like that of Banduan areas. In Baghmundi areas there are some series of isolated groups of hills in the north-east which extends to the south-western side to from a regular hilly range known as Ajodhya pahar ending abruptly in Matha.

The climate is generally much drier. The district is well known as a drought prone district and falls within the semi-arid region of West Bengal and is characterized by high evaporation and low precipitation and has a sub-tropical climate. The temperature varied from 7°C to 46°C from winter to summer. The humidity is very low with high temperature during summer months until monsoon shower arrives in the month of June. Then again after the shower is over the humidity gradually falls low from the month of October and remains as such throughout the winter season. The normal average rainfall is 1180 mm. The forests dealt with in district are situated scattered more or less all over the area with main concentration in south, south-western and southern sides. The forests are mostly tropical dry deciduous type and is characterized by fine Sal, miscellaneous forests, shrubs and creepers etc. The natural and valuable forests of the district are confined in Banduan areas i.e. in Duarsini, Chirudi and Kuilapal areas bordering the West Midnapore in east and forests of Jharkhand state in south and west. The Baghmundi and Matha are hilly areas and the flora is mixture of Sal and miscellaneous forests, Shrubs and Creepers etc. In those areas apart from natural vegetation the Forest Dept. has planted various types of trees like Sal, Akashmani, Subaul etc. The main trees, shrubs and creepers and grasses are :- *Acacia auriculiformis* (Akashmoni), *Mangifera indica* (Mango), *Phyllanthus omblica* (Amla), *Spondias mangifera* (Amra), *Terminalia arjuna* (Arjun), *Terminalia blerica* (Bahera), *Aegle marmalos* (Bel), *Ficus bengalensis* (Banyan), *Dellenia indica* (Chalta), *Ficus hispia* (Dumur), *Syzygium balsameum* (Jam), *Artocarpus integrifolia* (Kanthal), *Bauhina perpura* (Kanchan), *Phoenix sylvestris* (Khejur), *Schlerichera trifuga* (Kusum), *Diospyros melanoxylon* (Kendu), *Bassia latifolia* (mahua), *Butea frondosa* (Palash), *Buichanania latifolia* (Piasal), *Shorea robustia* (Sal), *Dulbergia lanceolaria* (Siris), *Lagerstroemia parvifolia* (Sidha), *Tamarindus indica* (Tentul), *Calotropis gigantia* (Akanda), *Eupatorium odoratum* (Asamlata), *Ipomia cornea* (Dholkamli), *Ocimum camum* (Bantulsi), *Lantana camara* (Bhutbairabi), *Dhatura atramonium* (Dhutra), *Sparagus recomosus* (Satamuli), *Mucana pruriona* (Alkusi), *Acacia pennata* (Biswal), *Ichnocarpus frutescena* (Dudhilata), *Butea superba* (Latapalash), *Chrysopogon aciculata* (Chorkata), *Gmelina arborea* (Bena), *Cygnopogom amyracae* (Babuigrass), *Cynodon dectylon* (Durba) etc.

MATERIALS AND METHODS

The surveys were made on foot on hills, forests and plain lands. Two field trips, one in each year, were undertaken in the month November. The first trip was for 10 days from 4.11.01 to 13.11.01. The second trip was for 13 days from 10.11.02 to 22.11.02. During the survey different species of mammals and birds were recorded from those areas. The observations were made in hilly areas, plain lands, road side, a few water bodies (which are not abundant in those areas), forests and agriculture fields. The species were recorded by direct observations and sometimes by collecting informations from the local people and personnels of the district forest department. The observations were mostly carried out by using Binocular for visual recording. Sometimes nocturnal observations were carried out by using headlight, spot-light and three celled torch. The main observations hour were daily from 6.30 AM to 12 AM for three to four days in each area.

OBSERVATION AND RESULTS

Mammals : (Fig 1–3)

A list of 28 species of mammals were recorded and their regionwise abundance and status are given in Table-I. Among 28 species of mammals three are placed in Schedule-I of the Wildlife (Protection) Act. They are Wolf, Sloth Bear and Indian Elephant. Some of other species of mammals, occur in the areas, are Madras Tree-Shrew, Indian flying Fox, Indian Pipistrelle, Hanuman Langur, Asiatic Jackal, Indian Fox, Jungle cat, Mongoose, Common Palm Civet, Wild Boar, Northern Palm Squirrel, Palm Squirrel, Indian Crested Porcupine, Blacknaped Hare, House Mouse, Indian Brown Spiny Mouse, Palm Mouse, Elliot's Spiny Mouse, Lesser Bandicoot Rat, Tree Rat and Antelope Rat etc.

The Madras Tree Shrew (*Anathana ellioti*) mainly lives on insects and fruits, is an endemic one in India since its discovery and has been wiped out from many areas of its earlier range mainly due to extension of agriculture fields (Alfred and Chakraborty, 2002). The Indian Flying Fox (*Pteropus giganteus*) is the largest Indian bats, roots during the day in large noisy colonies on trees leaving within half an hour after sunset and feeds only on juice of fruits. This is the most conspicuous and a common bat of West Bengal and observed in all the districts in rural and as well as urban areas (Agrawal *et al.* 1992). The Sloth Bear (*Melursus* ursinus) is nocturnal and feeds mainly on fruits and insects. This species is at present an endangered one due to severe declination of its population. The reason of its declination is the destruction of its habitat for human use and was killed in the past for its bile that was used in medicine (Tikadar, 1983). Indian Wild Boar (*Sus scrofa cristatus*) is diurnal as well as nocturnal and found in groups. Adult male lives singly except during matting period, live in shelters in tall grasses and feeds on grasses, roots, carrion, snakes, insects and cultivated crops. This species was once very common in all the districts of West Bengal. But now it is restricted

to Darjeeling, Jalpaiguri, Purulia, West Dinajpur, North and South 24-Parganas districts. Main reasons of its decline are habitat destruction and poaching for flesh (Agrawal, *et al.* 1992).

The Elephant (*Elephas maximus*) migration is one of the burning problems of the district as they severely damage the crops every year. The herds of Elephant migrate in the district from Dalma range of Jharkhand State mainly during winter season especially when rice are ripen. As a result conflict between man and elephant has become inevitable. The survival of the elephant outside the protected areas can only be assured if appropriate measures are adopted to reduce the human-elephant conflict. They may migrate in the district in other season also but mostly favour winter season. Though it has been stated that the elephant is a casual visitor to other district of West Bengal except Jalpaiguri, Darjeeling and Midnapore district (Anon 1992), the informations were recorded from the forest department and local people of the districts that a few elephants are resident of this district at present.

The Wolves (*Canis lupus*) live in rocky hills in dry open country around human habitations, nocturnal in habit and hunts fox, hare, sheep, goat etc. (Tikadar, 1983). The majority of wolf population in India survive outside the protected areas and subsists primarily on livestock (Jhala, 2003). In a village near Duarsini under Banduan area one of such incident of hunting of domestic goat by the wolf has been recorded. This species was once very common in the district but at present their population has become very low as a result of increased human settlement, persecution by man for the commercial value of its far. So, this species has been included in schedule-I of the Wildlife (Protection) Act. This steps completely ban its killing or trade in its parts (Anon, 1994).

Birds : (Fig 4–7)

A total of 98 species of birds were recorded (Table-2). Among them 4 species are placed in scheduled-I of Indian Wildlife (Protection) Act. They are Crested Serpent Eagle, Honey Buzzard, Shikra belonging the family Accipitridae and common Pea fowl belonging to family Phasianidae. Some of the other species in those areas are Heron, Egret, Stork, Lesser Adjutant, Teal, Kite, Vulture, Patridge, Quail, Jungle Fowl, Moorhen, Jacana, Snipe, Sandpiper, Lapwing, Tern, Dove, Pigeon, Parakeet, Cuckoo, Koel, Coucal, Owl, Nightjar, Swift, Kingfisher, Bee eater, Indian Roller, Barbet, Wood Pecker, Shrike, Oriole, Drongo, Myna, Tree Pie, Jungle Crow, Minivet, Bulbul, Flycatcher, Warbler, Chiffchaff, Robin, Bushchat, Spider hunter, White Eye, Weaver Bird, Munia, Larks etc.

The Lesser Adjutant (*Leptoptilos javanicus*) is a resident and locally migratory bird, normally solitary, occurs in well watered country feeds on fish, frogs, reptiles and invertebrates (Ali, 1996). It has been mentioned in the Fauna of West Bengal Part-I that in West Bengal this species occurs in Bardwan district only (Majumder *et al.*, 1992). But during the survey in 2001, one of the species was observed and recorded from Banduan area near Duarsini on the way to Balarampur in Purulia district. This species has also been recorded by the authors from Sundarban Tiger reserve of North

24-Paraganas district during 2000-01. This species was once very common throughout India but at present has experienced rapid declines and become rare due to habitat loss, hunting and disturbance of colonies by cutting of tall trees and damaging of wetland feeding side (Kumar *et al.*, 2005).

Only one Blackwinged Kite, (*Elanus caeruleus*) was recorded in the early morning on the way to Duarsini from Banduan town. Their population is very low, usually met with single or in pairs, activities resume in early morning and late evening (Mukherjee, 1995). The Vulture was once a very common bird throughout India. But at present their population has greatly run down perhaps due to out break of disease, chemical contamination and poisoning. The common Peafowl, *Pavo cristatus* was once widely distributed throughout the country. At present this species found in parts of West Bengal, Bihar, Orissa and Peninsular India but abundant in Gujrat and Rajasthan. Now there is no severe threat of this species primarily for its status as a National Bird and secondarily due to religious belief and this species is protected and included in Schedule-I of the Wildlife (Protection) Act (Anon, 1994). The Barbets are predominantly frugivorous but during the breeding seasons all species feed their young with insects. They help in seed dispersal and pollination and thus play an important role in maintaining the rich biodiversity of the country and they deserve conservation priority (Yahya, 2000).

DISCUSSION

Out of systematic lists mentioned in Table-1 & 2 the mammalian fauna represents three species–Wolf, Sloth Bear and Elephant are coming under Schedule-I. Five species–Hanuman Langur, Jackal, Indian Fox, Jungle Cat and Common Palm Civet are placed in Schedule-II, the Wild Boar is placed in Schedule-III, seven species—Indian Flying Fox, Indian Grey Mongoose, Indian Crested Porcupine, Black-napped Hare, House Mouse, Lesser Bandicoot Rat, Tree Rat, Indian Brown Spiny Mouse, Palm Mouse, Elliot's Spiny Mouse. Antelopes Rat etc. are placed in Schedule-V of the Indian Wildlife (Protection) Act. The majority of the avifauna are coming under Schedule-IV except Crested Serpent Eagle, Honey Buzzard, Shikra and Common Peafowl are listed under Schedule-I of the Indian Wildlife (Protection) Act.

The number of species of mammals of Banduan areas (28 species) and Baghmundi areas (27 species) are more or less same because both the areas are belonging more or less similar habitations. In Raghunathpur areas (19 species) the number of species of mammals are comparatively less than that of other mentioned areas. Because this area consisting of mainly plain lands with a few hilly areas where human habitation is more and causing the barrier for animal habitations. Hence in the Raghunathpur areas the numbers of mammalian species are lower than other two areas. The number of species of birds in Banduan areas (93 species) and Baghmundi areas (94 species) are fairly represented in comparison to Raghunathpur areas (75 species). Because the Banduan and the Baghmundi areas are more enriched with the vegetations in comparison to Raghunathpur areas.

Due to enriched vegetations and habitats the birds get there suitable shelter and necessary enough food like fruits, seeds, nectar, buds and fleshy petals of flower, insect etc. Hence the richness and diversity of species depends upon availability of food and safe shelter of the habitat (Nandy *et al.*, 2004) and it has been observed that the species diversity of birds and mammals are more in natural forests areas (Baghmundi and Banduan) in comparison to more planted forest areas (Raghunathpur).

In Purulia district there are small to large villages established in the forest area in between the forest lands or at the foothills which is a indicator of poor forest management and ultimately initiates evacuation of many wild species from the areas (Chakraborty and Kar, 2004). Though the Forest Department has taken protective measures to save the varied ecosystem and faunal diversity of the district yet illegal poaching, hunting and cutting of wood is still going on. Therefore Forest Department of the district should take more protective measures to protect those species specially belong to Scheduled of Wildlife (Protection) Act. 1972.

SUMMARY

In the survey areas the mammalian fauna is represented by as many as 28 species, of these 3 species are endangered and listed in Schedule-I, 5 species in Scheduled-II, one species in Scheduled-III, and 4 species in Scheduled-IV and 7 species in Scheduled-V of the Indian Wildlife (Protection) Act, 1972. The avifauna is represented by 98 species of which 4 species are endangered and listed in Scheduled-I and the majority of the rest species are listed in Schedule-IV of the Indian Wildlife (Protection) Act 1972. The richness and diversity of species depends upon availability of food and safe shelter of the habitat.

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Table 1. : Systematic list of Mammals Recorded from Raghunathpur, Banduan and Baghmundi areas showing area wise abundance and status. R = Resident, M = Migratory, ++ = Common, + = Rare, – = Not Observed

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Order : SCANDENTIA						
	Family: TUPAIIDAE						
1.	*Anathana ellioti* Lyon	Madras Tree-Shrew	–	+	–		R
	Order : INSECTIVORA						
	Family: SORICIDAE						
2.	*Suncus murinus* (Linnaeus)	House Shrew	++	++	++		R
	Order : CHIROPTERA						
	Family: PTEROPODIDAE						
3.	*Pteropus giganteus* (Brünnich)	Indian Flying Fox	+	+	+		R
4.	*Cynopterus sphinx sphinx* (Vahl)	Short-nosed Fruit Bat	+	++	++		R
	Family: VESPERTILIONIDAE						
5.	*Pipistrellus mimus* Wroughton	Indian Pygmy Pipistrelle	++	++	++		R
6.	*Scotophilus kuhlii kuhlii* Leach	Asiatic Lesser Yellow Bat	–	++	++		R
	Order : PRIMATES						
	Family: CERCOPITHECIDAE						
7.	*Semnopithecus entellus* (Dufresne)	Hanuman Langur	–	+	+	Sch-II	R
	Order : CARNIVORA						
	Family: CANIDAE						
8.	*Canis aureus* Hodgson	Asiatic Jackal	+	+	+	Sch-II	R
9.	*Canis lupas* Sykes	Wolf	+	+	+	Sch-I	R
10.	*Vulpes bengalensis* (Shaw)	Indian Fox	+	+	+	Sch-II	R

Sch-Schedule under Wildlife (Protection) Act.

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Family: FELIDAE						
11.	*Felis chaus* Hodgson	Jungle Cat	–	+	+	Sch-II	R
	Family: HERPESTIDAE						
12.	*Herpestes edwardsii* (E. Geoffery Saint-Hilaire)	Indian Grey Mongoose	++	++	++	Sch-IV	R
13.	*Herpestes auropunctatus* (Hodgson)	Small Indian Mongoose	++	++	++	Sch-IV	R
	Family: URSIDAE						
14.	*Melursus ursinus* (Shaw)	Sloth Bear	–	+	+	Sch-I	R
	Family: VIVERRIDAE						
15.	*Paradoxurus hermaphroditus (Pallas)*	Common Palm Civet	++	++	++	Sch-II	R
	Order : ARTIODACTYLA **Family: ELEPHANTIDAE**						
16.	*Elephas maximus* Cuvier	Indian Elephant	–	++	++	Sch-I	M
	Order : ARTIDACTYLA **Family: SUIDAE**						
17.	*Sus scrofa* Wagner	Wild Boar	–	++	++	Sch-III	R
	Order : RODENTIA **Family: SCIURIDAE**						
18.	*Funambulus palmarum* (Linnaeus)	Indian Palm Squirrel	++	++	++		R
19.	*Funambulus pennantii* Wroughton	Northern Palm Squirrel	–	+	+		R
	Family: HYSTRICIDAE						
20.	*Hystrix indica* (Kerr)	Indian Crested Porcupine	+	+	+	Sch-IV	R

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Family: MURIDAE						
21.	*Mus musculus* Hodgson	House Mouse	++	++	++	Sch-V	R
22.	*Bandicota bengalensis* Grey & Hardwicke	Lesser Bandicoot Rat	++	++	++	Sch-V	R
23.	*Ratus ratus arboreus* (Horsfield)	Tree Rat	++	++	++	Sch-V	R
24.	*Mus platythrix* Bennett.	Indian Brown Spiny Mouse	++	++	++	Sch-V	R
25.	*Tatera indica* (Hardwicke)	Antelope Rat	–	++	++	Sch-V	R
26.	*Mus saxicola* Elliot.	Elliot's Spiny Mouse	++	++	++	Sch-V	R
27.	*Vandeleuria oleracea* (Bennett.)	Palm Mouse	++	++	++	Sch-V	R
	Order : LAGOMORPHA						
	Family: LEPORIDAE						
28.	*Lepus nigricollis* Geoffroy	Black-naped Hare	++	++	++	Sch-IV	R
	Total number of species		**19**	**28**	**27**		

Table 2. : Systematic list of Birds reconded from Raghunathpur, Banduan and Baghmundi areas showing area wise abundance and status.

R = Resident, SLM = Subject to local migrant, WM = Winter migratory. ++ = Common, + = Rare, – = Not Observed.

List of Birds							
Sl. No.	**Species**	**Common Name**	**Raghunathpur**	**Banduan**	**Baghmundi**	**Status**	**Remarks**
	Order : PELECANIFORMES Family: PHALACROCORACIDAE						
1.	*Phalacrocorax fuscicolis* Stephens	Indian shag	+	–	–	Sch-IV	R
2.	*Phalacrocorax niger* (Vieillot)	Little Cormorant	++	+	+	Sch-IV	R
	Order : CICONIIFORMES Family: ARDEIDAE						
3	*Nicticorax nicticorax* (Linnaeus)	Night Heron	++	+	+	Sch-IV	R
4.	*Ardeola grayii* (Sykes)	Pond Heron	++	++	++	Sch-IV	R
5.	*Bubulcus ibis* (Linnaeus)	Cattle Egret	++	++	++	Sch-IV	R
6.	*Egretta intermedia* (Wagler)	Smaller Egret	++	++	++	Sch-IV	R
7.	*Egretta garzetta* (Linnaeus)	Little Egret	++	++	++	Sch-IV	R
	Family: CICONIIDAE						
8.	*Anastomus oscitans* (Boddaert)	Openbill Stork	++	+	+	Sch-IV	R
9.	*Leptoptilos javanicus* (Horsfield)	Lesser Adjutant	–	+	–	Sch-IV	RSLM
	Order : ANSERIFORMES Family: ANATIDAE						
10.	*Anas crecca* Linaeus	Common Teal	++	–	–	Sch-IV	W.M.
	Order : FALCONIFORMES Family: ACCIPITRIDAE						
11.	*Milvus migrans* (Boddaert)	Pariah Kite	++	+	+		R
12.	*Elanus caeruleus* (Desfontaines)	Black Winged Kite	–	+	–		R
13.	*Spilornis cheela* (Latham)	Crested Serpent Eagle	–	+	+	Sch-I	RSLM

Sch-Schedule Under Wildlife (Protection) Act.

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
14.	*Pernis ptilorhyncus* (Temminck)	Honey Buzzard	–	+	+	Sch-I	RSLM
15.	*Accipiter badius* (Gmelin)	Shikra	+	+	+	Sch-I	R
16.	*Gyps bengalensis* (Gmelin)	Bengal Vulture	–	+	+	Sch-IV	R
	Order : GALLIFORMES Family: PHASIANIDAE						
17.	*Francolinus pondicerianus* (Gemlin)	Grey Patridge	–	++	++	Sch-IV	R
18.	*Perdicula asiatica* (Latham)	Jungle Bush Quail	–	+	+	Sch-IV	R
19.	*Coturnix coromandelica* (Gemlin)	Rain Quail	–	+	+	Sch-IV	R
20.	*Gallus gallus* (Linnaeus)	Red Jungle Fowl	–	++	++	Sch-IV	R
21.	*Pavo cristatus Linnaeus*	Common Peafowl	–	++	++	Sch-I	R
	Order : GRUIFORMES Family: TURNICIDAE						
22.	*Turnix suscitator* (Gemlin)	Common Bustard Quail	–	+	+	Sch-IV	R
23.	*Turnix tanki* Blyth	Button Quail	–	+	+	Sch-IV	R
	Family: RALLIDAE						
24.	*Gallinula chloropus* (Linnaeus)	Moorhen	+	–	++	Sch-IV	RSLM
25.	*Amaurornis phoenicurus* (Pennant)	Whitebreasted Waterhen	++	++	++		R
	Order : CHARADRIIFORMES Family: JACANIDAE						
26.	*Metopidius indicus* (Latham)	Bronzewinged Jacana	+	–	++	Sch-IV	R
	Family: CHARADRIIDAE						
27.	*Gallinago gallinago* (Linnaeus)	Fantail Snipe	++	++	++	Sch-IV	R
28.	*Tringa hypoleucos* (Linnaeus)	Common Sand Piper	++	++	+	Sch-IV	R & WM
29.	*Vanellus malabaricus* (Boddaert)	Yellow-wattled Lapwing	++	+	+		RSLM

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Order : COLUMBIFORMES Family: COLUMBIDAE						
30.	*Streptopelia decaocto* (Frivaldszky)	Indian Ring Dove	++	++	++	Sch-IV	R
31.	*Streptopelia chinensis* (Scopoli)	Spotted Dove	++	++	++	Sch-IV	R
32.	*Streptopelia senegalensis* (Linnaeus)	Little Brown Dove	+	+	+		RSLM
33.	*Treron bicincta* (Jerdon)	Orangebreasted Green Pigeon	–	++	++	Sch-IV	R
34.	*Treron phoenicoptera* (Latham)	Green Pigeon	+	++	+	Sch-IV	R
	Order : PSITTACIFORMES Family: PSITTACIDAE						
35.	*Psittacula eupatria* (Linnaeus)	Alexandrine Parakeet	++	++	++	Sch-IV	R
36.	*Psittacula cyanocephala* (Linnaeus)	Blossomheaded Parakeet	+	++	++	Sch-IV	R
	Order : CUCULIFORMES Family: CUCULIDAE						
37.	*Cuculus varius* Vahl	Common Hawk-Cuckoo	+	+	+	Sch-IV	R
38.	*Cuculus canorus* Linnaeus	The Cuckoo	+	+	+	Sch-IV	R
39.	*Eudynamys scolopacea* (Linnaeus)	Koel	++	++	++	Sch-IV	R
40.	*Centropus sinensis* (Stephens)	Coucal	++	++	++	Sch-IV	R
	Order : STRIGIFORMES Family: STRIGIDAE						
41.	*Otus bakkamoena* Pennant	Collared Scops Owl	–	+	+	Sch-IV	R
42.	*Otus scops* (Linnaeus)	Scops Owl	+	++	++	Sch-IV	R
43.	*Bubo zeylonensis* (Gmlin)	Brown Fish Owl	+	+	+	Sch-IV	R
44.	Glaucidium radiatum (Tickell)	Jungle Owlet	–	++	++	Sch-IV	R
45.	*Athena brama* (Temminck)	Spotted Owlet	++	+	+	Sch-IV	R

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Order : CAPRIMULGIFORMES Family: CAPRIMULGIDAE						
46.	*Caprimulgus indicus* Latham	Jungle Nightjar	+	++	++	Sch-IV	R
47.	*Caprimulgus asiaticus* Latham	Common Indian Nightjar	++	++	++	Sch-IV	R
	Order : APODIFORMES Family: APODIDAE						
48.	*Cypsiurus parvus* (Lichtenstein)	Palm Swift	++	+	++		R
	Order : CORACIIFORMES Family: ALCEDINIDAE						
49.	*Alcedo atthis* (Linnaeus)	Small Blue Kingfisher	++	++	++	Sch-IV	R
50.	*Halcyon smyrnensis* (Linnaeus)	Whitebreasted Kingfisher	+	++	++	Sch-IV	R
51.	*Ceryle rudis* (Linnaeus)	Lesser Pied Kingfisher	++	++	++	Sch-IV	R
	Family: CORACIIDAE						
52.	*Coracius benghalensis* (Linnaeus)	Indian Roller	+	+	+	Sch-IV	R
	Family: MEROPIDAE						
53.	*Merops orientalis* Latham	Green Bea-eater	++	++	++		R
	Order : PICIFORMES Family: CAPITONIDAE						
54.	*Megalaima asiatica* (Latham)	Bluethroated Barbet	++	++	++	Sch-IV	R
55.	*Megaliama haemacephala* (P.L.S. Muller)	Crimsonbreasted Barbet	++	++	++	Sch-IV	R
	Family: PICIDAE						
56.	*Dinopium benghalense* (Linnaeus)	Lesser Golden-backed Woodpecker	+	++	++	Sch-IV	R
57.	*Picoides mahrattensis* (Latham)	Yellowfronted Pied Woodpecker	+	++	++	Sch-IV	R

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Family: ALAUDIDAE						
58.	*Eremopterix grisea* (Scopoli)	Blackbellied Finch Lark	++	++	++		R
59.	*Mirafra assamica* Horsefield	Bush Lark	++	++	++		R
	Order : PASSERIFORMES						
	Family: LANIIDAE						
60.	*Lanius cristatus* Linnaeus	Brown Shrike	++	++	++		WM
61.	*Lanius schach* Linnaeus	Rafousbacked Shrike	+	+	+		R
	Family: ORIOLIDAE						
62.	*Oriolus oriolus* (Linnaeus)	Golden Oriole	–	+	+	Sch-IV	R
63.	*Oriolus xanthornus* (Linnaeus)	Blackheaded Oriole	++	++	++	Sch-IV	R
	Family: DICRURIDAE						
64.	*Dicrurus adsimilis* (Bechstein)	Black Drongo	++	++	++	Sch-IV	R
65.	*Dicrurus aeneus* Vieillot	Bronzed Drongo	++	++	++	Sch-IV	R
66.	*Dicrurus hottentottus* (Linnaeus)	Haircrested Drongo	–	+	+	Sch-IV	R
	Family: STURNIDAE						
67.	*Sturnus malabaricus* (Gmelin)	Greyheaded Myna	++	++	++	Sch-IV	R
68.	*Sturnus contra* Linnaeus	Pied Myna	++	++	++	Sch-IV	R
69.	*Acridotheres tristis* (Linnaeus)	Common Myna	++	++	++	Sch-IV	R
70.	*Acridotheres fuscus* (Wagler)	Jungle Myna	++	++	++	Sch-IV	R
	Family: CORVIDAE						
71.	*Dendrocitta vagabunda* (Latham)	Indian Treepie	+	++	++	Sch-IV	R
72.	*Corvus macrorhynchos* Wagler	Jungle Crow	++	++	++		R

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Family: CAMPEPHAGIDAE						
73.	*Tephrodornis pondicerianus* (Gmelin)	Common Wood Shrike	+	–	+		R
74.	*Coracina novaehollandiae* (Gmelin)	Large Cuckoo Shrike	–	++	++		R
75.	*Pericrocotus cinnamomeus* (Linnaeus)	Small Minivet	++	++	++	Sch-IV	R
	Family: IRENIDAE						
76.	*Aegithina tiphia* (Linnaeus)	Common Iora	++	++	++	Sch-IV	R
77.	*Chloropsis cochinchinensis* (Gmlin)	Goldmantled Chloropsis	++	++	++	Sch-IV	R
	Family: PYCNONOTIDAE						
78.	*Pycnonotus jocosus* (Linnaeus)	Red Whiskerd Bulbul	–	+	+	Sch-IV	R
79.	*Pycnonotus cafer* (Linnaeus)	Redvented Bulbul	++	++	++	Sch-IV	R
	Family: MUSCICAPIDAE						
80.	*Turdoides striatus* (Dumont)	Jungle Babler	++	++	++	Sch-IV	R
81.	*Orthotomus sutorius* (Pennant)	Tailor Bird	++	++	++	Sch-IV	R
82.	*Muscicapa parva* Bechstein	Redbreasted Flycatcher	++	++	++	Sch-IV	WM
83.	*Muscicapa thalassina* Swainson	Verditer Flycatcher	–	++	++	Sch-IV	WM
84.	*Culicicapa ceylonensis* (Swainson)	Greyheaded Flycatcher	+	++	++	Sch-IV	RSLM
85.	*Rhipidura aureola* Lesson	Whitebrowed Fantail Flycatcher	–	+	+	Sch-IV	RSLM
86.	*Prinia socialis* Sykes	Ashy Wren-Warbler	++	+	+		RSLM
87.	*Phylloscopus collybita* (Vieillot)	Chiffchaff	–	+	+		WM
88.	*Copsychus saularis* Linnaeus	Magpie-Robin	++	++	++		R
89.	*Saxicola torquata* Linnaeus	Stone Chat	++	+	+		R

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

Sl. No.	Species	Common Name	Raghunathpur	Banduan	Baghmundi	Status	Remarks
	Family: MOTACILLIDAE						
90.	*Anthus novaeseelandiae* Gmelin	Paddyfield Pipit	++	++	+	Sch-IV	R
91.	*Motacilla flava* Linnaeus	Yellow Wagtail	–	+	+		WM
92.	*Motacilla alba* Linnaeus	White Wagtail	++	+	++		WM
	Family: DICAEIDAE						
93.	*Dicaeum erythronhynchos* (Lathan)	Tickell's Flower pecker	++	+	+	Sch-IV	R
	Family: NECTARINIIDAE						
94.	*Nectarinia zeylonica* (Linnaeus)	Purplerumped Sunbird	++	++	++	Sch-IV	R
95.	*Nectarinia asitica* (latham)	Purple Sunbird	++	++	++	Sch-IV	R
	Family: ZOSTEROPIDAE						
96.	*Arachnothera longirostris* (Lathan)	Little Spiderhunter	++	+	+	Sch-IV	R
	Family: PLOCEIDAE						
97.	*Lonchura malaca* (Linnaeus)	Blackheaded Munia	++	+	+	Sch-IV	M
98.	*Ploceus philippinus* (Linnaeus)	Baya	++	++	++	Sch-IV	R
	Total No. Species		**75**	**93**	**94**		

PLATE I

Fig. 1 : Wallowing Site of Elephant at Shymnagar.

Fig. 2 : Jackal (Knocked down by speeding vehicle) on Puruha – Raghunathpur Road.

PLATE II

Fig. 3 : Pygmy pipistrelle at Duarsini.

Fig. 4 : Common Peafowl (Sub adult) at Matha.

PLATE III

Fig. 5 : Openbill Stork in a Marshy land on the way to Duarsini.

Fig. 6 : Lesser Adjutant Stork on the way to Baghmundi.

PLATE IV

Fig. 7 : Alexandrine Parakeet in Raghunathpur.

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EARTHWORMS OF HEMIS NATIONAL PARK, JAMMU & KASHMIR, INDIA

R. PALIWAL

High Altitude Zoology Field station, Zoological Survey of India, Solan-173 211 (H.P.)

INTRODUCTION

Earthworms are distributed in tropical, subtropical and temperate regions of the world. Their presence in soil is primarily dependent on the availability of sufficient soil moisture and organic matter. The earthworms of Jammu & Kashmir have been studied by Stephenson (1922, 1923), Soota and Halder (1980), Sharma and Kaul (1974), Julka (1988), and Paliwal and Julka (2005). However, the trans-Himalayan region of the state remained unexplored for earthworms until recently Julka and Paliwal (in press) reported the occurrence of two species from Cold Desert ecosystem of Ladakh.

Hemis National Park is located (latitude 33°38'–34°11' north to longitude 77°00'–77°44' east) in the trans-Himalayan Cold Desert region of the Jammu & Kashmir. It is characterized by varying climatic conditions from temperate to sub-arctic, with scanty rainfall and sparse vegetation. Soil is sandy having low organic matter and moisture. The present communication deals with the earthworm diversity of Hemis National Park which has not so far been surveyed for earthworms. These species belong to the holarctic family Lumbricidae and occur mostly near human habitation in the Park, indicating their recent introduction in the region possibly due to accidental transportation in soil around roots of plants.

SYSTEMATIC ACCOUNT

Phylum ANNELIDA
Class OLIGOCHAETA
Order HAPLOTAXIDA
Suborder LUMBRICINA
Superfamily LUMBRICOIDEA
Family LUMBRICIDAE

Genus ***Allolobophora*** Eisen, 1874

1. ***Allolobophora parva*** Eisen, 1874

1874. *Allolobophora parva,* Eisen, *Ofvers. K. Vetensk Acad. Forh. Stockh.,* **31** : 46.

1972. *Bimastos parvus,* Gates, *Trans. Am. phil. Soc.,* **62** : 87.

1983. *Allolobophora parva,* Easton, In Satchell, J.E., *Earthworm Ecology from Darwin to Vermiculture* : 475.

Length 25-52 mm, diameter 1.5-2.5 mm, 95-104 segments. Colour reddish on dorsum, venter yellowish. Body cylindrical. Prostomium epilobic, tongue open. First dorsal pore 5/6. Clitellum saddle-shaped, 24-30, rarely extending to 31; tubercula pubertatis absent. Setae lumbricine, closely paired, *aa* = 3.18-3.67 *ab* = 1.09-1.14 *bc* = 2.92-5.0 *cd* = 0.31-0.41 *dd* on 12, *aa* = 2.67-3.82 *ab* = 1.14-1.31 *bc* = 5.0-6.0 *cd* = 0.31-0.47 *dd* on 36; genital tumescences lacking. Nephridiopores inconspicuous. Male pores minute, paired, at the base of small transverse clefts, located on somewhat circular whitish tumescences, confined to 15, extending laterally to mid *bc*. Female pores paired, tiny, shortly above *b*, on setal arc of 14. Spermathecal pores absent.

Pigmented, pigment red. Septa 5/6-12/13 slightly muscular. Typhlosole simple, lamelliform. Nephridial vesicles J-shaped in 14 and anterior segments with curved part directed caudad; U-shaped in 15 and posteriad segments with curved parts directed cephalad; lateral ends of vesicles closed. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles paired, small, in 11 and 12. Spermathecae absent. Atrial glands well developed, reaching above longitudinal muscle layer, extending into 14 and 16; sometimes atrial glands rudimentary.

Type locality : Mount Lebanon, New York New England, U.S.A.

Material examined : Coll. H.S. Mehta : 0-0-4 Karu, 30 Aug 1994, 0-0-7 Toko Khud, Nimu, 2 Aug 1998; coll. R. Paliwal 1996 : 0-0-9 Upshi, 11 Aug, 1-4-5 Hemis, 12 Aug; 1-0-9 Sumda, 31 July 1998, coll. T.R. Sharma.

Distribution : INDIA : Jammu & Kashmir, Himachal Pradesh, Punjab, Uttarakhand, Uttar Pradesh, Bihar, West Bengal, Rajasthan and Tamil Nadu.

Outside India : Pakistan, Myanmar, Malaya, Indonesia, Tibet, China, Korea, Central Asia, Russia, Kazakstan, Japan, Afghanistan, Tahiti, Hawaii, Australia, Mauritius, St. Paul, South Africa, South West Africa, Iceland, Denmark, Germany, England, Wales, Portugal, Spain, Switzerland, Italy, Corsica, Rhodes, Hungary, Romania, Bulgaria, St. Helena, U.S.A., Mexico, Guatemala, Costa Rica, Brazil, Argentina.

Genus ***Dendrodrilus*** Omodeo, 1956

2. ***Dendrodrilus rubidus*** (Savigny, 1826)

1826. *Enterion rubidum,* Savigny, *Mem. Acad. Sci. Inst. Fr. (Hist.),* **5** : 182.

1972. *Dendrobaena rubida,* Gates, *Trans. Am. phil. Soc.,* **62** : 92.

1979. *Dendrodrilus rubidus,* Gates, *Megadrilogica,* **3** : 152.

1983. *Dendrodrilus rubidus rubidus,* Easton, In Satchell, J.E. *Earthworm Ecology from Darwin to Vermiculture* : 479.

1983. *Dendrodrilus rubidus norvegicus,* Easton, In Satchell, J.E. *Earthworm Ecology from Darwin to Vermiculture* : 479.

1983. *Dendrodrilus rubidus subrubicundus,* Easton, In Satchell, J.E. *Earthworm Ecology from Darwin to Vermiculture* : 479.

1983. *Dendrodrilus rubidus tenuis,* Easton, In Satchell, J.E. *Earthworm Ecology from Darwin to Vermiculture* : 480.

Length 33-67 mm, diameter 2-3.5 mm, 92-108 segments. Colour light to dark red. Body cylindrical. Prostomium epilobic, tongue open. First dorsal pore 5/6, occasionally 4/5, rarely 6/7. Clitellum saddle-shaped, 26-31, sometimes extending to 25 and 32; tubercula pubertatis 28-30, longitudinal bands just lateral to *b*, usually grooved longitudinally. Setae lumbricine, widely paired, *aa* = 1.87-2.35 *ab* = 0.98-1.17 *bc* = 1.33-1.69 *cd* = 0.31-0.37 *dd* on 12, *aa* = 2.0-2.65 *ab* = 0.90-1.20 *bc* = 1.29-2.26 *cd* = 0.33-0.42 *dd* on 36; genital tumescences incorporating setae *a*, *b* on 16, 26-31, rarely on 25, 32. Nephridiopores inconspicuous. Male pores minute, paired, on 15, at the base of transverse clefts, located on somewhat spherical tumescences confined to 15, extending from *b* to mid *bc*. Female pores paired, tiny, just lateral to *b*, on setal arc of 14. Spermathecal pores minute, paired, in 9/10/11, close to *c* lines.

Pigmented, pigment red. Septa 5/6-12/13 slightly muscular. Typhlosole 20 to 78-97, with a median longitudinal groove on the ventral face. Nephridial vesicles U-shaped like hair pins, lateral ends closed, curved parts directed cephalad. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles paired, in 9, 11, 12. Spermathecae in 9, 10; ampulla medium sized, spheroidal to ovoidal, duct slender, much shorter than ampulla. Glands of tubercula pubertatis, atrium and genital setae present.

Type locality : Paris, France.

Material examined : 0-1-16 Hemis, 6 Aug 1981, coll. M. Chandra; 1-5-16 Karu, 30 Aug 1994, coll. H.S. Mehta; coll. R Paliwal 1996 : 4-4-7 Upshi, 11 Aug, 36-13-18 Hemis, 12 Aug; 25-8-27 Sumda, 31 July 1998, coll. T.R. Sharma; 1-2-3 Hemis, 20 Aug 2002, coll. R.M. Sharma.

Distribution : INDIA : Jammu & Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh and Tamil Nadu.

Outside India : Pakistan, Bhutan, Manchuria, Korea, Siberia, Kazakstan, Japan, Hawaii, Juan Fernandez Island, Australlia, New Zealand, Kermadec Islands, Stewart Island, Turkey, Turkestan, South Africa, Southwest Africa, Madagascar, Reunion, St. Paul Island, Kerguelen Island, Europe, Russia, Ukraine, Moldavia, Byelorussia, Crimea, Estonia, Latvia, Lithuania, Channel Islands, Rhodes Island, Azores, Madeira, Canary Islands, Tristan da Cunha, Tierra del Fuego, Falkland Islands, Greenland, Canada, U.S.A., Mexico, Guatemala, Colombia, Ecuador, Brazil, Chile, Argentina, Uruguay.

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Rec. zool. Surv. India : **108**(Part–3) : 81-84, 2008

POPULATION STATUS AND MALE GENITALIA OF *PATALA YAMA* (MOORE) (INSECTA : LEPIDOPTERA : SATYRIDAE)

NARENDER SHARMA

Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

INTRODUCTION

On the basis of sex marks, Bingham (1905) divided the genus *Lethe* Hübner into three groups. Evans (1932) divided *Lethe* group of satyrid butterflies in the Indian region into three subgroups, namely *Minerva*, *Sura* and *Yama*. Talbot (1947) accept this grouping and included six species in the *yama* group *i.e.*, *pulaha* Moore, *pulahina* Evans, *armandii* Oberthiir, *bhadra* Moore, *yama* Moore and *muirheadi* Felder. All these butterflies occur in the hilly habitats and reported from North-West Himalaya and North-East India. Some extend to Burma and beyond. Wynter-Blyth (1957) reported these as rare butterflies.

OBSERVATIONS

Patala yama (Moore)

Common name : **The Tailed Labyrinth**

1857. *Zophoessa yama* Moore, *in Horsfield & Moore, Cat. Lep. Ins. E. India Co.*, **1** : 221.

Patala yama yama (Moore)

1857. *Zophoessa yama yama* Moore, *in Horsfield & Moore, Cat. Lep. Ins. E. India Co.*, **1** : 221.

1911. *Neope yama yamoides* Fruhstorfer, In *Seitz, Gross-schmetterlinge der Erde, Fauna Indo-Austral.*, : 53.

1932. *Lethe yama yama* Evans, *The Identification of Indian Butterflies* : 110.

Diagnosis : Upperside velvety chocolate brown; forewing with a post-discal, more or less parallel to outer margin, row of four dark ocelli, bordered on outer side by lunular, ochraceous, faintly marked line, two subapical, white irregular spots, marginal area blackish, underside paler, cell

with a greyish-white band at base and crossed by three greyish-white, irregular bars, subapical white spots as on upperside, post-discal row of four black ocelli with white pupil, yellow iris, lying in the post-discal, ochraceous band, marginal and submarginal black and paler lines; hindwing outer margin dentate, upperside with a post-discal, slightly arched series of six black ocelli, obscurely ringed with brown, submarginal area blackish, underside with proximal area variegated by medially ochraceous bands bordered on both sides by paler lines, post discal row of seven black ocelli with white pupil, with inner ochraceous and outer black iris, the ocellus near the anal angle double, marginal and submarginal black and brown lines.

Male genitalia (Figs. 1-4) : Uncus longer than tegumen, almost straight, distal end narrower, proximal half broader; brachia long, slender, dorsally curved, strongly sclerotized; tegumen globular, narrow ventrally; appendices angulares somewhat hook-like, thin, well sclerotized; vinculum longer than tegumen, curved inwardly in the middle, strap-like; saccus moderately long, upwardly lifted; valva sword-like, proximal one-third broader, distal two-third narrow, produced distally into a curved, strongly sclerotized long spine; aedeagus broad, short, slightly curved at middle, subzone smaller than suprazone, coecum conical, ductus ejaculatorius entering dorsad.

Wing expanse : Half; Male : 32.0 mm.

Material examined : Uttarakhand : 2♂, 27.vi.1994, Bhimtal, Nainital.

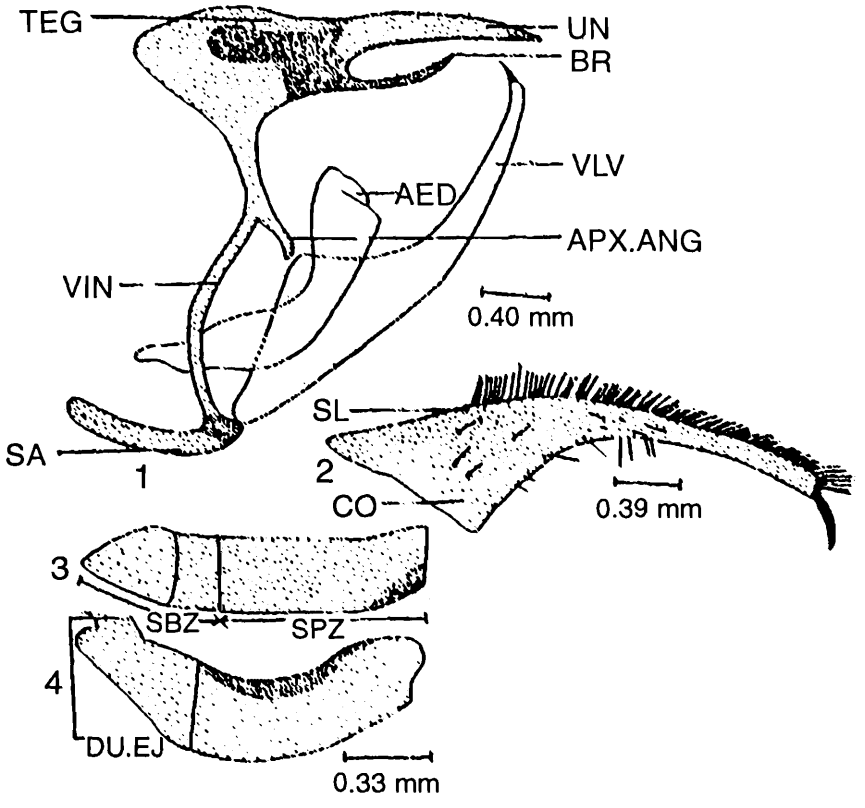
Distribution : According to D'Abrera (1985), the present range of *yama yama* is North-West India to Assam and Burma. Talbot (1947) given the distribution from Kullu to Nepal, Sikkim to Assam, Upper Burma (Chin Hills) to the Dawna Range.

Earlier it has been collected sporadically. Marshall & de Niceville (1883) reported it from Khasi hills and Sikkim. Mackinnon & de Niceville (1897) have studied its biology in Mussoorie (Uttarakhand). Hannyngton (1910) recorded the species from Nainital and Binsar at 7000 feet in May and June. Tytler (1911) reported the species from the Naga Hills. Peile (1937) reported the species from Mussoorie. Parsons & Cantille (1948) collected it from Shillong, Mawphlang and Laitlyngkot in the Khasi Hills.

The present author, on 27th June, 1994, collected it from Bhimtal, about 13 kms from Nainital in the Kumaon Himalaya.

Remarks : Moore (1857) reported *yama* under the genus *Zophoessa* Doubleday but subsequently proposed the generic name *Patala* on the type-species *Zophoessa yama* Moore (Moore, 1892). Somehow or the other, Moore in the same year reported a seasonal form of this species under a different name i.e., yamoides under *Patala* Moore which was subsequently synonymised by Bingham (1905) and Talbot (1947).

Further the scanning of the relevant literature reveals that the species, under reference, has been described under many generic names such as *Zophoessa* Doubleday (Marshall & de Niceville, 1883), *Patala* Moore (Watson, 1897), *Lethe* (Bingham, 1905; Evans, 1932; Talbot, 1947; Wynter-Blyth, 1957; Mani, 1986) and *Blanaida* Kirby (de Lesse, 1956) by respective workers. In view of



Figs. 1-4. : *Patala yama yama* (Moore) : 1. Male genitalia (lateral view), 2. Valva (inner view), 3. Aedeagus (dorsal view), 4. Aedeagus (Lateral view).

Abbreviations used in figures are : AED : Aedeagus, APX.ANG : Appendix angularis, BR : Brachium, CO : Costa, DU.EJ. : Ductus ejaculatorius, SA : Saccus, SBZ : Subzonal portion of aedeagus, SL : Sacculus, SPZ : Suprazonal portion of aedeagus, TEG : Tegumen, Un : Uncus, VIN : Vinculum, VLV : Valva.

the invalidity of the generic name *Blanaida* (Hemming, 1967), Smart (1985) has recognized the validity of the genus *Patala* Moore which was earlier synonymised under *Blanaida* by de Lesse (1956). Accordingly, Varshney (1989, 1994) listed the species under *Patala* Moore and the same arrangement is also currently followed. During the course of present studies, two males of this rare species have been examined and the male genitalia studied in detail. The aedeagus of this type-species has already been figured by de Lesse (1956). Talbot (1947) while giving the wing-venation of this type-species has not drawn the vein h in the hindwing and the needful is, accordingly done here.

It may also be added that the revival of the genus by Smart (1985) is supported by the fact that the male genitalia of the type-species *yama* Moore and *europa* Fabricius of the genera *Patala* Moore and *Lethe* Hübner respectively differ from each other drastically in respect of structures such as the aedeagus, tegumen, uncus and the valvae. This could not be ascertained on the basis of female genitalia which are wanting in both the sexes. In view of the study of the male genitalia, the diagnosis of *Patala* is updated,

The species is represented as *Patala yama yama* (Moore) in the North-West India whose range extends to Assam to Burma (Varshney, 1989, 1994).

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ACRIDOIDEA DIVERSITY OF HASTINAPUR WILDLIFE SANCTUARY, UTTAR PRADESH, INDIA

NARENDER SHARMA AND S. K. MANDAL

Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053, India

INTRODUCTION

Hastinapur Wildlife Sanctuary lies along the banks of the Ganga in Western Uttar Pradesh. The sanctuary was established mainly to accord protection to Swamp Deer *Cervus duvauceli duvauceli*, the state animal of Uttar Pradesh, and to conserve the fast vanishing, unique biome, locally known as Gangetic Khadar. It is unique in that it contains a variety of landforms and habitat types such as wetland, marshes, dry sand beds and gently sloping ravines known as Khola. Till a few decades ago (before 1980s), the Gangetic Khadar had extensive tracts of tall wet and dry grass, and khola had luxuriant forests. However, today much of the natural vegetation has been lost due to industries, human settlements and cultivation. Thus, the sanctuary is a highly disturbed protected area. The sanctuary is located between 78° 08' 47" E longitudes and 29° 32' 28" N latitudes. The temperature varies from 0°–48°C and the rainfall is more than 1000 mm. The sanctuary supports 180 species of birds. The vegetation of this sanctuary can be classified into tall wet grasslands, dry short grasslands, scrub and plantations (Nawab 2000).

Short-horned grasshoppers are included in the Superfamily Acridoidea. They are moderate in size, but range from less than 10 mm to 65 mm. The form of body shape, head and thorax are diverse; antennae are filiform but sometimes ensiform; tarsi three segmented; hind femora long, slender and thick towards base and adapted for leaping; wings are either fully developed or reduced or absent; forewings in the form of leathery tegmina; hind wings fan like; male external genitalia complex, symmetrical and concealed, when not in use, by the enlarged ninth abdominal sternum (Subgenital plate).

The most notable work on Indian grasshoppers was made by Kirby (1914). Later on Bolivar (1914, 1918), Uvarov (1921, 1923, 1925, 1927, 1929, 1940, 1940a, 1940b, 1942) have also studied the Orthoptera of Indian subcontinent. Willemese (1955) has studied the Orthoptera of Indo-Malayan

region. Later on Henry (1940), Dirsh (1954, 1958), Dirsh & Uvarov (1953), Banerjee and Kevan (1960), Hollis (1965, 1968, 1971, 1975), Mason (1973) and Ritchie (1981, 1982) have taxonomically treated several genera. Tandon (1975, 1976) and Tandon & Shishodia (1969, 1976, 1977) have studied Indian grasshoppers from different states. Shishodia & Hazra (1985, 1986) have studied the Acridoidea fauna of Silent Valley (Kerala), and Namdhapa (Arunachal) Pradesh. Bhowmik (1986) gave an account of the Acridoidea Fauna of West-Bengal, specially of North-Bengal. Further, Hazra *et. al.* (1993) have studied Acridoidea Fauna of West-Bengal.

The present paper deals with 25 species belonging to 2 families and 21 genera. All the species are reported from the sanctuary for the first time. Classification followed here is according to Uvarov (1966).

ABBREVIATIONS USED : Coll.– Name of the Collector, ex(s) – Number of example (s).

SYSTEMATIC ACCOUNT

Order ORTHOPTERA

Superfamily ACRIDOIDEA

Family PYRGOMORPHIDAE

Genus 1. ***Chrotogonus*** Serville, 1839

1. ***Chrotogous (Chr.) trachypterus trachypterus*** (Blanchard)

1836. *Ommexecha trachypterus* Blanchard, *Annls. Soc. ent. France*, **5** : 618.

1959. *Chrotogonus (Chr.) trachypterus trachypterus* : Kevan, *Publcoes cult. Co. Diam. Angola*, no. **43** : 147.

Material examined : 3 exs., 11.ix.2005, 4 exs., 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 6 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, South east of Maharastra, Madhaya Pradesh, Orissa, Tamil Nadu, and West Bengal.

Elsewhere : Sri Lanaka, Bangladesh and Pakistan.

Remarks : In general, it is widely distributed in the northern part of India. It is found on dry conditions on bare ground habitat and is a pest of various types of crops.

Genus 2. ***Atractomorpha*** Saussure, 1861

2. ***Atractomorpha crenulata*** (Fabricius)

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

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

Material examined : 6 exs., 10.ix.2005, 4 exs., 11.ix.2005, Hastinapur Range, Coll. N. Sharma; 5 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pardesh, Andaman & Nicobar, Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Lakshadweep, Madhaya Pradesh, Orissa, Rajasthan, Tamil Nadu, West Bengal.

Elsewhere : Bangladesh, Malaya, Myanmar, Pakistan, Sri Lanka, N. Sumatra, Thailand and S. Vietnam.

3. ***Atractomorpha burri*** Bolivar

1905. *Atractomorpha burri* Bolivar, *Bol. Soc. Espan. list. nat.,* **5** : 197, 203.

1969. *Atractomorpha burri* : Kevan and Chen, *Zool. J. Linn. Soc.*, **48** : 158, 160, 193.

Material examined : 1 ex., 11.ix.2005, 2exs., 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 2 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Arunachal Pradesh, West Bengal.

Elsewhere : Bhutan, Bangladesh, Malaya to Indo-China.

Remarks : The species is a new record from Uttar Pradesh. Hazra *et al.* (1993) while studying the fauna of West Bengal, has mentioned that no specimens of this species was found in the recent collections. However, a few examples collected earlier from Kurseong in Darjiling district were studied.

Genus 3. ***Pyrgomorpha*** Serville, 1839

4. ***Pyrgomorpha conica*** (Olivier)

1791. *Acrydium conicum* Olivier, *Encycl. Meth. Ins.,* **6** : 230.

1914. *Pyrgomorpha conica* : Kirby, *Fauna British India, Orthoptera* (Acridiidae) : 175.

Material examined : 2 ex., 11.ix.2005, 2exs., 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 14 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Karnataka, Rajasthan, West Bengal.

Elsewhere : N & W Africa, W. Asia, S. Europe.

Remarks : The species is a new record from Uttar Pradesh.

Genus 4. ***Poecilocerus*** Serville, 1831

5. ***Poecilocerus pictus*** Fabricius

1775. *Poecilocerus pictus* Fabricius, *Syst. Ent.*, p. 289.

1831. *Poecilocerus sonneeratii,* Serville, *Ann. Sci. Nat.* xxxii, 1831, p. 276.

1966. *Poecilocerus pictus : Akbar, Sind. Univ. Sci. Res. Journal,* : 1.

Material examined : 4 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Tamil Nadu.

Elsewhere : Baluchistan, Pakistan.

Remarks : The species could be collected from Sukartal only.

Family ACRIDIDAE

Subfamily HEMIACRIDINAE

Genus 5. ***Spathosternum*** Krauss, 1877

6. ***Spathosternum pr. prasiniferum*** (Walker)

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

1936. *Spathosternum prasiniferum prasiniferum* : Tinkham, *Lingman. Sci. Journ. Canton*, **15** : 51.

Material examined : 10 exs., 10.ix.2005, 4 exs., 11.ix.2005, 4 exs. 14.ix.2005, 5 exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 3 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma; 4 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Ptradesh, Andhra Pradesh, Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhaya Pradesh, Kerala, Maharastra, Orissa, Rajasthan,Tamil Nadu.

Elsewhere : Myanmar, S.E.China, Thailand and Vietnam.

Remarks : The species occurs almost throughout India and is associated with the grassy habitats.

Genus 6. ***Hieroglyphus*** Krauss, 1877

7. ***Hieroglyphus nigrorepletus*** Bolivar

1912. *Hieroglyphus nigrorepletus* Bolivar, *Trab. Mus. Cienc. nat. Madr.*, no. **6** : 56.

1973. *Hieroglyphus nigrorepletus* : Mason, *Bull. Brit. Mus. nat. Hist.* (Ent.), **28**(7) : 526.

Material examined : 2 exs., 10.ix.2005, 2 exs., 11.ix.2005, 1ex. 14.ix.2005, 1ex. 15.ix.2005, Hastinapur Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Assam, Bihar, Kashmir, Karnataka, Maharastra, Orissa, Punjab, West Bengal.

Elsewhere : Bangladesh and Pakistan.

Remarks : It is a serious pest of paddy.

Subfamily OXYINAE

Genus 7. ***Oxya*** Serville, 1831

8. ***Oxya fuscovittata*** (Marschall)

1836. *Gryllus fuscovittatus* Marschall, *Annls. Wien. Mus. Naturg.*, 1 : 211.

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

Material examined : 2 exs., 10.ix.2005, 3exs., 11.ix.2005, 2 exs. 14.ix.2005, 4exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andhra Pradesh, Rajasthan, Madhya Pradesh, Jammu & Kashmir, Orissa, West Bengal.

Elsewhere : Afghanistan, Pakistan, USSR (South West).

Remarks : In the sanctuary area, the species is associated with the paddy and grass adjoining the cultivated fields.

9. ***Oxya hyla hyla*** Serville

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

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

Material examined : 3 exs., 10.ix.2005, 4 exs., 11.ix.2005, 3exs. 14.ix.2005, 5exs., 15. ix.2005, Hastinapur Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Himachal Pradesh, Karnataka, Madhya Pradesh, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, and West Bengal.

Elsewhere : Africa, Afghanistan, Bangladesh, Madagascar, Nepal, Pakistan, Persia and Sri Lanka.

Subfamily EYEPREPOCNEMIDINAE

Genus 8. ***Choreodocus*** Bolivar, 1914

10. ***Choreodocus illustris*** (Walker)

1870. *Heteracris illustris* Walker, *Cat. Derm., Salt. Brit. Mus.*, **4** : 622, 623.

1921. *Choreodocus illustris* : Uvarov, *Trans. R. ent. Soc. London*, **69**(1 & 2) : 109.

Material examined : 2 exs., 10.ix.2005, 2 exs., 11.ix.2005, 1ex. 14.ix.2005, 2exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 2 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Uttaranchal, Himachal Pradesh and Tamil Nadu.

11. ***Choreodocus robustus*** (Serville)

1839. *Acridium robustus* Serville, *Ins. Orth.*, 647.

1921. *Choreodocus robustus* : Uvarov, *Trans. ent. Soc. Lond.*, (69) : 109.

Material examined : 2 exs., 10.ix.2005, 1ex., 11.ix.2005, 3 ex. 14.ix.2005, 2exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 4 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Arunachal Pradesh, Assam, West Bengal.

Elsewhere : Bangladesh.

Remarks : The species is a new record from Uttar Pradesh.

Subfamily CATANTOPINAE

Genus 9. ***Catantops*** Schaum, 1853

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

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

1953. *Catantops pinguis innotabilis* : Dirsh and Uvarov, *Tijdsch. Ent.*, **96**(3) : 233.

Material examined : 6 exs., 10.ix.2005, 4 exs., 11.ix.2005, 3exs. 14.ix.2005, 4exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 8 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma; 5 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Arunachal Pradesh, Assam, Himachal Pradesh, Kerala, Orissa, Tamil Nadu.

Elsewhere : Myanmar, Java, Malaya, New Guinea, Philippines, Sri Lanka, Sumatra, Yunan and Thailand.

Genus 10. ***Xenocatantops*** Dirsh and Uvarov, 1953

13. ***Xenocatantops humilis humilis*** (Serville)

1839. *Acridium humile* Serville, *Ins. Orth.*, : 662.

1953. *Xenocatantops humilis humilis* : Dirsh, & Uvarov, *Tijdschr. Ent.*, **96** : 237.

Material examined : 2 exs., 10.ix.2005, 2 exs. 14.ix.2005, 3exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 1 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma; 2 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andaman and Nicobar Islandas, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Kerala, Madhya Pradesh, Maharastra, Manipur, Meghalaya, Mizoram, Tamil Nadu, and West Bengal.

Elsewhere : Bangladesh, Borneo, Indo-China, Lombock, Malaya, Myanmar, New Guinea, Philippines, Sri Lanka, Sumatra, Thailand, S. Tibet, Vietnam and Yunan.

Genus 11. ***Stenocatantops*** Dirsh & Uvarov, 1953

14. ***Stenocatantops splendens*** (Thunberg)

1815. *Gryllus splendens* Thunberg, *Mem. Acad. Sci. St. Peterb.*, **5** : 236.

1953. *Stenocatantops splendens* : Dirsh, & Uvarov, *Tijdschr. Ent.*, **96** : 237.

Material examined : 1 exs., 11.ix.2005, 2 exs. 14.ix.2005, Hastinapur Range, Coll. N. Sharma; 4 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andaman and Nicobar Islandas, Arunachal Pradesh, Assam, Bihar, Delhi, Kerala, Madhya Pradesh, Maharastra, Orissa, Tamil Nadu, West Bengal.

Elsewhere : China, Myanmar, Nepal, Korea, Hainan, Philippines, Sumatra, Java, Taiwan, Vietnam.

Subfamily CYRTACANTHACRIDINAE

Genus 12. ***Cyrtacanthacris*** Walker, 1870

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

1758. *Gryllus locusta tataricus* Linnaeus, *Systema Naturae (10th ed.)* : 432.

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

Material examined : 1ex., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andhra Pradesh, Assam, Bihar, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Maharastra, Manipur, Orissa, Rajasthan, Tamil Nadu, Uttaranchal, West Bengal.

Elsewhere : Africa (except North Africa) and Sahara, Hainan, Madagascar, Phillipines, Seychelles, Sri Lanka, Sumatra and Thailand.

Subfamily ACRIDINAE

Genus 13. ***Acrida*** Linnaeus, 1758

16. ***Acrida exaltata*** (Walker)

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

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

Material examined : 1ex., 10.ix.2005, 6 exs., 11.ix.2005, 2ex. 14.ix.2005, 2exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 4 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA (Throughout India).

Elsewhere : Afghanistan, Aden, Arabia, Bangladesh, S.E. Iran, Nepal, Pakistan, Sri Lanka, S.E.Tibet and Yemen.

Genus 14. ***Phlaeoba*** Stål, 1860

17. ***Phlaeoba infumata*** Brunner

1893. *Phlaeoba infumata* Brunner, *Annali Mus. civ. Stor. Nat. Giacomo Doria*, **33** : 124.

1914. *Phlaeoba ifumata* : Kirby, *Fauna Brit. India, Orthopt.* (Acriddae) : 103.

Material examined : 2exs., 10.ix.2005, 1ex., 11.ix.2005, 2exs.2.ix.2005, 1ex. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 3 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA (Widely distributed).

Elsewhere : S. China, Malacca, Myanmar, E. Nepal.

Genus 15. ***Ceracris*** Walker, 1870

18. ***Ceracris striata*** (Brunner)

1989. *Ceracris fasciata* Ingrisch, *Spixiana*, **11**(3) : 235.

Material examined : 2 exs., 10.ix.2005, 5 exs., 11.ix.2005, 5 exs. 14.ix.2005, 2exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 2 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Uttaranchal, Tripura.

Elsewhere : S. Chaina, Myanmar and Thailand.

Remarks : It is newly recorded from Uttar Pradesh.

Genus 16. ***Perella*** Bolivar, 1914

19. ***Perella insignis*** Bolivar

1914. *Perella insignis* Bolivar, *Trab. Mus. Cienc. nat. Madr., Madrid,* **20** : 87

Material examined : 2 exs., 14.ix.2005, Hastinapur Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, West Bengal.

Remarks : The species is endemic to India and is newly recorded from Uttar Pradesh. It is a rare species.

Subfamily GOMPHOCERINAE

Genus 17. ***Dnopherula*** Karsch, 1896

Subgenus ***Aulacobothrus*** Bolivar, 1902

20. ***Dnopherula (Aulacobothrus) luteipes*** (Walker)

1871. *Stenobothrus luteipes* Walker, *Cat. Derm. Salt. Brit. Mus.*, **5** Suppl., : 82.

1971. *Dnopherula (Aulacobothrus) luteipes* : Jago, *Proc. Acad. Sci. Philad.*, **123**(8) : 243.

Material examined : 2 exs., 10.ix.2005, 3exs., 11.ix.2005, 2 exs. 14.ix.2005, 1ex. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 2 exs., 13.ix.2005, Sukartal, Coll. N. Sharma; 1 ex., 17.ix.2005, Dhanora Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Assam, Bihar Delhi, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharastra, Orissa, Tamil Nadu, Uttaranchal, West Bengal.

Elsewhere : Myanmar, Sri Lanka, N. America, China, Europe, Japan.

21. ***Dnopherula (Aulacobothrus) decisus*** (Walker)

1871. *Stenobothrus decisus* Walker, *Cat. Derm. Salt. Br. Mus.*, **5** : 80.

1971. *Dnopherula (Aulacobothrus) decisus* : Jago, *Proc. Acad. Sci. nat. Philad.*, **123**(8) : 24.

Material examined : 1ex. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; Coll. N. Sharma; 3 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Uttaranchal, Arunachal Pradesh, Karnataka, Maharastra.

Remarks : This species is limited in distribution.

Subfamily OEDIPODINAE

Genus 18. ***Aiolopus*** Fieber, 1853

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

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

1968. *Aiolopus thalassinus tamulus* : *Hollis, Bull. Brit. Mus. nat. Hist.* (Ent.), **22**(7) : 347.

Material examined : 1 ex., 10.ix.2005, 1 ex. 14.ix.2005, 1exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 3 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andaman & Nicobar Islands, Bihar, Delhi, Himachal Pradesh, Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu, Uttaranchal, West Bengal.

Elsewhere : Australia, Bangladesh, Borneo, Celebes, China, Hainan, Hong Kong, Japan, Java, Malaya, Myanmar, New Guinea, Papua, Philippines, Singapore, Sri Lanka, Sumatra, Taiwan, Thailand and Timor.

Remarks : This species is recorded throughout Oriental region and extends upto Australia.

Genus 19. ***Oedaleus*** Fieber, 1853

23. ***Oedaleus abruptus*** (Thunberg)

1815. *Gryllus abruptus* Thunberg, *Mem. Acad. Sc. St. Petersb.*, **5** : 233.

1981. *Oedaleus abruptus* : Ritchie, *Bull. Brit. Mus. nat. Hist. (Ent)*, **42**(3) : 104-107.

Material examined : 2 exs., 13.ix.2005, Sukartal, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhaya Pradesh, Meghalaya, Orissa, Rajasthan, Tamil Nadu, West Bengal.

Elsewhere : Afghanisthan, Bangladesh, China, Indo-Chaina, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand.

Remarks : It is widely distributed species.

Genus 20. ***Gastrimargus*** Saussure, 1884

24. ***Gastrimargus africanus africanus*** (Saussure)

1888. *Oedaleus (Gastrimargus) marmoratus var. africana* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, **30**(1) : 39.

1982. *Gastrimargus africanus africanus* : Ritchie, *Bull. Brit. Mus. nat. Hist. (Ent.)*, **44**(4) : 248.

Material examined : 2 exs., 10.ix.2005, 3 exs., 11.ix.2005, 2 exs. 14.ix.2005, 2exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma.

Distribution : INDIA : Uttar Pradesh, Andhra Pradesh, Bihar, Delhi, Goa, Himachal Pradesh, Karnataka, Orissa, Sikkim, Uttaranchal, West Bengal.

Elsewhere : Nepal, Saudi Arabia, Sri Lanka, Thailand, Tibet and Yemen A. R.

Genus 21. ***Trilophidia*** Stål, 1873

25. *Trilophidia annulata* (Thunberg)

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

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

Material examined : 3exs., 10.ix.2005, 3exs., 11.ix.2005, 2 exs. 14.ix.2005, 4 exs. 15.ix.2005, Hastinapur Range, Coll. N. Sharma; 4 exs., 13.ix.2005, Sukartal, Coll. N. Sharma; 3 exs., 17.ix.2005, Dhanora Range, Coll. N. Sharma.

Distribution : INDIA : Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Karnataka, Madhya Pradesh, Orissa, Sikkim, Tamil Nadu, and West Bengal.

Elsewhere : Afghanistan, Bangladesh, Borneo, South China, Japan, Java, Korea, Malayasia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sarawak, Singapore, Sri Lanka, Sumatra, Taiwan, Thailand, Vietnam.

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RECORD AND ABUNDANCE OF EARTHWORMS AT BALLAVPUR WILDLIFE SANCTUARY, BIRBHUM, WEST BENGAL

S. K. Biswas, G. C. Ray, C. K. Mandal and A. Misra

Zoological Survey of India, Kolkata

INTRODUCTION

With a view to study the earthworm fauna of Ballavpur Wildlife Sanctuary, Birbhum three study tours were conducted during 2003–2004. The Ballavpur Deer Park near Viswavarati University, Santiniketan, Birbhum is well known to the people of Kolkata. The area was developed as a Deer Park measuring about 200 hectares forest land and was promoted to the status of Wildlife Sanctuary by the Government of West Bengal on 11th July, 1977.

Ballavpur Wildlife Sanctuary (Fig. 1) is the best place for observing the wildlife fauna particularly, the birds of Birbhum. This Sanctuary is about 20 minutes drive from Bolepur (Santiniketan) Railway Station. The terrain of undulating and eroded lateritic soil partly mixed with morum and clay (the famous 'Khoai' of Santiniketan) was converted into a forest by plantation during the year 1954–55. Nearly 50 years have passed, and very little improvement is noticed to add the growth of the tree on the nutrient poor soil. Further the practice of sweeping away all leaf litters has only compounded to the misery of the soil and the flora. There is virtually no undergrowth.

The principal trees of the Sanctuary are Akashmoni (*Acasia monilliformis*), Sal (*Shorea robusta*) Sishu (*Dalbergia sissoo*), Cashew Nut tree (*Anacardium occidentale*), Behera (*Terminalia bellerica*), Amloki (*Emblica officinalis*), Chhatim (*Alstonia scholaris*), *Ficus* sp., *etc.*

Although the whole of the Sanctuary is fenced, the boundary has been destroyed at many places. However, an inner hundred acres separately wired off, holds only one species of ungulate, the Chital or spotted Deer (*Axis axis*). In the book named, Wildlife in West Bengal published by Government of West Bengal in 1985 reported 17 black Buck and 71 Chittal were available in the park. At present, only Chital is available, while the blackbuck (*Antilope cervicarpa*) did not survive there.

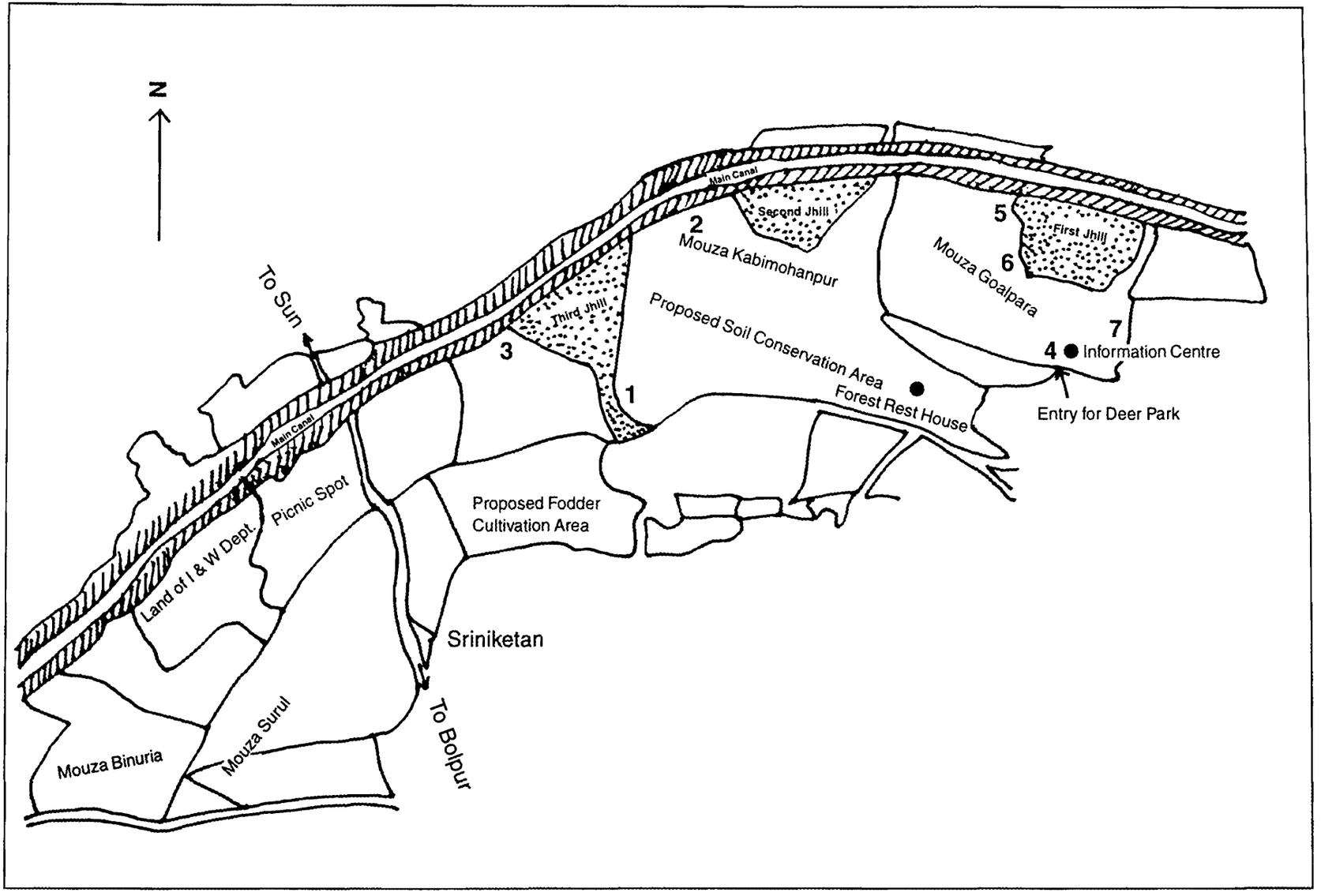


Fig. 1. : Map of Ballavpur Wildlife Sanctuary, Birbhum showing the collecting stations (1 to 7)
(Not to Scale)

There are three water bodies in the Sanctuary. They are named very imaginatively Jheel No. 1, 2 and 3. The first one falls within the privileged 100 acres and is the most spectacular aspect of the Sanctuary. This Jhill is separately fenced and cannot be approached over ground. One Watch Tower at the edge provides excellent views of the water fowl, specially ducks during the winter. Records show ducks are predominantly available in the Jheel. Pintail numbers the most followed by Lesser Whistling Teal. Tufted Duck, Comb Duck, Cotton Teal are few in number. The prevalent species—the Pin-tailed leave the Jheel at sun down in great silent batches of hundreds which form a dark cloud for a brief movement and then spreads out in rippling waves and flies away to the south-east in search of paddy fields.

Ducks are accompanied by other water birds. The purple Moorhen and the Bronze-winged Jacana with their chicks. Egrets and Herons softly tread the weed-covered edges searching for an unwary insects and amphibians. They in turn bring in the winged hunters. The Kestrel, the Honey Buzzer and then of course the Marsh Harrier swooping and snatching at the mass of Ducks-spreading them to a clear patch of water in the hope that a helpless victim may become isolated—a Moorhen perhaps.

The trees away from water also hold a variety of birds. There is a provision of spot entry permit on payment of a nominal sum. There is also a forest Bungalow at the edges of the forests, booking for which is available from the Division of the Forest Officer, Siuri, Birbhum, West Bengal or the Conservator of Forest, Central Circle, 35, Gopal Nagar Road, Kolkata-700 027.

From the literature (Gates, 1972; Halder, 1998; Julka, 1988; Julka & Senapati, 1987 and Stephenson, 1923) it appears that there is no published information on the earthworms fauna of Ballavpur Wildlife Sanctuary, Nadia. However, Halder (1988) recorded nine species of earthworms from Birbhum district, West Bengal. The present study reveals the presence the fourteen species in and around Ballavpur wildlife Sanctuary including eleven species from the sanctuary proper. In this connection, it may be mentioned here that earthworms are considered as an indicator of soil condition of the area concerned. On the other hand, reserve areas are the places where any group of organisms may live sustainably, if proper measures are taken. The soil of the Ballavpur Wildlife Sanctuary is of laterite type, locally called 'morum' which is not ideal for soil living organisms. It is perhaps, due to the continuous efforts of the Forest department by suitable afforestation programme, the sanctuary supports a good earthworm faunal diversity.

LIST OF SPECIES OF EARTHWORM COLLECTED FROM BALLAVPUR WILDLIFE SANCTUARY, BIRBHUM

Phylum ANNELIDA

Class OLIGOCHAETA

A. Order MONILIGASTRIDA

I. Family MONILIGASTRIDAE

1. Genus ***Drawida*** Michaelsen, 1900

1. *Drawida nepalensis* Michaelsen

Order HAPLOTAXIDA

Family ALMIDAE

Genus ***Glyphidrilus*** Horst, 1889

2. *Glyphidrilus tuberosus* Stepheneson

Family OCTOCHAETIDAE

Genus ***Eutyphoeus*** Michaelsen, 1900

3. *Eutyphoeus incommodus* (Beddard)
4. *Eutyphoeus nicholsoni* (Beddard)
5. *Eutyphoeus waltoni* (Michaelsen)

Genus ***Octochaetona*** Gates, 1962

6. *Octochaetona beatrix* (Beddard)
7. *Octochaetona surensis* (Michaelsen)

Family GLOSSOSCOLECIDAE

Genus ***Pontoscolex*** Schmande, 1861

8. *Pontoscolex corethrurus* (Muller)

Family MEGASCOLECIDAE

Genus ***Amynthas*** Kinberg, 1867

9. *Amynthas diffringens* (Baird)

Genus ***Lampito*** Kinberg, 1867

10. *Lampito mauritii* Kinberg

Genus ***Metaphire*** Sims & Easton, 1972

11. *Metaphire houlleti* (Perrier)
12. *Metaphire planata* (Gates)

Genus ***Perionyx*** Perrier, 1872

13. *Perionyx excavatus* Perrier
14. *Perionyx sansibaricus* Michaelsen

SYSTEMATIC ACCOUNT

Class OLIGOCHAETA

Order MONILIGASTRIDA

Family MONILIGASTRIDAE

Genus ***Drawida*** Michaelsen, 1900

1. ***Drawida nepalensis*** Michaelsen, 1907

1907. *Drawida nepalensis* Michaelsen, *Mitt. naturh. Mus. Hamb.*, **24** : 146.

Material : 5 ex., Ballavpur Stn. 3, 20.07.2003.

Diagnosis : Length 50-130 mm, diameter 2-5 mm, segments 120-180; clitellum in IX to XIV; dorsal pore absent; spermathecal pores one pair, small transverse slits, just median to C; genital markings one small, circular, translucent area lateral or anterior to each male porophore, another similar one on VII, just anterior to each spermathecal pore; male pores paired at or median to in B C in 10/11, and just in front of female pore (11/12).

Gizzards 2-4, in XII-XX; prostates glandular, prostatic capsules 2-4 mm long, slenderly club-shaped; spermathecal ampula irregularly pear-shaped; diverticulum sac-like, 3-5 mm long in VII with regular annulations.

Remarks : Recorded under grasses in forest floor with moderately rich organic matter. However, there abundance is very poor.

Order HAPLOTAXIDA

Family ALMIDAE

Genus ***Glyphidrilus*** Horst, 1889

2. ***Glyphidrilus tuberosus*** Stephenson, 1916

1916. *Glyphidrilus tuberosus* Stephenson, *Rec. Indian Mus.*, **12** : 349.

Material : 9 ex., Ballavpur Stn. 1, 20.07.2003; 13 ex., Ballavpur Stn. 4, 23.07.2003.

Diagnosis : 55-115 mm, diameter 2.5-3 mm, segments 215-220; prostomium prolobic; clitellum annular on XIV, XV, XVI-XXVIII, XXIX, with lateral, longitudinal and protuberant ridges (wing like) on XX-XXIV, extending forwards as slight ridges to XIV and sometimes back to XXVIII; spermathecal pores minute, 2-4 on each side in 13/14 and 14/15; genital markings small rounded papillae postsetal, usually arranged in a set of 6 in a transverse row on a segment-2 in A A, 1 in A B, slightly lateral to B on X-XII, XIII, 1 medial to A, 1 in A B and 1 lateral to B on XVI, XVII, XVIII-XIX, XXIV-XXVIII, XXX; male pores inconspicuous; female pores paired, minute, slightly lateral to B lines, pre-setal on XIV.

Gizzard in VII, sometimes extending in VI; intestine begins in XV; last pair of hearts in XI; spermathecae small spherical sacs without diverticula, 2-4 on each side in XIV & XV.

Remarks : Originally described from Orissa and endemic to India. Prefer moist soil or submerged soil only with high organic matter, and observed abundantly during post monsoon season.

Family OCTOCHAETIDAE

Genus ***Eutyphoeus*** Michaelsen, 1900

3. ***Eutyphoeus incommodus*** (Beddard, 1901)

1901. *Typhoeus incommodus* Beddard, *Proc. zool. Soc. Lond.*, **1901** : 200.

Material : 3 ex., Sriniketan, 17.12.2002; 7 ex., Agricultural Field, Surul, 21.07.2003.

Diagnosis : Length 25-145 mm, diameter 2.5-6 mm, segments 90-191; prostomium pro/epilobic or pro/tanylobic; clitellum annular on XIII to XVII, XVIII; spermathecal pores paired, small transverse slits in 7/8, slightly lateral to B; genital markings paired, postsetal at AB, on XII, XIII-XVI; male pores within slight transversely placed fissures, at or close to B, each fissure at the centre of a disc-shaped conical porophore; female pores paired, pre-setal at or slightly median to A lines. Lateral intestinal caeca absent, ventral intestinal caeca 3-9 in XXVII-XXXVI, supra-intestinal glands 3-6 pairs in LXII-LXXV; penial setae ornamented with sparse, rather widely separated rows of very fine spines, tip bluntly rounded; spermathecae paired, in VIII, each with a circle of seminal chambers or 4-5 stalked ental diverticula; genital marking glands absent.

Remarks : Rarely occurring, available only during post monsoon period only.

4. ***Eutyphoeus nicholsoni*** (Beddard, 1901)

1901. *Typhoeus nicholsoni* Beddard, *Proc. zool. Soc. Lond.*, **1901** : 195.

Material : 7 ex., 21.07.2003, Agricultural Field, Surul.

Diagnosis : Length 145-185 mm, diameter 5-5.5 mm, segments 190-225; clitellum annular on XIII to XVII; female pore single on left side of XIV; spermathecal pores paired at or just lateral to A; genital markings paired, circular or oval, in 15/16.

Prostrate coiled, duct muscular and long, in an S-shaped curve; penial setae about 4 mm long; seminal chambers in one or two clusters or a semi-circular row, on posterior face of duct.

Remarks : This species is endemic to India. Deep burrowing forms with tower like castings, prominently visible above the ground.

5. ***Eutyphoeus waltoni*** (Michaelsen, 1907)

1907. *Eutyphoeus waltoni* Michaelsen, *Mitt. naturh. Mus. Hamb.*, **24** : 179.

Material : 4 ex., 20.07.2003, Ballavpur Stn. 3.

Diagnosis : Length 53-230 mm, diameter 4-8 mm, segments 115-201; clitellum annular on XIII/XIV to XVII/XVIII; male pore in B, in a pair of narrow transverse depression; female pore single, on left side of XIV; spermathecal pores paired, on or median to C; first dorsal pore at 11/12; genital markings paired, post-setal, ca. in A B, on IX (VIII & X), in 14/15-15/16, 18/19 (19/20-22/23).

Prostrate extends through XVI or XVII-XIX or XX; duct 5-8 mm long; penial setae 4-5 mm long; seminal vescicles extending back to 14/15.

Remarks : This species is endemic to Oriental region.

Genus ***Octochaetona*** Gates, 1962

6. ***Octochaetona beatrix*** (Beddard, 1902)

1902. *Octochaetus beatrix* Beddard, *Ann. Mag. nat. Hist.* (ser. 7), **9** : 456.

Material : 4 ex., 20.07.2003, Ballavpur Stn. 3.

Diagnosis : Length 40-134 mm, diameter 2-5 mm, segments 133-197; clitellum annular on XIII-XVII, XVIII; male field depressed, male pores minute, median to A; female pore paired, pre-setal in A A; spermathecal pores paired, minute, at or slightly anterior to setal arc of VIII & IX, median to A; genital marking absent; first dorsal pore at 12/13, occasionally at 11/12.

Gizzard between septa 4/5 & 8/9; last pair of hearts in XIII; Prostrates in XVII-XIX, ducts thin and short, prostate glands two pairs.

Remarks : This is very rare in occurrence in the Sanctuary. Occur in lawns only with moderate amount of organic matter.

7. ***Octochaetona surensis*** (Michaelsen, 1910)

1910. *Octochaetus surensis* Michaelsen, *Abh. Geb. Naturw., Hamburg*, **19**(5) : 88.

Material : 2 ex., 17.12.2002, Sriniketan.

Diagnosis : Length 60-140 mm, diameter 2.5-6 mm, segments 175-180; colour brown; clitellum XII-XVI; first dorsal pore at 12/13; genital markings oval, paired or unpaired and median, post setal in some of XVIII-XXII; spermathecal pores minute at or near equators of VIII-IX, in A B; male pores minute median to B; prostatic pores minute, at B; female pores paired, sometimes unpaired and median.

Gizzards between septa 4/5 and 8/9; Last pair of hearts in XII; intestine begins in XVII; seminal vesicles in IX & XII.

Remarks : Castings in the form of globules which often fused with each other to form large irregular pyramidal structure of about 4 to 5 cm height in soils with high moisture contents.

Family GLOSSOSCOLECIDAE

Genus ***Pontoscolex*** Schmanda, 1961

8. ***Pontoscolex corethrurus*** (Muller, 1856)

1856. *Lumbricus corethrurus* Muller, *Abhandl. naturgesch. ges. Halle,* **4** : 26.

Material : 10 ex., 14.12.2002, Ballavpur Stn. 2.

Diagnosis : Length 48-120 mm, diameter 2 mm, segments 60-232; clitellum shaddle-shaped, XV, XVI-XXI, XXII, XXIII; lumbricine setal arrangement, first closely paired, then widely paired, and lastly "quincunx" arrangements at hinder end of the body; spermathecal pores three pairs, minute at C on 6/7-8/9; male pores minute, probably on 20/21; female pores minute, on left side at A B, slightly in front of 14/15.

Intestinal origin in XIV or XV; last pair of hearts in XI; spermathecae club-shaped, ducts slender.

Remarks : Also recorded earlier from manure and compost heaps, humus and sandy soil, under barks of trees, under rotting tree trunks and rotting plantain trunks. In Karnataka, this species was reported to make the soil compact, hard and cloddy.

Family MEGASCOLECIDAE

Genus ***Amynthas*** Kinberg, 1867

9. ***Amynthas diffringens*** (Baird, 1809)

1809. *Megascolex diffringens* Baird, *Proc. zool. Soc. Lond.,* **1809** : 40.

Material : 16 ex., 13.02.2004, Ballavpur, Stn. 3; 8 ex., 15.02.2004, Ballavpur Stn. 3.

Diagnosis : Length 45-170 mm, diameter 3-6 mm, segments 79-121; clitellum XIV-XVI; first dorsal pore usually at 11/12; genital marking small circular or shortly elliptical disk, paired pre-setal, just median to the line of spermathecal pores in some or all or VI-IX; post-setal, just in front of spermathecal pores in some or all V-VIII; spermathecal pores 4 pairs, minute, superficial, each in a small circular to transversely elliptical disk in 5/6-8/9.; female pores mid ventral.

Gizzards large, somewhat conical, narrow in front; intestinal origin usually in XVI; last pair of hearts in XIII.

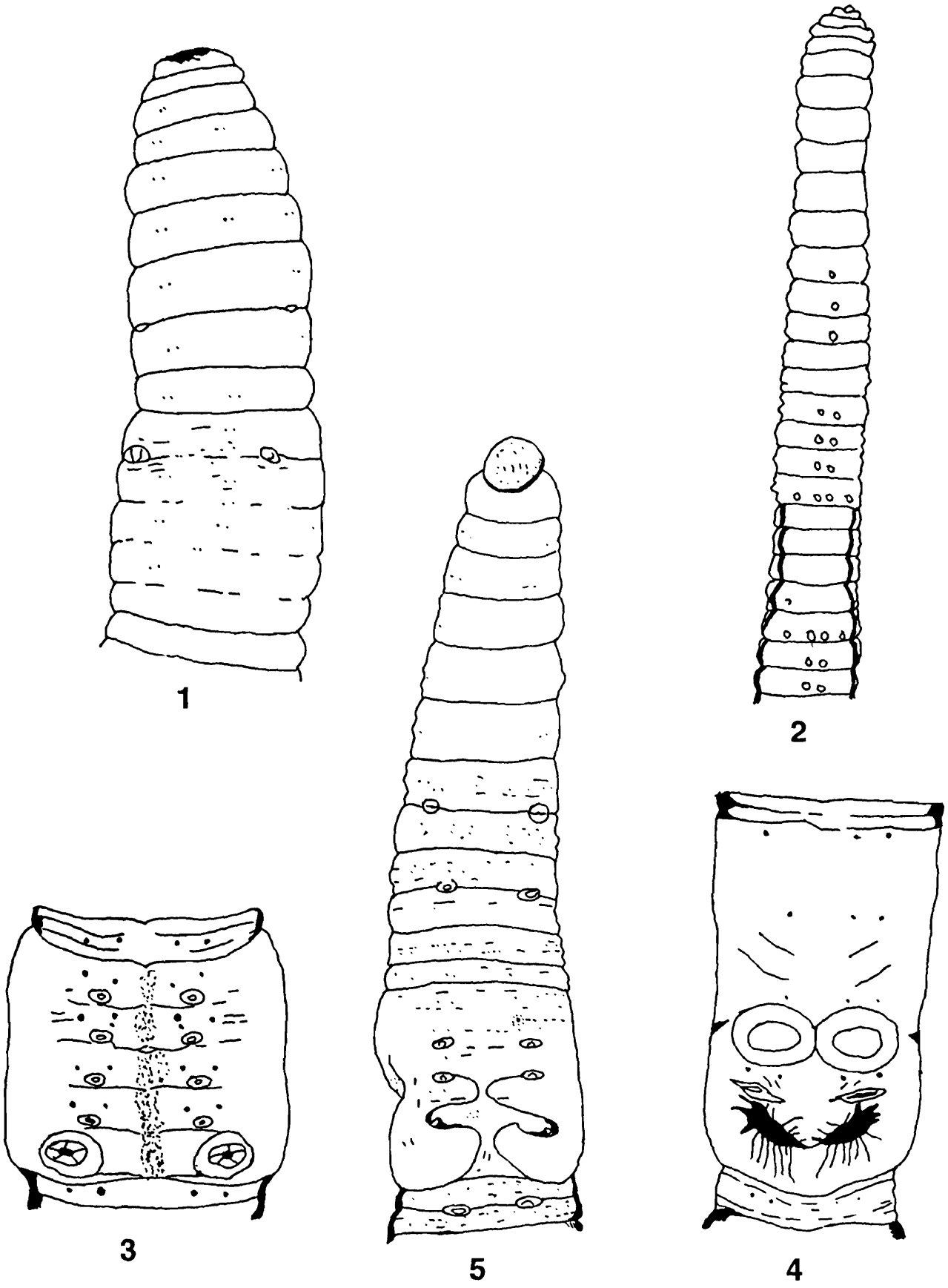
Remarks : Soils in forest floor with high organic matter; under stones and rocks and rotten woods near pond water.

Genus ***Lampito*** Kinberg, 1867

10. ***Lampito mauritii*** Kinberg, 1867

1867. *Lampito mauritii* Kinberg, *Ofvers. K. Vetens. Akad. Forhandl. Stockholm,* **23** : 103.

Material : 29 ex., 17.12.2002, Sriniketan; 36 ex., 13.02.2004, Sriniketan; 19 ex., 23.07.2003, Sriniketan; 5 ex., 15.02.2004, Ballavpur Stn. 2 Jhill No. 3; 15 ex., 14.02.2004, Ballavpur Stn. 1 (Jhill No. 3).



Figs. 1-5. : Showing the Genital regions of the Earthworms for identification. 1. *Drawida nepalensis*; 2. *Glyphidrilus tuberosus*; 3. *Eutyphoeus incommodus*; 4. *Eutyphoeus nicholsoni*; 5. *Eutyphoeus waltoni*.

Diagnosis : Length 95-155 mm, diameter 3-6 mm, segments 79-121; clitellum annular, XIV-XVII or XVIII; spermathecal pores 3 pairs, large, in EG, at 6/7, 7/8, 8/9; male pores in XVIII, at or lateral to B, in paired, circular, slightly raised porophores that extends from A into CE; female pores paired on XIV; genital marking absent.

Remark : This species is recorded abundantly throughout the year within the Sanctuary.

Genus ***Metaphire*** Sims & Easton, 1972

11. ***Metaphire houlleti*** (Perrier, 1872)

1872. *Perichaeta houlleti* Perrier, *Nouv. Arch. Mus. Hist. nat. Paris*, **8** : 99.

Material : 7 ex., 20.07.2003, Ballavpur Stn. 4; 1 ex., 17.12.2002, Sriniketan.

Diagnosis : Length 90-105 mm, diameter 3-6 mm, segments 79-121; Clitellum annular, XIV-XVI; seta perichaetine, often present on clitellar segments; spermathecal pores 3 pairs; male pores in XVIII, minute; female pore single, mid-ventral on XIV; genital markings lacking externally; pigment reddish brown; gizzard between septa 7/8 & 10/11.

Remarks : This is a common species, however, recorded mostly during post monsoon periods.

12. ***Metaphire planata*** (Gates, 1926)

1926. *Pheretima planata Gates, Ann. Mag, nat. Hist.,* (Se. 9), **17** : 411.

Material : 11 ex., 17.12.2002, Ballavpur Sanctuary, near Jhill No. 1, Stn. 7.

Diagnosis : Length 64-176 mm, diameter 4-7 mm, segments 115-142; clitellum XIV-XVI; genital markings small, circular, just median to each spermathecal pore; first dorsal pore at 10/11 or 11/12; spermathecal pore two pairs, minute and superficial, on anterior margins on VII and VIII; female pores single, mid-ventral, on XIV; male pores minute, on XVIII.

Intestinal origin in XV; last pair of hearts in XIII; seminal vesicles in XI & XII; prostrate in XVI-XXI, duct U-shaped; genital markings glands stalked.

Remarks : This is reported to be very rare in occurrence in India and endemic to Oriental region.

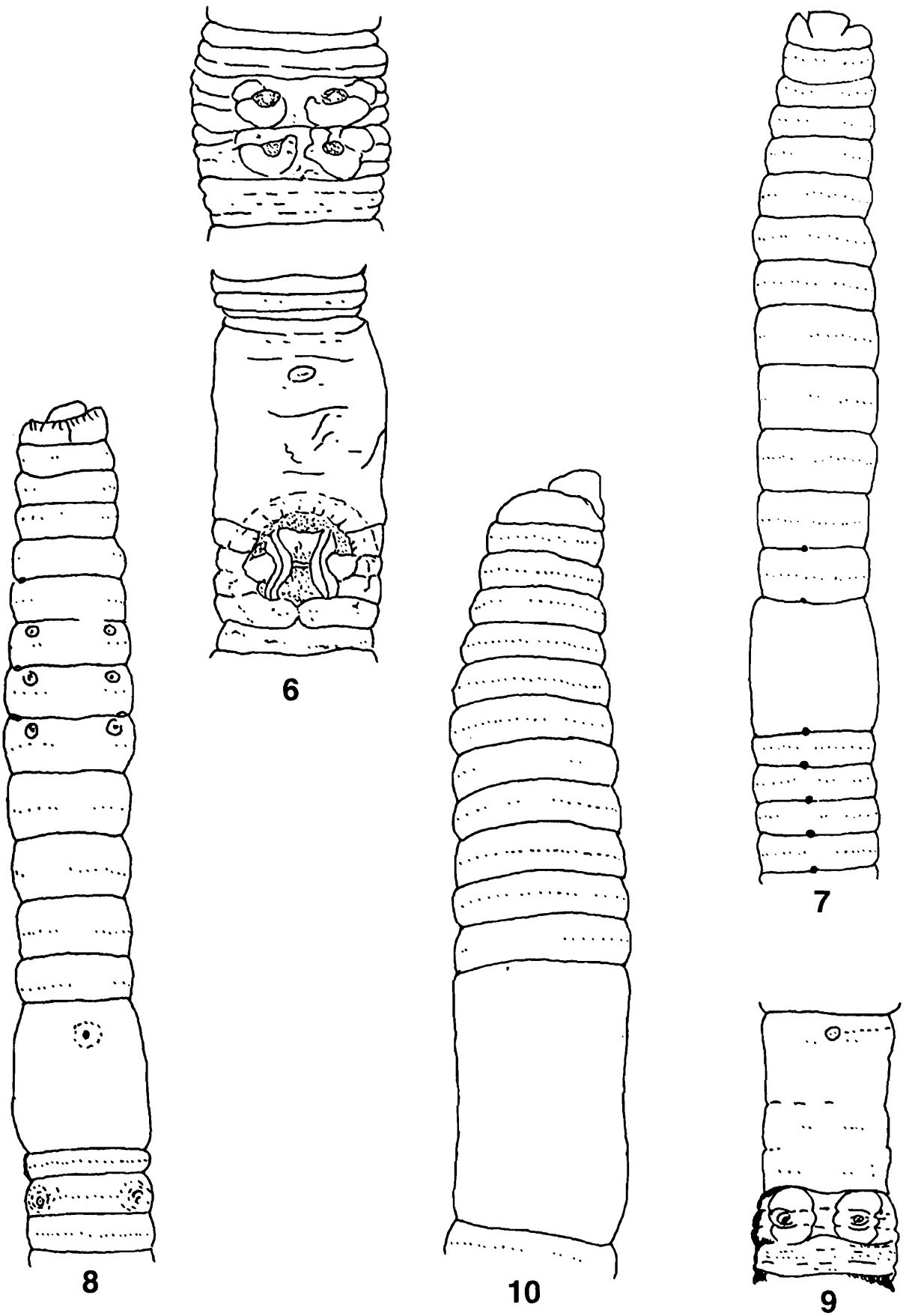
Genus ***Perionyx*** Perrier,, 1872

13. ***Perionyx excavatus*** Perrier, 1872

1872. *Perionyx excavatus* Perrier, *Nouv. Arch. Mus. Hist. Nat. Paris*, **8** : 126.

Material : 19 ex., 23.07.2003, Ballavpur Stn. 6 (Jhill No. 1).

Diagnosis : Length 35-125 mm, diameter 3-7 mm, segments 79-121; Clitellum annular, XIII-XVII. Spermathecal pores 2 pairs, near mid-ventral line, in 7/8, 8/9; male pores in small transverse protuberances within a single male field, each protuberance with a slightly irregular transverse groove containing apertures of 4-9 perisetal follicles, on XVIII; female pore single, mid-ventral, on XIV; genital marking absent; nephridiopores inconspicuous, in one rather irregular longitudinal rank on each side near m L.



Figs. 6-10. : Showing the Genital regions of the Earthworms for identification. 6. *Octochaetona surensis*; 7. *Amynthas diffringens*(dorsal); 8. *Amynthas diffringens*(Ventral); 9. *Lampito mauritii*; 10. *Perionyx sansibaricus*.

Remarks : This is recorded for the first time from Nadia district. The species is also very common within the sanctuary, however, restricted to the moist humus mixed soil near kitchen dranage.

14. ***Perionyx sansibaricus*** Michaelsen, 1891

1891. *Perionyx sansibaricus* Michaelsen, *Mitt. Naturh. Mus. Hamb.*, **9** : 4.

Material : 3 ex., 23.07.2003, Ballavpur Stn. 5 (Jhill No. 1).

Diagnosis : Length 32-65 mm, diameter 2.5-3.5 mm, segments 84-108; clitellum annular, XIII-XVII; male pores usually pre-setal, near mid-ventral line, in a slightly depressed transverse male field; spermathecal pores paired, near mid-ventral line, in 6/7/8/9; genital markings absent.

Gizzards slightly developed in VI; intestine begins in XVI; last pair of hearts in XII; spermathecae paired in VII-IX, each with an ental pear-shaped, shortly stalked, multi-occulate diverticulum; nephridia vesiculate.

SUMMARY

The paper deals with fourteen species of earthworms under nine genera and four families, of which eleven species were recorded from the sanctuary proper.

ACKNOWLEDGEMENTS

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Rec. zool. Surv. India : **108**(Part–3) : 109-118, 2008

WATERBIRDS OF NAMDAPHA TIGER RESERVE, ARUNACHAL PRADESH WITH SPECIAL REFERENCE TO WHITE-BELLIED HERON *ARDEA INSIGNIS*

GOPINATHAN MAHESWARAN*

Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053, India

INTRODUCTION

Namdapha Tiger Reserve has a rich aquatic bird fauna, mostly because of many freshwater lakes/ponds located at higher altitudes as well as within the evergreen forest patches and the complex river system it has. While surveys were carried out by the research team of the Zoological Survey of India (Ghosh, 1987) from March 1981 to March 1987, the following prominent waterbirds were recorded from Namdapha : Goliath Heron *Ardea goliath*, Large Egret *Casmerodius albus*, Chinese Pond Heron *Ardeola bacchus*, Little Egret *Egretta garzetta*, Common Merganser *Mergus merganser*, Eastern Marsh Harrier *Circus spilonotus*, and at least seven species of kingfishers, beside the migrant Common Teal *Anas crecca*. However, the team did not record any White-bellied Heron. Interestingly, I did not record Goliath Heron during my surveys in two years, which the team did so. The White-bellied Heron *Ardea insignis* (Family : *Ardeidae*) is a little known species occurring in swamps, marshes and forests from Nepal through Sikkim, Bhutan and northeast Assam in India to Bangladesh, Arakan and north Burma (Walters 1976). According to Ali and Ripley (1987), it is a highly endangered species and restricted to undisturbed reed beds and marshes in eastern Nepal and the Sikkim *terai*, Bihar (north of the Ganges river), Bhutan *duars* to northern Assam, Bangladesh, Arakan and north Burma (= Myanmar). In Assam, it has been reported from Kaziranga National Park (Barua and Sharma 1999), Jamjing and Bordoloni of Dhemaji district (Choudhury 1990, 1992, 1994), Dibru-Saikhowa Wildlife Sanctuary and Biosphere Reserve (Choudhury 1994), Pobitara Wildlife Sanctuary (Choudhury 1996a, Baruah *et al.* 2004) and also in Namdapha Tiger Reserve, Arunachal Pradesh (Choudhury 1996b).

*E-mail : *gmaheswaran@yahoo.com*

In January 1997, 16 White-bellied Herons were counted from Pobitara Wildlife Sanctuary, Assam —the biggest count for this species in Assam to date (Baruah *et al.* 2004). However, it has not been recorded from Nepal since 19th century, and is considered to be 'extirpated' (Baral and Inskipp, 2004). The White-bellied Heron is restricted to the southern foothills of the Himalayas, southwards at the eastern end through Bhutan and Assam, to northeast and northwest Burma. The only localities where the White-bellied Heron had been described as common were in northern Burma, for example along the Mali Kha river in Putao (Smythies 1953) and in the Irrawady river (Stanford & Ticehurst 1939). Since many years have passed by, no detailed accounts about the number of birds present in these areas are available, until King *et al.* (2001), had recorded a breeding-plumaged individual near the village of Ziyardum (1,000 m elevation) on 30 January 1998 in northern Myanmar (King *et al.* 2001). The team had also recorded few more individuals around Ziyardum in 1998 and 1999 and eventually these were the first sightings of this species for many years and also a handful of recent sightings in Myanmar. However, records in Myanmar as far southeast as Toungoo and Pegu suggest a migration or post-breeding dispersal (Hancock and Kushlan, 1984).

There have been a number of recent records from an area comprising north-eastern Bangladesh, Assam (India), and notably Bhutan (Inskipp and Inskipp 1993a,b). From Bhutan's forested rivers have come repeated sightings of solitary individuals. In Bangladesh, one solitary individual was seen on a reservoir (Harvey 1990) and a pair flushed from a forested lakeshore in the north-east (Thompson *et al.* 1993), and a solitary bird was seen in Namdapha Tiger Reserve in Arunachal Pradesh (Anon 1994). An unusual record of a solitary individual at Chilika Lake (Orissa), south-west of the Sundarbans (Jepson 1987) may be linked to a population reported in the Sundarbans (Scott 1989). The species is undoubtedly very rare and is considered to be globally threatened and categorized as Endangered A2c; C1 Vulnerable D1 (IUCN, 1996). However, since there is no justification for a population estimate of over 250 mature individuals, the scarcity and the combined known degree of habitat destruction and degradation over this species' range justifies classification as Critically Endangered (Kushlan and Hafner, 2000).

STUDY AREA AND METHODS

Surveys were carried in Namdapha Tiger Reserve and National Park (Figure 1), Arunachal Pradesh (27° 23' 30" N to 27° 39' 40" N and 96° 15' 20" E to 96° 58' 33" E) in 2005 and 2006 to find out the waterbird diversity with special reference to White-bellied Heron *Ardea insignis*. In 2005, surveys were conducted from 4-29 September (25 days), whereas in 2006 surveys were carried out from 12 November to 08 December (27 days). Different areas were surveyed (Table 1) within Namdapha to study its waterbird diversity in both the years. Namdapha Tiger Reserve (1,985 km^2) is situated in Changlang district of Arunachal Pradesh bordering Myanmar. It has a wider altitudinal variation which rises from 200m to 4500m. The main river of the area is

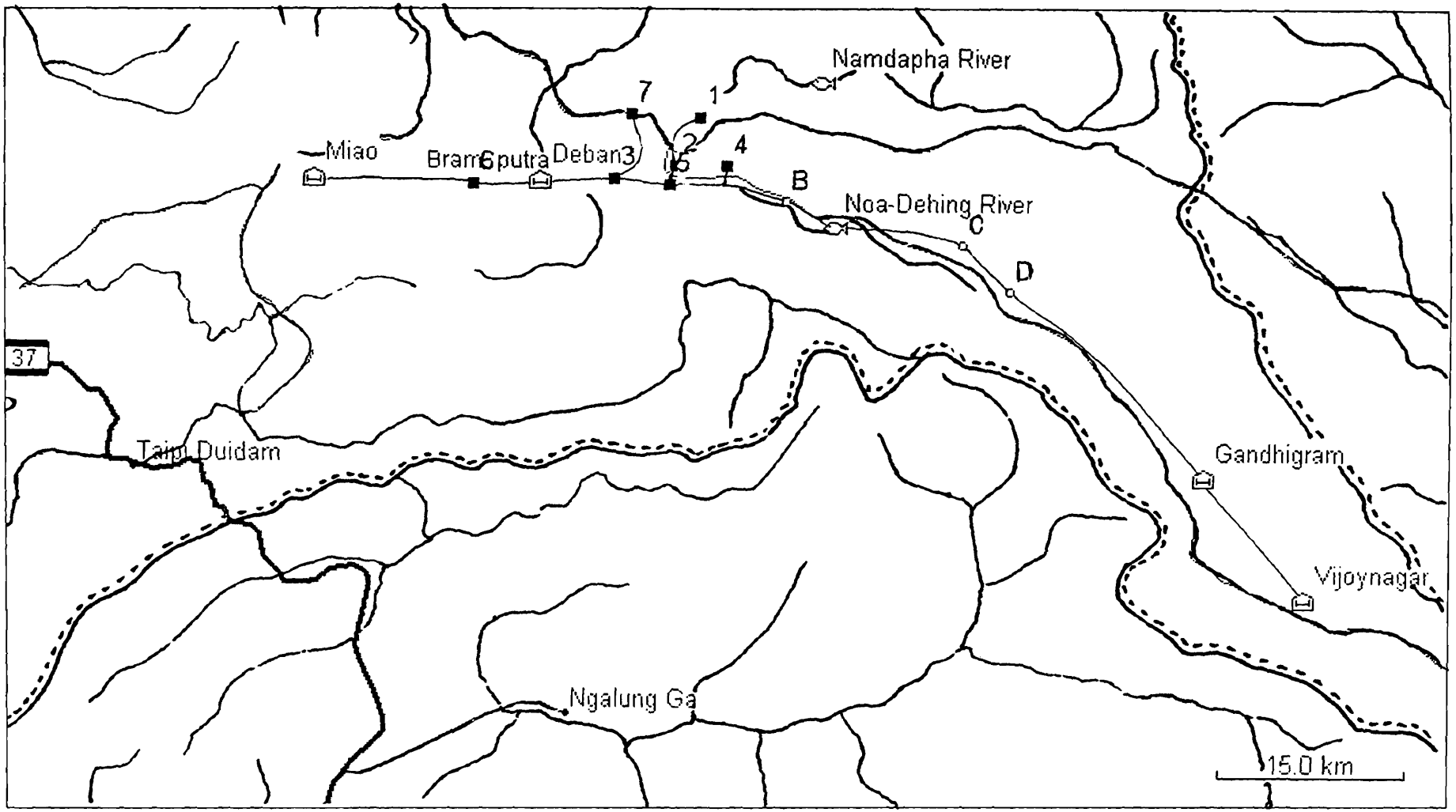

Fig. 1 : Showing the localities (black squares) where the White-bellied Herons were sighted inside the Namdapha Tiger Reserve and the small (white circles) and the big camps (symbol) being setup by the survey team.

1. Firmbase; 2. In between Firmbase and Embyong; 3. 30th Mile; 4. Burmanala; 5. Embyong; 6. Motijheel; 7. Ranijheel, B. 56 Mile camp, C. 63 Mile camp, D. 70 Mile camp.

Table 1 : Areas surveyed within Namdapha Tiger Reserve (in 2005 & 2006) and their coordinates.

Date	River	Place	Locality	Significant bird species recorded
05/09/2005	Noa-Dehing	Miao	27°31.58' N 96°31.13' E	Little Egret, Unidentified Duck
05/09/2005	Noa-Dehing	Embyong	27°29.32' N 96°29.42' E	–
05/09/2005	Noa-Dehing	7km from Miao	27°30.50' N 90°08.28' E	Little Egret, Common Sandpiper
07/09/2005	Noa-Dehing	Manabhum	27°30.03' N 96°14.29' E	–
09/09/2005	Noa-Dehing	Deban	27°30.06' N 96°23.42' E	Darter
09/09/2005	Debannala	Deban Junction	27°32.96' N 96°23.70' E	–
10/09/2005	Noa-Dehing	Deban to Miao	27°30.15' N 96°20.99' E	Darter, Great Stone Plover, White-breasted Kingfisher, Common Sandpiper
11/09/2005	Noa-Dehing	Deban to 18th Mile	27°29.81' N 96°24.46' E	–
12/09/2005	Motijheel	Deban to Motijheel	27°29.05' N 96°19.81' E	–
15/09/2005	–	Deban to Haldibari	27°31.46' N 96°23.92' E	–
15/09/2005	–	Hornbill Camp	27°32.41' N 96°26.51' E	–
16/09/2005	–	Bulbulia Camp	27°32.05' N 96°27.54' E	–
16/09/2005	Namdapha	Firmbase Camp	27°30.74' N 96°30.21' E	–
18/09/2005	Namdapha	Firmbase	27°31.58' N 96°31.13' E	White-bellied Heron
19/09/2005	Namdapha	Embyong	27°29.32' N 96°29.42' E	White-bellied Heron
15/11/2006	Miao River	Miao	27°29.05' N 96°23.59' E	

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

Date	River	Place	Locality	Significant bird species recorded
17/11/2006	Noa-Dehing	Deban	27°30.52' N 96°23.54' E	Black Stork, Brown Dipper
18/11/2006	Noa-Dehing	27-Mile	27°28.81' N 96°26.38' E	Common Merganser
19/11/2006	Noa-Dehing	Burmanala (40 Mile)	27°29.54' N 96°32.29' E	–
20/11/2006	Noa-Dehing	40 Mile	27°29 54' N 96°32.29' E	White-bellied Heron
21/11/2006	–	52-Mile	27°28.26' N 96°35.15' E	
22/11/2006	Noa-Dehing	56-Mile	27°27.35' N 96°39.36' E	–
23/11/2006	Noa-Dehing	62-Mile	27°25.94' N 96°43.45' E	–
23/11/2006	Noa-Dehing	72-Mile	27°24.39' N 96°46.04' E	–
24/11/2006	–	Gandhigram IB	27°16.50' N 96°54.88' E	Ibisbill, The Lapwing
25/11/2006	–	Vijoynagar IB	27°11.39' N 97°00.32' E	
30/11/2006	Namdapha-Noa-Dehing	Embyong	27°29.25' N 96°29.32' E	White-bellied Heron

Noa-Dehing or Diyun which originates from the mountains near the Chokan Pass on the Indo-Myanmar border and flows in east-west direction which finally joins Brahmaputra. The other major river within the Reserve is Namdapha, which originates from the Phonga Pass and runs north-south before joining Noa-Dehing at Embyong near Firmbase. Apart from these main rivers, there are numerous perennial rivers and rivulets and seasonal streams which drain out waters from both Dapha Bum and Patkai ranges to the river Noa-Dehing. The area is well known for excessive rainfall which starts in winter due to 'Western disturbances' and sue to that June, July and August receive 75% of the annual rainfall which is roughly 1991 mm.

Surveys were undertaken to know the distribution of White-bellied Herons within Namdapha as there are reports of this species occurring here, and in northern Myanmar. Due to logistic reasons we did not carryout any survey for this species in Myanmar, instead covered the areas within

Namdapha bordering that country. Since most of the Park is very uneven and intersected by rivers and big streams, surveys were carried out by walking along the river Noa-Dehing. At an average around 10 km were covered everyday during the surveys. Sometimes, a total of 15-18 km were covered daily looking for waterbirds including White-bellied Herons along Noa-Dehing river from Miao to Embyong in 2005 and almost the same distance from Miao to Vijoynagar (Figure 1). Often country-made boats of local villagers were used to cross Noa-Dehing, especially where water levels were more. However, while going from Deban to Embyong via Firmbase, circuitous route was taken and passed through Haldibari, Hornbill Camp, Bulbulia and Ranijheel (*see* Figure 1) mainly to avoid the surging river as there was no boat available beyond Deban to cross Noa-Dehing. Field camp was set up for six nights at Firmbase close to a rivulet that was fed by Namdapha river. On certain days, other waterbodies such as Ranijheel and Motijheel were also visited (*see* Figure 1) situated inside the rainforest mainly to see other waterbirds, including White-winged Duck *Cairina scutulata*-as the Park is said to have a few remnant population of this little known species. In 2006, after surveying the nearby areas of Miao, I moved to Deban and then from there to Vijoynagar through Gandhigram along the river Noa-Dehing so as not to miss any significant sighting(s) of heron. Daily, I walked for 7-8 hours looking for herons on either side of the river. It took me six nights and seven days to reach Vijoynagar and the same number of days to return to Deban. Magellen-300 GPS was used to record the coordinates of various places and later on those points were plotted on the map.

RESULTS AND DISCUSSION

In two years (2005 & 2006), 52 days were spent within Namdapha Tiger Reserve covering more than 250 km on foot looking for waterbirds, especially the White-bellied Heron. More than 90% of the time was spent walking along the Noa-Dehing and the remaining time was spent in visiting other waterbodies such as Ranijheel and Motijheel-two important natural ponds situated within the thick forest patches. Waterbirds as well as other water-dependent species recorded inside the reserve are given in Table 2. White-bellied Herons were sighted twice in 2005 in the river Namdapha near Embyong-where the confluence of Noa-Dehing and Namdapha takes place, and thrice in 2006 in Namdapha and Noa-Dehing rivers (Table 3). Assuming that these five herons are part of the 250 mature individuals of the species exist today in the wild (Kushlan and Hafner, 2000), Namdapha Tiger Reserve is considered to support about 2% of the world's total population of this species.

Rivers of Namdapha are perennial and have different depths at different places with high water current in some of the places especially where boulders are more. Crystal clear fresh water supports varieties of fish fauna which in turn attracts various bird species especially Little Cormorant *Phalacrocorax niger*, Great Cormorant *Phalacrocorax carbo* (only in winter) and Darter *Anhinga melanogaster*. Many flocks of Little Cormorant each comprises of more than 50-120

Table 2 : List of waterbirds recorded in Namdapha Tiger Reserve, Arunachal Pradesh in 2005 & 2006.

	Common Name	Scientific Name	2005*	2006
1.	Great Cormorant	*Phalacrocorax carbo* (Linnaeus, 1758)	+	+
2.	Little Cormorant	*Phalacrocorax niger* (Vieillot, 1817)	+	+
3.	Darter	*Anhinga melanogaster* Pennant, 1769	+	+
4.	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	+	+
5.	Black Bittern	*Dupetor flavicollis* (Latham, 1790)	+	+
6.	Black-crowned Night Heron	*Nycticorax nycticorax* (Linnaeus, 1758)	+	+
7.	White-bellied Heron	*Ardea insignis* Hume 1878	+	+
8.	Black Stork	*Ciconia nigra* (Linnaeus, 1758)	–	+
9.	Common Merganser	*Mergus merganser* Linnaeus, 1758	–	+
10.	Brahminy Shelduck	*Tadorna ferruginea* (Pallas, 1764)	–	+
11.	Greater Grey-headed Fishing Eagle	*Ichthyophaga ichthyaetus* (Horsfield, 1821)	+	+
12.	Elwe's (Black-tailed) Crake?	*Porzana bicolor* (Walden, 1872)	+	–
13.	Long-billed Plover	*Charadrius placidus* J.E. Gray, 1863	–	+
14.	Kentish Plover	*Charadrius alexandrinus* Linnaeus, 1758	+	+
15.	River Lapwing	*Vanellus duvaucelii* (Lesson, 1826)	+	+
16.	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	+	+
17.	Northern Lapwing	*Vanellus vanellus* (Linnaeus, 1758)	–	+
18.	Common Sandpiper	*Actitis hypoleucos* Linnaeus, 1758	+	+
19.	Ibisbill	*Ibidorhyncha struthersii* Vigors, 1832	–	+
20.	Great Stone-Plover	*Esacus recurvirostris* (Cuvier, 1829)	+	+
21.	Small Blue Kingfisher	*Alcedo atthis* (Linnaeus, 1758)	+	+
22.	Lesser Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)	+	+
23.	White-breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	+	+
24.	Large Pied Wagtail	*Motacilla maderaspatensis* Gmelin, 1789	+	+
25.	Brown Dipper	*Cinclus pallasii* Temminck, 1820	+	+
26.	Little Forktail	*Enicurus scouleri* Vigors, 1832	+	+
27.	Slaty-backed Forktail	*Enicurus schistaceus* (Hodgson, 1836)	+	+
28.	Plumbeous Redstart	*Rhyacornis fuliginosus* (Vigors, 1831)	+	+

'+' indicates the species was sighted; '–' indicates the species was not sighted.

*-please see 'Methods' for months during which the surveys were conducted.

Table 3 : Sightings of the White-bellied Heron in Namdapha Tiger Reserve in 2005 & 2006.

Date	River	Place	Locality	No. of birds
18/09/2005	Namdapha	Firmbase	27° 31.58' N 96° 31.13' E	01
19/09/2005	Namdapha- Noa-Dehing	Embyong	27° 29.32' N 96° 29.42' E	01
19/11/2006	Noa-Dehing	27 Mile	27° 29.21' N 96° 26.64' E	01
20/11/2006	Noa-Dehing	40 Mile	27° 29.54' N 96° 32.29' E	01
30/11/2006	Namdapha- Noa-Dehing	Embyong	27° 29.25' N 96° 29.32' E	01

individuals were seen in Noa-Dehing River right from Miao up to Gandhigram in November/ December 2006. They seem to be the big competitors of White-bellied Heron since they both depend on the fishes. However, the hunting strategy of both species differ significantly; while former prefers deep waters of the rivers whereas the later prefers mostly the edges or the places where the water level is comparatively less and strewn with boulders. Unlike in other places (especially in Assam) where the White-bellied Herons were reportedly seen in water close to reed-beds, herons of Namdapha in turn prefer fast-flowing rivers with abundant fish where human interference is negligible.

Though I could not see any significantly important migratory species (other than the Great Cormorant), presence of White-bellied Heron in Namdapha in September to December reveals that it is not a migratory species. Official photographer of the Park had taken a video footage of a lonely White-bellied Heron foraging in the fringes of river Noa-Dehing close to Deban Guest House (approx. 27° 29.06' N, 96° 24.27' E) sometime in August 2005. In January 1993, a single heron was spotted on the banks of Noa-Dehing river in between Deban and M'Pen (Choudhury 1996b), further west of Embyong. Of the five sightings, one was in a place where the depth of water was not so high. Another sighting was in a place where the water current was relatively less with free-flowing water of roughly two feet. Presence of White-bellied Heron in such habitat is in total contrast to what Hancock and Kushlan (1984) have mentioned about it as a bird of the '*terai*' and '*duars*' White-bellied herons were also sighted in Assam *terai* (Choudhury, 1992 and Baruah *et al.* 2004). The reasons why the herons preferred such areas in Namdapha could be due to less human disturbance and abundant fish in the rivers of the Reserve. However, within Namdapha, the Firmbase area has tall grassland patches intermingled with small streams branching out from the mighty river-Namdapha. Though, many of such streams loose much of their water during winter, possibility of herons using such streams when they have more water is not ruled out.

More than 80% of the areas within Namdapha are still unexplored, thereby raising the speculation that one could possibly see few more herons in the interior areas where accessibility is difficult. In general, though the wetlands with shallow water are ideal habitats for herons, White-bellied Herons in particular prefer to feed on fishes of rivers. The reasons behind why White-bellied heron select secluded freshwater riverbeds are not clear and still to be explored. However, I speculate that, the less-disturbance in terms anthropogenic activities seems to be a prime criterion behind the heron's selection of such habitat. Unfortunately, illegal fishing is also evident within Namdapha mainly by various tribes. I had come across many abandoned fishing camps setup by tribes. Most of these camps seem very close to the rivers and I even sighted a White-bellied heron a few meters away from one of such camps in Firmbase. In Deban, Chakma tribes collect fish and fingerlings using fishing nets and mosquito nets, respectively. Fishing is also very rampant with in the Park (from Miao to Vijoynagar) mainly by Lisu tribes who reside inside the Reserve. Floods in Namdapha are usual every year and they can drastically alter available feeding habitats by rendering large areas of usually suitable feeding habitats inhospitable for the herons. More surveys are needed in Arunachal Pradesh and also in the neighbouring Assam to find out the present status of this endangered species.

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PLATE I

Fig. 1 : Author (center) standing with field assistants at Vijoynagar, Namdapha Tiger Reserve.

PLATE II

Fig. 2a : Typical habitat of White-bellied Heron in Namdapha Tiger Reserve.

Fig. 2b : River Noa-Dehing the main river inside Namdapha during winter.

PLATE III

Fig. 3a : Field camp setup on the banks of river Noa-Dehing at 63 Mile of Namdapha.

Fig. 3b : Field assistants with forest department official Mr. A. Mosang (second from left).