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# **Records of the Zoological Survey of India**

**Volume 106(Part-3)**

*Edited by the Director, Zoological Survey of India, Kolkata*



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

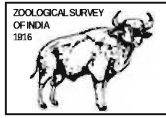
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These specimens will be registered and their data will be computerised. *They are further requested to deposit their type collection positively of ZSI and use the Registration number in their publication of the new taxon.*

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



*Rec. zool. Surv. India* : **106**(Part-3) : 1-8, 2006

## **ECOLOGY OF COLIFORM BACTERIA IN A HEAVY METALS CONTAMINATED RIVER AT MIDNAPORE DISTRICT AREA, WEST BENGAL**

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

### **INTRODUCTION**

A series of workers have published ecology as well as microbial communities of different aquatic ecosystem in India and abroad *viz.* Arnal (1958, 62), Carpelan (1961), Segers (1995), Rajkumar, Ramanibai and Devraj (1994), Krishnamoorthi and Sarkar (1979), Pandit (1986), Chattwal (1989), Sinha, Bruah, Singh and Sharma (1994), Verma and Delela (1975), Prasad (1988), Masood and Krishnamurthy (1990), Chakraborty and Asthana (1989), Chakraborty *et al.*, (2004). Several workers have studied the impact of heavy metals on microfauna *viz.* Failkowski and Newman (1998), Deshpande (1988), Gadd and Griffiths (1978). From the above literature it appeared that the hydro biological research have been oriented to assess the impact of different biotic and abiotic factors on the distribution and diversity of aquatic micro fauna with special reference to total coliform and fecal coliform. In addition, impacts of polluting agents like heavy metals and pH gradation on the population of aquatic bacteria have also been studied. This pollution affects the growth of beneficial microorganism in water bodies and resulting to increase of population of total coliform and fecal coliform. So far there is no record have available on these aspects from Subarnarekha River in Midnapore Dist area. For this reason the present investigation was undertaken. Total area was about 60 km along the riverbed each station was about 20km apart from other. From each station 3-sample unit were taken and a total of 9 sample plots have been selected and collections were made at an interval of one month for a period of one year (Oct. 2002–Sept. 2003). During pre winter the P<sup>H</sup> of river water was acidic ranges from 5.5–6.7 as a result level of heavy metals concentration was found to be maximum and the population of micro fauna minimum in number, might be due to increase level of heavy metals toxicity released from the industries

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situated on the bank of the river. The interrelationship between micro fauna and the aquatic factor and heavy metals and also between the physico-chemical factors and the heavy metals have been analysed and discussed.

### CHARACTERISTICS OF SAMPLING SITE

Area is located on both side of river Subarnarekha, it contain grasses like *Cynodon dactylon* etc. and also some herbs and shrubs with some trees. The soil was sandy loam in texture and reddish yellow in colour.

### MATERIAL AND METHODS

#### A. Sampling sites :

A total of 3 collection sites were chosen for this study. Each site includes three subsampling sites (one in the middle and two along the embankment of the rivers) (Fig. 1). Samples were collected at an interval of one month (Oct. 2002–Sept. 2003) and a total of 108 samples have been collected.

#### B. Collection of Sample and Preservation :

Composite water samples from each study site were collected from three different areas of both sides of riverine flow and also from the point of the river. Samples were taken in sterilized glass bottles for laboratory analysis of COD, BOD, Heavy Metals and Total and Faecal coliform following APHA, (1998). Other water quality parameters such as DO, pH, Temperature were measured by water quality checker (WQC-22A, TOA, Japan).

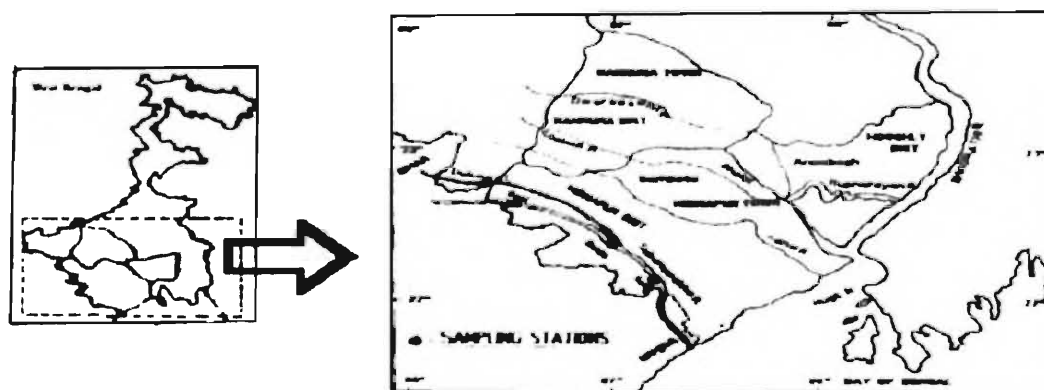


Fig. 1.

**b. Chemical and Microbiological analysis :**

BOD was measured by titration method. The results are expressed in terms of mg/l. BOD was determined

– after 5 days of incubation (APHA1998). COD was measured by rapid titration method. The result is expressed in terms of mg/l. The heavy metals were estimated by atomic absorption spectro-photometer (APHA1998) and were expressed in terms PPM. Total and Fecal Coliform study by a number of tubes containing specific growth media were inoculated with different amount of the samples and incubated for a particular time at a prescribed temperature. The results were expressed in terms MPN/100ml.

**RESULTS AND DISCUSSION**

The total and faecal coliform bacteria and physio-chemical parameters are presented in Table-1. The average monthly total coliform and faecal coliform bacterial population in the river Subarnarakha during the course of investigation were found to range from respectively 560 to 2133.33 MPN/100ml and varied from 240 to 1373.33 MPN/100ml. The monthly abundance of total coliform bacteria varied from 560 MPN/100ml in July to 2133.33 MPN/100ml in March. In general there, total count showed a decline trend from May to August, while there was a fluctuation trend through out the year. The annual fluctuating trend of total and faecal coliform population in Subarnarekha river can be represented as Pre monsoon > winter > monsoon. (Fig. 1)

The pH showed an overall acidic condition in monsoon, which ranged from 5.5–6.7, but in other seasons the pH was neutral either alkaline (Graph-1).

Temperature being considered as an important physical factor that influence the chemical changes of water, was found to range in between 16.43°C in December to 32.83°C in July. Similar results were also obtained by Hazrika *et al.*, (1996) Tasek lake of Meghalaya.

Dissolved oxygen content was found to be considerably higher in winter. While BOD level registered higher in level in winter and pre monsoon period but in monsoon period it expressed minimum level. Such findings corroborated the observation of Yousuf *et al.*, (1986).

Heavy metals concentration was found to be low throughout the year except during the monsoon season. In monsoon, the value of pH was also low as a result the river water was acidic in nature, so the conjugated form of heavy metals are easily dissolved in acidic water and formed the free heavy metals. These free-formed heavy metals might have adverse effect on the microbial population. This also coincides with the findings of Kebbekus and Mitra (1998). It could be concluded from the present study that the abiotic components evaluated here in conjunction with other biotic and abiotic components not considered collectively responsible for the distribution and fluctuations of microbial fauna in the river.

### SUMMARY

The pH of Subarnrekha river water during monsoon ranges from 5.5–6.7 and level of heavy metals concentration was maximum. The population of micro fauna was minimum in number during monsoon. The interrelations between micro fauna and the aquatic parameters along with the heavy metals in the river ecosystem have been discussed.

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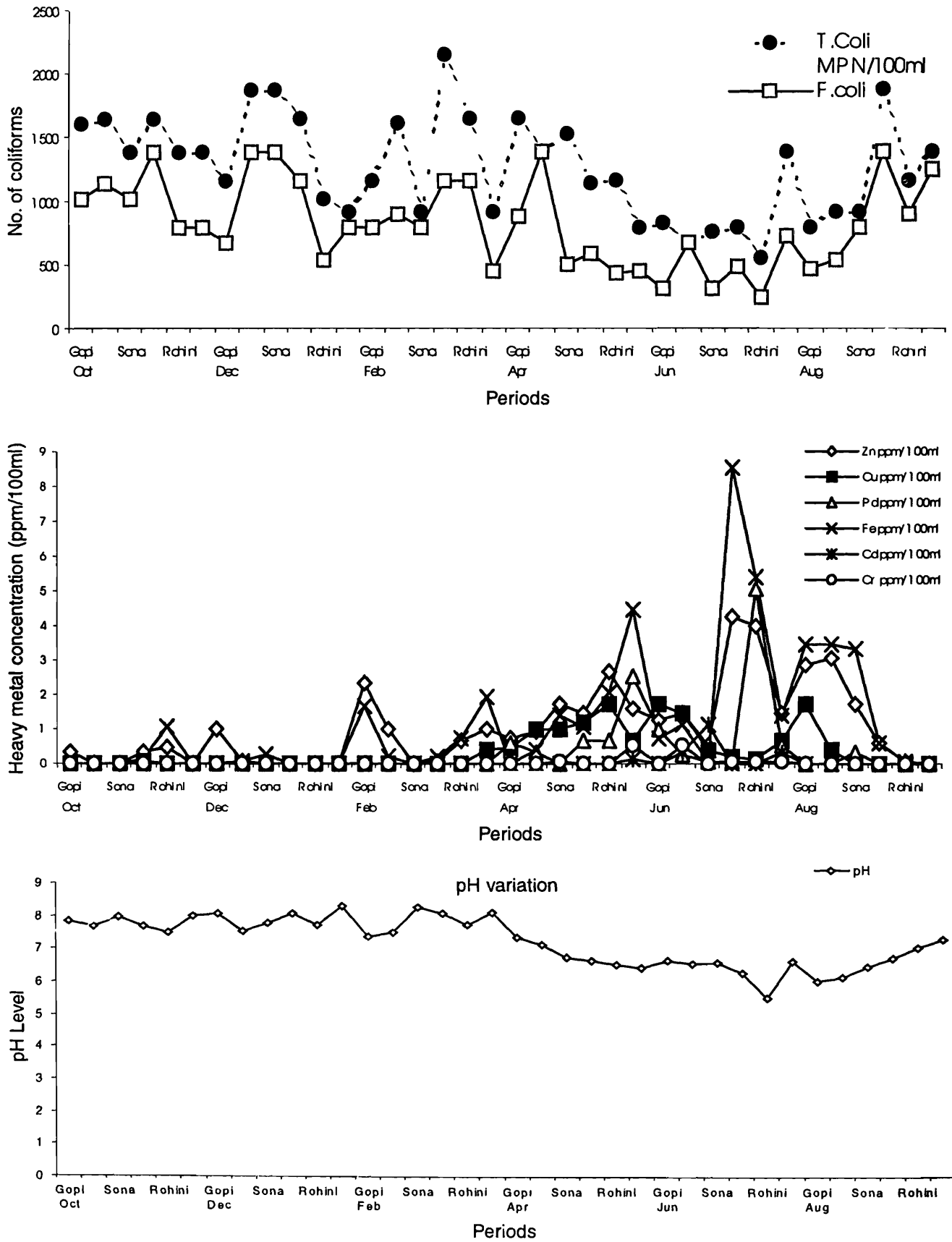


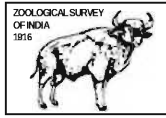
Fig. Monthly fluctuating of pH level, Heavy concentration and no. of total and faecal coliform bacteria.

**Table 1.** : Mean value of all Hydrological. Total and Faecal coliform data.

Month	SITE	Temp. °C	pH	Do mg/l	COD mg/l	BOD mg/l	T. Coli MPN/ 100 ml	F. Coli MPN/ 100 ml	Zn ppm/ 100 ml	Cu ppm/ 100 ml	Pd ppm/ 100 ml	Fe ppm/ 100 ml	Cd ppm/ 100 ml	Cr ppm/ 100 ml
OCT	Gopi	29.33	7.84	7.13	18.66	1.46	1600	1020	0.33	0.01	0	0	0	0
	Rohini	29	7.67	6.66	23.33	0.96	1640	1146	0	0	0	0	0	0
	Sona	29.16	7.97	6.35	21	1.41	1373.33	1020	0	0	0	0	0	0
NOV	Gopi	25.56	7.66	7	25.66	1.06	1640	1373.3	0.33	0.09	0	0.12	0	0
	Rohini	18.93	7.5	6.9	30.33	1.9	1373.33	793.33	0.47	0	0	1.07	0	0
	Sona	23.13	7.98	6.73	30.33	1.83	1373.33	793.33	0	0	0	0	0	0
DEC	Gopi	18.46	8.05	8.13	21	0.8	1146.66	666.66	1	0.02	0.02	0	0	0
	Rohini	16.43	7.53	7.55	21	1.71	1866.66	1373.3	0.07	0.01	0	0.09	0	0
	Sona	21.4	7.76	6.95	23.33	1.3	1866.66	1373.3	0	0.01	0	0.27	0	0
JAN	Gopi	19.46	8.04	8.13	28	0.91	1640	1146.6	0	0	0	0	0	0
	Rohini	18.1	7.72	7.33	25.66	0.56	1020	540	0	0	0	0	0	0
	Sona	23.23	8.26	7.24	28	0.48	920	793.33	0	0.003	0	0.02	0	0
FEB	Gopi	24.66	7.36	6.16	16.33	1.19	1146.66	793.33	2.33	0	0	1.69	0	0
	Rohini	22.2	7.48	6.35	16.33	0.83	1600	893.33	1	0	0	0.22	0	0
	Sona	23.46	8.25	6.96	28	0.86	920	793.33	0	0	0	0	0	0
MAR	Gopi	30.4	8.06	6.25	14	1.2	2133.33	1146.6	0.06	0	0	0.2	0	0
	Rohini	32.43	7.7	6.1	28	0.97	1640	1146.6	0.7	0	0	0.76	0	0
	Sona	32.33	8.1	6.7	11.66	0.55	920	440	1.03	0.4	0	1.96	0	0

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

Month	SITE	Temp. °C	pH	Do mg/l	COD mg/l	BOD mg/l	T. Coli MPN/ 100 ml	F. Coli MPN/ 100 ml	Zn ppm/ 100 ml	Cu ppm/ 100 ml	Pd ppm/ 100 ml	Fe ppm/ 100 ml	Cd ppm/ 100 ml	Cr ppm/ 100 ml
APR	Gopi	30.66	7.33	6.53	32.66	0.81	1640	886.66	0.73	0.5	0.62	0	0	0
	Rohini	29	7.1	6	37.33	0.67	1380	1380	0.96	0.97	0.36	0.4	0	0
	Sona	33	6.73	6.8	23.66	0.97	1516.66	503.33	1.73	1.03	0.02	1.4	0	0.07
MAY	Gopi	31.16	6.63	6.86	42	0.43	1146	580	1.46	1.23	0.7	1.08	0	0
	Rohini	30	6.5	6.96	37.33	0.37	1146.66	433.33	2.66	1.76	0.66	2.06	0	0.01
	Sona	30	6.4	6.9	30.33	1.04	793	441.33	1.61	0.66	2.55	4.47	0.11	0.53
JUNE	Gopi	36	6.63	6.7	23.8	0.56	830	306.66	1.26	1.73	0.97	0.76	0	0
	Rohini	30.16	6.53	6.21	30.33	0.17	666.66	666.66	1.46	1.45	0.3	1.13	0.36	0.53
	Sona	30	6.56	6.65	36.66	0.16	766.66	306.66	0.53	0.4	0.06	0.06	1.13	0
JULY	Gopi	29	6.26	5.84	114.33	0.92	793.33	476.66	4.27	0.2	0.08	8.56	0	0.09
	Rohini	30.66	5.5	5.5	53.66	0.49	560	240	4	0.11	5.05	5.43	0	0.08
	Sona	31	6.6	6.08	81.66	1	1373	730	1.5	0.7	0.56	1.43	0.36	0.1
AUG	Gopi	30.33	6	6.76	30.33	0.75	793	466.66	2.86	1.76	0.03	3.46	0	0.003
	Rohini	29.83	6.13	6.83	28	0.65	920	540	3.1	0.4	0	3.46	0.006	0.006
	Sona	30.83	6.43	6.66	27.66	1.07	920	793.33	1.76	0	0.36	3.33	0	0
SEPT	Gopi	29.33	6.7	6.73	32.66	1.72	1866	1373.3	0.6	0	0	0.6	0	0
	Rohini	29.83	7	6.96	35	1.09	1146.66	893.33	0.1	0	0	0.1	0	0.003
	Sona	30	7.26	6.7	30.33	1.43	1373.33	1246.6	0.03	0	0	0	0	0



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**A STUDY ON THE REARING OF *LAMPITO MAURITII* KINBERG  
(ANNELIDA : OLIGOCHAETA) IN VEGETABLE KITCHEN  
WASTES WITH SOME NOTES ON COCOON, HATCHING  
PATTERN, FECUNDITY AND GROWTH**

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**INTRODUCTION**

An increase in human population and rapid urbanization has led to an increased accumulation of organic wastes. Time-immemorial it has been proved that earthworm plays an important role in recycling biodegradable organic wastes and in solving problems of deteriorating soil conditions. vermitechnology is the method of converting waste into useful products through the action of earthworm. This species is considered as a potential one for vermitechnology in Indian conditions (Dash and Senapati, 1986; Senapati and Julka, 1993; Bhattacharjee and Chaudhuri, 2002).

Bhal (1927) first studied reproductive biology of Indian earthworms. Stephenson (1930), Evans and Guild (1948a), Satchell (1967), Lakhani and Satchell (1970), Reynolds (1973), Vail (1974), Phillipson and Bolton (1977), Tomlin and Miller (1980), Reinecke and Visser (1981), Edwards (1988), Elvira *et al.*, (1996) studied the reproductive strategies of different lumbricid earthworm species. The most comprehensive studies of life cycles of non-lumbricidae earthworms are those of Lavelle (1971b; 1974; 1979), who studied a mixed population of Megascolecidae and Eudrilidae. Ecology of reproductive biology of Indian worms was reported by Senapati and Dash (1979), Senapati *et al.*, (1979), Dash and Senapati (1980, '82). Tembe and Dubash (1961), Sahu and Senapati (1986, '91), Sahu *et al.*, (1988), Kale *et al.*, (1982), Kale and Bano (1985), Kaushal and Bisht (1992), Kaushal *et al.*, (1995), Kaushal, Bora and Kandpal (1999), Bhattacharjee and Chaudhuri (2002) also worked on reproductive biology of Indian earthworms. Kale, Bano and Krishnomoorthy (1982), Kale and Bano (1985), Julka and Paliwal (1993), Ismail (1997), Kaushal and Bisht (1992), Kaushal *et al.*, (1995), Kaushal, Bora and Kandpal (1999), Bhattacharjee and Chaudhuri (2002), Chaudhuri, Pal, Bhattacharjee and Dey (2003) worked on different aspects of vermiculture in India.

Method of reproduction in *Lampito mauritii* Kinberg, is amphimictic, sexual and biparental (Gates, 1972). Observation has been made that *Lampito mauritii* Kinberg, the selected species of earthworm, is successfully survive and reproduce in municipal waste disposal site of Kolkata and predominant earthworm species in that area. This study is intended to know whether this species is capable to survive, reproduce and grow in vegetable kitchen wastes (grows in West Bengal) medium, which is a prerequisite for successful vermicomposting.

## MATERIALS AND METHODS

### A. Method of Culture :

1. Earthen pot (upper dia.–25.4 cm., lower dia.–14 cm., height–19 cm.); 2. Broken brick; 3. Sand; 4. Soil; 5. Cowdung; 6. Vegetable wastes; 7. Jute cloth. The earthworms were collected from Dhapa, municipal waste disposal site of East Kolkata and kept for rearing in the laboratory of Zoological Survey of India, Kolkata. At first earthen pot is filled with broken bricks (4 cm) followed by sand (3 cm) and soil (5–6 cm). The soil used in this experiment was brought from the same site and precaution was taken so that no foreign cocoon could enter in the culture pot. Water was added to moistening the pot. Adult worms were introduced (20 in no. in each pot) and culture media was added on top. The pot is then wrapped with jute cloth. Regular watering was made to maintain moisture level 30%–35% with the temperature ranges from 25°C–28°C. Maintenance of moisture in the culture media is a key factor for obtaining good result, pH is maintained within 6.5–7.5. Old culture media was replaced by the same amount of fresh media at fortnight intervals, for maintenance of optimum supply of food.

### B. Media :

Vegetable kitchen wastes (like potato, banana, green leafy vegetables, cucurbita etc.) were collected from own and neighbouring families and stored in a plastic bucket, which contains holes for aeration. Cowdung was also added in the waste, in a ratio of 20 : 1 (wastes : cowdung) for primary decomposition. Sprinkle of water and mixing was done regularly to facilitate decomposition. Decomposition process continues for 15 days.

### C. Sorting out of Cocoon :

Another pot containing earthworm and culture media with above composition was maintained. Cocoons were collected from this pot to study the incubation time, hatching pattern and juveniles. Cocoons were sorted out with great care from culture pot by wet sieving (0.5 mm mesh size) and hand sorting method. The size and weight of cocoons were measured. Before weighing the cocoons were washed gently in sterile water to remove debris and organic particles adhering to the sticky hull. Freshly laid cocoons were placed on wet blotting paper in a closed petridish (15 cm diameter) under ambient condition (30°C) and hatching of cocoons were observed until juvenile worms comes out from the cocoon. Sterile water was periodically added to the blotting paper to keep the paper moist.

## OBSERVATIONS

## A. Rearing :

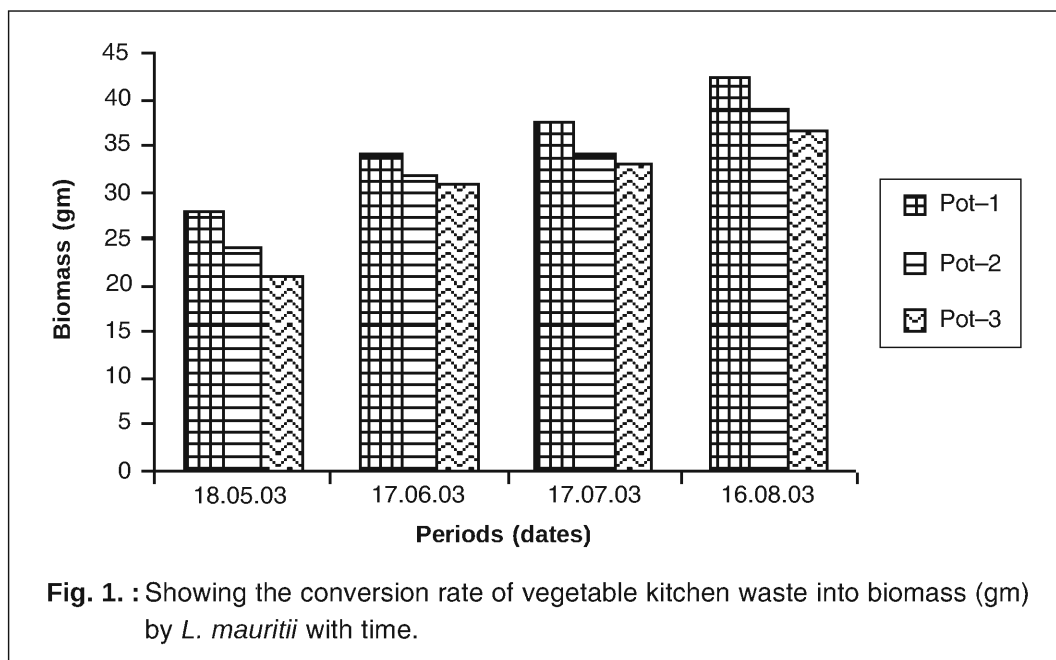
It was observed that at regular interval of 30 days, up to 90 days the number of cocoons and juveniles were increased in pot-1, 2 and 3 (Table 1). It is revealed from Table 1, that the rate of hatching of cocoon was significantly high from 75% to 78.78%. It is also revealed that the mean hatchling production is  $0.836 \text{ adult}^{-1} \text{ month}^{-1}$  ( $\pm \text{SD} : 0.063$ ) (Table 2). There is a distinct increase in biomass (Avg. 1.6 times) (Fig. 1) and increase in population up to juvenile stage (Table 1).

**Table 1.** : Showing number of cocoons and juveniles of *Lampito mauritii* in vegetable kitchen waste in three culture pots in the laboratory. (P = pot, C = cocoon, J = juvenile)

Day	P - 1		P - 2		P - 3		Mean ( $\pm \text{SD}$ )	
	C	J	C	J	C	J	C	J
0	0	0	0	0	0	0	0	0
30	11	6	9	9	8	7	9.33 (1.24)	7.33 (1.24)
60	24	14	18	13	17	15	19.66 (3.09)	14 (0.81)
90	72	54	66	52	58	45	65.33 (5.73)	50.33 (3.85)

**Table 2.** : Showing different features of cocoon, hatchling and culture of *L. mauritii* in vegetable kitchen wastes (means  $\pm$  SD).

Features	
Cocoons studied	25
Morphology	Ovoid, without ornamentation
Length (mm)	5.116 (0.367)
Breadth (mm)	3.338 (0.694)
Colour	Pale yellow
Fresh weight (mg)	21.072 (1.856)
Incubation time (days)	17.96 (1.754)
Hatching success (%) in pot	77.12 (1.577)
Hatching success (%) in blotting Paper	72
Hatchling per cocoon	One
Hatchling size (mm)	14.072 (0.951) $\times$
(Length $\times$ Breadth)	1.232 (0.25)
Fresh weight of hatchling	7.272 (0.741)
Cocoon $\text{adult}^{-1} \text{ year}^{-1}$	13.24 (1.163)
Hatchling $\text{adult}^{-1} \text{ month}^{-1}$	0.836 (0.063)
Increase in biomass (Avg.)	1.6 times



#### B. Shape and Size of Cocoons :

Each cocoon is ovoid in shape with out any ornamentation. The two poles are tapered and blackish in colour. Freshly laid cocoons are soft gelly like, transparent and translucent yellow in colour. Colour changes from light green to brownish with the progress of development and texture finally becomes hard. Size varies between 4.5–6 mm in length (Mean : 5.116,  $\pm$ SD : 0.367) and 2.5–5 mm (Mean : 3.388,  $\pm$ SD : 0.694) in breadth (across the widest part). Mean fresh weight varies between 18.5–23.5 mg (Mean : 21.072,  $\pm$ SD : 1.856).

#### C. Incubation Time :

Development time of cocoons varied between 15–20 days (Mean : 17.96,  $\pm$ SD : 1.754).

#### D. Hatching of cocoons :

All the cocoons were under close observation and at 11.30 p.m. (18-07-03) first cocoon were found to hatch. Initially the cocoon started shaking vigorously before it hatched, there after the hatchling started to come out from the cocoon shell by making a slit on the terminal end of the cocoon (Plate I). The hatchling came out with wriggling movement that took about 1–2 minutes to come out from cocoon. It was observed that the hatchling retreat back into their shells when disturbed at the time of emergence. Hatchling starts moving quickly after emergence (Plate II). Altogether 25 cocoons were under keen observation of which 18 cocoons were hatched. The estimated hatching success was 72%. Only one hatchling was hatched from each cocoon.

### E. Juveniles :

The hatchlings measures about 12.6–15.3 mm in length (Mean : 14.072,  $\pm$ SD : 0.951) when relaxed and 0.9–1.5 mm in breadth (Mean : 1.232,  $\pm$ SD : 0.250). Fresh weight of hatchlings varies between 6–8.2 mg (Mean : 7.272,  $\pm$ SD : 0.741). The colour was whitish red. Within 3–4 weeks, length 40 mm and fresh weight 80 mg of juveniles were recorded.

## DISCUSSION

The present study deals with 60 example of *Lampito mauritii* Kinberg for studying the biology in ambient laboratory condition. From the available literature it has been found that the shape, size, weight, incubation time, hatching success and production of cocoons differ greatly among earthworm species. Satchell (1967) reported *Aporrectodea caliginosa*, *A. longa* and *Octolasion cyaneum* produced between 3 and 13 cocoons year<sup>-1</sup>, *Allolobophora chlorotica* produced 25–27 and *Lumbricus rubellus*, *L. castaneus* and *Dendrodrilus rubidus* 42–106 cocoons year<sup>-1</sup>. Edwards (1988) reported that *Dendrobaena veneta* could produce 84 cocoons year<sup>-1</sup>; *Eudrilus eugeniae*, 188; *Eisenia foetida*, 198 and *Perionyx excavatus*, 1014 cocoons year<sup>-1</sup>. In field condition Dash and Senapati (1980) observed that the number of cocoons produced by *Lampito mauritii* Kinberg was 14.25 adult<sup>-1</sup> year<sup>-1</sup>. In the present study under laboratory culture this species shows an average cocoon production is 13.24 adult<sup>-1</sup>yr<sup>-1</sup> (Table 1). The slight decrease in number might be due to the change in microclimatic condition in laboratory. According to Bhattacharjee and Chaudhuri (2002), values of cocoon production for this species are at the rate of 43 adult<sup>-1</sup> year<sup>-1</sup>, which is much higher than the present investigation. This low rate in this experiment may be due to the higher parent worms density. Senapati and Sahu (1993) postulated that, considering both temperate and tropical species, the size of the worms bears a negative relationships with cocoon production; but worm diameter to cocoon diameter, worm biovolume to cocoon biovolume, worm dry weight to cocoon dry weight all bear significant positive correlation. Lee (1985) correlated the higher risk of mortality in early life with higher rate of cocoon production. According to Satchell (1967) there is a clear relationship between the number of cocoons produced and their location in the soil profile. Those species living near the surface and facing adverse conditions produce many more cocoons. A relationship between reproductive strategies and ecological categories in tropical earthworms was proposed by Lavelle *et al.*, (1998) and Barois *et al.*, (1999). They distinguished four groups of earthworms. According to their classification *Lampito mauritii* falls within group 3: small, mainly polyhumic endogeic species with intermediate fecundity (10–68 cocoons adult<sup>-1</sup> yr<sup>-1</sup>) and usually one hatchling per cocoon (Bhattercharjee and Chaudhuri, 2002). In the present observation only one hatchling emerge out from each cocoon (n = 25). But Bhattacharjee and Chaudhuri (2002) observed 53% of the cocoons produced more than one hatchling (2, rarely 3). Dash and Senapati (1980) observed, cocoons on hatching usually give rise to one and very rarely to two juveniles, in this species.

The development time of cocoons varies considerably among earthworm species. Hallatt *et al.*, (1990) observed mean incubation period was  $18.7 \pm 0.26$  days in *Perionyx excavatus*. Kaushal *et al.*, (1999) observed mean incubation period of  $31.9 \pm 1.2$  days in *Metaphire houletti* in different culture media. Edwards (1988) reported that the time that cocoons of *E. foetida* took to hatch was 32–73 days; *E. eugeniae* 13–27 days; *P. excavatus*, 16–21 days and *D. veneta*, 40–126 days. Bhattacharjee and Chaudhuri (2002) observed 15 days incubation period in pot culture, Ismail (1997) observed incubation period for 18 days in artificial culture, Sahu and Senapati (1991) observed 28 days in field condition, Dash and Senapati (1980) observed 28–30 days incubation period during October–December for *Lampito mauritii*. In this experiment mean incubation period of 17.96 (SD :  $\pm 1.754$ ) days is observed. So, incubation period is shorter in laboratory culture than to the field condition. Soil moisture and temperature both have considerable effect on cocoon incubation and emergence pattern of juveniles. In complete hydric conditions and in very dry condition (<5% soil moisture) cocoons never hatch (Dash and Senapati, 1980).

Bhattacharjee and Chaudhuri (2002) observed 60% hatching in this species, on the contrary in the present investigation 77.12% (SD :  $\pm 1.577$ ) hatching observed within the culture pot and 72% hatching in moist blotting paper. Hatching success is significantly higher may be due to the inhabitation of the species on the topsoil environment. Kaushal *et al.*, (1999) observed 100% hatching success in *Metaphire houletti*, when kept in moist filter paper. Hallatt *et al.*, (1990) observed mean hatching success of all the cocoons produced from parental worms of different ages was only 63.4% in *Perionyx excavatus*.

High fecundity, short incubation period, high hatching success in anecic (Dash and Senapati, 1980 : Ismail, 1997) or top soil endogeic (Bhattacharjee and Chaudhuri, 2002) worm *Lampito mauritii* is probably adaptive strategies of 'r' selected worms (Sahu and Senapati, 1991) to enable them to survive drastic environmental changes in top soil.

According to Evans and Guild (1948), Satchell (1967), Lee (1985), Edwards and Bohlen (1996) cocoon production, time of incubation varies with species, population density, age structure and with different environmental parameters *viz.* temperature, moisture and the energy content of the available food.

Growth in biomass (Fig. 1) clearly indicates that vegetable kitchen waste serves as a good food source for the present studied species. It can be concluded from the present study that this may be used as a good vermicomposting species from vegetable kitchen waste.

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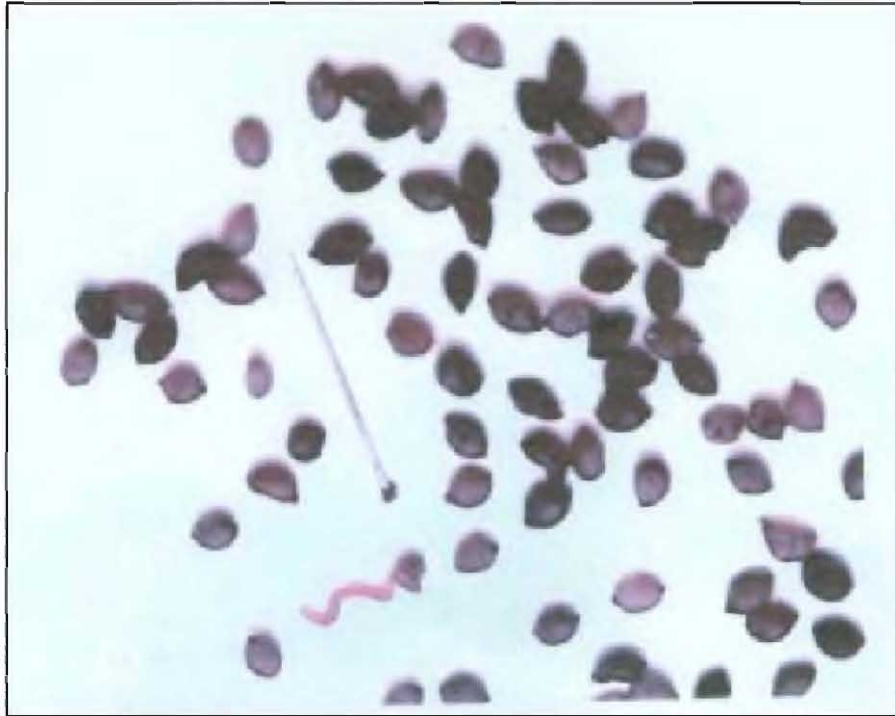
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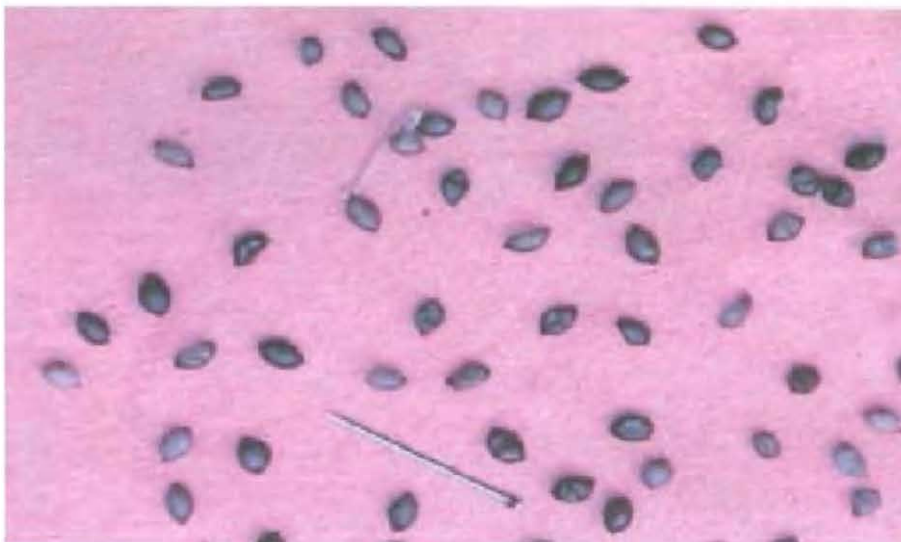
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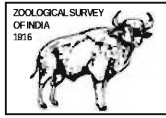
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**Plate I.** : Showing hatching of juvenile (pin : 25 mm).



**Plate II.** : Showing wiggling movement of juvenile (pin : 25 mm).



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## **IDENTIFICATION OF DORSAL GUARD HAIRS OF FOUR INDIAN SPECIES OF BEAR (MAMMALIA : CARNIVORA : URSIDAE)**

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### **INTRODUCTION**

The Indian species of the bears belonging to the family Ursidae are included in the Appendix I of CITES as well as in the Schedule I, Part I of Indian Wildlife (Protection) Act., 1972 amended in 1991 except *Selenarctos thibetanus* which is placed in the Part II of Schedule II. The population of bears are deteriorating day by day due to man-bear interaction and habitat destruction as well as illegal hunting for its skin, flesh and gallbladder of which later is supposed to have a medicinal value (Chakraborty, 1994; Mondal, 1994). Out of 7 subspecies of *Ursus arctos* only *isabellinus* is found in India (Ellerman and Morrison-Scott, 1951). So, hairs of *Ursus arctos* studied is of *isabellinus*.

Now-a-days, trichotaxonomy study is one of the outstanding disciplines in science not only for mammal survey and identification of prey species from the gut contents and scats of large predators but also in forensic science and in different enforcement agencies engaged for management of wildlife. Earlier studies revealed that the structure of hair has definite taxonomic values in the different systematic categories at least for some groups of mammals (Day 1966, Brunner and Coman 1974, Debrot *et al.*, 1982, Teerink 1991, Wallis 1993, Chakraborty *et al.*, 1999, Chakraborty and De 2001, 2002, De and Chakraborty 2002).

Knowledge on hair structure of the family Ursidae is still wanting and only Hausman 1920, Ishizu *et al.*, 1973, Moore *et al.*, 1974 have enlightened the field a little. Identification keys for the different species of the family Ursidae have been provided by Pocock(1941) and Corbet and Hill (1992) on the basis of external and cranial features but no identifying key is available to identify the skins of different bears. In this paper an attempt has been made to formulate an identifying key on the basis of the structure of dorsal guard hairs of the Indian species of the family Ursidae.

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**Key words** : *Indian Bears, Ursidae, dorsal guard hairs, identification*

## MATERIALS AND METHODS

Five tufts of hair of each species were collected from the five selected spots in the mid-dorsal region, keeping almost equidistance from each other. All the samples have been collected from the dry preserved skins housed in the National Zoological Collections of the Zoological Survey of India, Kolkata : *Ursus arctos*; 3 nos. (Kashmir 1; Zoo garden, Kolkata 2); *Selenarctos thibetanus* : 3 nos. (Zoo garden, Kolkata 3); *Helarctos malayanus* : 5 nos. (Arunachal Pradesh 2; Tundla, Uttar Pradesh 1; Zoo garden, Kolkata 2); *Melursus ursinus* : 4 nos. (Shillong, Meghalaya 2; Zoo garden, Kolkata 2). During collection, very often the woolly hairs would get mixed with the guard hair, which were sorted before processing them further. The sample size varied from 30–50 in number.

For macro and microscopic observations methodology given in Chakraborty *et al.*, (1999) was followed. Cross sectional study technologies of Brunner and Coman (1974) and Teerink (1991) were followed. Medullary index was taken with the ocular micrometer and was calculated as  $k = m/c$  where  $m$  = width of medulla and  $c$  = width of hair.

Hausman (1920), Brunner and Coman (1974) and Moore *et al.*, (1974) were followed for the use of terminologies in the article. Nomenclature of colour is according to Ridgway (1886).

## OBSERVATIONS

Findings have been summarized in Table 1 and 2.

## RESULT AND DISCUSSION

Though all the bears are placed under a single family Ursidae (Pocock 1941) yet except cuticular scale position and scale type (Table 1), no such character could be considered definitely as family character. Hairs of the 4 ursid species studied are devoid of any banding pattern except in *U. arctos* which usually possess a single band but may rarely be absent (Table 1). All the studied samples are 'Black' in colour except *U. arctos* which is 'Seal' to 'Clove brown' with white tips and may give the coat a silvery tinge. Moore *et al.*, (1974) made comments on the hairs of *U. americanus cinnamonum*, that unbanded colours vary according to individuals and they are commonly 'Black' or various shades of 'Brown' or 'Yellow'. It was also stated that there are several colour phases in the hairs of *U. arctos imperator*, however typical dark brown is also found. It is also true in case of *U. arctos isabellinus* where the shades vary not only from individual to individual but in the same individual also. However, this intraspecific variation in pelage colour is negligible.

Though there is similarity in colour between the colour of all the three bears *viz. S. thibetanus*, *H. malayanus* and *M. ursinus* yet profile of *H. malayanus* is curly with unshield pattern.

The profile of *S. thibetanus* and *M. ursinus* is almost same but it differs greatly in length, which is  $(34.42 \pm 4.39)$  mm and  $(69.44 \pm 3.02)$  mm in average respectively but there is no significant difference in diameter (Table 1) between the four species studied.

According to Prater (1980), shorter and smooth coat of *S. thibetanus* distinguish it at once from *M. ursinus*. Present study also shows that average length of hair of *S. thibetanus* is  $(34.42 \pm 4.39)$  mm, which is too less in comparison to that of *M. ursinus*  $(69.44 \pm 3.02)$  mm. Moore *et al.*, (1974) recorded that the average length of hair is 70 mm and 108 mm with  $148 \mu$  and  $153 \mu$  average diameter in *U. arctos imperator* and *U. americanus cinamonum* respectively. In the present study the length of hair noted in *U. arctos* is more or less similar with that of *U. arctos imperator* except in diameter which is  $(73.75 \pm 9.15) \mu$  in apical,  $(121.25 \pm 16.02) \mu$  in shield and  $(101.2 \pm 9.27) \mu$  in basal region. Diameter of both the subspecies of *U. arctos imperator* and *U. americanus cinamonum* is higher in comparison with *U. arctos isabellinus*. It may be due to geographical as well as seasonal variation. However, Hausman (1920) noted that diameter of hair of *Ursinus* (= *Ursus*) *americanus* is  $27 \mu$  and the same of *Thalarctos maritimus* is  $68 \mu$ . Thus, from the present and previous study, it can be said that the range of hair length and diameter varies greatly not only from species to species but in the same species also. At the same time scale count per millimeter of hair length also differs greatly in the four Indian species with minimum,  $(100 \pm 0.25)$  in *H. malayanus* and maximum in *S. thibetanus*,  $(510 \pm 20.05)$  (Table 1).

In the present study it is noted that the guard hairs of *U. arctos* possess 'irregular wave' scale pattern throughout except at shield region where it is 'irregular mosaic' (Table 2). The scale margin of the same is 'smooth' with 'intermediate' scale margin distance (Table 2, Plate I, Fig. 1). Similar type of observation was made by Moore *et al.*, (1974) in the hair of *U. arctos imperator* and *U. americanus cinamonum* with slight variation in scale margin which is 'crenate-rippled'. However, Hausman (1920) noted 'imbricate-acuminate' cuticular scales in *Ursinus* (= *Ursus*) *americanus*. From the above discussion it may be concluded that the scale type of all the ursids studied so far are definitely of 'imbricate' type but may be of 'smooth', 'crenate' or 'acuminate' variety. The scale pattern of *S. thibetanus* is same as *U. arctos isabellinus* (Table 2, Plate I, Fig 4). The scale patterns of *H. malayanus* and *M. ursinus* are 'regular wave' with 'irregular mosaic' pattern at basal and shield region respectively and the scale type is 'imbricate-crenate' and imbricate smooth respectively (Table 2).

Scale margin is 'smooth' in *U. arctos* and *M. ursinus* and in other two species the same is 'crenate' (Table 2, Plate I, Fig. 1-4). Scale margin distance is intermediate in all the species except *S. thibetanus* where it is 'close'. From the above study it is clear that cuticular scaler characters could not be used alone as identifying character but may be considered along with other characters. The 'SS' does not vary greatly from species to species which is lowest in *U. arctos*,  $(34 \pm 4.95) \mu$  and highest,  $(47 \pm 13.46) \mu$  in *H. malayanus* (Table 1), whereas 'PD' in two species *i.e.*, *S. thibetanus*

and *M. ursinus* is very less, ( $7 \pm 1.58$ )  $\mu$  and ( $7 \pm 2.58$ )  $\mu$  respectively and is much higher in *U. arctos* and *M. ursinus* i.e. ( $18 \pm 5.44$ )  $\mu$  and ( $17 \pm 2.58$ )  $\mu$  respectively.

The present study shows that the dorsal guard hair of *U. arctos isabellinus* is having an 'unbroken cellular' medulla like that of *U. arctos imperator*. Thus, it may be stated that medullary structure of *U. arctos* does not differ at least in the sub-specific level and may be used as an identifying character for *U. arctos* with other supporting characters. Medullary structure of *U. americanus* was also observed as 'Unbroken cellular' (Moore *et al.*, 1974). Hairs of *S. thibetanus* also possess "unbroken vacuolated medulla". Thus it could be stated that the genus *Ursus* and *Selenarctos* are both possessing either 'unbroken cellular or 'unbroken vacuolated' medulla which are quite identical in structure. Hausman (1920) observed continuous 'nodose' medulla in *T. maritimus*, *H. malayanus* and *M. ursinus* possess 'Simple unbroken amorphous', medulla (Table 2, Plate II, Fig. 3 & 4). So, from the above observations it may be concluded that, medullary configuration of all the hair samples of ursids studied is either 'Unbroken amorphous' or 'unbroken cellular/vacuolated' in structure.

The cross section of *U. arctos* is noted as 'oval' (Table 2, Plate III, Fig. 1), which is quite alike with that of Moore *et al.*, (1974) in *U. arctos imperator* and *U. americanus cinamonum*. It is a strong evidence that the cross sectional structure does not differ at sub-specific level. From this cross sectional study, it may also be noted that hairs of the species belonging to the genus *Ursus* possess 'oval' type shaft configuration, whereas in case of other two species i.e. *S. thibetanus* and *H. malayanus* the cross section is 'circular' in structure. But the cross sectional structure of *M. ursinus* is 'oblong' (Table 2, Plate III, Fig. 4). It is also assumed that, further study on dorsal guard hairs of rest of the bear species may help to establish the taxonomic hierarchy of the ursids.

Considering the above discussion an identification key for the Indian species of the family *Ursidae* is being proposed as follows.

#### KEYS TO THE FOUR INDIAN SPECIES OF BEARS

- 1a. Medullary configuration 'unbroken vacuolated/unbroken cellular, medullary index < 0.50 ..... 2
- 1b. Medullary configuration 'simple unbroken amorphous', medullary index > 0.50 ..... 3
- 2a. Shielded; scale margin 'smooth'; scale margin distance 'intermediate'; scale pattern 'irregular wave' with 'irregular mosaic' at shield region; medullary configuration 'unbroken cellular'; cross section; 'oval'; medullary index 0.33 ..... *Ursus arctos*
- 2b. Shielded; straight; scale margin 'crenate'; scale margin distance 'close'; scale pattern 'irregular wave' with 'irregular mosaic' at shield region; cross section 'circular'; medullary index 0.31 ..... *Selenarctos thibetanus*

- 3a. Shielded; scale margin 'smooth'; scale margin distance 'intermediate'; scale pattern 'regular wave' with 'irregular mosaic' at shield region; medullary configuration simple unbroken amorphous; cross section 'oblong'; medullary index 0.91 ..... *Melursus ursinus*
- 3b. Unshield; almost curly; scale margin 'crenate'; scale margin distance 'intermediate', scale pattern 'Regular wave' with 'irregular mosaic' at basal; cross section 'circular'; medullary index 0.87 ..... *Helarctos malayanus*

### SUMMARY

The dorsal guard hairs of four Indian species of bear viz. *Ursus arctos* Linnaeus, *Selenarctos thibetanus* (G. Cuvier), *Helarctos malayanus* (Raffles) and *Melursus ursinus* (Shaw) have been studied. The study reveals that *Ursus arctos* and *Selenarctos thibetanus* possess medullary index < 0.50 whereas *Melursus ursinus* and *Helarctos malayanus* possess medullary index > 0.50. An identification key is provided on the basis of combination of characters such as scale pattern, scale position, scale type, scale margin, scale margin distance, medullary configuration, medullary index, profile and cross section.

### ACKNOWLEDGEMENT

Authors are indebted to Dr. J.R.B. Alfred, Director, Zoological Survey of India for his kind permission to carry out this work.

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**Table 1** : Comparative account of the characteristics of the guard hairs of four Indian species of the family Ursidae (Mean & SD given in parenthesis).

SS : Side to side cuticular scale length; PD : Proximo distal scale length; A : Apical; B : Basal; M : Middle; S : Shield.

Name of species	Profile	Colour	No. of band	Length (mm)	Diameter ( $\mu$ )	Scale count/mm hair length	SS ( $\mu$ )	PD ( $\mu$ )
<i>Ursus arctos</i> Linnaeus	Shielded, spatulate, straight A : curly	Seal to clove brown	One or rarely absent	65–71 (68.8 $\pm$ 2.08)	A. 50–100 (73.75 $\pm$ 9.15) S. 100–150 (121.25 $\pm$ 16.02) B. 90–120 (101.25 $\pm$ 9.27)	290–360 (310 $\pm$ 9.25)	20–40 (34 $\pm$ 4.95)	10–30 (18 $\pm$ 5.44)
<i>Selenarctos thibetanus</i> (G. Cuvier)	Shielded, more or less straight A : Tapering	Black	Absent	25–40 (34.42 $\pm$ 4.39)	50–100 (73.75 $\pm$ 20.65) S. 100–200 (136.66 $\pm$ 34.96) B. 70–150 (106.25 $\pm$ 26.42)	450–600 (510 $\pm$ 20.05)	30–50 (40 $\pm$ 6.32)	2–10 (7 $\pm$ 1.58)
<i>Helarctos malayanus</i> (Raffles)	Unshield, Almost curly	Black	Absent	12–18 (15.5 $\pm$ 1.73)	A. 50–90 (62.5 $\pm$ 10.39) M. 90–100 (98.75 $\pm$ 3.3) B. 70–150 (70.25 $\pm$ 6.4)	95–120 (100 $\pm$ 0.25)	30–70 (47 $\pm$ 13.46)	10–20 (17 $\pm$ 2.58)
<i>Melursus ursinus</i> (Shaw)	Shielded, more or less straight	Black	Absent	59–73 (69.44 $\pm$ 3.02)	A. 100–170 (127.14 $\pm$ 26.57) S. 150–200 (170 $\pm$ 19.00) B. 100–160 (123.75 $\pm$ 19.07)	280–410 (380 $\pm$ 20.25)	30–60 (45 $\pm$ 10.25)	3–10 (7 $\pm$ 2.58)

**Table 2** : Comparative account of the characteristics of the guard hair of four Indian species of the family Ursidae (Mean and SD given in parenthesis). B : Basal; S : Shield.

Name of species	Scale margin	Scale margin distance	Scale type	Scale pattern	Scale position	Medullary configuration	Medullary index	Cross section
<i>Ursus arctos</i> Linnaeus	Smooth	Intermediate	Imbricate smooth	Irregular wave S. Irregular mosaic	Transversal	Unbroken cellular	0.32–0.34 (0.33 ± 0.012)	Oval
<i>Selenarctos thibetanus</i> (G. Cuvier)	Crenate	Close	Imbricate crenate	Irregular wave S. Irregular mosaic	Transversal	Unbroken vacuolated	0.29–0.32 (0.31 ± 0.01)	Circular
<i>Helarctos malayanus</i> (Raffles)	Crenate	Intermediate	Imbricate crenate	Regular wave B. mosaic Irregular	Transversal	Simple unbroken amorphous	0.86–0.89 (0.87 ± 0.001)	Circular
<i>Melursus ursinus</i> (Shaw)	Smooth	Intermediate	Imbricate smooth	Regular wave S. Regular mosaic	Transversal	Simple unbroken amorphous	0.91–0.92 (0.91 ± 0.008)	Oblong

PLATE I

Cuticular structure of dorsal guard hairs of Indian Bears.

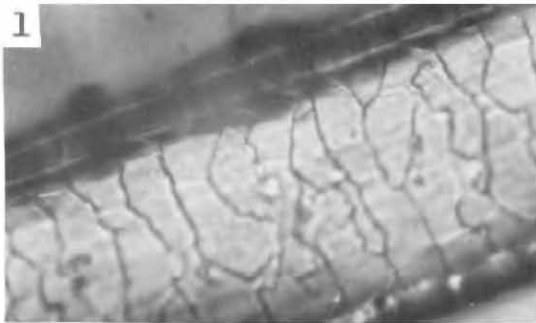


Fig. 1. : Cuticle of *Ursus arctos* : X 400.

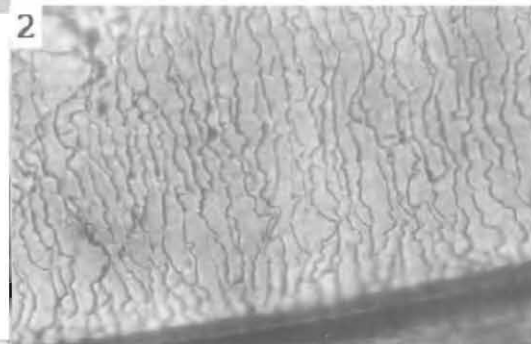


Fig. 2. : Cuticle of *Selenarctos thibetanus* : X 400.

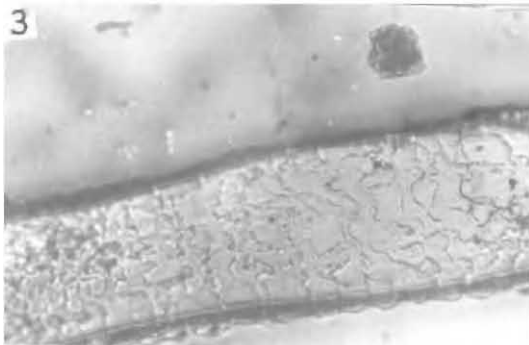


Fig. 3. : Cuticle of *Helarctos malayanus* : X 400.

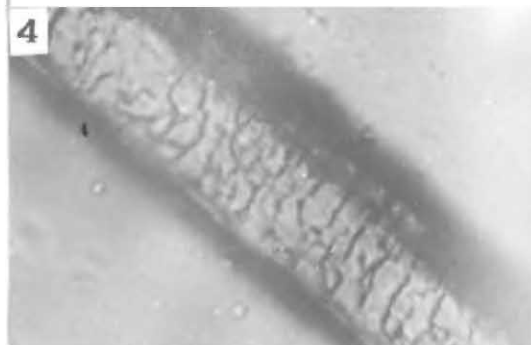
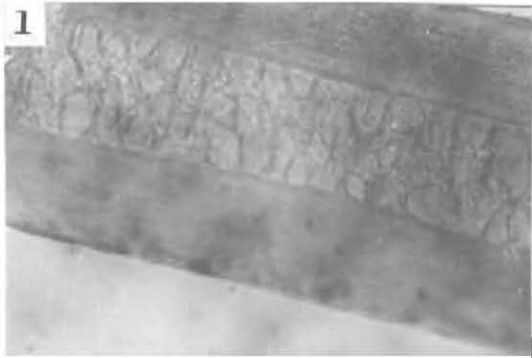
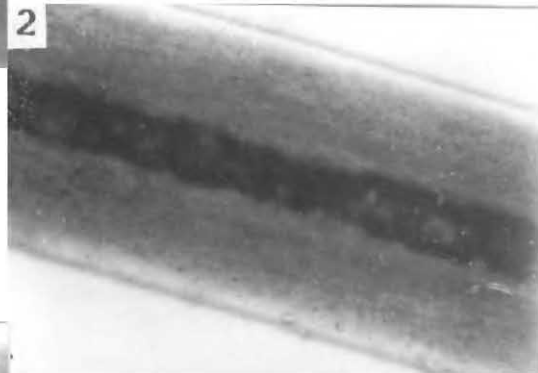


Fig. 4. : Cuticle of *Melursus ursinus* : X 400.

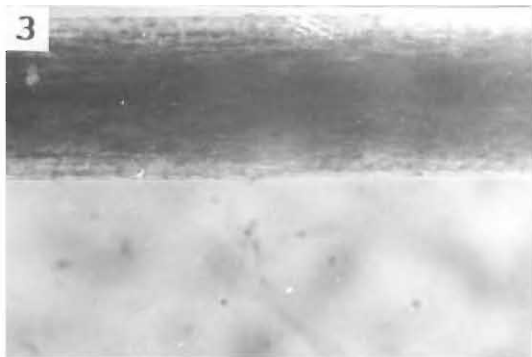
**PLATE II**  
**Medullary configuration of Indian Beers.**



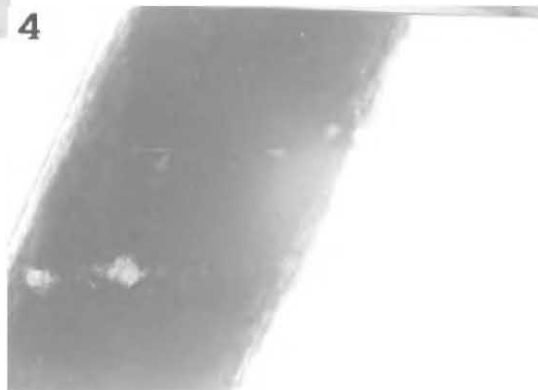
**Fig. 1.** : Medulla of *Ursus arctos* : X 400.



**Fig. 2.** : Medulla of *Selenarctos thibetanus* : X 400.



**Fig. 3.** : Medulla of *Helarctos malayanus* X 400.



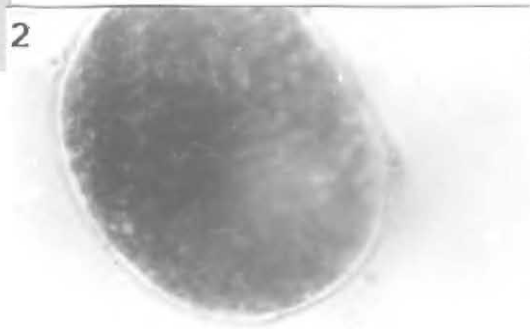
**Fig. 4.** : Medulla of *Helursus ursinus* X 400

**PLATE III**

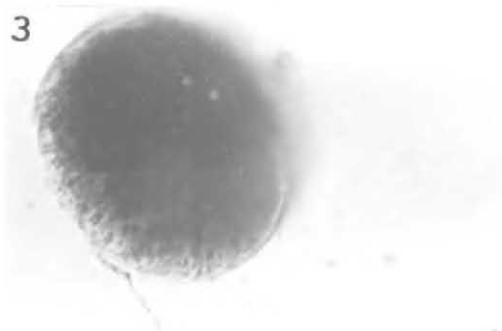
**Cross section of dorsal guard hairs of Indian bears.**



**Fig. 1.** : C.S. of *Ursus arctos* : X 400.



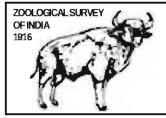
**Fig. 2.** : C.S. of *Selenarctos thibetanus* : X 400.



**Fig. 3.** : C.S. of *Helarctos malayanus* : X 400.



**Fig. 4.** : C.S. of : *Melursus ursinus* X 400.



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**ON A COLLECTION OF SCOLOPENDRID CENTIPEDES  
(CHILOPODA : SCOLOPENDROMORPHA) FROM ORISSA WITH  
NOTES ON SOME NEW DISTRIBUTIONAL RECORDS**

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**INTRODUCTION**

Being a tropical country with two hotspots of biodiversity India has no dearth of centipedes. The Centipede diversity of India is represented by 101 species, belonging to 11 genera under two families (Khanna, 2001). Systematic survey and studies of centipedes have so far been restricted to the Deccan, Western Ghats of Maharashtra, Indian Desert, and Western Himalayas (Jangi & Dass, 1984, Khanna 1994, 2001, 2003, Yadav 1993, Khanna and Yadav, 1997). Knowledge about the centipedes from Orissa is very scanty and fragmentary, with 7 species belonging to 5 genera and 2 sub-families so far known (Jangi & Dass 1984, Khanna 2001). The present study is based on a small collection of centipedes available in the Zoological Survey of India, Estuarine Biological Station, Orissa. In the present communication nine species of scolopendrid centipedes referable to 5 genera and 2 subfamilies pertaining to Orissa have been inventoried. Two species *viz.* *Asanada indica* Jangi & Dass and *Rhysida longipes longipes* (Newport) are reported here for the first time from the state. The collection is deposited in ZSI, EBS, Orissa.

**SYSTEMATIC LIST**

Class CHILOPODA

Order SCOLOPENDROMORPHA

Family SCOLOPENDRIDAE

Subfamily SCOLOPENDRINAE

Tribe SCOLOPENDRINI

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- |   |   |   |                                   |
|---|---|---|-----------------------------------|
| ● | <i>Scolopendra morsitans</i>            | + | <i>Otostigmus politus politus</i> |
| ○ | <i>Scolopendra amazonica</i>            | ∅ | <i>Rhysida nuda nuda</i>          |
| ⊙ | <i>Scolopendra indiae</i>               | ■ | <i>Rhysida longipes longipes</i>  |
| △ | <i>Cormocephalus dentipes</i>           | ▣ | <i>Asanada indica</i>             |
| □ | <i>Asanada agharkari singhbhumensis</i> |   |                                   |

1. ***Scolopendra amazonica*** (Bucherl)

1946. *Scolopendra morsitans amazonica* Bucherl. *Mem. Inst. Butantan*, **19** : 135-137.

1984. *Scolopendra amazonica* (Bucherl) : Jangi & Dass. *J. Scient. Indl. Res.*, **43**(2) : 29.

*Diagnostic characters* : 20<sup>th</sup> pair of legs without tarsal spur, prefemur of anal legs ventrally with 9 spines arranged in 3 rows of 3 each.

*Material examined* : 1ex. Gopalpur-on-sea (under stone), Ganjam dist., 27.vi.2005, coll. P.M. Sureshan (Reg. no. 3907).

*Distribution* : Cosmopolitan.

*Remarks* : It is a medium sized and common species of centipede. Jangi & Dass (1984) reported this species from Dhenkanal, Ganjam and Keonjhar Districts of Orissa.

2. ***Scolopendra morsitans*** Linnaeus

1758. *Scolopendra morsitans* Linnaeus. *Syst. Nat.* **10** : 638.

1984. *Scolopendra morsitans* Linnaeus : Jangi & Dass, *J. Scient. Indl. Res.*; **43**(2) : 29.

*Diagnostic characters* : 20<sup>th</sup> pair of legs with tarsal spur.

*Distribution* : Cosmopolitan.

*Remarks* : It is a large sized species, occurring more abundantly northwards and is the most dominant species of the Indo-gangetic plains. Jangi & Dass (1984) reported this species from Puri, Mayurbhanj and Sambalpur districts of Orissa. Not available in the present lot.

3. ***Scolopendra indiae*** (Chamberlin)

1914. *Trachycormocephalus indiae*, Chamberlin. *Ent. News*, Philadelphia. **25** : 390.

1987. *Scolopendra indiae*, Khanna. D.Phil. Thesis. Gharwal University. pp. 1-243.

*Diagnostic characters* : 21<sup>st</sup> tergite with a complete median suture; lateral margination only on 21<sup>st</sup> tergite; coxopleural process bearing three spines; anal legs short, prefemur with 3 dorso medial spines.

*Distribution* : India : Orissa, Maharashtra, Rajasthan.

*Remarks* : In India the species has a distribution, more or less restricted to Indo-Gangetic belt, and Deccan (Orissa). Jangi & Dass (1984) reported this species from Koraput district of Orissa. Not available in the present lot.

4. ***Cormocephalus dentipes*** Pocock

1891. *Cormocephalus dentipes* Pocock, *Ann. Nat. Hist. Ser.* 6, 7 : 66.

1984. *Cormocephalus pseudonudipes*, Jangi & Dass, *J. Scient. Indl. Res.*, **43**(2) : 37.

*Diagnostic characters* : All legs without tarsal spur; 21<sup>st</sup> tergite without a longitudinal median sulcus; lateral margination present on tergites anterior to 21<sup>st</sup>; maxillipedes with prefemoral process; anal legs in adult male tuberculate.

*Material examined* : 1 female, 1 male, Suniyer Dam : Mayurbhanj : Similipal Biosphere Reserve : 12.i.2003, coll. P.G.S. Setthy (Reg. no. 3679); 2 males, Bhajamari : Similipal Biosphere Reserve; 11.i.2003, coll. P.G.S. Setthy (Reg. no. 3666); 1 female, Hatighal (under stone) Similipal Biosphere Reserve, 13.ii.2003. coll. P.G.S. Setthy (Reg. no. 3713); 6 exs., Gopalpur-on-sea, Ganjam Dist., 1.xii.2004; 4 exs. 4.i.2005, coll. P.M. Sureshan (Reg. no. 3902, 3904); 1 ex. Gopalpur-on-sea, Ganjam district, 25.vi.2005, coll. P.M. Sureshan (Reg. no. 3906).

*Distribution* : India : Madhya Pradesh, Orissa, West.Bengal, Uttar Pradesh, Andaman and Nicobar Islands, Bihar, Delhi, Himachal Pradesh, Meghalaya, Mizoram and Uttaranchal.

*Remarks* : Jangi & Dass (1984) reported this species from Phulbani and Keonjhar districts of Orissa. It is endemic to India. The species appears commonly occurring in the area.

#### Tribe ASANADINI

##### 5. *Asanada agharkari singhbhumensis* (Gravely)

1912. *Pseudocryptops agharkari singhbhumensis* Gravely, *Rec. Indian Mus.*, **7** : 417.

2001. *Asanada agharkari singhbhumensis*. Khanna. *Annals of Forestry*, **9**(2) : 205.

*Diagnostic characters* : Anal legs short and thick; paired longitudinal median sutures always complete on 20<sup>th</sup> tergite; 21<sup>st</sup> tergite more than twice as broad as long, 21<sup>st</sup> sternite at least nearly twice as broad as long; anal leg claw dorsally with a dent; colour grey with a dark line down the middle of the back between longitudinal grooves (in life) and blue (ultimately brown) with the dark black middle line (in spirit).

*Material examined* : 1 ex. Gopalpur-on-Sea, Ganjam District, 10-xii-04. coll. P.M. Sureshan (Reg. no. 3903); 2 exs. Gopalpur-on-Sea, Ganjam District, 29.vi.05, 30.vi.05 (Reg. nos. 3907, 3910), coll. P.M. Sureshan.

*Distribution* : India : Orissa, Bihar.

*Remarks* : Gravely (1912) described this species from Singhbhum district of Chota Nagpur near Chakradharpur. Jangi & Dass (1984) reported it from Barkuda island in Chilka Lake, Orissa. This species is endemic to Deccan Plateau.

##### 6. *Asanada indica* Jangi & Dass

1984. *Asanada indica*, Jangi & Dass, *J. Scient. Indl. Res.*, **43**(2) : 38-39.

*Diagnostic Characters* : Longitudinal Median groove present on posterior half of anal leg prefemur and femur; 21<sup>st</sup> sternite nearly twice as broad as long, posteriorly narrowing, slightly arched and with a slight median notch at posterior margin.

*Material Examined* : 1 ex. Gopalpur-on-Sea, Ganjam District, 10.xii.04. coll. P.M. Sureshan (Reg. no. 3903).

*Distribution* : India : Maharashtra, Kerala, Delhi, Haryana, Rajasthan, Himachal Pradesh, Uttarpradesh and Uttranchal.

*Remarks* : This is the first record of the species from Orissa.

Sub-family OTOSTIGMINAE

Tribe OTOSTIGMINI

7. *Otostigma poilitus poilitus* Karsch

1881. *Otostigma politum*, Karsch, Berlin *ent. Z.*, **25** : 219.

1930. *Otostigma (O.) politus politus* Attems, *Das Tierr., Scolopendromorpha*, **54**(2) : 149.

*Diagnostic characters* : Claw of second maxillae with a spur; first 5-6 legs with two tarsal spurs and following legs up to 19<sup>th</sup> with a single tarsal spur; tergites smooth.

*Distribution* : India : Assam, Delhi, Himachal Pradesh, Kerala, Maharashtra, Meghalaya, Orissa, Sikkim, Uttaranchal, West Bengal.

*Remarks* : Jangi & Dass (1984) reported this species from Ganjam District, Orissa. It is an uncommon species. Not available in the present lot.

8. *Rhysida nuda nuda* (Newport)

1845. *Branchistoma nudum* Newport, *Trans. Linn. Soc.*, **19** : 412.

1930. *Rhysida nuda nuda*, Attems, *Das Tierr., Scolopendromorpha*, **54**(2) : 189-190.

1985. *Rhysida nuda*, Koch, *J. nat. Hist.*, **19** : 207.

*Diagnostic characters* : Coxopleural process not tipped with 3 spines, femoral spur absent on 1<sup>st</sup> leg; tergites preceding 21<sup>st</sup> ordinarily not marginate laterally and if at all a couple of them involved and that too incompletely and weakly.

*Distribution* : India : Assam, Andhra Pradesh, Haryana, Karnataka, Meghalaya, Maharashtra, Madhya Pradesh, Orissa, Tamil Nadu, Tripura and Uttar Pradesh.

*Remarks* : A medium sized centipede found usually under stones, bricks and also in moist soil. Jangi & Dass (1984) reported this species from Puri and Cuttack Districts of Orissa. Not available in the present lot.

9. *Rhysida longipes longipes* (Newport)

1845. *Brachistoma longipes* Newport, *Trans. Linn. Soc.*, London. **19** : 411.

1930. *Rhysida longipes*, Attems, *Das Tierr. Scolopendromorpha*, **54**(2) : 194.

1984. *Rhysida longipes longipes* (Newport). Jangi & Dass. *J. Scient. Indl. Res.*, **43**(2) : 49-50.

*Diagnostic characters* : Prefemur of anal leg with posteromedial spiny process; coxopleural process with lateral spine; tergites preceding 21<sup>st</sup> leg bearing segment clearly marginate laterally and several of them involved; tergites except anterior one with complete paramedian sutures.

*Material Examined* : 1 ex. Berhampur, Ganjam District 29.xii.2004, coll. P.M. Sureshan (Reg. no. 3905). 1 ex. Bhajamari, Simlipar Biosphere reserve, 11.i.2003, coll. P.G.S. Setthy (Reg. no. 3666).

*Distribution* : India : Assam, Andaman and Nicobar Islands, Delhi, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, Uttaranchal, Uttar Pradesh, West Bengal, Arunachal Pradesh, Goa, Orissa and Karnataka.

*Remarks* : A cosmopolitan species, but known in Deccan from few places only. This is the first record of the species from Orissa.

### Identification Key to the Scolopendrid Centipedes of Orissa

(For figures see Sureshan *et al.*, 2003)

1. Spiracles triangular, longish, parallel to the long axis of the body, each spiracle divided into an inner and outer chamber by tripartite valve ..... 2  
— Spiracles oval or round, with spiracular cavity undivided and fully exposed ..... 7
2. Terminal leg segment with coxopleural process and pores; antennae not short, extending well beyond the first segment ..... 3  
— Terminal leg segment without coxopleural process and pores; antennae extraordinarily short, hardly extending backwards beyond the first segment of the body Genus : *Asanada* Meinert] ..... 6
3. All legs without tarsal spur; cephalic plate bears 2 incomplete paramedian longitudinal sutures. Genus : *Cormocephalus* Newport. [21<sup>st</sup> tergite without a longitudinal median sulcus; lateral tergital margination present anteriorly to 21<sup>st</sup>; maxillepedes with prefemoral process; anal legs in adult male tuberculate] ..... species *C. dentipes* Pocock  
— Legs mostly with tarsal spur; cephalic plate without longitudinal sutures. Genus : *Scolopendra* Linnaeus (1<sup>st</sup> tergite opposed to or overlaying cephalic plate; a pair of spinules at the base of the claws of last leg) ..... 4
4. Anal leg prefemur ventrally with nine spines arranged in three rows of three each anal leg prefemur, femur, and tibia in adult males dorsally flat and marginate ..... 5  
— Anal leg prefemur without such arrangement of spine; no such secondary sexual characters visible in males [only 21<sup>st</sup> tergite marginate]-*Scolopendra indiae* ..... (Chamberlin)

5. 20<sup>th</sup> pair of walking legs with a tarsal spur .....*Scolopendra morsitans* Linnaeus  
 — 20<sup>th</sup> pair of walking legs without tarsal spur ..... *Scolopendra amazonica* Bucherl.
6. Anal leg claw dorsally with a dent (colour grey with a dark line down the middle of the back between the longitudinal grooves (in life) and blue (ultimately brown) with a dark middle line (in spirit) ..... *A. agharkari singhbhumiensis* (Gravely)  
 — Anal leg claw dorsally without a dent [Longitudinal median groove present on posterior half of anal leg prefemur and femur.] ..... *A. indica* Jangi & Dass.
7. 9 pairs of spiracles, one on each leg bearing segments 3,5,8,10,12,14,16,18 and 20 [Claw of second maxillae with a spur] Genus : *Otostigmus* Porat. (First 5-6 legs with two tarsal spur and following legs upto 19<sup>th</sup> with a single tarsal spur; tergite smooth) ..... *O. politus politus* Karsh.  
 — 10 pairs of spiracles one on each leg bearing segments 3,5,7,8,10,12,16,18 and 20. [prefemur of maxillepede with medial dental process; first pair of spiracles not very large and sieve like] Genus : *Rhysida* Wood ..... 8
8. Only 21<sup>st</sup> tergite laterally marginate [species *Rhysida nuda* Newport ] (femoral spur absent on 1<sup>st</sup> leg; coxopleural process not tipped with 3 spines; tibial spur present) .....  
 ..... sub-species *nuda* (Newport)  
 — Tergites preceding 21<sup>st</sup> clearly marginate laterally and several of them involved [coxopleural process with a lateral spine *R. longipes* (Newport) ] (prefemur of anal leg with posterior medial spiny process)..... sub-species : *longipes* (Newport)

## DISCUSSION

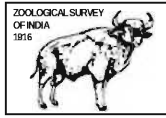
The present study reveals the occurrence of 9 species of Scolopendrid Centipedes belonging to 5 genera and 2 sub families in the state of Orissa. Out of these 6 species belong to subfamily Scolopendrinae and remaining to the subfamily Otostigminae. Scolopendrinae is represented by the tribes Scolopendrini with 4 species viz. *Scolopendra morsitans*, *Scolopendra amazonica*, *Scolopendra indiae* and *Cormocephalus dentipes* and tribe Asanadini with 2 species viz. *Asanada agharkari singhbhumiensis* and *Asanada indica*. *Scolopendra indiae* has a very limited distribution in India known only from Orissa, Rajasthan and Maharashtra. *Asanada indica* is reported here for the first time from Orissa. The subfamily Otostigminae is represented by 3 species viz. *Otostigmus politus politus*, *Rhysida nuda nuda* and *Rhysida longipes longipes*. Though a common species *Rhysida longipes longipes* is reported for the first time from Orissa. Though Orissa provides optimal topographic and climatic conditions, knowledge about the centipedes is very scanty. The reason for this is mainly the lack of serious faunal exploration and collection of specimens from the state. Extensive field collection is thus imperative to explore the rich fauna of Centipedes occurring in Orissa.

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## **ON THE DUNG BEETLES (COLEOPTERA : SCARABAEIDAE : COPRINAE) OF DHANUSHA DISTRICT, NEPAL**

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### **INTRODUCTION**

Beetles of the subfamily Coprinae are commonly known as dung beetles. Scarabaeidae is one of the largest and economically important group of Coleoptera, which can easily be separated by their characteristic lamellate antennae. Though, they are found all over the world but are quite common in tropics than in temperate region. These beetles act as nature's scavengers as they employ themselves everywhere in clearing the ground of offensive materials. These beetles collect and bury human faeces, dung of cattles, carrion, decaying fungi and other vegetable matters and carry them deep into the soil. In this way they help to protect the valuable plant nutrients from destruction and therefore, these beetles have an important role in terrestrial ecosystem.

The knowledge of Nepalese Coprinae is mainly based on the valuable contributions of Arrow (1931), and Balthasar and Chujo (1966). In recent years, some works have been carried out by Shrestha (1982, 1984, 1997, 1999, 2001, 2002) and by Entomology Division, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur, Nepal (2001), from some parts of Nepal. However, the available information on this subfamily from Nepal is still far from complete. Study of this group from Nepal was therefore, taken up for further exploration of fauna for enrichment of the present information. In the first phase, material collected from Dhanusha District in recent times are worked out. The result of this study comprises 21 species under 7 genera, of which 9 species are first time recorded from Nepal and all the species are first time recorded from Dhanusha district.

Nepal lies between China on the North and India on the East, West and South. Dhanusha is one of the 75 districts of Nepal which is situated in the South-East terai region. The length of the district is about 48 km. In North-South and about 42 km. width in East-West with a total area of

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about 1219 sq. km. with an altitudinal range from 61 m. to 610 m. The climate of this district ranges from tropical to subtropical with the average minimum and maximum temperature range from 19.3°C to 33.3°C respectively.

### SYSTEMATIC ACCOUNT

#### LIST OF SPECIES RECORDED FROM DHANUSHA DISTRICT

Subfamily COPRINAE (Scarabaeinae)

Division SCARABAEINI

Genus I. *Scarabaeus* Linnaeus

1. *Scarabaeus devotus* (Redtenbacher)

Genus II. *Gymnopleurus* Illiger

2. *Gymnopleurus cyaneus* Fabricius
3. *Gymnopleurus gemmatus* Harold

Division SISYPHINI

Genus III. *Sisyphus* Latreille

4. *Sisyphus longipes* Olivier
5. *Sisyphus indicus* Hope
6. *Sisyphus hirtus* Wiedmann

Division COPRINI

Genus IV. *Heliocopriss* Burmeister

7. *Heliocopriss bucephalus* (Fabricius)

Genus V. *Catharsius* Hope

8. *Catharsius molossus* (Linnaeus)
9. *Catharsius granulatus* Sharp
10. *Catharsius sagax* (Quenstedt)
11. *Catharsius birmanensis* Lansberge
12. *Catharsius capucinus* Fabricius
13. *Catharsius pithecius* Fabricius

Genus VI. *Copris* Geoffroy

14. *Copris sinicus* Hope
15. *Copris repertus* Walker
16. *Copris magicus* Harold

Genus VII. ***Onthophagus*** Latreille

17. *Onthophagus pactolus* Fabricius
18. *Onthophagus catta* Fabricius
19. *Onthophagus bonasus* Fabricius
20. *Onthophagus rectecornutus* Lansberge
21. *Onthophagus sagittarius* Fabricius

**TAXONOMIC DESCRIPTION**

Subfamily COPRINAE

Division SCARABAEINI

Genus I. ***Scarabaeus*** Linnaeus1758. *Scarabaeus linnaeus*, *Syst. Nat. ed.*, **10** : 345.1. ***Scarabaeus devotus*** (Redtenbacher)1848. *Ateuchus devotus* Redtenbacher, *Hugel's Kaschmir*, **4**(2) : 515.1931. *Scarabaeus devotus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 44-45.

*Material examined* : 4 exs., (3GG, 1E); 3 exs., Chisapani, 6.vi.03; 1 ex., Yadukuha, 20.vi.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India.

*Remarks* : Found rolling balls of dung alonely. First time recorded from Nepal.

Genus II. ***Gymnopleurus*** Illiger1803. *Gymnopleurus*, Illiger, *Mag. Ins.*, **11** : 199.1931. *Gymnopleurus*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 46-48.1963. *Gymnopleurus*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 243.2. ***Gymnopleurus cyaneus*** Fabricius1798. *Copris cyaneus* Fabricius, *Ent. Syst. Suppl.*, : 34.1840. *Gymnopleurus indicus* Cast, *Hist. Nat.*, **2** : 73.1931. *Gymnopleurus cyaneus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 49-50.

*Material examined* : 1 ex., (G), Dhalkebar, 3.ix.03, Collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district, Karnali region, Bardia district.

*Elsewhere* : India and Sri Lanka.

*Remarks* : Very rare in Dhanusha district, found only one specimen in the duration of last 4 years.

### 3. *Gymnopleurus gemmatus* Harold

1792. *Scarabaeus granulatus* Fabricius, (nec Oliv.), *Ent. Syst.*, **1** : 65.  
 1871. *Gymnopleurus gemmatus* Har., *Col. Hefte*, **8** : 117.  
 1931. *Gymnopleurus gemmatus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 53-54.

*Material examined* : 1 ex., (E), Godar, 20.ix.02; Collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district; Karnali region.

*Elsewhere* : India and Sri Lanka.

*Remarks* : Collected only one specimen.

#### Division SISYPHINI

#### Genus III. *Sisyphus* Latreille

1807. *Sisyphus* Latreille, *Gen. Crust. et Ins.*, **2** : 79.  
 1931. *Sisyphus*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 67-68.

### 4. *Sisyphus longipes* (Olivier)

1789. *Scarabaeus longipes* Oliv., *Entom.*, **1**(3) : 164.  
 1792. *Scarabaeus minutus* Fabricius, *Ent. Syst.*, **1** : 70.  
 1798. *Copris helwigi* Fabricius, *Ent. Syst. Suppl.*, : 35.  
 1931. *Sisyphus longipes* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 71-73.

*Material examined* : 1 ex., Janakpur, 5.i.04, collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district; Bardia district.

*Elsewhere* : India and Sri Lanka.

*Remarks* : Collected single specimen on light trap at night.

### 5. *Sisyphus indicus* Hope

1831. *Sisyphus indicus* Hope, *Gray's Zool. Misc.*, : 22.  
 1848. *Sisyphus kaschmirensis* Redtenbacher, *Hugel's Kaschmir.*, **4**(2) : 516.  
 1931. *Sisyphus indicus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 75-76.  
 1963. *Sisyphus* (*S. Str.*) *indicus* : Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 243.

*Material examined* : 1 ex., (E), Godar, 20.ix.02, Collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district, Karnali region (Western Nepal); Hatbazar (Dolakha district).

*Elsewhere* : India, Bangladesh, West China, Hongkong and Sri Lanka.

*Remarks* : Collected single specimen in cattle dung.

### 6. *Sisyphus hirtus* Wiedmann

1823. *Sisyphus hirtus* Wiedmann, *Zool. Mag.*, **2**(1) : 24.  
 1858. *Sisyphus setosulus* Walker, *Ann. Nat. Hist.*, **3**(2) : 208.  
 1931. *Sisyphus hirtus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 76-78.

*Material examined* : 2 exs., (EE); 1 ex., Dhanushadham, 10.ix.02; 1 ex., Godar, 20.ix.02, all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district, Bardia district (Western Nepal).

*Elsewhere* : India and Sri Lanka.

*Remarks* : Rare in Dhanusha district. Collected only two specimens in cattle dung.

### Division COPRINI

#### Genus IV. *Heliocopris* Burmeister

1846. *Heliocopris* Burmeister, *Gen. Ins.*, **10** : 27.  
 1931. *Heliocopris*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 84-85.  
 1963. *Heliocopris*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 297.

### 7. *Heliocopris bucephalus* (Fabricius)

1775. *Scarabaeus bucephalus* Fabricius, *Syst. Ent.*, : 24.  
 1931. *Heliocopris bucephalus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 88-90.  
 1963. *Heliocopris bucephalus* : Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 303.

*Material examined* : 3 exs., (2GG, 1E); 1 ex., Dhanushadham, 10.ix.02; 2 exs., Chisapani Churia hills, 24.ix.03, all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district; Swayambhu (Central Nepal).

*Elsewhere* : India, Burma, Malayasia, Indonesia.

*Remarks* : This is the largest species found in the district. It digs a very deep burrow into the soil below the dung. The specimens are collected about 40 cm. deep burrow. The males squeak like a bat when touched. The female of this species is dumb.

#### Genus V. *Catharsius* Hope

1837. *Catharsius* Hope, *Col. Man.*, **1** : 21.  
 1931. *Catharsius*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 92.  
 1963. *Catharsius*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 304.

### 8. *Catharsius molossus* (Linnaeus)

1758. *Scarabaeus molossus* Linnaeus, *Syst. Nat. ed.*, **10** : 347.  
 1931. *Catharsius molossus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 94-95.  
 1963. *Catharsius* (*S. Str.*) *molossus* : Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 307.

*Material examined* : 18 exs., (5GG, 13EE); 2 exs., Dhalkebar, 5.viii.02; 3 exs., Dhanushadham, 10.viii.02; 3 exs., Godar, 10.vi.03; 3 exs., Yadukuha, 20.vi.03; 3 exs., Janakpur, 1.viii.03; 4 exs., Bahumara, forest, 23.viii.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district, Gokarna forest; Pipar (Kaski district); Charikot and Jiri (Dolakha district); Swayambhu; Kathmandu valley.

*Elsewhere* : India and Sri Lanka.

*Remarks* : It is a widely distributed species in Nepal.

### 9. *Catharsius granulatus* Sharp

1875. *Catharsius granulatus* Sharp, *Col. Hefte.*, **13** : 41.

1931. *Catharsius granulatus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 95-96.

1963. *Catharsius* (S. Str.) *granulatus*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 309.

*Material examined* : 19 exs., (7GG, 12EE); 3 exs., Yadukuha, 15.ix.02; 4 exs., Janakpur, 1.viii.03; 4 exs., Dhalkebar, 5.viii.03; 4 exs., Bahunmara, 23.viii.03; 4 exs., Dhanushadham, 14.ix.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district, Bardia district.

*Elsewhere* : India, Pakistan and Sri Lanka.

*Remarks* : This species is almost identical with *C. molossus*, but without the smooth area adjoining the eye.

### 10. *Catharsius sagax* (Quenstedt)

1806. *Copris sagax* Quenstedt, *Schönh. Syn. Ins.*, **1** : 43.

1931. *Catharsius sagax* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 96.

1963. *Catharsius* (S. Str.) *sagax*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 39.

*Material examined* : 19 exs., (8GG, 11EE); 5 exs., Dhalkebar, 3.viii.02; 2 exs., Chisapani, Churia hills, 15.vi.03; 1 ex., Yadukuha, 20.vi.03; 6 exs., Bahunmara Churia hills, 23.viii.03; 2 exs., Janakpur, 1.ix.03; 2 exs., Dhanushadham, 14.ix.03; 1 ex., Godar, 20.x.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India, Pakistan, Bhutan, Sri Lanka.

*Remarks* : Closely similar to *C. molossus* but the head without the smooth area adjoining the eye on each side. First time recorded from Nepal.

### 11. *Catharsius birmanensis* Lansberge

1874. *Catharsius birmanensis* Lansberge, *Col. Hefte.*, **12** : 11.

1931. *Catharsius birmanensis* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 97-98.

*Material examined* : 52 exs., (25GG, 27EE); 4 exs., Dhanushadham, 10.ix.02; 9 exs., Janakpur, 1.iv.03; 5 exs., Dhalkebar, 5.vi.03; 7 exs., Chisapani, Churiya hills, 6.vi.03; 7 exs., Godar, 20.vi.03; 15 exs., Yadukuha, 25.vi.03; 5 exs., Bahunmara, Churia hills, 23.viii.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India, Bhutan, Myanmar.

*Remarks* : Very common in Dhanusha district. Collected during day time as well as in light trap. First time recorded from Nepal.

### 12. *Catharsius capucinus* Fabricius

1781. *Scarabaeus capucinus* Fabricius, *Spec. Ins.*, **1** : 25.

1931. *Catharsius capucinus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 99-100.

*Material examined* : 32 exs., (18GG, 14EE); 3 exs., Dhanushadham, 15.vi.02; 5 exs., Janakpur, 1.vi.03; 5 exs., Godar, 3.vi.03; 4 exs., Dhalkebar, 5.vi.03; 4 exs., Chisapani, 6.vi.03; 6 exs., Yadukuha, 30.vi.03; 5 exs., Bahunmara Churia hills, 23.viii.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India, Sri Lanka.

*Remarks* : First time recorded from Nepal.

### 13. *Catharsius pithecius* (Fabricius)

1775. *Scarabaeus pithecius* Fabricius, *Syst. Ent.*, : 21.

1781. *Scarabaeus sabaeus* Fabricius, *Spec. Ins.*, **1** : 23.

1792. *Scarabaeus nanus* Fabricius, *Ent. Syst.*, **1** : 42.

1842. *Copris sinensis* Hope, *Proc. Ent. Soc. Lond.*, : 60.

1858. *Copris cribricollis* Walker, *Ann. Mag. Nat. Hist.*, **2** : 208.

1931. *Catharsius pithecius* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 100-101.

1963. *Catharsius* (*S. Str.*) *pithecius* : Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 30.

*Material examined* : 32 exs., (18GG, 14EE); 6 exs., Dhalkebar, 3.viii.02; 6 exs., Janakpur, 1.vi.03; 5 exs., Godar, 3.vi.03; 4 exs., Chisapani, 6.vi.03; 7 exs., Yadukuha, 20.vi.03; 4 exs., Bahunmara, 23.viii.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district, Bardia district; Helambu.

*Elsewhere* : India and Sri Lanka.

*Remarks* : This species is very common in Dhanusha district.

Genus VI. *Copris* Geoffroy

1762. *Copris* Geoffroy, *Ins. des Env. des Paris*, : 87.  
 1931. *Copris*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 102.  
 1963. *Copris*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 317.

14. *Copris sinicus* Hope

1842. *Copris sinicus* Hope, *Proc. Ent. Soc. Lond.*, : 60.  
 1931. *Copris sinicus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 115-116.  
 1963. *Copris* (*S. Str.*) *sinicus* : Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 342.

*Material examined* : 2 exs., (1G, 1E); 2 exs., Bahunmara, Churia hills, 23.viii.03, collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India, Mayanmar, Java, Thailand, Vietnam and South east China.

*Remarks* : First time recorded from Nepal.

15. *Copris repertus* Walker

1858. *Copris repertus* Walker, *Ann. Mag. Nat. Hist.*, **2** : 208.  
 1877. *Copris claudius* Harold, *Ann. Mus. Civ. Genova*, **10** : 48.  
 1931. *Copris repertus*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 116-117.

*Material examined* : 7 exs., (3GG, 4EE); 1 ex., Dhalkebar, 5.iv.03; 2 exs., Godar, 15.vi.03; 4 exs., Yadukuha, 20.vi.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India and Sri Lanka.

*Remarks* : First time recorded from Nepal.

16. *Copris magicus* Harold

1881. *Copris magicus* Harold, *Mitth. Munch. Ent. Ver.*, **5** : 88.  
 1931. *Copris magicus*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 112-113.

*Material examined* : 6 exs., (4GG, 2EE); 1 ex., Dhalkebar, 5.ix.02; 1 ex., Chisapani, Churia hills, 6.vi.03; 3 exs., Godar, 15.vi.03; 1 ex., Yadukuha, 20.vi.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India, Sikkim, Yunnan, Mayanmar, Vietnam.

*Remarks* : First time recorded from Nepal.

Genus VII. *Onthophagus* Latreille

1802. *Onthophagus* Latreille, *Hist. Nat. Crust. et Ins.*, **3** : 141.  
 1931. *Onthophagus*, Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 159-162.  
 1963. *Onthophagus*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **2** : 153.

17. *Onthophagus pactolus* Fabricius

1787. *Scarabaeus pactolus* Fabricius, *Mant. Ins.*, **1** : 12.  
 1931. *Onthophagus pactolus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 203-204.

*Material examined* : 9 exs., (5GG, 4EE); 5 exs., Dhalkebar, Shripur, 5.ix.02 and 3.ix.03; 2 exs., Godar, 25.ix.03; 2 exs., Chisapani, Churia hills, 24.ix.03, all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district, Thakurbara (Bardia district); Karnali region.

*Elsewhere* : India.

*Remarks* : Found in cattle and goat dungs.

18. *Onthophagus catta* Fabricius

1787. *Scarabaeus catta* Fabricius, *Mant. Ins.*, **1** : 12.  
 1931. *Onthophagus catta* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 230-231.  
 1963. *Onthophagus (Digitonthophagus) gazella* Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **2** : 265.

*Material examined* : 49 exs., (24GG, 25EE); 12 exs., Janakpur, 1.iv.02, 1.viii.02, 1.ix.02; 2 exs., Godar, 20.viii.02, 20.ix.02; 11 exs., Dhalkebar, 3.viii.02, 3.ix.03; 6 exs., Dhanushadham, 10.ix.02, 14.ix.03; 7 exs., Yadukuha, 15.vii.02, 20.vi.03; 6 exs., Chisapani, 20.ix.03; 5 exs., Bahunmara, 17.ix.02; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district; Thakurbara (Bardia district); Karnali region.

*Elsewhere* : India, Pakistan, Arabia, Africa, Madagascar.

*Remarks* : This species is very common in Dhanusha district and is found throughout the year.

19. *Onthophagus bonasus* Fabricius

1775. *Scarabaeus bonasus* Fabricius, *Syst. Ent.*, : 23.  
 1931. *Onthophagus bonasus* Arrow, *Fauna Brit. India* (Coleoptera : Lamellicornia), **3** : 231-232.  
 1963. *Onthophagus (Digitonthophagus) bonasus* Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, **1** : 296.

*Material examined* : 38 exs., (22GG, 16EE); 6 exs., Janakpur, 17.v.02; 5 exs., Dhanushadham, 10.vii.02; 4 exs., Dhalkebar, 5.viii.02; 6 exs., Godar, 15.iv.03; 12 exs., Yadukuha, 20.vi.03; 5 exs., Bahunmara, 23.viii.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district; Karnali region; Helambu; Jiri (Dolakha district).

*Elsewhere* : India, Pakistan, Sri Lanka, Myanmar, Thailand, Vietnam and Cambodia.

*Remarks* : This species is very common in Dhanusha district.

### 20. *Onthophagus rectecornutus* Lansberge

1883. *Onthophagus rectecornutus* Lansberge, *Notes Leyd. Mus.*, 5 : 49.  
 1907. *Onthophagus rectecornutus*, Arrow, *Ann. Mag. Nat. Hist.*, 19(7) : 421.  
 1963. *Onthophagus (Serrophorus) rectecornutus*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, 1 : 499.

*Material examined* : 4 exs., (3GG, 1E); 2 exs., Janakpur, Lado Bela, 1.ix.02; 2 exs., Godar, 20.ix.02; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India, Bangladesh, Bhutan, Myanmar, Sri Lanka, North Vietnam and South China.

*Remarks* : First time recorded from Nepal.

### 21. *Onthophagus sagittarius* Fabricius

1775. *Onthophagus sagittarius* Fabricius, *Syst. Ent.*, : 24.  
 1931. *Onthophagus sagittarius*, Arrow, *Fauna Brit. India (Coleoptera : Lamellicornia)*, 3 : 304-306.  
 1963. *Onthophagus (Serrophorus) sagittarius*, Balthasar, *Monogr. Scarab. Aphod. palaearkt. orient.*, 1 : 509.

*Material examined* : 63 exs., (33GG, 36EE); 20 exs., Janakpur, Kurtha, 2.i.02; 16 exs., Dhalkebar, Shripur, 5.i.02; 9 exs., Dhanushadham, Mangalpur, 15.i.02; 9 exs., Yadukuha, Gothkuha, 15.ix.02; 9 exs., Godar, Portaha, 10.i.02; 6 exs., Chisapani, Churia hills, 24.ix.03; all collected by S.P. Mahto.

*Distribution* : Nepal : Dhanusha district.

*Elsewhere* : India, Myanmar, Malaysia, Indonesia, China.

*Remarks* : First time recorded from Nepal.

## SUMMARY

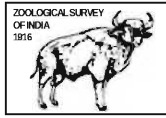
The present paper deals with materials of dung beetles of Dhanusha district, Nepal collected by S.P. Mahto. Altogether 21 species under 7 genera have been studied, of which 9 species are first time recorded from Nepal and all the 21 species are first time recorded from Dhanusha district.

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## **CYTOLOGY AND CYTOTAXONOMY OF ACRIDIDAE : A SUMMARY**

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### **CHROMOSOMES, SPECIES AND TAXONOMY**

A chromosome contains a linked group of genes, each consisting of a unique number of nucleotide pairs specifying a particular gene, arranged in a precise sequence. Functionally, the genome in a species is a stable integrated system and therefore the structure of chromosomes has to be conservative in order to maintain the integrity. Speciation is a change from one stable system to another and therefore, must involve changes in the genes and their subsequent integration either at the molecular or at the structural levels or both. The taxonomists in determining the evolutionary relationships, invariably emphasize the comparison of structures, which are more conservative in evolution and have empirically determined different sets of characters in different groups of organisms for the purpose. The chromosome complement of a species is a conservative set of morphological features and structural changes in them could be a basis for the study of evolutionary relationships within and between species. In ultimate analysis, all evolutionary changes must originate in changes in the genome, but most of them are at the molecular level and therefore, not so easily accessible for studies. In the mean time cytotaxonomists have gathered a lot of useful information at the microscopic levels of changes in the chromosome structure, which are mediators of evolution.

### **RESEARCH WORK**

#### **Preface :**

Acridid and Pyrgomorphid grasshoppers are the classic examples of karyotype stability and are thus interesting from evolutionary viewpoint.

Since the very beginning, even before the rediscovery of Mendel's work in the early part of the 20<sup>th</sup> century, grasshoppers had drawn the attention of cytologists as material for investigation.

Since then, grasshopper remained the classical animal for the learning of the grammar of chromosome biology. Their availability in most of the places and their easy maintenance in laboratory, relatively short life cycle, large size of chromosomes with low numbers in their complements made them the material of choice to animal cytologists. The ease with which meiosis can be studied and aberrations can be scored made the investigators use them as good experimental systems.

Earlier workers believed that survey of karyotypes of grasshoppers might be a useful endeavour. They had two purposes. The first was to compare closely related species or genera to discover the karyotypic variability and some trends of karyological evolution where data might also help orthopterists as an additional set of characteristics for distinguishing species and other taxonomic categories. Their second purpose was to discover material useful for cytological research, such as species with low diploid number and novel sex chromosome mechanisms.

They deferred presenting a summary of phylogenetic studies because interpretations based on gross chromosome morphology alone had led to erroneous conclusions. Related species possessed nearly identical chromosome constitutions and thus have not been able to revise taxonomy.

The situation has now changed with the advent of various banding techniques. Grasshoppers by virtue of having 'large' chromosomes are most useful, as banding minute differences that can be located and specified. In the present studies 'C' 'G' and Hoechst 33258 fluorescence banding techniques have been utilized for the study of karyotypes, meiotic patterns and species differentiation. 35 species under 32 genera and 11 sub-families have been investigated.

(A survey of literature on the cytology and cytotaxonomy of Indian Acridid and Pyrgomorphid grasshoppers has been published by the author (Singh, 2002)

## MATERIAL AND METHODS

### Techniques used in Chromosome Preparations :

Selected male and female grasshoppers were injected with 0.05% colchicine (0.02 to 0.04 ml) depending upon the size of the insect (colchicine is injected prior to dissection to arrest metaphase). Four to six hours after the injection, the testes and hepatic caecae were dissected out in 0.67% solution of insect saline from the males, while females were preferred to be dissected after 10–12 hours with a possibility to accumulate more metaphases in their somatic cells. The tissues thus dissected out were cleaned in the same medium. After cleaning, the tissues were transferred for a hypotonic treatment in a solution of 0.9% sodium citrate for 45–60 minutes. After that, the tissues were fixed instantly in a freshly prepared fixative of acetic acid and methanol (1 : 3) for 45–60 minutes. A slightly more hypotonic treatment and fixation were preferred for the somatic cells for better chromosomal preparation. The fixed tissues were transferred in small tubes and stored preferably at 4°C.

The slides were prepared by the air dry technique. The fixed material were squashed in 50% acetic acid on the slides cleaned in dichromate solution, and stored in the vapours of 50% acetic

acid at 4°C for over night. Next morning the slides were brought at room temperature and immersed in 1 : 3 acetic acid methanol mixture for an hour. The cover slips were removed with the help of a sharp blade in the immersed condition and dried at room temperature in a dust proof chamber. After a preliminary scanning of the unstained slides, the selected ones were stained in 2–3% solution of Giemsa [E. Merck (India) Private Ltd.] in phosphate buffer at p<sup>H</sup> 6.8 to 6.9. Staining was checked until appropriate contrast was obtained, they were then immediately rinsed in distilled water (two changes) and rapidly air dried under a lamp. After scanning, the slides were soaked in Xylene and mounted in DPX.

#### **a. C-banding**

C-banding was carried out according to the method by Sumner (1972) with some minor modifications. The air dried slides were treated with 0.2 N Hydrochloric acid for 30–60 minutes at room temperature, rinsed in distilled water and dried. These slides were dipped in a freshly prepared 5% aqueous solution of Barium hydroxide octahydrate at 50°C for 1–10 minutes. The treatment time depends on the ageing of slides; the stored slides produce sharp bands after comparatively longer treatment. After thorough rinsing with several changes in distilled water, they were incubated for 1 hour at 60°C in 2 x SSC (0.3 M sodium chloride and 0.03 M tri-sodium citrate at p<sup>H</sup> 7), rinsed in distilled water and dried. These slides were stained for 30 to 90 minutes in Giemsa stain; 2.5 ml of stock solution added to 50 ml of buffer (at p<sup>H</sup> 6.8). Finally, the slides were again rinsed briefly in distilled water, blotted, allowed to be dried thoroughly under lamp, soaked in Xylene and finally mounted in DPX.

#### **b. Fluorescence banding with Hoechst 33258**

Staining of chromosomes with Hoechst 33258 has provided yet another valuable technique of chromosome banding (Hilwig and Gropp, 1972) which is popularly called Hoechst 33258 for staining heterochromatin in mouse chromosomes. A simple direct and slightly modified staining procedure given here was followed throughout. The air dried slides were first soaked in McIlvain's buffer at p<sup>H</sup> 5.4 for 10 minutes, then stained with freshly prepared Hoechst solution (0.05 mg/ml or 0.1 mg/ml) in the same buffer at p<sup>H</sup> 5.4 for 15 to 20 minutes at room temperature. After staining, the slides were rinsed in the same buffer (two changes) and mounted either in buffer or in a glycerol buffer mixture. The slides were observed immediately with the help of fluorescence microscope or were stored for some days (up to a couple of weeks) in a refrigerator prior to observation. All fluorescence observations were made using Leitz ortholux photomicroscope with its transmitted light fluorescence attachments using appropriate barrier and exciter filters.

#### **c. Photomicrography**

Photomicrographs were taken with the help of Leitz ortholux microscope. Planapochromatic objectives of different magnifications were used. Filters of different combinations were used to obtain the best possible contrast. Black and white negative films (panchromatic) ranging from 50 to 120

ASA were used in fluorescence photomicrography. The negatives so obtained were printed on photosensitive Agfa bromide papers of different grades. Fine grain film and paper developer of Agfa-gevaert (A 901 and 902) and Kodak (D 76 and D 163) were used while developing negatives and positive prints. Digital cameras have also been used on several occasions for more precise results.

#### d. Karyotyping and construction of idiograms

The cells with good chromosome spreads were photomicrographed. The diploid number (2n) were determined by basic or most predominant number observed in the individual. The cut out of individual chromosomes which appeared similar in morphology and staining intensity were paired to construct karyotypes. All the karyotypes that could be prepared were used for the morphometric measurements. In case of C-band karyotypes the sex chromosomes were placed after the last autosomal pair. In some species very few individuals were available for study. In such cases a banding feature that was present on both the homologues of a given chromosome pair was assumed to occur throughout the species. Morphometric measurements of each chromosome were taken from several metaphase plates from either of the sex. Their mean values so obtained were used in calculating the relative length of the chromosome in percent of the total haploid length. These measurements were also used in drawing comparative idiograms.

#### SPECIES INVESTIGATED

(Taxonomic grouping according to Dirsh, 1961)

Name of the species	Name of the locality	Number of Specimens		
		Male	Female	Total
Order ORTHOPTERA Superfamily PAMPHAGOIDEA Family PYRGOMORPHIDAE Tribe TAGASTINI				
1. <i>Tagasta indica</i> Bolivar	1. Sukna forest Darjeeling (W. B.)	–	1	1
Tribe ATRACTOMORPHINI				
2. <i>Atractomorpha crenulata</i> (Fabricius)	1. Kunihar (H. P.) 2. Varanasi (U. P.) 3. North Bengal Univ. campus Siliguri (W. B.) 4. Jainagar 5. Matpukurdhapa 6. Golf club 7. Lake gardens 8. Narendrapur and 9. Indian Museum pond, Kolkata	65	15	80

Name of the species	Name of the locality	Number of Specimens		
		Male	Female	Total
Tribe CHROTOGONINI 3. <i>Chrotogonus (Ch.) trachypterus</i> (Blanchard)	1. Himachal Pradesh 2. N. B. U. campus 3. Singla and 4. Sukna forest Darjeeling 5. Matpukurdhapa, Kolkata	5	5	10
Superfamily ACRIDOIDEA Family ACRIDIDAE Subfamily HEMIACRIDINAE 4. <i>Spathosternum prasiniferum</i> (Walker)	1. Varanasi 2. N. B. U. campus 3. Sivok and 4. Sukna forest Darjeeling 5. Diamond harbour 6. Narendrapur and 7. Golf club Kolkata	04	18	122
Subfamily TROPIDOPOLINAE 5. <i>Tristria pulvinata</i> (Uvarov)	1. Golf club,	140	2	142
Subfamily OXYINAE 6. <i>Gesonula punctifrons</i> (Stål)	1. N. B. U. campus 2. Sivok 3. Sukna forest 4. Golf club 5. Indian Museum pond	27	8	35
7. <i>Oxya fuscovittata</i> (Marschall)	1. Sivok 2. Suknaforest 3. Narendrapur 4. Diamond harbour 5. Golf club	24	2	26
8. <i>Oxya hyla</i> Serville	1. Varanasi 2. N. B. U. campus 3. Suknaforest 4. Diamond harbour 5. Jainagar 6. Golf club	12	4	16
<i>Oxya</i> sp. Serville	1. Andaman Island (around Port Blair) 2. Golf club	34	2	36
9. <i>Caryanda paravicina</i> (Willemse)	1. Dow hill, Darjeeling	4	1	5

Name of the species	Name of the locality	Number of Specimens		
		Male	Female	Total
Subfamily COPTACRIDINAE 10. <i>Eucoptacra praemorsa</i> (Stål)	1. Sukna forest	1	–	1
Subfamily CALLIPTAMINAE 11. <i>Peripolus pedarius</i> (Stål)	1. Singla	7	15	22
Subfamily EYPREPOCNEMIDINAE 12. <i>Eyprepocnemis alacris</i> (Serville)	1. Himachal Pradesh 2. Singla 3. Canning, Sundarbans (W. B.)	2	2	4
13. <i>Eyprepocnemis rosea</i> Uvarov	1. Himachal Pradesh	3	–	3
14. <i>Choroedocus robustus</i> (Serville)	1. Singla 2. Sukna forest	1	3	4
15. <i>Tyloptropidius varicornis</i> (Walker)	1. Narang 2. Chail and 3. Saproon (H.P.) 4. Sukna forest	3	6	9
Subfamily CYRTACANTHACRIDINAE 16. <i>Cyrtacanthacris tatarica</i> (Linnaeus)	1. Matpukurdhapa	–	1	1
17. <i>Chondracris rosea</i> (de Geer)	1. Singla	1	–	1
18. <i>Patanga succincta</i> (Johansson)	1. Chail 2. Saproon and 3. Masobra (H.P.)	2	3	5
Subfamily CATANTOPINAE 19. <i>Catantops innotabilis</i> (Walker)	1. Himachal Pradesh 2. Sivoke 3. Sukna forest	8	–	8
20. <i>Catantops simlae</i> Dirsh	1. Masobra (H.P.)	1	1	2
21. <i>Xenocatantops humilis</i> (Serville)	1. Renuka lake (H.P.) 2. Singla 3. Sukna forest	16	–	16
22. <i>Stenocatantops splendens</i> (Thunberg)	1. Singla 2. Sukna forest	4	2	6
Subfamily GOMPHOCERINAE 23. <i>Leva cruciata</i> Bolivar	1. N.B.U. campus	2	–	2
24. <i>Chorthippus indus</i> Uvarov	1. Renuka lake and 2. Saproon (H.P.)	9	–	9
25. <i>Dnopherula (Aulacobothrus)</i> Jago	1. Narang 2. Chail 3. Saproon and 4. Happy valley (H.P.)	15	–	15

Name of the species	Name of the locality	Number of Specimens		
		Male	Female	Total
Subfamily OEDIPODINAE				
26. <i>Acrotylus inficita</i> (Walker)	1. N. B. U. campus 2. Sivoke	2	7	9
27. <i>Aiolopus tamulus</i> (Fabricius)	1. Himachal Pradesh 2. N. B. U. campus 3. Dow hill 4. Jainagar	9	4	13
28. <i>Dittopternis venusta</i> (Walker)	1. Sukna forest	4	1	5
29. <i>Heteropternis respondens</i> (Walker)	1. N. B. U. campus 2. Singla	–	3	3
30. <i>Pternoscirta cinctifemur</i> (Walker)	1. Sukna forest	–	1	1
31. <i>Scintharista notabilis</i> Uvarov	1. Himachal Pradesh	2	–	2
32. <i>Sphingonotus indus</i> Saussure	1. Singla	9	1	10
33. <i>Trilophidia annulata</i> (Thunberg)	1. Himachal Pradesh 2. Varanasi 3. N. B. U. campus 4. Canning, Sundarbans 5. Sivok 6. Sukna forest 7. Jainagar	29	15	44
Subfamily ACRIDINAE				
34. <i>Acrida exaltata</i> (Walker)	1. Kunihar (H.P.) 2. Varanasi 3. N. B. U. campus 4. Singla 5. Sukna forest 6. Diamond harbour 7. Golf club	28	3	31
35. <i>Ceracris nigricornis</i> (Walker)	1. Dow hill 2. Singla	18	7	25
36. <i>Sikkimiana darjeelingensis</i> (Bolivar)	1. Singla	1	4	5
37. <i>Phlaeoba antennata</i> Brunner	1. Sivoke 2. Sukna forest	14	3	17
38. <i>Phlaeoba infumata</i> Brunner	1. Renuka lake and 2. Kunihar (H.P.) 3. N. B. U. campus 4. Diamond harbour 5. Jainagar 6. Golf club	61	16	77

### COMPARATIVE KARYOLOGY OF THE SPECIES STUDIED

#### 1 *Tagasta indica* Bolivar

1	2	3	4	5	6	7	8	9	10
15.31	14.12	12.33	11.38	9.91	9.13	8.23	7.64	6.63	5.33

The X was largest in the complement. Length of chromosomes had gradually decreased.

#### 2 *Atractomorpha crenulata* (Fabricius)

17.23	13.99	12.29	10.91	9.69	9.16	8.44	7.78	6.64	3.84
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The X and the last pair of chromosomes were distinct by their size. C-band was hardly perceptible in the first 2 pairs of autosomes, and in Hoechst staining also, no bright centromeric regions were noticeable. On C-band staining the centromeric region of the smallest bivalent was prominent.

#### 3. *Chrotogonus trachypterus* (Blanchard)

14.15	13.37	12.59	14.46	9.84	9.39	8.78	8.09	7.35	5.97
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The X and the 1<sup>st</sup>, 2<sup>nd</sup> pairs of autosomes were large elements. Length of other chromosomes had gradually decreased.

#### 4. *Spathosternum prasiniferum* (Walker)

16.21	13.95	11.91	10.24	9.24	8.17	7.09	6.67	6.16	4.00	3.38	2.98
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Last 3 pairs were small. All the chromosomes had centromeric band. On the X it was prominent. The 7<sup>th</sup> and 9<sup>th</sup> pairs also had a band in their interstitial region. In Hoechst staining chromosomes showed brighter centromeric region. In all the bivalents random distribution of chiasmata was visible.

#### 5 *Tristria pulvinata* (Uvarov)

15.92	15.06	13.65	11.48	9.63	8.30	7.49	6.84	5.86	3.19	2.59
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Last 2 pairs were small. First 4 pairs had wider gaps than others. The 1<sup>st</sup> pair was distinct on its prominent centromeric band. The X had become marker element on its proximal band. In Hoechst staining, all the chromosomes showed brighter fluorescing centromeric region. The proximal band of the X had not fluoresced prominently. Chiasma was not restricted to any particular region in the bivalents.

#### 6 *Gesonula punctifrons* (Stål)

18.18	13.60	11.40	9.81	8.30	7.61	6.89	6.41	6.13	5.53	3.59	2.50
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The X was largest, and the last 2 pairs were separated as small ones. All the chromosomes had centromeric band. The 5<sup>th</sup> pair also had a proximal band. In Hoechst staining, centromeric regions were not distinct as band. Last 2 small pairs had formed chiasma in the distal region.

7 *Oxya fuscovittata* (Marschall)

14.71 12.55 11.21 9.85 8.91 7.71 7.13 6.87 6.48 5.93 5.18 3.62

The X was largest. The 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and the last pair had bigger size difference than remaining ones. All the chromosomes had centromeric band. On the 9<sup>th</sup> pair it was hardly perceptible, whereas, proximal half region of the smallest pair was C-band positive. 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup> and 10<sup>th</sup> pairs also had distal bands of different magnitude. In Hoechst staining, brighter centromeric ends were not delimited into sharp bands. All the bivalents had shown random distribution of chiasmata.

8 *Oxya hyla* Serville

16.05 14.17 12.55 10.53 8.89 7.97 7.36 6.84 5.84 4.45 2.92 2.41

The X was the largest. The 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> autosomal pairs had bigger size difference. The last 2 pairs were separated as small ones. All the chromosomes had centromeric band of equal magnitude. A proximal band was also present on the 2<sup>nd</sup> pair. All the chromosomes had brighter fluorescing centromeric band. The 7<sup>th</sup>, 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> pairs had mostly distal chiasma.

9 *Caryanda paravicina* (Willemse)

15.58 15.11 11.89 10.70 10.15 7.11 6.74 6.42 5.82 3.75 3.18 2.50

1 large 1 small and 2 medium groups were formed by 2, 3, 4 and 3 pairs of chromosomes respectively. This caryotypic feature was unique.

10 *Peripolus pedarius* (Stål)

15.39 13.23 11.18 10.10 9.80 8.28 7.39 6.81 6.40 4.81 3.61 3.0

Large size difference was noticed in the first 3 pairs. In others this difference was smaller and uneven.

11 *Eyprepocnemis alacris* (Serville)

12.95 11.60 11.46 10.25 9.78 9.17 8.29 7.28 7.15 5.46 3.57 2.90

Size difference between the pairs was not uniform. The last 2 pairs were small in size.

12 *Eyprepocnemis rosea* Uvarov

13.52 13.20 10.66 9.26 8.19 8.06 7.47 7.28 6.89 5.88 4.81 4.26

The 1<sup>st</sup> pair of autosome and the X of similar size were grouped as large elements. Size difference between other pairs was haphazard.

13 *Choroedocus robustus* (Serville)

14.24 13.43 10.57 9.87 9.78 9.03 8.55 8.00 6.24 4.79 2.77 2.54

The first 2 and the last 2 pairs were grouped as large and small ones. Among the medium ones, size difference was large between the 7<sup>th</sup>, 8<sup>th</sup> and 8<sup>th</sup>, 9<sup>th</sup> pairs.

14 *Tylotropidius varicornis* (Walker)

14.40 13.45 11.83 10.58 9.45 8.55 **8.17** 7.41 6.64 3.52 2.96 2.04

The last 3 pairs were considerably small in the complement. Size difference between pairs had gradually decreased.

15 *Cyrtacanthacris tatarica* (Linnaeus)

16.16 13.72 11.85 **10.51** 8.79 8.17 7.53 6.81 6.10 4.40 3.43 2.57

The first 3 and the last 3 pairs were grouped as large and small ones in the complement. Size difference was bigger between the pairs in the large size group. In medium and small groups this difference was small and even.

16 *Chondracris rosea* (deGeer)

15.98 **14.52** 13.46 11.69 9.93 8.16 6.69 6.04 5.41 3.05 2.70 2.36

The last 3 pairs of similar size were considerably small in the complement. Difference in the size of pairs was large and equal upto the 6<sup>th</sup> autosomal pair. The 7<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> had small size difference.

17 *Patanga succincta* (Johanson)

15.40 **12.90** 11.54 10.57 9.35 8.59 7.95 7.46 6.77 3.81 3.24 2.55

1 large, 7 medium and 3 small pairs of autosomes were present in the complement. Size difference between pairs of medium and small groups was similar.

18 *Catantops innotabilis* (Walker)

15.64 13.93 11.15 **9.04** 8.66 8.10 7.54 6.98 6.49 4.85 3.96 3.63

3 large, 5 medium and 3 small pairs were present in the complement. Large pairs had bigger size difference than others.

19 *Catantopa simlae* Dirsh

16.81 14.44 11.97 10.43 9.71 7.95 7.07 6.28 5.63 4.23 3.09 2.37

Grouping of chromosomes as 3 large 5 medium and 3 small sizes was however not distinct. The 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> pairs had large and equal gap in their length.

20 *Xenocatantops humilis* (Serville)

14.26 12.23 10.90 10.27 9.25 **8.50** 8.23 7.34 6.56 5.03 4.42 3.16

Grouping of chromosomes as 2 large 6 medium and 3 small pairs of autosomes was however not distinct.

21 *Stenocatantops splendens* (Thunberg)

14.87 12.74 **11.51** 10.21 9.08 8.15 7.25 6.95 6.46 5.74 4.17 3.28

2 large, 7 medium and 2 small pairs of autosomes were noted in the complement. Large pairs had big gap in their length.

22 *Chorthippus indus* Uvarov20.65 22.52 16.60 **8.53** 8.20 6.82 5.29 5.12 4.27

$2n = 17(G)$  consisted of 6 metacentric and 10 acrocentric autosomes and 1 acrocentric X chromosome. Smaller arms of the metacentrics were larger than the last four chromosomes. The X 4<sup>th</sup> longest in the complement, was half the size of the 3<sup>rd</sup> pair. The 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> largest metacentric elements were the fusion products of the 2<sup>nd</sup> and 4<sup>th</sup>, 1<sup>st</sup> and 8<sup>th</sup> and 3<sup>rd</sup> and 7<sup>th</sup> acrocentric chromosomes of the parental complement (*i.e.*  $2n = 23 G$ ).

23 *Dnopherula* (Aulacobothrus) sp. Jago14.89 13.02 11.05 **10.23** 9.97 8.74 7.67 6.88 6.41 4.70 3.74 2.75

The first 2 and the last 3 pairs could be grouped as large and small ones in the complement. Large pairs had bigger size gap than the small pairs. Those in between (3<sup>rd</sup> to 8<sup>th</sup> pairs) had uneven size difference.

24 *Acrotylus inficita* (Walker)15.05 12.96 11.59 **10.28** 9.74 8.50 7.93 7.30 6.20 4.67 3.48 2.35

First 3 pairs of autosomes could be separated as large ones. For other 5 and last 3 pairs medium and small size distinction was not convincing.

25 *Aiolopus tamulus* (Fabricius)18.17 13.23 11.02 **10.19** 9.89 8.90 8.25 7.48 6.65 4.02 3.00 2.18

2 pairs large, 6 pairs medium and 3 pairs were small in the complement.

26 *Heteropternis respondens* (Walker)

15.73 13.26 11.54 10.19 8.97 7.88 7.35 6.87 6.47 5.68 3.38 2.67

Last 2 pairs were very small in the complement. Large size difference up to 6<sup>th</sup> element had however gradually reduced. In others size difference was small and equal.

27 *Sphingonotus indus* Saussure15.09 13.40 11.64 9.82 **9.26** 8.16 7.36 6.84 6.52 5.89 3.31 2.78

The last 2 pairs were distinctly small. The 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> pairs were large elements. From 4<sup>th</sup> to 9<sup>th</sup> including X (5<sup>th</sup> longest) formed medium size group.

28 *Trilophidia annulata* (Thunberg)14.88 12.88 11.57 **10.18** 9.17 8.42 7.72 7.23 6.70 5.80 3.03 2.48

3 pairs long, 6 pairs medium and 2 pairs were distinctly small in the complement. The X 4<sup>th</sup> longest had bridged the gap between long and medium.

29 *Acrida exaltata* (Walker)14.54 12.79 10.93 **10.17** 9.13 8.15 7.76 7.24 6.87 6.21 3.47 2.73

The 1<sup>st</sup> and 2<sup>nd</sup> pairs were large and the last 2 pairs were very small in the complement. Others with small gap had formed medium size group. All the chromosomes had centromeric band. One small element was the supernumerary chromosome.

30 *Sikkimiana darjeelingensis* (Bolivar)

13.73 12.45 11.19 10.08 9.92 9.38 8.13 6.84 6.25 5.02 3.98 3.00

Grouping of chromosomes into large, medium or small was not possible. Also, the difference in the size of pairs was not uniform throughout.

31 *Phlaeoba antennata* Brunner15.79 14.73 11.80 **10.28** 8.95 7.54 6.78 6.40 6.24 4.35 3.84 2.51

3 large, 5 medium and 3 small autosomes were present. The 1<sup>st</sup> and 2<sup>nd</sup> pairs had small size difference.

32 *Phlaeoba infumata* Brunner14.33 12.34 11.01 **10.21** 9.15 8.34 7.74 7.13 6.36 5.62 2.97

The 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> pairs large, and the last pair was small in the complement. Size difference was small between medium pairs. All the chromosomes had centromeric band. On the 9<sup>th</sup> pair C-band was prominent. C-band was also present in the distal half region of the 3<sup>rd</sup> pair. Brighter fluorescing centromeric region of all the chromosomes was visible in Hoechst staining.

### A SUMMARY OF KARYOLOGICAL FINDINGS

The difference in the idiograms of 32 species reveal distinct karyotype for each of them, instead of all having 23G; 24E acrocentric chromosomes.

The number of chromosomes into different size classes, or gradual seriation of the complement were the distinguishing features of the karyotypes. Position of the X in the karyotypes of different species varied from 1<sup>st</sup> to 6<sup>th</sup> and was found to be a valuable cytotaxonomic character.

The finding is encouraging since it was believed by earlier workers that Acridoidea are a group with such uniform karyotypes that their study can throw little light on taxonomic problems.

On chromosomal banding patterns these species are highly distinct from each other.

### ACKNOWLEDGEMENTS

I am indebted to Dr. J.R.B. Alfred, Director, Zoological Survey of India for providing facilities and for his continued interest in the work. Research workers promptly supplied me reprints of their works, for this I express my gratitude to Prof. G.K. Manna, Prof. A.K. Saha, University of Kalyani, and Prof. J.S. Yadav, Dr. A.S. Yadav, Kurukshetra University. I also thank Prof. T. Sharma, and Prof. B.N. Singh of Banaras Hindu University and Prof. A.K. Duttgupta of Calcutta University for their hospitality during consultation of literature in their laboratories. I am thankful to Dr. Ch. Satyanarayana of Zoological Survey for helping in shaping the manuscript in electronic form. Dr. M.S. Shishodia of Z. S. I. has obliged me by identifying these grasshoppers for the cytotaxonomic study.

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## GLOSSARY

<b>Cytotaxonomy</b>	The study of the natural relationships of organisms by a combination of cytology and taxonomy.
<b>Cell</b>	Basic structural and functional unit of all living matter.
<b>Nucleus</b>	The spheroidal, membrane-bounded structure present in all eukaryotic cells which contains DNA, usually in the form of chromatin.
<b>Chromatin</b>	The complex of nucleic acids (DNA and RNA) and proteins (histones and non-histones) comprising eukaryotic chromosomes.
<b>Chromosome</b>	Thread like structures in the nucleus, consisting of chromatin, and carrying genetic information arranged in a linear sequence.
<b>Karyotype</b>	The term karyotype is applied to a systematized array of the chromosomes prepared either by drawing, digitized imaging, or by photography, with the extension in meaning that the chromosomes of a single cell can typify the chromosomes of an individual or even a species.
<b>Mitotic karyotypes</b>	Chromosomes at metaphase reveal their exact morphology on which they are paired and karyotyped. The karyotype is the first character in the cytotaxonomic evaluation of a species. Sex-chromosomes and chromosomal polymorphisms are readily detected in karyotyping. Gaps, constrictions, NORs are detected on the chromosomes which serve as the marker elements in the chromosomal differentiation of species.
<b>Idiogram</b>	Idiogram is the diagrammatic representation of a karyotype. A comparative analysis of which forms the basis of our cytotaxonomical conclusions.
<b>Chromosome band</b>	<p>A band is defined as a part of a chromosome which is clearly distinguishable from its adjacent segments by appearing darker or lighter with one of more banding techniques.</p> <p>The chromosomes are visualized as consisting of a continuous series of light and dark bands, so there are no "interbands". The banding techniques fall into two principal groups :</p> <p>(i). Those resulting in bands distributed along the length of the whole chromosome, such as G-, Q-, and R-bands, including techniques that demonstrate patterns of DNA replication, and</p>

- (ii). Those that stain specific chromosome structures and hence give rise to a restricted number of bands. These include methods which reveal constitutive heterochromatin (C-bands), telomeric bands (T-bands), and nucleolus organizing regions (NORs).

*C-band mitotic, meiotic and hoechst 33258 fluorescence band karyotypes*— the advent of C-banding has made it possible to differentially stain constitutive heterochromatic regions at condensed stages of a division cycle, and hence, at a time when such regions are normally indistinguishable from euchromatin. Analysis of C-band karyotypes may reveal—

- (1) interspecific variation, serving to distinguish related species.
- (2) it may be intraspecific in which case it may be either
  - (a) distinguish different populations of the same species creating polytypism or else
  - (b) it may distinguish different individuals of the same population creating a polymorphism.

C-band meiotic karyotypes help in analysis of chiasma localisation in relation to heterochromatin distribution, and morphological alterations among bivalent types.

*Hoechst-33258 fluorescence banding*— in grasshoppers it has been found that at early prophase stages only the centromeres of the autosomal bivalents fluoresced brightly whereas the entire X univalent showed bright fluorescence. It has been concluded that H-fluorescence is modulated by chromosome condensation brought about by differential ratios of DNA-protein at different chromosome regions and at different divisional stages. This property helps in distinguishing chromosomes in the karyotypes.

### **Meiosis**

In most sexually reproducing organisms, the doubling of the gametic chromosome number, which accompanies syngamy, is compensated for by a halving of the resulting zygotic chromosome number at some other point during the life cycle. These changes are brought about by a single chromosomal duplication followed by two successive nuclear divisions. The entire process is called meiosis, and it occurs during animal gametogenesis or sporogenesis in plants.

### **Meiotic bivalents**

A pairing configuration during the first meiotic division which consists of two completely or partially homologous chromosomes. The number of bivalents per cell (meiocyte) normally corresponds to half the somatic chromosome number of diploid and genome-allopolyploid species.

**Bivalent karyotypes** Analysis of meiotic bivalents in their karyotypes help considerably in localization of chiasmata and the range of its variation at intra and inter individual level. Chiasma analysis further indicate the recombination potential of that sex.

**Meiotic stages** Study of meiotic stages are very important in identifying the configuration of ditactic bivalents and characterizing megameric pairs. Both features act as marker elements in the cytotaxonomic identification of a species. Supernumerary chromosomes, unequal bivalents, pairing and inversions are readily distinct in meiotic stages.

PLATE I

Comparative Idiograms

Order ORTHOPTERA  
Superfamily PAMPHAGOIDEA  
Family PYRGOMORPHIDAE



*Tagasta indica*  
Bolivar



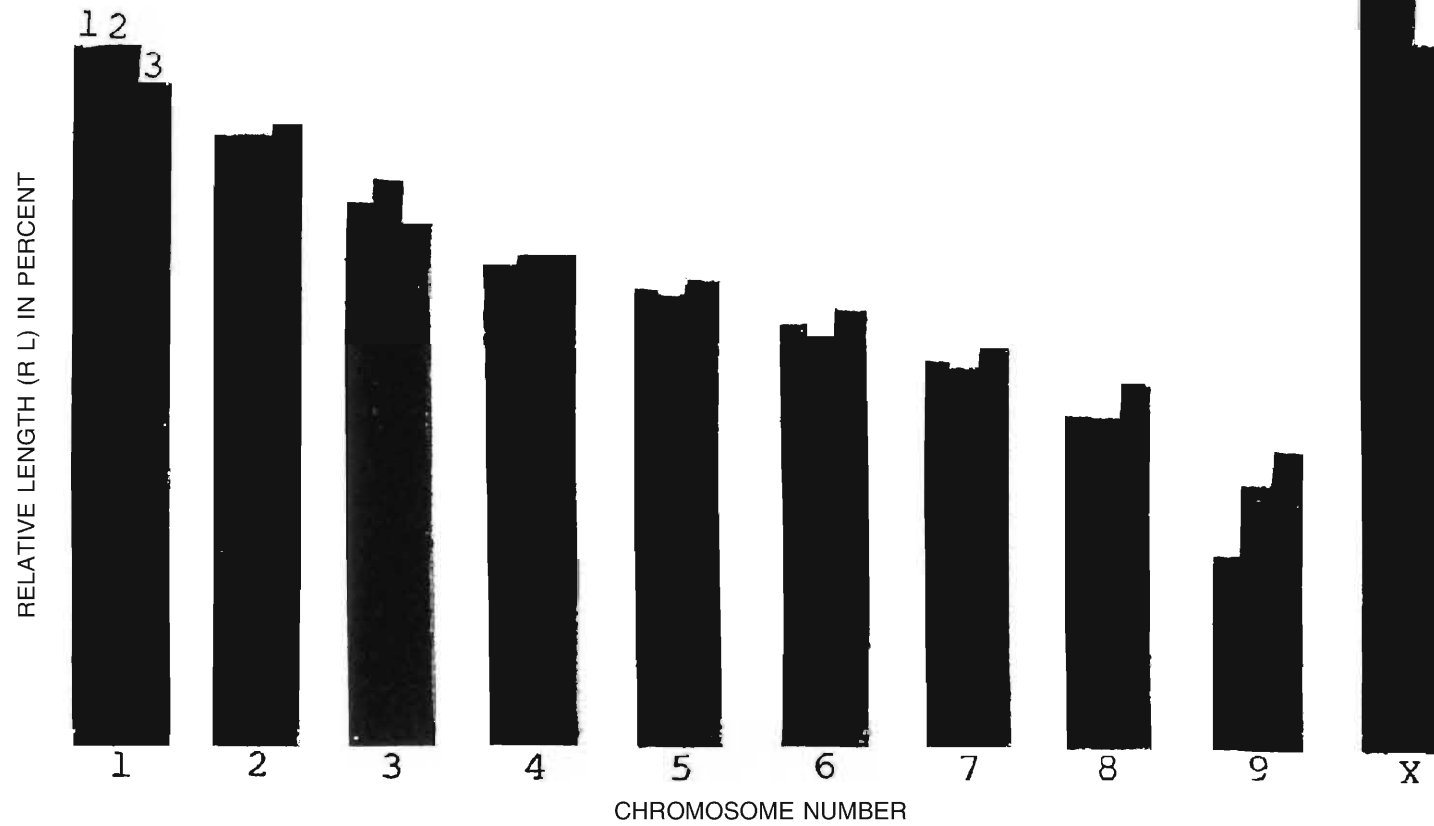
*Atractomorpha crenulata*  
(Fabricius)



*Chrotogonus trachypterus*  
(Blanchard)

PLATE II

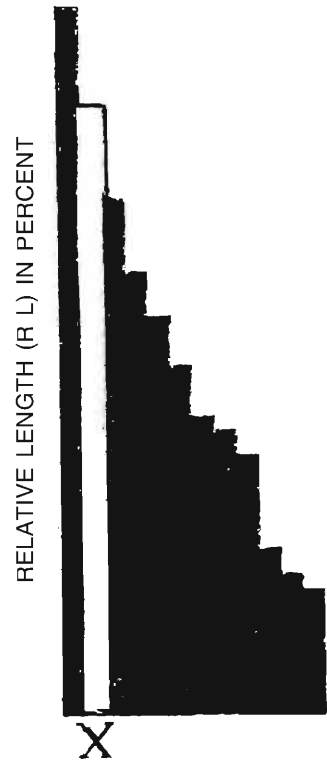
Tribe Atractomorphini  
Tribe Tagastini  
Tribe Chrotogonini



1. *Atractomorpha crenulata* (Fabricius); 2. *Tagasta indica* Bolivar; 3. *Chrotogonus trachypterus* (Blanchard)

PLATE III

Superfamily ACRIDOIDEA  
Family ACRIDIDAE  
Subfamily HEMIACRIDINAE



*Spathosternum prasiniferum*  
(Walker)

Subfamily TROPIDOPOLINAE

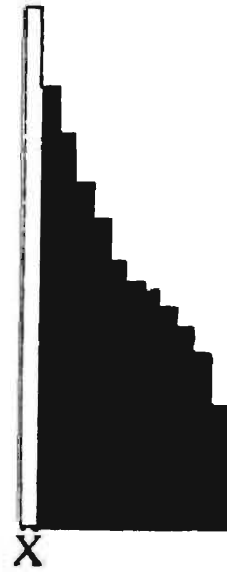


*Tristria pulvinata*  
(Uvarov)

Subfamily OXYINAE



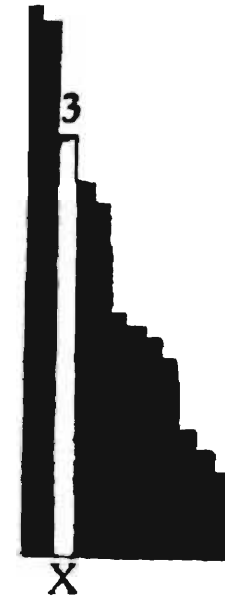
*Gesonula punctifrons*  
(Stål)



*Oxya fuscovittata*  
(Marschall)



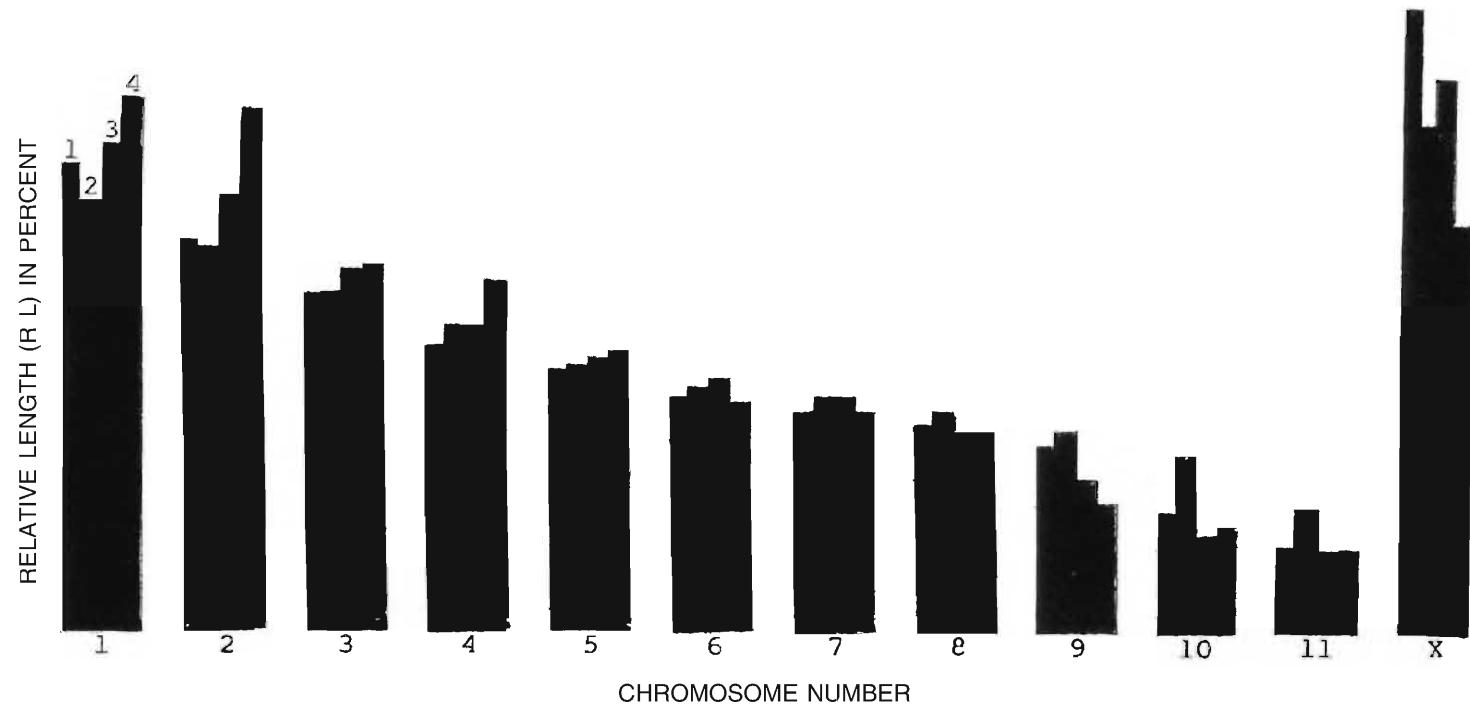
*Oxya hyla*  
Serville



*Caryanda paravicina*  
(Willemse)

PLATE V

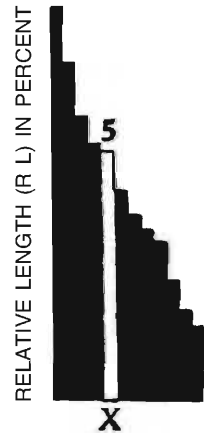
Subfamily OXYINAE



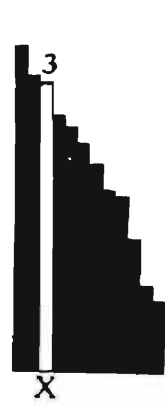
1. *Gesonula punctifrons* (Stål); 2. *Oxya fuscovittata* (Marschall);  
3. *Oxya hyla hyla* Serville; 4. *Caryanda paravicina* (Willemse)

Subfamily CALLIPTAMINAE

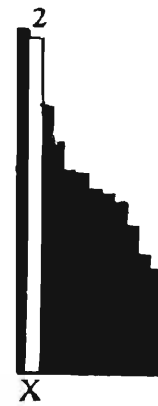
Subfamily EYPREPOCNEMIDINAE



*Peripolus pedarius*  
(Stål)



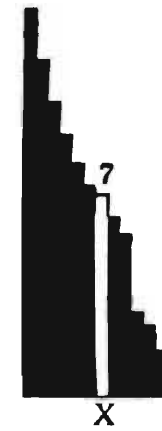
*Eyreprocnemis alacris*  
(Serville)



*Eyreprocnemis rosea*  
Uvarov



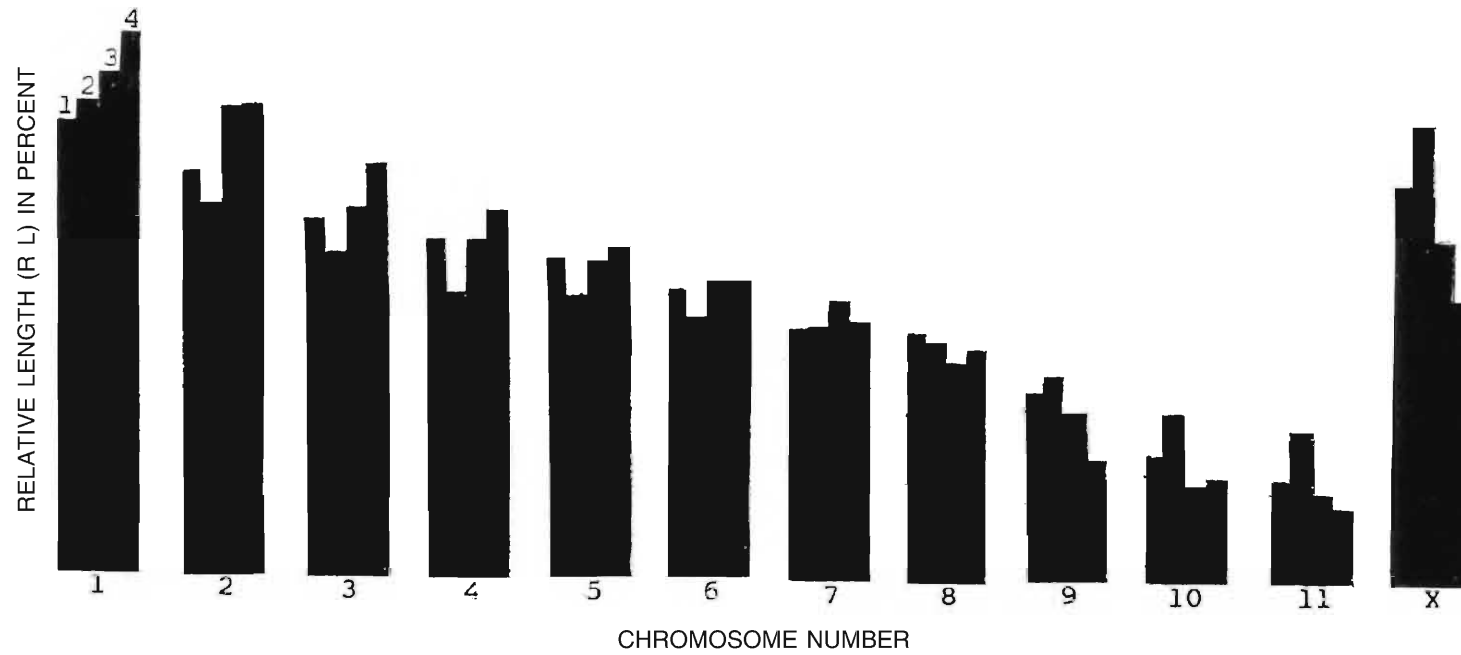
*Chroedocus robustus*  
(Serville)



*Tylotropidius varicornis*  
(Walker)

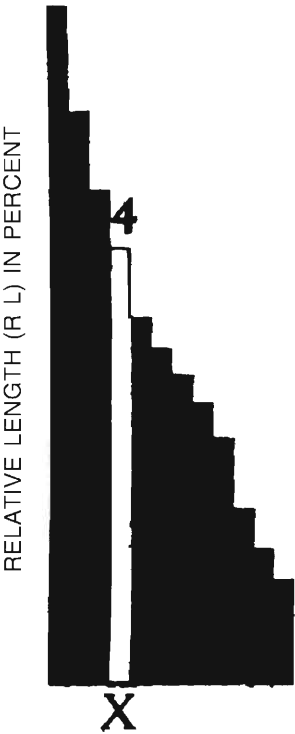
PLATE VII

Subfamily EYPREPOCNEMIDINAE



1. *Eyrepocnemis alacris alacris* (Serville); 2. *Eyrepocnemis rosea* Uvarov  
 3. *Choroedocus robustus* (Serville); 4. *Tylotropidius vricornis* (Walker)

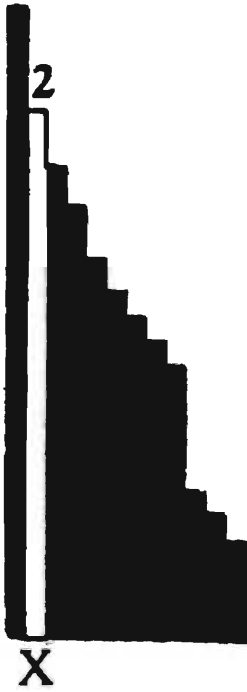
Subfamily CYRTACANTHACRIDINAE



*Cyrtacanthacris tatarica*  
(Linnaeus)



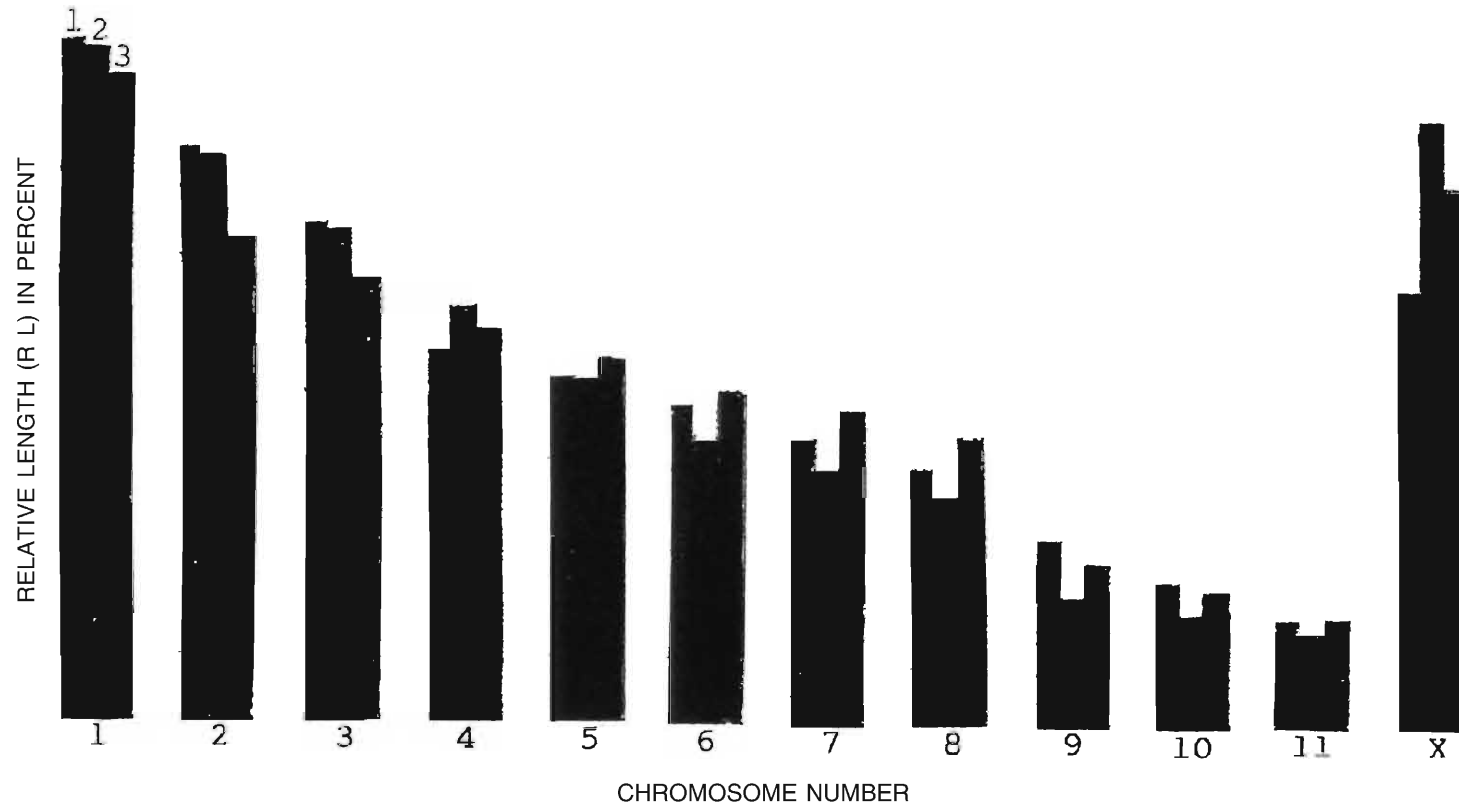
*Chondracris rosea*  
(de Geer)



*Patanga succincta*  
(Johansson)

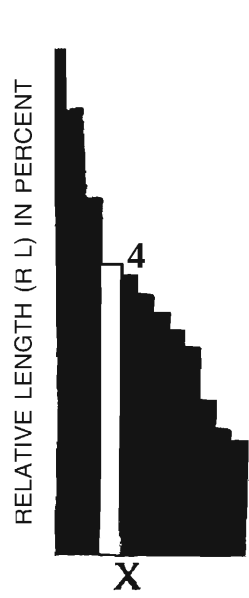
PLATE IX

Subfamily CYRTACANTHACRIDINAE



1. *Cyrtacanthacris tatarica* (Linnaeus); 2. *Chondracris rosea* (de Geer); 3. *Patanga succincta* (Johansson)

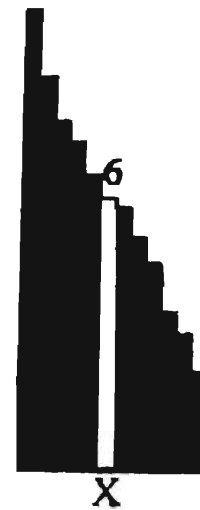
Subfamily CATANTOPINAE



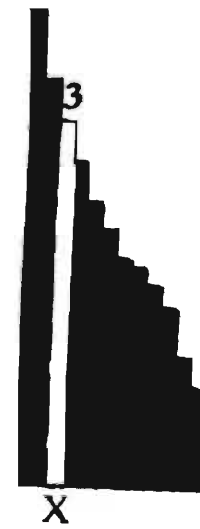
*Catantops innotabilis*  
(Walker)



*Catantops simlae*  
Dirsh



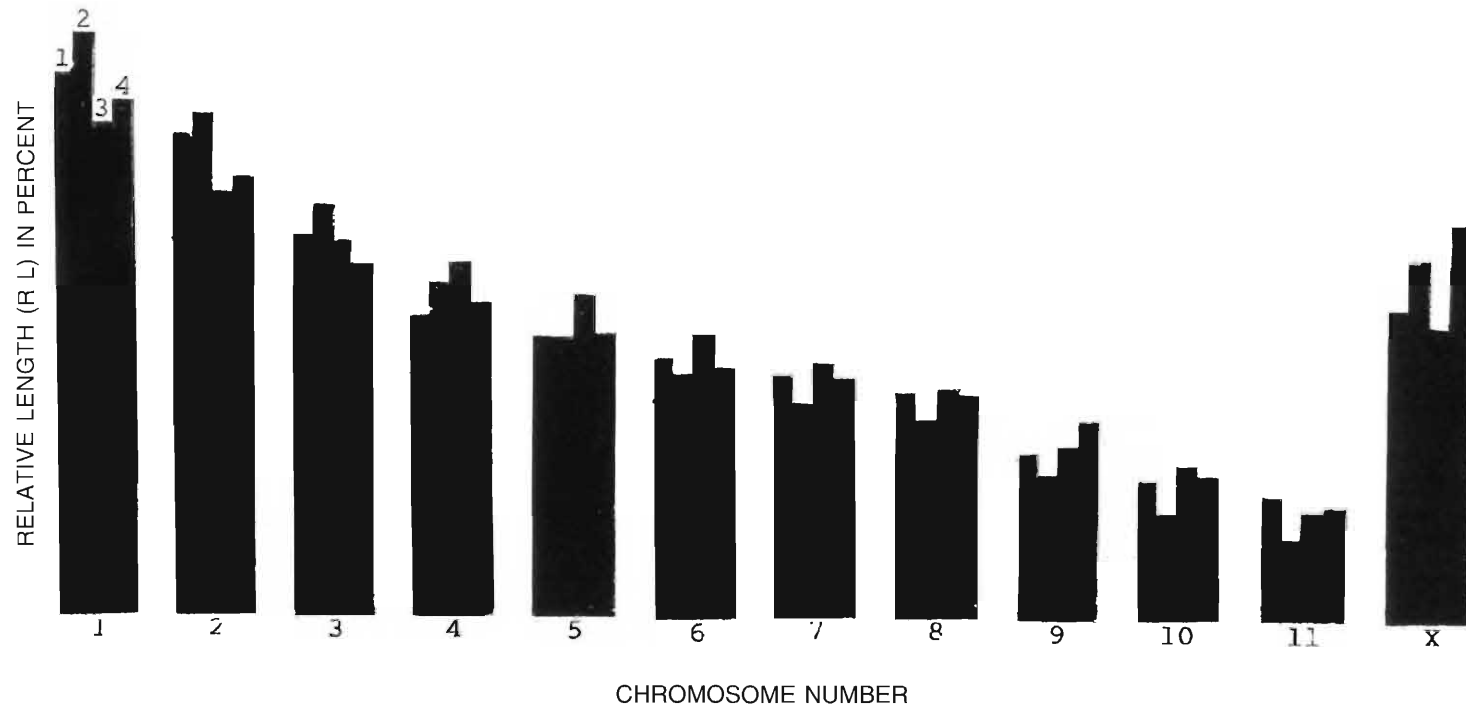
*Xenocatantops humilis*  
(Serville)



*Stenocatantops splendens*  
(Thunberg)

PLATE XI

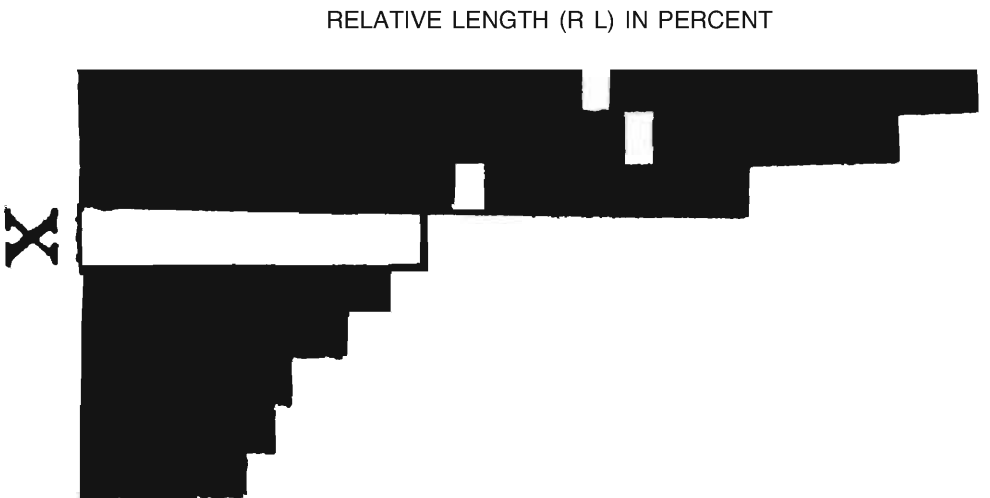
Subfamily CATANTOPINAE



1. *Catantops innotabilis* (Walker); 2. *Catantops simlae* Dirsh;  
3. *Xenocatantops humilis* (Serville); 4. *Stenocatantops splendens* (Thunberg)

PLATE XII

Subfamily GOMPHOCERINAE



*Chorthippus indus* Uvarov



*Aulacobothrus collinus* Uvarov

PLATE XIII

Subfamily OEDIPODINAE

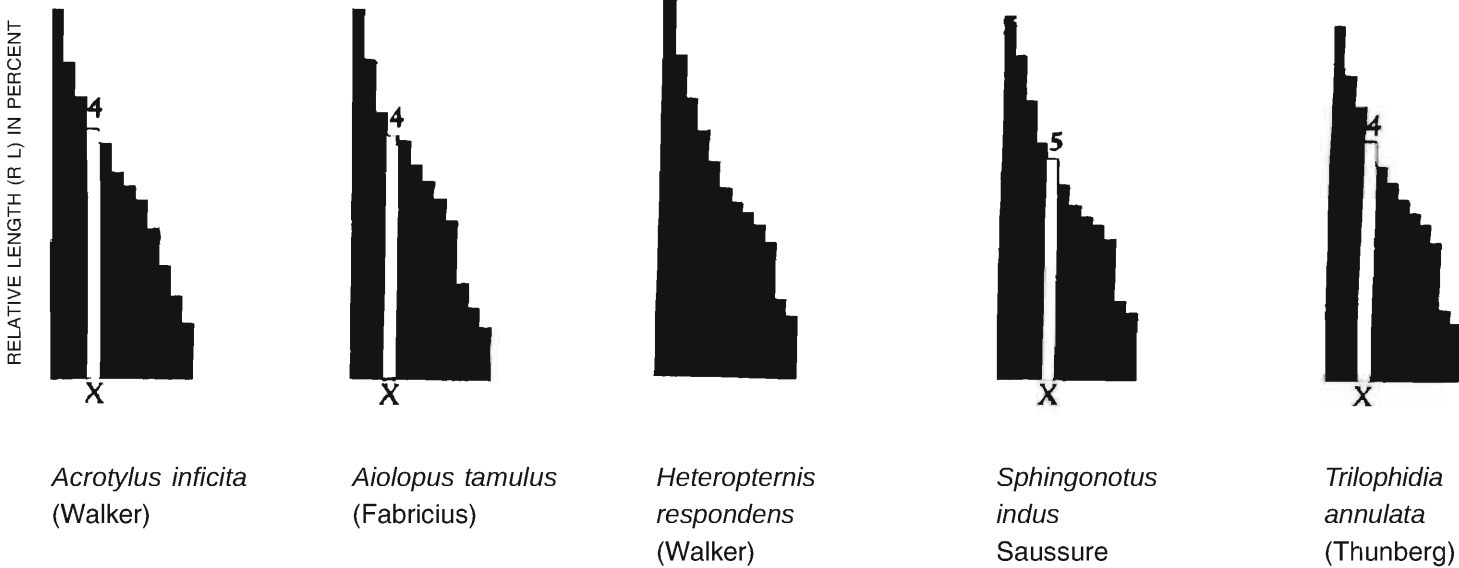
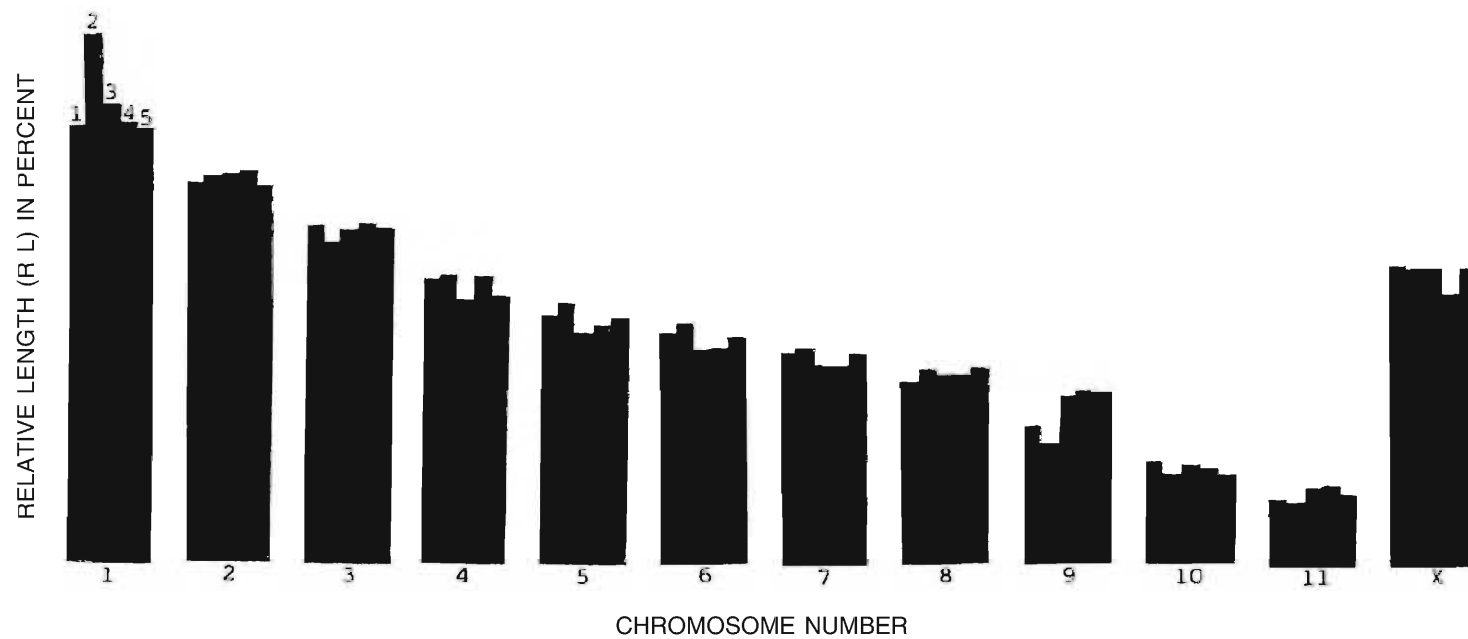


PLATE XIV

Subfamily OEDIPODINAE



1. *Acrotylus inficita* (Walker); 2. *Aiolopus tamulus* (Fabricius); 3. *Heteropternis respondens* (Walker);  
4. *Sphingonotus indus* Saussure; 5. *Trilophidia annulata* (Thunberg)

PLATE XV

Subfamily ACRIDINAE



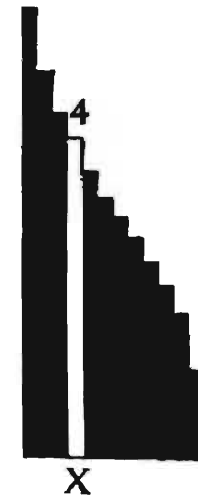
*Acrida exaltata*  
(Walker)



*Sikkimiana darjeelingensis*  
(Bolivar)

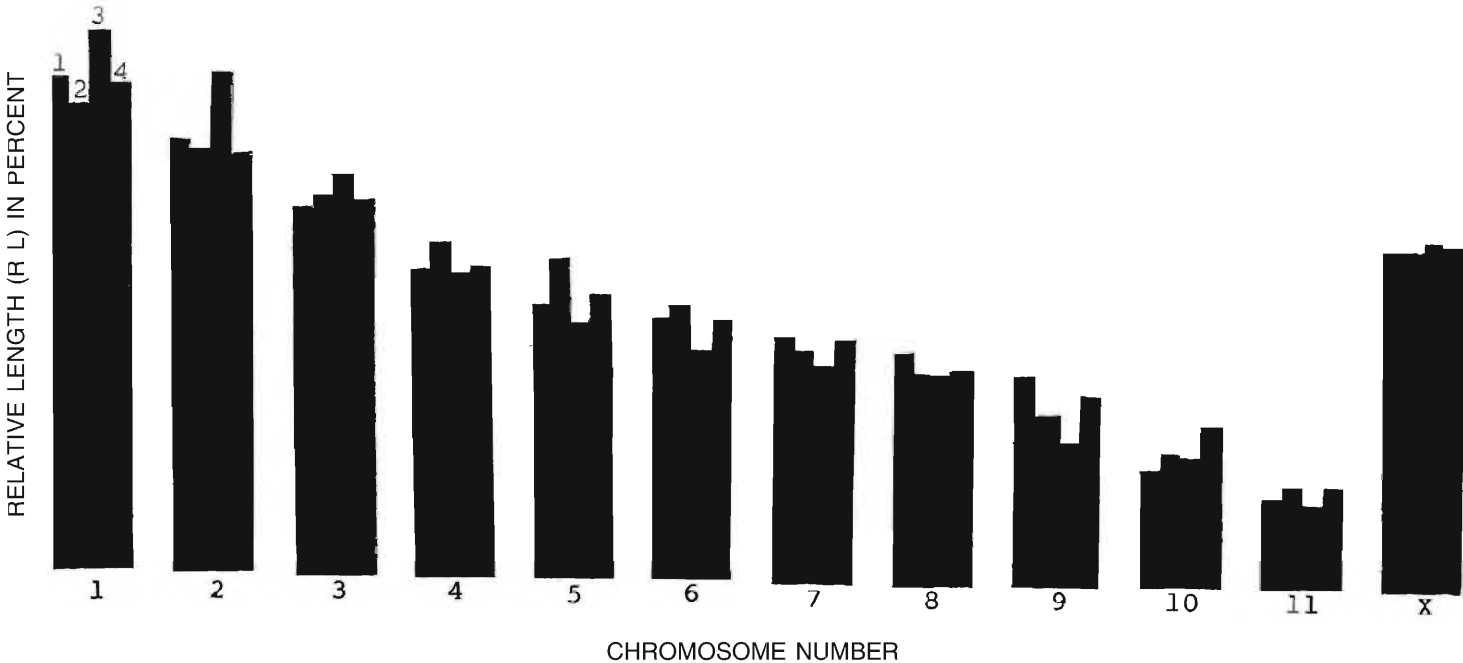


*Phlaeoba antennata*  
Brunner

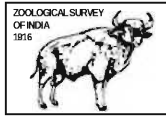


*Phlaeoba infumata*  
Brunner

Subfamily ACRIDINAE



1. *Acrida exaltata* (Walker);      2. *Sikkimiana darjeelingensis* (Bolivar)  
 3. *Phlaeoba antennata* Brunner;    4. *Phlaeoba infumata* Brunner



*Rec. zool. Surv. India* : **106**(Part-3) : 79-96, 2006

## **ROTIFER DIVERSITY (ROTIFERA : EUROTATORIA) OF FLOODPLAIN LAKES OF POBITORA WILD LIFE SANCTUARY, ASSAM**

SUMITA SHARMA

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### **INTRODUCTION**

Floodplain wetlands, an integral component of tropical riverine systems of the world, are known to be the richest habitats for the rotifer diversity (Segers *et al.*, 1993; Sanoamuang, 1998; Sharma and Sharma, 2001; Sharma, 2005). Various wild life sanctuaries of North-Eastern India and that of the state of Assam are characterized by myriads of floodplain lakes (locally known as “beels”) providing habitat par excellence for several wild animals as well as a wide array of vertebrates and invertebrates. However, no attention has so far been focused on the micro-faunal diversity of beels of sanctuaries of N. E. region in general and that of Rotifera in particular. The members of the later Phylum invariably comprise a dominant group of micro-invertebrate communities of these interesting ecotones and contribute significantly to their productivity.

The present study assumes special importance in view of the stated lacunae and deals with qualitative and quantitative diversity of summer rotifer communities of twelve perennial and seasonal floodplain lakes (beels) of the Pobitora Wild life Sanctuary, Assam. Various interesting species are briefly diagnosed and illustrated. Remarks are made on nature and composition of the examined fauna, distribution of interesting species and on richness, similarity, abundance, diversity, dominance and evenness of the rotifer communities.

### **MATERIALS AND METHODS**

Water and plankton samples were collected, during summer season (April 4–6, 2005), from nine perennial (Solmari, Haduk, Sitalmari, Goranga, Kandhi, Dhuptoli, Dholi, Gorkhonjan, Jagdal) and three seasonal (Tamuli dova, Pagla dova, Lamba dova) floodplain lakes (“beels”) of the Pobitora Wild life Sanctuary (Lat : 26°12'–26°15' N; Long : 90°02'–90°05' E; area : 15.9 sq. km).

Water samples, collected from the selected beels, were examined for water temperature, specific conductivity and pH with field probes while dissolved oxygen and other chemical parameters are analyzed following A.P.H.A. (1992). Plankton samples were collected with a nylobolt plankton net (No. 25, mesh size : 55  $\mu\text{m}$ ) and were preserved in 5% formalin. The rotifer species present in all the samples were identified and their densities measured. Various rotifer taxa were identified following Koste (1978), Segers (1995) and Sharma & Sharma (1987, 1997, 1999, 2000). The drawings were made with a Leitz-Dialux phase contrast stereoscopic microscope and measurements were indicated in micrometers ( $\mu\text{m}$ ). Percentage similarities (Sorensen index), diversity (Shannon index), dominance (Berger-Parker index) and evenness (El index) were calculated following Ludwig & Reynolds (1988) and Magurran (1988). Ecological correlations were examined using correlation coefficients and canonical analysis.

#### SYSTEMATIC LIST OF THE EXAMINED ROTIFER TAXA

Phylum ROTIFERA

Class EUROTATORIA

Subclass MONOGONONTA

Order PLOIMIDA

Family : BRACHIONIDAE		Family : MYTILINIDAE	
<i>Anuraeopsis fissa</i> (Gosse, 1851)	C	<i>Mytilina bisulcata</i> (Lucks, 1912)	Pt
<i>Brachionus angularis</i> (Gosse, 1851)	C	<i>M. ventralis</i> (Ehrenberg, 1832)	C
<i>B. bidentatus</i> Anderson, 1889	Pt	Family : TRICHOTRIIDAE	
<i>B. donneri</i> Brehm, 1951	Pt	<i>Macrochaetus longipes</i> (Myers, 1934)	C
<i>B. falcatus</i> Zacharias, 1898	Pt	<i>M. sericus</i> (Thorpe, 1893)	Pt
<i>B. forficula</i> Wierzejski, 1891	Pt	<i>Trichotria tetractis</i> (Ehrenberg, 1830)	C
<i>B. mirabilis</i> Daday, 1897	T	Family : LEPADELLIDAE	
<i>B. quadridentatus</i> (Hermann, 1783)	C	<i>Colurella uncinata</i> (O.F. Müller, 1773)	C
<i>Keratella lenzi</i> Hauer, 1953	Pt	<i>Lepadella acuminata</i> (Ehrenberg, 1834)	C
<i>K. tropica</i> (Apstein, 1907)	C	<i>L. ehrenbergi</i> (Perty, 1850)	C
<i>Platyias quadricornis</i> (Ehrenberg, 1832)	C	<i>L. cristata</i> (Rousselet, 1893)	C
<i>Platinous patulus</i> (O.F. Müller, 1786)	C	<i>L. heterostyla</i> (Murray, 1913)	C
<i>P. patulus macracanthus</i> (Daday, 1905)	N	<i>L. ovalis</i> (O.F. Müller, 1786)	C
Family : EPIPHANIDAE		<i>L. patella</i> (O.F. Müller, 1773)	C
<i>Epiphanes brachionus</i> (Ehrenberg, 1837)*	C	<i>L. rhomboides</i> (Gosse, 1886)	C
Family : EUCHLANIDAE		<i>L. triptera</i> Ehrenberg, 1830	C
<i>Euchlanis dilatata</i> Ehrenberg, 1832	C		
<i>Dipleuchlanis propatula</i> (Gosse, 1886)	C		

Family : LECANIDAE		Family : SCARIDIIDAE	
<i>Lecane aculeata</i> (Jakubski, 1912)	T	<i>Scaridium longicaudum</i> (O.F. Müller, 1786)	C
<i>L. bifurca</i> (Bryce, 1892)*	C	Family : TRICHOCERCIDAE	
<i>L. bulla</i> (Gosse, 1851)	C	<i>Trichocerca bicristata</i> (Gosse, 1887)	C
<i>L. crepida</i> Harring, 1914	T	<i>T. cylindrica</i> (Imhof, 1891)	Pa
<i>L. closteroerca</i> (Schmarda, 1898)	C	<i>T. kostei</i> Segers, 1993*	Pa
<i>L. curvicornis</i> (Murray, 1913)	T	<i>T. similis</i> (Wierzejski, 1893)	C
<i>L. furcata</i> (Murray, 1913)	C	Family : ASPLANCHNIDAE	
<i>L. hastata</i> (Murray, 1913)	T	<i>Asplanchna priodonta</i> Gosse, 1850	C
<i>L. hamata</i> (Stokes, 1896)	C	Family : SYNCHAETIDAE	
<i>L. inermis</i> (Bryce, 1892)	C	<i>Polyarthra vulgaris</i> Carlin, 1943	C
<i>L. leontina</i> (Turner, 1892)	T	Order : GNESIOTROCHA	
<i>L. ludwigii</i> (Eckstein, 1883)	C	Family : FILINIIDAE	
<i>L. luna</i> (O. F. Müller, 1776)	C	<i>Filinia camasecla</i> Myers, 1938	Pt
<i>L. lunaris</i> (Ehrenberg, 1832)	C	<i>Filinia longiseta</i> (Ehrenberg, 1834)	C
<i>L. monostyla</i> (Daday, 1897)	T	Family : TESTUDINELLIDAE	
<i>L. papuana</i> (Murray, 1913)	T	<i>Testudinella emarginula</i> (Stenroos, 1898)	C
<i>L. quadridentata</i> (Ehrenberg, 1832)	C	<i>T. parva</i> (Ternetz, 1892)	C
<i>L. signifera</i> (Jennings, 1896)	T	<i>T. patina</i> (Hermann, 1783)	C
<i>L. sola</i> Hauer, 1936	Pt	Subclass : BDELLOIDEA	
<i>L. unguitata</i> (Fadeev, 1925)	Pt	Family : PHILODINIDAE	
<i>L. ungulata</i> (Gosse, 1887)	C	<i>Rotaria rotatoria</i> (Pallas, 1766)	C
Family : NOTOMMATIDAE			
<i>Monommata longiseta</i> (O.F. Müller, 1786)	C		

\*New record from N.E. India, Pa–Palaeotropical, Pt–Pantropical, T–Tropicopolitan, N–Neotropical, C–Cosmopolitan

### TAXONOMIC NOTES ON INTERESTING SPECIES

#### *Brachionus donneri* Brehm, 1951

(Fig. 1)

**Characters :** Lorica oval and strongly compressed dorso-ventrally. Anterior occipital margin with six blunt spines and ventral margin with four short blunt spines. Lateral antennae located on conical lateral protuberances. Foot-opening deep and flanked with distinct club-shaped projections.

**Distribution :** INDIA : Assam, Meghalaya, Tripura, West Bengal and Tamil Nadu.

**Elsewhere :** Tropics and subtropics.

***Brachionus forficula*** Wierzejski, 1891

(Fig. 2)

*Characters* : Lorica rigid, moderately compressed dorso-ventrally and finely stippled. Anterior margin with four occipital spines, laterals longer than medians. Posterior spines stout, inwardly directed and widely separated at their bases; each with a knee-like swelling on inner side near the base.

*Distribution* : INDIA : Assam, Meghalaya, Tripura, West Bengal, Orissa, Bihar, Andhra Pradesh, Gujarat and Punjab.

*Elsewhere* : Tropics and subtropics.

***Brachionus mirabilis*** Daday, 1897

(Fig. 3)

*Diagnosis* : Ventral plate of lorica produced into two characteristic posterior spines extending backwards at an angle of 45°. Foot-opening situated between the bases of ventral spines and surrounded by a sheath,

*Distribution* : INDIA : Assam, Meghalaya, Tripura and West Bengal.

*Elsewhere* : Tropics and subtropics.

***Macrochaetus longipes*** (Myers, 1934)

(Fig. 4)

*Diagnosis* : Lorica serrated, compressed dorso-ventrally and characterized by 12 long spines.

*Distribution* : INDIA : Assam and Meghalaya.

*Elsewhere* : Cosmopolitan.

***Mytilina bisulcata*** (Lucks, 1912)

(Fig. 5)

*Characters* : Lorica thin, and its anterior end with two folds; almost rounded in cross section and dorsal keel with three stumps. Toes long, slender and terminating into distinct slender spines.

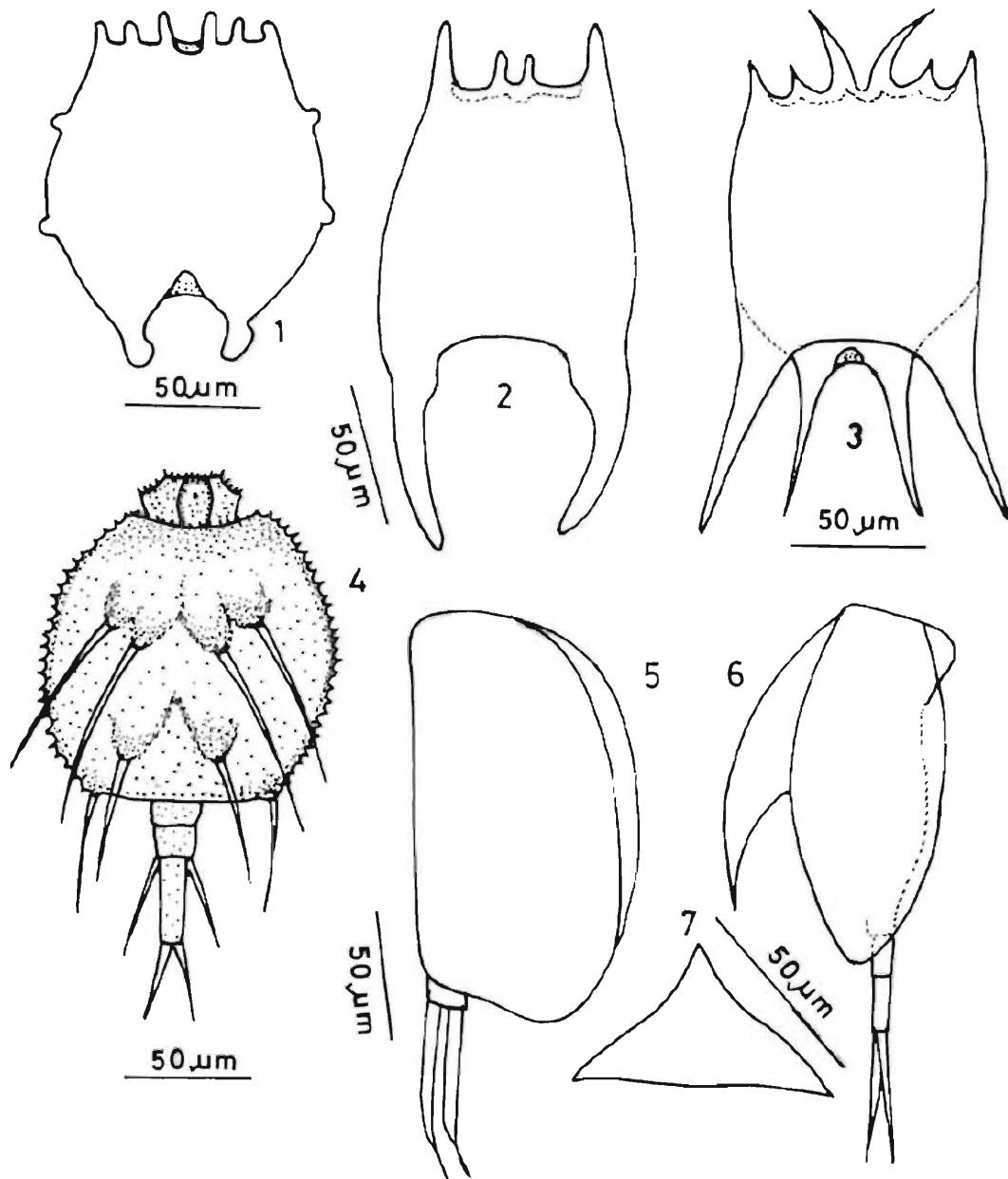
*Distribution* : INDIA : Assam, Meghalaya, Tripura, West Bengal and Orissa.

*Elsewhere* : Tropics and subtropics.

***Lepadella cristata*** (Rousselet, 1893)

(Figs. 6 &amp; 7)

*Characters* : Lorica oval, with a dorsal median keel and a distinct dorsal crest. Anterior dorsal margin nearly straight; anterior ventral margin with a V- shaped sinus. Last foot-joint projecting beyond lorica. Toes long and pointed.



**Figs. 1-7. :** 1. *Brachionus donneri* Brehm, dorsal view; 2. *B. forficula* Wierzejski, dorsal view; 3. *B. mirabilis* Daday, dorsal view; 4. *Macrochaetus longipes* (Myers), dorsal view; 5. *Mytilina bisulcata* (Myers), lateral view; 6 & 7. *Lepadella cristata* (Rousselet), lateral view and cross-section.

*Distribution* : INDIA : Assam, Meghalaya, Tripura and West Bengal.

*Elsewhere* : Cosmopolitan.

***Epiphanes brachionus*** (Ehrenberg, 1837)

(Fig. 8)

*Characters* : Body sacciform, semi-loricate; integument soft. Foot distinct, with three pseudo-segments, toes short. Pseudo-lorica with short lateral spines (var. *spinatus* Rousselet, 1901) in some specimens.

*Distribution* : INDIA : Kashmir and Delhi.

*Elsewhere* : Cosmopolitan.

***Lecane bifurca*** (Bryce, 1892)

(Fig. 9)

*Diagnosis* : Lorica small, oval compressed and without any markings. Ventral plate slightly narrower than dorsal plate and with small posterior projections. Toe small, claws divergent.

*Distribution* : INDIA : Delhi and Orissa.

*Elsewhere* : Cosmopolitan.

***Lecane hastata*** (Murray, 1913)

(Fig. 10)

*Characters* : Lorica oval, anterior margins coincident and anterior external angles of ventral plate with two small anteriorly directed spines. Dorsal plate smaller than ventral plate. Toes parallel-sided, slightly swollen at their free ends; claws distinct, with swollen bases.

*Distribution* : INDIA : Assam, Tripura and West Bengal.

*Elsewhere* : Tropicopolitan.

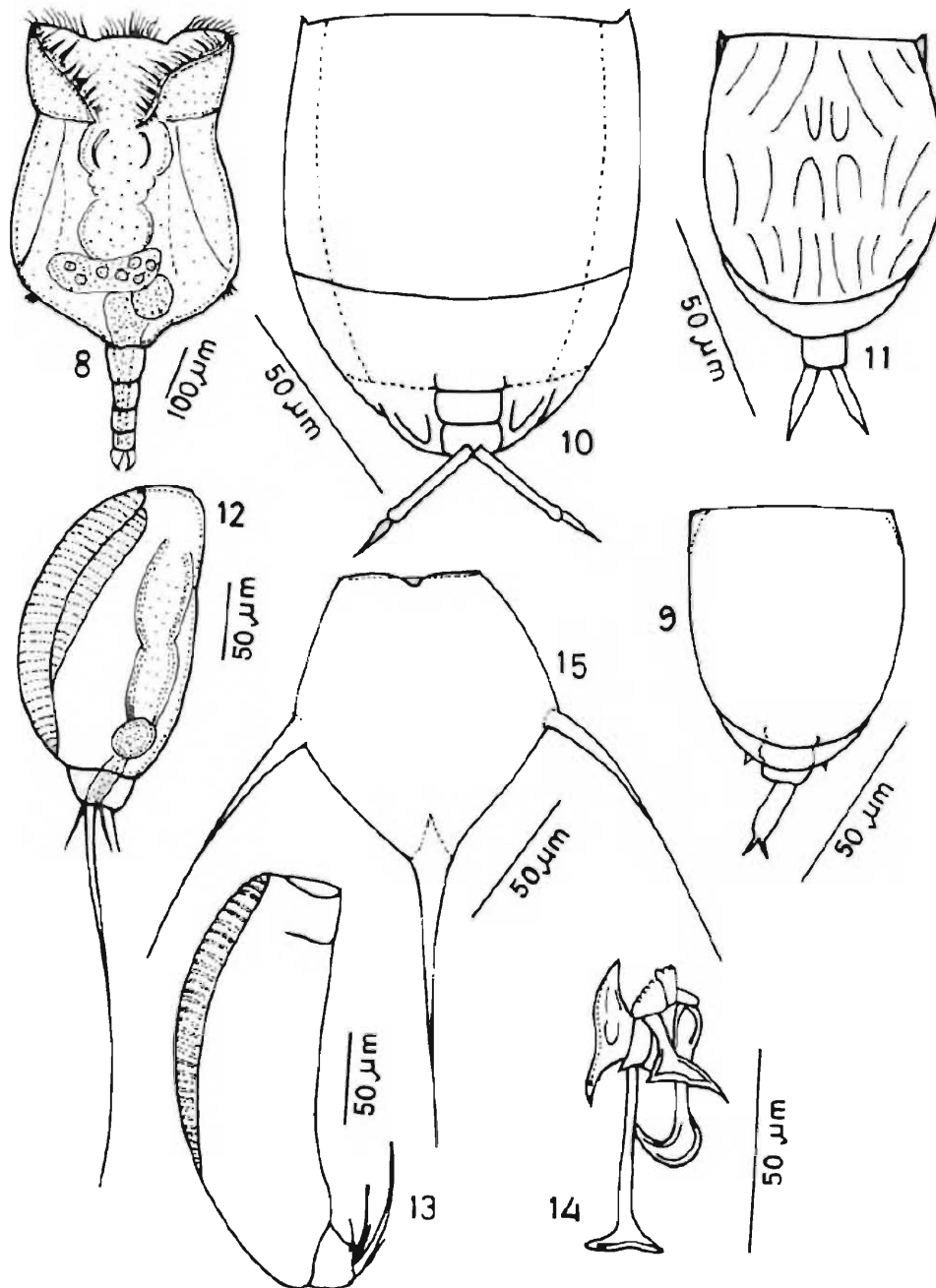
***Lecane sola*** Hauer, 1936

(Fig. 11)

*Characters* : Lorica small, oval, with straight and coincident anterior margins. Dorsal plate with distinct pattern. Ventral plate smaller than dorsal plate and with small spines at its external angles. Second foot-segment elongated, projecting beyond posterior end of lorica. Toes parallel-sided for about half of their length and then tapering to pointed tips.

*Distribution* : INDIA : Assam, Tripura and Tamil Nadu.

*Elsewhere* : Tropics and subtropics.



**Figs. 8-15.** : 8. *Epiphanes brachionus* (Ehrenberg), dorsal view; 9. *Lecane bifurca* (Bryce), dorsal view; 10. *L. hastata* (Murray), ventral view; 11. *L. sola* Hauer, dorsal view; 12. *Trichocerca bicristata* (Gosse), lateral view; 13 & 14. *T. kostei* Segers, lateral view and trophi; 15. *Filinia camasecla* Myers, dorsal view.

***Trichocerca bicristata* (Gosse, 1887)**

(Fig. 12)

*Diagnosis.* Lorica with two characteristic distinct keels extending upto 2/3 the length of dorsum. Left toe longer than body, right toe reduced; substyles present.

*Distribution :* INDIA : Bihar, Orissa and Assam.

*Elsewhere :* Cosmopolitan.

***Trichocerca kostei* Segers, 1993**

(Figs. 13 &amp; 14)

*Characters :* Body (lorica) elongated, slightly curved; dorsal keel extending to more than half the body length. Right toe about half the length of left toe; each toe with 2–3 basal spines. Trophi characteristic and strongly asymmetrical.

*Distribution :* INDIA : Kerala.

*Elsewhere :* Palaeotropical.

***Filinia camasecla* Myers, 1938**

(Fig. 15)

*Characters :* Body vase-shaped, with maximum width nearly in the middle region. Anterior dorsal margin straight, anterior ventral margin slightly elevated and with a shallow median sinus. Body with two lateral and one caudal stout and broad-based setae (spines); lateral setae nearly double the length of body.

*Distribution :* INDIA : Assam and Tripura.

*Elsewhere :* Tropics arid subtropics.

**RESULTS AND DISCUSSION**

All the sampled floodplain lakes (Table 1) are characterized by low ionic concentrations (mean conductivity :  $138.9 \pm 35.7$   $\mu\text{S/cm}$ ). Water temperature (29.5–31.5°C) affirms a tropical range concurrent with geographical location of these ecosystems. Dissolved oxygen (4.8–7.9 mg/l) indicates oxygenated nature of all the beels which also record occurrence of free CO<sub>2</sub> (4.0–12.0 mg/l). pH indicates slightly acidic character (6.75–6.82) of two beels, three show nearly neutral nature (7.02–7.07) while seven exhibit alkaline waters (7.10–7.56). Nine beels exhibit soft or nearly soft-waters and the rest indicate marginally hard-waters. The recorded salient features confirm with earlier observations of Sharma (2000a, 2000b, 2005) and Sharma & Sharma, 2001) in several floodplain lakes of upper and lower Assam. In addition, the studied beels are “Calcium-poor”

water bodies with lower concentrations of micronutrients, sulphate, chloride and dissolved organic matter.

Sixty-four species recorded presently indicate fairly rich  $\alpha$ -diversity of summer rotifer communities of the floodplain lakes of the Pobitora Wild-life sanctuary. The documented species form a notable fraction of North-Eastern Indian Rotifera (33.9%) and that of the fauna of Assam (37.5%). Total richness compares with the report of an identical number of species from five beels of upper Assam (Sharma, 2000a) while it is certainly higher than the reports of 29 species from four beels (Goswami, 1997), 48 species from 33 beels (Sarma, 2000), and 9 species from one beel (Goswami & Goswami, 2001) of Assam state, respectively. The observed richness is also higher than the report of 37 species from two Ox-bow lakes (Khan, 2002) and 38 species from 9 floodplain lakes (Khan, 2003) of South-eastern West Bengal.

*Trichocerca kostei*, *Epiphanes brachionus* and *Lecane bifurca* are new records from N.R. India. Among these rare elements, the palaeotropical *T. kostei* is so far known from India only from Kerala, *E. brachionus* is recorded from Kashmir and Delhi while the last lecanid is reported from Delhi and Orissa. Besides, *Macrochaetus longipes*, *Lecane monostyla* and *Filinia camasecla* deserve special mention because their occurrence is so far restricted to N. E. India. In addition, the examined material indicates several species of regional distributional/local importance namely *Brachionus donneri*, *B. mirabilis*, *Keratella lenzi*, *Lecane hastata*, *L. sola*, *Trichocerca bicristata* and *Testudinella parva*.

Nearly 67% of the recorded species are cosmopolitan. Pantropical (9 species) = cosmopolitan/tropicopolitan (9 species) elements, together, are well represented (28.2%). The examined collections also indicate three Palaeotropical species. Fourteen species (21.9%) are considered rare and these include *Brachionus donneri*, *B. forficula*, *Keratella lenzi*, *Epiphanes brachionus*, *Mytilina bisulcata*, *Lepadella cristata*, *Lecane bifurca*, *L. furcata*, *L. hastata*, *L. monostyla*, *L. signifera*, *L. sola*, *Trichocerca kostei* and *Filinia camasecla*. On the other hand, twelve species (18.7%) exhibit common occurrence in various beels; they include *Brachionus falcatus*, *B. quadridentatus*, *Keratella tropica*, *Platyonus patulus*, *Mytilina ventralis*, *Trichotria tetractis*, *Lecane bulla*, *L. leontina*, *L. lunaris*, *L. quadridentata*, *Asplanchna priodonta*, *Polyarthra vulgaris* and *Testudinella patina*.

The sampled beels depict qualitative and quantitative predominance of rotifers over other groups of zooplankton. This characteristic feature concurs with the findings of Sarma (2000), Sharma (2000a, 2000b, 2005), Sharma & Sharma (2001) and Khan (2002). The rotifer communities of different beels show 59.1–90.7% similarity (Table 2). A majority of instances in the matrix record higher similarity i.e., about 88% instances show similarity > 60.0–80.0% while 66.7% instances register similarity between 70.0–80.0%. Higher similarity results from common occurrence of 12 species in all beels and occurrence of another 7 species in 10–11 beels. Peak and minimum similarities are noted between Tamuli dova vs. Dholi and Gorkhonjan vs. Lamba dova respectively.

In general, the similarity range noted presently is higher than 42.9–80.4% (Sharma & Sharma, 2001) and 37.3–68.8% (Sharma, 2000b) reported earlier from the beels of the upper Assam. Further, the rotifer taxocoenosis of the perennial beels shows 74.2 % similarity with species recorded from the seasonal beels.

Lecanidae (21 species) > Brachionidae (12 species) > Lepadellidae (9 species) constitute a dominant fraction (65.6%) of overall rotifer richness and that of the communities of individual beels. This feature also agrees with general composition of the Indian Rotifera (Sharma, 1998) and that of N.E. India (Sharma & Sharma, 2005). In addition, Trichocercidae > Testudinellidae are other qualitatively notable families (10.9%).

‘Tropic-centered’ genus *Lecane* is a significant component (32.8%) of total rotifer richness and that of the faunas of individual beels and, hence, compares well with floodplain rotifer communities studied by Segers *et al.* (1993, 1998), Sanoamuang (1998), Jose de Paggi (2001), Sharma & Sharma (2001) and Sharma (2005). This salient feature assigns a general “tropical character” to the examined taxocoenosis and also concurs with the composition of ‘tropical rotifer faunas’ from different parts of the globe (Green, 1972; Pejler, 1977; Fernando, 1980; Dumont, 1983; Dussart *et al.* 1984; Segers, 1996,2001; Sharma, 1998). This generalization is also supported by distinct paucity of ‘temperate-centered’ *Keratella* (2 species). In addition, *Lepadella* (8 species) and ‘tropic-centered’ *Brachionus* (7 species) deserve mention for their qualitative contributions (23.4%).

The rotifer richness (31–51,  $37 \pm 5$  species) in different beels (Table 3) is a little lower than 42–68 species noticed in summer communities of certain other floodplain lakes of Assam (Sharma, 2005) while it is certainly higher than 11–20 species observed during the corresponding season in five floodplain lakes of upper Assam (Sharma, 2000b). Peak richness in Sitalmari (51 species) is followed by occurrence of 44 species in Solmari while 31–39 species are recorded in rest of the beels. The rotifer richness registers significant direct correlations with density ( $r = 0.625$ ,  $p = 0.05$ ), specific conductivity ( $r = 0.626$ ,  $p = 0.05$ ), alkalinity ( $r = 0.801$ ,  $p = 0.01$ ) and hardness ( $r = 0.642$ ,  $p = 0.05$ ) while it shows an inverse relationship with water temperature ( $r = -0.574$ ,  $p = 0.05$ ).

The rotifers comprise between 49.4–64.7% of zooplankton densities of the sampled beels and show variations (Table 3) in their abundance (101–257,  $166 \pm 57$  n/l). The recorded range concurs with the earlier reports of Sharma (2000a, 2005). Peak density in Haduk is followed by Sitalmari > Solmari > Goranga while the density is relatively lower (101–170 n/l) in rest of the beels, Brachionidae (33–138,  $61 \pm 41$  n/l) > Lecanidae (29–74,  $49 \pm 16$  n/l) > Lepadellidae (6–20,  $12 \pm 4$  n/l) contribute mainly to rotifer abundance in various beels. Of the individual species only *K. tropica* ( $24 \pm 26$  n/l) shows quantitative importance. Besides, *Platyonus patulus* > *Lecane bulla* *Polyarthra vulgaris* > *Brachionus falcatus* > *Lecane leontina*, all with mean density less than 10 n/l each, represent subdominant species. The rotifer density shows significant direct

relationships with alkalinity ( $r = 0.571$ ,  $p = 0.05$ ), hardness ( $r = 0.692$ ,  $p > 0.05$ ) and chloride ( $r = 0.618$ ,  $p > 0.05$ ) and an inverse correlation with water temperature ( $r = 0.552$ ). Canonical analysis indicates nearly 63% ( $R^2 = 0.6289$ ) cumulative influence of seven abiotic factors namely water temperature, pH, conductivity, dissolved oxygen, free  $\text{CO}_2$ , alkalinity and hardness while nine abiotic factors (water temperature, pH, conductivity, dissolved oxygen, free  $\text{CO}_2$ , alkalinity, hardness, chloride, dissolved organic matter) result in still higher cumulative influence ( $R^2 = 0.7889$ ).

The rotifer communities of different beels are characterized (Table 3) by higher diversity (2.666–3.393,  $3.193 \pm 0.207$ ); the recorded values are even higher than the findings of Sharma (2005) and distinctly higher than the results of Sharma (2000a). The diversity records no significant relationship with richness, density and various abiotic factors. The present observations register low dominance (0.080–0.447;  $0.159 \pm 0.096$ ) which, in turn, affirms quantitative influence of fewer species and, hence, endorses the quantitative results. The dominance shows significant direct correlations with alkalinity ( $r = 0.696$ ,  $p = 0.02$ ), hardness ( $r = 0.856$ ,  $p > 0.01$ ) and chloride ( $r = 0.767$ ,  $p > 0.01$ ) and an inverse relationship with water temperature ( $r = -0.619$ ,  $p = 0.05$ ). This study reflects a higher evenness (0.704–0.962;  $0.881 \pm 0.061$ ) and affirms an equitable abundance of a majority of species. The evenness exhibits significant inverse correlations with dominance ( $r = -0.847$ ,  $p = 0.01$ ), conductivity ( $r = -0.614$ ,  $p = 0.05$ ), alkalinity ( $r = -0.857$ ,  $p = 0.01$ ), hardness ( $r = -0.845$ ,  $p = 0.01$ ) and chloride ( $r = -0.681$ ,  $p = 0.02$ ) while it records direct correlation with water temperature ( $r = 0.565$ ,  $p = 0.05$ ).

The present study, though limited to collections during summer season, provides valuable information on qualitative and quantitative diversity of the rotifer communities of beels of the Brahmaputra river basin, lower Assam. Besides, it presents a pioneering account of the rotifer diversity of Rotifera of wetlands of any wild-life sanctuary of N.E. India

## SUMMARY

The summer rotifer communities of twelve perennial and ephemeral floodplain lakes of the Pobitora wild-life sanctuary reveal 64 species, belonging to 20 genera and 15 families. *Trichocerca kostei*, *Epiphanes brachionus* and *Lecane bifurca* are new records from N.E. India. *Macrochaetus longipes*, *Lecane monostyla* and *Filinia camasecla* are so far known only N.E. India. *Brachionus donneri*, *B. mirabilis*, *Keratella lenzi*, *Lecane hastata*, *L. sola*, *Trichocerca bicristata* and *Testudinella parva* are examples of regional distributional/local importance. Cosmopolitan species predominate (67.2%) the recorded species while Pantropical = cosmopolitan elements are well represented (28.2%). Fourteen species exhibit rare occurrence and twelve species exhibit common occurrence in various beels. The zooplankton communities of all the beels show qualitative predominance of rotifers, and register 59.1–90.7% similarity. Lecanidae > Brachionidae > Lepadellidae constitute a dominant fraction (65.6%) of alpha-diversity while Trichocercidae > Testudinellidae are other

notable families (10.9%). 'Tropic-centered' genus *Lecane* comprises a significant component (32.8%) of the recorded richness while *Lepadella* (8 species) and *Brachionus* (7 species) also deserve mention for their qualitative contributions (23.4%).

The richness (31–51,  $37 \pm 5$  species) in different beels registers significant direct correlations with density, specific conductivity, alkalinity and hardness and shows an inverse relationship with water temperature. The rotifer abundance (101–257,  $166 \pm 57$  n/1) records variations in different beels; it shows significant direct relationships with alkalinity, hardness and chloride and an inverse correlation with water temperature. Seven abiotic factors namely water temperature, pH, conductivity, dissolved oxygen, free CO<sub>2</sub>, alkalinity and hardness indicate a cumulative influence of nearly 63% ( $R^2 = 0.6289$ ) while nine abiotic factors (water temperature, pH, conductivity, dissolved oxygen, free CO<sub>2</sub>, alkalinity, hardness, chloride, dissolved organic matter) result in still higher cumulative influence ( $R^2 = 0.7889$ ). Brachionidae > Lecanidae > Lepadellidae contribute mainly to rotifer abundance. Of the individual species only *K. tropica* shows quantitative importance. The rotifer diversity (2.666–3.393,  $3.193 \pm 0.207$ ) records insignificant relationships with richness, density and abiotic factors. The rotifer communities are characterized by low dominance and higher evenness. The dominance shows significant direct correlations with alkalinity, hardness and chloride and an inverse relationship with water temperature. The evenness records significant inverse correlations with dominance, alkalinity, hardness and chloride while it shows a direct correlation with water temperature.

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**Table 1.** : Abiotic parameters of floodplain lakes of Pobitora Wildlife Sanctuary.

Parameters/Localities	Range	Mean $\pm$ SD
Water temperature ( $^{\circ}$ C)	29.5 – 31.5	30.5 $\pm$ 0.7
pH	6.75 – 7.56	7.14 $\pm$ 0.20
Specific Conductivity ( $\mu$ S/cm)	68.6 – 190.6	138.9 $\pm$ 35.7
Dissolved oxygen (mg/l)	4.8 – 7.9	6.2 $\pm$ 0.8
Free Carbon dioxide (mg/l)	4.0 – 12.0	7.7 $\pm$ 2.4
Alkalinity (mg/l)	30.0 – 68.0	44.6 $\pm$ 10.1
Hardness (mg/l)	26.0 – 72.0	39.8 $\pm$ 12.7
Calcium (mg/l)	16.2 – 31.5	21.6 $\pm$ 10.5
Magnesium (mg/l)	0.437 – 1.067	0.639 $\pm$ 0.222
Chloride (mg/l)	4.9 – 18.9	10.1 $\pm$ 4.6
Phosphate (mg/l)	0.027 – 0.340	0.120 $\pm$ 0.103
Nitrate (mg/l)	0.043 – 0.439	0.165 $\pm$ 0.128
Sulphate (mg/l)	2.253 – 16.495	7.633 $\pm$ 3.792
Dissolved organic matter (mg/l)	1.200 – 3.825	2.531 $\pm$ 0.917

**Table 2.** : Percentage similarity (Sorenson's index) between rotifer communities of floodplain lakes of Pobitora Wildlife Sanctuary.

Localities	1	2	3	4	5	6	7	8	9	10	11	12
1	–	68.3	75.8	71.6	66.7	79.5	76.9	74.3	82.5	74.1	74.3	73.7
2		–	78.6	77.3	69.6	75.3	72.3	80.5	78.4	69.3	77.8	71.4
3			–	75.0	65.8	84.4	77.6	75.3	78.2	77.3	75.3	72.3
4				–	67.6	73.4	72.3	78.9	82.2	81.8	70.4	66.7
5					–	71.4	73.8	70.8	65.7	70.6	64.6	73.0
6						–	77.8	68.5	90.7	68.4	76.7	73.2
7							–	70.6	77.1	73.2	70.6	66.7
8								–	77.1	76.1	70.6	78.8
9									–	71.2	80.0	79.4
10										–	59.1	69.6
11											–	66.7
12												–

1–Solmari, 2–Haduk, 3–Sitalmari, 4–Goranga, 5–Kandhi, 6–Tamuli dova, 7–Pagla dova, 8–Dhuptoli, 9–Dholi, 10–Gorkhonjan, 11–Lamba dova, 12–Jagdal.

**Table 3. :** Abundance of Rotifera (n/l) in floodplain lakes of Pobitora Wildlife Sanctuary.

Rotifer taxa / localities	1	2	3	4	5	6	7	8	9	10	11	12
<b>Family : BRACHIONIDAE</b>												
<i>Anuraeopsis fissa</i> (Gosse)	1	–	5	–	–	–	2	–	–	–	2	–
<i>Brachionus angularis</i> (Gosse)	5	10	20	–	–	–	5	3	–	2	–	2
<i>B. bidentatus</i> Anderson	4	–	–	–	–	–	–	–	–	–	–	–
<i>B. donneri</i> Brehm	2	2	–	–	–	–	–	–	–	–	–	–
<i>B. falcatus</i> Zacharias	6	10	20	15	–	5	5	5	7	5	6	–
<i>B. forficula</i> Wierzejski	–	58	10	–	–	–	–	–	–	–	2	–
<i>B. mirabilis</i> Daday	1	–	1	–	2	–	–	1	–	1	–	1
<i>B. quadridentatus</i> (Hermann)	5	5	5	1	–	1	1	–	2	1	–	1
<i>Keratella lenzi</i> Hauer	–	–	–	–	–	–	–	–	–	–	–	1
<i>K. tropica</i> (Apstein)	102	45	32	30	8	12	–	8	12	10	18	12
<i>Platylabus quadricornis</i> (Ehrenberg)	2	5	5	1	–	1	1	–	2	1	–	1
<i>Platylabus patulus</i> (O.F. Müller)	5	3	10	8	10	5	32	10	8	6	8	6
<i>P. patulus macracanthus</i> (Daday)	4	–	5	–	–	–	4	–	–	–	2	–
<b>Family : EIPHANIDAE</b>												
<i>Epiphanes brachionus</i> (Ehrb.)	–	–	–	–	–	–	12	–	–	–	–	–
<b>Family : EUCHLANIDAE</b>												
<i>Euchlanis dilatata</i> Ehrenberg	5	2	5	3	5	3	2	2	3	2	–	2
<i>Dipleuchlanis propatula</i> (Gosse)	–	2	1	2	–	–	–	1	1	–	2	1
<b>Family : MYTILINIDAE</b>												
<i>Mytilina bisulcata</i> (Lucks)	–	1	2	–	–	–	–	–	–	–	–	–
<i>M. ventralis</i> (Ehrenberg)	2	2	5	2	4	3	2	1	1	1	–	1
<b>Family : TRICHOTRIIDAE</b>												
<i>Macrochaetus longipes</i> (Myers)	2	–	3	5	4	–	2	–	–	–	–	–
<i>M. sericus</i> (Thorpe)	3	5	2	–	2	3	–	–	1	–	3	1
<i>Trichotria tetractis</i> (Ehrenberg)	3	7	4	5	3	4	2	3	2	4	3	2
<b>Family : LEPADELLIDAE</b>												
<i>Colurella uncinata</i> (O.F. Müller)	2	1	4	8	–	1	2	1	2	–	4	–
<i>Lepadella acuminata</i> (Ehrb.)	2	–	2	3	–	–	–	1	–	1	–	1
<i>L. ehrenbergi</i> (Perty)	–	–	–	–	–	–	–	2	–	–	–	–
<i>L. cristata</i> (Rousselet)	–	–	–	1	–	–	–	–	–	–	–	–
<i>L. heterostyla</i> (Murray)	–	2	–	2	2	–	–	1	–	2	–	–
<i>L. ovalis</i> (O.F. Müller)	2	3	2	1	3	4	3	2	3	2	3	2
<i>L. patella</i> (O.F. Müller)	3	2	5	3	4	2	4	3	3	1	3	3
<i>L. rhomboides</i> (Gosse)	–	2	3	–	5	3	3	–	–	–	2	–
<i>L. triptera</i> Ehrenberg	1	–	1	2	–	1	–	1	1	–	1	1

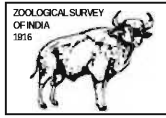
Table 3. : (Cont'd.)

Rotifer taxa / localities	1	2	3	4	5	6	7	8	9	10	11	12
<b>Family : LECANIDAE</b>												
<i>Lecane aculeata</i> (Jakubski)	1	–	2	–	–	2	1	–	1	–	1	1
<i>L. bifurca</i> (Bryce)	1	–	–	–	–	–	–	–	–	–	–	–
<i>L. bulla</i> (Gosse)	8	12	15	20	16	12	5	4	6	5	4	6
<i>L. crepida</i> Harring	1	–	2	–	–	1	2	–	1	–	–	–
<i>L. clostercera</i> (Schmarda)	6	10	8	2	–	6	8	5	8	4	3	–
<i>L. curvicornis</i> (Murray)	3	2	10	8	4	5	2	1	2	3	2	5
<i>L. furcata</i> (Murray)	–	–	–	2	–	–	–	–	–	–	–	–
<i>L. hastata</i> (Murray)	1	–	1	–	1	–	–	–	–	1	–	–
<i>L. hamata</i> (Stokes)	–	2	3	5	1	2	–	–	2	4	2	–
<i>L. inermis</i> (Bryce)	–	–	1	–	2	1	1	–	1	1	–	–
<i>L. leontina</i> (Turner)	6	10	7	12	8	8	5	6	4	5	6	8
<i>L. ludwigii</i> (Eckstein)	–	2	1	–	–	1	–	1	–	–	1	–
<i>L. luna</i> (O.F. Müller)	2	4	2	–	2	5	–	1	3	–	3	2
<i>L. lunaris</i> (Ehrenberg)	4	6	2	10	6	8	4	3	5	2	–	6
<i>L. monostyla</i> (Daday)	–	–	1	–	–	–	–	–	–	1	–	–
<i>L. papuana</i> (Murray)	1	3	5	6	–	4	2	2	4	2	4	5
<i>L. quadridentata</i> (Ehrenberg)	1	5	3	5	22	6	5	3	5	4	3	2
<i>L. signifera</i> (Jennings)	–	–	–	–	–	–	–	–	–	1	–	–
<i>L. sola</i> Hauer	–	–	1	–	–	–	–	–	–	–	–	–
<i>L. unguitata</i> (Fadeev)	1	3	2	1	1	2	2	1	2	–	2	1
<i>L. ungulata</i> (Gosse)	3	5	2	3	–	4	–	2	1	3	3	2
<b>Family : NOTOMMATIDAE</b>												
<i>Monommata longiseta</i> (Müller)	2	–	2	–	–	1	–	–	–	1	–	–
<b>Family : SCARIDIIDAE</b>												
<i>Scaridium longicaudum</i> (Müller)	1	–	2	1	–	2	–	–	1	–	–	–
<b>Family : TRICHOCERCIDAE</b>												
<i>Trichocerca bicristata</i> (Gosse)	–	6	–	4	6	–	2	–	–	1	–	–
<i>T. cylindrica</i> (Imhof)	1	–	3	2	–	3	2	–	2	2	2	–
<i>T. kostei</i> Segers	1	–	–	–	–	–	–	–	1	–	1	–
<i>T. similis</i> (Wierzejski)	4	5	2	5	4	6	3	2	4	1	4	5
<b>Family : ASPLANCHNIDAE</b>												
<i>Asplanchna priodonta</i> Gosse	2	8	2	10	8	4	5	5	6	3	5	6

Table 3. : (Cont'd.)

Rotifer taxa / localities	1	2	3	4	5	6	7	8	9	10	11	12
<b>Family : SYNCHAETIDAE</b>												
<i>Polyarthra vulgaris</i> Carlin	8	12	2	12	15	10	6	8	10	8	8	5
<b>Family : FILINIIDAE</b>												
<i>Filnia camasecla</i> Myers	–	–	1	2	–	–	–	–	–	1	–	–
<i>Filinia longiseta</i> (Ehrenberg)	4	6	1	8	4	–	1	3	–	6	4	–
<b>Family : TESTUDINELLIDAE</b>												
<i>Testudinella parva</i> (Ternetz)	–	2	1	–	–	1	–	–	–	–	–	1
<i>T. emarginula</i> (Stenroos)	2	–	3	–	2	1	2	1	2	3	–	1
<i>T. patina</i> (Hermann)	3	5	2	4	3	2	3	2	3	5	2	2
<b>Family : PHILODINIDAE</b>												
<i>Rotaria rotatoria</i> (Pallas)	1	–	–	–	1	1	–	–	–	–	1	–
<b>Total density</b>	228	275	241	214	170	150	150	101	126	110	123	101
<b>Species richness</b>	44	38	51	37	31	39	34	34	36	37	34	32
<b>Species diversity</b>	2.666	3.182	3.333	3.183	2.987	2.391	3.045	3.393	3.056	3.233	3.259	3.159
<b>Dominance</b>	0.447	0.210	0.133	0.140	0.129	0.080	0.213	0.099	0.095	0.091	0.146	0.119
<b>Evenness</b>	0.704	0.875	0.887	0.881	0.970	0.925	0.863	0.962	0.853	0.895	0.935	0.911

1–Solmari, 2–Haduk, 3–Sitalmari, 4–Goranga, 5–Kandhi, 6–Tamuli dova, 7–Pagla dova,  
8–Dhuptoli, 9–Dholi, 10–Gorkhonjan, 11–Lamba dova, 12–Jagdai



Rec. zool. Surv. India : 106(Part-3) : 97-122, 2006

## REPTILIAN FAUNA OF NAGARJUNASAGAR SRISAILAM TIGER RESERVE, ANDHRA PRADESH

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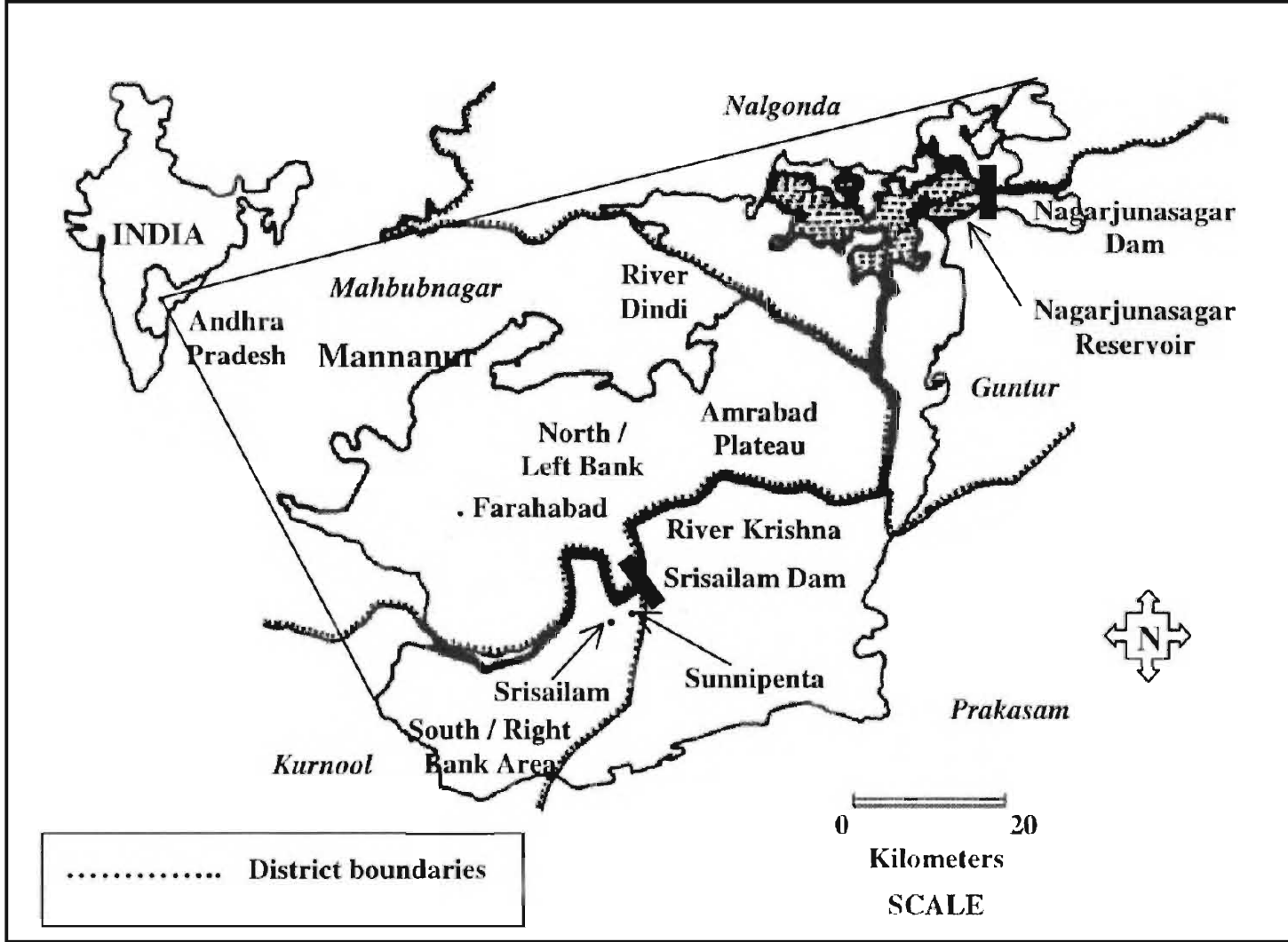
### INTRODUCTION

The Nagarjunasagar Srisailam Tiger Reserve (15°53'–16°43' N and 78°30'–79°28' E) spanning an area of 3,568 sq km (with a core area of 1,200 sq km) located in Andhra Pradesh is the largest of the Project Tiger sites in India (Fig. 1). Topographically the Reserve is located in the biodiversity rich Nallamala Hills (Srinivasulu and Nagulu, 2002) with a rich herpetofaunal diversity too (Srinivasulu and Das, *in press*). The river Krishna flows from East to West through the Reserve, dividing the area into a larger Northern bank and a smaller Southern Bank. The vegetation of the Reserve is primarily of Southern tropical dry deciduous forest type (Champion and Seth, 1968; Srinivasulu, 2001) characterized by species such as *Terminalia tomentosa*, *Anogeissus latifolia*, *Adina cordifolia*, *Hardwickia binata*, *Chloroxylon swietenia*, *Acacia nilotica sundra*, *Aegle marmelos*, *Dalbergia latifolia*, *Madhuca indica* etc. On the ground, the wide diversity of forest sub-types are clearly noticed including patches of almost pure bamboo (*Bambusa arundinacea*, *Dendrocalamus strictus*), Teak (*Tectona grandis*) plantation, Teak Mixed forest, Grasslands, and Riverine habitats among others.

At the instance of the Ministry of Environment and Forests, Government of India initiated faunal inventorisation of Protected Areas Programme, the Freshwater Biological Station, Zoological Survey of India, Hyderabad was assigned the task of inventorizing the faunal diversity of the Nagarjunasagar Srisailam Tiger Reserve. This paper presents the details of reptilian diversity that is found in the Tiger Reserve based on the observations carried out by the authors since 1995, collections made during June 2003 and also referral specimens collected from the Tiger Reserve

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deposited in the National Zoological Collection, Zoological Survey of India, Kolkata, Freshwater Biology Station, Hyderabad and ERM Labs, Sunnipenta, Kurnool district. The reptilian fauna of selected areas of the Tiger Reserve has been documented by Sharma (1969, 1971, 1976), Sanyal *et al.* (1993), Rao *et al.* (2005) and Srinivasulu and Das (in press). This paper presents an updated list of reptiles known from Nagarjunasagar Srisailem Tiger Reserve. The remarks on distribution include the specific localities in the Reserve and elsewhere and their current IUCN status such as EN – Endangered; Vu – Vulnerable; LRnT – Lower Risk near Threatened; LRLc – Lower Risk Least concern; DD – Data Deficient. The criterion on which the IUCN Status is based is provided in parenthesis.

## SYSTEMATIC ACCOUNT

Order CROCODILIA

Family CROCODYLIDAE

I. CROCODILES

1. *Crocodylus palustris* Lesson, 1831

**Marsh Crocodile**

1831. *Crocodylus palustris* R. P. Lesson. *Bull. Sci. Nat. Geol.* **25** : 121.

*Material examined* : None.

*Distribution* : Nagarjunasagar Reservoir, Ethipothala Falls.

*Elsewhere* : Throughout India; and Pakistan, Nepal, Bangladesh, Sri Lanka and Iran.

*Remarks* : Common. Found in rivers, lakes, dams and mangrove areas. The occurrence of this species from the Tiger Reserve is based on Srinivas *et al.* (1999).

*Status* : Vu (B1, 2a,b,c,d,e).

Order TESTUDINES

Family BATAGURIDAE

II. TURTLES and TORTOISES

2. *Melanochelys trijuga* (Schweigger, 1812)

**Indian Black Turtle**

1812. *Emys trijuga* A. F. Schweigger. *Prod. Monogr. Chel.* : 310.

*Material examined* : None.

*Distribution* : Nagarjunasagar Reservoir, Pulicheruvu, Peddacheruvu, Kotalcheruvu.

*Elsewhere* : Found distributed throughout northeastern and peninsular India; Sri Lanka, Nepal, Bangladesh, Maldives, Myanmar, and Thailand.

*Remarks* : Uncommon. Prefers lentic waters with aquatic vegetation but is also found in rivers and lakes. Based on sightings during 1997-1998.

*Status* : LRnT

### 3. *Pangshura tentoria* (Gray, 1834)

#### Indian Tent Turtle

1834. *Emys tentoria* J. E. Gray. *Proc. Zool. Soc. London*, **1834**(2) : 54.

*Material examined* : None.

*Distribution* : Maddimadugu, Padra, Nagarjunasagar Reservoir, Pecheruvu.

*Elsewhere* : Throughout India, and Bangladesh, Nepal, and Pakistan.

*Remarks* : Common. Prefers lotic habitats that are slow-moving and puddles near rivers. Based on sightings during 1996-1998.

*Status* : LRnT.

#### Family TESTUDINIDAE

### 4. *Geochelone elegans* (Schoepff, 1795)

#### Indian Star Tortoise

1795. *Testudo elegans* J. D. Schoepff. *Hist. Test.* **3** : 111; Pl. XXV.

*Material examined* : One example in ERM Labs, Sunnipenta (Reg. No. ERM-5a).

*Distribution* : Many locations in foothills along agriculture fields.

*Elsewhere* : Distributed along northwestern, southwestern and southeastern tracts of India; eastern Pakistan, northern and eastern Sri Lanka.

*Remarks* : Common. Found in scrub forests and near agriculture fields. First reported from the Nallamala Hills by Subba Rao *et al.* (1994).

*Status* : Vu (A1, a, c, d).

#### Family TRIONYCHIDAE

### 5. *Aspideretes gangeticus* (Cuvier, 1825)

#### Indian Softshell Turtle

1825. *Trionyx gangeticus* G. L. C. F. D. Cuvier. *Recherch Ossemens Foss.* **5** : 203.

*Material examined* : One example in ZSI, Kolkata (Reg. No. 21238, from Pullaredygudem, Guntur district, 2.9.1962, coll. by B. Nath).

*Distribution* : Peddavagu, near Ethipothala Falls.

*Elsewhere* : India; Bangladesh, Nepal, and Pakistan.

*Remarks* : Uncommon. Waterbodies, streams and rivers.

*Status* : Vu (A1 a, c, d).

#### 6. *Aspideretes leithii* (Gray, 1872)

##### **Leith's Softshell Turtle**

1872. *Trionyx leithii* J. E. Gray. *Ann. & Mag. nat. Hist. ser. 4*, **10** : 334.

*Material examined* : One example in ZSI, Kolkata (Reg. No. 21403, from Peddavagu River, Guntur district, 20.10.1963, coll. by B. Nath).

*Distribution* : Peddavagu, near Ethipothala Falls.

*Elsewhere* : Endemic to India.

*Remarks* : Uncommon. Found in waterbodies, streams and rivers.

*Status* : Vu (A1b).

#### 7. *Lissemys punctata* (Bonnaterre, 1789)

##### **Indian Flapshell Turtle**

1789. *Testudo punctata* M. Bonnaterre. *Tableau Encycl. Method. Nat.* : 30.

*Material examined* : None.

*Distribution* : Peddacheruvu, Ethipothala Falls and Peddavagu.

*Elsewhere* : Throughout India; Bangladesh, Nepal, Sri Lanka, Pakistan and northern Myanmar.

*Remarks* : Common. Found in waterbodies, streams and rivers. Based on sightings during 1996-1998. Sanyal *et al.* (1993) reported presence of a specimen of this taxon in ZSI, Kolkata bearing collection detail agreeing with that of *Aspideretes gangeticus* (Cuvier, 1825). Our study confirms the presence of *Aspideretes gangeticus* (Cuvier, 1825) in the National Zoological Collection, but not that of *Lissemys punctata* (Bonnaterre, 1789) as purported by Sanyal *et al.* (1993).

*Status* : LRnT.

Order SQUAMATA

Suborder SAURIA

III. LIZARDS

Family AGAMIDAE

8. *Calotes rouxii* (Duméril & Bibron, 1837)

**Roux's Forest Lizard**

1837. *Calotes rouxii* A.-M.-C. Duméril & G. Bibron. *Erp. Gén.* **4** : 407.

*Material examined* : Two examples (one each from ERM Labs, Sunnipenta [Reg. No. ERM-10a] and FBS, ZSI, Hyderabad [Reg. No. ZSI/FBS/N/1170]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Endemic to India.

*Remarks* : Common. Found mostly on the rocky outcrops in open and scrub forests, and agricultural fields.

*Status* : LRnT.

9. *Calotes versicolor* (Daudin, 1802)

**Indian Garden Lizard**

1802. *Agama versicolor* F.-M. Daudin. *Hist. nat. Rept.* **3** : 395; Pl. XLIV.

*Material examined* : Many examples [1 ex. in ERM Labs, Sunnipenta (ERM-12a); 2 ex. in ZSI, Hyderabad (ZSI/FBS/N/1165,1169)] and several examples from ZSI, Kolkata (approximately 31 collected from entire Reserve by B. Nath and I. N. Malgi).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India; Nepal, Bangladesh, Sri Lanka and Pakistan.

*Remarks* : Abundant. Found mostly on rocky outcrops in open and scrub forests, and agricultural fields.

*Status* : LRnT.

10. *Psammophilus blanfordanus* (Stoliczka, 1871)

**Blanford's Rock Agama**

1871. *Charasia blanfordana* F. Stoliczka. *Proc. Asiatic Soc. Bengal*, **1871**(9) : 194.

*Material examined* : Four examples in ZSI, Kolkata (2 ex. [Reg. No. 21436] from Nagarjuna Hill, Guntur district, 29.9.63, coll. by B. Nath; 2 ex. [Reg. No. 24685] from Amrabad, Mahbubnagar district, 19.1.88, coll. by D.P. Sanyal).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Endemic to India in peninsular region.

*Remarks* : Common. Found mostly on rocky outcrops in open and scrub forests.

*Status* : Not Assessed.

11. *Psammophilus dorsalis* (Gray in Griffith & Pidgeon, 1831)

**South Indian Rock Agama**

1831. *Agama dorsalis* J. E. Gray in : E. Griffith & E. Pidgeon. *Class Reptilia*, **9** : 56.

*Material examined* : Two examples (one each from ERM Labs, Sunnipenta [Reg. No. ERM-11a] and ZSI, Kolkata [Reg. No. 21291] from Vijaypuri South, Guntur district, 22.8.62, coll. by B. Nath).

*Distribution* : Many localities throughout the Tiger Reserve, very common in north of River Krishna areas.

*Elsewhere* : Endemic to India.

*Remarks* : Common. Found mostly on rocky outcrops in open and scrub forests.

*Status* : LRnT.

12. *Sitana ponticeriana* Cuvier, 1829

**Fan-throated Lizard**

1829. *Sit.* (= *Sitana*) *ponticeriana* G. J.-L.-N.-F. D. Cuvier. *Reg. Nat.*, **2** : 43.

*Material examined* : Many examples (one example from ERM Labs, Sunnipenta [Reg. No. ERM-9a]; three examples from ZSI, Hyderabad [Reg. No. ZSI/FBS/N/1166, 1170, 1171] and several examples from ZSI, Kolkata [approximately 59 examples collected from entire Reserve by B. Nath, I. N. Maligi and D. P. Sanyal]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India; Nepal, Pakistan and Sri Lanka.

*Remarks* : Abundant. Rocky outcrops in open and scrub forests, and agricultural fields.

*Status* : LRLc.

Family CHAMAELEONIDAE

13. *Chamaeleo zeylanicus* Laurenti, 1768

**Indian Chamaeleon**

1768. *Chamaeleo zeylanicus* J. N. Laurenti. *Syn. Rept.* : 46.

*Material examined* : One example (Reg. No. ERM-13a) from ERM Labs, Sunnipenta.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India; Sri Lanka and eastern Pakistan.

*Remarks* : Common. Open and scrub forests, and agricultural fields.

*Status* : Vu (A1a,c).

Family GEKKONIDAE

14. *Hemidactylus brookii* (Gray, 1845)

**Brooke's House Gecko**

1845. *Hemidactylus brookii* J. E. Gray. *Cat. Lizards British Mus.* : 153.

*Material examined* : Many examples [(one example [Reg. No. ERM-2a] from ERM Labs, Sunnipenta; one example [Reg. No. ZSI/FBS/N/1174] from ZSI, Hyderabad) and several examples from ZSI, Kolkata (approximately 13 examples collected from entire Reserve by B. Nath, D. P. Sanyal, K. Reddaiah and A. K. Mondal)].

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, and Pakistan.

*Remarks* : Abundant. Open forests, old temples, also human commensal, found in houses and other dilapidated man-made structures.

*Status* : LRLc.

15. *Hemidactylus flaviviridis* Rüppell, 1835

**Yellow-bellied House Gecko**

1835. *Hemidactylus flaviviridis* E. Rüppell. *Neue Wirbelth.-Fauna Abyss., Amph.* **18** : Pl. 6; Fig. 2.

*Material examined* : Two examples (one each from ERM Labs, Sunnipenta [Reg. No. ERM-3a] and ZSI, Hyderabad [ZSI/FBS/N/1173]).

*Distribution* : Few localities in the Tiger Reserve.

*Elsewhere* : Found mostly in northern and eastern India; and southern Asia, Middle East and northern Africa.

*Remarks* : Uncommon. Human commensal, found in houses and other man-made structures.

*Status* : LRLc.

16. *Hemidactylus frenatus* Duméril & Bibron, 1836

**South Asian House Gecko**

1836. *Hemidactylus frenatus* A.-M.-C. Duméril & G. Bibron. *Erp. Gén.* **3** : 366.

*Material examined* : Two examples (one each from ERM Labs, Sunnipenta [Reg. No. ERM-30a] and ZSI, Kolkata [1 ex. (Reg. No. 23700) from Mannanur, Mahbubnagar district, 15.2.79, coll. by A.K. Mondal]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Found throughout southern India; and introduced *Elsewhere*.

*Remarks* : Common. Open forests, old temples, also human commensal, found in houses and other dilapidated man-made structures.

*Status* : LRLc.

17. *Hemidactylus giganteus* Stoliczka, 1871

**Giant South Indian Tree Gecko**

1871. *Hemidactylus giganteus* F. Stoliczka. *Proc. Asiatic Soc. Bengal*, **1871**(9) : 193.

*Material examined* : Many examples (one example [Reg. No. ERM-1a] from ERM Lab, Sunnipenta; two examples [Reg. No. ZSI/FBS/N/1167, 1168] from ZSI, Hyderabad; and two examples from ZSI, Kolkata [1 ex. (Reg. No. 21411) from Nagarjuna Hill, Guntur district, 1.10.63, coll. by B. Nath; 1 ex. (Reg. No. 21412) from Siddler Hill, Guntur district, 11.11.63, coll. by B. Nath]).

*Distribution* : Few localities in the Tiger Reserve.

*Elsewhere* : Endemic to India.

*Remarks* : Uncommon. Open forests, old temples, and other dilapidated man-made structures.

*Status* : LRnT.

18. *Hemidactylus leschenaultii* Duméril & Bibron, 1836

**Bark Gecko**

1836. *Hemidactylus leschenaultii* A.-M.-C. Duméril & G. Bibron. *Erp. Gén.* **3** : 364.

*Material examined* : Few examples [one example [Reg. No. ERM-4a] from ERM Lab, Sunnipenta and a few examples from ZSI, Kolkata [1 ex. (Reg. No. 23693) from Mannanur, Mahbubnagar district, 13.2.79, coll. by A.K. Mondal; 4 ex. [Reg. No. 24510] from Srisailem, Kurnool district, 6.11.86, coll. by D.P. Sanyal and B. Dasgupta]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India; and Pakistan and Sri Lanka.

*Remarks* : Common. Open forests, old temples, also human commensal, found in houses and other dilapidated man-made structures.

*Status* : LRLc.

19. *Hemidactylus reticulatus* Beddome, 1870**Reticulated Gecko**

1870. *Hemidactylus reticulatus* R. H. Beddome. *Madras Monthly J. Med. Sci.* 1 : 33.

*Material examined* : Many examples (one example [Reg. No. ERM-17a] from ERM Labs, Sunnipenta and several examples from ZSI, Kolkata [approximately 29 examples collected from entire Reserve by B. Nath and I. N. Malgi]).

*Distribution* : Few localities throughout the Tiger Reserve.

*Elsewhere* : Endemic to India. Murthy (1986) reported this gecko from Kurnool district, Andhra Pradesh.

*Remarks* : Uncommon. Rocky outcrops in open and scrub forests.

*Status* : LRnt.

20. *Hemidactylus triedrus* (Daudin, 1802)**Termite Hill Gecko**

1802. *Gecko triedrus* F.-M. Daudin. *Hist. nat. Rept.* 4 : 155.

*Material examined* : Many examples (one example [Reg. No. ERM-7a] from ERM Labs, Sunnipenta; two examples from ZSI, Kolkata [1 ex. (Reg. No. 21239) from Vijaypuri North, Nalgonda district, 31.7.62, coll. by B. Nath; 1 ex. (Reg. No. 24509) from Srisailam, Kurnool district, 6.11.86; coll. by D.P. Sanyal and B. Dasgupta]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Widespread in India; Pakistan and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

## Family LACERTIDAE

21. *Ophisops jerdoni* (Blyth, 1853)**Jerdon's Snake-eyed Lacerta**

1853. *Ophisops Jerdoni* E. Blyth. *J. Asiatic Soc. Bengal*, 22 : 653.

*Material examined* : Many examples (one example [Reg. No. ERM-18a] from ERM Lab, Sunnipenta; three examples [Reg. No. ZSI/FBS/N/1176-1178] from ZSI, Hyderabad and several examples from ZSI, Kolkata [approximately 26 examples collected from the entire Reserve by B. Nath, D. P. Sanyal and I. N. Malgi]). Plentiful in the Reserve.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Western and central India; and Pakistan.

*Remarks* : Abundant. Scrub, open forests and near agricultural fields.

*Status* : DD.

22. *Ophisops leschenaultii* (Milne-Edwards, 1829)

**Leschenault's Snake-eyed Lacerta**

1829. *Lacerta leschenaultii* H. Milne-Edwards. *Ann. Sci. nat.* **16** : 86; Pl. VI; Fig. 9.

*Material examined* : Few examples from ZSI, Kolkata [1 ex. (Reg. No. 21296) from Nagarjuna Hill, Guntur district, 28.7.62, coll. by B. Nath; 1 ex. (Reg. No. 21297) from Nagarjuna Hill, Guntur district, 28.7.62, coll. by B. Nath; 1 ex. (Reg. No. 21438) from Nagarjuna Hill, Guntur district, 29.9.63, coll. by B. Nath; 1 ex. (Reg. No. 21439) from Nagarjuna Hill, Guntur district, 2.10.63, coll. by B. Nath].

*Distribution* : Northern dry areas of Tiger Reserve near Nagarjunasagar.

*Elsewhere* : India.

*Remarks* : Uncommon. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

23. *Ophisops minor* (Deraniyagala, 1971)

**Striped Snake-eyed Lacerta**

1971. *Cabrita jerdoni minor* P. E. P. Deraniyagala. *Ceylon J. Sci.* **32**(1) : 104; Fig. 1.

*Material examined* : Few examples (one example [Reg. No. ERM-8a] from ERM, Sunnipenta; and several examples from ZSI, Kolkata [9 examples collected from the entire Reserve by B. Nath and I. N. Maligi]).

*Distribution* : Northern dry areas of Tiger Reserve near Nagarjunasagar.

*Elsewhere* : India and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

Family SCINCIDAE

24. *Lygosoma ashwamedhi* Sharma, 1969

**Ashwamedha Supple Skink**

*Material examined* : Few examples from ZSI, Kolkata [1 ex. (Reg. No. 21173) from Pullareddygudem, Guntur district, 30.7.62, coll. by B. Nath; 1 ex. (Reg. No. 21174) from

Pullareddygudem, Guntur district, 30.7.62, coll. by B. Nath; 1 ex. (Reg. No. 21175) from Vijaypuri North, Nalgonda district, 8.7.62, coll. by B. Nath; 1 ex. (Reg. No. 21176) from 3 km S of Vijaypuri South, Guntur district, 22.8.62, coll. by I.N. Maligi; 1 ex. (Reg. No. 21177) from Eddenmotu Hill, Guntur district, 1.9.62, coll. by B. Nath; 1 ex. (Reg. No. 21179) from 3 km S of Vijaypuri South, Guntur district, 23.8.62, coll. by I.N. Maligi].

*Distribution* : Around Nagarjunasagar area in the Tiger Reserve.

*Elsewhere* : Endemic to Andhra Pradesh, India.

*Remarks* : Rare. Rocky scrub forests.

*Status* : Vu.

25. ***Lygosoma guentheri*** (Peters, 1879)

**Günther's Supple Skink**

1879. *Eumeces Güntheri* W. C. H. Peters. *S.-Ber. Ges. Naturf. Freunde Berlin*, **1879**(3) : 36.

*Material examined* : One example [Reg. No. ERMR-43a] from ERM Labs, Sunnipenta.

*Distribution* : Known only from Sunnipenta.

*Elsewhere* : India.

*Remarks* : Rare. Scrub forest. First report in Eastern Ghats.

*Status* : LRnt.

26. ***Lygosoma punctata*** (Gmelin, 1799)

**Spotted Supple Skink**

1799. *Scincus punctatus* J. F. Gmelin. *Hist. Amphib.* : 197.

*Material examined* : Few examples (one example [Reg. No. ZSI/FBS/N/1175] from ZSI, Hyderabad and a few examples from ZSI, Kolkata [1 ex. (Reg. No. 21294) from Eddenmotu Hill, Guntur district, 3.9.62. coll. by B. Nath; 1 ex. (Reg. No. 21376) from Nandikonda Valley, Nalgonda district, 9.8.62. coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Bangladesh, India, Pakistan and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

27. ***Mabuya carinata*** (Schneider, 1801)

**Common Skink**

1801. *Scincus carinatus* J. G. Schneider. *Hist. Amphib.* : 183.

*Material examined* : Few examples (one example [ERM-15a] from ERM Labs, Sunnipenta; two examples [Reg. No. ZSI/FBS/N/1179-80] from ZSI, Hyderabad, and approximately 8 examples collected from the entire Reserve by B. Nath, I.N. Maligi, D.P. Sanyal, B. Dasgupta and A.K. Mondal).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Bangladesh, India, Maldives and Nepal.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

28. ***Mabuya macularia*** (Blyth, 1853)

**Bronze Grass Skink**

1853. *Euprepes macularius* E. Blyth. *J. Asiatic Soc. Bengal*, **22** : 652.

*Material examined* : One example each from ERM Labs, Sunnipenta [Reg. No. ERM-16a] and ZSI Kolkata [1 ex. (Reg. No. 23701) from Mannanur, Mahbubnagar district, 15.2.79, coll. by A.K. Mondal].

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Bangladesh, India, Nepal, Pakistan and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

29. ***Mabuya nagarjuni*** Sharma, 1969

**Nagarjuna Hill Grass Skink**

1969. *Mabuya nagarjuni* R. C. Sharma. *Bull. Syst. Zool., Calcutta*, **1**(2) : 71; Fig. 1.

*Material examined* : Few examples (one example [Reg. No. ZS/FBS/N/1164] from ZSI, Hyderabad and four examples from ZSI, Kolkata [1 ex. (Reg. No. 21170) from Vijaypuri South, Guntur district, 23.8.62, coll. by I.N. Maligi; 1 ex. (Reg. No. 21171) from Vijaypuri South, Guntur district, 28.8.62, coll. by B. Nath; 2 ex. (Reg. No. 21172) from Vijaypuri South, Guntur district, 28.8.62, coll. by B. Nath]).

*Distribution* : Vijaypuri and Anupu near Nagarjunasagar area of Tiger Reserve.

*Elsewhere* : Endemic to Andhra Pradesh.

*Remarks* : Rare. Rocky scrub forests. This species has been recollected from the vicinity of type locality by Srinivasulu *et al.* (2005).

*Status* : EN (B1, 2c).

## Family VARANIDAE

30. *Varanus bengalensis* (Daudin, 1802)**Indian Monitor**

1802. *Tupinambis bengalensis* F.-M. Daudin. *Hist. nat. Rept.* 3 : 67.

*Material examined* : Four examples (one example [Reg. No. ERM-26a] from ERM Labs, Sunnipenta and two examples from ZSI, Kolkata [1 ex. (Reg. No. 21315) from Nagarjuna Hill, Guntur district, 2.9.62, coll. by B. Nath; 1 ex. (Reg. No. 21441) from Nagarjunakonda Valley, Guntur district, 6.11.63, coll. by B. Nath; 1 ex. (Reg. No. 21442) from Nagarjunakonda Valley, Guntur district, 7.11.63, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : Vu (A1, a,c,d).

## Suborder SERPENTES

## IV. SNAKES

## Family TYPHLOPIDAE

31. *Grypotyphlops acutus* (Duméril, Bibron & Duméril, 1844)**Beaked Blind Snake**

1844. *Onychocephalus acutus* A.-M.-C. Duméril, G. Bibron & A.-H.-A. Duméril. *Érp. Gen.* 6 : 333.

*Material examined* : One example from ZSI, Kolkata [1 ex. (Reg. No. 21330) from Nagarjuna Hill, Guntur district, 9.9.62, coll. by B. Nath].

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout peninsular India south of Gujarat, Gangetic plain and Kolkata, West Bengal.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

32. *Ramphotyphlops braminus* (Daudin, 1803)**Brahminy Blind Snake**

1803. *Eryx braminus* F.-M. Daudin. *Hist. Nat. Gen. Rept.* 7 : 279.

*Material examined* : Few examples (one example [Reg. No. ERM-19a] from ERM Labs, Sunnipenta and several examples from ZSI, Kolkata [approximately 28 examples collected from the entire Reserve by B. Nath and I. N. Maligi]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout the oriental region, Africa, Mexico and New Guinea.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

#### Family BOIDAE

### 33. *Eryx conicus* (Schneider, 1801)

#### **Russell's Sand Boa**

1801. *Boa conica* J. G. Schneider. *Hist. Amphib.* 2 : 268.

*Material examined* : Two examples (one example [Reg. No. ERM-14a] from ERM Labs, Sunnipenta and one example from ZSI, Kolkata [1 ex. (Reg. No. 21331) from Tiger Valley, Nalgonda district, 5.8.62, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, Sri Lanka and Pakistan.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

### 34. *Eryx johnii* (Russell, 1801)

#### **Red Sand Boa**

1801. *Boa johnii* P. Russell. *Continuation Account Indian Serpents* : 18; Pl. xvi-xvii.

*Material examined* : Three examples (one example [Reg. No. ERM-22a] from ERM Labs, Sunnipenta and two examples from ZSI, Kolkata [1 ex. (Reg. No. 21332) from Nagarjuna Hill, Guntur district, 27.7.62, coll. by B. Nath; 1 ex. (Reg. No. 21333) from Eddenmotu Hill, Guntur district, 3.9.62, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : India, Pakistan, Afghanistan, Iran and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

35. *Python molurus* (Linnaeus, 1758)**Indian Rock Python**

1758. *Coluber molurus* C. Linnaeus. 1758. *Syst. Nat.* 10th ed. 1 : 225.

*Material examined* : None.

*Distribution* : Few localities throughout the Tiger Reserve.

*Elsewhere* : Peninsular India, Pakistan and Sri Lanka.

*Remarks* : Uncommon. Rocky scrub, open forests and near agricultural fields. Based on sightings and Rao *et al.* (2005).

*Status* : LRnt.

## Family COLUBRIDAE

36. *Ahaetulla nasuta* (Lacepède, 1789)**Common Vine Snake**

1789. *Coluber nasuta* B.-G.-É. de L. V.-S.-I. Lacepède. *Hist. Nat. Serp.* 1 : 100.

*Material examined* : One example [Reg. No. ERM-6a] from ERM Labs, Sunnipenta.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India and Indo-Malayan region.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

37. *Amphiesma stolatum* (Linnaeus, 1758)**Buff-striped Keelback**

1758. *Coluber stolatus* C. Linnaeus. *Syst. Zool.* 10th ed. : 219.

*Material examined* : One example [Reg. No. ERM-27a] from ERM Labs, Sunnipenta.

*Distribution* : Few localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, Sri Lanka, Pakistan.

*Remarks* : Uncommon. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

38. *Argyrogena fasciolata* (Shaw, 1802)**Banded Racer**

1802. *Coluber fasciolatus* G. Shaw. *Gen. Zool.* : 528.

*Material examined* : One example [Reg. No. ERM-28a] from ERM Labs, Sunnipenta.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Most of India and Pakistan.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

39. *Atretium schistosum* (Daudin, 1803)

**Olive Keelback Water Snake**

1803. *Coluber schistosus* F.-M. Daudin. *Hist. Nat. Rept.* 6 : 132.

*Material examined* : None.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Most of India and Sri Lanka.

*Remarks* : Common. Near waterbodies and paddy fields. Based on sightings and it is reported as common in Andhra Pradesh by Sanyal *et al.* (1993).

*Status* : LRnt.

40. *Boiga forsteni* (Duméril, Bibron & Duméril, 1854)

**Forsten's Cat Snake**

1854. *Triglyphodon forsteni* A.-M.-C. Duméril, G. Bibron & A.-H.-A. Duméril. *Erp. Gén.* 7 : 1077.

*Material examined* : One example [Reg. No. ERM-20a] from ERM Labs, Sunnipenta.

*Distribution* : Few localities throughout the Tiger Reserve.

*Elsewhere* : India, Nepal and Sri Lanka

*Remarks* : Uncommon. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

41. *Boiga trigonata* (Schneider in Bechstein, 1802)

**Common Indian Cat Snake**

1802. *Coluber trigonatus* J. G. Schneider in : J. M. Bechstein. *La Cepede's Nat. Amphib.* : 256; Pl. 40; Fig. 1.

*Material examined* : Two examples (one example [Reg. No. ERM-37a] from ERM Labs, Sunnipenta and one example from ZSI, Kolkata [Reg. No. 21457] from Nagarjunakonda Valley, Guntur district, 13.11.63, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

42. *Coelognathus helena* (Daudin, 1803)

**Indian Trinket Snake**

1803. *Coluber helena* F.-M. Daudin. *Hist. nat. Rept.* **6** : 277; Pl. LXXVI.

*Material examined* : Three examples (one example [Reg No. ERM-32a] from ERM Labs, Sunnipenta; one example [Reg. No. ZSI/FBS/N/1181] from ZSI, Hyderabad and one example from ZSI, Kolkata [1 ex. (Reg. No. 21334) from Eddenmotu Hill, 3.9.62, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, Sri Lanka and Pakistan.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

43. *Coluber bholanathi* Sharma, 1976

**Nagarjunasagar Racer**

1976. *Coluber bholanathi* R. C. Sharma. *Comp. Physiol. Ecol.* **1**(3) : 106; Fig. 1.

*Material examined* : Three examples from ZSI, Kolkata [1 ex. (Reg. No. 21335) from Nagarjuna Hill, Guntur district, 27.7.62, coll. by B. Nath; 1 ex. (Reg. No. 21336) from Nagarjuna Hill, Guntur district, 4.9.62, coll. by B. Nath; 1 ex. (Reg. No. 21337) from Nagarjuna Hill, Guntur district, 9.9.62, coll. by B. Nath].

*Distribution* : Nagarjuna Hill.

*Elsewhere* : Known only from type locality–Nagarjuna Hill, in Andhra Pradesh.

*Remarks* : Rare. Scrub and open forests.

*Status* : Vu (D2).

44. *Dendrelaphis tristis* (Daudin, 1803)

**Common Bronzeback Tree Snake**

1803. *Coluber tristis* F.-M. Daudin. *Hist. nat. Rept.* **6** : 430.

*Material examined* : One example [Reg. No. ERM-25a] from ERM Labs, Sunnipenta.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Most of India and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

45. *Enhydris enhydris* (Schneider, 1799)

**Common Smooth Water Snake**

1799. *Hydrus enhydris* J. G. Schneider. *Hist. Amphib.* 1 : 245.

*Material examined* : None.

*Distribution* : Agriculture fields in the foothills and also in forest streams throughout the Tiger Reserve.

*Elsewhere* : Bangladesh, India and Nepal.

*Remarks* : Uncommon. Scrub, open forests and near agricultural fields. No vouchers collected, based on sightings in June 2003 survey.

*Status* : LRnt.

46. *Liopeltis calamaria* (Günther, 1858)

**Stripe-necked Snake**

1858. *Cyclophis calamaria* A. C. L. G. Günther. *Cat. Colubrine Snakes British Mus.* : 250.

*Material examined* : One example [Reg. No. ERMR-29a] from ERM Labs, Sunnipenta.

*Distribution* : Shikaram in Nagarjunasagar Srisailem Tiger Reserve.

*Elsewhere* : Bangladesh, India and Nepal.

*Remarks* : Rare. Scrub and open forests.

*Status* : LRnt.

47. *Lycodon aulicus* (Linnaeus, 1758)

**Common Wolf Snake**

1758. *Coluber aulicus* C. Linnaeus. *Syst. Nat.* 10th ed 1 : 220.

*Material examined* : One example [Reg. No. ERMR-35a] from ERM Labs, Sunnipenta.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, Sri Lanka, Hong Kong, Lao PDR, Malaysia, Nepal, Vietnam, Pakistan, Bangladesh, Philippines, Myanmar, Indonesia, S. China.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

48. *Lycodon striatus* (Shaw, 1802)**Barred Wolf Snake**

1802. *Coluber striatus* G. Shaw. *Gen. Zool.* : 527.

*Material examined* : One example [Reg. No. ERM-44a] from ERM Labs, Sunnipenta.

*Distribution* : Few localities throughout the Tiger Reserve.

*Elsewhere* : Throughout peninsular India.

*Remarks* : Uncommon. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

49. *Lycodon travancoricus* (Beddome, 1870)**Travancore Wolf Snake**

1870. *Cercaspis travancoricus* R. H. Beddome. *Madras Monthly J. Med. Sci.* **1** : 169.

*Material examined* : One example [Reg. No. ERM-38a] from ERM Labs, Sunnipenta.

*Distribution* : Shikaram in Tiger Reserve.

*Elsewhere* : India.

*Remarks* : Rare. Scrub and open forests.

*Status* : LRnt.

50. *Macropisthodon plumbicolor* (Cantor, 1839)**Green Keelback**

1839. *Tropidonotus plumbicolor* T. Cantor. *Proc. Zool. Soc. London*, **1829**(7) : 54.

*Material examined* : One example [Reg. No. ERM-36a] from ERM Labs, Sunnipenta.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Most of India.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

51. *Oligodon arnensis* (Shaw, 1802)**Banded Kukri Snake**

1802. *Coluber arnensis* G. Shaw. *Gen. Zool.* : 526.

*Material examined* : One example [Reg. No. ERM-41a] from ERM Labs, Sunnipenta.

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Most of India, Nepal, Pakistan, Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

52. *Oligodon taeniolatus* (Jerdon, 1853)

**Streaked Kukri Snake**

1853. *Coronella taeniolata* T. C. Jerdon. *J. Asiatic Soc. Bengal*, **22**(6) : 528.

*Material examined* : Few examples (one example [Reg. No. ERM-42a] from ERM Labs, Sunnipenta and two examples from ZSI, Kolkata [1 ex. (Reg. No. 21451) from Nagarjunakonda Valley, Guntur district, 11.11.63, coll. by B. Nath; 1 ex. (Reg. No. 21450) from Putlagudem near Pullareddygudem, Guntur district, 6.11.63, coll. by B. Nath]).

*Distribution* : Few localities throughout the Tiger Reserve.

*Elsewhere* : Most of India, Pakistan, Sri Lanka.

*Remarks* : Uncommon. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

53. *Oligodon travancoricus* (Beddome, 1877)

**Travancore Kukri Snake**

1877. *Oligodon travancoricum* R. H. Beddome. *Proc. Zool. Soc. London*, **1877**(4) : 685.

*Material examined* : Two examples from ZSI, Kolkata [2 ex. (Reg. No. 21338) from Pullareddygudem, Guntur district, 28.7.62, coll. by B. Nath].

*Distribution* : Few localities throughout the Tiger Reserve.

*Elsewhere* : India.

*Remarks* : Uncommon. Scrub, open forests and near agricultural fields.

*Status* : EN (B1, 2a, b, c).

54. *Ptyas mucosa* (Linnaeus, 1758)

**Indian Rat Snake**

1758. *Coluber mucosus* C. Linnaeus. *Syst. Nat.* 10th ed **1** : 216.

*Material examined* : Few examples (one example [Reg. No. ERM-39a] from ERM Labs, Sunnipenta and three examples from ZSI, Kolkata [1 ex. (Reg. No. 21446) from Pullareddygudem, Guntur district, 14.9.63, coll. by B. Nath; 1 ex. (Reg. No. 21449) from Nagarjunakonda Valley, Guntur district, 9.11.63, coll. by B. Nath; 1 ex. (Reg. No. 21447) from Tiger Valley, Nalgonda district, 3.10.63, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, Sri Lanka, Bangladesh and Myanmar.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

55. ***Sibynophis subpunctatus*** (Duméril, Bibron & Duméril, 1854)

**Peninsular Black-headed Snake**

1854. *Oligodon subpunctatum* A.-M.-C. Duméril, G. Bibron & A.-H.-A. Duméril. *Erp. Gén.* 7 : 58.

*Material examined* : One example [Reg. No. ERM-40a] from ERM Labs, Sunnipenta.

*Distribution* : So far known only from the vicinity of Sunnipenta in Tiger Reserve.

*Elsewhere* : Throughout peninsular India.

*Remarks* : Rare. Scrub and open forests.

*Status* : LRnt.

56. ***Xenochropis piscator*** (Schneider, 1799)

**Checkered Keelback Water Snake**

1799. *Hydrus piscator* J. G. Schneider. *Hist. Amphib.* 1 : 247.

*Material examined* : Four examples from ZSI, Kolkata [1ex. (Reg. No. 21452) from Pullareddygudem, Guntur district, 1.10.63, coll. by B. Nath; 1ex. (Reg. No. 21454) from Pullareddygudem, Guntur district, 8.11.63, coll. by B. Nath; 1ex. (Reg. No. 21455) from Pullareddygudem, Guntur district, 9.11.63, coll. by B. Nath; 1ex. (Reg. No. 21339) from Tiger Valley, Nalgonda district, 6.8.62, coll. by B. Nath].

*Distribution* : Many localities throughout the Tiger Reserve

*Elsewhere* : Throughout India, and Indo-Malayan region.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRLc.

Family ELAPIDAE

57. ***Bungarus caeruleus*** (Schneider, 1801)

**Common Indian Krait**

1801. *Pseudoboa caerulea* J. G. Schneider. *Hist. Amphib.* 2 : 284.

*Material examined* : Three examples (one example [Reg. No. ERM-24a] from ERM Labs, Sunnipenta and two examples from ZSI, Kolkata [1 ex. (Reg. No. 21459) from Putlagudem near

Pullareddygudem, Guntur district, 6.11.63, coll. by B. Nath; 1 ex. (Reg. No. 21458) from Nandikonda Valley, Nalgonda district, 7.10.63, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, Pakistan and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

58. *Calliophis melanurus* (Shaw, 1802)

**Slender Coral Snake**

1802. *Coluber melanurus* G. Shaw. *Gen. Zool.* : 552.

*Material examined* : One example from ZSI, Kolkata [1 ex. (Reg. No. 21460) from Putlagudem near Pullareddygudem, Guntur district, 6.11.63, coll. by B. Nath].

*Distribution* : Only from Nagarjunasagar area of the Tiger Reserve.

*Elsewhere* : Most of India and Sri Lanka.

*Remarks* : Rare. Scrub forests.

*Status* : LRnt.

59. *Naja naja* (Linnaeus, 1758)

**Common Cobra**

1758. *Coluber naja* C. Linnaeus. *Syst. Nat.* 10th ed. 1 : 221.

*Material examined* : Two examples (one each [Reg. No. ERM-33a] from ERM Labs, Sunnipenta and ZSI, Kolkata [1 ex. (Reg. No. 21461) from Pullareddygudem, Guntur district, 1.10.63, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India and Sri Lanka.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

Family VIPERIDAE

60. *Daboia russelii* (Shaw & Nodder, 1797)

**Russell's Viper**

1797. *Coluber russelii* G. Shaw & F. P. Nodder. *Nat. Misc.* 8 : Pl. 108.

*Material examined* : Two examples (one example [Reg. No. ERMR-34a] each from ERM Labs, Sunnipenta and ZSI, Kolkata [1 ex. (Reg. No. 21341) from Eddenmotu Hill, Guntur district, 4.9.62, coll. by B. Nath]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout India, Sri Lanka, Pakistan, Indo-Malayan and Indo-Australian regions.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

#### 61. *Echis carinatus* (Schneider, 1801)

##### Indian Saw-scaled Viper

1801. *Pseudoboa carinatus* J. G. Schneider. *Hist. Amphib.* 2 : 285.

*Material examined* : Few examples (one example [Reg. No. ERMR-23a] from ERM Labs, Sunnipenta and six examples from ZSI, Kolkata [1 ex. (Reg. No. 21342) from Eddenmotu Hill, Guntur district, 8.9.62, coll. by B. Nath; 1 ex. (Reg. No. 21402) from Eddenmotu Hill, Guntur district, 3.9.62, coll. by I.N. Maligi; 1 ex. (Reg. No. 21401) from Vijaypuri North, Nalgonda district, 8.8.62, coll. by I.N. Maligi]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Most of India, Sri Lanka, Saudi Arabia, Ghana.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

#### 62. *Trimeresurus gramineus* (Shaw, 1802)

##### Bamboo Pit Viper

1802. *Coluber gramineus* G. Shaw. *Gen. Zool.* : 420.

*Material examined* : Few examples (one example [Reg. No. ERMR-31a] from ERM Labs, Sunnipenta and two examples from ZSI, Hyderabad [ZSI/FBS/N/1182-83]).

*Distribution* : Many localities throughout the Tiger Reserve.

*Elsewhere* : Throughout peninsular India.

*Remarks* : Common. Scrub, open forests and near agricultural fields.

*Status* : LRnt.

### SUMMARY

A total of 62 species of reptiles belonging to 3 orders, 15 families and 41 genera are reported in the Tiger Reserve. In terms of abundance and diversity, lizards are plentiful while the crocodiles

and turtles are less in number. Among the squamates, snakes are more diverse than the lizards (32 vs 23 species). Two species, namely *Lygosoma ashwamedhi* Sharma, 1969 (Squamata : Scincidae) and *Coluber bholanathi* Sharma, 1976 (Squamata : Elapidae) are endemic to the Tiger Reserve and their current status seems to be uncertain as our efforts to find these species in June 2003 yielded no successful results even in the vicinity of the type locality. We rerecorded another endemic reptile, namely *Mabuya nagarjuni* Sharma, 1969 after a gap of four decades from Anupu in Tiger Reserve in June 2003 (Srinivasulu *et al.*, 2005). This paper, based on the collections made by the authors and reported earlier by other workers, provides a consolidated account of the reptilian fauna of the Tiger Reserve. A definitive herpetology of the Reserve, should, however await further explorations.

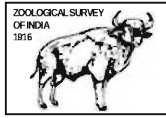
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*Rec. zool. Surv. India* : **106**(Part-3) : 123-130, 2006

## **A REPORT ON EARTHWORM SPECIES OF TARAKESWAR AND ADJOINING AREA OF HOOGHLY DISTRICT, WEST BENGAL WITH SOME ECOLOGICAL NOTES**

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### **INTRODUCTION**

Earthworms are elongated soft bodied segmented small invertebrates. In 1881 Darwin realised that the earthworms play an important role on the fertility of the soil. They burrow under the soil, leave the castings outside and help in mixing and churning of the soil. The burrows increase drainage and aeration. Moreover, the castings are rich in macro and micro nutrients, which are essential for plants growth.

Recently (due to so called green revolution), farmers are suffering from the loss of soil fertility, water content deficiency and many other problems due to indiscriminate use of chemical fertilisers and pesticides.

Now all people are searching for a sustainable lifestyle and agronomists are also recommending sustainable agriculture, which may succeed by the use of bio-pesticide and bio-fertiliser, which are very costly till now. If farmers make their own compost by simple methods then it may succeed.

For commercial Vermicomposting we need some special epigeic species (Edwards Lofty 1977, Dash, 1994). In our country mainly two exotic species, namely, *Eisenia foetida* and *Eudrilus eugeniae* are being used for this purpose. But these species are costly and their extensive use may be harmful in ecological aspect, as some conservationist are shouting about this matter. Most of the earthworms feed on decaying organic matter in the soil and after its assimilation in the alimentary canal, excrete the soil as cast (vermicast) which is rich in nutrients. This vermicast contains various amino acids, minerals and micro-organisms which humify the organic matter in the surrounding soil and act as soil conditioners and biofertilisers. However, the capability of decomposing organic matter varies from species to species. It is very essential to select suitable species of earthworms for the purpose of waste conversion by Vermicomposting. Therefore, we need detailed information

about the availability of earthworm species, their habitat, conditions of living, and nature of a particular area (Anonymous, 1993).

So it is very urgent to inventorise the local species of earthworms before going to commercial Vermicomposting in a certain locality.

Keeping these words in our mind, we are going for a random survey for earthworm species available in and around Tarakeswar locality, for the compatible species of earthworm for Vermicomposting.

Out of about 3900 global species and some 390 species reported from India, and 63 species are known to occur in West Bengal (Halder, 1994). The present report is based on the study made during July-September, 2004. Out of 46 specimens collected so far, 9 species were identified belonging to 6 genera and 2 families. Seven species are reported for first time from Hooghly district, where as one species namely *Drawida willsi* is recorded here for the first time from this state.

The diagnostic characters and proper habitat of each species are provided in this short communication with short ecological notes (Gates, 1972; Julka, 1988).

#### SYSTEMATIC ACCOUNT

Phylum ANNELIDA

Class OLIGOCHAETA

Order HAPLOTAXIDA

Family MEGASCOLECIDAE

1. *Amyntus morrisi* (Beddard, 1892)
2. *Amyntus diffringens* (Baird, 1809)
3. *Amyntus alexandri* Beddard, 1900
4. *Lampito mauritii* Kinberg, 1867
5. *Metaphire posthuma* (Vaillant, 1868)
6. *Perionyx excavatus* Perrier, 1870
7. *Polypheretima elongata* (Perrier, 1872)

Order MONILIGASTRIDA

Family MONILIGASTRIDAE

8. *Drawida nepalensis* Michaellesen, 1907
9. *Drawida willsi* Michaellesen, 1907

Family MEGASCOLECIDAE

*Diagnosis* : Setae sigmoid with simple pointed tip. Clitellum multilayered. Male pores behind female pores. Dorsal pores present. Intestinal origin behind ovarian segment. Last pair of hearts behind XI. Seminal vesicles trabeculate; prostates racemose without central canals; Ovaries in XIII, fan shaped.

**Key to Genera**

1. Nephridia stomate, ..... *Perionyx*  
 – Nephridia astomate, at least in some parts of body ..... 2
2. Gizzard in front of 7/8, ..... *Lampito*  
 – Gizzard behind 7/8 ..... 4
4. Intestinal caeaca present ..... 5  
 – Intestinal caeaca absent ..... *Polypheretima*
5. Copulatory pouches present ..... *Metaphire*  
 – Copulatory pouches absent ..... *Amyntus*

Genus *Amyntus* Kingberg

*Diagnosis* : Body cylindrical. Setae numerous, regularly arranged around each segment. Clitellum annular, XIV–XVI, rarely beginning on XIII. Spermathecal pores paired, occasionally numerous and single, between 4/5–8/9. Female pore single, rarely paired, on XIV. Copulatory pouches absent.

**Key to Species**

1. Spermathecal pores four pairs ..... 2  
 – Spermathecal pores two pairs and in 5/6–6/7 ..... *A. morrisoni*
2. Preclitellar genital markings present ..... *A. diffringens*  
 – Preclitellar genital markings absent ..... *A. alexandri*

1. *Amyntus morrisoni* (Beddard, 1892)

*Materials* : One example, from Dhallyan, Tarakeswar, date 5.vii.2004, Coll. Kaustav Ghosh.

*Diagnosis* : Length 40–150 mm, diameter 2.5 mm, segments 75–102. Clitellum in XIV–XVI; spermathecal pores two 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 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.

*Ecological notes* : Occurs in soil of gardens, lawns, open area and jungles; living in soil under bamboos and banyan trees. We observed its high population at the shed of a large Bamboo bush. Population counted as ~30\ sq. ft. Status of this species here considered as plenty.

*Remarks* : The original home of this species is China. In West Bengal, it was reported to occur from Darjeeling and Kolkata. Now it's reported for the first time from Hooghly district.

### 2. *Amyntas diffringens* (Baird, 1809)

*Materials* : 2 exs., ploughed field at Bhanjipur village, dated 4.vii.2004, Coll. S. Mitra.

*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; spermathecal pores 4 pairs, minute, superficial, each in a small circular to transversely elliptical disk in 5/6–8/9; female pores mid ventral. Gizzard large, somewhat conical, narrow in front; intestinal origin usually in XVI; last pair of hearts in XIII.

*Ecological notes* : It prefers soils in forest floor with high organic matter, under stones and rocks and rotten woods near pond water. We collect it from the surrounding area of a cultivated field. Status of this species is moderately common.

*Remarks* : This species originated from China, and successfully colonized in the Himalayas and other high altitude regions of India. Previously reported from four districts namely Darjeeling, Jalpaiguri, Burdwan and Midnapore (E), now it is reported for the first time from Hooghly district.

### 3. *Amyntus alexandri* Beddard, 1900

*Materials* : 2 exs., Bhanjipur, Tarakeswar, 5.vii.2004, Coll. S. Mitra; 3 exs., B.P.R. Gate, Tarakeswar, 4.vii.2004, Coll. K. Ghosh.

*Diagnosis* : Length 105–290 mm, diameter 4–9 mm, segments 90–141. Prostomium rudimentary, Clitellum XIV–XVI, occasionally reaching XVII. Setae 40–50 on VIII, 58–76 on XX, 9–22 between spermathecal pores and 9–28 between male pores. First dorsal pore at 12/13. Genital markings absent. Spermathecal pores 4 pairs, minute, superficial, in 5/6–8/9. Female pore midventral. Male pores minute, superficial, on XVIII, each in a rather circular disc. Septa 8/9–9/10 lacking. Intestinal origin in XV; Last pair of hearts in XIII, Prostates XVI–XXII.

*Ecological notes* : This species was collected from the soil beneath the rotten cow dung beside a cultivated land. It is also collected from the hard soil of Jute field. Generally it occurs in soils of

gardens, lawns, open fields, bamboo groves and deciduous jungles, rain forests, under logs. Status of the species here is not so common.

*Remarks* : This species originated from South East Asia and is endemic to Oriental Region. So far it was reported from Calcutta, Darjeeling and Jalpaiguri district from West Bengal. It is the first report from Hooghly district.

#### 4. *Lampito mauritii* Kinberg, 1867

*Materials* : 4 exs., Dhalyan, Tarakeswar, Coll. S. Mitra, 5.vii.2004.

*Diagnosis* : Length 90–115 mm, diameter 3–5 mm, segments 150–178. Clitellum annular, XIV–XVII or XVIII; Setae perichaetine, 40–51 on VIII, 30–43 on XX, 10–16 between spermathecal pores and none between male pores. 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 porophore that extends from A into CE; female pores paired on XIV; genital marking absent. Intestinal origin in XV. Holandric; Testes free in X and XI. Prostates in XVIII.

*Ecological notes* : Greyish-yellow in living condition; living in top 10 cm of semi-moist sandy-loam soil, sometimes blackish soil; castings abundantly available in lawns and grass beds on the border line of grassy area and open area, deposited on the surface of the soil in the form of small heaps of spheroidal or nearly globular pellets. It is a commonly occurring species of this area.

*Remarks* : These worms are reported to be utilised as waste conditioners. But survival rate of this species is very poor in artificial culture beds. Here it is collected from a semi decomposed sandy soil beside a big pond.

#### 6. *Metaphire posthuma* (Vaillant, 1868)

*Materials* : 3 exs., from beside a pond at Bhanjipur, Tarakeswar, 5.vii.2005, Coll. K. Ghosh.

*Diagnosis* : Length 60–140 mm, diameter 3–8 mm, segments 91–124. Prostomium epilobic. Tongue open. Clitellum XIV–XVI. Setae presents on clitellar segments ventrally. Genital markings paired, usually on XVII and XIX. Spermathecal pores 4 pairs minute and superficial, on posterior margins of V–VIII. Female pore single, mid-ventral on XIV, male pores minute and invaginate, on XVIII. Gizzard in VIII; intestinal origin in XV, last pair of hearts in XIII. Prostates in XV–XXI.

*Ecological notes* : Light to dark grey in living condition, curled into ball when touched; living in top 15 to 20 cm. of moist and semi-moist clayey loam soil, available in flower beds, grass beds and soil covered with dry heaps of leaf litter; comes out of the burrow after overnight shower; castings deposited on the surface of the soil in the form of small heaps of loose ovoidal pellets. This species is not so common in this area.

*Remarks* : This is a very common species in India. In West Bengal it was known to occur from Burdwan, Calcutta and 24-Parganas (N) districts only. So this the first record of this species from Hooghly district. It is commonly used as laboratory materials in India.

#### 6. *Perionyx excavatus* Perrier, 1872

*Materials* : 12 exs., Dhalyan, 5.vii.2005; 7 exs., Padmapukur, 8.vii.2005, Coll. S. Mitra.

*Diagnosis* : Length 30–175 mm, diameter 3–8 mm, segments 79–121. Colour deep purple to reddish brown dorsally, pale ventrally. Prostomium epilobic, tongue open, clitelum 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. Gizzard absent or rudimentary in V; Intestinal origin in XV or XVI. Last pair of hearts in XII.

*Ecological notes* : Living in top 10 cm of semi-moist sandy-loam soil, manure and compost heaps, under logs, bricks, rocks at edge of a water bodies, under barks of standing and fallen trees. Leaves of aquatic plants. Soil near water cources, soil saturated with water from bathroom and kitchen. Sometimes blackish soil; castings abundantly deposited on the surface of the soil in the form of short thread or rods.

*Remarks* : These worms are reported being utilized as waste conditioners. Probably this is the most common Indian species which has potentialities for Vermicomposting. This species has a bad habit of escaping the vermibed just after some rain. This is the most commonly occurring species in this area.

#### 7. *Polypheretima elongata* (Perrier, 1872)

*Material* : 1 ex., Padmapukur, 5.vii.2005, Coll. S. Mitra.

*Diagnosis* : Length 40–360 mm, diameter 1.5–10 mm, segments 136–297. Prostomium rudimentary or lacking. Genital markings transversely elliptical, paired, presetal on XIX and successive segments in line with or slightly median to male pores, occasionally on VI, VII and XVII. First dorsal pore at 12/13. Female pore single, mid ventral, on XIV. Male pores paired, Septa 8/9–0/10 absent. Intestinal origin in XVI. Last pair of hearts in XII.

*Ecological notes* : Under compost and manure heaps, rubbish, soils—red, black cotton or black taro; castings are found on soil surface in the form of cords of about 2 mm thickness and 20–24 mm in length or in irregular piles of 10–20 mm high and 20–35 mm wide.

*Remarks* : The species originated from the region including Indonesia and Philippines. In Karnataka, this species was found to have rendered the soil compact, hard and cloddy. It is very

common in the Sunderban area of West Bengal and this is the first report of this species from Hooghly district.

Family MONILIGASTRIDAE

*Diagnosis* : Setae sigmoid, single pointed, 4 pairs per segment. Dorsal pores absent. Female pores near B. Male pores in 10/11 to 12/13. Digestive system with oesophageal gizzards behind ovarian segment, intestinal origin behind XVII but without calciferous glands, typhlosole and suprainestinal glands.

Genus *Drawida* Michaelsen, 1900

*Diagnosis* : Nephrospore present from III. Spermathecal pores paired in 7/8. Female pores paired at or just behind 11/12. Male pores paired at or near 10/11. Gizzard in region of XII–XXVII; Intestinal caeca absent. Testes in 9/10. Ovaries in XI. Capsular prostates paired in X.

8. *Drawida willsi* Michaellesen, 1907

*Material* : 1 ex., Bhanjipur, Tarakeswar, 8.vii.2004, Coll. K. Ghosh.

*Diagnosis* : Length 55–60 mm, diameter 2.5 mm; segments 155–160. Colour reddish grey, prostomium prolobous, transversely oval in shape. Setae closely paired, especially the lateral. Male pores on transversely oval papillae in *b*; female pores in *ab*. Spermathecal pores in *ab*, inconspicuous. Septa 6/7–8/9 thickened, especially the first two. Two gizzards, in XIV and XV. Prostates short thick tubes, somewhat bent or depressed, nearly disc like.

*Ecological notes* : This species was collected from the moderately hard soil beside a jute cultivated field. The soil is somewhat brownish in colour and clayey in nature. Population of this species is very scanty.

*Remarks* : This species was earlier recorded from Bilaspur (M.P) and Hyderabad (A.P). So, it is the first record of this species from Hooghly district as well as West Bengal.

9. *Drawida nepalensis* Michaellesen, 1907

*Materials* : 8 exs., Bhanjipur, Tarakeswar, 12.viii.2004, Coll. K. Ghosh.

*Diagnosis* : Length 50–130 mm, diameter 2–5 mm, segments 120–180. Colour yellowish grey. Postomium prolobous. Setae closely paired; *aa* is little more than *bc*; *dd* a little more than  $\frac{1}{2}$  circumference. Dorsal pores absent, Clitellum ring shaped, IX–XIV. Male pores on prominent transverse oval papillae, midway between *b* and *c*. Female pores in *b*. Spermathecal pores just ventral from *c*. Septa 5/6–8/9 very strong. Four gizzards, in xiv–xvii, Prostates long, tube like, in a U shaped loop.

*Ecological notes* : This species was collected from underneath rotten leaves below a bush. It was early reported from soil in gardens, lawns, forests, under compost heaps, earth at base of bamboo bush, mud under water cress. As this species eats rotten leaves it may be suitable for Vermicomposting purpose.

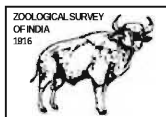
*Remarks* : This species originated from the Himalayas and recorded earlier from six districts of West Bengal namely, Bankura, Calcutta, Coochbehar, Darjeeling, Jalpaiguri and Nadia. So, it is the first record of this species from Hooghly district.

#### ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, Kolkata, for the facilities provided and Dr. Satyanarayana for critically going through the manuscript. We also thank Sri Kaustav Ghosh of Tarakeswar for his help in collecting the specimen.

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## **A REPORT ON INTERTIDAL MACROFAUNA OF TALSARI (BALASORE : ORISSA)**

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### **INTRODUCTION**

Talsari is a less popular tourist spot of Orissa, situated on the tributaries of Subarnarekha Estuary. Despite of Anthropogenic pressure and various types of fishing activities, this place is rich in marine faunal diversity. The first author investigated the intertidal faunal resources of this area since 1995 to 2003. As several types of marine habitats are found in this small area (2.5 sq. km. only), different types of faunal composition are found here in distinct zonation. Previously Goswamy (1992) reported some marine fauna of Digha coast. Rao & Misra (1986) reported the Macrofauna of Digha Beach of West Bengal. Very recently Chatterjee & Mitra (2003) reported the Estuarine Molluscs of Talsari. But till date there is no comprehensive report on the intertidal fauna of this region. Bairagi (1995); Subba Rao *et al.*, (1992) and Mitra *et al.*, (1997, 1998) contributed on some marine fauna of Digha coast.

The present paper deals with a comprehensive list comprising 90 species belonging to seven phyla of the Intertidal Macrofauna of Talsari with short notes on habitat choice, zonation, status of availability, threats and some recommendation for their conservation.

### **MATERIALS AND METHODS**

Talsari is a small coastal village in the District of Balasore of Orissa, close to Orissa-West Bengal border. There is a large mud flat, which remains submerged during high tides. The village is criss-crossed by the canals connected to the tributaries of the river Subarnarekha at its confluence with the Bay of Bengal. A natural Mangrove cover consisting of *Sonneratia apatala*, *Exocaria agalocha* and *Acanthus* sp., is coming up on the south west side of the village. Recently the Govt. of Orissa constructed a fishing harbour. A large Molluscan fishery has also been established on the Southeastern part of Talsari. The Intertidal beach is very much extended (more than 600 mt.) on Eastern portion of this area.

The observation and collection of specimens for this study were made on weekly/fortnightly basis. Horizontal and vertical survey were made in different time and tidal conditions. Littoral fauna was collected during low tide from the Sandy shore, as well as Mud flat area, Boulder, Rocks & Jetties, and also from Mangrove vegetations.

During sample collections and observation, type of the substrate, abundance, habit and habitats of individual species were noted.

Specimens were preserved in 70% Alcohol or in 10% Formalin after proper narcotisation, and attempts were made to identify all the collected specimens up to species level whenever possible.

## RESULTS AND DISCUSSION

In our study a total of 90 species of intertidal macrofauna belonging to 71 genera, 48 Families, 23 Orders, 11 Classes and 7 Phyla have been counted. (The Faunal list is given in Table 1). Among this groups phylum-Mollusca is dominated (55%) with a list of 49 species whereas phylum-Echiurida and Brachiopoda represented with a single species only. (The phylum wise species composition is shown in Fig. 1). The Intertidal Fauna of Digha coast studied by Rao & Misra (1984) comprises only 44 species of Macrofauna. Obviously due to occurrence of a diverse type of habitat the Faunal composition of Talsari beach is so healthy. Fauna associated with mudflat & mangrove area are totally absent in Digha beach. Due to excessive tourism pressure some animals shifted their population from Digha beach to Talsari sea beach, such as *Ocypode macrocera*, *Thorsonia investigatoris*, *Carcinoscorpious rotundicauda*.

According to habitat, most of the species found in Sandy beach (41%) where sandy beach with siltation and mud habitat dwelling species accounted 18% in each case, a total 6% animals are available in Mangrove forest as epifauna (Fig. 2).

Status of the Intertidal macro-fauna also observed, and 36% species are accounted as very common, whereas 11% species are considered as rare in this area. Some species are commercially exploited (19%) in large scale. Due to Anthropogenic activity, habitat loss and some other causes some species (14%) are threatened here also (Fig. 3).

As Talsari sea beach is very nearer to Digha beach (12 km), a very popular sea resort of West Bengal, a large number of tourists come here all the year round, of which a large number of students use to collect zoological specimens from here. These are one of the causes to decline the faunal population. Besides this, the recent advent of aquaculture industry in this area leads to the destruction of lot of invertebrate juveniles (including their egg capsules). The fishermen collect the post larval stages of tiger prawn (*Penaeus monodon*) and throw away the other forms caught in the same net (Juveniles of fish and other invertebrates) on the beach. This unscrupulous daily activity causes heavy loss of biodiversity of this area and causes ecological imbalance. Development of molluscan fishery is playing also a negative role in case of Biodiversity conservation, because it

depends here only on capture fishery. Establishment of a Fishing Harbour in the vicinity by the Govt. of Orissa in the recent past may lead to the rapid destruction of this unique ecologically diverse sea beach as well as its faunal resources.

The intertidal fauna of Digha beach is somewhat different in respect of Talsari beach, because the Digha beach is purely sandy and there are some artificial rocks on upper and supralittoral zone on the other hand Talsari has all types of coastal ecosystems. Species no. 4, 6, 14, 17, 22, 26, 27, 28, 29, 32, 33, 35, 37, 38, 41, 44, 45, 46, 57, 58, 59, 61, 62, 63, 65, 68, 69, 72 and 82 of Table No. 1 of this article are not available at the sandy shore of Digha.

**Table 1. :** List of intertidal macro fauna along with their habitat & status data

Sl. No.	Name of Specimen	Habitat						Status					
		A	B	C	D	E	F	1	2	3	4	5	
<b>I.</b>	<b>PHYLUM CNIDARIA</b>		+										
	Class HYDROZA Order THECATA Family CAMPANULARIIDAE												
1.	<i>Obelia spinulosa</i> (Bell)	+	+						+				
	Class ANTHOZOA Subclass HEXACORALLIA Order ACTINARIA Family ACTINIIDAE												
2.	<i>Paracondylactis indicus</i> Dave	+						+					+
	Family METRIDIIDAE												
3.	<i>Metridium schillerianum</i> (Stoliczka)				+			+					
	Subclass OCTOCORALLIA Order PENNATULACIA Family VERETILLIDAE												
4.	<i>Cavernularia elegans</i> Herklots		+							+			+
	Family VERGULARIDAE												
5.	<i>Virgularia elegans</i> Gray	+						+					+
6.	<i>Virgularia</i> sp.		+							+			
<b>II.</b>	<b>PHYLUM ANNELIDA</b>												
	Class POLYCHAETA Family AMPHINOMIDAE												
7.	<i>Chloeia parva</i> Baird	+			+			+					
	Family NEREIDIDAE												
8.	<i>Neries</i> sp.	+						+					

Table 1. : (Cont'd.)

Sl. No.	Name of Specimen	Habitat						Status						
		A	B	C	D	E	F	1	2	3	4	5		
	Family ONUPHIDAE													
9.	<i>Onuphis</i> sp.	+							+					
10.	<i>Diopatra cuprea</i> (Bosc)	+	+						+					
	Family LUMBRINERIDAE													
11.	<i>Lumbriconereis heteropoda</i> Morenzeller	+							+					
	Family GLYCERIDAE													
12.	<i>Glycera alba</i> (Muller)	+							+					
13.	<i>G. convoluta</i> Kefenstein	+							+					
	Family TERESELLIDAE													
14.	<i>Loimia medusa</i> (Savigny)		+						+					
	Family PHYLLODOCIDAE													
15.	<i>Eteone ornata</i> Fauvel	+							+					
16.	<i>Eteone barantollae</i> Fauvel	+												
<b>III.</b>	<b>PHYLUM ECHIURIDA</b>									+				
	Class ECHIURA Order ECHIUROINEA Family THALASSEMATIDAE													
17.	<i>Anelassorhynchus microrhynchus</i> (Prasad)			+							+			+
<b>IV.</b>	<b>PHYLUM ARTHROPODA</b>													
	Class CRUSTACEA Sub class CIRRIPIEDIA Order THORASICA Family BALANIDAE													
18.	<i>Balanus amphitrite</i> Darwin				+				+					
	Family CHTHMALIDDAE													
19.	<i>Chthamallus stellatus</i> (Poli)				+	+				+				
	Order DECAPODA Family DIOGENIDAE													
20.	<i>Diogenes costatus</i> Henderson	+							+					
21.	<i>Clibanarius padavensis</i> De Man		+	+					+					
	Family COENOBITIDAE													
22.	<i>Coenobita cavipes</i> Stimpson				+	+				+				

Table 1. : (Cont'd.)

Sl. No.	Name of Specimen	Habitat						Status				
		A	B	C	D	E	F	1	2	3	4	5
	Family OCYPODIDAE											
23.	<i>Ocypoda macrocera</i> H. Milne Edwards	+						+				+
24.	<i>Ocypoda ceratophthalma</i> (Pallas)	+								+		
25.	<i>Macrophthalmus transversus</i> (Latreille)	+						+				
26.	<i>Uca (Deluca) rosea</i> (Tweedie)			+			+	+				
27.	<i>Uca (Celuca) triangularis</i> Bengali Crane			+			+	+				
28.	<i>Uca (Celuca) lacteal annulipes</i> (Edwards)			+			+	+				
29.	<i>Uca acuteus</i> Stimpson						+		+			
30.	<i>Dotilla blanfordi</i> (Alcock)	+						+				
31.	<i>Dotillopsis</i> sp.	+					+					
	Family GRAPSIDAE									+		
32.	<i>Varuna litterata</i> (Fabricius-1798)			+					+		+	
33.	<i>Metaplex dentipes</i> (Heller-1865)			+				+				
	Family PORTUNIDAE											
34.	<i>Scylla serrata</i> De Haan			+				+			+	
35.	<i>Scylla tranquibarica</i>			+						+		+
	Class MEROSTOMATA Order XIPHOSURIDA Family XIPHOSURIDAE											
36.	<i>Tachypleus gigas</i> (Muller)	+	+					+			+	+
37.	<i>Carcinoscorpius rotundicauda</i> (Latreille)		+	+					+		+	+
<b>V.</b>	<b>PHYLUM MOLLUSCA</b>											
	Class GASTROPODA Order ARCHAEOGASTROPODA Family TROCHIDAE											
38.	<i>Umbonium vestiarium</i> (Linnaeus)			+				+			+	
	Family NIRITIDAE											
39.	<i>Nerita (Amphinerita) lineata</i> (Gmelin)				+				+			
40.	<i>Nerita (Dostina) violacea</i>				+				+			
	Order MESOGASTROPODA Family LITTORINIDAE											
41.	<i>Littorina (Littorina) melanostoma</i> Gray					+		+				
42.	<i>Littorona (Littorinopsis) scabra</i> (Linnaeus)				+			+				

Table 1. : (Cont'd.)

Sl. No.	Name of Specimen	Habitat						Status						
		A	B	C	D	E	F	1	2	3	4	5		
	Family TURITELLIDAE													
43.	<i>Turritella attenuata</i> Reeve	+	+					+				+		
	Family POTAMIDIDAE													
44.	<i>Cerithidea (Cerithidiopsis) cingulata</i> (Gmelin)			+				+						
45.	<i>Cerithidea (Cerithidea) obtusa</i> Lamarck					+			+					
46.	<i>Telescopium (Telescopium) telescopium</i> Montfort			+				+						
	Family NATICIDAE													
47.	<i>Natica tigrina</i> (Roeding)	+						+				+		
48.	<i>Natica vitellus</i> (Linnaeus)	+						+				+		
49.	<i>Natica lineata</i> Lamarck	+							+			+		
	Order NEOGASTROPODA Family MURICIDAE													
50.	<i>Murex tribulus</i> Linnaeus		+						+			+		
51.	<i>Cymia lacera</i> (Borne)				+			+						
	Family NASSARIIDAE													
52.	<i>Nassarius foveolatus</i> (Dunker, Reeve)		+	+					+					
	Family OLIVIDAE													
53.	<i>Amalda ampla</i> (Gmelin)	+						+				+	+	
	Family TURRIDAE													
54.	<i>Turricula javana</i> (Linnaeus)		+											
	Family AGLAJIDAE													
55.	<i>Melanochlamys</i> sp.	+	+									+		+
	Order BASOMATOPHORA Family ELLOBIIDAE													
57.	<i>Ellobium gangeticum</i> (L. Pfeiffer)			+						+				
58.	<i>Cassidula nucleus</i> Mortyn			+						+				
59.	<i>Pythia plicata</i> Ferussac			+						+				
	Order SOLEOLIFERA Family ONCHIDIIDAE													
60.	<i>Onchidium typhae</i> Buchannan			+				+	+					

Table 1. : (Cont'd.)

Sl. No.	Name of Specimen	Habitat						Status					
		A	B	C	D	E	F	1	2	3	4	5	
	Class BIVALVIA Order ARCOIDA Family ARCIDAE												
61.	<i>Anadara granosa</i> (Linnaeus)		+					+				+	
62.	<i>Anadara inequalvis</i> (Bruguiere)		+					+				+	
63.	<i>Scapharca deyrollei</i> Jousneume		+					+				+	
	Order MYTILOIDA Family MYTILIDAE												
64.	<i>Perna viridis</i> (Linnaeus)				+						+		+
65.	<i>Modiolus striatus</i>				+	+		+					
	Order OSTREOIDA Family OSTREIDAE												
66.	<i>Cassostrea madrasensis</i> Preston				+			+				+	
67.	<i>Saccostrea cucullata</i> (Born)				+	+		+				+	
	Family VENERIDAE												
68.	<i>Meretrix meretrix</i> (Linnaeus)		+	+				+				+	
69.	<i>M. casta</i> (Linnaeus)			+				+				+	
70.	<i>Pelecypora trigona</i> Reeve	+							+			+	
71.	<i>Paphia malabarica</i> (Schroeter)		+								+		
72.	<i>Paphia textiles</i> (Gmelin)		+								+		
	Family MACTRIDAE												
73.	<i>Mactra violacea</i> Gmelin	+						+				+	
74.	<i>Mactra (Mactrinula) luzonica</i> Deshayes	+						+				+	
	Family CULTELLIDAE												
75.	<i>Siliqua radiata</i> (Linnaeus)	+							+			+	
	Family PSAMMOBIIDAE												
76.	<i>Sanguinolaria (Soletettina) acuminata</i> Deshayes	+							+				
	Family DONACIDAE												
77.	<i>Donax scortum</i> Linnaeus	+							+				
78.	<i>Donax incurvatus</i> Gmelin	+						+					+
	Family TELLINIDAE												
79.	<i>Macoma birmanica</i> (Philippi)	+							+				

Table 1. : (Cont'd.)

Sl. No.	Name of Specimen	Habitat						Status				
		A	B	C	D	E	F	1	2	3	4	5
	Order ADAPEDONTA Family SOLENIDAE											
80.	<i>Solen brevis</i> Gray	+							+		+	
81.	<i>Solen</i> sp.	+								+		
	Family GLAUCONOMIDAE											
82.	<i>Glaucanome orientalis</i> (Gmelin)			+					+			+
	Order MYOIDA Family PHOLADIDAE											
83.	<i>Pholus orientalis</i> (Gmelin)	+						+			+	
84.	<i>Martesia fragilis</i> Sowerby				+					+		
	Family TEREDIIDAE											
85.	<i>Teredo calva</i> Gmelin				+	+			+			
	Family LATERNULIDAE											
86.	<i>Laternula truncata</i>			+						+		
<b>VI.</b>	<b>PHYLUM BRACHIOPODA</b>											
	Class INERTICULATA Family LINGULIDAE											
87.	<i>Lingula translucida</i> Lamarck		+	+					+			+
<b>VII.</b>	<b>PHYLUM ECHINODERMATA</b>											
	Class HOLOTHUROIDEA Order DENDROCHIROTIDA Family CUCUMARIIDAE											
88.	<i>Thorosonia investigatoris</i> (Koehler & Vaney)	+	+							+		+
	Order MOLPADIA Family CAUDINIDAE											
89.	<i>Acaudina molpadiodes</i> (Semer)	+	+					+				+
	Class ASTEROIDEA Order PAXILLOSIDA Family ASTROPECTINIDAE											
90.	<i>Astropecten indicus</i> Doederlin	+						+				+

**Abbreviations used are as follows :**

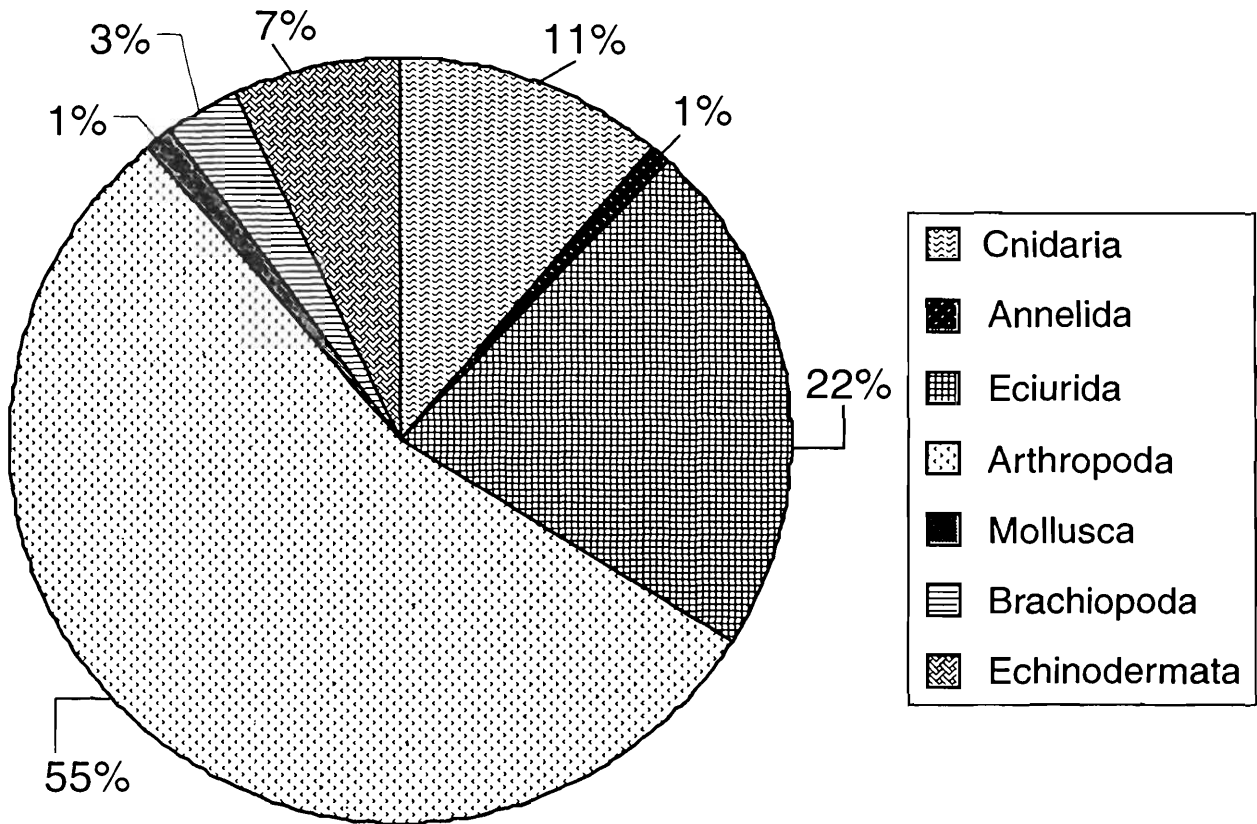
For denoting the habitats :

**A** : Sandy beach; **B** : Sandy beach with siltation; **C** : Mud; **D** : Boulder/Rocks/Jetties; **E** : Mangrove epifauna; **F** : Hard soil with grass bed.

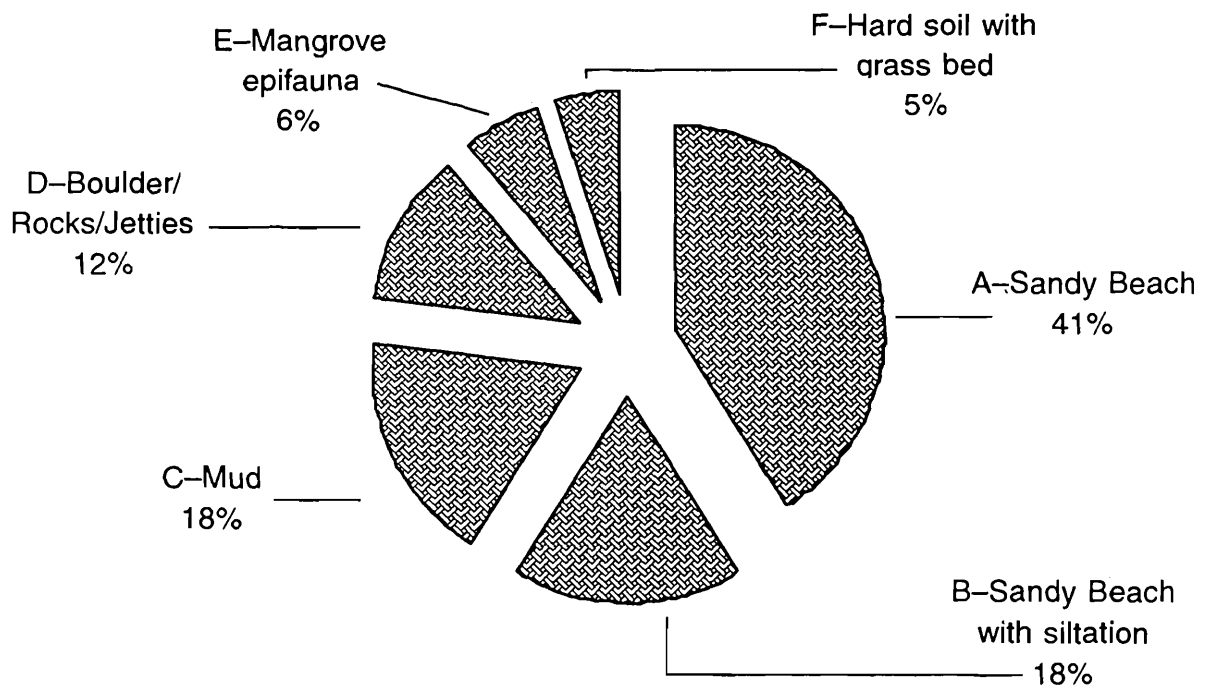
For suggesting the status of the specimens :

**1** : Very common; **2** : Common; **3** : Rare; **4** : Commercially exploited; **5** : Threatened due to human activity.

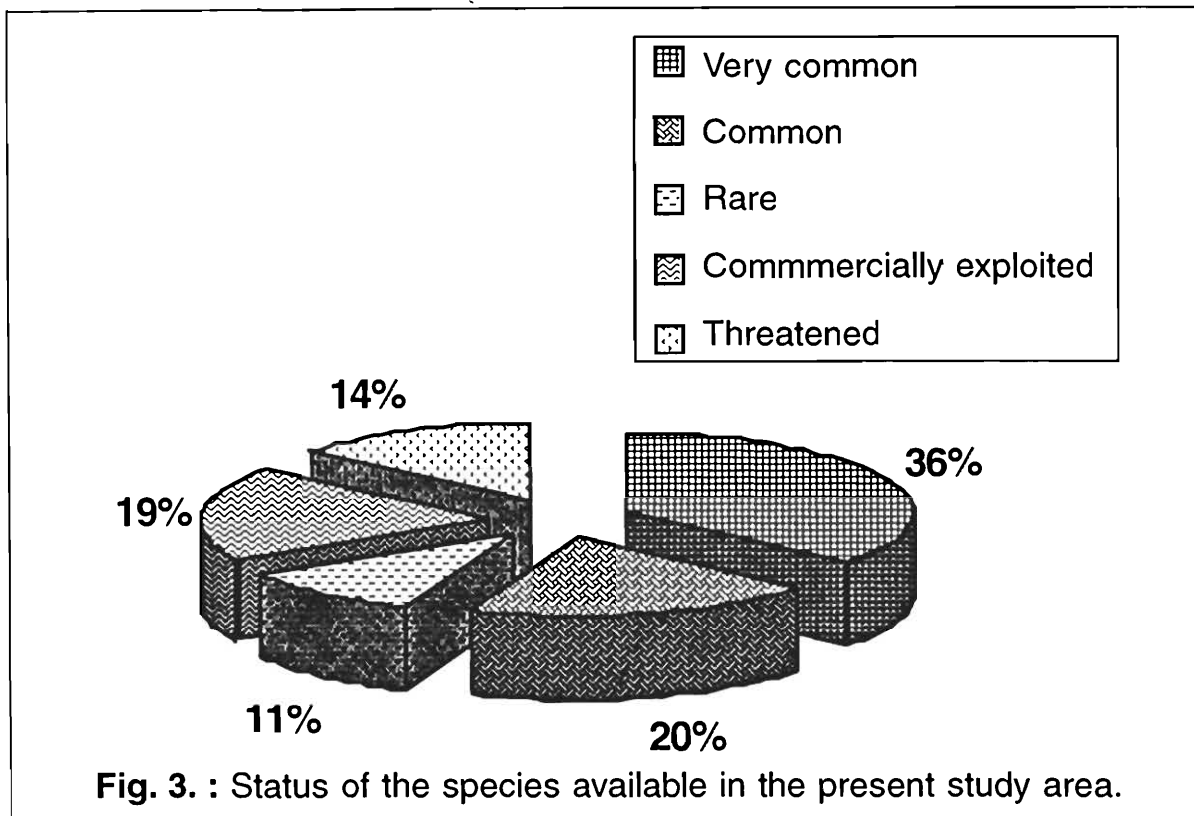
**Phylum wise species composition of intertidal macrofauna of Talsari**



**Fig. 1. :** Composition of different phyla available in intertidal region of Talsari.



**Fig. 2. :** Habitat wise species composition.



### SUMMARY

Talsari is a small coastal village in the district of Balasore of Orissa, close to Orissa-West Bengal border. There is a large mud flat which remains submerged during high tides. The village is criss-crossed by small canals connected to the tributaries of the river Subarnarekha at its confluence with the Bay of Bengal. A natural Mangrove cover consisting of *Sonneratia apatala*, *Exocaria agalocha* and *Acanthus* sp., is coming up on the south-west side of the village. As several types of habitats are found in this small area (2.5 km<sup>2</sup> only), different types of faunal composition are also found here with distinct zonation. There is no base line data regarding the intertidal macrofauna of this unique marine belt. This paper deals with a comprehensive list of the Intertidal Macrofauna of Talsari with a short note on habitat choice, zonation, status, threats and also with some recommendation for their conservation. The first author investigated the intertidal faunal resources of this area since 1995 to 2003. Till today a total of 90 species of intertidal macrofauna covering cnidarians, annelids, crabs, mollusks, lingulids, echinoderms, etc. are recorded from this area. All these species found to be under 71 genera, 48 Families, 23 Orders, 11 Classes and 7 Phyla. Among these, mollusc is dominated (55%) with a list of 49 species, whereas phylum-Echiurida and Brachiopoda represented here with a single species each only. According to habitat data, majority of the species found in Sandy beach (41%), whereas sandy beach with sufficient silt and muddy-habitat are preferred by 18% species each. Six percent of the total fauna are available in Mangrove forest as epifauna. Status of the specimens of Intertidal macrofauna also studied. Study also reveals that 36% species are recorded as very common, whereas 11% species are considered as rare in th

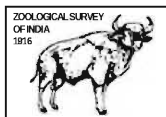
area. Some of the species are commercially exploited (19%) in large scale. Due to Anthropogenic activity, habitat loss and some other causes some species (14%) are threatened here also. As Talsari sea beach is very nearer to Digha beach (12 km), a very popular sea resort of West Bengal, a large number of tourists come here all the year round, of which a considerable number of students collect zoological specimens from the locality. These are some of the causes for declination of the beach faunal population. Beside this, the recent growing interest in aquacultural activities all along the east coast has introduced a new enthusiastic group among the fishermen and their daily activity destroy a good number of Invertebrates including their egg capsules, juveniles at the time of collecting the post larvae of tiger Shrimp (*Penaeus monodon*). Development of molluscan fisheries is playing also a negative role in case of Biodiversity conservation, because it depends here only on capture fishery. Very recently Govt. of Orissa constructed a Fishing Harbour, which may destroy in near future this unique ecologically diverse sea beach as well as its faunal resources.

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### ***Short Communication***

## **A SHORT NOTE ON REVISIONARY STUDIES OF INDIAN LANIATORES**

### **INTRODUCTION**

The class Arachnida is a unique group of Arthropoda differing from its nearest relatives like crustacea and insecta in lacking antennae and in having chelicerae and pedipalp. Of the twelve living orders of class Arachnida, the order Opiliones is the third largest group, representing about 4000 species, placed behind Aranae and Acari. It is among the four arachnid orders, which are distributed all over the world including the frigid regions.

The order Opiliones or Phalangida are commonly termed as harvestman. Their ancestors are found as before as carboniferous period, about 280–320 millions years before (Savory, 1977). These are average sized arachnids, with comparatively long legs. Prosoma dorsally covered by an unsegmented carapace. The two eyes are located near the front edge of carapace normally on an ocularium. The ocularium may be smooth, tuberculate or bear spines. Chelicerae are three segmented and chelate type, whereas pedipalps are six segmented and nonchelate, comparatively simple and leg like. The legs are seven segmented, tarsi with many segments. There is no pedicel. Phalangids are characterized by the presence of odoriferous glands in prosoma, above the 1<sup>st</sup> or 2<sup>nd</sup> coxa.

Phalangids occurs mostly in litters of forests, under stones, woods, barks of large trees and in caves. These are mostly nocturnal in habit and found abundantly during autumn.

The order Phalangida is broadly divided into two suborders, the Laniatores and the Palpatores. The suborder Laniatore is highly specialized and more numerous than Palpatores. They characteristically differ from Palpatores in having well developed, strong and well-armed palps with reflexable claws; 4<sup>th</sup> leg strong with broad coxae. In Laniatores the 3<sup>rd</sup> and 4<sup>th</sup> legs are with two or three tarsal claws, whereas Palpatores have single claw in all legs. The opening of the odoriferous glands present above the 2<sup>nd</sup> coxa in Laniatores and not above 1<sup>st</sup> coxa as in Palpatores. The opisthosoma of Laniatores with 8 tergites and 9 sternites, whereas Palpatores have 9 tergites and 9 sternites. The first five tergites of Laniatores fused together to form the scutum, which may

be smooth or armed with tubercles or spines. The genital operculum of Laniatore small and roughly triangular, whereas that of Palpatores comparatively large and elongated. The genital organs of laniatores also differ much from that of Palpatores.

The suborder Laniatore is represented with five families from India, out of the twelve known from all over the world. These are Assamiidae, Phalangodidae, Oncopodidae, Biantidae and Podoctidae. Among these the latter two previously had subfamily status under family Phalangodidae and have been raised to family level recently (Marten, 1977 and Suzuki, 1977). Assamiidae is the largest and widely distributed in India, on the other hand Oncopodidae represents only two genera, confined to North-eastern India.

Though the suborder is well distributed in India, very few works has been done on Indian Laniatores. Some of the taxonomic works were done by Thorell (1876), Soerensen (1884–1932), Simon (1879–1909), *etc.*, on Indian Phalangids. Recently J. Marten (1971–1999) has done some contribution on Phalangid fauna of Nepal Himalaya. It was Roewer (1910–1959) who has done some substantial works on Indian Phalangids. Roewer (1935) in his monumental work, “Die Weberknechte de Erde” has thrown light on Opiliones from entire Oriental region.

The works put forth by Roewer and other authors on Indian Laniatores comply to give about 93 known species belonging to 5 families and 64 genera. Roewer has deposited 46 para/lecto/cotypes in Indian Museum, Kolkata, 1 at Berlin, 18 at Geneva and 13 in his personal collections (place not known). Regarding the deposition of types of remaining species (about 15) seems to be not mentioned in the concerned literature.

After Roewer for many years the group remained almost ignored from India. Roewer’s work, though monumental, was confined to previous methods of taxonomy of Opiliones based only on external morphology and numerological characters such as tarsal joints, number and arrangement of spines, furrows, shape of organs and even colour. Such descriptive characters created ambiguity in proper identification of genera and species. To overcome such problems, the revisionary work is inevitable for full redescription and illustrations of important morphological characters along with the genitallial characters of male and female. Unfortunately after Roewer there was almost no contribution on this large group of Arachnids. Mrs. J.P. Despande (1987) has made some attempts to revise 40 species of the Indian Phalangids of suborder Palpatore for her Ph.D. thesis, submitted to BAMU, Aurangabad.

The suborder Laniatore remains unattended except the recent revisionary studies of five species belonging to family Assamiidae (D.B. Bastawade, 2002).

Thus it is emphatically essential to make revisionary studies of available 46 (para/lecto/cotypes) Laniatores species deposited in Indian Museum, Kolkata, so as to up date the studies of this widely spread group of Indian Phalangids.

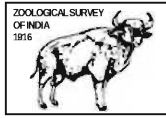
### ACKNOWLEDGEMENTS

Authors are greatly indebted to the Director, Zoological Survey of India, Kolkata and the Officers-in-Charge of Technical section, ZSI, Kolkata for allowing us to undertake the revisionary work on Indian Laniatores (Phalangids). We are also thankful to the Officer-in-Charge, ZSI, Western Regional Station, Pune for providing laboratory and library facilities and help.

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**Short Communication**

**NEW RECORD OF THE MONOTYPIC GENUS AND SPECIES OF *STYLARAEA* EDWARDS AND HAIME (SCLERACTINIA : PORITIDAE) FROM THE GULF OF MANNAR BIOSPHERE RESERVE**

Family Poritidae includes five genera viz., *Porites*, *Goniopora*, *Stylaraea*, *Alveopora* and *Poritopora*. Edwards and Haime (1851) first described the genus *Stylaraea*, which was synonymised with *Porites* in 1860. Later Klunzinger (1879) treated this as a separate genus. Veron and Pichon, (1982) described *Stylaraea* as the smallest of all scleractinian corals in the world, being not more than 15 mm in size. Genus *Stylaraea* is a monospecific genus (Veron, 2000). The present report deals with the new record of *Stylaraea punctata* from the Shingle Island of Gulf of Mannar Biosphere Reserve (GoMBR), Tamil Nadu.

**DESCRIPTION**

Phylum CNIDARIA

Class ANTHOZOA

Subclass ZOANTHARIA De Blainville, 1830

Order SCLERACTINIA Bourne, 1905

Family PORITIDAE Gray, 1842

Genus *Stylaraea* Edwards and Haime, 1851

The family Poritidae is colonial and hermatypic and are mostly extant. Colony formation is primarily by extra-tentacular budding. Corallites have porous walls of clearly differentiated synapticulae and trabeculae and corallites are closely compacted with little coenosteum. Among the five genera reported in the world, except *Stylaraea* and *Poritopora*, all the other genera are reported in India (Venkataraman *et al.*, 2003).

***Stylaraea punctata* (Linnaeus, 1758)**

(Figs. 1 &amp; 2)

1834. *Porites punctata* (Linnaeus) Ehrenberg. Phys. Abh. Konigl. Akad. Wissensch. Berlin aus d. Jahre 1832, p. 342.
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1983. *Porites punctata* (Klunzinger) Scheer and Pillai. *Zoologica*, p. 100.
2000. *Stylaraea punctata* (Linnaeus) Veron. *Australian Inst. of Mar. Sci.*, Australia, 3 : p. 346.

**Material :** During the coral reef status survey of GoMBR (January 2003), two colonies were collected in the intertidal reef flat from the Eastern part of the Shingle Island (lat. 9°14'39" N; long. 79°13'23" E) (Reg. No. ZSI/MBS-C/0011 & ZSI/MBS-C/0012 dt. 21.08.03), GoMBR by K.P. Raghuram, Marine Biological Station, Zoological Survey of India, Chennai.

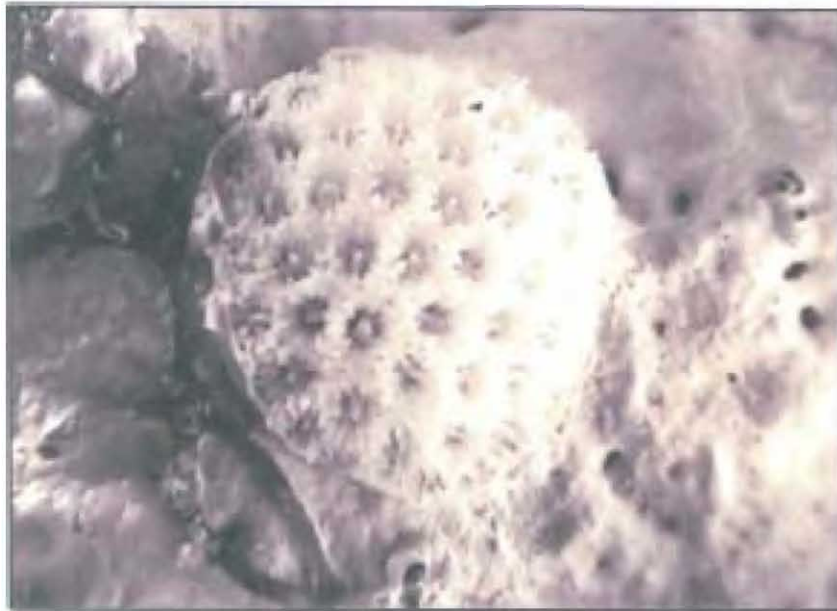
**Characters :** Colonies are encrusting and attached on the dead corals, and are more or less circular in shape. The size of two colonies is 7.01 and 9.14 mm in diameter respectively. Corallites are evenly arranged. Septa are in 2 cycles of 6 each (Fig. 2). Corallites are 1.26 mm in diameter. Calices are 0.6 mm in diameter (Fig. 1). The corallites are highly echinulate, walls are thick. Columella is style like in appearance, and lack in some corallites. The columella is 0.12 mm in diameter.

**Distribution :** The present species has so far been recorded from the Red Sea, Tulear, Aldabra, Moluccas and the Great Barrier Reef (Veron and Pichon, 1982). Scheer and Pillai (1983) recorded the present species only from the Red sea and it is a new record to India.

**Remarks :** The present species is collected from the Shingle Island, Gulf of Mannar. Though 15 families, including 60 genera are reported from India (Venkataraman, *et al.*, 2003), the genus *Stylaraea* has not been listed in this. The present report adds one more genus to the Indian fauna. It was found in the intertidal region where the dead corals were dominant. Colonies were collected from 1.5 m depth.

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**Fig. 1.** : *Stylaraea punctata* on a dead coral.



**Fig. 2.** : Enlarged view of *S. punctata* corallite.

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