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Dr. K. VENKATARAMAN
Director
Zoological Survey of India

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Dr. K. VENKATARAMAN
Director
Zoological Survey of India



STATISTICAL STUDIES AND ECOLOGY OF BENTHIC FORAMINIFERA FROM TAMILNADU COAST, INDIA

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INTRODUCTION

The foraminiferans are the most diverse phylum of meiofauna. Foraminifera are found in all marine environments. They may be planktic or benthic in mode of life. It has been estimated that the total number of foraminiferans species might be approximately 4000 living species of foraminifera. The present paper deals with the distribution and diversity of marine foraminiferans all over Tamilnadu Coast. Foraminiferal distribution has been reported by many workers. Foraminiferans were the most abundant group of meiofauna at the sampling sites. The number species per station ranged from 11 to 32.

MATERIAL AND METHODS

The sediment samples were collected from intertidal areas of Tamil Nadu coast during 2006 to 2007. Twelve stations were chosen for the present study from Chennai-1 Pondicherry-2, Cuddalore-3, Karaikal-4, Nagapattinam-5, Thondi-6, Thiruchendur-7, Tuticorin-8, Mandapam-9, Pamban -10, Rameswaram-11 and Kanyakumari along the Tamil Nadu Coast. Sediment samples were collected with a plastic cover (3 cm internal diameter) up to a depth of 15 cm. Sampling was made during low tide, mostly near the mid tide level. The samples were vertically subdivided into slices of 0-2, 2-4, 4-6, 6-10 and 10-15 cm depth. Meiobenthos was extracted from sediments by decanting with tap water and washing through a 500 mm sieve suspended above a 45-µm sieve (McIntyre, 1969). Animals were stored in 5% formaldehyde solution and coloured with Rose Bengal (0.1 g in 100 ml distilled water).



Fig. 1. Map showing the study area

HISTORY AND DISTRIBUTION OF FORAMINIFERANS

The recent reviews of Bhalla *et al.* (2007) and Khare *et al.* (2007) on foraminiferal studies in near shore regions of western and eastern coasts of India reveal that most of the studies are related to taxonomic and ecological aspects and palaeoenvironmental interpretations. A few studies have been undertaken along the eastern coast of India on applied aspects of Foraminifera. Taxonomic and ecological studies on foraminifera from west coast of India were carried out by some

Family: Textulariidae													
34	<i>Textularia cuneiformis</i>	+	-	-	-	-	-	-	-	-	+	-	-
35	<i>T. candiana</i>	-	-	-	-	-	-	-	-	-	-	-	+
36	<i>T. agglutinans</i>	-	+	-	+	-	-	-	+	-	+	-	+
Family: Miliolidae													
37	<i>Triloculina</i> sp.	+	+	+	+	+	+	+	+	+	+	+	+

Abundance of foraminiferans

The foraminiferan density ranged from 24 to 285 ind. 10 cm⁻², 72 to 220 ind. 10 cm⁻², 65 to 345 ind. 10 cm⁻², 20 to 210 ind. 10 cm⁻², 40 to 210 ind. 10 cm⁻², 90 to 190 ind. 10 cm⁻², 90 to 235 ind. 10 cm⁻², 15 to 140 ind. 10 cm⁻², 110 to 160 ind. 10 cm⁻², 90 to 240 ind. 10 cm⁻², 85 to 190 ind. 10 cm⁻², and 50 to 150 ind. 10 cm⁻², at stations 1-12 respectively during 2006.

Whereas during 2007, it was observed 24-151 no/10 cm², 90-175 no/10 cm², 45-180 no/10 cm², 50-330 no/10 cm², 5-90 no/10 cm², 80-395 no/10 cm², 120-495 no/10 cm², 20-70 no/10 cm², 90-155 no/10 cm², 90-290 no/10 cm², 40-180 no/10 cm² and 60-150 no/10 cm² at stations 1-12 respectively.

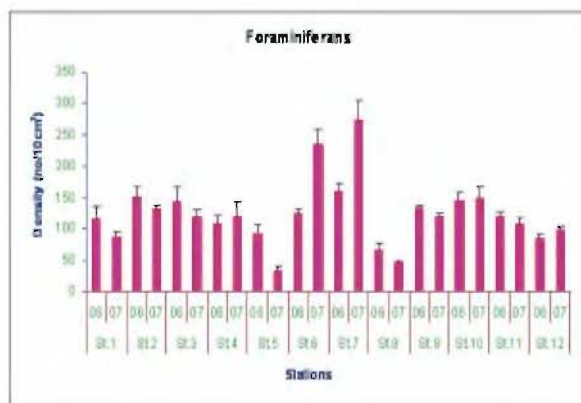


Fig. 2. MDS for foraminiferans of Tamil Nadu coast during 2006 and 2007.

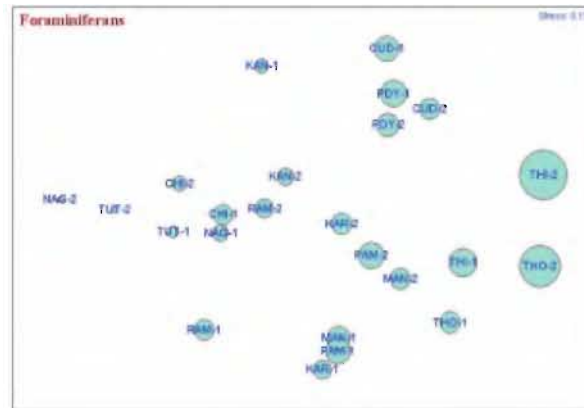


Fig. 3. MDS for foraminiferans of Tamil Nadu coast during 2006 and 2007.

Fig. 3. CHI-Chennai; PDY-Puducherry; CUD-Cuddalore; KAR-Karaikal; NAG-Nagapattinam; THO-Thondi; THI-Thiruchendur; TUT-Tuticorin; MAN-Manddapam; PAM-Pamban; RAM-Rameswaram; KAN-Kanyakumari; 1-2006; 2-2007

The mean density of foraminiferans ranged between 67 no/10 cm² and 160 no/10 cm² during 2006 and 32 no/10 cm² and 275 no/10 cm² during 2007. Highest densities of foraminifera were recorded at station 7 during 2006 and 2007 (Figs. 2 & 3), while lowest density was observed at stations 8 and 5 respectively during 2006 and 2007.

Species composition of foraminiferans

A total of 37 species belonging to 24 genera were identified. The number species per station ranged between 13 to 24. The foraminiferans were dominated by *Rosalina globularis* (0.63-3.39%), *Quinqueloculina bradyana* (0.5-3.38%), *Eponides repandus* (0.67-2.26%), *Rosalina agglutinans* (0.37-2.08%) and *Triloculina* sp. (0.27-1.51%) There was only seven species, which occurred in all the 12

stations. These are *Eponides repandus*, *Quinqueloculina bradyana*, *Rosalina globularis*, *Rosalina agglutinans*, *Rosalina bradyi*, *Spirillina limbata* and *Triloculina* sp. (Table 1). The species such as *America* sp., *Cibicides lobotulus*, *C. refulegens*, *Cyclammina* sp., *Rotalia pulchella*, *Elphidium* sp., *Globigerinita* sp., *Neoconorbina* sp., *Nonion depressulum*, *Oridosalis umbonatus*, *Planulina* sp., *Planorbullina* sp., *Q. laevigata*, *Q. agglutinans*, *Q. oblonga*, *Q. lamarkiana*, *Spirillina latseptata*, *Spiroloculina antillarum*, *Textularia cuneiformis*, *T. candiana* and *T. agglutinans* were observed occasionally.

Family composition of foraminiferans

A total of 21 families of foraminiferans were recorded. These were in order of their importance: Rosalinidae (1.89-6.23%), Hauerinidae (0.75-3.69%), Eponididae (0.67-2.26%), Rotaliidae (0.34-2.26%)

and Spirillinidae (0.3-2.38). Only 5 families could be characterized as very common at all the 12 stations. These are Eponididae, Hauerinidae, Rotaliidae, Spirillinidae and Miliolidae.

The families such as Soritidae, Cibicidae, Cyclamminidae, Elphididae, Vaginulinidae, Neoconorbinidae, Nonionidae, Heterolepidae and planulinidae were occurred sporadically.

Diversity indices of foraminiferans

The diversity indices were lowest at stations 9 (Mandapam) and 11 (Rameswaram), which can be considered as indications of the stress at these sites. At station 11 is situated very close to Rameswaram temple. At stations 1, 2 and 3 had higher values of diversity indices although it had very high density of foraminiferans. It must be also be stated the sediment here was fine sand. (Table-2)

Table 2. Shannon-Winner diversity index (H') and evenness of foraminiferans species at various stations of Tamil Nadu coast during 2006 and 2007.

Stations	S	N	D	J'	$H'(\log_2)$	1-Lambda'
1	20	116	3.997	0.9498	4.105	0.9402
2	24	152	4.578	0.9655	4.427	0.9547
3	22	144	4.226	0.9408	4.195	0.941
4	14	107	2.782	0.9743	3.71	0.9272
5	13	92	2.654	0.9489	3.512	0.9071
6	15	124	2.904	0.9558	3.734	0.9216
7	19	160	3.547	0.9416	4	0.9265
8	20	67	4.519	0.9616	4.156	0.9498
9	12	135	2.242	0.9577	3.433	0.9053
10	17	146	3.211	0.9158	3.743	0.91
11	13	119	2.511	0.9693	3.587	0.919
12	16	85	3.376	0.9622	3.849	0.9345

No significations difference between the meiofauna and stations could be demonstrated by

the ANOVA test at the $p > 0.05$ level (Table 23).

Table 3. One-way ANOVA of all species of foraminiferans and different stations.

Factor	SS	Df	Ms	F(cal)	P(F<=F(cal)	F(0.05)
A (Between Groups)	246.40	11	22.40	1.002	N.S. (P>0.05)	1.811
R(A) (Within Groups)	9654.81	432	22.35			
AR (Total)	9901.21	443				

The k -dominance curves for the foraminiferans species and stations show that in terms of dominance and diverse are similar (Fig. 4) The k -dominance curves were significant different from the stations. At stations 9 and 11 are the most highly dominated. Probably because at stations 11 situated very close to Rameswaram temple, which was highly disturbing by tourist. Whereas stations 2 and 3 are the more diverse. It must be also be stated that sediment here was fine sand. Thus the foraminiferal population and diversity are highest in very fine grained sediments, while density decrease coarser grained sediments. These findings also support the results of Shannon- Wiener diversity index (H') and MDS analysis. The differences between the other stations are less amenable interpretation as the curves cross (Fig. 4)

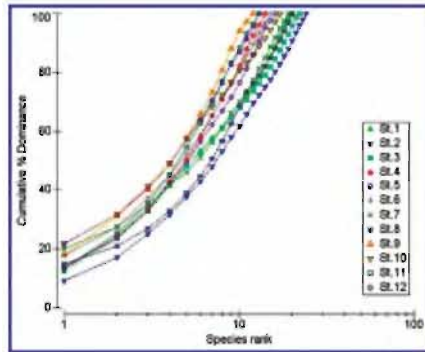


Fig. 4. Average k -dominance curves derived from foraminiferans species at all the 12 stations of Tamil Nadu coast.

Vertical distribution of foraminiferans

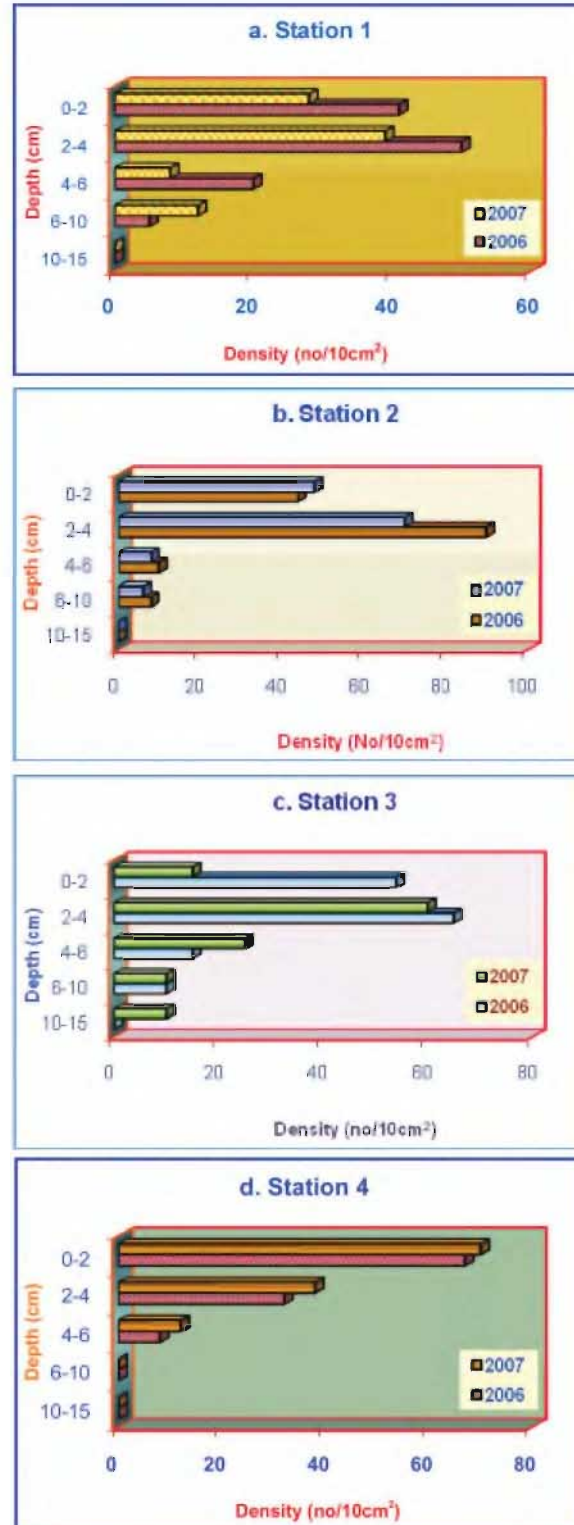
The upper layers of 0-2 cm (20-120 ind. 10 cm^{-2} ; 4-11% of the total meiofauna at this interval) and 2-4 cm interval (10-70 ind. 10 cm^{-2} ; 3-10% of the total meiofauna at this interval) show a high abundance of foraminiferans in muddy sediments (Fig. 30d, e, f, g, h, j & k) Whereas in sandy sediment, the maximum value of 90 ind. 10 cm^{-2} (9% of the total abundance) was recorded at 2-4 cm interval (Fig. 31a, b, c & 1)).

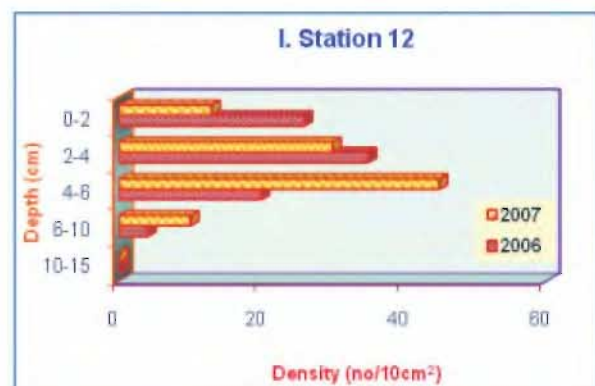
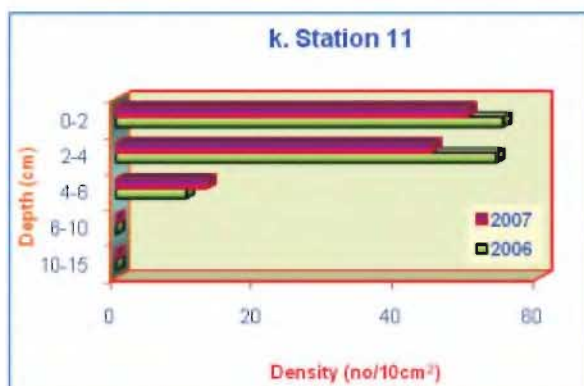
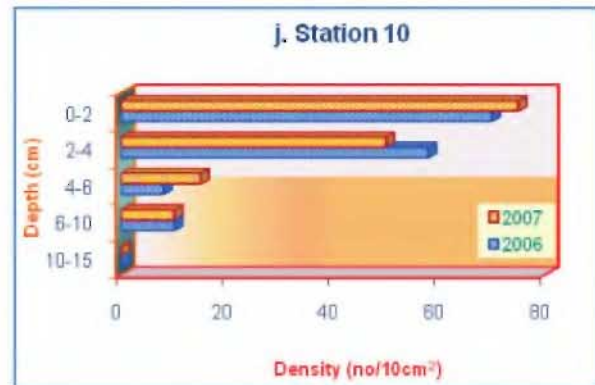
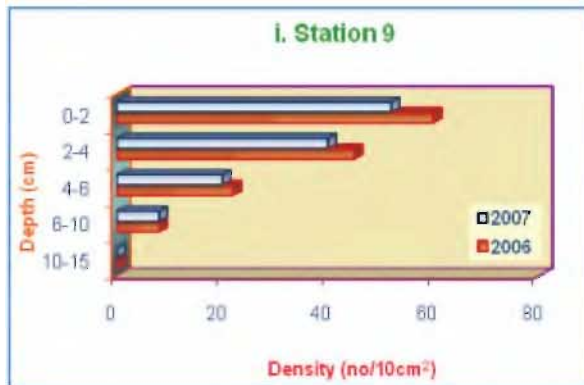
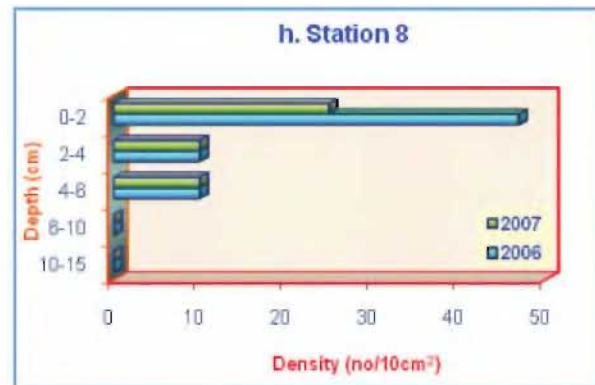
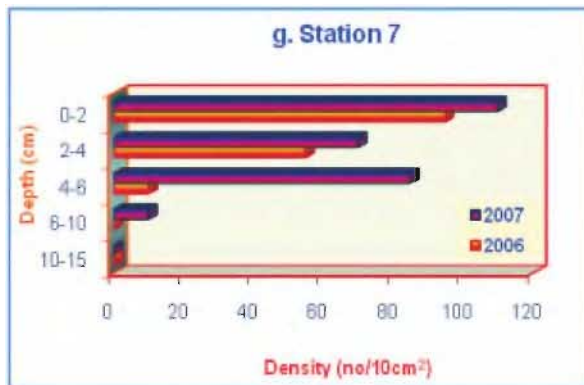
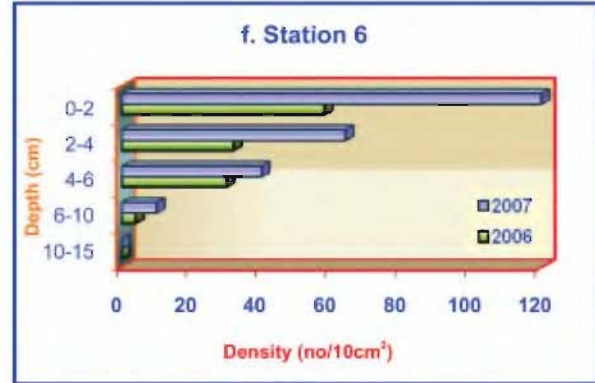
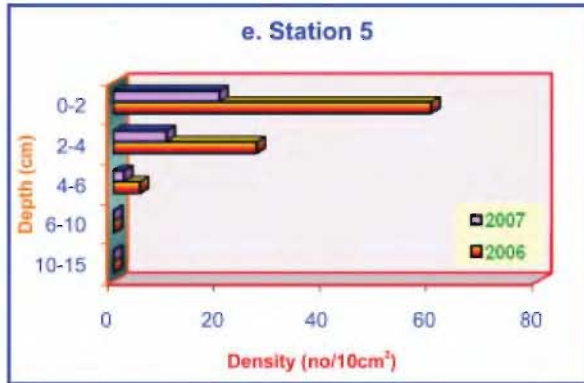
From 4-6 cm interval in sandy sediments, a minimum of 8 ind. 10 cm^{-2} and maximum of 45 ind. 10 cm^{-2} was recorded, whereas in muddy sediments range between 2-85 ind. 10 cm^{-2} was recorded.

The other depth intervals of sandy sediments had 4-12 ind. 10 cm^{-2} and 0-15 ind. 10 cm^{-2} at 6-10 cm and 10-15 cm intervals respectively. In muddy

sediments, it's range from 0 to 10 ind. 10 cm^{-2} at 6-10 cm interval. However, it was totally absent in 10-15 cm depth interval in muddy sediments.

Fig. 5. Vertical distribution of foraminiferans of Tamil Nadu coast at stations 1-12





Foraminiferans were most important among meiofauna, probably because all sampling sites situated in the marine environment had fine sand. Similar observation was made by Varshney *et al.* (1984) and Nigam and Chaturvedi (2000). It is well known that foraminiferans occur mostly under high saline conditions with few species penetrating into the estuarine conditions (Gooday, 1988).

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The author is highly thankful to Director, ZSI, Kolkata for support and facilities provided to carryout my Ph.D programme and for his excellent guidance and encouragement in Ph.D and also Officer-in-charge Dr. C. Venkatraman, Scientist-C and Officer-in-Charge MBRC/ZSI for his support.

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VARIATION OF MEIOFAUNA DURING DAY TIME FOLLOWING FULL MOON AND NEW MOON

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ABSTRACT

Aim of this research was to investigate meiofaunal movement patterns in day time at two stations in the polluted and unpolluted area in every three hours during full moon and new moon time during 2006 & 2007. Meiofauna was abundant in all samples, the animals are Harpacticoida, Nematoda, Oligochaeta, Tardigrada, Ostracoda etc.

(Adayar) stressed by sewage pollution and station 2 (Besant Nagar) a relatively unpolluted area (Tables 4 a,b). Meiofauna population in the two stations was composed of nematodes, harpacticoid copepods, foraminiferans, polychaetes, oligochaetes and ostracods.

The nematodes comprised 25-40% of the population at station 1 and 53-65% at station 2 (Fig. 1 a, b). Nematodes, copepods and foraminiferans formed more than 60% at station 1 and 80% at station 2, and small percentage was made up by communities of polychaetes and ostracods (Fig. 1 a, b).

INTRODUCTION

Meiofauna variation during sunlight period was studied at two stations namely station 1

Table 1a. Variation of meiofauna density at Adayar following New Moon (Station 1) during 2006 and 2007.

Fauna	Time intervals									
	6am		9am		12pm		3pm		6pm	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Nematodes	160	112	148	120	210	160	132	120	120	80
Copepods	40	34	35	48	42	25	30	35	25	12
Foraminiferans	15	40	87	59	75	30	60	44	35	18
Polychaetes	65	38	98	25	75	45	53	43	25	30
Oligochaetes	120	90	180	129	194	140	100	110	80	102
Ostracodes	5	10	38	12	93	14	42	18	15	10
Total	405	324	586	393	689	414	417	370	300	252

Table 1b. Variation of meiofauna density at Besant Nagar following Full Moon (Station 2) during 2006 and 2007.

Fauna	Time intervals									
	6am		9am		12pm		3pm		6pm	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Nematodes	220	350	210	378	350	410	310	390	250	250
Copepods	120	180	110	202	190	240	190	210	120	125
Foraminiferans	87	109	70	147	98	190	90	120	80	80
Polychaetes	25	50	20	50	25	98	30	44	20	40
Oligochaetes	15	20	10	12	10	15	12	22	10	15
Ostracodes	15	10	20	45	15	60	10	40	10	25
Total	482	719	440	834	688	1013	642	826	490	535

The mean density of meiofauna at station 1 was in the range of 300-689 n/10cm² and 252-414 n/10cm² during 2006 and 2007 respectively. At station 2, it was observed in the range of 440-688 n/10cm² and 535-1013 n/10cm² during 2006 and 2007 respectively. The nematode/Copepod-ratio (N/C-ratio) varied between 6:1 (station 1) and 2:1 (station 2). The wide range of N/C ratio was observed at station 1 (Adayar), probably due to pollution.

Fig. 1a. Mean percentage composition of meiofauna communities at Adayar and Besant Nagar 2006.

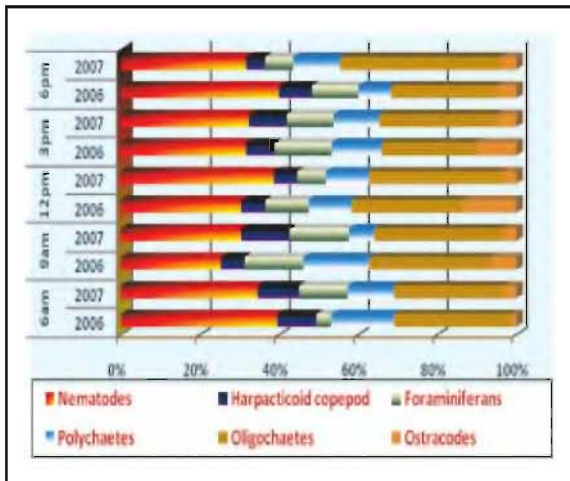
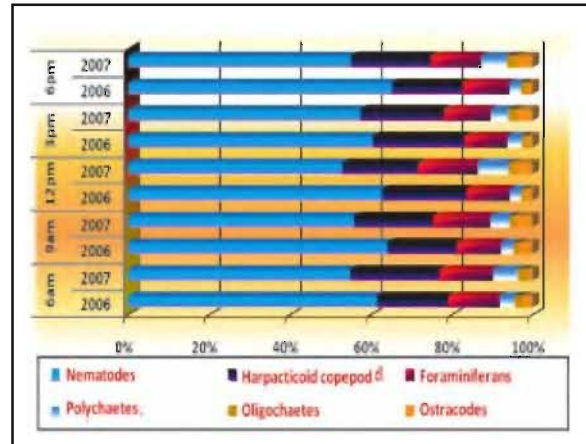


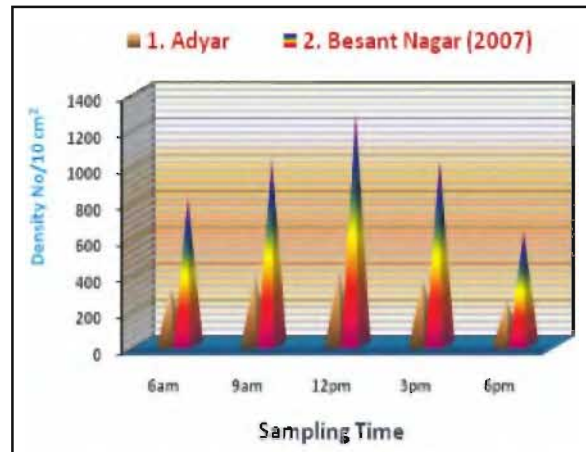
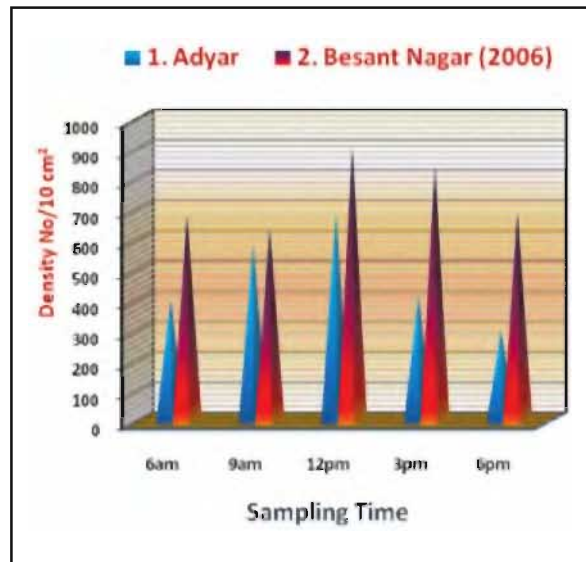
Fig. 1b. Mean percentage composition of meiofauna communities at Adayar and Besant Nagar 2007.



With respect to variation during sunlight period, meiofauna was at its peak during midday (12 noon), probably due to availability of food (Fig. 2). Midday peaks in meiofauna generally indicate consumption of microalgae, but the diel response varies among taxa and demographic groups. Co-variation of environmental factors may complicate interpretation of feeding patterns during sunlight periods.

The abundance of meiofaunal groups is known to be controlled by physical factors like temperature, grain size, salinity, wave action, beach slope, tidal action and capillary water and its action as well.

Fig. 2. Mean total density of meiofauna at Adayar and Besant Nagar during 2006 and 2007.



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The author is highly thankful to Director, ZSI, Kolkata for support and facilities provided to carryout my Ph.D programme and for his excellent guidance and encouragement in Ph.D and also thankful to Dr.C.Venkatraman Scientist-C and Officer-in-charge, MBRC/ZSI for his support.

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HOME RANGE COMPARISON OF MALE AND FEMALE GREY FRANCOLIN (*FRANCOLINUS PONDICERIANUS*) USING RADIOTELEMETRY.

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SUMMARY

Attempts were made to map species distribution to consider identification of appropriate surrogates (i.e. habitat features, food, climatic zones and various biotic factors). The use of sophisticated technologies, particularly Remote Sensing and GIS, has opened up a new paradigm in mapping spatial pattern of species distribution and wildlife habitat (Worah *et al.*, 1989, Buckland and Elston, 1993, Mladenoff *et al.*, 1995, Nagendra and Gadgil, 1999, Gough and Rushton, 2000). The present study was conducted in the district of Yamunanagar which lies between 30°24' N Latitude and 77°32' E longitude. Yamunanagar is situated in the state of Haryana in India and constitutes important habitats for grey francolins. The study area was centered at Yamuna Nagar along the Western Yamuna canal. Radiotelemetry was carried to obtain home ranges of male and female grey francolin. Trapping was done with trap and leg-hold traps fixed on thin rope. The francolins were fitted with backpack radio-transmitters weighing 5 gm. and released back. During the present study intensive radio tracking, about 296 sequential radiolocations were obtained for the grey francolins. Radio-locations were then plotted on classified habitat maps of study area during the Rabi and kharif cropping seasons and home ranges were estimated in hectares using the minimum convex polygon (MCP) and Kernel methods. During the present investigations the home range of male francolins were bigger than the female. The mean core area of home ranges, as determined by the Kernel

methods, of male Grey francolin was also bigger than that of female.

INTRODUCTION

The use of sophisticated technologies, particularly Remote Sensing and GIS, has opened up a new paradigm in mapping spatial pattern of species distribution and wildlife habitats (Worah *et al.*, 1989, Buckland and Elston, 1993, Mladenoff *et al.*, 1995, Nagendra and Gadgil, 1999, Gough and Rushton 2000). This is primarily because these tools are cost effective for the vast areas of landscape and help in establishing linkages between diverse potential correlates that affect the presence of species and consequently, enables modeling species distribution. The studies conducted so far in India have focused largely on image processing and visual interpretation of satellite data for vegetation characterization (e.g. Negi, 1980, Porwal and Pant, 1989, Pant and Roy, 1992, Singh, 1999, Sen, 2000, Uniyal, 2001), detecting changes in land cover or land use (Lal *et al.*, 1991, Pant and Kharakwal, 1995, Das *et al.*, 1996, Ghosh *et al.*, 1996, Awasthi, 2001) and preparation of wildlife habitat maps (Dutt *et al.*, 1986, Worah *et al.*, 1989, Porwal and Roy 1991, Roy *et al.*, 1995, Porwal *et al.*, 1996, Kushwaha 1997, Behera *et al.* 2000, Naithani 2000, Alfred *et al.*, 2001).

Preparation of distribution maps can range from a simple one, by connecting outer most points of location data to application of advanced mathematical functions such as prescriptive or probabilistic models (Bonham-Carter 1994, Lenton *et al.* 2000).

Availability of food resources, climatic conditions and biotic disturbances are highly variable in space and time. As a result, species distribution is generally aggregated in patches, thus exhibiting relative preference to such areas. Therefore, documentation of such patterns becomes a necessity in any basic research on the species and more significantly, it has conservation implication. The information generated through intensive field research on one or more species not only provide useful insight of their ecology, but also helps in generating spatial distribution maps, which could be used to address conservation issues both at the local and landscape levels.

Attempts to map species distribution would have to consider identification of appropriate surrogates (such as habitat features, food, climatic zones and various biotic factors). Though identification of 'appropriate surrogates' may be a relatively simple task, but it is often impossible to correctly measure all the factors involved. Also, some factors exert only a limited influence on the species and effects of several factors are unknown (Gough and Rushton 2000). It is also redundant to quantify each one of them, when there is scope to detect fewer surrogates that can potentially explain the species occurrence. Therefore, it becomes important to develop a model (a simplified representation of the relationship between species and, biotic and abiotic factors) using minimum possible variables that account for maximum influence on the species occurrence. The other important aspect or usefulness of the model is that it allows for extrapolation in both space and time (Starfield and Bleloch 1986).

STUDY AREA AND METHODOLOGY

The study was conducted in district Yamuna Nagar which lies between 30°24' N Latitude and 77°32' E longitude. Yamuna Nagar is situated in state of Haryana in India and constitutes important habitats for Grey francolins. The study area was centered at Yamuna Nagar along the Western Yamuna Canal. Radiotelemetry was carried to obtain home ranges of male and female Grey francolin.

Trapping of Grey francolins was done with nets and leg-hold traps fixed on thin rope. Observers closely monitored the traps from a distance of at

least 500 m. and trapped francolins were extracted immediately from the traps to prevent injury. The francolins were fitted with backpack radio-transmitters weighing 5 gm. and were released back in the same habitat where they were trapped. Radio-transmitters gives 138 to 174 Mhz signal at regular interval. A MARINER radio-telemetry receiver of 75 - 200 KHz frequency range was used to detect pulses emitted by transmitter. Radio-tracking was done with a three-element handheld YAGI Antenna. A MEGELLAN 12 - Channel GPS was used to obtain geographical co-ordinates of radio-tracked Grey francolins. Universal Transverse Mercator (UTM) co-ordinate system was used to record geographical co-ordinates.

For home-range analyses, point locations from radio-tracking data, taken at two-hour intervals during the daytime were used. The geographical co-ordinates at each point location of radio-tracked birds were recorded using a GPS receiver. The radio-locations were then plotted on classified habitat maps of the study area during the Rabi and Kharif cropping seasons and home ranges were estimated in hectares (ha) using the Minimum Convex Polygon (MCP) and Kernel methods.

For home-range analyses, ArcView 3.1 extension package "Animal Movement Analysis" was used. Models were run using the Universal Transverse Mercator (UTM) co-ordinate system. Two non-parametric methods, the Minimum Convex Polygon (MCP) method and Kernel method were used to estimate home-range sizes. 95% and 50% kernel contours were determined, and 50% interval was taken as the core area of home-range. The home-range sizes of the male and female Grey francolins were compared using Mann-Whitney test.

RESULTS

The MCP home ranges of the male was averaged 4.38 ha (Range = 3.50 - 5.26 ha), whereas, MCP home range of female Grey francolins was 4.11 ha (Range = 1.26 - 6.55 ha), (Table 1.). The kernel (95%) home ranges of the male and female Grey francolins averaged 5.25 ha (Range = 4.62 - 5.89 ha), and 5.80 ha (Range = 1.56 - 10.04 ha), respectively (Table 2). The kernel (50%) home ranges of the male and female Grey francolins averaged 0.82 ha (Range =

0.65 – 1.00 ha), and 0.66 ha (Range = 0.27 – 1.04 ha), respectively.

The mean home range of the male Grey francolin was bigger than that of the female (Table 1, Fig. 1)

but the difference was not significant (Mann-Whitney U test statistic [U] = 2, p = 1). The mean core area of home ranges, as determined by the kernel method, of the male Grey francolin was also bigger than that of the female.

Table 1. Mean home range estimates of radio-tracked Grey francolins using the minimum convex polygon and kernel methods.

	Home range estimate (Hectares)					
	MCP method		Kernel method			
			95%		50%	
Sex	Mean	S.E.	Mean	S.E.	Mean	S.E.
Male	4.38	0.88	5.25	0.64	0.82	0.18
Female	4.11	2.45	5.80	4.24	0.66	0.39

S.E. = Standard error of mean

DISCUSSION

Literature available on modeling species distribution in GIS reveals an increasing trend in such studies since 1990s, but largely on the associative category (e.g. Walker 1990, Buckland and Elston 1993, Carroll *et al.* 1999, Manel *et al.* 1999, Collingham *et al.* 2000, Franco *et al.* 2000, Lenton *et al.* 2000, Odom *et al.* 2001, Osborne *et al.* 2001). Difficulties in acquiring data on population responses compounded by lack of thorough knowledge on species biology and behaviour have perhaps resulted in a limited number of process-based models (Kareiva and Wennergren 1995, Wennergren *et al.* 1995, Lima and Zollner 1996, Allen *et al.* 2001). Nonetheless, the models based on associative approach can effectively depict and predict current pattern of distribution at varying scales and are no means inferior in planning and executing conservation actions. Home ranges of Grey partridge were variable and did not differ by season (Church and Porter 1990). Mean home ranges of female Grey partridge were smaller than males, and home ranges of birds in pairs with unsuccessful breeding were smaller than those of birds in a covey with young (Birkan *et al.* 1992). Birkan *et al.* (1992) measured home ranges of Grey partridge using Kernel analysis and analyzed that mean home ranges of female are smaller than males.

During intensive radio-tracking, 296 sequential radio-locations were obtained for the Grey francolins. The radio-locations were then plotted on classified habitat maps of the study area during the Rabi and Kharif cropping seasons and home ranges were estimated in hectares using the Minimum Convex Polygon and Kernel methods.

The mean home ranges of the male Grey francolins were bigger than that of the females. The mean core area of home ranges, as determined by the kernel method, of the male Grey francolin was also bigger than that of the female. As the female Grey francolin performs incubation activities, whereas male is not involved in any kind of incubation activity (Khan 1998). The role of female Grey francolin leads to the shrinkage of home range.

Prior knowledge on relationships between habitat features and presence/absence of animals would play a guiding role in mapping distribution. Rule-based models (an associative approach category) make effective use of such knowledge and determine the species distribution at least on a coarse scale by delineating area used/preferred by the species. When dealing with a large number of predictor variables, which is often the case, several multivariate statistics are helpful in removing redundancy that occur due to correlation within variables. Statistical methods such as

regression and discriminant function analysis have the ability to deal with such data sets and enable construction of mathematical functions for predicting spatial distributions. However, the logistic regression technique has been more popular in GIS based spatial analysis as it works on the basis of binomial distribution theory. Hence, it can effectively deal with presence/absence data (dichotomous response variable) to map and predict distribution (Trexler and Travis 1993, Menard 1995, Manel *et al.* 1999, de Vasconcelos *et al.* 2001). The

distribution predicted by these models is, however, not necessarily without bias as the probability of distribution in a given unit tends to be dependent upon the values at neighbouring units within a particular zone of influence (Legendre and Fortin 1989). The effect of neighbours in a spatial sense is generally referred to spatial autocorrelation and, it is important to investigate and incorporate such information while developing distribution models (Legendre 1993, Augustin *et al.* 1996, Gough and Rushton 2000).

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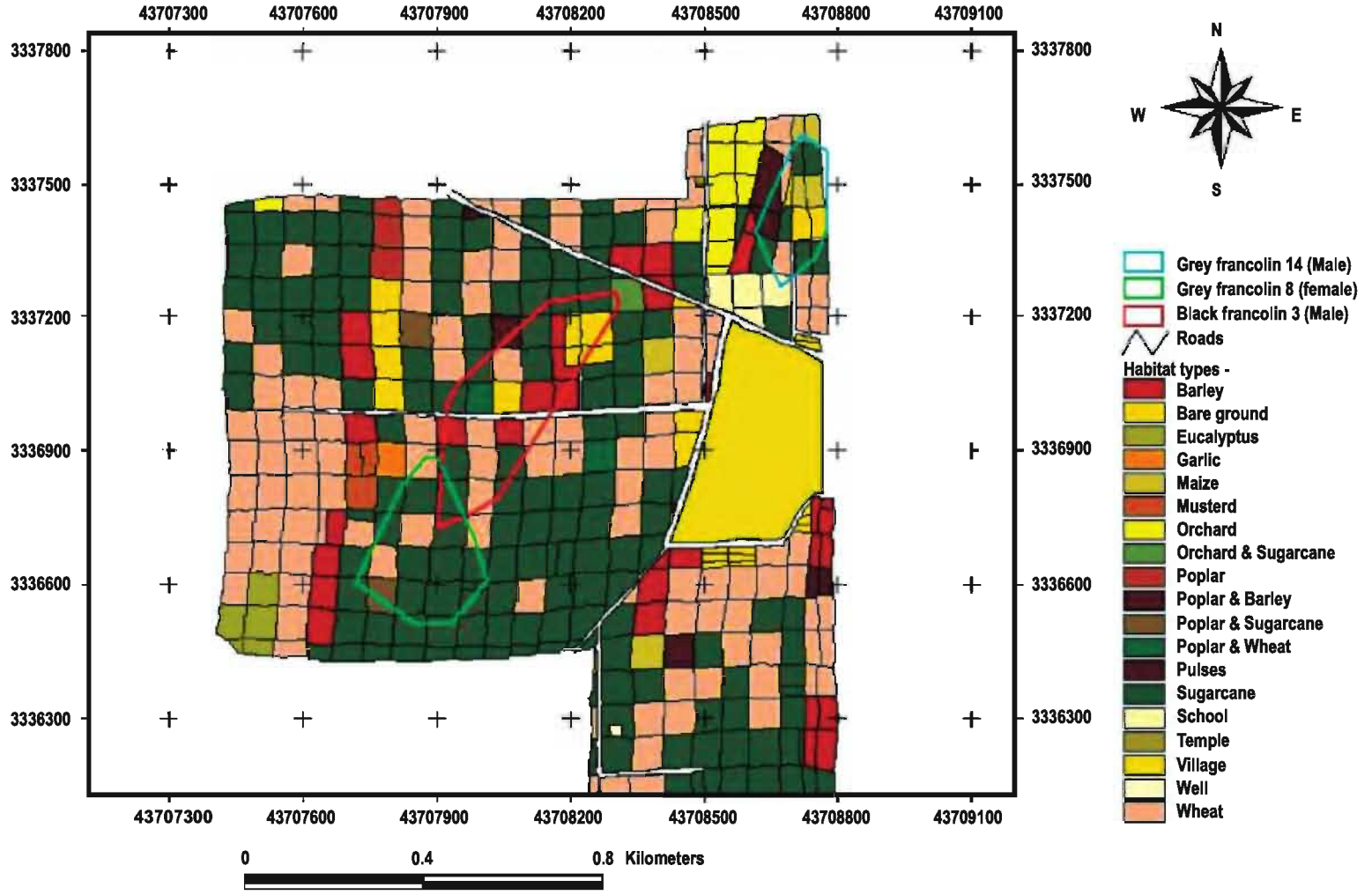


Fig. 1. Habitat map (Rabi season) with home ranges of Grey and Black francolins estimated by Minimum Convex Polygon (MCP) method.

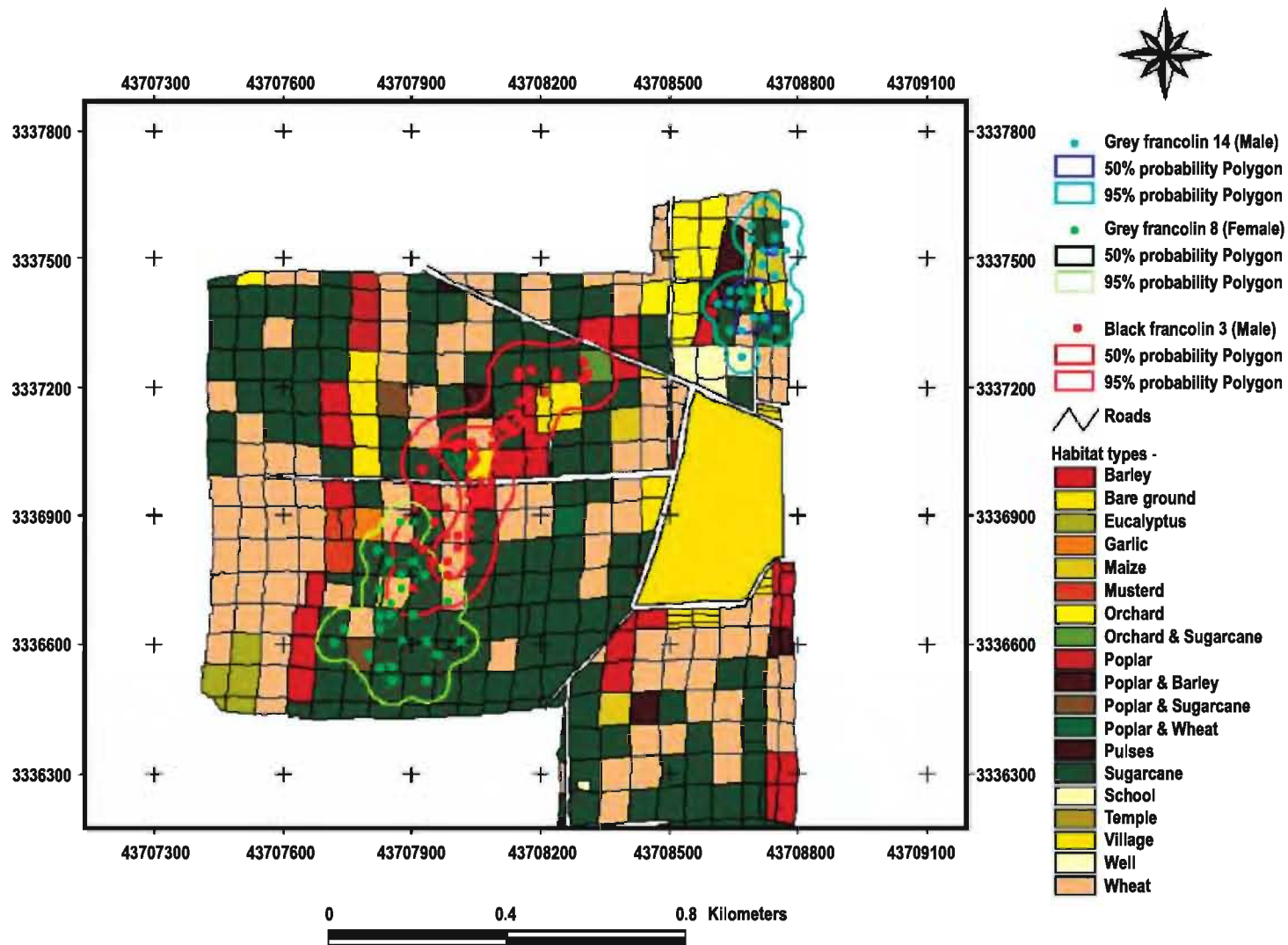


Fig. 2. Habitat map (Rabi season) with home ranges of Grey and Black francolins estimated by kernel method showing 50% and 95% probability polygons (dots indicate radio-locations).



STUDIES ON THE GENUS *LAGENONEMA* ANDRÁSSY, 1987 (NEMATODA: THORNENEMATIDAE)

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INTRODUCTON

The genus *Lagenonema* was established by Andrassy (1987) belonging to the subfamily Thornenematinae Siddiqi, 1969, family Thornenematidae Siddiqi, 1969 under the order Dorylaimida. He erected the genus by differentiating it from *Thornenema* Andrassy, 1959 in having abruptly narrowed, bottle-shaped anterior region, well sclerotized spatulate cephalic framework, ventrally concave spear and smaller amphids. Jairajpuri and Ahmad (1992) did not agree with him and noted that *Lagenonema* was close to *Thornenema*. Gantait, Bhattacharya and Chatterjee (2010) however agreed with Andrassy's opinion that *Lagenonema* is a well defined, distinct genus.

Andrassy (1987) established the genus to accommodate four species viz. *Lagenonema caudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andrassy, 1987, *L. longicaudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andrassy, 1987, *L. loofi* (Jairajpuri, Ahmad and Dhanachand, 1980) Andrassy, 1987 and *L. wickeni* (Yeates, 1970) Andrassy, 1987. He shifted these species from the genus *Thornenema*. At the same time he described *L. tropicum* Andrassy, 1987 from New Guinea. He also provided a species key of the genus. Gantait, Bhattacharya and Chatterjee (2010) described *L. thornei* from west Bengal, India. We want to add *Thornenema spicatum* Shaheen and Ahmad, 2005 to this genus. Presently the genus possesses seven species globally. A compendium of these seven species and a revised species key of the genus are being provided hereunder.

SYSTEMATIC POSITION

- Class NEMATODA
- Subclass ADENOPHOREA (Von Linstow, 1905) Chitwood, 1958
- Order DORYLAIMIDA (De man, 1876) Pearse, 1942
- Suborder DORYLAIMINA (De man, 1876) Pearse, 1942
- Superfamily DORYLAIMOIDEA (De man, 1876) Thorne, 1934
- Family THORNENEMATIDAE Siddiqi, 1969
- Subfamily THORNENEMATINAE Siddiqi, 1969

Genus *Lagenonema* Andrassy, 1987

Diagnosis : *Lagenonema* comprises of small-sized nematodes, body 0.6-0.9 mm long. Cuticle smooth or very finely striated. Anterior end of body bottle-shaped, abruptly narrowing to a cylindroid truncate head. Lip region about half of adjacent body width; lips amalgamated. Labial framework well sclerotized, spatulate. Amphids small, $1/4^{\text{th}}$ - $1/3^{\text{rd}}$ of corresponding body width. Odontostylet straight, slightly concave distally on its ventral side; 9-15 μm long, about 1.5-2.0 times as long as cephalic diameter. Stylet aperture small, occupying about $1/5^{\text{th}}$ - $1/4^{\text{th}}$ of stylet length. Guiding ring thin. Oesophagus expands at 55-65% of its length. Female reproductive system mono-opisthodelphic. Vulva pre-equatorial or equatorial, at 33-52% of body.

Key words : Nematode, Dorylaimida, *Lagenonema*, compendium, species key.

Tail 3-15 anal diameters long; tapering gradually to the finely rounded tip, or first hemispheroid then digitate to filiform. Male unknown in all the species of the genus.

Relationship : The genus *Lagenonema* is related to the genus *Thornenema* Andr ssy, 1959. But it differs from that in the abruptly narrowed, bottle-shaped anterior region, the well sclerotized spatulate cephalic framework, ventrally concave spear and the smaller amphids. Besides, all the species of the genus *Lagenonema* are monosexual whilst the *Thornenema* species are bisexual.

Type species : *Lagenonema caudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andr ssy, 1987.

Synonym : *Thornenema caudatum* Jairajpuri, Ahmad and Dhanachand, 1979.

Other species : *L. longicaudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andr ssy, 1987, *Thornenema longicaudatum* Jairajpuri, Ahmad and Dhanachand, 1979

L. loofi (Jairajpuri, Ahmad and Dhanachand, 1980) Andr ssy, 1987 *Thornenema loofi* Jairajpuri, Ahmad and Dhanachand, 1980.

L. spicatum (Shaheen and Ahmad, 2005) comb. n. *Thornenema spicatum* Shaheen and Ahmad, 2005.

L. thornei Gantait, Bhattacharya and Chatterjee, 2010.

L. tropicum Andr ssy, 1987.

L. wickeni (Yeates, 1970) Andr ssy, 1987 *Thornenema wickeni* Yeates, 1970.

DISCUSSION

At the time of establishment of the genus *Lagenonema*, Andr ssy (1987) shifted four species viz. *Thornenema caudatum*, *T. longicaudatum*, *T. loofi* and *T. wickeni* to this genus. *T. wickeni* was described by Yeates (1970) from Wicken, Fen, Cambridgeshire, England. He collected the holotype female from 'mixed fen' and paratypes (46 female and 38 juveniles) from sites in sedge (*Cladium mariscus* Pohl.) bed, alder buckthorn (*Frangula alnus* Mill.) carr and buckthorn (*Rhamnus catbarticus* L.) carr. The species is characterized in having almost straight, cylindrical body, tapering over about three body widths anteriorly and from beginning of prerectum posteriorly. Cuticle smooth, thick

opposite to spear base. Lip region rounded, amalgamated and distinctly narrower than adjacent body, about one-fifth as wide as body at base of oesophagus. Odontostyle basically cylindroid, its aperture about one-third of its length. Odontophore as long as odontostyle. Guiding ring appeared fine and simple. Slender part of oesophagus slightly constricted posterior to spear extensions and at nerve ring. Basal expanded part of oesophagus occupied 37- 44% of total oesophageal length. Oesophago-intestinal vulve globular. Vulval opening transverse, vaginal opening cross-like; no sclerotization in vulval region. Gonad opisthodelphic. Prerectum about two and a half anal body widths long. Rectum about one anal body width long. Tail elongate-conoid with a rounded lip in most specimens. Carbonell and Coomans (1986) redescribed the species from Maraou , Ivory Coast from grass savanna. Despite some differences in measurements their specimens are considered conspecific with the type populations of Yeates (1970).

T. caudatum and *T. longicaudatum* were described by Jairajpuri *et al.* (1979) from Imphal of Manipur state, India. The specimens were collected from soil around roots of unidentified wild flowering plants. *T. caudatum* has almost straight body, tapering towards both the extremities. Cuticle finely striated. At base of lip region the cuticle suddenly thickens and then becomes thinner at level of base of odontophore. A little above the anus it again gradually starts to become thicker and remains so in the anterior one-third of tail length. Lip region amalgamated, strongly sclerotized, very narrow, about one-fourth of body width as base of oesophagus. Odontostyle cylindroid, about two head-widths long; its aperture about one-fourth of its length. Odontophore equal to spear length. Guiding ring appeared fine and simple. Basal expanded part of oesophagus occupied 35-38% of total oesophageal length. Vulva a transverse slit. Vagina thick walled, about one-half of body-width long. Gonad opisthodelphic, reflexed. Pre-vulval uterine sac almost absent. Prerectum 1.5-2.3 anal body widths long. Rectum about one anal body width long. Tail long, two parts; the first part hemispheroid and covered with very thick cuticle, the second part elongate filiform with a rounded terminus. Sauer

(1981) redescribed the species from Gemas, Malaysia, collected from paddy soil. Carbonell and Coomans (1986) also redescribed the species based on two paratypes, deposited in the nematode collection of the Instituut voor Dierkunde, Gent, Belgium, by Jairajpuri *et al.* (1979). Carbonell and Coomans (1986) found two principal differences with respect to the original description (Jairajpuri *et al.*, 1979): (a) smaller amphidial aperture, about two thirds of the fovea width, already noted by Sauer (1981); (b) different position of the pharyngeal gland nuclei and outlets.

T. longicaudatum has ventrally curved body, tapering towards both the extremities. Cuticle finely striated. At base of lip region the cuticle suddenly expands and then becomes thinner at level of base of odontophore. Lip region amalgamated, strongly sclerotized, very narrow, about $1/6^{\text{th}}$ - $1/5^{\text{th}}$ of body-width as base of oesophagus. Odontostyle cylindroid, about two head-widths long; its aperture about one-fifth of its length. Odontophore nearly equal to spear length. Basal expanded part of oesophagus occupied 40-45% of total oesophageal length. Vulva a transverse slit. Vagina thick walled, about one-half of body-width long. Gonad opisthodelphic, reflexed. Preuvulval uterine sac almost absent. Prerectum 1.5-2.5 anal body widths long. Rectum 1.2-1.6 anal body widths long. Tail long filiform with rounded terminus. Sauer (1981) redescribed the species from Bachok, Malaysia, collected from tobacco field. Carbonell and Coomans (1986) also redescribed the species based on one paratype, deposited in the nematode collection of the Instituut voor Dierkunde, Gent, Belgium, by Jairajpuri *et al.* (1979). Carbonell and Coomans (1986) observed the specimen differs from the original description (Jairajpuri *et al.*, 1979) in amphidial shape, position of pharyngeal gland nuclei and a distinct sphincter between uterus and oviduct.

Jairajpuri *et al.* (1980) opined that the description of *T. thienemanni* by Jairajpuri (1966) is no longer conspecific with *Dorylaimus* (= *Thornenema* now *Dorylaimoides*) *thienemanni* Schneider, 1937. Accordingly, a new name has to be proposed by them for *T. thienemanni* apud Jairajpuri, 1966. Jairajpuri *et al.* (1980) designated it as *T. loofi* and described as new species. The species is characterized in having ventrally curved body,

tapering towards both the extremities. Cuticle finely striated. Lip region amalgamated, strongly sclerotized, very narrow, about $1/5^{\text{th}}$ of body-width as base of oesophagus. Odontostyle cylindroid, about two head-widths long; its aperture about one-fourth of its length. Odontophore about 1.5 times the odontostyle length. Basal expanded part of oesophagus occupied 45% of total oesophageal length. Cardia tongue shaped. Vulva a transverse slit. Vagina thick walled, about one-half of body-width long. Gonad opisthodelphic. Prerectum 1.5-2.0 anal body widths long. Rectum 1.2-1.5 anal body widths long. Tail long, gradually tapering with rounded terminus. Carbonell and Coomans (1986) also redescribed the species based on a population, collected from Maraoué, Ivory Coast from grass savanna. They observed that the specimens differed in body length and vulval position from the type population described by Jairajpuri (1966). Since then they also studied three females, collected from soil, near the bank of the Mayel Sao river, Ouro Haousas, Cameroon and found that the measurements of the specimens are closer to those of the type population (Jairajpuri, 1966). Both Ivory Coast and Cameroon populations studied, differ in amphid shape from that description by Jairajpuri (1966).

Andrásy (1987) described *L. tropicum* (holotype female; two female and a juvenile paratypes) from Gogol River, Papua New Guinea, humus from a primary rain forest. The species is characterized in having ventrally curved body, tapering towards both the extremities. Cuticle smooth. Head very narrow, 4.5-5.0 μm , about half as wide as adjacent body. Lips amalgamated. Labial frame work and collare sclerotized. Spear almost twice the head diameters; its aperture about one-fourth of its length. Guiding ring very thin. Basal expanded part of oesophagus occupied 64-65% of total oesophageal length. Cardia short, tongue shaped. Vulva a transverse slit, not sclerotized. Vagina piriform, slightly directed backward. Gonad mono-opisthodelphic. Anterior uterine sac practically absent. Rectum as long as prerectum, 1.0-1.6 times longer than anal body diameter. Tail 4 anal body diameters long, first rounded then elongate-digitiform with finely rounded terminus. Andrásy (1987) opined that the species of Coomans and Carbonell (1981) described as *Thornenema loofi* from the Ivory Coast agrees very well with *L. tropicum*.

Table 1. Measurements and diagnostic features of *Lagenonema* species (all measurements in μm ; except L in mm)

Morphometric chracters	<i>L. caudatum</i> n = 17 ♀♀	<i>L. longicaudatum</i> n = 12 ♀♀	<i>L. loofi</i> n = 11 ♀♀	<i>L. thornei</i> n = 11 ♀♀
L	0.60-0.89	0.67-0.75	0.60-0.70	1.48-1.55
a	22-31	26-31	20-26	39.5-39.8
b	3.5-4.5	4.3-4.7	4.0-4.6	5.0-5.2
c	8-10	3-4	6-8	7.7-7.9
c'	3-4	13-15	5-6	9.1-9.2
V	44-52	33-41	32-38	33.1-34.4
G2	12-18	11-15	14-15	10.8-12.0
Odontostyle length	13-15	10-11	9	16.9-17.9
Odontophore length	13-17	12-13	11-13	23.4-24.4
Guiding ring from ant. end	7	6-7		9.1-9.6
Nerve ring from ant. end		60-65		119.7-121.4
Basal expanded part of oesophagus	70-75	75-80	46-50	137.1-142.1
Vulva from ant. end	385-395	275-285	215-235	491.3-520.7
Prerectum	30-35	22-40	27-32	44.7-47.7
Rectum	20-28	18-22	19-20	20.8-21.4
Tail length	78-94	175-225	72-86	191.7-196.4

Continued to Table 1

Morphometric chracters	<i>L. spicatum</i> n = 3 ♀♀	<i>L. tropicum</i> n = 3 ♀♀	<i>L. wickeni</i> n = 36 ♀♀
L	0.61-0.68	0.57-0.59	0.78-0.96
a	24-32	21-23	25-36
b	3.9-4.2	4.0-4.1	4.1-4.7
c	15-18	7.6-8.3	4.8-7.8
c'	1.92-1.95	4	6.3-8.9
V	43-45	40-41	39-44
G2	10.5-11.5	11-12	19-40
Odontostyle length	8.0-8.5	8	9-12
Odontophore length	10.5-11.0	10-11	9.5-13.0
Guiding ring from ant. end	5.8	6	8
Nerve ring from ant. end	72-73	68-70	85-90
Basal expanded part of oesophagus	60-68	62-64	70-73
Vulva from ant. end	276-296	271-284	298-311
Prerectum	48-52	22-32	52-56
Rectum	24-25	19-26	29-32
Tail length	34-43	70-77	121-143

Shaheen and Ahmad (2005) described *Thornenema spicatum* from soil around roots of forest trees from Haflong, North Cachar Hill, Assam State, India. The species is characterized by having small sized body (L=0.6 mm); abruptly narrowed, bottle-shaped anterior region; amalgamated lips; genital system mono-opisthodelphic with anterior uterine sac less than one anal body width long and spicate tail. In the characteristic shape of lip region the species closely resembles to the species of the genus *Lagenonema*. Thus we shifted the species from the genus *Thornenema* to *Lagenonema*, and described as *L. spicatum*. Besides the above characteristics, the other important characters of the species are slightly curved ventrad body upon fixation; cuticle with fine transverse striations; amphids with cup-shaped fovea and slit-like aperture; spear 1.8-2.0 times the lip region width long with its aperture about one-third of its length; guiding ring single; odontophore 1.2-1.5 times the spear length; cardia dome-shaped; vulva a transverse slit, not sclerotized; prerectum and rectum 2.4-2.9 and 1.2 anal body widths long respectively; tail hemispheroid then spicate, terminus rounded.

L. thornei was described by Gantait *et al.* (2010) from Paschim Medinipur district of West Bengal, India, collected from rhizospheric soil of banana cv. Kanthali. The species is characterized in having ventrally curved body mainly at posterior region, tapering towards both the extremities. Cuticle with fine transverse striations. Lip region amalgamated, narrow and cylindroids-truncated in shape. Labial 1 framework strongly sclerotized. Odontostyle 2.5-2.7 times the lip region width long, its aperture about 1/4th-1/3th of its length. Guiding ring single. Basal expanded part of oesophagus occupied 46-48% of total oesophageal length. Cardia tongue-shaped. Vulva a transverse slit. Vagina thick-walled. Gonad mono-opisthodelphic. Preovulval uterine sac short (3.5 μ m). Prerectum 2.0-2.5 times anal body width long. Rectum as long as anal body diameter. Tail long, filiform with subacute terminus, about 9 times anal body width long.

We can conclude that the genus *Lagenonema* Andrassy, 1987 is a well defined and distinct genus. It possesses seven species globally *viz.* *L. caudatum* (Jairajpuri, Ahmad and Dhanachand, 1979) Andrassy, 1987, *L. longicaudatum* (Jairajpuri, Ahmad

and Dhanachand, 1979) Andrassy, 1987, *L. loofi* (Jairajpuri, Ahmad and Dhanachand, 1980) Andrassy, 1987, *L. spicatum* Shaheen and Ahmad, 2005, *L. thornei* Gantait, Bhattacharya and Chatterjee, 2010, *L. tropicum* Andrassy, 1987 and *L. wickeni* (Yeates, 1970) Andrassy, 1987.

Key to species of *Lagenonema*

(Based on female; male unknown in all the species)

1. Tail long, filiform, 13-15 times as long as anal body width.....2
 - Tail shorter, 3-9 times as long as anal body width 3
2. Body 0.67-0.75 mm long; a= 26 -31; b= 4.3-4.7; c= 3- 4; c'= 13-15; odontostyle = 10-11 μ m; odontophore=12-13 μ m
 -*longicaudatum* (Jairajpuri, Ahmad & Dhanachand, 1979) Andrassy, 1987
 - Body 1.48-1.55 mm long; a = 39.52-39.86; b = 5.07-5.27; c = 7.72-7.93; c' = 9.20-9.23; odontostyle= 16.92-17.96; odontophore= 23.46-24.44*thornei* Gantait *et al.*, 2010
3. Tail in two parts: anterior portion hemispheroid and posterior portion digitate or spicate, suddenly narrowing about one anal body width behind anus4
 - Tail not so abruptly tapering between its anterior and posterior part5
4. Body 0.60-0.89 mm long; c= 8-10; c'= 3-4; V= 44-52; odontostyle= 13-15 μ m; Odontophore =13-17 μ m; tail= 78-94 μ m.....
 - *caudatum* (Jairajpuri, Ahmad & Dhanachand, 1979) Andrassy, 1987
 - Body 0.61- 0.68 mm long; c = 15-18; c' = 1.92-1.95; V = 43-45; odontostyle = 8.0-8.5 μ m; odontophore= 10.5-11.0 μ m; tail= 34-43 μ m.....*spicatum* Shaheen & Ahmad, 2005
5. Body 0.8-0.9 mm long; tail 6-9 times anal body width long; c'= 6.5-9
 - *wickeni* (Yeates, 1970) Andrassy, 1987
 - Body 0.6-0.7 mm long; tail 4-6 times anal body width long; c'= 4-6 6
6. Cuticle conspicuously thickened behind spear; oesophagus gradually enlarged; L= 0.6-0.7

- mm; a = 24-26; b = 4.1-4.3; V = 32-38; c' = 5-6
 *loofi* (Jairajpuri,
 Ahmad & Dhanachand, 1980) Andrassy, 1987
- Cuticle not thickened behind spear; oesophagus
 abruptly enlarged; L= 0.57-0.59; a= 21-23; b=
 4.0-4.1; V= 40-41; c'= 4
*tropicum* Andrassy, 1987

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NEW RECORDS OF TWO SPECIES OF FAMILY ARCTIIDAE (LEPIDOPTERA) FROM WESTERN GHATS OF INDIA

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INTRODUCTION

Majority of the arctiid moths can be studied under two subfamilies i.e., Arctiinae and Lithosiinae and the members of this group are of much economic importance. They can be identified from the meta thoracic tymbal organ, a pre-spiracular counter tympanal hood and a pair of pheromonal glands between the ovipositor lobes. Arctiid moths are an integral and complex part of our ecosystem and play a vital role in its functioning. Therefore, knowledge about the distributional limits and ecological relationship of these insects is a practical necessity. Recently Kirti *et al.*, 2010, reported *Cyclomilta melanolepia* (Dudgeon) for the first time from Western Ghats of India. In this manuscript two more species i.e. *Pseudoblabe oophora* Zeller and *Micraloa lineola* (Fabricius) have been included which were collected for the first time from Western Ghats of India. Before this, these species were never been reported from the western ghats of India. The collections were made with the help of light traps during night time and the collected samples were treated and preserved as per techniques in lepidopterology. Identification was done with the help of relevant literature (Hampson 1894, 1901). The identification was also confirmed by comparison of the species under reference with the identified collections of Natural History Museum (NHM), London, personally by the first author.

OBSERVATIONS

Pseudoblabe oophora Zeller

Pseudoblabe oophora Zeller, 1853, *Bull. Soc. Nat. Moscou*, 26(2) : 514.

Old distribution: India: Assam, central India; Sri Lanka, Myanmar and Java.

MATERIAL EXAMINED

Karnataka : Ganeshgudi (480mtrs.), 15.xi.03 – 2 m, 14.x.05 – 1 m; Bhagamandala (900mtrs.), 24.xi.03 – 1 m; Medikeri (1100mtrs.), 13.xi.05 – 1 f.

Kerala : Vallakadava (780mtrs.), 9.ix.04 – 3 m 1 f; Vadasserikkara (30mtrs.), 7.ix.04 – 2 m 1 f. (Coll. Singh, N.)

Taxonomic note: Genus *Pseudoblabe* was proposed by Zeller in 1853 on the type species *oophora* Zeller from Java. The external male and female genitalia of the species under reference was studied by Holloway (2001). Species *oophora* Zeller can easily be identified from the general ground colour ochreous. Fore wing with a large brown patch covering whole of the middle and inner region. Hind wing with an androgonial patch. In the present studies a total number of 12 representatives of the species under reference were collected from Western Ghats of India.

Micraloa lineola (Fabricius)

Bombyx lineola Fabricius, 1793, *Ent. Syst.*, 3 (1) : 465.

Old distribution : India: Jammu and Kashmir, North-West Himalayas, Punjab and West Bengal.

*Pseudoblabe oophora* Zeller*Micraloa lineola* (Fabricius)**MATERIAL EXAMINED**

Gujarat : Waghai (180mtrs.), 27.ix.05 – 2 m 1 f;
Ahwa (520mtrs.), 28.ix.05 – 8 m; Saputara (970mtrs.),
29.ix.05 – 1m 1 f.

Maharashtra : Malshej Ghat (690mtrs.), 1.x.05 –
1 f.

Karnataka : Ganeshgudi (480mtrs.), 20.vii.04 –
2 m, 21.vii.04 – 1 f.

Kerala : Agali (520mtrs.), 6.x.03 1 m. (Coll. Singh,
N.)

Taxonomic note : The species was dealt in detail
by Dubatolov (2004), in which the author has
provided a stable status to *lineola* (Fabricius) by
shifting it under a newly proposed genus *Micraloa*
Dubatolov, 2004.

SUMMARY

The present communication deals with the first
time record of two species i.e. *Pseudoblabe oophora*
Zeller and *Micraloa lineola* (Fabricius) from Western
Ghats of India.

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STUDY ON CORAL BLEACHING (2010) IN MIDDLE ANDAMAN, ANDAMAN AND NICOBAR ISLANDS

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INTRODUCTION

Coral reefs are the most diverse marine habitat, and support an estimated 0.5 million species globally (Splading *et al.* 2001). They are among the most sensitive of all ecosystems to temperature changes, exhibiting bleaching when stressed by higher than normal sea temperatures (Jokiel *et al.* 1977). The dinoflagellates algae called Zooxanthellae lives in the endodermal cells of the Corals. The zooxanthellae provide the coral with large quantities of organic materials, especially high calorific value lipids and carbohydrates which are believed to provide most of the energy for maintenance, tissue and skeletal growth, and possibly reproduction (Veron, 1986; Brown and Ogden, 1993; Meehan and Ostrander, 1997). Coral bleaching refers to the loss of the zooxanthellae by the host (i.e. the coral), or the loss of photosynthetic pigments within the alga itself, which makes the coral transparent. Consequently, coral colony appears white due to the underlying skeleton. The phenomenon of coral bleaching affecting extensive reef areas across the Pacific was first described by Glynn in 1984. A coral bleaching event may be evoked by various environmental factors, such as higher than normal sea temperatures (Glynn *et al.*, 1988; Glynn, 1993; Goreau and Hayes, 1994; Winters *et al.*, 1998), higher levels of ultraviolet radiation (Gleason and Wellington, 1993), fluctuations in salinity (Holthus *et al.*, 1989; Glynn, 1993), increased sedimentation (Stafford-Smith, 1993; Riegel and Bloomer, 1995), bacterial infection (Kushmaro *et al.*, 1996), and various anthropogenic toxicants (Kendall *et al.*, 1983). Corals usually recover from

bleaching, but they die in extreme cases (McClanahan, 2004). Increased frequency of bleaching events will reduce corals' capacity to recover (Lough, 2000). In 2002, coral bleaching was observed in the different coastal areas of India (Palk Bay and Andaman), Australia (Great Barrier Reef Marine Park), Sri Lanka and Venezuela during the period of April to June (Kumaraguru, 2002). One such bleaching event has occurred recently around the Andaman and Nicobar Islands during the period of April - June, 2010. The middle Andaman region comprises wide range of coral reefs around the Aves, Sound, Rail, Karlo and Interview Island. Hence the present study was conducted to estimate the extent of coral bleaching in this area.

STUDY AREA

During survey we selected five areas in Middle Andaman region named as Aves Island (Stn. 1), Karlo Island (Stn. 2), Sound Island (Stn. 3), Rail Island (Stn. 4) and Interview Island (Stn.5). The brief description of the study areas are as follows:

a. Aves Island (Stn. 1): Elv: 10ft. Lat: N 12°54.917' and Long: E 92°55.954'. This area has limited sandy beach otherwise covered with mangrove vegetation. Live coral cover present at a depth range between 2-12m. In the eastern side shallow intertidal extended with rocky areas upto a length of 200m.

b. Karlo Island (Stn. 2): Elv: 19ft. Lat: N12°56.282' and Long: E 92°53.541'. Shore area is muddy and mostly brackish water around the

Key Words: Coral Bleaching, Zooxanthellate, Middle Andaman, Surface Sea-water temperature (SST), live coral cover.

island. Island is meandrous, swampy and densely lined with mangrove vegetation. Live coral patches are found at shallow water depth upto 7m. Reef slope are started more than 100m away from shore area.

c. Sound Island (Stn. 3) : Elv: 142ft. Lat: N 12°56.156' and Long: E 92°58.123'. Island is extended about 10 sq km. Coast is much intended. Live corals abound. Reefs start from shore and extend to 10m depth. The area near to shore itself is deep.

d. Rail Island (Stn. 4) : Elv: 78ft. Lat: N 1256.860 and Long: E 9254.620. Mangrove thick, narrow sandy beach with occasional coral stones. Intertidal areas restricted to few places getting exposed in patches only during neap low tides. In Northern side of the island dead coral stones are found at 1-2m depths and live coral occurs at a depth range of 2-6m depth.

e. Interview Island (Stn. 5): Elv: 146ft. Lat: N 12°59.304' and Long: E 92°43.245'. In northern tip of island live coral cover extends upto 200m areas. Shore side mangroves covered. Thin strip of sandy beach in places devoid of rocks and dead coral boulders. During low tide, exposed area extends upto a length of 300m. Live corals are found depth upto 10m.

MATERIALS AND METHODS

Line-intercept transect method (English *et.al*) was employed to monitor the health of coral reefs during the survey period of April'10-July'10. At each site out of five selected areas, the total length of the transect was 50 m on the reef flat and reef slope. Four transects were laid on parallel to the coast at the depths between 2 m - 12 m in each study sites. All the above locations were fixed using GPS (Garmin Model 12XL) and were revisited periodically, at least once a month. Atmospheric temperature and Sea Surface temperature was measured by using a mercury bulb thermometer and refractometer was used to determine the water salinity. Biophysical status of the coral reef ecosystem was assessed based on observations on bleached coral, non bleached coral, partially bleached coral and algal population. Live and dead form of coral reefs has also been assessed separately on the collected data.

Abbreviation Used: AT- Atmospheric temperature; SST- Sea Surface Temperature; SD: Standard deviation. Stn: Study sites.

RESULTS

Coral bleaching occurs along the entire coast of Andaman and Nicobar Islands and it's started from April, 2010. As much as 57%-90% corals was found to have been bleached in the Middle Andaman region during April-July, 2010. The corals species *Acropora*, *Merulina*, *Pocillopra*, *Porites*, and *Pachyseris* are most badly affected by this bleaching event. However, at the end of July 8%-15% corals are found to have recovered. The mean SST varied from 30.7-32.1°C during the study period, with the maximum observed in May at Stn. 5 (Table 1). The SST continues above 30°C from April through July in all five study sites. The water salinity value ranged from 33.8-34.2 ppt during the study period, with the maximum occurring in April at Stn. 1 and Stn. 5 (Table 1). The salinity values in all the study sites were lower during July compared to those observed in April. The biophysical status of corals and other life forms was observed and reported (Table 2). The distribution of actual coral cover with dead forms was calculated and it was given in Fig 3. The occurrence of bleaching at different stations have been patchy with more severe bleaching recorded in shallow waters than at deeper offshore sites. During April 2010, maximum coral cover was observed in Stn. 5 (56.04%) and most of the dead forms were found in Stn. 2 (64.92%). The live coral cover in the reefs include hard corals, soft corals, sponges, others benthic macro-organisms found in the transect areas and dead forms include dead corals, rocks, rubbles etc. Most healthy reefs found in Sound (Stn. 3) and Interview Island (Stn. 5) with the live coral covers of 56.96% and 53.11% respectively during the last week of July. A maximum of 89.58% coral bleaching was observed in the reef area of Stn4. Aves Island (Stn. 1) and Sound Island (Stn. 3) also recorded considerable level of bleaching, i.e. 57.86% and 48.89% respectively. Due to low temperature was observed in July compared to April, the effect of bleaching also decreased at different study sites (Table 3). Recovery of corals was noticed from the data of June-July'2010. Partially bleached corals at different study sites recovered quickly with percentage of 25%-30% and completely bleached coral recovered in scanty extent (5%-10%).

DISCUSSION

The overall biophysical status of the coral reefs observed during April-July'10 indicated that the bleaching was rapidly affected the reef areas but percentage of recovery is very slow. The species of corals affected were those of the families Acroporidae, Pocilloporidae, Faviidae, Poritidae, Merulinidae, Agariciidae, and Fungiidae. The mortality was severe in the *Acropora aspera*, *Pachyseris gemmae*, *Pocillopora damicornis*, *Merulina ampliata* and *Pectinia* sp. Recovery of corals after the 1998 bleaching phenomenon in the Gulf of Mannar was very slow that took as much as one year to achieve a stable recovery (Kumaraguru, 2002). According to ZSI report, 25% of live cover of coral reefs in 1998 has increased to 45% in 2003, revealing the regeneration of these reefs after 1998 unprecedented coral bleaching in Gulf of Mannar (Venkataraman and Melkani, 2007). During 2002 bleaching event the bleaching was found to be faster than that of 1998 bleaching event (Kumaraguru, 2002). Recovery was slow in the present coral bleaching event, particularly in the branching form of corals like Acroporidae and Pocilloporidae. Members of the families Poritidae and Fungiidae showed better recovery. Post-bleaching surveys conducted in the Middle Andaman region for a short period of time. According to our observation, it will take more than one year to achieve a successful recovery. The coral bleaching event in 2010 has also been reported from the neighboring countries bordering Andaman Sea such as Thailand, Malaysia and Myanmar during May, 2010.

Generally, A variety of stressors have been invoked as being potentially responsible for causing coral bleaching and evidence is steadily accumulating for the role of specific factors both in the field and laboratory. Some of the factors responsible are elevated SST, exposure to excessive irradiance and lowered salinity. Bleaching is a result of expulsion of symbiotic algae, zooxanthellae, from the corals. Mass bleaching of corals had been noticed when SST rose well above the average for summer, causing stress on the corals (Hyne, 1998). Frequently, the hot temperature coincided with more solar radiation, particularly during calm periods (Wilkinson, 1998). A corresponding increase in SST was noticed during April and May, 2010 and the maximum mean SST (32.1°C) was observed during whole study period

(Table1). Coral reefs form one of the most dynamic and productive marine ecosystems in the world. Reefs provide the feeding and breeding grounds for thousands of food and ornamental fishes (Birkeland, 1997). There are tens of millions of people in the tropics whose livelihood depends on coral reefs. It has been estimated that a part of the protein consumed in their diet is being obtained from the coral reefs (Salvet, 1992). Although the bleaching occurs in Middle Andaman as well as various part of Andaman Sea, they need to be protected because these bleached reefs will slowly recover in time by way of new growth of coral colonies over the old ones. The most noticeable thing is that if we look at the scientific records, this phenomenon of coral bleaching has been taking place periodically all over the world. The process of natural selection is in operation, with the growth of new coral colonies and any disturbance in the system is only temporary. Therefore, in spite of the odds, the corals will resurge under the sea, which we need to protect and conserve for our benefit.

SUMMARY

The Coral bleaching occurred during April- July 2010 was monitored in five sites of the reefs of Middle Andaman. The entire coastal area of Andaman Sea was affected by this bleaching event. 57-90% bleaching was observed on the species of the coral families Acroporidae, Pocilloporidae, Faviidae, Poritidae, Merulinidae, Agariciidae, and Fungiidae. The major causative factors for bleaching might be due to unusual rise in surface sea-water temperature, upto 32.1°C during May, 2010. This unusual thermal stress on the corals leads to expulsion of zooxanthellate from their bodies, causing coral bleaching. The result of this bleaching event might affect the distribution of reef organisms, mainly food fishes which depend on the corals for feeding and breeding. It may also affect the percentage of live coral cover in Middle Andaman region by increasing mortality of corals.

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Table 1. Monthly Variation of biophysical parameters of the study sites

Study Sites	April' 2010		May' 2010		June' 2010		July' 2010	
	SST (°C)	Salinity (ppt)	SST (°C)	Salinity (ppt)	SST (°C)	Salinity (ppt)	SST (°C)	Salinity (ppt)
Aves (Stn1)	31.8	34.2	32.1	34.1	30.8	33.9	30.8	34
karlo (Stn2)	31.8	34.1	32	34	31.1	33.8	30.7	33.8
Sound (stn3)	31.8	34	32	33.9	31.3	33.9	30.7	33.9
Rail (Stn4)	31.9	34.1	32.1	34.1	30.9	34	30.4	33.8
Interview (Stn5)	31.9	34.2	32.2	34.1	31	34	31.1	34
SD ±	0.05	0.08	0.08	0.09	0.19	0.08	0.25	0.10
Mean	31.8	34.1	32.1	34.0	31.0	33.9	30.7	33.9

Table 2. Monthly variation of live form at different study sites

Live and Dead Form	Stn1		Stn2		Stn3		Stn4		Stn5	
	April	July	April	July	April	July	April	July	April	July
Live coral cover (%)	37.28	39.35	25.78	26.15	54.15	53.11	31.5	32.9	56.04	56.96
Dead Coral Cover (%)	54.12	53.45	64.92	64.18	34.65	33.89	60.1	60.7	37.86	37.94
Sand	8.6	7.2	9.3	9.67	11.20	13.00	8.4	6.4	6.1	5.1

Table 3. Monthly variation of coral bleached form at different study sites

Bleached form	Stn1		Stn2		Stn3		Stn4		Stn5	
	April	July	April	July	April	July	April	July	April	July
Bleached coral (%)	57.86	54.91	32.59	30.17	48.89	45.71	89.58	85.12	52.41	47.12
Healthy coral (%)	32.53	38.90	56.15	58.57	32.17	39.52	8.79	12.21	27.18	36.61
Partially bleached (%)	6.92	3.89	5.76	4.19	16.67	12.54	1.32	1.12	15.16	11.10
Algae (%)	2.69	2.30	5.50	5.12	2.27	2.23	0.31	1.55	5.25	5.17

PLATE-I



Fig. 1



Fig. 1A



Fig. 1B



Fig. 1C



Fig. 1D



Fig. 1E



Fig. 1F



Fig. 1G

Fig 1 : Coral bleaching occurs at different coral colonies.

Fig. 1A, 1B- *Porites* sp, *Goniastrea* sp.

Fig. 1C, 1D, 1E- *Acropora* sp, *Pocillopra* sp, *Fungia* sp.

Fig. 1F, 1G- *Pachyseris* sp, *Pectinia* sp.

PLATE-II

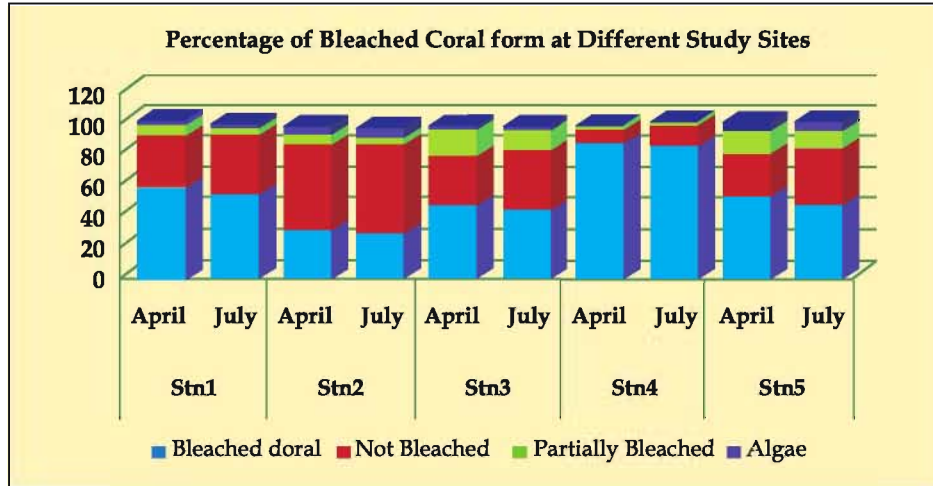


Figure 2. Percentage of coral bleaching in Middle Andaman Region.

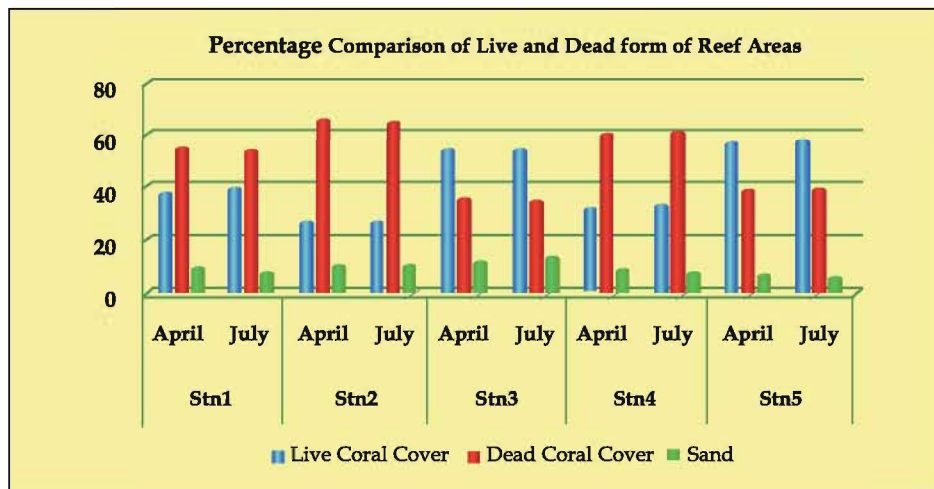


Figure 3. Comparison of Live and Dead forms at Different Study Sites.

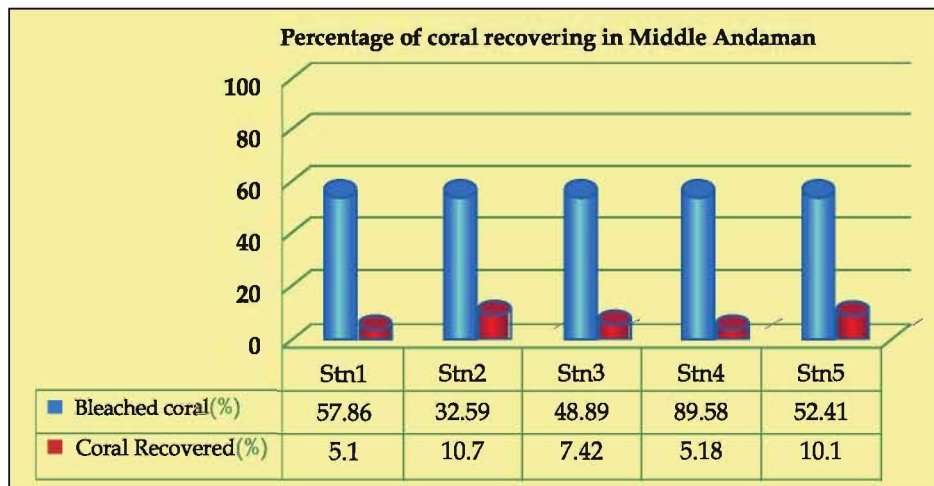
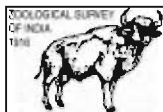


Figure 4. Percentage of recovery from bleaching in Middle Andaman.

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THYSANOPTERA FAUNA OF THE ITANAGAR WILD LIFE SANCTUARY, (ARUNACHAL PRADESH)

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INTRODUCTION

The earliest work on the faunistic study of thrips of Arunachal Pradesh was initiated by the Zoological Survey of India way back 1970s and that survey resulted in the collection of 8 species along with the discovery of a new species namely *Liothrips ananthakrishmani* Sen, 1976. Subsequently, Sen *et al.*, (1988) gave a consolidated list of all the nine species collected from different places of Arunachal Pradesh. Recently Singh *et al.*, (2010) collected 23 species of thrips from Kane Wildlife Sanctuary, Arunachal Pradesh. But the present study highlights collection of thysanopterans from the Itanagar Wild Life Sanctuary, Arunachal Pradesh. The survey was carried out during autumn (2009) and spring (2010). The specimens were processed for permanent mounting by the standard protocol (Mound and Pitkin, 1972; Bhatti, 1997) and were identified with the help of standard key available for thrips of the Indian Sub continent (Ananthakrishnan & Sen, 1980). The identified specimens are kept in the insect museum of the Department of Life sciences, Manipur University.

The results of the survey indicated the occurrence of 40 thrips species belonging to 30 genera, of which 18 were under the suborder Terebrantia and 22 under Tubulifera. Family wise it indicated the collection of 1, 17 and 22 species respectively under Aeolothripidae, Thripidae and

Phlaeothripidae. Subfamily wise the survey showed the presence of a predator, *Mymarothrips garuda* Ramakrishna & Margabandhu under Mymarothripinae and 34 phytophagous members with the breakup of 11, 6, and 17 species under Thripinae, Panchaethripinae and Phlaeothripinae respectively, besides 5 species of spore feeding Idolothripines. These individuals were collected from diverse micro-niches like leaf gall, flowers, grasses, leaf sheath, litter and leaves of the plant. The details of the collection records and the systematic accounts of all the specimens are provided below.

Order THYSANOPTERA

Suborder TEREBRANTIA

Family AEOLOTHRIPIDAE

Subfamily MYMAROTHRIPINAE

Genus *Mymarothrips* Bagnall, 1928

1. *Mymarothrips garuda* Ramakrishna and Margabandhu, 1931

1928. *Mymarothrips* Bagnall, *Ann. Mag. Nat. Hist.*, (10) 1: 306.

1990. *Mymarothrips garuda*: Bhatti, *Zoology*, 2(4):243.

Specimen studied: 1♀; ex. leaves; Dt. 3.iii.2010.
(Predatory species)

Host plant : Tumeric leaves (Zingiberaceae)

Key words : *Thysanoptera*, *Thrips*, *Faunistic study*.

Location : Chimpu (500m MSL).

Distribution : Coimbatore (Tamil Nadu).

Remark : This species has been recorded for the first time from NE India.

Family THIRIPIDAE

Subfamily THIRIPINAE

Genus *Anaphothrips* Uzel, 1895

2. *Anaphothrips sudanensis* Trybom, 1911

1911. *Anaphothrips sudanensis* Trybom, *Results Sweedish Zool. Exped. Egypt, pt. 4*: 1-4.

1988. *Anaphothrips sudanensis*: Sen, Pramanik & Sengupta, *Zool. Surv. India, occl. Paper*, 100: 8.

1990. *Anaphothrips sudanensis*: Bhatti, *Zoology*, 2(4): 212.

Specimen studied : 4 ♀♀; ex. Grass; Dt. 29.ix.2009.

Host plant : *Dactyloctenium aegypticum* Beauv. (Poaceae)

Location : Chimpu (500m MSL).

Distribution : India (widely distributed), Asia, Japan, Central and South America, Africa, Australia, West Indies, Bismarck Archipelago (New Britain).

Genus *Ayyaria* Karny, 1926

3. *Ayyaria chaetophora* Karny, 1926

1926. *Ayyaria chaetophora* Karny, *Mem. Dept. Agri. India, Ent. Ser.*, 9: 193.

1980. *Ayyaria chaetophora*: Ananthkrishnan & Sen, *Zool. Surv. India, Handbk. Ser.*, 1: 63 and 135.

1992. *Ayyaria chaetophora*: Varatharajan *et al.*, *Bull. Ent.*, 33: 69.

Specimen studied : 3 ♀♀; ex. flowers of *Glycine max*; Dt. 29.ix.2009.

Host plant : *Glycine max* (Fabaceae)

Location : Chimpu (500m MSL).

Distribution : Andhra Pradesh, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Tamil Nadu, Manipur, Nagaland.

Genus *Dichromothrips* Priesner, 1932

4. *Dichromothrips nakahari* Mound, 1976

1976. *Dichromothrips nakahari* Mound, *Biol. J. Linn. Soc.*, 8 (3): 258-259.

1980. *Dichromothrips nakahari*: Ananthkrishnan & Sen, *Zool. Surv. India, Handbk. Ser.*; 1: 67 & 137.

Specimen studied : 3♀♀; ex. flowers of orchids; Dt.03.ix.2009.

Host plant : *Dendrobium* sp. (Orchidaceae)

Location : Batt village (450m MSL).

Distribution : India (Widely distributed), Bangladesh, Burma, Malaya, Indonesia, Hong Kong, Taiwan, Philippines, Japan, Australia, Fizi, Hawaii, Central and South America, and West Indies.

Genus *Fulmekiola* Karny, 1925

5. *Fulmekiola serrata* (Kobus, 1893)

1925. *Fulmekiola serrata* Karny, H. Die an Tabak auf Java and Sumatra angetroffenen Blasenfusser. *Bulletin van het deli Proefstationte Medan*. 23: 1-55.

1990. *Fulmekiola serrata* Bhatti, J. S., *Zoology (Journal of Pure and Applied Zoology)*, 2: 233.

Specimen studied : 2♀♀; ex. Sugarcane leaf; Dt.29.viii.2009.

Host plant : *Saccharum officinarum* Linn. (Poaceae)

Location : Batt village (450m MSL).

Distribution : India - Uttar Pradesh, Haryana, World - Mauritius, Indonesia, Malay Archipelago, Taiwan, Japan and Bangladesh.

Genus *Megalurothrips* Bagnall, 1915

6. *Megalurothrips distalis* (Karny, 1913)

1913. *Taeniothrips distalis* Karny, *Arch. Naturgesch (A)* 79(2): 122-124.

1990. *Megalurothrips distalis*: Bhatti, *Zoology*, 2(4): 239.

1992. *Megalurothrips distalis*: Varatharajan, *et al.*, *Bull. Ent.*, 33(1-2): 70.

Specimen studied : 3 ♀♀; ex. flowers of *Phaseolus lunatus* L.; Dt.29.ix.2009.

Host plant : *Phaseolus lunatus* L. (Fabaceae)

Location : Batt village (450m MSL).

Distribution : India (Widely distributed). Bhutan, Bangladesh, Sri Lanka, Indonesia, Japan, Korea, Taiwan, China, and Philippines.

7. *Megalurothrips peculiaris* (Bagnall, 1918)

1918. *Physothrips peculiaris* Bagnall, *Ann. Mag. nat. Hist.*, 1(9): 206-207.

1980. *Megalurothrips peculiaris*: Ananthkrishnan & Sen, *Zool. Surv. India, Handbk. Ser.*, 1: 70.

Specimen studied : 3♀♀; ex. flowers of *Phaseolus lunatus* L (Fabaceae); Dt.29.ix.2009.

Host plant : *Phaseolus lunatus* L (Fabaceae).

Location : Batt village (450m MSL).

Distribution : India - Bihar, Delhi, Karnataka, Tamil Nadu, Uttar Pradesh, Meghalaya, Manipur, Nagaland. World - Nepal, Bangladesh, Philippines.

Genus *Microcephalothrips* Bagnall, 1926

8. *Microcephalothrips abdominalis* (Crawford, 1910)

1910. *Thrips abdominalis* Crawford, *Pomona College J. Ent.* 2(1): 157.

1926. *Microcephalothrips abdominalis*: Bagnall, *Ann. Mag. Nat. Hist.*, 18 (9): 113.

1980. *Microcephalothrips abdominalis*: Ananthakrishnan & Sen, *Zool. Surv. India Handbk. Ser. 1*: 71.

1992. *Microcephalothrips abdominalis*: Varatharajan *et al.*, *Bull. Ent.*, 33 (1-2): 70.

Specimen studied : 7♀♀; ex. flowers of Marigold; Dt. 29. viii. 2009.

Host plant : *Tagetes erecta* Linn. (Asteraceae)

Location : Chimpu (500m MSL).

Distribution : India- Widely distributed World-widely distributed in the tropics and sub-tropics on Asteraceae flowers

Genus *Sciothrips* Bhatti, 1969

9. *Sciothrips cardamomi* (Ramakrishna, 1935)

1935. *Taeniothrips cardamomi* Ramakrishna, *Bull. Ent. Res.*, 26(3): 357.

1969. *Sciothrips cardamomi*: Bhatti, *Oriental Ins.*, 3(4): 379.

1980. *Sciothrips cardamomi*: Ananthakrishnan & Sen, *Zool. Surv. India. Handbk.Ser.*, 1: 58.

Specimen studied : 2 ♀♀ & 1♂; ex. leaves of Cardamom and other wild Zingiber plants; Dt.29.ix.2009.

Host plant : *Amomum subulatum* (Zingiberaceae)

Location : Chimpu (500m MSL).

Distribution : Assam, Kerala, Tamil Nadu.

Genus *Thrips* Linnaeus, 1758

10. *Thrips flavus* Shrank, 1776

1776. *Thrips flavus* Shrank, *Beitr. Zur., Natur.*, 31-33.

1928. *Thrips nilgiriensis*: Ramakrishna, *Mem. Dept. Argi. India, Ent. Ser.*, 10(7): 262-263.

1988. *Thrips flavus*: Sen, Pramanik & Sengupta, *Zool. Surv. India, Occ. Paper*, 100: 18 & 20.

1990. *Thrips flavus*: Varatharajan, *et al.*, *Bull. Ent.*, 33(1-2): 71.

Specimen studied : 3♀♀; ex. Flowers of *Solanum indicum*; Dt.3.iii.2010

Host plant : *Solanum indicum* Linn. (Solanaceae)

Location : Yupia (800m MSL).

Distribution : India- Punjab, Himachal, Jammu & Kashmir, Tamil Nadu. World- Pakistan, Nepal, Korea, Japan, Europe, N.America

11. *Thrips hawaiiensis* (Morgan, 1913)

1913. *Euthrips hawaiiensis* Morgan, *Proc. U.S. nat. Hist. Mus.*; 46: 3.

1966. *Thrips hawaiiensis*: Ananthakrishnan & Jagadish, *Ent. Tidskr.*, 87 (1-2): 88.

1988. *Thrips hawaiiensis*: Sen, Pramanik & Sengupta, *Zool. surv. India, Occ. Paper*, 100: 18.

Specimen studied : 7 ♀♀; 2 ♂♂; Rose flowers; Dt. 28.viii.09.

Host plant : *Rosa chinensis* Jacq (Rosaceae)

Location : Batt village (450m MSL); Chimpu (500m MSL).

Distribution : Widely distributed.

12. *Thrips tabaci* Lindeman, 1889

1889. *Thrips tabaci* Lindeman, *Bull., Soc. Imp. Nat. Moscow*, 1: 61-75.

1971. *Thrips tabaci*: Ananthakrishnan. *J. Sci. & Ind. Res.*, 30 (3): 2 & 3.

1980. *Thrips tabaci*: Bhatti, *Syst. Ent.*, 5: 157 & 158.

Specimen studied : 4 ♀♀, 1♂; onion leaves and flowers; Dt.3.iii.2010.

Host plant : *Allium cepa* Linn. Liliaceae

Location : Yupia (800m MSL).

Distribution : Worldwide .

Subfamily Panchaetothripinae.

Genus *Helionothrips* Bagnall, 1932

13. *Helionothrips kadaliphilus* (Ramakrishna & Margabandhu, 1931)

1932. *Helionothrips* Bagnall, *Ann. Mag. Nat. Hist.* (10) 10: 506.

1931. *Heliothrips kadaliphilus* Ramakrishna & Margabandu, *J. Bom. Nat. Hist. Soc.*, **34**: 1033-1034.

1968. *Helionothrips kadaliphilus*: Bhatti, *Oriental Insects*, **2** (1): 35.

1988. *Helionothrips kadaliphilus*: Sen, Pramanik & Sengupta, *Zool. Surv. India, Occ. Paper*, **100**: 22.

Specimen studied : 2 ♀♀, ex. Banana leaf; Dt. 18.ix.2009.

Host plant : *Musa paradisiaca* Linn. (Musaceae)

Location : Yupia (800m MSL).

Distribution : India- Tamil Nadu, Kerala, Maharashtra, West Bengal, Manipur, Nagaland, Assam.

Genus *Heliothrips* Haliday, 1836

14. *Heliothrips haemorrhoidalis* (Bouche, 1833)

1833. *Thrips haemorrhoidalis* Bouche, p.42 (Source : Wilson,1975).

1836. *Heliothrips adonidum* Haliday, *Ent. Mag.*, **3** : 443 (Source: Bhatti, 1990).

1980. *Heliothrips haemorrhoidalis*: Ananthakrishnan & Sen, *Zool. Surv. India, Handbk. Ser.*, **1**: 81

1982. *Heliothrips haemorrhoidalis*: Mound & Walker, *Fauna of New Zealand* **1**: 41.

Specimen studied : 4 ♀♀; ex. Leaves of *Bauhinia variegata*; Dt. 18.ix.09.

Host plant : *Bauhinia variegata* Linn. (Caesalpiniaceae)

Location : Bhatt (450m MSL).

Distribution : India- Andaman & Nicobar Island, Karnataka, Kerala, Tamil Nadu, Manipur, Nagaland. World- Burma, Thailand, Malaya, Sri Lanka, Hong Kong, Taiwan, Hawaii, New Guinea, Borneo, North & South America

Genus *Monilothrips* Moulton, 1929

15. *Monilothrips kemp* Moulton, 1929

1929. *Monilothrips kemp* Moulton. *Rec. Indian Mus.*, **31**:94-95.

1988. *Monilothrips kemp*: Sen, Pramanik & Sengupta, *Zool. Surv. India, Occ. Paper*, **100** :23-24.

1990. *Monilothrips kemp*: Bhatti, *Zoology*, **2** (4):241.

Specimen studied : 2♀♀; ex. Wild grasses and fern; Dt. 29.vi.2009.

Host plant : *Dryopteris marginata* (Polypodiaceae)

Location : Batt village (450m MSL).

Distribution : India- West Bengal, Uttar Pradesh, Tamil Nadu, Manipur, Nagaland. World- South Africa, North America.

Genus *Panchaetothrips* Bagnall, 1912

16. *Panchaetothrips indicus* Bagnall, 1912

1912. *Panchaetothrips indicus* Bagnall, *Rec. Indian Mus.*, **7**: 258-260.

1928. *Panchaetothrips indicus*: Ramakrishna, *Mem. Dept. Agri. India, Ent.*, **7**(10):273.

1980. *Panchaetothrips indicus*: Ananthakrishnan & Sen, *Zool. Surv. India Handbk. Ser.*, **1**: 81 & 144.

1990. *Panchaetothrips indicus*: Bhatti, *Zoology*, **2**(4): 244.

Specimen studied : 3♀♀; 1♂; ex leaves of turmeric; Dt.29.vi.09.

Host plant : *Curcuma longa* Linn. (Zingiberaceae).

Location : Chimpu (500m MSL).

Distribution : India – Goa, Kerala, Tamil Nadu, Manipur, Assam, Nagaland, Uttar Pradesh. World- Bangladesh, Thailand, China.

Genus *Rhipiphorothrips* Morgan,

17. *Rhipiphorothrips pulchellus* Morgan 1913

1913. *Rhipiphorothrips* Morgan, New genera and species of Thysanoptera with notes on distribution and food plants. *Proceeding of the United States National Museum*, **46**: 155

1990. *Rhipiphorothrips pulchellus*: Bhatti, *Zoology*, **2**(4): 249.

1995. *Rhipiphorothrips pulchellus*: Kudo, *Insecta Matsumurana*, **52**: 99

Specimen studied : 5♀♀; ex. leaves of castor; Dt. 29.ix.09.

Host plant : *Jatropha sp.* (Euphorbiaceae)

Location : Batt village (450m MSL).

Distribution : India (Madhya Pradesh), Burma, Indonesia (Java), Philippines.

Remark : This species has been recorded for the first time from NE India.

Genus *Selenothrips* Karny, 1911

18. *Selenothrips rubrocinctus* (Giard, 1901)

1901. *Physopus rubrocinctus* Giard, *Bull. Soc. Ent. Fra.*, **15** : 263-265.

1911. *Heliothrips (Selenothrips) decolor*: Karny, *Ent. Rund.*, **28**(23): 179-181.

1980. *Selenothrips rubrocinctus*: Ananthakrishnan & Sen
Zool. Surv. India Handbk. Ser., 1: 81 & 145.

Specimen studied : 10♀♀; 3♂♂; ex leaves of Mango and Oak; Dt 10.vi.09.

Host Plant: *Mangifera indica* Linn. (Anacardiaceae) and Oak foliage (Fagaceae)

Location : Batt village (450m MSL).

Distribution : India-Andaman & Nicobar, Kerala, West Bengal, Assam, Nagaland, Manipur. World: Bangladesh, Burma, Honduras, Mexico, Philippines, Sri Lanka, Taiwan, Thailand.

Sub order TUBULIFERA

Family PHLAEOTHIRIPIDAE

Subfamily PHLAEOTHIRIPINAE

Genus *Androthrips* Karny, 1912

19. *Androthrips flavitibia* Moulton 1932

1932. *Androthrips flavitibia* Moulton, *Indian Forest. Rec.*, 19(1): 1-2.

1964. *Androthrips flavitibia*: Ananthakrishnan, *Opusc. Ent. Suppl.*, 25: 31.

1982. *Androthrips flavitibia*: Muraleedharan, *Rec. zool. Surv. India*, 79: 373.

Specimen studied : 3♀♀; ex. Galls; Dt.29.ix.2009.

Host plant : *Ficus sp* (Moraceae)

Location : Yupia (800m MSL).

Distribution : Assam, Dehradun, Manipur.

Genus *Araeothrips* Ananthakrishnan, 1976

20. *Araeothrips longisetis* Ananthakrishnan, 1976

1976. *Araeothrips longisetis* Ananthakrishnan, 1976, *Proc. Indian Acad. Sci.*, 83B (5): 202-204.

1980. *Araeothrips longisetis* :Ananthakrishnan & Sen, *Zool. Surv. India Handbk. Ser.*, 1: 149

1988. *Araeothrips longisetis*: Sen, Pramanik & Sengupta, *Zool.surv. India Occl., Paper*, 100: 39

Specimen studied : 3♀♀; ex. Sal foliage; Dt. 29.ix.2009.

Host plant : *Dalbergia sp* (Papilionaceae)

Location : Batt village (450m MSL).

Distribution : Western Ghats, Madhya Pradesh, NE India.

21. *Araeothrips vamana* Muraleedharan, 1982

1982. *Araeothrips vamana* Muraleedharan, *Rec. Zool. surv. India*, 79: 374-376.

1988. *Araeothrips vamana*: Sen, Pramanik & Sengupta, *Zool. surv. India. Occ. Paper*, 100:40-41.

Specimen studied : 4♀♀; ex. leaf; Dt.2.xi.2009.

Host plant : *Quercus serrata* (Fagaceae)

Location : Chimpu (500m MSL).

Distribution : Manipur, Nagaland. (Endemic to NE India)

Genus *Athlibothrips* Priesner, 1952

22. *Athlibothrips inquilinus* (Ananthakrishnan & Varadarasan, 1978)

1978. *Thlibothrips inquilinus* Ananthakrishnan & Varadarasan, *Oriental Insects*, 12(3): 391-402.

1980. *Thlibothrips inquilinus*: Ananthakrishnan & Sen, *Zool. Surv. India. Handbk. Ser.*, 1: 115 & 165.

1981. *Athlibothrips inquilinus*: Okajima, *Transactions of Shikoku Entomological Society*. 15: 141-150.

Specimen studied : 4♀♀; ex. Oak leaf gall; Dt. 3.ix.2009.

Host plant : *Quercus sp.* (Fagaceae).

Location : Chimpu (500m MSL).

Distribution : Jharkhand, Manipur, Nagaland, Tamil Nadu, Kerala.

Genus *Dolichothrips* Karny, 1912

23. *Dolichothrips assimilis* Priesner & Seshadri, 1952

1952. *Dolichothrips assimilis* Priesner & Seshadri, *Indian J. Agri. Sci.*, 22.

1980. *Dolichothrips assimilis*: Ananthakrishnan & Sen, *Zool. Surv. India. Handbk. Ser.*, 1: 90 & 151.

Specimen studied : 8♀♀; ex foliage of *Quercus*; Dt. 2.xi.09.

Host plant : *Quercus sp* (Fagaceae)

Location : Yupia (800m MSL).

Distribution : Eastern Ghats, Nagaland.

24. *Dolichothrips montanus* Ananthakrishnan, 1964

1964. *Dolichothrips montanus* Ananthakrishnan, *Ent. Ts. Agr.*, 85 (1-2): 99-120.

1980. *Dolichothrips montanus*: Ananthakrishnan & Sen, *Zool. Surv. India Handbk. Ser.*, 1: 90 &151.

Specimen studied : 6♀♀; ex. leaves; Dt. 2.ix.09.

Host plant : *Lantana camara* Linn. (Verbenaceae)

Location : Yupia (800m MSL).

Distribution : Western Ghats, Nagaland.

Genus *Ecacanthothrips* Bagnall, 1910

25. *Ecacanthothrips tibialis* (Ashmead, 1905)

1905. *Idolothrips tibialis* Ashmead, *Ent. News.* 16: 20.

1908. *Acanthothrips sanguineus* Bagnall, *Ann. Mag. nat. Hist.*, (8)1 : 362.

1980. *Ecacanthothrips tibialis*: Ananthakrishnan & Sen, *Zool. surv. India, Handbk. Ser.*, 1: 92

1988. *Ecacanthothrips tibialis*: Sen. Pramanik & Sengupta, *Zool. surv. india, Occ. Paper*, 100: 52

Specimen studied : 3♀♀; ex. Dry twigs; Dt. 30.iii.09.

Host plant : *Manihot esculenta* (Euphorbiaceae).

Location : Itanagar (460m MSL).

Distribution : Widely distributed.

Genus *Gigantothrips* Zimmerman, 1900

26. *Gigantothrips elegans* Zimmerman, 1900

1900. *Gigantothrips elegans* Zimmerman, *Bull. Inst. Bot. Bull.*, 7: 18-19.

1926. *Gigantothrips elegans*: Karny, *Mem. Dept. Agri. India. Ent. Ser.*, 9(6): 239.

1980. *Gigantothrips elegans*: Ananthakrishnan & Sen, *Zool. Suro. India, Handbk. Ser.*, 1: 92 & 152.

Specimen studied : 3♀♀; ex. *Ficus* leaf; Dt. 30.iii.09.

Host plant : *Ficus* sp (Moraceae).

Location : Itanagar (460m MSL).

Distribution : India- Tamil Nadu, Karnataka, Orissa, Bihar, Manipur, Mizoram, Nagaland. World- Philippines, Siam, Japan, Java, Thailand.

27. *Gigantothrips tibialis* (Bagnall, 1921)

1921. *Cercothrips tibialis* Bagnall, *Ann. Mag. Nat. Hist.*, 9(7): 355-368.

1964. *Cercothrips tibialis* : Ananthakrishnan, *Opuscula Ent. Suppl.*, 25: 36.

1980. *Gigantothrips tibialis* : Ananthakrishnan & Sen, *Zool. Suro. India. Handbk. Ser.*, 1: 92 & 152.

Specimen studied : 2♀♀; ex. *Ficus* leaf; Dt. 1.xi.2009.

Host plant : *Ficus* sp (Moraceae).

Location : Itanagar (460m MSL), Chimpu (500m MSL).

Distribution : Kerala, Karnataka, Uttar Pradesh, Uttaranchal, Nagaland.

Genus *Haplothrips* Amyot & Serville, 1843

28. *Haplothrips gowdeyi* (Franklin, 1908)

1908. *Androthrips gowdeyi* Franklin, *Proc. U.S. nat. Mus.*, 33: 724.

1980. *Haplothrips gowdeyi*: Ananthakrishnan & Sen, *Zool. surv. India Handbk. Ser.*, 1: 95 & 153.

1992. *Haplothrips gowdeyi*: Varatharajan *et al.*, *Bull. Ent.* 33(1-2): 72

Specimen studied : 6♀♀ & 2♂♂; ex flowers; Dt. 2.xi.09.

Host plant : *Lantana camara* Linn. (Verbenaceae)

Location : Batt village (450m MSL), Chimpu (500m MSL), Itanagar (460m MSL).

Distribution : Polyphagous and widely distributed.

29. *Haplothrips montanus* (Ananthakrishnan & Jagadish, 1970)

1970. *Neoheergeria montana* Ananthakrishnan & Jagadish, *Oriental Insects*, 4 (3): 262-264.

1980. *Neoheergeria montana*: Ananthakrishnan & Sen, *Zool. Suro. India, Handbk. Ser.*, 1: 109 & 160.

2007. *Haplothrips montanus*: Mound & Minaei, *Journal of Natural History*, 41(45-48): 2919-2978.

Specimen studied : 2♀♀; ex inflorescences; Dt. 2.ix.2009.

Host plant : *Amaranthus* sp (Amaranthaceae).

Location : Chimpu (500m MSL).

Distribution : West Bengal, Manipur, Nagaland.

30. *Haplothrips tenuipennis* Bagnall, 1918

1918. *Haplothrips tenuipennis* Bagnall, *Ann. Mag. nat. Hist.*, 9(1): 210.

1968. *Haplothrips tenuipennis*: Mound, *Bull. Br. Mus. nat. Hist. (Ent.)*, *Suppl.*, 11: 118.

1980. *Haplothrips tenuipennis*: Ananthakrishnan & Sen, *Zool. surv. India, Handbk. Ser.*, 1: 95

1992. *Haplothrips tenuipennis*: Varatharajan, *et al.*, *Bull. Ent.*, 33(1-2): 72.

Specimen studied : 5♀♀ & 1♂; ex. leaves of Mango; Dt. 28.viii.09.

Host Plant : *Mangifera indica* (Anacardiaceae)

Location : Itanagar (459m MSL); Yupia (800m MSL).

Distribution : Widely distributed.

Genus *Leeuwenia* Karny, 1912

31. *Leeuwenia eugeniae* Bagnall, 1924

1924. *Leeuwenia eugeniae* Bagnall, R.S. Brief description of new Thysanoptera- XIV. *Ann. Mag. Nat. Hist.* (9)14: 640. (Source: Ananthakrishnan, T.N. (1970) *Oriental Insects*, 4(1): 50.

Specimen studied : 3♀♀; ex leaves of unidentified plant; Dt.19.iii.2010

Location : Chimpu (500m MSL).

Distribution : India-Tamil Nadu.

Remarks : This species has been recorded for the first time from NE India.

Genus *Liothrips* Uzel, 1895

32. *Liothrips aequilus* Ananthakrishnan & Jagadish, 1969

1969. *Liothrips aequilus* Ananthakrishnan & Jagadish, *Marcellia*, 36 (1-2): 7-103.

1974. *Liothrips aequilus*: Ananthakrishnan & Muraleedharan, *Oriental Insects suppl.*, 4: 10 & 46.

1980. *Liothrips aequilus*: Ananthakrishnan & Sen, *Zool. Surv. India Handbk. Ser.*, 1: 100 & 156.

Specimen studied : 2♀♀, ex. Leaf galls; Dt. 7.iv.09.

Host plant : *Pouzolzia zeylanica* (Urticaceae).

Location : Itanagar (460m MSL).

Distribution : Andhra Pradesh, Nagaland.

33. *Liothrips himalayanus* Ananthakrishnan & Jagadish, 1970

1970. *Liothrips himalayanus* Ananthakrishnan & Jagadish, *Oriental Insects*, 4(3): 259-261.

1980. *Liothrips himalayanus* :Ananthakrishnan & Sen, *Zool. Surv. India Handbk. Ser.*, 1: 100

1988. *Liothrips himalayanus*:Sen, Pramanik & Sengupta, *Rec. zool. Surv. India Occ. Paper*, 100: 74.

Specimen studied : 3♀♀, ex. Leaf galls; Dt 7.iv.2009.

Host plant : *Pouzolzia zeylanica* (Urticaceae)

Location : Itanagar (460m MSL).

Distribution : Darjeeling, Manipur, Nagaland.

Genus *Preeriella* Hood, 1939

1939. *Preeriella* Hood JD, *Revista de Entomologia.*, 10: 550-619.

Specimen studied : 2♀♀, ex. Mixed leaf litter; Dt. 01.xi.2009.

Location : Yupia (800m MSL).

Distribution : Florida, Brazil, Mexico, Angola, South Africa, Japan, Taiwan, Thailand, Malaya-Peninsular.

Remark : This genus has been recorded for the first time from India and the identity of the species is yet to be established.

Diagnostic character : Body length <1mm (smallest among the tubuliferan). Head longer than wide. Antennal segment 3 cup shaped. Mouthcone broadly rounded. Wings extremely narrow. Tube relatively short and slender.

Genus *Xylaplothrips* Priesner, 1928

35. *Xylaplothrips debilis* Ananthakrishnan & Jagadish, 1971

1971. *Xylaplothrips debilis* Ananthakrishnan & Jagadish, *Zool. Anz.*, 186: 266-267.

1976. *Xylaplothrips debilis*: Pitkin, *Bull. Br. Mus. Nat. Hist. (Ent)*. 34: (4): 268-269.

1980. *Xylaplothrips debilis*: Ananthakrishnan & Sen, *Zool. Surv. India. Handbk. Ser.*, 1: 116.

Specimen studied : 1♀; ex. Mixed leaf litter, Dt. 30.x.2009.

Host plant : Bamboo, Croton etc.

Location : Batt village (450m MSL).

Distribution : Kerala, Andhra Pradesh, West Bengal.

Subfamily IDOLOTHRIPINAE

Genus *Elaphrothrips* Buffa, 1909

36. *Elaphrothrips denticollis* (Bagnall, 1909)

1909. *Dicaiothrips denticollis* Bagnall, *Trans. Nat. Hist. Soc. Northumb.*, 3: 527

1934. *Elaphrothrips beesoni* Ramakrishna, *Indian For. Rec.*, 20 (4): 7.

1978. *Elaphrothrips denticollis*: Palmer & Mound, *Bull. Br. Mus. Nat. Hist. (Ent)*, 37 (5): 179-180.

1981. *Elaphrothrips denticollis*: Muraleedhran & Sen, *Rec. Zool. Surv. India* 79: 209.

Specimen studied : 2♀♀; ex. bamboo leaf litter; Dt -3-xi-09

Host plant : Bamboo (Poaceae)

Location : Itanagar (460m MSL).

Distribution : India- West Bengal, Manipur, Meghalaya, Nagaland. World- Bhutan, Laos, Thailand, Malaya, Sumatra, Germany.

37. *Elaphrothrips greeni* (Bagnall, 1914)

1914. *Dicaiothrips greeni* Bagnall, *Am. Mus. Nat. Hist.*, **8**, 13: 289.

1934. *Elaphrothrips beesoni* Ramakrishna, *Indian forest Rec.* **20**(4): 7-8.

1980. *Elaphrothrips greeni*: Ananthakrishnan & Sen, *Zool. Surv. India, Handbk. Ser.*, **1**: 119

Specimen studied : 1♀; ex leaf litter; Dt. 3.ix.2009.

Host plant : Bamboo (Paoceae)

Location : Yupia (800m MSL).

Distribution : Tamil Nadu, Kerela, Karnataka, Maharashtra, Assam.

Genus *Meiothrips* Priesner, 1929

38. *Meiothrips menoni* Ananthakrishnan, 1964

1964. *Meiothrips menoni* Ananthakrishnan, *Opus. Ent. Sypppl.*, **25**: 99-101.

1980. *Meiothrips menoni*: Ananthakrishnan & Sen, *Zool. Surv. India, Handbk. Ser.*, **1**: 121 & 169.

Specimen studied : 1♀; ex: Dry twigs and leaf litter, Dt.30.xi.09.

Host plant : *Lantana camara* (Verbenaceae)

Location : Yupia (800m MSL).

Distribution : Kerala, Karnataka, Andhra Pradesh, Manipur, Nagaland.

Genus *Nesothrips* Kirkaldy, 1907

39. *Nesothrips lativentris* (Karny, 1913)

1913. *Rhaebothrips lativentris* Karny, *H. Sauter's Formosa-Ausbeute. Suppl. Ent.*, **2**: 129-130.

1988. *Nesothrips lativentris*: Sen, Pramanik & Sengupta, *Zool. Surv. India. Occ. Paper*, **100**: 118.

Specimen studied : 2♀♀; ex. Leaf litter; Dt. 30.ix.2009.

Host plant : *Dipterocarpus* (Dipterocarpaceae)

Location : Batt village (450m MSL).

Distribution : **India**- West Bengal, Tripura, Assam. **World**- Mauritius, Philippines, Japan, Guam, Queensland, Hawaii, Jamaica, Virgin Is.

Genus *Oidanothrips* (Schmutz, 1909)

40. *Oidanothrips enormis* Ananthakrishnan, 1969

1969. *Oidanothrips enormis*: Ananthakrishnan *Oriental Insects*, **3** (3): 302-303.

1980. *Oidanothrips enormis*: Ananthakrishnan & Sen, *Zool. Surv. India, Handbk. Ser.*, **1**: 122

Specimen studied : 1♀; ex dry twigs and leaf litter; Dt .30-10-09.

Host plant : *Croton* sp. (Euphorbiaceae).

Location : Itanagar (460m MSL).

Distribution : Tamil Nadu, Andhra Pradesh.

SUMMARY

18 species of terebrantians and 22 species of tubuliferans were recorded from the Itanagar Wild Life Sanctuary, Arunachal Pradesh during autumn [2009] and spring seasons [2010]. The collection records revealed the occurrence of 11 and 6 species under the subfamily Thripinae and Panchaethripinae, one species under Mymarothripinae, 17 and 5 species of Phlaeothripinae and Idolothripinae respectively. Of the 40 species belonging to 30 genera, 6 species are reported for the first time from North East India. In terms of their feeding habit and habitat, the survey revealed the presence of 10 species of foliage feeders, 8 flower dwellers, 7 litter thrips, 5 gall makers, 5 pests, 3 grass invaders and 2 predatory forms.

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NOTES ON A COLLECTION OF DERMAPTERA

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INTRODUCTION

The present study is based on Dermaptera collected by various survey parties of Zoological Survey of India, Kolkata during the period from 1922 to 1961 and deposited in the National Zoological Collection, Zoological survey of India, Kolkata. A total of 17 species belonging to 13 genera under 10 subfamilies of 06 families and 03 superfamilies were identified. It includes 06 species recorded for the first time from different states of India and 01 species from Myanmar. Out of the 17 species recorded, 05 viz; *Cranopygia kallipygos* (Dohrn, 1863), *Cranopygia raja* (Burr, 1911), *Acrania fletcheri* Bharadwaj and Kapoor, 1967, *Metisolabis bifoveolata* (Bolivar, 1897) and *Gonolabidura astruci* Burr, 1911, are endemic to India whereas 03 species viz; *Isolaboides burri* (Borelli, 1909), *Forcipula abbreviata* Srivastava, 1986 and *Anechura stoliczkae* Burr, 1911 are distributed within Indian subcontinent.

SYSTEMATIC ACCOUNT

Super family PYGIDICRANOIDEA

Family PYGIDICRANIDAE Verhoef, 1902

Subfamily PYGIDICRANINAE Burr, 1908

Genus *Cranopygia* Burr, 1908

1839. *Pygidicrana* (pars) Serville, *Hist. Nat. Inst. Orth.*, :30.
1908. *Pyge* Burr, *Ann. Mag. nat. Hist.*, (8)2: 384, 390 (Type-*Pygidicrana modesta* Bormans).
1910. *Kalocrania* Zacher, *Ent. Rdsch.*, 27: 106 (*Pygidicrana marmoricrura* Serville).

Cumingi Group

1. *Cranopygia kallipygos* (Dohrn, 1863)

1863. *Pygidicrana kallipygos* Dohrn, *Stettin ent. ztg.*, 24: 53 (♂, ♀; *India orientali* (Hugel)).
1900. *Pygidicrana callipyga*; Bormans and Krauss, *Das Tierreich*, 11: 16, 21;
1915. *Cranopygia kallipygos*; Burr, *J. R. micr. Soc.*, 1915: 435, pl.6, fig.13 (♂ genitalia).

Material examined : South India: Nilgiri Hills, Gundulur, 1 ♂, 2♀♀, 2 nymphs, 22.xi.1930 (J.C. fernandes); Palni Hills, Kukkal, Alt. 6500 ft.. 1♀, 31.viii.1922 (S.Kemp).

<i>Measurements</i> : (in mm.)	Male	Female
Length of body	25	20-25
Length of Forceps	06	06-08

Distribution : INDIA : Tamil Nadu: Nilgiri Hills, Ootacamund, Gundulur, Coonoor, Elk Hill, Doda-Hokal, Kodaikanal; Palni Hills, Kukkal, Ca 6500 ft.

Elsewhere : Not yet recorded.

2. *Cranopygia raja* (Burr, 1911)

1911. *Kalocrania raja* Burr, *J. Asiat. Soc. Beng. (N.S.)*, 7 (11): 773 (♂, Nilgiri Hills).
1923. *Cranopygia raja*; Hebard, *Mem. Dep. Agric. India, ent. Ser.*, 7(11): 199.

Material examined : SOUTH INDIA : Palni Hills, neutral saddle, 5000 ft., 1 ♂, Sept. 1922, S. Kemp.

Distribution : INDIA : Nilgiri Hills and Annamalai Hills; Salem district (Tamil Nadu).

Elsewhere : Not yet recorded.

Remark : This species has so far been recorded from South India only.

Genus. *Acrania* Burr, 1915

1915. *Acrania* Burr. *J.R. micr. Soc.*, 1915: 432, 436 (Type-*Pygidicrana picta* Guerin-Meneville)

1993. *Acrania*; Srivastava, *Rec. zool. Surv. India*, 92(1-4): 44.

3. *Acrania fletcheri* (Bharadwaj and Kapoor, 1967)

1967. *Cranopygia fletcheri* Bharadwaj and Kapoor, *Bull. Ent.*, 8(2) : 1(♂; India: Meghalaya; Shillong, 5000 ft.)

1914. *Kalocrania picta* (nec. Guerin-Meneville); Burr, *Rec. Indian Mus.*, 8(2): 136 (1♂, 1♀, Kobo).

1993. *Acrania fletcheri*; Srivastava, *Rec. zool. Surv. India*, 92(1-4): 45.

Material examined : INDIA : Manipur: Imphal, 16 miles North on Dimapur Road, Alt., 3500 ft., 14.x.1945 (Major M.L. Roonwal).

Measurements : (in mm): Male

Length of body 20

Length of forceps 5.5

Distribution : INDIA : Meghalaya, (Shillong and Manipur) (Imphal district).

Elsewhere : Not yet recorded.

Remarks : It is reported for the first time from the state of Manipur.

Super family ANISOLABOIDEA

Family ANISOLABIDIDAE

Sub Family ANISOLABIDINAE

Genus *Euborellia* Burr, 1910

1910. *Euborellia* Burr, *Proc. U.S. natn. Mus*, 38: 448.

1912. *Heterolabis Borelli*, *Bull. Mus. Hist. nat. Paris*, 18: 231 (Type species: *Heterolabis brasiliensis* Borelli, 1912).

1915. *Landex* Burr, *J.R. micr. Soc.*, 1915: 445 (Type species: *Labidura femoralis* Dohrn, 1863).

4. *Euborellia compressa* (Borelli, 1907)

1907. *Anisolabis compressa* Borelli, *Boll. Musei Zool. Comp. R. Univ. Torino*, 22(558): 3 (♂, ♀, Uganda).

1915. *Euborellia compressa*; Burr, *J.R. micr. Soc.*, 1915: 545, pl. 12, fig. 8 (♂ genitalia).

Material Examined : INDIA: Kashmir, Srinagar, 1♂, 08.ix.1932 (H.S. Pruthi).

Measurements: (in mm): Male

Length of body 12mm

Forceps 1.6mm.

Distribution : INDIA (Tamil Nadu, Himachal Pradesh, West Bengal and Kashmir).

Elsewhere : Pakistan, Uganda and Zaire.

Remarks : This species is recorded for the first time from Kashmir.

5. *Euborellia annulata* (Fabricius, 1793)

1793. *Forficula annulata* Fabricius, *Ent. Syst.*, II : 4 (sex ; *Americae meridionale*).

1867. *Anisolabis stali*; Scudder, *Proc. Boston soc. Nat. Hist.*, 18: 308.

1910. *Borellia stali* Burr, *Fauna of British India*, *Dermoptera*: 88.

Material Examined : INDIA: Chennai, Elliots Beach, Radio Station, 1♂, 18.9.1961.

Measurements: (in mm): Male

Length of body 10mm

Forceps 1.5mm.

Distribution : INDIA (Kerala, Tamil Nadu, Karnataka, Maharashtra, Orissa, West Bengal, Manipur and Lakshadweep islands).

Elsewhere : Sri Lanka, Pakistan and China.

Sub family BRACHYLABIDINAE

Genus *Metisolabis* Burr, 1910

1910. *Metisolabis* Burr, *Fauna of British India*, *Dermoptera*: 108 (Type Species: *Brachylabis voeltzkowi* Burr, 1908)

2003. *Metisolabis*; Srivastava, *The Fauna of India and adjacent countries, Dermoptera, Part-2*: 127-128

Superfamily ANISOLABOIDEA

6. *Metisolabis bifoveolata* (Bolivar, 1897)

1897. *Brachylabis bifoveolata* Bolivar, *Annl. Soc. Ent. Fr.*, 64, p.285, pl.10, fig.1 (♂; Madras Presidency).

1911. *Ctenisolabis bifoveolata* Burr, *J. Asiat. Soc. Beng. (N.S.)*, 7: 780.

1966. *Isolabis bifoveolata* Popham and Brindle, *Entomologist*, 99: 245.

Material Examined : South India: Kodaikanal, under rotten wood, 1♂.

Distribution : INDIA : Tamil Nadu (Tiruchirappally), Shembaganur (Madura dist.), Kodaikanal, Annamalai Hills (Cinchona, 3500 ft. and Valparai and Palni Hills (Maryland, Tigershola, 1600 ft.).

Elsewhere : Not yet recorded.

Family LABIDURIDAE

Sub family ALLOSTETHINAE

Genus *Gonolabidura* Zacher, 1910

1910. *Gonolabidura* Zacher, *Ent. Rdsch*, **27**: 30 (Type species: *Anisolabis piligera* Bormans, 1900.)

7. *Gonolabidura astruci* Burr, 1911

1911. *Gonolabidura astruci* Burr, *J. Asiat. Soc. Beng. (N.S.)*

7: 776 ((♂♂, ♀♀; South India: Madura District, Shembaganur).

1990. *G. astruci*; Srivastava, *Rec. zool. Surv. India*, **87** (1) : 35 (♂, ♀ and nymph; India Tamil Nadu, 8 miles, N.E. Munnar, 6200 ft.

Material examined : South India: Palni Hills, Kodaikanal, under litter, S. Kemp., Aug. 1922 (Male).

Distribution: INDIA: Madura district, Shembaganur, Palni Hills, Kodaikanal.

Elsewhere : Not yet recorded.

Subfamily ISOLABOIDINAE Brindle, 1978

Genus *Isolaboides* Hinks, 1958

1958. *Isolaboides* Hincks, *Eos, Madr.*, **34**: 131 (Type species- *Pseudisolabis kosswigi* Burr, 1947.)

1990. *Paralaboides* Steinmann, *Das Tierreich*, **106**: 10 (Type species- *Pseudisolabis jonathani* Kapoor & Katiyar, 1971).

8. *Isolaboides burri* (Borelli, 1909)

1909. *Pseudisolabis burri* Borelli, *Boll. Musie. Zool. Anat. Comp. R. Univ. Torino*, **24** (603): 1, (♂, ♀, N.E. Kashmir, along the road from Gilgit to Srinagar).

1958. *Isolaboides burri*; Hincks, *Eos Madr.*, **34**: 132.

Material examined - Punjab : Murree, near sunny bank (now in Pakistan), 6500 ft., 1 ♂, 03. ix. 1928 (Coll. H.S Pruthi).

Measurements: (in mm):	Male
Length of body	11 mm.
Length of forceps	2mm.

Distribution : India (Kashmir and Himachal Pradesh)

Elsewhere : Pakistan.

Genus *Labidura* Leach, 1815

1815. *Labidura* Leach, *Edin. Encyl.*, **9**(1): 48. (Type species: *Forficula riparia* Pallas, 1773)

1831. *Forficesila* Serville, *Ann. Sci. nat.*, **22**: 32 (Type species: *Forficula gigantea* Fabricius= *Forficula riparia* Pallas 1773)

9. *Labidura riparia* (Pallas, 1773)

1773. *Forficula riparia* Pallas, *Reise Russ. Reichs*, **2** : 727 (Sex ♂; Shores of Irtysh River, Western Siberia).

1979. *Labidura orientalis* Steinmann, *Acta zool. Hung.*, **25** (3-4): 422 figs. 12-13 (♂; Nepal, Trisuli).

Material Examined : INDIA : Manipur : 16 miles north of Imphal on Dimapur road, evergreen forest, 3500 ft, under stones, 1♂, 2♀♀, 17.ix. 1945; 1♂, 1♀, 21-30.ix.1945; 3♂♂, 3♀♀, 5 nymphs 15.x.1945; 3♀♀, 25.x.1945 (M.L.Roonwal); Madhya Pradesh: Pachmarhi, 1♂, 20.i.1953 (K.K.Tiwari); Burhmer river near Mohgaon, on the sides of the water channel, under stones, 1♀, Nov., 1927; The river beach at marble rocks, 2♀♀, Dec. 1927 (H.S.Pruthi); Bihar: Hazaribagh district, Lohedih tank, Karmatongri village, 2 miles from Nimiaghat inspection bungalow, 1♂ 12.iv.1948 (Nath and Sinha); Kashmir: near P.W.D. Rest house, sena marg, 1♀, 27.vii.1955 (K.S.Pradhan); Kashmir valley, a slow running stream near inspection bungalow Sunarwani, 1♂, 1♀, 11.ix.1955 (K.S.Pradhan); West Bengal: Darjeeling district on the bank of the river Rilli, Kalimpong, 1♂, 1♀, 1 nymph, 29.i.1931 (S.L. Hora); Palta F.B. II, 1♂, 2♀♀, 26.iv.1937; near the cistern of extension F.B. VIII, 1♂, 1 nymph, 23.iv.1937.

Distribution : Cosmopolitan - ranging from sea shore to mountains in diverse ecological niches.

Remarks : This species is most common in tropical parts of the world.

Genus *Forcipula* Bolivar, 1897

1897. *Forcipula* Bolivar, *Annl. Soc. Ent. Fr.*, **66**: 328 (Type species: *Labidura quadrispinosa* Dohrn, 1863- designated by Kirby, 1904).

1974. *Genitalata* Kapoor, *Zool. J. Linn. Soc.*, **55** : 83, figs. 1-4 (Type- *Genitalata mahajani* Kapoor, 1974).

10. *Forcipulaquadrispinosa* (Dohrn, 1863)

1863. *Labidura quadrispinosa* Dohrn, *Stettin. Ent. Ztg.*, **24** : 311 (♂; Tranquebar, India and Ceylon)

Material Examined : India : INDIA : Madhya Pradesh, Nerbudda river near the river channel at Mandla, under stones, 4♀♀ and Gorakpur, under stones on the sides of water channel, 2♂♂, 2♀♀,

Nov.1927 (H.S. Pruthi); Rewastate, opposite Harra camp, 2625 ft, 1♂, 1♀, 1 nymph, March 1927 (H.S.Pruthi); West Bengal: Darjeeling dist, Kalimpong, on the bank of the river Rilli, under stones, 2♂♂, 2♀♀ (S.L.Hora); Kharagpur dist, under gravels on the semi dried up bed of cutting river near its mouth, about 1.5 miles N.W. of Phulbaria bunglow, 2♂♂, 2♀♀, 2 nymphs; Jharkhand: Santal paragnas, near Ronbyhad stream on way from Lalitara to Kunjulona, 1♂, 1♀, 1.ix.1938 (H.A.Hafiz); Mondhaboun stream, 2 miles S.W. of Litipara Dakbunglow, under stones, 1♀, 5.xi.1938.

Measurements: (in mm)	Male	Female
Length of body	17.0-22.0	18.0 - 22.0
Length of forceps	9.0-17.0	5.0- 8.0

Distribution : All over India below 3000 ft in Himalayas .

Elsewhere : Nepal, Bhutan, Myanmar, South China, Thailand, Indo-China, Philippines Island, Reunion and Mauritius .

Remarks : This species is recorded for the first time from Madhya Pradesh.

11. *Forcipula abbreviata* Srivastava, 1986

1904. *Forcipula decolyi* (nec Bormans) Burr, *Trans. R. ent. Soc. Lond.*, **1904**: 289.

1986. *Forcipula abbreviata* Srivastava, *Rec. zool. Surv. India*, Occ. Paper, **89**: 10, figs. 5-8 (♂, ♀; India: Arunachal Pradesh, W. B. (Darjeeling dist.) and Sikkim.

Material examined : INDIA : West Bengal, Darjeeling dist., Jora stream, above Cinchona plantation, 3000ft, (Eastern Himalayas), 1♂, (S.L Hora).

Measurements: (in mm)	Male
Length of body-	16mm
Forceps	9mm.

Distribution : INDIA : Arunachal Pradesh, W.B. (Darjeeling dist.) and Sikkim.

Elsewhere : It occurs all along the Himalaya in India, Nepal and Bhutan.

Superfamily FORFICULOIDEA

Family LABIIDAE

Subfamily LABIINAE

Genus *Circolabia* Steinmann, 1987

1987. *Circolabia* Steinman, *Acta. zool. hung.*, **33**: 178 (Type species: *Labia arcuata* Scudder, 1876).

1989. *Paralabella* Steinmann, *Das Tierreich*, **106**: 470 (Type species- *Forficula annulata* Fabricius, 1793)

12. *Circolabiacurvicauda* (Motschulsky, 1863)

1863. *Forficesila curvicauda* Motschulsky, *Bull. Soc. Imp. Moscou.*, **36**: 2., pl. 2, fig. 1 (♂, ♀; Nura Illia Mountains, Ceylon).

1989. *Paralabella curvicauda*; Steinmann, *Das Tierreich*, **106**: 497, figs. 920-922.

1993. *Circolabiacurvicauda*; Srivastava, *Rec. zool. Surv. India*, **95**(1-2): 102.

Material Examined : INDIA: Tamil Nadu : Palni Hills, neutral saddle, 5000 ft. , 4♂♂, 1♀, Sept. 1922 (S. Kemp); West Bengal: Kolkata, Bansdroni, 1♂, 1♀, 1 nymph, 22:10.1959 (A.R. Bhowmick).

Measurements (in mm.)	Male	Female
Length of body	4.5-5	4.7- 4.9
Length of forceps	0.7-0.8	0.8- 0.9

Distribution : INDIA (Arunachal Pradesh, Karnataka, Assam, Meghalaya, West Bengal, and Tamil Nadu: Palni Hills).

Elsewhere : Luzon, Mindanao, Sri Lanka, Bangladesh, Thailand, and Philippine Isles.

Remarks : This species is recorded for the first time from South India : Tamil Nadu and West Bengal: Kolkata.

Family CHELISOCHIDAE

Subfamily CHELISOCHINAE

Genus *Chelisoches* Scudder, 1876

1839. *Lobophora* Serville, *Hist. nat. Ins. Orth.*: 32 (type species: *Lobophora rufitarsis* Serville, 1839= *Forficula morio* Fabricius, 1775).

1876. *Chelisoches* Scudder, *Proc. Boston Soc. nat. Hist.*, **18**: 292.

1907. *Enkrates* Burr, *Trans. Ent. Soc. Lond*, **1907**: 131 (type species: *Forficula flavipennis* Fabricius, 1793).

1911. *Kleiduchus* Burr, *Genera Ins.*, **122**: 64 (type species: *Forficesila australicus* Le Guillou, 1841).

13. *Chelisoches brevipennis* Borelli, 1923

1923. *Chelisoches brevipennis* Borelli, *Boll. Musei zool. Anat. comp. R. Univ. Torino*, **38**(13): 12 (♂, ♀; Philippine: Palawan N.).

1929. *Chelisoches bimammatus* Hebard, *Trans. Ann. Ent. Soc.*, **55**: 338 (♂, ♀; Sumatra: Selangor, Batucaves).

Material examined : Myanmar (Upper Burma): Myitkyina Dist., Sattan Chaung stream, inside and near Paudawmu cave, about 8 miles from Kamaing, 2 ♂♂, 2 ♀♀ and 3 nymphs, 22 & 30. Xii. 1926 (B. Chopra).

Diagnostic characters : Male: Build Stout, general color deep brownish black to black. Antennae except first three basal segments and tarsi deep brown; occiputs, femora, tibiae, pronotum, elytra and wings deep brownish black; Frons, 1st to 3rd antennal segments, abdomen, ultimate tergite and forceps black. Head moderately convex, frons and occiputs feebly raised, sutures distinct. Antennae 17 segmented, 1st stout and cylindrical, length almost equal to the distance between antennal bases, 2nd very small, 3rd long, almost equal to 5th in length, 4th slightly shorter than the preceding, 6th and onwards slightly longer and thinner, gently expanded apically. Pronotum longer than broad. Suture distinct in prozona only. Anterior margin truncated while the posterior margin broadly rounded, prozona slightly reflexed. Elytra, wings, ultimate tergite and abdomen punctulated. Ultimate tergite transverse, rectangular, posterior margin depressed in the middle with a pair of compressed tubercles in the depression, gently tumid over the base of forceps. Forceps stout, branches remote at base, flattened and elongated with a broad and flat denticulated dilation on the inner margin upto the three fifth from the base beyond which gradually incurved without any teeth on the inner margin. Pygidium vertical, broader at base, narrowed apically with hind margin bifid. Penultimate sternite punctate with hind margin round and slightly emarginated in the middle.

Female : Resembles in most characters with males except abdomen dilated in the middle, ultimate tergite narrowed posteriorly. Pygidium protruded into a narrow spine directed downwards.

Distribution : INDIA : Meghalaya: (South Garo hills Dist., Siju cave); Arunachal Pradesh and West Bengal.

Elsewhere : Sumatra, Malaysia, Philippine Islands and Myanmar.

Remarks : It is recorded for the first time from Myanmar.

Family FORFICULIDAE

Subfamily ANECHURINAE Burr, 1907

Genus *Anechura* Scudder, 1876

1876. *Anechura* Scudder, *Proc. Boston Soc. Nat.Hist.*, **18**: 289.

14. *Anechura zuboovskii* Semenov, 1901

1901. *Anechura zuboovskii* Semenov, *Horae Soc. Ent. Res.*, **35**: 188 (♂, ♀; Valley of the river Drass, 9-1100 ft, Ladakh, Kashmir).

1955. *Anechura bipunctata* pirpanjalae Santokh Singh, *Agra Univ. J. Res. (Sci.)*, **4**(1):32

1966. *Anechura pirpanjalae* Kapoor, *Ann. Mag. Nat. Hist.*, **13** (9): 391

Material Examined : INDIA: Kashmir, top of Pissu Ghat, on the way from Chandanwari to Vavjan, under stones, 1 ♂, 2 ♀♀, 11.vii.1955.

Distribution : INDIA (Kashmir: Ladakh and Top of Pissu Ghat; Himachal Pradesh).

Elsewhere : China (S.W. Tibet).

15. *Anechura stoliczkae* Burr, 1911

1911. *Anechura stoliczkae* Burr, *J. Asiat. Soc. Beng. (N.S.)*, **7**: 792 (♂; Northern India, Upper Sutlej District, Bashar).

1955. *Anechura himalayana* Santokh Singh, *Agra Univ. J. Res. (Sci.)***4**: 180

1955. *Himanechura lahaulensis* Santokh Singh, *Agra Univ. J. Res. (Sci.)***4**: 183.

Material examined : INDIA: Kashmir: Around Pahalgam, a stream, 11.vi.1955, 2 ♂♂ and 4 ♀♀.

Female : Forceps simple and straight. Pygidium not visible from above.

Distribution : INDIA : Himachal Pradesh, Uttarakhand, and Kashmir; (Around Pahalgam).

Elsewhere : Nepal, and Bhutan (all along the Himalaya)

Remarks : High altitude species, commonly occurs under stones on the edge of streams and rivers. It shows variations in the morphogenesis of forceps. Macrolabic form of forceps is present in the material studied. This species is recorded for the first time from Kashmir.

Subfamily OPISTHOCOSMIINAE Verhoeff, 1902

Genus *Eparchus* Burr, 1907

1907. *Aparchus* Burr, *Trans. ent. Soc. Lond.*: 120 (Type species: *Forficula insignis* Haan, 1842).

1908. *Taipinia* Shiraki, *Trans. Sapparo nat. Hist. Soc.*, 2 (1-2) : 105 (Type *Taipiniapulla* Shiraki, 1908)
 1911. *Narberia* Burr, *Genera Insect.*, 122: 94 (Type species *Opisthocosmia biroi* Burr, 1902.)

16. *Eparchus insignis* (Haan, 1842)

1842. *Forficula insignis* Haan, *Verh. Nat. Gest. Nederl. Overz. Bezeit.* 243, fig. 15 (♂, ♀; Java).
 1865. *Opisthocosmia insignis*; Dohrn, *Stettin. Ent. Ztg.*, 26: 81.

Material Examined : South India: Palni Hills, neutral saddle, 5000ft, 3 ♂♂, 1 ♀, 1 nymph, Sept. 1922 (S. Kemp); Manipur: 16 miles North of Imphal on Dimapur Road, ca 3500ft, 1 ♂, 1 ♀, 1 nymph, evergreen forest, under stones, 23.x.1945 (Major M.L. Roonwal)

Measurements (in mm.)	Male	Female
Length of body	10-12	8-10
Length of forceps	5-6	3-4

Distribution : INDIA (Assam, Arunachal Pradesh, Sikkim, Meghalaya, West Bengal and Tamil Nadu)

Elsewhere : Sri Lanka, Nepal, Myanmar, Siam, Java, Celebes, and Hainan.

Remarks : The occurrence of this species from South India (Tamil Nadu: Palni Hills, 5000 ft.) extends its distribution from North East India to South India. It is observed that the species collected from higher altitude is brown to deep brown in color while at lower altitude is blackish brown. This variation in color is due to the survival at different altitudes and adaptive zones (ecological niches).

Recorded for the first time from Tamil Nadu (South India, Alt. 5000 ft.) and Manipur (Imphal, Alt. 3500 ft.) states.

Subfamily FORFICULINAE Burr, 1907

Genus *Elaunon* Burr, 1907

1907. *Elaunon* Burr, *Trans. Ent.Soc. London*: 123.

17. *Elaunon bipartitus* Kirby, 1891

1891. *Sphingolabis bipartita* Kirby, *J. Linn. Soc. (Zool.)* 23: 526 (♂♀; India).
 1910. *Elaunon bipartitus* Burr, *Fauna of British India, Dermaptera*, p. 163, figs. 53 and 102.

Material examined : South India: Palni Hills, Kodaikanal, 6900 ft., Coll. S. Kemp, Aug. 1922, 1♀.

Diagnostic Characters : Male: Abdomen almost parallel sided. Forceps macrolabic, not dilated near base. Mesotarsus lobately expanded. Genital lobe single with a basal vesiculum and long virga.

Distribution : INDIA: Assam, Himachal Pradesh, Uttarakhand, Karnataka, Nilgiri and Palni Hills.

Elsewhere : Sri Lanka, Vietnam, Philippine islands, Formosa, New Guinea and Australia.

ACKNOWLEDGEMENTS

We are very much indebted to Dr. K. Venkataraman Director, Zoological Survey of India for facilities. We are thankful to Dr. G.K. Srivastava, Retd. Scientist, ZSI for his valuable suggestion during the preparation of the manuscript and Dr. Sheela, S. for her constant help during our study and all other staffs of Coleoptera Section, ZSI for encouragement.

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ORB-WEAVING SPIDERS OF BANGLADESH-II : GENUS *LARINIA* SIMON (ARANEAE : ARANEIDAE) WITH DESCRIPTION OF A NEW SPECIES

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INTRODUCTION

Members of the orb-weaving spider family Araneidae (=Argiopidae) are abundant throughout Bangladesh but have little attention on their study. Chowdhury and Pal (1984), Biswas, *et al.* (1993), Okuma, *et al.* (1993), Begum and Biswas (1997) and Biswas and Raychaudhuri (1998 & 2003) have made some contributions on these spiders from different parts of the country. Studies on these spiders in neighbouring countries like-India (Pocock, 1900; Tikader, 1970, '82; Tikader & Bal, 1981; Tikader & Biswas, 1981; Saha, *et al.*, 1995; Biswas, *et al.*, 1997), Burma (Thorell, 1895), Pakistan (Dyal, 1935), China (Chen & Zhang, 1991; Yin, *et al.*, 1997; Zhao, 1993; Song, *et al.* 1999) and Japan (Tanikawa, 1989; Yaginuma, 1986) are rather well documented. Beside these, Kaston (1948), Levi (1975) and Barrion and Litsinger (1995) have valuable contributions on these spiders in different parts of the globe.

The genus *Larina* Simon was recorded since 1992 from Bangladesh and composed of 3 (three) species of which *L. modhuchhandae* is recognised as new to science while *L. phthisica* (L. Koch) and *L. chloris* (Audouin) are new record for the country. An illustrated description of the new species together with the key are provided herewith.

The types are at present in the collection of the Department of Zoology, Government P.C. College, Bagerhat and will be deposited to the Museum of the Department of Zoology, University of Dhaka, Bangladesh in due course of time.

SYSTEMATICS

Genus *Larina* Simon

1874. *Larina* Simon, *Arach. de France*, 1: 115.
1948. *Larina* : Kaston, *Bull. Conn. St. Geol. nat. Hist. Surv.*, 70: 228.
1975. *Larina* : Levi, *Bull. Mus. comp. Tool. Harv.*, 145(3): 102.
1982. *Larina* : Tikader, *Fauna of India*, Spiders (Araneidae : Gnaphosidae) 2(1) : 205.
1986. *Larina* : Yaginuma, *Spiders of Japan in colour*, : 115.
1997. *Larina* : Yin, *et al.*, *Fauna Sinica*, Arachnida (Araneae: Araneidae) : 312.
1999. *Larina* : Song, *et al.*, *The Spiders of China* : 291.
2005. *Larina* : Majumder, *Mem. zool. Surv. India*, 20 (3): 12.

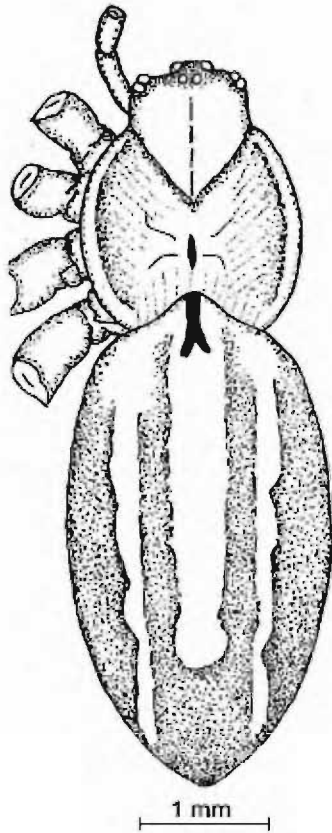
Diagnosis : Body elongate, abdomen 2-3 times longer than cephalothorax. Cephalothorax rather long, scarcely convex posteriorly, 2nd row of eyes nearly straight, laterals nearly equal and closely placed; posteromedians nearer, anteromedians widely separated; ocular area trapezoid. Chelicerae not long, thick, teeth variable. Maxillae longer than wide. Legs long and slender, clothed with strong spines and hairs.

Abdomen elongate, with a single median, blunt, pointed in front; caudal process absent; ventrally with longitudinal white band guarded laterally by black patches between epigastric furrow and spinnerets.

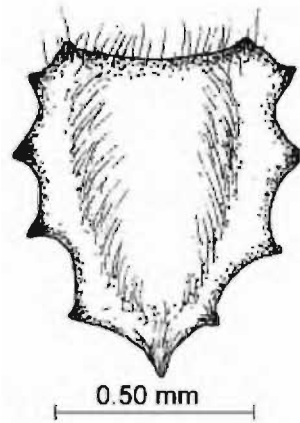
Type-species : *Larina lineata* (Lucas).

1. Present Address : Department of Zoology, Khulna Govt. Women's College, Khulna-9000, Bangladesh.

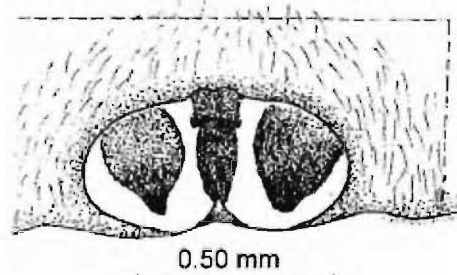
Figs. 1-6 : *Larinia chloris* (Savigny & Audouin)



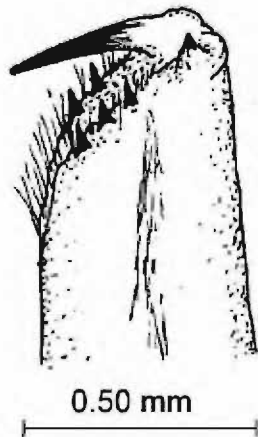
Figs. 1. Female dorsal view (legs omitted)



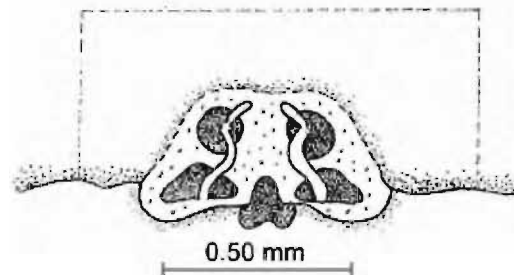
Figs. 4. Sternum



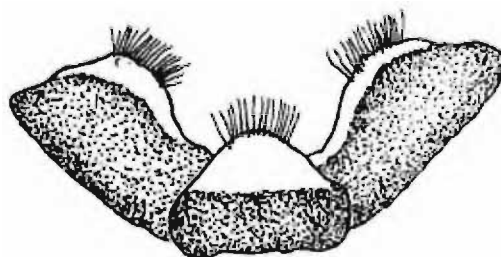
Figs. 5. Epigynum



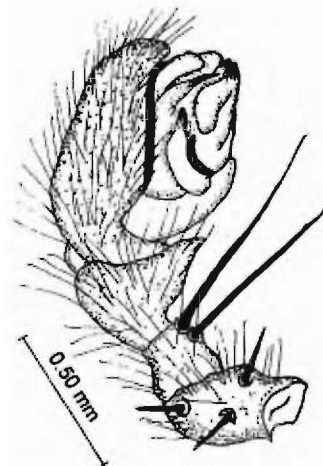
Figs. 2. Chelicerae



Figs. 6. Internal genitalia

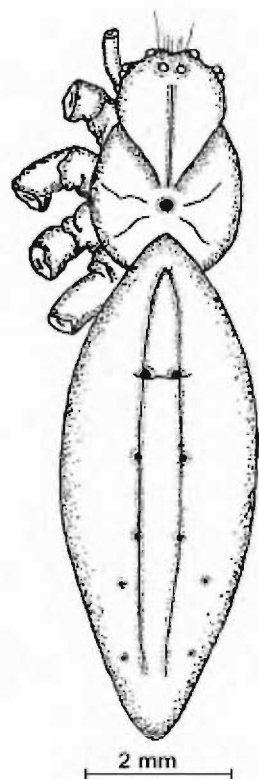


Figs. 3. Maxillae and Labium

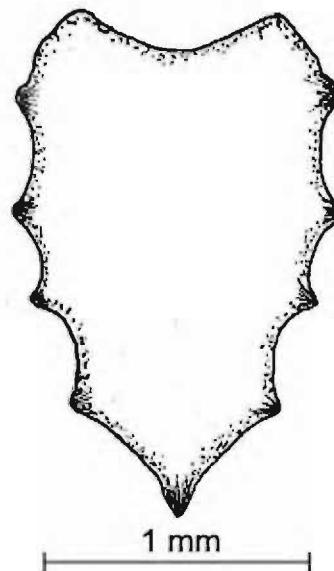


Figs. 7. Male palp

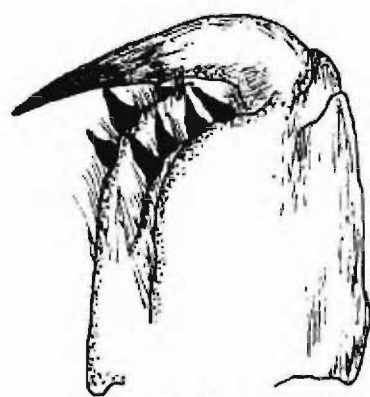
Figs. 8-13 : *Larinia modhuchhandae* sp. n.



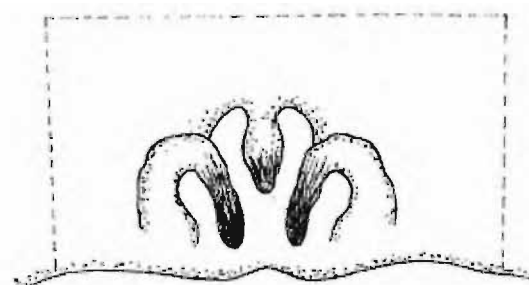
Figs. 8. Female dorsal view (legs omitted)



Figs. 11. Sternum

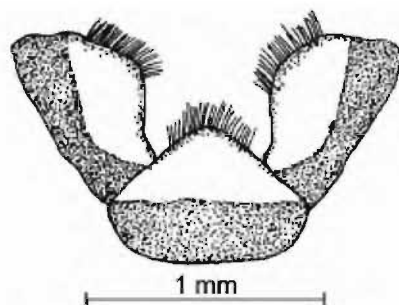


0.50 mm
Figs. 9. Chelicerae

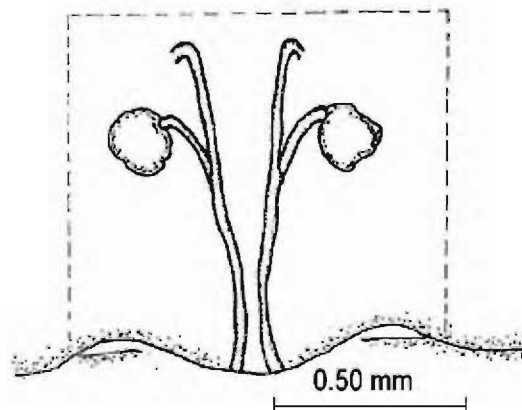


0.50 mm

Figs. 12. Epigynum

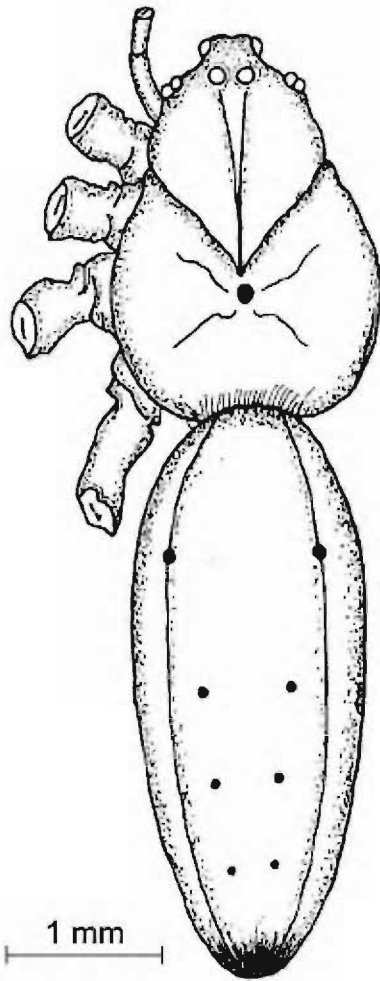


1 mm
Figs. 10. Maxillae and Labium

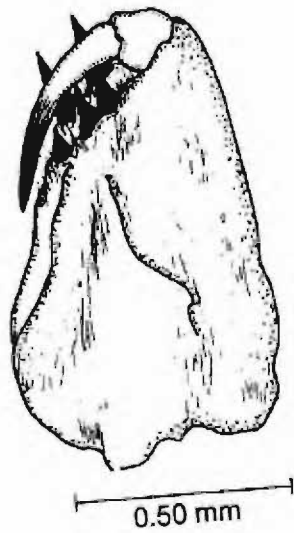


0.50 mm
Figs. 13. Internal genitalia

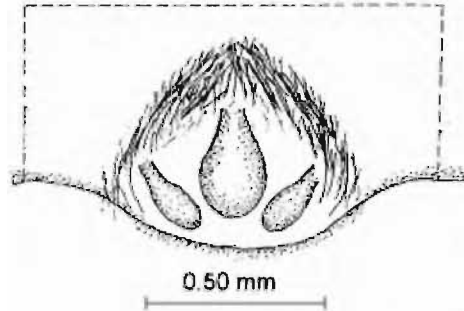
Figs. 14-19 : *Larinia phtisica* (L. Koch)



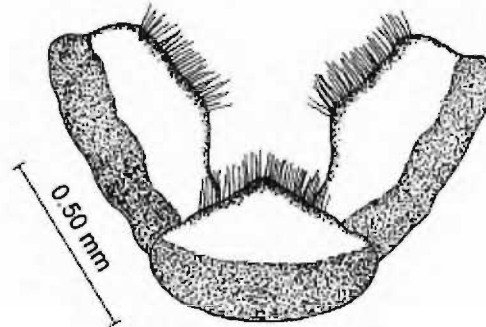
Figs. 14. Female dorsal view (legs omitted)



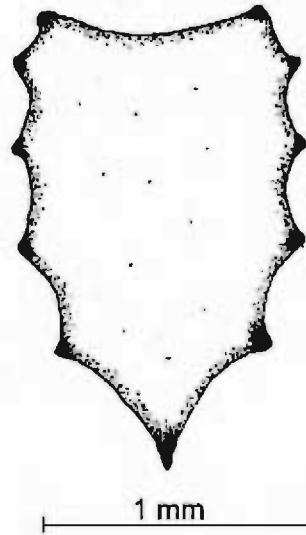
Figs. 15. Chelicerae



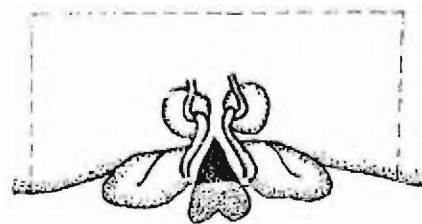
Figs. 16. Maxillae and Labium



Figs. 17. Sternum



Figs. 18. Epigynum



Figs. 19. Internal genitalia

Distribution : All the tropical and sub-tropical countries of the world.

Key to the species

1. Abdomen spindle-shaped, more or less pointed at both ends; cephalic region anteromedially never produced; inner margin of chelicerae with 4 teeth; epigyne and internal genitalia as in figs. 12 and 13
*madhuchhandae* sp. n.

Abdomen elongately oval, but never boat shaped; uphalic region anteromedially produced into a protuberance; inner margin of chelicerae with 3 teeth.....2

2. Cephalic region with 'Y'-shaped marking; fovea in the thoracic region round, radii distinct; abdomibal dorsum with sigilla; epigyne and internal genitalia as in figs. 18 and 19.....
*phthisica*

Cephalic region without any such marking; fovea in the thoracic region eongate, radii indistinct; abdominal dorsum without any sigilla; epigyne and internal genitalia never as above, figs. 5 and 6
*chloris*

**1. *Larinia chloris* (Audouin)
 (Figs. 1-7)**

- 1825. *Epeira chloris* Audouin, Descr. de l'Egripte, **22** : 347.
- 1872. *Argiope epeiroides* : O.P. Cambridge, *Proc. zool. Soc. Lond.*, : 301.
- 1911. *Larinia epeiroides* : Petrunkevitch, *Bull. Am. Mus. nat. Hist.*, **29** : 353.
- 1937. *Larinia chloris* : Bodenheimer, *Mem. Inst. Egypte.*, **33** : 238.
- 1982. *Larinia chloris* : Tikader, *Fauna of India, Spiders*, **2(1)** : 206.

Material examined : 2♀, Durbarchar, Sunderban forest, Bagerhat, 15. XII. 1991, Coll. V. Biswas; 10, Jessore, 19. IX. 1992, Coll. V. Biswas; 1♂ 1♀, Mymensingh, 15. V. 1993, Coll. V. Biswas; 1♀, Tangail, 2. V. 1993, Coll. V. Biswas.

Distribution : BANGLADESH : Bagerhat (Sunderban), Jessore, Mymensingh, Tangail; EGYPT; INDIA; ISRAEL; LIBIYA; SYRIA; UGANDA (Tikader, 1982).

**2. *Larina madhuchhandae* sp. n
 (Figs. 8-13)**

General : Cephalothorax brownish-yellow; legs pale yellow; abdomen yellowish with light brown spots. Total body length (Holotype) 9.00 mm. Carapace 3.00 mm. long, 2.00 mm wide; abdomen 6.00 mm long, 2.20 mm wide.

Cephalothorax : Longer than wide, anteriorly narrowing; cephalic region raised, constricted anteromedially with two distinct cervical furrows, medially with a longitudinal brown line. Eyes pearly-white, similar; anterior row strongly recurved while posterior row nearly straight; lateral eyes close, placed marginally; anteromedians situated on 2 protuberances; ocular quad ateriorly wide and posteriorly narrowing. Thoracic region wide, with distinct radii. Chelicerae brown, broad, each of inner and outer margins with 4 dissimilar and 3 similar teeth (Fig. 9). Maxillae brown, longer than wide, anteriorly broad and scopulate (Fig. 10). Labium brown, wider than long, anteriorly bluntly pointed and scopulate (Fig. 10). Sternum elongate, cylindrical, posteriorly pointed, anteriorly wide and concave (Fig. 11). Legs long and slender, clothed with spines and hairs; leg formula 1243 and measurments (in mm) as in Table-1.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.70/2.70	1.10/1.10	2.70/2.70	4.20/4.20	1.10/1.10	11.80/11.80
II	2.50/2.50	0.85/0.85	2.20/2.20	2.50/2.50	0.80/0.80	8.85/8.5
III	1.30/1.30	0.50/0.50	1.00/1.00	1.10/1.10	0.50/0.50	4.40/4.40
IV	2.65/2.65	0.90/0.90	2.00/2.00	2.20/2.20	0.60/0.60	8.35/8.35

Table-1. Length of legs of female (O) holotype of *Larinia madhuchhandae* sp. n.

Abdomen : Elongated, boat-shaped, both ends pointed; dorsum with median white longitudinal band and 5 pairs of sigilla, clothed with sharp hairs; ventrally pale; epigyne and internal genitalia as in figs. 12 and 13.

Male : Unknown.

Holotype : Female in spirit.

Paratype : 2♀, Bagerhat (Sunderban), 12. IX. 1992, Coll. V. Biswas.

Type-locality : BANGLADESH : Durbarchar and Hironpoint, Sunderban forest, Dist. Bagerhat, 15. XII. 1991 & 12. IX. 1992, Coll. V. Biswas.

Etymology : The species has been named after one of my laboratory mate Mrs. Madhuchhanda Kundu who helped me in many ways during the course of present study.

Remarks : The species appears close to *L. tyloridia* Patel (Patel, 1975) because of the typical wedge-shaped abdomen, maxillae, labium and sternum. But however, it stands distinct in having strongly raised and produced cephalic region, deeply distinct cervical furrows, rounded fovea, four strong teeth on inner margin of chelicerae besides the epigynum. None of the other *Larinia* species (Tikader, 1982; Tanikawa, 1989; Yaginuma, 1986; Kaston, 1948) seem to show any similarity with the present species. And accordingly, the species is described as new to science.

3. *Larina phthisica* (L. Koch) (Figs. 14-19)

1871. *Epeirtaphthisica* L. Koch, *Die Arachniden Australiens*, 1(1) : 193.
1878. *Lipocrea phthisica* : Thorell, *Annali. Mus. civ. Geneva*, 13 : 6.
1887. *Epeira phthisica* : Keyserling, *Die Arachniden Australiens*, 2 : 171.
1887. *Larinia phthisica* : Simon, *Annl. Soc. ent. Fr.*, 7(6) : 186.

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1997. *Larinia phthisica* : Yin, *et al.*, *Fauna Sinica, Spiders* : 321.

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Material examined : 1♀, Barisal, 12. VIII. 1992, Coll. V. Biswas; 1♀, Jhenidah, 19. V. 1993, Coll. V. Biswas; 1♀, Faridpur, 19. IX. 1992, Coll. V. Biswas; 1♀, Faridpur, 29. IX. 1992, Coll. V. Biswas.

Distribution : BANGLADESH : Barisal, Jhenidah, Faridpur; INDIA (Tikader, 1982); JAPAN (Yaginuma, 1986); CHINA (Yin, *et al.*, 1997; Song, 1999); THE PHILIPPINES (Barrion & Litsinger, 1995).

SUMMARY

The present paper deals with 3 (three) species of orb-weaving spiders of the genus *Larinia* Simon from Bangladesh. Of these, *L. madhuchhanda* is recognised as new to science while *L. chloris* (Audouin) and *L. phthisica* (L. Koch) are new record for the country.

The study on these spiders was started in 1992 have revealed the existence of the above species of a particular area of Bangladesh. Identity of the species were later confirmed from the Zoological Survey of India, Kolkata.

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ON SOME COLLECTIONS OF ECHINODERMATA FROM ANDHRA PRADESH AND ORISSA COASTS OF INDIA

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Accounts of faunal resources of different coastal segments are important to trace the availability and to assess the extent of distribution as well as the similarity among the fauna and the habitats. Knowing the echinoderm resources is additionally important because of their connection with the health of the environment. The studies of Ganapati and Lakshmana Rao (1962a, b), Rao and Rao (1962), Radhakrishna and Ganapati (1968) and Vijayakumar *et al.* (1991) on the Andhra Pradesh fauna and of Nagabhushanam and Rao (1969) on Orissa are mainly directed towards ecological aspects and only common species of echinoderms are included in their faunal lists. Recently Sastry (2007) compiled a list of echinoderm species reported from the Indian coast with state wise distribution in the annotation which included 85 spp. from Andhra Pradesh (assuming the echinoids *Salmaciella dussumieri* and *Lovenia elongata* might be from Andhra Pradesh though reported from 'Coromandal Coast' which includes Tamil Nadu and Andhra Pradesh coasts but not definitely known) and 52 spp. from Orissa coasts. During the recent survey of Andhra Pradesh and Orissa coasts, 40 species of echinoderms were encountered. The material included several species new to these coasts including one asteroid and one holothurian new to India and reveals extensive distribution along these coasts. These are briefly reported hereunder. Photographs of most of the species are given to facilitate identification of future local collections. All the material is present in the Zoological Collections of Marine Biology Laboratory, Andhra University, Visakhapatnam.

Phylum ECHINODERMATA
Class CRINOIDEA
Order COMATULIDA
Family HIMEROMETRIDAE

1. *Heterometra philiberti* (J. Müller, 1849)

1909. *Amphimetra mortenseni* A. H. Clark, *Proc. U. S. nat. Mus.*, **36**: 635. South Andamans: Port Blair.
1912. *Amphimetra philiberti*: A. H. Clark, *Echinoderma of the Indian Museum*, Part VII: 107, 316. Andaman Id, Port Blair.
1971. *Heterometra philiberti*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow water Indo-West Pacific echinoderms*, 8-9 (distribution) and 77 (key).
1983. *Amphimetra philiberti*: James, D. B. *Bull. cent. Mar. Res. Inst.*, **34**: 88 (Andamans)
2007. *Heterometra philiberti*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 12

Material : Andhra Pradesh: Vizianagaram District- off Santapalli Rocks, 18°03' N 83°39' E, 10 m, 20 specs.

Description : Arms 21 in number, 60-80mm long; first brachial syzygy at 3+4 and the second well beyond 9+10. Proximal pinnules smooth, not conspicuously flared or spinose; P1, P2 and P3 gradually becoming longer and stouter. IBr of two ossicles and IIBr of four ossicles with syzygy at 3+4. There is only one IIIBr series in each specimen, of two segments without a syzygy in one specimen and of four segments with syzygy at 3+4 in the other two. Cirri about 20 in number, of about 30 segments, a prominent median dorsal spine on each of the distal segments; terminal claw curved.

Remarks: In Sastry (2007: 164, *Chaetodiadema granulatum* and elsewhere) Santapalli was inadvertently mentioned as in Srikakulam District under Koehler (1927), but it is in Vizianagaram District.

Distribution : India- Andaman Islands. The species is newly recorded here from Andhra Pradesh of Indian peninsula.

Elsewhere : Bay of Bengal and East Indies.

Family MARIAMETRIDAE

2. *Lamprometra palmata* (J. Müller, 1841)

(Pl. I. Fig. 1)

1971. *Lamprometra palmata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 8-9 (distribution) and 24 (key).

2007. *Lamprometra palmata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 13

Material : Andhra Pradesh : Visakhapatnam District- off Pudimadaka, 5 m, 1.11.2008, five specs; off Pudimadaka, 5 m, 17.3.2009, two specs.

Description : Arms up to 40 in number, more than 40 mm long. Division series of only two segments, no syzygy; IIIBr series sometimes only on inner or outer side, rarely IIIBr series absent. P2 larger than P1 and P3. First brachial syzygy at 3+4 and the second at 16+17. Cirri about 30 in number with about 25 segments, dorsal side of segments smooth and rounded.

Remarks : Larger specimens were once common in the intertidal rocky habitat at Pudimadaka and Rao and Sowbhagyavathi (1972) reported several associates, particularly myzostomes from these. The two specimens collected on 17.3.2009 were on a gorgonacean and had five small specimens of the epizoic ophiothricid ophiuroid *Ophiothela danae*.

Distribution : India- Daman, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh.

Elsewhere : West coast of India and Maldives to Hawaiian and South Pacific Islands.

Family TROPIOMETRIDAE

3. *Tropiometra carinata* (Lamarck, 1816)

(Pl. I. Fig. 2)

1971. *Tropiometra carinata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 10-11 (distribution) and 25 (key).

2007. *Tropiometra carinata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 19

Material : Andhra Pradesh: Vizianagaram District- off Santapalli Rocks, 18°03' N 83°39' E, 10 m, 20 specs; Visakhapatnam District- off Pudimadaka, 5 m, 1.11.2008, 21 specs and 15 m, one spec; 25 m, 17.3.2009, seven specs.

Description : Arms 10 in number, 20-80 mm long, arm segments with a longitudinal tubercle-like thickening on dorsal side at the middle of the distal margin giving a keeled appearance; first brachial syzygy at 3+4 and the second mostly at 9+10. Pinnules erect, segments prismatic and keeled on dorsal side. IBr of two ossicles, no syzygy. Cirri 25-40 in number, of about 20-25 segments, dorsal and ventral sides smooth and rounded, no spines or ridges.

Remarks : The species is very common at the rocky habitats of Visakhapatnam coast.

Distribution : India- Andhra Pradesh and Tamil Nadu.

Elsewhere : Red Sea, SE Arabia, East coast of Africa and Madagascar to Bay of Bengal and? East Indies.

Class ASTEROIDEA

Order PAXILLOSIDA

Family LUIDIIDAE

4. *Luidia hardwicki* (Gray, 1840)

(Pl. I. Figs. 3, 4)

1971. *Luidia hardwicki*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 44 (key), 30-31 (distribution)

2007. *Luidia hardwicki*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 24

Material : Andhra Pradesh: Srikakulam District- off Barua (INS-06, Station 12, D-1, September, 2006), 30m two specs, R = 12 and 15 mm; Visakhapatnam District- Pudimadaka, 35 m, 1.11.2008, one spec; Pudimadaka, St. 3, 15 m, 17.3.2009, one spec, R = 20 mm; Guntur District- Nizampatnam Bay (Station 19/1, 12.10.2006), two specs, R/r = 37/7 and 32/7 mm; (Station 14/2, 12.10.2006), one spec, R/r = 45/8 mm in the longest arm, remaining regenerating arms 20-22 mm; (Station 19/2, 13.10.2006), 1 spec; (Station 17/1, 12.10.2006), two specs, larger specimen complete arm R = 75 mm, other arms broken; (Station 18/1, 12.10.2006), four specs, R = 11-65 mm.

Remarks: The specimens measure 12-65 mm in R; some of the specimens have only one complete arm and the others are broken or regenerating small arms.

Distribution: India- Maharashtra, Tamil Nadu and West Bengal. The species is newly recorded from Andhra Pradesh.

Elsewhere : SE Arabia, Persian Gulf, Islands of Western Indian Ocean, Bay of Bengal, East Indies, South China Sea and North Australia.

Family ASTROPECTINIDAE

5. *Astropecten euryacanthus* Lütken, 1872

(Pl. I. Figs. 5, 6)

1971. *Astropecten euryacanthus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 44 (key), 30-31 (distribution)

2007. *Astropecten euryacanthus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271: 27*

Material : Andhra Pradesh: Guntur District- Vodarevu, 9 km NE of Chirala; 20-22 Dec. 1964; N. V. Subba Rao; 24 specs.

Description : The specimens measure from about 50 mm to 80 mm in R. In the largest specimen, R/r = 80/20, width at base 19 mm, broadest after a few segments (21 mm), width of paxillar area = 11 mm. Actinal plates mostly three, two in some interradial. Superomarginal spines are absent, inferomarginals with a chisel shaped flat spine at the margin and scale like spinelets on the actinal surface.

Remarks : Clark (1989) proposed justification of suppression of the senior synonym *Asterias petalodea* Retzius, 1805 to avoid confusion arising out of application of priority. The specimens are in the National Zoological Collection of Zoological Survey of India, Kolkata and inadvertently missing in Sastry (2007).

Distribution : India- Andhra Pradesh (Krishna District), West Bengal and Nicobar Islands. This is an additional locality from Andhra Pradesh.

Elsewhere : Sri Lanka.

6. *Astropecten monacanthus* Sladen, 1883

(Pl. I. Figs. 7, 8)

1971. *Astropecten monacanthus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 46 (key), 30-31 (distribution)

2007. *Astropecten monacanthus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271: 30*

Material : Orissa: Off Chilika Lake (INS-06, Station 14, D-1; Sep. 2006), 20m, one spec.

Remarks : The specimen measures R/r = 55/15 mm; actinal plates two; interradial superomarginals without spines; distal superomarginals with very small tubercles; inferomarginals with one broad pointed spine, below the main spine, one spine one-fourth of the main one or still smaller, actinal surface covered with rounded scales.

Distribution : India : Tamil Nadu, Orissa and Andaman Islands. Earlier it was also reported from 'Coromandel Coast' which includes Tamil Nadu and part of Andhra Pradesh. Though the exact location is not clear, the record was mentioned as from Andhra Pradesh Coast in Sastry (2007)

Elsewhere : Arabian Gulf, East Africa to South China Sea and Philippine Islands and north Australia.

7. *Astropecten vappa* Müller and Troschel, 1843

(Pl. VI. Fig. 41)

1971. *Astropecten vappa*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 45 (key), 30-31 (distribution)

2007. *Astropecten vappa*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271: 31*

Material : Andhra Pradesh: Visakhapatnam District- off Pudimadaka, 10 m, 29.10.2008, one specimen, R/r = 40/9 mm, Br = 9 mm, Px = 4.5 mm, two interradial superomarginals on each side with a tubercle-like spine on the inner margin and the series on the outer margin extending up to two-thirds the length of the arm; off Pudimadaka, St. 1, 5 m, 17.3.2009, five (three, R=30-32 mm and two juvenile) specs; off Pudimadaka, St. 2, 5 m, 17.3.2009, one spec., R/r=37/12 mm; off Pudimadaka, St. 3, 15 m, 17.3.2009, one spec, R/r=42/13 mm; off Pudimadaka, St. 1, 10 m, 18.3.2009, three specs, R=36-37 mm; East Godavari District- Kakinada Bay (Station 2C-D2, 11.06.2007), one spec; R/r = 15/5 mm, superomarginal spines only on the proximal three segments, others without spines; (Station 3-D2, 11.06.2007), one spec; R/r = 34/10 mm; (Station 1-D1, 19.06.2007), one spec, R/r = 30/8 mm. **Orissa:** Off Subarnarekha river mouth (Station 3-D1, 19.6.2007), five specs, R/r = 27/7 mm;

superomarginal spines short and continuous from interradial area to tip of the arm, 2-3 plates about the middle of the arm with an inner series of spines; adambulacrals with three furrow spines, subambulacrals in two series of two and two or three spinelets; inferomarginals with one long pointed spine on the margin, one large spine of half the length of the main surrounded by two or three small spinelets; actinal surface with small rounded scale-like covering; (Station 1A-D1), 17 specs, R = 18-26 mm.

Distribution : India- Gujarat, Tamil Nadu and Andaman Islands. This is the first report of the species from Andhra Pradesh and Orissa.

Elsewhere : Sri Lanka, South China Sea, Philippine Islands and SW Australia to southern Queensland.

8. *Astropecten velitaris* von Martens, 1865

(Pl. II. Fig. 9)

1865. *Astropecten velitaris* von Marten, E. Arch. Naturgesch. 31: 360

1971. *Astropecten velitaris*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 46 (key), 30-31 (distribution)

1989. *Astropecten velitaris*: Clark, A. M. In: M. Jangoux and J. M. Lawrence (eds.), *Echinoderm Studies*, 3: 271. Taiwan (Formosa), Philippine Islands, Indonesia, Western Australia, 25-113 m.

Material : Andhra Pradesh: Srikakulam District-off Barua (INS-06, Station 10, D-1, Sep. 2006), 10 m, one spec, intact arm- R/r = 45/10 mm, four arms broken and regenerating; (INS-06, Station 11, D-1, Sep. 2006), 20m; one spec, R = 55 mm; (INS-06, Station 11, D-2, Sep. 2006), 20 m, three specs, R = 10, 43 and 47 mm; (INS-06 Station 12, D-2, Sep. 2006), 30m, 10 specs, R = 8-15 mm, only larger specs with small tubercle-like spines on interradial superomarginal plates; (INS-06, Station 12, D-1, Sep. 2006), 30 m, 10 specs, R = 7-13 mm; Visakhapatnam District- off Pudimadaka, 5 m, 1.11.2008, one spec, R/r = 35/18 mm, Br = 12 mm, Px = 6 mm, two interradial superomarginal plates on each side with a single tubercle like spine on the inner margin, inferomarginal plates with one marginal spine and one or two smaller spines below; East Godavari District- Kakinada Bay (Station 2C-D2, 11.06.2007), one spec, R/r = 60/13 mm, two interradial superomarginals with a little

prominent spines, very small spinelets on 6-7 plates beyond one-third of the arm, adambulacrals with three furrow spines, two large spinelets behind and a cluster of small spinelets in the distal area, inferomarginals with one long pointed spine at the margin, two large pointed spinelets, actinal surface covered with short pointed spinelets; (Station 2C-D2, 11.06.2007), three specs, R = 50, 60 and 62 mm, R = 4r; Guntur District- St. 10. Vodarevu, 21 m, 9.9.2008, five specimens, R = 9-16 mm; Nizampatnam Bay (Station 9/2, 11.10.2006), two specs, R = 9 and 10 mm; (Station 18/1, 12.10.2006), one spec, R = 18 mm; (Station 19/1, 12.10.2006): one spec; (Station 17/1, 12.10.2006), one spec; St. 5/1, 18 m, 9.7.2008, four specs; St. 5/2, 18 m, 9.7.2008, one spec. Orissa: Off Chilika Lake (INS-06, Station 13, D-1, Sep. 2006), 10 m, two specs; (INS-06, Station 13, D-2, Sep. 2006), 10 m, two specs, R = 13 and 25 mm; (INS-06, Station 15, D-2, Sep. 2006), 30 m; one spec.

Remarks : The specimens measure 7-62 mm in R and R = 4-4.5 r.

Distribution : India : The species newly recorded from the coasts of Andhra Pradesh and Orissa is new to India.

Elsewhere : Sri Lanka, East Indies, South China Sea and North Australia.

Order VALVATIDA

Family ASTERINIDAE

9. *Asterina lorioli* Koehler, 1910

(Pl. II. Fig. 10)

1971. *Asterina lorioli*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 38-39 (distribution) and 67 (key).

2007. *Asterina lorioli*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271: 44*

Material : Andhra Pradesh: Visakhapatnam District- off Pudimadaka, St. 1, 10 m, 18.3.2009, one specimen.

Remarks : The specimen measures 20 mm in R and 12 mm in r, with R/r = 1.67. Abactinal armament of short and blunt granuliform spinelets. Popular pores single, confluent radially, margin of interradial areas thin, arms slightly thick.

Distribution : India- Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh.

Elsewhere : known only from India.

Family OREASTERIDAE

10. *Anthenea pentagonula* Lamarck, 1816

(Pl. II. Figs. 11, 12)

1997. *Anthenea pentagonula*: James, D. B. *J. mar. biol. Ass. India*, **38**: 134.2007. *Anthenea pentagonula*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 58

Material : Andhra Pradesh : Guntur District-Nizampatnam Bay (Station 18/1, 12.10.2006), five specs, R/r = 19/8, 20/8, 25/12, 28/13, 30/13, colour after preservation, pinkish on abactinal, and some actinal plates, others colourless; (Station 18/2, 12.10.2006), one specimen, R/r = 65/30, colour reddish when live, turned light brown on preservation; (Station 17/1, .09. 03.2007), one specimen, R/r = 13/6; St. 10. Vodarevu, 21 m, 9.9.2008, one spec, R/r = 57/23 mm.

Description : Abactinal side moderately convex, abactinal plates irregularly polygonal, closely packed, covered with uniform granulations, a single enlarged tubercle on some of the abactinal plates only in the largest specimen. Superomarginal plates large, vertically aligned but extending to abactinal side forming a side wall, covered with uniform granulation. Inferomarginal plates with a prominent flat spine on the outer lower margin. Actinal plates parallel to the adambulacrals, covered with uniform granulation and with 1-3 large bivalved pedicellariae conspicuous particularly on the plates adjacent to the adambulacrals. Adambulacral plates with 6-8 furrow spines, 2-3 subambulacrals spines and fine granulation outer to these.

Remarks : The smallest specimen from Station 17/1 with poorly developed granulation only on the abactinal side, pedicellariae not yet developed, and very small subactinal spines, appears to be a juvenile. James (1997) revised the species of the genus and gave full synonymy.

Distribution : India- Gujarat, Tamil Nadu, Orissa and Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Bay of Bengal and South China Sea.

11. *Pentaceraster affinis* (Müller and Troschel, 1842)

(Pl. II. Figs. 13, 14)

1971. *Pentaceraster affinis*: Clark, A. M. and Rowe, F. W. *E. Monograph of shallow-water Indo-West Pacific echinoderms*, 34-35 (distribution) and 56 (key).1993. *Pentaceraster affinis*: Clark, A. M. *Echinoderm Studies*, **4**: 310. Sri Lanka area, Bay of Bengal.2007. *Pentaceraster affinis*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 62

Material : Andhra Pradesh: Guntur District-Nizampatnam (St.18/1), m, 8.3.2007, one specimen.

Description : The specimen measures 95/35 mm in R/r. Abactinal surface covered with small rising granules. Primary plates each with a spine like tubercle, continuing on the carinal series of plates, smaller in the proximal half and prominent in the distal half; also a lateral series on either side of the carinals. Supero- and inferomarginals granule covered with a prominent tubercle, no inter-marginal pores or plates. Adambulacrals with 8-10 small spines deep in the furrow spines and two series of subambulacrals often of three and two spines. Actinal plates covered by irregular granules, some large and high.

Distribution : **India**- Andhra Pradesh and Tamil Nadu.

Elsewhere : Bay of Bengal. The species is newly recorded from Andhra Pradesh.

Order SPINULOSIDA

Family ECHINASTERIDAE

12. *Echinaster purpureus* (Gray, 1840)

(Pl. II. Figs. 15, 16)

1971. *Echinaster purpureus*: Clark, A. M. and Rowe, F. W. *E. Monograph of shallow-water Indo-west Pacific echinoderms*, **73** (key), 40-41 (distribution)2007. *Echinaster purpureus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 82

Material : Andhra Pradesh: Guntur District-Nizampatnam Bay (Station 17/1, 12.10.2006), one spec, R/r = 28/6 mm, br = 6 mm.

Remarks : Cylindrical arms with bluntly rounded tips, space between the furrow spines and subambulacral spines, and a single madreporite characterize the species.

Distribution : India- Gujarat, Tamil Nadu, Orissa and Nicobar Islands. The species is new to Andhra Pradesh.

Elsewhere : Red Sea, East Africa, Islands of Western Indian Ocean, Mascarene Islands, Maldives and Bay of Bengal.

Class OPHIUROIDEA
Order OPHIURIDA
Family OPHIONEREIDAE

13. *Ophiochiton ambulator* Koehler, 1897

(Pl. III. Fig. 17)

1897. *Ophiochiton ambulator* Koehler, R. *Ann. Sci. nat. Zool.* (8) IV: 337. Goa: 72° 38' 10" E 15° 05' 03" N, 1273 m (696 fms.); Maldives, 7° 05' 45" N 75° 04' E, 1315 m (719 fms.); Bay of Bengal; Sri Lanka: Trincomale, 366-640 m (200-350 fms.); Pakistan: Coast of Baluchistan, 1628 m (890 fms.).

1899. *Ophiochiton ambulator*: Koehler, R. *Echinoderma of the Indian Museum*, Part I: 49. Off Andhra Pradesh: Godavari Delta, 494 m (270 fms.); Off Kerala: Malabar Coast, 75°36' 30" E 9°34' 57" N, 741 m (405 fms.).

2007. *Ophiochiton ambulator*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 120

Material : Andhra Pradesh : Krishna District-Divi Point (Krishna River Mouth), *Sagar Sampada* Cruise No. 225, 700 m, three specs, dd about 28 mm; *Sagar Sampada* Cruise No. 245, 750 m; two specs, dd 25 and 22 mm, arms broken; *Sagar Sampada* Cruise No. 236, 700 m, one spec, dd = 27 mm; *Sagar Sampada* Cruise No. 236, East Godavari District- Off Kakinada, 300 m, four specs, smallest spec with dd 12 mm. **Orissa**: *Sagar Sampada* Cruise No. 225, Paradeep, 700 m, one spec, dd 20 mm; *Sagar Sampada* Cruise No. 236, Paradeep, 500 m, one spec, dd 13 mm.

Distribution : India- Goa, Kerala and Andhra Pradesh. The species is new to Orissa.

Elsewhere : Indo-Pacific.

Family OPHIACTIDAE

14. *Ophiactis savignyi* (Müller and Troschel, 1842)

1971. *Ophiactis savignyi*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 103 (key), 82-83 (distribution)

2007. *Ophiactis savignyi*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 27: 132

Material : Andhra Pradesh : Vizianagaram District- off Santapalli Rocks, 18° 03' N 83° 39' E, 10 m, four juvenile specs.

Remarks : The specimens were found entangled among coils of the arm of the crinoids from the locality. The species is characterized by rugose arm spines and trilobed distal margin of the dorsal arm plates. The species is common among the sponges and algal tufts in the rocky habitats of most localities.

Distribution : India- Gujarat, Lakshadweep, Tamil Nadu, Andhra Pradesh, Orissa and Andaman & Nicobar Islands.

Elsewhere : Tropicopolitan (Tropical Atlantic and Indo-Pacific).

Family AMPHIURIDAE

15. *Amphioplus* (A.) *cyrtacanthus*

H. L. Clark, 1915

1971. *Amphioplus* (A.) *cyrtacanthus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 101 (key), 78-79 (distribution)

2007. *Amphioplus* (A.) *cyrtacanthus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Papers*, No. 271: 134

Material : Andhra Pradesh: Krishna District-Divi Point (Krishna River Mouth) (INS-06, Station 3 (D-1); four specs; (INS-06, Station 3 (D-2), four specs.

Remarks : The species is characterized by radial shields less than half the disc radius; fourth oral papilla not larger than the third; two tentacle scales similar in size and six arm spines, hooked at the tips.

Distribution : India- Gujarat and Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Philippine Islands.

16. *Amphioplus* (Lymanella) *depressus*

(Ljungman, 1867)

(Pl. III. Figs. 18, 19)

1971. *Amphioplus* (Lymanella) *depressus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 102 (key), 80-81 (distribution)

2007. *Amphioplus* (Lymanella) *depressus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 135

Material : Andhra Pradesh : Visakhapatnam District- St. 10/1. off Pudimadaka, 30 m, 31.10.2008,

one specimen, dd = 9 mm; Off Pudimadaka, St. 6, 20 m, 18.3.2009, five specs, dd = 2-9 mm; Guntur District- Nizampatnam Bay (Station 1/2, 10.10.2006), 2 specs; (Station 2/1, 10.10.2006), 3 specs; (Station 2/2, 10.10.2006), 2 specs. **Orissa:** Off Subarnarekha river mouth (Station 7, 20.6.2007), seven specs, dd = 5-6 mm, largest arm bit about 20 mm long.

Description : Radial shields twice as long as broad and less than half the disc radius; disc scales uniformly small, not large centrally; oral shield pointed orally, distally elongated and narrow, adoral shields meeting in front of the oral shield, four oral papillae, third larger than fourth, three lateral spines, pointed, smooth, dorsal arm plates broader than long, distal margin convex; ventral arm plates broader than long, two tentacle scales.

Distribution : India- Kerala, Andhra Pradesh, Orissa and Andaman Islands.

Elsewhere : Bay of Bengal, East Indies, Philippine Islands, North Australia and South Pacific Islands.

17. *Amphioplus (Lymanella) hastatus*

(Ljungman, 1867)

(Pl. III. Figs. 20, 21)

1971. *Amphioplus (Lymanella) hastatus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 80-81 (distribution) and 102 (key).

2007. *Amphioplus (Lymanella) hastatus*: Sastry, *Rec. zool. Surv. India, Occ. Paper*, No. 271: 135

Material : Andhra Pradesh : Visakhapatnam District- St. 3/2. Pudimadaka, 30 m, 8.6.2008, one specimen, dd = 3.5 mm; St. 7/1 off Pudimadaka, 40 m, 30.10.2008, one spec.

Description : Longest intact arm 7 mm long. Disc scales smooth, naked, larger centrally, primary rosette can be discerned. Radial shields twice as long as broad, about half the radius in length. Oral papillae four on each side, third one much larger than the rest. Dorsal arm plates more than twice as broad as long, distal margin straight. Ventral arm plates with distal margin notched at the centre and lateral margins concave. Lateral arm plates with three small smooth pointed spines, the middle one largest. Oral shields narrowed in front and prolonged distally; lateral shields meeting in front of the oral shield. Tentacle pores with two scales.

Remarks : The specimen from St. 7/1 (40 m) has the central disc scales distinctly larger than the other disc scales and the distal margin of the dorsal arm plates straight (fig. 20). In the one from St. 3/2 (30 m) difference in the size of central and other disc scales is discernible only on close examination but the distal margin of dorsal arm plates is straight as in the other specimen (fig.21).

Distribution : India- West Bengal and Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Persian Gulf and East coast of Africa to Bay of Bengal.

Family OPHIOTHRICIDAE

18. *Macrophiothrix longipeda* (Lamarck, 1816)

1971. *Macrophiothrix longipeda*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 114 (key), 82-83 (distribution)

2007. *Macrophiothrix longipeda*: Sastry, *Rec. zool. Surv. India, Occ. Paper*, No. 271: 142

Material : Andhra Pradesh : Visakhapatnam District- off Pudimadaka, 20 m, two young specimens; Prakasam District- St 7/1. Vodarevu, 12 m, 9.7.2008, four specs; St. 7/2. Vodarevu, 12 m, 9.7.2008, two specs; St. 8/1. Vodarevu, 14 m, 9.7.2008, two specs; St. 9/1. Vodarevu, 15 m, 9.7.2008, two specs; St. 10. Vodarevu, 21 m, 9.9.2008, two specs. **Orissa:** Off Paradeep, (INS-06, Station 18, D-2), two specs, dd = 9 and 12 mm.

Remarks : The specimens show characteristic shape of the dorsal arm plates, disc granulation etc. of the species. The specimens from Vodarevu have the dorsal arm plates fragmented.

Distribution : India : Lakshadweep, Tamil Nadu, West Bengal and Andaman Islands. The species is new to Andhra Pradesh and Orissa coasts.

Elsewhere : East coast of Africa to North Australia and South Pacific Islands.

19. *Ophiocnemis marmorata* (Lamarck, 1816)

(Pl. IV. Fig. 24)

1971. *Ophiocnemis marmorata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 106 (key), 84-85 (distribution)

2007. *Ophiocnemis marmorata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 145

Material : Andhra Pradesh: Srikakulam District-off Barua, (INS-06, Station 12, D-2), two specs, dd = 4 mm; Visakhapatnam District-off Visakhapatnam, (INS-06, Station 7, D-2), 10 m, one spec, dd = 13 mm, a.l. = 23+ mm; (INS-06, Station 9, D-1), one spec, dd = 6 mm; St. 3. Off Pudimadaka, 30 m, 29.10.2008, two specs; St. 4. Off Pudimadaka, 10 m, 30.10.2008, five specs, dd = 6-8 mm; St. 4/2 off Pudimadaka, 10 m, 30.10.2008, four specs; St. 5. Off Pudimadaka, 20 m, 30.10.2008, five specs; Off Pudimadaka, St. 6, 20 m, 18.3.2009, five specs, dd = 2-9 mm; Off Pudimadaka, 5 m, 17.3.2009, two specs, dd = 7 and 9 mm; 15 m, 17.3.2009, two specs, 3 and 4 mm; 25 m, 17.3.2009, five specs, dd = 6-9 specs; Off Pudimadaka, St 3/2, 30 m, 18.3.2009, two specs; St. 5/2, 10 m, 18.3. one spec, dd = 10 mm; Off Pudimadaka, St. 9/1, 19.3.2009, three specs (dd one of 12 mm and two of 2 mm); Off Pudimadaka, St. 9/2, 19.3.2009, five specimens (dd one of 6 mm and four of 3 mm); Guntur District-Nizampatnam Bay, (Station 1/1, 10.10.2006), one spec; (Station 1/2, 10.10.2006), one spec; (Station 2/2, 10.10.2006), one spec; (Station 17/2, 12.10.2006), one spec, dd = 14 mm; Prakasam District- St. 10. Vodarevu, 21 m, one spec.

Remarks : The specimens show extremely large radial shields and naked ventral interradial regions devoid of scales typical of the species and with disc granulation.

Distribution : India : Tamil Nadu, West Bengal and Andaman Islands. The species is newly recorded from the coast of Andhra Pradesh.

Elsewhere : East Coast of Africa, Bay of Bengal, East Indies, South China Sea, Philippine Islands and North Australia.

20. *Ophiothela danae* Verrill, 1869

(Pl. IV. Figs. 22, 23)

1971. *Ophiothela danae*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 84-85 (distribution) and 116 (key).

2007. *Ophiothela danae*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 164

Material : Andhra Pradesh : Visakhapatnam District-off Pudimadaka, 5 m, 17.3.2009, seven specs from the crinoid *Lamprometra palmata*.

Remarks : Disc diameter of the specimens very small, arms coiling vertically, disc and arm plates

with one or more granular tubercles, limits of arm plates distinct. The species usually lives as an epizoic form on gorgonaceans

Distribution : India : Maharashtra, Tamil Nadu, Orissa, Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Persian Gulf to East coast of Africa and to South Pacific Islands (excepting Australia).

21. *Ophiothrix* sp.

Material : Andhra Pradesh: Visakhapatnam District-off Visakhapatnam (INS-06, Station 8, D-2), one disc and part of an arm; Guntur District-Nizampatnam Bay (Station 18/1, 12.10.2006); one disc.

Remarks : Because of the bad condition of the arm bit, the specimens could not be identified with any species. Koehler (1897 and 1899) reported *Ophiothrix* (*O.*) *aristulata* Lyman from Coromandel Coast of Andhra Pradesh (13°45' 38" N 80°29' 37" E, 210 fathoms *i.e.* 384 m). However no species of the genus has so far been reported from shallow waters of the Andhra Pradesh coast.

Class ECHINOIDEA

Order DIADEMATOIDA

Family DIADEMATIDAE

22. *Chaetodiadema granulatum*

Mortensen, 1903

(Pl. IV. Fig. 25)

1971. *Chaetodiadema granulatum*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 152 (key), 140-141 (distribution)

2007. *Chaetodiadema granulatum*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 164

Material : Andhra Pradesh : Guntur District-off Nizampatnam Bay, 30 m, six specimens.

Remarks : The specimens measure 100-130 mm in diameter and 30-40 mm in height with D = 3-3.5H. The test is somewhat leathery.

Distribution : India : Andhra Pradesh, Orissa, West Bengal and Andaman Islands. In Sastry (2007: 164 and elsewhere) Santapalli was inadvertently mentioned as in Srikakulam District under Koehler (1927), but it is in Vizianagaram District.

Elsewhere : Red Sea, Maldive area, Bay of Bengal, East Indies, South China Sea, Philippine Islands and North Australia.

Order PHYMOSOMATOIDA

Family STOMECHINIDAE

23. *Stomopneustes variolaris* (Lamarck, 1816)

(Pl. VI. Fig. 39)

1971. *Stomopneustes variolaris*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 140-141 (distribution) and 153 (key).

2007. *Stomopneustes variolaris*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 163

Material : Andhra Pradesh : Visakhapatnam District- Visakhapatnam (Palm Beach, Shingle led, Jalari Peta, Kailasa Hill), Yarada, Pudimadaka, Bhimuniapatnam; several specimens; DRK Sastry and others.

Remarks: The species is characterized by stirodont dentition, compound diadematoid ambulacral plates and a deep sinuous groove between the two series of interambulacral plates. The spines are generally black, sometimes with pink broken, regeneratig tips. At habitats with strong wave action, it lives in bores, supposed to be made by itself. When living in bores or in deep crevices, the spines on the protected side are short and the ones on the open side are long and pointed and projecting out into the open. This appears to be a protective adaptation.

Distribution : India : Karnataka, Lakshadweep, Tamil Nadu, Andhra Pradesh, Andaman and Nicobar Islands.

Elsewhere : Indo-Pacific tropical and subtropical coasts from the African coast to New Caledonia, Samoa and the Bonin Islands (Mortensen in Sastry, 2007).

Order TEMNOPLEUROIDA

Family TEMNOPLEURIDAE

24. *Salmaciella dussumieri* (L. Agassiz, 1846)

1971. *Salmaciella dussumieri*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 155 (key), 140-141 (distribution)

2007. *Salmaciella dussumieri*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 172

Material : Andhra Pradesh: Guntur District-

Nizampatnam Bay (Station 18/1, 12.10.2006), three specs, D/H = 20/7, 20/7 and 23/8 mm.

Remarks : Test is somewhat concave on the oral side. The specimens show angular pits, primary tubercles one each aboral ambulacral plate but one in two or three ambulacral plates at the ambitus. Primary spines banded green and secondary tubercles reddish at base.

Distribution : India : Orissa and Tamil Nadu. The species is new to Andhra Pradesh. The exact location under 'Coromandel Coast' which includes parts of Tamil Nadu and Andhra Pradesh, reported by Anderson (1894 in Sastry, 2007) is not known.

Elsewhere : SE Arabia, Red Sea and East Coast of Africa to Philippine Islands and North Australia.

25. *Salmacis virgulata* (L. Agassiz, 1846)

(Pl. IV. Fig. 26)

1846. *Salmacis virgulata* Agassiz, L. In: L. Agassiz and E. Desor, *Ann. Sci. nat.* (3) 6: 359.

1971. *Salmacis virgulata*: Clark, A. M. Clark and Rowe, *Monograph of shallow-water Indo-west Pacific echinoderms*, 156 (key), 140-141 (distribution)

2007. *Salmacis virgulata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 174

Material : Andhra Pradsh : Guntur District-Nizampatnam Bay (St.17/1, March 2007), four specs; (St. 9/2, October 2007), one spec.

Remarks : The specimens measure D/H = 50/25 mm. Test with angular pores, primary tubercles crenulate. Aboral and ambital ambulacral plates each with a primary tubercle. The spines are characteristically violet in colour, not banded.

Distribution : India : Lakshadweep and Tamil Nadu. The species is newly recorded from Andhra Pradesh.

Elsewhere : Bay of Bengal, East Indies, Philippine Islands and South China Sea.

26. *Temnopleurus toreumaticus* (Leske, 1778)

(Pl. IV. Fig. 27)

1971. *Temnopleurus toreumaticus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 154 (key), 142-143 (distribution)

2007. *Temnopleurus toreumaticus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 176

Material : Andhra Pradesh : Visakhapatnam District- off Pudimadaka, 25 m, 19.3.09, two dead tests, D = 14 and 18 mm; Guntur District- Nizampatnam Bay (Station 1/1, 10.10.2006), seven specs; (Station 1/2, 10.10.2006), four specs; (Station 2/1, 10.10.2006), 10 specs; (Station 2/2, 10.10.2006), six specs; Nellore District- St. 6/1 off Krishnapatnam, 12 m, 7.7.2008, one spec., D/H = 12/8 mm. **Orissa**: Off Subarnarekha river mouth- Station 1A, D-2, 31 specs; Station 1B, D-1, 125 specs; Station 1B, D-2, 60 specs; Station 1C, D-1, 195 specs; Station 1C, D-2, 255 specs; Station 2C, D-1, three specs; Station 2C, D-2, three specs; Station 6, D-2, 20 specs; Station 7, D-1, 55 specs; Station 7, D-2, 26 specs, D = 12-22 mm.

Remarks : The specimens have large angular pits and crenulate tubercles on the test and pore pairs are in arcs of three. Spines are banded with rusty red. The young ones occur in large aggregations in the subtidal depths, particularly around the river mouths.

Distribution : India : Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman Islands.

Elsewhere : Persian Gulf and East Coast of Africa to Hawaiian Islands.

Order ECHINOIDA

Family ECHINOMETRIDAE

27. *Echinometra mathaei*. (H. M. de Blainville, 1825)

(Pl. VI. Fig. 40)

1971. *Echinometra mathaei*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 142-143 (distribution) and 157 (key).

2007. *Echinometra mathaei*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 181

Material : Andhra Pradesh: Visakhapatnam District- Visakhapatnam (Shingle Beach); three specimens. L = 52-64 mm.

Remarks : In the specimens collected long back in early seventies, the spines were olive green or white but turned dark green on preservation in formalin.

Distribution : India- Lakshdweep, Tamil Nadu, Andhra Pradesh, Andaman and Nicobar Islands.

Elsewhere : Indo-west Pacific.

Order CLYPEASTEROIDA

Family CLYPEASTERIDAE

28. *Clypeaster humilis* (Leske, 1778)

(Pl. V. Fig. 28)

1922. *Clypeaster humilis*: Koehler, R. *Echinoderma of the Indian Museum*, part IX: 51. No specimen of *Investigator* collection from Indian coast was available to Koehler, hence a specimen from Red Sea was described. This makes one doubt the identity of specimens reported by Anderson, 1894 (*vide supra*).

1971. *Clypeaster humilis*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 161 (key), 144-145 (distribution)

2007. *Clypeaster humilis*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 186 [non: Anderson, 1894. probably *Clypeaster reticulatus*]

Material : Andhra Pradesh : Guntur District, Nizampatnam Bay (Station 18/1, 12.10.2006), one spec; anterior radius = 40 mm, breadth = 70 mm, posterior region broken.

Remarks : In view of the non-availability of any specimens of the species to Koehler, identity of specimens reported by Anderson is doubtful. The exact locality of 'Coromandel Coast' is also not known.

Distribution : India : Kerala and Tamil Nadu. The species is newly recorded from Andhra Pradesh.

Elsewhere : Persian Gulf and East Coast of Africa to South Pacific Islands.

29. *Clypeaster rarispinus* de Meijere, 1903

(Pl. V. Figs. 29, 30)

1971. *Clypeaster rarispinus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 160 (key), 144-145 (distribution)

2007. *Clypeaster rarispinus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 187

Material : Andhra Pradesh : Srikakulam District- off Barua (INS-06, Station 12, D-1), 30 m, one spec, l = 44 mm; Visakhapatnam District- Off Visakhapatnam (INS- 06, Station 9, D-1), five specs; l = 20-38 mm; (INS- 06, Station 9, D-2), four specs, l x b = 23x20, 25x24, 40x40, and 45x40 mm; off Pudimadaka, St. 10/1, 30 m, 19.3.2009, two specs,

l/b = 20/20 and 23/22 mm; Krishna District- Divi Point, 30 m (Station 3, D-2), one spec; Guntur District- Nizampatnam Bay (Station 18/1, 12.10.2006), 18 specs; (Station 2/1, 10.10.2006), two specs, l = 18 and 22 mm, as long as or longer than broad; (Station 19/2, 13.10.2006), one spec, l x b = 35x32 mm; (Station 15/2, 12.10.2006), four specs; l x b in the largest = 45 x 40 mm.

Distribution : India- Gujarat, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal.

Elsewhere : SE Arabia and East Coast of Africa to East Indies.

Family LAGANIDAE

30. *Laganum decagonale* (de Blainville, 1827)

(Pl. V. Figs. 31, 32)

1971. *Laganum decagonale*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 144-145 (distribution) and 162 (key).

2007. *Laganum decagonale*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 191

Material : Andhra Pradesh : Visakhapatnam District- St. 7/1. off Pudimadaka, 40 m, 30.10.2008, four dead tests of 14-20 mm diameter; off Pudimadaka, 25 m, 17.3.2009, one dead test, l/b = 22/20mm; off Pudimadaka, 35 m, 17.3.2009, five dead tests; off Pudimadaka, St. 10/1, 30 m, 19.3.2009, one dead test.

Description : Test ten sided, appearing almost round, tests as long as broad. Five genital ores and madreporic pores in a sinuous slit. Periproct nearer to posterior margin

Distribution : India- Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman Islands.

Elsewhere : Arabian Sea to South China Sea, Philippine Islands and North Australia.

Family ASTRICLYPEIDAE

31. *Echinodiscus auritus* Leske, 1778

(Pl. V. Fig. 33)

1971. *Echinodiscus auritus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 162 (key), 144-145 (distribution)

2007. *Echinodiscus auritus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 198

Material : Andhra Pradesh : Srikakulam District- off Barua (INS-06, Station 11, D-1), 20 m, one spec; l = 87 mm, as long as wide; (INS-06, Station 11 (D-2); 20 m, one spec; l = 97 mm; (INS-06, Station 12, D-1), five specs; (INS-06, Station 12, D-2), 30 m, one spec, l = 84 mm, as long as wide; Guntur District- Nizampatnam Bay (Station 17/1, 12.10.2006), five specs; l = 95-120 mm, lunules about 35 mm long. Orissa: Off Chilika Lake (INS-06, Station 14, D-1), 20 m, nine specs; l = 27-48 mm; (INS-06, Station 14, D-2), 20 m, seven specs, l = 22-32 mm, slightly broader than long.

Distribution : India : Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman Islands.

Elsewhere : Persian Gulf and East Coast of India to Philippine Islands.

Order CASSIDULOIDA

Family ECHINOLAPADIDAE

32. *Echinolampas ovata* Leske, 1778

(Pl. V. Figs. 34, 35)

1971. *Echinolampas ovata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 163 (key), 144-145 (distribution)

2007. *Echinolampas ovata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 201

Material : Orissa : Off Chilika Lake (INS-06, Station 14, D-1), 20 m, one spec; l = 82 mm; (INS-06, Station 14, D-2), 20 m, four specs; l x b x h = 17 x 15 x 12, 51 x 47 x 30, 56 x 49 x 34, and 56x50x32 mm.

Remarks : The species is common in the Gulf of Mannar of Tamil Nadu coast

Distribution : India : Lakshadweep, Tamil Nadu and Orissa.

Elsewhere : SE Arabia, Red Sea, Islands of West Indian Ocean, Mascarene Islands, Bay of Bengal, East Indies and North Australia,

Order SPATANGOIDA

Family BRISSIDAE

33. *Brissopsis luzonica* (Gray, 1851)

(Pl. V. Fig. 36)

1971. *Brissopsis luzonica*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 165 (key), 146-147 (distribution)

2007. *Brissopsis luzonica*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 205

Material : Andhra Pradesh: Visakhapatnam District- off Pudimadaka, St. 1, 10 m, 18.3.2009, one specimen, l = 35 mm, b = 25 mm, anterior height = 10 mm, posterior height = 20 mm; Guntur District- Nizampatnam Bay (Station 15/2, 12.10.2006), two specs; (Station 19/2, 12.10.2006), one spec; l = 26 mm, b = 20 mm, posterior h = 10 mm.

Remarks : Along the coast of Andhra Pradesh, the species was earlier reported from RIMS Investigator Sta. 98. off Santapalli of Vizianagaram District.

Distribution : India- Kerala, Tamil Nadu, Andhra Pradesh, Orissa and Andaman Islands.

Elsewhere : Red Sea, East Cost of Africa to Hawaiian Islands.

Family SPATANGIDAE

34. *Nacospatangus (Pseudomaretia) alta* (A. Agassiz, 1863)

(Pl. VI. Figs. 37, 38)

1971. *Pseudomaretia alta*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 165 (key), 146-147 (distribution)

2007. *Nacospatangus (Pseudomaretia) alta*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 210

Material : Andhra Pradesh: Srikakulam District-off Barua (INS-06, Station 12, D-1), 30 m, five specs, primary spines (2+1); (INS-06, Station 12, D-2), 30 m, five specs, l x b x h = 26x19x10 mm, sternum posteriorly strongly carinate, raised, only single series of primary tubercles in the posterior lateral interambulacra; Guntur District- Nizampatnam Bay (Station 9/2, 11.10.2006), one spec; (Station 18/1, 12.10.2006), one spec, primary spines only two in a single row in lower area of posterior lateral interambs; (Station 17/1, 12.10.2006), two specs, l x b x h. = 30x22x9 and 33x24x12 mm; St. 5/1, 18 m, 9.7.2008, one spec; St. 5/2, 18 m, 9.7.2008, five specs. **Orissa**: Off Chilika Lake (INS-06, Station 14, D-2), 20 m, five specs; l x b x h = 34x25x12 mm, others 12-13 mm in length, space between pore series of posterior ambs raised, appearing carinate, highest at the apical system only subanal fasciole present, no inner or peripetalous fasciole; primary spines limited to the two posterior lateral interambs, close to the ambitus, number varying from three to 6 in

two to three rows; labrum to ½ to end on the 2nd plate; outer series of anterior lateral petals developed only in the distal half; (INS-06, Station 14, D-1), 20 m, five specs, largest 32 mm long, six primary spines (3+2+1) in the right and five (3+2) in the left anterior lateral interambs.

Distribution : India : Karnataka, Tamil Nadu, Andhra Pradesh, Orissa and Andaman Islands.

Elsewhere : Western Indian Ocean to Philippine Islands and North Australia.

Family LOVENIIDAE

35. *Lovenia elongata* (Gray, 1845)

1971. *Lovenia elongata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 164 (key), 146-147 (distribution)

2007. *Lovenia elongata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 211

Material : Andhra Pradesh : Guntur District- Nizampatnam Bay (Station 17/1, 12.10.2006), one spec, l x b x h = 38 x 30 x 14 mm, highest at posterior interambulacrum, flat and low anterior to apical system.

Distribution : India : Tamil Nadu and Andaman Islands. The exact location on 'Coromandel Coast' which includes parts of Andhra Pradesh and Tamil Nadu coasts, reported by Anderson (1894 in Sastry, 2007) being not known, this is the first report of the species from Andhra Pradesh.

Elsewhere : Persian Gulf and East Coast of Africa to Philippine Islands and North Australia.

Class HOLOTHUROIDEA

Order DENDROCHIROTIDA

Family CUCUMARIIDAE

36. *Havelockia versicolor* (Semper, 1868)

1971. *Havelockia versicolor*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 180-181 (distribution).

2007. *Havelockia versicolor*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 248

Material : Andhra Pradesh : Visakhapatnam coast, K. A. Sai (the material was already mentioned in Sastry, 2007).

Distribution : India : Tamil Nadu, Andhra Pradesh and Andaman Islands.

Elsewhere : Bay of Bengal, East Indies, Philippine Islands and North Australia.

37. *Leptopentacta javanicus* (Sluiter, 1880)

(Pl. fig. 38)

1971. *Leptopentacta javanicus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 180-181 (distribution).

2007. *Leptopentacta javanicus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 250

Material : Andhra Pradesh : Visakhapatnam District- Visakhapatnam, 20 m, one spec; Visakhapatnam, 30 m, one spec; Pudimadaka, St.2, 20 m, 8.6.2008, eight specs; St. 4, 40 m, 8.6.2008, one spec; off Pudimadaka, St. 4/1, 40 m, 18.3.2009, two specs; St. 4/2, 40 m, 18.3.2009, one spec; St. 10/1, 30 m, 19.3.2009, one spec; Orissa: Off Chika Lake, 10 m, one spec; Off Chika Lake, 30 m, one spec.

Distribution : India- Kerala, Tamil Nadu and Andhra Pradesh. Newly recorded from Orissa coast. The species is recently collected from the coast of Karnataka also (unpublished)

Elsewhere : SE Arabia, Maldives, Bay of Bengal and East Indies.

Order APODIDA

Family SYNAPTIDAE

38. *Protankyra inflexa* Koehler and Vaney, 1905

1905. *Protankyra inflexa* Koehler, R. and Vaney, C. *Echinoderma of the Indian Museum*, part III: 109. Bay of Bengal, 750 m (410 fms), 2 specs.

Material : Andhra Pradesh : Krishna District- Divi Point, 853 m, three specs; Divi Point, 452 m, one spec; West Godavari District- Kakinada, 202 m, 83 specs; Kakinada, 454 m, five specs.

Distribution : India : Newly recorded from Andhra Pradesh and also new to Indian fauna. The types are from Bay of Bengal, but without exact locality. This is the first report with exact locality since its discovery.

39. *Protankyra similis* (Semper, 1868)

1971. *Protankyra similis* (Semper): Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 186-187 (distribution).

2007. *Protankyra similes* (sic!): Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 260

Material : Andhra Pradesh : Kakinada (Mouth of Godavari River), Dipti. (included in Sastry, 2007)

Distribution : India : Andhra Pradesh.

Elsewhere : Bay of Bengal, Philippine Islands and North Australia.

Order MOLPADIIDA

Family CAUDINIDAE

40. *Acaudina molpadioides* (Semper, 1868)

1971. *Acaudina molpadioides*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 184-185 (distribution)

2007. *Acaudina molpadioides*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 267

Material : Andhra Pradesh : Kakinada (Mouth of Godavari River), Dipti.

Distribution : India : Gujarat, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman and Nicobar Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Bay of Bengal, East Indies, Philippines and South China Sea.

SUMMARY

The echinoderm collections from Andhra Pradesh and Orissa coasts consisted of three species of Crinoidea, nine species each of Asteroidea and Ophiuroidea, 14 species of Echinoidea and five species of Holothuroidea, totaling to 40 species. Of these the asteroid *A. velitaris* and the holothuroid *Protankyra inflexa* encountered first since its discovery are new to Indian coast. The material included one species of crinoid, five species of asteroids, six species of ophiuroids, four species of echinoids and one species of holothurians new to Andhra Pradesh. Further, the asteroids *Astropecten vappa* and *A. velitaris* and the ophiuroid *Macrophiothrix longipeda* are new to Andhra Pradesh as well as to Orissa. The deep water ophiuroid *Ophiochiton ambulator* and the holothurian *Leptopentacta javanicus* are also new to Orissa. All the echinoderms consisting of 100 species from Andhra Pradesh and 57 species from Orissa, including the present additions, are listed.

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APPENDIX-I

Classified list of echinoderms of Andhra Pradesh coast		
(*spp. new to Andhra Pradesh, **spp. new to India, # deepwater spp.)		
Phylum ECHINODERMATA		
Class CRINOIDEA		
Order COMATULIDA		
Family HIMEROMETRIDAE	1.	<i>Heterometra philiberti</i> (J. Müller)*
	2.	<i>Heterometra reynaudi</i> (J. Müller)
Family MARIAMETRIDAE	3.	<i>Lamprometra palmata</i> (J. Müller)
Family COLOBOMETRIDAE	4.	<i>Oligometra serripinna</i> (P. H. Carpenter)
Family TROPIOMETRIDAE	5.	<i>Tropiometra carinata</i> (Lamarck)
Class ASTEROIDEA		
Order PAXILLOSIDA		
Family LUIDIIDAE	6.	<i>Luidia (Luidia) hardwicki</i> (Gray)*
	7.	<i>Luidia (Luidia) denudata</i> Koehler#
Family ASTROPECTINIDAE	8.	<i>Astropecten bengalensis</i> Döderlein
	9.	<i>Astropecten euryacanthus</i> Lütken
	10.	<i>Astropecten hemprichi</i> Müller & Troschel
	11.	<i>Astropecten indicus</i> Döderlein
	12.	<i>Astropecten monacanthus</i> Sladen
	13.	<i>Astropecten vappa</i> Müller & Troschel *
	14.	<i>Astropecten velitaris</i> v. Martens**
	15.	<i>Craspidaster hesperus</i> (Müller & Troschel)
Order VALVATIDA		
Family ASTERINIDAE	16.	<i>Asterina coronata</i> v. Martens
	17.	<i>Asterina lorioli</i> Koehler
Family GONIASTERIDAE	18.	<i>Plinthaster investigatoris</i> (Alcock)#
	19.	<i>Pseudarchaster mozaicus</i> Wood-Mason and Alcock #
	20.	<i>Stellaster childreni</i> Gray
Family OREASTERIDAE	21.	<i>Anthenea pentagonula</i> Lamarck*
	22.	<i>Goniodiscaster forficulatus</i> (Perrier)
Order SPINULOSIDA		
Family ECHINASTERIDAE	23.	<i>Echinaster purpureus</i> (Gray)*
Order FORCIPULATIDA		
Family ZOROASTERIDAE	24.	<i>Zoroaster alfredi</i> Alcock #
	25.	<i>Zoroaster barathri</i> Alcock #

Class OPHIUROIDEA		
Order PHRYNOPHIURIDA		
Family EURYALIDAE	26.	<i>Asteromorpha flosculus</i> (Alcock)
Order OPHIURIDA		
Family OPHIURIDAE		
Subfamily OPHIOLEPIDINAE	27.	<i>Ophiomusium fimbriatum</i> Koehler #
Subfamily OPHIURINAE	28.	<i>Ophiomastus tumidus</i> Koehler#
	29.	<i>Ophiopyrgus alcocki</i> Koehler #
	30.	<i>Ophiura kinbergi</i> (Ljungman)
Family OPHIONEREIDAE	31.	<i>Ophiochiton ambulator</i> Koehler #
	32.	<i>Ophionereis dubia</i> (Müller and Troschel)
Family OPHIODERMATIDAE	33.	<i>Bathypectinura heros</i> (Lyman)#
Family OPHIACANTHIDAE	34.	<i>Ophiacantha vestita</i> Koehler#
Family OPHIACTIDAE	35.	<i>Ophiactis maculosa</i> v. Martens
	36.	<i>Ophiactis modesta</i> Brock
	37.	<i>Ophiactis savignyi</i> (Müller & Troschel)
Family AMPHIURIDAE	38.	<i>Amphiodia caullery</i> (Koehler)#
	39.	<i>Amphioplus</i> (A.) <i>cyrtacanthus</i> H. L. Clark*
	40.	<i>Amphioplus</i> (<i>Lymanella</i>) <i>andreae</i> (Lütken)
	41.	<i>Amphioplus</i> (<i>Lymanella</i>) <i>depressus</i> (Ljungman)
	42.	<i>Amphioplus</i> (<i>Lymanella</i>) <i>hastatus</i> (Ljungman)*
	43.	<i>Ophiocentrus verticillatus</i> (Döderlein)
Family OPHIOTHRICIDAE	44.	<i>Macrophiothrix aspidota</i> (Müller and Troschel)
	45.	<i>Macrophiothrix longipeda</i> (Lamarck)*
	46.	<i>Ophiocnemis marmorata</i> (Lamarck)*
	47.	<i>Ophiogymna pellicula</i> (Duncan)
	48.	<i>Ophiothela danae</i> Verrill*
	49.	<i>Ophiothrix</i> (<i>Ophiothrix</i>) <i>aristulata</i> Lyman#
	50.	<i>Ophiothrix</i> sp.* (shallowater sp.)
Class ECHINOIDEA		
Order CIDAROIDA		
Family CIDARIIDAE	51.	<i>Prionocidaris baculosa</i> (Lamarck)
Order ECHINOTHURIOIDA	52.	<i>Phormosoma bursarium</i> A. Agassiz #
Family ECHINOTHURIIDAE		
Order DIADEMATOIDA		
Family DIADEMATIDAE	53.	<i>Chaetodiadema granulatum</i> Mortensen

	54.	<i>Echinothrix calamaris</i> (Pallas)
Order PHYMOSOMATOIDA		
Family STOMECHINIDAE	55.	<i>Stomopneustes variolaris</i> (Lamarck)
Order TEMNOPLEUROIDA		
Family TEMNOPLEURIDAE	56.	<i>Salmaciella dussumieri</i> (L. Agassiz)*
	57.	<i>Salmacis bicolor</i> (L. Agassiz)
	58.	<i>Salmacis virgulata</i> L. Agassiz*
	59.	<i>Temnopleurus toreumaticus</i> (Leske)
Family TOXOPNEUSTIDAE	60.	<i>Tripneustes gratilla</i> (Linnaeus)
Order ECHINOIDA		
Family ECHINOMETRIDAE	61.	<i>Echinometra mathaei</i> (de Blainville)
Order CLYPESTEROIDA		
Family CLYPEASTERIDAE	62.	<i>Clypeaster annandalei</i> Koehler
	63.	<i>Clypeaster humilis</i> (Leske)*
	64.	<i>Clypeaster rarispinus</i> de Maijere
Family FIBULARIIDAE	65.	<i>Fibularia volva</i> L. Agassiz
Family LAGANIDAE	66.	<i>Laganum decagonale</i> (de Blainville)
Family ASTRICLYPEIDAE	67.	<i>Echinodiscus auritus</i> Leske
	68.	<i>Echinodiscus bisperforatus</i> Leske
Order CASSIDULOIDA		
Family ECHINOLAMPADIDAE	69.	<i>Echinolampas castanea</i> Alcock #
Order SPATANGOIDA		
Family HEMIASTERIDAE	70.	<i>Hemiaster vanus</i> Koehler #
Family SCHIZASTERIDAE	71.	<i>Schizaster (Paraster) gibberulus</i> (Koehler)
Family BRISSIDAE	72.	<i>Brissopsis luzonica</i> (Gray)
	73.	<i>Brissopsis oldhami</i> Alcock #
	74.	<i>Metalia sternalis</i> (Lamarck)
Family SPATANGIDAE	75.	<i>Nacospatangus (Pseudomaretia) alta</i> (A. Agassiz)
Family LOVENIIDAE	76.	<i>Lovenia elongata</i> (Gray)*
Class HOLOTHUROIDEA		
Order ASPIDOCHIROTIDA		
Family SYNALLACTIDAE	77.	<i>Pelopatides insignis</i> Koehler & Vaney #
	78.	<i>Synallactes pellucidus</i> Koehler & Vaney #
Order DENDROCHIROTIDA		
Family PHYLLOPHORIDAE	79.	<i>Actinocucumis typicus</i> Ludwig
	80.	<i>Phyllophorus (Phyllophorella)</i> sp.

Family CUCUMARIIDAE	81.	<i>Cucumaria</i> sp.
	82.	<i>Havelockia versicolor</i> (Semper)
	83.	<i>Leptopentacta imbricata</i> (Semper)#
	84.	<i>Leptopentacta javanicus</i> (Sluiter)
	85.	<i>Pseudocnus echinatus</i> (von Marenzeller) #
	86.	<i>Pseudocolochirus violaceus</i> Théel
	87.	<i>Stolus buccalis</i> (Stimpson)
Order APODIDA		
Family SYNAPTIDAE	88.	<i>Anapta gracilis</i> Semper
	89.	<i>Protankyra conferta</i> Koehler & Vaney #
	90.	<i>Protankyra denticulata</i> Koehler & Vaney #
	91.	<i>Protankyra inflexa</i> Koehler & Vaney#**
	92.	<i>Protankyra similis</i> (Semper)#
	93.	<i>Protankyra tristis</i> Koehler and Vaney #
	94.	<i>Psamothuria ganapati</i> Rao
Family MYRIOTROCHIDAE	95.	<i>Ankyloderma contortum</i> Koehler & Vaney#
	96.	<i>Ankyloderma intermedium</i> Koehler & Vaney#
	97.	<i>Ankyloderma musculus</i> (Risso)#
	98.	<i>Ankyloderma polymorphium</i> Koehler & Vaney#
	99.	<i>Trochostoma albicans</i> Koehler & Vaney#
Order MALPADIIDA		
Family CAUDINIDAE	100.	<i>Acaudina molpadioides</i> (Semper)

APPENDIX-II

Classified list of echinoderms of Orissa Coast (* spp. new to Orissa, ** spp. new to India, # deepwater spp.)		
Phylum ECHINODERMATA		
Class CRINOIDEA		
Order COMATULIDA		
Family HIMEROMETRIDAE	1.	<i>Heterometra bengalensis</i> (Hartlaub)
	2.	<i>Heterometra reynaudi</i> (Müller)
Family MARIAMETRIDAE	3.	<i>Dichrometra ciliata</i> A, H. Clark
Family COLOBOMETRIDAE	4.	<i>Cenometra herdmani</i> A, H. Clark
	5.	<i>Oligometra imbricata</i> A, H. Clark
	6.	<i>Oligometra serripinna</i> (P. H. Carpenter)
Class ASTEROIDEA		
Order PAXILLOSIDA		
Family LUIDIIDAE	7.	<i>Luidia (Luidia) limbata</i> Sladen
	8.	<i>Luidia (Luidia) maculata</i> Müller & Troschel
Family ASTROPECTINIDAE	9.	<i>Astropecten bengalensis</i> Döderlein
	10.	<i>Astropecten indicus</i> Döderlein
	11.	<i>Astropecten monacanthus</i> Sladen
	12.	<i>Astropecten vappa</i> Müller & Troschel*
	13.	<i>Astropecten velitaris</i> v. Martens**
	14.	<i>Craspidaster hesperus</i> (Müller & Troschel)
Order VALVATIDA		
Family GONIASTERIDAE	15.	<i>Stellaster childreni</i> Gray
Family OREASTERIDAE	16.	<i>Anthenea pentagonula</i> Lamarck
	17.	<i>Goniodiscater vallei</i> (Koehler)
Order SPINULOSIDA		
Family ECHINASTERIDAE	18.	<i>Echinaster purpureus</i> (Gray)
Family METRODIRIDAE	19.	<i>Metrodira subulata</i> Gray
Class OPHIUROIDEA		
Order PHRYNOPHIURIDA		
Family OPHIOMYXIDAE	20.	<i>Ophiomyxa australis</i> Lütken
Order OPHIURIDA		
Family OPHIURIDAE		
Subfamily OPHIURINAE	21.	<i>Ophiura kinbergi</i> (Ljungman)

Family OPHIONEREIDAE	22.	<i>Ophiochiton ambulator</i> *#
Family OPHIACANTHIDAE	23.	<i>Ophiacantha vagans</i> Koehler
Family OPHIACTIDAE	24.	<i>Ophiactis savignyi</i> (Müller & Troschel)
Family AMPHIURIDAE	25.	<i>Amphioplus (Lymanella) depressus</i> (Ljungman)
	26.	<i>Dougaloplus echinatus</i> (Ljungman)
	27.	<i>Ophiostigma formosa</i> (Lütken)
Family OPHIOTHRICIDAE	28.	? <i>Macrophiothrix hirsuta</i> (Müller & Troschel)
	29.	<i>Macrophiothrix longipeda</i> *
	30.	<i>Ophiogymna pellicula</i> (Duncan)
	31.	<i>Ophiothela danae</i> Verrill
	32.	<i>Ophiothrix (Ophiothrix) ciliaris</i> (Lamarck)
	33.	<i>Ophiothrix (Ophiothrix) foveolata</i> Marktanner-Turneretscher
	34.	<i>Ophiothrix (Placophiothrix) striolata</i> Grube
Class ECHINOIDEA		
Order CIDAROIDA		
Family CIDARIIDAE	35.	<i>Stereocidaris alcocki</i> (Anderson)#
Order DIADEMATOIDA		
Family DIADEMATIDAE	36.	<i>Astropyga radiata</i> (Leske)
	37.	<i>Chaetodiadema granulatum</i> Mortensen
Order TEMNOPLEUROIDA		
Family TEMNOPLEURIDAE	38.	<i>Salmaciella dussumieri</i> (L. Agassiz & Desor)
	39.	<i>Salmacis bicolor</i> L. Agassiz
	40.	<i>Temnopleurus toreumaticus</i> (Leske)
Order ECHINOIDA		
Order HOLECTYPOIDA		
Order CLYPESTEROIDA		
Family CLYPEASTERIDAE	41.	<i>Clypeaster rarispinus</i> de Meijere
Family LAGANIDAE	42.	<i>Laganum decagonale</i> (de Blaineville)
Family ASTRICLYPEIDAE	43.	<i>Echinodiscus auritus</i> Leske
	44.	<i>Echinodiscus bisperforatus</i> Leske
Order CASSIDULOIDA		
Family ECHINOLAMPADIDAE	45.	<i>Echinolampas alexandri</i> de Loriol
	46.	<i>Echinolampas ovata</i> (Leske)
Order SPATANGOIDA		
Family BRISSIDAE	47.	<i>Brissopsis luzonica</i> (Gray)

	48.	<i>Rhynobrissus pyramidalis</i> A. Agassiz
Family SPATANGIDAE	49.	<i>Nacospatangus (Pseudomaretia) alta</i> (A. Agassiz)
Family LOVENIIDAE	50.	<i>Lovenia subcarinata</i> (Gray)
Class HOLOTHUROIDEA		
Order DENDROCHIROTIDA		
Family CUCUMARIIDAE	51.	<i>Cucumaria ardens</i> Koehler & Vaney
	52.	<i>Cucumaria inflexa</i> Koehler & Vaney#
	53.	<i>Leptopentacta imbricata</i> (Semper)
	54.	<i>Leptopentacta javanicus</i> (Sluiter)*
	55.	<i>Pseudocnus echinatus</i> (von Marenzeller)
	56.	<i>Pseudocolochirus violaceus</i> (Théel)
Order MALPADIIDA		
Family CAUDINIDAE	57.	<i>Acaudina molpadioides</i> (Semper)

PLATE-I



Fig. 1. *Lamprometra palmata*



Fig. 2. *Tropioometra carinata*

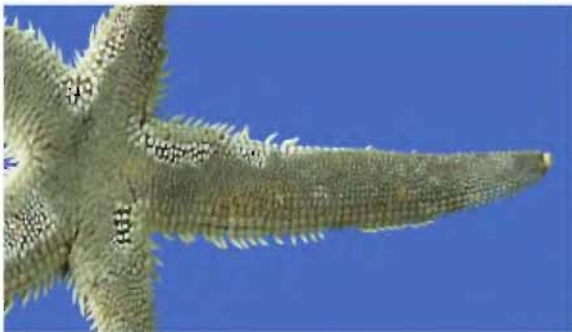


Fig. 3. *Luidia hardwicki* (abactinal view)

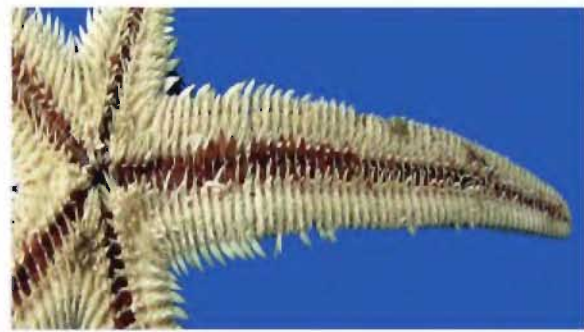


Fig. 4. *Luidia hardwicki* (actinal view)

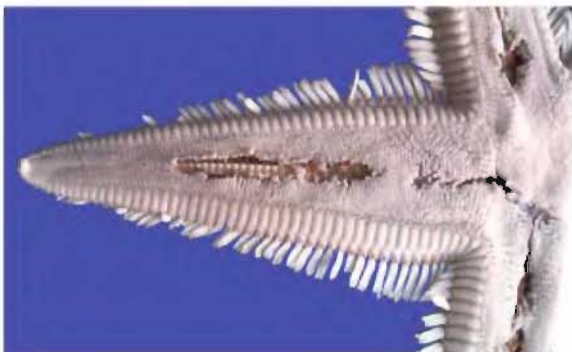


Fig. 5. *Astropecten euryacanthus* (abactinal view)



Fig. 6. *Astropecten euryacanthus* (actinal view)

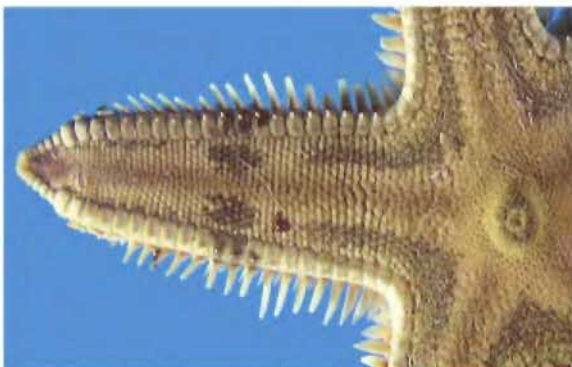


Fig. 7. *Astropecten monacanthus* (abactinal view)



Fig. 8. *Astropecten monacanthus* (actinal view)

PLATE-II

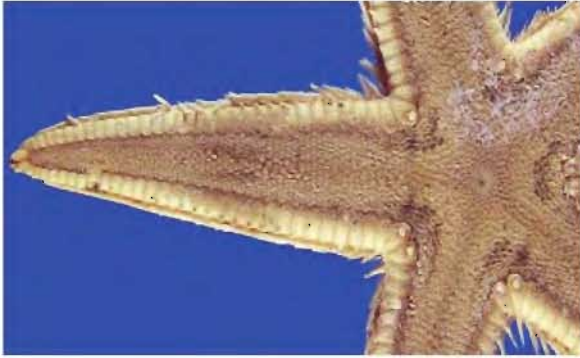


Fig. 9. *Astropecten velitaris* (abactinal view)



Fig. 10. *Asterina lorioli* (abactinal view)



Fig. 11. *Anthenea pentagonula* (abactinal view)

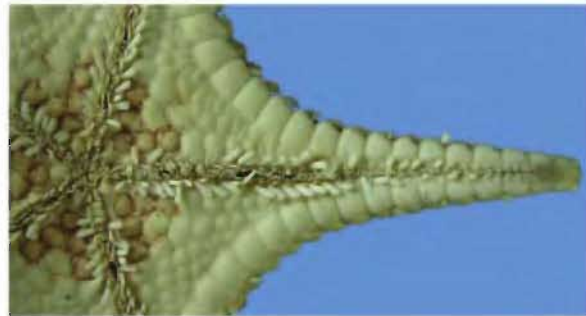


Fig. 12. *Anthenea pentagonula* (actinal view)



Fig. 13. *Pentaceraster affinis* (abactinal view)

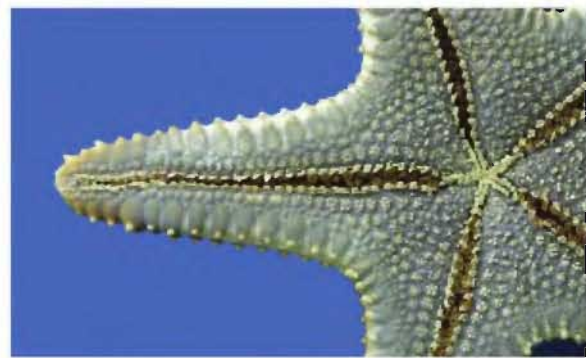


Fig. 14. *Pentaceraster affinis* (actinal view)



Fig. 15. *Echinaster purpureus* (abactinal view)

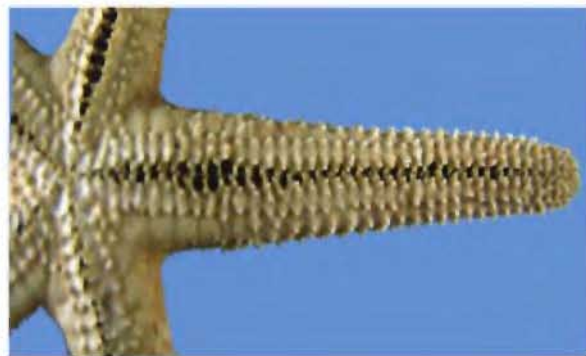


Fig. 16. *Echinaster purpureus* (actinal view)

PLATE-III



Fig. 17. *Ophiochiton ambulator* (dorsal view)



Fig. 18. *Amphioplus depressus* (dorsal view)



Fig. 19. *Amphioplus depressus* (ventral view)



Fig. 20. *Amphioplus hastatus*
(dorsal view of specimen from St. 7/1)



Fig. 21. *Amphioplus hastatus*
(dorsal view of specimen from St. 3/2)

PLATE-IV

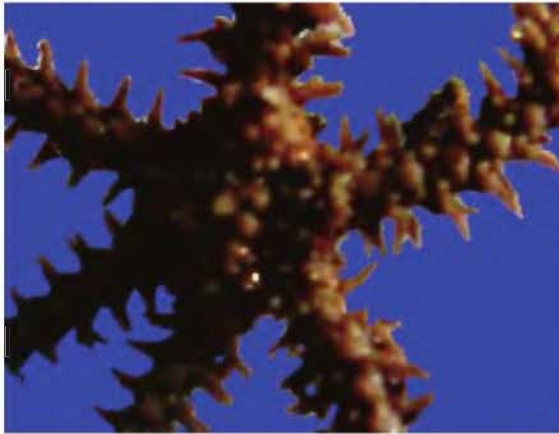


Fig. 22. *Ophiothela danae* (dorsal view)

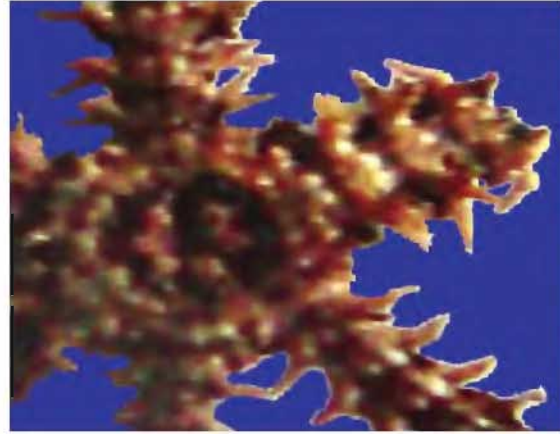


Fig. 23. *Ophiothela danae* (ventral view)



Fig. 24. *Ophiocnemis marmorata* (dorsal view)



Fig. 25. *Chaetodiadema granulatum* (apical view)



Fig. 26. *Salmacis virgulata* (apical view)



Fig. 27. *Temnopleurus toreumaticus* (apical view)

PLATE-V



Fig. 28. *Clypeaster humilis*
(apical view)



Fig. 29. *Clypeaster rarispinus*
(apical view)



Fig. 30. *Clypeaster rarispinus*
(oral view)



Fig. 31. *Laganum decagonale*
(apical view)



Fig. 32. *Laganum decagonale*
(oral view)

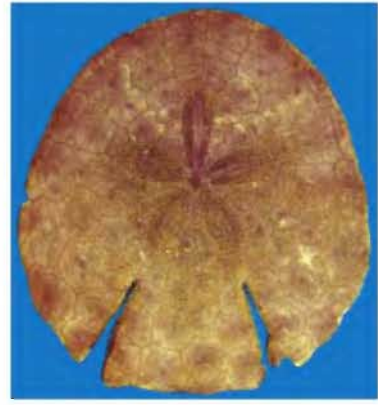


Fig. 33. *Echinodiscus auritus*
(apical view)



Fig. 34. *Echinolampas ovatus*
(apical view)



Fig. 35. *Echinolampas ovatus*
(oral view)



Fig. 36. *Brissopsis luzonica*
(apical view)

PLATE-VI



Fig. 37. *Nacospatangus alta* (apical view)



Fig. 38. *Nacospatangus alta* (oral view)



Fig. 39. *Stomopneustes variolaris* (apical view)



Fig. 40. *Echinometra mathaei* (apical view)

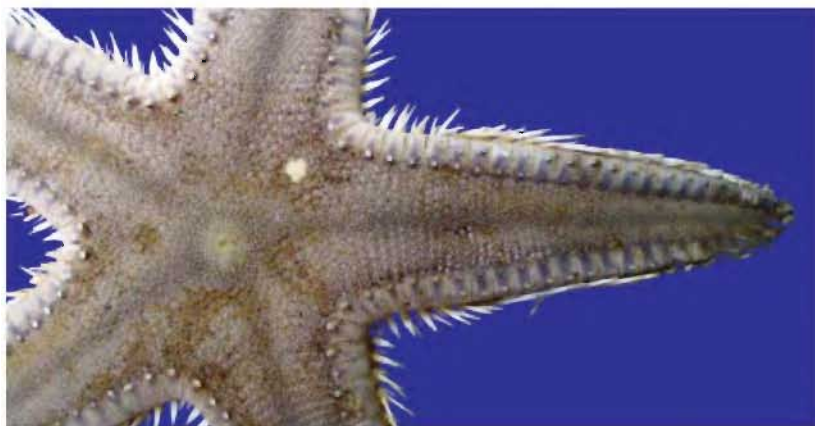


Fig. 41. *Astropecten vappa* (abactinal view)



NEW RECORD OF THE GENUS *OMICROIDES* GIORDANI SOIKA (HYMENOPTERA: VESPIDAE: EUMENINAE) FROM INDIA

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INTRODUCTION

The genus *Omicroides* was raised by Giordani Soika in 1961 based on the type species *Eumenes singularis* Smith. This genus differs from its nearest genus *Eumenes* Latrielle by having a distinct epicnemial carina on mesepisternum. This Oriental genus is represented by a single species *Omicroides singularis* (Smith). This species so far reported from Indonesia (Sumatra, Kalimantan), Malaysia (Sarawak), Myanmar, Singapore and Thailand (Smith, 1858; Giordani Soika, 1935; Vecht, 1937). In this paper, this genus is recorded for the first time from India based on the specimen collected from Nongpoh of Meghalaya state of north eastern India and a redescription is also provided.

MATERIAL AND METHODS

This study is based on a specimen collected from Nongpoh, Meghalaya, India. The specimen was studied and photographed by using a Leica Stereo microscope with LAS software version 3.6.0., and drawings were made by using the drawing tube of the same microscope.

The identified specimen was properly registered and added to the 'National Zoological Collections' of the Hymenoptera Section of Zoological Survey of India, Kolkata.

Abbreviations used for the Museums: NZSI = 'National Zoological Collections' of Zoological Survey of India, Kolkata, India; UMO = University Museum of Natural History, Oxford, England.

Abbreviations used for the terms: F1-F2 = Flagellar segments 1 and 2; H = Head; M = Mesosoma; OOL = Ocellocular length; POL = Postocellar length; S1-

S2 = Metasomal sterna 1 and 2; T1-T3 = Metasomal terga 1 to 3.

RESULTS

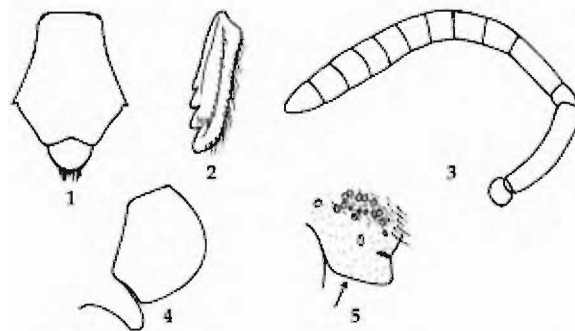
Omicroides singularis (Smith)

(Figs. 1-5; Images 1-10)

1858. *Eumenes singularis* Smith, 109, ♀, Sarawak, Borneo (UMO). Additional citations: Smith, 1871: 372 (cat.); Giordani Soika, 1935 (1934): 129, ♀, text fig. II, pl. 2 fig.1 (Borneo, Malaya; in subgenus *Omicroides*); van der Vecht, 1937: 277 (Sumatra; in subgenus *Omicroides*).

1882. *Eumenes pomiformis* var. *singularis* (Smith): Maindron, 268 (cat.). Additional citation: Dalla Torre, 1894: 31 (cat.); Dalla Torre, 1904: 24 (cat.).

1961. *Omicroides singularis* (Smith): Giordani Soika, 241.



Omicroides singularis (Smith) Female

Fig. 1. Clypeus and labrum, Fig. 2. Left mandible, Fig. 3. Antenna, Fig. 4. Tegula and Parategula, Fig. 5. Postero-lateral corner of propodeum showing propodeal valvulae.

Redescription: Female: Body length (H+M+T1+T2) 12.89 mm; forewing length 9 mm. Body black with the following yellow and brown colourations. The

yellow markings as follows: two elongated spots at the base of clypeus which fuse together at upper portion, two elongated spots at the lateral sides of clypeus, an elongate-rounded spot at supraclypeal area, a spot in between antennal scrobe which is almost fuse with the spot at supraclypeal area, a spot on ocular sinus, a spot on the upper part of temple near to eye margin, a transverse line on pronotum anteriorly, a spot on pronotum near to tegula, a spot on tegula posteriorly, parategula, a spot on upper part of mesepisternum, a transverse line in each side of propodeum at its base, two ovate lines at its apex, fore and mid femora at their outer apex, fore and mid tibiae at their outer side, a transverse band near the apical margin of petiole, a small ovate spot on each side and a transverse band on apex of T2. Brown markings as follows: mandible at its apex, apical antennal segments beneath, tegula except the yellow mark, fore and mid tibiae except the outer yellow marks, hind tibia and all tarsi. Wings fusco-hyaline, iridescent, the apical margin of forewing darker. Body covered with fine griseous pile.

Head : maximum width 1.21x its median length in front view (Image 2); clypeus (Fig. 1) convex, the apex broadly emarginate forming two rounded teeth on either sides, with scattered punctures; mandible (Fig. 2) long, moderately stout with four distinct teeth on inner side, with moderately large setae dorsally; labrum (Fig. 1) rounded at apex; supraclypeal area and the space in between antennal scrobe almost smooth with very fine punctures; frons except lower lateral margins closely and strongly punctured, interspaces less than diameter of punctures; ocular sinus with scattered punctures except inner margins almost smooth; area in front of median ocellus with scattered punctures (Image 3); vertex, temple and occiput almost smooth with scattered minute punctures; POL 1.04x OOL (Image 3); diameter of anterior ocellus equal to the distance between anterior ocellus and posterior ocelli; interocular distance on vertex 2.23x than at clypeus; temple 0.53x narrower than eye in profile (measured through its ocular sinus); antennal scrobe 8.5x farther from each other than from eyes; scape 4.5x as long as pedicel, 1.64x as long as F1; F1 2.89x as long as wide, 1.83x as long as F2; flagellar segments

slightly widening towards apex as in figure 3; apical antennal segment 1.4x as long as wide.

Mesosoma (Image 4 & 5): pronotum strongly and closely punctured except anterior face and posterior margin near to tegula smooth; mesoscutum strongly and closely punctured except postero-lateral area and parategula with few scattered punctures, maximum width of mesoscutum 1.20x its median length; scutellum and metanotum strongly and closely punctured, punctures on posterior margin with longitudinally raised carina; propleuron smooth; upper part of mesepisternum above transverse suture smooth and convex; lower part of mesepisternum below transverse suture rugosely punctate; epicnemial carina well developed; epicnemium and posterior margin of mesopleuron smooth, polished with distinct scattered punctures; dorsal metapleuron with a smooth area; ventral metapleuron with a groove or channel transversely carinated; propodeal dorsum rugosely punctured except at dorso-lateral angle smooth; ventral side of propodeum rugosely punctured including inner concavity; lateral area of propodeum rugosely punctured, lateral margin transversely carinated; median groove of propodeum distinct, punctured and complete; anterior face of pronotum separated from posterior portion by a sharp carina, not well pronounced at middle; pronotum without pretegular carina; parategula (Fig. 4) exceeding tegula posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of propodeum and scutellum, not raised in profile view; propodeal valvulae (Fig. 5) quadrangular in lateral view (Fig. 5), contiguous with the lateral margin of propodeum and sharply chitinized; midtibia with one spur; Forewing (Image 6) 3.26x as long as broad, pterostigma 4.19x prestigma; second submarginal cell acute basally; hind wing as in image 6.

Metasoma : petiole 1.48x as long as mesosoma in lateral view, 1.55x as long as T2; dorsum of petiole (T1) punctured, punctures more strong on basal 3/4th area, remaining apical portion with minute scattered punctures except a depressed portion near to apex strongly punctured (Image 7), lateral sides less punctured; S1 (Image 8) smooth, polished without punctures; T2 and S2 with small, scattered punctures, the diameter of the punctures

distinctly less than the distance between punctures; T2 and S2 (Image 9 & 10) with lamellae separated by apical thickening, a line of crenulated punctures at the point of separation; T2 1.53x as long as broad, distinctly curved inwards medially at apex; S2 slightly curved inwards medially at apex; remaining segments minutely punctured.

Material examined : 1♀, India: Meghalaya, Ri-Bhoi district, Nongpoh, 25.9° N 91.88° E, Alt. 485 m, 15.x.1975, Coll. V.K. Gupta & Party (NZSI Regd. No. 12922/H3).

Distribution : India (new record): Meghalaya. *Elsewhere*: Indonesia (Sumatra and Kalimantan), Malaysia (Sarawak, Borneo), Myanmar, Thailand and Singapore.

Discussion : In the original description of this species by Smith (1858) described that a yellow line present in the middle of the T3 and the following tergites. This character is not visible in the studied specimen since the T3 and the following segments are concealed very much.

Remarks: New record of the genus *Omicroides* Giordani Soika from Indian subcontinent; the species *Omicroides singularis* (Smith).

SUMMARY

The potter wasp genus *Omicroides* Giordani Soika is newly recorded from India with the species *O. singularis* (Smith) reported. The redescription of female with illustrations was also provided.

ACKNOWLEDGEMENTS

The author is grateful to Dr. K. Venkataraman, Director, Zoological Survey of India, Kolkata, Dr. Kailash Chandra, Additional Director & Officer-in-Charge of Entomology Division (A), Zoological Survey of India, Kolkata and Dr. Gaurav Sharma, Officer-in-Charge, Hymenoptera Section, Zoological Survey of India, Kolkata for providing facilities and encouragements. I sincerely thank Shri. Mridul Purakayastha, IT Assistant (Data Entry), ENVIS Centre on Faunal Diversity, Zoological Survey of India, Kolkata for editing photos.

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PLATE-1



1. Body profile.



2. Head front view.



3. Head dorsal view.



4. Mesosoma dorsal view.



5. Mesosoma lateral view.



6. Forewing and Hindwing.

PLATE-2



7. Petiole dorsal view.



8. Petiole ventral view.



9. Second gastral tergum.



10. Second gastral sternum.



ON SOME COLLECTION OF COLLEMBOLA PRESENT IN THE APTERYGOTA SECTION

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INTRODUCTION

While going through the collection present in the Apterygota section of National Zoological Collection of Zoological Survey of India, we came across the following collections of collembolan specimens which has not been identified and published so far. From those collections, we have identified 14 species of Collembola under 9 genera distributed over 3 families. There are about 8000 described species of Collembola worldwide (Frans Janssens, 2012). Indian fauna of Collembola represented by 299 species in 103 genera under 19 families (Mandal, 2010). Identification of specimens is done using a phase contrast compound microscope following Christiansen, K.A and Bellinger, P.F., (1998).

Family ENTOMOBRYIDAE Schaffer, 1896

I. Genus *Sinella* Brook, 1882

1. *Sinella montana* Imms, 1912

1912. *Sinella montana* Imms, Proc. Zool. Soc., London: 80-125.

Diagnosis : Body length 0.9 mm long. Body coloration white. Eyes and post antennal organ absent. Ant. Ratio as 8:13:13:26. Body clothed with pilose hairs; setae are present. Unguis with two large slender proximal teeth; Relative length index of Abds I: II: III: IV: V: VI=5:11:11:32:7:5. Manubrium: Dentes as 2:3. Mucro with a single stout and prominently curved tooth, and a basal backwardly directed spiniform tooth.

Material examined : Pir Panjal, Himalaya expedition, 28.v.1955, Coll. Santokh Singh, 3 exs; Dhroni, Himalaya expedition, 13.vi.1955, Coll. Santokh Singh, 15 exs;

Distribution : INDIA: Himachal Pradesh and Uttarakhand.

II. Genus *Seira* Lubbock, 1871

2. *Seira cinerea* Yosii, 1966

1966. *Seira cinerea* Yosii, Kyoto Univ. Sci. Exp. Karakoram and Hindukush, 8: 333-405.

Diagnosis : Body length 1.4mm. Ground colour bluish grey, slightly brown with scales. Antennae slightly darker upon proximal two segments. Head coloured ventrally. Th.II anteriorly and Th.III - Abd. II posteriorly with coloured margins. Ant.: Head as 8:3. Ant. Ratio as 25: 38: 35: 65. Scales present from the base until to the middle of Ant. III. Eyes 6+6. Unguis straight, with one inner basal and two inner distal teeth. Unguiculus lanceolate, acute on apex. Tenent hair long, robust and apically dilated. Furcal ratio as 7:8. Manubrium and dentes ventrally scaled and dorsally with many, long, ciliated setae.

Material examined : Chandigarh, 10.x.1976, Coll. G.P.Sharma, 3 exs; Ludhiana, Punjab, 15.x.1976, Coll. Dr. Dhaliwal, 1 ex.

Distribution : INDIA: Punjab, Maharashtra.

Remarks : Yosii (1966) described this species from Malabar hill, Bombay. This species first time recorded from the state of Punjab.

III. Genus *Homidia* Börner, C, 1906

3. *Homidia cingula* (Börner, C, 1906)

1906. *Homidia cingula* Börner, Mitt. Naturhist. Mus. Hamburg., 23: 147-188

1976a. *Homidia cingula* Mitra, Orient. Ins., 10(1): 145-150.

Diagnosis : Back ground yellowish. Body not compressed. Dentes with 33 spines. Abdominal segments III and IV with black blue pigmented transverse bands. Apical mucronal tooth smaller than anteapical.

Material examined : Hasimara, Jalpaiguri dist., West Bengal : 3.xii.1974, Coll.T.Sengupta, 02exs; Kaziranga, Assam; 14.xi.1974, Coll.T.Sengupta, 03exs;Gustia, Howra dist., Coll. N.C.Gayen, 20.iii.1966, 1 exs; Bhadreswar, Hoogly dist., Coll. S.K.Mitra, 26.xii.1965, 3 exs.

Distribution : INDIA: Uttar Pradesh, Arunachal Pradesh, Manipur, Sikkim, Mizoram, Nagaland, Orissa and West Bengal.

Family CYPHODERIDAE Börner, 1913

IV. Genus *Delamarerus* Mitra, 1976b

4. *Delamarerus immsi* Mitra, 1976b

1976b. *Delamarerus immsi* Mitra, *Rev. Ecol. Biol. Sol.*, **13**(4): 645-652.

Diagnostic characters : White without any trace of pigment. Antenna/body 20:64. Antennae uniformly clothed with short setae; legs clothed with spiniform, long, ciliated setae; furcula clothed with long plumose scales and setae.; Ratio of antennal segments I-IV 2:8:4:7 Relative length index of Ths. II:III =35:18; Unguis extremely modified in the presence of a large tunica at apex, fringed plate-like structures, originating from the base of each unguis and continuing anteriorly through its outer surface, pairs inner unguis and distal teeth present; unguiculilanceolate without outer winglike- tooth, tenent hairs setaceous; Relative length index of Abds I:II:III:IV:V:VI=8:10:9:73:3:1. Manubrium: Dentes: Mucro as15:7:5. Mucro very long, slender with 2 apical teeth. Body length 1.6.mm.

Material examined : Kenduah, Birbhum dist., Coll. A.K.Hazra, 7.xi.1974, 30 exs;

Distribution : INDIA: West Bengal, Orissa and Andhra Pradesh. This species first time recorded from the state of West Bengal.

Family PARONELLIDAE Börner, 1913

V. Genus *Salina* MacGillivray, 1894

5. *Salina montana* (Imms), 1912

1912. *Cremastocephalus montanus* Imms, *Proc. Zool. Soc., London*: 80-125.

1957. *Salina montana* Salmon, *Acta. Zool. Cracov.*, **11**(14): 313-362.

1973. *Salina montana* Mitra, *Oriental Insects, Delhi*, **7**(2): 159-202.

Diagnostic characters : Coloration: Ground colour of head and body usually white, sometimes pale yellow; tergal margins of Ths. II, III and Abd. I & II edged with violet to blue-black pigment; scattered patches and streaks present dorsally and laterally on Ths. II, III, Abd. I. Clothing: Body clothed with slender acuminate, ciliated macrochaetae interspersed with longer macrochaetae. **Thorax**: relative length index of thoracic segments II: III: 29:17; unguis with paired basal and two distal unpaired teeth on inner margin, unguiculus truncate with a prominent midrib, nondentate; tenent hair long, clavate, finely ciliated, tronceteral organ with c.32 spines; **Abdomen**: Relatively length index of abdominal segments I: II: III: IV: V: VI =13:23:4:79:14:8.5. Manubrium: mucrodens 56:63, mucro short, broad and distinctly lobed into 3 teeth, dental scale appendages large, subequal to mucro. Length (excluding appendages): 2 mm.

Material examined : Landsdown, Pauri Garwal dist., Uttarakhand, 5.iii.1965, Coll. S.K.Mitra, 1ex;

Distribution : INDIA: Uttarakhand and West Bengal.

6. *Salina yosii* Salmon, 1964

1964. *Salina yosii* Salmon, *Bull. Roy. Soc. N.Z.*, (7) **2**: 145-644.

1973. *Salina yosii* Mitra, *Oriental Insects, Delhi*, **7**(2): 159-202.

Diagnostic characters : Coloration : General ground colour of body varying from white to pale yellow; symmetrical purple to violet markings present dorsally on thoracic II, III and abdominal segment III. Legs and furca pale yellow and without pigment. Clothing: Body clothed with slender acuminate, ciliated macrochaetae interspersed with longer macrochaetae. **Thorax**: Prothorax reduced, relative length index of thoracic segments II: III: 29:15. Hind tibio-tarsi much longer than the fore and mid ones; unguiculus truncate with a prominent midrib; tenent hair long, clavate, finely ciliated. **Abdomen**: Relatively length index of abdominal segments I: II: III: IV: V: VI =13:26:3:84:14.5:7.5. Manubrium: mucrodens 56:68,

mucro short, broad and distinctly lobed into 3 teeth, dental scale appendages large, subequal to mucro. Length (excluding appendages): 2 mm.

Material examined : Wakro, Lohit dist., 4.xii.1969, Coll. J.M.Julka, 3 exs;

Distribution : INDIA (Arunachal Pradesh, Orissa, West Bengal); CHINA and THAILAND.

Remarks : This species first time recorded from the state of Arunachal Pradesh.

7. *Salina striata* Handschin, 1928

1928. *Cremastocephalus striatus* Handschin, *Treubia*, **10**: 245-270.

1929. *Salina striata* Handschin *Rev. Suisse. Zool.*, **36**: 229-262.

1961. *Salina striatella* Yosii, *Nature and life in South East Asia*, **1**: 171-200.

1973. *Salina striata* Mitra, *Orient. Ins.*, **7**(2): 159-202.

Diagnostic characters : Coloration: Head and body white pale yellow to white in colour, head capsule with a medial dirty brown patch. Antennal segment I with a bluish longitudinal basal streak and another distal blue black pigmented patch. Clothing: Body sparsely clothed with short, ciliated acuminate microchaetae interspersed with flexed macrochaetae. Head: Pear shaped dorsally, frontal spine present 1+1; ocelli 8+8. Thorax: Relative length index of thoracic segments II: III=15:9. Legs similar, unguis slightly curved with paired basal and single unpaired distal teeth on inner margin. Abdomen: Abdominal segments I: II: III: IV: V: VI=8:14:3:41:7:3; Ventral tube well developed. Manubrium: mucrodens 28:33, mucro short, broad, prominently lobed into three teeth, median sometimes truncated tooth; dental scale appendages subequal to mucro with faint longitudinal striations. Body length: 3 mm

Material examined : Robbers cave, Dehradun dist., 4.ii.1964, Coll. S.K.Mitra, 1 ex.

Distribution : INDIA: Arunachal, Assam, Meghalaya, Nagaland, Uttarakhand and Nilgiri Hills.

VI. Genus *Dicranocentroides* Imms, 1912

8. *Dicranocentroides salmoni* Mitra, 1975

1957. *Dicranocentroides fasciculatus* Salmon, *Acta, Zool. Cracov.*, **11**(14): 313-362.

1957. *Handschinphysa crassicornis* Sensus Salmon, *ibid.*

1975. *Dicranocentroides salmoni* Mitra, *Rec.Zool. Suro. India*, **71**: 57-95.

Diagnostic characters : Coloration: Extremely variable colour pattern. Pigmented; thoracic II and abdominal segment III with median pigmentation extending laterad, abdominal segment IV with two transverse bands. Clothing: Body clothed with scales and ciliated obliquely truncated macrochaetae (brush setae) present on head, thoracic II III and abdominal segments I,II; segment IV with posterior-median and of V,VI acuminate, ciliated setae, III with 2 median macrochaetae on each side and IV with 16 macrochaetae at the middle. Head : Pear shaped when viewed from above; ocellar field dark 1+1 each with 8 ocelli in two longitudinal rows. Antennae subequal to the length of head and body; ratio of length of antennal segments I-IV 20:19.5:14:25. Thorax: Relative length index of thoracic segments II: III=14:10. Legs similar; tibio-tarsi anteriorly segmented with 6-7 lateral spine like setae; unguis elongate, unguiculus lanceolate; tenent hair long and clavate. Abdomen: Relative length index of segments I:II:III:IV:V:VI 7:7:4:37:4:2; ventral tube long, rami of reticulum each with 4 teeth. Manubrium : mucrodens 28 :40; each dentes armed with a row of stout spines of more than three fourth of its length and transiting into stiff ciliated setae; mucro large with 6 teeth. Body length 2.3 mm.

Material examined : Shillong Peak, Meghalaya, 26.xi.1974, Coll.T. Sengupta, 03exs; Songsak, Garo Hills, Meghalaya, 20.xi.1974, Coll.T. Sengupta, 05exs;

Distribution : INDIA: Arunachal, Assam, Manipur, Mizoram, Meghalaya, Nagaland and Sikkim.

9. *Dicranocentroides flavescens* Yosii, 1966

1966. *Dicranocentroides fasciculatus* f. n. *flavescens* Yosii, *Res. Kyoto Univ. Sci. Exped. Karakoram and Hindukush*, 1955, **8**: 333-405.

1975. *Dicranocentroides flavescens* Mitra, *Rec. Zool. Suro. India*, **71**: 57-95.

Diagnostic characters : Coloration: Body pale yellow to brownish generally without dark patches; tergal margins margins of abdomen III and IV with faint bluish pigment having a dark characteristic patch on vertex in between two ocellar

fields; antenna without pigment. Head: Pear shaped when viewed from above; 1+1 dark ocellar field, each with 8 ocelli in two longitudinal parallel rows. Antennae subequal to body; relative length index of antennal segments is I-IV: 15:17:12:19. Thorax: Relative length index of thoracic segments II: III 14:8.5. Legs similar; unguis little curved with paired external basolateral teeth; unguiculus lanceolate, acuminate usually with 2 outer teeth. Abdomen: Relative length index of abdominal segments I: II: III: IV: V: VI 5:6:4:39:5.5:2; ventral tube long with protrusible vesicles retracted. Manubrium: mucrodens 28:38; dentes armed with two closely apposed rows of spines on inner margin; mucro large, parallel sided with 6 teeth. Body length 2-3.5mm.

Material examined : Hasimara, Jalpaiguri dist., West Bengal: 3.xii.1974, Coll.T.Sengupta, 01ex;

Distribution : INDIA: Manipur, Maharashtra, Mizoram, Nagaland, Sikkim, Tripura, Arunachal Pradesh, Uttar Pradesh and West Bengal; NEPAL.

VII. Genus *Callyntrura* Börner, C, 1906

10. *Callyntrura variabilis* Mitra, 1974

1974. *Callyntrura variabilis* Mitra, *Rev. Ecol. Biol. Sol.*, 11(3): 397-439.

Diagnosis : General ground colour of body yellow to brown with variable dark blue black patches, antennae yellowish to dirty brown. Body clothed with scales and flexed setae; 8+8 ocelli in pigmented ocellar fields. Relative length index antennal segments I-IV 18:17:11:27. Relative length index of thoracic segments II: III=42:25. Relative length index of abdominal segments I: II: III: IV: V: VI = 17:24:8:94:10:4; ventral tube moderately long. Manubrium: mucro dens=23:29.5; mucro with six teeth; dental scale appendage absent. Body length (excluding appendages) 2 mm.

Material examined : Madarihat, Jalpaiguri dist., West Bengal, Coll.T.Sengupta, 04exs;

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

11. *Callyntrura lineata* (Parona, 1892) Yosii, 1961

1892. *Entomobrya lineata* Parona, *Atti. Soc. Ital., Milano*, 34: 132-135.

1912. *Paronella borneri* Imms, *Proc. Zool. Soc. London*, pp. 80-125, new synonymy.

1912. *Paronella phanolepis* Imms, *ibid*, pp. 80-125, new synonymy

1957. *Handschinphysa lineata* Salmon, *Acta. Zool. Cracov.*, 11(14): 313-362.

1961. *Callyntrura lineata* Yosii, *Nature and life in Southeast Asia*, 1: 171-200.

1974. *Callyntrura (Handschinphysa) lineata* Mitra, *Rev. Ecol. Biol. Sol.*, 11(3): 397-439.

Diagnostic characters : Coloration : Body pale yellow with variable purple to blue black pigment; head with or without pigment thoracic I,II and abdominal segments I,II,III. Pigmented with purple to blue black pigment laterally or entirely. **Clothing**: Head, body and appendages clothed with setae and pseudoscales; macrochaetae flexed, obliquely truncated and ciliated (brush setae) setae on thoracic II, III and abdominal segments I, II, III. Antennae and legs clothed with darker, acuminate, ciliated setae. Head: Pear shaped, frontal spines 4+4 present; ocelli, 8+8. .Head / Ant I = 28/27; ratio of length of antennal segments I-IV 28:28:18:48; apex segment IV with a conspicuous sense knob encircled with setae. Thorax: Relative length index of thoracic segments II: III 52:22; unguis elongate, little curved, unguis with paired inner and 2 distal unpaired teeth; unguiculus lanceolate; tenent hair clavate. Abdomen: Relative length index of the segments 13:24:8:130:12:5; rami of retinaculum each with 4 teeth. Manubrium: mucrodens 110:148; dentes stout; mucro plump with 6-9 teeth. Body length 2.5 - 4mm.

Material examined : Kansrao, Dehradun dist., Uttarakhand, Coll. S.K.Mitra, 2exs; Nagalhat Nullah, Dehradun dist., Uttarakhand, Coll. S.K.Mitra, 7exs; Narendra Nagar, Tehri Garhwal dist., 23.ii.1965, Coll. S.K.Mitra, 10 exs.

Distribution : INDIA: Manipur, Tripura and Uttarakhand.

12. *Callyntrura vestita* (Handschin, 1925)

1925. *Microphysa vestita* Handschin, *Treubia*, 6: 225-270; 1928, *Treubia*, 10: 225-270

1957. *Handschinphysa vestita* Salmon, *Acta. Zool. Cracov.*, 11 (14): 313-362

1974. *Callyntrura (Handschinphysa) vestita* Mitra, *Rev. Ecol. Biol. Sol.*, 11(3): 397-439

Diagnostic characters : Coloration: Unique in colour pattern and usually without any variation;

body green in fresh, pale yellow in spirit dark purple to blue black patches covering head, thoracic II,III and abdominal segments I,II,III. Clothing: Body clothed with flexed macrochaetae, acuminate, nonflexed setae and scales. Head: Pear shaped with 4+4 dark frontal spines; ocelli 8+8. Antennae subequal or little longer than body, ratio of length of antennal segments I-IV 43:40:27:60. Thorax: Relative length index of thoracic segments II: III 63:31; unguis straight, little curved apically with inner, paired basal teeth reduced, single unpaired tooth small; external basolateral teeth large; unguiculilanceolate. Abdomen: Relative length index of abdominal segments I: II: III: IV: V: VI 18:31:14:172:22:9; rami of retinaculum each with 4 teeth. Manubrium: mucrodens =45:53; mucro usually with 6 teeth, dental scale appendages small. Body length 2-2.5 mm.

Material examined : Lopchu Tea Estate, Darjeeling dist., W.B., 20.x.1967, Coll. G.Topal, 1 ex; Shillong Peak, Meghalaya, 17.viii.1965, 1 ex; Gorubathan, W.B., 10.xii.1973, Coll. G.K.Srivastava, 3 exs.

Distribution : INDIA: Assam, Manipur, Meghalaya and Nagaland West Bengal; INDONESIA.

VIII. Genus *Yosiia* Mitra, 1967

13. *Yosiia dehradunia* Mitra, 1967

1967. *Yosiia dehradunia* Mitra, *Proc. Zool. Soc. Calcutta*, **20**: 43-47.

Diagnostic characters : Coloration: Pale yellow with dust of blue pigment over the body and a pair of dark blue-black patches one on each side on abdominal segments III and IV. Clothing: Scales absent; head and body clothed with setae, mostly ciliated; longer setae broad, cylindrical and blunt or slender acuminate; setae arising in clusters from the cervix and decumbent on posterior margin of head, similar setae also present anteriorly on mesotergum, head capsule and body. Head: Pear-shaped; ocelli 8+8 in pigmented ocellar fields each group of 8 ocelli arranged in two longitudinal parallel rows. Thorax: Segment I reduced; the relative length index of segments II: III= 23:11. Legs similar; each tibio-tarsus with two large tibio-tarsal lobes; unguiculus of the "truncate" type; trochanteral organ with 24 short spines. Abdomen:

Relative length index of segments I:II:III: IV :V:VI = 6:15:4:67:9:6; Ventral tube short, anterior face with 4+4 long ciliated setae; rami of tenaculum each with 4+4 teeth; dens and manubrium subequal, dens crenulated; mucro vestigial; dental scale appendages greatly enlarged, dorsal in relation to dens and with longitudinal striations. Body length 1.14 mm.

Material examined : Daitari, Keonjhor dist., Orissa, 23.xi.1967, Coll. G.Topal, 9 exs; Joynagar, Agartala, Tripura, 30.x.1974, Coll. M.S.Shishodia, 2 exs; Golapbag, Burdwan dist., W.B., 3.v.1971, Coll. B.Bhattacharyya, 5 exs.

Distribution : Orissa, West Bengal, Sikkim, Tripura and Uttarakhand.

IX. Genus *Idiomerus* Imms, 1912

14. *Idiomerus pallidus* Imms, 1912

1912. *Idiomerus pallidus* Imms, *Proc. Zool. Soc., London*: 80-125.

1990. *Idiomerus pallidus* Mitra, *Rec. zool. Surv. Ind.*, **86**: 69-82.

Diagnosis : Ground colour of body yellow with variable bluish black pigment, head capsule pigmented anteriorly, body clothed with flexed macrochaetae, head pear shaped, longer than broad; 8+8 ocelli; Th.II prominently humped posteriorly, degree of prominence varies with the age of individuals; relative length of Th.II: III= 18: 5; Unguis slightly curved with paired inner basal and single distal unpaired teeth, external basal teeth well developed; unguiculilanceolate, relative length index of Abds.I:II :III: IV :V:VI = 4:8:4:40:9:3; ventral tube long, relative length index of manubrium: dentes=30:40, dentes not crenulated, with two closely apposed rows of spines, dental scale appendage absent; mucrones short, broad with six teeth. Body length excluding appendages: 3-4 mm.

Material examined : From the side of a hill stream, Venkolla, Quilon dist., Kerala, 14.xii.1976, Coll. S.K.Mitra, 8 exs.

Distribution : INDIA:Kerala.

SUMMARY

The present paper deals with 14 species of Collembola under 9 genera distributed over 3 families.

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OBSERVATIONS ON THE STATUS AND DIVERSITY OF BUTTERFLIES IN THE FRAGILE ECOSYSTEM OF LADAKH (J & K)

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INTRODUCTION

As one of the more inaccessible parts of the Himalayan Ranges, the cold deserts of India are resource poor regions. These could be considered as an important study area because of their extremely fragile ecosystem. The regions on the north flank of the Himalayas experience heavy snowfall and these remains virtually cut off from the rest of the country for several months in the year. Summers are short. The proportion of oxygen is less than in many other places at a comparable altitude because of lack of vegetation. There is little moisture to temper the effects of rarefied air. The people of these areas depend predominantly on agriculture and animal husbandry.

Ladakh is the highest altitude plateau region in India, situated in the state Jammu and Kashmir between Karakoram mountain range in the north and the main Great Himalayas in the south. It has an area of 45,110 km. Ladakh borders Tibet to the east, the Lahaul and Spiti to the south, the Valley of Kashmir, Jammu and Pakistan to the west and Afganistan and China in the north.

Bounded by two of the world's mightiest mountain ranges, the Karakoram in the north and the Great Himalaya in the south, Ladakh is traversed by two other parallel chains, the Ladakh Range and the Zanskar Range. Ladakh range and Zansker range running in the east and west side respectively through Ladakh, divides it into three main valleys i.e., Zansker valley, Indus valley and Nubra valley. The Zansker valley lies west to Zansker range, the Indus valley sandwiched

between Zansker and Ladakh ranges and Nubra valley on the east side of Ladakh range crossing the Khardungla pass. The river Indus is the backbone of Ladakh.

As a distinct biome, this cold desert need specially focused research and a concerted effort in terms of natural resource management, especially in the light of their vulnerable ecosystems and highly deficient natural resource status. Ecology and biodiversity of the Ladakh is under severe stress due to severe pressures. Ladakh and Kargil districts have been greatly disturbed since 1962 because of extensive military activities. Since 1992, tourists and others have been allowed to visit some pristine areas. There has been tremendous increase in human and livestock populations. Increased agricultural and developmental activities have further contributed to the loss of wildlife in the area. The situation is critical, as almost all the large mammals in this zone are on the endangered list.

The floral and faunal elements of this area are unique and have high level of endemism which need to be protected. They have direct bearing on sustaining the ecosystem as well as the life of people. Insects form a predominant group and have a vital role in the equilibrium of the cold desert. But as compared to other vertebrate groups, this group has received little attention from researchers.

Butterflies are the most important component of our biodiversity. Apart from being aesthetically attractive, they act as indicators to depict the health

of a habitat. The larvae of butterflies are associated with plants but cause only little damage to the hosts. The adults act as incidental, wild pollinators and help in pollination of many native plants. The larvae as well as adults are food for many predators like lizards and birds. The butterfly diversity in an ecosystem tells how much healthy it is, as butterflies are very sensitive to any change in the environment. But in the present day scenario, many butterfly species are under a real threat due to depletion of the natural cover for various developmental activities. This is truer in case of high altitude areas. In Ladakh, some species of Apollo butterflies are of great interest because of their high money value in insect trade. During the survey by Zoological Survey of India in Ladakh in July 2009 to September, 2009, about 20 species of butterflies have been identified from Ladakh. Some of them are also available in lower altitudinal ranges of Himalayas but certain species such as The Mountain Blue, the Small Jewel White, The Lofty Bath White, The Lesser Bath White, The Common Red Apollo, The Mountain Satyr and The high Brown Silverspot are confined to high altitude only. Of these, two species i. e. The Common Red Apollo and The high Brown Silverspot are also included in Indian Wildlife (Protection) Act. The area from south Pullu to Khardungla is quite rich in common red Apollo, but due to traffic and tourism this habitat of Apollo butterflies is being destroyed and need to be conserved.

OBSERVATIONS

The species collected from Ladakh have been identified consulting the works of Evans (1932), Wynter-Blyth (1957), Cantlie (1963) and Mani (1986). The following species of butterflies are being reported from Ladakh.

SYSTEMATIC ACCOUNT

Order LEPIDOPTERA
 Sub Division RHOPALOCERA
 Super Family PAPILIONOIDEA
 Family PAPILIONIDAE
 Genus *Parnassius* Latreille, 1804

1804. *Parnassius* Latreille, *Nouv. Dict. Hist. nat.* 24 (6): 185, 199.

Type-species : *Papilio apollo* Linnaeus

1. *Parnassius epaphus* Oberthur, 1879

1879 *Parnassius epaphus* Oberthur, *Etudes d'Ent.* 4: 23

Common Name : Common Red Apollo

Diagnostic features : Male : Upperside of fore wing with crimson black-encircled spots reduced to a minute subcostal dot in the black mark beyond the cell; the subhyaline terminal margin much narrower, with dentate white spots in the interspaces along the actual margin; cilia white, markedly alternated with black at the apices of the veins. Hind wing: the dusky black along the dorsal margin comparatively much broader, its inner border more irregular, deeply bi-emarginated, the crimson centre to the black mark above the tornal angle entirely absent. In no specimens that I have seen are the crimson spots centered with white. Underside: on the fore wing the white dentate spots in the terminal row are larger, which give to the wing the appearance of having a subterminal as well as a post-discal transverse series of dusky-black lunules. On the hind wing the row of basal and the obliquely-placed pre-tornal spots are of a duller shade, while as in that form all the crimson spots are broadly centered with white. Female differs from the male in the dusky black markings on the upperside that are broader, especially the postdiscal series on the fore wing: this generally forms a diffuse band and so often restricts the lunules of the white ground-colour beyond it, blending as it does diffusely with the subhyaline terminal margin. Anal pouch of fertilized of the posterior high keel or carina absent.

Material examined : Ladakh, Khardungla, 5 exs, 29.VII.2008, coll. A. K. Sidhu and party.

Distribution : Afghanistan, Pakistan, Tadjikistan, Northern India (Jammu & Kashmir and Sikkim), Nepal, Bhutan and China.

Remarks : All the species of genus *Parnassius* Latreille are Palaearctic, present above the tree line in isolated pockets. The species *Paranassius epaphus*, though has wide distribution but the subspecies *Parnassius epaphus hillensis* Bang-Haas is confined to Ladakh and Spiti areas of cold desert is included in Wildlife (Protection) Act of India (Schedule II, Part II). As per present survey this subspecies is commonly available in a small stretch of seven kilometers from South Pullu to Khardungla. But

due to rapidly expanding tourism this subspecies in Ladakh is under a real threat and this area is immediately needed to be conserved.

Genus *Papilio* Linnaeus, 1758

1758. *Papilio* Linnaeus, *Syst. Nat.* (Edn 10) 1: 458.

Type-species : *Papilio machaon* Linnaeus

2. *Papilio machaon* Linnaeus, 1758

1758. *Papilio machaon* Linnaeus, *Syst. Nat.* (Edn 10) 1: 462.

Common name : Common Yellow Swallowtail

Diagnostic features : Sexes similar; wings dorsally yellow with black markings, veins black; upperside of forewing with basal area black dusted with yellow scales; rest of the cell yellow with a black bar in cell and a black bar at end cell; marginal area black with a complete series of regular small yellow spots near termen. The hind wings have a pair of protruding tails, below each tail is a red eye spot.

Material examined : Tsomoriri, 1 exs, 26.VII.2008, coll. A. K. Sidhu and party.

Distribution : Throughout the Palearctic region in Europe and Asia; across North America.

Remarks : This species though widely distributed and moderately available in hilly areas of north-west India but in Ladakh as per present surveys, it is quite rare and mainly present near brackish water lakes. In Ladakh the tail of this species is shorter as compared to the other specimens available in Himachal Pradesh.

Family PIERIDAE

Genus *Pontia* Fabricius, 1807

1807. *Pontia* Fabricius, *Magazin f. Insektenk.* (Illiger) 6: 283.

Type-species : *Papilio daplidice* Linnaeus

3. *Pontia callidice* (Hubner, 1799)

1799. *Papilio callidice* Hubner, *Samml. eur. Schmett.* [1] : pl. 81 (1799-1800), f. 408-409.

Common name : Lofty Bath White

Diagnostic features : Male : Upperside of wings white; Forewing: with black at extreme base; discocellulars marked with a quadrate black spot; a discal curved series of inwardly dentate spots; Hindwing with uniformly white, the pattern of the

underside visible through transparency; base densely irrorated with black scales. Underside of forewing white, basal half of costal margin and quadrate spot on discocellulars dull black. Hindwing green, an elongate oval yellowish-white spot in cell, followed beyond by complete curved series of discal and terminal yellowish-white, inwardly lanceolate spots. Female Upperside of wings similar to that of the male, the black scaling at the base of the wings more extended, especially on the hind wing where it stretches broadly down the dorsal half of the wing and occupies also the apex of the cell.

Material examined : Ladakh, Khardungla, 2 exs, 29.VII.2008, coll. A. K. Sidhu and party.

Distribution : North-west Himalayas above 12,000 feet from Chitral to Mussoorie. Occurs in the higher mountains of Europe; in Asia from the Altai to the Himalayas.

Remarks : This species is typically Palearctic present above tree line. As per present surveys, it shares common habitat with *Parnassius epaphus* and is available in a small stretch of seven kilometers from South Pulla to Khardungla and need to be conserved.

4. *Pontia chloridice* (Hubner, 1808-1813)

Papilio chloridice Hübner, 1808-1813, *Samml. eur. Schmett.* [1] : pl. 141.

Common name : Lesser Bath White.

Diagnostic characters : Male : Upperside ground colour white, forewing with discocellulars edged broadly with black on each side ; a short broad transverse pre apical black bar present and another similar short bar further outwards; hindwing uniform, unmarked. Underside : white; fore wing markings as on the upperside, but those at apex green and with a few scattered superposed black scales on the upper preapical bar; hind wing with basal area green, an oval white spot in middle of cell. Female Upperside on fore wing the black edging to the discocellulars broader; a curved, postdiscal, irregular, macular, black band, the upper three and lowest spot that compose it large; hind wing with an anterior, postdiscal, short, curved, macular, black band, followed by a more or less complete terminal series of spots at the apices of the veins.

Material examined : Nubra Valley, Panamic, 1ex, 08.VII.2008, coll. H. S. Mehta and party.

Distribution : Chitral and Ladakh in India and Pakistan.

Remarks : *Papilio chloridice* a typically Palaearctic species, has very restricted distribution. During present surveys it has been found to confine to Nubra valley and is quite rare in this area.

5. *Pontia daplidice* (Linnaeus, 1758)

1758. *Papilio daplidice* Linnaeus, *Syst. Nat.* (Ed. 10) 1: 468.

Common name : Bath White

Diagnostic characters : Male with wings white; upperside of forewing with apex black studded with white spots and lines, end cell with black spot; underside of hindwing blotched with green colour. Female similar to male except upperside of forewing with a discal spot and upperside of hindwing with an obscure row of terminal and marginal spots.

Material examined : Leh, Neyoma, 2exs, 18.VII.2008, coll. A. K. Sidhu and party; Chilling, 2 exs, 15.VII.2008, coll. H. S. Mehta and party.

Distribution : Central and Southern Europe, Baluchistan, Peshawar, Chitral, Kashmir and along the Himalayas right across the Central Himalayas up to Darjeeling.

Remarks : This species is widely distributed from plains of India to cold desert of Ladakh. As per present surveys, it is commonly available in Agricultural fields of Ladakh adjoining Leh.

Genus *Colias* Fabricius, 1807

1807. *Colias* Fabricius, *Magazin f. Insektenk.* (Illiger) 6: 284.

Type-species : *Papilio hyale* Linnaeus

6. *Colias erate* (Esper, 1805)

1805. *Papilio erate* Esper, *Ausl. Schmett.* 1 (2): 13, pl. 119, f. 3.

Common name : Pale Clouded yellow

Diagnostic features : Male with wings dorsally lemon yellow with broad unspotted black outer border, a prominent black spot present in cell of forewing. Female as in male but borders spotted with ground colour; upperside of hindwing heavily dusted with black scales.

Material examined : Ladakh, Leh, Ganglas, 1 exs,

29.VII.2008, coll. A. K. Sidhu and party; Leh, Horze, 1 exs, 11.VII.2008, coll. H. S. Mehta and party; Leh, Nyeoma, 7 exs, 05.VII.2008, coll. H. S. Mehta and party; Hemis, 2 exs, 04.VII.2008, coll. H. S. Mehta and party.

Distribution : Himalayas from Chital to Kumaon; hills of south India.

Remarks : As per present surveys, *Colias erate* is commonly available in agriculture fields of Ladakh adjoining Leh. Otherwise this species in moderately available in Northwest India from plains to high altitude areas.

Genus *Pieris* Schrank, 1801

1801. *Pieris* Schrank, *Fauna Boica* 2 (1): 152, 161.

Type -species : *Papilio brassicae* Linnaeus

7. *Pieris brassicae* (Linnaeus, 1758)

1758. *Papilio brassicae* Linnaeus, *Syst. Nat.* (Ed. 10) 1: 467.

Common name : Large cabbage White

Daignostic features : Male with wings dorsally white with black apex of forewing and apical spot on hindwing; no discal spot present in forewing; underside of hindwing pale yellow. Female similar with two additional discal spots on upperside of forewing.

Material Examined : Leh, Ganglas, 2 exs, 11.VII.2008, coll. H. S. Mehta and party; Chilling, 1 ex, 15.VII.2008, coll. H. S. Mehta and party; Chishul, 2 exs, 25.VII.2008, coll. A. K. Sidhu and party; Chumathan, Skidmang, 7 exs, 13.VII.2008, coll. H. S. Mehta and party; Chilling, Sumdhoo, 1 ex, 15.VII.2008, coll. H. S. Mehta and party; Nubra Valley, Khardung, 1ex, 15.VII.2008, coll. H. S. Mehta and party.

Distribution : Throughout Europe, North Africa and Asia to the Himalayas.

Remarks : This species is very common in agricultural fields of Ladakh and is widely distributed. In India it is available from plains to high altitude areas.

8. *Pieris canidia* (Linnaeus, 1768)

1768. *Papilio canidia* Linnaeus, in Sparrman, *Amoenit. acad.*, 7 (150): 504.

Common name : Indian Cabbage White.

Diagnostic characters : Male upperside of wings white; upperside of forewing with apex black, inwardly dentate black outer margin and with a black discal spot; upperside of hindwing with apical spot and terminal spots. Female similar to male with an additional discal spot on upperside of hindwing.

Material examined : Leh, Ganglas, 3exs, 11.VII.2008, coll. H. S. Mehta and party.

Distribution : North-west India, Himalayas, Assam, Burma, Nilgiris, Palnis, Travancore, Cochin, Tibet, West China.

Remarks : As per present surveys, this species is moderately available in agricultural fields of Leh and surrounding areas.

9. *Pieris rapae* (Linnaeus, 1758)

1758. *Papilio rapae* Linnaeus, *Syst. Nat.* (Ed. 10) 1: 468.

Common name : Small Cabbage White.

Diagnostic characters : Male wings dorsally white, very small apical black area on forewing, one discal spot on forewing and apical spot on hindwing. Female similar to male but with additional discal spot on upperside of forewing.

Material examined : Diskit, 1ex, 07.VII.2008, coll. H. S. Mehta and party.

Distribution : Australia, New Zealand, Palaearctic area, in India Ladakh, Kashmir, North-West India.

Remarks : The species *Pieris rapae* is distributed only in high altitude areas of India and in present surveys it has been found to be rare.

Family LYCAENIDAE

Genus *Celastrina* Tutt, 1906

1906. *Celastrina* Tutt, *Ent. Rec.* 18: 131.

Type-species : *Papilio argiolus* Linnaeus

10. *Celastrina argiolus* (Linnaeus, 1758)

1758. *Papilio argiolus* Linnaeus, *Syst. Nat.* (Edn 10) 1: 483.

Common name : Hill Hedge Blue.

Diagnostic features : Male with wings dorsally blue with broad dark border on forewing, increasing to apex, female with very broad dark borders and discal area pale blue. Wing below grey coloured in both sexes.

Material examined : Nubra, Diskit, 1 ex, 15.VII.2008, coll. H. S. Mehta and party; Chilling, Sumdhoo, 2 exs, 15.VII.2008, coll. H. S. Mehta and party; Leh, Nyeom, 5 exs, 05.VII.2008, coll. H. S. Mehta and party, 4 exs, 18.VII. 2008, A. K. Sidhu and party; Leh, Stock, 1ex, 10.VII.2008, coll. H. S. Mehta and party.

Distribution : Eurasia and South Asia, Chitral to Kumaon.

Remarks : This species is commonly available in hilly areas of north-west India and as per present surveys, it is commonly present in wild vegetation and in agricultural fields of Ladakh.

Genus *Albulina* Tutt, 1909

1909. *Albulina* Tutt, *Nat. Hist. Brit. Butts* 3 (6): 154.

Type-species: *Papilio orbitulus* Prunner

11. *Albulina omphisa* (Moore, 1875)

1875. *Polyommatus omphisa* Moore, *Proc. zool. Soc. Lond.* 1874 (4): 573, pl. 66, f. 2.

Common name : Dusky Green Under Wing.

Diagnostic features : Male with wings dorsally dusky violet blue with broad dark border; on hind wing the blue colouration confined to base; female plain brown; underside of hindwing green upto margins with faint white spots.

Material examined : Leh, Ganglas, 3exs, 11.VII.2008, coll. H. S. Mehta and party.

Distribution : In India in the Himalayas (Chitral, Ladakh, Lahul) and north China.

Remarks : It is an high altitude species. It is moderately available in wild vegetation of Leh and surrounding areas, as per the present surveys.

12. *Albulina pheretes* (Hoffmansegg, 1804).

1804. *Papilio pheretes* Hoffmansegg, *Mag. f. Insektenk. (Illiger)* 3: 187.

Common name : Mountain Blue.

Diagnostic features : Male with upperside of wings purple blue; underside of forewing with spots black or white; underside of hindwing all greenish white or all brown or central green metallic, highly variable, with spots large in size. Female is brown.

Material examined : Nubra Valley, Khardung, 1ex, 09.VII.2008, coll. H. S. Mehta and party.

Distribution : Chitral to Kumaon; Sikkim.

Remarks : The species *Albulina pheretes* is a high altitude and Palearctic species. As per present surveys it is quite rare and confined to Nubra Valley.

Genus *Plebejus* Kluk, 1780

1780. *Plebejus* Kluk, *Hist. nat. pocz. gospod.* 4: 89.

Type-species : *Papilio argus* Linnaeus

13. *Plebejus christophi* (Staudinger, 1874)

1874. *Lycaena christophi* Staudinger, *Stett. ent. Ztg.* 35: 87.

Common name : Small Jewel Blue.

Diagnostic features : Male: Wings dorsally dull violet blue; forewing with narrow dark border; ventrally wings without prominent red marginal spots, hindwing with small metallic spots along entire margin; marginal spots of both wings faintly orange crowned.

Female : wings dorsally brown, bases blue scaled; otherwise similar to male.

Material examined : Leh, Nyeoma, 4exs, 05.VII.2008, coll. H. S. Mehta and party; Pangong Tso, 1 ex, 24.VII.2008, A. K. Sidhu and party.

Distribution : North Iran, Caucasus, Kurdistan, Turkestan, Chitral, North Afghanistan, Ladakh, Kashmir.

Remarks : It is a high altitude species commonly available in Ladakh.

Genus *Pseudophilotes* Beuret, 1958

1958. *Pseudophilotes* Beuret, *Mitt. ent. Ges. Basel (n.f.)* 8 (6): 100.

Type-species : *Papilio baton* Bergtrasser

14. *Pseudophilotes vicrama* (Moore, 1865)

1865. *Polyommatus vicrama* Moore, *Proc. zool. Soc. Lond.* 1865 (2): 505

Common name : Chequered Blue.

Diagnostic features : Male with wings dorsally dusky blue; female dark brown; wings with fringe prominently chequered; ventrally wing creamish in colour with black spots, marginal spots orange crowned.

Material examined : Nubra valley, Huder, 1ex, 07.VII.2008, coll. H. S. Mehta and party.

Distribution : Baluchistan, Chitral to Shipki.

Remarks : It is an high altitude species. It is moderately available in wild vegetation of Ladakh, as per the present surveys.

Family NYMPHALIDAE

Genus *Fabriciana* Reuss, 1920

1920. *Fabriciana* Reuss, *Ent. Mitt.* 9: 92 nota.

Type-species : *Papilio niobe* Linnaeus

15. *Fabriciana adippe* (Schiffermuller, 1775)

1775. *Papilio adippe* Schiffermuller, *Ankündigung eines systematischen Werkes von den Schmetterlingen der Wienergegend*: 176.

Common name : High Brown Silver Spot.

Diagnostic features : Sexes similar; wings dorsally tawny with black spots; underside with three upper discal silver spots at right angles to the costa not in line with the fourth spot; two small silver spots inside the upper two; three basal silver spots

Material examined : Leh, Horzey, 1ex, 11.VII.2008, coll. H. S. Mehta and party; Tsomoriri, 1ex, 26.VII.2008, coll. A. K. Sidhu and party.

Distribution : Chitral to Kumaon; Ladakh.

Remarks : This species though commonly available in hilly areas of north-west India but in Ladakh as per surveys conducted presently, it is quite rare. In Ladakh it is distributed near the brackish water lakes.

Genus *Vanessa* Fabricius, 1807

1807. *Vanessa* Fabricius, *Magazin f. Insektenk.* (Illiger) 6: 281.

Type-species: *Papilio atalanta* Linnaeus

16. *Vanessa cardui* (Linnaeus, 1758)

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

Common name : Painted Lady.

Diagnostic features : Sexes similar; wings dorsally pinkish red with black markings; forewing slightly concave below apex; hindwing slightly wavy but otherwise evenly rounded; upperside of forewing with apex black bearing inner three conjoined and four separate marginal white spots.

Material examined : Diskit, 1ex, 07.VII.2008, coll. H. S. Mehta and party.

Distribution : Europe, Africa, Asia, Australia, New Zealand, Hawaii.

Remarks : This species is commonly available in North-west India including cold desert areas of Ladakh.

17. *Vanessa cashmiriensis* Kollar, 1844

1844. *Vanessa caschmirensis* Kollar, in Hügel, *Kaschmir und das Reich der Siek*, 4 (2): 442.

Common name : Indian Tortoise Shell.

Diagnostic features : Sexes similar; forewing narrower, more produced and cut off at apex; termen slightly concave; hindwing toothed at vein 4; wings dorsally tawny; forewing with one black patch in cell, one at end cell and one beyond the cell; upperside of hindwing blue submarginal spots inwardly bordered brownish.

Material examined : Tsomoriri, 1ex, 26.VII.2008, coll. A. K. Sidhu and party.

Distribution : Himalayas, Pamir.

Remarks : This species is quite common in hilly areas of North-west India including cold desert areas of Ladakh.

Family SATYRIDAE

Genus *Aulocera* Butler, 1867

1867. *Aulocera* Butler, *Ent. mon. Mag.* 4: 121.

Type-species : *Satyrus brahminus* Blanchard

18. *Aulocera swaha* (Kollar, 1844)

1844. *Satyrus swaha* Kollar, in Hügel, *Kaschmir und das Reich der Siek*, 4 (2): 444.

Common name : Common Satyr.

Diagnostic features : Male and female with wings dorsally dark brown; discal band varying from white to bright yellow in colour, narrows towards dorsum on hindwing; wings below pale in colour.

Material examined : Leh, 1ex, 28.VII.2008, coll. A. K. Sidhu and party.

Distribution : Himalayas.

Remarks : The species *Aulocera swaha* is a high altitude butterfly. As per present surveys it is moderately available in Ladakh.

Genus *Hyponephele* Muschamp, 1915

1915. *Hyponephele* Muschamp, *Ent. Rec.* 27: 156.

Type-species : *Papilio lycaon* Rottemburg

19. *Hyponephele davendra* (Moore, 1865)

1865. *Maniola davendra* (Moore.) *Proc. Zool. Soc. Lond.* 1865: 502.

Common name : White ringed meadow brown.

Diagnostic features : Sexes similar; upperside of forewing tawny with a prominent black ocellus towards apex; underside of hindwing with ocelli; discal line dark, outwardly white margined.

Material examined : Leh, Ganglas, 1ex, 11.VII.2008, coll. H. S. Mehta and party.

Distribution : Iran - Afghanistan, Himalayas, Tibet, Middle Asia, Baluchistan - Kumaon, North West India

Remarks : This species is also a high altitude butterfly. As per recent surveys, it is less available in Ladakh.

Genus *Paroeneis* Moore, 1893

1893. *Paroeneis* Moore, *Lepidoptera Indica* 2 : 36.

Type-species : *Chionobas pumilus* C. & R. Felder

20. *Paroeneis pumilus* (C. & R. Felder, 1867)

1867. *Chionobas pumilus* C. & R. Felder, *Reise Fregatte Novara, Lep. Rhop.* (3): 490.

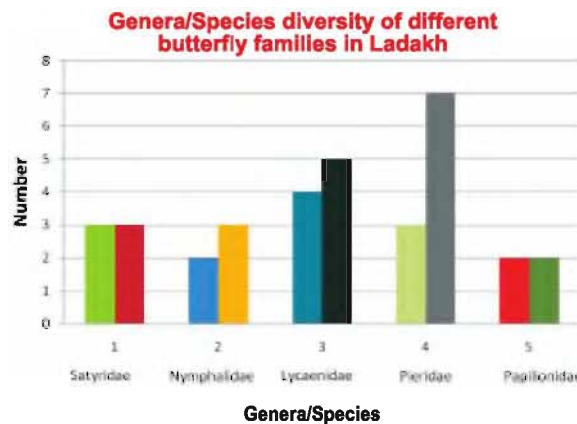
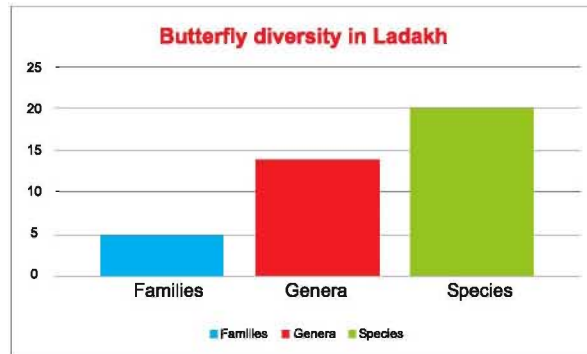
Common name : Mountain Satyr

Diagnostic features : Sexes similar; wings dorsally mostly tawny except for dark border; with a tawny discal band, the latter ill defined, diffused inwards;

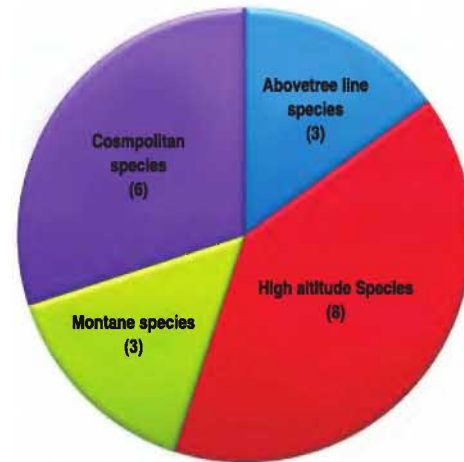
Material examined : Nyoma, 1ex, 23.VII.2008, coll. A. K. Sidhu and party.

Distribution : Himalayas, Kashmir, Tibet.

Remarks : It is typically a high altitude species. According to the present surveys, it is less available in Ladakh.



Distribution of various species of Ladakh in Borth-West India



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The authors are thankful to Dr. Ramakrishna, Director, Zoological Survey of India, Kolkata for giving us opportunity for Ladakh survey and for providing facilities for under taking the present studies.

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PLATE-I



Parnassius epaphus



Papilio machaon



Pontia callidice



Pontia chloridice



Colias erate



Pieris brassicae

PLATE-II



Pieris canidia



celastrina argiolus



Hyponephele davendra



Argynnis adippe pallida



Vanessa cardui



Plebejus christophi

PLATE-III



Albulina omphisa



Aulocera swaha



Vanessa cashmiriensis



Pseudophilotes vicrama



Albulina pheretes



Paroeneis pumilus

PLATE-IV



Ladakh-A fragile ecosystem



A habitat of Apollos near Khardungla



Short Communication

RECORD OF PLEASING FUNGUS BEETLES (COLEOPTERA: EROTYLIDAE) FROM TRIPURA STATE, INDIA

INTRODUCTION

The representatives of the coleopteran family Erotylidae are commonly known as “pleasing fungus beetles”. They are often elongate-elliptical to hemispherical or sub-orbicular in shape, moderately flattened and brightly patterned with red or yellow and black or seldom metallic blue color. They are primarily inhabitants of the humid forest areas where diverse fungi grow, necessarily mycophagous, feed mostly on surface of fungal fruiting bodies or occasionally feed inside them. Their larvae generally feed within the larger fruiting bodies of mushrooms and bracket fungi. In the background of habitat requirements and ecological needs the erotylids flourished considerably in humid forest areas in the tropical and subtropical parts of both the Old and New Worlds but diversified more in the eastern hemisphere. By now, about 60 species are known from India. However, occurrence of the erotylids in recent times has become less prevalent due to gradual loss of forests and woodlands. The NorthEast Indian (NEI) region that possesses rich evergreen and subtropical vegetations has been an important zone of rich beetle fauna of India. But the exploration and inventorisation of the beetle fauna of this region remained far from adequate. This is far more true for the erotylids with records of about 40 species till date. A large area still remained unexplored while primary vegetations and habitats have been depleted due to multitudes of factors. All these necessitated organized taxonomic study and documentation of the beetle fauna in an urgent manner. Recently, during a field work for collection of sap beetles and related groups in Tripura by one of the authors (J D) an example of erotylid beetles was found in the wood inhabiting fungi in a forested area. It forms the first record of this beetle family as there has been no earlier record of erotylid

beetle from Tripura State. A taxonomic account of the material is presented.

SYSTEMATIC ACCOUNT

Family EROTYLIDAE

Subfamily DACNINAE

Genus *Episcapha* Lacordaire

Episcapha septentrionis Heller

1918. *Episcapha quadrimacula septentrionis* Heller, *Archiv. f. Nat.*, **84**: 68.

1925. *Episcapha septentrionis*: Arrow, *Fauna Brit. India, Coleoptera, Clavicornia*: 41.

General appearance (Text Figs. 1, 2) elongate-ovoid, subdepressed, covered with fine velvety pubescence, blackish body and elytra patterned with two pairs of transverse bands - on both anterior and posterior halves.



Fig. 1. *Episcapha septentrionis* Heller, Dorsal view.

Head broader than long, front margin truncate; eyes large and finely faceted, separated dorsally by less than thrice their width, puncturation on dorsal side not prominent but surface dull due to dense pubescence; antennal insertions widely separated, antenna moderately long and slender, scape moderately large and broadly elongate, pedicel shorter and narrower than scape, segments 3-7 subequal, progressively slightly wider and little elongate, 8 about as broad as long, 3-segmented club rather compact with segments more or less transverse.



Fig. 2. *Episcapha septentrionis* Heller, Ventral view.

Prothorax transverse (1.0:1.5), widest slightly above base, moderately narrowed anteriorly, sides arcuate, front margin distinctly emarginated, front angles produced; lateral margin thickly carinate, a small elongate pit on either extremity of carina, base bisinuate with broad median lobe, no prebasal impression, hind angles nearly right angle, no visible punctations through dense pubescence on pronotum. Scutellum transverse, pubescent, apical margin angulate.

Elytra broadly elongate (1.3:1.0), slightly wider than prothorax at base, sides gently arcuate and widest little above middle, elytral apex rounded, no punctations visible through dense pubescence; each elytron decorated with two large reddish-yellow transverse spots, first one situated little

below base behind humeral angle, extending from slightly away of side margin to well before sutural line and extending anteriorly a narrower elongated branch towards basal border, second one slightly narrower than first one and situated behind middle, its hind border somewhat arcuate, not touching side margin and suture of elytra, spots somewhat irregular in outlines but more or less clearly delineated.

Ventral surface less pubescent, apical margin of prosternal process emarginated, meso- and metasternum less pubescent and impunctate, abdominal ventrites a little more pubescent than metasternum.

Length- 12.7 mm.

Material examined: 1 ex. INDIA: Tripura, W. Tripura Distt., Sepahijala Wildlife Sanctuary, 21.iii.2012, J. Dasgupta, ex. under bark.

Distribution : INDIA: Tripura (New record), Meghalaya, Assam, Sikkim, Andaman & Nicobar islands; VIETNAM, TAIWAN, CHINA.

Comments : This species shows certain resemblance with *E. xanthopustulata* Gorham but can be distinguished by the yellowish spots on elytra somewhat narrower and vertex of head devoid of any orange spot.

REMARKS

The beetle fauna of specialized habitats in rain-fed forest zones have been continuously under increasing anthropogenic pressures and many of the species are seen less frequently in these days. The present species has not been found after the record by Arrow in 1925. It has therefore, been urgent to take up coordinated field explorations and taxonomic study of various beetle groups from the NEI for a better knowledge of the fauna of this biodiversity-rich region.

ACKNOWLEDGMENTS

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the Forest Department extended generous support in carrying out field works in Tripura State to JD are also duly acknowledged. We are thankful to Dr. T.K. Pal, ZSI for confirming the identity of the erotylid beetle.

SUMMARY

The erotylid species, *Episcapha septentrionis* Heller recorded from the Tripura State forms the first report of the Erotylidae from this Indian state.

REFERENCE

ARROW, G. J. 1925. *The Fauna of British India, including Ceylon and Burma; Coleoptera, Clavicornia (Erotylidae, Languriidae and Endomychidae)* xv+416 pp., 1 pl., 1 map; Taylor & Francis, London.

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Short Communication

FIRST REPORT OF STARGAZER *ICHTHYSOPUS LEBECK* (BLOCH AND SCHNEIDER, 1801) FROM DIGHA COAST, INDIA.

INTRODUCTON

The commonly known Stargazers of the family Uranoscopidae is represented by four species in Indian water limited to three genera (Taiwar, 1991) and 50 species in world from 8 genera, 8 species known in genus *Ichthyoscopus* (Froese & Pauly, 2011). Digha being one of the most renowned fish landing center of eastern India has been in prime focus for the Ichthyologic faunal diversity of the region. Various studies have been carried out to study the fish faunal diversity of this region (Manna and Goswami, 1985; Goswami, 1992; Chatterjee *et al.* 2000), and that have documented only one species of the family Uranoscopidae, so far from the area. During the present study two examples stargazers were collected which after close observation identified as *Jchthysopus lebeck* (Bloch and Schneider, 1801). It is the first report of the species from coastal waters of Digha. The present paper deals with the description of the species in detail.

SYSTEMATIC POSITION

Class PISCES

Sub-Class TELEOSTEI

Order PERCIFORMES

Family URANOSCOPIDAE Richardson.

1801. *Uranoscopus lebeck*, Bloch & Schneider, *Syst. Ichthyol.* 47 (Tranquebar, Tamil Nadu, India)
1829. *Uranoscopus inermis*, Cuvier, in Cuvier and Valenciennes, *Hist. Nat. Poiss.*, 3 : 310, pi. 65. (Coromandel, Malabar, Pondichery, India)
1876. *Ichthyoscopus inermis*, Day, *Fish.India*: 261, pi. 55.
2001. *Ichthyoscopus lebeck*, Kishimoto, in Carpenter and Niem, *The living marine resources of Western Central Pacific*: 3526.

MATERIAL EXAMINED

Regd. No. F612, lex, SL 362 mm, Locality: Kirtiniyaa (Balasore), Odisha, Date of collection: 04.09.2009. & Regd. No. F768, lex, SL 254 mm, Locality: Mohana, Digha, Date of collection. 17.12.2010.

DIAGNOSTIC CHARATERS

Body short and round form. Head massive, nearly cup shaped, flattened dorsally, rounded anteriorly, dorsal and lateral surfaces of head almost entirely encased in sculptured by bony structures. Head length 2.8-2.83 times in standard length; body depth 2.3-2.9 times in standard length; eye diameter 17.4-18.3 times in head length. Eyes small directed dorsally, placed on head. Head slightly depressed on the frontal and the occipital regions. Mouth large, protactile almost vertical, jaws pre-vomer palatine toothed and lips with fimbriate ridges. Upper margin of nasal valves fringed. Dorsal fin single with two spines and 18 soft rays, pectoral fin fleshy knife shaped, having 19 soft rays and the upper rays are longer than the middle, pelvic fin with 6 soft rays, anal fin long with 17 soft rays and caudal fin truncate with 12 soft rays. The cleithrum is entirely concealed with fleshy appendages near the pectoral fin. A respiratory groove present between upper part of the cleithrum and pectoral fin which connects the gill opening. A dermal fold present along midventral margin of belly. Lateral line naked or covered with some scales and it running close to soft dorsal fin base. Body canary yellow, with buffer brown markings along sides enclosing pure white round spots. White spots are also extended to the pectoral and dorsal fins (Fig. 1). Body scales arranged in regular oblique rows.



Fig. 1: Dorsal and anterior view of *Ichthyoscopus lebeck*, Indian Stargazer

HABIT AND DISTRIBUTION

Members of this family are circumtropical in distribution and occur in warm and temperate

waters from estuaries to the deep sea. They are nocturnal and during the day bury their body into sand or mud, with only the eyes and mouth cleft protruding from the substrate. Therefore, they are rarely taken by beach seines during daytime but are often fished by gill nets at night. They are distributed in Indo-West Pacific: mainly from the southern coasts of India; a single record from Singapore (Kishimoto, 2001). From Indian waters, the species is reported from Odisha (Barman *et al.*, 2007) and Tamil Nadu (Barman *et al.*, 2011)

ACKNOWLEDGEMENT

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Short Communication

A NOTE ON OCCURRENCE OF YELLOW-WING FLYING FISH, *CYPSILURUS POECILOPTERUS* (VALENCIENNES, 1847) FROM DIGHA, EAST COAST OF INDIA.

INTRODUCTION

Flying fishes of Family Exocoetidae is represented by 8 genera, comprising of about 67 species throughout the world (Eschmeyer, 2005). From Indian waters six species of flying fishes of genus *Cypselurus* was reported by Weber and de Beaufort (1922). Hornell (1923) reported *Cypselurus coromandelensis* from Madras and Nagapattinam as new to science. Chandi (1954) reported 4 species of genus *Cypselurus* and an undetermined species of which two were additions to the flying fish fauna of India. A recent review of flying fishes includes 6 genera comprising 14 species occurring in Indian waters including 3 from genus *Cypselurus* (Barman and Mishra, 2006). The systematic study on the fish fauna of Digha coast was carried out by Chatterjee *et al* (2000), who reported 212 species from 145 genera and 88 families, included only one species *Exocoetus volitans* Linnaeus, 1758 of flying fish from the Family Exocoetidae. Previously no flying fish was recorded by Talwar *et al.* (1992) from West Bengal coasts. During the routine collection of marine ornamental fishes we have come across a specimen of flying fish which after through observation was identified as *Cypselurus poecilopterus* (Valenciennes, 1847) which was not reported by previous workers from the West Bengal coasts.

MATERIALS EXAMINED

1 ex., location: Hospital Ghat, Digha, (21° 61'N and 87°53'E) Date: 22.09.2010, Coll.: Dr. Prasanna Yannawar & Mr. P.C. Tudu, 252 mm TL, Reg. No. ZSI/MARC-F1532.

COMMON NAME

Cypselurus poecilopterus (Valenciennes, 1847) is commonly known as Yellow-wing flying fish, Spotted flying fish and spot-wing flying fish.

SYNONYMS

1846. *Exocoetus poecilopterus*: Valenciennes, in Cuvier and Valenciennes, *Hist nat. Poiss* A9 : 112 (Type locality: new Britain Is., Bismark Archipelago)
1922. *Cypselurus poecilopterus*: Weber and de Beaufort, *Fish. Indo-Aust.archip.*, 4: 186.
2006. *Cypselurus poecilopterus*: Burman and Mishra, *Rec. zool. Surv. India, Occ. Paper No. 256* : 14

DIAGNOSIS

Body elongate and broadly cylindrical; D 13; A 9, LL 45, GR 22, SL 201mm, HL 45mm, CL 51mm, PL 131mm. Pectoral fin long, more than half of the total length of the fish reaching almost last ray of dorsal fin, with 1 unbranched and 14 branched fin rays. Body dark, iridescent blue dorsally and silvery white below (Fig. 1), ovate black spots arranged in bands on the upper part of the pectoral fin and absent in the lower part of the fin in the fresh specimen. Upper jaw not protrusible, lower jaw little shorter than the upper jaw and included beneath the upper jaw which character distinguishes the specimen as belonging to the genus *Cypselurus* and not to the genus *Cheilopogon*.



Fig.1. *Cypselurus poecilopterus* (Valenciennes, 1847)

HABITAT

Cypselurus poecilopterus (Valenciennes, 1847) is epipelagic, neritic and oceanic in habitat and is prone to emerge rapidly from the water by beating the water with the large lobe of caudal fin and glide over a long distance by means of their expanded pectoral fins.

DISTRIBUTION

The distribution of *Cypselurus poecilopterus* (Valenciennes, 1847) is scattered in the tropical Indian Ocean and Pacific Ocean. From Indian waters the species was reported earlier from Orissa and Tamilnadu states from east coast only. From Tamilnadu coast the existence of the *Cypselurus poecilopterus* (Valenciennes, 1847) was confirmed from Rameswaram by Barman *et al.* (2006). Two species of flying fishes *Exocoelus volitans* Linnaeus,

1758 and *Cypselurus poecilopterus* (Valenciennes, 1847) were reported from Orissa coast by Barman *et al.* (2007) and another species *Paraexocoetus mento* (Valenciennes, 1847) was added by Mishra *et al.* (2010). In coastal Andhra Pradesh, nine species from four genera of flying fishes of the Family Exocoetidae were reported which does not include the present species. Moreover, there is no record of occurrence of this species on the west coast of India also. The present report suggests that the distribution of *Cypselurus poecilopterus* (Valenciennes, 1847) is along the stretch of East Coast of India from West Bengal up to Tamilnadu coasts.

ACKNOWLEDGEMENT

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Short Communication

OCCURRENCE OF PENNAT CORAL FISH, *HENIOCHUS ACUMINATUS* (LINNAEUS, 1758) (PERCIFORMES: CHAETODONTIDAE) ALONG DIGHA COAST, INDIA.

The family Chaetodontidae popularly known as Butterfly fish is an important aquarium fish distributed in coral reefs of tropical and subtropical regions (Allen *et al.*, 1998). They are also important bio-indicator species for assessing the health of coral reefs as they feed on coral polyps (Hourigan *et al.*, 1988). There are 128 species from 13 genera available worldwide (Froese and Pauly, 2012), out of which 38 species from 4 genera reported in Indian waters (Rajan, 2010). The genus *Heniochus* is represented by 8 species of which 7 are occurring in Indian Waters (Froese and Pauly, 2012). Previous literature of ichthyofauna of Digha coast does not have report of this family in the area (Manna & Goswami, 1985; Goswami, 1992; Talwar *et al.*, 1992 and Chatterjee *et al.*, 2000). Recently, during the local survey for ornamental fish fauna collection around Digha coast for aquarium exhibits, we incidence an example from family Chaetodontidae.

The careful observation of distinguishing features of the specimen led us to identify as *Heniochus acuminatus* (Linnaeus, 1758) long-fin banner fish. Misra (1962) was listed *Heniochus acuminatus* (Linnaeus, 1758) from West Bengal coast. But, later Talwar *et al.* (1992) in their comprehensive list of marine and estuarine fishes of West Bengal, considered presence of *Heniochus acuminatus* (Linnaeus, 1758) is doubtful and need conformation. So, this report confirms the occurrence of *Heniochus acuminatus* (Linnaeus, 1758) in West Bengal coast.

CLASSIFICATION

Phylum	CHORDATA
Class	ACTINOPTERYGII
Order	PERCIFORMES
Family	CHAETODONTIDAE

Heniochus acuminatus (Linnaeus, 1758)

1758. *Systema Naturae*, ed. 10: 272 (type locality: 'Indies').

1758. *Heniochus acuinatus* Linnaeus, *Systema Naturae*, ed. 10: 272 (type locality: 'Indies').

Material examined : Reg. No. F752; 1 ex., SL 108mm, Collected by: Dipanjan Ray; location: Digha Mohana, Date of Coll. 14.12.2010.

Distinguishing characters : D: XI, 24; A: III, 18; P: 18; V: I, 5. HL: 3.7mm, TL: 128 mm, SL: 108mm, GR: 11, LL: 46. Body compressed, elevated, sub-rhomboid. Snout short, conical, mouth opening small. Teeth villiform in jaws. Dorsal spine strong, 4th dorsal spine and its membrane long, filamentous, narrowing towards the end, reaching to beyond of caudal fin and longer than body length. Ventral fin reaches the origin of anal spine. Caudal fin truncated. Eyes diameter equal to inter orbital space. Snout with dark blotch from nostrils to tip, dark bar crosses interorbital from one eye to other eye. Body white in colour; upper part of snout and interorbital space black. Two wide black oblique anterior three dorsal spines, touches the hind margin of operculum, base of pectorals and continued to base of spinous anal and pelvic fin base; posterior one start from 5th to 7th dorsal spine to posterior part of soft anal. Soft rays of dorsal and caudal fins yellow; ventral fins black (Fig. 1). Distinguished from the very similar *Heniochus diphreutes* by the longer snout, rounded shape and longer and more angular anal fin (Rajan, 2010) and in numbers of dorsal spines.

Distribution : Distributed throughout the tropical Indo - West Pacific region. From Indian waters Andhra Pradesh (Barman *et al.*, 2004), Orissa (Barman *et al.*, 2007), Tamil Nadu (Krishnan *et al.*, 2007), Andaman and Nicobar Island (Rajan, 2010), Gujarat (Barman *et al.*, 2000), Lakshadweep (Anand & Pillai, 2003).

Remarks : This is the first ever report of *Heniochus acuminatus* (Linnaeus, 1758) the long-fin banner fish in the area. Incidence of this species, which are usually coral inhabiting, in addition to few more habitant species, shows need for further extensive study on distribution and habitat preference of this species as the locality does not have coral reef nearby.

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Fig 1: *Heniochus acuminatus* (Linnaeus, 1758) and necessary facilities for the work. DR is thankful to ZSI for offering JRF to carry out the work.

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Short Communication

ADDITIONAL INFORMATION ON *XENOPHRYS ZUNHEBOTOENSIS* MATHEW & SEN, 2007 (AMPHIBIA: ANURA: MEGOPHRYIDAE) AND RANGE EXTENSION IN MEGHALAYA, INDIA.

INTRODUCTION

The genus *Xenophrys* is represented by 9 species (*X. boettgeri*, *X. glandulosa*, *X. kempii*, *X. major*, *X. parva*, *X. robusta*, *X. serchhipii*, *X. wuliangshanensis*, and *X. zunhebotoensis*) in North East India (Mathew & Sen, 2010). Recently, 2 new species of *Xenophrys*, *X. serchhipii* and *X. zunhebotoensis* were described from Mizoram and Nagaland, respectively (Mathew & Sen, 2007). So far, these 2 new species are known from their type locality only. The authors came across a specimen of male *Xenophrys* collected from East Khasi Hills district of Meghalaya and present in the unidentified holdings of NERC/ZSI, Shillong. After thorough study it was identified as *X. zunhebotoensis* (V/A/ERS/1009) (Plate-I). This is the first record outside its type locality, after the species was described more than 4 years ago. Besides, both the Holotype and Paratype of this species present in the holdings of NERC/ZSI, Shillong were also studied for proper identification and comparison.

GENERAL DESCRIPTION

MATERIAL EXAMINED

One specimen of *X. zunhebotoensis* (V/A/ERS/1009) was studied. The specimen was collected by one survey team of NERC/ZSI, Shillong from Mawmluh, (N 25°13'54", E 91°41'0.8", Altitude 739 meters ASL) near Cherrapunjee, from East Khasi Hills district of Meghalaya on 25/10/ 2010.

DIAGNOSIS

Head is broader than long, nostril is closer to eye, supratympanic glandular fold is white and distinct, curving on the anterior region of the tympanum to give it a round shape. Fingers free

with swollen disc. Hind limbs slender, TTA reach middle of eye, digits free with swollen discs. Dorsum is smooth with few ridges and warts. A dark triangular patch between the orbit; a broad incomplete 'V' shaped ridge behind the eye, another similar ridge of inverted 'V' towards the posterior side making an indistinct and incomplete hourglass pattern on the dorsum. 2 parallel lines on either side of the 'V' shaped ridge. Flanks with small round tubercles. Ventrally abdomen and thighs are off white with light round blotches. Axial and femoral glands are prominent (Mathew & Sen, 2009).

DISCUSSION

Although in the original description the SVL was between 30 mm to 39 mm, the new specimen is having SVL of 55 mm. Another difference that was noticed was the distinct ridges on the dorsum of the specimen unlike the smooth ridges of the types described. Moreover, the body of the specimen was stout, whereas the type specimens were soft and weak.

DISTRIBUTION

Nagaland and Meghalaya

REMARKS

This is the first record of the species from Meghalaya and outside its type locality in Nagaland.

ABBREVIATION

ASL : Above Sea Level
NERC/ZSI : North Eastern Regional Centre/
Zoological Survey of India
SVL : Snout Vent Length

V/A/ERS : Vertebrate/Amphibia/Eastern
Regional Station (Erstwhile name
of NERC)

TTA : Tibio Tarsal Articulation

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Rana and his party for collecting the specimen from
their survey tour.



A. *Xenophrys zunhebotoensis* Mathew and Sen
Dorsal view



B. *Xenophrys zunhebotoensis* Mathew and Sen
Ventral view

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INSTRUCTION TO AUTHORS

Frequency of Publication : Quarterly – 4 parts in one volume.

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- G. Sivaleela and K. Venkataraman - Statistical Studies and Ecology of *Benthic Foraminifera* from ... India...1-8
- G. Sivaleela and K. Venkataraman - Variation of Meiofauna ... Full Moon and New Moon.....9-11
- Sarita Rana, Rajiv, S. Kalsi and Mani Ram Burra - Home range comparison of male and female Grey Francolin... using radiotelemetry.....13-18
- Viswa Venkat Gantait and A. K. Sanyal - Studies on the Genus *Lagenonema* Andr assy, 1987 (Nematoda: Thornelematidae).....19-24
- Navneet Singh and Jagbir Singh - New Records of Two Species of Family Arctiidae (Lepidoptera) from Western Ghats of India.....25-26
- Koushik Sadhukhan and C. Raghunathan - *Study on Coral bleaching (2010) in ... Nicobar Islands*.....27-34
- Shyam Maisnam and R. Varatharajan - Thysanoptera Fauna of Arunachal Pradesh.....35-43
- B. Lal and V.D. Hegde : Notes on a Collection of Dermaptera.....45-51
- V. Biswas and D. Raychaudhuri - Orb-weaving Spiders of Bangladesh-II : Genus ...Araneidae).....53-59
- D. R. K. Sastry, Y. K. V. Rao, T. Ganesh, M. Srinivasa Rao, N. Sateesh, A. Bharati, C. Annapurna and A. V. Raman - On some collections of Echinodermata from Andhra Pradesh and Orissa Coasts of India.....61-87
- P. Girish Kumar - New record of the Genus *Omicroides* Giordani Soika ... from India.....89-93
- G.P. Mandal, K.K. Suman and K.K. Bhattacharya - On some collection of Collembola present in the Apterygota Section.....95-100
- Avtar Kaur Sidhu, Kailash Chandra and Jafer Palot Dr. - Observations on the Status and Diversity of Butterflies in the Fragile Ecosystem of Ladakh (J & K).....101-112
- SHORT COMMUNICATIONS**
- J. Dasgupta and V.D. Hegde - Record of pleasing Fungus Beetles ... from Tripura State, India.....113-115
- Prasanna Yennawar, Prasad Chandra Tudu and Anil Mohapatra - First Report of Stargazer Ichthyoscopus Lebeck (Bloch and Schneider, 1801) from Digha Coast, India.....117-118
- Anil Mohapatra, Prasad Tudu And Prasanna Yennawar - A Note on Occurrence of Yellow-wing Flying Fish, *Cypselurus Poecilopterus* (Valenciennes, 1847) from Digha, East Coast of India.....119-120
- Prasanna Yennawar, Dipanjan Ray & Anil Mohapatra - Occurrence of Pennat Coral Fish, *Heniochus Acuminatus* (Linnaeus, 1758) (Perciformes : Chaetodontidae) Along Digha Coast, India.....121-122
- Bhaskar Saikia and Nibedita Sen - Additional Information On *Xenophrys Zunhebotoensis* Mathew & Sen, 2007 (Amphibia: Anura: Megophryidae) And Range Extension In Meghalaya, India.....123-124