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AN APPEAL

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

Officer-in-Charge, Identification and Advisory Section,
Zoological Survey of India, "M"- Block, New Alipore,
Kolkata-700 053

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

DR. K. VENKATRAMAN
Director
Zoological Survey of India

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STATUS OF CORAL REEFS IN PALK BAY

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INTRODUCTION

Palk Bay is the sea between southeast of India and northwest of Sri Lanka, separated by Pamban Pass from Gulf of Mannar in the South and extends up to Kodiakarai coast in the North. The bay is characterized by a shallow basin with an average depth of 9 m. There is a well defined fringing reef which runs parallel to the shore, at the south west of the Palk Bay, extending 7.46 km from 09° 17' 14.8" N; 079° 11' 16.4" E at the East near Pamban to 09° 17' 34.4" N; 079° 06' 57.8" E towards the west of the bay, with the width varying from 200 m to 600 m at different places, and occurring at a maximum depth of 4 m. The lagoon is 1 -2 m deep, sandy with molluscan shells and pieces of disintegrating corals (Pillai, 1969). Described by the same author, a narrow channel divides the reef at mid-length in to eastern and western portions, locally called Kathuvallumuni reef and Vellapertumuni reef respectively. Beyond this reef to the west and extending northward are dense seagrass beds, which sustain the high productivity of this basin. There are also patchy occurrence of corals in this basin, occurring from southwest of the Rameswaram Island to its North.

Many scientific studies on Hydrology, physicochemical parameters, fauna and flora of Palk Bay are available, as reviewed by Venkataraman *et al.*, 2007. Information with respect to scleractinian corals are available for the fringing reef as early as 1969 (Pillai, 1969), and lately in 2007 (Venkataraman *et al.*, 2007). These works, though studied scleractinian diversity, especially Pillai's (1969) with species composition data (number of colonies in a perpendicular transect from the shore, a measure of benthic cover of coral species and other status assessment parameters were not covered. The coral patches around Rameswaram Island had not also been covered in these studies. Bio-physical status assessments (% benthic cover of life-forms) were made in these reefs, along the assessment of bleaching in 2002, however lacking in species-wise cover data (Kumaraguru *et al.*, 2003). Given this, a base-line information on coral status, based on diversity, species-wise cover, and other bio-physical categories has been made for the first-time in these reefs in 2010 and monitoring assessments in 2013. The report presented here is the status of these reefs based on the study as mentioned above and an analysis of change in terms of scleractinian species diversity and composition from Pillai's (1969) and Venkataraman *et al.*, (2007) work and available bio-physical data.

STUDY AREA AND METHODS

Seven stations in the fringing reef in the south west of the Palk Bay and 3 stations in the patch reefs in the East of Palk Bay have been marked (Fig.1), and bio-physical status assessed in October 2010 and subsequently in March 2013. The assessed parameters (hereafter mentioned as bio-physical categories) include, hard corals diversity, species-wise cover, live coral cover (LC), dead coral cover (DC), dead coral cover encrusted with turf algae (DCTA), coralline algae (COR), calcareous algae (CA), macro algae (MA),

Fig. 1 : Map showing the monitoring stations in Palk Bay.

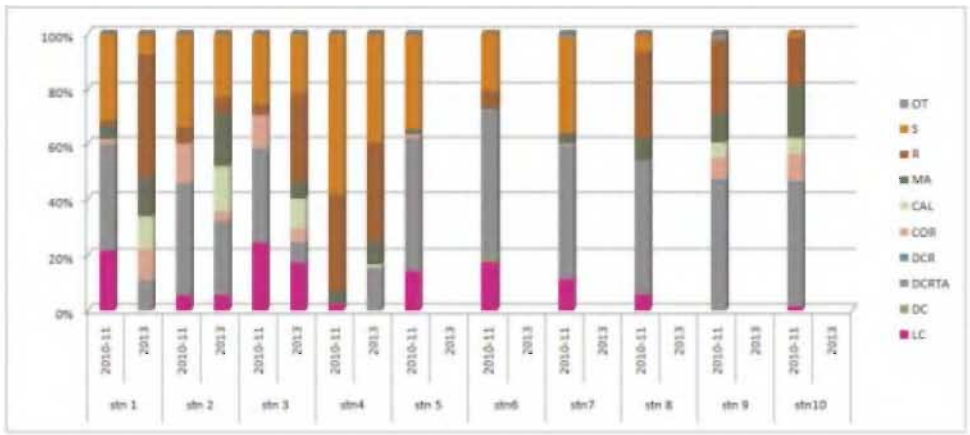

Fig. 2 : Station-wise comparison of life-form categories between 2010 and 2013

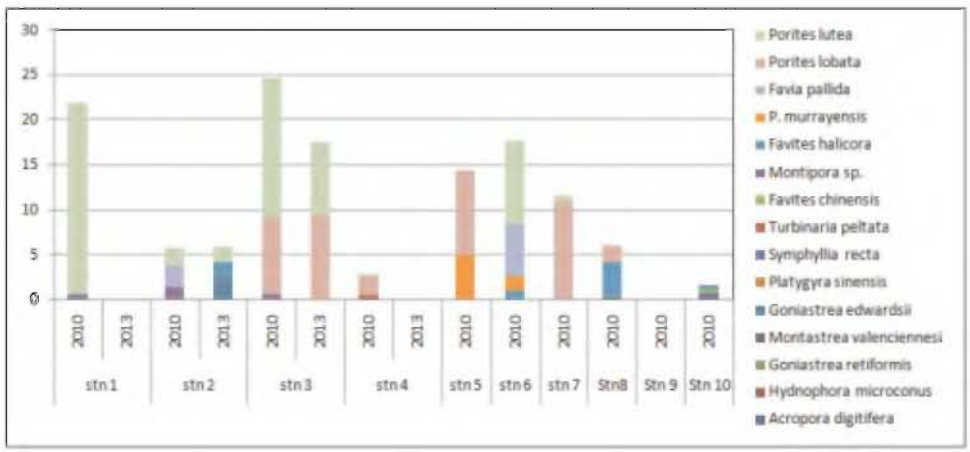

Fig. 3: Average species - wise benthic cover at the transects.

Table 1 : Summary Results

Life-form categories	2010	2013
LC	9.89 ± 8.73	5.83 ± 8.42
DC	0.19 ± 0.91	0.22 ± 0.63
DCR	0.08 ± 0.39	0.00 ± 0.00
DCTA	41.28 ± 20.80	16.31 ± 10.52
COR	4.06 ± 5.55	4.48 ± 4.28
CAL	0.94 ± 2.70	10.65 ± 6.77
MA	5.34 ± 8.29	12.88 ± 7.37
FA	0.47 ± 1.29	0.00 ± 0.00
R	15.92 ± 19.46	26.85 ± 19.02
S	21.69 ± 18.31	22.67 ± 12.52
OT	0.16 ± 0.45	0.06 ± 0.16

Table 2 : Average and station-wise live cover values and diversity indices for the years 2010-11 and 2013 and Pillai, 1969.

	LC		S		D		H'		E	
	2010	2013	2010	2013	2010	2013	2010	2013	2010	2013
stn 1	21.9	0.0	2	--	0.94	--	0.13	--	0.18	--
stn2	5.7	5.83	3	4	0.21	0.19	1.08	1.14	0.98	0.82
stn3	24.65	17.5	3	2	0.50	0.47	0.74	0.69	0.67	1
stn4	2.75	0.0	3	--	0.36	--	0.73	--	0.67	--
stn 5	14.33	*	2	*	0.51	*	0.65	*	0.93	*
stn6	17.66	*	4	*	0.1	*	1.07	*	0.77	*
stn7	11.6	*	2	*	0.87	*	0.24	*	0.35	*
stn 8	5.97	*	4	*	0.38	*	0.9	*	0.65	*
Stn 9	0.0	*	--	*	--	*	--	*	--	--
stn 10	1.63	*	9	*	1.07	*	1.85	*	0.84	*
Ave ±	**9.89	**5.83	3.5 ±	3.0 ±	0.31 ±	0.33 ±	0.82 ±	0.92 ±	0.67 ±	0.91 ±
stdev	± 8.73	± 8.42	2.2	1.4	0.59	0.2	0.51	0.32	0.26	0.12
Pillai , 1969	--		15		0.25		1.9		0.7	

S - Total No. of species; D - Simpson's Dominance Index; H' - Shannon diversity index ; E - Shannon's Evenness Index

* surveys in these stations are not completed for the year 2013

** Calculated incorporating data from all the transects

filamentous algae (FA), coral rubbles (R), sand (S) and others (OT) which include, soft corals, octocorals and other sessile benthos such as echinoderms and mollusks. The dead coral cover recorded in this study is of recently dead corals and were not encrusted with turf algae or sediment. At each station, three 20 m transects were laid at the fore-reef area (depth of 2 - 4 m) and the data collected employing Line Intercept Transect (LIT) as per English *et. al.*, 1997. Species diversity was estimated both within and outside the transects; for which specimens of *Scleractinians* were photographed *in-situ* using underwater digital cameras with the macro option for identification up to species level.

RESULTS

The % cover of life-form categories summarized for the Palk Bay reefs in the years 2010 and 2013 are presented in Table 1. The average LC cover observed during both the

Table : 3. List of species recorded under the diversity studies during 2010 (I) and 2013 (II)

		stn 1		stn 2		stn 3		stn 4		stn 5		stn 6		stn 7		stn8		stn 9		stn 10	
No.	Scleractinian species	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	
1	**Montipora monasteriata* (Forskal, 1775)	*		*	*	*			*												
2	*Acropora Formosa* (Dana, 1846)															*					
3	*Acropora gemmifera* (Brook, 1892)															*				*	
4	*Acropora digitifera* (Dana, 1846)															*		*		*	
5	*Hydnophora microconus* (Lamarck, 1816)															*		*		*	
6	**Turbinaria Peltata* (Esper, 1794)							*													
7	*Turbinaria frondens* (Dana, 1846)																	*			
8	*Symphyllia recta* (Dana, 1846)																	*		*	
9	*Favia speciosa* Dana, 1846															*					
10	***Favia tragrum (Esper, 1797)*																			*	
11	***Favia albidus* Veron, 2000																			*	
12	**Favia pallia* (Dana, 1846)			*								*									
13	***Favia lizardensis*															*					
14	*Favia rotumana* (Gardiner, 1899)															*					
15	*Favites pentagona* (Esper, 1794)																	*			
16	*Favites halicora* (Ehrenberg, 1834)				*							*				*		*		*	
17	***Favites russeli* (Wells, 1954)																			*	
18	*Favites complanata* (Ehrenberg, 1834)																			*	
19	*Favites vasta* (Klunzinger, 1879)																			*	
20	*Goniastrea edwardsii* Chevalier, 1971				*											*		*			
21	*Goniastrea retiformis* (Lamarck, 1816)															*		*		*	
22	*Goniastrea aspera* Verrill, 1905																			*	
23	*Platygyra sinensis* (Milne Edwards and Haime, 1849)															*		*		*	

		stn 1		stn 2		stn 3		stn 4		stn 5		stn 6		stn 7		stn8		stn 9		stn 10	
No.	Scleractinian species	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	
24	*Platygyra deadalia* (Ellis and Solander, 1786)															*					
25	****Montastrea colemani*** Veron, 2000															*				*	
26	*Montastrea valenciennesi* (Milne Edwards and Haime, 1848)															*				*	
27	*Pleasiastrea versipora* (Lamarck, 1816)																	*		*	
28	****Leptastrea aequalis*** Veron, 2000															*					
29	*Leptastrea purpurea* Dana, 1846																	*		*	
30	*Cyphastrea micropthalma* (Lamarck, 1816)															*				*	
31	*Porites lobata* Dana, 1846					*	*	*		*				*		*		*		*	
32	*Porites lutea* Milne Edwards and Haime, 1860	*		*	*	*	*	*				*		*		*		*			
33	*Porites murrayensis* Vaughan, 1918									*		*				*		*		*	
34	*Goniopora minor* Crossland, 1952																			*	
	Total Number of species recorded at each station in 2010 and 2013.	2	0	3	4	3	2	3	1	2	- -	4	- -	2	- -	20	- -	14	- -	20	- -
	Total number of species recorded (combined number from the two observations for each station)		2		5		3		4		2		4		2		20		14		20

- - not assessd

** Previous distribution records are not available for the species in Gony.

* Photographs were not seemed for these species in the present study.

observations indicate the 'poor' status, as per Gomez and Yap (1998), of the reefs, with the reduction in cover from 2010 – 2013. In tandem, the algal covers (both macro and calcareous algae) increased from 2010 to 2013. As the significant observation indicating further degradation, dead corals covered with turf algae (DCTA) (comprised mostly of *Acropora* tables) – the dominant category in the observation in 2010, were disintegrated into rubbles, and was observed as the dominant category in 2013.

The station-wise comparisons between 2010 and 2013 (Fig. 2) confirm the overall trend: there is obvious reduction in the live coral cover (Stn. Nos. 1, 3 & 4), and increases in rubbles (Stn. Nos. 1 , 3 & 4) and macro algae and calcareous algae (1, 2, 3 & 4), which indicate continuing degradation of these reefs. The life-form categories between stations exhibit variations in live coral cover (Figure 2 & Table 2). The stations assessed in east-side of the Palk Bay (Stn. Nos. 8, 9 & 10) had low live coral cover, which could attributable to the patchy occurrence of corals, where they had not formed a well defined reef. Other notable variations are the absence of sand cover in the stations 8, 9 and 10, which could again be attributable to the benthic structure in these stations.

The list of station-wise occurrence of species recorded in the diversity surveys is presented in Table 3. A total of 34 species under 15 genera have been recorded in the 2010 and 2013 surveys. Interestingly, six species have been recorded newly for this reef area. The number of species recorded ranged from 0 to 20, with numbers >14 in the stations 8, 9 and 10, which fall in the patchy coral occurrences in the southeast of the Palk Bay. On the contrary very low numbers of species were recorded from the fringing reef in the mainland shore. The species-wise cover of scleratinian corals estimated in the transects showed 'stress tolerators', as per Edinger and Risk (2000), forming the major cover and also being reported from more number of stations (Fig. 3). The diversity indices estimated for the species recorded within the transects for the Palk Bay reefs showed variations between stations, with some stations exhibiting high diversity indices(H' and E) and lower dominance indices, while *vice versa* in majority of the stations (Table 2). Stations which exhibited high dominance (D) with low diversity and evenness (E) indices in the first assessment (2010) showed a reduction in live coral cover in the latest surveys (e.g., stn 1). On the other hand, stations which exhibited high diversity (H') and evenness (E) indices with low dominance (D) indices showed an increase in coral cover (e.g, stn 2). Nevertheless, decrease in coral cover was observed in most of the stations assessed conforming to the former scenario.

DISCUSSION

Lack of quantitative data (e.g. % coral cover), in the studies of Pillai (1969) and Venkataraman *et al.*, (2007) may deter from comparison of reef health to the present status. Nonetheless, a rough estimate of the colony sizes over a perpendicular transect from Pillai's (1969) study, characterize this reef to having fair to good cover i. e., >25% (Gomez and Yap, 1988) during that period. The estimates by Kumaraguru *et al.*,(2003), in August 2002, after the recovery from the bleaching event in April - June 200, showed the live cover of 32.9 – 42.9%. Thus, there is definitely a notable decline in reef health from the past and from the observations between 2010 and 2013 in the present study, which is shown by the increase in algal covers, and the disintegration of the intact DCTA (*Acropora* tables) in to rubbles, between 2010 and 2013, The reasons for which could be a combination of local to climate change related to stressors.

Though observations of bleaching are available for Gulf of Mannar for the 1998 event (Arthur, 2000; Venkataraman, 2000), the reefs of Palk Bay have not been observed during that time. The report of bleaching in these reefs for the event in April – June 2002, showed a bleached cover of 35.5 – 47.1%, with a live coral cover ranging from 6.5 – 9.9 % (Kumaraguru *et al.*, 2003). The corals however recovered in August 2002 with a sharp increase in live coral cover, of 32.9 – 42.9 %, with bleaching mortality ranging from 2.7 – 4.5%

(Kumaraguru *et al.*, 2007). This shows the impact of bleaching as minimal for that particular event, lack of monitoring in these reefs, however is a handicap to pointing the reasons for declining coral health which could be attested by the absence of bleaching information for the 2010 mass bleaching event. The very low LC cover reported in this study is the result of that event is not clear. However the observations of the present study being carried out in October 2010, well after the bleaching event in May, suggest the reduced coral cover may be due to bleaching related mass mortality than any other mortality event.

Scleratinian species composition and diversity studied by Pillai (1969) and Venkataraman *et al.*, (2007), pointed out zonation of species for the fringing reef (however, indistinct in comparison to other reef structures) as per lagoon, shore-ward reef, reef crest and sea-ward reef zones. In Pillai's (1969) observation, encrusting and massive types of 10 – 20 cm sizes formed majority in the shore-ward side, the reef crest lacking corals, and the shore-ward reef comprising mostly of ramose forms of 30 – 40 cm in greater diameter. Similar species composition was observed again by Venktataraman *et al.*, (2007) for the fringing reef, with the shoreward reef dominated by *Favia pallida* and *Leptastrea transvera*, in the reef crest the occurrence being rare, and the reef slope dominated by branching forms of *Pocillopora*, *Acropora* and *Montipora*. Though the zonation of species could be viewed in the dead skeletal forms as DCTA in the present study (observations in 2010), the same could not be viewed in the latest observation (2013), owing to the disintegration of the ramose forms in to rubbles. The species richness too remarkably declined from the 63 species under 22 genera in Pillai's (1969) and 61 species under 22 genera in Venkataraman *et al.*'s (2007) to 34 species under 15 genera in the present study (Table 3), with the absence of many prominent species from the both the former studies. The species-wise covers (Fig. 3) estimated further pointed out the dominance of 'stress tolerators' which is not of the reported species composition the previous studies. The diversity indices too show a decline in the present study from the 1969 observation (calculated from the number of colonies listed per species in Pillai's (1969) publication; Table 2) which could be attributable to the changes in community structure in relation to the climate change issues and the persistent local stressors such as sedimentation, sewage and industrial effluents in to the reef, and over exploitation of resources.

Studies have indicated that community patterns of coral species in bleached reefs are manipulated by thermal tolerence in species (Done, 1999; Coles and Brown, 2003: Loya *et al.*, 2001), similarly noting that sediments reduced coral settlement and algal turfs inhibited coral settlement (Birrell *et al.*, 2005), thus validating the possible causes of changed community structure in Palk Bay. Most remarkably in the present monitoring observations (i.e., 2010 to 2013), the stations exhibiting low diversity indices in combination with high dominance indices – where a few stress tolerant species dominating the reef, have proceeded to a reduction in coral cover (e.g., Stn. 1) is an obvious sign of overall coral decline.

The six new records of coral species in this study however is a significant observation, with the species observed being not of very common occurrence. Though this might indicate the coral seeding from elsewhere and recruitment, the previous diversity studies did not cover the patch reefs around Rameswaram in their diversity assessment could be one reason these species were not reported earlier.

SUMMARY

The fringing reef along the mainland shore and the patch reefs surrounding Rameswaram Island in Palk Bay were assessed for status of reef health, based on scleractinian diversity, species-wise cover, and other bio-physical categories, in 2010 and monitored subsequently in 2013. The live coral (LC) covers indicated the poor status of the reefs, in comparison with the past reports. The reasons for decline however are not clear given the absence of monitoring reports especially for

the large-scale bleaching event in 2010. The LC cover regressed again i.e., from 2010 to 2013, observed in tandem with the increase in algal covers and the disintegration of intact dead corals covered with turf algae (DCTA) in to rubbles (R), indicating further degradation of reef health. Diversity studies showed reduction in species richness from >60 species in the previous studies to 34 species in the present study. Species-wise cover and diversity indices showed dominance of species (by stress tolerators) with low diversity and evenness. The combination of climate change related mortality events and continuous local scale factors are deduced as reasons for the coral decline in these reefs. The patch reefs in Palk Bay being assessed for the first time for scleractinian diversity and not covered in the previous studies, resulted in to six coral species being new records from these reefs.

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Plate 1

Acropora digitifera

Acropora formosa

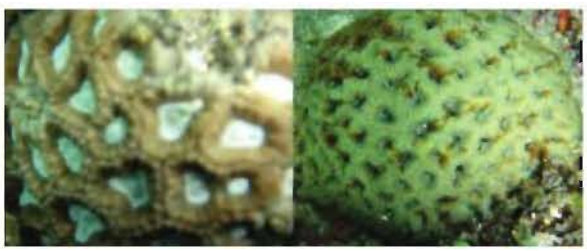
Acropora gemmifera

Cyphastria micropthalma

Favia albidus

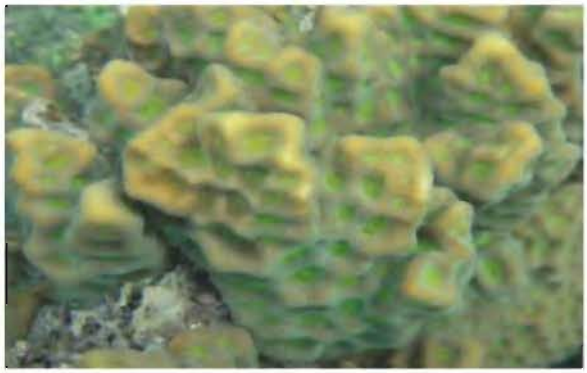
Favia lizardensis

Favia rotumana *Favia speciosa*

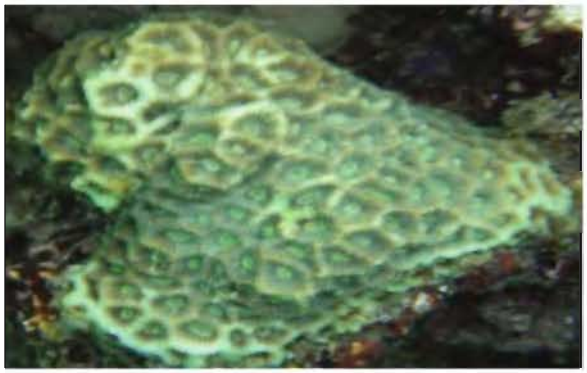


Favia veroni *Favites complanata*

Plate 2



Favites halicora



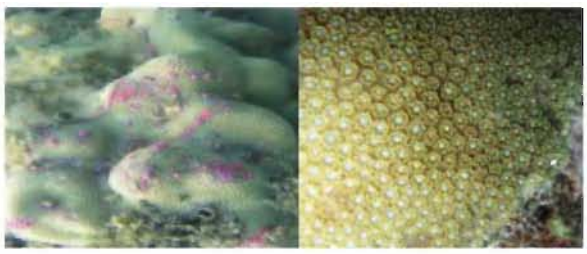
Favites pentagona

Favites russeli

Favites vasta

Goniopora aspera

Goniopora edwardsii



Goniastrea retiformis *Goniopora minor*

Hydnophora microconus *Lepastrea aequalis*

Plate 3

Leptastrea purpurea *Montastrea valenciennesi* *Montastrea colemani*

Platygyra deadalia *Platygyra sinensis* *Pleasiastrea versipora*

Porites lobata *Porites lutea* *Porites murrayensis*

Symphyllia recta *Turbinaria frondens*

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A TAXONOMIC REVIEW OF *CHRYSOCHARIS* FOERSTER (HYMENOPTERA: EULOPHIDAE) OF INDIAN SUBCONTINENT

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INTRODUCTION

The genus *Chrysocharis* Foerster is represented so far by 137 species in the world (Noyes, 2012). Among these 25 species occur in the Oriental Region and 13 species are known from the Indian subcontinent (which includes India, Pakistan, Bangladesh, Nepal, Myanmar, Bhutan and Sri Lanka) (Hansson, 1985a, 1985b; Khan et al., 2005). The species of *Chrysocharis* are economically very important since their hosts are mostly larvae or pupae of Leaf mining insects. The purpose of this paper is to review *Chrysocharis* species of the Indian subcontinent, to describe new taxa and to provide a new key for identification of these species.

Depository: The Holotypes and paratypes of all new species described in this paper are deposited in ZSIK.

Acronyms: BMNH= The Natural History Museum, London; GBP= G.B. Pant University, Pant Nagar, India; CNC = Canadian National Collection, Ottawa, Canada; DZUC= Department of Zoology, University of Calicut, India; ETHZ= Entomologisches Institute der E.T.H., Zurich, Switzerland; HNHM = Hungarian Natural History Museum, Budapest, Hungary; LUZN = Zoological Museum, Lund University, Sweden.; NPC = National Pusa Collection, Indian Agricultural Research Institute, New Delhi; NZSI = National Collections of Zoological Survey of India, Kolkata, India; ORST = Muséum National d'Histoire Naturelle, Paris, France USNM = United States National Museum of Natural History, Washington, D.C. ZSIK = The Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, India; ZDAMU = Insect Collection, Department of Zoology, Aligarh Muslim University, Aligarh, India.

Abbreviations used: CC = Costal cell; F1 to F4 = Funicular segments 1 to 4; L = Length; MV = Marginal vein; OOL = Minimum distance between eye and posterior ocellus; PMV = Postmarginal vein; POL = Minimum distance between posterior ocelli on vertex; PSGA = Parastigma; SMV = Submarginal vein; STV = Stigmal vein.

Genus ***Chrysocharis*** Foerster

Chrysocharis Foerster, 1856: 79. Type species *Chrysocharis femoralis* Foerster, 1861: 38; designated by Ashmead, 1904 : 370.

Euophthalmomyia Ashmead, 1904: 339. Type species *E. pallidipes* Ashmead. 1904, by original designation. Synonymy with *Chrysocharis* by Yoshimoto, 1973.

Nesomyia Ashmead, 1904a: 344. Type species *N. albipes* Ashmead, 1904b, by original designation. Synonymy with *Chrysocharis* by Peck, 1951.

Keywords: Review, Chrysocharis, Indian subcontinent, key, new species, Eulophidae

Omphalchrysocharis Girault, 1917: 3. Type species *N. orientalis* Girault, 1917, by original designation. Synonymy with *Chrysocharis* by Kamijo, 1976.

Rhicnopeltoidea Girault, 1917: 3. Type species *R. amsterdamensis* Girault, 1917, by monotypy. Synonymy with *Chrysocharis* by Yoshimoto, 1973.

Kratochviliana Malac, 1943: 87. Type species *K. moravica* Malac, 1943, by monotypy. Synonymy with *Chrysocharis* by Graham, 1963.

Epilampsis Delucchi, 1954a: 3. Type species *Derostenus boops* Thompson, 1878: 266, by original designation. Synonymy with *Chrysocharis* by Graham, 1963.

Eidolampsis Delucchi, 1954a: 3. Type Species: *Entedon gemma* Walker, 1839:53 , by monotypy. As subgenus of *Epilampsis* Delucchi.

Oxycharis Delucchi, 1954b: 286. Type species *Dendrostenus punctifrons* Thmopson, 1878:263, by original designation. As subgenus of *Chrysocharis* Foerster.

Trichocharis Delucchi, 1954b : 286. Type species *Chrysocharis pilosa* Delucchi, 1954b, by original designation. As subgenus of *Chrysocharis* Foerster.

Xenocharis Delucchi, 1954b: 286. Type species *Entedon syma* Walker, 1839:98, by original designation. [Subgenus *Chrysocharis* Főrster].

Diagnosis: Female and Male: Length 0.7 – 3.0 mm. Usually with bright metallic refringence; antennal formula 11332 or 11342; third anellus usually larger than preceding two anelli; frontal fork present, either "Y" or "T" shaped; antennal torulus usually situated on lower frons, above level of ventral margin of eye; occiput weakly or strongly carinated, occasionally carina indistinct; mandible bidentate or tridentate or multidentate. Pronotum with or without a cross carina or ridge; mesoscutum reticulate; notauli rather wide, shallow and may or may not diffuse posteriorly; scutellum as long as wide or distinctly longer than wide; propodeum with or without a median carina or with a raised anchor or "Y" shaped structure; plicae and costulae absent; forewing with CC with or without rows of ventral setae; speculum closed or open; PMV usually atleast 2x as long as STV. coxae reticulated. Petiole very short (hardly visible in some species) to 2.5x as long as wide with a smooth neck and raised surface; gaster of female elongated or oval shaped, usually with parallel sides and posteriorly pointed or rarely circular or subcircular in shape; male gaster narrow at base and widened posteriorly.

Hosts: Parasitic on larvae or pupae of insect leaf miners; one on gall midge; mostly primary parasites; rarely secondary parasites; a few are gregarious parasites (Hansson,1985a).

Distribution: Holarctic, Oriental and Australian regions.

Remarks: Among Indian genera, *Chrysocharis* resembles *Achrysocharoides* Girault, *Chysonotomyia* Ashmead, *Closterocerus* Westwood, and *Neochrysocharis* Kurdjumov in general appearance but these genera differ from *Chrysocharis* as follows: *Achrysocharoides* differs from *Chrysocharis* in having the combination of characters viz. antenna with 3 discoid anelli; frons with "T" shaped frontal grooves; pronotum without collar; scutellum often with distinct groups of pits or longitudinal foveae overlapping each other and forewing broadly spatulate. *Chrysonotomyia* differs from *Chrysocharis* in having 1) antenna with 1 or 2 anelli; 2) funicle usually 2 segmented; 3) PMV always shorter than STV and 4) PMV usually with a dark spot extending from STV. *Closterocerus* differs from *Chrysocharis* in having scrobe extending slightly below toruli and 2) peg sensillae of flagellum always slanting. *Neochrysocharis* differs from *Chrysocharis* in having:1) three apical segments of antenna fused; and 2) PMV never as long as STV.

Key to species of Chrysocharis of India and adjacent countries (Based on females)

1. PMV longer than STV ……........……….………..2
- PMV shorter than STV or at the most as long as STV……......…..........….............................……22
2. Funicle 4 segmented………………………….........3
- Funicle 3 segmented……..……………….........…5

3. Petiole longer than propodeum (19:12) (Fig. 20); legs pale white with brown at extreme base of fore and mid coxae and dark metallic patch at base of hind coxae; mesoscutum with a median fovea (Fig. 20) starting from scutoscutellar groove and extending to near middle .....*C. neoviridis* Narendran & Razak sp.nov.

- Petiole and other characters partly or completely different…….....……..4

4. Gaster broadly rounded at apex; scape 3.1x as long as wide; general body colour dark brown without metallic refringence...*C. funicularis* Khan

- Gaster oval and pointed at apex posteriorly; scape 5x as long as wide; general colour of head and mesosoma metallic bluish green or golden green or golden red or bluish violet or greenish blue…..…..…….. *C. pallipes* (Nees)

5. Pronotum with a cross carina present……...6

- Pronotum with cross carina absent……...13

6. Propodeum (Fig. 2) with a very short (0.4x median length of propodeum) and week median carina located between two pits at base; petiole hardly distinct; body metallic green …..... *C. cuticisi* Narendran & Sureshan sp.nov.

- Propodeum not as above; petiole distinct; body colour variable…….……..…..……7

7. Propodeum with median carina absent…....8

- Propodeum either with a median carina present or with an inverted "T" or "Y" shaped or anchor shaped structure 9

8. Mesoscutum and scutellum each with a median longitudinal fovea or depression; F1 0.71x as long as F2; pedicel 1.71x as long as F1; body yellowish brown…….....…*C. longiclavatus* Khan, Agnihotri & Sushil

- Mesoscutum and scutellum without a median longitudinal fovea or depression; F1 0.91x as long as F2; pedicel 0.7x as long as F1; body dark brown with metallic refringence *C. longiscapus* Khan, Agnihotri & Sushil

9. Propodeum with a distinct wide median carina (Figs. 9, 15)…….…….....10

- Propodeum with an inverted "Y" or "T" shaped or anchor shaped structure ……..…11

10. Propodeum (Fig. 9) in median part with a strong carina in anterior part, becoming wider and weaker towards posterior margin of propodeum; clypeus with 2 yellowish spots on sides of oral fossa……..…. *C. euterpe* Hansson

- Propodeum (Fig. 15) with a wide strong and complete median carina; clypeus testaceous .....…….....*C. lankaensis* Hansson

11. Pedicel 1.4x as long as F1; F2 longer than F1 (15:13); propodeum with anchor shaped or inverted "Y" or "T" shaped structure at anterior part, remaining region with several short longitudinal carinulae or with weak reticulation; scutellum as long as wide; raised surface of petiole 0.32 to 0.4x as long as propodeum; gaster 1.4-1.5x as long as wide.....…*C. pentheus* (Walker)

- Pedicel shorter than alternate, other characters partly or completely different from above……..……..…….....…….....12

12. MV 2.3x as long as PMV; hind femur swollen, 0.6x as long as wide; petiole 3x as broad as long; F1, F2 and F3 1.5x as long as wide .....*C. imphalensis* Chisti & Shafee

- MV 3.2x as long as PMV; hind femur not swollen as above, petiole 0.9x as long as wide; F1 and F2 about 2x and F3 about 1.5x as long as wide .....*C. nitetis* (Walker)

13. Petiole 1.4 to 1.5x as long as propodeum; mesoscutum with a short median groove starting from scutoscutellar groove towards middle of mesoscutum; frontovertex mostly smooth and shiny with metallic green or blue refringence [Fore and mid coxae pale whitish yellow; forewing with a row of 6 setae below CC; propodeum with a median carina absent; antennal funicle usually 4 segmented (which may look 3 segmented with F4 closely connected to clava)] .....*C. neosunosei* Narendran & Razak sp.nov.

- Petiole distinctly shorter than 1.4x length of propodeum; mesoscutum without a median groove; frontovertex and other characters variable .....……..…….....……...14

14. Propodeum with a median carina absent.....18

- Propodeum with a median carina……...…….20

18. Propodeum with raised structure on anterior part as in Fig. 25; occipital margin with an edge or a low carina behind ocellar triangle .....……..... *C. pubicornis* (Zetterstedt)

- Propodeum without such shaped structure 1

19. Occipital margin with a strong and sharp carina along entire vertex and half way down temples (in part)..... *C. polyzo* (Walker)

- Occipital margin without a sharp edge or margin .....*C. differentis* Narendran & Sureshan sp.nov.

20. Petiole almost one-third length of gaster; legs pale yellow with bases slightly infuscated; PMV 3.75x as long as STV; pedicel 0.87x length of F1…..... *C. indicus* Khan

- Characters not as in above combination, partly or completely different.....…….....21

21. Dorsellum with a large subcircular pit (Fig. 12) medially; occipital ridge or carina hardly reaching behind eyes, strong only behind ocellar triangle, not reaching half way down temples; clava (including specula) 2.8x as long as F3; pedicel 0.75x as long as F1, 0.53x length of scape; MV 2.4x as long as PMV; petiole a little wider than long (Fig. 12)…..…… *C. harithi* Narendran & Razak sp.nov.

- Dorsellum without a large pit as above (Fig. 24); occipital margin with a strong and sharp carina along entire vertex and a half way down temples; clava including specula 1.47x as long as F3; pedicel 0.6x as long as F1, 0.4x length of scape; MV 3.5x PMV; petiole not wider than long (in part)..... *C. polyzo* (Walker)

22. PMV as long as STV; general body colour largely yellow; mesosoma dark greenish brown; gaster dark brown with base yellow; scape about 2.6x as long as broad (Fig.8)..... *C. echinata* (Mani)

- PMV shorter than STV; other characters different from above…….....……..…23

23. Lower margin of clypeus medially pointed (Fig.22) with a tooth; frontal fork "T" shaped; propodeum with raised anchor shaped structure (Fig. 23) ..... *C. nitida* Hansson

- Lower margin of clypeus without a tooth; frontal fork "Y" shaped; propodeum with raised inverted "V" or "Y" shaped fold…….. *C. zizyphi* Hansson

Note: The taxa are treated below in alphabetical order for convenience.

1. ***Chrysocharis cuticisi*** Narendran & Sureshan, sp.nov.
(Figs. 1-3)

Female (Holotype): Length 2.2 mm. Metallic green; frons below frontal fork violet with golden refringence; eyes and ocelli pale reflecting yellow; antenna brown, scape and pedicel darker; tegula pale yellow; wings hyaline, veins brown; all coxae black with apices slightly pale; other segments of legs pale yellow; pubescence on body white.

Head: Width in anterior view 1.31x its height (21:16); width in dorsal view 2.3x as wide as long; ratio of eye height: malar space : mouth opening = 20:4:16; height of malar space equal to length of scape. POL 2x OOL (6:3); AOL a little longer than OOL (4:3); area above frontal fork with raised close reticulations; area below fork with reticulation weaker; frontal fork "Y" shaped; occipital margin with a weak edge. Antennal formula 11333; antenna inserted at level of ventral margin of eyes; relative L:W of antennal segments: scape = 40:8; pedicel = 13:8; F1 = 11:7; F2 = 13:9; F3 = 14:11; clava = 30:11.

Mesosoma: Pronotum with anterior cross carina present, 1.64x as wide as long with distinct raised reticulation; mesoscutum as long as scutellum; scutellum slightly longer than wide (40:39) with a pair of setae; dorsellum with weak reticulation at middle, more well reticulate at submedian part; propodeum with extremely short median carina (0.4x median length of propodeum) from base with a small pit on either side (Fig. 2); plicae absent; callus with 1 or 2 setae. Forewing 2x as long as wide; speculum closed behind by cubital line of setae; CC with 5-6 setae below in an irregular row; marginal fringe shorter than STV; relative length of CC = 17; SMV = 11; PSGA= 9; MV = 55; PMV = 22; STV = 9.

Metasoma: Petiole slightly visible from dorsal side, 5x as wide as long (10:2); gaster longer than mesosoma (27:20) but shorter than combined length of head plus mesosoma (27:29); gaster 2.1x as long as wide in dorsal view.

Male: Unknown

Material examined: Holotype Female, INDIA, Jammu & Kashmir, Ladakh, Nimmu near Kargil, 5.vii.2009. P.M. Sureshan (Deposited in DZUC pending transfer to ZSIK).

Host: Unknown.

Distribution: India (Jammu & Kashmir).

Etymology: The species name is an arbitrary combination of letters.

Remarks: This new species comes to *Chrysocharis elongata* (Thomson) in the key to species by Hansson (1985a.) but differs from *C. elongata* in having :1) malar space 0.7x as long as mouth opening (in *C. elongata* malar space 0.25x as long as mouth opening); 2) F1 to F3 equal in length and width (in *C. elongata* F1 to F3 unequal in length and width); and 3) MV 2.5x as long as PMV (in *C. elongata* MV 3.68x as long as PMV).

This new species comes to *Chrysocharis laomedon* (Thompson) in the key to species by Ikeda (1996) but differs from it in having: 1) fore coxa black (in *C. laomedon* fore coxa predominantly white); 2) malar space 0.25x as long as mouth opening (in *C. laomedon* malar space 0.13x mouth opening); 3) median carina of propodeum at base 0.4x median length of propodeum (in *C. laomedon* median carina of propodeum at base 0.31x as long as median length of propodeum); 4) propodeum without a median carina at posterior distal part (in *C. laomedon* propodeum with a short median carina at posterior distal part); and 5) POL 2x OOL (in C. laomedon POL equal to OOL).

2. ***Chrysocharis differentis*** Narendran & Sureshan, sp. nov.
(Figs. 4-7)

Female (Holotype): Length: 1.43 mm. Head, mesosoma and metasoma dark metallic green; eyes brownish yellow; ocelli pale reflecting yellow; antenna including scape black; wings hyaline with veins pale brown; all coxae concolorous with mesosoma; all femora dark brown or black with apices pale; tibiae and tarsi pale yellowish white; pubescence on body pale white.

Head: Width in anterior view 1.31x its height (17:13); width in dorsal view 2.2x its length (20:9); ratio of height of eye: malar space: mouth opening = 18:4:16; POL 2.5x OOL (5:2); AOL longer than OOL (3:2); area above and below of frontal fork with strong reticulation; frontal fork somewhat "T" shaped; occipital margin without sharp edge. Antennal formula 11332; antenna inserted slightly below level of ventral margin of eyes; relative L:W of antennal segments : scape = 38:8; pedicel 12:7; F1 = 12:7; F2 = 14:7; F3 = 12:7; clava = 27:7.

Mesosoma: Pronotum with cross carina absent; 2.2x (11:5) as broad as long, with distinct raised reticulation; mesoscutum shorter than scutellum (10: 12); scutellum slightly longer than wide (12:11), with a pair of setae; dorsellum with a weak reticulation; propodeum distinctly reticulate, median carina or "Y" or "T" or anchor shaped structures absent, with two transverse fovea at base medially; each callus with 2 setae. Forewing 2x as long as wide; CC without a row of setae on ventral side; speculum closed behind by cubital line of setae. Forewing 2x as long as wide; CC without a row of setae on ventral side; speculum closed behind by cubital line of setae; relative length of SMV = 12; MV = 52; PMV = 14; STV = 13.

Metasoma: Petiole 1.83x as wide as its length; gaster as long as mesosoma, 1.3x as long as wide (26:20).

Male: Unknown

Material examined: Holotype Female: INDIA, Jammu & Kashmir, Ladakh, Nimmu near Kargil, 5.iii.2001. P.M.Sureshan (Deposited in DZUC pending transfer to ZSIK). Paratype Female: INDIA, Himachal Pradesh (H.P.), Solan, Rabon, 18.iii.2009, S.B. Anis & T. Rehmat (ZDAMU).

Host: Unknown.

Distribution: India (Himachal Pradesh, Jammu & Kashmir)

Remarks: This species comes to *Chrysocharis amanus* (Walker) in the key to species by Hansson (1985a) but differs from that species in having : 1) antenna including pedicellus black (in *C. amanus pedicellus* white); 2) all coxae concolorous with mesosoma (in *C. amanus* mid coxa predominantly white and hind coxa varying from completely white to basal half dark and metallic with outer parts white to basal half dark and metallic with outer parts white); 3) frons below fork dark metallic green (in *C. amanus* frons below fork red or purple); 4) MV 3.71x as long as PMV (in *C. amanus* MV 2.5x as long as PMV); and 5) pedicel as long as F1 (in *C. amanus* pedicel 1.25x as long as F1). This new species does not fit to the key of Ikeda (1996) though it runs to couplet

number. 30, but differs greatly from *Chrysocharis submutica* Graham and *Chrysocharis albicoxis* Erdös.

3. ***Chrysocharis echinata*** (Mani) (Fig. 8)

Nesomyia echinata Mani, 1989: 1473. Holotype Female, India, Madras [=Chennai] (NZSI; lost?).

Chrysocharis echinata (Mani): Narendran & Sudheer, 2005: 11).

Diagnosis: (Based on Mani, 1989, and Narendran & Sudheer, 2005): Female: Length 1.5 mm. Body largely yellow; mesosoma dark greenish brown; gaster dark brown with base yellow; antennae dark brown except scape and pedicel yellow; head width in anterior view 1.16x its height in dorsal view; slightly wider than mesosoma; OOL subequal to POL; malar space about 0.45x eye length; antennal funicle 3 segmented, clava 2 segmented; relative L:W of antennal segments (as measured from Figure 359 of Mani, 1989): scape = 18:7 (in original description it is "about 2x as long as thick"); pedicel =7:3; F1 = 9:3; F2 = 9:2; F3 = 8:3; clava (including spicula) 14:2 (in the original description it is stated that funicular segments 1-3 length ratio 10:9:8). Mesoscutum with fine reticulate squamous sculpture; notauli fading posteriorly; forewing (excluding marginal fringe) 2.6x as long as wide (as in figure 359b of Mani 1989) (in the original description L:W ratio 3:1); relative length of CC = 20; SMV = 27; parastigma = 4; MV = 26; PMV = 3; STV = 3 (Fig. 359B Mani 1989a). Gaster sessile, subequal to rest of body, globose-ovate.

Male: Similar to female except characters mentioned by Mani (1989).

Host: Reared from echinate galls on leaf of Ficus bengalensis Linn.

Distribution: India (Tamil Nadu).

Remarks: This is a unique species of *Chrysocharis* having reported from the galls of *Ficus bengalensis* Linn and in having PMV as long as STV and general body colour is predominantly yellow. The nature of antenna is also a little unusual in the enlarged scape and elongated flagellum. Since the number of anelli is not clear from the description or figures I doubt whether this species is actually *Chrysocharis*. The antennae look like that of *Chrysonotomyia* Ashmead or *Obesulus* Boucek (1988) but to make sure the type has to be examined.

Dr. S. Sheela and Dr. P. Girish Kumar searched in the National collection of Zoological survey of India, Kolkata, the stated depository of the Holotype of *N. echinata*, and informed us that the type is not present in NZSI.

4. ***Chrysocharis euterpe*** Hansson (Fig. 9)

Chrysocharis eupterpe Hansson, 1985b: 221-223. Holotype Female , Pakistan (BMNH)

Diagnosis: (Based on Hansson, 1985b) Female: Length 2.5 mm. Frons below fork yellowish green; frons above fork bluish green; clypeus metallic with 2 yellowish spots on sides of oral fossa; vertex yellowish green, tinged with blue; antenna brown except pale apical one-fourth of scape; mesoscutum and scutellum bluish green; propodeum same colour as of scutellum; wings hyaline; legs pale except dark metallic coxae,. Antenna with F1 about 2.3x as long as wide; F2 about 2x as long as wide; F3 about 1.5x as long as wide. Head width 1.5x its height (90:60); POL 1.7x OOL when measured from Figure 6 of Hansson (1985b); pronotum with a strong carina along hind edge; surface behind carina smooth and shiny; scutellum slightly elongated and flattened. Forewing with speculum closed, SMV with a complete row of setae on under side; relative length of MV =10; PMV = 2.6; STV = 1. Propodeum with a strong carina in anterior part, becoming wider and weaker towards posterior margin; also with a pair of short carinae ascending from the corners of petiolar foramen and with a carina between petiolar foramen and spiracle; each callus with 4 setae. Petiole a little wider than long (20:16). Gaster oval, a little longer than mesosoma.

Male: Unknown

Host: Lepidopterous leaf miner on Hedera helix (Hansson,1985b).

Distribution: Pakistan (Mianadan).

Remarks: This species comes near *Chrysocharis lankaensis* Hansson in having propodeum with a median carina and with 3-4 setae on callus on either side but differs from *C. lankaensis* in having :1) propodeum with median carina expanding and weaker in posterior half (in *C. lankaensis* propodeum with a wide and complete median carina);and 2) clypeus metallic with 2 yellow spots (in *C. lankaensis* clypeus testaceous).

5. ***Chrysocharis funicularis*** Khan

Chrysocharis funicularis Khan, 1985: 380. Holotype Female, India (Uttar Pradesh) (GBP?)

Diagnosis (Based on Khan, 1985): Female: General body colour dark brown; scape with a yellowish strip at ventral side; metasoma light brown except petiole and basal end yellowish; legs light brown except dark brown hind coxae. Relative L:W of antennal segments (as measured from fig.10 of Khan,1985). Scape = 46:15; pedicel 16:10; 1st anellus = 1:5; 2nd anellus = 1:5; F1 = 21:9; F2 = 24:10; F3 = 20:10; F4 = 20:11; clava = 29:10. Forewing more than 2x as long as wide; relative length of PMV = 44; STV = 18; distance between anterior margin of wing and stigma as long as height of stigma; petiole 0.21x length of gaster; gaster (excluding petiole) width subequal to its length; apex broadly rounded.

Host: *Phytomyza* sp. (Diptera: Agromyzidae)

Distribution: India (Uttar Pradesh)

Remarks: This species comes near *Chrysocharis pallipes* (Nees) in having funicle 4 segmented but differs from it in having: 1) gaster of female broadly rounded at apex (in *C. pallipes* gaster oval and pointed at apex posteriorly) and 2) scape 3.1x as long as wide (in *C. pallipes* scape 5x as long as wide).

6. ***Chrysocharis harithi*** Narendran & Razak, sp.nov.
(Figs. 10-13)

Female Holotype: Length 1.76mm. Dark metallic green except the following: antenna black with slight metallic green refringence on scape and pedicel; wing hyaline with veins pale brown; all coxae concolorous with mesosoma; femora concolrous with coxae except pale apical one-fourth; trochanters pale brown; fore and mid tibiae and tarsal segments pale yellow with a brownish tinge; hind tibia and first two basal hind tarsal segments pale white; third hind tarsal segment with a slight brownish tinge; fourth hind tarsal segment dark brown; all pretarsi dark brown; pubescence on body pale brownish yellow.

Head: Width in anterior view 1.4x its length; width in dorsal view 2.2x its length; ratio of height (in profile) of eye: height (in profile) of malar space: mouth opening (in anterior view) = 17:6:12. POL 2x OOL (8:4); AOL as long as OOL (4:4); frontal fork (Fig. 10) somewhat bent on sides; area below and above fork strongly reticulate; occiput sharply margined posteriorly behind posterior ocelli, extending weakly to margin behind eye. Antennal formula 11332; antenna inserted slightly above lower margin of eyes , the distance between level of lower margin of eyes and toruli being 0.2x distance between a torulus and eye margin; relative L:W of antennal segments (except anelli): scape = 17:7; pedicel = 9:7; F1 = 12:9; F2 = 12:9; F3 = 12:9; clava = 25:9.

Mesosoma: Pronotum with cross carina absent; mesosoma 1.5x as long as broad, with distinct raised hexagonal reticulations; mesoscutum a little shorter than scutellum (7:8); scutellum slightly longer than wide (8:7), with a pair of setae; dorsellum with a median subcircular, large (Fig.12) pit with reticulate sculpture inside; propodeum with a distinct median carina (Fig.12), submedian part shiny but with weak reticulation; each callus with 2 setae; forewing 2.1x as long as wide (Fig.13), speculum closed behind by cubital line of setae; CC without rows of setae on underside; relative length of CC = 27; SMV = 21; MV = 48; PMV = 20; STV = 8.

Metasoma: Petiole as long as wide (Fig. 12); metasoma slightly shorter than mesosoma (34:33); gaster (excluding petiole) 1.45x as long as wide (29:20).

Male: Similar to female except antenna with a longer setae and metasoma distinctly shorter than

mesosoma (26:21). *Variation*: Length varies from 1.5 to 1.8mm.

Material examined: Holotype Female: INDIA, Jammu & Kashmir, Srinagar, April 2008, ex. Agromyzidae, Nakeer Razak. Paratypes: 10 Females, 5 males with same data as Holotype. (Holotype and paratypes in ZSIK).

Host: ex Undetermined Agromyzidae (Diptera).

Distribution: India (Jammu & Kashmir).

Remarks: This new species comes to *Chrysocharis pubicornis* (Zetterstedt) in the key to species by Hansson (1985a) and Ikeda (1996) but differs from *C. pubicornis* in having: 1) propodeum with a straight and complete median carina (in *C. pubicornis* propodeum with anchor or "Y" shaped structure in anterior median part); 2) median part of dorsellum with a large pit (in *C. pubicornis* median part of dorsellum with no such pit) and 3) MV 2.4x as long as PMV (in *C. pubicornis* MV 3.4x as long as PMV).

7. ***Chrysocharis imphalensis***
(Chishti & Shafee)
(Fig. 14)

Pediobius imphalensis Chisti & Shafee, 1988: 21. Holotype Female, India (ZDAMU) [examined]

Chrysocharis imphalensis (Chisti & Shafee): Hayat *et al.*, 2005: 21.

Redescription: Female: 1.9mm. Head dark with bluish green refringence; antenna dark except basal half of scape light yellow; mesosoma dark with metallic bluish green refringence; legs dark except base and apical three-fourths of mid and hind tibiae, mid longitudinal band on fore tibia and basal four tarsal segments light yellow; metasoma dark with metallic refringence.

Head: Width in anterior view 1.39x its height; frons with "Y" shaped frontal fork; POL 1.33x OOL (4:3); AOL half of POL (2:4). Relative ratio of mouth: malar space: eye height = 12:5:18. Relative L: W of antennal segments: scape = 40:9; pedicel = 15:8; first anellus = 1:4; second anellus = 1:3; third anellus =5:8; F1 = 15:10; F2 = 15:10; F3 = 15:10; clava (including spicula): 27:10.

Mesosoma: Pronotum with cross carina distinct; mesoscutum and scutellum distinctly punctate with interstices carinate; scutellum slightly longer than its width (15:14); propodeum with anchor shaped structure anteromedially. Forewing 2.05x as long as its width (80:39); speculum closed behind by setae; relative L:W of CC = 17; SMV = 11; parastigma = 6; MV = 30; PMV = 13; STV =5; CC without rows of setae below.

Metasoma: About as long as mesosoma; petiole half as long as wide (3:6) ratio of length of petiole: gaster (excluding petiole) = 3:53; gaster length 1.6x its width in dorsal view (53:34); ovipositor sheaths: gaster length = 6:53.

Male: Unknown.

Material examined: Holotype.

Host: Unknown

Distribution: India (Manipur: Imphal)

Remarks: This species comes near *Chrysocharis nitetis* (Walker) in general appearance but differs from it in having hind femur swollen, 0.6x as long as wide (in *C. nitetis* hind femur shorter than 0.6x as long as wide). This species resembles *Chrysocharis nautius* (Walker) in having hind femur stout but differs from it in having: 1) MV 2.3x as long as STV (in C. nautius MV 7.8x as long as STV); PMV 2.6x as long as STV (in *C. nautius* PMV 2.1x as long as STV) and eye height 1.2x width of mouth (in *C. nautius* eye height 2x width of mouth).

8. ***Chrysocharis indicus*** Khan

Chrysocharis indicus Khan, 1985: 376. Holotype Female, India (NZSI?; lost?)

Diagnosis (Modified from Khan, 1985): Female: Length 1.52 mm. Head and mesosoma dark brown with greenish refringence; antenna light brown except scape yellowish with slight infuscation at apex; gaster dark brown with metallic bluish green refringence; wings hyaline; legs pale yellow except bases of coxae slightly infuscated; without any infumation. Head width in anterior view 1.5x its height; mandibles bidentate; relative L :W of antennal segments = scape = 37:7; pedicel = 12:7; first anellus = 1:4; second anellus = 1:4; third anellus 5:5; F1 = 16:5; F2 = 15:6; F3 = 13:7; clava = 26:7.

Pronotum without cross carina; scutellum with a single pair of setae; propodeum smooth, median and lateral carinae present (but not shown in figure 4 of propodeum by Khan,1985); forewing hyaline, 2x as long as wide; relative length of CC = 24; SMV = 15; parastigma = 5; MV = 36; PMV = 14; STV = 4. Gaster longer than mesosoma (excluding petiole); petiole one-third length of gaster; ovipositor sheaths not visible.

Male: Resembles female except in proportion of antennal segments. (see Khan, 1985).

Host: Phytomyza sp. (Diptera:Agomyzidae).

Distribution: India (Uttar Pradesh).

Remarks: This species comes near *Chrysocharis polyzo* (Walker) in having propodeum with a median carina, petiole distinctly shorter than 1.4x length of propodeum and pronotum without a cross carina. However it differs from *C. polyzo* in having: 1) MV 2.6x as long as PMV (in *C. polyzo* MV 3.5x as long PMV; 2) PMV 3.5x STV (in *C. polyzo* PMV 2.6x as long as STV); 3) Head and mesosoma dark brown with greenish refringence (in *C. polyzo* head and mesosoma metallic blue or green); 4) propodeum with median and lateral carinae present (in *C. polyzo* with lateral carinae absent); and 5) anteromedian part of propodeum without a median fovea (in *C. polyzo* anteromedian part of propodeum with a triangular fovea bordered by sharp edge.

9. ***Chrysocharis lankaensis*** Hansson (Fig. 15)

Chrysocharis lankaensis Hansson, 1985b. 223-224. Holotype Female, Sri Lanka (LUZN).

Diagnosis: Female (Based on Hansson, 1985b): Length 2.5 mm; frons below frontal fork yellowish green; frons above fork greenish yellow; clypeus testaceous; vertex outside ocellar triangle bluish green, inside triangle greenish yellow; antenna brown except pale scape (with tip brownish); mesoscutum, scutellum and propodeum yellowish green; forewing with median fuscous spot; all coxae dark and metallic, remaining parts of legs pale; pronotum with a strong and sharp carina along hind edge; propodeum with a wide, strong and complete median carina; each callus with 3 setae; petiole shorten than median length of propodeum (20:26), 1.25x as long as its width; ratio of mesosoma/gaster 1.10.

Male: Unknown

Host: Unknown

Distribution: Sri Lanka (Central Province).

Remarks: This species comes near *Chrysocharis albipes* (Ashmead) in the key to Palearctic species by Hansson (1985a) but differs from it in having: clypeus smooth without striations (in *C. albipes* clypeus with longitudinal striations and 2) propodeal callus with 3 setae (in *C. albipes* propodeal callus with 2 setae).

10. ***Chrysocharis longiclavatus*** Khan, Agnihotri and Sushil

Chrysocharis longiclavatus Khan, Agnihotri & Sushil, 2005: 94. Holotype Female (GBP? or NPC?)

Diagnosis (modified from Khan *et al.*, 2005): Female: Length "about 1.26 mm"; head and body yellowish brown; antenna dark brown except very slight infuscation at basal part of scape; fore and hind coxae brown; mid coxa yellow; fore and mid femora brown with apex pale; all fore tarsal segments and last two hind tarsal segments brown; mid leg completely and remaining segments of all legs yellow. Frontal fork "Y"shaped; antennal formula 11332; scape not reaching level of anterior ocellus; relative L:W of antennal segments : scape = 61:14; pedicel = 30:13; first anellus = 1:5; second anellus = 1:6; third anellus = 6:8; F1 = 16:11; F2 =22:12; F3 = 21:14; clava including spicula:14. Pronotum with cross carina present; mesoscutum and scutellum with two pairs of setae on each; propodeum smooth, median carina and plicae absent; forewing 2.48x as long as wide; maximum length of mv as long as STV; relative length of MV = 39; PMV =13; STV = 6; speculum closed behind; petiole L:W = 5:8; gaster (excluding petiole) longer than mesosoma.

Male: Unknown

Host: Unknown

Distribution: India (Uttarakhand).

Remarks: This species comes near *C.longiscapus* Khan, Agnihotri & Sushil in the key to species given in this paper but differs from *C. longiscapus* in having: 1) mesoscutum and scutellum with a median longitudinal fovea or depression (in *C. longiscapus* mesoscutum and scutelum without such a fovea or depression); 2) F1 0.71x as long as F2; (in *C. longiscapus* F1 0.91x as long as F2); 3) pedicel 1.71x as long as F1 (in C. longiscapus pedicel 0.7x as long as F1); and 4) body yellowish brown (in *C. longiscapus* body dark brown with metallic refringence).

11. ***Chrysocharis longiscapus*** Khan Agnihotri and Sushil

Chrysocharis longiscapus Khan, Agnihotri and Sushil, 2005: 92-95. Holotype Female, India (GBPU? or NPC?)

Diagnosis: (Modified from Khan *et al.*, 2005): Female: Length 1.65mm. Dark brown with metallic refringence ; antenna brown except scape yellow with apex slightly brown; mesosoma dark brown; gaster brown; legs yellow except brownish black basal half of hind coxa. Head with frontal fork "Y" shaped; POL slightly longer than OOL; antennal formula 11332; relative L: W of antennal segments: scape = 46:7; pedicel = 16:9; first anellus 1:4; second anellus 1:5; third anellus 8:7; F1 = 23:12; F2 = 24:12; F3 =24:11; clava = 36:11. Mesoscutum 1.4x as long as scutellum; scutellum slightly wider than long (18:16) with 2 pairs of setae; propodeum with median carina and plicae absent, smooth; forewing 2.1x as long as wide; relative length of MV = 49; PMV = 13; STV = 6. Gaster longer than mesosoma; petiole long.

Male: Unknown

Host: ex leaf miner

Distribution: India (Uttar Pradesh)

Remarks: As pointed out under remarks of *C. longiclavatus* this species differs from that species in having: 1) mesoscutum and scutellum without longitudinal fovea or depression (in *C. longiclavatus* mesoscutum and scutellum with longitudinal fovea or depression present); 2) F1 0.91x as long as F2 (F1 0.71x as long as F2 in *C. longiclavatus* ; 3) pedicel 0.7x as long as F1 (in *C. longiclavatus* pedicel 1.71x as long as F1 0 and 4) body dark brown with metallic refringence (body yellowish brown in *C. longiclavatus).*

12. ***Chrysocharis neosunosei*** Narendran & Razak, sp.nov. (Figs. 16–18)

Female Holotype: Length: 1.71mm. Head, mesosoma and metasoma metallic greenish blue; scape pale yellow with apical one-fourth dark brown, particularly on posterior part; remaining antennal segments dark brown; eyes black with margins around pale grey; wings hyaline and veins pale brown; fore and mid legs including coxae pale whitish yellow; hind coxa concolorous with mesosoma, remaining segments pale whitish yellow except pale brown fourth tarsal segment and pretarsus..

Head: Width in anterior view 1.1x (35:32) its length; width in dorsal view 2.8x (34:12); ratio of eye height : malar space: mouth opening = 26:6:12. POL 2x OOL (6:3); AOL longer than OOL (4:3); frontal fork "Y" shaped; area below and above frontal fork and vertex smooth and shiny; occipital margin sharp behind hind ocelli, becoming weak or obsolescent near eyes; relative L:W of antennal segments : scape = 40:9; pedicel = 13:8; F1 = 18:7; F2 = 16:9; F3 = 15:8; F4= 14:8;clava = 15:6; clava with spicula present.

Mesosoma: Pronotum without cross carina; mesosoma 1.5x as broad as long, with raised reticulation; mesoscutum with a short shallow median fovea as in the Australian Pleurotropopseus Girault; scutellum a little longer than mesoscutum (18:16), with a pair of setae; scutellum reticulate with admarginal area smooth and shiny; dorsellum medially with a narrow tongue – like projection (Fig.17), with a raised fovea bordered by sharp edge on anterior part of propodeum; median part of propodeum reticulate, sides smooth and shiny; each callus with 3 setae. Forewing 2.14x as long as wide (98:46); speculum closed behind by cubital line of setae; CC with a row of 6 setae beneath wing; relative length of MV = 53; PMV = 22; STV = 6.

Metasoma: as long as mesosoma; petiole longer than propodeum (20:14) with strong raised reticulations; gaster 1.55x as long as wide (65:42).

Male: Unknown

Material examined: Holotype Female, INDIA: Kashmir, May 2009, Nakeer Razak. Deposited in DZUC pending transfer to ZSIK or NZSI)

Host: Undetermined Agromyzidae (Diptera).

Distribution: India (Jammu & Kashmir).

Remarks: This species comes near Chrysocharis sunosei Kamijo in the key to species of Hansson (1985a) and Ikeda (1996) but differs from *C. sunosei* in having: 1) eyes bare (in *C. sunosei* eyes pubescent); 2) inner orbits straight (in *C.sunosei* inner orbits strongly sinuate); 3) height of malar space 0.23x height of eye (in *C. sunosei* height of malar space 0.12 – 0.14x height of eye); 4) propodeum with median carina absent (in *C. sunosei* propodeum with median carina present); 5) propodeum with median area reticulate, sides smooth and shiny (in *C. sunosei* propodeum with median area smooth and shiny); 6) PMV 3.7x as long as STV (in *C. sunosei* PMV 2 – 2.4x as long as STV); 7)frons above and below fork smooth and shiny without reticulation (in *C. sunosei* frons above fork smooth but reticulated with low narrow septae in some places); 8) frons above fork green (in C.sunosei frons above fork golden green); 9) F3 1.9x as long as wide (in *C.sunosei* F3 1.3 – 1.5x as long as wide); 10) clava 1.93x as long as F3 (in *C.sunosei* clava 1.63 to 1.83x as long as F3); and 11) mesoscutum with a median short fovea starting from scutoscutellar sulcus to one-third distance towards anterior side (in *C.sunosei* mesoscutum without any such fovea).

13. ***Chrysocharis neoviridis*** Narendran & Razak, sp. nov.
(Figs. 19 -21)

Female Holotype: Length 1.56mm. Head, mesosoma and metasoma dark metallic green with bluish tinge; scape pale white; pedicel brown, remaining segments dark brown; wings hyaline, veins pale brown; legs pale white with brown patch at extreme base of fore and mid coxae and dark metallic patch at base of hind coxae.

Head: Width in anterior view 1.2x (37:31) its height; width in dorsal view 1.8x (34:18) its length; ratio of height of eye: malar space: and mouth opening = 22:4:12; POL 1.5x OOL (6:4); AOL as long as OOL; area above frontal fork faintly reticulate on parascrobal part and on area below toruli; frontal fork "T" shaped; occipital margin sharply edged behind hind ocelli but not extending to posterior part of eye; vertex smooth with faint reticulation. Antennal formula 11342; antenna inserted a little (distance between antennal insertion and level of ventral margin of eye equal to diameter of a toruli) above level of ventral margin of eye; relative L: W of antennal segments: scape = 49:8; pedicel = 16: 9; F1 = 21:12; F2 = 20:11; F4 = 17:10; clava = 21:8.

Mesosoma: Pronotum with cross carina absent; mesosoma 1.4x as long as broad (22:16), with distinct raised reticulation, mesoscutum shorter than scutellum (8:12), with a short (reaching middle of mesoscutum from scutoscutellar line) median groove (slightly longer than that of *C. neosunosei*); scutellum as long as broad, with a pair of setae; scutellum with raised reticulation in median part, smooth and shiny on admarginal area; dorsellum medially with a narrow tongue like projection (Fig. 20) with a raised fovea on anterior part of propodeum; propodeum with a weak broken median carina; sub median part smooth and shiny; each callus with 5 setae. Forewing 2.1x as long as wide (91:44), without a row of setae below CC; speculum closed behind by cubital line of setae; relative length of MV = 42; PMV = 16; STV = 4.

Metasoma as long as mesosoma; petiole longer than propodeum (Fig.20) with raised reticulation with a tooth at each side; gaster 1.2x as long as broad (42:36)

Male: Similar to female except shorter gaster.

Material examined: Holotype Female, INDIA, Jammu & Kashmir, Barjulla, June 2009. Nakeer Razak. Paratypes: 6 females and 4 males of same data of Holotype. 1 Female, Kashmir, Pulwarna, August, 2009, Nakeer Razak. [Holotype and paratypes in ZSIK]

Host: ex Agromyzidae (Diptera)

Distribution: India (Jammu & Kashmir).

Remarks: This new species closely resembles *Chrysocharis viridis* (Nees) in similar colour of

body and in the structure of propodeum but differs from *C. viridis* in having: 1) mesoscutum with a median groove posteriorly (in *C.viridis* mesoscutum without such a median groove); 2) height of malar space 0.18x eye height (in C.viridis malar space 0.13x eye height); 3) MV 2.6x PMV (in *C. viridis* MV 3.44x PMV) and 4) petiole longer than propodeum (in *C. viridis* petiole not longer than propodeum).

14. ***Chrysocharis nitetis*** (Walker)

Entedon nitetis Walker, 1839: 52, Lectotype Female (designated by Graham, 1963), England (BMNH).

Entedon novellus Walker, 1839: 55, Lectotype Female (designated by Graham, 1963), England (BMNH). Synonymy with *C. nitetis* by Askew & Coshan, 1973. *Derostenus boops* Thompson, 1878: 266. Lectotype Female (designated by Hansson,1985a), (LUZN). Synonymy with *C. nitetis* by Boucek & Askew, 1968.

Chrysonotomyia elegantissima Girault, 1917: 20. Female, USA (USNM). Synonymy with *C. nitetis* by Hansson, 1987.

Chrysocharis (Kratochviliana) milleri Yoshimoto,1973: 1327-1328. Holotype Female Canada (CNC). Synonymy with *C. nitetis* by Hansson, 1987.

Diagnosis: (Based on Hansson, 1985a): Female Length: 1.3–2.4mm. Frons below frontal fork golden green or red; frons above frontal fork blue with or without golden green in lower part; vertex golden green; antenna dark except pale apex (except dark tip); mesoscutum, scutellum and propodeum metallic greenish blue, bluish violet or golden green; fore and mid coxae dark brown with weak reticulation; hind coxa dark metallic; fore leg with tarsus pale brown; femur with or without dark brown; mid and hind femora usually completely (predominantly) dark; remaining parts of legs pale; forewing with or without a pale fuscous spot. F1 and F2 about 2x and F3 about 1.5x as long as wide; scutellum usually flattened; anteromedian part of propodeum with a raised and relatively strong "anchor" or "Y" shaped structure. Petiole slightly shorter than broad (7:8), 0.7x as long as median length of propodeum; gaster shorter than mesosoma.

Male: Length 1.3–1.6mm. Scape dark and wider than in female. Funicular segments about 2x as long as wide. (For further comments see Hansson, 1985a).

Hosts: Solitary parasitoid of Coleoptera (Chrysomelidae and Curculionidae); Diptera (Agromyzidae); Hymenoptera (Tenthredenidae); Lepidoptera (Coleophoridae, Eriocraniidae, Gracillaridae, Heliozetidae, Lyonetidae, Nepticulidae, Tischeriidae, and Yponomeutidae). Secondary parasitoid of Hymenoptera (Braconidae & Eulophidae) (Noyes, 2012).

Distribution: India (Kashmir, Srinagar) (Hansson, 1985b)

Remarks: This species comes near *Chrysocharis pentheus* (Walker) in the key to species by Hansson (1985a) but differs from it in having: 1) raised surface of petiole about half as long as propodeum (in *C. pentheus* raised surface of peiole atmost 0.38x as long as propodeum); 2) petiole with strong sculpture (in *C. pentheus* petiole with weak sculpture); and 3) mid and hind femora predominantly dark (in *C. pentheus* fore and hind femora white). According to Ikeda (1996) *C. nitetis* is similar to *C. nautius* (Walker) but differs from it in having slender hind femur (less than 0.33x its length) whereas in *C. nautius* hind femur stout and its width 0.33x its length); and 2) reticulation on mesoscutum and on vertex with low, narrower septae (in *C. nautius* reticulation on mesoscutum and vertex with very high and very wide septae). This species comes near *C. imphalensis* in the key given in this paper, but differs from it by having :1) Hind femur slender much less than 0.6x as long as wide)(in *C. imphalensis* hind femur 0.6x as long as wide); 2)MV 3.2x as long as PMV (in *C. imphalensis* MV 2.3x as long as PMV); 3) petiole 0.9x as long as wide (in *C. imphalensis* petiole 3x as long as broad); and 4) F1 and F2 about 2x and F3 about 1.5x as long as wide (in *C. imphalensis* F1,F2 and F3 1.5x as long as wide).

15. ***Chrysocharis nitida*** Hansson (Figs, 22-23)

Chrysocharis nitida Hansson, 1985b: 220–221. India (BMNH).

Diagnosis: (Based on Hansson, 1985b). Female: Length 1.8 mm. Frons below fork yellowish green; frons above fork bluish violet; vertex yellowish green; clypeus and face metallic greenish yellow; antenna dark except pale scape. Mesoscutum and scutellum yellowish green; fore coxa predominantly pale, with base dark; mid coxa brownish with a weak metallic tinge and with pale outer parts; hind coxa completely dark and metallic; remaining parts of legs pale with claws darkened; wings hyaline without dark infuscation. Lower margin of clypeus with pointed tooth; clypeus smooth and shiny with very smooth wrinkles; frontal fork "T" shaped; pronotum with a cross carina; propodeum with a raised anchor-shaped structure on anterior median part; area below anchor with smooth sculptures, otherwise smooth and shiny; petiole wider than long (10:8); forewing with STV longer than PMV (24:10). Gaster a little shorter than mesosoma (1:0.95)

Male: Unknown

Hosts: Leaf miner of Sorghum (Hansson, 1985b)

Distribution: India (Andhra Pradesh)

Remarks: According to Hansson (1985b) *C. nitida* can be easily distinguished from all species of *Chrysocharis* by the shape of clypeus, and by the anchor shaped structure on the propodeum.

16. ***Chrysocharis pallipes*** (Nees)

Elachestus (sic) pallipes Nees 1834: 138-139. Stuttart, Germany (Boucek and Askew, 1968, placed it under 'incertae sedis').

Eachertus pallipes Nees: Schmiedeknecht, 1909: 36 Brussels (valid species)

Entedon lycambes Walker, 1839: 21. Lectotype Male, (designated by Hansson, 1985a), England (BMNH). Synonymy with *Chrysocharis* chilo Walker by Boucek & Askew, 1968, and with *Chrysocharis pallipes* by Graham, 1993).

Chrysocharis petiolata Forster, 1861: 38. Switzerland. (type lost). Synonymy with *C. allipes;* Graham, 1993).

Entedon chilo Walker, 1839: 63-64. Lectotype Female, (designated by Hansson, 1985a),

England (BMNH). Synonymy with *C. pallipes* by Graham, 1993. Entedon alphenus Walker, 1839: 64. Lectotype Female, (designated by Hansson, 1985), England (BMNH). Synonymy with *C. chilo* by Boucek & Askew, 1968 and with *C. pallipes* by Graham, 1993. *Entedon parmys* Walker, 1839: 71. Lectotype Female, (designated by Hansson 1985a), England, (BMNH). Synonymy with *C. chilo* by Boucek & Askew, 1968, and with *C. pallipes* by Graham, 1993. Derostenus petiolatus Thompson, 1878: 264. Lectotype Female, (designated by Hansson, 1985a), Sweden (LUZN). Synonymy with *C. pallipes* by Graham, 1993.

Chrysocharis pallipes (Nees): Graham, 1993: 221-230.

Diagnosis: Female. Length 1.6 -2.4 mm. Frons metallic bluish-green, golden green or golden red; vertex golden green; mesoscutum and scutellum golden green or metallic greenish blue or bluish violet; fore and mid coxae varying from completely pale to completely brown; hind coxa dark and metallic; remaining parts of legs white or pale yellow. Frons with somewhat "T" shaped frontal fork. Antennal formula 11341; scape 7x as long as wide (37:7); pedicel shorter than F1 (13:17); first anellus 4x as wide as long (4:1); second anellus L:W = 0.75:5; third anellus L:W = 4:5; F1 = 17:8; F2 = 17:8; F3 = 18:8; F4 = 15:7; clava L:W = 18:6. Pronotum with cross carina absent; propodeum smooth and shiny, with a complete or incomplete median carina; petiole longer than propodeum; gaster oval shaped; mean ratio length of mesosoma/gaster 1.15+/0.099 (n.11) (Hansson, 1985a).

Male: Length 1.5–2.3mm. For differences with female see Hansson (1985a).

Material examined: 10 Females, 5 males, INDIA, Karnataka, Puttur, xi. 2011. Collector Unknown.

Host: Diptera (Agromyzidae, Drosophilidae, Ephydridae, Scatophagidae); Lepidoptera (Gracillaridae, Nepticulidae) (Noyes, 2012).

Distribution: Palearctic (Europe); Oriental: India (new record), Nepal, People's Republic of China, Taiwan, Nearctic (USA).

Remarks: This species comes very near *Chrysocharis pubens* Delucchi and *Chrysocharis pilosa* Delucchi in having : 1) petiole longer than propodeum, 2) pronotal collar without cross carina; 3) CC with a complete row of setae on underside; and 4) female antennal formula = 11341. However *C. pallipes* differs from these two species in having : 1) clava at least 1.1x (mostly longer) as long as F1 (clava almost 2x as long as F1 in the two species) and 2) female eye about 4.5x as high as malar space (in the latter 2 species female eye 6.5x as high as malar space)

17. ***Chrysocharis pentheus*** (Walker)
(Figs. 26-28)

Entedon penthius Walker, 1839: 38. Lectotype male (designated by Graham, 1963),England (BMNH)

Entedon ergetelis Walker, 1848: 230. Lectotype Female (designated by Graham, 1963) England (BMNH). Synonymy with C.penthius by Graham, 1963).

Epilampsis mirabilis Sundby, 1957:40. Lectotype Female (designated by Graham, 1963), England (BMNH). Synonymy with *C. pentheus* by Graham,1963.

Chrysocharis aquilegiae Erdos, 1961: 479. Holotype Female, Hungary (HNHM). Synonymy with C. pentheus by Hansson, 1985a.

Chrysocharis pentheus (Walker): Graham, 1963: 223.

Redescription: Plesiotype: Female: Length 1.5mm. Dark Metallic green. Antennal flagellum and pedicel dark brown; scape pale white; coxae concolorous with mesosoma except pale apex; remaining segments pale white; wings hyaline, veins pale brown; pubescence pale yellow.

Head: Width in anterior view slightly wider than long (30:28); width in dorsal view 2.1x its length; Height of eye: malar space: mouth opening = 21:4:11; POL 2x OOL; AOL longer than OOL (4:3); frontal fork "Y" shaped; area below and above frontal fork and on vertex with raised reticulation; occiput not margined; antennal formula 1132; antennae inserted at level of ventral margin of eyes; relative L:W of antennal segments: scape = 45:9; pedicel = 18:11; F1 = 13:10; F2 = 15:10; F3 =13:11; clava 29:10.

Mesosoma: Pronotum with cross carina absent; mesoscutum a little shorter than scutellum (9:10), mesosoma 1.9x as broad as long (17:9) with raised reticulation; scutellum as long as wide, with a pair of setae, with raised reticulation; dorsellum with longitudinal carinulae (Fig. 26); propodeum with an anchor shaped structure on anteromedian part; area posterior to the anchor shaped structure with several longitudinal carinulae and longitudinal reticulation (Fig. 26), each callus with 2 setae. Forewing 2.1x as long as wide; CC with 3 or 4 setae in a row from base to near middle beneath; relative length MV = 37; PMV = 12; STV = 5; speculum closed behind by cubital line of setae.

Metasoma: 1.2x as long as mesosoma, total length of petiole 0.76x length of propodeum; gaster 1.54x (86:56) as long as broad.

Male: See Hansson (1985a).

Variation: In the redescription provided by Hansson (1985a) the funicular segments are stated as 2x as long as wide but in the specimen we have the F1 , 1.3x, F2 1.5x, and F3 1.1x as long as wide. The colour of frons more darker.

Hosts: Parasites of Agromyzidae (Diptera) and occasionally other leaf mining Lepidoptera.

Distribution: Palearctic, Nearctic, Neotropical and Oriental regions.

Remarks: This species comes near *Chrysocharis nitetis* (Walker) in the key to species by Hansson (1985a) and Ikeda (1996) but differs from it in having: 1) raised surface of petiole 0.32 to 0.4x as long as propodeum with weak sculpture or completely smooth (in *C. nitetis* raised surface of petiole about 0.5x as long as propodeum with strong sculpture) and 2) mid and hind femora white (in *C. nitetis* mid and hind femora predominantly dark).

18. ***Chrysocharis polyzo*** (Walker)
(Fig. 24)

Entedon polyzo Walker, 1839: 40. Lectotype Female (designated by Hansson, 1985a), England (BMNH) *Entedon acerbas* Walker, 1839: 40. Lectotype Female (designted by Hansson, 1985a), England (BMNH). Synonymy with *C. polyzo* by Graham in Boucek & Askew, 1968. *Entedon enephes* Walker, 1839:67. Lectotype Female (designated by Hansson, 1985a),

England (BMNH). Synonymy with *C. polyzo* by Boucek and Askew, 1968. *Omphale plaustris* Goureau, 1851: 137. Lectotype Female? France (ORST).

Synonymy with *C. polyzo* by Boucek & Askew, 1968. *Chrysocharis plana* Delucchi, 1954a:7. Holotype Female Germany (ETHZ). Synonymy with *C. polyzo* by Boucek & Askew, 1968. *Chrysocharis depressa* Delucchi, 1954a: 8. Holotype Female, Germany (ETHZ). Synonymy with *C. polyzo* by Boucek & Askew, 1968. *Chrysocharis polyzo* (Walker): Graham, 1959: 195.

Diagnosis: (Based on Hansson, 1985a): Female Length 1.5–2.5mm. Frons above frontal fork metallic blue or bluish violet; vertex metallic bluish green or golden green; scape colour varying from entirely dark to pale; mesoscutum and scutellum metallic bluish violet green or violet; all coxae dark metallic; remaining segments pale (fore tibia sometimes darkened). Occipital margin with a strong carina along entire vertex and half way down temples; antennal formula 11332; relative L:W of antennal segments (From Fig. 45, Hansson,1985a) = Scape = 38:7; pedicel = 12:6; F1 = 20:9; F2 = 18:11; F3 = 17:11; Clava = 25:11. Anteromedian part of propodeum (Fig. 24) with a triangular fovea bordered by sharp edge, propodeum weakly or strongly reticulate; relative length of MV = 9.2; PMV = 2.6; STV = 1.0. Petiole wider than long or longer than wide; gaster shorter than mesosoma, oval-shaped.

Male: See Hansson (1985a).

Host: Diptera: Agromyzidae. Lepidoptera: Gracillariidae (Hansson, 1985a, and Noyes, 2012).

Distribution: widely distributed in Palearctic region; Oriental region (India).

Remarks: This species comes near *Chrysocharis liriomyzae* Delucchi in the key to species by Hansson, (1985a) but differs from it in having: 1) no outgrowth between toruli (in *C. liriomyzae* with an outgrowth between toruli); 2) arms of frontal fork not raised as a carina (in *C. liriomyzae* arms of frontal fork raised to form a carina); 3) raised surface of petiole with strong sculpture, shape trapezoid, quadrate or rectangular with protruding corners (in *C. liriomyzae* petiole with raised surface punctated, about as long as wide with anterior part semicircular) and 4) propodeal callus with 3-4 setae (in *C. liriomyzae* propodeal callus with 2 setae).

19. ***Chrysocharis pubicornis*** (Zetterstedt) (Fig. 25)

Entedon pubicornis Zetterstedt, 1838: 427. Male, Sweden (LUZN) *Entedon punctellus* Zetterstedt, 1838: 431. Male, Sweden (LUZN). Synonymy with *C. pubicornis* by Graham in Boucek & Askew, 1968.

Entedon amyrtaeus Walker, 1839: 58. Lectotype Female (designated by Hansson, 1985a) England (BMNH). Synonymy with *C. pubicornis* by Boucek & Askew, 1968.

Entedon cydon Walker,1839: 58. Lectotype Female (designated by Hansson,1985a) England (BMNH). Synonymy with *C. pubicornis* by Boucek & Askew, 1968.

Entedon aesopus Walker, 1839: 74. Lectotype Male (designated by Hansson,1985a) England (BMNH). Synonymy with *C. pubicornis* by Hansson, 1985a.

Entedon eropus Walker, 1839: 75. Lectotype Male (designated by Hansson,1985a) England (BMNH). Synonymy with *C. pubicornis* by Graham in Boucek & Askew, 1968.

Entedon syma Walker,1839: 98. Lectotype Female (designated by Hansson (1985a) England (BMNH). Synonymy with *C. pubicornis* by Graham,1959.

Entedon hersilia Walker, 1840: 235.Lectotype Male (designated by Hannson,1985a) England (BMNH). Synonymy with *C.pubicornis* by Graham in Boucek & Askew, 1968.

Entedon adreus Walker, 1848: 231. Lectotype Male (designated by Hansson, 1985a) England (BMNH). Synonymy with *C. pubicornis* by Hansson,1985a.

Chrysocharis femoralis Forster, 1861: 38. Female? Synonymy with *C. pubicornis* by Hansson, 1985a.

Derostenus aeneiscapus Thompson, 1878: 267. Lectotype Female (designated by Hansson, 1985a) (LUZN). Synonymy with *C. pubicornis* by Delucchi,1954.

Chrysocharis avellanae Erdös, 1961: 478. Holotype Female,Hungary (HNHM). Synonymy with *C. pubicornis* by Hansson,1985a.

Chrysocharis bipicturata Szelenyi, 1977: 456. Holotype Female, Mongolia (HNHM). Synonymy with *C. pubicornis* by Hansson,1985a.

Chrysocharis asclepiadeae Szelenyi, 1979: 177. Holotype Female,Hungary (HNHM). Synonymy with *C. pubicornis* by Hansson,1985a.

Chrysocharis tranquillus Szelenyi, 1981: 280. Holotype Female,Hungary (HNHM). Synonymy with *C. pubicornis* by Hansson,1985a.

Chrysocharis pubicornis (Zetterstedt): Graham, 1959:195.

Diagnosis: (Based on Hansson, 1985a): Female: Length 1.1–1.9mm. Frons below fork golden purple or green; frons above fork metallic bluish green or violet; vertex golden green; antenna including scape dark. Mesoscutum metallic bluish green, greenish blue or golden green; scutellum metallic purple, golden red or metallic bluish-green; propodeum concolorous with mesoscutum; all coxae dark metallic; femora predominantly dark brown and sometimes metallic; fore tibia and tarsus pale brown; mid and hind tibia and tarsi white or pale yellow; wings hyaline; veins pale brown or pale yellow. Head with ratios of eye height:malar space: mouth opening = 4.6:1.0:4.2. Occipital margin with an edge or low carina behind ocellar triangle; dorsellum tongue tike; forewing with speculum closed; relative length of MV = 7.1; PMV = 2.1; STV = 1.0. Anteromedian part of propodeum with a raised anchor or "Y" shaped structure; each callus with 3-4 setae.Petiole shorter than propodeum (16:24), wider than long. Gaster oval shaped.

Male: See Hansson (1985a).

Hosts: Diptera: Agromyzidae, Cecidomyiidae, Drosophilidae, Tephritidae; Lepidoptera: Gracillaridae, Lyonetiidae, Tischeriidae, Tortricidae.

Distribution: Oriental (India,Pakistan), Palearctic, Nearctic and Australasian Regions.

Remarks: This species comes near *Chrysocharis crassiscapus* (Thompson) in the key of Hansson (1985a) but differs from it in having :1) femora predominantly dark (in *C.crassiscapus* femora white); 2) dorsellum without foveae (in *C.crassiscapus* dorsellum with 2 foveae); 3) raised surface of petiole only a narrow strip (in *C.crassiscapus* petiole rectangular with strong sculpture and 4) anchor or "Y" shaped structure of propodeum smaller and weaker (in *C.crassiscapus* anchor or "Y" shaped structure of propodeum larger and stronger).

20.***Chrysocharis zizyphi*** Hansson
(Fig. 29)

Chrysocharis zizyphi Hansson, 1985b: 221. Holotype Female, Pakistan (BMNH).

Diagnosis (Based on Hansson, 1985b): Female: Length 1.4–1.5mm. Face and clypeus yellowish green or purple; frons below fork yellowish green, yellowish purple or purple; frons above fork bluish violet; vertex greenish blue; antenna dark except pale scape; mesoscutum , scutellum and propodeum bluish green or yellowish green; all coxae dark and metallic and remaining parts of legs pale; wings hyaline. All funicular segments about 1.4x as long as wide; frontal fork "Y"shaped; propodeum with an inverted "V" or "Y" shaped raised fold anteromedially; relative length of MV = 8; PMV = 1; STV = 2.2. Petiole half as long as medium length of propodeum. Gaster oval.

Male: See Hansson (1985b).

Hosts: Coleopteran leaf miner on *Zizyphus* sp. (Hansson,1985b).

Distribution: Pakistan (Malir, Peshawar).

Remarks: Among Indian species of *Chrysocharis*, this species comes near *Chrysocharis nitida* Hansson in the key given in this paper but differs from *C. nitida* in having: 1) lower margin of clypeus without a tooth (in *C.nitida* lower margin of clypeus with a pointed tooth); 2) frontal fork with "Y" shaped structure (in *C. nitida* frontal fork "T" shaped); and 3) propodeum with inverted "V" or "Y" shaped structure (in *C. nitida* frontal fork with raised anchor shaped structure. According to Hansson (1985b) ,among Palearctic species *C. zizyphi* comes near *C. pentheus* but differs from it by small dorsellum and the nature of sculptures in the anterior part of propodeum.

SUMMARY

The species of *Chrysocharis* Foerster of the Indian subcontinent are taxonomically reviewed. Diagnosis of 13 known species is given and two little known species are redescribed. Five new species are described. These are: *Chrysocharis cutisi* Narendran & Sureshan, sp. nov., *C. differentis* Narendran & Sureshan, sp. nov., *C. harithi* Narendran & Razak, sp. nov., *C. neosunrosi* Narendran & Razak, sp. nov. and *C. neoviridis* Narendran & Razak, sp. nov. A key to species of *Chrysocharis* of the Indian subcontinent and the available data on their hosts and distribution are provided.

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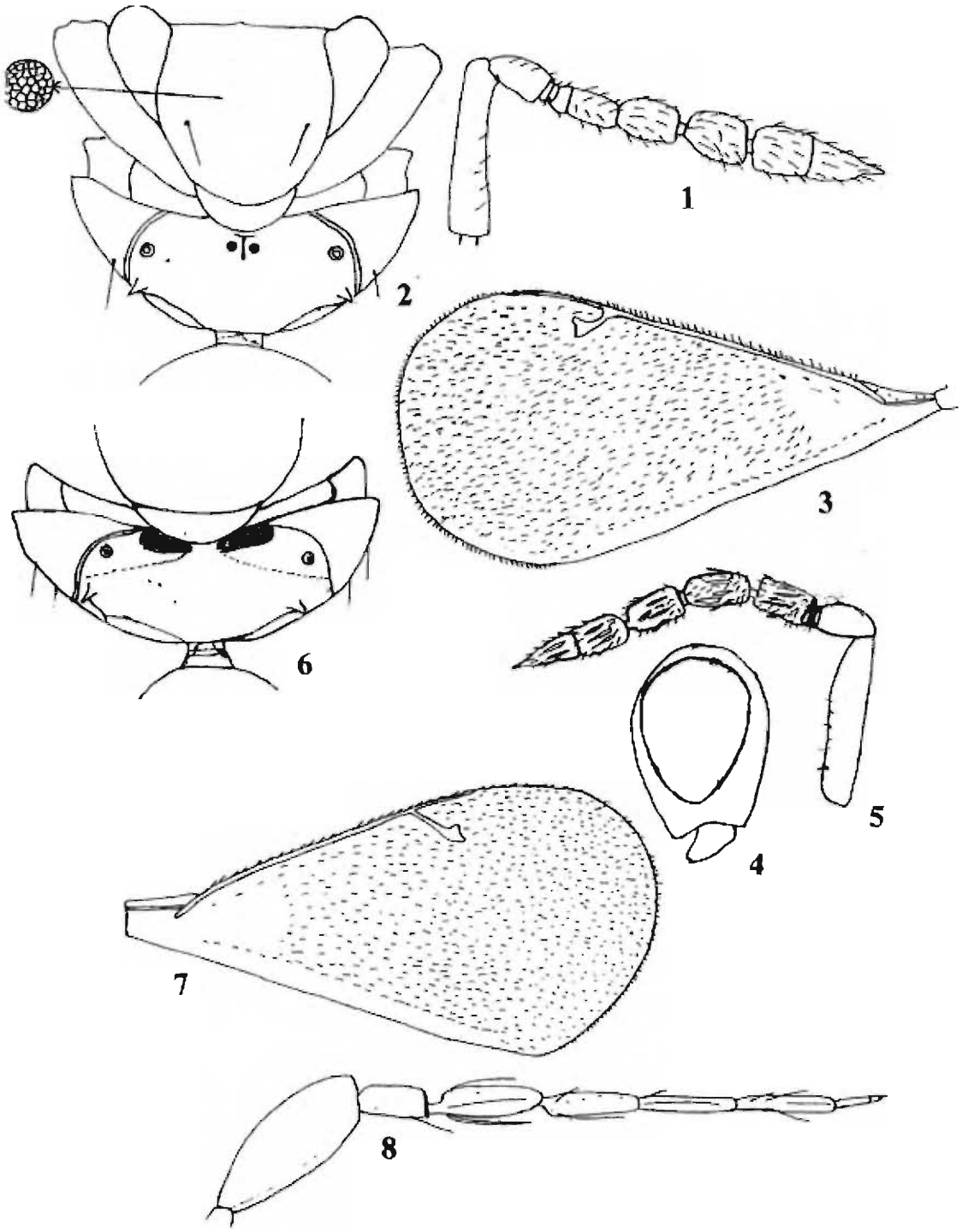


Figs. 1-3: *Chrysocharis cuticisi* Narendran & Sureshan, sp.nov., female:
1. Antenna; 2. Scutellum and propodeum; 3. Forewing

Figs. 4-7 : *Chrysocharis differentis* Narendran & Sureshan, sp.nov., female:
4. Head profile; 5. Antenna; 6. Propodeum and petiole; 7. Forewing.

Fig. 8 : *Chrysocharis echinata* Mani, female, antenna (Modified from Mani, 1989)

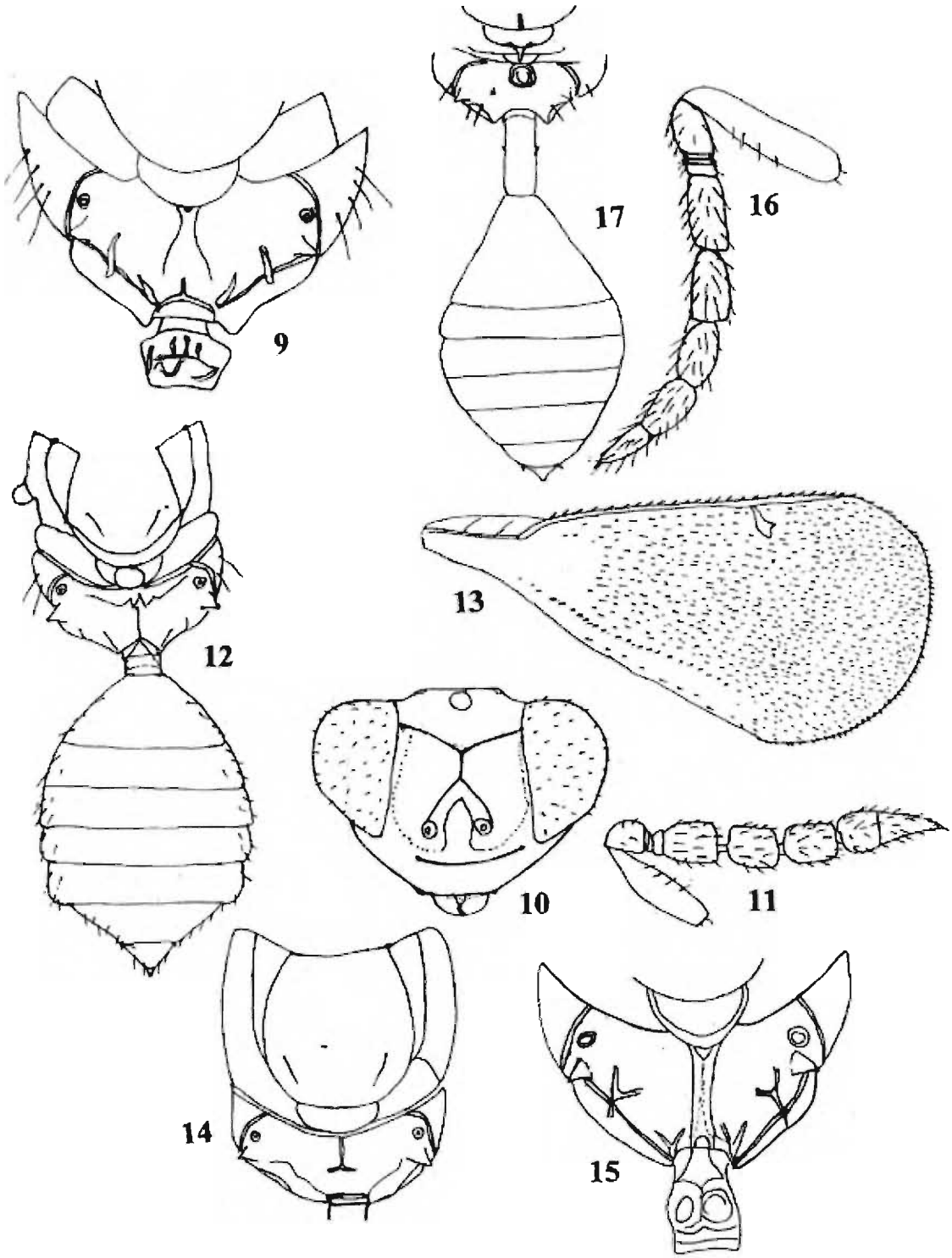


Fig. 9 : *Chrysocharis euterpe* Hansson, female, propodeum and petiole (modified from Hansson 1985b)
Figs. : 10- 13. *Chrysocharis harithi* Narendran & Razak,sp.nov., female:
10. Head anterior view; 11. Antenna; 12. Part of mesosoma and metasoma dorsal view; 13. Forewing.
Fig. 14 : *Chrysocharis imphalensis* Chisti & Shafee, female, scutellum and propodeum
Fig.1 5 : *Chrysocharis lankensis* Hansson, female [?], propodeum (Modified from Hansson,195b)
Figs. 16-17 : *Chrysocharis neosunosei* Narendran & Razak, sp.nov., female:
16. Antenna; 17. Propodeum and metasoma;

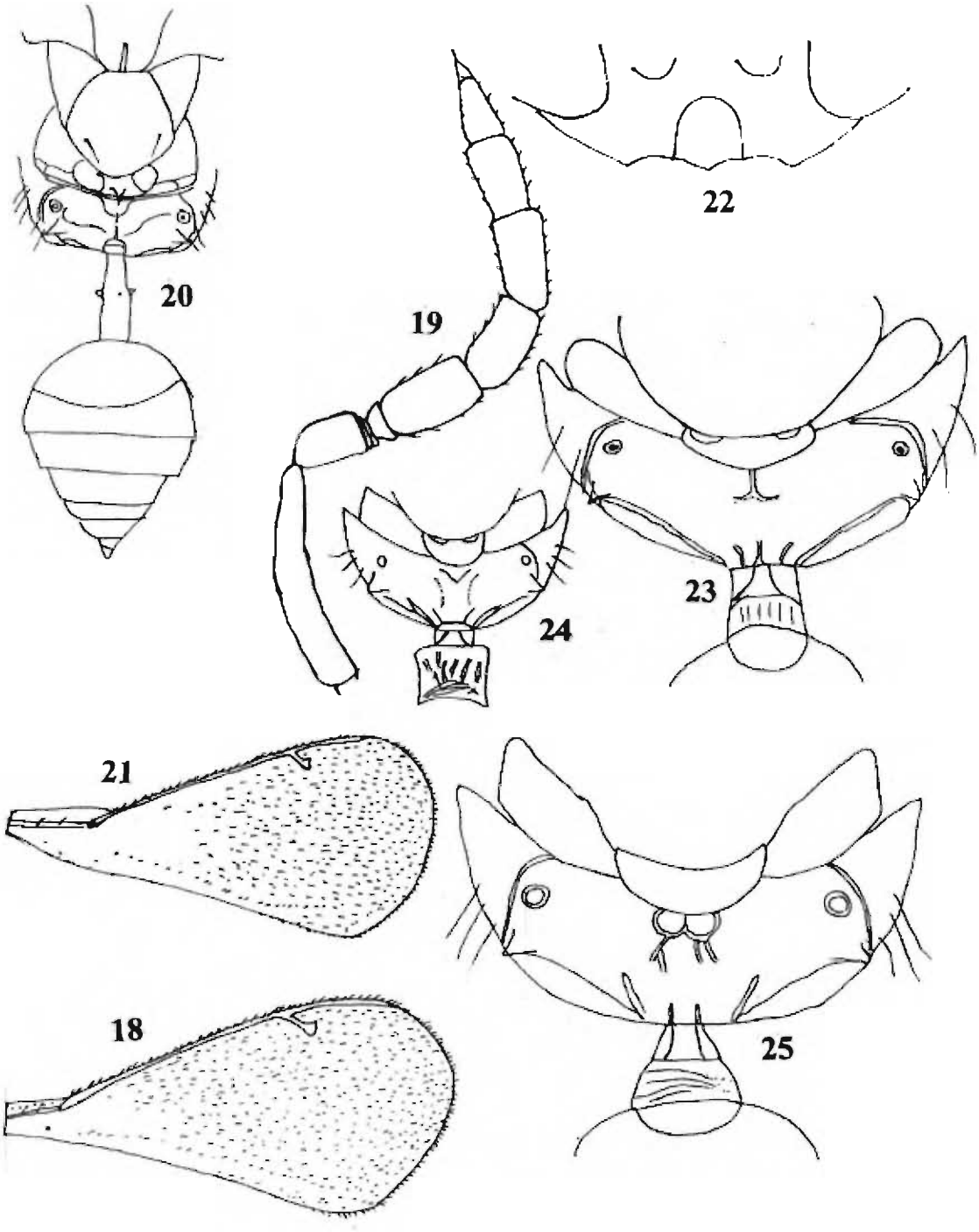
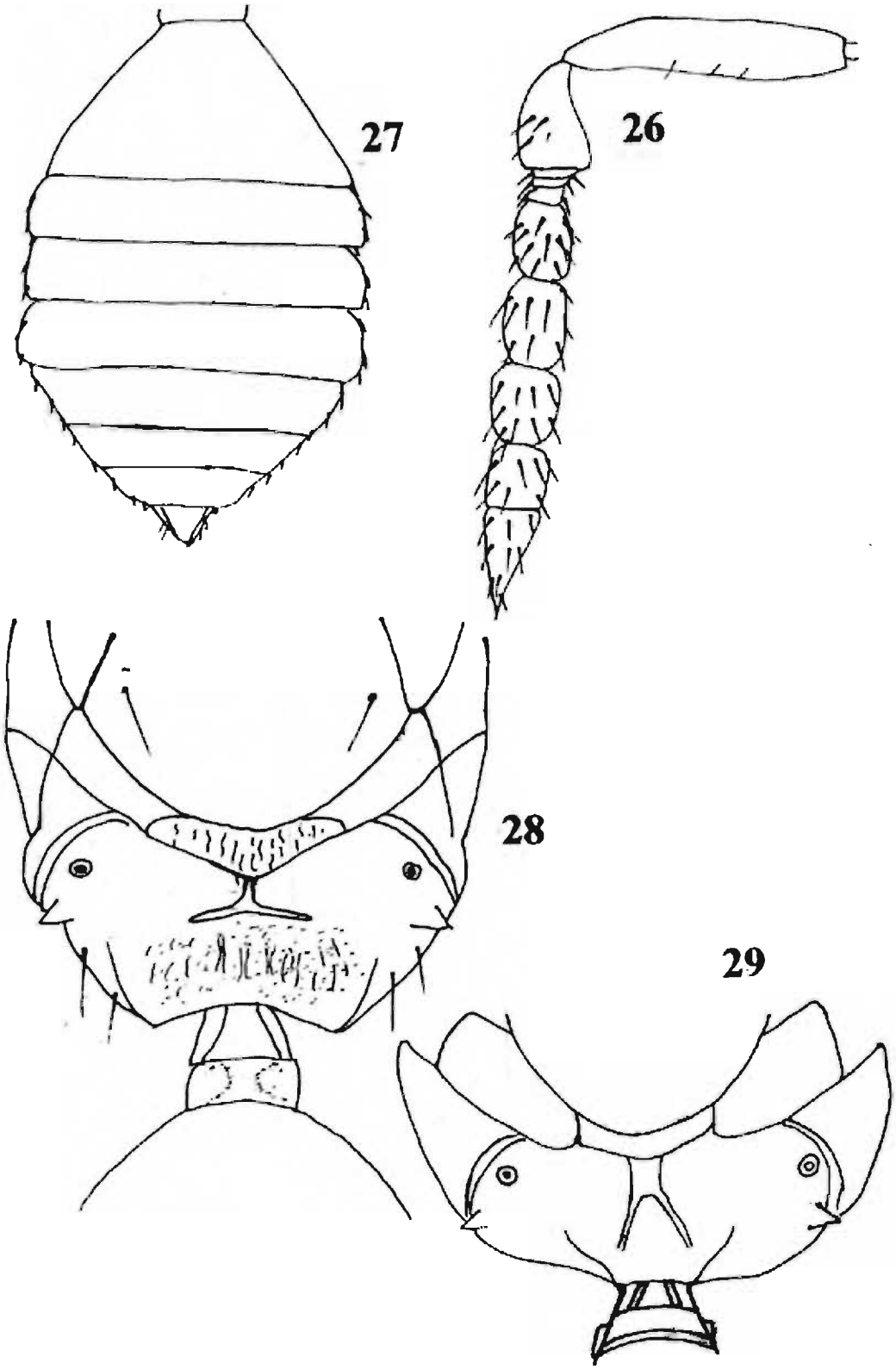


Fig. 18 : Forewing
Fig. 19-21 : *Chrysocharis neoviridis* Narendran & Razak, sp.nov., female :
19. Antenna; 20. Scutellum, propodeum and metasoma; 21. Forewing.
Figs. 22-23 : *Chrysocharis nitida* Hansson, female: 22. Lower face; 23. Propodeum and petiole.
Fig. 24:*Chrysocharis polyzo(*Walker), female, propodeum and petiole.
Fig. 25: *Chrysocharis pubicornis* (Zett.), female, propodeum and petiole



Figs. 26-28 : *Chrysocharis pentheus* (Walker), female: 26. Antenna; 27. Metasoma;
Fig. 28 : Propodeum and petiole.
Fig. 29 : *Chrysocharis zizyphi* Hansson, female, propodeum and petiole.

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A NEW SPECIES OF *PODAGRION* SPINOLA (HYMENOPTERA: TORYMIDAE) FROM INDIA WITH A CHECKLIST OF SPECIES OF INDIA AND ADJACENT COUNTRIES

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INTRODUCTION

The genus *Podagrion* was erected by Spinola (1811) from Caucasia based on the type species *Podagrion splendens* Spinola. Later several authors like Walker (1833), Westwood (1847), Costa (1856), Holmgren (1869), Saussure (1890), Schulz (1906), Girault (1913) and Gahan and Fagan (1923) redescribed or treated it under various junior synonyms. In the recent past Narendran (1994) revised the Indian species of *Podagrion* and gave a key to species in his revision of Torymidae and Eurytomidae of Indian subcontinent. Grissell (1995) treated *Podagrion* in his world revision of Toryminae. The genus *Podagrion*is distributed all over the world, comprising 101 species; of which 37 species present in Oriental region and 25 species (including the new species described hereunder) in the Indian subcontinent. The genus is reported so far only from oothecae of praying mantids (Mantodea).

Abbreviations used: AOL = Distance between front ocellus and hind ocellus; CC = Costal cell; EH = Eye height; EL = Eye Length; F1 to F7 = Funicular segments 1 to 7; L = Length; MV= Marginal vein; MS = Malar space; OOL = Ocellocular distance; OPS = Ovipositor sheath; PMV= Postmarginal vein; POL= Post ocellarlength; PSGA = Parastigma; SLG = Sublateral groove(s) of scutellum; SMV = Submarginal vein; STV = Stigmal vein.

The Holotype of the new species described here is deposited in the National collection of Zoological Survey of India, Kolkata (NZC, ZSI).

Keywords: Hymenoptera, Torymidae, *Podagrion*, New species, Checklist, India & adjacent countries.

Podagrion moradabadense sp. nov.
(Figs. 1-5)

Female (Holotype): Length: 2.6 mm (excluding ovipositor sheath). Body metallic green except the following: eyes dark gray; ocelli pale reflecting yellow; scape pale brownish yellow; pedicel and funicle pale yellowish brown; clava black, refringence brighter on frons; apices of coxae, bases and apices of femora yellow; fore and mid tibiae and fore and mid tarsi yellow; fore and mid femora infuscated at middle; hind femora dark metallic green medially; hind tibia pale yellowish brown with middle part darker; fourth hind tarsal segment and all pretarsi brown; tegulae pale brown; gaster metallic green with basoventral part brownish yellow; ventral side of last tergite and hypopygium pale brown; ovipositor sheath black.

Head: Width in anterior view 1.17x its height (27:23); width in dorsal view 1.6x its length (27:17); POL 3x OOL (6:2); AOL equal to OOL; minimum width between eyes on vertex 2.5x POL (15:6); vertex and frons with distinct raised reticulation. EH 1.7x EL (10:6); MS 0.4xEH (4:10);

occipital carina reaching down temple margin. Antenna inserted a little above lower ocular line (distance between toruli and lower ocular line 0.33x EH) ; antennal formula 11173; scape almost reaching anterior ocellus, not reaching level of vertex; relative L:W of antennal segments: scape = 9:2; pedicel = 4:2; F1 = 3:2; F2 = 4:3; F3 = 3:3; F4 = 3:3; F5 = 2.75:3; F6 = 2:4; F7 = 2:4; clava = 13:5.

Mesosoma: Pronotum 2.8x as broad as long (14:5); mesoscutum longer than pronotum (8:5), 1.88x as wide as its length (15:8); scutellum as long as mesoscutum, a little wider than long (9:8); pronotum, mesoscutum and scutellum with raised reticulations; propodeum shorter than scutellum (6:8) with an inverted "V"shaped carina (with no basal median carina or stalk); area inside arms of carina irregularly carinate and reticulate, outside carina with distinct raised reticulations; spiracle oval, separated from posterior margin of metanotum by a distance equal to its length; prepectus slightly bulged upwards.

Forewing 2.7x as long as broad; CC with several minute setae on ventral side; relative length of SMV = 28; PSGA = 6; MV =22; PMV = 4; STV = 2.

Hind coxa shorter than hind femur (10:14); hind femur 2x as long as wide; ventral margin with 7 teeth, second, fourth and fifth smaller than remaining teeth, seventh largest.

Metasoma: Excluding ovipositor sheath, a little longer than mesosoma (13:12); ovipositor sheath longer than head, mesosoma and metasoma combined (38:29), 2.92x as long as metasoma; hypopygium almost reaching near apex of gaster; tergites smooth and shiny.

Male: Unknown.

Host: Unknown.

Etymology: Named after collection locality Moradabad.

Material examined: Holotype Female, INDIA, Uttar Pradesh, Moradabad, 26.iii.2007. S. Sheela (NZC, ZSI).

Remarks: This new species comes near *Podagrion mantisiphagum* (Mani, 1936) in the key to species by Narendran (1994). However it differs from *P. mantisiphagum* in having: 1) Clava longer (13:10) than combined length of 4 preceding segments (in *P. mantisiphagum* clava as long as combined length of four preceding segments); 2) propodeum with an inverted "V" shaped carina (in *P. mantisiphagum* propodeum with an inverted "Y" shaped carina); 3) MV 5.5x as long as PMV (in *P. mantisiphagum* MV 3.7x as long as PMV); 4) ventral teeth of hind femur with first, third, sixth and seventh larger than others (in *P. mantisiphagum* ventral teeth of hind femur with first, third, fourth, and seventh larger than others); 5) ovipositor sheath 1.3x as long as length of body (in *P. mantisiphagum* ovipositor sheath 2.7x length of body) ; 6) hind femurdark metallic green with extreme base and extreme apex pale (in *P. mantisiphagum* hind femur pale yellowish brown with slight metallic green refringence); and 7) funicular segments3 to 7 quadrate (in *P. mantisiphagum* funicular segments longer than wide).

CHARACTER STATES

A. Colour of Head & Mesosoma: 1) Dark metallic 2) Bright metallic 3) Without metallic refringence.

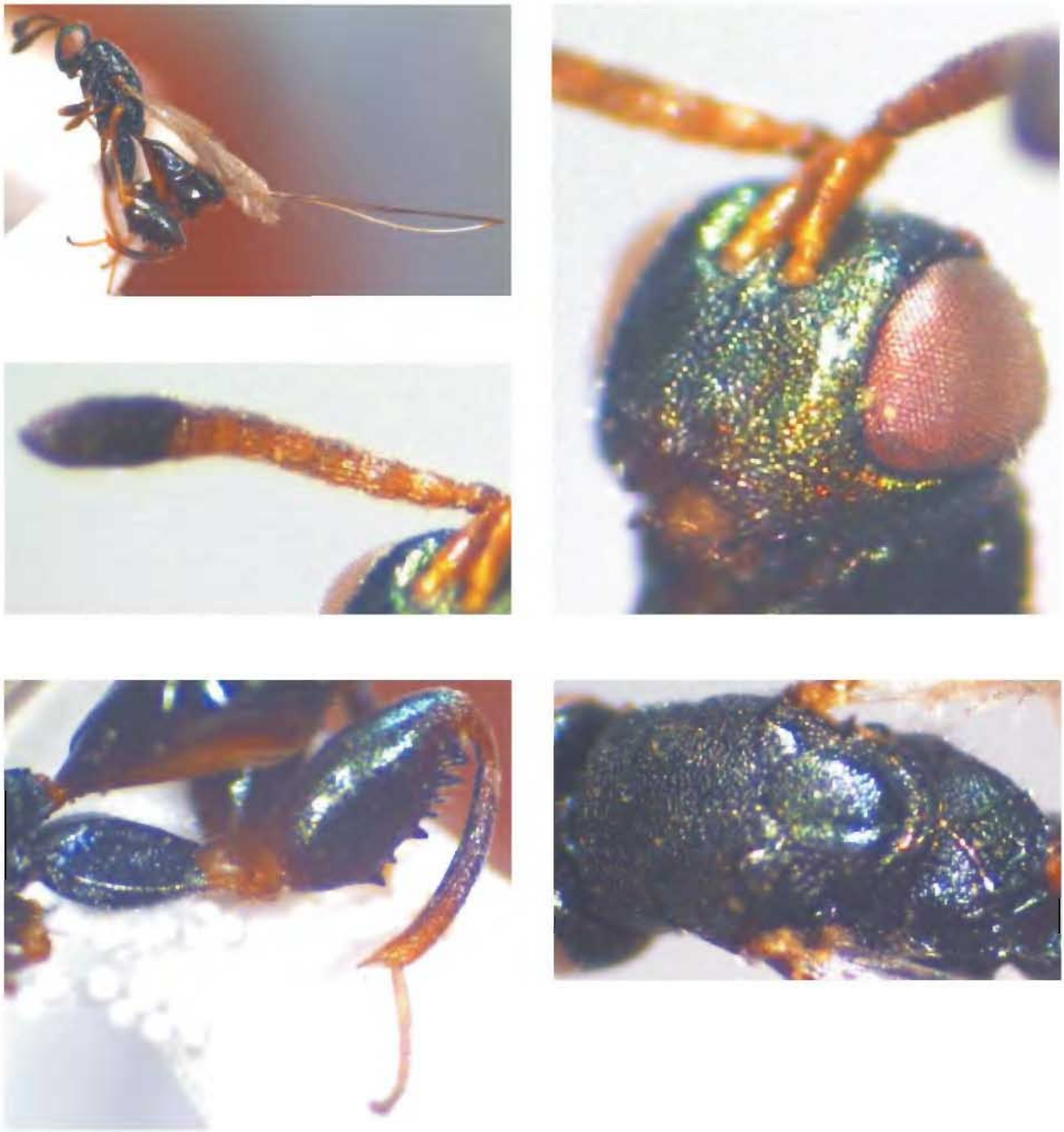
B. Colour of Gaster: 1) With strong metallic refringence 2) weak metallic refringence ; 3) No metallic refringence

C. Colour of Hind Coxa: 1) Concolorous with mesosoma; 2) Dark or black but not concolorous with mesosoma; 3) Brown or yellow or red or yellowish brown or brownish yellow.

D. Colour of Hind Femur:1) Black or dark brown with metallic refringence;2) Dark without metallic refringence; 3) yellow or brown or yellowish brown.

E. Length of Clava: 1)As long as or subequal to or shorter than 3 preceding segments combined; 2) Longer than 3 preceding segments combined but not longer than 4 preceding segments combined; 3)Longer than 4-7 funicle segments combined.

F. Length of MV: 1) 3x or shorter than 3x length of PMV; 2) Longer than 3x but not reaching 4x



Figs. : 1-4. *Podagrion moradabadense* Narendran & Sheela sp. nov.
Female: 1. Body profile, **2.** Head anterior view; **3.** Antenna; **4.** Scutellum and propodeum; **5.** Hind leg.

as long as PMV; 3) As long as 4x or longer than 4x PMV.

G. Number of teeth on ventral margin of hind femur: 1)10; 2)9; 3)8; 4)7; 5) 6. 6) 5.

H. Length of Ovipositor sheath: 1) Shorter than body; 2) Longer than body; 3) As long as body.

I. Median carina of Propodeum: 1) Inverted "Y" shaped; 2) Inverted "V" shaped.

J. Length of Pedicel: 1)Shorter than F1; 2) Equal to F1; 3) Longer than F1

Note: [0 = unknown]

Character state matrix

CHECKLIST OF *PODAGRION* SPECIES OF INDIA AND ADJACENT COUNTRIES

(Valid names are in roman letters.
Invalid names are in italics)

ahlonei Mani and Kaul, 1972.....Myanmar (Burma)

Character state matrix

Species	A	B	C	D	E	F	G	H	I	J
P. ahlonei	3	3	2	2	4	3	1	3	1	2
P. aligharhensis	1	1	1	1	4	3	3	1	1	1
P. calopeplum	2	1	1	2	1	1	3	3	1	1
P. charybdis	2	0	2	3	3	0	0	2	2	2
P. chatterjeei	2	2	2	3	2	1	4	2	2	1
P. chichawatnensis	1	3	1	3	2	2	6	0	1	1
P. dalbergium	1	2	1	1	2	1	4	2	2	3
P. dineni	2	1	1	1	3	3	5	2	1	2
P. epibulum	2	3	1	3	2	1	4	2	1	3
P. fulvipes	1	3	1	3	2	2	2	2	1	2
P. hayati	2	1	3	3	1	1	2	3	1	3
P. indiensis	1	3	3	3	1	1	3	1	1	2
P. judas	2	1	2	2	3	0	5	2	2	2
P. keralensis	1	2	1	1	3	3	3	2	1	1
P. malabarensis	1	1	1	3	2	3	5	1	1	1
P. manii	2	1	1	1	3	2	5	1	1	1
P. mantisiphagum	1	0	1	1	2	2	4	2	1	1
P. micans	1	2	3	3	0	0	0	2	0	0
P. moradabadense	2	1	1	1	3	3	4	2	2	2
P. noyesi	1	1	1	1	3	1	5	2	2	2
P. opisthocanthum	1	1	1	1	3	3	5	2	1	3
P. pachymerum	1	1	1	2	0	0	4-5	1	0	0
P. prionomerum	1	2	1	1	3	2	2	1	2	2
P. repens	1	1	1	1	3	3	3	3	1	3
P. scylla	1	3	2	2	2	0	5	2	2	3

Note: This character matrix is indented only to compare the different features of Podagrion species existing in the region at a glance. It is not indented for cladistics analysis in this paper

aligharensis Narendran, 1994…..India (Uttar Pradesh)
calopeplum Mani and Kaul, 1972..India (Uttar Pradesh)
charybdis Fernando, 1957.....Sri Lanka (Gammaduwa)
chatterjeei Mani and Kaul, 1972..India (Uttar Pradesh)
chichawatnensis Mani and Kaul, 1972....India (Punjab)
dalbergium Mani and Kaul, 1972.....India (Punjab)
dineni Narendran, 1994…..……..India (Kerala)
epibulum Masi, 1926…..……...Taiwan (Masi,1926), Sri Lanka (Narendran,1994)
fulvipes (Holmgren) 1869…..……People's Republic of China (Holmgren, 1869) India (Kerala,Tamil Nadu & Assam.. (Narendran, 1994)
hayati Narendran, 1994……..….India (Uttar Pradesh)
indicum Girault……..……in Ramakrishna Ayyar, 1919 *Nomennudum* (Grissell. 1994)
indiensis Narendran, 1994…...……India (Kerala)
judas Fernando, 1957…..….....Sri Lanka
keralensis Narendran, 1994.....India (Kerala)
malabarensis Narendran, 1994…..……India (Kerala)
manii Narendran, 1994…....……...India (Kerala)
mantisiphagum (Mani)1936…....……India (Kolkatta Mani, 1936; Orissa, Delhi, Narendran : 1994)
micans Strand, 1911.....….Sri Lanka
moradabadensis Narendran & Sheelasp. nov.....India (Uttar Pradesh)
noyesi Narendran, 1994 ……..……India (Kerala)
opisthacanthum Masi,1926……...Taiwan (Masi, 1926), India (Tamil Nadu, Mani & Kaul, 1972; Kerala, Narendran: 1994).
pachymerumpachymerum (Walker), 1833..... France (Walker:1833; Caucasus and Western Europe: Nikolskaya and Zerova, 1978; Tamil Nadu: Mani, 1938)
prionomerum Masi, 1926.....…Taiwan (Masi, 1926) India (Kerala, Karnataka: Narendran, 1994)
repens (Motschulsky) 1859 .....….Sri Lanka
ylla Fernando, 1957…….....Sri Lanka (Ratnapura)

SUMMARY

A new species of *Podagrion* is described with an up to date checklist of species of India and adjacent countries.

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VERTEBRATE FAUNA OF SAGAR ISLAND OF SUNDERBAN, WEST BENGAL

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INTRODUCTION

Sunderban is one of the largest mangrove and a wetland ecosystem with reverien areas, comprises number of rivers, rivulets and creeks. It starts from river hughly in the west to river Meghna in the east. It lies between 87°51'- 92° 30' east longitudes and 21° 31'-22° 30' north latitudes. Out of the total forest area only 4264 sq/km are persist within the Indian limit and the rest is in Bangladesh. It harbors variety of fauna and flora in its unique habitat. It is a feeding and breeding site for estuarine crocodile, water monitor and a landing site for olive ridley turtle.

The comprehensive surveys on vertebrate fauna in Sunderban had not been conducted until Mandal and Nandi (1989) reported whole fauna of Sunderbans and Chowdhury and Vyas (2005) listed 41 species of Reptiles in Sunderbans in their study. The present study is an outcome of one survey conducted to Sagar Island area of Sunderban for ten days and encountered five species of fishes, three species of amphibia, six species of reptiles, 25 species of birds and 2 species of mammals. The objectives of the present study are (i) To document vertebrate fauna in Sagar Island of Sunderbans and (ii) To provide a consolidated report on vertebrate fauna in Sagar Island.

STUDY AREA

The study was carried out at different habitats in and around Sagar Island including fresh water ponds, forest, river, paddy field and human inhabited area.

Conditions of present topography of the area

(i) *Physical features*: In Sunderban tides have influence on water quality and water movement caused by surface and bottom currents. The circulation of water is of very importance in maintaining the population of sessile or benthic organism. Salinity is an important factor in influencing the distribution and biology of the living organisms. The depth and width of the estuary is varied with season and place depends upon influence of fresh water and distance from the sea. Turbidity is high during monsoon and low during winter.

(ii) *Climate*: The seasons can be classified mainly into three types namely monsoon during which the rain fall is heavy and it starts from July and ends up to October with occasional rain throughout the year. Post-monsoon is characterized by cold weather and starts from November and ends around February. Pre-monsoon is predominated by dry weather with thunder storm, it starts from March and ends in June.

(iii) *Humidity*: In Sunderban humidity is as high as 80% on average due to the proximity of the Bay of Bengal.

(iv) *Temperature*: Mean annual maximum and minimum recorded at the latter was 34 degrees Celsius (°C) and 20°C, respectively.

METHODOLOGY

The survey was made randomly, selected habitat sites were surveyed by foot and visually searched the prospective habitats. The fauna was searched at deeply shaded forest, inside the soil, fresh water ponds, paddy field, tree trunks, tree holes and bushes. Different species of vertebrate were identified based on the morphological features using field guide and reference books (Grimmett *et al.*, 1999; Kazmierczak and Perlo, 2000; Whitaker and Captain, 2004). The habit and habitat was recorded based on the field observations.

SYSTEMATIC LIST OF THE SPECIES

Phylum CHORDATA
Sub Phylum VERTEBRATA
Class PISCES
Order CYPRINIFORMES
Family CYPRINIDAE

1. *Cirrhinus mrigala* (Hamilton, 1822)
2. *Labeo bata* (Hamilton, 1822)
3. *Crossocheilus latius* (Hamilton, 1822)
4. *Labeo rohita* (Hamilton, 1822)

Order PERCIFORMES
Family OSPHRONEMIDAE

5. *Trichogaster chuna* (Hamilton, 1822)

Class AMPHIBIA
Order ANURA
Family DICROGLOSSIDAE
Subfamily DICROGLOSSINAE
Genus ***Euphlyctis***

6. *Euphlyctis cyanophlyyctis* (Schneider, 1799)

Genus ***Fejervarya***

7. *Fejervarya limnocharius* (Gravenhorst, 1829)

Genus ***Hoplpbatrachus***

8. *Hoplobatrachus tigerinus* (Daudin, 1803)

Class REPTILIA
Order SQUAMATA
Family GEKKONIDAE
Genus ***Hemidactylus***

9. *Hemidactylus brooki (Gray, 1845)*

Family AGAMIDAE
Genus ***Calotes***

10. *Calotes versicolor (Daudin, 1802)*

Family CHAEMAELEONIDAE
Genus ***Chaemaeleon***

11. *Chaemaeleon zeylanicus (Linnaeus, 1768)*

Family SCINCIDAE
Genus ***Mabuya***

12. *Mabuya carinata (Schneider, 1801)*

Family VARANIDAE
Genus ***Varanus***

13. *Varanus salvator (Daudin, 1820)*

Family COLUBRIDAE
Genus ***Amphiesma***

14. *Amphiesma stolatum (Linnaeus, 1758)*

Genus ***Xenochrophis***

15. *Xenochrophis piscator (Schneider, 1799)*

Class AVES
Order CICONIFORMES
Family ARDEIDAE

16. *Egretta garzetta (Linnaeus, 1766)*
17. *Anastonus oscitans (Boddaert, 1783)*

Order ANSERIFORMES
Family ANATIDAE

18. *Tadorna ferruginea (Pallas, 1764)*
19. *Aythya marila (Linnaeus, 1761)*

Order Falconiformes
Family Falconidae

20. *Falco peregrines (Tunstall, 1771)*

Family ACCIPITRIDAE

21. *Gyps bengalensis* (Gmelin, 1788)
22. *Ichthyophaga ichthyaetus* (Horsfield, 1821)

Order CHARADRIFORMES
Family LARIDAE

23. *Larus ridibundus (Linnaeus, 1766)*
24. *Larus argentatus* (Pontoppidan, 1763)

Order COLUMBIFORMES
Family COLUMBIDAE

25. *Streptopelia decaocta* (Frivaldszky, 1838)
26. *Streptopelia chinensis.*

Order CUCULIFORMES
Family CUCULIDAE

27. *Clamator jacobinus* (Boddaert, 1783)

Order CORACIIFORMES
Family ALCEDINIDAE

28. *Halycon smyrnensis (Linnaeus, 1758)*

Family HALCYONIDAE

29. *Todiaramphus chloris (*Boddaert, 1783)

Order PICIFORMES
Family PICIDAE

30. *Dinopium bengalensis* (Linnaeus, 1758)

31 .*Chrysocolaptes lucidus* (Scopoli, 1786)

Order PASSERIFORMES
Family PASSERIDAE

32. *Passer domesticus* (Linnaeus, 1758)

Family ESTRILDIDAE

33. *Lonchura striata* (Linnaeus, 1766)

Family PYCNONOTIDAE

34. *Pycnonotus cafér* (Linnaeus, 1766)

Common Name: Red Vented Bulbul
Family STURNIDAE

35. *Sturnus malabarica* (Gmelin, 1789)

Family SYLVIIDAE

36. *Acrocephalus Agricola* (Jerdon, 1845)

Family CORVIDAE

37. *Corvus macrorhynchos* (Wagler, 1827)

38. *Acridotheres fuscus (*Wagler, 1827)

39. *Acridotheres tristis* (Linnaeus, 1766)

Class MAMMALIA
Order RODENTIA
Family MURINAE
Genus ***Bandicota***

40. *Bandicota bengalensis* (Gray, 1835)

Genus ***Mus***

41. *Mus booduga* (Gray, 1837)

SYSTEMATIC ACCOUNT

Phylum CHORDATA
Sub Phylum VERTEBRATA
Class PISCES
Order CYPRINIFORMES
Family CYPRINIDAE

1. ***Cirrhinus mrigala*** (Hamilton, 1822)

Common Name: Mrigal

Materials examined: Observed in the field.

Sighting record: Sighted at Ashram pond, Sagar Island; Date: 13th and 15th . 10.2009; time: 9:20 a.m and 12:10.p.m; No of exs. 04.

Notable character in the field: It has bilaterally symmetrical and streamlined body with cycloid scales, usually dark grey above, silvery below. Head without scales. broad mouth with single pair of short rostral barbells.

Habit and habitat: It is found in rivers and tanks.

Food and feeding habit: It is bottom feeder and feeds on decaying vegetation.

Distribution: Northern India.

Conservation status: Least Concern (LC)

2. ***Labeo bata*** (Hamilton, 1822

Common Name: Bata

Materials examined: Observed in the field.

Sighting record: Ramakrishnapur area, Sagar Island; Date:16.10.2009; time: 11:10.a.m. No. of exs. 12.

Notable character in the field : It has elongated body, dorsally bluish and ventrally silvery with orange opercle. It has bluntly pointed snout.

Habit and habitat: It is bentho-pelagic and inhabits rivers.

Food and feeding habit: It is herbivorous and feeds on plant vegetation.

Distribution: West Bengal.

Conservation status: Least Concern (LC)

3. ***Crossocheilus latius*** (Hamilton, 1822)

Common Name: Gangetic latia

Materials examined: Observed in the field.

Sighting record: Sighted at Kapil Muni Ashram pond, Sagar Island; Date:15.10.2009; time: 12:10.p.m; No. of exs. 06.

Notable character in the field: It is characterised by possessing 8 branched dorsal fin rays, immobile rostral lobes and lacking a dorsal spine.

Habit and habitat: It is found in streams, rivers and lakes.

Distribution: Ganga, Brahamputra in North India, Mahanadi river of Orissa, Arunachal Pradesh, Manipur, Mizoram, Meghalaya and Tripura.

Conservation status: Least Concern (LC)

4. *Labeo rohita* (Hamilton, 1822

Common Name: Rohu

Materials examined: Observed in the field.

Sighting record: Ramakrishnapur area, Sagar Island; Date:15.10.2009; time: 1:10.p.m; No. of exs. 08.

Notable character in the field; It is bilaterally symmetrical, bluish dorsally and silvery ventrally, moderately elongate, eyes dorso-lateral in position, dorsal fin rays three or four, lateral line distinct, complete and running along median line of the caudal peduncle.

Habit and habitat: It is found in fresh water rivers and lakes.

Food and feeding habit: It is herbivorous and feeds on phytoplankton and submerged vegetation.

Distribution; Northern and Central India.

Conservation status: Least Concern (LC)

Order PERCIFORMES
Family OSPHRONEMIDAE

5. ***Trichogaster chuna*** (Hamilton, 1822)

Common Name: Honey Gourami

Materials examined: Observed in the field.

Sighting record: Ashram pond, Sagar Island; Date:16.10.2009; time: 12:50.p.m; No. of exs. 12.

Notable character in the field; It has compressed body, slightly narrower and ventral fins are threadlike. Dorsally silvery gray to light yellow with a light brown horizontal band in mid body. The belly is bluish black and has a labyrinth organ.

Habit and habitat: It is found in pools, ditches, inundated paddy field, ponds, rivers and lakes covered with vegetation.

Food and feeding habit: It is omnivorous and feeds on white worms, blood worms, brine shrimp, etc.

Distribution: Gangetic province, Assam and Manipur.

Conservation status: Least Concern (LC)

Class AMPHIBIA
Order ANURA Fischer
Family DICROGLOSSIDAE
SubFamily DICROGLOSSINAE
Genus ***Euphlyctis***

1. ***Euphlyctis cyanophlyyctis*** (Schneider, 1799)

Common Name: Skipper Frog

Materials examined: Observed in the field.

Sighting record: Kapil Muni Ashram pond, Sagar Island; Date:13, 16 and 19.10.2009; time: 9:20 a. m, 11:10.a.m. and 1:20 p.m; No. of exs. 12.

Notable character in the field; It has darker irregular spot marks all over body and legs. The hind limbs are completely webbed and seen floating on water surface.

Habit and Habitat: It is found in ponds and skips on the water surface.

It is a variations feeling feeds on aquatic insects, beetle, grass hopper was also butterflies.

Food and feeding habit:

Distribution: It occurs throughout India.

Conservation status: Least Concern (LC)

Genus ***Fejervarya***

2. ***Fejervarya limnocharius*** (Gravenhorst, 1829)

Common Name: Paddy Field frog

Materials examined: Observed in the field.

Sighting record: Sighted at Tetultala, Sagar Island; Date:14, 16 and 19.10.2009; time: 11:10.a.m, 12:10 and 4:10 p. m; No. of exs. 06.

Notable character in the field; It has black spots and a pale stripe on its back. It is brown in color, there is a pointed snout and numerous warts on the back.

Habit and habitat: It inhabits vicinity of tanks, water streams and paddy field.

Food and Feeding Habit: It feeds on insects and worms.

Distribution: It occurs throughout India.

Conservation status: Least Concern (LC)

Genus ***Hoplobatrachus***

3. ***Hoplobatrachus tigerinus*** (Daudin, 1803)

Common Name: Indian Bull frog

Materials examined: Observed in the field.

Sighting record: Sighted at Ramakrishna Mission, Sagar Island; Date:13, 16, 17, and 18. 10.2009; time: 11.10.a.m; No. of exs. 08

Notable character in the field: It is dorsally brown with darker spots on the body and a pale stripe running along the side of the body. Ventrally yellowish in color.

Habit and habitat: It is aquatic in nature and inhabits wells, tanks and ponds throughout the year.

Food and Feeding Habit: It feeds on insects and worms.

Distribution: It is found throughout India.

Conservation status: Least Concern (LC)

Class REPTILIA
Order SQUAMATA
Family GEKKONIDAE
Genus ***Hemidactylus***

1. ***Hemidactylus brooki*** (Gray, 1845

Common Name: Spotted Indian House gecko

Materials examined: Observed in the field.

Sighting record: Sighted at Kamalapur, Sagar Island; Date:16.10.2009; time: 11.10.a.m; No. of exs. 04.

Notable character in the field: It has series of black spots on its back and brown in color

Habit and habitat: It is terrestrial, inhabits open forest, bark of tree trunks and abandoned buildings.

Food and Feeding Habit: It is insectivorous and feeds on insects and spiders.

Distribution: It is found all over India.

Conservation Status: Least Concern (LC)

Family AGAMIDAE
Genus ***Calotes***

2. *Calotes versicolor* (Daudin, 1801)

Common Name: Indian Garden lizard

Materials examined: Observed in the field.

Sighting record: Sighted at Bemankhali, Sagar Island; Date: 14, 16 and 18.10.2009; time: 11:10. a.m, 1:50 p.m and 3:20 p.m; No. of exs. 04.

Notable character in the field: It is a greyish brown lizard with swollen head and a series of spines extends from head along its body.

Habit and habitat: It is arboreal in habit and inhabits bushy, shrub and plain areas.

Food and Feeding Habit: It is insectivorous and feeds on insects, spiders and centipedes.

Distribution: It is found all over India.

Conservation Status: Least Concern (LC).

Family CHAEMAELEONIDAE
Genus ***Chamaeleo***n

3. ***Chaemaeleon zeylanicus*** (Linnaeus, 1768)

Common Name: Indian chaemaeleon

Materials examined: Observed in the field.

Sighting record: Sighted at Kamalapur, *Sagar Island; Date 15 and 20.10.2009 time: 12:35 p.m and 3.10.p.m; No. of exs. 06.*

Notable character in the field: It has a long tongue, feet that are shaped into bifid claspers, a prehensile tail, independent eye movement and the ability to change skin colour.

Habit and habitat: It is an arboreal lizard, always moving from one tree to another.

Food and Feeding Habit: It is insectivorous, feeds on insects and spiders.

Distribution: It is found all over India.

Conservation Status: Least Concern (LC)

Family SCINCIDAE
Genus ***Mabuya***

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

Common Name: Common skink

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Light House, Sagar Island; Date:17.10.2009; time: 1.10.p.m. No. of exs. 03.

Notable character in the field; It is dorsally brown with small black spots and a light dorso-

lateral band begins at supra ciliary, whereas ventrally yellowish. It has moderate snout, scaly eyelid and no postnasal. A pair of nuchals also present.

Habit and habitat: It is terrestrial, diurnal and inhabits bushy area.

Food and Feeding Habit: It is insectivorous and feeds on insects.

Distribution: Penninsular India, Assam and West Bengal.

Conservation Status: Least Concern (LC)

Family VARANIDAE
Genus ***Varanus***
5. ***Varanus salvator*** (Daudin, 1820)

Common Name: Indian Water monitor.

Materials examined: Observed in the field.

Sighting record: Sighted at Bemankhali, Sagar Island; Date:17.10.2009; time: 12; 40 p. m.; No. of exs. 01.

Notable character in the field: It has muscular body with a long, powerful and laterally compressed tail.

Habit and habitat: It is aquatic, inhabits wet, marshy and humid forest, banks of rivers, estuarine forest and also paddy field flooded with water.

Food and Feeding Habit: It is carnivorous and feeds on bird eggs and fishes.

Distribution: It is found all over India.

Conservation Status: Protected species under Schedule I, IWPA, 1972 and is at risk throughout its range.

Family COLUBRIDAE
Genus ***Amphiesma***
6. *Amphiesma stolatum* (Linnaeus, 1758)

Common Name: Striped snake

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Mela, Sagar Island; Date: 18 and 21.10.2009 time: 8:10 and 10:20.a.m.No. of exs. 03.

Notable character in the field: It is brown in color, has two yellowish stripes running all along the body and dorsally has black rectangular marks.

Habit and habitat: It is found in moist grassy area, under stones, logs, under leaves, on trees and also in gardens.

Food and Feeding Habit: It feeds on frogs, toads, lizards and also small mammals.

Distribution: It is found all over India.

Conservation Status: Least Concern (LC)

Genus ***Xenochrophis***
7. *Xenochrophis piscator* *(Schneider, 1799)*

Common Name: Checkered keelback

Materials examined: Observed in the field.

Sighting record: Sighted at Ashram Pond, Sagar Island;16 and 19.10.2009; time: 11.10.a.m.and 12:30p.m. No of exs. 02.

Notable character in the field; It is a olive brown snake has black spots along the body and rounded pupils with black lines running from eye to lips.

Habit and habitat: It is found in marshy area, pools, ditches, canals and shallow edge of rivers covered with vegetation.

Food and Feeding Habit: It feeds on small fishes and frogs.

Distribution: It is found all over India.

Conservation Status: Protected species under Appendix III of CITES.

Class AVES
Order CICONIFORMES
Family ARDEIDAE
1. ***Egretta garzetta*** (Linnaeus, 1766)

Common Name: Little Egret

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Light house, Sagar Island; Date:16 and 17.10.2009 time: 11:15.a.m and 12:35 p. m. No of exs. 03.

Notable character in the field : It is pure white with black bill and legs. It has yellow feet and filamentous ornamental feathers

Habit and habitat: It is found in flocks, more gregarious roosts communally on trees and

inhabits marshes, jheels, lakes, rivers, paddy fields and mudflats.

Food and feeding habit: It feeds on fishes, frogs, crustaceans and aquatic insects.

Distribution: It is found throughout India up to 900 m, except NW and NE.

Conservation status: Least Concern (LC)

Family CICONIDAE

2. ***Anastonus oscitans*** (Boddaert, 1783)

Common Name: Open Billed stork

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Mission, Sagar Island; Date: 16 and 17.10.2009; time: 11:10.a.m. and 4:30 p. m; No of exs. 06.

Notable character in the field : It has small stork with white plumage, greenish black wings and tail, greenish horny bill with arching mandibles.

Habit and habitat: It is found singly or in flocks, congregates at the time of nesting and inhabits jheels, marshes, shallow wetlands, paddy fields and river beds.

Food and feeding habit: It feeds on mollusca, frogs and fishes.

Distribution: Widely distributed in India.

Conservation status: Least Concern (LC)

Order ANSERIFORMES
Family ANATIDAE

3. ***Tadorna ferruginea*** (Pallas, 1764)

Common Name: Brahminy duck

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Light house, Sagar Island; Date: 15 and 19.10.2009; time: 12:40 p.m and 4:50 p.m. No of exs. 12.

Notable character in the field : It has pale buff head and neck with black feet, beak and tail. It has white wings with prominent metallic green speculum.

Habit and habitat: It is found in pairs or flocks, congregates in lakes, reservoirs and inhabits large open lakes with extensive single banks and mudflats.

Food and feeding habit: It is omnivorous and feeds on grains, aquatic plants, algae and some invertebrates.

Distribution: It is found throughout India.

Conservation status: Least Concern (LC)

4. ***Aythya marila*** *(Linnaeus, 1761)*

Common Name: Scaup Duck

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Light house, Sagar Island; Date:19 and 20.10.2009; time: 4:10p.m and 5:20 p.m; No of exs; 06.

Notable character in the field: It wholly looks black in color except abdomen looks white. It has blue bill with black tip and greyish yellow legs and feet.

Habit and habitat: It is a gregarious bird, inhabits coastal areas, fresh water lakes and rivers.

Food and feeding habit: It feeds on aquatic mollusca, invertebrates and also seed plants.

Distribution: It is found in Kashmir to Maharashtra, East India.

Conservation status: Least Concern (LC)

Order FALCONIFORMES
Family FALCONIDAE

5. Falco peregrines *(Tunstall, 1771)*

Common Name: Peregrine falcon

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Mission, Sagar Island; Date:16 and 17.10.2009 time: 3:20 p.m. and 4:10 p.m. No of exs; 06.

Notable character in the field : It has slaty black head and grey under parts barred with blackish marks. It has black cheek stripes contrasting with white chin and throat

Habit and habitat: It is seen in single or in pairs and inhabits near large lakes, rivers and marshes.

Food and feeding habit: It feeds on water fowl, pigeons, partridges and other birds.

Distribution: Widely distributed in India.

Conservation status: Least Concern (LC)

Family ACCIPITRIDAE

6. ***Gyps bengalensis*** (Gmelin, 1788)

Common Name: White Rumped vulture

Materials examined: Observed in the field.

Sighting record: Sighted at Kamalapur, Sagar Island; Date; 17.10.2009; time: 12.10.p.m. No. of exs. 03.

Notable character in the field : It has an un-feathered head and neck, with broad wings and short tail feathers. The head is tinged in pink and bill is silvery with dark ceres.

Habit and habitat: It builds nest on tall trees often near human habitations and forms roost colonies. It often moves in flocks.

Food and feeding habit: It is a scavenger, feeding mostly on carcasses of dead animals.

Distribution: It is a resident species.

Conservation status: Critically Endangered.

7. ***Ichthyophaga ichthyaetus*** (Horsfield, 1821)

Common Name: Grey headed fish eagle

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar mela, Sagar Island: Date;16 and 18.10.2009; time: 11:10.a.m and 3:20 p.m. No. of exs. 03.

Notable character in the field : It has grey breast and upper mantle uniform brown in color, maroon brown breast contrast to grey head.

Habit and habitat: It builds stick nest on trees near water and lays two to four eggs.

Food and feeding habit: It is a fish eater and hunts in lakes, lagoons and large rivers for fishes.

Distribution: Widely distributed in India.

Conservation status: Near Threatened (LR/nt).

Order CHARADRIFORMES

Family LARIDAE

8. ***Larus ridibundus*** (Linnaeus, 1766)

Common Name: Black Headed gull

Materials examined: Observed in the field.

Sighting record: Sighted at Bemankhali, Sagar Island; Date 19 and 20.10.2009; time: 11:30.a.m. and 2:30 p.m.

Notable character in the field: It has white leading edges to wings and deep red bill, legs and feet.

Habit and habitat: It is gregarious, found along with brown headed gull, scavenger on sea, and inhabits seacoasts, estuaries, large rivers, inland jheels and lakes.

Food and feeding habit: It is carnivorous and feeds on fishes, prawns, crabs, sea birds and insects.

Distribution: It is a winter migrant along coasts of India and common in Western coast.

Conservation status: Least Concern (LC)

9. Larus argentatus (Pontoppidan, 1763)

Common Name: European Herring Gull

Materials examined: Observed in the field.

Sighting record: Sighted at Light house, Sagar Island; Date: 16 and 17.10.2009 time: 10:10.a.m and 3: 25 p.m.. No of exs. 04.

Notable character in the field : It has grey black plumage and upper wings with white head and under parts. The bill is yellow with a red spot and there is a ring of bare yellow skin around the pale eye.

Habit and habitat: It inhabits sea shores and inland garbage dumps.

Food and feeding habit: It is omnivores and opportunistic feeder. It scavenges from garbage dumps, landfill sites and sewage outflows. It also steals the eggs and young of other birds and seeking small prey in fields, on the coast or in urban areas, or robbing or lapwings of their catches. It also dive from the surface of the water or engage in plunge diving in the pursuit of aquatic prey.

Conservation status: Least Concern (LC)

Order COLUMBIFORMES

Family COLUMBIDAE

10. ***Streptopelia decaocta*** (Frivaldszky, 1838)

Common Name: Eurasian Collared Dove

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Mission,

Sagar Island; Date:15 and 16.10.2009; time: 11:15.a.m. and 2: 15 p.m. No of exs. 03.

Notable character in the field: It is grey-buff to pinkish-grey, a little darker above than below. It has a black half-collar edged with white on its nape from which it gets its name. The legs are short and red with a black bill.

Habit and habitat: It is a gregarious species and sizable winter flocks were form where there are food supplies.

Food and feeding habit: It feeds on grain as well as seeds, shoots and insects.

Distribution: It is a migratory species.

Conservation status: Least Concern (LC)

11. ***Streptopelia chinensis***

Common Name: Spotted dove

Materials examined: Observed in the field.

Sighting record: Sighted at Chemaguri, Sagar Island; Date:14 and 16.10.2009; time: 10.50.a.m and 6: 00 p.m. No of exs. 04.

Notable character in the field : It has long-tail, wings and tail are pale brown and buff. During flight, it shows blackish flight feathers bordered on the inner edge with pale grey

Habit and habitat: It is usually alone or in pairs and calm, but leery of humans and other animals. It builds a very simple stick nest and lays two white, glossy eggs.

Food and feeding habit: It feeds on grass, seeds, and other vegetation.

Distribution: It is a resident species.

Conservation status: Least Concern (LC)

Order CUCULIFORMES
Family CUCULIDAE

12. ***Clamator jacobinus*** (Boddaert, 1783)

Common Name: Pied Crested cuckoo/ Jacobin cuckoo

Materials examined: Observed in the field.

Sighting record: Sighted at Ramakrishnapur, Sagar Island; Date: 15 and 17 .10.2009; time: 3:20 p. m and 5:10 p. m; No. of exs. 06.

Notable character in the field : It is slim black and white cuckoo with a crest. The white wing patch on the black wing and the pattern make it unmistakable even during flight

Habit and habitat: It inhabits light and densely wooded forests. It was seen singly or in pairs in the wild and also seen in flocks.

Food and feeding habit: It was seen hunting for food within the tree foliage and feeds on insects such as butterflies, bees, wasps, locusts and ants.

Distribution: It is seasonal migratory in the south of Himalayas.

Conservation status: Least Concern (LC)

Order CORACIFORMES
Family ALCEDINIDAE

13. ***Halycon smyrnensis*** (Linnaeus, 1758)

Common Name: White Breasted Kingfisher

Materials examined: Observed in the field.

Sighting record: Sighted at Lot No. 5, Sagar Island; Date: 16, 19 and 21.10.2009; time: 3:10 p. m, 4:00 p. m and 4:30 p.m; No. of exs. 12.

Notable character in the field: It has large red bill, brown head and under parts with white throat. The rump and tail are brilliant blue color.

Habit and habitat: It is a bold and noisy bird found on telephone wires, poles, branches and inhabits streams, rivers, canals and tanks.

Food and feeding habit: It feeds on fishes, crabs, beetles, grasshopper and other insects.

Distribution: Commonly found in India.

Conservation status: Least Concern (LC)

Family HALCYONIDAE

14. ***Todiaramphus chloris*** (Boddaert, 1783)

Common Name: White Collard Kingfisher

Materials examined: Observed in the field.

Sighting record: Sighted at Lot No. 5, Sagar Island 16 and 17.10.2009; time: 11:40.a.m and 3:20 p.m.; No of exs. 04.

Notable character in the field : It is blue to green above and under parts white with a white collar around the neck giving its name.

Habit and habitat: It is found either single or in pairs and abundance at open plantation.

Food and feeding habit: It feeds on large insects, small lizards, occasionally takes small fish over the reef at low tide.

Distribution: Andaman Nicobar Islands.

Conservation status: Least Concern (LC)

Order PICIFORMES

Family PICIDAE

15. ***Dinopium bengalensis*** (Linnaeus, 1758)

Common Name: Rumped Golden Flameback

Materials examined: Observed in the field.

Sighting record: Sighted at Tetultala, Sagar Island; Date; 18.10.2009; time: 12:10.p.m; No. of exs. 03.

Notable character in the field : It has black rump. The black throat finely marked with white differentiates it from other golden backed woodpeckers. The head is whitish with a black nape and throat.

Habit and habitat: It is found mainly on the plains going up to an elevation of about 1200m.

Food and feeding habit: It feeds on insects mainly beetle larvae from under the bark, visit termite mounds and sometimes feeds on nectar.

Distribution: It is widely distributed in India, South of the Himalayas and East till the Western Assam valley and Meghalaya.

Conservation status: Least Concern (LC)

16.***Chrysocolaptes lucidus*** (Scopoli, 1786)

Common Name: Greater flameback

Materials examined: Observed in the field.

Sighting record: Sighted at Lot No. 5, Sagar Island: 13 and 16.10.2009; time: 10:50 a.m and 1:30p.m; No of exs. 03.

Notable character in the field: It has an erect crest and a long neck. The head is whitish with a black pattern and a straight pointed, long bill. The rump is red and the tail is black.

Habit and habitat: It is found in the foothills of the Himalayas and also inhabits mangrove forest.

Food and feeding habit: It feeds on small invertebrates and the adults drink nectar. They nest in tree holes, laying three or four white eggs.

Distribution: Widely distributed and quite common in parts of its range,

Conservation status: Least Concern (LC)

Order PASSERIFORMES
Family PASSERIDAE

17. ***Passer domesticus*** (Linnaeus, 1758

Common Name: House sparrow

Materials examined: Observed in the field.

Sighting record: Sighted at Lot No. 5, Sagar Island; Date: 13, 16 and 17.10.2009; time: 11:10.a.m, 12:30 p.m and 1: 40 p.m.. No of exs. 12.

Notable character in the field : It has a large rounded head, short tail and a stout bill.

Habit and habitat: It inhabits nearby human habitation and cultivation lands.

Food and feeding habit: It is an opportunistic feeder and feeds on seeds of grains and weeds.

Distribution: Widely distributed in India.

Conservation status: Least Concern (LC)

Family ESTRILDIDAE

18. ***Lonchura striata*** (Linnaeus, 1766)

Common Name: White Rumped Munia

Materials examined: Observed in the field.

Sighting record: Sighted at Sagar Light house, Sagar Island; Date: 16, 17 and 19.10.2009; time: 12:10, 2:30 and 4:15 p.m; No. of exs. 06.

Notable character in the field : It has a stubby grey bill and a long black pointed tail. The adults are brown above on the breast, lighter below and the rump is white

Habit and habitat: It occurs in open woodland, grassland and scrub. It also forms nest in a large domed grass structure in a tree, bush or grass.

Food and feeding habit: It is a gregarious bird and feeds on seeds.

Distribution: It is native species.

Conservation status: Least Concern (LC)

Family PYCNONOTIDAE

19. ***Pycnonotus cafer*** (Linnaeus, 1766)

Common Name: Red Vented Bulbul

Materials examined: Observed in the field.

Sighting record: Sighted at Bemankhali, Sagar Island; Date; 13 and 16.10.2009; time: 10:50 and 11:10.a.m. No. of exs. 04.

Notable character in the field : It has short crest giving the head a squarish appearance and body is dark brown with a scaly pattern while the head is darker or black. The rump is white .Tail is black and tipped in white.

Habit and habitat: It inhabits dry scrub, open forest, plains and cultivated lands.

Food and feeding habit: It feeds mainly on fruits, petals of flowers, nectar, insects and occasionally geckos.

Distribution: In its native range it is rarely found in mature forests.

Conservation status: Least Concern (LC)

Family STURNIDAE

20. ***Sturnus malabarica*** (Gmelin, 1789)

Common Name: Chestnut-tailed starling (Myna)

Materials examined: Observed in the field.

Sighting record: Sighted at Lot No. 5, Sagar Island; Date: 13, 16 and 17.10.2009; time: 10:20 a.m, 10:30 a.m and 1:10.p.m. No. of exs. 04.

Notable character in the field : Its head and chest are white, underparts are grey with blackish remiges. Bills are yellow with pale blue base.

Habit and habitat: It is found in open woodland and cultivation lands. It builds a nest in hole and lays 3-5 eggs in a clutch.

Food and feeding habit: It is omnivorous and feeds on fruits, nectar and insects.

Distribution: North-east India, Wetsern Ghats.

Conservation status: Least Concern (LC)

Family SYLVIIDAE

21. ***Acrocephalus Agricola*** (Jerdon, 1845)

Common Name: Paddyfield Warbler

Materials examined: Observed in the field.

Sighting record: Sighted at Kamalapur, Sagar Island; Date 14 and 16.10.2009; time: 10:50 a. m and 12:10.p.m; No. of exs. 05.

Notable character in the field: It has shorter bill and wingspan, clear whitish supercilium. The bill is short and pointed

Habit and habitat: It is found in low vegetation such as long grass, reeds and rice. It lays 4-5 eggs in a nest in grass.

Food and feeding habit: It is insectivorous and feeds on insects and worms.

Distribution: It is a migratory species.

Conservation status: Least Concern (LC)

Family CORVIDAE

22. ***Corvus macrorhynchos*** (Wagler, 1827)

Common Name: Jungle Crow (Long Billed Crow)

Materials examined: Observed in the field.

Sighting record: Sighted at Bemankhali, Sagar Island; Date: 15 and 16.10.2009; time: 10:20 a.m and 12.10.p.m. No. of exs. 06.

Notable character in the field : It has dark greyish plumage from back of the head, neck and lower body with wings, tail, face and throat glossy black. It has long bill with upper one is thick and arched.

Habit and habitat: It occurs in woodland, parks, gardens, cultivated lands and also on trees.

Food and feeding habit: It is versatile in feeding ranging from ground or in trees. It feeds on a wide range of items and will attempt to feed on anything appearing edible, alive or dead, plant or animal. It is well known for its regular habit of killing domestic chickens, more so than any other species of crow.

Distribution: It is quite common in the south of its range.

Conservation status: Least Concern (LC)

23. ***Acridotheres fuscus*** (Wagler, 1827)

Common Name: Jungle Myna

Materials examined: Observed in the field.

Sighting record: Sighted at Chemaguri, Sagar Island; Date : 13 and 16.10.2009 time: 11:10.a.m and 3:20 p.m; No. of exs. 03.

Notable character in the field : It has grey plumage, darker on the head and wings. There are large white wing patches obvious during flight and a white tail tip

Habit and habitat: It is commonly found in forest and cultivation land. It builds a nest in hole and lays normal clutch of 3-6 eggs.

Food and feeding habit: It is omnivorous and feeds on fruit, grain and insects.

Distribution: It is a resident species.

Conservation status: Least Concern (LC)

24. ***Acridotheres tristis*** *(Linnaeus, 1766)*

Common Name: Common Myna

Materials examined: Observed in the field.

Sighting record: Sighted at Bemankhali, Sagar Island; Date: 16 and 19.10.2009; time: 11:10.a.m and 12:30 p. m No. of exs. 06.

Notable character in the field : It has brown body, black hooded head and the bare yellow patch behind the eye. The bill and legs are bright yellow.

Habit and habitat: It is found in pairs and inhabits open woodland, cultivation and around habitation.

Food and feeding habit: It is omnivorous and feeds on insects, arachnids, crustaceans, reptiles, small mammals, seeds, grain and fruits and discarded waste from human habitation.

Distribution: It is a native species.

Conservation status: Least Concern (LC).

Class MAMMALIA
Order RODENTIA
Family MURINAE
Genus BANDICOTA

1. Bandicota bengalensis (Gray, 1835)

Common Name: Lesser Bandicoot rat

Materials examined: Observed in the field.

Sighting record: Sighted at Bemankhali, Sagar Island; 13, 15, 19 and 20.10.10.2009; time: 10:05 a. m, 11:10.a.m, 12:30 p.m. 2:10 p. m; No. of exs. 12.

Notable character in the field : It has greyish brown to blackish above and dark grey below with short tail. It is short and harsh.

Habit and habitat: It is nocturnal, fossorial and inhabits burrows in the cultivated fields. It is one of the crop pests in India and stores large quantity of grains in its burrow during harvest season.

Food and Feeding Habit: It feeds on vegetable matter.

Distribution: It is found throughout India.

Conservation status: Least Concern (LC).

Genus Mus

2. Mus booduga (Gray, 1837)

Common Name: Field Mouse.

Materials examined: Observed in the field.

Sighting record: Sighted at Chemaguri area of Sagar Island; 16 and 18.10.2009 time: 12:10.p.m and 6:10 p. m; No of exs. 03.

Notable character in the field : It is light sandy, dark grey in color and rusty brown above and white below. The fur is soft. The head and body are bicolored.

Habit and habitat: It is nocturnal, fossorial and inhabits irrigated fields, thorn scrub on edges of cultivation.

Food and Feeding Habit: It feeds on vegetable matter and occasionally feeds on insects.

Distribution: It is found throughout India.

Conservation status: Least Concern (LC).

SUMMARY

The present study deals with five species of fishes, three species of amphibia, seven species of reptiles, twenty four species of birds and two species of mammals. The habit and habitat and description were also given for each species studied. The conservation status as per the IUCN, 2011 was also given for all the species studied.

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ON THE GENUS *ANISOPS* (HETEROPTERA : NEPOMORPHA : NOTONECTIDAE) FROM ANDAMAN AND NICOBAR ISLANDS, WITH A NEW RECORD TO INDIA

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INTRODUCTION

Notonectidae are back-swimmers characterized by body convexed dorsally, having large eyes, hidden antennae, four segmented rostrum, abdominal venter with a median longitudinal keel and fore and mid legs are raptorial and the hind legs are adapted for swimming. The Notonectidae is one of the larger Nepomorphan families with about 370 described species, well represented in both temperate and tropical areas of the World (Nieser, 2004). The genus *Anisops* Spinola, 1837 is characterized by the presence of hair-lined pit on the hemelytral commissure, stridulatory comb on a stridulatory ridge of fore tibia of males and one segmented fore tarsus and male rostrum with lateral prong. Most of the *Anisops* can fly, so that they migrate to various lentic water bodies and very few species to lotic ecosystems. Chandra *et al.* (2012) recorded seven species of *Anisops* including two new record *Anisops barbatus* Brooks and *A. naustus* (Fieber) with the earlier record by Polhemus and Starmühlner (1990) and Thirumalai (2007). In the present study *A. breddini* Kirkaldy, *A. exiguus* Horvath, *A. occipitalis* Breddin, are newly recorded to the Union Territory and the later species is a new record to India. A total of 9 species of *Anisops* are recorded in the present study, but *A. sardeus sardeus* Herrich-Shaffer has not encountered in the surveys made by the authors. So far, there is no endemic species from the genus recorded from Andaman and Nicobar islands. All the materials examined in the present study were collected by the first author from the freshwater bodies of South Andaman and Great Nicobar Biosphere Reserve during March 2012 and April 2012 and all the studied materials were deposited in the National Zoological Collection, Zoological Survey of India, Kolkata.

Infraorder NEPOMORPHA
Family NOTONECTIDAE
Subfamily NOTONECTINAE

Anisops barbatus Brooks, 1951

1951. *Anisops barbata* Brooks, *Kan. Univ. Sci. Bull.*, **34**: 387.

2012. *Anisops barbatus* Brooks: Chandra, Jehamalar & Ragunathan, *Rec. zool. surv. India*, **112** (Part-2): 82.

Material examined: South Andaman, Wandoor, 5.iii.2012, (3 ♂, 2 ♀exs.).

Diagnosis: (Fig. 1A) *Male*: Length, 7.9-9.3 rostral prong of males originating on the proximal third of third rostral segment and slightly longer than the third segment; head width seven to eight times the anterior width of vertex; tylus swollen, with a pair tufts of hairs, reaches base of labrum; stridulatory comb on foretibia with 20-25 teeth; scutellum milky white; clavus yellowish white. *Female*: Length, 8.0-9.1; tylus slightly swollen, without hair tufts; head width five to six times the anterior width of vertex.

Distribution: Andaman and Nicobar Islands, Bihar, Chandigarh, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: China, Java, Perak, Singapore and Sumatra.

Remarks: Collected from pond and this is the largest species from the genus so far known from India.

Anisops bouvieri Kirkaldy, 1904

1904. *Anisops bouvieri* Kirkaldy, *Wiener Ent. Zeit.*, **23**: 116.

2007. *Anisops bouvieri* Kirkaldy: Thirumalai, *Rec zool. Surv. India, Occ. Paper No.*, **273**: 37.

Material examined: South Andaman, Wandoor, 5.iii.2012,) (1 ♂, 2 ♀).

Diagnosis: (Fig. 1B) *Male*: Length, 7.03-7.1, head has a long cephalic projection with acute apex; synthlipsis narrow; tylus excavated medially, lateral rim having groove reaching upto apex of cephalic projection; labrum with three hair tufts; rostral prong originating on the proximal third of third rostral segment and the prong slightly shorter than the third segment; stridulatory comb on foretibia with about 12 teeth. *Female*: Length, 6.22-6.97, head without cephalic projection and rounded anteriorly in dorsal view; synthlipsis wide; labrum with short hairs, but not forms a tuft.

Distribution: Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Bangladesh, China, Indonesia, Malaysia, Myanmar, New Guinea, Singapore, Thailand and Vietnam.

Remarks: This species was collected from stream and this species is the third largest species so far known from India.

Anisops breddini Kirkaldy, 1901

1901. *Anisops breddini* Kirkaldy, *Entomologist*, London, **34**: 5.

2007. *Anisops breddini* Kirkaldy: Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.*, **273**: 37-38.

Material examined: South Andaman, Wandoor, 3.iii.2012, (10 ♂, 15 ♀exs.), 5.iii.2012, (4 ♂, 12 ♀exs.)., Mongulton, 6.iii.2012, (2 ♂, 10 ♀exs.).

Diagnosis: (Fig. 1C) *Male*: Length, 5.7-6.6, This species can be easily identified by holoptic eyes; in lateral aspect head seems triangular; rostral prong slightly longer than third rostral segment; second rostral segment with a distal outgrowth reaches the tip of rostrum posteriorly; stridulatory comb with few irregular teeth; lateral pronotal margin parallel. *Female*: Length, 5.4-6.8 distal outgrowth on the second rostral segment short, not reaching tip of rostrum.

Distribution: Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Delhi, Kerala, Madhya Pradesh, Odisha, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere*: Indonesia, Malaysia, Myanmar, New Guinea, Singapore, Sri Lanka, Thailand and Vietnam.

Remarks: Collected from Pond and also recorded from brackish waters (Thirumalai, 2001). It is the first time record from the Union Territory.

Anisops exiguus Horvath, 1919

1919. *Anisops exigua* Horvath, *Abhandl. Senckenberg. Naturf. Gesell.*, **35**: 314.

2007. *Anisops exiguus* Horvath: Thirumalai, *Rec. zool. Surv. India, Occ. Paper No.*, **273**: 38-39.

Material examined: South Andaman, Manjery, 3.iii.2012, (42 ♂, 59 ♀exs.).

Diagnosis: (Fig. 1D) *Male*: Length, 4.3-4.8 vertex of head slightly indented; synthlipsis very narrow; rostral prong slightly shorter than the third rostral segment and originating from its proximal third; stridulatory comb of fore tibia with 9-11 teeth; tylus slightly swollen. *Female*: Length, 4.3-5.2; tylus flat.

Distribution: Andaman and Nicobar Islands, Andhra Pradesh, Chandigarh, Kerala, Himachal Pradesh, Madhya Pradesh, Maharashtra, Punjab and Tamil Nadu. *Elsewhere*: China, Malaysia, New Guinea, Singapore and Vietnam.

Remarks: It is the first time record from the Union Territory.

Anisops naustus Fieber, 1851

1851. *Anisops nausta* Fieber, *Abhandl. Konigl. Bohm. Ges. Wiss.*, **7**: 484-485.

2012. *Anisops naustus* Fieber: Chandra, Jehamalar & Ragunathan, *Rec. zool. surv. India*, **112** (Part-2): 82.

Material examined: Recorded from literature Chandra *et al.* (2012).

Distribution: Andaman and Nicobar Islands (GNBR), Andhra Pradesh, Assam, Madhya Pradesh, Odisha, West Bengal. *Elsewhere*: Australia, Indonesia, Melaka, Pacific Islands, Singapore, Southern China and West Malaysia.

Anisops niveus (Fabricius, 1775)

1775. *Notonecta nivea* Fabricius, *Systema Entomologiae Flensburgi et Lipsiae*, 690.

2012. *Anisops niveus* (Fabricius): Chandra, Jehamalar & Ragunathan, *Rec. zool. surv. India*, **112** (Part-2): 82.

Material examined: South Andaman, Manjery, 3.iii.2012, (1 ♂, 4 ♀exs.)., Wandoor, 5.iii.2012, (2 ♂, 4 ♀exs.), GNBR, Johinder Nagar, 20.iii.2012, (15 ♂, 13 ♀exs.)., GNBR, Govind Nagar 7th km, 7.iv.2012, (2 ♂, 5 ♀exs.).

Diagnosis: (Fig. 1E) *Male:* Length, 4.8 mm – 5.7 mm; labrum with long white hairs; tylus and frons are excavated; stridulatory comb with 13 teeth in equal length; rostral prong shorter than the 3rd rostral segment, originating near its proximal margin; wings surpassing the last abdominal segment. *Female*: Length, 5.4-6.5 tylus flat; vertex of head slightly extending in front of eyes.

Distribution: Andaman and Nicobar Islands (GNBR), Assam, Bihar, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Africa, Indonesia, Malaysia, Myanmar, Philippines, Seychelles, Sri Lanka, Thailand and Vietnam.

Remarks: Collected from pond.

Anisops occipitalis Breddin, 1905

1905. *Anisops occipitalis* Breddin, *Mitteil. Naturh. Mus.* Hamburg, **20**: 152.

2004. *Anisops occipitalis* Breddin: Nieser, *Raff. Bull. Zoology*, **52**(1): 89.

Material examined: Nicobar, GNBR, Johinder Nagar, 20.iii.2012, (2 ♂, 1 ♀) .

Diagnosis: (Fig. 1F) *Male*: Length, 7.6-7.7 mm, Colour yellow to grayish, head anteriorly truncate; synthlipsis wide; rostral prong medially sulcated and longer than third rostral segment, originating from distal margin of third rostral segment, which is slightly protruded posteriorly; tylus swollen; labrum covered with short hairs (Fig. 1G); dorsal margin of forefemur with a wide shallow indentation in apical third portion, apex broadly rounded (Fig. 1K); fore tibia with four short stout pale spines adjacent to stridulatory comb, which has 20-25 teeth surrounded by broad ring-like structure (Fig. 1I); fore tibia with five minute denticles arranged longitudinally (Fig. 1J); *Female*: Length, 7.3 mm; tylus flat; labrum with short hairs.

Distribution: Andaman and Nicobar Islands (GNBR). *Elsewhere*: Australia, China, Indonesia, Japan, Malaysia, New Caledonia, Philippines, Singapore and Taiwan.

Remarks: Nieser (2004) mentioned that the labrum of female is bare, but the female example examined in the present study having short hairs. This species has been collected from pond. The present record is the new record to India. This species is the second largest species from the genus so far recorded from India.

Anisops sardeus sardeus Herrich-Shaffer, 1850

1850. *Anisops sardeus* Herrich-Shaffer, *Die wanzenartigen Insecten*, **9**: 41.

2007. *Anisops sardeus sardeus* Herrich-Shaffer: Thirumalai, *Rec. zool. surv. India, Occ. Paper No.*, **273**: 41.

Material examined: Recorded from literature Thirumalai (2007).

Distribution: Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Chandigarh, Delhi, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Afghanistan, Africa, Albania, Canary Islands, Myanmar, Syria and Turkey.

Remarks: This species has not been encountered in the surveys made during the years 2010 and 2012 by the authors. Results of Polhemus and Starmühlner (1990) on aquatic Heteroptera of Andaman Islands are also not recorded this species.

Anisops tahitiensis Lundblad, 1934

1934. *Anisops tahitiensis* Lundblad, *Bull. Bishop. Mus. Honolulu*, **113**: 121.

2007. *Anisops tahitiensis* Lundblad: Thirumalai, *Rec. zool. surv. India, Occ. Paper No.*, **273**: 41.

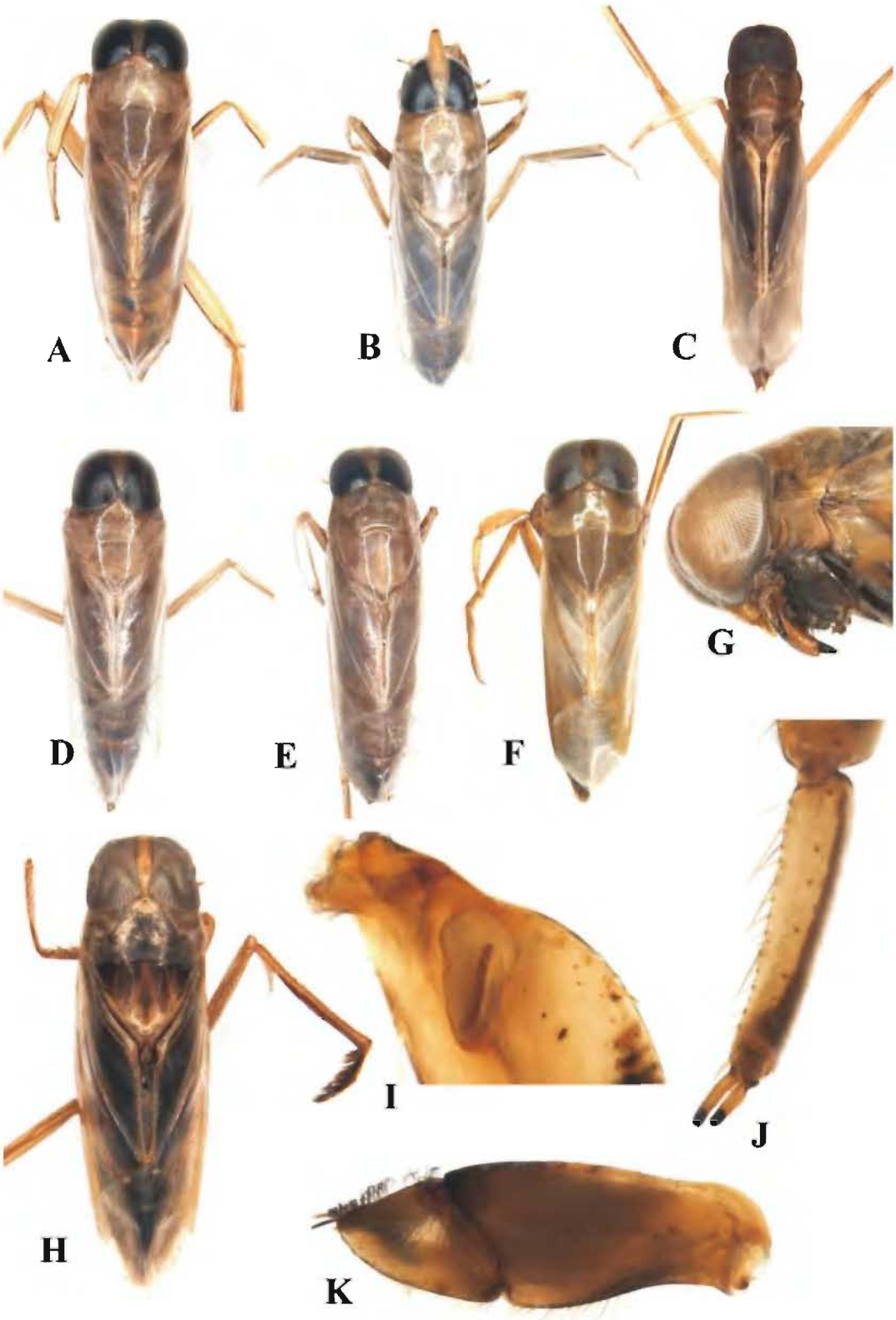

Fig. : 1. A–K Male *Anisops* spp. of Andaman and Nicobar Islands:
A, *A. barbatus*; **B**, *A. bouvieri*; **C**, *A. breddini*; **D**, *A. exiguus*; **E**, *A. niveus*; **F**, *A. occipitalis*;
G, *A. occipitalis* male head lateral view; **H**, *A. tahitiensis*. **I–K**, *A. occipitalis*:
I, Base of fore tibia: J, fore tarsus; K, fore trochanter and fore femur.

Material examined: Nicobar, GNBR, Sastri Nagar, 24.iii.2012, (4 ♂, 1 ♀exs.)., Johinder Nagar, 20.iii.2012, (1 ♂ , 1 ♀ exs.)., GNBR, Afra Bay, 14.iv.2012, (1 ♂, 2 ♀ exs.)., Govind Nagar 6th km, 10.iv.2012, (25 ♂, 20 ♀ exs.)., GNBR, Chingen Village, 29.iii.2012, (1 ♀ ex.)., Laxmi Nagar, 26.iii.2012, (1 ♂ ex.)., Govind Nagar, Nature Trail, 30.iii.2012, (2 ♂exs.).

Diagnosis: (Fig. 1H) *Male*: Length, 5.5 mm – 5.7 mm; colour: Yellowish white; synthlipsis about one third the anterior width of vertex; head anteriorly truncate; tylus swollen with blunt carina; rostral prong longer than third rostral segment, originating middle of the segment; stridulatory comb of males with 23-34 teeth; middle of last abdominal sternum of female with black longitudinal stripe; scutellum in wet condtion seem three dark brown longitudinal rectangular bands. *Female*: Length, 5.5 mm – 6.1 mm; tylus slightly convex.

Distribution: Andaman and Nicobar Islands (GNBR).

Elsewhere: Australia, Guadalcanal, Johor, Malaysia, Okinawa, Pahang, Perak, Selangor, Singapore, Tahiti, Terengganu and Vietnam.

Remarks: This species found both in lentic and lotic ecosystems.

SUMMARY

A total of 270 specimens of *Anisops* belonging to the infraorder Nepomorpha and family Notonectidae were examined, results the record of seven species. *A. tahitiensis* are widely distributed throughout GNBR, has not been recorded in the present study from South Andaman from where Polhemus and Starmühlner (1990) also had not been recorded this species. *A. barbatus* Brooks and *A. niveus* (Fabricius) are recorded both from Andaman and Nicobar Islands. The species *A. naustus* Fieber, *A. occipitalis* Breddin and *A. tahitiensis* Lundblad recorded from GNBR has not recorded from South Andaman and the species *A. bouvieri* Kirkaldy, *A. breddini* Kirkaldy and *A. exiguus* Horvath recorded from South Andaman has not recorded from GNBR. Through the work of Polhemus and Starmühlner (1990), Thirumalai (2007), Chandra *et al.* (2012) and by the present work a total of nine species of *Anisops* are recorded from Andaman and Nicobar Islands.

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ON A COLLECTION OF AQUATIC BEETLES (ORDER: COLEOPTERA: GYRINIDAE, DYTISCIDAE AND HYDROPHILIDAE) OF RENUKA WILDLIFE SANCTUARY, HIMACHAL PRADESH, INDIA

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INTRODUCTION:

The Renuka Wildlife Sanctuary (RWLS) is situated in the low subtropical zone and located about 60 kilometres from Nahan in Sirmour district of Himachal Pradesh. The total area of the sanctuary is about 4.028 square kilometres. The aquatic insects were collected between the Longitude of 77.4509 and Latitude of 30.6105 at an altitude of 668 meters. The entire sanctuary is Renuka Reserve Forest and has been declared as Abhayaranya. An area of roughly about 3 square kilometres that lies outside the sanctuary has been declared as a buffer belt.

The present studies on aquatic beetles from Renuka Wildlife Sanctuary deal with 13 species referable to 10 genera and 3 families (Gyrinidae, Dytiscidae and Hydrophilidae) of aquatic Coleoptera were recorded is based on a small collection, collected from different parts of Sanctuary of Himachal Pradesh by authors in October 2012. The species *Rhantaticus congestus* (Klug) and *Hydaticus ricinus* Wewalka are first time recorded from Himachal Pradesh state and 9 species among 13 species are first recorded from Renuka Wildlife Sanctuary. The current knowledge of aquatic beetle fauna of Renuka Wildlife Sanctuary of Himachal Pradesh are limited to the work of Biswas (2000) recorded 20 aquatic beetles species under 6 families from Renuka Wildlife Sanctuary, those materials were conducted by High Altitude Station, Zoological Survey of India, Solan. Biswas (2000) treated *Hydaticus fabricii* Macleay as a synonym for *Hydaticus ricinus* Wewalka; altogether, a list of 28 aquatic species belonging 6 families (Gyrinidae, Dytiscidae, Hydrophilidae, Georyssidae, Byrrhidae and Elmidae) of aquatic Coleoptera currently known from Renuka Wildlife Sanctuary and few photographs of the species are also appended.

SYSTEMATIC LIST

Family GYRINIDAE

1. *Dineutus (Protodineutus) indicus* Aube, 1938

Family DYTISCIDAE

2. *Rhantaticus congestus* (Klug, 1833)
3. *Hydaticus (Prodaticus) ricinus* Wewalka, 1979
4. *Hydroglyphus flammulatus* (Sharp, 1882)
5. *H. pradhani* (Vazirani, 1969)
6. *L. inefficiens* (Walker, 1859)
7. *L. sharpi* Regimbart, 1889

Family HYDROPHILIDAE

8. *Sternolophu srufipes* (Fabricius, 1792)
9. *Amphiop spedestris* Sharp, 1890
10. *Helochare sanchoralis* Sharp, 1890
11. *Berosu sindicus* Motschulsky, 1861
12. *B. pulchellus* Mcleay, 1825
13. *Regimbartia attenuata* Fabricius, 1801

SYSTEMATIC ACCOUNT

Key to the families of aquatic Coleoptera known from examined materials of Renuka WLS.

1. Metacoxae fused with metasternum. Maxillary palpi not longer than antennae……..... 2

- Metacoxae not fused with metasternum. Maxillary palpi often elongated and longer than antennae. Last glabrous joint obconic or more or less asymmetrical cuplike, embracing the pubescent club…….....……..... *Hydrophilidae*

2. Eyes divided, appearing as dorsal and ventral pair; antennae short and stout; middle and hind legs short and flattened, tarsi folding fanwise ..... *Gyrinidae*

- Eyes not divided, antennaeelongate, slender; middle and hind legs with tarsi not modified……..... *Dytiscidae*

I. Family GYRINIDAE

(1) Genus ***Dineutus*** Macleay, 1825

1825. *Dineutus* Macleay: *Ann. Jav.*1: 30.

1. ***Dineutus (Protodineutus) indicus*** Aube, 1938

1938.*Dineutus indicus* Aube: *Species Coleopters,* 6: 772.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (1ex.).

Distribution: India: Himachal Pradesh, Andhra Pradesh, Bihar, Gujarat, Karnataka, Jammu & Kashmir, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere: Pakistan.

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

II. Family DYTISCIDAE

Key to the species of Dytiscidae known from examined materials of Renuka WLS.

1. Scutellum visible……..... 2

   Scutellum not visible……..... 3

2. Suture between the metepisternum and metasternal wing, curved; apical spurs of the hind tibiae blunt, more or less bifid .....*Rhantaticus congestus* (Klug)

- Suture between the metepisternum and metasternal wings traight; apical spurs of the hind tibiae simple, pointed…….. *Hydaticus ricinus* Wewalka

3. Fourth segment of the pro and mesotarsi much reduced, hardly visible; prosternal process arched and oblique……..... 4

- Fourth segment of the pro and mesotarsi not reduced and sub-equal to the 3rd tarsal segment, prosternal Process straight, occasionally a little depressed…..... 5

4. Laterobasal plica on pronotum not continued on elytra, Length 2.4 mm……..... *Hydroglyphus flammulatus* (Sharp)

- Laterobasal plica on pronotum, minutely continued (as small point) on elytra, Length 2.3 mm..... *Hydroglyphus pradhani* (Vazirani)

5. Elytra testaceous, with solid brown/black irrotations…..... *Laccophilus inefficiens* (Walker)

- Elytra markings consisting of zigzag double lines, clear and thick but never coalescent .....……..... *Laccophilus sharpi* Regimbart

(2) Genus ***Rhantaticus*** Sharp, 1882

1882. *Rhantaticus* Sharp: *Sci. Trans. R. Dublin Soc.,* 2: 691.

2. ***Rhantaticus congestus*** (Klug, 1833)

1833. *Hydaticus congestus* Klug: *Symb. Physicae, Insectes Madagascar,* p. 48.

1885. *Rhantaticus congestus*: Branden, *Ann. Soc. Ent. Belg.* 29, (1): 107.

2012. *Rhantaticus congestus*: Ghosh & Nilsson, *Skorvnopparn supplement,* 3: 18.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Delhi, Madhya Pradesh, Maharashtra, Manipur, Orissa, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere: Bangladesh, Nepal, China, Japan, Madagascar, Philippines, Saudi Arabia, Sunda Islands, Taiwan, Afrotropical region, Australian region and North Africa.

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

(3) Genus ***Hydaticus*** Leach, 1817

1817. *Hydaticus* Leach: *Zool. Miscell.*, 3: 69, 72.

3. Hydaticus (Prodaticus) ricinus Wewalka, 1979

1979. *Hydaticus ricinus* Wewalka: *Koleopterologische Rundschau* **54**:128.

2000. *Hydaticus fabricii*: Biswas, *Fauna of Renuka Wetland*, Zoological Survey of India, **2**: 97-103.

2012. *Hydaticus (Prodaticus) ricinus*: Ghosh & Nilsson, *Skorvnopparn supplement* **3**: 27.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India: Assam and Tamil Nadu.

Elsewhere: Afghanistan, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka, China, Laos, Thailand, Vietnam.

Remarks: This species is first time recorded from Himachal Pradesh state.

(4) Genus ***Hydroglyphus*** Motschulsky, 1853

1853.Hydroglyphus Motschulsky: Imprimerie de la Societe de Literature Finnoise, p. 5.

2012. *Hydroglyphus*: Ghosh & Nilsson, *Skorvnopparn supplement* 3: 29.

4. ***Hydroglyphus flammulatus*** (Sharp, 1882)

1882. *Bidessus flammulatus* Sharp: *Sci. Trans. R. Dublin Soc.*, 2: 359.

1988. *Hydroglyphus flammulatus*: Bistrom, *Acta zool. Fenn.* 184: 12.

2012. *Hydroglyphus flammulatus*: Ghosh& Nilsson, *Skorvnopparn supplement*3: 29.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India : Assam, Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Pakistan and China.

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

5. Hydroglyphus pradhani (Vazirani, 1969)

1969. *Guignotus pradhani* Vazirani: *Oriental Insects* 2: 315.

1988. *Hydroglyphus pradhani*: Bistrom, *Acta zool. Fenn.* 184: 14.

2012. *Hydroglyphus pradhani*: Ghosh & Nilsson, *Skorvnopparn supplement* 3: 31.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India: Bihar and Himachal Pradesh.

Elsewhere: Not yet recorded.

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

(5) Genus ***Laccophilus***Leach,1817

1817. *Laccophilus* Leach: *Zool. Misc.*3: 69.

6. ***Laccophilus inefficiens*** (Walker,1859)

1859. *Hydroporus inefficiens* Walker: *Ann. Mag. Nat. Hist.* 3: 51.

1882. *Laccophilus inefficiens*: Sharp, *Sc. Trans. R. Dubline Soc.* 68: 287.

2012. *Laccophilus inefficiens*: Ghosh & Nilsson, *Skorvnopparn supplement* 3: 49.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77. 4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India : Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Tripura, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere: Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, Sri Lanka, Indonesia, Iran and Malaysia.

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

7. ***Laccophilus sharpi*** Regimbart, 1889

1889. *Laccophilus sharpi* Regimbart: *Ann. Soc. ent. Fr.*, 9: 151.

2012. *Laccophilus sharpi*: Ghosh & Nilsson, *Skorvnopparn supplement* 3: 51.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India: Andaman & Nicobar Islands, Assam, Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere: Myanmar, Nepal, Pakistan, Sri Lanka, China, Hong Kong, Indonesia, Iran, Iraq, Japan, Philippines, Saudi Arabia, South Korea, Taiwan, Vietnam, African region and Australian region.

Remarks: Biswas (2000) recorded this species from the Sanctuary.

III. FAMILY HYDROPHILIDAE

Key to the species of Hydrophilidae known from examined materials of Renuka WLS.

1. *Antennae 9-segmented; Scutellum not longer than* its width at base……..……..... 2
- *Antennae 8-segmented; Scutellum a long triangle* .....……..... 3
2. *Meso and metasternal carinae united intimately and forming only one ridge* ……..... *Sternolophus rufipes* (Fabricius)
- *Meso and metasternal carinae not united intimately, maxillary palpi more or less slender*……..……..…… *Helochares anchoralis* Sharp
3. *Eyes divided by aconspicuous, complete canthus reaching vertex behind; posterior legs without swimming hairs* ……..….. *Amphiops pedestris* Sharp
- *Eyes very convex, prominent canthus; posterior legs with swimming hairs*…..…..... 4
4. *Antennae composed of 8 segments (5+3)* ……..……*Regimbartia attenuata* Fabricius
- *Antennae composed of 7 segments (4+3)* ……..... 5
5. *Elytra apex with spin, smaller species, elytra shining*…..…… *Berosus indicus* Motschulsky
- *Elytra apex without spin, pronotum with black patch*…….....…… *Berosus pulchellus* Mcleay

(6) Genus ***Sternolophus*** Solier, 1834

1834. *Sternolophus* Solier: *Ann. Soc. ent. Fr.*, 3: 302.

8. ***Sternolophus rufipes*** (Fabricius, 1792)

1792. *Hydrophilu srufipes* Fabricius: *Entom. Syst.*, 1: 183.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India: Jammu & Kashmir, Andhra Pradesh, Bihar, Maharashtra, Meghalaya, Manipur, Punjab, Sikkim, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Myanmar, Philippines, Japan, Formosa, Indonesia, Indochina, China and Sri Lanka.

Remarks: Biswas (2000) recorded this species from the Sanctuary.

(7) Genus ***Amphiops*** Erichson, 1843

1843. *Amphiops* Erichson: *Archiv. Naturg.*9(1): 229.

9. ***Amphiops pedestris*** Sharp, 1890

1890. *Amphiops pedestris* Sharp: *Trans. Ent. Soc. Lond.* p. 354.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (4ex.).

Distribution: India: West Bengal and Himachal Pradesh.

Elsewhere: Sri Lanka.

Remarks: Biswas (2000) recorded this species from the Sanctuary.

On Genus ***Helochares*** Mulsant, 1844

1844. *Helochares* Mulsant: *Palpi*, p. 197.

1920. *Helochares*: Tullgren & Wahlgren, *Svenska Ins.*, (2): 234-235.

10. ***Helochare sanchoralis*** Sharp, 1890

1890. *Helochares anchoralis* Sharp: *Trans. Ent. Soc. Lond.* p. 352.

1924. *Helochares anchoralis*: Knisch, *Col. Cat.*, 14(Pars 79): 193.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (1ex.).

Distribution: India: Andhra Pradesh, Assam, Bihar, Manipur, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Sri Lanka, Indochina, Indonesia, Philippines, Laos, Tonkin, Cambodia and China.

Remarks: This species is first time recorded from this Sanctuary.

(9) Genus ***Berosus*** Leach, 1817

1817. *Berosus* Leach: *Zool. Misc.* 3: 92.

11. ***Berosu sindicus*** Motschulsky, 1861

1861. *Berosus indicus* Motschulsky: *Bull. Soc. Ent. Fr.*, 71: 473.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (3ex.).

Distribution: India : Andhra Pradesh, Bihar, Goa, Karnataka, Kerala, Manipur, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Sri Lanka, China, Myanmar, Formosa, Indonesia, Philippines, Cambodia, Laos, Indochina, Tonkin, Pakistan, Nepal and Bangladesh.

Remarks: Biswas (2000) recorded this species from the Sanctuary.

12. ***Berosus pulchellus*** Mcleay, 1825

1825. *Berosus pulchellus* Mcleay: *Annul. Jav.*, p. 35; ed. 2, 1833, p.140.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (1ex.).

Distribution: India : Andhra Pradesh, Assam, Bihar, Delhi, Haryana, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Nagaland, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere: Philippines, Myanmar, Indonesia, Sri Lanka and Indochina.

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

On Genus ***Regimbartia*** Zaitzev, 1908

1908. *Regimbartia* Zaitzev: *Horae Soc. Ent. Ross.* 38:362.

13. ***Regimbartia attenuata*** Fabricius, 1801

1801. *Regimbartia attenuata* Fabricius: *Syst. Eleuth.*, 1: 253.

1924. *Regimbartia attenuata*: Knisch, *Col. Cat.*, 14 (Pars 79): 276.

Material Examined: Himachal Pradesh, Sirmour district, Renuka Wildlife Sanctuary, 77.4509N, 30.6105E, alt. 668 meters, 3.X.2012, coll. S.K. Ghosh & V.D. Hegde (2ex.).

Distribution: India: Andhra Pradesh, Andaman Is., Bihar, Manipur, Nicabor Is., Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Sri Lanka, S. Asia, Philippines, Sunda Is., Australia, Japan, Formosa, Indonesia, Cambodia, Cochin-china and Indochina.

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

SUMMARY

This paper deals with thirteen species under ten genera and 3 families of Gyrinidae, Dytiscidae and Hydrophilidae. Two species from Himachal Pradesh and nine species from Renuka WLS are first time recorded in this paper. Biswas (2000) recorded 20 aquatic beetles species under 6 families from Renuka Wildlife Sanctuary. Altogether, a list of 28 aquatic species belonging 6 families of aquatic Coleoptera currently known from Renuka Wildlife Sanctuary.

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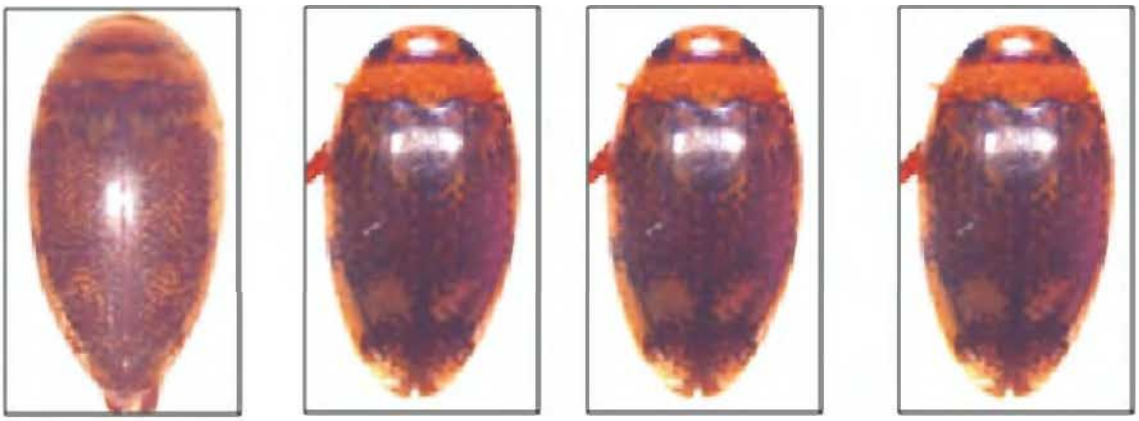

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Figs : **1.** *Dineutus indicus*, **2.** *Hydaticus ricinus*, **3.** *Hydroglyphus flammulatus*, **4.** *Hydroglyphus pradhani*, **5.** *Laccophilus inefficiens*, **6.** *Laccophilus sharpi*, **7.** *Rhantaticus congestus*, **8.** *Sternolophus rufipes*

List of species known from Renuka Wildlife Sanctuary:

Family **GYRINIDAE**

1. *Dineutus (Protodineutus) indicus* Aube
2. *Orectochilus (s.str.) murinus* Regimbart
3. *O. (Patrus) neglectus* Ochs

Family **DYTISCIDAE**

4. *Rhantaticus congestus* (Klug)
5. *Sandracottus dejeani* (Aube)
6. *S. festivus* (Illiger, 1801)
7. *Hydaticus (Prodaticus) ricinus Wewalka*
8. *Hydroglyphus flammulatus*(Sharp)
9. *H. pradhani* (Vazirani)
10. *Hydrovatus sp.*
11. *Hyphoporus elevates* Sharp
12. *Laccophilus flexuosus* Aube
13. *L. inefficiens* (Walker)
14. *L. parvulus parvulus* Aube
15. *L. sharpi* Regimbart

Family **HYDROPHILIDAE**

16. *Sternolophus rufipes* (Fabricius)
17. *Amphiops pedestris* Sharp
18. *Helochares anchoralis* Sharp
19. *H. crenatus* Regimbart
20. *Berosus indicus* Motschulsky
21. *B. pulchellus* Mcleay
22. *Regimbartia attenuata* Fabricius
23. *Hydrochus sp.*
24. *Laccobius sp.*
25. *Coelostoma sp.*

Family **GEORYSSIDAE**

26. *Georyssus sp.*

Family **BYRRHIDAE**

27. *Byrrhus sp.*

Family **ELMIDAE**

28. *Stenelmis sp.*

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THE FUSILIERFISHES (FAMILY : CAESIONIDAE) OF ANDAMAN AND NICOBAR ISLANDS

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INTRODUCTION

Fusiliers are tropical Indo-Pacific marine perciform fish of the family Caesionidae and they are most associated with the reefs. Within the family there are 4 genera and 21 species (Carpenter, 1988 and Allen & Erdmann, 2008). They are colourful fishes; many have bright yellow stripes and patches. The caesionidae are related to the family Lutjanidae, the snapper fishes. The fusiliers possess unique morphological features characteristic of their feeding mode. They are specialized for planktivorous feeding, while their nearest relatives, the snappers are typically benthic carnivores. The fusiliers possess a jaw morphology and body shape. They have a highly protrusible upper jaw which is an adaptation for picking zooplankton from the water column. Genus *Caesio* have a single postmaxillary process on the premaxilla and in the remaining genera *Dipterygonatus*, *Gymnocaesio and Pterocaesio* there are 2 postmaxillary processes. The additional process presumably allows greater control, and perhaps extent, of jaw protrusion. Another trend within the fusiliers relating to planktivory is the reduction of dentition. Fusiliers feed primarily on zooplankton and there is no need for a well developed dentition to seize and hold prey. They have small, weak teeth and some species lack teeth on the vomer, palatines and premaxillaries. Fusiliers are planktivouous, schooling fishes. Their schooling behaviour relates to predation pressure and they are actively preyed upon by groupers, snappers, jacks and tunas. Fusiliers often school in mixed species aggregations. It is common to see a school of 3-4 species of fusiliers. Species with similar markings, especially caudal markings, tend to be found most often in the same school. Fusiliers with a dark blotch at the tip of each caudal lobe, such as most species of *Pterocaesio* and the species of *Gymnocaesio*, often school together. The species with a black streak inside the caudal lobes, such as *Caesio caerulaurea*, *C. varilineata* and *C. pterocaesio* tile may be found in the same school. *Caesio cuning* and C. *xanthonota* with yellow caudal fins sometimes aggregate with one another. *Dipterygonotus balteatus* aggregate together with sardines, anchovies and other nearshore pelagic species.

MATERIAL AND METHOD

Samples of Fusiliers (Family : Caesionidae) were collected from the fish landing centers of the Andaman Islands in the fishing season during 1992-2012. Samples were separated into 12 different species and the specimens were preserved in 10% buffered formaldehyde and deposited in the reference collection of Zoological Survey of India, Port Blair, vide registration number ZSI, ANRC: 2282, 3342, 3803, 3804, 3805, 3806, 3807, 3808, 3809, 3810 and 3811. SCUBA gears are used for surveying, underwater observation and photography of fusiliers. Morphometric characters were measured with a caliper. Meristic characters that vary among species are referred to in the diagnoses and compared the number of dorsal fin spines, pectoral fin rays, peduncular scale rows, lateral line scales and lateral transverse scales. Colour

TABLE1

Genera	Species
Caesio Lacepede, 1801	***Caesio caerulaurea*** Lacepede, 1801
	Caesio cuning (Bloch, 1791)
	Caesio lunaris Cuvier, 1830
	Caesio xanthonota (Bleeker, 1845)
Dipterygonotus Bleeker, 1849	***Dipterygonotus balteatus*** (Valenciennes, 1830)
Gymnocaesio Bleeker, 1876	***Gymnocaesio gymnoptera*** (Bleeker, 1856)
Pterocaesio Bleeker, 1876	***Pterocaesio chrysozona*** (Cuvier, 1830)
	Pterocaesio marri Schultz, 1953
	Pterocaesio pisang (Bleeker, 1853)
	Pterocaesio tessellate Carpenter, 1987
	Pterocaesio tile (Cuvier, 1830)
	Pterocaesio trilineata Carpenter, 1987

photographs for each species were taken with Nikon D 300 camera.

RESULTS

There are 21 species in four genera are reported in the world; 12 species and all the four genera are reported from Andaman and Nicobar Islands.

Genus ***Caesio*** Lacepede, 1801

Caesio caerulaurea Lacepede, 1801 Blue and Gold Fusilier

1801. *Caesio caerulaurea* Lacepede, *Hist. Nat. Poiss.*, **3**: 85 (Type locality, Moluccas).

1988. *Caesio caerulaurea*: Carpenter, *FAO Fish. Synop.*, **8** (125): 35.

Diagnostic features: D. X, 15; A. III, 12 P. 20-21; V. I, 5; Ll. 59-62. Ltr. 9/16. Post maxillary process single; peduncular scale rows; upper 11, lower 15; 22-24 predorsal scales; dorsal and anal fins scaled; supratemporal bands of scales interrupeted at dorsal midline. Body bluish, lower sides bluish-white; an yellow stripe bordered by a white stripe above lateral line; caudal lobes with a black median streak; dorsal fin light blue, edge black; other fins white; axil and upper base of pectoral black.

Habitat : Found around coral reef areas in groups.

Distribution : Indo-West Pacific, from Red Sea, east coasts of Africa to Japan and Australia to Samoa Island.

Caesio Cuning (Bloch, 1791)

1791. *Sparus cuning* Bloch, *Nat. Ausland Fische.*, **5**: 31; pl. 263 (Type locality, Indonesia).

1988. *Caesio cuning*: Carpenter, *FAO Fish. Synop.*, **8** (125) : 37, pl. 1, fig. 44a & b.

D. X, 15; A. III, 11; P. 18; V. I, 5; Ll. 47-50. Ltr. 9/15-16. Post maxillary process single; peduncle scale rows; upper 9, lower 13; scale rows on cheek 5; 21-23 predorsal scales; supratemporal band of scale rows confluent at dorsal midline; dorsal and anal fins scaled. Body greenish-blue; lower sides and belly pinkish white; caudal peduncle and fin yellowish; dorsal fin yellowish-blue; other fins white; axil and upper base of pectoral fin black.

Habitat: Found over rocky and reef areas below 6mt depth.

Distribution: Eastern Indian Ocean to Western Pacific, from east coast of India to Australia.

Caesio lunaris Cuvier, 1830 Lunar Fusilier

1830. *Caesio lunaris* Cuvier, *Hist. Nat. Poiss.*, **6**: 441 (Type locality, New Ireland).

1988. *Caesio lunaris*: Carpenter, *FAO Fish. Synop.*, **8** (125): 38, pl. 111, fig. 51a & b.

D. X, 14; A. III, 11 P. 20; V. I., 5; Ll. 53. Ltr. 8 + 1 + 8, Body fairly deep; post maxillary process single; supratemporal band of scales interrupted at dorsal midline; 21 predorsal scales; dorsal and anal fins scaled. Body blusih, belly paler; tip of caudal lobes, axil of pectoral fins black; ventral, and and caudal fins white to pale blue.

Habitat : Found in reef areas.

Distribution : Indo-Pacific, from east coast of Africa to coasts of India, Andaman Is., Sri Lanka to Ryukyu Is., and New Guinea to Solomon Island.

Caesio xanthonota (Bleeker, 1845)
Yellowback Fusilier

1845. *Caesio xanthonotus* Bleeker, *Nat. Tijd. Ned. Indie.*, **4**: 466 (Type locality, Indonesia).

1988. *Caesio xanthonota*: Carpenter, *FAO Fish. Synop.*, **8** (125): 45, pl. 1, fig. 43a & b.

D. X, 14; A. III, 12; P. 21; V. I., 5; Ll. 59. Ltr. 10 + 1 + 18. Single post maxillary process; 4 scales rows on cheek; 21 predorsal scales; dorsal and anal fins scaled; supratemporal scales interrupted at dorsal midline of narrow scaleless zone. Upper third of body yellowish, sides of body bluish and lower sides white; axil and upper base of pectoral black; dorsal and caudal fins yellow; other fins white.

Habitat : Found around coral reefs.

Distribution : Indian Ocean, from Zanzibar to coasts of India, Andaman Is., Christmas and Indonesia.

Genus ***Dipterygonotus*** Bleeker, 1849
Dipterygonotus balteatus (Valenciennes, 1830)
Mottled Fusilier

1830. *Smaris balteatus* Valenciennes. *Hist. Nat. Poiss.*, **6**: 424 (Type locality, Sri Lanka).

1988. Carpenter, *FAO Fish. Synop.* 8 (125) : 47, pl. 1, fig. 42.

D. XIV, 9; A. III, 9; P. 18; V. I. 5; Ll. 76. Ltr. 10 + 1 +16. Body slender, two post maxillaryu processes; palatines edentate; caudal peduncular scale rows; upper 13, lower 16; cheeks with 6 scale rows; 32 predorsal rows; dorsal and anal fins without scales. Body brownish above, silvery white below; a thin yellowish black stripe of one scale width above lateral line from orbit to caudal, above this two interrupted stripes of the same colour; all fins light pinkish; axil of pectoral fin black.

Habitat : Found near shallow reefs in coastal waters.

Distribution : Indo-West Pacific, from east coast of Africa to coasts of Indi, Andaman Is., Sri Lanka to South China Sea and New Guinea to Samoa Island.

Genus ***Gymnocaesio*** Bleeker, 1876

Gymnocaesio gymnoptera (Bleeker, 1856)
Slender Fusilier

1856. *Caesio gymnopterus* Bleeker, *Nat. Tijd. Ned. Indie.*, **10**: 372 (Type locality, Ternate, Indonesia).

1988. *Gymnocaesio gymnoptera* Carpenter, *FAO Fish. Synop.*, **8** (125) : 49, pl. IV, fig. 56.

D. X, 15; A. III, 12 P. 20-21; V. I., 5; Ll. 69-70; Ltr. 8 + 1 + 13. Body slender, two post maxillary processes; palatines and premaxilla edentate; 23-24 predorsal scales; dorsal and anal fins without scales. Body bluish green, silvery white ventrally; an yellow stripe, about one scale width, along lateral line; axil of pectoral fin black; caudal fin dusky, tips of lobes black.

Habitat : Found in reef areas in large groups.

Distribution : Indo-West Pacific, from Red Sea, east coast of Africa to coasts of India, Andaman Is., Sri Lanka to Fiji.

Genus ***Pterocaesio*** Bleeker, 1876
Pterocaesio chrysozona (Cuvier, 1830)
Goldband Fusilier

1830. *Caesio chrysozona* Cuvier, *Hist. Nat. Poiss.*, **6**: 440 (Type locality, Indonesia).

1988. *Pterocaesio chrysozona* : Carpenter, *FAO Fish. Synop.*, **98** (125) : 52, pl. IV. Fig. 54a, b.

D. X, 15; A. III, 12; P. 17-19; V. I, 5; Ll. 65-68. Ltr. 8/14-15. Two post maxillary processes; predorsal scale 23-25; dorsal and anal fins scaled. Body bluish-brown above, whitish pink below; a bright yellow band below lateral line form eye to base of caudal fin; all fins white; axil of pectoral black; tip of caudal fin lobes black.

Habitat : Found around coral reef areas.

Distribution : Indo-West Pacific, from Red Sea, east coast of Africa to coasts of India, Andaman Is., Si Lanka to South China Sea and New Guinea and Australia.

Pterocaesio marri Schultz, 1953
Marr's Fusilier

1953. *Pterocaesio marri* Schultz, *U. S. Natl. Mus. Bull.*, **202**: 545 (Type locality, Bikini Atoll, Marshall Islands).

1988. *Pterocaesio marri:* Carpenter, *FAO Fish. Synop.*, **98** (125): 56, pl. V. Fig. 60a, b.

D. X, 15; A. III, 12; P. 22-24; V. I, 5; Ll. 70-74. Body fusiform and compressed; caudal fin forked. Body bluish green dorsally, white ventrally; two longitudinal stripes, upper running along dorsal profile ending on caudal peduncle and the other along lateral line; margin of dorsal fin dusky; all fins white to light pink; axil of pectoral fin and tips of caudal lobes black. Attains 30 cm.

Habitat : Found around coral reefs in small schools.

Distribution : Indo-West Pacific.

Pterocaesio pisang (Bleeker, 1853)
Banana Fusilier

1853. *Caesio pisang* Bleeker, *Nat. Tijd. Ned. Indie.*, **4**: 113 (Type locality, Ambon, Molucca Islands).

1988. *Pterocaesio pisang* Carpenter, *FAO Fish. Synop.*, **8** (125) : 58, pl. III, fig. 52a & b.

D. X, 15; A. III, 12, P. 19; V. I., 5; Ll. 66. Ltr. 9/14. Body elongate and compressed; two post-maxillary processes; vomer and palatines dentate; 4 scale rows on cheek; 23 predorsal scales; dorsal and anal fins scaled; caudal peduncular scale rows; upper 11, lower 1.5. Body dark reddish silvery, paler ventrally; lateral line scales darker; axil of pectoral fin black; tip of caudal fin lobes dark red to black.

Habitat : Found around coral reef areas in shallow waters.

Distribution : Indo-West Pacific, from Zanzibar to coasts of India, Andaman Is., Sri Lanka to Fiji.

Pterocaesio tessellate Carpenter, 1987
One - stripe Fusilier

1987. *Pterocaesio tessellate* Carpenter, *Indo-Pacific Fishes*, (15): 47 (Type locality, Philippines).

1988. *Pterocaesio tessellate* Carpenter, *FAO Fish. Synop.*, **8** (125) : 60, pl. V, fig. 58a & b.

D. X, 15; A. III, 12; P. 21; V. I. 5; Ll. 70. Ltr. 9/16. Two post maxillary processes; palatines edentate; 5 scale rows on cheek; 29 predorsal scales; dorsal and anal fins scaled; supra-temporal band of scales confluent at dorsal mid-line. Body light bluish green, whitish to pink below; a longitudinal yellow stripe about one scale width covering lateral line; pectoral, ventral and anal fins pinkish; axil and pectoral fin black; dorsal fin light bluish green; caudal fin dusky, tip of lobes black.

Habitat : Found in reef areas.

Distribution : Eastern Indian Ocean, from east coast of India, Andaman Is., Sri Lanka to New Hebrides.

Pterocaesio tile (Cuvier, 1830)
Dark – banded Fusilier

1830. *Caesio tile* Cuvier, *Hist. Nat. Poiss.*, **6**: 428 (Type locality, Caroline Islands).

1988. *Pterocaesio tile* Carpenter, *FAO Fish. Synop.*, **8** (125) : 61, pl. II, fig. 48a & b.

D. XI, 19; A. III, 13; P. 24; V. I, 5; Ll. 71. Two post maxillary processes; 4 scale rows on cheek; 29 predorsal scales; dorsal and anal fins scaled. Scales above lateral line bluish-green; a black stripe about one scale row width along lateral line; below the stripe a brilliant blue zone; lower third of body white to pinkish; axil and upper base of pectoral black; dorsal light pinkish; caudal with black streak in each lobe, the upper streak continuous with the lateral stripe.

Habitat : Found around coral reef areas.

Distribution : Indo-Pacific, from Zanzibar to coasts of India, Andaman Is., Sri Lanka to Ryukyu Island and Mariana to Tuamotu.

Pterocaesio trilineata Carpenter, 1987
Three-stripe fusilier

1987. *Pterocaesio tessellate* Carpenter, *Indo-Pacific Fishes.*, (15): 43 (Type locality, Fiji).

1988. *Pterocaesio tessellate* Carpenter, *FAO Fish. Synop.*, **8** (125) : 63, pl. V, fig. 59a & b.

D X-XI,14-16; A III, 11 - 12. 4-5 cheek scales; 20-30 predorsal scales; supra temporal scale band

confluent at dorsal midline; scaled dorsal and anal fins; postmaxillary processes 2; posterior end of maxilla tapered; upper peduncular scale rows usually 11; lower peduncular scale rows usually 15. Body silver with three yellowish to brownish stripes alternate with three bluish stripes on back; dark tail tips. Form aggregations, often mix with other fusiliers. Attains 20 cm.

Habitat : Inhabits shallow coastal, lagoon, steel slpoes and seaward reefs.

Distribution : Indo-Pacific.

DISCUSSIONS

The fusiliers were formerly included in Lutjanidae but (Johnson, 1980) recognized them as distinct family. These fishes are characterized by a slender, streamlined body, a small mouth with a very protrusible upper jaw, 1-2 bony processes on the upper edge of the side of the premaxilla, small and conical teeth (absent in the genus *Dipterygonatus)*, a single dorsal fin with IX-XV slender spines and 9-12 soft rays, anal fin with III spines and 9-13 rays, a deeply forked caudal fin, and a band of scales across the forehead separated by a narrow scaleless area. The Fusiliers is moderately important in coastal fisheries, and is common in markets of Andaman Islands and are caught by many fishing methods. They are midwater, schooling fishes and therefore most likely to be caught by nets. In terms of overall biomass, they are one of the most important groups of coral reef fishes. They are harvested over reefs by gill nets and over soft bottom by trawl nets. They feed on zooplanktons which make them unlikely candidates for hook-and-line fisheries. In certain areas however, fusilier are routinely taken by hook-and-line. In Andaman and Nicobar Islands blast-fishing is a common method used by foreign poachers. Fusiliers are caught by explosives in the remote islands from the reef by foreign poachers, mainly from Indonesia, Thailand and Burma. In blast fishing, a bomb was thrown into a school of reef fishes over a reef slope. Blast fishing is a significant threat when targeted at large schools of fish. Despite it being an illegal fishing method, it is still widespread through the Andaman and Nicobar Islands (Rajan 2003). However caesionids has a broad geographic range, is only fished in parts of its range, and is resilient to moderate levels of harvest therefore these threats are not considered to pose a significant threat to the global population at present. The development of reef fisheries in a particular area will largely determine the fishing methods to be used and the importance of fusiliers to total fisheries production. In Andaman Islands reef fisheries are composed of numerous small engine driven wooden canoes using gillnets and hook-and –line. These fishermen use small hooks and special techniques to catch fusiliers. Their flesh is excellent eating and several species are common in the markets of Andaman Islands where they command a medium range price (Rs. 80/per kg.).

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Plate - 1

Caesio caerulaurea Lacepede, 1801

Caesio cuning (Bloch, 1791)

Caesio cuning (Bloch 1791) (underwater photo)

Caesio lunaris Cuvier, 1830

Caesio xanthonota (Bleeker, 1845)

Caesio xanthonota (Bleeker, 1845) (underwater photo)

Gymnocaesio gymnoptera (Bleeker, 1856)

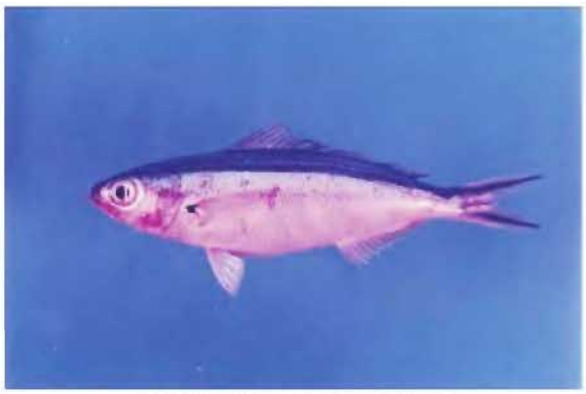
Pterocaesio chrysozona (Cuvier, 1830)

Plate - 2

Pterocaesio marri Schultz, 1953

Pterocaesio pisang (Bleeker, 1853)

Pterocaesio tessellate Carpenter, 1987



Pterocaesio tile (Cuvier, 1830)

Pterocaesio tile (Cuvier, 1830) (underwater photo)

Pterocaesio trilineata Carpenter, 1987 (underwater photo)

Pterocaesio trilineata Carpenter, 1987

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FIRST RECORD OF BANDED KRAIT, *BUNGARUS FASCIATUS* (SCHNEIDER, 1801), (REPTILIA: ELAPIDAE), FROM GURU GHASIDAS NATIONAL PARK, KORIYA DISTRICT, CHHATTISGARH, INDIA

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The present communication reports the occurrence of Banded Krait for the first time from Guru Ghasidas National Park (GGNP) as well as Koriya district of Chhattisgarh. This also represents the significant north western range extension of the species in Chhattisgarh. While undertaking the faunal survey of Protected Areas of Chhattisgarh, banded krait was sighted at the Amapani beat, Sonhat range (23°35'12.7", 82°29'20.7") of Guru Ghasidas National Park at night (10:30 PM) on 23rd May 2012 (Fig. 1). The snake was observed while it was crossing a narrow road from a paddy field to a water body on the opposite side. The paddy field was surrounded by dense bushes of *Lantana camara* interspersed with small bamboo patches. The site was at a distance of only 100 m from the nearby human habitation. The individual was an adult female with a length of 4 ft 3 in (1.31 m) from head to tail and weighing 1 kg and 250 gm (See Fig. 2A-2D). Considering the fact that the State has remained a part of the major State, Madhya Pradesh, two species of Krait namely, Banded Krait *Bungarus fasciatus* (Schneider, 1801) and Common Krait *Bungarus caeruleus* (Schneider, 1801), have been reported from the Central Indian landscape. In India, Common Krait is distributed throughout the country except some parts in Assam, Himachal Pradesh and Jammu and Kashmir. Whereas, Banded Krait is mostly restricted to the eastern part of India particularly in North-east India (Brahmaputra Basin), Andhra Pradesh (Hyderabad, Godavari valley), Central India (Chhattisgarh and parts of Madhya Pradesh), Orissa (Mahanadi valley), Bihar, Uttar Pradesh and West Bengal (northern part) (Wall 1912, Kinnear 1913, Smith 1943, Sanyal 1993, Sanyal *et al.* 1993, Sharma 2003, Whitaker & Captain 2004). Both the snakes are common throughout their ranges.

Physiography of GGNP

Guru Ghasidas National Park is located in the extreme north western part of Chhattisgarh state in Koriya district. Earlier it was included in the Sanjay National Park, but after the separation of Chhattisgarh from Madhya Pradesh it was renamed and re-established on 7th August 2001. The park extends between 81°49'29.890"E to 82°44'20.117"E Longitude and 23°30'13.815" N to 23°52'16.087" N Latitude with an area of 2898.70 sq. Km. Some part of the park (30%) falls in Surguja district. The area falls in the Central highlands and Chotanagpur subdivisions of the great Deccan Peninsula biogeographic zone (Rodgers *et al.*, 2002). Being situated at the central part of the country the biodiversity of Chhattisgarh is influenced by both northern and southern elements. The state harbours several forest types like dry-deciduous, moist-deciduous,

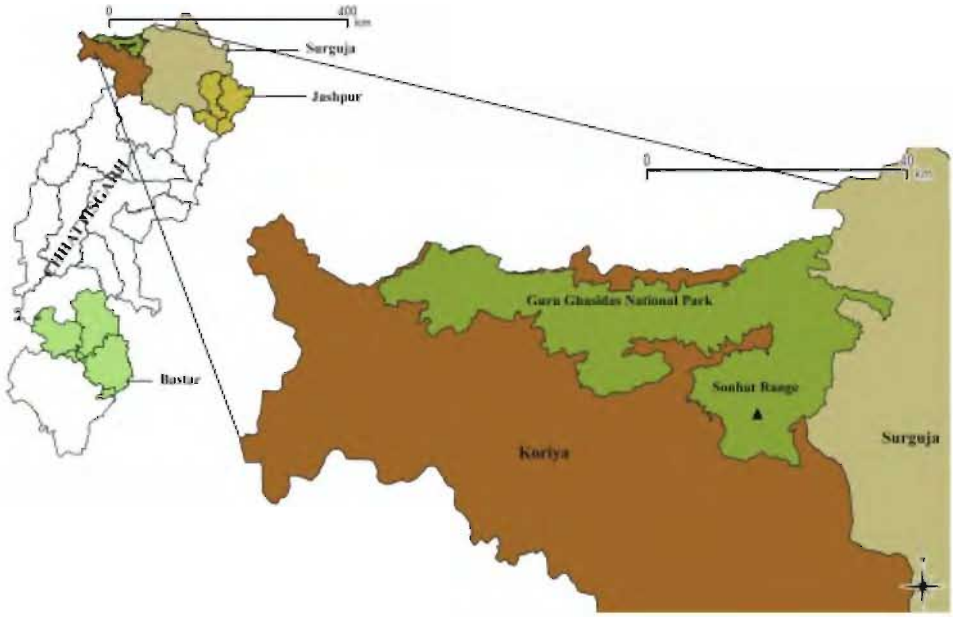

Figure 1 : Map showing the location of Guru Ghasidas National Park, Koriya and present observation site of Banded Krait (black triangular mark) and Surguja, Jashpur and Bastar districts from where the snake has been recorded in past literatures.

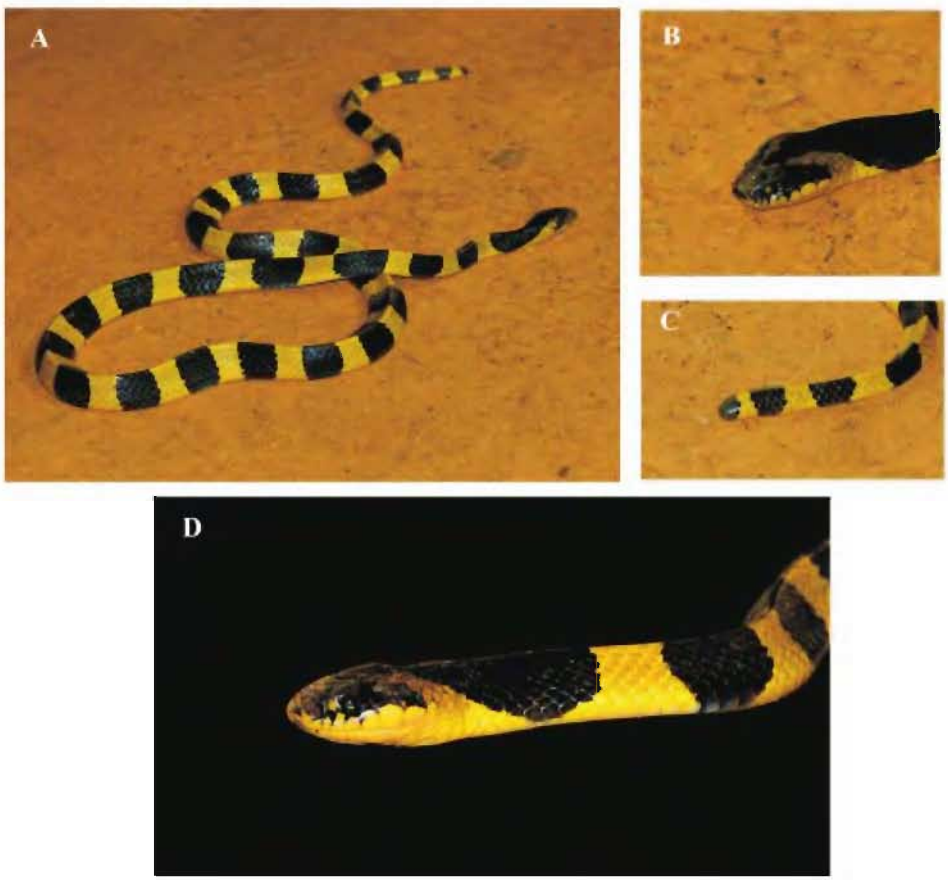

Figure 2 : A - Banded Krait (*Bungarus fasciatus*) observed at Guru Ghasidas National Park; B - Head showing distinct black mark with inverted 'V' shaped yellow border; C - Blunt tail end; D - Lateral view showing head portion.

grassland, bamboo patch and small semi evergreen forests, besides certain wetland ecosystems and freshwater bodies.

Brief note on the reptiles of Chhattisgarh

As is expected not much is known about the reptile fauna of Chhattisgarh. Except few notable works, the state lacks proper documentation of its rich faunal resources. Earlier literatures on reptiles of Chhattisgarh revealed that the Banded Krait was reported from Bastar, Surguja and Jashpur districts (Agrawal 1981, Sanyal & Dasgupta 1990, Kalaiarasan *et al.*, 1991, Ingle 2003, Chandra & Gajbe 2005). Among Protected Areas of the state, the snake was only reported from Kanger Valley National Park (Chakraborty *et al.*, 2008). According to the survey made by Zoological Survey of India in 2008, a total of 25 reptilian species including 10 species of snakes were recorded from Guru Ghasidas National Park.

A consolidated account of the herpetology of Chhattisgarh based on a large series of samples is the need of the hour. Sighting of Banded Krait though considered as common has become considerably rare in recent times due to anthropogenic activities like unregulated burning of forest floor by villagers. A concrete inventorisation of faunal diversity as well as effective conservation of the National Park is in immediate need before substantial portion of the fauna become extinct from the area without being scientifically surveyed, identified and documented.

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ON THE OCCURRENCE OF CRIMSON SNAPPER, *LUTJANUS ERYTHROPTERUS* (PERCIFORMES: LUTJANIDAE) FROM WEST BENGAL, INDIA

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INTRODUCTION

The snappers (Perciformes: Lutjanidae) are important food fishes throughout its range of occurrence including India. Their flesh is of delicate taste and highly esteemed, but some species have been reported to cause ciguatera poisoning. These fishes usually found near the bottom in tropical and subtropical seas from shallow water to depths of about 550 m. The snappers comprise 17 genera with about 106 species worldwide (Nelson, 2006; Moura and Lindeman, 2007). Indian species of snappers were last reviewed by Talwar and Kacker (1984), wherein Caesionids were erroneously grouped together under family Lutjanidae. Subsequently Talwar (1991) stated that the snappers in Indian water are represented by 9 genera and 41 species. Considerable developments in the taxonomy of snappers have been put forth worldwide (Allen, 1985; Randall *et al*., 1987; Allen, 1995) over the period, with at least 4 more species including *Lutjanus boutton* (Lacepede) (Dhandapani and Mishra, 1993) added to the list of Lutjanids of India.

A perusal of literature on snappers of West Bengal reveals that Misra (1962) has reported occurrence of 8 species of snappers, *viz*., *Lutjanus argentimaculatus* (Forsskal), *L. bengalensis* (Bloch), *L. johnii* (Bloch), *L. russelli* (Bleeker) (now *L. indicus* Allen *et. al*.,) *L. kasmira* (Forsskal), *L rivulatus* (Cuvier), *L. sanguineus* (Cuvier) and *L. vaigiensis* (Quoy & Gaimard) (=*L. fulvus*). However, Talwar *et al*., (1992) observed that the reports of *L. kasmira*, *L. rivulatus*, *L. sanguineus* and *L. vaigiensis* from West Bengal by Misra (1962) are without material confirmation and, therefore erroneous, whereas doubtfully included *L. carponotatus* (Richardson) and *L. guilcheri* Fourmanoir. Reports of *Aprion virescens* Valenciennes and *Lutjanus fulviflamma* (Forsskål) by Goswami (1992) also need to be verified. *Lutjanus holocentrum* (Bleeker) in Goswami (1992) is a wrong combination for *Priacanthus holocentrum* Bleeker (=*Priacanthus tayenus* Richardson) in the family Priacanthidae. Supporting the observations of Talwar *et al*., (1992), Chatterjee *et al* (2000) recorded only first four species from Digha coast. But Das *et al*., (2007) listed all these species except *A. virescens* and added two more names, *viz*., *L. lutjanus* (Ruppell) and *L. malabaricus* (Bloch and Schneider) to the list.

It has been well observed that adults of some species of the genus *Lutjanus* (at least 10 species) show different colour pattern in contrast with their colouration in juvenile stages. Barman *et al*. (2004) studied the morphological changes during the development of the juveniles of marine fish species occurring in West Bengal. However, occurrence of *Lutjanus erythropterus* was also not observed during that study. On the course of the study of the fishes belonging to Lutjanidae from West Bengal, the authors happened to collect 5 juvenile specimens of the Crimson Snapper during a recent visit to Digha Mohana, West Bengal. On critical examination the identity of these specimens revealed to be *Lutjanus erythropterus* Bloch that can be well distinguished from juveniles of *L. malabaricus*, a similar species.

A brief description of the species with its geographical distribution, maximum size, Interest to fisheries and habitat and biology and its affinity with its related species is discussed below to note its first record from West Bengal coast.

***Lutjanus erythropterus* Bloch, 1790**
(Crimson snapper)

1790. *Lutjanus erythropterus* Bloch, *Naturg. ausland. Fische.*, **4**: 115 (Japan).

1985. *Lutjanus erythropterus*, Allen, *FAO Fish. Synop.*, (125) **6**: 78-79.

Materials examined : 5 ex., 105 to 144 mm SL. Regd. No.: ZSI F-10618; Locality: Digha Mohana, West Bengal, India; Collected by R.P. Barman and party; on 26.ii.2012.

Diagnostic features: D X-XI, 12-14; A III, 9; P. 15 to 17; V I, 5; LL 52-53; Gr. 6-7 + 12-13. Body moderately elongate to deep and flattened. Body depth 2.21 to 2.38 and head length 2.57 to 2.61 times in standard length. Head profile convex in adults. Eye diameter 3.62 to 3.70 times in head length. Interorbital space strongly convex, 4.55 to 5.0 times in head length. Margins of preopercle finely serrate. Preopercular notch and knob poorly developed. Preorbital region between mouth and eyes without scales but scale present on cheek and preopercle. Mouth relatively small, length of upper jaw smaller than the length between last dorsal and anal fins rays. Teeth in both jaws in bands with an outer row of stronger teeth, 2 or 4 moderate canines in front of upper jaw. Teeth on vomer in a triangular patch without a median posterior extension. Caudal fin truncate or lightly emarginate. Hind part of dorsal and anal fins almost rounded. Longitudinal scale rows above and below lateral line oblique. Soft dorsal and anal fins with a scaly sheath.

Body crimson red coloured. Juveniles with a broad, oblique, black band extending from snout to origin of dorsal fin. A large black blotch, not touching ventral profile, at base of caudal fin with a white stripe extending from dorsal profile of caudal peduncle to just below lateral line anterior to the blotch.

Geographical distribution: Widely distributed in the Indo-West Pacific: from the Gulf of Oman, through India to Western Pacific, north to southern Japan, south to northern Australia.

Maximum size: It attains 60 cm, but usually found up to 45 cm in total length.

Interest to fisheries: It is an excellent food fish, generally found along its entire range of occurrence but in small quantities.

Habitat and biology: This species inhabits shallow coastal waters to about 60 m depth. It feeds on bottom living invertebrates and fish.

DISCUSSION

The Crimson Snapper, *L. erythropterus*, is similar to Malabar red-snapper, *L. malabaricus* in several accounts including the colour pattern (both the species are red in colour) and appearance of juveniles. The juvenile specimens

Fig. : *Lutjanus erythropterus* Bloch (Juvenile)

of both the species have two common features: one is dark vertical band on the caudal peduncle and another a dark band arising from snout to origin of the spinous part of dorsal fin passing through the eyes. The dark band on the caudal peduncle extends from dorsal profile to below lateral line, but not touching the ventral profile, and a white border anterior to it from dorsal profile to just below lateral line in *L. erythropterus* versus the dark band extends throughout the caudal peduncle from upper to lower parts on sides and have white borders on both the anterior and posterior of it in *L. malabaricus*.

L. erythropterus may be further distinguished from *L. malabaricus* by the possession of the following combination of characters: (i) maxilla length distinctly less than the distance between bases of last rays of dorsal anal fins (versus almost equal), (ii) interorbital width less than 5 times in head length (versus more than 5 times) in larger specimens, (iii) some longitudinal scale rows below lateral line rising obliquely in posterior direction toward dorsal surface. In *L. malabaricus* longitudinal scale rows below lateral line horizontal although some scale rows may be oblique in juveniles (Allen, 1985).

It is possible that juveniles of *L. erythropterus* may sometimes be mistaken for those of *L. malabaricus* due to the similarities stated above. At this juncture, occurrence of *L. malabaricus* along West Bengal coast as stated in Das *et al* (2007) needs further verification. Owing to having similarities in both juvenile and adult stages in colouration and morphology, the occurrence of this species along West Bengal coast might have evaded observation of earlier workers, and therefore herein it is reported as first record from West Bengal.

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IMPACT OF CLIMATE CHANGE ON THE DIVERSITY AND DISTRIBUTION OF MOSS-INHABITING INVERTEBRATE FAUNA IN SCHIRMACHER OASIS, EAST ANTARCTICA

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INTRODUCTION

Climate change have impacts on marine, terrestrial and limnetic systems, and hence will influence future biological diversity of the globe. Present day Polar Regions experience greater rates of climatic change than elsewhere on the earth. The smallest shift of climate may threat to these uniquely adapted fauna of this extreme environment. However, some small areas of terrestrial habitat still supporting terrestrial and limnetic biotas have been continuously available for periods of time ranging from the several million to only a few thousand years. Among them Schirmacher oasis (17 km long in East-West trend in between 11° 22′ 40″ and 11° 54′ 20″ longitude and about 0.7 km to 3.3 km wide in between 70° 43′ 50″ and 70° 46 ′ 40″ latitude) of East Antarctica is one of the largest ice-free terrestrial and limnetic habitat which support an unique ecosystem of Antarctica. Habitats of the Schirmacher oasis can be defined as.

Cryptoendothilic and fauna therein are associated with mosses. The moss-inhabiting fauna of Schirmacher oasis, being exposed to highly unstable and often extreme environmental condition are commonly regarded as more sensitive to the changes in climate than those inhabiting biomass having less severe environment. But nothing was reported on the effect of the gradual increasing of temperature to the terrestrial and limnetic invertebrate fauna in the Oasis.

The present article reviews the study of different scientists, including present authors on the moss-inhabiting invertebrate fauna of Schirmacher oasis of last fifteen years (1985-2000). The analysis of data so far recorded shows that the faunal density was much higher in the year 1987 than in 1985 (Ingole & Parulekar, 1993). The findings made by the scientists of Zoological survey of India (1990-2000) also support the previous results. It has also been observed that the microscopic Protozoa and Nematoda population were much more in the year 1996 than in 1990. The faunal records made in the year 2000 reveal that mite population was quantitatively and qualitatively more than earlier records from the oasis. Considering one physical parameter i.e., surface water temperature of the lakes it has been observed that the temperature ranged between 1.0° C to 3.0° C, 1.0° C to 7.9° C, 1.0° C to 7.8° C, 1.9° C to 4.0° C, 1.0° C to 4.2° C, 1.9° C to 8.4° C, 1.2 C to 7.9° C and 1.8° C to 8.9° C in 1985, 1987, 1990, 1992, 1994, 1996,1999 and 2000 austral summer respectively.

The present paper reports invertebrate species so far recorded from Schirmacher oasis and their correlation with temperature in aquatic and terrestrial ecosystems with the comments on impact of climatic changes on moss-inhabiting fauna at Schirmacher oasis.

Keywords: Antarctica, Schirmacher Oasis, Invertebrate fauna.

Table 1 : List of moss-inhabiting invertebrate genus/species reported from Schirmacher oasis

Sl.No.	Group	Sl. No.	Species
1.	PROTOZOA	1.	*Arcella arenaria* Greef
		2.	*Diplochlamys* sp.
		3.	*Parmulina* sp.
		4.	*Centropyxix aerophila* (Diflandre)
		5.	*Difflugia* sp.
		6.	*Nebella* sp.
		7.	*Corythion dubium* Taranck
		8.	*Assulina muscorum* Greef
		9.	*Euglypha* sp.
		10.	*Trinema* sp.
		11.	*Colpoda* sp.
		12.	*Oxytricha fallax* Stein
		13.	*Stylonchia* sp.
2.	ROTIFERA	14.	*Philodina gregarina*
3.	TARDIGRADA	15.	*Hypsibius chinensis* (Plate)
		16.	*Macrobiotus polaris* (Murray)
		17.	*Echinoiscoides* sp.
4.	NEMATODA	18.	*Helicotylenchus* sp.
		19.	*Rotylenchus* sp.
		20.	*Dorylaimus* sp.
		21.	*Rhabditis* sp.
		22.	*Mononchus* sp.
		23.	*Teratocephalus tilbrooki*
		24.	*Plectus* sp.
5.	COLLEMBOLA	25.	*Xenella* sp.
		26.	*Isotoma* sp.
		27.	*Cryptopygus antarcticus*
		28.	*Calx* sp.
		29.	*Sphaeridia* sp.
6.	ACARINA	30.	*Chelacaropsis moorei* Baker
		31.	*Nanorchestes* sp. nr. *antarcticus* Strandtmann
		32.	*Pronematus* sp.
		33.	*Paratydeus* sp.
		34.	*Raphignathus* sp.
		35.	*Pediculaster* sp. nr. *mongolichus* Mahunka
		36.	*Acarus siro* Linnaeus
		37.	*Tyrophagus longior* (Gervais)
		38.	*Suidasia nesbitti* Hughes
		39.	*Proctolaelaps antarcticus* Sanyal & Gupta
		40.	*Hypoaspis* sp. nr. *oblonga* (halberd)
		41.	*Hypoaspis* sp.
		42.	*Haplochthonius antarcticus* Sanyal, Basak & Barman
		43.	*Haplochthonius maitri* Sanyal, Basak & Barman
		44.	*Haplochthonius longisetosus* Sanyal, Basak & Barman
		45.	*Maudheimia petronia* Wallwork
7.	TURBELLARIA	46.	*Neorhabdocoel* sp.
		47.	*Kalyptorhynchia* sp.
8.	OLIGOCHAETA		NOT IDENTIFIED

Table 2 : Physico-chemical parameter of the lakes of Schirmacher Oasis in austral summer (Year-wise)

	1985	1987	1990	1992	1994	1996	1999	2000
Surface water Temperature (°C)	3.0	7.9	7.8	4.0	4.2	8.1	7.9	8.2
D.O. mgl^{-1}	10.5	12.02	9.9	8.5	8.4	11.2	11.0	10.2
pH	8.1	8.77	8.25	8.25	5.6	8.4	7.9	8.0

Brief description of the Lake watersystems at Schirmacher Oasis

The lakes in Antarctica vary from brackish to freshwater in nature, depending upon their distance from the coast. In Schirmacher oasis the hill slopes remain covered with ice in winter, but in summer melting water gets accumulated in the depression areas between the hills and forming the large and small fresh water lakes. The shape, size and the formation of the lakes depend very much upon the quantity of melting water. The catchment consists of barren moraine material, and patches of macrophytes in wet area. The majority of these lakes are archaic, possessing no outflow, and the annual ablation rate is generally balanced by the summer ephemeral inflow of glacial melt streams.

Moss-inhabiting invertebrate Faunal Composition at Schirmacher Oasis

Altogether 47 species of 8 micro faunal groups were identified from this Oasis of which Acarina (16 species) shares the maximum number of species followed by Protozoa (13 species), Nematoda (7 species), Collembola (5 species), Tardigarda (3 species), Turbellaria (2 species) Rotifera (1 species) and Oligochaeta (species not known) (Table.2).

The scientific exploration in Schirmacher Oasis was started in 1965 with the publication of Bardin & Leflat on the chemical characteristics of the lake water system. This was followed by investigation on the nutrient concentrations and primary productivity in some freshwater lakes of Schirmacher Oasis (Kaup, 1988a, b).

Ingole & Parulekar (1987) were the first to report Protozoa from this region and recorded only one species of ciliate. They have stated that Protozoa are the most dominant group and comprising of 22.31% of the total lacustrine fauna of this area.

Ingole & Parulekar (1988, 1990 and 1993), Fondekar & Goes (1988) and Hussain *et al.* (1990) studied the limnology, chemistry and benthic fauna of the lake water system of the oasis. The study revealed 7 microfaunal groups, dominated by Protozoa, Rotifera, Nematoda, Turbellaria, Tardigrada, Oligochaeta and Acarina. Faunal density was found to be high in moss-associated sediments.

Hazra (1994) was the first to record 5 genera/species of nematode from the Schirmacher oasis. Further addition of other 5 genera/species of nematode from this oasis was made by Mitra (1999).

Afterwards Mitra *et al.* (1997) and Mitra (1999) reported 17 species of Protozoa from this area of which 16 were new to the Oasis. Chaterjee *et al.* (2000) first time made the community analysis of testacean species from this oasis.

Hazra & Mitra (2002) studied 36 sites (33 lakes and 3 swampy areas) and reported 6 micro faunal groups from this oasis. They also reported that the faunal density is much more in the lakes, situated in between shelf and Polar ice caps. Among the protozoans, *Assulina muscurum* Greef is the most widely distributed species and among the nematodes, the *Tylenchorhyncus* sp. is the most dominant genus and represented by 41% of the total nematode fauna of this oasis. Ghosh *et al.* (2000) studied the nematode fauna of this area and described the first new species *Antarctenchus motililus* Gosh, Chaterjee, Mitra & De (2005) from the Scirmacher Oasis.

Venkataraman (1995) reported a lone species of Rotifera *Philodina gregarina* and Mitra (1999) recorded 2 species of Tardigrada from this oasis.

Mitra (1999) was the first man who reported two species of Collembola and two unidentified mite species from this Oasis. Afterwards Sanyal (2004, 2005), Sanyal *et al.* (2002) and Sanyal & Gupta (2005) reported 17 species of mites including five new species which was the pioneering work on mites from Schirmacher Oasis.

DISCUSSION

Over 150 years of Antarctic biological research has produced more than 2000 publications in the field of taxonomy, biology, physiology and ecology of different groups of invertebrate fauna of marine, terrestrial and lacustrine fauna. But very few works have so far been documented on the threats of the invertebrate fauna due to recent climatic change over the Antarctica and Schirmacher Oasis in particular.

Maritime Antarctic freshwater habitats are amongst the fastest changing environments on earth. Temperature has raised around 1° C and ice cover has dramatically decreased in 15 years (Peak, 2005). Environment changes pose a range of problems for species that vary between site and species. Abilities to cope with change differ from individual to species levels. Researches on abilities to withstand have focused primarily on temperature changes, but other environmental factors are also likely to be affected. It is still unknown to us how biota in Schirmacher Oasis will respond to climatic change.

The present paper has summarized the changing pattern of faunal composition and density due to various factors which are directly related with risen of temperatures from 1985 to 2000. Summer cooling is particularly important to Antarctic terrestrial ecosystem that is poised at the interface of ice and water. All the invertebrate species of this area are going to reproduce or multiply their numbers in the short span of austral summer.

In the austral summer of the year 1985, Ingole & Parulekar (1987) observed that among the seven microfaunal groups found in the Oasis, the nematodes were the dominant group (22.13%). In other comparative studies in austral summer between 1985 and 1987, it was found that faunal density had a strong correlation with organic carbon content and the sediment texture and therefore the faunal density was much higher in 1987 than in 1985 (Ingole & Parulekar,1993).

According to Ando (1979) increase of air temperature in 1987, must be a factor responsible for the differentiation of faunal standing crop between 1985 and 1987 and may affect the microfauna with other factors. While studying the ecobiology of a freshwater lake at Schirmacher Oasis, Ingole and Dhargalkar (1998) showed that faunal density was increasing year-wise i.e. 1639 (1985), 2930 (1987), 3569 (1992) and 3489 (1994) respectively. According to them the increase in population of microorganisms was due to increased sedimentation, organic enrichment and silt deposition from an inflow of streams.

Afterwards several workers (Mitra, 1999; Ghosh *et al.*, 2002 & 2005; Hazra & Mitra, 2008; Sanyal *et al.* 2002; Sanyal, 2004 & 2005; Sanyal & Hazra, 2008) have worked on the invertebrate faunal composition and contributed 47 species under 8 microfaunal groups (Table 2). From their findings it has been found that addition of species has been made in every austral summer but the numbers of micro faunal groups were not changed.

Mitra (1999) reported that dominancy of the immature forms in the population particularly in the groups like, Protozoa, Nematoda and Acarina indicated the over lapping of generation. This was the clear indication that the environment was suitable for their reproduction or multiplication. Sanyal (2004) reported that mite population was quantitatively and qualitatively more than earlier records from the Oasis.

Chatterjee *et al.* (2000) stated that the assemblages of Testaceans were dependant upon more than one abiotic parameter. They also opined that pH of water might be the most important factor influencing the community structure of the Testaceans.

The reason for maximum aggregation of population in the upper layer during summer in Antarctic region might be related to the density of texture of moss which acted as a source of food for

nematodes and other invertebrate fauna (Maslen, 1981).

From the above analysis it is clear that the gradual increase of temperature accelerates the melting of ice, which increases the sedimentation of the lakes, phytoplankton productivity and ultimately increases the population density of the invertebrate fauna.

As a whole, 47 species under 8 micro faunal groups are so far reported from this area. It is interesting to note that the finding on Oligochaeta by Ingole & Parulekar (1987) in Scirmacher Oasis was not reported by the recent workers. This may be the indication of loss of biodiversity due to increase of population density of other groups dominated over this area.

From the above analysis it can be concluded that Schirmacher Oasis is also under threat of recent climatic change. These changes are not only in temperature but also precipitation, increased sedimentation, organic enrichment, silt deposition, pH concentration, etc. Current models predict that subantarctic and Maritime Antarctic terrestrial sites are likely to warm significantly over the next 100 years, by possibly as much as 5° C. According to Peck (2005), that species diversity, community biomass and complexity will increase in coming years. So there is every possibility that new species will eventually appear on the Schirmacher Oasis as warming continues, and these new species could displace the current endemic groups. Therefore, a long term monitoring work on the climate change in the area is highly needed to understand the impact on the global warming on the moss-inhabiting faunal composition of this extreme and unique ecosystem of the earth.

SUMMARY

Since the beginning of the Indian scientific expedition to Antarctica many scientists were engaged to study the moss-inhabiting invertebrate faunal composition of terrestrial and limnetic ecosystem of Schirmacher Oasis. Fifteen years (1985-2000) of meteorological data indicate that there is a trend of warming the lake water system of the Schirmacher Oasis which has an impact on the faunal composition of this ice-free area of East Antarctica. The record shows gradual increase of temperature directly correlates with the increase of faunal population density and low species richness.

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ENDEMIC ANNELIDS (EARTHWORMS) OF DARJEELING DISTRICT, WEST BENGAL, INDIA

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INTRODUCTION

Earthworms occur in diverse habitats all over the world. However, they rarely survive in deserts, marine environments, areas under constant snow and ice, and areas devoid of soil and vegetation. They possess limited means of active dispersal. High mountain ranges and seas are the effective barriers for extension of their natural distribution. The origin of earthworms is unclear due to absence of any fossil records. Therefore, their phylogeny has been derived by the analysis of distribution, ecology, and comparative anatomy of the extant species. Stephenson (1930) considered their appearance in the Cretaceous, coinciding with dicotyledonous plants. Michaelsen (1903) and Arldt (1908) estimated their origin much earlier during Upper Jurrasic and Upper Triassic periods, respectively. Sims (1980) believed that ancestors of present day earthworms were prevalent in the undivided palaeocontinent of Pangaea that existed during the Palaeozoic. Later, Bouché (1983) ascertained their origin in Palaeozoic period, and believed that the Oligochaeta acquired the characters adapted to true terrestrial life at the end of Palaeozoic or during early Mesozoic. Plate tectonics, in addition to special physiological and developmental strategies evolved during the past, influenced the speciation events that resulted in modern distribution of earthworm taxa (Michaelsen, 1922; Omodeo, 1963, 2000). Bouché (1983) also inferred the present-day distribution of earthworms as an outcome of three factors *viz.*, the origin of founders, their migratory capacity and their ability to survive. Some species are distributed over wide areas in different regions of the world owing to anthropogenic actions. Anthropochorous or peregrine species are capable of colonizing disturbed environments in contrast to endemic species. These species are, therefore, disregarded for distributional considerations of earthworms (Julka, 1993).

Endemic taxa occur naturally and are restricted to a specific geographical region; therefore, the area where endemics live is wholly irreplaceable. Endemics may be categorized on the basis of their spatial distribution, inferred evolutionary age and affinities, and abundance. From spatial distribution perspective, endemics may occupy limited geographical ranges, *i.e.* have a limited 'extent of occurrence' and also have a limited 'area of occupation' within their geographical range (Gaston, 1991). In practice, endemics are loosely and commonly categorized in four contexts (Hawksworth and Kalin-Arroyo, 1995) as: (a) site or restricted area endemic (b) biotope endemic (c) biogeographical region endemic, and (d) political area endemic, also called national endemic. Range sizes for defining local endemism of species endemic to a given geographical area are often arbitrarily set varying from less than 50,000 km^2 for birds and plants (Terborgh and Winter, 1982; Gentry, 1986; ICBP, 1992) to 2000 km^2 for locally endemic plants in the

Cape Floristic Region of South Africa (Cowling and Holmes, 1992). Harvey (2002) suggested a nominal distribution range of less than 10,000 km^2 as a working definition for species with naturally small distribution ranges, termed as short-range endemic (SRE) species. Eberhard *et al.* (2009) recommended a smaller area of less than 1,000km^2 for stygofauna.

PHYSIOGRAPHY

Darjeeling, the northern most district of West Bengal, lies between 26°27' to 27°13' N and 88°53' to 87°59' E, stretches out in an area of 3149 km^2. The Hill areas of the district are located within the Lesser and Sub-Himalayan belts of the Eastern Himalaya. The Sikkim Himalaya in the north, the Bhutan Himalaya in the east and Nepal Himalaya in the west bound the area. The altitude in the district varies significantly from 100 msl to mighty snow clad Kanchenjungha (8579 msl). The variations in topographical features due to three primary attributes (i.e., latitude: south-north; longitude: east-west; altitude: low-high) bring on diversity in climate and habitat conditions within the region (O'Malley, 2001).

The temperature in the district fluctuates greatly depending upon the location and altitude. It ranges from 24°C in the plains to 15°C on the ridge during summer and drops from (-)5°C to 10°C during winter. There is no distinct correlation between total rainfall and altitude. The southern slopes of the ridges get much higher (4000-5000mm) precipitation than the leeward sides (2000-2500mm). The next main ridge with Tiger Hill gets 3000mm while to the north the Great Rangit valley receives about 2000mm of rainfall. The annual total rainfall in Darjeeling district fluctuates between 3040-4570mm (O'Malley, 2001).

Soils of Darjeeling hill areas are extremely varied, depending on elevation, degree of slope, vegetative cover and geolithology. The soils in the Kalimpong area are predominantly reddish in color with occasional dark soils; in the highlands stretching from the west to the east are mainly mixed sandy loams and loamy, while on the southern slopes of Mirik and Kurseong are mainly clayey loam and reddish in color. Sandy soils are mainly found in the east of the river Tista (O'Malley, 2001).

Due to vast altitudinal variation, the forest type varies in different altitudinal ranges, *viz.* tropical moist deciduous forest (300-1000m), tropical evergreen lower montane forest (1000-2000m), tropical evergreen upper montane forest (2000-3000m), temperate forest (3000-3500m), and sub temperate forest (above 3500m). However, major tracts of the forests are found at elevations of 2000m and above. The area located between 1000-2000m is transformed either into tea gardens or agriculture fields (O'Malley, 2001).

The vegetation in the district is very rich in diversity as well as density. These include about 4,000 species of flowering plants, 300 species of ferns including tree ferns, 283 species of orchids (Yonzone *et al.*, 2012), and several species of moss, algae and fungi. The trees of *Shorea robusta*, *Acacia catechu*, *Dalbergia sissoo*, *Terminalia* sp., *Albizia* sp., *Dendrocalamus* sp., etc., are growing in the tropical zone; *Magnolia* sp., *Michelia* sp., *Quercus* sp., *Pyrus* sp., *Synplocos* sp., *Eugenia* sp. and conifers (*e.g. Juniperus* sp., *Cryptomeria* sp., *Abies* sp., *Pinus* sp., *Larix* sp., *Tsuga* sp.), *Salix* sp., *Rhododerdron* sp., *Arundinaria* sp. in the temperate zone; junipers, *Rhododendron* sp., etc. in the alpine zone are among commonly occurring plants. The understory of shrubs, herbs and climbers comprises mostly species of *Acanthaceae*, *Melastomataceae*, *Apocynaceae*, *Rubiaceae*, *Malvaceae*, *Urticaceae*, *Polygonaceae*, *Vitaceae*, *Cucurbitaceae*, *Convolvulaceae*, *Smilax*, *Dioscorea*, *Rhaphidophora*, etc., and several species of orchids, ferns and grasses in the tropical zone; and *Clematis*, *Berberis*, *Ilex*, *Rosa*, *Potentilla*, *Cotoneaster*, *Spiraea*, *Aucuba*, *Lonicera*, *Osbeckia*, *Vaccinium*, *Agapetes*, *Polygonum*, *Aconitum*, *Viola*, *Chrysosplenium*, *Fragaria*, *Gentiana*, *Campanula*, balsam, lilies, etc., in the temperate zone. About 30% of the forest covers found in the lower hills are deciduous. Evergreen forest constitutes only about 6% of the total forest area. *Shorea robusta* is the most prominent species of tropical moist deciduous forest along with heavy undergrowth. Tropical lower montane evergreen forests are

found on steep higher slopes with good drainage condition, whereas, tropical upper montane evergreen forests are found in high humidity areas, along with dense fog and less sunlight. Undergrowth is dense and contains nettles, raspberries, ferns and bamboos. On the steep ridges, rhododendrons and bamboos are abundant (O'Malley, 2001).

Earthworm Diversity

India is identified as mega biodiversity country representing vast area of two major hotspots, *viz.*, Himalaya and the Western Ghats. Both the regions hold a rich biological wealth with especially high number of endemic species. Earthworm diversity (Megadrili) in Indian territory, including islands of Andaman & Nicobar, and Lakshadweep, is known by 418 species belonging to 70 genera spread over 9 families displaying high diversity concentrations in these hotspots (Julka *et al.*, 2009). Endemism among Indian earthworms at genus and species level is enumerated around 71 and 89 percent respectively. Eastern Himalaya including northeast hill Ranges and hills of Darjeeling district and Sikkim harbour rich biological wealth due to their varied physiography and geological history. Earthworms of Darjeeling and Sikkim Himalayan region have been studied by Michaelsen (1907), Stephenson (1916, 1917, 1920, 1931), Gates (1972), Julka (1975), Soota and Halder (1981), Halder (1999) and Halder *et al.* (2007). Rich earthworm diversity of Darjeeling district is represented by 47 species spread over 6 families exhibiting about 11% of the Indian species. Most diverse family Megascolecidae is represented by 30 species followed by Lumbricidae (8 spp.), Octochaetidae (5 spp.), Acanthodrilidae (2 spp.), and Moniligastridae and Glossoscolecidae by one species each. Wide-ranging physiographic features of the district provide appropriate ecological requirements for the proliferation and sustenance of these species.

Distribution

Family-wise details of earthworm fauna recorded from Darjeeling district is given below. Species marked with an asterisk (*) are also distributed elsewhere outside Darjeeling district.

Family **Moniligastridae** : *Drawida nepalensis**.

Family **Lumbricidae** : *Aporrectodea rosea rosea**, *Bimastos parvus**, *Dendrobaena hortensis**, *Dendrodrilus rubidus**, *Eisenia fetida**, *Eiseniella tetraedra tetraedra**, *Octolasion cyaneum**, *Octolasion tyrtaeum**.

Family **Glossoscolecidae** : *Pontoscolex corethrurus**.

Family **Acanthodrilidae** : *Plutellus (=?Argilophilus) ghumensis*, *Plutellus (=?Argilophilus) sikkimensis*.

Family **Octochaetidae** : *Dichogaster modigliani**, *Dichogaster saliens**, *Eutyphoeus gammiei**, *Octochaetona beatrix**, *Scolioscolides bergtheili**.

Family **Megascolecidae** : *Amynthas alexandri**, *Amynthas corticis**, *Amynthas gracilis**, *Amynthas morrisi**, *Amynthas robustus**, *Lampito mauritii**, *Metaphire anomala**, *Metaphire californica**, *Metaphire houlleti**, *Metaphire planata**, *Perionyx alatus*, *Perionyx annandalei*, *Perionyx excavatus**, *Perionyx gravelyi**, *Perionyx heterochaetus*, *Perionyx himalayanus*, *Perionyx inornatus*, *Perionyx jorpokriensis*, *Perionyx macintoshi**, *Perionyx nanus*, *Perionyx pallidus*, *Perionyx pincerna*, *Perionyx pokhrianus*, *Perionyx pokhrianus affinis*, *Perionyx pulvinatus*, *Perionyx rimatus*, *Perionyx setnai*, *Perionyx sikkimensis*, *Perionyx variegatus**, *Tonoscolex monarchis**.

Moniligastridae family belongs to primitive earthworms with genus *Drawida* being the largest one in terms of species diversity. Natural distribution of the genus extends to the southeast and eastern Asia. In India, the natural range of the genus is in eastern Himalaya, northeast Ranges, and Peninsula. Anthropochorus *Drawida nepalensis* is distributed in western and eastern Himalaya, northeast hill region, and Andaman and Nicobar Islands. The original home of the species is believed likely in Himalaya, and wide distribution is attributable to transportation (Gates, 1972).

Members of the family Lumbricidae are endemic throughout the Palaearctic region and eastern North America. However, a number of anthropochorous lumbricids have successfully

colonized in other zoogeographical regions of the world. All lumbricids occurring in the district are exotic and distributed in the Himalaya and other hilly regions due to their inherent ability to survive in their climatic boundaries and soil types.

Glossoscolecidae family forms a dominant group in tropical South America. *Pontoscolex corethrurus* is a circummundane species that is also widely distributed in many parts of India and acquiring newer domains.

Acanthodrilidae family is well represented in its home range in South America, some parts of North America, Africa, southeast Asia and Australasia. Three genera occur in India, *viz. Plutellus*, *Microscolex*, and *Pontodrilus*, the later two being peregrines. Twenty two species of *Plutellus s. lat.* (=?*Argilophilus*, generic definition under revision) are distributed in southern hills, Gangetic plain, eastern and western Himalaya, and northeast hill Ranges, showing discontinuous distribution in India.

Distribution of Octochaetidae family is exhibited in New Zealand, Australia, Indian Subcontinent (excluding Sri Lanka and other islands) through tropics of America and Africa, including Madagascar. Indian Octochaetids comprise 140 species distributed under 30 genera, including exotic Ethiopian genus *Dichogaster* represented by 5 species. *Eutyphoeus* and *Scolioscolides* genera are distributed in north and northeastern region of Indian subcontinent, whereas, *Octochaetona* is widespread in its home range in peninsular India. The monotypic *Scolioscolides* earlier known from its type locality Sandakphu in Darjeeling district has been found widespread in the forested areas of eastern Nepal (Julka *et al.*, 2009).

Distributional range of family Megascolecidae extends between warm temperate Asia and Australasia. Pheretimoid *Amynthas* and *Metaphire* belong to the Indo-Malayan zoogeographical sub-region (Gates, 1972). These are represented by peregrine species on the Indian mainland. Native *Lampito* known by 8 species has its home range in southern hills of Peninsula including a widely distributed *Lampito mauritii* that frequently occurs in almost all types of agro-ecosystems (Julka and Paliwal, 2005). *Tonoscolex* occurs in eastern Himalaya, northeastern hill Ranges and Myanmar, with 7 species discovered in India. *Perionyx* is native in Peninsula, eastern and western Himalaya and Myanmar, though, *Perionyx excavatus* and *Perionyx sansibaricus* have acquired wide range of distribution.

Endemism

Harvey (2002) noted several life history features that are characteristic, and may be central to the evolution of short-range endemism, including poor powers of dispersal, ecological confinement to discontinuous or rare habitats, slow growth and low fecundity. Diversity, distribution and abundance of earthworms, in general, are closely related with the soil characteristics, vegetation and precipitation. Earthworms have limited power of active dispersal as most of the species can move generally less than 10m per year, except those known to migrate large distances.

The distribution of *Plutellus s. lat.* and *Perionyx* extends from Deccan peninsula to eastern and northeastern region. A few species are also discovered from western Himalaya and Gangetic Plains. Majority of species in these genera has been found in the Deccan region, and eastern Himalaya and northeast hill Ranges. Similar trend of high species diversity in these taxa has also been documented in the, somewhat congruent, Myanmar (Gates, 1972). These areas are the centres of high rainfall, rich vegetation cover and so the soil organic matter. Stephenson (1923) has stated the chief home of *Perionyx* is the eastern Himalaya. Ancestors of *Plutellus s. lat.*, and *Perionyx* arose in peninsular India (Gates, 1972). It appears that peninsular India passed on these genera to northeast Hills and eastern Himalaya, over the Miocene land-Bridge (Julka and Paliwal, 2005). A high level speciation seems to have occurred in eastern Himalaya and adjacent Myanmar contributing to the evolution of the endemic species.

Studies revealed occurrence of 17 short-range endemic species of earthworm belonging to *Plutellus s. lat.* (2 species) and *Perionyx* (15 species).

These are known exclusively from the hills of Darjeeling district and have not been recorded anywhere else, even in the same biogeographic region, and flanking Myanmar. Soil characteristics, native floral cover and high rainfall that define suitability of habitat for these endemic species, coupled with their dispersal capacity may be determinants of species range.

It is noteworthy that concept of endemism is particularly influenced by taxonomic impediment and poor regional survey. Endemic status of a given species may change with the expansion of geographical distribution range.

List of earthworms endemic to Darjeeling district

Family : ACANTHODRILIDAE

1. *Plutellus* (=?*Argilophilus*) *ghumensis* Julka, 1975
2. *Plutellus* (=?*Argilophilus*) *sikkimensis* Michaelsen, 1907

Family : MEGASCOLECIDAE

3. *Perionyx alatus* Stephenson, 1920
4. *Perionyx annandalei* (Michaelsen, 1907)
5. *Perionyx heterochaetus* (Stephenson, 1917)
6. *Perionyx himalayanus* Michaelsen, 1907
7. *Perionyx inornatus* Stephenson, 1916
8. *Perionyx jorpokriensis* Julka, 1975
9. *Perionyx nanus* Stephenson, 1917
10. *Perionyx pallidus* Stephenson, 1917
11. *Perionyx pincerna* Stephenson, 1916
12. *Perionyx pokhrianus* Stephenson, 1920
13. *Perionyx pokhrianus affinis* Stephenson, 1920
14. *Perionyx pulvinatus* Stephenson, 1916
15. *Perionyx rimatus* Stephenson, 1920
16. *Perionyx setnai* Stephenson, 1931
17. *Perionyx sikkimensis* (Michaelsen, 1907)

SYSTEMATIC ACCOUNT

Phylum : ANNELIDA
Sub-phylum : CLITELLATA
Class : OLIGOCHAETA
Order : HAPLOTAXIDA
Sub-order : LUMBRICINA
Family : ACANTHODRILIDAE

1. *Plutellus* (=?*Argilophilus*) *ghumensis* Julka, 1975.

1975. *Plutellus ghumensis* Julka, *Mitt. zool. Mus. Berlin*, **51**(1): 24.

Diagnosis: Length 27-54 mm, diameter 1-1.5mm, 61-109 segments. Prostomium epilobic, tounge open, unpigmented. First dorsal pore at 6/7. Setae lumbricine, *AB*<*CD*<*BC*<*AA*, *DD*<½C. Clitellum saddle-shaped, ½13-17/18, dorsal pores and intersegmental furrows lacking, setae retained. Male pores minute, at centre of conspicuously raised circular porophores in *AB* on 18. Female pores paired, on 14, in *A* lines. Spermathecal pores at 7/8/9, on or slightly median to *C* lines. Genital markings small, nearly circular, in transversely placed rows of 2-5, intersegmental in some of 8/9/10, 11/12/13, 14/15/16/17/18, 19/20, 21/22/23/24.

Septa 5/6 slightly muscular, 6/7-8/9 muscular. Gizzard in 5, intestinal origin in 15, typholosole absent. Last pair of hearts in 12, those of 10-12 latero-oesophageal. Holandric, male funnels apparently free; seminal vesicles small, in 11 and 12, those of 11 touching each other dorsally. Prostates tubular, coiled, may extend up to 21; duct short, slender, nearly straight; vasa deferentia unrecognizable anteriorly, in 17 it passes into anterior face of prostatic duct just ental to parietes. Penial setae 0.464 to 0.532 mm long, 0.012 mm thick; shaft slightly bow-shaped with a notch at the tip, ornamentation of 8-12 circles of fine rather triangular teeth. Quadrithecal; spermathecae fairly large; ampulla ovoid; duct about as long as ampulla, straight , thick, slightely tapering before entering parietes; bidiverticulate; with laterally and mesially, slenderly club-shaped diverticula. Diverticulum close to parieties, as long as or slightly longer than spermathecal duct. Ovisacs in 14. Genital marking glands unrecognizable internally.

Distribution: Jorpokri, Hima Falls, Ghum Bhanjang, Darjeeling district, West Bengal, India.

2. *Plutellus* (=?*Argilophilus*) *sikkimensis* Michaelsen, 1907

1907. *Plutellus sikkimensis* Michaelsen, *Jb. hamb. wiss. Anst.*, **24**: 147.

1972. *Plutellus sikkimensis* Gates, *Trans. Am. phil. Soc.*, **62**(7): 45.

Diagnosis: Length 42mm, diameter 1mm, 90 segments. Prostomium epilobic, tongue open. First dorsal pore at 6/7. Setae widely spaced, *DD*<½C, *A*, *B*/18 penial. Male pores paired, on 18, at *B*, within a median field that reaches into 17 and 19. Spermathecal pores at 4/5/6/7/8/9, just median to *B* line. Genital markings paired, transversely elliptical, in *AB* and across 12/13.

Gizzard small, in 5; intestinal origin in 14. Last pair of hearts in 12. Holandric; seminal vesicles apparently in 9, 11 and 12. Penial setae *ca.* 0.33mm long and 9μ thick at middle, ectal portion of shaft bent at an obtuse angle, tip sharply pointed, slender, slightly curved, ornamentation of 9 oblique circles with about 9 very large teeth in each circle.

Distribution: Sandakphu, Darjeeling district, West Bengal, India.

Remarks: The species is known from only immature specimens. The description of the species is inadequate due to unrecognizable specific characteristics.

Family : MEGASCOLECIDAE

3. ***Perionyx alatus*** Stephenson, 1920

1920: *Perionyx alatus* Stephenson, *Mem. Indian Mus.*, **7**: 212.

Diagnosis: Length 84mm, diameter 3mm, 123 segments. Prostomium epilobic, tounge open. First dorsal pore at 4/5. Setal rings closed dorsally as well as ventrally, setae rather closer set ventrally. Clitellum in segments 13-⅓ 17. Genital papillae one pair, on 18, large, transversely elongated, joined in the middle line by a narrow neck, with crenulated margins; the conjoined papillae surrounded by a deep groove. Male pores as transverse grooves in the broader inner part of the papillae. Spermathecal pores two pairs, in 6/7/8, in line with setal interval *DE*.

Gizzard large, cylindrical, in 5; intestinal origin in 20. Last pair of hearts in 13. Nephridia end all in the same line. Holandric; testis sacs in 10 and 11; seminal vesicles in 11 and 12, fused dorsally over the alimentary canal in each segment. Prostates large, in 17-19, duct irregularly twisted, widest at its ectal end. Penial setae 1mm long, 20μ thick; shaft almost straight but curved like hockey-stick at the proximal end; tip bluntly pointed, shaft distally ornamented by minute irregularly scattered spines. Quadrithecal; posterior pair larger; ampulla sac-like, duct stout shorter than ampulla, separated from ampulla by a constriction, swollen upper part of the duct corresponds to diverticulum, devoid of definite seminal chambers.

Distribution: Sitong Ridge, Darjeeling district, West Bengal, India.

4. ***Perionyx annandalei*** (Michaelsen, 1907)

1907. *Perionychella annandalei* Michaelsen, *Mitt. naturh. Mus. Hamb.*, **24**: 154.

1923. *Perionyx annandalei* (part), Stephenson, *Fauna Br. India, Oligochaeta*: *324. (Excluding specimens from Cherrapunji (Meghalaya).*

Diagnosis: Length 160-280mm, diameter 6-10mm, 170-215 segments. Prostomium proepilobic, shortly epilobous or half epilobous. First dorsal pore at 6/7. Setae very small in anterior part of the body, more closed ventrally, rings complete or shortly interrupted dorsally. Clitellum in segments 12-24. Male genital field depressed or elevated, occupying the whole length of 18, the area elevated in the setal zone forming a ridge; male pores in the lateral parts of the area in the setal zone, a few setae on the ridge between male pores. Spermathecal pores two pairs in 7/8/9, near middle line.

Gizzard moderately large, in 6; calciferous glands absent. Holandric; male funnels apparently free, in 10 and 11; seminal vesicles in 11 and 12 or 11, 12 and 13, compact and grape-like. Prostates occupying 18 and 19; duct short and thick. Penial setae absent. Quadrithecal; ampulla sac-like or irregular; duct half as long as ampulla; seminal chambers two or three, papilla-like or as many small knobs, on the duct.

Distribution: Kurseong, Darjeeling district, West Bengal, India.

5. *Perionyx heterochaetus* (Stephenson, 1917)

1917. *Perionyx aborensis* var. *heterochaetus* Stephenson, *Rec. Indian Mus.*, **13**: 379.

1923. *Perionyx heterochaetus*, Stephenson, *Fauna Br. India, Oligochaeta*: 335.

Diagnosis: Length 60mm, diameter 2.5mm, 100 segments. Prostomium epilobic, tongue open behind. First dorsal pore at 5/6. Setae on dorsal surface in anterior part of body much larger and set further apart than posterior region. Clitellum in segments 13-17. Male genital field a whitish patch taking up the whole length of 18, lateral margins rather swollen, the centre rather concave; male pores as transverse grooves in the setal zone, *ca.* 2/15 body circumference apart. Spermathecal pores two pairs in 6/7/8, in line with *E*, $^{1}/_{6}$ body circumference apart.

Gizzard vestigial, in 5; oesophagus swollen in 11-13; intestinal origin behind the prostates. Last pair of hearts in 12. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles in 11 and 12, meeting dorsally. Prostates squarish, confined to 18; duct slightly muscular, curled and twisted. Penial setae absent. Quadrithecal; ampulla irregular in shape, about as broad as long, duct 2/3 as long as ampulla; diverticulum single, knob-like, sessile, at the ental end of duct with a few indistinct seminal chambers.

Distribution: Pashok, Darjeeling district, West Bengal, India.

6. ***Perionyx himalayanus*** Michaelsen, 1907

1907. *Perionyx himalayanus* Michaelsen, *Mitt. naturh. Mus. Hamb.*, **24**: 158.

1909. *Perionyx himalayanus*, Michaelsen, *Mem. Indian Mus.*, **1**: 176.

Diagnosis: Length 56-62mm, diameter 2.5-3mm, 86-95 segments. Prostomium epilobic, tongue open behind. First dorsal pore at 8/9, if not 7/8 or 6/7. Setae moderately large; circles nearly complete, indistinctly interrupted in the middorsal line. Clitellum in segments 13-17. Male pores rather post setal, *ca.* 1/5 body circumference apart, on small transversely oval papillae, each situated in the central depression of a large nearly circular glandular protuberance. Spermathecal pores two pairs, in 6/7/8, about 1/8 body circumference apart.

Gizzard vestigial, in 6(?); calciferous glands absent. Nephridia end apparently in the same line. Holandric; male funnels apparently enclosed in unpaired sacs, in 10 and 11; seminal vesicles three pairs, in 10-12. Prostates small, compact irregularly glandular, in 18; duct moderately thick, irregularly bent or coiled. Penial setae absent. Quadrithecal; ampulla large, ovoid, obliquely placed; duct narrowed abruptly at ectal end, half as long as ampulla; diverticula two, sessile, very small, at ental end of the duct, nearly opposite to each other.

Distribution: Sandakphu, Darjeeling district, West Bengal, India.

7. ***Perionyx inornatus*** Stephenson, 1916

1916. *Perionyx inornatus* Stephenson, *Rec. Indian Mus.*, **12**: 320.

Diagnosis: Length 96mm, diameter 5mm, 124 segments. Prostomium apparently proepilobic. First dorsal pore at 6/7. Setae closer ventrally than dorsally, setal rings unbroken ventrally, a small and irregular dorsal break behind the genital region. Male pores in *DE*, on the sides of a shallow transversely oval depression with shelving sides in transverse extent equal to 1/9 body circumference. Spermathecal pores two pairs, in 6/7/8, apart about equal to the distance between male pores.

Gizzard soft, squarish, in 5; intestinal origin in 14. Last pair of hearts in 12. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles in 11 and 12, large, situated dorsally over the gut. Prostates small, confined to 18; duct soft, comparatively narrow, straight. Penial setae 0.92mm long, 30μ thick at the middle, shaft straight, distal end ornamented with about 14 irregular and interrupted rings of very minute sculpturings. Quadrithecal; ampulla small, ovoid; duct short, stout, not marked off, diverticula absent.

Distribution: Sandakphu, Darjeeling district, West Bengal, India.

8. ***Perionyx jorpokriensis*** Julka, 1975

1975. *Perionyx jorpokriensis* Julka, *Mitt. zool. Mus. Berlin*, **51**(1): 21.

Diagnosis: Length 58-62mm, diameter 3mm, 99-106 segments. Prostomium epilobic, tongue open. First dorsal pore at 4/5. Setae closely spaced ventrally, more widely separated dorsally, circles with a ventral gap. Clitellum 13-17, dorsal pores occluded, setae retained. Nephropores in a single irregular rank, near mL. Male genital field a little depressed rectangular area, slightly raised along mV, reaching anteriorly to 17/18 and posteriorly to 18/19, laterally to *FG* or *GH*; male pores postsetal, on the centre of two circular, short, porophores, in line with *D* or *E*. Spermathecal pores three pairs, in 6/7/8/9, transverse slits, with protuberant and annular lips, in line with *F* or *G*.

Gizzard small, in 5; oesophagus widened and bead-shaped, in 13. Last pair of hearts in 12. Nephridia avesiculate; ducts long and slender, passing into parietes in a slightly irregular rank on each side. Holandric; testes and male funnels free; seminal vesicles in 11 and 12. Prostates squarish, confined to 18; duct slender, straight, forming a loop before entering parietes. Penial setae absent. Sexthecal; spermathecae medium-sized; ampulla globular; duct muscular, slightly shorter than ampulla, widens before entering parietes; a distinct ridge with two or three iridescent lobes present on the anterior face of duct just beneath ampulla.

Distribution: Sukiapokri, Jorpokri, Palmazoa, Darjeeling district, West Bengal, India.

9. ***Perionyx nanus*** Stephenson, 1917

1917. *Perionyx nanus* Stephenson, *Rec. Indian Mus.*, **13**: 381.

Diagnosis: Length 53mm, diameter 1.5mm, 100 segments. Prostomium epilobic, tongue open. First dorsal pore at 5/6. Setal ring almost closed dorsally and ventrally. Clitellum 14-17, conspicuous. Male pores in a transverse groove, slightly prolonged towards middle line, in line with *G* or *GH*, slightly behind setal zone, ¼ body circumference apart; each pore surrounded by a whitish thickened patch, taking up the whole ventral surface of 18. Spermathecal pores two pairs in 6/7/8, widely apart.

Gizzard vestigial, in 5; oesophagus protuberant in 9; intestinal origin in 19. Last pair of hearts in 12. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles large, in 11 and 12, of 11 fusing together. Prostates extending in to 17 and 19; duct thin, soft and bent. Penial setae absent. Quadrithecal; ampulla pear-shaped; duct broad and short, not sharply marked off; diverticulum single, wart-like, sessile, at the junction of ampulla and duct.

Distribution: Pashok, Darjeeling district, West Bengal, India.

10. ***Perionyx pallidus*** Stephenson, 1917

1917. *Perionyx pallidus* Stephenson, *Rec. Indian Mus.*, **13**: 376.

Diagnosis: Length 80mm, diameter 3.25mm, 118 segments. Prostomium epilobic. First dorsal pore at 4/5. Setae set closer ventrally, rings closed ventrally, almost so dorsally. Clitellum 13-16, slightly swollen. Male pores in transverse grooves, on 18, small cracks, 1/10 body circumference apart. Spermathecal pores two pairs in 6/7/8, small, slit-like, same distance apart as the male pores.

Gizzard vestigial, in 6; intestinal origin in 17. Last pair of hearts in 13. Nephridial ducts terminating in the same line. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles in 11 and 12, united dorsally in each segment. Prostates very small; duct straight. Penial setae 0.175mm long, 17µ thick; a few fine sculpturing on distal half. Quadrithecal; ampulla small, sac-like, rather constricted in the middle; duct short, scarcely separately distinguishable, diverticulum lacking (?).

Distribution: Kalimpong, Darjeeling district, West Bengal, India.

11. ***Perionyx pincerna*** Stephenson, 1916

1916. *Perionyx pincerna* Stephenson, *Rec. Indian Mus.*, **12**: 319.

Diagnosis: Length 45mm, diameter 3mm, 88 segments. Prostomiun epilobous, tongue cut off behind. First dorsal pore at 4/5. Setal ring with small and irregular dorsal and ventral break, ventral break may be lacking in front of clitellum,

setae set closer ventrally than dorsally. Clitellum indistinguishable. Male genital field a transversely oval depression on 18, deepest towards margin, so that middle of its floor somewhat raised above its periphery; a thick whitish lip surrounds the whole and extends over the posterior half of 17 and anterior half of 19; male pores in *C* or *D* lines. Penial setae present. Spermathecal pores two pairs in 6/7/8, small slits, near middle line, *ca.* 1/10 body circumference apart.

Gizzard of moderate size, in 5; intestinal origin in 18. Last pair of hearts in 12. Nephridia opening in the same line. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles in 11 and 12, single in each segment, overarching dorsal vessel and gut. Prostates limited to 18, small, lobed; duct soft, narrow, slightly wavy. Penial setae 0.63mm long, 24μ thick at the middle; shaft straight, tip slightly curved and blunt; ornamentation of about a dozen, irregular broken circles of faint sculpturing near the tip appearing as fine points. Quadrithecal; ampulla oval sac, sessile on the parietes; duct indistinguishable; diverticulum absent.

Distribution: Near Ghoom, Darjeeling district, West Bengal, India.

12. ***Perionyx pokhrianus*** Stephenson, 1920

1920. *Perionyx pokhrianus* Stephenson, *Mem. Indian Mus.*, **7**: 208.

Diagnosis: Length 65mm, diameter 3mm, 96 segments. Prostomium epilobous, tongue open. First dorsal pore at 4/5. Setal rings almost closed dorsally and ventrally, setae closer set ventrally. Clitellum 13-16. Male genital papillae one pair, on 18, mid-ventral, touching each other, taking up the greater part of the length of the segment, not delimited from rest of the surface on their outer sides, bounded in front and behind by a common transverse groove; male pores on the posterior part of the papillae, near the middle line. Spermathecal pores two pairs in 6/7/8, very close together, nearly in line with *B*.

Gizzard large, barrel-shaped, in 5; intestinal origin in 18. Last pair of hearts in 13. Nephridia apparently terminate in the same line. Holandric; testis sacs in 10 and 11; seminal vesicles in 11 and 12, meeting together dorsally in each segment. Prostates large, much indented, in 17-19; duct short, soft and thin, irregularly twisted, somewhat dilated at the ectal end. Penial setae absent. Quadrithecal; ampulla irregularly lobed; duct short, marked off from ampulla by a constriction; diverticula in the form of three small swellings on the upper half of the duct.

Distribution: Sitong, Darjeeling district, West Bengal, India.

13. ***Perionyx pokhrianus affinis*** Stephenson, 1920

1920. *Perionyx pokhrianus* var. *affinis* Stephenson, *Mem. Indian Mus.*, **7**: 210.

Diagnosis: Length 55mm, diameter 2.25mm, 105 segments. Prostomium epilobous, tongue open. First dorsal pore at 4/5. Setal rings almost unbroken dorsally and ventrally. Clitellum 13-16. Male genital field on 18, as a depression with sloping sides, on these sides are placed male pore papillae facing somewhat inwards, papillae rather wider transversely, are delimited by grooves in front and behind, separated in the middle line by a slight interval, laterally fade away without definite delimitation; male pores transverse slits on the papillae, in line with *C*, *D* or *E*. Spermathecal pores two pairs in 6/7/8, in line with interval *CD*.

Gizzard moderate size, in 5; intestinal origin in 18. Last pair of hearts in 12. Nephridial ducts terminate at different levels without regular alternation. Holandric; testis sacs in 10 and 11; seminal vesicles in 11 and 12, those in 11 continuous with testis sac, united dorsally in each segment. Prostates large, in 17-19; duct moderately long, bent, soft and rather thin in its ental portion, thicker and shining ectally. Penial setae absent. Quadrithecal; ampulla large, irregularly lobed; duct short, well marked off, considerably longer than ampulla; diverticulum a rounded knob with two seminal chambers on the ental end of duct.

Distribution: Sitong, Sitong Ridge, Darjeeling district, West Bengal, India.

14. ***Perionyx pulvinatus*** Stephenson, 1916

1916. *Perionyx pulvinatus* Stephenson, *Rec. Indian Mus.*, **12**: 317.

1975. *Perionyx pulvinatus*, Julka, *Mitt. zool. Mus. Berlin*, **51**(1): 22.

Diagnosis: Length 57-93mm, diameter 3-3.5mm, 121-126 segments. Prostomium epilobous, tongue closed, a median dorsal groove on prostomium extending posteriorly a little beyond setal ring of 2. First dorsal pore at 4/5. Setae more closely set ventrally than on dorsum. Clitellum 11, 12-19, intersegmental furrows indistinct, setae retained, dorsal pores occluded. Nephropores in a single irregular rank on dorsum. Male genital field a conspicuous depression, rectangular with rounded corners, on 18, dislocating anteriorly 17/18 and posteriorly 18/19; male pores large, slightly postsetal, on longitudinal oval-shaped cushions. Spermathecal pores two pairs in 7/8/9, large transverse slits in line with *J-K*, slightly posterior to intersegmental furrows.

Gizzard small, in 5; oesophagus widened in 12; intestinal origin in 15; typhlosole lacking. Last pair of hearts in 12. Nephridia avesiculate, duct slender and long. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles in 11 and 12, pair of 12 extending back and fusing each other in 14 and 15. Prostates large, lobed, in 18 and 19; duct stout, muscular, straight. Penial setae absent. Quadrithecal; ampulla irregularly shaped, roughly pyramidal, with nodular surface; duct as long and almost as wide as ampulla; no diverticulum.

Distribution: Jorpokri, nr. Ghoom, Darjeeling district, West Bengal, India.

15. ***Perionyx rimatus*** Stephenson, 1920

1920. *Perionyx rimatus* Stephenson, *Mem. Indian Mus.*, **7**: 206.

1975. *Perionyx rimatus*, Julka, *Mitt. zool. Mus. Berlin*, **51**(1): 23.

Diagnosis: Length 75-80mm, diameter 4-4.5mm, 105-107 segments. Prostomium epilobous, tongue open. First dorsal pore at 4/5. Setal rings closed or almost so dorsally and ventrally; setae smaller and closer set ventrally. Clitellum 13-16, dorsal pores and intersegmental furrows indistinct, setae retained. Nephropores near mL in a single rather irregular rank. Male genital field transversely elliptical, a glandular dermal thickening, dislocating anteriorly 17/18 and posteriorly 18/19, extending laterally into region of *IJ*; male pores in deep transverse furrow across the middle of 18. Spermathecal pores two pairs in 6/7/8, small slits, close together in line with *C*, or the space *CD*.

Gizzard small, in 5; oesophagus widened in 13-14; intestinal origin behind the prostates. Last pair of hearts in 12. Nephridia avesiculate, ducts slender and straight. Holandric; testes and male funnels free; seminal vesicles in 11 and 12, each pair fused dorsally above the alimentary canal; sperm duct passes through the anterior lobe of prostate to open into ental end of prostatic duct. Prostates large, 17-18/18-19; duct narrow at ental end, much twisted, ectal end muscular and broader than ental end. Penial setae absent. Quadrithecal; ampulla a large irregular sac; duct stout, a little shorter than ampulla; diverticula in the form of iridescent swellings near the junction of ampulla and duct.

Distribution: Sitong, Daw Hill (Kurseong), Darjeeling district, West Bengal, India.

16. ***Perionyx setnai*** Stephenson, 1931

1931. *Perionyx setnai* Stephenson, *Proc. zool. Soc. Lond.*, **1931**: 63.

Diagnosis: Length 85-130mm, diameter 3-3.5mm, 124 segments. Prostomium epilobous, tongue not cut off behind. First dorsal pore at 4/5. Setae more closely set ventrally, setal circle slightly irregularly broken dorsally. Clitellum 13-½17, setae retained, dorsal pores not apparent. Nephropores almost in the same rank on each side. Male genital field sharply defined deeply sunk rectangular depression, half as wide again as long, situated mid-ventrally on 18; taking up whole length of the segment, floor is flat; male pores small, on the floor of the depression, near the middle line. Spermathecal pores two pairs in 6/7/8, moderately close together, but not quite as close as the male pores.

Gizzard very small, vestigial, in 5; intestinal origin behind the prostates, in 19. Last pair of hearts in 12. Holandric; testes and male funnels free, in 10 and 11; seminal vesicles in 11 and 12, fused in the middle line and taking up whole of the space in their segments. Prostates small, confined to 18; ducts short, thin and soft, bent; ectal portion rather wider than ental. Penial setae absent. Quadrithecal; ampulla regularly ovoid sacs, lying on the body wall; duct short wide; no diverticulum.

Distribution: Darjeeling, West Bengal, India.

17. ***Perionyx sikkimensis*** (Michaelsen, 1907)

1907. *Perionychella sikkimensis* Michaelsen, *Jb. hamb. wiss. Anst.*, **24**: 156.

1909. *Perionychella sikkimensis*, Michaelsen, *Mem. Indian Mus.*, **1**: 170.

1910. *Perionyx sikkimensis* (part), Michaelsen, *Abh. Geb. Naturw. Hamburg*, **19**(5): 60.

1923. *Perionyx sikkimensis*, Stephenson, *Fauna Br. India, Oligochaeta*: 358.

Diagnosis: Length *ca.* 120mm, diameter 4-5mm, 109 segments. Prostomium epilobous. First dorsal pore at 6/7 or 7/8. Setal circles nearly complete, only slightly and irregularly broken dorsally; setae more closely set dorsally than ventrally. Clitellum 13-17, ringed-shaped in the middle, interrupted ventrally in front and behind. Male pores on small papillae, *ca.* 1/8 body circumference apart, surface between pores somewhat depressed. Spermathecal pores two pairs in 6/7/8, *ca.* 1/7 body circumference apart, inconspicuous.

Gizzard small, in 6(?). Last pair of hearts in 12(?). Holandric; testes and male funnels free, in 10 and 11; seminal vesicles large, in 11 and 12, meeting dorsally covering oesophagus. Prostates small and compact, in 18; duct fairly thick, nearly straight, about as long as the glandular part. Penial setae *ca.* 0.9mm long and 28µ thick; almost straight, slightly bent at distal end; narrowing distally, with fairly sharp tip; distal part ornamented with irregular, sometimes oblique, transverse rows of small triangular teeth. Quadrithecal; ampulla fairly large, almost cylindrical; duct slightly shorter and thinner, not set off from ampulla; no diverticulum.

Distribution: Sandakphu, Kurseong, Darjeeling district, West Bengal, India.

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A TAXONOMIC STUDY ON THE GENUS *RHYNCHIUM* SPINOLA (HYMENOPTERA: VESPIDAE: EUMENINAE) FROM THE INDIAN SUBCONTINENT

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INTRODUCTION

Spinola (1806) provided the name *Rygchium* which is an incorrect original spelling of *Rhynchium* Spinola based on the type species *Rygchium europaeum* Spinola, *1806*. The genus *Rhynchium* Spinola is distributed at Australian, Ethiopian, Oriental and Palearctic Regions. Forty seven species with several subspecies are recorded under this genus from the world (EOL Data Portal webpage) of which five species/ subspecies namely *Rhynchium brunneum brunneum* (Fabricius, 1793), *R. brunneum ceylonicum Giordani Soika, 1994, R. carnaticum* (Fabricius, 1798), *R. haemorrhoidale haemorrhoidale* (Fabricius, 1775) and *R. oculatum leviscutis* (Cameron, 1908) are recorded from the Indian subcontinent. In addition to this five species/subspecies, a distinctly different colour form of *R. haemorrhoidale* namely *R. haemorrhoidale andamanicum subsp. nov.* is also described in this paper. The occurrence of *Rhynchium atrum* de Saussure, 1852 from the Indian subcontinent is doubtful. All the species/subspecies from the Indian subcontinent are herewith redescribed in detail since the available descriptions are inadequate for easy identification and a key to separate the species of the Indian subcontinent is also provided. Several new distributional records are also reported in this paper.

MATERIAL AND METHODS

This study is based on about 153 specimens present in the Hymenoptera Section of the Zoological Survey of India, Kolkata, collected from various localities of Indian subcontinent. The specimens were studied and photographed by using a Leica Stereo microscope with LAS software version 3.6.0. All the specimens were properly preserved and added to the 'National Zoological Collections' of the Hymenoptera Section of the Zoological Survey of India, Kolkata (NZC).

Abbreviations used for the Museums: BMNH = British Museum (Natural History), London, England; MSNV = Museo di Storia Naturale di Venezia, Italy; NZC = 'National Zoological Collections' of Zoological Survey of India, Kolkata, India; USNM = United States National Museum of Natural History, Washington D. C., U. S. A.; UZMC = Universitetets Zoologiske Museum, Copenhagen, Denmark.

Abbreviations used for the terms: F1-F2 = Flagellar segments 1 to 2; H = Head; M = Mesosoma; OOL = Ocellocular distance; POL = Postocellar distance; S1-S7 = Metasomal sterna 1 to 7; T1-T7 = Metasomal terga 1 to 7.

RESULTS

Genus ***Rhynchium*** Spinola

Rygchium Spinola, 1806, *Ins. Ligur.*, **1**: 84, genus (incorrect original spelling of *Rhynchium* Spinola).

Rhynchium Spinola, 1806, *Ins. Ligur.*, **1**: 84, genus, emendation of *Rygchium* validated by Opinion 747 (ICZN, 1965). Type species: *Rygchium europeaum* Spinola, 1806 [= *Vespa oculata* Fabricius, 1781], by monotypy.

Eurrhynchium Dalla Torre, 1904, *Genera Insect.*, **19**: 33, name for division II of *Rhynchium* Spinola in de Saussure, 1852, *Ét. Fam. Vesp.*, **1**: 105. Type species: *Vespa oculata* Fabricius, 1781, by subsequent designation of van der Vecht and Carpenter, 1990, *Zool. Verh., Leiden.*

Diagnosis: Labial palp 4-segmented; maxillary palp 6-segmented; pronotum smooth in front without punctures or impressions; mesoscutum posteriorly and scutellum anteriorly impunctate; metanotum somewhat compressed medially without tubercles; propodeum without deep fossae; tegula not evenly rounded posteriorly, emarginate adjoining parategula and not reaching the apex of parategula; axillary fossa narrower than long, slit-like; forewing with second submarginal cell not petiolate, prestigma more than half the length of pterostigma; midtibia with one spur; metasoma sessile; T1 wider than long in dorsal view, not carinate; midfemur of male basally emarginate.

Distribution: Australian, Ethiopian, Oriental and Palaearctic Regions.

Key to species/subspecies of the genus *Rhynchium* Spinola from the Indian subcontinent

1. Apex of clypeus, in male, narrow, almost pointed (Image 23) and not sharply truncate, almost rounded in female (Image 21); T2 almost entirely yellow with a basal black or brown mark (Images 20 & 22). .....*oculatum leviscutis* (Cameron)

- Apex of clypeus, in both sexes, broad and truncate (Images 2, 5, 10, 12, 14, 16 & 19); T2 not yellow, either black or reddish brown or both (Images 1, 4, 9, 11, 15 & 18). 2

2. Clypeus, in both sexes, with punctures extremely small and superficial (Images 10 & 12); punctures on T1 and basal 2/3 of remaining tergites, in both sexes, small, shallow and sparse (Images 9 &11). .....*carnaticum* (Fabricius)

- Clypeus, in female, with large and dense punctures (Images 2, 14 & 19); punctures on tergites, in both sexes, large and dense (Images 1, 4, 15 & 18). 3

3. Gaster entirely black, usually the last tergites and sternites pale reddish brown .....*atrum atrum* de Saussure

- Gaster not entirely black, at least tergites III-IV in female (Images 1 & 18) and III-VII in male with large reddish brown markings (Images 4 & 15). 4

4. T1 and T2 black at basal half and a broad reddish brown or yellowish brown band at apex (Images 1 & 4); mesosoma predominantly to entirely reddish brown or yellowish brown (Images 1, 3 & 4). 5

- T1 and T2 usually entirely black, rarely with a thin reddish brown band at apex of first or second or both segments (Images 15 & 18); mesosoma predominantly to entirely black (Images 15 & 18). 6

5. Body with black and reddish brown colouration. Widely distributed. ..... *brunneum brunneum* (Fabricius)

- Body with black and yellowish brown colouration. Sri Lanka..... *brunneum ceylonicum* Giordani Soika

6. Pronotum partly or completely reddish brown (Image 15); mesosoma not entirely black; head predominantly reddish brown to yellowish brown with black markings (Images 14 & 16). .....*haemorrhoidale haemorrhoidale* (Fabricius)

- Pronotum entirely black (Image 18); mesosoma entirely black; head predominantly black with or without brown and yellow markings (Image 19). .....*haemorrhoidale andamanicum* subsp. nov.

1. ***Rhynchium brunneum*** (Fabricius)

This is a polytypic species with many subspecies. There are three subspecies are recorded from Oriental Region namely, *Rhynchium brunneum brunneum* (Fabricius), *R. brunneum ceylonicum Giordani Soika and R. brunneum maladivum Gusenleitner*. Out of these three subspecies, the nominotypical subspecies namely *R. b. brunneum* is widely distributed in the Oriental Region. *R. b. ceylonicum*is recorded from Sri Lanka and *R. b. maladivum* recorded from Maldives.

(a) ***Rhynchium brunneum brunneum*** (Fabricius)

(Images 1-8)

Vespa brunnea Fabricius, 1793, *Entomol. Syst.*, **2**: 264, Syntype, sex not mentioned, "Tranquebariae, India (UZMC)".

Odynerus brunneus: Latreille, 1806, *Gen. Crust. Ins.*, **1**: pl. 14 fig. 3.

Rhynchium brunneum: Spinola, 1808, *Ins. Ligur*, **2**: 189.

Rhynchium haemorrhoidale var. *brunneum*: de Saussure, 1862, *Stettin. Ent. Ztg.*, **23**: 190.

Rhynchium quinquecinctum var. *brunneum*: Dalla Torre, 1894, *Cat. Hym.*, **9**: 45 (cat.).

Odynerus haemorrhoidale var. *brunneum*: Cheesman, 1928, *Ann. Mag. Nat. Hist.*, (10) **1**: 182 (in subgenus *Rynchium*; syn. *tahitense* de Saussure; Marquesas Is., Society Is., distribution, note on biology).

Rhynchium brunneum brunneum: Gusenleitner, 2006, *Linzer biol. Beitr.*, **38** (1): 692 (Sikkim, Meghalaya, West Bengal).

Female (Image 1): Body length (H+M+T1+T2) 13-16 mm; Forewing length 12-15 mm. Body brownish red (and sometimes mixed with yellowish red) with the following black marks: a spot on interantennal space, a vertical line on lower frons, around ocelli, occiput, a large triangular mark on mesoscutum in front, a transverse line along its apex, propleuron, mesopleuron (except brownish red below tegula), metapleuron, propodeum in the middle and lateral sides below, basal two thirds of the T1 and the basal half of T2, S1 and S2 almost entirely, base of S3. Legs brownish red with variegated black markings. The black markings in the body are highly variable. Wings yellowish hyaline, deeper and darker towards base; veins yellow, brown towards base; apical margin of forewing slightly infumated. Body with rather sparsely to moderately dense fine golden pubescence mixed with brown and silvery white pubescence.

Head: As wide as long in front view (Image 2); clypeus strongly convex, pyriform, the apical third with a broad medial vertical groove, the extreme apex truncate, apex of truncated portion slightly incised, maximum width 0.98x length medially, with moderately deep punctures, larger punctures on middle and smaller on sides; mandibles on inner side with four rather broad and irregularly shaped teeth; labrum elongate rounded at apex; interantennal space smooth; a short but distinct strong carina present at the middle of interantennal space; frons closely, strongly and rugosely punctured, the diameters of the punctures greater than the distance between the punctures; ocular sinus with weak punctures; area between the antennal toruli and inner eye margin smooth; POL 1.13x OOL; diameter of anterior ocellus 0.87x longer than the distance between anterior ocellus and posterior ocelli; vertex strongly punctured except at shallow postocellar fovea and area towards occipital carina; temple strongly punctured, 1.03x as wide as eye in profile (measured through its ocular sinus); interocular distance 0.92x greater on vertex than at clypeus; occipital carina strong, complete and narrowed ventrally. Antenna 3.29x farther from each other than from eyes; antennal scrobe granulately punctured; scape 2.37x as long as F1, 4.10x as long as wide; pedicel 0.32x F1, 0.69x as long as wide; F1 1.69x as long as F2. 1.68x as long as wide; flagellar segments slightly widening towards apex except last antennal segment; apical antennal segment 1.24x as long as wide.

Mesosoma (Image 3): Anterior face of pronotum smooth without punctures; pronotal carina strong and reaching the lateral margin of pronotum; posterior face and lateral sides of pronotum and mesoscutum strongly, closely and rugosely punctate except at posterior portion of mesoscutum; mesoscutum as long as wide; mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially, strongly punctured except at posterior portion smooth; propleuron almost smooth; mesopleuron rugosely punctured except epicnemium and posterior margin smooth; epicnemial carina distinct; upper metapleuron smooth at lower portion and distinctly punctate at upper portion, lower metapleuron almost impunctate with few weak incomplete transverse striations at anterior margin. Propodeum vertical, concavo-truncate posteriorly, the sides of triangular segment at the base of propodeum is of equal length, bordered on each side by a deep groove, punctures on basal half of dorsolateral area of propodeum with strong and rugose punctures except a small smooth area anteriorly, apical half of dorsolateral area of propodeum with strong transverse striations, posterior concave area of propodeum with somewhat regular transverse striations, lateral sides of propodeum with weak and sparse rugose

punctures at upper portion and fine irregular transverse striations at lower portion, postero-lateral sides of propodeum with few strong stout spine-like structures. Tegula not evenly rounded posteriorly, emarginated adjoining parategula and shorter than parategula at apex; axillary fossa narrowed, slit-like. Midtibia with 1 spur. Forewing length 3.18x its maximum width, prestigma 1.19x pterostigma.

Metasoma: T1 0.64x as long as wide, 0.59x as wide as T2 in dorsal view; T1-T5 and S2-S4 with distinct punctures, the diameter of most of the punctures less than interspace; S5 with few scattered punctures; T6 and S6 almost smooth; the narrow basal part of S1 smooth, posterior transverse area of S1 rather irregularly transversely striate, rugose at apex.

Male (Image 4): Body length (H+M+T1+T2) 11.5-12.5 mm; Forewing length 10.5-12 mm. Colour pattern is almost same as that of female except clypeus, a transverse band at lower frons and scape ventrally yellow. Inner eye margin sometimes yellow (usually yellowish brown) and extends towards frons, ocellar area, vertex and temple (Image 5). Head 1.03x as wide as long in front view; mandible with teeth not strong as in female; interocular distance 1.19x greater on vertex than at clypeus; clypeus (Image 5) more elongate and the apex between two teeth emarginate, width 0.87x length medially; POL 1.39x OOL; occipital carina come close to the eye at the lower side; antenna (Image 6) with the last segment hook like, almost reaches the apex of tenth antennal segment in curved position; mid femur basally emarginate (Image 7); stiff and stout hairs forms spine-like structures at the apical margin of S7; genitalia as in image 8, apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female.

Material examined: INDIA: Andhra Pradesh, Visakhapatnam, 1♀, date of collection and name of collector unknown, NZC Regd. No. 13642/H3. Arunachal Pradesh, West Siang district, Basar, 1♀, 31.x.1966, Coll. S. K. Tandon & Party, NZC Regd. No. 13643/H3; Lower Dibang Valley, Roing, Durga Mandir, 1♂, 30.ix.2001, Coll. B. Mitra & Party, NZC Regd. No. 13644/H3. Assam, Tinsukia district, Margherita, 1♀, date of collection unknown, Coll. Doherty, NZC Regd. No. 13645/H3; Sibsagar district, Sivasagar, 4♀, date of collection unknown, Coll. S. E. Peal, NZC Regd. Nos. 13646/H3 to 13648/H3 & 13655/H3; Dima Hasao district, Dehangi, 1♂, 23.v.1979, Coll. S. B. Roy & Party, NZC Regd. No. 13649/H3; Dima Hasao district, Gunjung, 1♀, 25.v.1979, Coll. S. B. Roy & Party, NZC Regd. No. 13650/H3; Manas Tiger Reserve, Kamrup district, Kahitama & Alabari, 3♀, 31.iii.1986 & 4.iv.1986, Coll. S. S. Saha & Party, NZC Regd. Nos. 13652/H3 to 13654/H3. Chhattisgarh: Dhamtari district, Sitanadi Wildlife Sanctuary, Sankara forest, 1♀, 20.x.2011, Coll. S. Gupta & Party, NZC Regd. No. 13850/H3. Himachal Pradesh, Kangra Valley, 1♀, June 1899, Coll. Dudgeon, NZC Regd. No. 13656/H3; Solan district, Solan, 1♂, 1.vii.1968, Coll. O. B. Chhotani & Party, NZC Regd. No. 13657/H3. Jharkhand, Ranchi, 3♀, date of collection unknown, Coll. W. H. Irvine, NZC Regd. Nos. 13658/H3 to 13660/H3; Giridih district, Paresnath Hills, 1♀, 10.iv.1909, Coll. Annandale, NZC Regd. No. 13661/H3. Karnataka, Bengaluru, 3♀& 1♂, date of collection unknown, NZC Regd. Nos. 13662/H3 to 13665/H3; Kodagu district, Mercara, 1♀, 10.x.1915, Coll. F. Hannyngton, NZC Regd. No. 13666/H3; Bengaluru, 1♀, 4.xi.1978, Coll. Neelu, NZC Regd. No. 13667/H3. Kerala, Thiruvananthapuram, 2♀, March 1888, name of collector unknown, NZC Regd. Nos. 13668/H3 & 13669/H3; Thiruvananthapuram, 1♂, May 1903, name of collector unknown, NZC Regd. No. 13670/H3; Thiruvananthapuram, 1♀, 13.xi.1908, Coll. Annandale, NZC Regd. No. 13671/H3; Thrissur district, Chalakkudy, 2♂, 14-30.ix.1914, Coll. F. H. Gravely, NZC Regd. Nos. 345/H3 & 13672/H3; Kollam, 1♀, May 1915, Coll. G. P. Pillai, NZC Regd. No. 13673/H3; Thiruvananthapuram district, Kudappanakunnu, 1♂, 24.vii.1980, Coll. M. S. Mani & Party, NZC Regd. No. 13674/H3. Madhya Pradesh, Balaghat district, Muki Banjar Valley, 1♀, September 1957, Coll. S. Biswas &

Party, NZC Regd. No. 13675/H3. Manipur, Imphal, 1♀, 27.viii.1945, Coll. M. L. Roonwal, NZC Regd. No. 13676/H3; Churachandpur, 1♂, 21.ix.1975, Coll. M. S. Shishodia & Party, NZC Regd. No. 13677/H3; Imphal West district, Kangchup, 2♂, 9.x.1976, Coll. Kuldip, NZC Regd. Nos. 13678/H3 & 13679/H3. Meghalaya, Khasi Hills, 1♀, date of collection and name of collector unknown, NZC Regd. No. 13680/H3; East Garo Hills district, Songsak, 1♀, 20.ix.1975, Coll. N. Muraleedharan, NZC Regd. No. 13681/H3; East Khasi Hills district, Cherrapunji, 1♂, 23-26.iv.1979, Coll. J. K. Jonathan & Party, NZC Regd. No. 13682/H3; East Khasi Hills district, Dainadubi, 3♀& 4♂, 8-13.v.1979, Coll. S. B. Roy & Party, NZC Regd. Nos. 13683/H3 to 13688/H3& 13692/H3; East Khasi Hills district, Darugiri, 3♀& 1♂, 14-20.v.1979, Coll. S. B. Roy & Party, NZC Regd. Nos. 13694/H3 to 13697/H3; West Garo Hills district, Machangpani, 1♀, 15.x.1988, Coll. K. K. Ray & Party, NZC Regd. No. 13698/H3; Chipinag, 1♀, 24.x.1988, Coll. K. K. Ray & Party, NZC Regd. No. 13699/H3; Bamandanga, 1♀, 27.x.1988, Coll. K. K. Ray & Party, NZC Regd. No. 13700/H3; Rh-Bhoi district, Umtru, 1♂, 7.iv.1991, Coll. S. K. Saha & Party, NZC Regd. No. 13701/H3. Mizoram, Aizawl district, Lushai Hills, 1♀, 9.vi.1904, Coll. M. C. McLeod, NZC Regd. No. 13702/H3; Aibawk, 1♀, 17.xii.1995, Coll. M. S. Shishodia & Party, NZC Regd. No. 13703/H3. Odisha, Puri, 1♀, 7.xii.1908, Coll. J. Caunter, NZC Regd. No. 13704/H3; Ganjam district, Barkuda Island, 1♀, 18.ix.1919, Coll. Brunetti, NZC Regd. No. 13705/H3; Mayurbhanj district, Baripada, 1♀, 9.iv.1923, Coll. R. P. Mullins, NZC Regd. No. 13706/H3. Sikkim, exact locality not known, 1♀, date of collection unknown, Coll. Knyvett, NZC Regd. No. 13707/H3; exact locality not known, 1♂, date of collection unknown, Coll. Niceville, NZC Regd. No. 13708/H3; exact locality not known, 3♀, July 1897, Coll. Dudgeon, NZC Regd. Nos. 13709/H3 to 13711/H3. Tamil Nadu, Thirunelveli district, Mundanthurai Tiger Reserve, 1♀, 22.xi.1994, Coll. S. S. Saha & Party, NZC Regd. No. 13712/H3. Tripura, South Tripura district, Garjee, 5♀& 3♂, 13.v.1978, Coll. J. K. Jonathan & Party, NZC Regd. Nos. 13713/H3 to 13720/H3; Gumati district, Udaipur, 1♀, 14.v.1978, Coll. J. K. Jonathan & Party, NZC Regd. Nos. 13721/H3; West Tripura district, Baramura, 1♀, 22.v.1978, Coll. J. K. Jonathan & Party, NZC Regd. Nos. 13722/H3; Agartala, 1♀, 11.v.1992, Coll. B. C. Das & Party, NZC Regd. Nos. 13723/H3. Uttarakhand, Dehradun, 3♀, date of collection and name of collector unknown, NZC Regd. Nos. 13724/H3 to 13726/H3; Dehradun district, Mussorie, 1♀, 20.v.1905, Coll. Brunetti, NZC Regd. No. 13727/H3; Corbett National Park, Nainital district, Dhikala, 1♀, 26.iv.1908, name of collector unknown, NZC Regd. No. 13728/H3; Almora, 2♀, 10.vi.1911, Coll. C. Paiva, NZC Regd. Nos. 13729/H3 & 13730/H3; Bageshwar district, Kousanie, 1♀& 1♂, 29.vii.1914, Coll. Tytler, NZC Regd. Nos. 13731/H3 & 13732/H3; Dehradun district, Rishikesh, 1♀, 19.ix.1979, Coll. S. K. Gupta & Party, NZC Regd. No. 13733/H3; Rudraprayag district, Chopta, 1♂, 11.x.2001, Coll. B. C. Das & Party, NZC Regd. No. 13734/H3; Nainital district, Kathagodam, 1♀, 25.ix.2002, Coll. P. H. Roy & Party, NZC Regd. No. 13735/H3. West Bengal, Kolkata, 3♀& 2♂, date of collection and name of collector unknown, NZC Regd. Nos. 13736/H3 to 13740/H3; Darjeeling district, Tindharia, 1♀, date of collection and name of collector unknown, NZC Regd. No. 13741/H3; Siliguri, 1♀& 1♂, 1.vii.1906, name of collector unknown, NZC Regd. Nos. 13742/H3 & 13743/H3; S-24 Parganas district, Sonarpur, 1♀, 26.xi.1965, Coll. R. N. Tiwari & Party, NZC Regd. No. 5180/H3; N-24 Parganas district, Phultala, Dudhnoi, 1♂, 8.viii.1977, Coll. S. K. Gupta & Party, NZC Regd. No. 13744/H3; Darjeeling district, Kalimpong, 1♂, 1.vi.1980, Coll. S. K. Gupta & Party, NZC Regd. No. 13745/H3; Darjeeling district, Kalimpong, 2♀, 24.iv.1981, Coll. R. K. Ghosh & Party, NZC Regd. Nos. 13746/H3 & 13747/H3; N-24 Parganas district, Duttapukur, 1♀, 25.xi.2010, Coll. P. Girish Kumar, NZC Regd. No. 13748/H3; Nadia district, Uttar Panchpota, Chakdaha, 1♀, 13.xii.2010, Coll. C. R. Satpati, NZC Regd. No. 13749/H3. MYANMAR:

Arakan, 1♀, date of collection and name of collector unknown, NZC Regd. No. 13750/H3. NEPAL: Valley, 1♀, date of collection and name of collector unknown, NZC Regd. No. 13751/H3.

Behaviour: See Horne (1870), Stebbing (1905), Maxwell-Lefroy (1909), Dutt (1912) and Cheesman (1928).

Distribution: India: Andhra Pradesh (new record), Arunachal Pradesh, Assam (new record), Bihar, Chhattisgarh (new record), Himachal Pradesh (new record), Jharkhand, Karnataka (new record), Kerala (new record), Madhya Pradesh (new record), Maharashtra, Manipur (new record), Meghalaya, Mizoram (new record), Odisha, Sikkim, Tamil Nadu, Tripura (new record), Uttarakhand, West Bengal. *Elsewhere*: Afghanistan, Cambodia, China, Guam, Indonesia, Iran, Iraq, Malaysia, Marquesas Island, Myanmar, Nepal, New Britain, Pakistan, Society Islands, Taiwan, Thailand.

(b). ***Rhynchium brunneum ceylonicum*** Giordani Soika

Rhynchium brunneum ceylonicum Giordani Soika, 1994, *Lavori Soc. Venez. Sci. Nat.*, 19: 37, 40 (key), 48 female, male. Holotype, male, Sri Lanka: C. Province: Triconmali (MSNV); also from numerous other localities.

This subspecies is very similar to the nominotypical subspecies *R. brunneum brunneum* except in a slight differences in colouration. In *R. b. brunneum* body marked with black and reddish brown colouration. But in *R. b. ceylonicum* body marked with black and yellowish brown colouration.

Material examined: SRI LANKA: Paradeniya, 5♀, 2.vi.1910, name of collector unknown, NZC Regd. Nos. 13752/H3 to 13756/H3.

Distribution: Sri Lanka.

2. ***Rhynchium carnaticum*** (Fabricius)
(Images 9-13)

Vespa carnatica Fabricius, 1798, *Suppl. Entomol. Syst.*, p. 261. Syntype, sex not mentioned, Tranquebariae, India (UZMC).

Rhynchium carnaticum: de Saussure, 1852, *Ét. Fam. Vesp.*, **1**: 112, male, female, (*Rhygchium*; Bengal).

Rhynchium brunneum var. *carnaticum*: de Saussure, 1855, *Ét. Fam. Vesp.*, **3**: 172.

Rhynchium haemorrhoidale var. *carnaticum*: Maindron, 1882, *Ann. Soc. Entomol. France*, (6) **2**: 277 (cat.; *Rynchium*).

Odynerus haemorrhoidalis carnaticus: Dover, 1925, *J. Proc. Asiat. Soc. Bengal*, n. s., **20** (1924): 298 (in subgenus *Rynchium*; geographical race confined to Western and southern India and Ceylon).

Rhynchium carnaticum: Gusenleitner, 2006, *Linzer biol. Beitr.*, **38** (1): 692 (Rajasthan).

Female (Image 9): Body length (H+M+T1+T2) 13-16 mm; Forewing length 13-15 mm. Body brownish red (and sometimes mixed with yellowish red) with the following black marks: a spot on interantennal space (sometimes reduced or absent), a vertical line on lower frons (sometimes reduced), around ocelli (sometimes reduced or absent), occiput (sometimes reduced), a triangular mark on mesoscutum in front (sometimes reduced or absent), a transverse line along its apex, lateral sides of propleuron (sometimes absent), epicnemium (sometimes absent), propodeum in the middle, basal area of T1 (sometimes absent), at the base of T2, in between S1 and S2 (sometimes absent), base of S3. Legs brownish red with variegated black markings (black markings highly reduced). The black markings in the body are highly reduced. Wings yellowish hyaline, deeper and darker towards base; veins yellow, brown towards base; apical margin of forewing slightly infumated. Body with rather sparsely to moderately dense fine golden pubescence mixed with brown and silvery white pubescence.

Head: As wide as long in front view (Image 10); clypeus strongly convex, pyriform, the apical third with a broad medial vertical groove, the extreme apex truncate, apex of truncated portion slightly incised, maximum width 0.96x length medially, with weak and sparse minute punctures; mandibles on inner side with four rather broad and irregularly shaped teeth; labrum elongate rounded at apex; interantennal space smooth; a short but distinct weak carina present at the middle of interantennal space; frons closely,

weakly and rugosely punctured, the diameters of the punctures greater than the distance between the punctures; ocular sinus almost smooth; area between the antennal toruli and inner eye margin smooth; POL 1.31x OOL; diameter of anterior ocellus1.30x longer than the distance between anterior ocellus and posterior ocelli; vertex weakly punctured except at shallow postocellar fovea and area towards occipital carina almost smooth; temple weakly punctured, 0.93x as wide as eye in profile (measured through its ocular sinus); interocular distance 0.91x greater on vertex than at clypeus; occipital carina strong, complete and narrowed ventrally. Antenna 3.21x farther from each other than from eyes; antennal scrobe granulately punctured; scape 2.28x as long as F1, 4.57x as long as wide; pedicel 0.36x F1, 0.80x as long as wide; F1 1.63x as long as F2. 2.21x as long as wide; flagellar segments slightly widening towards apex except last antennal segment; apical antennal segment 1.05x as long as wide.

Mesosoma: Anterior face of pronotum smooth without punctures; pronotal carina strong and reaching the lateral margin of pronotum; posterior face and lateral sides of pronotum and mesoscutum strongly, closely and rugosely punctate except at lateral corner of posterior face of pronotum and posterior portion of mesoscutum; mesoscutum 0.97x as long as wide; mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially, strongly punctured except at posterior portion smooth; propleuron almost smooth; mesopleuron rugosely punctured except epicnemium and posterior margin smooth; epicnemial carina distinct; upper metapleuron almost smooth except some weak punctures at upper margin, lower metapleuron almost impunctate. Propodeum vertical, concavo-truncate posteriorly, the sides of triangular segment at the base of propodeum is of equal length, bordered on each side by a deep groove, punctures on basal half of dorsolateral area of propodeum with strong and rugose punctures except a small smooth area anteriorly, apical half of dorsolateral area of propodeum with strong transverse striations, posterior concave area of propodeum with somewhat regular transverse striations, lateral sides of propodeum with weak and sparse rugose punctures at upper portion and fine irregular transverse striations at lower portion, postero-lateral sides of propodeum with few strong stout spine-like structures. Tegula not evenly rounded posteriorly, emarginated adjoining parategula and shorter than parategula at apex; axillary fossa narrowed, slit-like. Midtibia with 1 spur. Forewing length 2.76x its maximum width, prestigma 0.88x pterostigma.

Metasoma: T1 0.47x as long as wide, 0.95x as wide as T2 in dorsal view; T1 with very minute sparse and shiny punctures; T2-T5 with very minute sparse and shiny punctures on ¾ area and S2-S4 with distinct punctures, the diameter of most of the punctures less than interspace; S5 with few scattered punctures; T6 and S6 almost smooth; the narrow basal part of S1 smooth, posterior transverse area of S1 rather irregularly transversely striate, rugose at apex.

Male (Image 11): Body length (H+M+T1+T2) 8-11.5 mm; Forewing length 8-11 mm. Colour pattern is almost same as that of female except clypeus, a transverse band at lower frons and scape ventrally yellow. Inner eye margin sometimes yellow (usually yellowish brown) and extends towards frons, ocellar area, vertex and temple (Image 12). Head 1.05x as wide as long in front view; mandible with teeth not strong as in female; interocular distance 1.24x greater on vertex than at clypeus; clypeus (Image 12) more elongate and the apex between two teeth slightly emarginate, width 0.90x length medially; POL 1.53x OOL; occipital carina come close to the eye at the lower side; antenna with the last segment hook like, almost reaches the apex of tenth antennal segment in curved position; mid femur basally emarginate; stiff and stout hairs forms spine-like structures at the apical margin of SVII; genitalia as in image 13, apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female.

Material examined: INDIA: Andhra Pradesh, Kurnool district, Mahanandi, 1 ♀, 22.viii.2001, Coll. I. B. Dutta & Party, NZC Regd. No. 13761/H3. Assam: Cachar district, Ramnagar, 1 ♂, 27.v.1979, Coll. S. B. Roy & Party, NZC Regd. No. 13651/H3; Bihar: Katihar, 1 ♀, date of collection unknown, Coll. C. A. Paiva, NZC Regd. No. 13762/H3. Delhi: Delhi University Campus, 3 ♀, 3.viii.1976, 8.ix.1976 & 16.ix.1976, Coll. V. K. Gupta & Party, NZC Regd. Nos. 13763/H3 to 13765/H3. Himachal Pradesh: Bilaspur district, Kallar, 1 ♀, 8.ii.1992, Coll. A. S. Mahabal & Party, NZC Regd. No. 13766/H3. Jharkhand: Ranchi, 1 ♀, date of collection unknown, Coll. W. H. Irvine, NZC Regd. No. 13767/H3. Karnataka: Bengaluru, 2 ♀ , date of collection unknown, Coll. J. Cameron, NZC Regd. Nos. 356/H3 & 13768/H3. Madhya Pradesh: Jabalpur district, Vijay Nagar, 1 ♀, 5.ix.2010, Coll. E. E. Jehamalar, NZC Regd. No. 13769/H3. Meghalaya: East Khasi Hills district, Dainadubi, 4 ♂ , 8-13.v.1979, Coll. S. B. Roy & Party, NZC Regd. Nos. 13689/H3 to 13691/H3 & 13693/H3; Odisha: Khorda district, Khandagiri, 1 ♀, 7.xi.1912, Coll. F. H. Gravely, NZC Regd. No. 13770/H3; Ganjam district, Barkuda Island, 1 ♀, 18.ix.1919, Coll. E. Brunetti, NZC Regd. No. 13771/H3. Uttarakhand: Almora district, Lamgara, 1 ♀, 19.ix.2003, Coll. B. Mitra & Party, NZC Regd. No. 13772/H3. West Bengal: Bankura, 1 ♀ , 11.x.1951, Coll. N. C. Chatterjee & Party, NZC Regd. No. 13773/H3; S-24 Parganas district, Lakshmikantapur, 1 ♀, 15.x.1965, Coll. S. P. Chakraborty & Party, NZC Regd. No. 5274/H3; Bankura district, Simlapal, 1 ♀, 8.x.1985, Coll. K. K. Ray & Party, NZC Regd. No. 13774/H3. PAKISTAN: Karachi, 1 ♀ , date of collection unknown, Coll. Cumming, NZC Regd. No. 13775/H3.

Behaviour : See Horne (1870).

Distribution: India: Andhra Pradesh (new record), Assam (new record), Bihar (new record), Delhi (new record), Himachal Pradesh (new record), Jharkhand (new record), Karnataka (new record), Madhya Pradesh (new record), Meghalaya (new record), Odisha (new record), Rajasthan, Tamil Nadu, Uttarakhand (new record) and West Bengal. *Elsewhere*: Indonesia (Sumatra), Pakistan (new record), Sri Lanka.

3. ***Rhynchium haemorrhoidale*** (Fabricius)

This is a polytypic species with many subspecies. There are four subspecies are recorded from Oriental Region namely, *Rhynchium haemorrhoidale haemorrhoidale* (Fabricius), *R. haemorrhoidale sanguineum* (de Saussure), *R. haemorrhoidale dohertyi* (de Saussure) and *R. haemorrhoidale umeroatrum* (Gusenleitner) (Giordani Soika, 1994). Out of these four subspecies, the nominotypical subspecies namely *R. haemorrhoidale haemorrhoidale* (Fabricius) is recorded from Indian subcontinent. During our studies we found that there is one distinctly different colour form from Andaman & Nicobar Islands. For the time being we consider it as a separate subspecies namely, *R. haemorrhoidale andamanicum* subsp. nov. The species *R. haemorrhoidale haemorrhoidale* (Fabricius) and *R. haemorrhoidale andamanicum* subsp. nov. are very close to each other in their structure and sculptures. But the colour patterns on head and mesosoma are distinctly different as mentioned in the key. While studying a moderately large collection of specimens from different localities of Indian subcontinent, we found that *R. haemorrhoidale haemorrhoidale* (Fabricius) are present in both mainland and in Andaman & Nicobar Islands. But *R. haemorrhoidale andamanicum* subsp. nov. is so far recorded from Andaman & Nicobar Islands only. So, it requires further studies for the conformation of species status of these colour forms. For the time being we are considering them as two colour forms (subspecies) of the same species.

Behaviour: See Iwata (1938, 1942 & 1965).

(a). ***Rhynchium haemorrhoidale haemorrhoidale*** (Fabricius)
(Images 14-17)

Vespa haemorrhoidalis Fabricius, 1775, *Syst. Entomol.*, p. 366, Type male, "ad Cap. b. Spei" (BMNH).

Odynerus dimiatus Guèrin, 1834, in Bèlanger, *Voyage Indes-Orient. Zool.*, p. 503, pl. 4 fig. 4 , "Côte du Coromandel".

Rygchium haemorrhoidale: de Saussure, 1852, *Ét. Fam. Vesp.*, **1**: 109 (male, female).

Odynerus haemorrhoidalis: Bequaert, 1918, *Bull. Am. Mus. Nat. Hist.*, **39**: 300 (occurrence in Cape Province very doubtful).

Rhynchium haemorrhoidale: Bingham, 1897, *Fauna Brit. India*, Hym., **1**: 353 (key), 354, male, female (India; Burma; Ceylon; Tenasserim; Java; Cape of Good Hope).

Female: Body length (H+M+T1+T2) 14-16 mm; Forewing length 13-15.5 mm. Body black with the following reddish brown marks: antenna, mandibles except at margin, clypeus, a broad transverse mark on lower frons, inner eye margins, extending towards posterior ocelli and towards vertex, temple and lower portion of occiput, pronotum almost entirely except lateral margins, tegula almost entirely, a spot on mesopleuron below tegula, apical half and remaining portions of fore femora, apical margin of T2 and the visible parts of remaining tergites, apical margins of S2 to S4 and visible parts of S5 & S6. Wings yellowish hyaline, deeper and darker towards base; veins yellow, brown towards base. Body with rather sparsely to moderately dense fine brown pubescence.

Head: 1.02x as wide as long in front view (Image 14); clypeus strongly convex, pyriform, the apical third with a broad medial vertical groove, the extreme apex truncate, apex of truncated portion slightly incised, maximum width 1.03x length medially, with moderately deep punctures, larger punctures on middle and smaller on sides; mandibles on inner side with four rather broad and irregularly shaped teeth; labrum elongate rounded at apex; interantennal space smooth; a short but distinct strong carina present at the middle of interantennal space; frons closely, strongly and rugosely punctured, the diameters of the punctures greater than the distance between the punctures; ocular sinus with weak punctures; area between the antennal toruli and inner eye margin smooth; POL 1.35x OOL; diameter of anterior ocellus as long as the distance between anterior ocellus and posterior ocelli; vertex strongly punctured except at shallow postocellar fovea and area towards occipital carina; temple strongly punctured, as wide as eye in profile (measured through its ocular sinus); interocular distance 0.93x greater on vertex than at clypeus; occipital carina strong, complete and narrowed ventrally. Antenna 3.12x farther from each other than from eyes; antennal scrobe granulately punctured; scape 2.38x as long as F1, 4.00x as long as wide; pedicel 0.35x F1, 0.69x as long as wide; F1 1.69x as long as F2, 1.73x as long as wide; flagellar segments slightly widening towards apex except last antennal segment; apical antennal segment 0.93x as long as wide.

Mesosoma: Anterior face of pronotum smooth without punctures; pronotal carina strong and reaching the lateral margin of pronotum; posterior face and lateral sides of pronotum and mesoscutum strongly, closely and rugosely punctate except at posterior portion of mesoscutum; mesoscutum 0.99x as long as wide; mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially, strongly punctured except at posterior portion smooth; propleuron almost smooth; mesopleuron rugosely punctured except epicnemium and posterior margin smooth; epicnemial carina distinct; upper metapleuron smooth at lower portion and distinctly punctate at upper portion, lower metapleuron almost impunctate with few weak incomplete transverse striations at anterior margin. Propodeum vertical, concavo-truncate posteriorly, the sides of triangular segment at the base of propodeum is of equal length, bordered on each side by a deep groove, punctures on basal half of dorsolateral area of propodeum with strong and rugose punctures except a small smooth area anteriorly, apical half of dorsolateral area of propodeum with strong transverse striations, posterior concave area of propodeum with somewhat regular transverse striations, lateral sides of propodeum with weak and sparse rugose punctures at upper portion and fine irregular transverse striations at lower portion, postero-lateral sides of propodeum with few strong stout spine-like structures. Tegula not evenly rounded posteriorly, emarginated adjoining parategula

and shorter than parategula at apex; axillary fossa narrowed, slit-like. Midtibia with 1 spur. Forewing length 2.73x its maximum width, prestigma 0.90x pterostigma.

Metasoma: T1 0.66x as long as wide, 0.92x as wide as T2 in dorsal view; T1-T5 and S2-S4 with distinct punctures, the diameter of most of the punctures less than interspace; S5 with few scattered punctures; T6 and S6 almost smooth; the narrow basal part of S1 smooth, posterior transverse area of S1 rather irregularly transversely striate, rugose at apex.

Male (Image 15): Body length (H+M+T1+T2) 12.5-13.5 mm; Forewing length 12-13 mm. Colour pattern is almost same as that of female except clypeus, a transverse band at lower frons and scape ventrally yellow. Inner eye margin sometimes yellow (usually yellowish brown) and sometimes extends towards the margins of frons and temple (Image 16). Head as wide as long in front view; mandible with teeths not strong as in female; interocular distance 1.13x greater on vertex than at clypeus; clypeus (Image 16) more elongate and the apex between two teeth slightly emarginate, width 0.86x length medially; POL 1.27x OOL; occipital carina come close to the eye at the lower side; antenna with the last segment hook like, almost reaches the apex of tenth antennal segment in curved position; mid femur basally emarginate; stiff and stout hairs forms spine-like structures at the apical margin of S7; genitalia as in image 17, apical tip of aedeagus rounded. Other characters almost same as in female.

Material examined: INDIA: Andaman & Nicobar Islands, South Andaman district, Premnagar, 1♀, 25.iii.1992, Coll. D. D. Prakasam, NZC Regd. No. 13781/H3. West Bengal: S-24 Parganas district, Sunderbans Tiger Reserve, Gosaba, 1♀& 1♂, 12.ix.1983, Coll. S. S. Saha & Party, NZC Regd. Nos. 13785/H3&13851/H3.

Distribution: India: Andaman & Nicobar Island (new record), Karnataka, Tamil Nadu, West Bengal. *Elsewhere*: Throughout the Oriental Region, from Iran to New Guinea, Australia, Borneo, Indonesia (Batavia, Buitenzorg, Flores, Java, Korinchi Valley, Krakatau, Sumatra), Malaysia (Malaya), Myanmar, New Guinea, Singapore, Sri Lanka, Taiwan. A questionable record from the Cape Province of the Cape of Good Hope of the Republic of South Africa.

(b). ***Rhynchium haemorrhoidale andamanicum*** subsp. nov.
(Images 18-19)

This new subspecies is almost same to the nominotypical subspecies except mesosoma entirely black and head predominantly black with or without brown and yellow markings. Mandibles usually brown; clypeus usually with varying degree of brown markings (sometimes entirely black), sometimes a narrow brown marks on inner margin of eye; usually a brown area on temple; usually a transverse yellow band on lower frons (sometimes brownish and sometimes absent).

This subspecies comes close to *Rhynchium haemorrhoidale dohertyi* Schulz of Sanana Island (Indonesia) in general colour pattern but distinctly differs in the following characters: (1). Antenna ferruginous (In *R. h. dohertyi* antenna brown black at upper side and red ferruginous at lower side) and (2). Apex of S3-S5 (sometimes apex of S2 also) and S6 entirely red ferruginous to yellow ferruginous (In *R. h. dohertyi* sternites entirely black).

Material examined: Holotype: INDIA: Andaman & Nicobar Islands, South Andaman district, Port Blair, Delanipur, 1♀, 14.viii.1978, Coll. K. C. Banerjee, NZC Regd. No. 13777/H3. Paratypes: South Andaman district, Aberdeen bazar, 1♀, 19.vi.1935, Coll. H. S. Rao, NZC Regd. No. 13776/H3; Wandoor, 1♀, 15.vi.1982, Coll. R. M. Sharma, NZC Regd. No. 13778/H3; Port Blair, 1♀, 7.i.1984, Coll. Gopichand, NZC Regd. No. 13779/H3; Nicobar Islands, 1♀, 28.vii.1984, Coll. S. S. Saha, NZC Regd. No. 13780/H3; Port Blair, Dilthaman Tank, 1♀, 22.viii.1992, Coll. S. Kumar, NZC Regd. No. 13782/H3; North Andaman, North Reef Island, 1♀, 12.iii.1993, Coll. G. C. Rao & Party, NZC Regd. No. 13783/H3; South Andaman district, Port Blair, Haddo, 1♀,

16.vi.1996, Coll. P. Boominathan, NZC Regd. No. 13784/H3 (All type specimens are deposited at NZC).

3. ***Rhynchium oculatum leviscutis*** (Cameron) (Images 20-24)

Odynerus leviscutis Cameron, 1908, *J. Bombay Nat. Hist. Soc.*, **18**: 306, male, Bombay (BMNH).

Rynchium levisticus: Meade-Waldo& Morley, 1914, *Ann. Mag. Nat. Hist.*, (8) **14**: 405.

Odynerus "oculatum var. *lefebrei* Lep.": Dover, 1925, *J. Proc. Asiat. Soc. Bengal.*, **20**: 297 (in subgenus *Rynchium*).

Odynerus oculatum levisticutis: Giordani Soika, 1941, *Boll. Soc. Venez. Stor. Nat.*, **2**: 262 (note on type; in subgenus *Rynchium*).

Rhynchium oculatum levisticutis: Giordani Soika, 1952, *Boll. Soc. Venez. Stor.Nat.*, **6**: 49.

Female (Image 20): Body length (H+M+T1+T2) 13.5 mm; Forewing length 13.5 mm. Body brown (and sometimes mixed with yellowish brown) with the following yellow markings: a broad transverse marks on lower frons; inner margins of eye extends towards temple and lower sides of occiput; tegula (sometimes yellowish brown); T2 almost entirely except basal triangular brownish marks; lateral sides of S2. Wings yellowish hyaline; veins yellowish brown. Body with rather sparsely to moderately dense fine golden pubescence.

Head: 1.05x as wide as long in front view (Image 21); clypeus strongly convex, pyriform, the extreme apex not sharply truncated, almost rounded, maximum width 0.93x length medially, with moderately deep punctures, larger punctures on middle and smaller on sides; mandibles on inner side with four rather broad and irregularly shaped teeth; labrum elongate rounded at apex; interantennal space smooth; a short and weak carina present at the middle of interantennal space; frons closely, weakly and rugosely punctured, the diameters of the punctures greater than the distance between the punctures; ocular sinus with weak punctures; area between the antennal toruli and inner eye margin smooth; POL 1.08x OOL; diameter of anterior ocellus 1.50x longer than the distance between anterior ocellus and posterior ocelli; vertex weakly punctured except at shallow post ocellar fovea and area towards occipital carina almost smooth; temple weakly punctured, 0.93x as wide as eye in profile (measured through its ocular sinus); interocular distance 0.95x greater on vertex than at clypeus; occipital carina strong, complete and narrowed ventrally.

Mesosoma: Anterior face of pronotum smooth without punctures; pronotal carina strong and reaching the lateral margin of pronotum; posterior face and lateral sides of pronotum and mesoscutum strongly, closely and rugosely punctate except at lateral corner of posterior face of pronotum and posterior portion of mesoscutum; mesoscutum 0.89x as long as wide; mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially, strongly punctured except at posterior portion smooth; propleuron almost smooth; mesopleuron rugosely punctured except epicnemium and posterior margin smooth; epicnemial carina distinct; upper metapleuron smooth at lower portion and punctate at upper portion, lower metapleuron almost impunctate with few weak incomplete transverse striations at anterior margin. Propodeum vertical, concavo-truncate posteriorly, the sides of triangular segment at the base of propodeum is of equal length, bordered on each side by a deep groove, punctures on basal half of dorsolateral area of propodeum with strong and rugose punctures except a small smooth area anteriorly, apical half of dorsolateral area of propodeum with strong transverse striations, posterior concave area of propodeum with somewhat regular transverse striations, lateral sides of propodeum with weak and sparse rugose punctures at upper portion and fine irregular transverse striations at lower portion, postero-lateral sides of propodeum with few strong stout spine-like structures. Tegula not evenly rounded posteriorly, emarginated adjoining parategula and shorter than parategula at apex; axillary fossa narrowed, slit-like. Midtibia with 1 spur. Forewing length 3.25x its maximum width, prestigma as long as pterostigma.

Metasoma: T1 0.61x as long as wide, 0.93x as wide as T2 in dorsal view; T1-T5 and S2-S5 with distinct but fine, smooth punctures, the diameter of most of the punctures less than interspace; T6 and S6 almost smooth; the narrow basal part of S1 smooth, posterior transverse area of S1 rather irregularly transversely striate, rugose at apex.

Male (Image 22): Body length (H+M+T1+T2) 10-12 mm; Forewing length 9.5-12.5 mm. Colour pattern is almost same as that of female except clypeus, a transverse band at lower frons and scape ventrally yellow. Inner eye margin yellow and narrowly extends towards temple Head (Image 23) 1.06x as wide as long in front view; mandible with teeth not strong as in female; interocular distance 1.21x greater on vertex than at clypeus; clypeus (Image 23) more elongate and the apex pointed, width 0.82x length medially; POL 1.21x OOL; occipital carina come close to the eye at the lower side; antenna with the last segment hook like, almost reaches the apex of tenth antennal segment in curved position; mid femur basally emarginate; stiff and stout hairs at the apical margin of S7; genitalia as in image 24, apical tip of aedeagus almost rounded. Other characters almost same as in female.

Material examined: INDIA: Delhi, Delhi University Campus, 1 ♀ & 2 ♂, 21.ix.1961, Coll. V. K. Gupta & Party, NZC Regd. Nos. 13786/H3 to 13788/H3.

Distribution: India: Delhi (new record), Maharashtra.

Remarks: This is the second report of this subspecies from India after its original description from Mumbai (=Bombay) by Cameron in 1908.

5. ***Rhynchium atrum atrum*** de Saussure

Rhynchium atrum de Saussure, 1852, *Ét. Fam. Vesp.*, **1**: 109, female, male (*Rhygchium*), Indes Orientales, Sunda Is., New Guinea (Neotype female USNM).

Rhynchium haemorrhoidale var. *atrum*: Maindron, 1882, *Ann. Soc. Entomol. France*, (6) **2**: 280.

Rhynchium atrum atrum: van der Vecht, 1968, *Zool. Meded.*, **42**: 256 (designation of neotype female from Manila; redescription female, male)

Diagnosis: *Female*: Body length (H+M+T1+T2) 13-16 mm. Body black except the following parts dull red: mandibles, clypeus, a spot between and above the antennae, a line at inner and outer orbits, dilated on upper part of temples, part of the post-ocellar fovea on the vertex, and anterior part of pronotum; antennae ferruginous; terminal antennal segment somewhat brownish; ill-defined reddish markings on the sides of scutellum and propodeum and on upper part of mesepisternum; legs black; fore legs with red spot on coxae, and reddish beyond the base of femora; distal half of midfemora reddish anteriorly. Wings yellowish, basal third of forewing and basal half of hind wing infuscated.

Male: Body length (H+M+T1+T2) 11-13 mm. Similar to female, but the red markings often less extensive; mandible black, clypeus yellow; interantennal mark, a line on the antennal scape and a line on the lower side of the eye emargination pale yellow.

Behaviour: See Williams (1919& 1928).

Distribution: India ('Indes Orientales") is doubtful. Elsewhere: Malayan region to New Guinea, Myanmar, Philippines, Sunda Islands and Taiwan.

Remarks: Saussure (1852) described this species from "Indes Orientales" and Smith (1857) in his catalogue mentioned its presence from India. Bingham (1897) not studied any specimens of this species from India but mentioned its presence in India based on de Saussure and Smith. After that there is no reference of this species from Indian region. We examined a large number of specimens of the genus *Rhynchium* from all over India, but did not find any single specimen of this species. So, we strongly doubted about the identity of this species by de Saussure (1852) from "Indes Orientales" is incorrect.

Since the specimens are not available, the diagnostic characters were taken from van der Vecht (1968).

SUMMARY

The genus *Rhynchium* Spinola from Indian subcontinent is reviewed, recognizing 4 species in the subcontinent. An illustrated key to species/subspecies of the genus from Indian subcontinent is provided. Detailed description of each species is also provided. The species *Rhynchium brunneum* (Fabricius, 1793) is reported here for the first time from Andhra Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Manipur, Mizoram and Tripura. The species *R. carnaticum* (Fabricius, 1798) is reported here for the first time from Andhra Pradesh, Assam, Bihar, Delhi, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Meghalaya, Odisha and Uttarakhand. This species is herewith recorded for the first time from Pakistan also. The subspecies *R. haemorrhoidale haemorrhoidale* (Fabricius, 1775) is reported here for the first time from Andaman & Nicobar Island. A new colour form of the species *R. haemorrhoidale* namely *R. haemorrhoidale andamanicum* subsp. nov. is described. The subspecies *R. oculatum leviscutis* (Cameron, 1908) is recorded for the first time from Delhi.

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PLATE I

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Images : 1-6. *Rhynchium brunneum brunneum* (Fabricius). 1-3 Female. 1 Body profile; 2. Head front view; 3. Mesosoma dorsal view. 4-6 Male. 4. Body profile; 5 Head front view; 6. Antenna.

PLATE II

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Images : 7-8. *Rhynchium brunneum brunneum* (Fabricius) Male. 7. Mid femur; 8. Genitalia. Images 9-12. *R. cornaticum* (Fabricius). 9-10 Female. 9. Body profile; 10. Head front view. 11-12 Male. 11. Body profile; 12. Head front view.

PLATE III

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Image : 13. *Rhynchium cornaticum* (Fabricius) Male. Genitalia. Images 14-17. *R. haemorrhoidale haemorrhoidale* (Fabricius). 14. Female Head front view. 15-17 Male. 15. Body profile; 16. Head front view; 17. Genitalia (Parameral spine broken). Image 18. *R. haemorrhoidale andamanicum* ssp. nov. Female Body profile.

PLATE IV

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Image : 19. *Rhynchium haemorrhoidale andamanicum* ssp. nov. Female. Head front view. Images 20-24. *R. oculatum leviscutis* (Cameron). 20-21. Female. 20. Body profile; 21. Head fron view. Images 22-24. Male. 22. Body profile; 23. Head front view; 24. Genitalia.

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CONTRIBUTION TO THE KNOWLEDGE OF INDIAN MARINE MOLLUSCS WITH A NOTE ON THE NATIONAL ZOOLOGICAL COLLECTIONS FROM OTHER COUNTRIES: FAMILY – TURRITELLIDAE

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INTRODUCTION

In this paper, we have made an attempt to update knowledge on marine molluscs of India of various individual families and to compile the collections present in NZC, both Indian and foreign specimens and presenting an account of the families with as much as details possible on them. This is the sixth in the series of our contributions, and the earlier five were done by Zoological Survey of Indian's malacologist on the families Mitridae (Subba Rao and Dey, 1984) and Donacidae (Subba Rao and Dey, 1986), Muricidae (Subba Rao and Surya Rao, 1993), Tellinidae (Dey, 2006), Terebridae (Venkitesan and Mukhopadhyay, 2011).

This family is a large family commonly known as Turret shell, which is elongate, slender, multi-whorled, ornamented with spiral ridges and usually brown or yellow. There is no umbilicus and the thin outer lip is seldom complete even in mature examples. Operculum is thin, chitinous and multispiral. There are many species worldwide, living as herbivores in sandy or muddy plans, but few occur in Indian subcontinent. Identification is difficult because shell vary greatly in ornament, colour pattern and spire angle, even at one locality.

EARLIER WORKS

The genus Turritella has been some what neglected by Conchologists. Lamarck (1822) described only 11 species and later another 6 species were dealt by Kiener (1839). Reeve (1960) reported about 65 species of Turritellidae in his Monograph in *Conchological Iconica.* Marwik (1957) work upon the generic revision of Turritellidae. Gerrad (1972) revised the Australian Turritellidae. In India two genera *Turritella* and *Haustator* belonging to the subfamily Turritellinae are reported. Subba Rao and Dey (2000) reported about 4 species of Turritellidae belonging to two genera *Haustator* and *Turritella* from Indian waters. Subba Rao (2003) described 5 species in his book Indian Sea shell. Venkitesan and Mukhopadhyay (2011) recorded one species from Indian waters for the first time.

DIAGNOSTIC FEATURES AND GENERAL ACCOUNT OF THE FAMILY

Turritellidae, the tower shells, is a family of small to medium-sized marine gastropod mollusca. Shells of this family are elongate, many whorled shells, similar to the terebrids in general shape but distinguished by not having either an anterior or a posterior canal. The outer lip bears a large sinus, but the lip in the sinus area is very thin and usually broken, even in life. The shape of the sinus is best seen in the growth lines behind the growing edge. There is strong spiral sculpture, but axial sculpture is restricted to growth lines of the shape of the outer lip. The *turritella* shell shape

is somewhat variable and shells are thin, rough and not lustrous. The rounded mouth and complete absence of a siphonal canal at the anterior end of the aperture are the distinguishing features of Turritellidae. The shells have, in addition a very tall spire, numerous convex whorls, no umbilical opening, absence of folds on the columella, and a horny, flexible operculum that is supported by flexible bristles. The operculum can be withdrawn far inside the shell when the animal retreats.

The member of the family Turritellidae generally live sub-tidally, down to at least 1500 m from sea surface, but a few occur in the lower intertidal as well. Animals of this family are ciliary deposit feeders with limited crawling ability. They lay upon or are partly buried in the substrate, usually soft muddy-sand, and filter minute particles from the sea water as it is drawn over their gills. The particles are then fed in a mucous string to the mouth. Quite unlike the *Terebra* mollusca, the *Turritellids* lacks the venomous dart mechanism needed for an actively carnivorous life style. Many *Turritellas* make use of their gills to filter out fine food particles much as clams do. In this family some species are dioecious, meaning they exist as male or female throughout their life. Sperm may be transferred from male to female in packets, or broadcast into the water by males and captured by females in the inhalant water stream. In some species fertilized eggs are brooded in the mantle cavity of the female, with juveniles either being released into the plankton or released onto the substrate as crawling juveniles. Other species attach the egg mass to wood, rocks or other solid substrate, from whence they hatch (Subba Rao, 2003).

The family Turritellidae is worldwide in distribution, but more number of species found in temperate seas. It is a large family consisting of five sub-families embracing 18 genera and 150 species.

Similar families occurring in the area - Terebridae: General shape of the shell similar to Turritellidae, but with a well-marked, notched siphonal canal at the anterior end; operculum ovate, with a terminal nucleus.

SYSTEMATIC ACCOUNT

Family Turritellidae
Subfamily Turritellinae

Family TURRITELLIDAE

Shell medium to large, thick, elongate, slender, sharply conical; numerous whorls and somewhat small to medium rounded aperture; Outer lip thin, inner lip smooth; Umbilicus absent; Whorls strongly sculptured with spiral ribs or keels; Anterior siphonal canal absent; operculum corneous and rounded with a central nucleus; border thin. They are mainly herbivores. Lot of species present in worldwide but India represent only a few.

Sub-family TURRITELLINAE

Outer lip of aperture arcuate, parasigmoid, or doubly sinused; columella curved or slightly twisted; operculum multispiral with central nucleus.

Turritellidae is a large family consisting of five subfamilies comprising 18 genera and an estimated 150 species. Two genera under the family Turritellidae are found in India. They are *Haustator* and *Turritella*.

Genus ***Haustator***

Shell moderate, relative smaller than *Turritella*; suture indistinct, number of whorls 12-13, whorl acuminately turreted, aperture sub-quadrangular. Outer lip sinuses; sculpture with three spiral ridges; concave intermediate groove and concentric. Colour brown with chestnut to deep brown maculation present around the shell. Apical portion of the fresh shell often seen tinged with violet or blue.

Globally there are 11 species reported under this genus. However, in India, the genus *Haustator* is represented by a single species *H. trisulcata*. This species was named by Lamarck (1822) and is an extant species.

1. ***Haustator trisulcata*** (Lamarck)

1822. *Turritella trisulcata* Lamarck, *Hist. nat. Anim. Sans. Vert.*, **(1)**7:58.

1906. *Turritella cerea*: Comber, *J. Bombay nat Hist. Soc.*, **17**: 209.

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1982. *Turritella trisulcata*: Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No.*, **28**: 18.

2003. *Haustator trisulcata*: Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.*, **192**: 141, pl.23, fig.4.

2012. *Turritella (Haustator) trisulcata*:Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** i) 13 exs., shore coll, Mandapam camp, Coromandel coast, Coll. A.S.Rajagopal & H.P.Mukherjee, 31.1.1995,Regd. No. M21027/4;ii) 8exs., shore coll., Verrapandian pattinam, Coromandel coast, Coll. A.S.R. & H.P.M. , 27.1.1978, Regd. No. M21029/4; iii) 2 exs., shore collection in front of circuit house, Tuticorin, Coll. A.S.R. and H.P.M., 21.1.1978, Regd. No. M21028/4; iv) 1 ex., shore collection near port of New Tuticorin, Coll. A.S.R. and H.P.M., 22.1.1978, Regd. No. M20996/4; v) 10 exs., shore collection near Subramanium temple, Trichendur, Coll. A.S.R. and H.P.M., 25.1.1978, Regd. No. M20994/4; vi) 1 ex., Setukkarai, Gulf of Mannar, Coll. A.S.R. and Party, 19.1.1978, Regd. No.M21428/4.

Measurement: **(mm)**

Length	Width	Aperture Length
36.30-10.00	11.20-3.80	6.20-1.40

Description: Protoconch of 3 whorls, teleoconch 18 whorls in adult shells. Whorls convex, suture impressed. Whorls spirally ribbed; latter whorls sculptured with up to 18 spiral riblets, variable in size and spacing, some beaded. Axial sculpture of sparse growth lines conforming to shape of outer lip sinus. Inner lip of aperture reflected outwards at base; outer lip thin, with moderate sinus, lip usually broken. Aperture higher than wide. Base with numerous unequal threads. Colour off-white to pale brown, with deep chestnut band either above, or below, or on both sides of suture. Operculum circular, corneous.

***Remarks*:** The well rounded whorls, the riblets varying in size and spacing, allied with the chestnut band at the suture, separate this from other species of similar size. In this size range, *C. cordismei* also has rounded whorls and numerous threads, but there is a rib at the bottom of whorls, and alternating brown and white markings on the ribs. Synonyms include *Turritella fascialis* Menke, 1830 and *Torcula parvus* Angas, 1877.

Genus ***Turritella*** Lamarck

1799. *Turritella* Lamarck, *Mem. Soc.Hist. nat. Paris*, p. 74.

***Characters*:** Shell elongately turreted, lanceolately acuminated, never umbilicated, whorls numerous, mostly transversely ribbed or striated, never longitudinally sculptured. Sculpture consists of spiral striations, destitute of varices, never spined or prickly, aperture rather small, more or less rounded, margins disjoined, lip often sinuated in the middle, rounded or angle at the top, attenuated with 15-20 rounded whorls. Outer lip is thin with a convex outer margin. In some, whorl strongly keeled in the middle with sloping upper part, curved lower part; thin, circular chitineous operculum with a central nucleus.

The best characters for the discrimination of species reside in the first eight or ten whorls from the apex; beyond this point the sculpture varies slightly or becomes obsolete, as the shell approaches maturity. The *Turritella* have a wide range of habitation and dwell at a considerable depth as well as near the surface.

KEY TO SPECIES

There are more than 87 species under the genus *Turritella*. However, in India, only 11 species have been reported. Recently there is a new species recorded from the state of Karnataka in India (Venkitesan & Mukhopadhyay, 2012).

1. No. of whorl 20 or more .....*Turritella columnaris*
- No. of whorl less than 20.....2
2. Presence of spiral striation with keels.....3
- Absence strong spiral striations or keels.....4

3. One no. prominent spiral striation or keel .....*T. attenuata*

- Two or more no. of prominent, median ridges/ keel.....5

4. Three prominent spiral striation from penultimate whorl to body whorl.....*T. monilifera*

- Two to more spiral striation present.....6

5. Two no. of sharp prominent spiral ridges/keel, in the middle of the whorl, 14-20 whorls, sides of the whorls sharply keeled without painting. .....*T. duplicata*

- Two No. of conspicuous swollen keel at the base of each whorl with bold style of painting below suture.....*T. bicingulata*

6. Numerous spiral ridges present along the body.....8

   Two prominent spiral ridges present along the body.....7

7. Two prominent spiral ridges present along the body, but not keeled with smooth outer lip, shell more or less glossy.....*T. fastigiata*

- Two no. of spiral ridges with brown maculation .....*T. maculata*

8. Body ornamented with reddish brown dots, whorls about 20, spiral striation with uniform pattern.....*T. infraconstricta*

- Body white ; each whorls encircled by strong ridges with lesser ridges between; fine straight or curved, axial striae between ridges.....*T. fultoni*

Genus: ***Turritella***

1799. *Turritella* Lamarck, *Mem. Soc.Hist. nat. Paris*, p. 74.

2. ***Turritella attenuata*** Reeve

1869. *Turritella attenuata* Reeve, *Conch. Icon.*, **5**: *Turritella* sp. No.,4, pl. 1, fig. 4.

1942. *Turritella attenuata*: Gravely, *Bull. Madras Govt. Mus. New Ser. (Nat. Hist)*, **5(2):**22.

1952. *Turritella attenuata*: Satyamurti, *Bull. Madras Govt. Mus. New Ser. (Nat. Hist)*, **1(2):**71, pl. 4, fig. 9.

1982. *Turritella attenuata*: Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No.*,**28**: 16.

1990. *Turritella attenuata*: Pinn, *Sea Shells of Pondicherry*, Nehru Science Centre, p.14, fig. 15.

1992. *Turritella attenuata*: Subba Rao, Dey and Barua, *Fauna of West Bengal, State Fauna series*, **3(9):** 173, pl.4, fig. 10. Zool. Surv. India.

2003. *Turritella attenuata*: Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.*, **192**: 140, pl.23, fig.1.

2007. *Turritella attenuata*: Ramakrishna, Dey, Barua and Mukhopadhya, *Fauna of Andhra Pradesh, State Fauna series*, **5(7):** 49, Pl. II, Figs. 15 & 16. Zool. Surv. India.

2008. *Turritella attenuata*: Mahapatra, *Fauna of Krishna Estuary, Estuarine Ecosystem series*, **5**: 125. Zool. Surv. India.

2010. *Turritella attenuata*: Mahapatra, *Fauna of Vamsadhara and Nagavali Estuary, Estuarine Ecosystem series*, **6:** 57. Zool. Surv. India.

2010. *Turritella attenuata*: Raghunathan, Sivaperuman and Ramakrishna, In: *Recent Trends in Biodiversity of Andaman and Nicobar Islands*, pp. 255, 258, 262, 266. Zool. Surv. India.

2012. *Turritella attenuata*: Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** i) 2 exs., Coastal waters of Madras from High court to triplicane, Coll. A. S. Rajagopal & H.P. Mookherjee, 25.2.1975,Regd. No.M20972/4; ii) 13 exs., coastal waters of Madras, North of Harbour, Coll. A.S. Rajagopal & H.P.Mookherjee,29.2.1975, Regd.No.M20971/4; iii) 2 exs., coastal area of Puducherry up to Nallamkuppam, Coll. A.S. Rajagopal & H.P.Mookherjee,18.2.1975, Regd. No. M21000/4; iv) 1 ex., shore collection, Santhome beach, South upto the mouth of Adyar, Madras, Coll. A.S. Rajagopal & H.P.Mookherjee, 24.2.1975, Regd. No. M20998/4; v) 1 ex.,river bank in front of Marine Biological Station, Madras, Coll. A.S.Rajagopal, 11.12.1968, Regd. No. M20970/4; vi) 1 ex., Colva beach, Goa, Coll. A.K. Das and party, Feb, 1975, Regd. No.M22407/4; vii) 1 ex., shore collection between Killai river mouth and chinnavayakal village, Madras (Chennai), Coll. A. S. R., 13.2.1968, Regd. No. M20968/4; viii) 1 ex., Plliots beach, opposite radio station, Madras (Chennai), Regd. No. M17333/3; ix) 1 ex., Cortalim, Goa, Coll. K.S. Pradhan and Party, 15.11.1967, Regd. No.M22455/4; x) 2 exs., shore collection, North of Fort, Tranquebar, Coll. A.S.R. and H.P.M., 12.12.1975, Regd. No. M20999/4; xi) 5 exs., shore collection opposite to Fort, Tranquebar, Coll. A.S.R. and H.P.M., 11.2.1975,

Regd. No. 21007/4; xii) 2 exs., Sea coast near Chinna tarangapatti, 3 miles north of Tranquebar, Coll. Dr. Menon and Ramakrishna, 20.2.1957; Regd. No. M20997/4; xiii) 1 ex., Digha, West Bengal, Coll. Mr. F.M.J. Pinn, Regd. No. M20524/4; xiv) 5 exs, Eastern Sea, Regd. No.1442; xv) 6 exs., Madras , Coromandal Coast, Regd. No. M18304/3; xvi) 1 ex., shore collection, from Cape Comorin, Coll. Mr. C.V. Kurian, Regd. No. M26441/5; xvii) 7 exs., Suratkal beach, Karnataka, Coll. K.V.S.R., M.K. Ghosh and S.K. Roy, 19.12.1970, Regd. No. M27081/5; xviii) 1 ex., Puri, Regd. No. M1631/1.

***Measurements*: (mm)**

Length	Width	Aperture Length
108.65-37.20	20.30-13.15	22.25-7.25

Description: Shell sharply attenuated, nearer to the body whorl with 15-16 rounded whorls, gradually larger from the pointed apex to the anterior end; on later whorls from 12-16 middle striation becoming stronger and other gradually weak and obsolete making single distinct spiral cords and obscure few cords on each whorl; suture distinct; whorls strongly keeled in the middle with sloping upper part and curved lower part. Aperture nearly round and sinuate, colour light brownish to pinkish, upper part of the whorl tinged with blue.

***Remarks*:** This species is a ciliary –suspension feeder, sexes separate, fertilization internal. Eggs are laid in a stalked capsule, attached to stones. Occurs in intertidal to offshore beyond the low tide mark. Used as decorative items in the shell craft industry. Common.

Distribution: India: Andhra Pradesh, Odisha, Tamil Nadu, West Bengal; Elsewhere: Eastern Seas.

3. *Turritella columnaris* Kiener

1844. *Turritella columnaris* Kiener, *Icon. Coq. Viv.*, **10**: 10, pl.7, fig.1.

1952. *Turritella columnaris*: Subramanyam, Karandikar and Murti, *J. Univ. Bombay*, **21(3)**:32.

1961. *Turritella columnaris*: Menon, Datta Gupta and Das Gupta, *J. Bombay nat. Hist. Soc.*, **58(2):** 481, pl.3, fig.31.

1982. *Turritella columnaris*: Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No.*,**28**: 18.

1990. *Turritella columnaris*: Pinn, *Sea Shells of Pondicherry*, Nehru Science Centre, p.14, fig. 16.

1991. *Turritella columnaris*: Rao, Rao and Maitra, *Fauna of Orissa, State Fauna series*, **1(3):** 40. Zool. Surv. India.

1995. *Turritella columnaris*: Subba Rao, Surya Rao and Manna, *Fauna of Chilka lake, Wetland Ecosystem series*, **1**: 398. Zool. Surv. India.

2003. *Turritella columnaris*: Subba Rao, *Rec. zool. Surv. India Occ. Paper No.*, **192**: 140, pl.23, figs.2, 3.

2004. *Turritella columnaris*: Rao, Maitra, Barua and Ramakrishna, *Fauna of Gujarat, State Fauna series*, **8(2):** 289. Zool. Surv. India.

2007. *Turritella columnaris*: Ramakrishna, Dey, Barua and Mukhopadhya, *Fauna of Andhra Pradesh, State Fauna series*, **5(7):** 50. Zool. Surv. India.

2012. *Turritella columnaris*: Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** i) 1 ex., Chhatrapur, Coll; Unknown, Orissa, 24.11.1962, Regd. No.M22537/5; ii) 1 ex., Madeli, Odisha, Coll. N.V. Subba Rao, 1.3.1964, Regd No. M22522/4; iii) 1 ex., Sea Coast, Adirampattinam, Palk Bay, Coll. A.S. Rajagopal & H.P. Mookherjee; iv) 1 ex., sandy shore of South bar at the mouth Chilka, Coll. R.N. Manna, 21.9.1987, Regd. No. M23327/4, M23326/4; v) 4 exs, Adatara beach, Okha, Coll. K.V. Surya Rao, 10.8.1972, M26450/5; vi) 1 ex., Hanumandandi, Okha, Coll. K.N. Reddy, 8.4.1977, Regd. No. M26451/5; vii) 7 exs, Hanumandandi, Okha, Coll. H. C.Ray, 23.1.1953, Regd. No. M26452/5.

***Measurement* : (mm)**

Length	Width	Aperture Length
95-66.30	16.25-12.35	4.30-1.15

Description: Solid, semi translucent, spire angle about 10^0, very sharply lanceolately turreted with about 30 whorls, the first two-keeled, keels approximated, the rest rather flattened. Each whorl overhangs succeeding whorl to make suture deep; sometimes flattened in the middle, base strongly angulated; strong spiral ridges on

lower part of whorls, lesser ridges above. Thin-edged aperture squarish, columella straight.

Colour- Greyish-whitish heavily mottled with brown fading to orange brown.

***Remarks*:** This species has the largest number of whorls, and is the most elongated forms of the genus. Occurs in muddy sand among stones in the intertidal to sub tidal; mostly beyond the low tide line. Plays an important role in the environment as detritus feeder. Sexes separate, fertilization internal, Eggs lay in clusters, attached to stones. Uncommon.

Distribution: India: Andhra Pradesh, Gujarat, Maharashtra, Odisha, Puducherry, Tamil Nadu; Elsewhere: Sri Lanka, Myanmar.

4. ***Turritella duplicata*** (Linnaeus)

1767. *Turbo duplicata* Linnaeus, *Syst. Nat.*, ed. **12**: 1239.

1898. *Turritella (Zaria) duplicata*: Melvill and Sykes, *Proc. malac. Soc.* London,**3**: 45.

1906. *Turritella(Zaria) duplicata* : Comber, *J. Bombay nat Hist. Soc.*, **17**: 209.

1940. *Turritella duplicata*: Crichton, *J. Bombay nat. Hist. Soc.*, **42**: 339.

1952. *Turritella duplicata*: Subramanyam, Karandikar and Murti, *J. Univ. Bombay*, **21(3):**32, fig.31.

1986. *Turritella duplicata*: Tikader, Daniel and Subba Rao, *Sea shore animals of Andaman and Nicobar Islands*, Zool. Surv. India, p.167.

1990. *Turritella duplicata*: Pinn, *Sea Shells of Pondicherry*, Nehru Science Centre, p.14, fig. 14.

2000. *Turritella duplicata*: Subba Rao and Dey, *Rec. zool. Surv. India Occ. Paper No.*, **187**: 53.

2003. *Turritella duplicata*: Subba Rao, *Rec. zool. Surv. India Occ. Paper No.*, **192**: 141, pl.23, figs.7-9.

2004. *Turritella duplicata*: Rao, Maitra, Barua and Ramakrishna, *Fauna of Gujarat, State Fauna series*, **8(2):** 289. Zool. Surv. India.

2007. *Turritella duplicata*: Ramakrishna, Dey, Barua and Mukhopadhya, *Fauna of Andhra Pradesh, State Fauna series*, **5(7):** 50, Pl. II, Figs. 17 & 18. Zool. Surv. India.

2008. *Turritella acutangula*: Mahapatra, *Fauna of Krishna Estuary, Estuarine Ecosystem series*, **5**: 124. Zool. Surv. India.

2010. *Turritella acutangula*: Mahapatra, *Fauna of Vamsadhara and Nagavali Estuary, Estuarine Ecosystem series*, **6**: 56. Zool. Surv. India.

2010. *Turritella duplicata*: Rao, *Field Guide to Corals and Coral Associates of Andaman and Nicobar Islands*, p. 212. Zool. Surv. India.

2012. *Turritella acutingula*: Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India. (error for *Turritella acutangula*).

2012. *Turritella duplicata*: Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** i) 2 exs., Colva beach, Goa, Coll. K.S. Pradhan, 11.11.1967, Regd. No.M22406/4; ii) 9 exs., Colva beach, Goa, Coll. K.S. Pradhan, 11.11.1967, Regd. No. M21941/4; iii)1 ex., Cortalim, Goa, Coll. K.S. Pradhan, 15.11.1967, Regd. No. M21916/4; iv) 1 ex., Betul beach, Goa, Coll. A.K.Das and Party; 3.3.1975, Regd. No. M21942/4; v) 1 ex., shore collection in front of Karaikal medu village, Karaikal, Tamil Nadu, Coll. A.S.R. and H.P.M., 7.2.1975, Regd. No.M21006/4; vi) 2 exs., Colva beach, Goa, Coll. K.S.Pradhan, 4.4.1966, Regd. No. M21919/4; vii) 5exs., Goa, Coll. K.S. Pradhan, Regd. No. M21917/4; viii) 7 exs, Madras, Regd. No. M26435/5; ix) 7 exs., Madras, Regd. No. M18311/3; x) 2 exs., Bombay, Regd. No. M18310/3; xi) 10 exs., Colva beach, Goa, 12.11.1967, Regd. No. M21223/4; xii) 1 ex., Port Sikka, Gulf of Kutch, Coll. H.C.Ray, 13.1.1953, Regd. No. M26453/5; xiii) 1 ex. Nayabandar, Bedi, K.V.S.R., 20.8.1972,Regd. No. M26454/5; xiv) 1 ex., Hanumandandi, Okha, Coll. K.N.R., 8.4.1977, Regd. No. M26455/5; xv) 3 exs., Gangolli beach harbor, Karnataka, Coll. K.V.S.R., 23.12.1970, Regd. No. M27267/5; xvi) 7 exs, Suratkal beach, Mysore, Karnataka, Coll. K.V.S.R. and Party, 19.12.1970, Regd. No. M27073/5; xvii) 1 ex., Porto Novo, Madras, Coll. A.S.R., 11.2.1968, Regd. No. M20942/4; xviii) 2 exs., between Killai River mouth and Chinnavayakal village, Madras, Coll. A.S.R., 13.2.1968, Regd. No.M20943/4; xix) 2 exs., Dammula Palem, Kakinada, A.P., 23.5.1955,

Regd. No. M21202/4; xx) 2 exs., Chilka Lake, Tip of South bar near mouth, Coll. R.N. Manna, Regd. No. M23676/4; xxi) 4 exs., Kovelong, Madras, Coll. A.S.R. and H.P.M., 28.1.1975; Regd. No. M20955/4; xxii) 2 exs., Vaithikuppam, 3.2 km North of Pondicherry, Coll. Dr. A.G.K. Menon, 8.2.1958, Regd. No. M20941/4; xxiii) 2 exs., Karaikal, Madras, Coll. A.S.R. and H.P.M., 7.2.1975, Regd. No.M20956/4; xxiv) 16 exs., Tranquebar, Madras, Coll. A.S.R. and H.P.M., 11.2.1975, Regd. No. M20957/4; xxv) 4 exs, Point Calimere, Coll. A.S.R., 16.2.1968, Regd. No. M20952/4; xxvi) 1 ex., Tuticorin, Coll. A.S.R., 25.2.1968, Regd. No. M20953/4; xxvii) 3 exs., rocky shore of Gulf of Mannar near quarantine camp, Mandapam, Coll. H.C. Ray, 11.5.1955, Regd. No.M20940/4; xxviii) 10 exs., Madras, north of harbor bottom, Coll. A.S.R. and H.P.M., 29.2.1975, Regd. No. M21005/4; xxix) 2 exs., Devgad, Coll. B.K. Tikadar, 14.11.1963, Regd. No. M17242/3; xxx) 1 ex., Adirampattinam, Palk Bay, Coll. A.S.R. and H.P.M. Regd. No.M20990/4; xxxi) 1 ex., Shore collection, Mallipattinam, Palk Bay, Coll. A.S.R. and H.P.M., 13.1.1978, Regd. No. M20989/4; xxxii) 3 exs., Virampattnam village, Puducherry, Coll. A.S.R. and H.P.M., 19.2.1975, Regd. No. M20992/4; xxxiii) 1 ex., shore collection, Madras, 27.2.1975, Regd. No. M20993/4; xxxiv) 1 ex., Rameswaram, Coll. H.C.Ray, 6.5.1955, Regd. No. M20938/4; xxxv) 2 exs., Kundugal Point, Madras, Coll. H.C.Ray, 8.5.1955, Regd. No. M20939/4; xxxvi) 8 exs., Colva beach, Goa, Coll. K.S. Pradhan, 11.11.1967, Regd. No. M2120/4; xxxvii) 2 exs., Tranquebar, Coll. A.S.R and H.P.M., 12.2.1975, Regd. No. M20949/4; xxxviii) 1 ex., Tranquebar, Coll. A.S.R. and H.P.M., 14.2.1975,Regd. No. M20950/4; xxxix) 1 ex., Puducherry, Coll. A.S.R. and H.P.M. , 17.2.1975, Regd. No. M20951/4; xxxx) 1 ex., Puri, Odisha, Regd. No. 1466; xxxxi) 1 ex., Ganjam Coast, Odisha, Coll. Bengal fisheries, Regd. No. M4506/1; xxxxii) 1ex., Ganjam Coast, Odisha, Coll. Bengal fisheries, Regd. No. M4507/1; xxxxiii) 1 ex., coastal water of Madras off Thandiyarpet on board" Chhota Investigator" (Bottom Trawl), Coll. A.S.R. and H.P.M., 25.1.1975, Regd. No. M20954/4.

***Measurement*: (mm)**

Length	Width	Aperture Length
105.859.00	31.00-3.60	18.90-2.30

Description: Shell large, up to 107mm in height, elongate, sharply conical, about 18-20 whorls, the earlier whorls convex with many fine spiral ridges, on the other whorls two sharp ridges in the middle, after the first six whorls the central ridges becomes elevated into a strong keel, most of the others tending disappear, after about ten whorls another elevated ridge begins to appear, but less prominently, and over the last two or three whorls both of these gradually become less conspicuous. Whorls rounded at both ends, sharply angular in the middle. Operculum corneous, rounded, with many spiral coils and a central nucleus. Colour :The upper half of each whorl medium dark brown and the lower pale cream brown (Subba Rao, 2003).

***Remarks*:** This species is a ciliary filter feeding animals drawing organic particles through the mantle cavity by means of ciliary wáter currents, sorted by the small tentacles and the tiny bristles of the opeculum, trapped in mucuous sheets on their gills and transferred to the mouth. Sexes are seperate, fertilization internal. Eggs are generally laid in cluster of spherical stalked capsules, attached to stones. A short planktonic larval stage usually present but some species brood their eggs and embryos to the crawling stage (Poutiers, 1998). Frequent synonyms / mis identifications: *Turritella acutangula* (Linnaeus, 1758); *Zaria duplicata* (Linnaeus, 1758). On sub-tidal sand and mud bottoms. Most common species.

Distribution: India: Andaman and Nicobar Islands, Andhra Pradesh, Goa, Gujarat, Maharashtra, Tamil Nadu; Elsewhere: Myanmar, Sri Lanka. in the Southeast Asian region. Indo-West Pacific, from Madagascar to Indonesia; north to the Philippines and south to northern Queensland.

5. ***Turritella fastigiata*** Adams and Reeve

1850. *Turritella fastigiata* Adams and Reeve, *Zool. Sammal. Moll.*, **(7):** 48, t 12, fig.9.

1986. *Turritella fastigiata*: Tikader, Daniel and Subba Rao, *Sea shore animals of Andaman and Nicobar Islands*, Zool. Surv. India, p.167.

2000. *Turritella fastigiata*: Subba Rao and Dey, *Rec. zool. Surv. India Occ. Paper No.*, **187**: 54.

2004. *Turritella fastigiata*: Venkataraman, Jeyabaskaran, Raghuram and Alfred, *Rec. zool. Surv. India, Occ. Paper No.* **226**: 325.

2010. *Turritella fastigiata*: Rao, *Field Guide to Corals and Coral Associates of Andaman and Nicobar Islands*, p. 213. Zool. Surv. India.

2012. *Turritella fastigiata*:Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** i) 7 exs., Andaman, Regd. No.M18314/3.

***Measurements*: (mm)**

Length	Width	Aperture Length
43.05-16.70	10.9-4.7	6.8-2.5

Description: Shell moderate in size, number of whorls 14 or less, very minute spiral striation present, less than 25 spiral striations, evenly spaced. Aperture quadra angular, shell turreted, last whorl compressed, brown in colour, deep chestnut brown body covered with white brown maculation. Two prominent spiral ridges present along the body, but not keeled. Aperture circular with smooth outer lip, shell more or less glossy than other Turritellidae, suture distinct, penultimate whorl and body whorl are convex.

***Remarks*:** The oblique clouded streaks of painting are the diagnostic characteristics of this species.

Distribution: India: Andaman and Nicobar Islands; Elsewhere: No records.

6. *Turritella fultoni* Melvill

1897. *Turritella fultoni* Melvill, *Mem. Proc. Manch. Lit. Phil. Soc.* **41**(7): 14, pl.6, fig. 12. (Type locality: Omara Bay, Persian Gulf).

1901. *Eglisia fultoni*: Melvill and Standen, *Proc. Zool. Soc.* London, **2:** 387, pl.21, fig.8.

1968. *Eglisia fultoni*: Ray, *Indian Mus. Bull.*, **3 (1&2)**: 18, Text fig., 5.

1991. *Turritella fultoni*: Rao, Rao and Maitra, *Fauna of Orissa, State Fauna series,* **1(3):** 41. Zool. Surv. India.

2012. *Turritella fultoni*: Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** i) 1 ex., Off Puri, Coll. S.W.K

***Measurement*: (mm)**

Length	Width	Aperture Length
18.00	5.60	4.42

Description: Solid, opaque, spire angle about 16-20^0; rounded whorls separated by deep sutures; each whorls encircled by strong ridges with lesser ridges between; fine straight or curved, axial striae between ridges. Thin-edged aperture broadly ovate, columella straight. White ,or rarely with flame like orange-brown markings on the whorls.

Remarks: Some controversy exists as to the taxonomic status of *fultoni* standing on the borderland between *Turritella* and *Eglisia* (Family- Epitonidae) which really calls for some attention . Ray (1968) wrongly identified this species to the genus *Eglisia*. Rare.

Distribution: India: Odisha: Puri; Elsewhere: Persian Gulf. : Omara Bay (its Type locality), Henjam Island and Mussandam.

7. *Turritella infraconstricta* Smith

1878. *Turritella infraconstricta* Smith, *Proc. Zool. Soc.* London, **1878**: 817, Pl. L, fig.20.

1897. *Turritella infraconstricta*: Melvill and Sykes, *Proc. Malac. Soc.* London, **2**: 170.

1986. *Turritella infraconstricta*: Tikader, Daniel and Subba Rao, *Sea shore animals of Andaman and Nicobar Islands*, Zool. Surv. India, p.167.

2000. *Turritella infraconstricta*: Subba Rao and Dey, *Rec. zool. Surv. India Occ. Paper No.*, **187**: 54.

2004. *Turritella infraconstricta*: Venkataraman, Jeyabaskaran, Raghuram and Alfred, *Rec. zool. Surv. India, Occ. Paper No.* **226**: 325.

2010. *Turritella infraconstricta*: Rao, *Field Guide to Corals and Coral Associates of Andaman and Nicobar Islands*, p. 213. Zool. Surv. India.

2012. *Turritella infraconstricta*: Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** 6 exs., Andaman, Regd. No. 1455.

***Measurement*: (mm)**

Length	Width	Length of the aperture;
66.9-42.20	16.60-11.00	10.3-6.15

Description: Shell moderate in size, subulate, subturreted, whorls about 20, somewhat convex at the top and sides, and sloping narrowed at the base, thus making the width at the suture considerably less a little distance above it, transversely finely lirated, lirae varying in thickness, a few being a trifle coarser than the rest, two especially the upper , situated very near the middle of the whorl, and the lower one at the broadest part of it, being conspicuous and forming indistinct angles. Last whorl excavated beneath, finely lirated and of uniform brownish white or pale pink tint with a rather acute ridge circumscribing the base. Aperture irregularly obliquely quadrate, of the same colour as the exterior, columella slightly oblique and a little arcuate.

Colour: Brownish white ornamented with reddish brown dots.

***Remarks*:** This species can be identified by the form of the whorl, the character of the markings and the spiral liration. The dottings on the ridges are very small and are arranged under one another in oblique and more or less flexuous lines which are interrupted by numerous spiral sulci. Through the prominence, although slight of the two principal lirae the whorls between them appear some what concave, and ridge around the base of the last whorl passes just above the labrum and winds up the spire of sutural line (Smith, 1878). Uncommon.

Distribution: India: Andaman and Nicobar Islands; Elsewhere: No records.

8. ***Turritella monilifera*** Adams and Reeve

1850. *Turritella monilifera* Adams and Reeve, *Zool. Sammal. Moll.*,**(7):** 48.

1986. *Turritella monilifera*: Tikader, Daniel and Subba Rao, *Sea shore animals of Andaman and Nicobar Islands*, Zool. Surv. India, p.167.

2000. *Turritella monilifera*: Subba Rao and Dey, *Rec. zool. Surv. India Occ. Paper No.*, **187**: 54.

2004. *Turritella (Haustator) monilifera*: Venkataraman, Jeyabaskaran, Raghuram and Alfred, *Rec. zool. Surv. India, Occ. Paper No.* **226**: 325.

2010. *Turritella monilifera*: Rao, *Field Guide to Corals and Coral Associates of Andaman and Nicobar Islands*, p. 213. Zool. Surv. India.

2012. *Turritella monilifera*: Venkataraman, Rajan, Satynanarayana, Raghunathan and Venkataraman, *Marine ecosystems and Protected areas of India*, p. 191. Zool. Surv. India.

***Material Examined*:** i) 1 ex., Andaman, Regd. No. M26446/5.

***Measurement*: (mm)**

Length	Width	Length of the aperture;
42.05	11.80	6.7

Description: Shell acuminately pyramidal, depressly concave and sharply angled at the base, whorls fifteen in number, with a broad keel beneath the sutures, concave in the middle, then two-ridged; pinkish white ,keel ornamented with distant oblique red-brown dots. Aperture nearly quadrangular, strongly angulated at base, and shell moderate in size. Whorls with three prominent spiral striation, prominent from penultimate whorls to body whorls.

***Remarks*:** The only painting in this species, beyond its delicate violet-pink hue, consists in the necklace –like row of red-brown dots upon the keel (Reeve, 1850)

Distribution: India: Andaman and Nicobar Islands; Elsewhere: No records.

9. ***Turritella maculata*** Reeve

1849. *Turritella maculata* Reeve, *Conch. Icon.*, **5**: *Turritella* sp. No., 33.

2004. *Turritella maculata*: Rao, Maitra, Barua and Ramakrishna, *Fauna of Gujarat, State Fauna series*, **8(2):** 289. Zool. Surv. India.

2005. *Turritella maculata*: Subba Rao and Sastry, *Conservation Area Series*, **23**: 43. zool. Surv. India.

List of the foreign species present in NZC:

Si. No.	Name of	Collector the species	Location	Number of examples	Regd. No.
1.	*Torcula clathrata* Kiener		Ceylon	1	1469
2.	*Turritella declivis* Adam & Reeve		Mauritius	3	M18309/3
3.	*Turritella fuscocincta* Petit		Australia	30	1453
4.	*Turritella sinuata* Reeve		Australia	9	1454
5.	*Turritella exoleta* Linn.	R.W.Foster	Tabago Island, British West Indies	18	M19314/3
6.	*Turritella gunni*		Tasmania	4	1461
7.	*Turritella terebra* Linn.		Eastern Sea	6	M26447/5
8.	*Turritella broderipiana* d' orb		1	1464	
9.	*Turritella communis* Risso		Algiers	2	1462
10.	*Turritella vittulata* Adam & Reeve	China	7	1444	
11.	*Turritella nivea* Gray		East Africa, Gwadur, Baluchistan	23	M18318/3
12.	*Turritella nivea* Gray		Persian Gulf	8	M26445/5
13.	*Turritella capensis* Reeve		Cape of Good Hope	6	1459
14.	*Turritella capensis* Reeve		False Bay	12	M18306/3
15.	*Turritella cingulifera* Sowerby	Dr. J. Anderson	Margui archipelago	1	
16.	*Turritella sanguine natalensis* Smith	Donar : Natal Museum	Natal (21.6.1989)	2 exs.	M23502/4
17.	*Turritella variegates* Linn.		West Indies	5 exs	M18321/3.
18.	*Turritella punctata* Kiener		California	2 exs.	1449
19.	*Turritella nebulosa* hinds			1	
20	*Turritella bacillum* Hinds	Prof. J. Meggitt	Rangoon	2 exs.	M14492/2
21.	*Turritella bacillum* Hinds		Hong Kong	1	1443
22.	*Turritella gonostoma* Valenciennes-1832			1	1463
23.	*Turritella chrysotoxa* Tomlin	Natal Meseum	Aug, 1994.	3	M23529/4
24.	*Turritella carinifera* Lamarck		Cape	5	1447
25.	*Turritella rosea* Quoy & Gaimard		New Zealand	12	1452
26.	*Turritella hanleyana* Reeve		Ceylon	1	1456
27.	*Turritella triplicata* philippi		Algiers	1	M18319/3
28.	*Turritella fascialis* Menke	I.R.L.B. Tomlin Esq.	Maskat	13	M18313/3

Si. No.	Name of	Collector the species	Location	Number of examples	Regd. No.
29.	*Turritella fascialis* Menke	Ex. Tomlin Colln.	Gulf of Oman	14	M13368/2
30.	*Turritella fascialis* Menke		Babylon Coast	2	3001/1
31.	*Turritella bicolor* Reeve		Japan	1	M18305/3
32.	*Turritella maculata* Reeve		Aden	15	
33.	*Mesalia waria* Kiener	Dr. Kobelt	Gibralter	1	M18324/3
34.	*Turritella cornea* Lamarck		England	8	1457
35.	*Turritella incise* Reeve		Australia	1	1465
36.	*Turritella ungulina* Linn.	Tiachi	Napoli	2	M18322/3
37.	*Turritella gracilis* A.Ad.		Japan	1	1458
38.	*Turritella multilyrata* Adam & Reeve		Singapore	16	1460
39.	*Turritella capensis* Reeve		False Bay	3	M18316/3
40.	*Mesalia lacteal* Miller		Green land	1	M18323/3
41.	*Mesalia brevialis* Lamarck		Japan	1	146

***Material Examined*: i)** 7 ex., St. Mary's Island, Udipi district, Karnataka, 01.01.2006., Coll. R. Venkitesan and party.

***Measurement*: (mm)**

Length	Width	Length of the aperture;
25.90-39.00	9.00-10.80	4.20-6.00

Description: Shell up to 39 mm, thin, semi translucent or opaque, acuminate turreted, whorls about 11, and spire angle about 20^0. Each whorl has 2 strong, rounded spiral striation, occasional spiral ridges and many fine spiral threads. Aperture thin edged, squarish. Outer lip sinuous. Keels sometimes obsolete.

Colour-Violet white with brown mottling and stripes; fine, brown lines sometimes encircle whorls.

***Remarks*:** The base of the shell is more concave , and is marked of numerous coloured linear striae, but the upper margin of the whorl is always distinguished by a row of irregular red brown spots immediate beneath the suture.A pure white form was named, unnecessarily, var. *chionia* by Melvill, 1928:102 (Bosch, 1995),

Distribution: India: Gujarat, Karnataka: St. Mary's Island; Elsewhere: Gulf of Aden, Gulf of Arabia.

10. ***Turritella bicingulata*** Lamarck

1822. *Turritella bicingulata* Lamarck, *Anim. Sans. Vert.* (Deshayes edit) **9**:256.

1860. *Turritella bicingulata* Lamarck, Reeve, *Conch Icon,* **5**. Pl.5, sp.no. 20.

2011. *Turritella bicingulata* Venkitesan and Mukhopadhyay *Rec. zool. Surv. India,* ***111(2)****: 94-95.*

***Material Examined*: i)** 17 ex., St. Mary's Island, Udipi district, Karnataka, 01.01.2006., Coll. R. Venkitesan and party.

***Measurement*: (mm):**

Length	Width	Length of the aperture;
3.10-5.70	6.20-10.80	20.80-35.90

Description: Shell medium in size, up to 36.00 mm in height, acuminate turreted, whorls about 11, aperture sub quadrangular, outer lip sinuous, sculptured with two spiral ridges,

which are equally distant and prominent, intermediate grooves concave and spirally striated. Ornamented with profusely flamed, variegated with reddish brown markings. Suture rather deeply excavated, below the suture spotted with reddish brown mottling and stripes. Brown line encircles whorls. Brown line seen through the aperture. Base concave and neatly striated with violet colour. Shell white with brown markings, white base marked with violet; brown markings and the interior of the aperture purple rose.

***Remarks*:** It can be distinguished from other by which a pair of conspicuous swollen keels and a bold profuse style of painting. *T. maculata* a nearer species differs from *T. bicingulata* having in difference in early whorls the keels are very prominent developed even to the apex. The base of the shell is more concave, and is marked of numerous coloured linear striae, but the upper margin of the whorl is always distinguished by a row of irregular red brown spots immediate beneath the suture.

Distribution: India: Karnataka: St. Mary's Island. Elsewhere: Pakistan and Adens.

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Subba Rao, N.V. and Dey, A. 2000. Catalogue of Marine Molluscs of Andaman and Nicobar Islands, *Rec. zool. Surv. India*. Occ. Paper.**187**;p 53-54.

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PLATE I

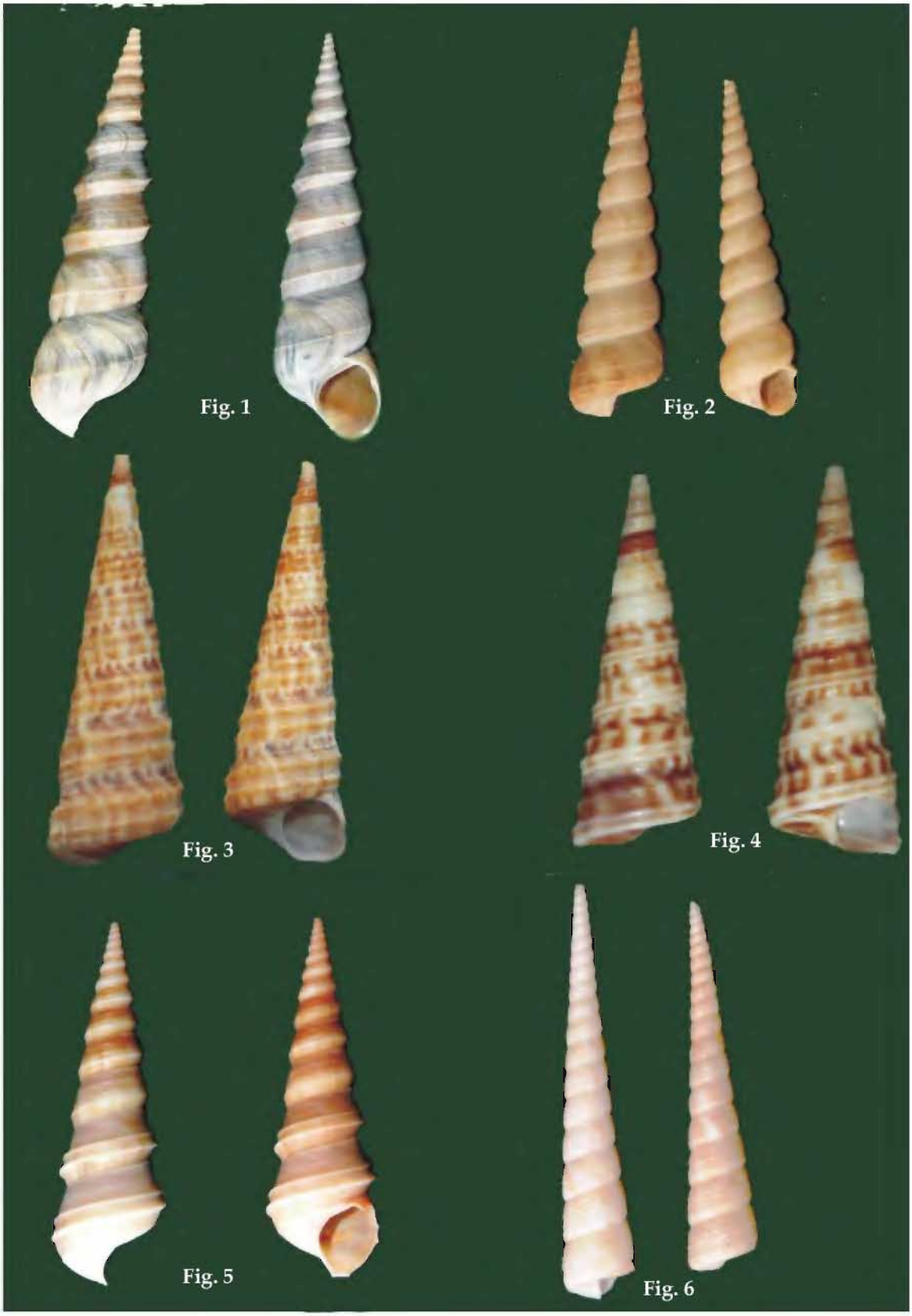

Fig. : 1. *Turitella attenuata* Reeve; Fig.2. *Turitella infraconstricta* Smith; Fig.3. *Turritella bicingulata* Lamarck; Fig. 4. *Turritella maculata* Reeve; Fig. 5. *Turritella duplicata* (Linnaeus); Fig. 6. *Turritella columnaris* Kiener

PLATE II

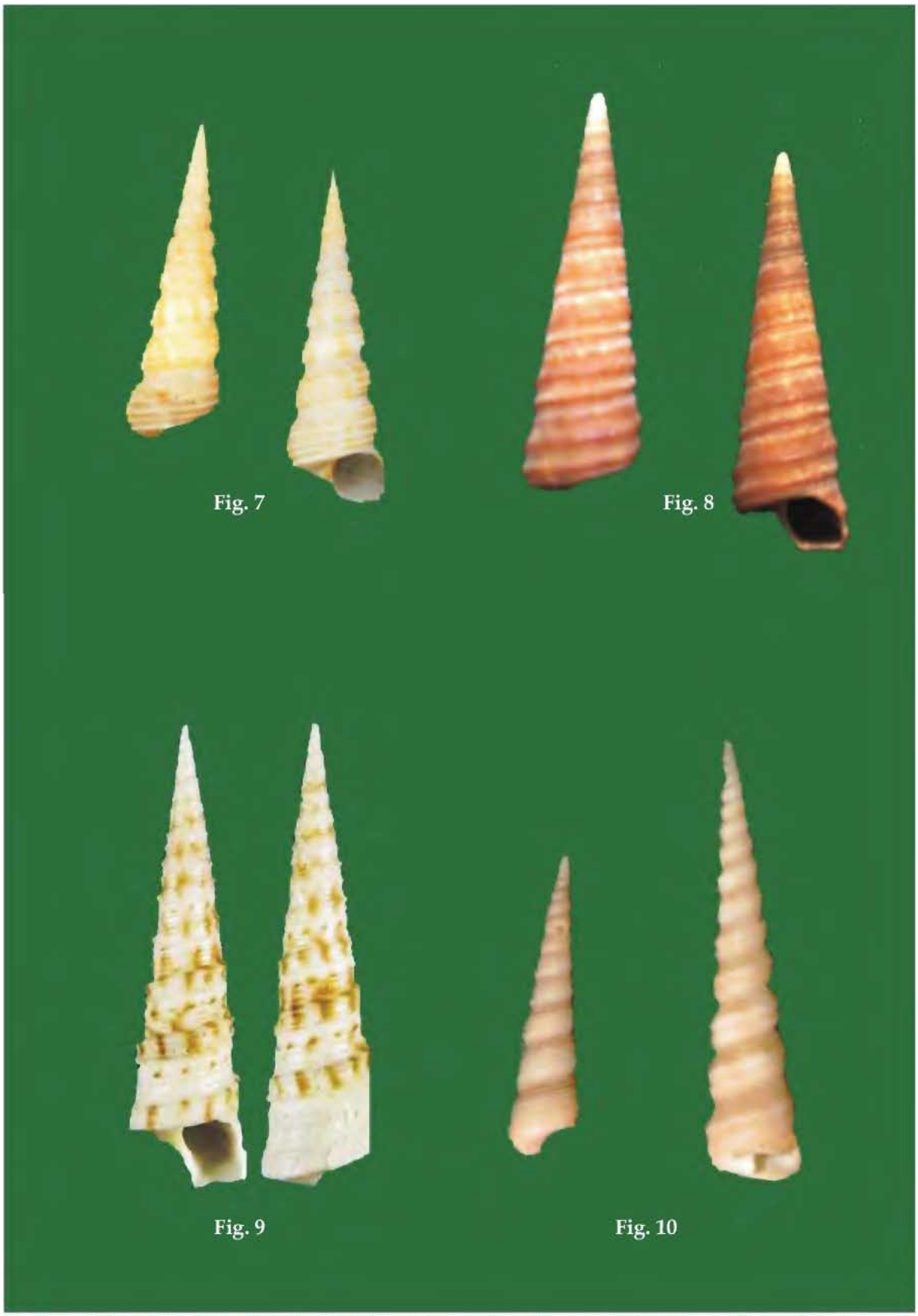

Fig. : 7. *Turritella fultoni* Melvill; Fig. 8. *Haustator trisulcata* (Lamarck); Fig. 9. *Turritella monilifera* Adam & Reeve ; Fig. 10. *Turritella fastigiata* Adam & Reeve.

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THREE NEW RECORDS OF BIVALVIA *NUCULA CONSENTANEA* MELVILL & STANDEN 1907, *CONGETIA CHESNEYI* (OLIVER & CHESNEYI, 1994) *AND PERIGLYPTA ALBOCANCELLATA* (HUBER, 2010) FROM THE WEST COAST OF INDIA

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INTRODUCTION

Among the various classes, Bivalvia is considered as the most primitive in the phylum Mollusca and is an important element of benthic epifauna. Bivalvia restricted their distribution to aquatic habitats both in the freshwater and marine environment. A total of 646 species of marine bivalves have been reported from India under 171 genera, 11 order and 69 families (Ramakrishna and Dey, 2010). In this paper, we have described three new records of Bivalves for the first time from West Coast of India.

During the identification of unnamed collections of the National Zoological Collections of ZSI HQ, the authors come across with one no. of example of Bivalves (one valve) collected by ZSI survey team from Kathiar, Gujarat. There was no collection details tagged to the specimen. However, the specimen after thorough examination was confirmed to be *Nucula consentanea*. There are major distinctive characteristics in the shell belonging to the genus under the family Nuculidae. The shell is small, sub-ovate, trigonal or elongate, teeth taxodont, typically V shaped in section, long, sharp and pointed and with a persistent greenish periostracum. Bivalves under the genus *Nucula* inhabit offshore mud and sand sediments to considerable depths (Bosch *et al.*, 1995). A total of nine species under this family have been reported from India (Ramakrishna and Dey, 2010) and *Nucula consentanea* is considered to be a newly added species in the list Bivalves recorded from India.

Similarly, 11 no. of examples of Bivalves from the unnamed collections of the Gujarat survey was attempted for identification and after thorough investigation into the taxonomic characters of the shells, was confirmed to be *Congetia chesneyi* under the family Neotidae. Earlier only one species was reported under this family from India. The *Congetia chesneyi* (Oliver and Chesneyi, 1994) is therefore considered new report from India totaling two species under the family Neotidae.

The four valves from the unnamed collections of the Gujarat survey and subsequently five examples of Bivalves collected by the last author from Piroton Island of Gulf of Kachchh in Gujarat and two examples from Karnataka after identification of all taxonomic characters was confirmed as *Periglypta clathrata* under the family Veneridae. The diagnostic characters in the shell were distinct i.e. having oval to triangular shape, tumid and with solid and with well developed escutcheon. In India, only four species of Bivalves are reported under the Genus *Periglypta* (Ramkrishna and Dey, 2010). The present new record of Bivalve *Peruiglypta albocancellata* adding to the distributional list under the genus *Periglypta* reported from India.

Class BIVALVIA
Subclass PROTOBRANCHIA
Order NUCULOIDA
Superfamily NUCULOIDEA
Family NUCULIDAE
Genus ***Nucula*** Lamarck

1. ***Nucula consentanea*** Melvill & Standen, 1907

(Fig. No. 1)

1907. *Nucula consentanea* Melvill & Standen, *Trans. R. Soc.* Edinburg, 46: 2.

1995. *Nucula consentanea:* Bosch *et al.*, *Seashells of Eastern Arabia*, P. 203, fig. 897.

2010. *Nucula consentanea*: Huber *Compendium of Bivalves*, Hackenheim; Conch Books, pp. 901.

Material Examined: 1 valve, Kathiawar, Gujarat Coast, Coll: ?, Date: ?

Measurements (in mm):

Length	Width
2.00	1.85

Distribution : India: Gujarat coast; Elsewhere: Gulf of Oman.

Remarks : Shell is very small, solid, ovate – trigonal, beak submedial, hinge with a series of a sharp teeth, ligament internal; escutcheon slightly domed, concentric ridges and radial lines present on dorsal surface; ventral margin crenulated.

Subclass PTERIOMORPHA
Superfamily ARCOIDEA
Family NOETIIDAE
Genus : ***Congetia*** Huber,2010

2. ***Congetia chesneyi*** (Oliver & Chesneyi, 1994)
(Fig. No. 2)

1994. *Noetiella chesneyi Oliver and Chesney, Taxonomy of Arabian bivalves. Part 1p. 210.*

1995. *Noetiella chesneyi:* Bosch *et al., Sea shell of Eastern Arabia*, p. 212, fig. 934.

2010. *Congetia chesneyi:* Huber,*Compendium of Bivalves*, Hackenheim; Conch Books, pp. 901.

Material Examined: i) 11 examples, Adatara beach near Okha, Coll. K.V. Surya Rao., 10.viii.1972.

Measurements : (in mm):

	Length	Width
Largest	11.80	8.15
Smallest	7.10	5.25

Distribution : India: Gujarat coast; Elsewhere: Arabian Sea: North West Gulf.

Remarks : Shell is compressed. Beaks slightly towards posterior end. Taxodont teeth arranged in subcircular fashion. Anterior area more expanded than posterior; anterior margin rounded, posterior subcute. Ligament in front of beaks. Sculptured with many narrow riblets. White in colour.

Superfamily VENEROIDEA
Family VENERIDAE
Subfamily VENERINAE
Genus ***Periglypta*** Deshayes

3. ***Periglypta albocancellata*** (Huber, 2010)
(Fig. No. 3)

1853. *Venus clathrata:* Deshayes, *Proc. Zool. Soc, London*, 1853: 2.

1972. *Periglypta clathrata*: Cernohorsky, *Marine shells of the Pacific*, 2: 233, pl.5, fig. 5.

1986. *Periglypta clathrata* : Abbott and Dance, *Compendium of Sea Shell*, p. 353, fig. 11.

2010. *Antigona albocancellata* Huber *Compendium of Bivalves*, pp. 901.

Material Examined:

i) 4 valves, Adatara beach near Okha, Gujarat, Coll. K.V. Surya Rao, 10. viii. 1972.

ii) 5 exs., Piroton Island, Gulf of Kachchh, Gujarat, Coll. A. K. Mukherjee, 23.iv.2005.

iii) 2 exs., Gangolli fishing harbour, Karnataka, Coll. A.K. Mukherjee 14.vi.2006.

Measurements (in mm):

Length	Width
55.85	46.85
47.85	37.40

Distribution : India: Gujarat, Karnataka; Elsewhere: North West Gulf, South Eastern Gulf, Gulf of Oman, Southern Oman.

Remarks : Shell cordately ovate, rather oblique, thick, ventricose, cream coloured, faintly blotched and rayed with reddish –fawn, concentrically densely ridged, ridges irregular and thin near the umbo, then callous and flattened, latticed throughout with radiating

Fig. : 1. *Nucula consentanea* Melvill & Standen; **Fig. 2.** *Congetia chesneyi* (Oliver & Chesney); **Fig. 3.** *Periglypta albocancellata* (Huber).

linear grooves, ridges on the posterior area, serrately laminated. Commonly known as Venus Clams.

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NOTES ON SOME PROTOZOA AND ZOOPLANKTON OF SEWAGE SYSTEMS IN KOLKATA

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INTRODUCTION

Sewage is water carried wastes, in either solution or suspension, that is intended to flow away from a community. It is more than 99. 9% pure water and is characterized by its volume or rate of flow, its physical condition, its chemical constituents and the bacterial organisms that it contains. Sewage water is a complex matrix with many distinctive chemical characteristics. These include high concentrations of ammonium, nitrate, phosphorus, high conductivity (due to high dissolved solids), high alkalinity, with pH typically ranging between 7 & 8.

Several major taxonomic groups of protozoa *viz.*, flagellates, naked and tested amoebae, actinopods and ciliates occur in biological sewage treatment plants. Amongst these, ciliated protozoa are the most significant component. They are numerically dominant and occupy different trophic levels by being detritivorous, carnivorous and occasionally herbivorous. It has been shown experimentally that ciliates actively contribute to the regulation of entire complex of purification plants by regulating bacterial population and controlling BOD level (Curds, 1973). Thus ciliates are useful bioindicators for determining water quality and also for quick monitoring of water purification plants. Like protozoa different plankton species are also indicators of water bodies. Das *et al.*, (1993) reported only few species from sewage systems of West Bengal. On considering their immense role in self purification process, present study was undertaken to provide background data of the abundance and distribution of some of the protozoa and plankton fauna in sewage systems of Kolkata *viz.*, East Kolkata wetlands, Bagjola and Tollynala .

MATERIALS AND METHODS

Water samples were collected during 2009-10 from the above mentioned three sewage systems and triplicate samples were collected from each canal. Those samples were then thoroughly examined under the microscope from time to time. The free living rhizopods and ciliates occurring in them were isolated and examined for more than 15 days in living condition by keeping them in a drop of natural medium. Free-living ciliates occurring in them were isolated, processed and stained following standard fixation and preservation methods (Mandal *et al.*, 1990; Das *et al.*, 1993). Rhizopods and Planktons were also isolated and identified.

RESULTS AND DISCUSSION

The presence of considerable amount of dissolved organic matter provided suitable environment for the growth of varieties of micro-organisms. In the present study three species of rhizopods under two genera, 10 species of ciliates coming under 10 genera and 10 families and 5 species of zooplankton were observed. These 13 species of protozoa belong to 7 orders and 13 families. All the 3 rhizopods are coming under the order Arcellinida. Prostomatid ciliates represent 3 species followed by 2 species each of nassulids and hymenostomatids and one species each of pleurostomatid, colpodid and synhymenid

Table-1: Systematic list of free-living protozoa and zooplankton species recorded from Kolkata sewage systems (classification according to Levine *et al.*, 1980)

Systematic list of species	Occurrence in Kolkata sewage systems	Earlier records in India (Ref.)
A. Protozoa Phylum Sarcomastigophora Class Lobosea Order Arcellinida Family Arcellidae		
1. *Arcella discoides* Ehrenberg 1843 Family Difflugiidae	Bg, EKW	AP, Arp, Man, Meg, Miz, Nag, HP, Skm, Tp, WB (Das *et al*., 1993, 1995, 2000, 2004)
2. *Diiflugia corona* Wallich 1864	Bg, TN	AP, Man, Tp, WB (Das *et al*., 1995, 2000)
3. *Difflugia lobostoma* Leidy 1879 Phylum Ciliophora Class Kinetofragminophorea Order Prostomatida Family Colepidae	EKW, TN	AP, Arp, Man, Meg, Miz, Nag, HP, Raj, Skm, Tp, WB (Das *et al*.,1993, 1995; 2000, 2004; Mahajan, 1971)
4. *Coleps hirtus* (Muller) 1786 Family Tracheliidae	Bg,EKW	Raj, WB (Mahajan, 1971; Das *et al*., 1995)
5. *Trachelius gutta* (Cohn)1866 Family Didiniidae	EKW	WB (Das *et al*., 1995)
6. *Didinium nasutum* (Muller) 1773 Order Pleurostomatida Family Amphileptidae	TN	Raj, WB (Mahajan, 1971; Das *et al*., 1995)
7. *Litonotus fasciola* (Ehrenberg)1838 Order Colpodida Family Colpodidae	Bg, EKW	Mah, Raj, WB (Mahajan, 1971; Das *et al*., 1995, Bindu & Saha, 2012)
8. *Colpoda cucullus* Muller1773 Order Synhymeniida Family Scaphidiodontidae	TN	AP, Mah, WB (Das *et al., 1995,*2004; Bindu & Saha, 2012)
9.*Chilodontopsis bengalensis* (Ghosh) 1921 Order Nassulida Family Nassulidae	Bg, EKW, TN	WB (Das *et al.,*1995)
10. *Nassula ornata* Ehrenberg 1833 Family Microthoracidae	Bg	Raj, WB (Mahajan, 1971; Das *et al*., 1995)
11.*Microthorax pusillus* Engelman 1862 Class Oligohymenophorea Order Hymenostomatida Family Tetrahymenidae	TN	WB (Das *et al*., 1995)
12.*Tetrahymena pyriformis*(Ehrenberg) 1866 Family Frontoniidae	Bg	WB (Das *et al*., 1995)
13. *Frontonia leucas* (Ehrenberg) 1838 B. Zooplankton Class Rotifera Order Ploimida Family Lecanidae	Bg ,TN	Raj, Mah, WB (Mahajan, 1971; Das *et al*., 1995, Bindu & Saha, 2012)
1. *Lecane leontina* (Turner, 1892) Class Crustacea Order Cladocera Family Sididae	EKW	AP, MP, Osa, WB (Sharma, B. K., 1998; Sumita Sharma & Sharma, B.K., 2008)
2. *Pseudosida bidentata* Herrick 1884 Family Moinidae	EKW	Raj, Meg, WB (George Michael & Sharma, B. K. 1998; Sumita Sharma & Sharma, B.K., 2008)
3. *Moina micrura* Kurz 1874 Order Cyclopoida Family Cyclopidae	Bg, EKW,	Raj, WB, Bhr (Sharma, B.K.,1998)
4. *Mesocyclops leuckarti* (Claus)1857 Order Podocopa Family Cyprididae	EKW	AP, Mah, TN, UP, WB (Sumita Sharma & Sharma, B.K., 2008; Sharma, B.K.,1998)
5. *Cypris subglobosa* Sowerby 1840	Bg	Mah, MP, AP, Tamil Nadu (Reginald Victor & Fernando, C. H., 1979)

(Table-1). All the species are reported earlier from different ststes of India. (Das *et al.*, 1993, 1995, 2000, 2004; Mahajan, 1971; Bindu and Saha, 2012). All the 5 species of zooplankters reported herewith belong to 4 different orders *viz.*, plomida, cladocera, cyclopoida and podocopa.

(Bg- Bagjola, EKW - East Kolkata wetland, TN-Tollynalla, AP-Andhra Pradesh, Arp-Arunachal Pradesh, Bhr-Bihar, Mah-Maharashtra, Man-Manipal, Meg-Meghalaya, Miz-Mizoram, Nag-Nagaland, HP-Himachal Pradesh, Osa-Orissa, Raj-Rajasthan, Skm-Sikkim, Tp-Tripura, TN, Tamil Nadu, WB-West Bengal)

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NOTES ON SOME SNAKEHEAD FISHES OF INDIA WITH AN AID TO THEIR IDENTIFICATION

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INTRODUCTION

The identity of snakehead fishes (Perciformes: Channidae) in India, particularly species belonging to *Channa gachua* complex remains to be confusing due to clubbing of a number of species under the synonymy of *Channa orientalis* Bloch and Schneider by several authors including Talwar and Jhingran (1991), Jayaram (1999) and Menon (1999) as well. Courtenay and Williams (2004) considered most of these synonyms are incorrect and records of *C. orientalis* from southern parts of India and elsewhere except for Sri Lanka are erroneous. Ng and Lim (1989, 1990) and Ng *et al.* (1999) suggested that *C. gachua* is in need of revision.

Myers and Shapovalov (1931) discussed in detail the differences between *Ophiocephalus* Bloch (1793) and *Channa* Scopoli (1777) and argued in support of merging *Ophiocephalus* with *Channa*, considering the former as a generic synonym. Their observations were based on a comparison of *Ophiocephalus gachua* Hamilton (with pelvic fins) and *Channa orientalis* Bloch and Schneider (without pelvic fins) as under.

The genera *Ophiocephalus* and *Channa* had been previously separated by the presence or absence of pelvic fin and phyloric or caecal appendages (Day, 1876). But, Hora (1921) and Deraniyagala (1929) observed that the phyloric caecae were present in both *O. gachua* and *C. orientalis*. Deraniyagala (1929) also considered both the species are identical in head scale and other characters and found no significant differences, apart from the lack of pelvic fins in *C. orientalis*. Both the species in Sri Lanka are known from the same biotope. Further, Day (1876) noted that, "It is not uncommon in India to find specimens of *Ophicephalus gachua* having a ventral fin deficient, but I have not observed both wanting" and as a specimen of *O. gachua* lacking both pelvic fins was taken on the Island of Formosa by Leo Shapovalov, Myers and Shapovalov (1931) concluded that *C. orientalis* may be regarded as a "series of anomalous specimens".

However, after an excellent discussion on merging of genera, Myers and Shapovalov (1931) were hesitant to synonymise both the species (as was also in Deraniyagala, 1929) and listed them separately. Taking a leaf from Myers and Shapovalov (1931), De Witt (1960) considered absence of pelvic fins in snakeheads is an anomalous character and so, *C. gachua* is placed under synonymy of *C. orientalis*. The same has been followed by Talwar and Jhingran (1991), Jayaram (1999) and Menon (1999).

The present piece of work is aimed at examining the synonymy given for snakehead fishes (Perciformes, Channidae) by Talwar and Jhingran (1991) and Menon (1999) which includes merger of *C. burmanica*, *C. gachua*, *C. harcourtbutleri* and *C. orientalis*. It also points out identity of *C. diplogramma*, the giant Malabar snakehead.

MATERIAL AND METHOD

With the above backdrop all the specimens present in the National Zoological Collection

labeled as *Channa orientalis* (Bloch and Schneider) have been examined and other eminent Indian Scientists were contacted for their concurrence. Several Indian literatures reporting this species from different parts of India were studied for presence or absence of pelvic fins being it the only significant difference.

Material examined: *C. orientalis*: F-12482/1, 2 ex., 69-80 mm SL, Dambua Estate, Sri Lanka (pelvic fin absent).

Indian specimens labeled as *C. orientalis*: F-11332/1, 3 ex., Dam Guva Estate, Jakvala (W.P.); F-4365/2, 8 ex., Fateh Sagar, Udaypur, Rajastan; F-4389/2, 4 ex., Fateh Sagar, Udaypur, Rajastan; F-4390/2, 1 ex., Fateh Sagar, Udaypur, Rajastan; F-4490/2, 13 ex., Birwan Nalla, Jammu; F-6283/2; 10 ex., Sulkam River, Mandla, Madhya Predesh; FF-3385, 2 ex., Malbasa pond, Amarpur, South Tripura; F-5834/2, 1 ex., Stn.13, Dhanodi Nala, about 3 miles west of Udhampur, Jammu; F-5835/2, 1 ex., a small 'Bauli' by side of Nadiali Nala of Megehna, Jammu; FF-2665, 1 ex., Deo R., Kanchanpur, north Tripura; FF-2741, 2 ex., Thangal Davar, Imphal, Manipur; FF-2751, 1 ex., Bishnupur, 30km from Imphal, Manipur; FF-2762, 1 ex., Nambul, Manipur; FF-3194, 11 ex., Karo special phase-II, 12 km east of Karghati, Bokaro, Jharkhand; FF-3200, 1 ex., Konnar nalla, Hazaribag, Jharkhand; FF-3195, 7 ex., Khasmahal surrounding Bokaro thermal power station, Jharkhand; FF-3333, 1 ex., Tiau R., 25 km east of Champai, Mizoram; FF-3440, 1 ex., Damodar R., Dishergarh; FF-3450, 1 ex., Kawrawng Lui R., Ngengbui, Chimtuipui, Mizoram; FF-3716, 1 ex., Subarnarekha R., down stream from Chandil Dam, Jharkhand; FF-4031, 3 ex., Morna R., Akola, Maharashtra; FF-4043, 2 ex, Waghur R., tributary of Tapi R., Jalgao, Maharastra (pelvic fin present in all).

Indian specimens labeled as *C. harcourtbutleri*: F-10038/1, 1 ex., Stream 3 miles N-W of Potsengboum, Manipur; F-10039/1, 2 ex., Khurdo stream near Thanga, Manipur; F-10040/1, 1 ex., Loktak Lake, Manipur; F-10041/1, 2 ex., Haingang-pat, Manipur; F-10042/1, 1 ex., Maklong R., Manipur; F-4250/2, 28 ex., Imphal River, 4 miles down Karrkopi dakbunglow, Manipur; F-4297/2, 1 ex., Imphal River, Manipur; F-4296/2, 1 ex., Borak River, Karrong, Manipur.

DISCUSSIONS

The conclusion of merging *Ophiocephalus gachua* (Hamilton) with *Channa orientalis* (Bloch and Schneider) considering absence of pelvic fin as an anomalous character (De Witt, 1960) is not supported by several species that are lacking pelvic fins like *C. orientalis* (*i.e.*, *C. asiatica* (Linnaeus, 1758), *C. bleheri* Vierke, 1991, *C. burmanica* Choudhuri, 1919 and *C. nox* Zhang *et al.*, 2002). Apart from that, it is important to note that Hora and Mukerji (1934) examined the specimens from Sri Lanka to find that *C. orientalis* is lacking basipterigoids and even traces of pelvic fin rudiments, a finding mostly overlooked.

Munro (1955), following Deraniyagala (1929), determined the snakehead species without pelvic fins of Sri Lanka as *C. orientalis* and other species with pelvic fins as *C. gachua kelaarti*, a nominal name identical with *C. gachua*. Lim *et al.*, (1990) suggested that *C. gachua* is separate from *C. orientalis*. Pethiyagoda (1991) differentiate *C. orientalis* and *C. gachua* on the basis that,

i) *C. orientalis* is endemic to Sri Lanka;

ii) *C. gachua* attains a larger size than *C. orientalis*;

iii) *C. orientalis* does not possess pelvic fins while *C. gachua* usually has pelvic fins;

iv) the breeding behavior of *C. orientalis* is to orally incubate their eggs whilst *C. gachua* orally incubate, build a crude nest or scatter their eggs and

v) *C. orientalis* is the more colourful species than *C. gachua*.

Kottelat (1998), Musikasinthorn (2000), Viswanath and Geetakumari (2009) and others consider *C. gachua* a valid species, not a junior synonym of *C. orientalis*, a species distinct from the former on account of absence of pelvic fin.

To ascertain identity of specimens in National Zoological Collection, Kolkata those were earlier determined as *Channa orientalis* were re-examined. But, it was found that none of them

were identical with the Sri Lankan specimens of *Channa orientalis* Bloch and Schneider (1801) (Figure 1 & 2). All these specimens are having pelvic fins and so, those are to be considered as *Channa gachua* (Hamilton). Personal communications from Dr. K. Remadevi from Z.S.I., Chennai, Dr. K.C. Gopi from Z.S.I., Kozhicode and Dr. A.K. Karmakar from Z.S.I., Kolkata confirmed that they have not come across a single specimen from Indian water bodies without having pelvic fin to be regarded as *Channa orientalis*. Dr. P. Musikasinthorn also expressed similar view regarding Indian specimens when discussed in person.

Further, published information on *C. orientalis* from different parts of India were also studied. Specimens from Assam (Sen, 1985: 179), Andhra Pradesh (Barman, 1993: 267), Arunachal Pradesh (Sen, 2006: 380), Sikkim (Karmakar, 2006: 212), Manipur (Karmakar and Das, 2005: 163), Nagaland (Karmakar and Das, 2006: 420), Mizoram (Karmakar and Das, 2007: 531), Tripura (Barman, 2002: 294), Meghalaya (Sen, 1995: 594), Gujarat (Sen and Banerjee, 2000: 454), West Bengal (Sen, 1992: 216), Madhya Pradesh (Sharma, 2007: 228) were identified as *C. orientalis* but having pelvic fins, and so, all are referable to *C. gachua*. Similarly, specimens of *C. gachua* having pelvic fin were determined as *C. orientalis* from Cauvery river system (Jayaram *et al.*, 1982: 95-96), Tadoba Andhari Tiger Reserve (Yadav, 2006: 154), Melghat Tiger Reserve (Yadav, 2005: 285), Bandhavgarh Tiger Reserve (Thilak, 2009: 156), Pachmarhi Biosphere Reserve (Sharma, 2009: 167), Jabalpur District, Madhya Pradesh (Sharma, 2008: 267). Dr. S. Kar kindly expressed that there was no specimen lacking pelvic fin were present among the materials collected from conservation areas of Madhya Pradesh and Chhattishgarh (Kar, 2008). Reports of this species from Andamans (Rao *et al.*, 2000) also said to have pelvic fins and so, it is too not to be considered as *C. orientalis*.

From distributional point of view, Day (1876), Deraniyagala (1929) and Pethiyagoda (1991) equally observed that *Channa orientalis* is endemic to Sri Lanka. In the original description (Bloch and Schneider, 1801) the specimens said to have come from 'Indies' and most probably not from India exactly.

It is therefore concluded that *Channa orientalis* Bloch and Schneider does not occur in India and the synonymy given in Talwar and Jhingran (1991) as well as Menon (1999) is erroneous. And, the name *Channa orientalis* is misapplied to *Channa gachua* specimens in Indian waters. The *Channa* specimens having a combination of characters – 'moderate to large scales; 39 to 47 scales in lateral line; 4 or 5 rows of scales between hind border of eye and angle of preopercle; pelvic fins present; length of pelvic fin less than half of pectoral fin length; dorsal fin with 32 to 37 rays; anal fin with 20 to 23 rays and head length 27-32% of standard length' are to be determined as *Channa gachua* (Hamilton).

Among the synonymy of *C. orientalis*, given in Menon (1999), *Ophiocephalus apus* Canestrini, *O. coramota* Cuvier, *O. fusca* Cuvier, *O. kellartii* Gunther, *O. limbatus* Cuvier, *O. marginatus* Cuvier, *O. montanus* McClelland, and *Philypnoides surakartensis* Bleeker are referable to *Channa gachua* (Hamilton) (Pethiyagoda, 1991; Roberts, 1993; Ng *et al.*, 1999; Courtenay and Williams, 2004). Talwar and Jhingran (1991) considered *O. aurantiacus* Hamilton as a possible synonym of *C. orientalis*, which has been followed by Menon (1999), Eschmeyer (1999) and Froese and Pauly (2010) as well. But from the figure drawn in Hamilton (1822), it is evident that this is having pelvic fins and other morphological characters (D 34; A 22; cheek scales 5-6) bring it closer to *Channa gachua*. The 'orange-peel colour' of body and fins, with some irregular stains of a redder hue, especially on the sides of the head, the pectoral and on the caudal fins, may be attributed to colour variance owing to ecological conditions.

Kullander *et al.*, (2000) has treated *Channa burmanica* Chaudhuri as a valid species and characterized in having no pelvic fin, higher lateral line scale count (50 vs 36 to 46 in *C. orientalis* and *C. bleheri*) and more anal fin rays (28 vs 20 to 25).

Ng *et al.*, (1999) distinguished *O. harcourtbutleri* Annandale from its congener as

a distinct species. *Channa harcourtbutleri* (Annandale, 1918), described from Inle Lake, Myanmar and also known from Manipur in India (Hora, 1921a), closely resemble *C. gachua*, but differs in having anal fin with 23 to 26 rays; postorbital head depth 31-35% of head; head length 32-34% of SL and width of head 17-19% of SL (vs 39-44%, 27-32% and 18.6-21.7% in *C. gachua*). No ocelli on posterior part of dorsal fin at any life stage of *C. harcourtbutleri* while an ocellus present in subadults of *gachua*. The authors examined the Indian specimens labeled as *C. harcourtbutleri* to find them as erroneous identification. Vishwanath and Geetakumari (2009) correctly doubted its presence in Manipur and it is certain that *C. harcourtbutleri* is not occurring in India. *Channa burmanica* Chaudhuri, known from Myanmar, is characterized in having no pelvic fin, lateral line scales 50, dorsal fin rays 38, anal fin rays 28 and predorsal scales 8 and can easily be distinguished from *C. bleheri* and *C. orientalis*, the other two species lacking pelvic fins and found in India and Sri Lanka.

Day (1865a) described a species as *Ophiocephalus diagramma* from Malabar and Canara coast and the same name was also used in his Fishes of Malabar (1865b). But considering the smallness of scales Sir F. Day (1876) placed it under synonym of *O. micropeltes* (Cuvier), a species known from Thailand, Viet Nam, Malaysia, Sumatra and Borneo. This synonymy was followed for quite a long time. It is quite unnatural to have a patchy distribution of *C. micropeltes* away from its natural habitat unless introduced and then colonized. The Indian species with small scales is now proved to be a distinct species (*Channa diplogramma*, the giant Malabar snakehead) on the basis of molecular studies (Benziger *et al*, 2011; Bhat *et al*, 2012).

In this present context, the identity of Indian snakeheads including the species clubbed earlier with *Channa orientalis* are placed hereunder in form of a working key so as to clearly distinguish them from each other. Another species, *Channa melanostigma*, of *C. gachua* complex recently described by Geetakumari and Vishwanath (2010), has also been included in the key. Of the 30 species belonging to the genus *Channa* Scopoli known till date (Froece and Pauly, 2012), Indian waters are represented by only 11 species. But the key includes three more extra-limit species, *viz.*, *C. burmanica*, *C. harcourtbutleri* and *C. orientalis* for easy identifications.

Working Key for identification of *Channa* species of Indian region:

1a. Scales small; lateral line contains more than 70 scales 2

1b. Scales moderate to large; lateral line contains 35 to 70 scales 3

2a. Lateral line scales 95 to 110; predorsal scales 22 ..... ***C. diplogramma*** (Kerala, India)

2b. Lateral line scales about 80; predorsal scales 17 ..... ***C. amphibeus*** (Northern Bengal, India and Bhutan)

3a. Pelvic fins absent 4

3b. Pelvic fins present 6

4a. Lateral line scales 50, dorsal fin rays 38; anal fin rays 28 ..... ***C. burmanica*** (Myanmar)

4b. Lateral line scales 36 to 46; dorsal fin rays 30 to 37; anal fin rays 20 to 25 5

5a. Dorsal fin with 30 to 34 rays; anal fin with 20 to 22 rays; lateral line consists of 36 to 42 pored scales ..... ***C. orientalis*** (Sri Lanka)

Channa orientalis, ventral view (F-12482/1)

Channa orientalis, lateral view (F-12482/1)

5b. Dorsal fin with 35 to 37 rays; anal fin with 24 or 25 rays; lateral line consists of 43 to 46 pored scales .... ***C. bleheri*** (Assam, India)

6a. Cheek scale 4 or 5 rows between hind border of eye and angle of preopercle 7

6b. Cheek scale 8 to 12 rows between hind border of eye and angle of preopercle 11

7a. Length of pelvic fin more than half of pectoral fin length; pectoral fin without band ... . ***C. punctatus*** (India; Pakistan, Afghanistan, Sri Lanka, Nepal, Bangladesh, Myanmar, Yunnan in China)

7b. Length of pelvic fin less than half of pectoral fin length; pectoral fin banded ... 8

8a. Body covered with scattered numerous dark black spots; dorsal fin with 36 or 41 rays; lateral line contains 45 to 53 scales ... 9

8b. Scattered dark black spots on body absent; dorsal fin with 32 to 37 rays; lateral line contains 39 to 48 scales 10

9a. Caudal fin with 14-15 distinct black zigzag transverse bars; dorsal fin origin after 3-4 scales vertically above the pectoral fin origin; vertebrae 50-51... ***C. melanostigma*** (Arunachal Pradesh, India)

9b. No distinct black bars on caudal fin; dorsal fin origin vertically above the pectoral fin origin; vertebrae 44 ..... ***C. stewartii*** (Eastern Himalayas - India & Nepal)

10a. Depth of head behind orbit 39 to 44% of head length; head length 27 to 32% of standard length; anal fin with 20 to 23 rays ... ...***C. gachua*** (India; Sri Lanka, Pakistan, Myanmar, Malaysia, Thailand, Viet Nam, Sunda Island, & Indonesia)

10b. Depth of head behind orbit 31 to 35% of head length; head length 32 to 34% of standard length; anal fin with 23 to 26 rays ... ...***C. harcourtbutleri*** (Myanmar)

11a. Sensory pores arranged singly under lower jaw; two large cycloid scales on each side of lower jaw undersurface 12

11b. Sensory pores under lower jaw arranged in groups; big cycloid scales on lower jaw undersurface absent 13

12a. Lateral line scales 61 to 63; dorsal fin rays 50 to 52; anal fin rays 33 to 34; scattered dark black spots on head and body ... ... ***C. barca*** (West Bengal and Assam, India; Bangladesh)

12b. Lateral line scales 51 to 54; dorsal fin rays 45 to 47; anal fin rays 28 to 30; no dark black spots on head and body ... ... ***C. aurantimaculata*** (Assam, India)

13a. Dorsal fin rays 50 to 55; anal fin rays 31 to 35; predorsal scales 13 to 16; a large ocellus on upper part of caudal fin base often present; white spots on body and fins ... ... ***C. marulius*** (India; Pakistan, Sri Lanka, Bangladesh, southern Nepal, Myanmar, Thailand, Mekong basin of Laos & Cambodia, southern China)

13b. Dorsal fin rays 42 to 45; anal fin rays 25 to 29; predorsal scales 18 to 20; no ocellus on caudal fin ... ... ***C. striata*** (India; Pakistan, eastward to Thailand, south China)

SUMMARY

Examination of specimens labeled as *Channa orientalis* and study of reports of this species in literature resulted in concluding that *Channa orientalis* Bloch and Schneider does not occur in India. Status of the species given in synonymy of *C. orientalis* in Menon (1999) has been discussed and summarized that all species including *Opheocephalus aurantiacus* Hamilton are considered as to be referable to as *Channa gachua* (Hamilton) except for *C. orientalis*, *C. burmanica* and *O. harcourtbutleri* which are treated as valid species. No Indian specimens are confirmed to be *Channa harcourtbutleri*. A working key for identification of snakehead fishes of India along with *C. burmanica* and *C. orientalis* have been provided to avoid future confusion.

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HEMICLEPSIS CHHARWARDAMENSIS SP. NOV. (HIRUDINEA : GLOSSIPHONIDAE) A NEW SPECIES OF LEECH FROM JHARKHAND, INDIA

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INTRODUCTION

More than 667 species of leeches are in the world. In India only 64 leech species of leeches are recorded so far Mandal (2010). This new species has been collected from *Chharwar* dam of Jharkhand during recent faunistic survey carried out by Zoological survey of India. In addition to this many new records have also recorded along with this. Harding and Moore (1924, 1927), have described number of new species from India. Mandal (2004) has described two new species from West Bengal. Soos (1965) is the pioneer in Taxonomy of leeches. Bandyopadhyay (2005), Mandal (1966, 2002, 2004 and 2005), Raut and saha (1986, 1986b, 1987) have done some work on taxonomy and ecological work of leeches in West Bengal. Soota (1977), Chandra, M (1983), Blanchard, R (1917), Ghosh G.C. (1998) contributed a lot on the taxonomy of leeches.

MATERIAL AND METHODS

After making the collection, leeches were sorted out. Then the cleaned leeches were placed in a tray with a small quantity of water and were slowly killed by anaesthetizing with alcohol. Leeches usually die in an extended condition by the process. Just after death, the leeches were kept in 70% alcohol for permanent preservation. As fixing fluid 4% formalin may be used.

Hemiclepsis chharwardamensis sp. nov.

Holotype: Z.S.I. Reg. No. An 3662/1 1ex. Coll. C.K.Mandal. 11. iii. 2009, Chharwardam, Bokaro, Jharkhand, India.

Diagnosis

Colour: Greyish green in living condition, fade up at preserved state.

Body: Small, cylindrical, distinct head region, middle part of the body is more in breadth than the two ends.

Length: The total length of the body of ***Hemicleps ischharwardamensis*** is 7.5 mm.

Breadth: 1.5mm.

Sucker: Anterior sucker .5 mm. in diameter, posterior sucker 1mm. in diameter. Posterior sucker is almost round, anterior sucker almost round. Horse shoe shaped jaws are in the anterior sucker.

Eyes: Two pairs of eyes. Ist pair smallest, closest and form a small line.

Host and habitat: It is found in lake, sucks the blood of mollusc and fishes.

Distribution: India: Bokaro, Jharkhand.

Remarks: The specific name is proposed according to the name of the place where from the first example was collected.

SUMMARY

Hemiclepsis chharwardamensis (Plate I and II) is described as a new species from Jharkhand. Due to having two pairs of eyes, it belongs to the genus *Hemiclepsis*. It is distinguished in possessing the following characters. Body is cylindrical. Eyes are two pairs. 1st pair smallest, closed and form a small line. 9 pairs of caeca

Table showing comparison of ***Hemiclepsis chharwardamensis*** sp. nov. with the other two species of the genus *Hemiclepsis* in India.

	Hemiclepsis bhatiai	*Hemiclepsis marginataasiatica*	*Hemiclepsis marginatamarginata*	*Hemiclepsis viridis*	*Hemiclepsis chharwardamensis*
Body	Claviform	Flattened	Flattened	Ovate lanceolate	Cylindrical
Colour	Cream colour	Reddish brown	Greenish yellow	Pea green	Grey-ish green
Eyes	3 pairs cup shaped	Two pairs	Two pairs	Three pairs	Comma shaped
Caecae	Nine pairs, Last pair branched	More than seven pairs	Eleven pairs Branched	Eleven pairs Less branched	Nine pairs not branched
Ring	70	70	72	70	60

(without branch) are present in the body. Papillae are found on the mid-dorsal area of the body. 9 whitish brown patches are on the both anterior lateral line of the body. 3 whitish brown patches are found on the mid dorsal area of anterior region. Horse shoe shaped jaws are in the anterior sucker. Number of ring is 60. Two brownish lines are on the anterior sucker. The leech is grayish green in living. Length of a full-grown preserved specimen is 7.5 mm. and width is 1.5 mm. Posterior sucker is 1mm. In diameter; anterior sucker measures . 5 mm diameter. Body breadth is almost triple than posterior sucker. A living specimen becomes double in length in full extension.

ACKNOWLEDGEMENTS

I am grateful to Dr. Ramakrishna, Director, Zoological Survey of India, for lucid suggestions during the study of the leeches, and our special thanks to Dr. J.G. Pattanayak O/C General Non-Chordata Section, and deep gratitude to the officers and staffs, General Non-Chordata section for their valid suggestions.

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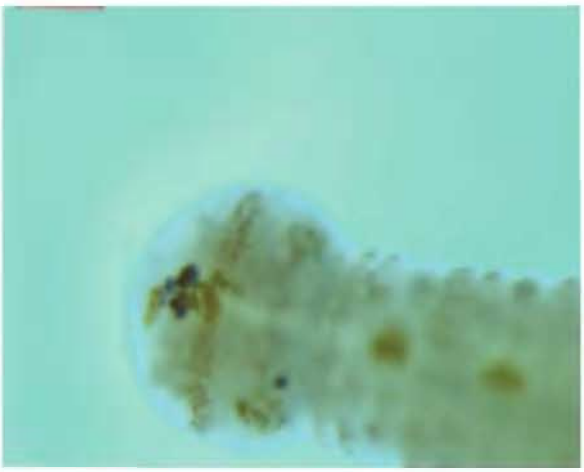
Plate showing the pictures of the leech species

Hemiclepsis charwardamensis **(Ventral)**

Hemiclepsis charwardamensis **(Dorsal)**



Hemiclepsis charwardamensis **(Dorsal and Ventral view of Head)**

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ORB-WEAVING SIDERS OF BANGLADESH-I : GENUS *ARANEUS* CLERCK (ARANEAE : ARANEIDAE) WITH TWO NEW SPECIES

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INTRODUCTION

Spiders of the genus *Araneus* are very little known from Bangladesh. The genus was first established by Clerck (1757) with the type-species *A. angulatus*. Thorell (1895) first reported the genus with only two species from Burma the then British India. Later Pocock (1900) recorded 11 species from Indian Sub-continent. Patel (1975), Tikader (1970, '82), Tikader and Biswas (1981), Tikader and Bal (1981) made numerous contributions of different species from different parts of India. In Bangladesh, Chowdhury and Pal (1984), first recorded only one species from Chittagong and Begum and Biswas (1997) from Barisal. The present paper composed of two species namely *A. mitifica* and *A. rumiae*. Of these, *A. rumiae* is described as new to science.

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 : ***Araneus*** Clerck, 1757

1757. *Araneus* Clerck, *Argn. Suec.*, : 15.

1805. *Epeira* : Walckenaer, *Tableau des Araneides*, : 53.

1837. *Atea* : C.L. Koch, *Uebersicht des Arachnidensystems*, **1** : 3.

1864. *Neopora* : Simon, *Hist. Nat. des. Araign., ed.*, **I** : 261.

1893. *Burgessia* : Mc Cook, *Amer. Spid.*, **3** : 182.

1895. *Araneus* : Simon, *Hist. Nat. Araign.*, **1**(4) : 829.

1900. *Araneus* : Pocock, *Fauna Brit. India, Arachn.*, : 227.

1935. *Araneus* : Dyal, *Bull. Dept. Zool. Panjab Univ*, : 177.

1951. *Conepeira* : Archer, *Am. Mus. Novit.*, **1487** : 12.

1960. *Araneus* : Yaginuma, *Spiders of Japan in colour*, : 51-55.

1970. *Araneus* : Tikader, *Rec. zool. Surv. India*, **64**(1-4) : 30.

1971. *Araneus* : Levi, *Bull. Mus. Comp. Zool. Harv.*, **145**(9) : 473.

1991. *Araneus* : Chen & Zhang, *Fauna of Zhejiang, Araneida*, : 85.

1995. *Araneus* : Barrion & Litsinger, *Riceland spid. South & S.E. Asia*, : 631.

1997. *Araneus* : Yin, *et al., Fauna Sinica*, Araneae : Araneidae : 123.

1999. *Araneus* : Song, *et al., Spiders of China*, : 236.

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2006. *Araneus* : Platnick, *World Spider Catalogue*, Version 6.5 :

2009. *Araneus* : Biswas : In Ahmed (ed.), *Encyclopedia of Flora & Fauna of Bangladesh*, Arachnida **18**(1) : 129.

Diagnosis : Spiders of this genus are medium in size. Cephalothorax oval, moderately high, convex with no horny outgrowth; thoracic groove conspicuous, transverse in female, but longitudinal in male having lateral prolongations. Eyes unequal, medians forming a quad, laterals

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close and situated on prominent tubercles; both rows of eyes recurved; ocular quad forming a trapezium. Chelicerae short, with dissimilar teeth. Maxillae and labium short and scopulate anteriorly. Sternum variable, clothed with hairs and spines. Legs long and slender; male with hook on coxa I and groove on femur II ; tibia II armed with spines. Male palpus with terminal apophysis.

Abdomen broad, rounded or oval; epigyne with a prominents scape which may be long or short and straight ; epigynal openings situated in the grooves at base.

Type genus : *Araneus angulatus* Clerck.

Distribution : Cosmopolitan.

Key to the species

1. Abdomen with scaly reticulation (fig. 1); sternum triangular (fig. 4); each of inner and outer margins of chelicerae with 2 teeth (fig. 2) ; clypeus convex, never tuberculate; epigyne and internal genitalia as in figs. 5 and 6.....***mitifica***

- Abdomen never with scaly reticulation (fig. 8); sternum broadly heart-shaped; inner and outer margins of chelicerae with 3 and 1 teeth respectively (fig. 9); clypeus tuberculate; epigyne as in fig. 12.....***rumiae*** n. sp.

1. *Araneus mitifica* Simon
(Figs. 1-7)

1886. *Epeira mitifica* Simon, *Act. Soc. Linn., Bordeaux,* **40** : 150.

1887. *Epeira mitifica* : Thorell, *Annali. Mus. civ. Genova,* **25** : 187.

1896. *Epeira mitifica* : Workman, *Malays. Spid.,* : 39.

1906. *Araneus mitifica* : Baesenberg & Strand, *Abh. senekenb. naturforsch. Ges.,* **39**(1-2) : 22.

1935. *Zilla nawazi* : Dyal, *Bull. Dept. Zool., Panjab Univ.,* **1** : 186.

1939. *Araneus mitifica* : Satio, *Satio Ho-no Kai Mus. Res. Bull.,* **18** : 19.

1963. *Araneus mitifica* : Tikader, *J. Univ. Poona, Sci. & Tech.,* **24** : 43.

1978. *Araneus mitificus* : Yaginuma, *Spiders of Japan in color* : 55.

1981. *Araneus mitifica* : Tikader & Bal, *Rec. zool. Surv. Inida, occ. pap.* **24** : 53.

1982. *Araneus mitifica* : Tikader, *Fauna of India, Araneidae,* **2**(1) : 233.

1986. *Araneus mitificus* : Yaginuma, *Spiders of Japan in color* : 100.

1991. *Araneus mitificus* : Chen & Zhang, *Fauna of Zhejiang, Araneida* : 89.

1995. *Araneus mitificus* : Barrion & Litsinger, *Riceland spider of south & southeast Asia* : 638.

1997. *Araneus mitificus* : Platnick, *Advances in Spider Taxonomy,* : 483.

1997. *Araneus mitificus* : Yen *et al., Fauna Sinica, Araneidae,* : 139.

1999. *Araneus mitificus* : Song *et al., The spiders of China,* : 239.

2004. *Araneus mitifica* : Gajbe, *Rec. zool. Surv. India, occ. pap.* **227** : 34.

2005. *Araneus mitifica* : Majumder, *Mem. Zool. Surv. India,* **20**(3) : 6.

2009. *Araneus mitifica* : Ahmed ed., *Flora & Fauna of Bangladesh,* Arachn., **18**(1) : 131.

Material examined : 2♀ , 1♂ , Bagerhat, 9.II.1993, Coll. V. Biswas ; 8♀ , S. Park, Dhaka, 4. III. 1993, Coll. V. Biswas ; 2♀ , Kustia, 12.III.1993, Coll. V. Biswas ; 1♀ , Rajshahi, 3.III.1992, Coll. V. Biswas ; 2♀ , Manikganj, 3.VI.1992, Coll. V. Biswas; 3♀ , BAU, Mymensingh, 15.XI.1993, Coll. V. Biswas ; 2♀ , Japhlong, Sylhet, 28.XII.1993, Coll. V. Biswas.

General : Cheplalothorax and legs yellow-brown; abdomen dorsally silvery-white and ventrally green. Total body length 9.00 mm. Carapace 3.65 mm long, 2.80 mm wide ; abdomen 5.59 mm long and 6.00 mm wide.

Distribution : BANGLADESH : Bagerhat, Dhaka, Kustia, Manikganj, Mymensigh, Rajshahi, Sylhet; BURMA; CHINA (Chen and Zhang, 1991); INDIA (Tikader, 1980); JAPAN (Yaginuma, 1986); MALAYSIA (Koh, 1989); PAKISTAN (Tikader, 1980) ; SINGAPORE (Koh, 1989).

2. *Araneus rumiae* n. sp.
(Figs. 8-12)

Material examined : 1♀ , Barisal, 2.X.1993, Coll. V. Biswas ; 1♀ , Jessore, 20.X.1993, Coll. V. Biswas.

General : Cephalothorax yellow-brown, legs yellowish ; abdomen light brown with white

Table-1: Measurements (in mm) of different leg segments of ***Araneus rumiae*** n. sp.

Leg	Femur	Patella & Tibia	Metatarsus	Tarsus	Total
I	2.50/2.50	0.80/0.80	2.70/2.70	1.20/1.20	9.70/9.70
II	2.30/2.30	0.60/0.60	2.60/2.60	1.00/1.00	8.80/8.80
III	1.40/1.40	0.50/0.50	2.40/2.40	0.80/0.80	7.10/7.10
IV	2.00/2.00	0.50/0.50	2.50/2.50	0.80/0.85????	7.95/7.95

median band. Total body length 9.20 mm. Carapace 4.50 mm long, 4.00 mm wide; abdomen 4.70 mm long and 4.60 mm wide.

Cephalothorax : Broad, posteromedially wide, slightly longer than wide; cephalic region raised, with deeply distimet cervical furrows. Eyes pearly white, similar, each of anterior and posterior row of eyes strongly recurved, anteromedians situated on a protuberance, lateral eyes close; ocular quad wider anteriorly, wider than long. Chelicerae brown, long, anteriorly narrowing, inner margin with 3 and outer margin with 1 teeth (fig. 9). Maxillae dark brown, longer than wide, anteriorly scopulate (fig. 10). Sternum brown, broad, wider than long, clothed with spines and fine hairs (fig. 11). Legs long and slender, clothed with hairs and spines; leg formula and the measurements (in mm) : 1243.

Abdomen : Globular, medially wide, narrowing at both ends, clothed with fine pubescence; dorsum decorated with white patch ; ventrally brown; epigyne as in fig. 12.

Male : Unknown.

Holotype : Female in spirit.

Type-locality : Barisal and Jessore, Bangladesh. Coll. V. Biswas.

Etymology : The species has been named after my beloved niece Dr. Rumi Biswas.

Remarks : The present species *Araneus rumiae* n. sp. in having produced tongue like epigynal scape comes close to the Indian congeners *A. pahalgaonensis* Tikader & Bal and *A. anantonagensis* Tikader & Bal. These species (Tikader, 1982) however are with a pair of shoulder humps on the abdominal dorsum which is absent in the new species. Typical globular, shape of the abdomen brings it, close to *A. pentagrammicus* (Karsch) (Yaginuma, 1986; Shinkai & Takano, 1984) easily be seperated out in not having, the sigilla on the abdominal dorsum. *Araneus ventricogus* (L. Koch) (Chen & Zhang, 1991; Yin, *et al.*, 1990) may also be related to the present species but of shoulder humps and sigilla on abdominal dorsum and thick, short and blunt epigynal scape justify its distinction. The species is, therefore described as new to science.

SUMMARY

The present paper deals with 2 (two) species of orb-weaving spiders of the genus *Araneus* Clerck of Bangladesh. The species are *A. mitifia* (Simon) and *A. rumiae* sp. n.

The study on these was initiated since 1994, have revealed the existance of above two species of a particular area of Bangladesh. Identity of the species were later confirmed by the Zoological Survey of India, Kolkata.

ACKNOWLEDGEMENTS

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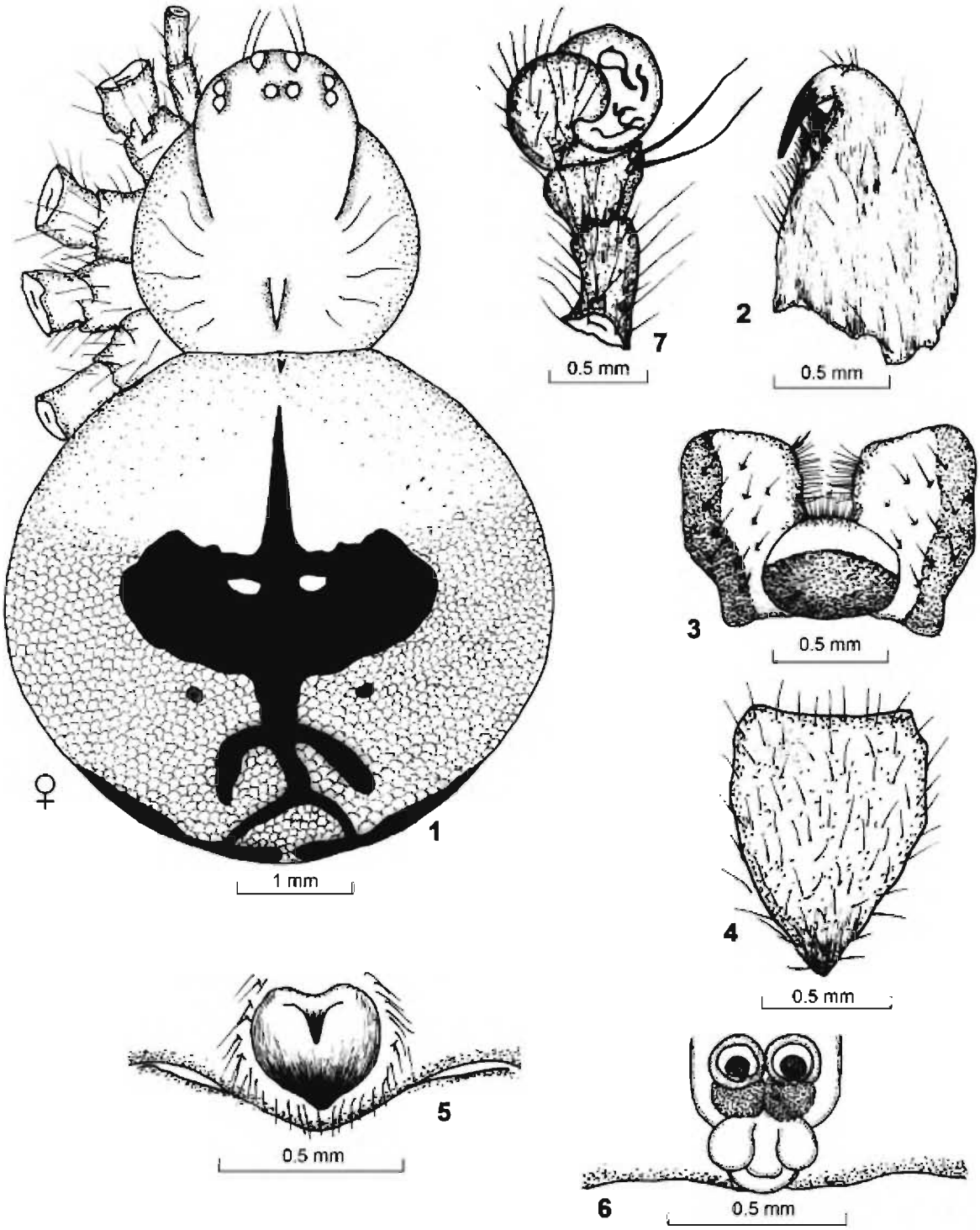
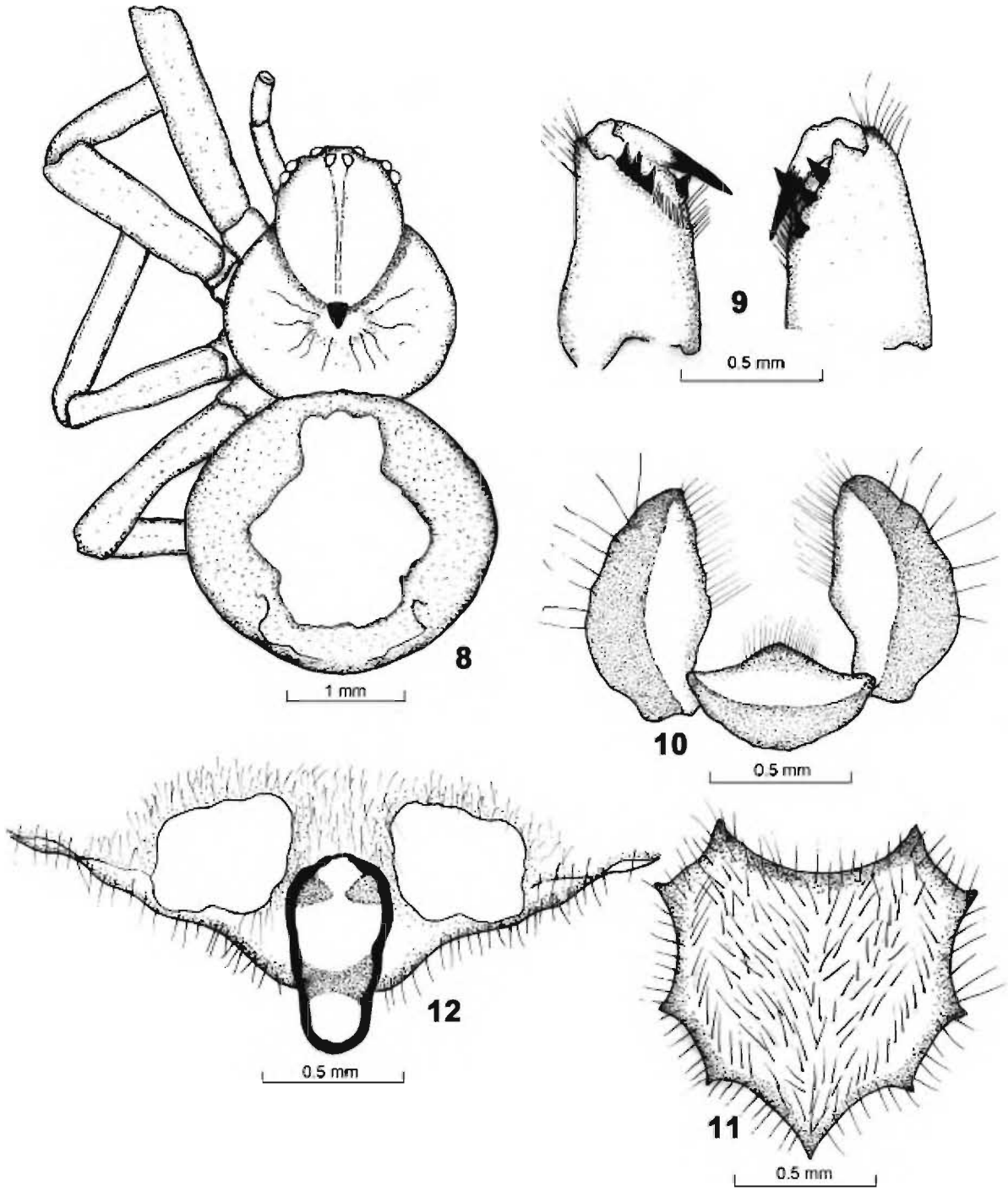


Figs. 1-7 : ***Araneus mitifica*** Simon **1.** Whole body (dorsal view) ; **2.** Chelicerae ; **3.** Maxillae and Labium ; **4.** Sternum ; **5.** Epigynum ; **6.** Internal genitalia ; **7.** Male palp.



Figs. 8-12 : *Araneus rumiae* n. sp. **8.** Whole body (dorsal view); **9.** Chelicerae ; **10.** Maxillae and Labium ; **11.** Sternum; **12.** Epigynum.

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DESCRIPTION OF A NEW SPECIES OF THE GENUS *ULOBORUS* LATREILLE FROM BANGLADESH (ARANEAE : ARANEIDAE)

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INTRODUCTION

Spiders of the genus *Uloborus* Latreille (Family: Uloboridae) are little known in the fauna of Bangladesh. The genus was first established by Latreille in 1806 with the type-species *Uloborus walckenaeirius*. In Bangladesh, Biswas, *et al.*, (1993) reported only one species from Jhenidah district. Although, several species of the genus are known from different countries like - India (Tikder, 1969 & '70; Tikader & Biswas, 1981; Biswas & Biswas, 1992; Bhandari & Gajbe, 2001), Pakistan (Dyal, 1935), China (Hu, 1983; Zhu & Sha, 1983 ; Zhu, *et al.*, 1989 ; Chen & Gao, 1990; Chen & Zhang, 1991; Zhao, 1993), Japan (Yoshida, 1980, '81, '82a, '82b, '92 ; Shinkai & Takano, 1984 ; Yaginuma, 1986), Korea (Paik, 1978), U.K. (Roberts, 1995 ; Locket & Millidge, 1951), Hungary (Loksa, 1969), Germany (Wunderlich, 1976 ; Miller, 1971) and U.S.A (Kaston, 1948; Muma & Gertsch, 1964; Opel, 1979, '82, '83, '84, '91; Roth, 1994; Breene, *et al.*, 1993).

The present paper contains description of a new species *Uloborus chinmoyiae* sp. n. collected from the rice-field of village Shikerpur, district Jhenidah, Bangladesh. The materials were studied in the laboratory following Tikader (1987). The identity of the species were confirmed from the Zoological Survey of India, Kolkata.

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 : *Uloborus* Laterille, 1806

1806. *Uloborus* Latreille, *Genera Crustaceorum et Inscetorum*, **I** : 109.

1850. *Uloborus* : Hentz, *Bost. J. H. H.*, **6** : 25.

1975. *Uloborus* : Simon, *Ar. Fr.*, : 244.

1895. *Uloborus* : Simon, *Hist. Nat. Araign.*, **1** : 214.

1940. *Uloborus* : Comstock, *The Spider Book*, : 262.

1948. *Uloborus* : Kaston, *Conn. St. Geol. Nat. Hist. Surv.*, **70** : 513.

1970. *Uloborus* : Tikader, *Rec. zool. Surv. India*, **64**(1-4) : 4.

1981. *Uloborus* : Tikader & Biswas, *Rec. zool. Surv. India*, Occ. pap. **30** : 15.

1984. *Uloborus* : Shinkai & Takano, *Field guide to Spider of Japan* : 187.

1986. *Uloborus* : Yaginuma, *Spiders of Japan in Color* : 15.

1990. *Uloborus* : Mauer & Hanggi, *Cat. der Swd. Ar.* : 30.

1991. *Uloborus* : Chen & Zhang, *Fauna of Zhejiang, Araneida* : 321.

1993. *Uloborus* : Zhao, *Spiders in Cotton fields in China* : 222.

1995. *Uloborus* : Barrion & Litsinger, *Riceland Spiders of South & Southeast Asia* : 28.

1997. *Uloborus* : Platnick, *Adv. in Spider Taxonomy* : 250.

Present Address : Department of Zoology, Khulna Govt. Womens' College, Khulna-9000, Bangladesh.

Table-1: Measurements (in mm) of different leg segments of ***Uloborus chinmoyiae*** sp. n.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	3.50/3.50	0.70/0.70	1.80/1.80	1.80/1.80	0.80/0.80	8.60/8.60
II	3.00/3.10	0.70/0.70	1.60/1.60	1.60/1.60	0.80/0.80	7.80/7.80
III	2.10/2.10	0.50/0.50	1.50/1.50	1.40/1.40	0.60/0.60	6.10/6.10
IV	4.00/4.00	0.80/0.80	2.00/2.00	2.00/2.00	2.00/2.00	9.70/9.70

1997. *Uloborus* : Mikhailov, *Cat. of Spiders of former USSR* : 31.

1999. *Uloborus* : Song, *et al.*, *The Spiders of China* : 80.

2002. *Uloborus* : Buchar & Ruzicka, *Cat. Spiders of Czech Rep.* : 30.

2004. *Uloborus* : Majumder, *Mem. zool. Surv. India*, **20**(2) : 37.

2004. *Uloborus* : Gajbe, *Rec. zool. Surv. India*, Occ. pap. **227** : 28.

2005. *Uloborus* : Majumder, *Mem. zool. Surv. India*, **20**(3) : 55.

2006. *Uloborus* : Platnick, *World Spider Cat.*, Version 6.0 : 622.

2009. *Uloborus* : Biswas : In Ahmed (ed.), *Flora & Fauna of Bangladesh*, Arachn., **18**(1) : 366.

Diagnosis : The members of this genus are small to nearly large in size. Cephalothroax triangular, flat, variably coloured. Eyes dark, dissimilar; both rows recurved or nearly so. Chelicerae moderately robust, nearly parallel sided. Anterior legs largest; femora with dorsal trichobothria; tarsi with 3 claws; tibia I of males with 6-7 dorsal teeth like spines.

Abdomen broad, dark; anal tubercle prominent in female and recduced in male.

Type-species : *Uloborus walckenaerius* Latreille

Distribution : AFRICA; AMERICA; ASIA and EUROPE.

164. ***Uloborus chinmoyiae*** sp. n.
(Figs. 1-6)

Material examined :

Holotype : ♂, Jhenidah, 19.IX.1992 ; Coll. V. Biswas.

Paratype : Nil.

General : Cephalothroax and legs brownish; abdomen dirty-white. Total body length (holotype) 4.25 mm. Carapace 1.30 mm long, 1.30 mm wide; abdomen 2.95 mm long and 2.05 mm wide.

Cephalothroax : broad, rounded, anteriorly narrowing and posteriorly broad, 2 lateral longitudinal band extended from anterior to posterior forming a longitudinal median white marking. Eyes white each ringed with black basal band; anteromedians slightly larger than the others; both rows of eyes recurved; anterior row strongly so. Chelicerae brown, strong, longer than wide, each of inner and outer margins with 1 and 3 teeth (fig. 2). Maxillae brown, flat, longer than wide, anteromedially wide, scopulate (fig. 3). Labium brown, medially wide, basally flat and anteriorly scopulate (fig. 3). Sternum brown, long, cylindrical, narrowed and pointed poseriorly (fig. 4). Legs long and slender, with few sharp spines; leg formula and the mesurements (in mm) : 4123.

Male palp brown, strong as in figs. 5 and 6.

Abdomen : broadly oval, medially wide; dorsum without any decoration; median spinnerets broad, pointed, others similar. Female unknown.

Distribution : BANGLADESH : Jhenihah (type locality).

Etymology : The species is named after one of my friend Smt. Chinmoyi Chanda, Lecturer in Zoology, Gopalpur College, Dist. Tangail, Bangladesh.

Remarks : None of the *Uloborus* species (Tikader, 1970; Tikader & Biswas, 1981; Yaginuma, 1986; Koh, 1989; Shinkai & Takano, 1984; Locket & Millidage, 1951) are known to

posses a tubercle at the mid-anteriormost cephalic region which on either side bears anteromedian eyes, extremely elongate posteriorly narrowed sternum. The species as such is described as new to science.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. S.C. Majumder, Scientist-SD, Sunderban Field Research Station, Zoological Survey of India, Canning, West Bengal, for confirmation of the identity of the species and the Head, Department of Zoology, University of Calcutta for laboratory facilities throughout the course of this study.

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Yoshida, H., 1982. Spiders from Taiwan I. Two new species of the genus *Octonoba* (Araneae : Uloboridae). *Acta Arachnol.*, **30** : 71-74.

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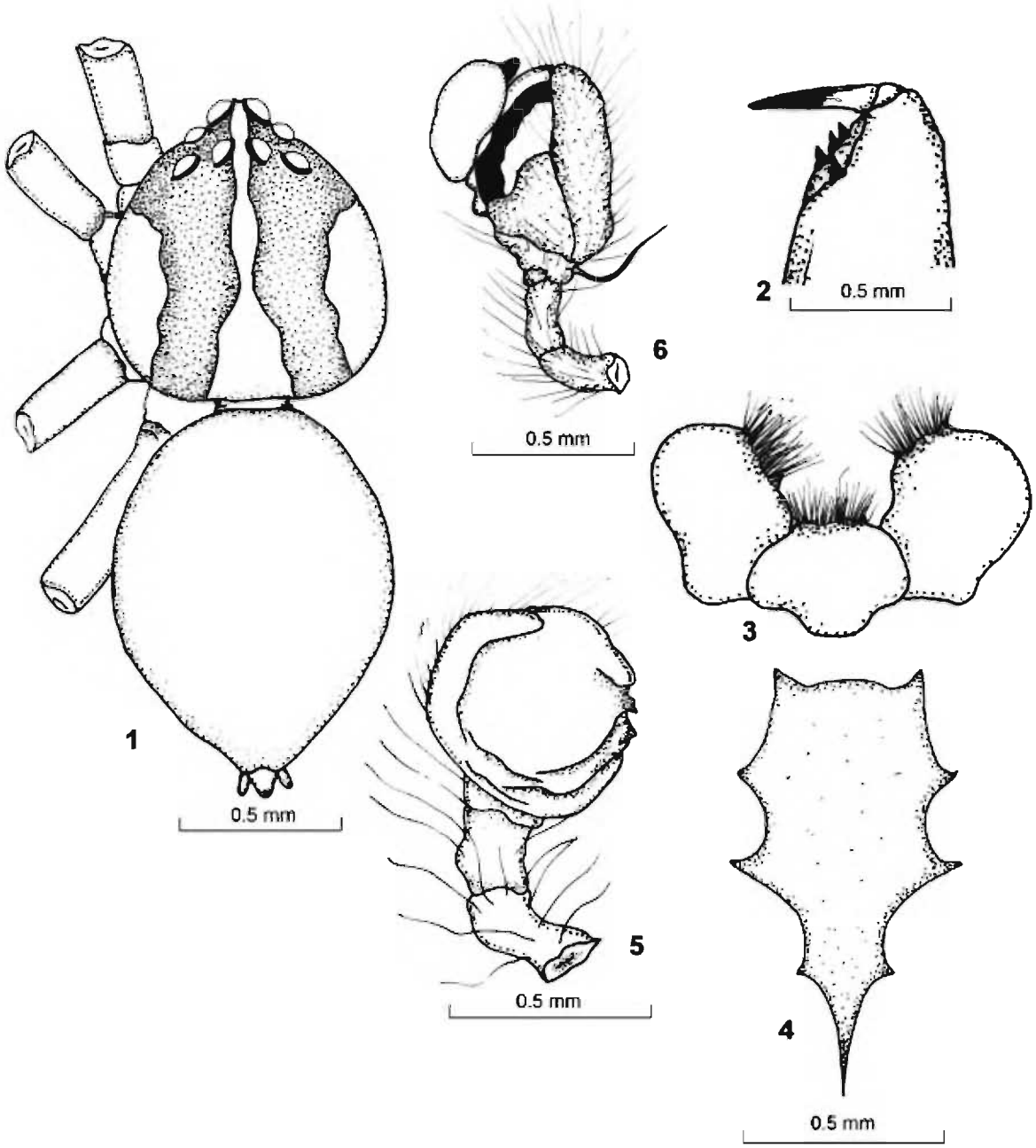

Figs. 1-6 : ***Uloborus chinmoyiae*** n. sp. **1.** Whole body (dorsal view); **2.** Chelicerae; **3.** Maxillae and Labium; **4.** Sternum; **5.** Male palp (ventral view); **6.** Male palp (retrolateral view).

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ORB-WEAVING SPIDERS OF BANGLADESH : GENUS *NEOSCONA* SIMON (ARANEAE : ARANEIDAE)

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INTRODUCTION

Members of the orb-weaving spider family Araneidae (= Argiopidae) are abundant throughout Bangladesh. Genus *Neoscona* Simon are common orb-weavers in the crop-fields and gardens but works on this spiders in Bangladesh, are poorty known (Chowdhury & Pal, 1984 ; Biswas, *et al.*, 1993; Okuma, *et al.*, 1993; Begum & Biswas, 1997). Although, several contributions are found in different countries like-India (Tikader & Bal, 1981; Tikader & Biswas, 1981; Tikader, 1982; Gajbe & Gajbe, 2000; Bhandari & Gajbe, 2001), China (Chen & Zhang, 1991; Yin, *et al.*, 1997; Song, *et al.*, 1999), Japan (Yaginuma, 1986), Australia (Davies, 1988), Philippines (Barrion & Litsinger, 1995) and USA (Barman & Levi, 1971; Levi, 1992).

Present paper contains a report of 11 (eleven) species of the genus *Neoscona* Simon of which 4 (four) species are described as new to science and other 7 (seven) species are recorded for the first time from Bangladesh.

Materials were studied in the laboratory following Berman and Levi (1971), Levi (1992), Tikader (1982, 87), Tikader and Bal (1981), Yaginuma (1986), Chen and Zhang (1991), Yin, *et al.* (1997), Barrion and Litsinger (1995) and Song, *et al.*, (1999). The identity of the spices were later confirmed from the Zoological Survey of India, Kolkata.

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

SYSTEMATICS

Genus : *Neoscona* Simon, 1864

1864. *Neoscona* Simon, *Hist. nat. des Araign.*, **1** : 261.

1924. *Chinestela* : Chamberlin, *Proc. U.S. natn. Mus.*, **63**(13) : 20.

1926. *Cubanella* : Franganillo, *Bolan Soc. ent. Esp.*, 9 : 69.

1940. *Neoscona* : Comstock, *The Spider Book*, : 509.

1951. *Firovixia* : Archer, *Am. Mus. Novit.*, **1487** : 34.

1960. *Neoscona* : Yaginuma, *Spiders of Japan in color* : 56-57.

1971. *Neoscona* : Levi, *Bull. Mus. Comp. Zool.*, **14**(8) : 465.

1981. *Neoscona* : Tikader & Ball, *Rec. zool. Surv. India*, Occ. pap. no. 24 :

1982. *Neoscona* : Tikader, *Fauna of India, Araneidae*, **2**(1) : 238.

1986. *Neoscona* : Yaginuma, *Spiders of Japan in color* : 395.

1988. *Neoscona* : Davies, *Mem. Qld. Mus.*, **25**(2) : 21.

1989. *Neoscona* : Koh, *Guide to Singapore Spiders* : 32.

1991. *Neoscona* : Chen & Zhang, *Fauna of Zhejiang, Araneida* : 119.

1993. *Neoscona* : Okuma, *Illustr. Monogr. Ricefield spiders Bangladesh* : 82.

1995. *Neoscona* : Barrion & Litsinger, *Riceland spiders of south and southeast Asia* : 612.

1997. *Neoscona* : Platnick, *Adv. Spider Taxonomy* : 512.

1997. *Neoscona* : Yin, *et al.*, *Fauna Sinica, Araneidae*, : 412.

Present Address : Department of Zoology, Khulna Govt. Womens' College, Khulna-9000, Bangladesh.

1999. *Neoscona* : Song, *et al.*, *The spiders of China*, : 245.

2004. *Neoscona* : Gajbe, *Rec. zool. Surv. India*, Occ. pap. no. 227 : 12.

2004. *Neoscona* : Majumder, *Mem. Zool. Surv. India*, **20**(2) : 14.

2006. *Neoscona* : Platnick, *World Spider Cat.*, version 6.5 : 612.

2009. *Neoscona* : Biswas : In Ahmed (ed.), *Flora & Fauna of Bangladesh*, Arachn., **18**(1) : 145.

Diagnosis : Spiders of this genus are small to medium in size. The females are usually larger than the males. Thoracic region with a longitudinal groove. Ocular quad forming a trapezium; lateral eyes close and not situated one any tubercle; anteromedian eyes largest or subequal to the posteromedians; posteralateral eyes smallest; both rows of eyes recurved. In male, coxa I ventrally provided with a hook on the distal rim ; tibia II having macrosetae (spine like) on prolateral surface.

Abdomen oval or sub-oval, triangular or sub-triangular. Epigyne tongue-like; scape completely fused to the base and provided with 1 or 2 pairs of lateral lobes; epigynal openings situated on the underneath of scape. Male palpal patella provided with 2 long, curved and strong spines; Cymbium broad and rather narrow and strip-like.

Type-species : *Neoscona anabesca* (Walckenaer).

Distribution : All over the world.

Key to the species

1. Cervical furrows deeply distinct **2**
- Cervical furrows absent or weakly impressed **7**
2. Abdomen rhomboid or roughly triangular.....**3**
- Abdomen globoid or elongately oval **4**
3. Abdomen rhomboid ; thoracic fovea round; each of cheliceral margins with 3 teeth (fig. 25) fang segmented; epigyne and internal genitalia as in figs 28 and 29..... .....***laglezei***
- Abdomen triangular ; thoracic fovea elongate; each of cheliceral margins with 2 teeth (fig. 2); fang unsegmented; epigyne and internal genitalia as in figs. 5 and 6 .....***bengalensis***
4. Abdomen elongately oval, with a white median longitudinal dorsal band; epigyne strongly produced and constricted at base (fig. 41) cephalic region transversely rectangutar; internal genitalia as in fig. 42 ..... ***mukerjei***
- Abdomen globoid, never with such band; epigyne not so produced and constricted; ecphalic region never rectangular; internal genitalia never as above.....**5**
5. Abdomen dorsally decorated and without any sigilla; inner margin of chelicerae with 3 teeth ***6***
- Abdomen dorsally not decorated but with sigilla; inner margin of chelicerae with 2 teeth (fig. 51); epigyne and internal genitalia as in figs. 54 and 55 .....***nautica***
6. Cephalothorax globular; sternum nearly heart shaped, medially broad; chelicerae not spieled and with 2 teeth on outer margin (fig. 9); epigyne and internal genitalia as in figs. 12 and 13 .....***elliptica***
- Cephalothorax clongate; sternum alongate, never broad medially; ehelicerae spined and with 1 tooth on outer as in fig. 20 .....***kabiri* n. sp.**
7. Abdomen globase ***8***
- Abdomen elongately oval ***9***
8. Cephalothorax and abdomen with a central longitudinal band; sternum nearly rounded; inner and outer margins of chelicerae with 1 and 2 teeth (fig. 58; epigyne as in fig. 61.....***rahamani* n. sp.**
- Cephalothorax and andomen without any such band; sternum heart shaped; inner and outer margins of chelicerac with 3 and 1 teeth (fig. 46); epigyne as in fig. 49.....***nasidae* n. sp.**
9. Epigyne tongue-shaped; cheliceral margins with more teeth (fig. 63); thoracic region in male with longitudinal median fovea; internal genitalia as in fig. 67.....***theis***
- Epigyne never tongue-shaped ; cheliceral margins with few teeth.....***10***
10. Cephalothorax medially with a longitudinal band; abdomen dorsally with a pair of sigilla; sternum centrally with ovoid, white marking; outer margin of chelicerae with 1 tooth (fig. 15); labium basally rounded, apically truncate (fig.16); epigyne as a fig. 18 .....***govindai* n. sp.**
- Cephalothorax without any decoration; abdomen dorsally without any sigilla; sternum without any such marking; outer margin of chelicerae with 2 teeth (fig. 31); labium basally truncate, apically convex (fig. 32); epigyne as in fig. 34.....***molemensis***

Table-1: Measurements (mm) of leg segments of ***Neoscona govindai*** n. sp.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	4.10/4.10	1.00/1.00	3.00/3.00	3.00/3.00	0.80/0.80	11.90/11.90
II	2.50/2.50	0.80/0.80	2.50/2.50	2.50/.250	0.60/0.60	8.90/8.90
III	3.00/3.00	0.50/0.50	1.20/1.20	1.40/1.40	0.80/0.80	6.90/6.90
IV	3.50/3.50	1.00/1.00	2.50/2.50	2.50/2.50	0.80/0.80	10.30/10.30

1. *Neoscona bengalensis* Tikader & Bal
(Figs. 1-6)

1981. *Neoscona bengalensis* Tikader & Bal, Rec.zool. surv. India, **24** : 15.

1982. *Neoscona bengalensis* : Tikader, Fauna of India, spiders, **2** (1) : 246.

Material examined : 2♀ , Jhenidah, 12. V. 1992, Coll. V. Biswas ; 1♀ , Manikganj, 9. VII. 1991, Coll. V. Biswas ; 1♀ , Rajshahi, 3. III. 1992, Coll. V. Biswas.

Distribution : BANGLADESH : Jhenidah, Manikganj, Rajshahi ; INDIA (Tikader, 1982)

2. *Neoscona elliptica* Tikader & Bal
(Figs. 7-13)

1981. *Neoscona elliptica* Tikader & Bal, *Rec. zool. Surv. India*, **24**:24.

1982. *Neoscona elliptica* : Tikader, Fauna of India, Spiders, **2**(1) : 259.

1991. *Neoscona elliptica* : Yin, *et al.*, Fauna Sinica, Spiders, : 347.

1999. *Neoscona elliptica* : Song, *et al.*, The Spiders of China, : 299.

Material examined : 1♀ , Chittagong, 12. IX. 1991, Coll. V. Biswas ; 1♀ , ADI, Faridpur, 12. XI. 1992, Coll. V. Biswas ; 2♀ , Jhenidah, 18. V. 1990, Coll. V. Biswas ; 1♀ , Mymensingh, 5. VII. 1992, Coll. V. Biswas; 1♀ , Rajshahi, 3. III. 1992, Coll. V. Biswas.

General : Cephalothorax reddish-brown ; legs brown with dark brown spines ; abdomen brown with white patches. Total body length 12.60 mm. Carapace 4.80 mm long, 4.20 mm wide ; abdomen 7.80 mm long and 6.00 mm wide.

Distribution : BANGLADESH : Chittagong, Faridpur, Jhenidah, Mymensingh, Rajshahi; INDIA ; CHINA (TiKader, 1982 ; Yin, *et. al*, 1997 ; Song, *et. al.*, 1999).

3. *Neoscona govindai* n. sp.
(Figs. 14-18)

Genaral : Cephalothorax brownish-yellow ; legs yellow. Abdomen brownish with longitudinal white band. Total body length (holotype) 7.00mm. Carapace 3.00mm long and 2.80mm wide. Abdomen 4.00mm long and 3.00mm wide.

Cephalothorax : Elongately oval, posteriorly broad, anteriorly narrowing, longer than wide, dorsal ridge dark-brown; cephalic region slightly raised; ocular area brown. Eyes similar, lateral eyes forming a protuberance anterolaterally; anterior row strongly recurved while posterior row weakly so; ocular quad rectangular, wider than long. Chelicerae brown, broad medially; each of inner and outer margins with 2 and 1 tooth respectively (fig. 15). Maxillae yellow-brown, broad, longer than wide, scopulate near base (fig-16). Labium brown, wider than long, scopulate anteriorly (fig. 16). Sternum brown, nearly heart-shaped anteriorly broad, medially with a white, oval, patch, posteriorly produced and pointed (fig.19). Legs long and slender; leg formula 1423 and the measurements (in mm) as in Table-1.

Abdomen : Broad, oval, medially wide and narrowing at both ends, clothed with fine hairs; dorsum with yellow-brown and white longitudinal band, this on either side with 2 dark brown spots; epigyne as in fig. 18.

Holotype : Female in spirit.

Male : Unknown.

Type-locality : Jhenidah, Bangladesh.

Table-2 : Measurements (in mm) of 1eg segments of ***Neoscona kabiri*** n. sp.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.00/2.00	0.50/0.50	1.00/1.00	2.00/2.00	0.90/0.90	6.40/6.40
II	2.00/2.00	0.80/0.80	1.70/1.70	1.70/1.70	0.90/0.90	7.10/7.10
III	1.50/1.50	0.30/0.30	0.80/0.80	1.00/1.00	0.80/0.80	4.40/4.40
IV	2.10/2.10	0.80/0.80	1.90/1.90	1.50/1.50	0.90/0.90	7.20/7.20

Etymology : The species has been named after Shri Govinda Lal Ghosh, BCIC Dhaka, Bangladesh, who use to inspire the first author throughout the course of this study.

Remarks : None of the other congeners of *Neoscona* (Tikader, 1982 ; Tikader & Bal, 1981 ; Zhao, 1993 ; Yaginuma, 1986 ; Yin, *et al.*, 1997 ; Song, *et al.*, 1999 ; Barrion & Litsinger, 1995 ; Shinkai & Takano, 1984 ; Davies, 1988) appear close to the present species *N. govindai* n. sp., excepting *N. elliptica* Tikader & Bal (Tikader, 1982 ; Tikader & Ba1,1981). The species stands distinct in not having produced cephalic region, cervical furrows, fovea, irregularly distributed scally reticulation and too many sigilla over the abdomen and bluntly conical epigynum. The species is therefore, described as new to science.

4. ***Neoscona kabiri* n. sp.**
(Fig. 19-23)

General : Cephalothorax brown ; legs yellowish-brown ; abdomen yellowish, dorsally with brown bands. Total body length 7.40mm; carapace 3.20mm long and 3.00mm wide ; abdomen 4.20mm long and 4.00mm wide.

Cephalothorax : Elongately ovoid, posteriorly broad, anteriorly narrowing, longer than wide, clothed with fine spines; dorsum centrally with an elevated longitudinal ridge extending almost upto the entire length ; cervical furrows and radii distinct ; cephalic region dark brown, raised. Eyes pearly-white ; anterior row of eyes more recurved than posterior row; antero-median eyes widely seperated and slightly larger than posteromedians; lateral eyes close ; ocular quad anteriorly wide and posteriorly narrowed. Chelicerae brown, strong, broad basally, clothed with strong spines; each of inner and outer margins with 3 and 1 tooth respectively (fig. 20). Maxillae yellow brown, broad, medially wide and scopulate anteriorly (fig.21), Labium yellow-brown, medially board and anteriorly scopulate (fig.21). Sternum long, cylindrical, posteriorly narrowed and pointed (fig. 22). Legs long and slender, clothed with hairs and strong spines.; leg formula 4213 and the measurements (in mm) as in Table-2.

Abdomen : Broad, rounded, longer than wide, clothed with fine hairs and pubescence ; dorsum with both longitudinal and transverse blackish brown bands ; epigyne produced, medially concave (fig.23).

Material examined : Type-data : Holotype : 0 in spirit, will be deposited in the museum of the Department of Zoology, University of Dhaka, Bangladesh.

Type-locality : districts Comilla and Jessore, dated 12.VII. 1992 and 28.Ix.1993, Coll. V. Biswas.

Paratype : 10, Jessore, 28.Ix,1993, Coll. V. Biswas.

Distribution : BANGLADESH : Comilla and Jessore.

Etymology : The species has been named after Professor S.M.H. Kabir, Department of Zoology, University of Dhaka, Bangladesh.

Remarks : Comparison with congeners (Tikader & Bal, 1981; Tikader, 1982; Shinkai & Takano, 1984; Yin, *et al.*, 1997; Chen & Zhang, 1991; Yaginuma, 1986; Kaston, 1948; Song, *et al.*, 1999; Barrion & Litsinger, 1995; Berrnan & Levi, 1971; Levi, 1992) of *Neoscona* the present species shows a similarity in the general appearance with that of N. *scylla* (Karsh) (Chen & Zhang, 1991 ; Yin, *et. al.*, 1997; Song, *et al.*, 1999). But the epigynum

appears much different. The closest ally of the species appears to be *N. mukerjei* TiKader (Tikader, 1982) but stands distinct in having a long cephalothoracic band medially, deeply distinct cervical furrows, globose subtriangular abdomen which is anteriorly truncate, epigynum short, constricted at basal 1/3rd pointed distally. These sufficiently justify its erection as a new species.

5. *Neoscona lagiazei* (Simon)
(Figs. 24-29)

Material examined : 20, Bagerhat, 12.VIII. 1993, Coll. V. Biswas; 10, Barisal, 19. V. 1992, Coll. V. Biswas ; 20, Noakhali, 12.IX. 1994, Coll. V. Biswas; 10, Dhaka,16.IX, 1994, Coll. V. Biswas; 10, Manikganj, 18. XI. 1993, Coll. V. Biswas.

General : Cephalothorax yellowish; legs yellowish with blackish colour ; abdomen greyish yellow with white hairs. Total body length 8.50mm. Carapace 3.10mm long and 2.60mm wide ; abdomen 6.20mm long and 4.85 mm wide.

Distribution : BANGLADESH: Bagerhat, Barisal, Noakhali, Dhaka, Manikganj; AUSTRALIA; BURMA; INDIA; INDONESIA; SRILANKA (Tikader, 1982).

6. *Neoscona molemensis* Tikader & Bal
(Figs. 30-36)

1981. *Neoscona molemensis* Tikader & Bal, *Rec. zool. surv.* India, occ, pap. No. **24**: 22.

1982. *Neoscona molemensis* : Tikader, Fauna of India, Spiders **2**(1) : 257.

1995. *Neoscona molemensis* : Barrion & Litsinger, Riceland spiders of South and S. Asia, : 627.

1997. *Neoscona molemensis* : Platnick, Adv. Spider Taxonomy, :523.

Material examined : 20, Barisal, 28,VII, 1992, Coll. V. Biswas; 20, Pabna, 12.VIII.1993, Coll. V. Biswas; 10, Narayanganj, 12.III.1991, Coll. V. Biswas; 20, Rajshahi, 18.III.1992, Coll. V. Biswas.

General : Cephalothorax and abdomen brown; legs orange brown. Total body legnth 5.90 mm. Carapace 2.20 mm long, 1.90 mm wide; abdomen 3.70 mm long and 3.20 mm wide.

Distribution : BANGLADESH : Barisal, Pabna, Narayanganj, Rajshahi; INDIA; INDONESIA; PHILIPPINES (Platnick, 1997).

7. *Neoeoona mukerjei* Tikader
(Figs. 37-44)

1980. *Neoscona mukerjei* Tikader, Proc. Indian Acad. Sci., **89**(3) : 247.

1981. *Neoscona mukerjei* : Tikader & B al, *Rec. zool, Surv.* India, Occ. pap. **24** : 17.

1982. *Neoscona mukerjei* : Tikader, Fauna of India, Spiders, **2**(1) : 248.

1992. *Neoscona mukerjei* : Biswas & Biswas, Fauna of West Bengal, Spiders : 467.

Material examined: 10, ADI, Faridpur, 24.X.1991, Co1L. V. Biswas; 20, BARI, Jessore, 21.II.1991, Coll. V. Biswas; 20, 1 , Manikganj, 12. III. 1990, Coll. V. Biswas; 20, Mymwnsingh, 18. IX. 1992, Coll. V. Biswas; 20, Moulovi bazar, Sylhet, 29. XII. 1993, Coll. V. Biswas.

General : Cephalothorax and legs orange-brown; abdomen brown with black and yellow patches. Total body length (female) 9.50 mm. Carapace 4.00 mm long, 3.35 mm wide; abdomen 5.50 mm long and 6.00 mm wide. Total body length (male) 8.00 mm. Carapace 3.00 mm long, 3.10 mm wide ; abdomen 5.00 long and 5.10 wide.

Distribution: BANGLADESH: Faridpur, Jessore, Manikganj, Mymensingh, Noakhali, Sylhet ; INDIA.

8. *Neoscona nasidae* n. sp.
(Figs. 45-49)

General : Cephalothorax and legs brown ; abdomen yellowish brown with white patches. Total body length (holotype) 9.00 mm. Carapace 3.90 mm long and 3.40 mm wide. Abdomen 5.10 m long and 4.80 mm wide.

Cephalothorax : Elongately oval, posteriorly broad and anteriorly narrow, longer than wide, clothed with long spine-like hairs ; cephalic region slightly raised; ocular area brownish. Eyes similar; both row of eyes recurved, anteromedian eyes widely seperated, posteromedians close; lateral eyes closed; ocular quad anteriorly wide

Table-3 : Measurements (in mm) of leg segments of ***Neoscona nasidae*** n. sp.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	4.00/4.00	1.00/1.00	3.00/3.00	3.00/3.00	0.80/0.80	11.80/11.80
II	2.50/2.50	0.80/0.80	2.50/2.50	2.50/2.50	0.60/0.60	8.90/8.90
III	3.00/3.00	0.50/0.50	1.20/1.20	1.40/1.40	0.80/0.80	6.90/6.90
IV	3.50/3.50	1.00/1.00	2.50/2.50	2.50/2.50	0.80/0.80	10.30/10.30

and posteriorly narrowed. Chelicerae brown, each of inner and outer margins with 3 and 1 teeth respectively (fig. 51). Maxillae brown, leaf-like, longer than wide and anteriorly scopulate (fig-52). Labium wider than long, anteriorly produced and without scopulae (fig. 52). Sternum brown, heart-shaped, clothed with sharp spines, anteriorly wide and posteriorly pointed (fig-53). Legs long and slender, clothed with hairs and spines; leg formula 1423 and the measurements (in mm) as in Table-3. Male unknown.

Abdomen : Globose, medially broad, narrowed at both ends, clothed with spines and hairs; dorsum decorated with irregular white patches; ventrally pale. Epigyne as in fig. 49.

Holotype : Female in spirit.

Male : Unknown.

Type-locality : BANGLADESH : Faridpur and Potuakhali.

Etymology : The species has been named after Professor Dr. Nasida Banu, Department of Zoology, University of Dhaka, Bangladesh.

Remarks : None of the congeners (Tikader, 1982; Yin, *et. al.*, 1997; Yaginuima, 1986; Chen & Zhang, 1991; Shinkai & Takano, 1984; Kaston, 1948; Comstock, 1995; Levi & Levi, 1968 ; Berman & Levi, 1971; Levi, 1992; Davies, 1938; Zhao,1993; Barrion & Litsinger, 1995; Song, *et. al.*, 1999) of *Neoscona* seem to posses strongly globose abdomen and the typical epigynum. And therefore, the species is considered as new to science.

9. *Neoscona nautica* (Koch)
(Figs. 50-55)

1875. *Epeira nautica* Koch, *Aegypt. Abyssin Arachn. Jickeli,* : 17.

1877. *Epeira pullata* : Thorell, *Annali. Mus. civ. Genova,* **10** : 385.

1885. *Epeira volucripes* : Keyserling, *Verh. zool. bot. Ges. Wein,* **34** : 528.

1900. *Araneus nauticus* : Pocock, *Fauna Brit. India, Arachn.,* : 228.

1904. *Neoscona volucripes* : F.O.P Cambridge, *Biologia cent. am.,* **2** : 473.

1907. *Araneus nauticus* : Simon, *Annali. Mus. civ. Genova,* **43** : 290.

1930. *Neoscona nautica* : Petrunkevitch, *Trans. Conn. Acad. Arts. Sci.,* **30** : 320.

1960. *Neoscona nautica* : Yaginuma, *Spiders of Japan in color,* : 56.

1971. *Neoscona nautica* : Levi, *Bull. Mus. Comp. Zool. Harv.,* **141**(8) : 489.

1981. *Neoscona nautica* : Tikader & Bal, *Rec. Zool. Surv. India,* Occ. pap. **24** : 12.

1982. *Neoscona nautica* : Tikader, *Fauna of India, Araneidea,* **2**(1) : 242.

1986. *Neoscona nautica* : Yaginuma, *Spiders of Japan in color,* : 105.

1989. *Neoscona nautica* : Koh, *Guide to Singapore Spiders* : 38.

1991. *Neoscona nautica* : Chen & Zhang, *Fauna of Zhejiang, Araneida* : 115.

1993. *Neoscona nautica* : Zhao, *Spiders in the cotton fields in China* : 253.

1995. *Neoscona nautica* : Barrion & Litsinger, *Riceland spiders of South and Southeast Asia* : 629.

1997. *Neoscona nautica* : Platnick, *Adv. in Spider Taxonomy* :

1997. *Neoscona nautica* : Yin, *et al., Fauna Sinica, Araneidae*:

1999. *Neoscona nautica* : Song, *et al., The Spiders of China,* :

2004. *Neoscona nautica* : Majumder, *Mem. Zool. Surv. India,* **20**(2) : 9.

Table-4 : Measurements (in mm) of leg segments of ***Neoscona rahamani*** n. sp.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	4.00/4.00	1.00/1.00	3.00/3.00	3.00/3.00	0.80/0.80	11.80/11.80
II	2.50/2.50	0.80/0.80	2.50/2.50	2.50/2.50	0.60/0.60	8.90/8.90
III	3.00/3.00	0.50/0.50	1.20/1.20	1.40/1.40	0.80/0.80	6.90/6.90
IV	3.50/3.50	1.00/1.00	2.50/2.50	2.50/2.50	0.80/0.80	10.30/10.30

Material examined : 10, Bagerhat, 12. V. 1990 Coll V. Biswas; 10, BRRI, Joydevpur, Gazipur, 18. VIII. 1992 Coll V. Biswas; 20, Jhenidah, 10. VII. 1991 Coll V. Biswas; 10, Manikganj 5. V. 1992 Coll V. Biswas; 20, Mymensingh, 23. IX. 1992 Coll V. Biswas; 20, Rangpur, 18. V. 1993 Coll V. Biswas; 10, Japhlong, Sylhet, 2. XII. 1993 Coll V. Biswas.

General : Cephalothorax and legs yellowish-brown; abdomen greenish with whitish hairs. Total body length 10.80 mm. Carapace 4.30 mm long, 3.70 mm wide; abdomen 6.50 mm long and 6.00 mm wide.

Distribution : BANGLADESH : Bagerhat, Gazipur, Jhenidah, Manikganj, Mymensingh, Rangpur, Sylhet; USA (Cambridge, 1904; Comslock, 1965; Levi, 1977); BURMA (Thorell, 1877); CHINA (Chen & Zhang, 1991; Zhao, 1993); INDIA; Biswas & Biswas, 1990; Pocock, 1900; Tikader, 1982); JAPAN (Shinkai & Takano, 1984; Yaginuma, 1986); SINGAPORE (Koh, 1989).

10. ***Neoscona rahamani*** n. sp.
(Figs. 56-61)

General : Cephalothorax and legs brown. Abdomen yellow-brown. Total body length 10.20 mm. Carapace 4.20 mm long and 3.30 mm wide. Abdomen 6.00 mm long and 5.60 mm wide.

Cephalothorax : Elongately oval, posteriorly broad and anteriorly narrow, clothed with fine pubescence and hairs; medially with a long fovea; radiating striae distinct; laterally with brown longitudinal bands. Ocular area blackish; anterior row of eyes strongly recurved while posterior row nearly straight; posteromedian eyes encireled with black band, these smaller than anteromedians; lateral eyes close; ocular quad posteriorly narrowed. Chelicerae brown, strong, clothed with spines, inner margin with 1 long, strong tooth and outer margin with 2 teeth (fig.58). Maxillae medially wide, longer than wide and anteriorly scopulate (fig.59). Labium roughly triangular, antreiorly convex and scopulate (fig.59). Sternum nearly rounded, posteriorly pointed, anterior margin concave (fig.60). Legs long and slender; leg formula 1423 and the measurements (in mm) as in Table-4. Male unknown.

Abdomen : Globose, medially broad, anteriorly with a hump, wider than long, clothed with hairs, dorsum posteriorly decorated with few brown patches; epigyne as in fig. 61.

Holotype : Female in spirit.

Male : Unknown.

Type-locality : BANGLADESH : Jessore and Jhenidah.

Etymology : The species has been named after professor Dr. M. Fazlur Rahman. Department of Zoology, Dhaka University, Bangladesh.

Remarks : None of the congeners (Tikader, 1982; Yin, *et al.*, 1997; Yaginuma, 1986; Chen & Zhang, 1991; Shinkai & Takano, 1984; Kaston, 1948; Comstock, 1965; Levi & Levi, 1968; Berman & Levi, 1971; Levi, 1992; Davies, 1988; Zhao, 1993; Barrion & Litsinger, 1995; Song, *et. al.*, 1999) of *Neoscona* seem to posses strongly globose abdomen and the typical epigynum. Therefore, the spices is considered as new to science.

11. ***Neoscona theis*** **(Walckenaer)**
(Figs. 62-69)

1841. *Epeira theis* Walckenaer, *Hist. Nat. Ins. Apt.*, **2** : 53.

1847. *Epeira mangareva* : Walckernaer, *Hist. Nat. Ins. Apt.*, **4** : 469.

1869. *Epeira braminica* : Stoliczka, *J. Asiat. Soc. Beng.*, **38**(2) : 238.

1877. *Epeira theisis* : Thorell, *Annali. Mus. civ. Genova,* ***10*** : 390.

1897. *Epeira obscura : Rainbow, Mem. Aust. Mus., 3(2) : 116.*

1904. Neoscona theisi : F.O.P Cambridge, *Biologia cent. am.,* **2** : 470.

1911. *Araneus theisi* : Merian, *Zool. Jb. (Syst.),* **31**(2) : 213.

1939. *Araneus theisi* : Saito, *Saito Ho-onkai Mus. Res. Bull.* **18** : 22.

1960. *Araneus theisi* : Chrysanthus, *Nova Guinea (Zool.),* **10** : 39.

1975. *Araneus theisi* : Patel, *'Vidya' J. Gujrat Univ.,* **18**(1) : 158.

1981. *Neoscona theis* : Tikader & Bal, *Rec. zool. Surv. India,* Occ. Pap. **24** : 32.

1982. *Neoscona theis* : Tikader, *Fauna of India, Araneidea,* **2**(1) : 269.

1986. *Neoscona theisi* : Yaginuma, *Spiders of Japan in color,* : 104.

1988. *Neoscona theisi* : Davies, *Mem. Qld. Mus.,* **25**(2) : 301.

1991. *Neoscona theisi* : Chen & Zhang, *Fauna of Zhejiang, Araneida* : 118.

1993. *Neoscona theisi* : Okuma, *et al., Illustr. Monogr. Rice-field Spiders of Bangladesh* : 17.

1995. *Neoscona theisi* : Barrion & Litsinger, *Riceland spiders of South and Southeast Asia* : 625.

1997. *Neoscona theisi* : Platnick, *Adv. in Spider Taxonomy* : 524.

1997. *Neoscona theisi* : Yin, *et al., Fauna Sinica, Araneidae* : 375.

1999. *Neoscona theisi* : Song, *et al., The Spiders of China,* : 301.

2004. *Neoscona theis* : Gajbe, *Rec. zool. Surv. India,* Occ. Pap. **227** : 55.

2005. *Neoscona theis* : Majumder, *Mem. Zool. Surv. India,* **20**(3) : 11.

2006. *Neoscona theisi* : Platnick, *World Spider Cat.,* version 6.5 : 1250.

2009. *Neoscona theis* : Biswas : In Ahmed (ed.), *Flora & Fauna of Bangladesh,* Arachn., **18**(1) : 175.

Material examined : 2♀ , Barisal, 12. IX. 1991, Coll. V. Biswas; 2♀ , ADI, Faridpur, 9. IV. 1992, Coll. V. Biswas; 1♂, 1♀ , BARI, Jessore, 1-5. V. 1992, Coll. V. Biswas; 4♀ , Jhenidah, 2. VII. 1992, Coll. V. Biswas; 2♀ , BARI, Joydevpur, 12. X. 1992, Coll. V. Biswas; 1♀ , Manikganj, 18. V. 1991, Coll. V. Biswas; 2♀ , Narayanganj, 3. VII. 1993, Coll. V. Biswas; 1♀ , Rangpur, 25. VIII. 1993, Coll. V. Biswas.

General : Cephalothorax and legs yellow-brown; abdomen yellowish with chalk-white band. Total body length (female) 12.00 mm. Carapace 4.00 mm long, 3.40 mm wide; abdomen 8.00 mm long and 5.85 wide. Total body length (male) 8.00 mm. Carapace 3.80 mm long, 1.90 mm wide; abdomen 4.50 mm long and 3.00 mm wide.

Distribution : BANGLADESH; Barisal, Faridpur, Jessore, Jhenidah, Joydevpur, Manikganj, Narayanganj, Rangpur; CHINA; INDIA; JAPAN; PHILIPPINES (Platnick, 1997).

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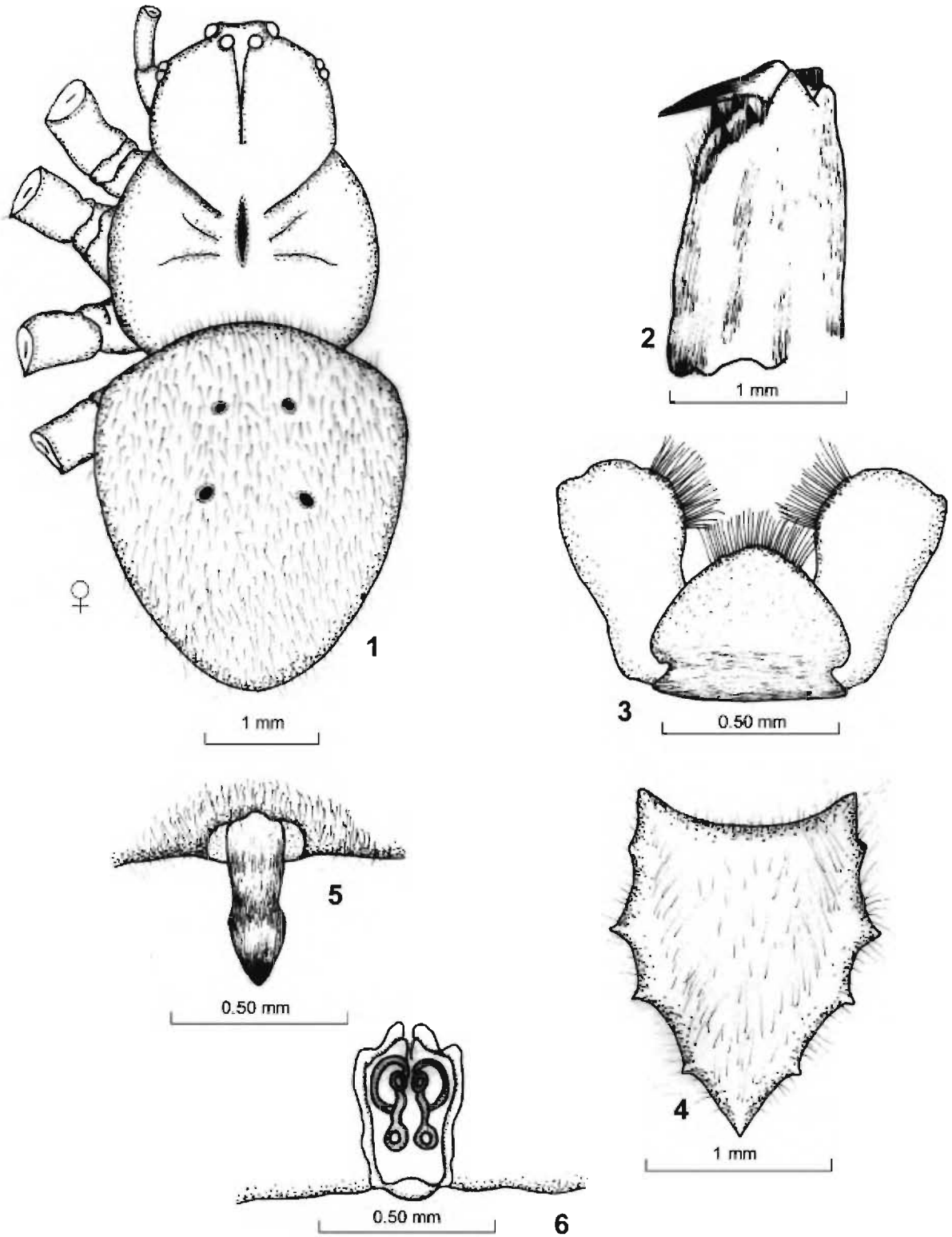
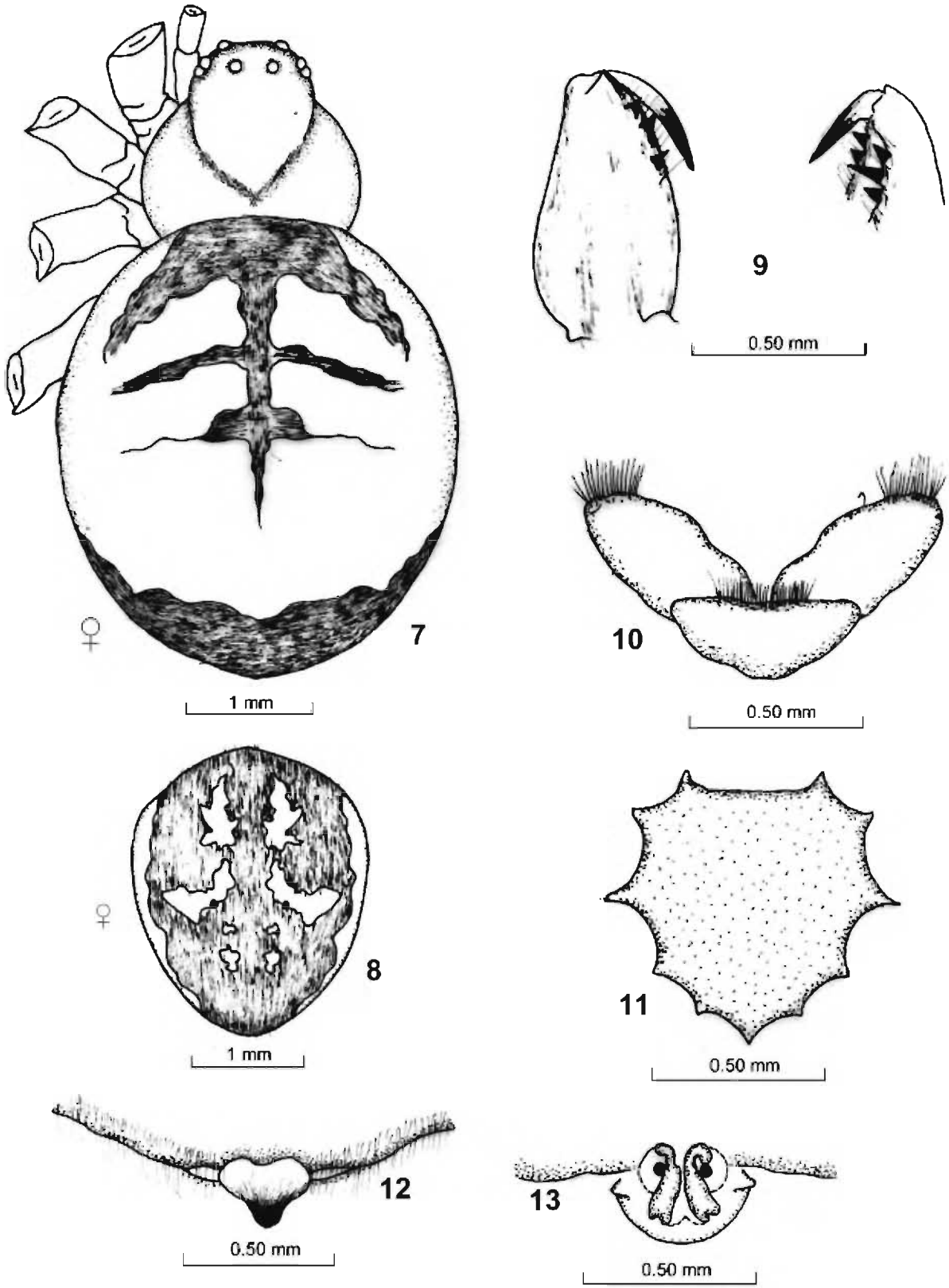
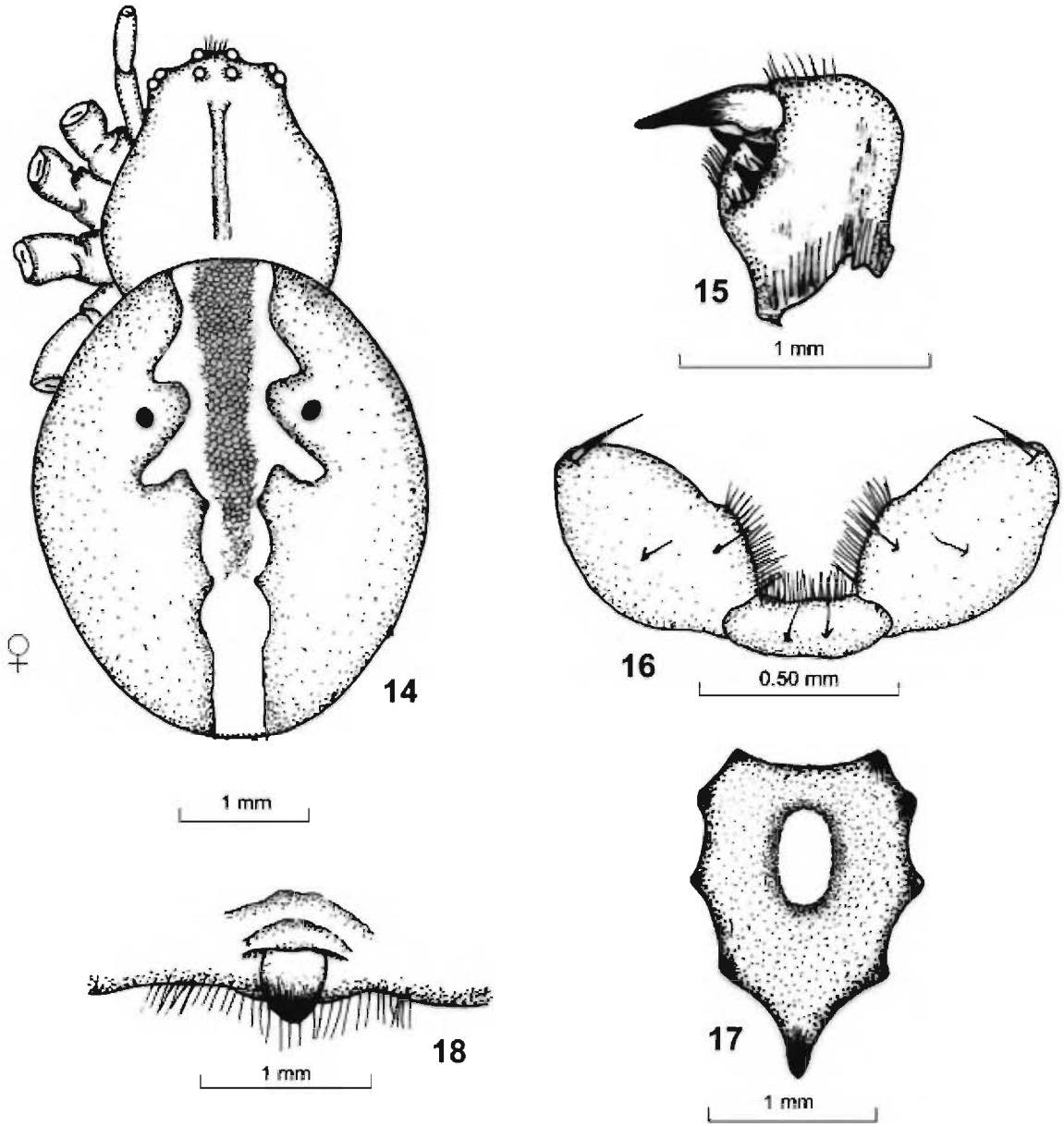


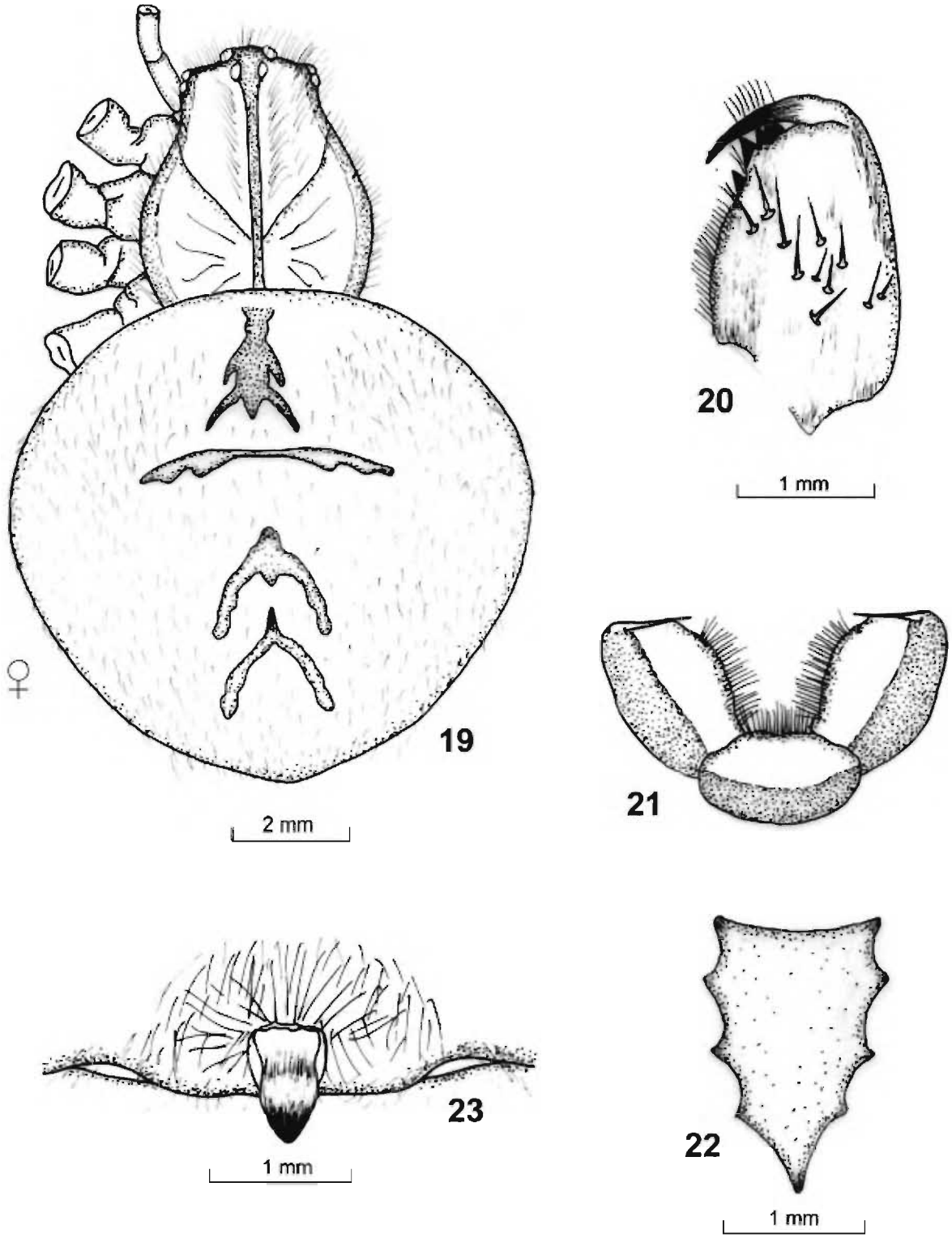
Figs. 1-6 : ***Neoscona bengalensis*** Tikader & Bal **1.** Whole body (dorsal view); **2.** Chelicerae; **3.** Maxillae and Labium; **4.** Sternum; **5.** Epigynum; **6.** Internal genitalia.



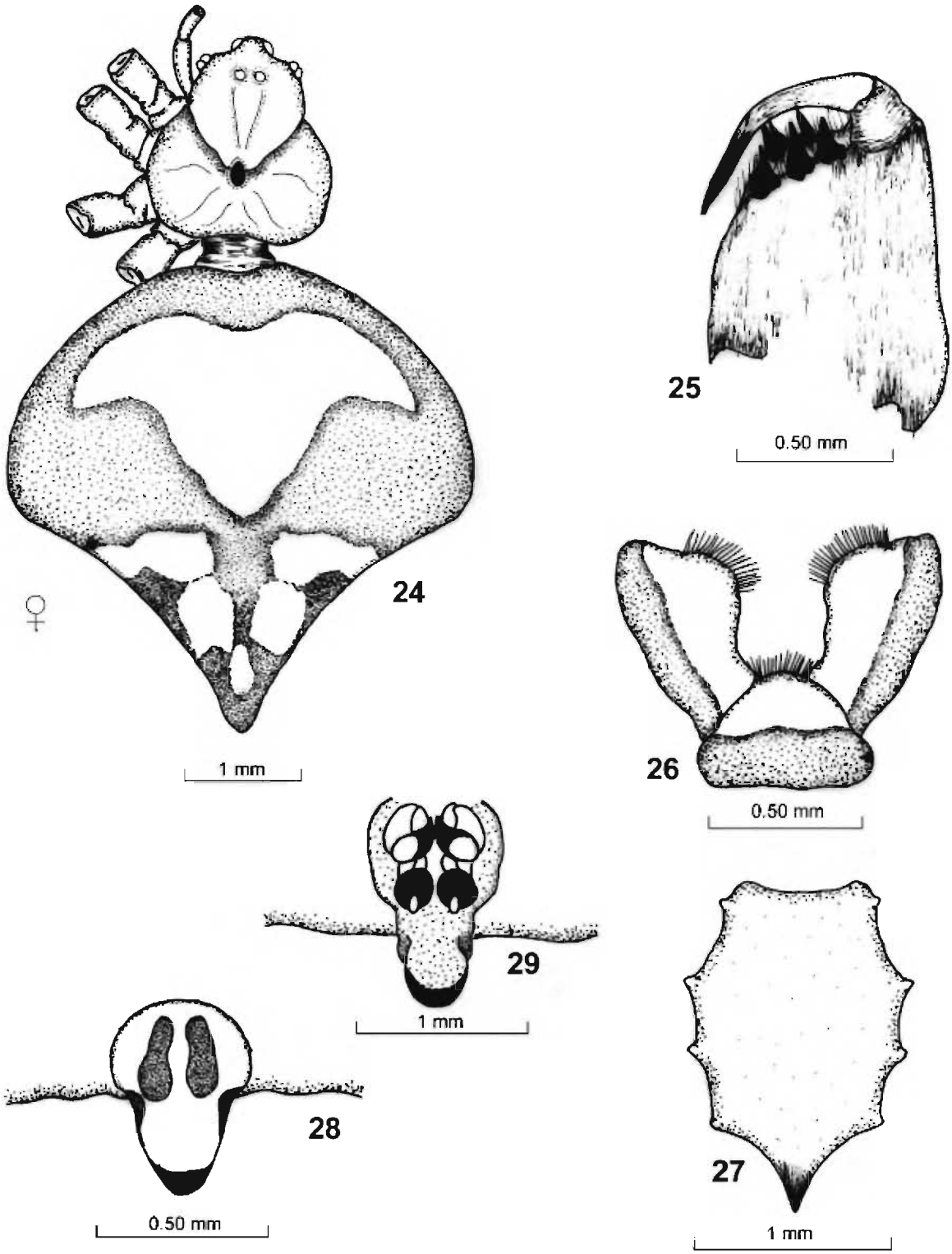
Figs. 7-13 : ***Neoscona elliptica*** Tikader & Bal **7.** Whole body (dorsal view); **8.** Abdomen of another one; **9.** Chelicerae; **10.** Maxillae and Labium; **11.** Sternum; **12.** Epigynum; **13.** Internal genitalia.



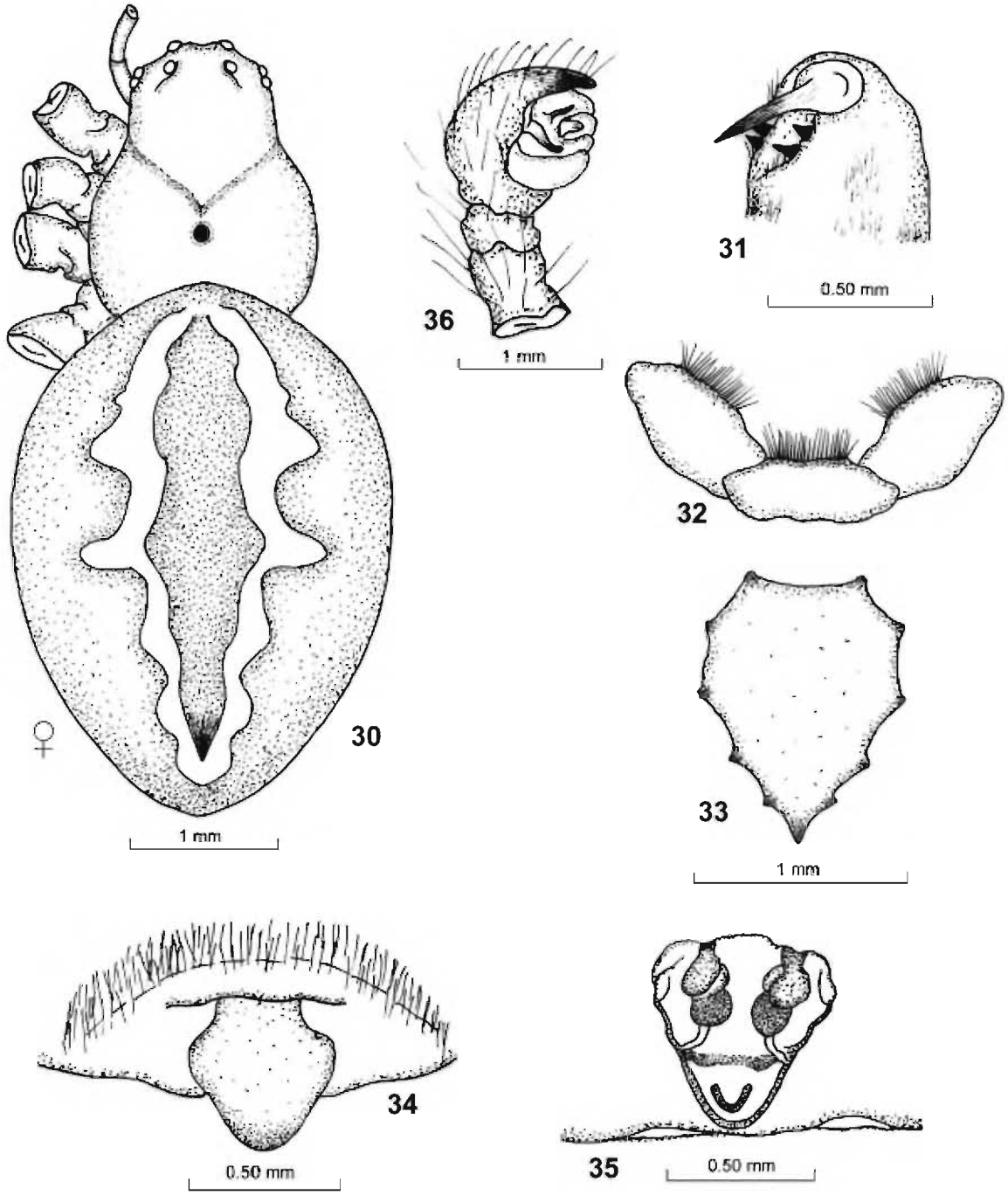
Figs. 14-18 : ***Neoscona govindai*** n. sp. **14.** Whole body (dorsal view); **15.** Chelicerae; **16.** Maxillae and Labium; **17.** Sternum; **18.** Epigynum.



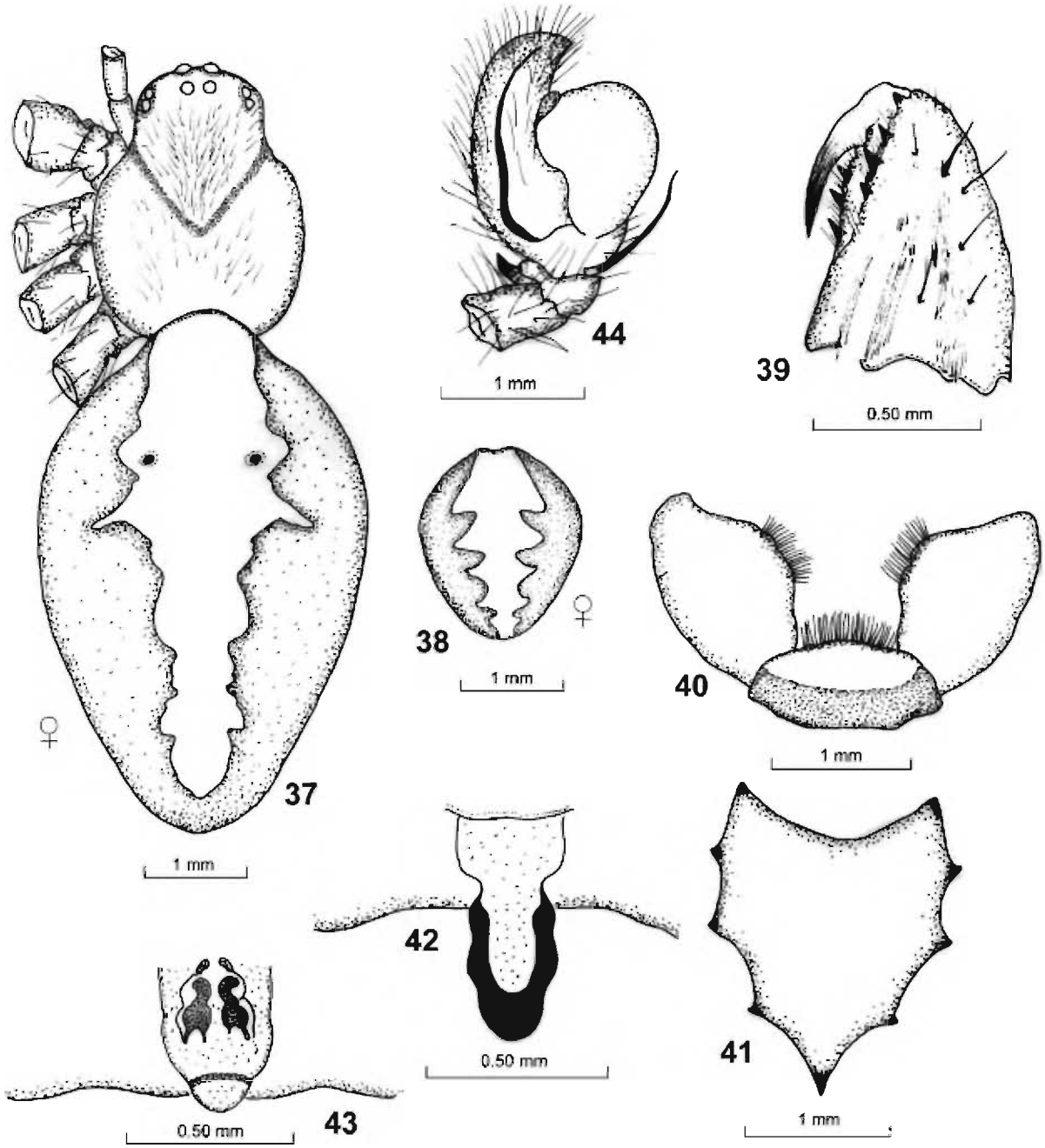
Figs. 19-23 : ***Neoscona kabiri*** n. sp.**19.** Whole body (dorsal view); **20.** Chelicerae; **21.** Maxillae and Labium; **22.** Sternum; **23.** Epigynum.



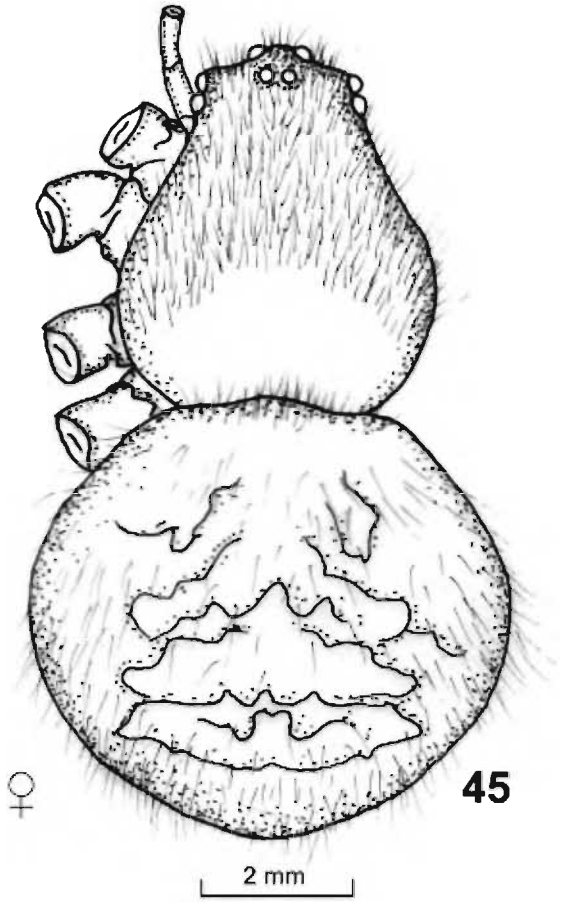
Figs. 24-29 : ***Neoscona leglaizei*** (Simon) **24.** Whole body (dorsal view); **25.** Chelicerae; **26.** Maxillae and Labium; **27.** Sternum; **28.** Epigynum; **29.** Internal genitalia.

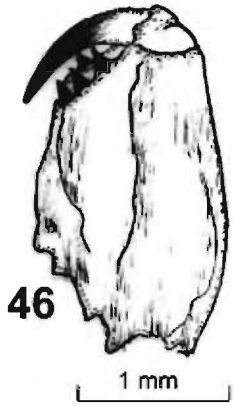


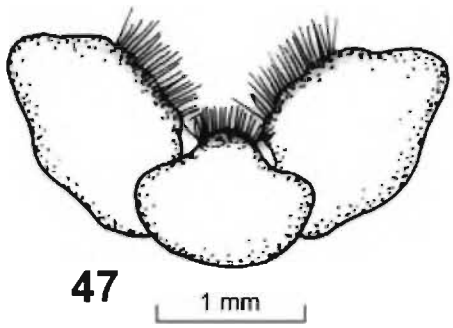
Figs. 30-36 : ***Neoscona molemensis*** Tikader & Bal; **30.** Whole body (dorsal view); **31.** Chelicerae; **32.** Maxillae and Labium; **33.** Sternum; **34.** Epigynum; **35.** Internal genitalia; **36.** Male palp.

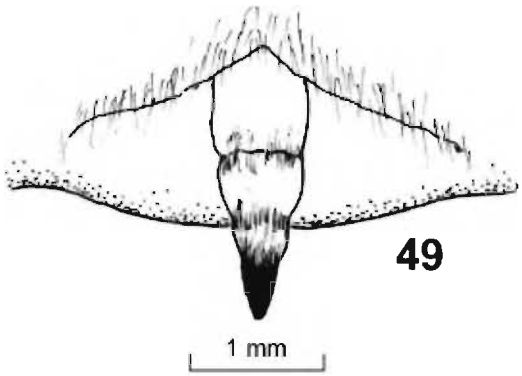


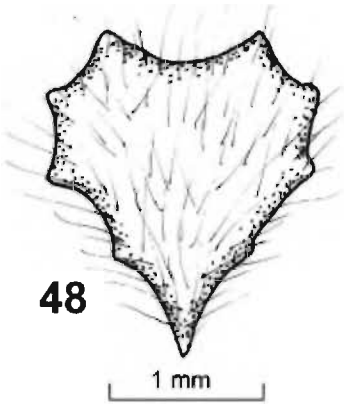
Figs. 37-44 : ***Neoscona mukerjei*** Tikader; **37.** Whole body (dorsal view); **38.** Abdomen (variation); **39.** Chelicerae; **40.** Maxillae and Labium; **41.** Sternum; **42.** Epigynum; **43.** Internal genitalia; **44.** Male palp.



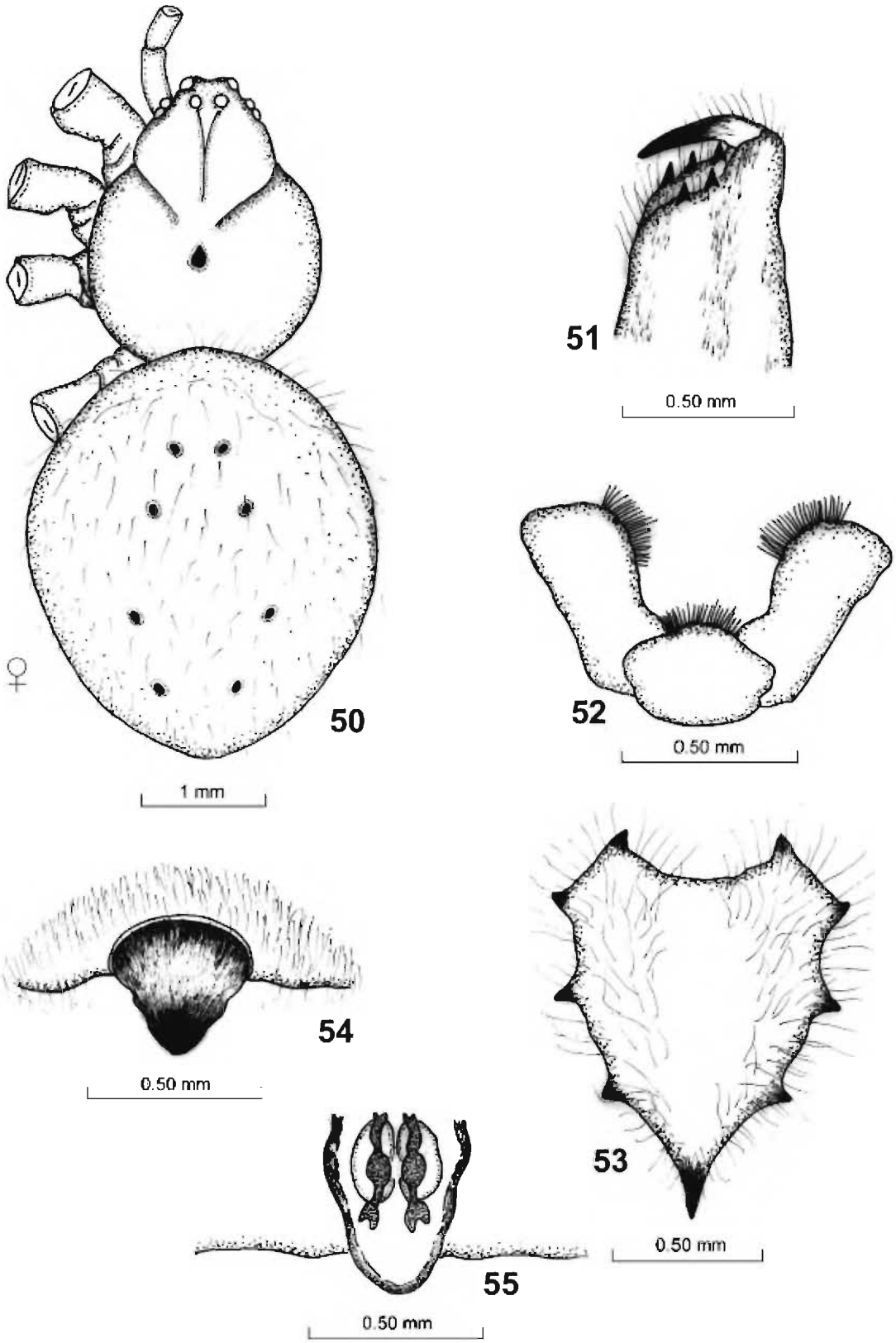




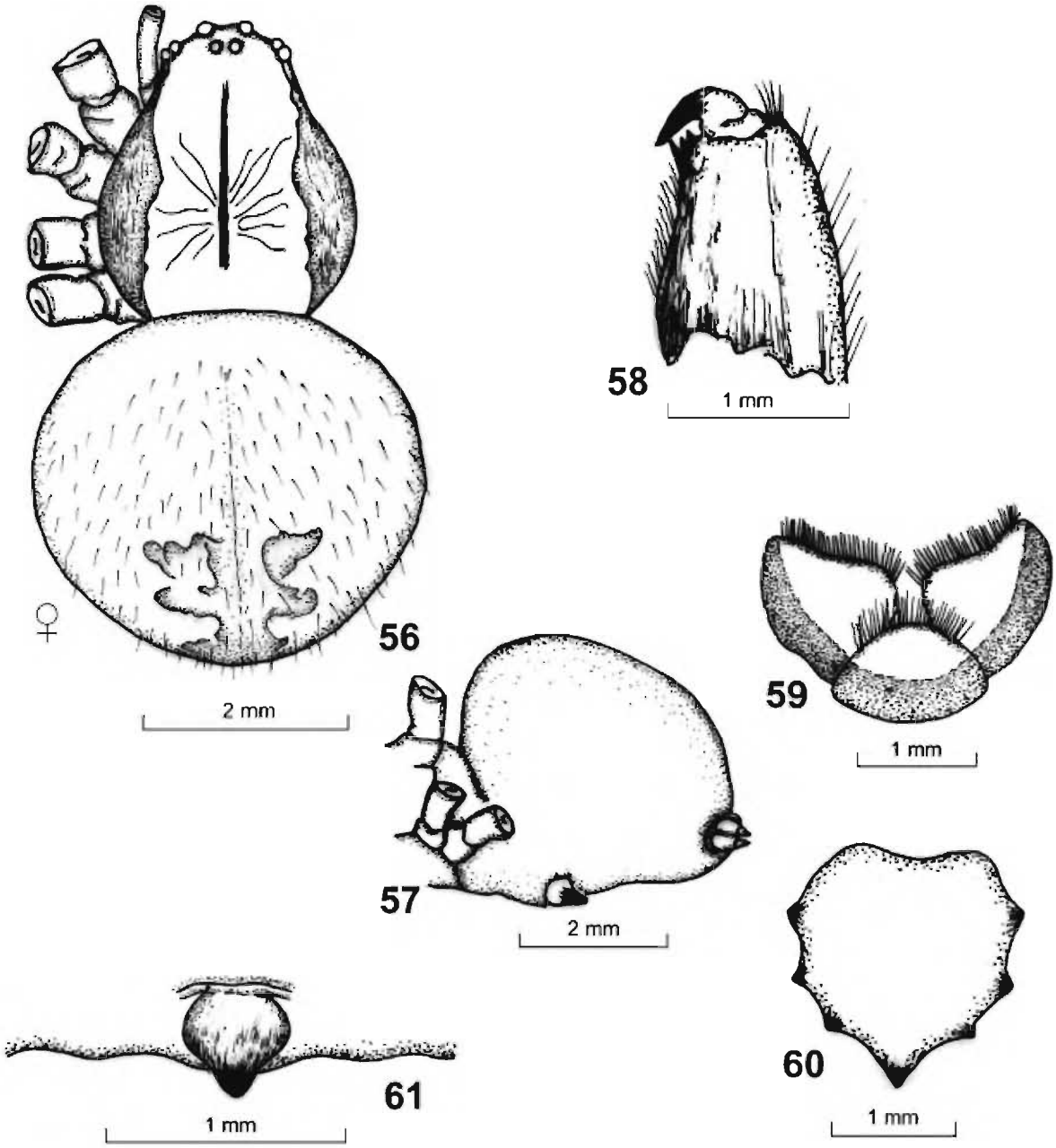




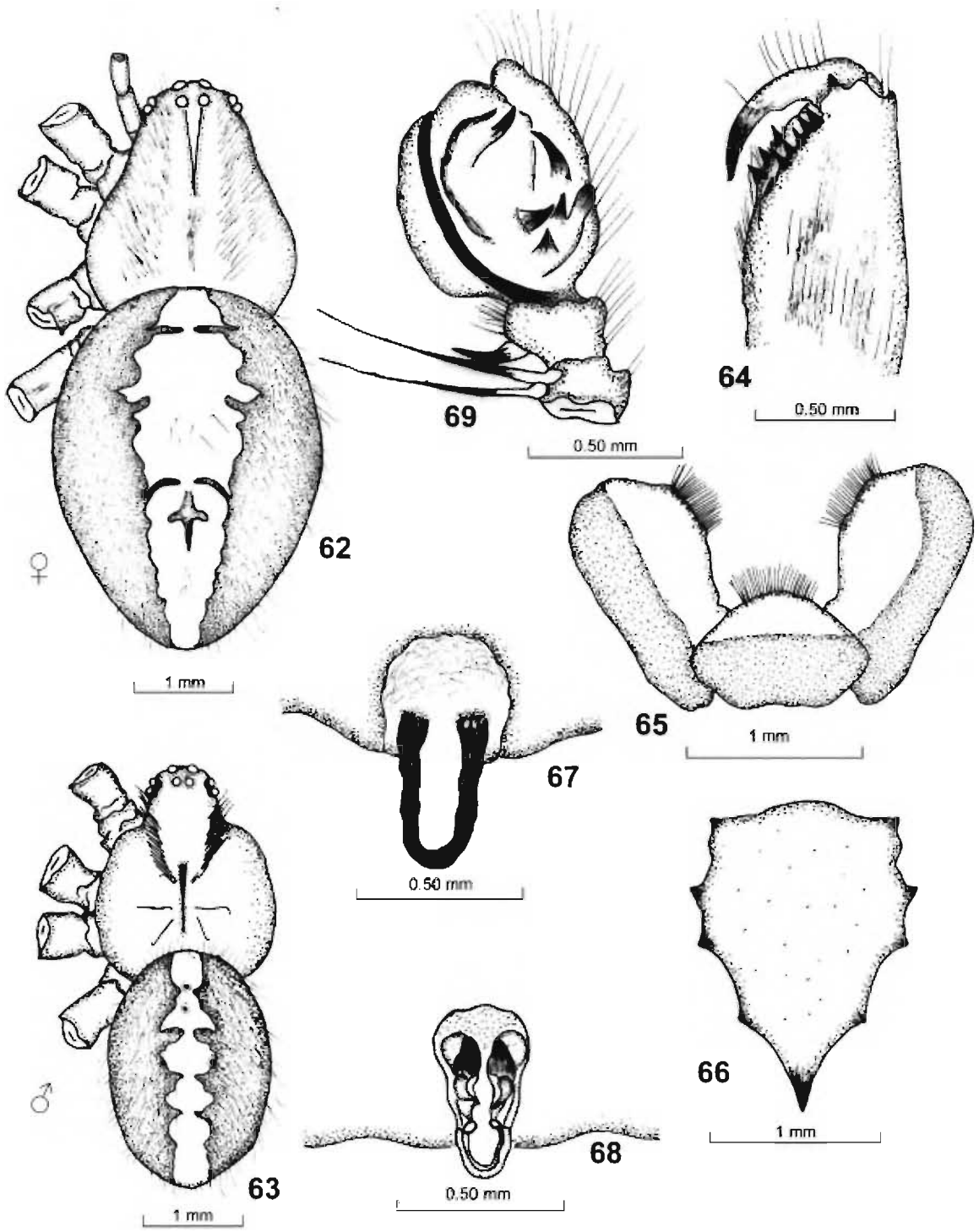
Figs. 45-49 : ***Neoscona nashidae*** n. sp. **45.** Whole body (dorsal view); **46.** Chelicerae; **47.** Maxillae and Labium; **48.** Sternum; **49.** Epigynum.



Figs. 50-55 : ***Neoscona nautica*** (Koch) **50.** Whole body (dorsal view); **51.** Chelicerae; **52.** Maxillae and Labium; **53.** Sternum; **54.** Epigynum; **55.** Internal genitalia.



Figs. 56-61 : ***Neoscona rahamani*** n. sp. **56.** Whole body (dorsal view); **57.** Abdomen (lateral view); **58.** Chelicerae; **59.** Maxillae and Labium; **60.** Sternum; **61.** Epigynum.



Figs. 62-69 : ***Neoscona theis*** Walckenaer **62.** Whole body (dorsal view); **63.** Whole body (male); **64.** Chelicerae; **65.** Maxillae and Labium; **66.** Sternum; **67.** Epigynum; **68.** Internal genitalia; **69.** Male palp.

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ADDITIONAL COLLECTION RECORD OF SINHGARH RAT *MILLARDIA KONDANA* MISHRA AND DHANDA FROM SINHGARH, PUNE, INDIA

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INTRODUCTION

Mishra and Dhanda (1975) described a new species *Millardia kondana* distinct from other three known species under genus *Millardia* viz., *gleadowi* (Gujarat, Rajasthan and Pakistan), *kathleenae* (Myanmar) and most common Indian species *meltada* (India, Sri Lanka; E Pakistan and Terai region of Nepal) (Musser and Carleton in Wilson and Reeder, 2005). It differs from other species in having comparatively larger cranial and external measurements, possessing six well-developed planter pads, proportionately small ears, hind feet and bullae and long toothrow and diastema (Mishra and Dhanda, 1975).

The type collection of the *Millardia kondana* specimens is deposited in National Institute of Virology (NIV), Pune; Zoological Survey of India (ZSI), Kolkata and British Museum (Natural History), London. Taxonomic reviews were published on museum specimens studied by Corbet and Hill (1992) and Agrawal (2000). Talmale (2007) also studied the NIV collection for his doctoral research. Table 1 gives comparative measurements of *M. kondana* specimens studied. Though the species has been reported from its type locality, Sinhgarh plateau, one subadult specimen was collected from the nursery at the base of the fort in the year 1978 by ZSI, Pune (ZSI.WRC. M/156). Since last three decades no collection of this species has been reported, a attempt was made to collect fresh specimens, recognise its validity and status in the present communication.

MATERIAL AND METHODS

Study Area : Sinhgarh a small platue of about 1 square kilometer (Latitude 18° 23' North and Longitude 73° 42' East) is located about 30 kms. southwest of Pune city, Maharashtra, India. Geographically the area falls under Sahyadri ranges of Western Ghats. In monsoon season it appears lush green while in other seasons the plateau remains dry (Mishra and Dhanda, 1975). Currently the fort serves as a training centre for cadets of National Defence Academy, Khadakwasla.

One of the authors (RT) undertook rodent survey at Sinhgarh for ectoparasite studies during the month of June, 2012. About 150 standard sized Sherman traps, baited with freshly made onion pakoras (salty fried snack made with onion and

Table-1: External and cranial measurements (mm) of *Millardia kondana* Mishra and Dhanda, 1975.

	Specimens studied during Present Study			NIV specimens studied by Talmale (2007)			
	Male (R3)	Female (R4)	Male (R5)	Mean	Range	SD	N
HB	150	170	170	174.85	155 – 195	±12.87	7
TL	150	150	175	167.66	165 – 170	±2.51	3
Tl as % of HB	100	88.23	102.94	92.48	87.17 – 96.0	±4.68	3
HF	32.3	32.9	35.2	32.48	31 – 34	±1.46	7
HF as % of HB	21.53	19.35	20.70	18.64	16.46 – 20.23	±1.34	7
E	21	22.6	22.7	18.45	16.0 - 20.2	±1.84	7
E as % of HB	14.0	13.29	13.35	10.59	9.41 – 11.9	±0.87	7
onl	39.9	41.6	41.5	40.54	39.5 - 41.7	±0.90	7
cbl	38.7	40.7	39.7	40.11	39.0 - 41.4	±0.94	7
nas	15.7	17.6	16.1	15.58	14.5 - 16.4	±0.56	7
pal	21.9	22.9	22.7	22.54	21.6 - 23.7	±0.69	7
mtr	7.1	7.0	7.1	7.5	7.3 – 7.7	±0.17	7
mtr as % of onl	17.79	16.82	17.10	18.49	18.7 – 18.78	±0.26	7
iw	5.9	6.2	6.5	6.27	6.1 – 6.4	±0.11	7
dia	11.4	13	12.2	11.78	11.4 – 12.5	±0.49	7
dia as % of onl	28.57	31.25	29.39	29.06	28.04 – 30.12	±0.77	7
bl	6.1	6.5	6.2	6.65	6.2 – 7.1	±0.36	7
bl as % of onl	15.28	15.62	14.93	16.40	15.69 – 17.7	±0.59	7
apf	8.9	9.6	8.5	9.1	8.2 – 10.0	±0.58	7
zw	17.9	19.7	19.1	19.45	18.8 – 20.5	±0.52	7
ml	22.2	23.1	22.4	22.81	22.2 – 24.3	±0.80	7

ground gram flour) were set up on the plateau and near main gate at lower altitude of the fort. Twelve rodent samples were collected, sacrificed and preserved in 10% Formalin for further studies. The specimens were numbered R1 to R12. The authors (SST & MSP) studied and identified the specimens. External and osteological measurements were taken as per Roonwal and Agrawal (1966) and Agrawal (2000). Identification studies of the specimens were carried out following Corbet and Hill (1992) and Agrawal (2000). Out of twelve collected specimens three (R3 & R5 : 2 Male and R4 : 1 Female) were identified as *Millardia kondana* Mishra and Dhanda, 1975 ; three (R2, R6 & R12) as *Mus platythrix* Bennet while remaining six (R1, R7-R11) as *Mus booduga* (Gray). Measurements in detail of *Millardia kondana* is given in Table 1 for further discussion. For more clarification the measurements are compared with those reported for this species by Talmale (2007). All the specimen under present study will be deposited in National Zoological Collection of Zoological Survey of India, Western Regional Centre, Pune.

Abreviations : HB : Head & Body length; TL : Tail length; HF : Hind foot; E : Ear; onl : Occipito-nasal; cbl : Condylobasal; nas : Nasal; pal : Palate; mtr : Maxillary toothrow; iw : Interorbital width;

dia : Length of diastema; bl : Bullae; apf : Anterior palatal foramena; zw : Zygomatic width; ml : Mandible; N : Sample Size; SD : Standard Deviation.

RESULTS AND DISCUSSION :

Millardia kondana is commonly known as large metad on the basis of its larger size. It has a slightly harsher fur, dorsum dark brown and grayish white under parts (gray base with white tips), tail slightly bicolour, dark above and grayish below, poorly haired, clear six planter pads in the hind feet and four pairs of mammae in the female specimen. Analysis of the contents in Table 1, shows that tail is shorter or equal to in two specimens while in other slighly larger than head and body length. So individual variations in tail length is considerable in the present species. Most of the cranial measurements of the studied specimens match with those mentioned for the type series by Mishra and Dhanda (1975).

The associate rodent species collected together with *M. kondana* are *Mus platythrix* and *Mus booduga*. Talmale (2007) also reports *Mus booduga* (Gray), *Rattus rattus rufescence* (Gray) and Pradhan (personal observation) observed *Bandicota bengalensis* (Gray) from Sinhgarh plateau. The present communication reports latest collection record of *M. kondana* specimens from the Sinhgarh plateau. Corbet and Hill (1992) questioned about the presence or absence of *M. meltada* from plateau area. There are reports of *M. meltada* population from Khadakwasla and nearby localities of Hadapsar and Pune (Talmale, 2007). However, there is not a single collection record of *M. meltada* from the plateau till this date.

On the basis of area of occupancy (One square kilometer) and single locality collection record the species has been categorised under Critically Endangered species by IUCN (Pradhan *et al.*, 2008). It is listed under Schedule V (Vermin) of Indian Wildlife (Protection) Act, 1972 (Ammended upto 2006). Present study expresses its taxonomic validity and current status of availability in the type locality.

AKNOWLEDGEMENTS

Author (SST) is grateful to the Director, Zoological Survey of India, Kolkata and Officer-in-Charge, ZSI, CZRC, Jabalpur for providing facilities. One of the author (RT) is thankful to the Armed Forces Medical College and the Dept of Community Medicine, Pune for the administrative and logistic support provided for the survey.

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NEW RECORDS OF ACRIDOIDEA (INSECTA : ORTHOPTERA) FROM UTTARAKHAND, INDIA

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INTRODUCTION

Acridoidea is one of the most sought after superfamilies of the order Orthoptera. Short-horned grasshoppers are included in the superfamily Acridoidea. They constitute an interesting and agriculturally important group of insects. They are moderate in size, but range from less than 10 mm to 65 mm. The form of body shape, head and thorax are diverse; antennae are filiform but sometimes ensiform; tarsi three segmented; hind femora long, slender and thick towards base and adapted for leaping; wings are either fully developed or reduced or absent; forewings in the form of leathery tegmina; hind wings fan like; male external genitalia complex, symmetrical and concealed, when not in use, by the enlarged ninth abdominal sternum (Subgenital plate). Male of most of these insects produce sound by different methods; female, generally, do not produce sound. They are also well adapted for flight since both direct and indirect muscles work together during flight movements thus explaining the reason that these insect can cover long distances during swarming conditions that mainly result from overcrowding and scarcity of food.

The most notable work on Indian grasshoppers was made by Kirby (1914) and mentioned 329 species belonging to 124 genera under 8 subfamilies. Tandon and Shishodia (1995) listed 97 species distributed over 11 families of Acridoidea, Grylloidea, Tettigonoidea and Tridactyloidea of Orthoptera from Western Himalaya (Uttarakhand). Tandon *et al.* (1976) dealt with 12 species under 12 genera and 2 families of Acridoidea from Tons Valley. Tandon and Shishodia (1976) have given an account of 16 species under 15 genera and 2 families of Acridoidea from Grahwal region of Uttarakhand. Singh and Bhargava (1979) have given an inventory of 34 species of Orthoptera which includes 28 species of Acridoidea from Corbett Tiger Reserve. Mandal *et al.* (2010) have given an account of 64 species distributed under 48 genera and 2 families of Acridoidea from Uttarakhand.

The present paper deals with 3 new records of Acridoidea under three genera and 2 families from the state, Uttarakhand. Classification followed here is according to Uvarov (1966) and Shishodia *et al.* (2010).

TAXONOMIC ACCOUNT

Order ORTHOPTERA
Superfamily ACRIDOIDEA
Family 1. PYRGOMORPHIDAE
Genus 1. ***Poekilocerus*** Serville, 1831

1. *Poekilocerus pictus* (Fabricius)

1775. *Gryllus pictus* Fabricius, *Systema entomologicea systems Insectorum classes, ordines, genera, species, adjectis synonymis, locies. Flensburg et Leipzig* : 289.

Keywords: Orthoptera, Acridoidea, Oedipodinae, Catantopinae, Uttarakhand.

1966. *Poekilocerus pictus* : Ambar, *Sind Univ. Sci. Res. Journal, Karachi* : 1.

1914. *Poekilocerus pictus*: Kirby, *Fauna Brit. India, Orth.,(Acrididae)* : 172.

2007. *Poekilocerus pictus* : Mandal & Yadav, *State Fauna Series*, **5** : *Fauna of Andhra Pradesh*, Part 3, Zool. Surv. India, : 190.

Material examined : Distt. Dehradun : Rishikesh, 2 ♂, 26.ix.1969, coll. A. Singh & party.

Diagnostic characters : Body large in size with finely rugose integument; head and pronotum with faint median carina; antennae blue black with yellow beyond the basal third of their length; lateral carinae of pronotum obsolete.

Distribution : India : Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Bangladesh, Nepal and Pakisthan .

Remarks: Tandon and Shishodia (1995) listed only three species of the family Pyrgomorphidae in a list of 97 species of Orthoptera from Western Himalaya (Uttarakhand). Mandal *et al.* (2010) have given an account of 5 species of the family Pyrgomorphidae in Fauna of Uttarakhand .

This species is one of the most colorful grasshoppers of India and commonly known as Ak grasshopper. They feed on *Calotropis* sp. (Ak plants) especially *C. procera*, however it is known to attack many crops, vegetables and fruit plants. The color in nymphs as well as adults is bright and warning and is explained due to the presence of toxic alkaloids present in Calotropis they feed on.

Family 2. ACRIDIDAE

Key to Subfamilies

1. Prosternal process usually absent; if present, then antenna ensiform and body strongly elongate ..... ***Oedipodinae***

- Prosternal process always present; antenna and body variable..... ***Catantopinae***

Subamily **OEDIPODINAE**

Genus 2. ***Scintharista*** Saussure, 1884

2. ***Scintharista notabilis pallipes*** Uvarov

1870. *Quiroguesia notabilis* Walker, *Cat. Derm. Salt. Brit. Mus.*, **4** : 745.

1941. *Scintharista notabilis pallipes* Uvarov *Proc. R. ent. Soc. London*, ***10B***(6): 96.

1985. *Scintharista notabilis pallipes* : *Bhowmik, Rec. zool. Surv.India, Occ. Pap. No.*, ***78*** : *40.*

2007. *Scintharista notabilis pallipes* : Saini & Mehta, *Bionotes*, 9(3) : 76.

Material examined : Distt. Dehradun : Bengal Gad, 3 ♂, 15.x.1966, Coll. A. Singh & party; Dharagad, 1 ♂, 15.x.1966, Coll. A. Singh & party.

Diagnostic characters : Fastigium concave and without median carinule; pronotum convex, anterior margin bent on head, posterior margin angulate; tegmen with narrow light bands-1st from the base, and the 2nd (median) dark band are nearly or entirely fused jointly occupying the basal half of tegmen; wing base light pinkish, narrow light dark brown band present from costa to anal angle, apex with dark spots; hind tibia with dark-colored ring at knee joint.

Distribution : India : Himachal Pradesh, Punjab and Rajasthan.

Elsewhere: Afghanistan, Baluchistan and Iran.

Remarks: Tandon and Shoshodia (1995) listed 13 species of the subfamily Oedipodinae from Western Himalaya. Mandal *et al.* (2010) have given an account of 12 species of the subfamily Oedipodinae in fauna of Uttarakhand. Earlier this species has been recorded from only above mentioned three states and the species has limited distribution (Shishodia *et al.* 2010).

Subfamily **CATANTOPINAE**

Genus 3. ***Choreodocus*** Bolivar, 1914

3. ***Choreodocus robustus*** (Serville)

1839, *Acridium robustum* Serville, *Ins. Orth.*, : 647.

1914. *Heteracris robusta* : Kirby, *Fauna Brit, India, Orth.*, : 262.

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

1990. *Choreodocus robustus* : Bhowmik *et al. Rec. zool. Surv. India,* **86** : 222.

Material examined : Distt. Dehradun : Chakrata, Tiuni, 1 ♀, 18.x.1966, Coll. A. Singh & Party.

Diagnostic characters : Moderately long; antennae filiform, median segments almost twice as long as wide; fastigium rounded in front; frontal ridge flat, narrowing between antennae, gradually widening towards clypeus; median carina of pronotum cut by all the three transverse sulci; prosternal tubercle gradually tapering apically, weakly incurved and pubescent; tegmina extending well beyond posterior knee, without spots; supra-anal plate tongue shaped, apex broadly rounded; subgenital plate gradually tapering apically; cerus wide, thick, strongly compressed, incurved and downcurved.

Distribution : Arunachal Pradesh, Andhra Pradesh, Assam, Haryana, Himachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim, Tripura, Uttar Pradesh and West Bengal.

Elsewhere: Bangladesh.

Remarks: Tandon and Shoshodia (1995) listed 5 species of the subfamily Catantopinae from Western Himalaya. Mandal *et al.* (2010) have also given an account of 5 species of the subfamily Catantopinae in Fauna of Uttarakhand. However, the above authors have mot mentioned Choreodocus robustus from Uttarakhand. The locality, Tiuni (Chakrata) from where one female specimen was collected is at the border of state Himachal Pradesh from where this species has already been reported.

This species prefers mixed vegetation and attacks paddy fields once it starts growing towards maturity. The nymph appears towards the end of May and adults start appearing in the first week of August. It has single annual generation.

SUMMARY

Three species of Acridoidea *i.e., Poekilocerus pictus* (Fabricius), *Scintharista notabilis pallipes* Uvarov and *Choreodocus robustus* (Serville) under two families have been recorded for the first time from the state Uttarakhand.

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Short Communication

A NOTE ON HIMALYAN GORAL *NEMORHAEDUS GORAL* (HARDWICKE 1825) AT DARJEELING DISTRICT, WEST BENGAL, INDIA

INTRODUCTION

Himalayan goral, a well built goral having antelope-like also known as goat-even antelope. It is a medium sized goat even smaller than domestic goat possesses short horn backwardly curved with ring marks. Two sub-species such as *Nemorhaedus goral goral* (Hardwicke) and *Nemorhaedus goral hodgsoni* Pocock, occur within Indian limit. The *Nemorhaedus goral goral* is known to occur in Jammu & Kashmir, Uttar Pradesh, Uttarakhand, West Bengal and north-eastern states of India (Alfred *et al.*, 2002). The other sub- species *Nemorhaedus goral hodgsoni* found in Nepal, Bhutan and Sikkim state of India. Himalayan goral was earlier found in Jalpaiguri and Darjeeling district of West Bengal, now it is restricted to Himalayan foot hills of Darjeeling district,West Bengal (Inglish 1919, Mitra 1957). Gavallini (1992) surveyed different areas of Himachal Pradesh to find the goral population. Mishra *et al.*, (1994) surveyed parts of Doon valley and some areas of Mizoram state for occurrence of goral. The predator of gorals and their role in ecosystem was carried out by Thomas (2001), which constitutes Snow leopard, Grey wolf, Feral dogs etc.

The present report is based on survey conducted at two sanctuaries *viz* Mahananda Wildlife Sanctuary and Senchal Wildlife Sanctuary both located at Darjeeling district, West Bengal, falls at the foothills of eastern Himalaya.

Goral is a herbivorous mammalian montane species comes under family Bovidae. Two sanctuaries comprised of 197 sq. km. area altogether and out that 50 sq. km. was habitable area for gorals which comprised of 25% of total sanctuaries area. Field trip in these two sanctuaries carried out during September 2011, six days field work in each sanctuary was made for locating gorals. A total of 90 hours were spent in the field. Topography of the areas was hilly and abruptly undulating with loose top soil. No standared survey method could be followed ,only random sampling and point method have been adopted depending upon the terrain. Survey was conducted mostly on foot on forest tracks and trails for locating the gorals and their pellets collection. Mahananda Wildlife Sanctuary is situated in Kurseong Sub – division, lies between 26° 23′ and 26° 47′ N and 88° 33′ and 88° 23′ E with an area of 159 sq. km. extending between an elevation of 1300 m and 1500 m. Latpanchar is the highest peak of Mahananda WLS (1135m) and it is the ideal habitat for observing and locating wild animals from a number of watch towers. Forest type of the sanctuary varies from riverine to mixed forest both in higher and lower elevation. Flora constitutes mainly Khair, Sisu, Simul, Sal, Kapasi, Cheeta Sal, Dhupi, among the herbs are Tinpati jhar, Gokleto among shrubs varieties of flokets species and various type of broad leaved plants.

Senchal Wildlife Sanctuary lies between 26° 94′ and 27° 07′ N and 88° 33′ and 88° 23′ E with an area of 38 sq. km. and elevation between 2000m and 2400m. This sanctuary contains the main catchment area of water supply of Darjeeling district. The forest cover of the sanctuary is compact block of both natural and man made plantation. The floral community consisted of various species of Oak, Birch, Pine,

Rhododendron, Dhupi, Mohonia, *Michelia sp.* and orchids.

Twelve days survey for search of goral yield very poor results, only 2(two) gorals were sighted at Mahananda WLS and one goral at Senchal WLS. Himalayan gorals live in small herds of five to eight while Lydekker (2005) reported that if one animal is sighted others are almost sure to occur. Pellets counts of both sanctuaries related that number of animals are more in number but difficult to put in figure. Pellets that were collected from the field were compared with those of the forest department collections and pellets size exactly matched with those samples of forest department ones. Present survey revealed that though gorals are inhabiting in both sanctuaries are rarely visible. Forest personnel of the field and local people who accompanied our survey party confirmed that gorals occasionally sighted in the sanctuaries but reported us encounter of four to five gorals at a time is rare and chance factor, though the habitat is congenial for gorals. Duckworth and Mackinnon (2008), observed that gorals were hunted for meat, wool, antler and the population of the species are declining at a alarming rate. Anthropogenic activities, construction of road deep into the forest caused severe damage to the forests of Darjeeling's fragile ecosystems.

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Short Communication

GYNAUTOCERA PAPILIONARIA GUERIN-MENEVILLE (LEPIDOPTERA: ZYGAENIDAE) - A NEW DISTRIBUTIONAL RECORD FROM JHARKHAND

INTRODUCTION

Family Zygaenidae comprises moths commonly called Burnet Forestor moths, or smoky moths. They are typically diurnal or crepuscular in wings with a slow fluttering flight. They have rather clubbed antennae and have metallic sheen with prominent spots of red or yellow. Lefroy and Howlett (1971) described the Batesian mimicry shown by some species of these moths, and they also secrete their own toxin throughout all stages of their life-cycle rather than obtaining from host plants.

Zygaenidae is one of the important family belonging to the order Lepidoptera (Heterocera), widely distributed in tropical and in temperate regions of the world. About 1000 species are reported under the family worldwide, of which, more than 150 species and subspecies are known to occur in Indian sub-region (Hampson, 1892). Later, Fletcher (1925) treated 315 species and subspecies of Zygaenidae in the catalogue of Indian Insects. The family is divided into four subfamilies viz., Zygaeninae, Chalcosiinae, Paudinae and Himantopterinae on the basis of presence or absence of mouth parts and structure of antennae (flagellate at the tip or not). In India, the subfamily Zygaeninae is represented by 14 genera and 52 species and subspecies, Chalcosiinae, 26 genera and about 80 species and subspecies and the other subfamilies, Paudinae and Himantopterinae comprise 4 species under 3 genera and 4 species and one genus respectively.

While studying the insect fauna of Dalma Wildlife Sanctuary, Jharkhand during 2007-2009 a single live moth specimen (fig.1 & 2) was collected during the morning hours in the core area (Kongadhasa) of the sanctuary and was identified into Gynautocera papilionaria Guerin-Meneville, a rare moth belonging to the subfamily Chalcosiinae. The genus Gynautocera Guerin is represented by only one species known so far from India. Literature study reveals that moths from Jharkhand state were not reported as such till date. However, fragmentary works on moths have been reported from eastern part of India, viz., Orissa and West Bengal by Mandal and Maulik (1991), Bhattacharya (1997), Mandal and Maulik, (1997). Sambath (2009) reported a preliminary list of moths of 31 species from Dalma Wildlife Sanctuary, Jharkhand. Recently, Sambath (2012) have also reported 132 species of moths from the same locality (communicated).

Fig.1 : *Gynautocera papilionaria* (Dorsal side)

Fig.2 : *Gynautocera papilionaria* (Ventral side)

The distribution of the present moth is fragmentary and not reported so far from Eastern part of India especially in Bihar and Jharkhand. Hence, reported for the first time from Jharkhand.

The diagnostic and systematic accounts etc., dealt in this paper is mainly based on the works of Hampson (1892) and Bhattacharya (1997).

SYSTEMATIC ACCOUNT

Class Insecta
Order Lepidoptera
Suborder Heterocera
Superfamily Zygaenoidea
Family Zygaenidae
Subfamily Chalcosiinae
Genus : *Gynautocera* Guerin, 1831

Gynautocera papilionaria Guerin-Meneville

1831. *Gynautocera papilionaria* Guerin-Meneville, Mag. Zool.: 12.

1892. *Gynautocera papilionaria*, Hampson, Fauna Brit. India, Moths, 1: 279.

1997. *Gynautocera papilionaria*, Bhattacharya, Fauna of West Bengal, State Fauna Series, Part-7: 233. Zool. Surv. India,

Diagnostic features: Antennae metalic dark blue. The head, thorax and abdomen black; vertex of head crimson; pectus and segmental bands on abdomen below and end of abdomen crimson. Wings are black. The apex of the fore wing is more produced; the hind wing is round, shot with blue and a large white patch with its edges and veins crossing it metallic blue. The base of the wings crimson ventrally. Wingspan: 80 mm (M).

Material examined: 1ex., 8.xii.08, Kongadhasa, Dalma Wildlife Sanctuary, East Singhbhum, coll. S. Sambath.

Distribution: India: Jharkhand, Assam, Himalayas, Jammu & Kashmir, Meghalaya, Nagaland, Sikkim, Uttar Pradesh and West Bengal.

Elsewhere: Bangladesh, Bhutan, Myanmar, South China, and Vietnam.

Remarks: Hampson (1892) mentioned two forms of G. papilionaria Guerin-Meneville viz., fraterna and rara. The present specimen is a fraterna form as described by Hampson. It is a forest form, not occurring in the plains.

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Short Communication

RECORD OF *ABOROLABIS PERVICINA* (BURR, 1913) FROM TERAI ECOSYSTEM OF UTTAR PRADESH, INDIA

INTRODUCTION

This species was so far recorded from montane and sub montane regions in India [Himachal Pradesh, West Bengal (Darjeeling district), Sikkim, Arunachal Pradesh, Assam, Meghalaya and Manipur], Nepal and Bhutan (Srivastava, 1993, 2003).

The present record from Terai Ecosystem in eastern Uttar Pradesh is of interest.

SYSTEMATIC POSITION

Superfamily: ANISOLABOIDEA
Family: ANISOLABIDIDAE
Subfamily: ANISOLABIDINAE
***Aborolabis pervicina* (Burr, 1913)**

Anisolabis pervicina Burr, 1913. *Rec. Indian Mus.*, **8**(2):137 (Male, Female; India: Assam and Arunachal Pradesh, Siang dist.)

Paralabis pervicina; Burr, 1915. *J.R. micr. Soc.*, **1915**: 540, pl. 12, fig. 3

Aborolabis pervicina; Srivastava, 1969, *Entomologist's rec. J. Var.*, **81**: 246, fig.1

Aborolabis nigrescens Brindle, 1987.*Courier Forsch.-Inst. Senckenberg*, **93**: 337 (Male, Female; Nepal, Nuwakot Dist., Trisuli, Kulturland, Waldreste, 600-650 m).

Material examined: INDIA: Uttar Pradesh: Deoria district, Khukhundoo village, under bricks near stream, 1 ♂, 1 ♀and 01 nymph, 17.viii.2010. Coll: V.D. Hegde and party.

DIAGNOSTIC CHARACTERISTICS

Apterous; sides of abdominal segments 6th to 9th acute angled posteriorly and carinate. Penultimate sternite (Fig.1) broadly rounded, punctulate, posterior margin sub truncate. Genitalia (Fig. 2) with parameres three times longer than broad, gently dialated at about middle and narrowed towards apex, tip rounded, outer margin convex, internally at base armed with a triangular tooth, distal lobes apically with rows of minute teeth.

Fig. 1. Penultimate Sternite

Fig. 2. Male Genitalia

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DR. K. VENKATRAMAN
Director
Zoological Survey of India

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