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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



TWO NEW SPECIES OF THE GENUS *YPETHIMA* HÜBNER (LEPIDOPTERA : PAPILIONOIDEA : SATYRIDAE) FROM INDIA AND MYANMAR

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INTRODUCTION

The genus *Ypthima* Hübner is represented by about 100 species distributed in the Palaetropical and East Palaearctic regions. Identification of certain species and population complexes is, in fact, an intricate problem. Consultation of relevant literature (vide Marshall & de Niveville, 1883; Moore, 1890, 1892; Elwes & Edwards, 1893; Evans, 1932; Talbot, 1947; Shirozu & Shima, 1977, 1979) has critically been made. Shirozu & Shima (1979) dealt with seventy three described species from Asia, South Pacific Islands and Australia. They have studied the male genitalia of as many as fifty-three species. In view of the presently examined material represented by seven examples belongs to *Philomela*-group of the genus *Ypthima* Hübner (Shirozu & Shima, 1979). Evans (*loc.cit.*) distinguished four groups among the Indian species of this genus. His grouping was mainly based on the wing markings of the hindwing underside. In his book of the Indian butterflies Talbot (*loc.cit.*) followed mainly Evans in the grouping of the Indian *Ypthima* Hübner. This article deals with the description of two new species of the genus *Ypthima* Hübner from India and Myanmar. The material has been studied from the National Zoological Collections, collected by different workers. Type specimens are deposited in the National Zoological Collections, Zoological Survey of India.

SYSTEMATIC ACCOUNT

Genus *Ypthima* Hübner
Common name : The Rings

Ypthima Hübner, 1818, *Zutr.z. samml.exot. Schm.*, 1:17.

Type-species : *Ypthima hübnerei* Kirby.

Key to Indian species of *Philomela*-group of the genus *Ypthima* Hübner

1. Hindwing underside with double ocellus (WSF) or black dots (DSF) in space Culb in line with ocelli or black dots in spaces M_3 and Cula; male genitalia with appendices angulares, small, stumpy, blunt at distal end, vinculum more or less incurved; female genitalia with ductus bursae smaller.....2
- Hindwing underside with double ocellus (WSF) or black dots (DSF) in space Culb out of line with ocelli or black dots in spaces M_3 and Cula; male genitalia with appendices angulares more or less curved, pointed distally, vinculum nearly straight; female genitalia with ductus bursae comparatively longer.....5
2. Hindwing underside with greyish -brown striations, white pupil and ocelli comparatively larger; male genitalia with anterior one-third of aedeagus nearly straight.....*lisandra* Cramer
- Hindwing underside with greyish -white striations, white pupil and ocelli comparatively smaller; male genitalia with anterior one-third of aedeagus curved ventrally.....3
3. Forewing upperside with subapical ocellus wanting or obscurely marked in male; male genitalia with uncus smaller; female genitalia with ductus bursae strongly sclerotized....*singala* Felder

- Forewing upperside with subapical ocellus prominent in both sexes; male genitalia with uncus longer; female genitalia with ductus bursae comparatively less sclerotized 4
- 4. Larger in size; marginal and discal fasciae distinct on the hindwing underside; male genitalia with uncus strongly curved ventrally, aedeagus 2/3 curved posteriorly in lateral view (figs.19, 24); female genitalia with lamella antevaginalis nearly rectangular process, slightly concave posteriorly (fig. 25)..... *marshalli* Butler
- Smaller in size; marginal and discal fasciae ill-defined on the hindwing underside; male genitalia with uncus weakly curved ventrally, aedeagus 2/3 more or less straight posteriorly in lateral view (figs. 3, 9); female genitalia with lamella antevaginalis crescent-shaped, deeply notched posteriorly (fig.10)..... *coorgensis* sp.n.
- 5. Forewing upperside with proximal half dark brown and distal half paler, brand prominent.....6
- Forewing upperside either dark brown or paler, brand moderately developed 7
- 6. Ocelli on the underside hindwings are either large or small; male genitalia with uncus curved ventrally, valva has simple costal process (figs. 26, 27)..... *baldus* (Fabricius)
- Ocelli on the underside hindwings are represented by minute black dots; male genitalia with uncus weakly curved ventrally, valva has bifurcated costal process (figs. 13-14)..... *tripuraensis* sp.n.
- 7. Upperside dark-brown, submarginal and discal fascia less prominent; male genitalia with uncus less curved ventrally; female genitalia with ductus bursae sharply curved and broader *indecora* Moore
- Upperside paler, submarginal and discal fascia prominent; male genitalia with uncus strongly curved ventrally; female genitalia with ductus bursae nearly straight and narrower *sarkaghatensis* Rose & Sharma

1. *Ypthima coorgensis* sp.n.

Adult (Male): Head with frontoclypeal area clothed with brown and white scales and hair, eyes dark brown, medium sized, glabrous; labial palpi obliquely upturned, basal segment smallest, distal segment acuminate, middle segment long, closely appressed with white and black scales and hair; antenna 6.0 mm, club slender, black, nudum

extends from the base of the club to the base of the flagellum, the latter dark brown; thorax dressed with brown hair and scales dorsally, white and brown scales and hair ventrally; foreleg strongly reduced, meso and meta legs white scaled, femur longer than tibia, tarsus five segmented and clawed; upperside ground colour brown; forewing upperside with subapical, bipupilled, ringed with diffuse yellow or bright yellow, more or less rounded ocellus, marginal and discal fascia not prominent, brand obscure, underside striated with greyish-white, subapical ocellus as on upperside but the ring more prominent and broader, marginal and discal fasciae ill defined; hindwing upperside with two black, single pupilled, small, rounded, yellow ringed ocelli in M_3 & Cula, fasciae obscure, underside striations as on forewing underside, submarginal fascia distinct, discal faciae obscure, five black, single pupilled, yellow-ringed ocelli present in R_s , M_1 , M_3 , Cula and Culb, ocelli in M_3 & Cula may contiguous or spaced, ocellus in Culb bipupilled.

Venation (Figs.1-2): Forewing cell less than half the length of wing, R_1 arising beyond the upper angle of the cell, mdc and ldc slightly incurved; hindwing cell more than half the length of the wing, Cula before the lower angle of the cell, humeral vein (h) (precostal vein) more or less T-shaped.

Abdomen dorsally brown & ventrally clad with white scales.

Adult (Female): Foreleg well developed, otherwise as in male.

Length of the forewing: Male: 13.0-14.0 mm.

Female: 14.0 mm.

Male genitalia (Figs. 3-9): Tegumen in dorsal view broad at base, gradually narrowed posteriorly, in lateral view subequal to vinculum in height, with membranous incision antero-ventrally; uncus shorter than tegumen, gradually narrowed posteriorly to a pointed tip, in lateral view weakly curved ventrally, narrow membranous slit at the base; fenestrula of a small membranous spot; appendix angularis short, narrower and blunt at apex; vinculum weakly

curved inwardly; saccus less than $\frac{1}{2}$ x as long as ring, tubular; valva broad at middle than both the ends, costa long with narrow, small costal process and continues to ampulla + harpe, sacculus narrow and long, distal end deeply notched in dorsal view, sparsely setosed; aedeagus in dorsal view more or less straight, broader posteriorly, gradually narrowed towards anterior end; in lateral view, curved dorsally, suprazone longer than subzone, ductus entering dorsad; juxta more or less U-shaped.

Female genitalia (Fig.10): Anterior portion of copulatory cavity narrower anteriorly, broader posteriorly; lamella antevaginalis crescent-shaped, covered with minute setulae, lateral lobes of lamellae antevaginalis are semicircular plates covered with broad, small setulae; apophysis anterioris wanting, apophysis posterioris small membranous; papilla analis elongated; ductus seminalis originate from ductus bursae near corpus bursae; ductus bursae moderately long, sclerotized, broad posteriorly, narrow anteriorly; corpus bursae subglobular.

Material Examined

Holotype: ♂, MYANMAR, Hanzada, 01.ii.1893 (Regd. no. 6868/H9), De Niceville collection. Paratypes: INDIA: Karnataka, Western Ghat, Coorg, 1 ♂, 06.iii.1889 (Regd. no. 6652/H9), De Niceville collection. MYANMAR: Hanzada, 1 ♀, 01.ii.1893 (Regd. no. 6869/H9) De Niceville collection.

Etymology : The species is named after the name of the locality in India (Western Ghats) from where one male individual has been collected.

Remarks : This species has been described from the very old specimens lying in the National Zoological Collections. The male specimen from Coorg (India) have ocelli in M_3 & Cula prominent. However, when the male genitalia of this specimen was dissected for close examination, it was found conspecific with male genitalia of the specimen from Hanzada (Myanmar).

The species is closely related to *Ypthima marshalli* Butler, however it differs from the latter species as given below:

2. *Ypthima tripuraensis* sp. n.

Adult (Male): Head with frontoclypeal area studded with black and white scales and hair; eyes light brown, medium sized, glabrous; labial palpi forwardly and upwardly directed, three segmented, middle segment long, distal segment tapering towards apex, densely fringed with black and white scales and hair; antenna 7.0 mm, club slender, light brown, nudum extends from the base of the club to the base of the flagellum, the latter dark brown; foreleg strongly reduced, femur longer than tibia, densely fringed with white & brown scales & hair, meso and meta legs white scaled, tibia shorter than femur, tarsus five segmented and clawed; forewing upperside with black, bipupilled, yellow iris, subapical ocellus, proximal half dark brown with long & broad, distinct band, outer distal half paler,

	<i>Ypthima marshalli</i> Butler	<i>Y. coorgensis</i> sp. n.
1.	Larger in size (length of forewing = 17.0 mm)	Comparatively smaller in size (length of forewing = 13.0 - 14.0 mm).
2.	Marginal and discal fasciae distinct with more white striations in between the fasciae on the underside of the hindwings.	Marginal and discal fasciae ill-defined with less white striations in between the fasciae on the underside of the hindwings.
3.	Male genitalia with uncus strongly curved ventrally, apex of the valva forked in dorsal view.	Male genitalia with uncus weakly curved ventrally, apex of the valva deeply notched in dorsal view.
4.	Suprazonal portion of aedeagus narrower in dorsal view.	Suprazonal portion of aedeagus broader in dorsal view.
5.	In female genitalia, lamella antevaginalis is more or less rectangular plate.	In female genitalia, lamella antevaginalis is crescent-shaped.

	<i>Ypthima baldus</i> (Fabricius)	<i>Y. tripuraensis</i> sp. n.
1.	Hindwing underside has well developed ocelli.	Ocelli are represented by only black dots on the hindwing underside.
2.	Uncus in male genitalia curved ventrally.	Uncus in male genitalia weakly curved ventrally.
3.	In male genitalia, valva has simple costal process.	In male genitalia, valva has bifurcated costal process.
4.	Subzone portion of aedeagus in dorsal view is comparatively less broader	Subzone portion of aedeagus in dorsal view is comparatively broader

submarginal fascia prominent, underside grey with more white striations in distal half, ocellus as above but yellow ring broader, submarginal and discal fascia prominent and form loop around the ocellus; hindwing upperside with discal and marginal fasciae prominent, proximal half dark brown & distal half paler, two black, single pupilled, nearly equal in size, yellow ringed ocelli in Cula and M₃, additional minute ocelli may present in Culb and M₁, one in each, underside with proximal half brown & distal half light brown, five black dots present in Rs, M₁, M₃, Cula & Culb, black dots may prominent or obscure.

Venation (Figs. 11-12): Cell of forewing less than half the length of wing, vein R₁ arising beyond the upper angle of the cell, vein M₂ equidistant between veins M₁ and M₃, udc minute, mdc incurved, ldc longer than others; hindwing cell more than half the length of wing, vein Cula before lower angle of the cell, humeral vein (h) (precostal vein) more or less T-shaped.

Abdomen dark brown dorsally, furnished with fuscous scales, below clad with dirty white scales.

Length of forewing: Male: 18.0-20.0mm.

Adult (Female): Not studied.

Male genitalia (Figs. 13-18): Tegumen in dorsal view broad at base, gradually narrowed posteriorly, in lateral view shorter than vinculum in height with small, membranous incision on its antero-ventral margin; uncus in dorsal view gradually tapering towards pointed apex, subequal in length to tegumen, in lateral view, weakly curved ventrally, with narrow membranous slit on its base; fenestrula of a small,

membranous, rounded spot; appendix angularis short and narrow, weakly curved inwardly; vinculum inwardly curved; saccus short, tubular and stumpy; valva broad at middle than both the ends, costa with bifurcated costal process and continues to ampulla + harpe, distal end forked in dorsal view; aedeagus almost straight in dorsal view, curved anteriorly in lateral view, ductus entering dorsad; juxta more or less V-shaped.

Material examined

Holotype: ♂, INDIA, West Tripura, Kalabagan, 20.ii.1991, G.K. Srivastav.

Paratypes: INDIA: West Tripura, Kalabagan, 2♂, 20.ii.1991, G.K. Srivastav; North Tripura, Jadurambari Beat, 1♂, 1.iii.1991, G.K. Srivastav.

Etymology: The species is named after the name of the state from where four male individuals have been collected.

Remarks: One male specimen from Kalabagan (West Tripura) have additional minute ocelli in Culb and M₁, one in each, on the upperside of the hindwing, whereas, one male specimen from Jadurambari Beat (North Tripura) have additional minute ocellus in Culb on the upperside hindwing. When the male genitalia of these variable individuals was dissected for close examination of their constituent parts like uncus, tegumen, vinculum, saccus, valva and aedeagus, it was found conspecific.

The species is closely related to *Ypthima baldus* (Fabricius), however it differs from the latter species as given below:

Discussion: Elwes & Edwards (1893) pointed out that owing to a lot of variations, different

species of the genus *Ypthima* Hübner were difficult to identify/separate and the genus, as such, having been remained for many years a stumbling block to the Lepidopterists. Eliot (1992) has also recommended that the males admit of ready identification from the characteristic forms of their genitalia. During the course of present studies, seven examples have been identified to belong to *Philomela* group (Shirozu & Shima, 1979). In respect of characters such as, the uncus, tegumen, aedeagus and the valva in the male genitalia and the corpus bursae, ductus bursae and genital plate in the female genitalia, the presently studied two new species differ not only from each other but also from other species of the group (Shirozu & Shima, 1977, 1979).

SUMMARY

Two new species of genus *Ypthima* Hübner (Lepidoptera : Papilionoidea : Satyridae) are described from India and Myanmar and illustrated in this paper.

ACKNOWLEDGEMENTS

Author is thankful to Dr. K. Venkataraman, Director, Zoological survey of India, Kolkata and Incharge, Entomology Division, Zoological survey of India, for giving me opportunity and all sorts of facilities to study the National Zoological Collections.

Explanation to the Figures

Ypthima coorgensis sp.n. : 1. Venation of forewing 2. Venation of hindwing 3. Male genitalia (lateral view) 4. Valva (Inner view) 5. apex of valva 6. Dorsum (dorsal view) 7. Juxta (Dorsal view) 8. Aedeagus (dorsal view) 9. Aedeagus (lateral view) 10. Female genitalia (ventral view).

Ypthima tripuraensis sp.n. : 11. Venation of forewing 12. Venation of hindwing 13. Male genitalia (lateral view) 14. Valva (Inner view) 15. Juxta (Dorsal view) 16. Dorsum (dorsal view) 17.

Aedeagus (Lateral view) 18. Aedeagus (dorsal view).

Ypthima marshalli Butler : 19. Male genitalia (lateral view) 20. Valva (Inner view) 21. Dorsum (dorsal view) 22. Juxta (Dorsal view) 23. Aedeagus (dorsal view) 24. Aedeagus (lateral view) 25. Female genitalia (ventral view).

Ypthima baldus (Fabricius) 26. Male genitalia (lateral view) 27. Valva (Inner view) 28. Apex of valva (dorsal view) 29. Dorsum (dorsal view) 30. Juxta (Dorsal view) 31. Aedeagus (lateral view) 32. Aedeagus (dorsal view).

Explanation to the Photographs

Ypthima coorgensis sp.n. : 1. Holotype male (Dorsal side) 2. Holotype male (Ventral side) 3. Paratype female (Dorsal side)

Ypthima tripuraensis sp.n. : 4. Holotype male (Dorsal side) 5. Holotype male (Ventral side)

Abbreviations used

1A+2A : Fused first and second anal veins, 3A : Third anal vein, AED : Aedeagus, APX.ANG. : Appendix angularis, CO : Costa, CRP.BU. : Corpus bursae, Cu1a : Upper branch of first cubital, Cu 1b : Lower branch of first cubital, D : Discal cell, DSF : Dry-season form, DU.BU. : Ductus bursae, DU.EJ. : Ductus Ejaculatorius, DU.SEM. : Ductus seminalis, h : Humeral vein, LA.AV. : Lamella antevaginalis, ldc : Lower discocellular, M₁ : First medial vein, M₂ : Second medial vein, M₃ : Third medial vein, mdc : Middle discocellular, P.A. : Papilla analis, PO.APO : Apophysis posterioris, R₁ : First radial vein, R₂ : Second radial vein, R₃ : Third radial vein, R₄ : Fourth radial vein, R₅ : Fifth radial vein, Rs : Radial sector, SA : Saccus, SBZ : Subzonal portion of aedeagus, Sc : Subcosta, Sc+ R₁ : Stalk of veins Sc and R₁, SL : Sacculus, SPZ : Suprazonal portion of aedeagus, TEG : Tegumen, udc : Upper discocellular, UN : Uncus, VIN : Vinculum, VLV : valva, WSF : Wet-season form.

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PLATE - 1

Ypthima coorgensis sp.n.



1. Holotype male (Dorsal side)



2. Holotype male (Ventral side)



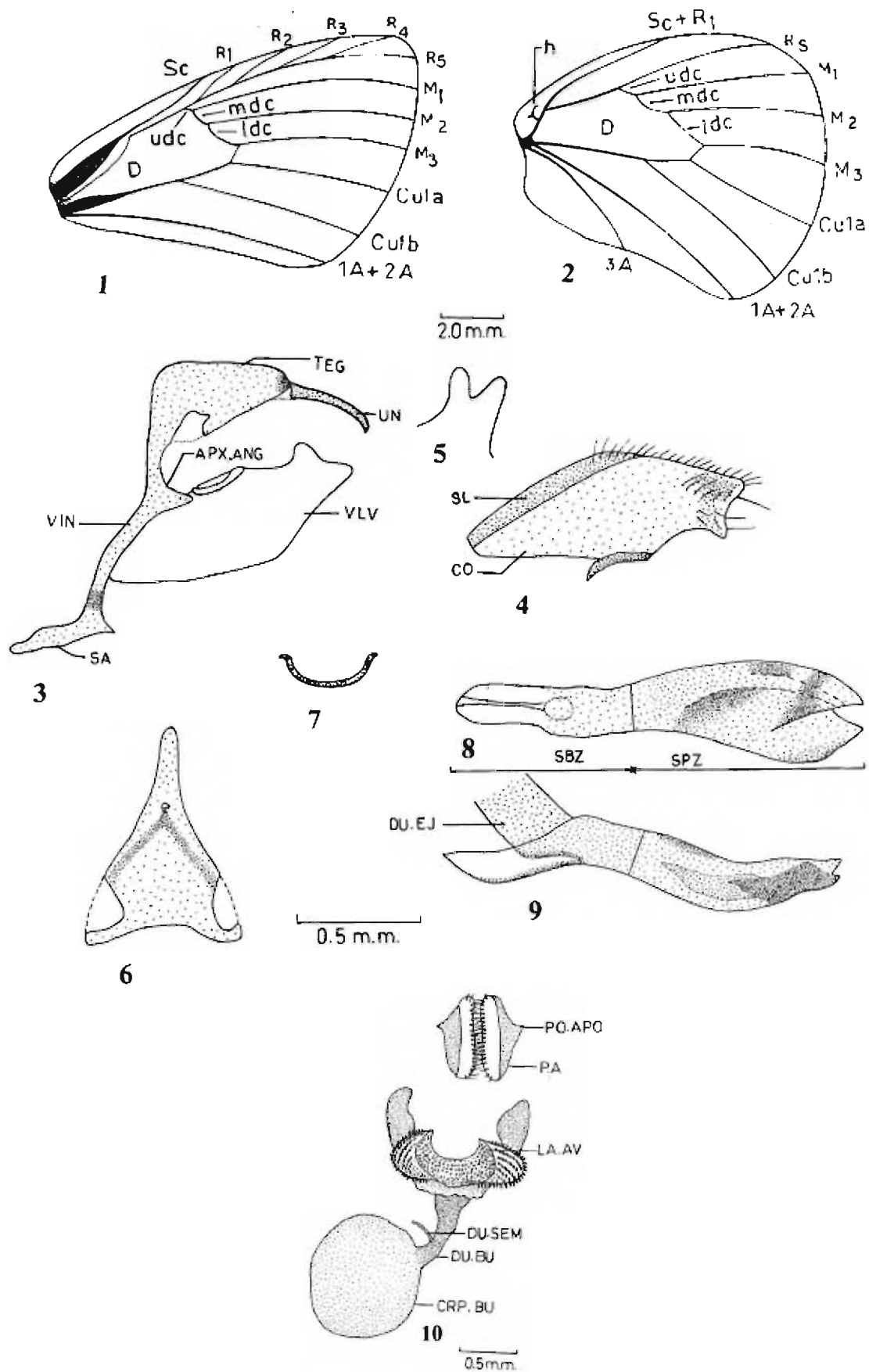
3. Paratype female (Dorsal side)

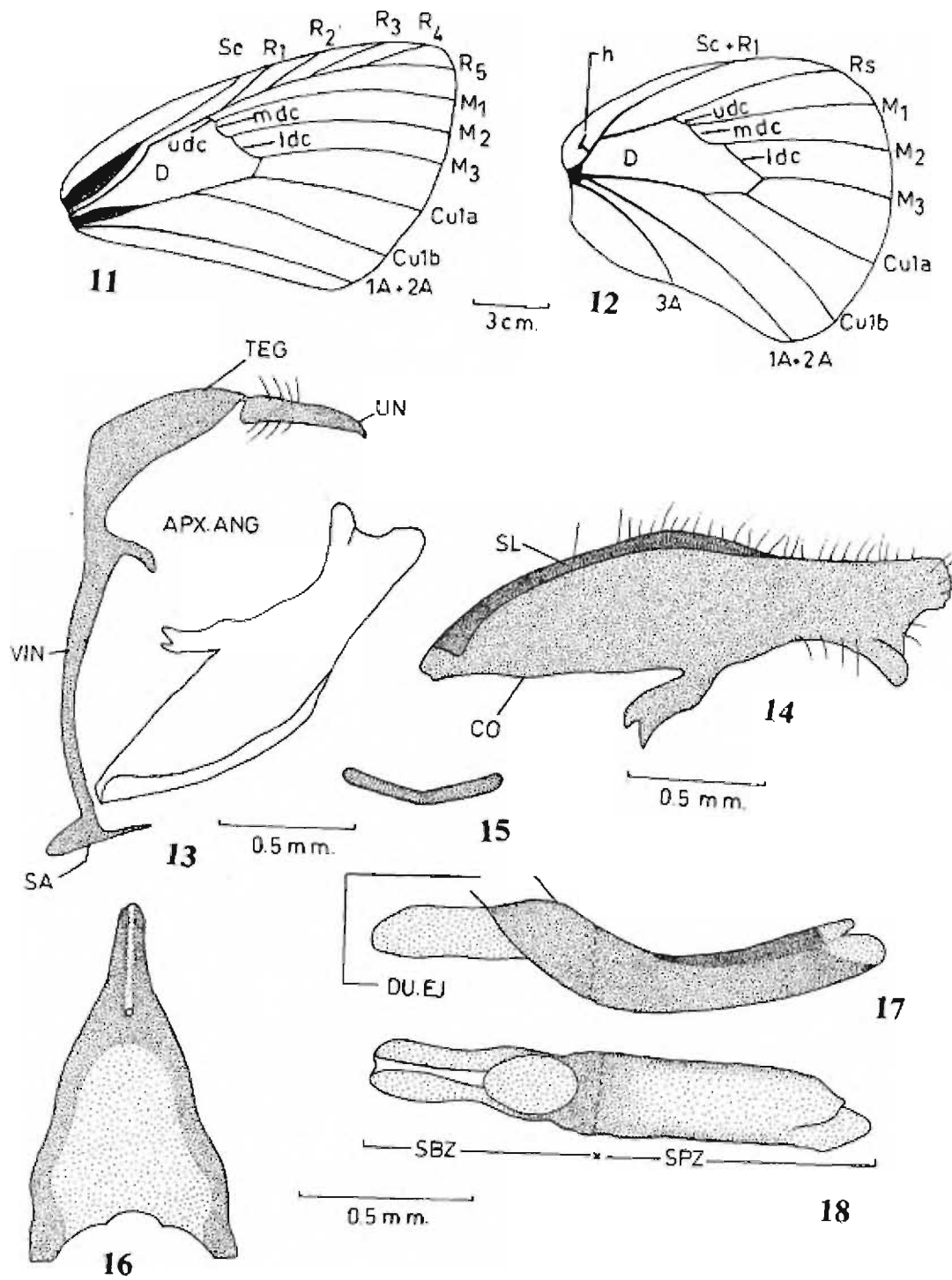


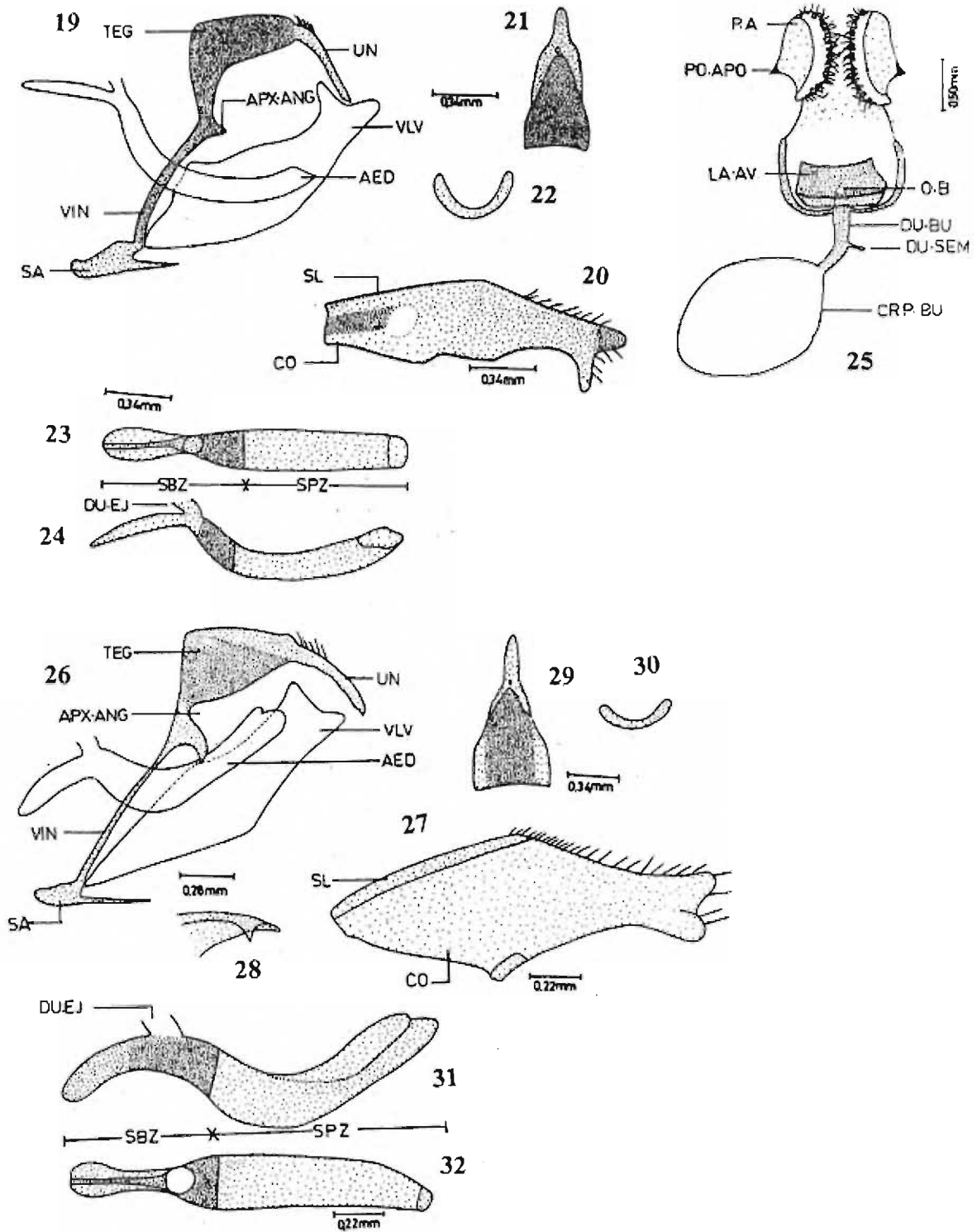
4. Holotype male (Dorsal side)



5. Holotype male (Ventral side)









THREE NEW AND FOUR KNOWN SPECIES OF THE GENUS APORCELAIMELLUS HEYNS, 1965 (NEMATODA: DORYLAIMIDA) FROM WEST BENGAL, INDIA

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INTRODUCTION

The genus *Aporcelaimellus* was erected by Heyns, 1965 belonging to the family *Aporcelaimidae* Heyns, 1965 under the order *Dorylaimida*. Tjepkema et. al., (1971) provided a general review of the genus. Determination keys to the species were given by Baqri and Jairajpuri (1968) and Thorne (1974) respectively. Baqri & Khera (1975) transferred 12 species from *Eudorylaimus* Andrassy, 1959 to *Aporcelaimellus*. Andrassy (2002) synonymised 17 species and transferred 24 species of *Aporcelaimellus* to other genera and provided a key to the species. Gantait et al., (2008) compiled the genus and also provided the species key including 49 valid species under the genus. Three new viz. *Aporcelaimellus istvani* n. sp., *A. tiasiae* n. sp., *A. wasimi* n. sp. and four known species viz. *A. amazonicus* Andrassy, 2004; *A. budauniensis* Khatoon and Sharma, 2000; *A. obtusicaudatus* (Bastian, 1865) Altherr, 1968; *A. subhasi* Gantait et. al., 2006 of the genus are being described and illustrated herein. *A. budauniensis* is being reported first time from West Bengal; *A. amazonicus* and *A. obtusicaudatus* are being reported first time from India.

MATERIALS AND METHODS

Specimens were collected from rhizospheric soil of different cucurbitaceous plants from

different localities of the district North 24 Paganas, West Bengal, India. Nematodes were extracted from soil by Cobb's sieving technique (Cobb, 1918) and decanting method followed by Modified Baermann's funnel technique (Christie and Perry, 1951); processed by Seinhorst's slow dehydration method (Seinhorst, 1959); mounted on slides in anhydrous glycerin and sealed. Specimens were identified following the taxonomic key, made by Jairajpuri and Ahmad (1992). Measurements were taken with the help of an ocular micrometer using Olympus research microscope with drawing-tube attachment, model no. BX 41. Dimensions were presented in accordance with De Man's formula (De Man, 1884). Positions of the oesophageal gland nuclei were presented according to Andr  ssy's formula (Andr  ssy, 1998). Diagrams were drawn with the help of a camera lucida.

De Man's Formula

- L = body length
- a = body length/ maximum body width
- b = body length/ oesophageal length
- b' = body length/ distance from head end to posterior end of oesophageal glands
- c = body length/ tail length
- c' = tail length/ body width at anus

V = distance from head end to vulva x 100/ body length

V' = distance from head end to vulva x 100/ distance from head end to anus

G_1 = anterior genital branch x 100/ body length

G_2 = posterior genital branch x 100/ body length

Andrássy's formula

Glandularium = distance between dorsal oesophageal gland and oesophago-intestinal junction which contains two pairs of oesophageal gland nuclei

D = distance between head end and dorsal oesophageal gland x 100/ oesophageal length

AS_1 = distance between dorsal oesophageal gland and first anterior sub-ventral oesophageal gland x 100/ glandularium

AS_2 = distance between dorsal oesophageal gland and second anterior sub-ventral oesophageal gland x 100/ glandularium

PS_1 = distance between dorsal oesophageal gland and first posterior sub ventral oesophageal gland x 100/ glandularium

PS_2 = distance between dorsal oesophageal gland and second posterior sub ventral oesophageal gland x 100/ glandularium

SYSTEMATIC ACCOUNTS

Order DORYLAIMIDA Pearse, 1942

Suborder Dorylaimina, Pearse, 1936

Superfamily Dorylaimoidea De Man, 1876

Family Aporcelaimidae Heyns, 1965

Subfamily Aporcelaiminae Heyns, 1965

Genus Aporcelaimellus Heyns, 1965

Aporcelaimellus istvani n. sp.

(Table 1; Figs. 1 & 2)

Material examined: 6 females.

Measurements: Shown in Table 1.

Description: Female: Body ventrally curved

upon fixation. Body plump, tapering slightly towards the tail but more strongly in the anterior part of neck towards the lip region which is only one-fourth or less the maximum body width. Cuticle with two thin transparent outer layers followed by a slight broader layer, which is then followed by a thick main layer with transverse striations. Total cuticle width is 7-9 μ m at mid body and 10-12 μ m at tail. Dorsal and ventral body pores distinct. Two to four dorsal pores in the anterior part of the neck and numerous ventral pores over the entire body are present. Lateral chords about one-third of total body width at mid body. Lips separated with prominent papillae, labial region separated from the adjoining body by deep constriction. Amphids stirrup-shaped with its aperture 11-12 μ m wide or about half of the corresponding body width. Odontostyle 1.3-1.4 lip region width long, its aperture is more than half of its length. Odontophore rod-like 2.6-2.7 of the odontostyle length. Guiding ring single, non sclerotised, plicated and located at 0.8-0.9 lip region width from anterior end. Nerve ring encircling the anterior slender part of oesophagus at 22-24% of the oesophageal length from anterior end. Oesophageal expansion gradual, expanded part occupying about 60-61% of the total oesophageal length. Cardia conoid about one-fourth to one fifth as long as corresponding body width. Genital system amphidelphic with both the branches equally developed. Ovary reflexed with oocytes arranged in a single row except near the tip. Oviduct joins the ovary subterminally. Vulva longitudinal. Vagina extending about 30-32% of the corresponding body width and with 5-6 muscle bands. Vulva vaginal junction with moderate sclerotisation. Prerectum 2.5-2.6 and rectum about 0.8 anal body width long. Tail conoid with convex dorsal contour and a small subdigitate projection at the tail tip, 0.6-0.7 anal body width long with a pair of caudal pores on each side.

Male: Not found

Type habitat and locality: Specimens were collected by the first author on 26.6.2007 from the

Table-1: Measurements of *Aporcelaimellus istvani* n. sp. (all measurements are in μm except L in mm).

Morphometric characters	Holotype female (n = 5)	Paratype females	Mean $\pm$ SD
L	3.435	3.506 – 3.603	3.492 $\pm$ 0.12
a	24.89	24.49 – 25.28	24.94 $\pm$ 0.41
b	4.16	4.02 – 4.21	4.13 $\pm$ 0.10
c	70.1	73.82 – 75.84	74.83 $\pm$ 1.01
c'	0.61	0.61 – 0.63	0.62 $\pm$ 0.01
V	50.22	49.96 – 50.31	50.12 $\pm$ 0.18
G ₁	20.01	19.45 – 21.25	20.44 $\pm$ 0.91
G ₂	18.85	19.23 – 21.25	20.46 $\pm$ 1.08
Height of lip	10	8.75 – 10	9.58 $\pm$ 0.72
Lip width	25	-	25 $\pm$ 0
Amphid position	15	13.75 – 15	14.17 $\pm$ 0.72
Guiding ring	22.5	21.25 – 22.5	21.67 $\pm$ 0.72
Nerve ring	195	187.5 – 202.5	197.5 $\pm$ 8.66
Stylet length	32.5	32.5 – 35	33.33 $\pm$ 1.44
Stylet aperture	20	20 – 21.25	20.42 $\pm$ 0.72
Odontophore	65	65 – 67.5	65.83 $\pm$ 1.44
Oesophageal length	852.5	837.5 – 855	844.17 $\pm$ 9.46
Expanded oesophagus	518.5	502.5 – 517.5	510.83 $\pm$ 7.63
DO	367.5	367.5 – 391.25	382.08 $\pm$ 12.76
AS ₁ from DO	187.5	187.5 – 202.5	195 $\pm$ 7.5
AS ₂ from DO	207.5	207.5 – 215	211.67 $\pm$ 3.82
PS ₁ from DO	372	367.5 – 382.5	376.67 $\pm$ 8.04
PS ₂ from DO	402.5	395 – 412.5	404.17 $\pm$ 8.78
Cardia	27.5	27.5 – 30	28.33 $\pm$ 1.44
Maximum width	138	137.5 – 142.5	140 $\pm$ 2.5
Anterior end to vulva	1725	1682.5 – 1812.5	1750.5 $\pm$ 65.21
Vaginal length	42.5	42.5 – 45	33.33 $\pm$ 1.44
Vaginal width	21.5	21.5 – 28.75	17.92 $\pm$ 0.73
Pars distalis	1.25	1.25 – 2.75	2.58 $\pm$ 0.14
Pars refringes	3.75	-	3.75 $\pm$ 0
Pars proximalis	17.5	17.5 – 29.75	18.25 $\pm$ 1.29
Anterior gonad	745	655 – 745	714.17 $\pm$ 51.26
Uterus	147.5	120 – 147.5	136.67 $\pm$ 14.65
Oviduct	280	255 – 280	269.5 $\pm$ 12.97
Ovary	347.5	255 – 347.5	308 $\pm$ 47.71
Posterior gonad	752.5	647.5 – 752.5	715 $\pm$ 58.57
Uterus	152.5	122.5 – 152.5	140.83 $\pm$ 16.47
Oviduct	277.5	237.5 – 277.5	252.17 $\pm$ 22.03
Ovary	363.5	247.5 – 363.5	322 $\pm$ 64.66
Rectum	61.5	58.75 – 62.5	61.25 $\pm$ 2.17
Prerectum	192.5	185 – 192.5	188.33 $\pm$ 3.82
Tail length	49	45 – 47.5	46.67 $\pm$ 1.44

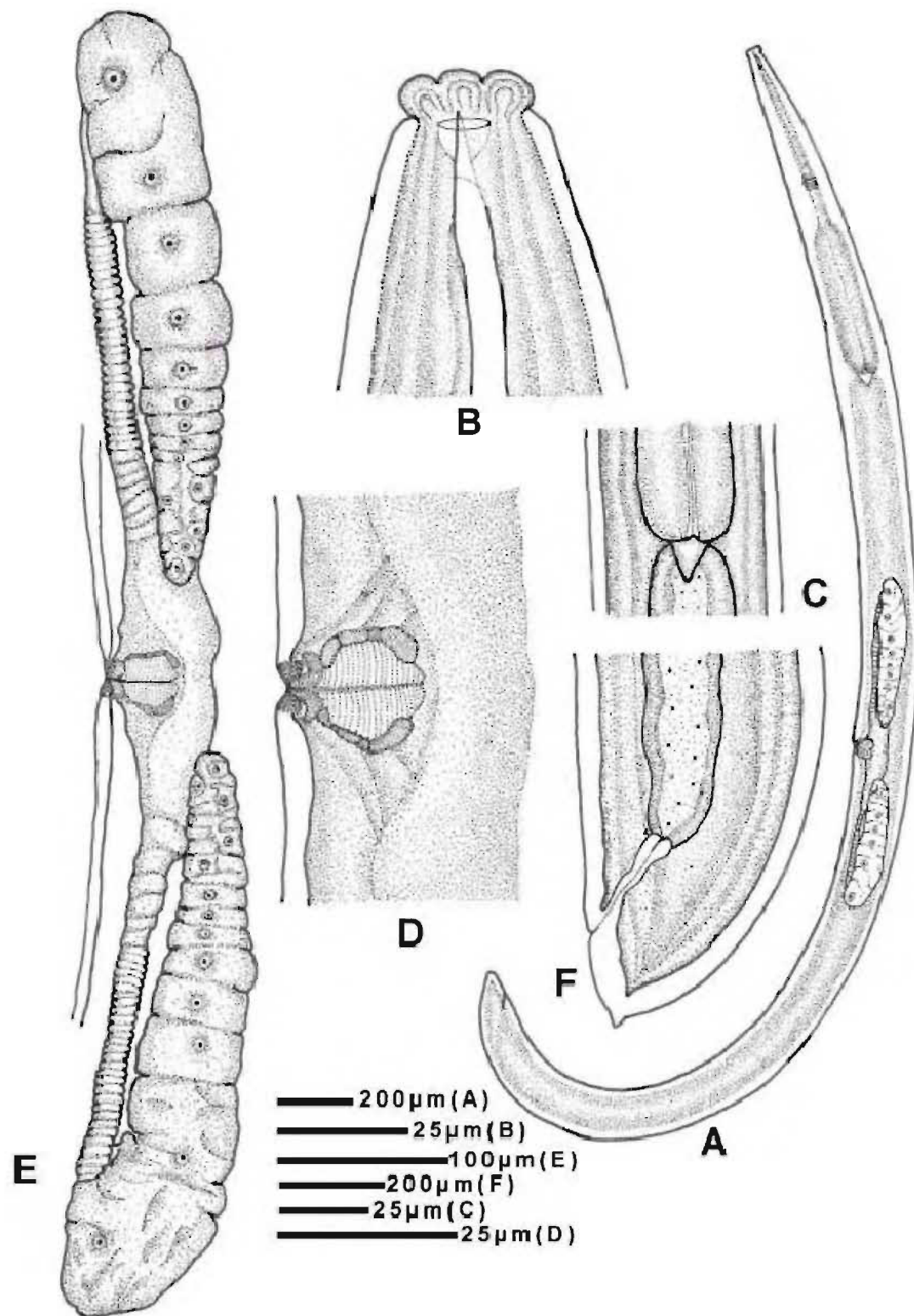


Fig. 1: Camera lucida drawings of *Aporcheimellus istvani* n. sp.; **A.** Entire female; **B.** Lip region and Odontostyle of female; **C.** Cardia of female; **D.** Vulval region; **E.** Gonads; **F.** Tail region of female.

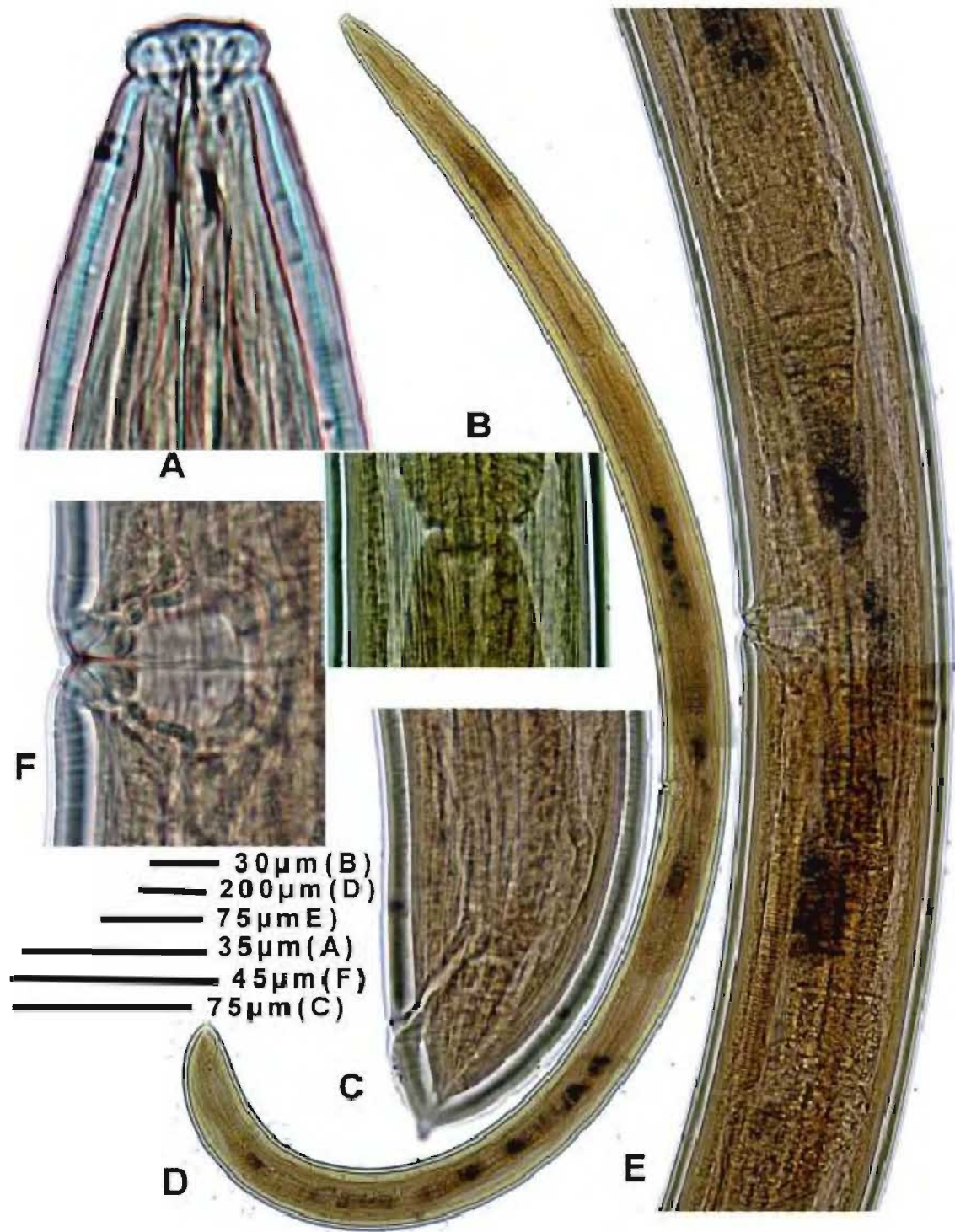


Fig. 2: Photomicrographs of *Aporcelaimellus istvani* n. sp; **A.** Lip region and Odontostyle of female; **B.** Cardia of female; **C.** Tail region of female; **D.** Entire female; **E.** Gonads; **F.** Vulval region.

rhizospheric soil of snake cucumber (*Cucumis utilissimus* L.) from the Village Madhyamgram, district North 24 Parganas, West Bengal, India.

Type materials: Specimens were deposited in the National Zoological Collections of the Zoological Survey of India, Kolkata, West Bengal, India under the Registration No. WN 1348 (Holotype) and WN 1349 (Paratypes) on glass slide.

Differential diagnosis and relationships: The present species is characterized by its large and robust size (L = 3.5-3.6 mm); separated and prominent labial papillae with lip region separated from the adjoining body by deep constriction; conoid cardia; longitudinal vulva with 5-6 muscle bands and presence of moderate sclerotisation in the vulva vagina junction; unspecialized uterus with equally developed gonads and hemispherical tail with a small centrally located subdigitate projection. Out of all the known valid species, the present species closely resembles the following species.

The species under discussion in its general morphology bears a close resemblance with *Aporcelaimellus macropunctatus* Heyns, 1995 regarding its body length, body width, lip width, length of odontophore, oesophageal length, shape of cardia, position of vulva, length of prerectum and tail shape. However, it differs from the latter in having a longer odontophore (vs 53-61 µm), longitudinal vulva (vs transverse), shorter rectum (vs 70-77 µm) and longer tail (vs 26.5-38 µm).

The present species also closely resembles *Aporcelaimellus insularis* (Andrassy, 2001) regarding its cardia and specialized mammillate tail but differs from it in having a larger and robust body (vs 1.2-1.5 mm), more wider lip region (vs 18-20 µm), longer odontostyle (vs 28-30 µm), longer oesophagus (vs 360-406 µm), longitudinal vulva (vs transverse) and larger vagina (vs 29-33 µm). Thus from the above discussion, it is obvious that the species under discussion differs from all other valid species of

the genus as well as other new species created in this report and thus can be considered new to science.

Etymology: The new species has been named after the eminent nematologist, Prof. István Andrassy, Institutum Zoosystematicum Universitatis, Budapest of Hungary.

***Aporcelaimellus tiasiae* n. sp.**
(Table-2; Figs. 3 & 4)

Materials examined: 7 females.

Measurements: Shown in Table 2.

Description: Female: Body ventrally curved upon fixation. Cuticle with transverse striations, 4-6 µm thick at mid body and 8-9 µm at tail. Dorsal and ventral body pores distinct. Three to four dorsal pores in the anterior part of the neck and numerous ventral pores over the entire body are present. Lateral chords about one-third of total body width at mid body. Lips partially amalgamated, papillae not prominent, labial region separated from the adjoining body by constriction. Amphids stirrup-shaped with its aperture 10-12 µm wide or about half of the corresponding body width. Odontostyle 1.2-1.5 lip region width long, its aperture about half of its length. Odontophore rod-like and about two times the odontostyle length. Guiding ring single, non sclerotised, plicated and located at 0.7-1.3 lip region width from anterior end. Nerve ring encircling the anterior slender part of oesophagus at 27-28% of the oesophageal length from anterior end. Oesophageal expansion gradual, expanded part occupying about 52-56% of the total oesophageal length. Cardia rounded about one-third as long as corresponding body width. Presence of a thin cardiac disc at oesophagus-intestinal junction. Genital system amphidelphic with both sexual branches equally developed. Ovary reflexed with oocytes arranged in a single row especially near the tip. Oviduct joins the ovary subterminally. Vulva longitudinal. Vagina extending about 32-33% of the corresponding body width and with 5-6 muscle bands. Presence of pars refringens vaginae at vagina vulval junction. Prerectum 3.6-3.8 and rectum about one anal body

Table-2: Measurements of *Aporcelaimellus tiasiae* n. sp. (all measurements in μm except L in mm)

Morphometric characters	Holotype female	Paratype females (n =6)	Mean $\pm$ SD
L	2.675	2.675 – 3.2	3.166 $\pm$ 0.03
a	31.4	31.4 – 37.12	35.68 $\pm$ 1.24
b	4.26	4.26 – 4.98	4.97 $\pm$ 0.02
c	41.96	40.5 – 50.32	48.35 $\pm$ 1.82
c'	1.41	1.32 – 1.41	1.34 $\pm$ 0.02
V	55.5	47.94 – 55.5	49.81 $\pm$ 2.05
G1	13.5	11.45 – 23.25	18.4 $\pm$ 6.17
G2	14.6	12.04 – 20.51	17.68 $\pm$ 4.88
Height of lip	7.5	6.75 – 7.5	7.08 $\pm$ 0.38
Lip width	19.6	15.5 – 20	17.67 $\pm$ 2.25
Amphid position	10	–	10 $\pm$ 0
Guiding ring	15.5	–	15.5 $\pm$ 0
Nerve ring	175	175 – 180	177.5 $\pm$ 3.53
Stylet length	22.7	22.5 – 23	22.75 $\pm$ 0.25
Stylet aperture	12.5	12.5 – 15	13.5 $\pm$ 1.25
Odontophore	40	40 – 42.5	40.83 $\pm$ 1.44
Oesophageal length	627.5	632.5 – 640	635.83 $\pm$ 3.82
Expanded oesophagus	361.75	355 – 362.5	358.33 $\pm$ 3.82
DO	297	290 – 305	296.83 $\pm$ 7.58
AS1 from DO	134.5	112.5 – 135	122.67 $\pm$ 11.41
AS2 from DO	149.75	145 – 152.5	149.17 $\pm$ 3.82
PS1 from DO	237.5	235 – 237.5	236.67 $\pm$ 1.44
PS2 from DO	268.5	255 – 275	265.83 $\pm$ 10.10
Cardia	22.5	22.5 – 30	24.33 $\pm$ 2.88
Maximum width	85	85 – 90	88.33 $\pm$ 2.88
Anterior end to vulva	1485	1485 – 1655	1600.83 $\pm$ 77.15
Vaginal length	27.5	27.5 – 30	29.17 $\pm$ 1.44
Vaginal width	20	17.5 – 20	19.17 $\pm$ 1.44
Pars distalis	2.5	–	2.5
Pars refringes	7.5	–	7.5
Pars proximalis	17.5	17.5 – 20	19.17 $\pm$ 1.44
Anterior gonad	361.5	361.5 – 731.5	546.5 $\pm$ 261.45
Uterus	45	45 – 145	95 $\pm$ 70.71
Oviduct	168.5	168.5 – 237.5	203 $\pm$ 48.79
Ovary	147.5	147.5 – 348.5	248 $\pm$ 142.13
Posterior gonad	390	380 – 645	512.5 $\pm$ 187.5
Uterus	52.5	52.5 – 145	65.41 $\pm$ 98.75
Oviduct	200	200 – 225	212.5 $\pm$ 17.67
Ovary	137.5	137.5 – 275	206.5 $\pm$ 97.22
Rectum	45	45– 50	48.5 $\pm$ 1.77
Prerectum	175	175 – 182.5	179.17 $\pm$ 3.82
Tail length	63.75	62.5 – 67.5	65 $\pm$ 2.5

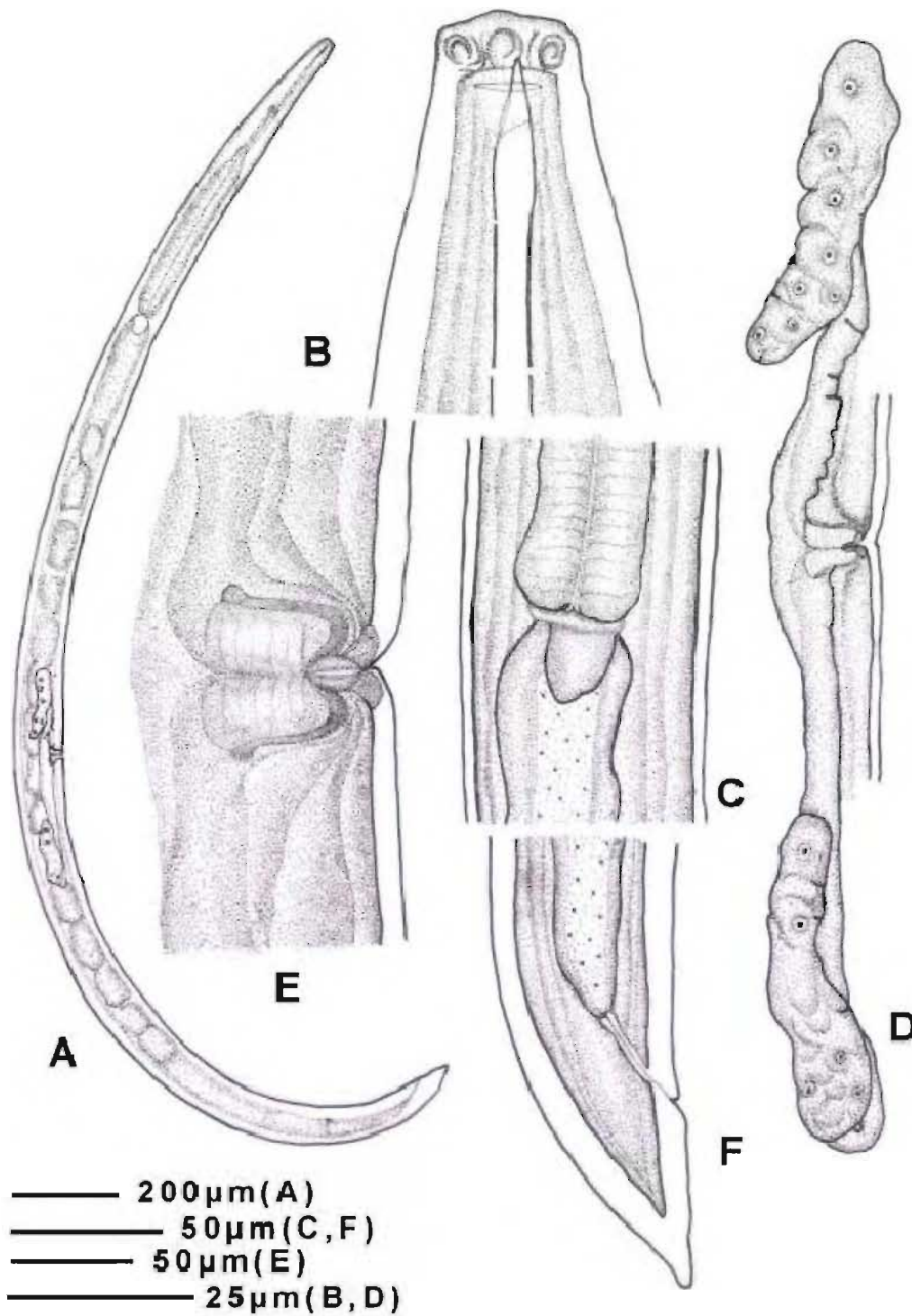


Fig. 3: Camera lucida drawings of *Aporcelaimellus tiasiae* n. sp. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Gonads; **E.** Vulval region; **F.** Tail region.

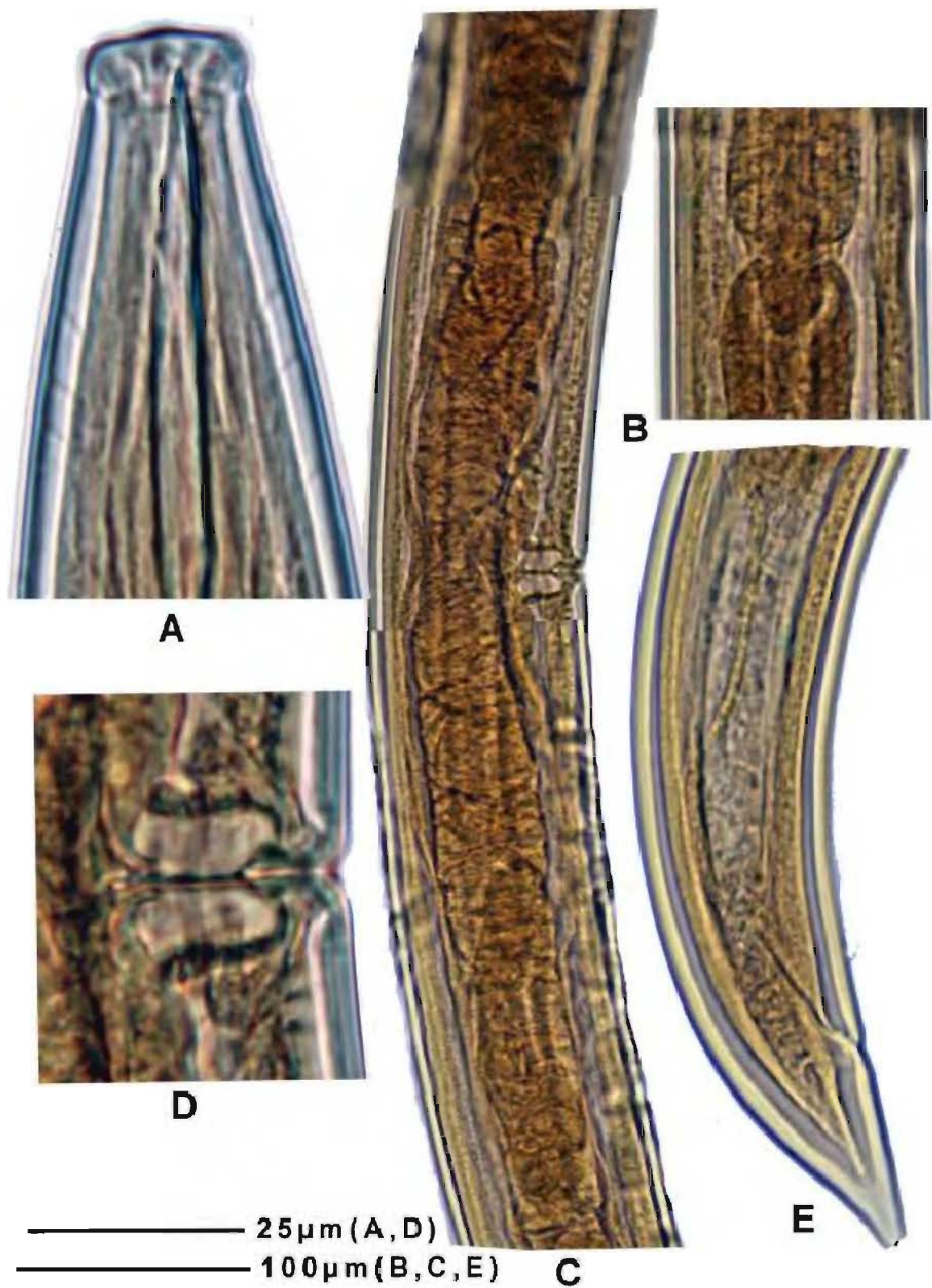


Fig.4: Photomicrographs of *Aporcelaimellus tiasiae* n. sp. Female: **A.** Lip region and Odontostyle; **B.** Cardia; **C.** Gonads; **D.** Vulval region; **E.** Tail region.

width long. Tail conoid, 1.3-1.4 anal body width long with a pair of caudal pores on each side.

Male: Not found

Type habitat and locality: Specimens were collected by the first author on 04-3-2007 from the rhizospheric soil of bottle gourd (*Lagenaria siceraria*) from the village Halisahar of the district North 24-Parganas, West Bengal, India.

Typematerials: Holotypefemale along with six paratype females were mounted on slides and deposited in the National Zoological Collections (Registration No. WN 1346, WN 1347) of the Zoological Survey of India, Kolkata, West Bengal, India.

Differential diagnosis and relationships: The present species is large and robust in size ($L=2.67-3.2$ mm) with partially amalgamated lips and non prominent papillae separated from the adjoining body by constriction. Rounded cardia with presence of cardiac disc in the oesophageal-intestinal junction. Longitudinal vagina with 5-6 muscle bands and presence of sclerotisation in the vulva vagina junction; unspecialized uterus with equally developed gonads and conoid tail. Out of all the known valid species, the present species closely resembles the following species.

The proposed species in its general morphology bears a close resemblance with *Aporcelaimellus macropunctatus* Heyns, 1995 in its body length, labial region, length of odontostyle, oesophageal length, position of vulva and length of prerectum. However, it differs from it in having a narrow lip region (vs 25-27.5 μ m), shorter odontostyle (vs 26-30 μ m) and odontophore (vs 53-61 μ m), presence of cardiac disc at oesophagus-intestinal junction (vs absence), different cardia shape (vs conoid), different vulva (vs transverse), shorter rectum (vs 70-77 μ m), longer tail (vs 26.5-38 μ m) and different tail shape (vs subdigitate).

The species under consideration also closely resembles *Aporcelaimellus conicaudatus* (Altherr, 1953) Monteiro, 1970 regarding its body length, body width, lip width, rectum length and

tail length but differs from it in having a longer odontostyle (vs 17-18 μ m) and odontophore (vs 31-34 μ m), shorter oesophagus (vs 760 μ m), smaller cardia (vs 28 μ m) with different cardia shape (vs elongate conoid), different vulval opening (vs transverse) with presence of sclerotisation at vulva vaginal junction, small prerectum (vs 195-210 μ m) and tail shape (vs conoid with round terminus). Thus the differences are significant, substantial and sufficiently reasonable to consider the species as new to science.

Etymology: The authors suggest its name as *Aporcelaimellus tiasiaen* sp. after Dr. Tiasi Jana, the eminent nematologist of India.

***Aporcelaimellus wasimi* n. sp.**
(Table-3; Figs. 5 & 6)

Materials examined: 13 females.

Measurements: Shown in Table-3.

Description: Female: Body ventrally curved upon fixation. Cuticle with transverse striations, 5-7 μ m thick at mid body and 8-10 μ m at tail. Lateral chords about one-fourth to one-third of total body width at mid body. Lips distinct, well separated and pressed fairly close together, set off from the adjoining body by a deep constriction. Amphids stirrup-shaped with its aperture 9-11 μ m wide or about half of the corresponding body width. Odontostyle about one lip width long, its aperture about half of its length. Odontophore rod-like, 1.4-1.5 times the odontostyle length. Guiding ring single, plicated and located at 1.2-1.3 lip region width from anterior end. Nerve ring encircling the anterior slender part of oesophagus at 29-30% of the oesophageal length from anterior end. Oesophageal expansion gradual, expanded part occupying about 50-52% of the total oesophageal length. Cardia rounded about one-third to one-fourth as long as corresponding body width. Genital system amphidelphic with anterior gonad slightly longer than the posterior one. Ovary reflexed with oocytes arranged in a single row near the tip. Oviduct joins the ovary subterminally. Highly muscular uterus with

Table-3: Measurement of *Aporcelaimellus wasimi* n. sp. (all measurements in μm except L in mm).

Morphometric characters	Holotype female	Paratype females (n=12)	Mean $\pm$ SD
L	2.44	2.427 - 2.645	2.541 $\pm$ 0.11
a	52.19	49.79 - 52.9	50.89 $\pm$ 1.74
b	4.84	4.76 - 4.92	4.83 $\pm$ 0.08
c	49.53	44.14 - 46	45.12 $\pm$ 0.93
c'	1.69	1.69 - 1.76	1.73 $\pm$ 0.04
V	56.24	56.23 - 58.41	57.38 $\pm$ 1.09
G1	24	20.32 - 24	22.27 $\pm$ 1.85
G2	18.44	18.43 - 22.87	20.26 $\pm$ 2.32
Height of lip	6.25	-	6.25 $\pm$ 0
Lip width	17.5	15 - 17.5	15.25 $\pm$ 0.35
Amphid position	6.25	6.25 - 6.5	6.38 $\pm$ 0.18
Guiding ring	11.75	11.75 - 12.5	12.13 $\pm$ 0.53
Nervering	157.5	152.5 - 157.5	155 $\pm$ 2.5
Stylet length	19.5	16.25 - 19.5	16.83 $\pm$ 0.63
Stylet aperture	10	-	10 $\pm$ 0
Odontophore	27.5	25 - 27.5	26.67 $\pm$ 1.44
Oesophageal length	510	510 - 537.5	525 $\pm$ 13.92
Expanded oesophagus	275	275 - 282.5	279.17 $\pm$ 3.82
DO	255	255 - 262.5	259.17 $\pm$ 3.82
AS1 from DO	105	87.5 - 105	95.83 $\pm$ 8.79
AS2 from DO	125	100 - 125	113.33 $\pm$ 12.58
PS1 from DO	205	200 - 205	201.67 $\pm$ 2.89
PS2 from DO	230	215 - 230	223.33 $\pm$ 7.63
Cardia	12.5	12.5 - 15	13.75 $\pm$ 1.77
Maximum width	48.75	48.75 - 50	49.25 $\pm$ 0.66
Anterior end to vulva	1365	1365.5 - 1545	1436.67 $\pm$ 95.43
Vaginal length	16	15 - 17.5	16.25 $\pm$ 1.77
Vaginal width	10	10 - 12.5	11.25 $\pm$ 1.77
Pars distalis	7.5	-	7.5
Pars proximalis	8.5	7.5 - 10	8.75 $\pm$ 1.77
Anterior gonad	582.5	537.5 - 582.5	558.33 $\pm$ 22.68
Uterus	75	75 - 187.5	113.33 $\pm$ 64.24
Oviduct	245	187.5 - 245	219.17 $\pm$ 29.19
Ovary	262.5	162.5 - 265.5	203.5 $\pm$ 52.37
Posterior gonad	447.5	447.5 - 605	535.83 $\pm$ 80.48
Uterus	70	70 - 75	72.5 $\pm$ 2.5
Oviduct	232.5	232.5 - 275	252.5 $\pm$ 21.36
Ovary	145	145 - 255	200 $\pm$ 55
Rectum	32.5	30 - 32.5	31.67 $\pm$ 1.77
Prerectum	150	150 - 155	152.5 $\pm$ 3.53
Tail length	54.5	55 - 57.5	56.67 $\pm$ 1.44

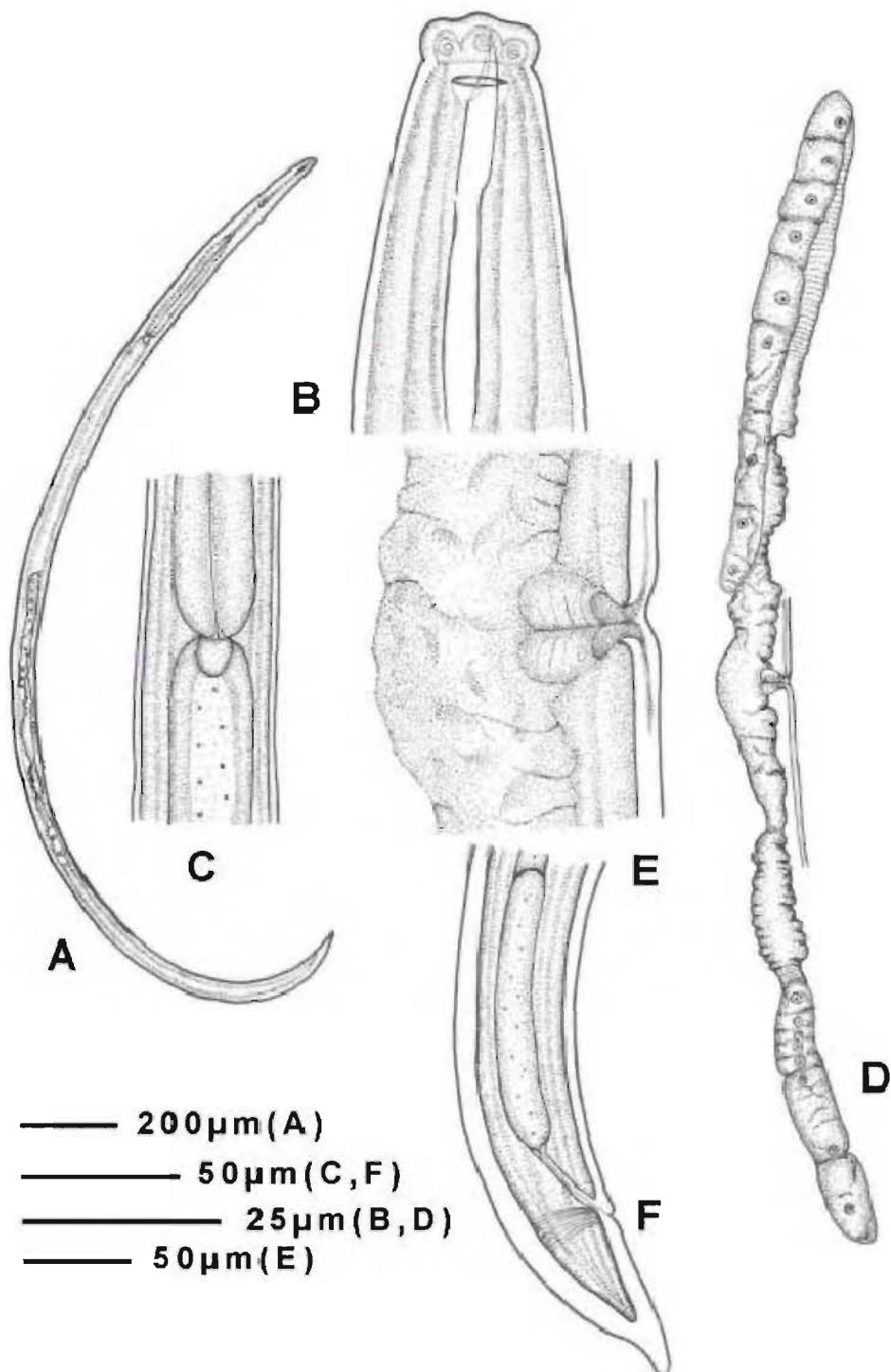


Fig.5: Camera lucida drawings of *Aporcelaimellus wasimi* n. sp. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Gonads; **E.** Vulval region; **F.** Tail region.

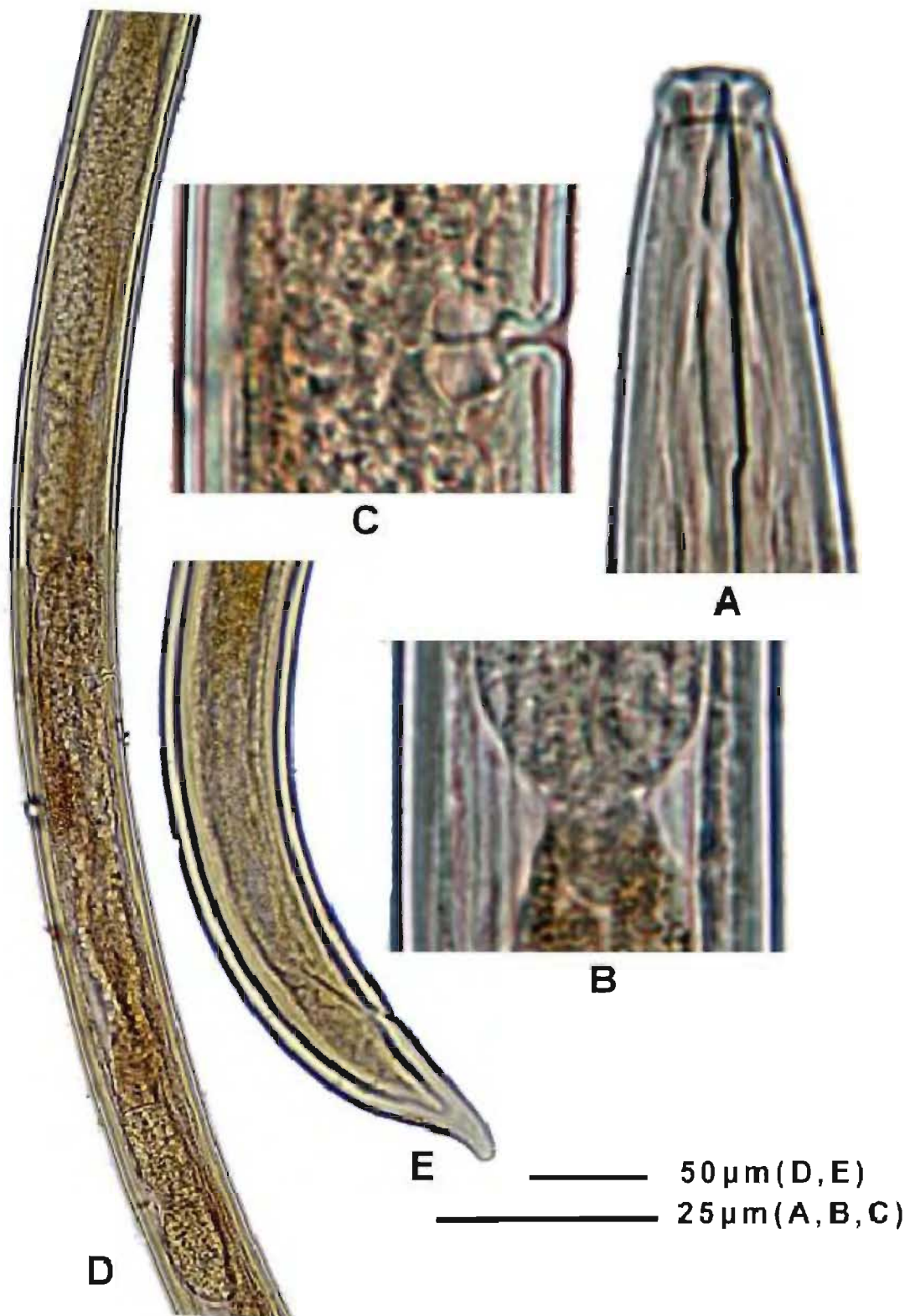


Fig.6: Photomicrographs of *Aporcelaimellus wasimi* n. sp. Female: **A.** Lip region and Odontostyle; **B.** Cardia; **C.** Vulval region; **E.** Gonads; **E.** Tail region.

presence of distinct pars dilatata and sphincter at oviduct-uterus junction. Vulva transverse. Vagina extending about 30-35% of the corresponding body width. Absence of pars refringens vaginae at vagina vulval junction. Prerectum 4.5-4.6 and rectum about one anal body width long. Tail conoid with the tip slightly dorsally bent, 1.4-1.5 anal body widths long with a pair of caudal pores on each side.

Male: Not found

Type habitat and locality: Specimens were collected by the first author on 25-5-2006 from the rhizospheric soil of Cucumber (*Cucumis sativus*) from the village Habra of district North 24-Paganas, West Bengal, India.

Type specimens: Holotype female along with twelve paratype females are mounted on slides and are deposited in the National Zoological Collections (Registration No. WN 1350, WN 1351, WN 1357) of the Zoological Survey of India, Kolkata, West Bengal, India.

Differential diagnosis and relationships: The proposed species is characterized by its large and slender body ($L = 2.43\text{--}2.65\text{ mm}$) with separated lips offset from the adjoining body by deep constriction; rounded cardia; transverse vagina with absence of sclerotisation in the vulva vagina junction, presence of sphincter muscles and pars dilatata in the uterus-oviduct junction; short and conoid tail with the tip slightly dorsally bent. Out of all the known valid species, the present species closely resembles the following species.

The present species in its general morphology bears a close resemblance with *Aporcelaimellus obscurus* Thorne and Swanger, 1939 Heyns, 1965 regarding its body length, oesophageal length, position of vulva and tail length. However, it differs from it in having a narrow lip region (vs $20.3\text{ }\mu\text{m}$), shorter odontostyle length (vs $23.8\text{ }\mu\text{m}$), absence of cardiac disc at oesophagus-intestinal junction (vs presence), different cardia shape (vs conoid), longer prerectum (vs $102\text{ }\mu\text{m}$) and different tail shape (vs convex-conoid).

The species under discussion also closely resembles *Aporcelaimellus futaii* Khan and Araki, 2002 regarding its body length, oesophageal length and length of prerectum but differs from it in having a slender body (vs $88\text{--}96\text{ }\mu\text{m}$), narrow lip region (vs $21\text{--}27\text{ }\mu\text{m}$), shorter odontostyle (vs $22\text{--}26\text{ }\mu\text{m}$) and odontophore (vs $40\text{--}48\text{ }\mu\text{m}$) length, more anteriorly located guiding ring (vs $14\text{--}16\text{ }\mu\text{m}$), smaller cardia (vs $28\text{--}37\text{ }\mu\text{m}$), shorter rectum (vs $55\text{--}69\text{ }\mu\text{m}$), longer tail (vs $35\text{--}41\text{ }\mu\text{m}$) and tail shape (vs conoid). Thus the present species does not fit well with the existing valid species and the newly described ones of the genera and can be considered new to science.

Etymology: The authors suggest its name as *Aporcelaimellus wasimi* after the eminent nematologist, Prof. Wasim Ahmad, Department of Zoology, Aligarh Muslim University, U.P., India.

Aporcelaimellus amazonicus Andrassy, 2004
(Table-4; Figs. 7 & 8)

Materials examined: 8 females.

Measurements: Shown in Table-4.

Description: Female: Body ventrally curved upon fixation. Body moderate and plump. Cuticle with transverse striations, $4\text{--}5\text{ }\mu\text{m}$ thick at mid body and $6\text{--}8\text{ }\mu\text{m}$ at tail. Lateral chords about one-third to one-fourth of total body width at mid body. Lips practically amalgamated and set off from the adjoining body by deep constriction. Amphids stirrup-shaped with its aperture $8\text{--}9\text{ }\mu\text{m}$ wide or about half of the corresponding body width. Odontostyle rod-like, its length about 1.3 lip width long, its aperture about one-third of its length. Odontophore rod-like, 1.4-1.5 times the odontostyle length. Guiding ring single, plicated, sclerotised and located at 0.7-0.8 lip region width from anterior end. Nerve ring encircling the anterior slender part of oesophagus at 34-35% of the oesophageal length from anterior end. Oesophageal expansion gradual, expanded part occupying about 45-46% of the total oesophageal length. Cardia rounded, its length about one-third as long as corresponding body width. Presence of

Table-4: Measurements of *Aporcelainellus amazonicus* Andrassy, 2004 (all measurements in μm except L in mm).

Morphometric characters	Females (n=8)	Mean $\pm$ SD
L	1.550 - 1.707	1.631 $\pm$ 0.08
a	20.05 - 20.69	20.38 $\pm$ 0.44
b	4.34 - 4.51	4.02 $\pm$ 0.38
c	34.44 - 35.02	34.71 $\pm$ 0.29
c'	1.09 - 1.15	1.12 $\pm$ 0.03
v	50 - 50.22	50.08 $\pm$ 0.18
G1	32.09 - 40.72	35.93 $\pm$ 4.39
G2	30.45 - 31.55	30.96 $\pm$ 0.55
Height of lip	5 - 7.5	6.25 $\pm$ 1.25
Lip width	15 - 17.5	15.83 $\pm$ 1.44
Amphid position	-	7.5 $\pm$ 0
Guiding ring	-	10 $\pm$ 0
Nerving	122.25 - 137.5	130.75 $\pm$ 7.77
Stylet length	20 - 22.5	21.67 $\pm$ 1.67
Stylet aperture	7.5 - 7.75	7.58 $\pm$ 0.14
Odontophore	28.75 - 32.5	30.25 $\pm$ 1.98
Oesophageal length	357.5 - 392.5	375 $\pm$ 17.5
Expanded oesophagus	162.5 - 177.5	171.67 $\pm$ 14.22
DO	215 - 225	220.83 $\pm$ 5.20
AS1 from DO	45 - 55	49.17 $\pm$ 5.20
AS2 from DO	55 - 70	62.5 $\pm$ 7.5
PS1 from DO	105 - 112.5	108.75 $\pm$ 5.33
PS2 from DO	112.5 - 127.5	119.17 $\pm$ 7.64
Cardia	25 - 27.5	26.67 $\pm$ 1.44
Max. width	77.25 - 82.5	80.33 $\pm$ 2.74
Anterior end to vulva	775 - 857.5	755.83 $\pm$ 88.36
Vaginal length	20 - 22.5	20.83 $\pm$ 1.44
Vaginal width	-	12.5 $\pm$ 0
Pars distalis	-	1.25 $\pm$ 0
Pras refringes	5 - 7.5	5.83 $\pm$ 1.44
Pars proximalis	12.5 - 13.75	12.92 $\pm$ 0.72
Anterior Gonad	497.5 - 695	572.5 $\pm$ 106.97
Uterus	75 - 90	82.5 $\pm$ 7.5
Oviduct	265.5 - 412.5	330 $\pm$ 75.13
Ovary	157 - 192.5	172.33 $\pm$ 18.24
Posterior gonad	462.5 - 520	489.17 $\pm$ 28.98
Uterus	72.5 - 162.5	107.5 $\pm$ 48.22
Oviduct	227.5 - 245	235 $\pm$ 9.01
Ovary	145 - 195	165.83 $\pm$ 26.02
Rectum	30 - 32.5	31.67 $\pm$ 1.44
Prerectum	65 - 68.75	67.08 $\pm$ 1.91
Tail length	45 - 48.75	47.08 $\pm$ 1.91

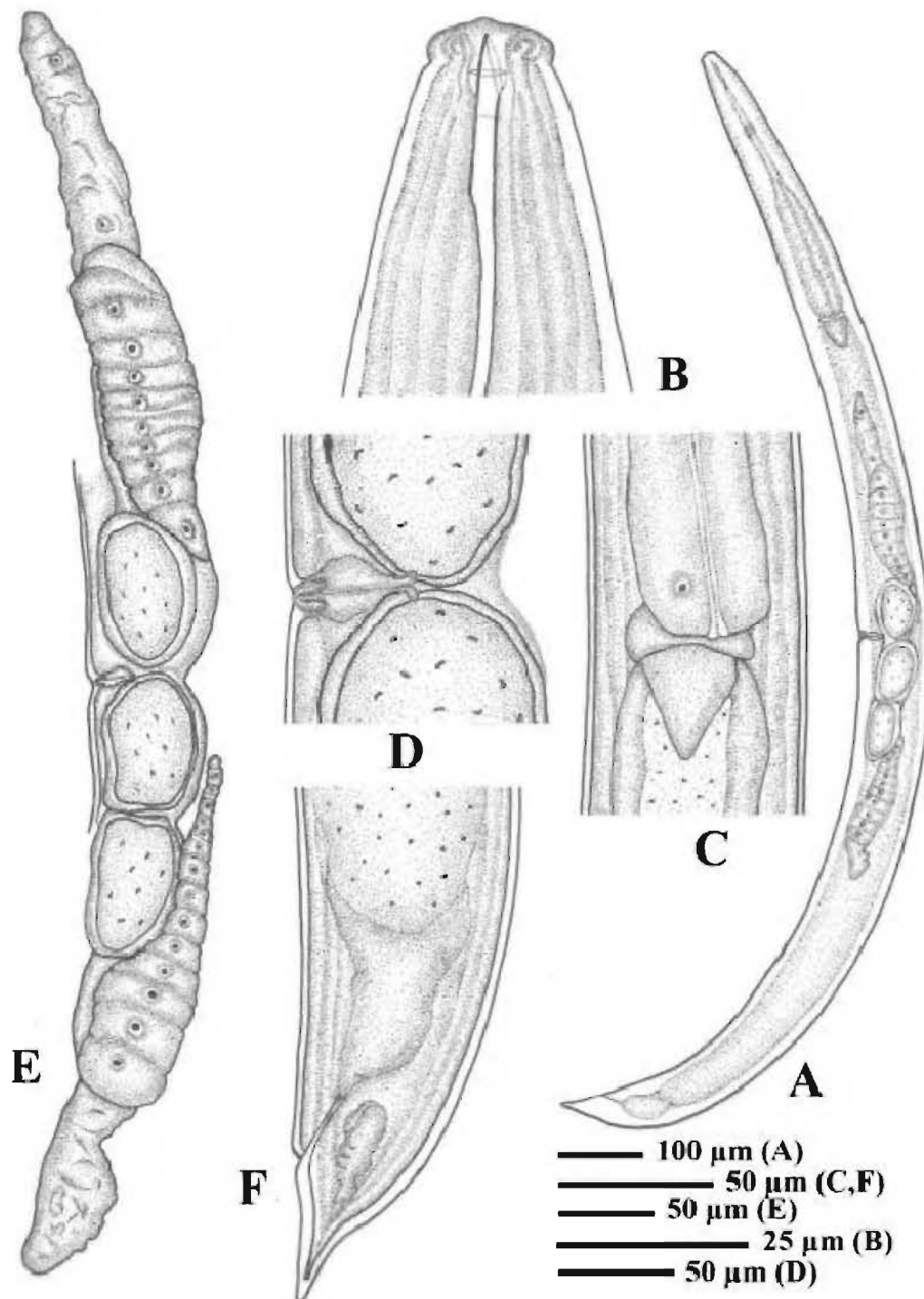


Fig. 7: Camera lucida drawings of *Aporcelaimellus amazonicus*. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Vulval region; **E.** Gonads; **F.** Tail region.

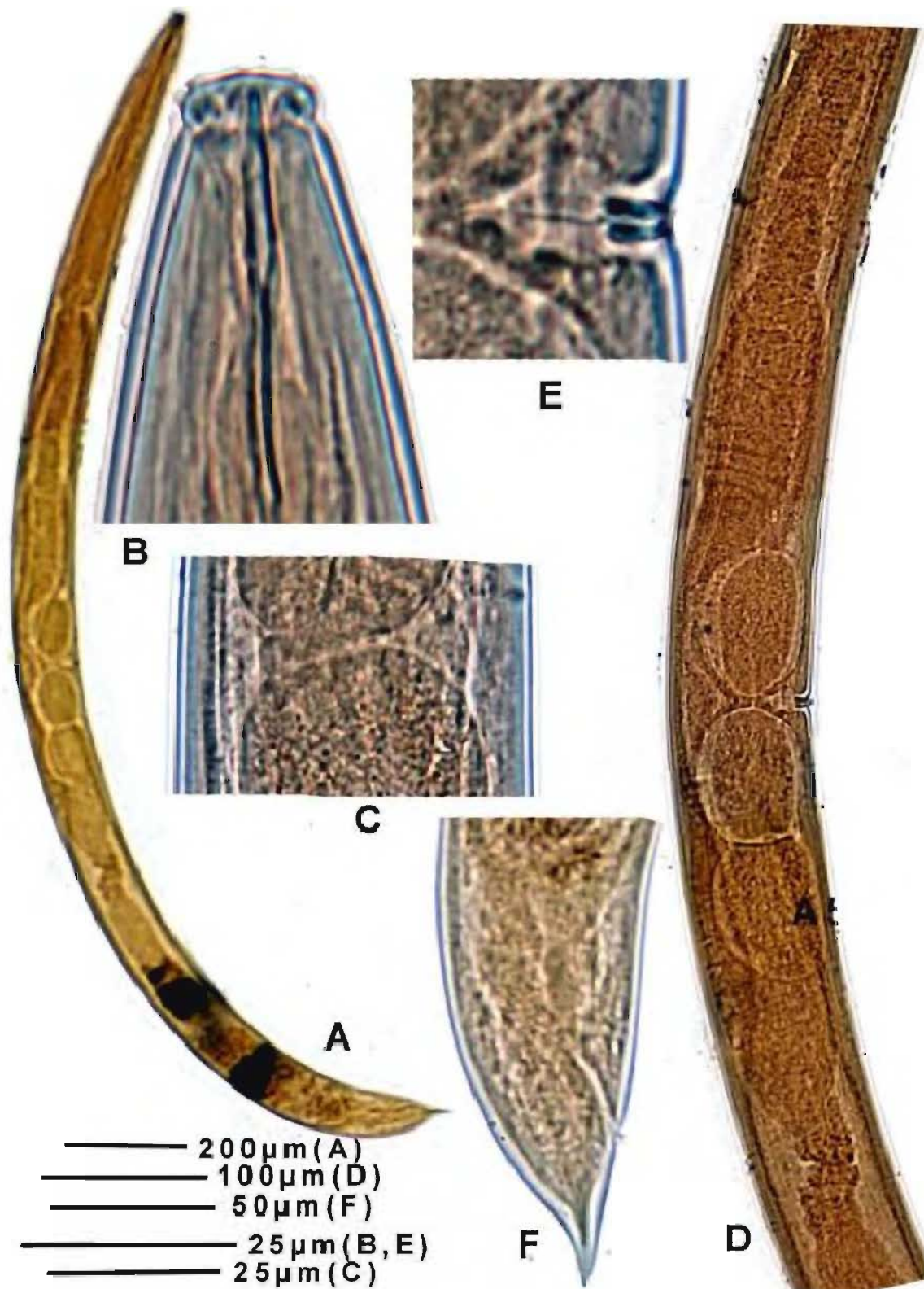


Fig.8: Photomicrographs of *Aporcelainellus amazonicus*. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Gonads; **E.** Vulval region; **F.** Tail region

cardiac disc at oesophageal-intestinal junction. Genital system amphidelphic with both the sexual branches equally developed. Ovary reflexed with oocytes arranged in a single row. Oviduct joins the ovary subterminally. Vulva transverse. Vagina extends about 26-27% of the corresponding body width. Presence of rod-shaped sclerotised pars refringens vaginae at vagina vulval junction. Prerectum 1.4-1.5 and rectum less than one anal body width long. Tail convex conoid with the tip pointed with a pair of caudal pores on each side.

Male: Not found.

Habitat and locality: Specimens were collected by the first author on 17.05.2007 from the rhizospheric soil of bottle gourd (*Lagenaria siceraria*) from the village Kaugachi of district North 24-Paganas, West Bengal, India.

Remarks: The species *A. amazonicus* was described by Andrassy (2004) from Amazonia forest, the greatest rain forests of Brazil. This species is characterised by its sharply pointed tail showing concave contour on dorsal side of tail. The presently described species completely corresponds with the previous description but slightly differs from it in having a shorter odontostyle (vs 24-26 μm), greater body width (vs $a=21-23$), posteriorly located vulva (vs 44-45%) and shorter prerectum (vs 45-50 μm). This species is reported for the first time from India.

Aporcelaimellus budauniensis

Khatoon and Sharma, 2000
(Table-5; Figs. 9 & 10)

Materials examined: 6 females.

Measurements: Shown in Table-5.

Description: Female: Body ventrally curved upon fixation. Cuticle with transverse striations, 4-5 μm thick at mid body and 6-8 μm at tail. Lateral chords about one-fourth to one-third of total body width at mid body. Lips practically amalgamated and set off from the adjoining

body by deep constriction. Amphids stirrup-shaped with its aperture, 8-9 μm wide or about half of the corresponding body width. Odontostyle slightly arcuate, its length about one lip width long, its aperture more than half of its length. Odontophore rod-like, 1.7-1.9 times the odontostyle length. Guiding ring single, plicated, sclerotised and located at 0.7-0.8 lip region width from anterior end. Nerve ring encircling the anterior slender part of oesophagus at 35-36% of the oesophageal length from anterior end. Oesophageal expansion gradual, expanded part occupying about 42-43% of the total oesophageal length. Cardia tongue shaped, its length about one-third as long as corresponding body width. Genital system amphidelphic with both the sexual branches equally developed. Ovary reflexed with oocytes arranged in a single row. Oviduct joins the ovary subterminally. Vulva transverse. Vagina extends about 44-48% of the corresponding body width. Presence of moderate sclerotisation at vagina vulva junction. Prerectum and rectum about one anal diameter long. Tail conoid, 1.1-1.2 anal body widths long with a pair of caudal pores on each side.

Male: Not found.

Habitat and locality: Specimens were collected by the first author on 12.09.2008 from the rhizospheric soil of spiny bitter gourd (*Momordica cochinchinensis*) from the village Amdanga of district North 24-Paganas, West Bengal, India.

Remarks: The species *A. budauniensis* was described by Khatoon and Sharma (2000) from Uttar Pradesh, India. The presently described species fits well with the previous description but slightly differs from it in having a shorter odontostyle (vs 28-35 μm), anteriorly located nerve ring (vs 146-150 μm), shorter prerectum (vs 70-72 μm) and rectum (vs 50 μm), may be due to intraspecific variations. This species is reported for the first time from West Bengal.

Table-5: Measurements of *Aporcelaimellus budauniensis* Khatoon and Sharma, 2000 (all measurements in μm except L in mm).

Morphometric characters	Females (n=6)	Mean $\pm$ SD
L	1.250 - 1.375	1.319 $\pm$ 0.02
a	20.69 - 24.4	22.53 $\pm$ 1.85
b	3.6 - 4.35	4.02 $\pm$ 0.38
c	41.67 - 44.06	42.74 $\pm$ 1.21
c'	1.09 - 1.15	1.12 $\pm$ 0.03
V	50.22 - 55.8	52.84 $\pm$ 2.81
G1	17.8 - 40.72	28.67 $\pm$ 11.50
G2	16.4 - 30.45	23.95 $\pm$ 7.08
Height of lip	5 - 6.25	5.42 $\pm$ 0.72
Lip width	16.25 - 17.5	16.67 $\pm$ 0.72
Amphid position	-	6.25 $\pm$ 0
Guiding ring	-	12.5 $\pm$ 0
Nerve ring	120 - 127.5	123.33 $\pm$ 3.82
Stylet length	15 - 17.5	15.83 $\pm$ 1.44
Stylet aperture	8.5 - 10	9.17 $\pm$ 1.15
Odontophore	28.75 - 30	29.17 $\pm$ 0.72
Oesophageal length	345 - 358.5	353.67 $\pm$ 7.52
Expanded oesophagus	147.5 - 155	151.67 $\pm$ 3.82
DO	215 - 222.5	219.17 $\pm$ 4.23
AS1 from DO	45 - 47.5	49.17 $\pm$ 5.20
AS2 from DO	55 - 61.75	58.42 $\pm$ 3.26
PS1 from DO	95 - 102.5	98.75 $\pm$ 3.75
PS2 from DO	105 - 112.5	108.33 $\pm$ 3.82
Cardia	15 - 20	16.67 $\pm$ 2.87
Maximum width	51.25 - 52.5	51.67 $\pm$ 0.72
Anterior end to vulva	697.5 - 857.5	755.83 $\pm$ 88.36
Vaginal length	22.5 - 25	23.33 $\pm$ 1.44
Vaginal width	-	12.5 $\pm$ 0
Pars distalis	2.5 - 2.75	2.58 $\pm$ 0.14
Pras refringes	5 - 7.5	5.83 $\pm$ 1.44
Pars proximalis	12.5 - 17.25	14.08 $\pm$ 2.74
Anterior gonad	222.5 - 695	420.83 $\pm$ 145.21
Uterus	25 - 90	48.33 $\pm$ 36.17
Oviduct	125 - 412.5	255 $\pm$ 145.71
Ovary	72.5 - 192.5	117.5 $\pm$ 65.38
Posterior gonad	205 - 520	356.66 $\pm$ 137.82
Uterus	27.5 - 162.5	77.23 $\pm$ 52.07
Oviduct	122.5 - 227.5	170.83 $\pm$ 52.93
Ovary	55 - 195	112.5 $\pm$ 43.27
Rectum	30 - 32.5	31.67 $\pm$ 1.44
Prerectum	30 - 38.75	34.58 $\pm$ 4.39
Tail length	41.67 - 44.06	42.74 $\pm$ 1.21

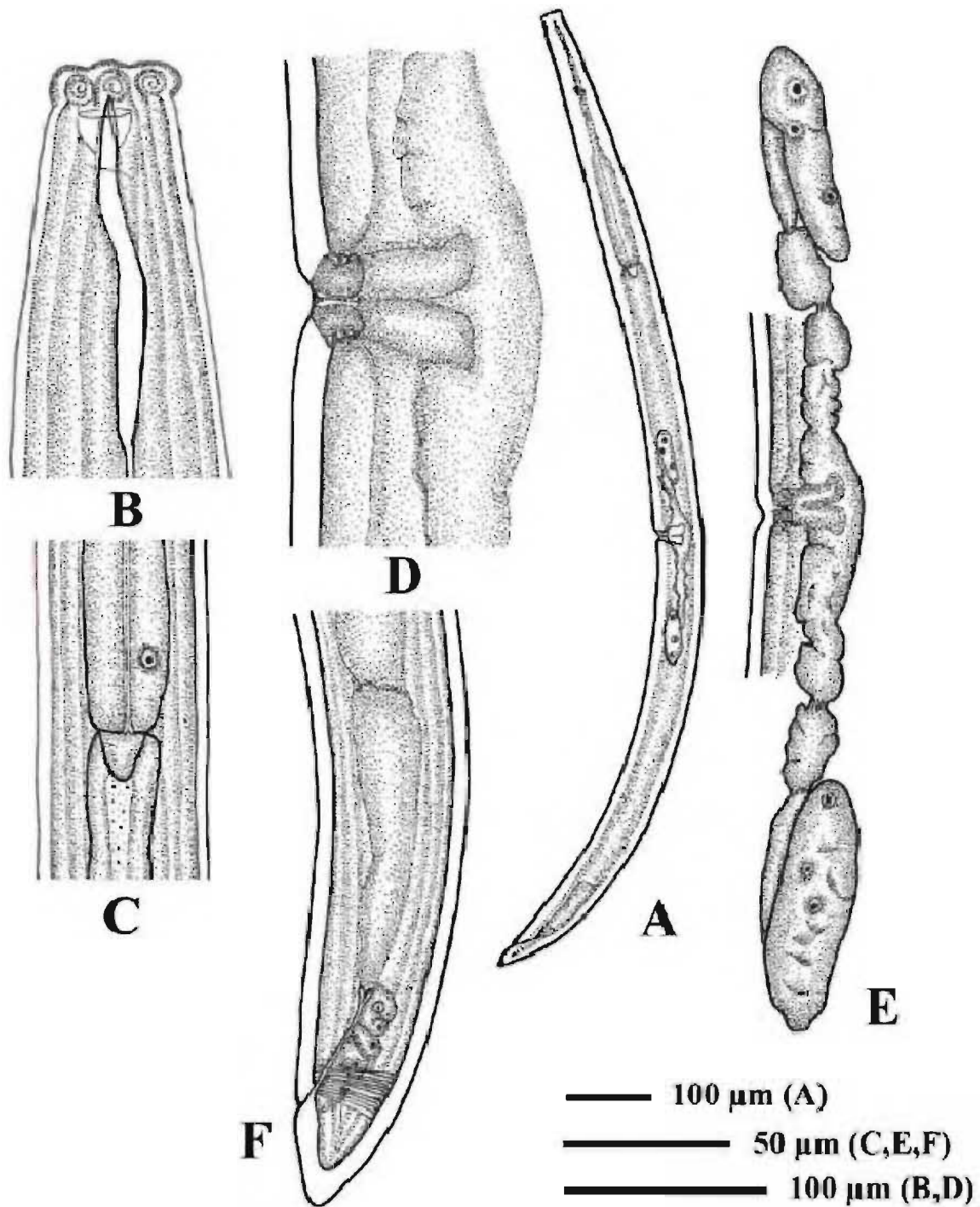


Fig. 9: Camera lucida drawings of *Aporcelaimellus budauniensis*. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Vulval region; **E.** Gonads; **F.** Tail region.

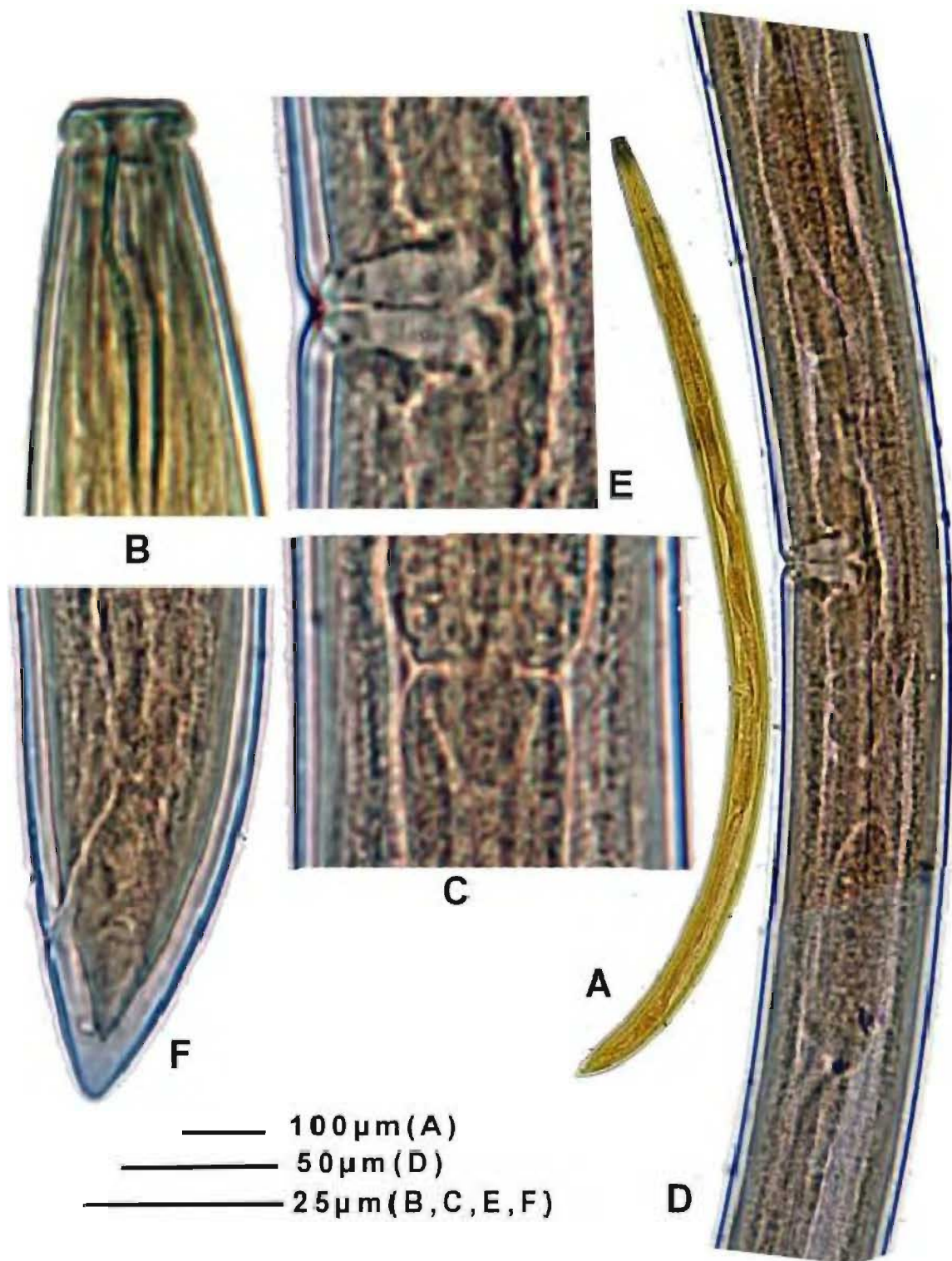


Fig.10: Photomicrographs of *Aporcelainellus budauniensis*. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Gonads; **E.** Vulval region; **F.** Tail region.

Aporcelaimellus obtusicaudatus

(Bastian, 1865) Altherr, 1968

(Table-6; Figs. 11 & 12)

Materials examined: 22 females.

Measurements: Shown in Table-6.

Description: Female: Body ventrally curved upon fixation. Cuticle with transverse striations, 5-7 μm thick at mid body and 8-10 μm at tail. Lateral chords about one-third to one-fourth of total body width at mid body. Lips partially amalgamated and pressed fairly close together, set off from the adjoining body by deep constriction. Amphids stirrup-shaped with its aperture 8-10 μm wide or about half of the corresponding body width. Odontostyle about one lip width long, its aperture about half of its length. Odontophore rod-like, 2-2.7 times the odontostyle length. Guiding ring single, plicated and located at 0.5-0.6 lip region width from anterior end. Nerve ring encircling the anterior slender part of oesophagus at 29-32% of the oesophageal length from anterior end. Oesophageal expansion gradual, expanded part occupying about 49-55% of the total oesophageal length. Cardia conoid, about one-third as long as corresponding body width. Genital system amphidelphic with both branches of ovary equally developed. Ovary reflexed with oocytes arranged in a single row. Oviduct joins the ovary subterminally. Vulva transverse. Vagina extends about 36-38% of the corresponding body width. Presence of large and sclerotised pars refringens vaginae at vagina vulva junction. Prerectum 3.0-5.6 and rectum about one anal body width long. Tail shape rounded or conoid, about one anal body widths long with a pair of caudal pores on each side.

Male: Not found.

Habitat and locality: Specimens were collected by the first author on 25.03.2006 from the rhizospheric soil of pumpkin (*Cucurbita pepo* L.) from the village Hridaypur of district North 24-Paganas, West Bengal, India.

Remarks: The species *A. obtusicaudatus* was originally described by Bastian (1865) under the

genus *Dorylaimus*. Later after many alterations it was finally transferred to the genus *Aporcelaimellus* and is now designated as its type species. De Ley et al. (1993) and Andrassy (2002) provided a good redescription of the species. It is distributed over the world and belongs to most frequent species of soil nematodes. This species has been reported from Africa (Jacob, 1984), Costa Rica (Esquivel, 2003), Sevilla (Pena Santiag et al., 2005) and Pakistan (Shahina et al., 2006). This species completely fits with the previous description but slightly differs from it regarding its body length (vs 2.2-3.0mm), odontostyle length (vs 22-24 μm) and vaginal length (vs 48-52%), due to intraspecific variations. This is the first report from India.

Aporcelaimellus subhasi Gantait

Bhattacharya & Chatterjee, 2006

(Table-7; Figs. 13 & 14)

Materials examined: 25 females.

Measurements: Shown in Table-7.

Habitat and locality: Specimens were collected by the first author on 25.04.2006 from the rhizospheric soil of pumpkin (*Cucurbita pepo* L.) from the village Hridaypur of district North 24-Paganas, West Bengal, India.

Description: Female: Body ventrally curved upon fixation. Cuticle with transverse striations, 4-5 μm thick at mid body and 6-8 μm at tail. Lateral chords about one-third to one-fourth of total body width at mid body. Lips practically amalgamated and set off from the adjoining body by deep constriction. Amphids stirrup-shaped with its aperture 7-8 μm wide or about half of the corresponding body width. Odontostyle rod-like, its length about 1.2-1.6 lip width long, its aperture about half of its length. Odontophore rod-like, 1.6-1.7 times the odontostyle length. Guiding ring single, plicated, sclerotised and located at 0.6-0.8 lip region width from anterior end. Nerve ring encircling the anterior slender part of oesophagus at 32-46% of the oesophageal length from anterior end. Oesophageal expansion gradual, expanded part occupying about 51-64% of the total oesophageal length. Cardia conoid with abruptly

Table-6: Measurements of *Aporcelainellus obtusicaudatus* (Bastian, 1865) Altherr, 1968 (all measurements in μm except L in mm).

Morphometric characters	Females (n=22)	Mean $\pm$ SD
L	1.817 - 2.372	1.914 $\pm$ 0.66
a	27.92 - 33.92	30.07 $\pm$ 1.67
b	3.85 - 4.33	4.11 $\pm$ 0.17
c	62.5 - 83.2	68.68 $\pm$ 6.49
c'	0.52 - 1.7	0.99 $\pm$ 0.41
v	51.43 - 59.12	53.85 $\pm$ 2.79
G1	11.28 - 18.2	14.49 $\pm$ 2.14
G2	10.62 - 19.4	16 $\pm$ 3.47
Height of lip	5.5 - 7.5	6.53 $\pm$ 0.71
Lip width	17.5 - 18.75	17.75 $\pm$ 0.50
Amphid position	-	7.5 $\pm$ 0
Guiding ring	8.75 - 11.25	10.57 $\pm$ 1.12
Nerve ring	150 - 167.5	161.38 $\pm$ 7.27
Stylet length	17.5 - 22.5	18.75 $\pm$ 1.59
Stylet aperture	8.75 - 12.5	10.84 $\pm$ 1.13
Odontophore	35- 50	42.16 $\pm$ 4.55
Oesophageal length	470 - 575	520.68 $\pm$ 34.37
Expanded oesophagus	232.5 - 315	277.73 $\pm$ 25.73
DO	262.5 - 312.5	285.56 $\pm$ 19.23
AS1 from DO	67.5 - 100	84.29 $\pm$ 11.96
AS2 from DO	75 - 112.5	92.18 $\pm$ 12.84
PS1 from DO	162.5 - 220	181.5 $\pm$ 15.81
PS2 from DO	169.5 - 232.5	192.5 $\pm$ 19.96
Cardia	24.25 - 27.5	25.83 $\pm$ 1.37
Maximum width	62.5 - 85	72.05 $\pm$ 7.48
Anterior end to vulva	1057.5 - 1280	1132.4 $\pm$ 72.12
Vaginal length	22.5 - 30	26.25 $\pm$ 2.20
Vaginal width	17.5 - 25	21.81 $\pm$ 3.37
Pars distalis	2.5 - 3.75	2.96 $\pm$ 0.62
Pras refringes	6.25 - 7.5	7.31 $\pm$ 0.42
Pars proximalis	12.5 - 16.75	14.53 $\pm$ 1.75
Anterior gonad	205 - 395.5	309 $\pm$ 56.64
Uterus	61.5 - 132.5	85 $\pm$ 27.51
Oviduct	75 - 132.5	111.8 $\pm$ 19.95
Ovary	67.5 - 137.5	111.5 $\pm$ 26.87
Posterior gonad	242.5 - 483.75	357.38 $\pm$ 74.93
Uterus	62.5 - 215	109.17 $\pm$ 53.14
Oviduct	85 - 170	126.75 $\pm$ 22.14
Ovary	62.5 - 187.5	126.87 $\pm$ 35.50
Rectum	37.5 - 47.5	40.55 $\pm$ 4.28
Prerectum	132.5 - 167.5	147.5 $\pm$ 14.21
Tail length	25 - 47.5	32.5 $\pm$ 6.71

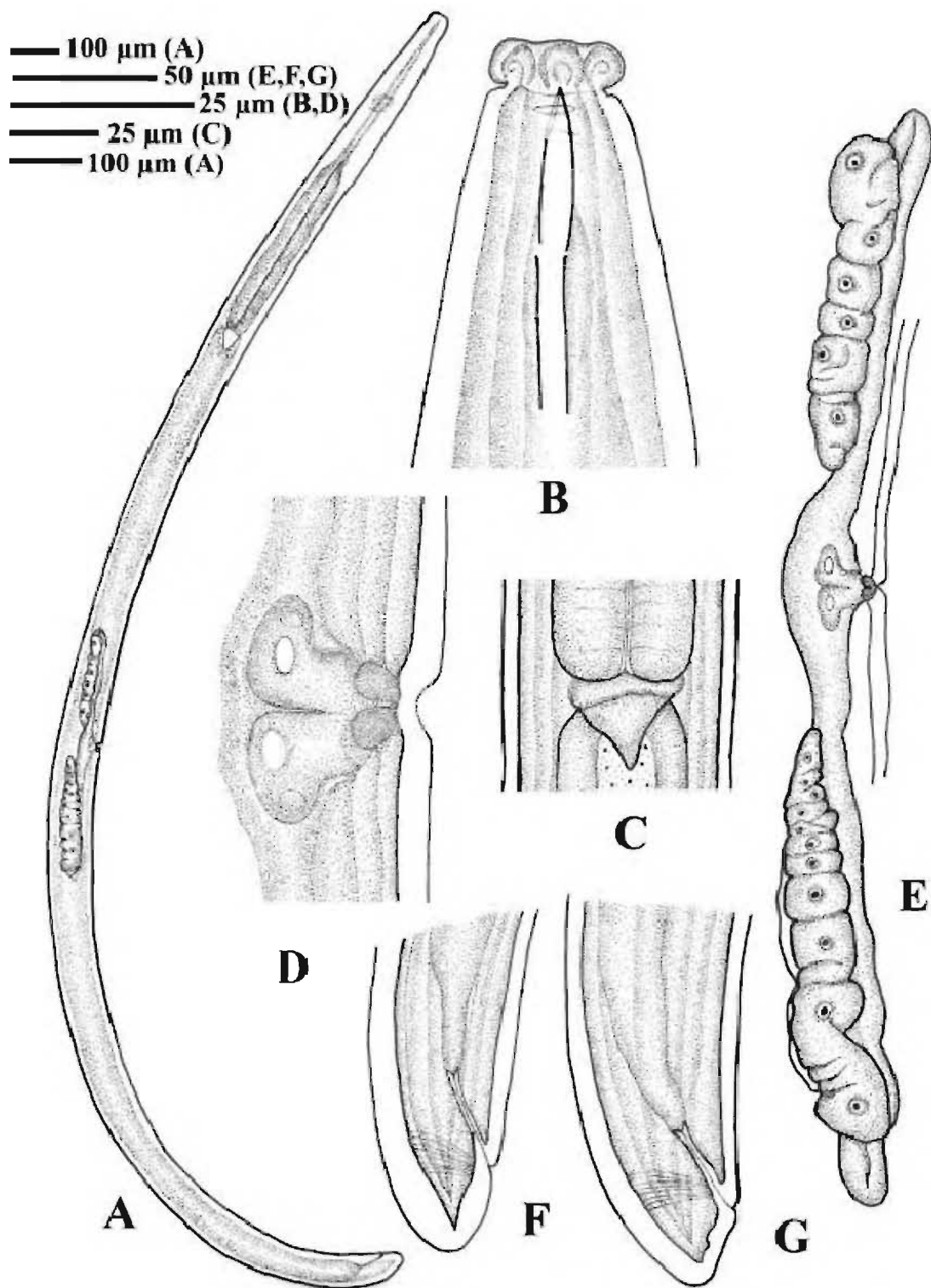


Fig. 11: Camera Lucida drawings of *Aporcelaimellus obtusicaudatus*. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Vulval region; **E.** Gonads; **F, G.** Tail region.

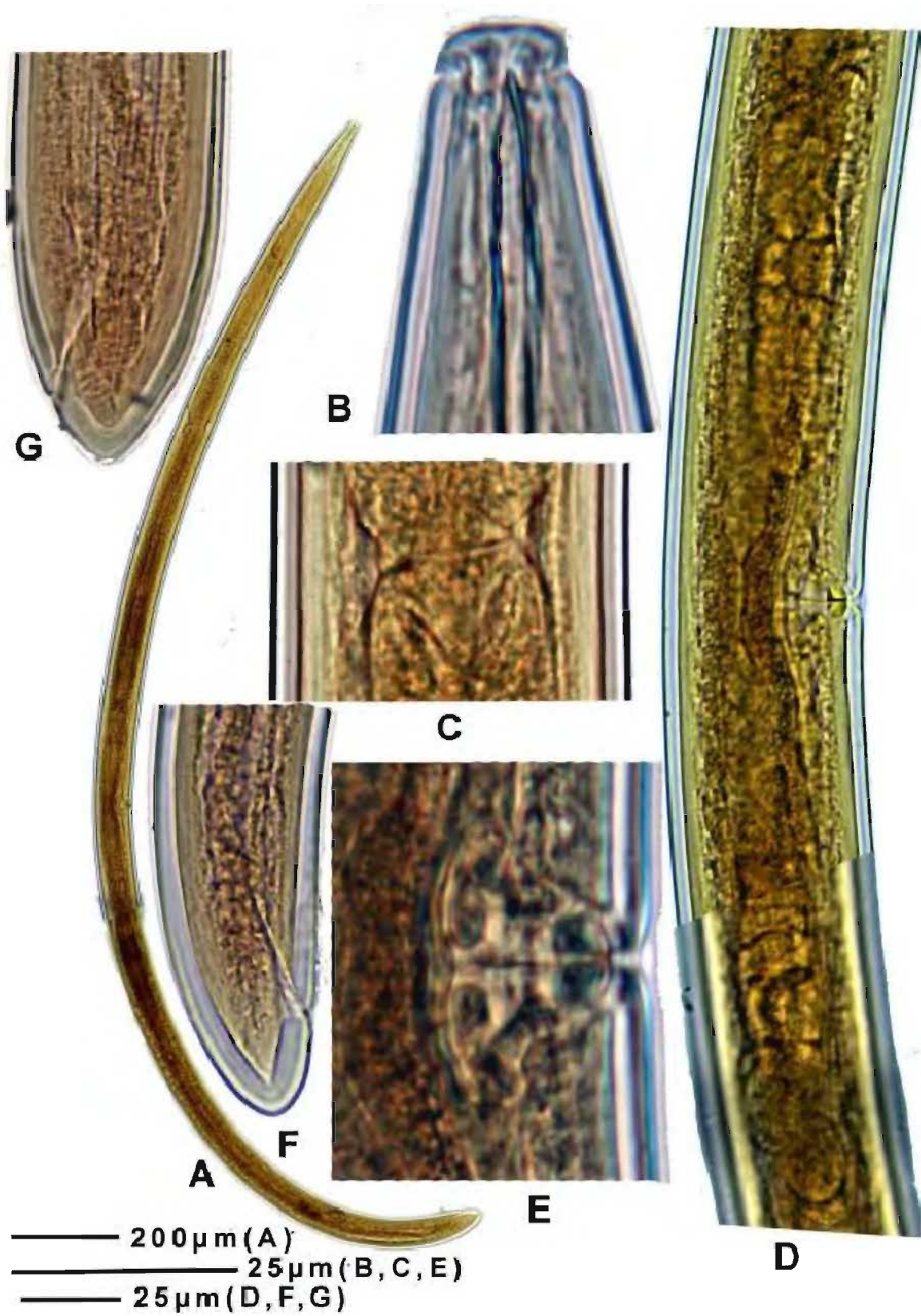


Fig. 12: Photomicrographs of *Aporcelainellus obtusicaudatus*. Female: **A**. Whole body; **B**. Lip region and Odontostyle; **C**. Cardia; **D**. Gonads; **E**. Vulval region; **F, G**. Tail region.

Table-7: Measurement of *Aporcelaimellus subhasi* Gantait et al., 2006 (all measurements in μm except L in mm).

Morphometric characters	Females (n=25)	Mean $\pm$ SD
L	1.377 - 1.880	1.586 $\pm$ 0.19
a	20.29 - 40.08	29.57 $\pm$ 5.47
b	3.71 - 5.35	4.29 $\pm$ 0.57
c	24.83 - 42.47	31.45 $\pm$ 5.40
c'	1.12 - 2.17	1.56 $\pm$ 0.45
V	41.66 - 54.54	49.46 $\pm$ 3.57
G1	11.55 - 24.2	18.14 $\pm$ 4.41
G2	13.13 - 26.08	18.37 $\pm$ 4.30
Height of lip	-	5
Lip width	15 - 16.25	15.58 $\pm$ 0.54
Amphid position	5 - 6.25	5.57 $\pm$ 1.35
Guiding ring	8.75 - 13.75	10.5 $\pm$ 0.86
Nerve ring	118 - 127.5	121.75 $\pm$ 5.07
Stylet length	17.5 - 25.5	21.19 $\pm$ 2.71
Stylet aperture	7.5 - 11.25	9.47 $\pm$ 1.22
Odontophore	30- 40	33.67 $\pm$ 3.72
Oesophageal length	257.5 - 399.5	373 $\pm$ 44.03
Expanded oesophagus	165 - 202.5	187.5 $\pm$ 14.08
DO	198.5 - 227.5	212.64 $\pm$ 13.20
AS1 from DO	50 - 93.5	67.96 $\pm$ 17.42
AS2 from DO	55 - 112.5	70.07 $\pm$ 20.45
PS1 from DO	117.5 - 172.5	142.14 $\pm$ 22.05
PS2 from DO	125 - 175	149.57 $\pm$ 19.58
Cardia	22.5 - 28	26 $\pm$ 2.09
Maximum width	45 - 83.36	59.48 $\pm$ 14.52
Anterior end to vulva	670 - 937.5	799.44 $\pm$ 93.08
Vaginal length	19.25 - 22.5	20.83 $\pm$ 1.45
Vaginal width	12.5 - 17.5	14.88 $\pm$ 2.18
Pars distalis	2.0 - 2.5	2.46 $\pm$ 0.22
Pras refringes	5 - 7.5	6.25 $\pm$ 1.09
Pars proximalis	10 - 12.5	11.16 $\pm$ 0.91
Anterior gonad	165 - 455	293.4 $\pm$ 100.92
Uterus	50 - 140	75.27 $\pm$ 31.92
Oviduct	60 - 125	97.38 $\pm$ 21.03
Ovary	50 - 190	120.61 $\pm$ 54.74
Posterior gonad	195 - 450	297.22 $\pm$ 100.98
Uterus	49 - 137.5	75.33 $\pm$ 32.07
Oviduct	71 - 140	99.36 $\pm$ 24.42
Ovary	62.5 - 200	122.5 $\pm$ 49.54
Rectum	27.5 - 40	34.5 $\pm$ 4.84
Prerectum	62.5 - 85.5	72.82 $\pm$ 7.98
Tail length	45 - 57.5	51.72 $\pm$ 3.85

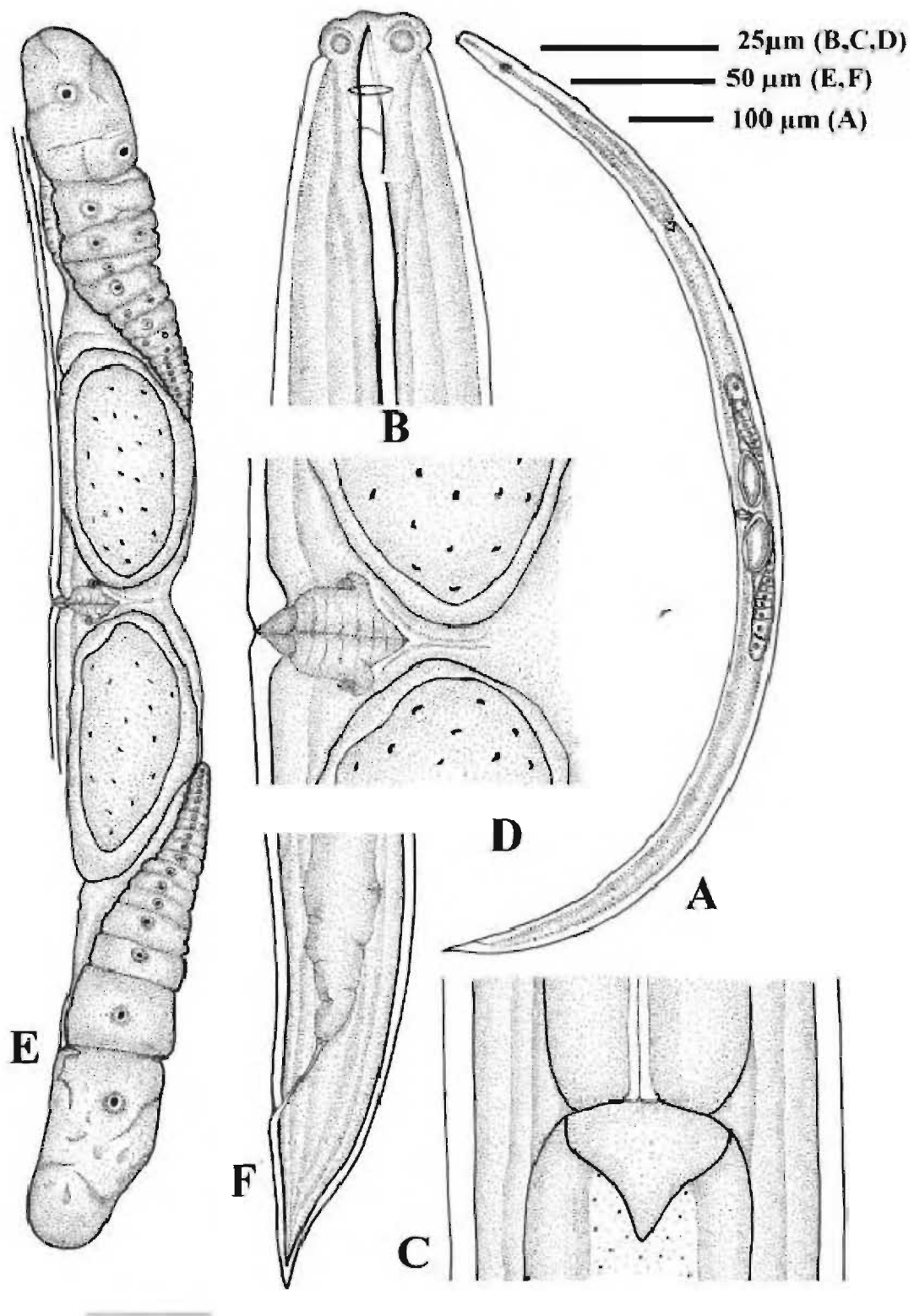


Fig. 13: Camera lucida drawings of *Aporcelaimellus subhasi*. Female: **A.** Whole body; **B.** Lip region and Odontostyle; **C.** Cardia; **D.** Vulval region; **E.** Gonads; **F.** Tail region.

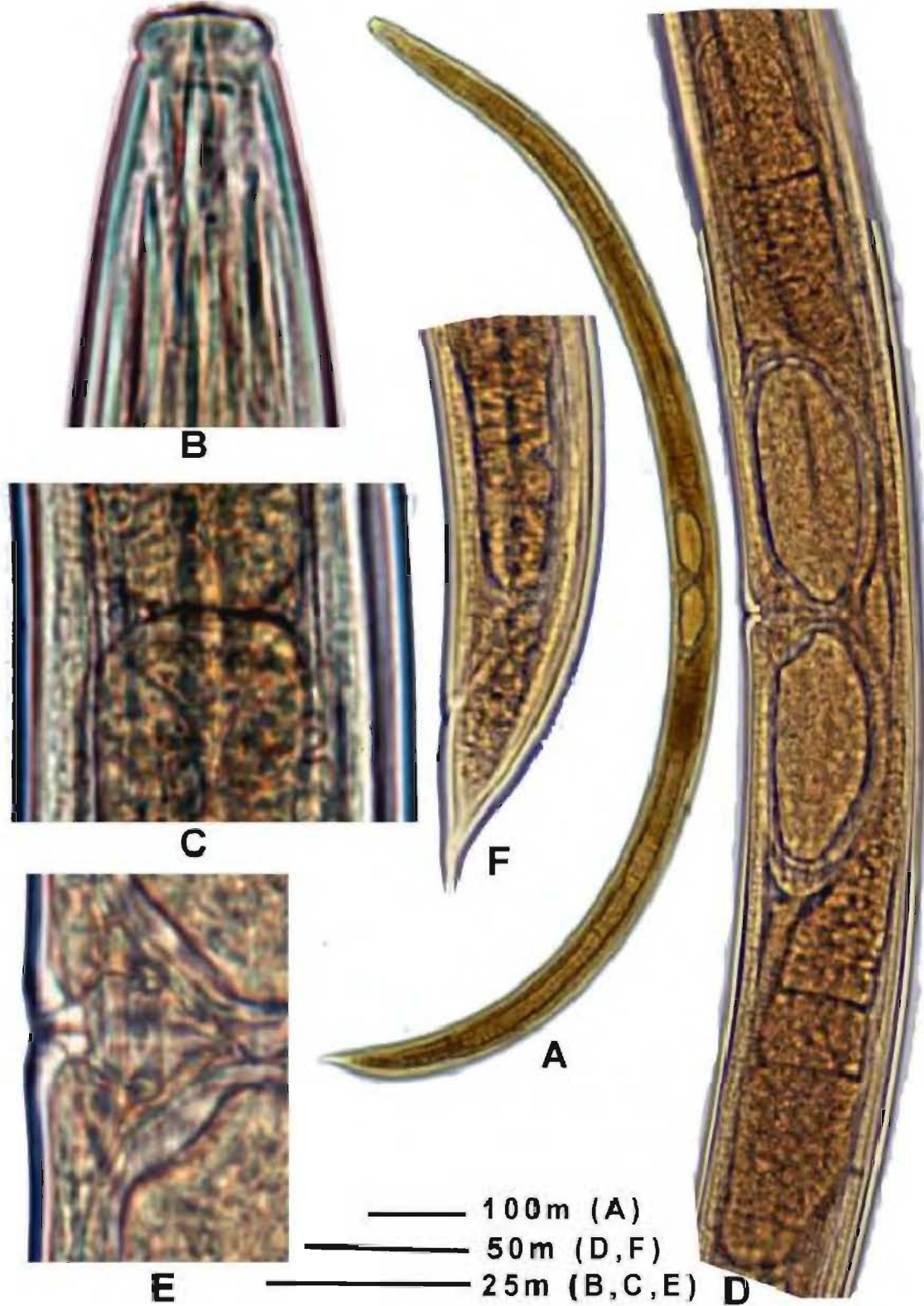


Fig. 14: Photomicrographs of *Aporcelaimellus subhasi*. Female: **A**. Whole body; **B**. Lip region and Odontostyle; **C**. Cardia; **D**. Gonads; **E**. Vulval region; **F**. Tail region.

tapering pointed tip, its length about half to one third as long as corresponding body width. Genital system amphidelphic with reflexed ovary and oocytes arranged in a single row. Oviduct joins the ovary subterminally. Vulva transverse. Vagina extends about 27-42% of the corresponding body width. Presence of triangular, sclerotised pars refringens vaginae at vagina vulval junction. Prerectum 1.9-2.4 and rectum about one anal body width long. Tail convex conoid with the tip pointed with a pair of caudal pores on each side.

Male: Notfound

Remarks: The species *A. subhasi* was described by Gantait et al., (2006) from the rhizospheric soil of banana (*Musa paradisiaca* L. cv. Kanthali) from Murarichak village under Sabang Block in Paschim Medinipur district, West Bengal, India. The presently described species completely resembles the previously described species but slightly differs from it in having posteriorly located guiding ring (vs 7-8.4 μ m), longer odontostyle (vs 19-21 μ m), anteriorly placed nerve ring (vs 132-146 μ m) and shorter tail length (vs 53-66 μ m), may be due to intraspecific variations. This is the first report from the district North 24 Parganas.

SUMMARY

Three new and four known species of dorylaimid nematodes viz. *Aporcelaimellus istvani* n. sp.; *A. tiasiae* n. sp.; *A. wasimi* n. sp.; *A. amazonicus* Andrassy, 2004; *A. budauniensis* Khatoon and Sharma, 2000; *A. obtusicaudatus* (Bastian, 1865) Altherr, 1968 and *A. subhasi* Gantait et al., 2006, collected from rhizospheric soil of different cucurbitaceous plants from different localities of the district North 24 Parganas, West Bengal, India have been described and illustrated.

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FIRST RECORD OF THE GENUS *NESTICODES* SIMON, 1894 FROM INDIA WITH TAXONOMIC STUDIES ON A RED COB-WEB-SPIDER *NESTICODES RUFIPES* (LUCAS, 1846) (ARANEAE : THERIDIIDAE) FROM WEST BENGAL, INDIA

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INTRODUCTION

Araneid Taxonomy in India was initially started with Westwood (1835). Many other workers like Blackwell(1864), Stoliczka (1869), Thorell (1877), Pocock (1895), Tikader (1966, 1970, 1977, 1977, 1980, 1982 & 1987), Tikader & Biswas (1981), Tikader & Gojbe (1982). Biswas 1985, Biswas & Biswas 1992, Saha *et al.*, (1995), Majumder & Tikader (1991), Majumder (2004), Saha & Roychowdhuri (2004), Majumder & Talukdar (2006, 2008), Sebastian & Peter (2009) and many more contributed in this field of study. But the first comprehensive literature regarding the same was *The fauna of British India including Ceylon and Burma: Araneae* published by Pocock in 1900 and after the publication of the Hand book of Indian spiders by Tikader in 1987 studies in this group has got special impetus among the budding taxonomist in India and adjacent countries. Studies on Theridiid spiders of India also were initiated by Westwood(1835). Later Doleschall (1857), Fanfold (1867), Cambridge (1869), Thorell (1870), Simon (1895) Lerado (1902) and Patel (1973) along with some other worker made much contribution in this field. Finally extensive studies on the spider family Theridiidae from India was executed by Tikader during 1963-1977.

The genera of the family Theridiidae can be distinguished into six groups based on their habit and habitat (Murphy & Murphy, 1993).

Genus *Nesticodes* are included in the group of genera which are found in the habitat like building or shrubs along with other genera namely *Achaeearanea*, *Anelosimus*, *Enoplognatha* and *Theridion*, out of which only two genera (*Achaeearanea* and *Theridion*) have yet been reported from India. Due to their identical size and appearance and due to unavailability of proper generic key of these genera these Spiders have been advised to identify on the basis of their web structure (Ganesh Kumar & Silwal , 2007).

Spider fauna of Bibhuti Bhusan Wildlife Sanctuary at Parmadan in North 24 Parganas District of West Bengal has not yet been studied in a comprehensive manner. Fauna of the order Araneae from the state of West Bengal has been described by Biswas and Biswas, 1992. Besides there are several published records from the state of West Bengal (Pocock, 1900 & 1901; Simon 1906; Gravely 1931; Sinha 1951; Tikader 1970; Tikader 1980 & 1982; Sethi & Tikader 1988; Majumder & Tikader 1991; Biswas & Biswas 1992, Talukdar & Majumder, 2007) as well as from India on taxonomy of spider fauna (Tikader, 1970, 1977, 1977, 1980 & 1982; Tikader & Biswas 1981; Tikader; Tikader & Gojbe 1982; Biswas 1985). But in these publications there is no mention of the Red Cob-Web-Spider *Nesticodes rufipes* (Lucas, 1846) from any part of India.

In recent years the authors had surveyed the whole areas of this Wildlife Sanctuary in different seasons during 2008-2010 for studying the habitats, behavior and diversity of spider along with other arthropods to prepare a faunal inventory from this environment towards the goal of conservation. During their surveys, the authors came across some 0.8cm-1cm long *Nesticodes rufipes* spiders belonging to the family Theridiidae Sundevall, 1833 under the old furniture of the Forest rest house of Parmadan at an altitude of 68ft. between the GPS co-ordinate of 23°11'18.26" E and 88°45'53.45"N of the state of West Bengal and conducted taxonomic studies on this fauna.

MATERIALS AND METHOD

A. The Study Area : The present work was initiated from Spread out over 640 hectares of forest land with a variable altitudes between 50 - 90ft. from sea level. The forest land is bounded on all its three sides by the River Ichamati while the eastern side is bounded by adjoining village areas namely Parmadan and Jhupa. The sanctuary is also known as Parmadan Deer Park and is around 150 km North-East from Kolkata between the GPS Co-Ordinates of 88° 46' 03.03"-88° 45' 13. 18 "E in East-West direction and 23° 11' 22.62"-23° 10' 46.87" N in North to South. More than 65 % of the sanctuary is encircled by the River Ichhamoti along the North-West to South-East boundary. The nearest major town is Bongaon, which is around 30 kms away.

- i. Vegetation :** Main trees of the forest are arjan, shrish, minjiri, tut, shimul, shirish and bamboo trees, strewn the landscape along with about 209 species of angiosperms altogether cover the floral biodiversity which contain 59 trees, 98 herbs, 34 shrubs, 15 climbers and 3 creepers.
- ii. Climate :** The climate is tropical, like the rest of the Gangetic West Bengal. The hallmark is the Monsoon, which lasts from early June to mid-September. The

weather remains dry during the winter (mid of November to mid-February) and humid during summer. Annual Rainfall is 1,579 mm (Normal in Southern Bengal), Atmospheric temperature ranges between 41°C in May (Max) and 10°C in January (Min) and Relative Humidity Between 50% in March & 90% in July.

B. Collections : Spiders were collected from the study areas directly from the webs by hand picking method, sweeping insect net (129cm in diameter) and by beating the furniture's in to an inverted umbrella. A Sunca electronic emergency lamp was used during night collection.

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

D. Identification : Well preserved spider specimens were sorted and transferred in a Petri dish containing ethyl alcohol and studied under binocular microscope. The specimens were identified up to species level. Photograph of the specimens were taken by Nikon D60 Digital SLR and Sony Mini DV DCR-HC42E.

SYSTEMATIC POSITION

Kingdom ANIMALIA
Phylum ARTHROPODA
Class ARACHNIDA
Order ARANEAE
Sub Order LABIDOGNATHA
Infraorder ARANEOMORPHAE
Family THERIDIIDAE Sundevall, 1833
Genus *Nesticodes* Archer 1950
Species *rufipes* (Lucas, 1846)

Type Species : *Theridion rufipes* Lucas 1846.

Type Locality : Oran, Algiers

Synonyms:

Theridion rufipes Lucas, H. 1846. Histoire naturelle des animaux articulés. Exploration Scientifique de l'Algérie. Zoologie 1 (Arachn.) : 89-271 [263].

- Nesticodes* Archer 1950, p. 22; type *Theridion rufipes* Lucas, 1846; removed from the synonymy of *Theridion* Walckenaer, 1805 by Wunderlich, 1987a: 214, contra Levi, 1957a: 19.
- Nesticodes rufipes*. Archer, 1950: 22, pl. II, f. 7-8 (T mf from *Theridion*).
- Theridion luteolum* Blackwell, J. 1859. Descriptions of newly discovered spiders captured by James Yate Johnson Esq., in the Island of Madeira. *Annals and Magazine of Natural History*, 4: 255-267 [259].
- Anelosimusnelsoni* Bryant, E.B. 1945. Notes on some Florida spiders. *Transactions of the Connecticut Academy of Arts and Sciences*, 36: 199-213 [200].
- Robertuspilosus* Denis, J. 1956. Notes d'aranéologiemarocaine. — VI. Bibliographie des araignées du Maroc et addition d'espèces nouvelles. *Bulletin de la Société des Sciences Naturelles du Maroc* 35, : 179-207 [203].
- Theridion borbonicum* Vinson, A. 1863., *Aranéides des îles de la Réunion, Maurice et Madagascar*. Paris : A la Librairie Encyclopédique de Roret pp. 1-337 [318].
- Theridion luteipes* Cambridge, O.P.- 1869. Catalogue of a collection of Ceylon Araneidae lately received from Mr J. Nietner, with descriptions of new species and characters of a new genus. I. *Journal of the Linnean Society of London, Zoology* 10, : 373 - 397 [382].
- Theridion albonotatum* Taczanowski, L. 1872. Les aranéides de la Guyane française. *Horae Societatis Entomologicae Rossicae*, 9: 64-11 [56].
- Theridion bajulans* Koch, L. in Koch, L. & Keyserling, E. [1871-1883] 1875. *Die Arachniden Australiens*. Nürnberg: Bauer & Raspe pp. 1 [21].
- Theridion flavoaurantiacum* Simon, E. 1880. Matériaux pour servir à une faune arachnologique de la Nouvelle Calédonie. *Annales de la Société Royale Zoologique de Belgique*, 23 (C.R.): 164 - 175 [171] [as *flavo-aurantiacum*].
- Theridion longipes* Hasselt, A.W.M. van 1882. Araneae. In Weth, P.J. (ed.) *Midden Sumatra IV. 3de A flev. Natuurlijke Historie*. Leiden, 11A: 1-56 [33].

Diagnostic Characters

Dark brown, slightly mottled, globular abdomen with red-brown legs and cephalothorax. It builds a small, tangled web in dark corners and under the furniture inside

houses or under rims of garden pots and similar structures. Epigynum with a spherical sclerotized plate; a pair of openings situated anterior part of the plate. Conductor of male palpus large, nearly as high as wide, and has two basal spurs; embolus forming a stout tube; median apophysis situated behind embolus. All coxae of male legs distally with a retrolateral cone. This genus resembles *Theridion*, but is distinguished from the latter by the epigynum with a spherical plate, conductor of male palpus nearly as high as wide and the abdomen without distinct cardiac pattern.

Materials Studied :

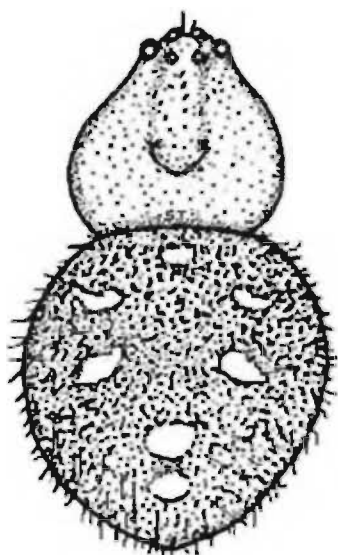
Observed 10 specimens in the field at their original habitat measuring total length of 1cm-0.8cm long in living posture while the body length of the preserved specimen measured female: 7 mm and male: about 3 mm by S. Talukdar, 7 female and 3 male at Bibhuti Bhusan Wildlife Sanctuary, Parmadan, Bongaon, North 24 Parganas, West Bengal 26.xi.2008. coll and Examined: S. Talukder.

Distribution : Algiers : Oran, Japan: Amami-oshima Is., Minami-daito Is, and Iriomote Is. of the Nansei Islands. Widely distributed in tropical area of the world. India : Bibhuti Bhusan Wildlife Sanctuary, Parmadan, Bongaon, North 24 Parganas, and West Bengal (Through this text).

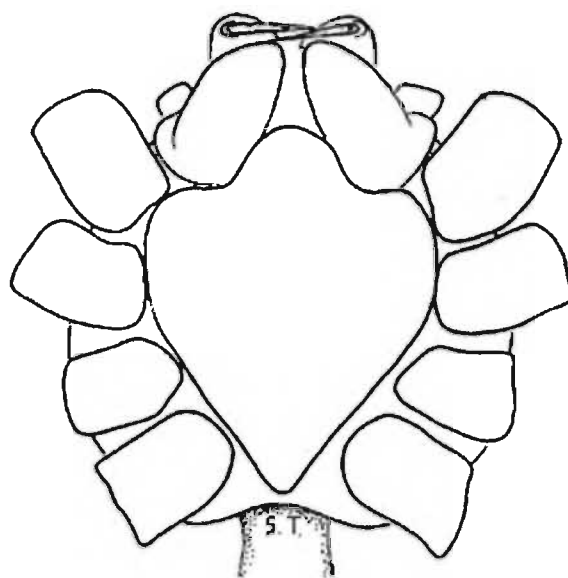
Habit and Habitat : This species builds a small, tangled web in dark corners inside a house, or under the furniture and rims of garden pots and similar structures; its round egg sac is often found nearby, the web also serving as a retreat. They are generally nocturnal hunter and found on roaming over the wall while hunting. They prey insects from nearby areas of domestic electric lamps.

Common Name : Red Cob-Web -Spider or Red Comb Legged Spider.

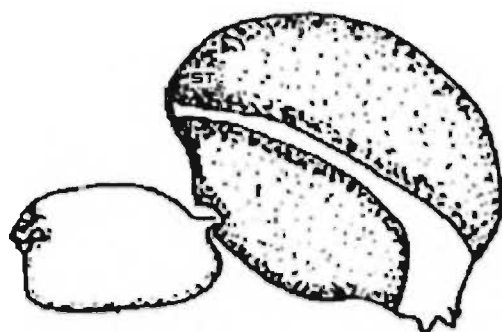
Economic Importance : Like all other spiders (Except Spiders of family Uloboridae) particularly the Theridiid spiders *Nesticodes rufipes* (Lucas, 1846) also have neurotoxin poisons in their lively uses and are considered to be

External Morphology of *Nesticodes rufipes*

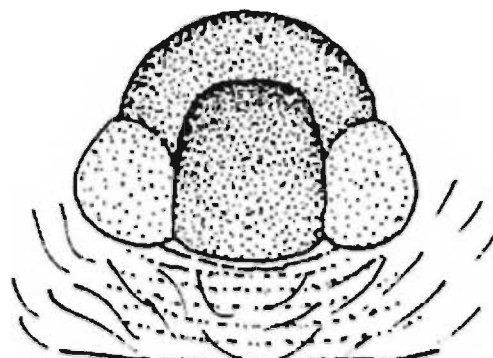
DORSAL VIEW



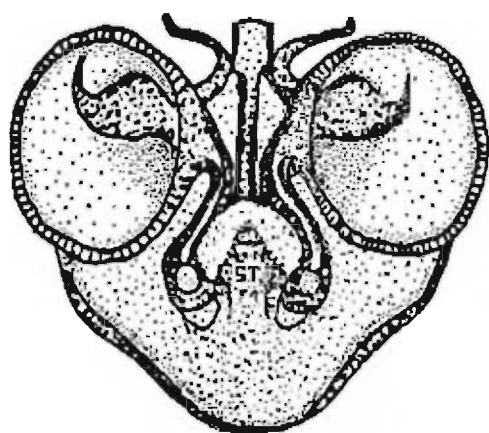
STERNUM



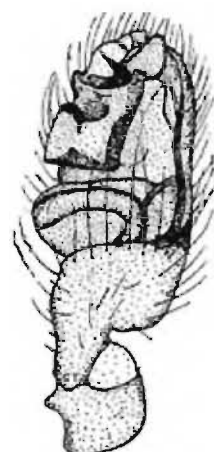
LATERAL VIEW



EPIGYNE



LATERAL VIEW



PEDIPALP



Dorsal View



Dorso - Lateral View



Mother with Egg Sacs



Ventral View



Ventro - Lateral View

medicinally important to human being. As comb-legged Spiders are used by the tribals of rural areas of the hills as drug for the treatment of Dysmenorrhoea and pain removing purposes as their traditional medicines significance of the poisons of *Nesticodes rufipes* towards ethno and modern medicinal use is noteworthy. The absolute insect predating feeding behavior of this group of animal naturally controls the pest insects and play causative function in agriculture and domestic hygiene.

DISCUSSION AND CONCLUSION

As spider from this genus *Nesticodes* have never been collected or reported from India as well as from the sub-continent, the present study was proved to be significant from the zoo-geographical point of view. Discovery of the habitat of this spider in the particular study area i.e. Gangetic Plane-ecosystem in this Subcontinent also noteworthy. Description and taxonomic record of this spider species have been

highlighted in this paper as database for future study. Occurrence of this spider is significant from the viewpoint of biodiversity and distributional pattern as hitherto unrecorded from the same habitat of this geographical area. Socio-Economic importance and possibilities as a bio-medicinal resource for exploitation enlighten the importance of conservation of this Biodiversity.

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The authors are grateful to Dr. K. Venkataraman, Director, Zoological Survey of India for kind permission to carry out the work. The Author express their indebtedness to the Forest department of West Bengal for providing facilities and necessary permission to conduct this study into the conservation area. Thanks are due to all supporting technical and scientific staff of Zoological Survey of India for their support to materialize the work without which the work could not have been completed.

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STUDIES ON *LINGULA ANATINA* (BRACHIOPODA: INARTICULATA) IN SUBARNAREKHA ESTUARY, ODISHA WITH SPECIAL REFERENCE TO HABITAT AND POPULATION

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INTRODUCTION

Lingula is the oldest living genus belongs to the phylum Brachiopoda commonly known as 'Lamp shell'. It is flourished from Cambrian times to the present (MacGINITIE and MacGINITIE, 1968) and come down to the ages with little changes. Among the 150 extant species family Lingulidae, it is considered to be the most primitive and has only 12 species (living) belong to 2 genera (Emig, 1997). Genus *Lingula* is distributed in Asia, Australia, Europe and Africa while the other genus *Glottidia* confined only in the continents of America.

Soota and Reddy (1976) reported on the genus *Lingula* from Talsari, the western most part of the Subarnarekha estuary and the detailed taxonomical account and their habitats were not investigated. During the Faunistic survey in Subarnarekha Estuary (2006-2010), a vast bed of *Lingula anatina* Lamarck, 1801 were noticed. The present attempt is to investigate on the taxonomical account, habitat and population of *Lingula anatina*.

MATERIAL AND METHOD

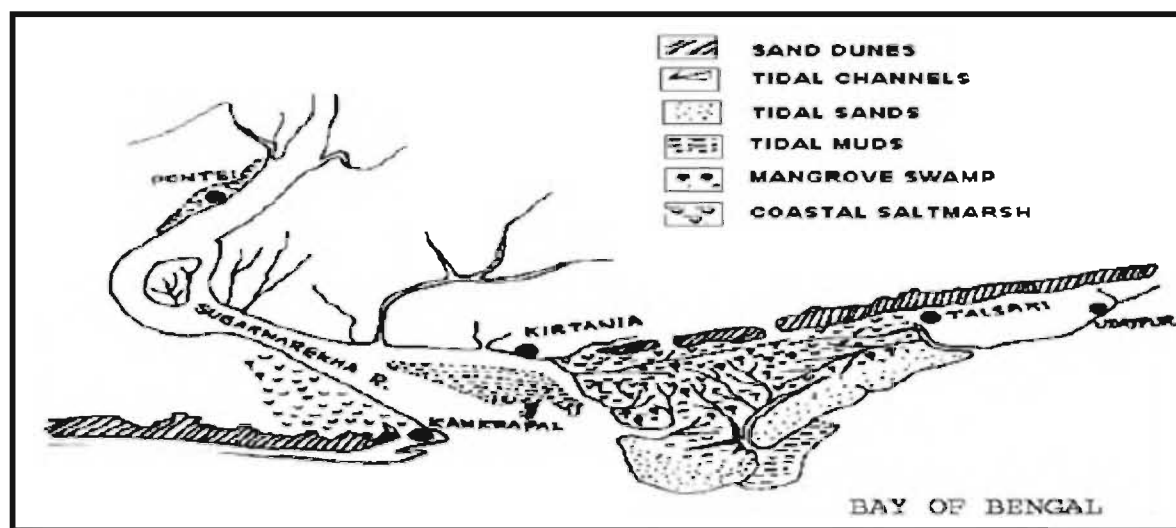
The Subarnarekha is one of the major rivers of eastern coast of India. It originates from the Ranchi plateau of Jharkhand state and flows over 477 km distance covering three states of India and forming an estuary complex composed of mangrove trees, bushes, salt marshes, mudflats and sandy beaches at the extreme north eastern

part of Odisha (Latitude 21° 34' - 21° 37' and Longitude 87° 20' - 87° 27'), which opens into Bay of Bengal.

A long mudflat (19 km) besides the narrow creeks, surrounded by mangrove bushes and salt marshes in between Talsari to Kirtania are overwhelming habitats, which makes a sheltered bed for this species (Map. 1).

For taxonomical identification Specimens were collected from the mud by using a shovel and spade for especially bigger specimens. After collection, the specimens were washed and anesthetized by using magnesium chloride in estuarine water. A small chip of wood used to be placed in between two valves of the shell of these specimens before preservation in 90% alcohol; this will allow effective penetration of preservatives into the soft body parts of the specimens.

The observation and collection of specimens for this study were made in different seasons during the period of 2006-2010. Surveys were made in low tidal conditions. Littoral fauna were collected during low tide from the mud flat area along the *Lingula* habitat. During sample collection and observation, type of the substrate, abundance, habit and habitats of individual species were noted, population of brachiopods are estimated by calculating their number and nest holes in 1 square meter area by using a plastic frame of 1 meter X 1 meter.



Map 1.: Different habitat of Subarnarekha estuary showing the mangrove zonation as habitat of *Lingula anatina*

TAXONOMICAL ACCOUNT

Phylum BRACHIOPODA Dumerill, 1806

Class LINGULATA

Order LINGULIDA Waagen, 1885

Family LINGULIDAE Menke, 1828

Genus *Lingula* Bruguiere, 1797

Lingula anatina Lamarck 1801

Lingula anatina Lamarck 1801, p. 140, pl. 1-6.

Material examined: 16 ex; Loc: India, Orissa, Dist: Balasore, Subarnarekha Estuary, Talsari, Date: 05. vi. 2006; Coll: A. Misra and party, Regd. No. MP 1/5.; 13 ex., Loc: India, Orissa, Dist: Balasore, Subarnarekha Estuary, Kirtania, Date: 13. X. 2007, A. Misra and party; Regd. No. MP 2/5.; 11 ex; Loc: India, Orissa, Dist: Balasore, Subarnarekha Estuary, Talsari, Date: 19. iii. 2008; Coll: A. Misra and party, Regd. No. MP 3/5.

Diagnosis: Shells shape oblong; sub parallel lateral margins; anterior margin slightly convex to straight with a median projection; smooth external valve surface but distinct growth lines. Colour greenish (from translucent green to dark green), sometimes slightly brownish along the lateral and posterior margins (Fig.1). Deltoidal regions acute: dorsal valve with triangular beak with straight to slightly concave profile; ventral valve with a pedicle groove without visible growth lines, discontinuous with the internal side

of the valve. The general muscle disposition is elongate. On the ventral face, the left perimial line is strongly curved below the median internal oblique muscle, anterior internal oblique muscles (near the anterior oblique muscle) and posterior internal oblique muscles are well separated.

Distribution: India: East coast: Subarnarekha Estuary (Orissa); Kankinda Bay and Krishna Estuary (Andhra Pradesh); Parangipettai Beach (TamilNadu). West Coast: Karwar (Karnataka) Konkan Coast (Maharashtra); Beyt Island, Okha (Gujarat); Mayabandar, Phoenix Bay and Port Blair (Andaman).

Elsewhere: Australia, Japan, China, Philippines.

HABITAT

In Subarnarekha estuary, the habitat of *Lingula anatina* occurs in either side of the tidal creeks, substrata are generally soft muddy area, but sometimes black soil (decomposed) and sand mixed mud were preferred for living. Juvenile's bed was found in fine soft mud only. The Lingulids beds are only 2-8 mts in width. Both the banks of the creeks covered by patchy mangroves and mudflats highly exposed during low tide, the area is inundated by sea water at a depth of 0.5 to 1.2 mts during high tide.



Figs : 1. *Lingula anatina*(adult). 2. Habitat of *Lingula anatina* at Subarnarekha estuary.
3. Juvenile bed of *L. anatina*. 4. Nest hole of *lingula anatina* with one adult form in its hole

OCCURRENCE AND POPULATION DENSITY

The occurrences of the Lingulids were predominant in the scanty zones of mangrove forest of the Subarnarekha estuary (Fig. 2). Due to presence of suitable habitat and lack of disturbance in this estuary a vast belt of 19 km long and several meters width of Lingulids habitat is nowhere reported in our country. The

mean population were measured 640-720/ m² on the soft mud just beside the narrow creeks and 900-1200/ m², at a distance of 4-8/ m² from the creek and on silty sand. Juveniles are found in pre and post monsoon with a population of 2300-2700/ m² (Fig.3). Juvenile beds are found only in the soft, blackish mud. Some macro benthic fauna (Table-1) were recorded from the same habitat, to relate ecological relationship with

Table-1. : List of Macrofauna found in the Lingula bed

Sr. No.	Group	Species
1.	CNIDARIA	<i>Pelocoetes exul</i> Annandale, 1915
2.		<i>Edwardsia jonesii</i> Seshaiya & Cuttress, 1971
3.		<i>Virgularia</i> sp.
4.	POLYCHAETA	<i>Euchymene annandalei</i> Southern, 1921
5.		<i>Phyllodoce malmgreni</i> Gravier, 1900
6.		<i>Loimia medusa</i> (Savigny, 1818)
7.		<i>Diopatra cuprea</i> (Bosc, 1802)
8.		<i>Parheteromastus tenuis</i>
9.		<i>Dendronereides heteropoda</i> Southern, 1921
10.	SIPUNCULIDA	<i>Phasolosoma arcuatum</i> (Gray)
11.	BIVALVIA	<i>Glauconome sculpta</i> Sowerby, 1894
12.		<i>Laternula truncata</i> (Lamarck, 1818)

Lingula anatina. Based on the burrows opening the bedding can be described the type of genus lives in the habitat. Here in the study *Lingula anatina* Lamarck 1801 bed was observed which has elliptical opening based on the animal morphological pattern. Slit or oblique openings of their nest hole are distinguished the *Lingulid* bed from the bivalve, as the latter has a rounded burrow openings (Fig.4).

DISCUSSION

Live beds of *Lingula* sp. reported from Balapur Bay of Beyt Island from Gujrat coast (Hornell, 1909); Maharashtra coast (Awati & Kshirsagar, 1935 & 1957); Vellar river mouth of Tamilnadu (Rama Moorthy *et. al.*, 1973); mudflats of Kakinada Bay (Radhakrishna and Ganapathi, 1969); Digha Mohana, West Bengal and Talsari, Orissa (Soota and Reddy, 1976); Karwar waters of Karnataka (Veena & Nayak, 2004) and recently from Krishna estuary, Andhra Pradesh (Rao, 2009). Beside this some stray report on the dry shell collection also available (Patil, 1953; Soota & Reddy, 1976 and Rao, 2009). The studies on the habitat and population of these primitive animals were not quiet explored.

Thus, this investigation shows the detailed study on *Lingula anatina*, which mainly prefers the silty sand substrata near the estuarine mouth. The

discontinuous, sporadic and patchy distribution of this species also indicates that the species is a rare faunal elements of the coastal areas of India (Rao, 2009). Lesley cherns, (1979) found two common species in the Lower Leintwardine Beds, *Lingula lewisii* and *Lingula lata* which occur commonly in such associations, have distributions indicative of such an environment and occurrence resembles an indicator of very nearshore environments, particularly when found in monospecific assemblages which was coincided with the the huge population of *Lingula anatina* occurrence in Subarnarekha estuary.

Subarnarekha estuary, merely rich in biological resources (Mitra *et. al.*, 2009) recently facing some disturbance by the fishing activity of local people and tourist trampling which should be restricted to some extent to conserve and restore this ecosystem.

SUMMARY

Lingula anatina belongs to phylum Brachiopoda is a rare and primitive animal occurs in Indian coast and estuaries as patchy distribution. Here it is reported from the Subarnarekha estuary of Orissa with the other invertebrate fauna occurs in the same habitat of this species. The habitat of *Lingula anatina* of Subarnarekha estuary is the widest (19 km long)

in India. The population of the *Lingula* and other fauna are also measured and polychaetes found the dominant species. As the habitat of *Lingula anatina* is situated in the estuaries mudflat where a freshwater discharge is opens in the estuaries, this condition should be maintained and conservation of the habitat may be needed to conserve this species.

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MANGROVE ASSOCIATED SIPUNCULID (SIPUNCULA : PHASCOLOSOMATIDAE) AND ECHIURID (ECHIURA: THALASSEMATIDAE) FROM ODISHA COAST, INDIA

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INTRODUCTION

The Sipuncula and Echiura form important groups of intertidal invertebrate distinguished by their members dwelling in burrowed substrata. They are found in the temporarily exposed intertidal limits to the abyssal depths of vast seas and also certain tropical estuaries of the globe. Though they are typically of marine origin but a few apparently well adapted to the estuarine environment. This paper deals with a single species of Sipuncula, *Phasolosoma* (*Phasolosoma*) *arcuatum* (Gray, 1928) and a single species of Echiura namely *Annelassorhynchus microrhynchus* (Annandale and Kemp, 1915) which were collected during the recent faunal survey (2011-2012) of the estuaries and mangrove fringed coastal districts of Odisha. Haldar (1985, 1989 & 1995) reported *Phascolosoma arcuatum* from Sundarbans and Hugly Matla Estuary and Haldar (1991) reported this species from different regions of Indian coast. *Annelassorhynchus microrhynchus* was first described from the estuarine zone of Chandipore by Prasad (1919). Both the species were described from the estuarine zone of Subarnarekha estuary by Mitra *et. al.*, (2010). Here both the species are first time reported from the other estuaries of Odisha.

MATERIALS AND METHODS

The collections were made from hard and sticky mud or black humus soil or mixed with fine sand granules. Specimens were picked up

carefully and brought to the camp laboratory in estuarine water. The animals were narcotized by sprinkling some quantity of menthol crystals or adding a few drops of 70% ethyl alcohol in the water containing specimens at frequent intervals for the period of more than one hour. The narcotized specimens with fully expanded condition were initially fixed in 4% formaldehyde and permanently preserved in 70% ethyl alcohol for further studies.

SYSTEMATIC ACCOUNTS

Phylum SIPUNCULA

Class PHASCOLOSOMATIDEA

Order PHASCOLOSOMATIDA

Family PHASCOLOSOMATIDAE

Phasolosoma (*Phasolosoma*) *arcuatum*
(Gray, 1928)
(Fig. 1)

1828. *Sipaculus arcuatus* Gray, *Spicilegia Zoologica*, London, Trietel, WurtZ & Co. and W. Wood, (1):8

1995. *Phascolosoma arcuatum*: Haldar, *Estuarine Ecosystem Part 2: Hugli Matla Estuary*: Zool. Surv. India: 37.

Material examined: Bandar, Devi river estuary, Puri District, Odisha; 01.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. MP396/2; 2 ex; Balaramgadi, Budha Balanga estuary, Balasore District, Odisha; 13.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. MP397/2; 3 ex, Subarnapur, Subarnarekha estuary, Balasore District, Odisha;



Fig. 1 : *Phascolosoma arcuatum*



Fig. 2 : *Anelassorhynchus microhynchus*

15.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. MP398/2; 2 ex; Talsari, Subarnarekha estuary, Balasore District, Odisha; 16.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. MP399/2; 2 ex;

Diagnosis: Trunk length 30-50mm, introvert is slender. Tentacles 10 in number, finger like, arranged in a horse-shoe shaped pattern and placed dorsally to mouth. Hooks are arranged in 50-60 closely set complete rows. Each hook is dark in colour with sharply

bent apex forming an obtuse angle. Rectum is short and without caecum. Nephridium is 1/3 as long as trunk and attached to body wall by 2/3 of their length.

Distribution: This species was described by Gray from the material collected from the Indian Ocean, no specific type locality was mentioned there, however this is an Indo west Pacific species found in tropical shallow water.

India: Subarnarekha estuary, Budha Balanga estuary, Devi river estuary (Odisha); Hooghly -Matla estuary (West Bengal); Kakinada & Visakhapatnam (Andhra Pradesh); North Andamans.

Elsewhere: Southern China to Northern Australia, Malaysia, Indonesia and Bangladesh.

Habitat and associated fauna: These animals were found in hard clayey soil (blackish in colour) at a depth of 25-35 cm from the surface. A bivalve namely *Glouconeme scluptata* and one species of brachiopod (*Lingula anatina*) are found in the same habitat. Polychaetes namely *Iphione* sp. is encountered in the same burrows of this sipuncula. This association appears as first time observation where as *Euclymene annandale* and *Parheteromastus tenuis* are very common in relatively soft mud of the same habitat. One small gastropod, *Assimineia* sp. are noticed to crawl on the surface soil of this area.

Remarks: The species was described from the estuarine zone of Subarnarekha estuary by Mitra *et. al.*, (2010). Here it is first time reported from the other estuaries of Odisha.

Phylum ECHIURA
Class ECHIUROIDEA
Order ECHIURIDA
Family ECHIURIDAE
Subfamily THALASSEMATINAE

Anelassorhynchus microhynchus (Annandale and Kemp, 1915)
(Fig. 2)

1915. *Thalassema microhynchus* Annandale and Kemp, *Mem. Indian Mus.*, 5:55-63.

1919. *Thalassema microhynchus*, Prasad, *Rec. Indian Mus.*, 16:399-400.

1946. *Anelassorhynchus microhynchus*: Fisher, *Proc. U. S. natn. Mus.*, 96:222.

1995. *Anelassorhynchus microhynchus*: Haldar, *Estuarine Ecosystem Part 2: Hugli Matla Estuary : Zool. Surv. India*:35-36.

Material examined: 1 ex; Balaramgadi, Budha Balanga estuary, Balasore District, Odisha; 15.xii.2009, S. Mitra & J.G. Pattanayak, Reg. No. MP029/3; 2 ex; Astaranga, Devi river estuary, Puri District, Odisha; 30.iii.2011, S.

Mitra & J.G. Pattanayak, Reg. No. MP030/3; 1 ex; Bandar, Devi river estuary, Puri District, Odisha; 02.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. MP031/3; 1 ex; Balaramgadi, Budha Balanga estuary, Balasore District, Odisha; 13.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. MP032/3; 3 ex, Subarnapur, Subarnarekha estuary, Balasore District, Odisha; 15.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. MP033/3.

Diagnosis: The trunk ranges from 13 to 30 mm long (after full narcotisation). Proboscis varies from 1 to 13 mm in length. In live condition the anterior part of the trunk is somewhat translucent, posterior part each quite opaque. Proboscis is rudimentary, its two lateral margins at the proximal end fused ventrally free and end each truncate. Circumanual region possesses papillae. Ventral hooks are well developed and their free ends are broad and curved. Color of the trunk is grayish white, proboscis cream coloured.

Geographical Distribution: Chandipore (type locality), Balaramgadi, Subarnapur (Balasore District, Odisha); Bandar, Astaranga, (Puri District, Odisha); South 24 Parganas (West Bengal).

Habitat and associated fauna: These animals were found in soft and sticky mud or black humus soil or mixed with fine sand granules at a depth of 15-25 cm from the surface. A polychaete *Glycera tessellata* and one species of unidentified capitellids are frequently found in this habitat.

Remarks: The species was described from the estuarine zone of Chandipore by Prasad (1919) and after that by Mitra *et. al.*, (2010) from Subarnarekha estuary. Here it is first time reported from the other estuaries of Odisha.

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SUMMARY

The present paper deals with the diagnostic features, habitat and distribution of one species of sipuncula and one species of echiura available in some estuaries and mangroves of Odisha.

A Polynoid polychaete, *Iphione* sp. was found in the same burrows of this sipunculids. Literature review suggests that globally there is no any report of such association.

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MANGROVE ASSOCIATE GOBIES (TELEOSTEI : GOBIOIDEI) OF INDIAN SUNDARBANS

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INTRODUCTION

The gobioid fishes are distributed throughout the temperate and tropical zones of the world. They occur in fresh to hyper saline waters, in mud, sand as well as reef habitats. Some species have a very wide distribution, while a few are markedly localized. Most species are cryptic bottom dwelling carnivores that usually feed on small benthic invertebrates. Abundance in number of species, intraspecific morphological diversity and interesting habitat, behaviour and adaptations make them a subject of great biological importance. Most of the gobioid fishes found in the Sundarbans are mangrove associates, particularly the mudskippers are characteristic of any mangrove habitat.

The Sundarbans is known as the world's largest mangrove ecosystem. Mangroves are well known as transition from the marine to freshwater and terrestrial ecosystems. They provide critical habitat for numerous species of fishes and crustaceans that are adapted to live, reproduce and spend their juvenile lives among the tangled mass of roots, known as pneumatophores, that grow upward from the anaerobic mud to get the trees' supply of oxygen. However, it is difficult to say which species are confined to the mangroves and are not occurring in other habitats (Macnae, 1966). Hence, the total habitat is taken into consideration to study this peculiar group of fish.

Our knowledge of these fishes of Bengal (pre-partitioned) dates from Hamilton (1822) who described 16 gobioid species from the lower reaches of the River Ganga. Later, Annandale (1907), Hora (1933, 1935 a, b), and others contributed significantly to the fishes of Hugli-Matla estuarine system. The monumental work of Koumans (1941) gives a vivid account of gobioid fishes of India that incorporates a number of species from lower Bengal. Chatterjee (1978) studied the gobioid fishes of the Gangetic delta and described a new genus and new species (Chatterjee and Mishra 2013). Talwar *et al.*, (1992) and Mukherjee (1995) further contributed to the wealth of gobioid fauna of West Bengal and the Hugli-Matla estuaries.

The present study aims at giving an account of the mangrove associate gobioid fishes of the Indian Sundarbans, where inundation and exposure occur twice in every block of 24 hours. This work incorporates the review of the gobioid fishes occurring in the region. The current status of species is mostly following Froese and Pauly (2013) and Eschmeyer (2013). The gobiid classification in to subfamilies is in accordance with Nelson (2006). The identification keys provided here are meant for Indian Sundarbans only and that may not be suitable for other geographic regions.

MATERIAL AND METHODS

The largest part of the material, on which the present work is based, is housed in the National

Zoological Collections of the Zoological Survey of India (Z.S.I.), Kolkata. The collections include a large number of gobioid fishes collected by Sir F. Day, A. W. Alcock, N. Annandale, S. L. Hora, and others, which include a number of type specimens. Most of the specimens on which F. P. Koumans based his monumental work (Koumans, 1941) are also preserved in the Z.S.I. These specimens include several collections from the adjoining areas of Sundarbans. All specimens included in Mukherjee (1995), housed in Z.S.I., were re-examined and used for the present work. It is also supplemented by recent collections of gobioid fishes during 2007-08 from the various locations of Sundarbans. The study area is shown in fig.1 and a satellite picture of the Sundarbans is also shown in fig.2. Recent collections were made from the following places. Garmin 12 channel GPS was used to mark the latitude and longitude of the places surveyed. The places surveyed recently and their GPS points are as follows:

Gosaba	22°09.924' N; 88°47.819' E
Sajnakhali	22°07.485' N; 88°49.809' E
Dobanki	21°59.368' N; 88°45.259' E
Haldibadi	21°43.547' N; 88°46.966' E
Chamta	21°51.667' N; 88°54.831' E
Khatuajhuri	22°03.293' N; 88°59.356' E
Burirdhabri	22°04.653' N; 89°01.730' E
Jhila	22°11.393' N; 88°57.543' E
Neti Dhopani	21°55.219' N; 88°44.759' E
Dobanki	22°59.368' N; 88°45.259' E
Sudhanyakhali	22°06.058' N; 88°48.075' E
Basanti	22°12.167' N; 88°42.660' E
Jharkhali	22°01.127' N; 88°40.935' E
Sonakhali	22°12.259' N; 88°42.655' E
Canning	22°19.184' N; 88°40.471' E

Abbreviations of names of the organizations used in this work:

SDCMBRI Susama Devi Chowdhurani Marine Biological Research Institute, Sagar Island

ZSI	Zoological Survey of India
ZSI-ASB	Asiatic Society of Bengal collections, now housed in the Zoological Survey of India, Kolkata
ZSI-SFRS	Sundarban Field Research Center, ZSI, Canning collections

The Sundarbans

The Sundarbans can be defined as a group of islands starting from the mouth of river Hughly on the west and extending upto the river Meghna in the east, covering four districts, two from West Bengal viz. North 24-Parganas, South 24-Parganas districts; and two from Bangladesh, viz., Khulna and Barishal districts. The Indian Sundarbans at the apex of Bay of Bengal (latitude 21°13'- 22°40' N. and longitude 88°03'- 89°06' E.) is located on the southern fringe of the state of West Bengal, covering the major portions of North and South 24-Parganas districts. The region is bordered by Bangladesh in the east, the Hughly river in the west, Dampier-Hodges line in the north and Bay of Bengal in the south. As regards the total area of Sundarban forests, a number of estimations are found in literatures (Dey, 2006). In a recent estimation by the Forest department, it has been stated that 4,264 sq. km. forest persists within Indian Territory and 4,109 sq. km. in Bangladesh. With considerable degree of marine characteristics in the major portion of the ecosystem, the important morphotype of the deltaic Sundarbans are beaches, mudflats, coastal dunes, sand flats, estuaries, creeks, inlets and mangrove swamps. The mangrove environment can be differentiated into four forest types, viz., Tidal Swamp Forests, Saline Water Type Mixed Forests, Brackish Water Type Mixed Forests, and Palm-Swamp Type. Though it is very difficult to define the mangrove fauna as a whole, Ekman (1935) stated that the mangrove fauna is characterized by its low species diversity represented by large populations. Macnae (1966) observed that it is difficult to say which species are confined to the mangrove and are not occurring in other habitats. On the other hand, same species may be available in various mangrove ecosystems within the same ecological region.

Main Flora and fauna : There are 64 plant species in the Sundarbans with the capacity to withstand estuarine conditions and saline inundation as a result of tidal effects. Some of them are listed here: *Excoecaria agallocha*, *Heritiera fomes*, *Ceriops decandra*, *Ceriops tagal*, *Phoenix paludosa*, *Sonneratia alba*, *Avicennia* spp., *Rhizophora apiculata*, *Rhizophora mucronata*, *Xylocarpus granatum*, *Nypa fruticans*, *Bruguiera* spp. etc. The invertebrate faunal diversity of Indian Sunderbans, as enumerated by Mandal and Nandi (1989), comprised one species of Porifera, 5 Cnidaria, 1 Ctenophora, 5 Rotifera, 2 Nematoda, 2 Chaetognatha, 3 Ectoprocta, 1 Brachiopoda, 2 Echiura, 1 Sipuncula, 48 Annelida, about 170 Crustacea, 155 Insecta, 35 Arachnida, 94 Mollusca, and 14 Echinodermata. In addition to Royal Bengal Tiger, the vertebrate fauna comprise 58 species of mammals, around 248 bird species and 55 species of reptiles as per 2004 census. Although the Census report includes only 47 species of fishes from the Indian part of the Sundarbans, Mandal and Nandi (1989) gives a list of about 140 species that include only 14 species of gobioid fishes. Mangrove associate gobies are generally represented by aquatic and semi-aquatic communities adapted at stress conditions.

Gobioids of Bangladesh Sundarban: As there is no physical, climatic or any other natural barrier in Sundarbans between India and Bangladesh, it can be presumed that similar composition of mangrove associate gobies are available in Bangladesh side of Sunderbans. Only 27 species of Gobioid fishes so far recorded from Bangladesh (Rahman, 1989; Ahmed, 1991), out of which *Eleotris lutea* Day, *Acentrogobius caninus* (Valenciennes), *A. cyanomos* (Bleeker), *Awaous grammepomus* (Bleeker), *A. guamensis* (Valenciennes), *Eugnathogobius oligactis* (Bleeker), *Exyrias puntang* (Bleeker), *Oxyurichthys microlepis* (Bleeker) and *Periophthalmus barbarus* Linnaeus have not been recorded from Indian side of Sunderban. The other 18 species are mentioned in the text. Reports of *Ophiocara porocephala* (Valenciennes) (Kapoor *et. al.*, 2002) and *Boleophthalmus dussumieri* Valenciennes (Talwar and Jhingran, 1991) from Bangladesh waters are unconfirmed.

TAXONOMIC ACCOUNT

The suborder Gobioidae belongs to the Class Actinopterygii (ray-finned fishes) and the Order Perciformes. Gobies are primarily marine fishes, also found in brackish and freshwater environments. The characteristics of the gobioid fishes (Miller, 1973) are as follows. Body without lateral line canal, but with only exposed neuromast organs (pit organs). Head generally with sensory canal-pores. Oculoscaphular lateral line canal, when present, may or may not extend over snout before nostrils, preopercular canal with 2-5 primary pores, or often absent; horizontal section of preopercular canal at best very short, distant from angle of jaw and usually lacking. Scales with only peripheral ctenii consistently developed, sometimes cycloid or absent. Five to 7 branchiostegal rays. The suborder Gobioidae is grouped under nine families (Nelson, 2006), of which only two families are found to occur in the Sunderbans.

FAMILY ELEOTRIDAE

Body elongate, scales small to moderate. Two dorsal fins separate or connected only at their bases. First dorsal fin comprises 6 flexible spines; second with one spine and 8 or 9 rays. Anal fin with one spine and 6 to 9 rays. Ventral fins separate either completely to the base or almost to it. Body without lateral line canal, only exposed neuromast organs (pit organs). Head usually with sensory canal pores. Six branchiostegal rays.

Key to genera

1. (a) A single spine at preopercular margin .. *Eleotris*
(b) No spine at preopercular margin 2
2. (a) Serrated ridges on head; head flat *Butis*
(b) No serrated ridges on head.....3
3. (a) Scales small, 40 or more in longitudinal series *Odonteleotris*
(b) Scales moderate, less than 40 in longitudinal series 4
4. (a) Sensory canal pores on snout, interorbital and posterior margin of preoperculum; pit organs in longitudinal and transverse lines *Ophiocara*
(b) Sensory canal pores only on posterior margin of preoperculum; pit organs in only longitudinal lines *Ophieleotris*

Genus Butis Bleeker**Key to species:**

- 1 (a) Maxillary not extending beyond anterior margin of eye; caudal fin black with a light margin dorsally*Butis butis*
- (b) Maxillary extending up to middle of eye; caudal fin uniformly black*Butis melanostigma*

Butis butis (Hamilton)

1822. *Cheilodipterus butis* Hamilton, *Fish. Ganges*: 57, 367 (Ganges river below Calcutta).

1991. *Butis butis*: Talwar and Jhingran, *Inland Fishes of India*, 2: 973.

Material examined: 1 ex., Gosaba (Sundarbans), 02.iv. 2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: Widespread in sheltered waters of tropical Indian and West Pacific including Bangladesh. It is known to enter estuaries.

Butis melanostigma (Bleeker)

1849. *Eleotris melanostigma* Bleeker, *Verh. batav. Genoot. Kunst. Wet*, 22: 23 (Indonesia).

1991. *Butis melanostigma*: Talwar and Jhingran, *Inland Fishes of India*, 2: 974.

Material examined: 8 ex., Calcutta, no date, Asiatic Society of Bengal coll., ZSI ASB Cat. 246; 3 ex., Calcutta, no date, Asiatic Society of Bengal coll., ZSI ASB Cat. 247; 1 ex., Haldibari (Sundarbans), 27.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: In brackish waters of eastern India, Bangladesh, Myanmar, Thailand and Indo-Australian Archipelago.

Genus : Eleotris Bloch and Schneider**Key to species:**

1. (a) Lateral series scales 60-68*Eleotris fusca*
- (b) Lateral series scales 40-55*Eleotris melanostoma*

Eleotris fusca (Forster)

1801. *Poecilia fusca* Forster, in Bloch and Schneider, *Syst. Ichthyol.*: 453 ("Oriadea insulae rivulis" = Pacific Islands).

1991. *Eleotris fusca* (Bloch and Schneider): Talwar and Jhingran, *Inland Fishes of India*, 2: 975.

Material examined: 3 ex., Uttarbhadra, Lower Bengal, 06.ix.1934, S.L. Hora, ZSI F-5649/2; 1 ex.,

Uttarbhadra, Lower Bengal, 1934, S.L. Hora, ZSI F-5610/2; 1 ex., Edward's creek, Fraserganj, 11.viii.1974, T.K. Chatterjee, ZSI F-7254/2.

Distribution: Red Sea and east coast of Africa, India, Bangladesh to French Polynesia in the Pacific, Ryukyu Islands in north to New Caledonia in south.

Eleotris melanostoma Bleeker

1852. *Eleotris melanostoma* Bleeker, *Natuurk. Tijdschr. Ned.-Indie.*, 3: 705 (Wahai, Western Sumatra, Indonesia).

1991. *Eleotris melanostoma*: Talwar and Jhingran, *Inland Fishes of India*, 2: 977.

Material examined: 1 ex., off Jambu Island (Gangetic delta), 07.ix.1974, T.K. Chatterjee, ZSI F 7382/2.

Distribution: Indo-Pacific- from east coast of Africa to Society Islands in the Pacific, north to Japan.

Remarks: This species has been recorded for the first time from the Gangetic delta by Chatterjee (1978).

Genus Odonteleotris Gill**Odonteleotris macrodon (Bleeker)**

1853. *Eleotris macrodon* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, 25: 104, p1. 2, fig. 1 (Hooghly river at Calcutta).

1991. *Odonteleotris macrodon*: Talwar and Jhingran, *Inland Fishes of India*, 2: 978.

Material examined: 1 ex., Sagar Island, no date, A. Khuda-Buksh, ZSI F-7384/2; 4 ex., Calcutta, no date, F. Day, ZSI ASB Catal. 253.

Distribution: Estuaries and rivers of India, Myanmar, Malaysia and Indonesia.

Remarks: No specimen could have been collected in recent past.

Genus : Giuris Sauvage**Giuris margaritacea (Valenciennes)**

1837. *Eleotris margaritacea* Valenciennes, in Cuvier & Valenciennes, *Hist. nat. poiss.*, 12: 240 (Vanikoro Island, Santa Cruz Islands, South-Western Pacific).

1991. *Ophieleotris aporos*: Talwar and Jhingran, *Inland Fishes of India*, 2: 979.

Material examined: 1 ex., Sundarban delta (Bengal), no date, collector unknown, ZSI F-7383/2.

Distribution: Freshwaters and estuaries of India; Madagascar; Indonesia to the Philippines, Northern Australia, Fiji and Palau.

Remarks: No specimen could have been collected in recent past. IN literature, this species was known as *Ophieleotris aporos* (Bleeker, 1854) till Hoese (2006) considered it with treating genus *Ophieleotris* Aurich, 1938 as a Junior synonym of *Giuris* Sauvage, 1880.

Genus *Ophiocara* Gill

Ophiocara porocephala (Valenciennes)

1837. *Eleotris porocephala* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, 12: 237 (Seychelles; New Ireland, Bismarck Archipelago).

1991. *Ophiocara porocephala*: Talwar and Jhingran, *Inland Fishes of India*, 2: 980.

Material examined: 1 ex., Bakkhali, 08.ix.1974, T.K. Chatterjee, ZSI F-7252/2; 3 ex., Edward's creek, Fraserganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7255/2.

Distribution: Throughout the temperate Indo-Pacific, except Far East Pacific, usually in cloudy water.

Family : GOBIIDAE

Body oblong to elongate, eel-like in some. Two dorsal fins, separate or connected at their bases, the second dorsal fin is longer than the first dorsal fin. Ventral fins typically united forming a disc-like structure, basal membrane present or absent. Body with ctenoid or cycloid scales. Teeth simple, in upper jaw in one to several rows. Body without lateral line canal, only exposed neuromast organs (pit organs). Head usually with sensory canal pores and cutaneous papillae. Five branchiostegal rays.

Key to genera

1. (a) A single confluent fin formed of the dorsal, caudal and anal fins; eyes greatly reduced (Amblyopinae) 2
- (b) Two dorsal fins, separate or connected at base only, not confluent with caudal; eyes prominent 9

2. (a) No groove on the upper gill cover 3
- (b) A small groove on the upper gill cover which has a blind end 6
3. (a) Chin and lower jaw with barbels; canine present 4
- (b) No barbel on chin and lower jaw; canine absent 5
4. (a) Pectoral fin length about 70% of head length *Odontamblyopus*
- (b) Pectoral fin length about 30% of head length *Taenioides*
5. (a) Chin with pores; pectoral fin rays not more than 25 *Caragobius*
- (b) Chin without pore; pectoral fin rays about 40 *Pseudotrypauchen*
6. (a) Fang-like canines present; some patch of scales on head *Amblyotrypauchen*
- (b) No fang-like canines on jaws; head naked 7
7. (a) Ventral fins separated to the base; ventral fin with one small outer ray and 3 branched rays *Trypauchenichthys*
- (b) Ventral fins united or emarginated; ventral fin with one undivided ray and 5 branched rays 8
8. (a) Ventral fins united to form an adhesive disc; belly scaled *Trypauchen*
- (b) Ventral fins united but emarginate posteriorly; belly without scales *Paratrypauchen*
9. (a) Lower jaw with only a single row of teeth; eyes located mostly dorsally (Oxudercinae) 10
- (b) Lower jaw with two or more rows of teeth; eyes mostly lateral 18
10. (a) Base of second dorsal fin short, segmented rays in second dorsal fin less than 15; pectoral fin base muscular 11
- (b) Base of the second dorsal fin much longer, segmented rays in second dorsal fin 20 or more; pectoral fin base not muscular 12
11. (a) Teeth in upper jaw uniserial *Periophthalmus*
- (b) Teeth in upper jaw biserial *Periophthalmodon*
12. (a) Free lower eyelid present 13
- (b) Free lower eyelid absent 14
13. (a) Teeth in lower jaw pointed; chin with barbels *Scartelaos*
- (b) Teeth in lower jaw notched; chin without barbels *Boleophthalmus*

14. (a) First dorsal fin with V spines 15
 (b) First dorsal fin with VI spines 16
15. (a) Dorsal and anal fin with 23 or less total elements; scales in longitudinal series about 100 *Apocryptes*
 (b) Dorsal and anal fin with 26 or more total elements; scales in longitudinal series about 200 *Pseudapocryptes*
16. (a) Longitudinal scale rows less than 60; anal fin with 23 or less elements *Apocryptodon*
 (b) Longitudinal scale rows more than 60; anal fin with 24 or more elements 17
17. (a) Prominent canine teeth on each side of upper jaw symphysis; head length more than 24% of standard length *Oxuderces*
 (b) No prominent canine teeth on each side of upper jaw symphysis; head length less than 24% of standard length *Parapocryptes*
18. (a) Anterior interorbital pores paired or head pores absent; pelvic frenum usually present, simple, not folded forward (Gobionellinae) 19
 (b) A single anterior interorbital pore present or head pores absent; if 2 pores present, pelvic frenum folded forward and a fleshy lobe present around each spine (Gobiinae) 24
19. (a) Shoulder girdle under gill cover with distinct finger-like flaps; gill membrane fused together forming a free fold across isthmus *Awaouichthys*
 (b) Shoulder girdle under gill cover smooth or with minute bump 20
20. (a) Head pores absent 21
 (b) Head pores present 22
21. (a) Head papillae in transverse pattern; body without scales below dorsal fin; transparent or yellowish translucent *Gobiopterus*
 (b) Head papillae in longitudinal pattern; body fully scaled; body with dusky bands or spots *Brachygobius*
22. (a) Only one pair of pores or no pore present on snout 23
 (b) Two pairs of pores present on snout 24
23. (a) Mucous canal on cheek in longitudinal rows only; lateral canal over opercle present; body colour variable *Hemigobius*
 (b) Mucous canal on cheek with some transverse rows radiating from eye; body distinctly spotted *Stigmatogobius*
24. (a) Cheek with large scales; a violet streak below eye *Gnatholepis*
 (b) Cheek naked; no streak below eye *Oligolepis*
25. (a) Barbels present 26
 (b) Barbels absent 27
26. (a) Barbels present only on chin *Parachaeturichthyes*
 (b) Barbels present on chin, snout and sides of head *Gobiopsis*
27. (a) Upper pectoral fin rays free and silky 28
 (b) Upper pectoral fin rays not free and silky 29
28. (a) A curved canine tooth present on each side of lower jaw *Istigobius*
 (b) No curved canine tooth on each side of lower jaw *Bathygobius*
29. (a) Caudal fin longer than head; predorsal scales 6 to 9 *Drombus*
 (b) Caudal fin not longer than head; predorsal scales 12 to 30 29
30. (a) Scales small, more than 100 scales on lateral series *Amblyeleotris*
 (b) Scales moderate, less than 40 scales on lateral series 30
30. (a) Head depressed; snout pointed *Glossogobius*
 (b) Head compressed; snout obtuse *Acentrogobius*
- Subfamily: AMBLYOPINAE
- Body elongate, with both dorsal fin joined by membrane. Dorsal and anal fins confluent with caudal fin. Usually pink or purple in colour.
- Genus *Amblyotrypauchen* Hora
- Amblyotrypauchen arctocephalus* (Alcock)
1890. *Amblyopus arctocephalus* Alcock, *Ann. Mag. nat. Hist.*, Ser. 6, 6 (36): 432 (Off Máhánaddi Delta and off Vizagapatam coast, India).
2003. *Amblyotrypauchen arctocephalus*: Murdy, *Proc. Biol. Soc. Wash.*, 116 (2): 330.
- Material examined: 1 ex., Sandheads, Mouth of R. Hughly, 26 fms, no date, P. V. Fraser, ZSI F-10819/1 (holotype of *Amblyotrypauchen fraseri* Hora).
- Distribution: Indo-West Pacific; India; and the South China Sea.

Genus *Caragobius* Smith and Seale*Caragobius urolepis* (Bleeker)

1852. *Amblyopus urolepis* Bleeker, *Natuurk. Tijdschr. Ned.-Indie*, **3**: 581 (Palembang, Sumatra).

1991. *Brachyamblyopus urolepis*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 982.

2003. *Caragobius urolepis*: Murdy and Shibukawa, *Zootaxa*, **301**: 5, fig. 1-2, tab. 1-2.

Material examined: No material from Sunderbans examined.

Distribution: India to the Philippines. Oceania: Papua New Guinea.

Remarks: Koumans (1941) examined specimens from the lower Bengal in the Indian Museum collections, but presently the specimens are not traceable.

Genus *Odontamblyopus* Bleeker*Odontamblyopus rubicundus* (Hamilton)

1822. *Gobioides rubicundus* Hamilton, *Fish. Ganges*: 37, 365; p1. 5, fig. 9 (Estuaries of Ganges).

1991. *Odontamblyopus rubicundus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 983.

Material examined: 4 ex., Matlah River, Dec. 1916, S. W. Kemp, ZSI F-5296/2; 2 ex., Sundarbans, no date, J. T. Jenkins, ZSI F-5296/2; 3 ex., Ichamati River, no date, A. Alcock, ZSI 13290-13291 & 13293.

Distribution: Eastern Africa to the Pacific, including India and Bangladesh.

Genus *Paratrypauchen* Murdy*Paratrypauchen microcephalus* (Bleeker)

1860. *Trypauchen microcephalus* Bleeker, *Act. Soc. Indoneerl.*, **8**: 62 (Sungi-Dugri, Borneo).

1991. *Ctenotrypauchen microcephalus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 987.

2008. *Paratrypauchen microcephalus*: Murdy, *Aqua*, **14**(3): 118.

Material examined: 1 ex., mouth of Hooghly River, no date, R. M. Daly, ZSI -11614; 1 ex., Mutlah River, Sundarbans, 17.xi.1909, collector unknown, ZSI F-5444/2; 1 ex., Kakdwip, 10.iii.1985, B.P. Halder & P. Mukherjee, ZSI F-8155/2; 1 ex., Kakdwip, 06.iv.1987, B.P. Halder &

P. Mukherjee, ZSI F-8108/2 (last two specimen labelled as *Trypauchenichthys typus* Bleeker).

Distribution: Widespread in Indo-Pacific.

Remarks: This species has been assigned to the genus *Ctenotrypauchen* Steindachner by many authors (Menon and Chatterjee, 1977; Talwar and Jhingran, 1991) in the past. However, *Paratrypauchen* differs noticeably from *Ctenotrypauchen* in the absence of a prominent serrated frontal crest and in lacking scales on the abdomen (Murdy, 2008).

Genus *Pseudotrypauchen* Hardenberg*Pseudotrypauchen multiradiatus* Hardenberg

1931. *Pseudotrypauchen multiradiatus* Hardenberg, *Treubia*, **13** (3-4): 418, fig. 8 (Bagan Si Api Api, Sumatra, Indonesia).

1953. *Brachyamblyopus multiradiatus*: Koumans, *Fish. Indo-Aust. Archip.*, **10**: 267.

2002. *Pseudotrypauchen multiradiatus*: Murdy and Shibukawa, *Mar. Freshw. Res.*, **53** (2): 255; fig. 1-2.

Material examined: 1 ex., Sandheads, mouth of Hooghly River, 17.vi.1885, A. Millner, ZSI 11336; 3 ex., mouth of Hooghly River, 1929, 'Lady Fraser' coll., ZSI F-5308/2;

Distribution: Mouth of the Hooghly river, and Sumatra.

Genus *Taenioides* Lacepede

Key to species

- 1.(a) Dorsal and anal fins continuous with the caudal, caudal fin pointed 2
- (b) Dorsal and anal fins separated from the caudal, by a deep notch, caudal fin rhomboid *Taenioides cirratus*
- 2.(a) Vertical fins black, pre-anal distance more than 40% of standard length *Taenioides buehneri*
- (b) Vertical fins yellowish, pre-anal distance less than 40% of standard length *Taenioides anguillaris*

Taenioides anguillaris (Linnaeus)

1758. *Gobius anguillaris* Linnaeus, *Syst. Nat.* (ed. 10) **1**: 264 (China).

1991. *Taenioides anguillaris*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 984.

Material examined: 3 ex., Uttarbhag, 23.ii.1934, S. L. Hora, ZSI F-5547/2; 1 ex., Uttarbhag, no date, S. L. Hora, ZSI uncat.; 1 ex., Calcutta, no date, F. Day, ZSI F-2116.

Distribution: River mouths on the Asian Coast from India, to China, and New Guinea.

***Taenioides buchanani* (Day)**

1873. *Amblyopus buchanani* Day, *Proc. Zool. Soc. Lond.*, 1873 (1): 110 (Calcutta and Moulmein).

1991. *Taenioides buchanani*: Talwar and Jhingran, *Inland Fishes of India*, 2: 985.

Material examined: 1 ex., Sagar Island, 1977, A. Khuda-Buksh, ZSI F-7352/2; 1 ex., Burirdabri (Sundarbans), 26.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: East coasts of India, Bangladesh and Myanmar.

***Taenioides cirratus* (Blyth)**

1860. *Amblyopus cirratus* Blyth, *J. Asiat. Soc. Beng.*, 29 (2): 147 (probably Hooghly river at Calcutta).

1991. *Taenioides cirratus*: Talwar and Jhingran, *Inland Fishes of India*, 2: 985.

Material examined: 8 ex., Fraserganj, 05.09.1974, T. K. Chatterjee, ZSI F-7360/2; 1 ex., Calcutta, no date, F. Day, ZSI 2072.

Distribution: Indo-Australian archipelago, East coast of Africa to India including Andaman-Nicobar Islands, Bangladesh, to New Guinea and Australia, north to Japan.

Genus *Trypauchen* Valenciennes

***Trypauchen vagina* (Bloch and Schneider)**

1801. *Gobius vagina* Bloch and Schneider, *Syst. Ichthyol.*: 73 (Tranquebar, India).

1991. *Trypauchen vagina*: Talwar and Jhingran, *Inland Fishes of India*, 2: 988.

Material examined: 1 ex., Matlah River, 1916, S. W. Kemp, ZSI F-5291/2; 1 ex., mouth of Hooghly River, date unknown, R.I.M.S. 'Investigator' coll., ZSI F-5361/2; 3 ex., Calcutta, no date, F. Day, ZSI 2105-2107.

Distribution: Persian Gulf, Pakistan, India including Nicobar Islands; Bangladesh, Sri Lanka, Thailand, Vietnam, Malaya, China and Taiwan.

Remarks: This has been described as *Gobioides ruber* in Hamilton (1822) from estuary below Calcutta [Kolkata] (Murdy, 2006).

Genus *Trypauchenichthys* Bleeker

***Trypauchenichthys sumatrensis* Hardenberg**

1931. *Trypauchenichthys sumatrensis* Hardenberg, *Treubia*, 13 (3-4): 146, 417; fig. 7 (Sumatra, Indonesia).

2008. *Trypauchenichthys sumatrensis*: Murdy, *Aqua*, 14 (2): 62; fig. 2 A-B; tab.1-3.

Material examined: 1 ex., Sand heads, mouth of Hooghly river, 1928, P.V. 'Lady Fraser' coll., ZSI 11536; 3 ex., Sand heads, mouth of Hooghly river, 1927, P.V. 'Lady Fraser' coll., ZSI F 5228/2; 1 ex., Sand heads, mouth of Hooghly river, 1928, P.V. 'Lady Fraser' coll., ZSI F 5613/2.

Distribution: India (mouth of Hooghly River) and Indonesia (Sumatra).

Remarks: Mukherjee (1995: 386) reported *Trypauchenichthys typus* Bleeker as first record from India. The specimens examined and found to have I, 5 elements in the ventral fin, hence are not *Trypauchenichthys* species, which have I, 3 elements only. With noticed absence of fang-like teeth and scales on head and belly, the specimens of Mukherjee (1995) are considered as *Paratrypauchen microcephalus* (Bleeker). Hora (1924) has also mistaken this species as *Trypauchensis typus* Bleeker (Talwar and Jhingran, 1991).

Subfamily OXUDERCINAE

Body elongate; eyes located dorsally; dorsal fins separated by a gape; dorsal and anal fins separated from caudal fin; lower jaw typically with a single row of teeth.

Genus *Apocryptes* Valenciennes

***Apocryptes bato* (Hamilton)**

1822. *Gobius bato* Hamilton, *Fish. Ganges*: 40, 365; p1. 37, fig 10 (estuaries of Ganges).

1991. *Apocryptes bato*: Talwar and Jhingran, *Inland Fishes of India*, 2: 951.

Material examined: 7 ex., Hooghly river, 13 miles down Nawadwip ghat, 26.v.1953, Hooghly

Survey, ZSI F-248/2; 2 ex., Hoogly river, near Nilmahal, 08.v.1954, Hooghly Survey, ZSI F-4972/2; 3 ex., Hoogly river, near Uporhat, 12.v.1954, Hooghly Survey, ZSI F-4974/2; 1 ex., Matlah River, Canning, 29.v.1977, B.C. Goswami, ZSI F-7355/2.

Distribution: Indian mainland, Bangladesh and Myanmar.

Genus *Apocryptodon* Bleeker

Apocryptodon madurensis (Bleeker)

1849. *Apocryptes madurensis* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, **22**: 35 (Strait Madura).

1991. *Apocryptodon madurensis*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 952.

Material examined: No material from Sunderbans examined.

Distribution: India, East Indies, Thailand, Philippines, north to Japan.

Remarks: Koumans (1941: 278) examined specimens from Port Canning and Uttarbhag, Lower Bengal in the Indian Museum collections, but the specimens are presently not traceable.

Genus *Boleophthalmus* Valenciennes

Key to species

1. (a) Lateral body with dark spots or oblique bands, first dorsal fin grayish with blue spots *Boleophthalmus boddarti*
- (b) Lateral body without spots or bands, first dorsal fin purplish with black spots *Boleophthalmus dussumieri*

Boleophthalmus boddarti (Pallas)

1770. *Gobius boddarti* Pallas, *Spicilegium Zool.*, **1** (8) :11; pl. 2, figs. 4-5 (Indian Ocean).

1991. *Boleophthalmus boddarti*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 954.

Material examined: 14 ex., canal near Forest Range Office, Fraserganj, 05.ix.1974, T. K. Chatterjee, ZSI F-7362/2; 1 ex., canal at Bakkhali, Fraserganj, 08.ix.1974, T. K. Chatterjee, ZSI F-7251/2.

Distribution: India, Bangladesh, Thailand, Malaysia to New Guinea, north to China; also reported from Persian Gulf.

Remarks: *Gobius plinianus* described by Hamilton (1822) is referred to be this species (Rahman, 1989; Murdy, 1989).

Boleophthalmus dussumieri Valenciennes

1837. *Boleophthalmus dussumieri* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, **12**: 207, pl. 354 (Bombay, India).

1991. *Boleophthalmus dussumieri*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 954.

Material examined: 2 ex., Jambu Island, 07.ix.1974, T. K. Chatterjee, ZSI F-7385/2;

Distribution: West coast of India, Baluchistan, Iraq and Pakistan. Probably occurs in Bangladesh.

Remarks: This has been first recorded from Eastern India by Chatterjee (1978: 164). Later, Talwar and Jhingran (1991) have reported it as common in Gangetic delta.

Genus *Oxuderces* Eydoux and Souleyet

Oxuderces dentatus Eydoux and Souleyet

1842. *Oxuderces dentatus* Eydoux and Souleyet, *Zoologie*, **1** (2): 182; pl. 8, fig. 2 (Macao, China).

1991. *Oxuderces dentatus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 955.

Material examined: 2 ex., Jambu Island (from a shallow depression at the muddy bank of China River mouth), 07.ix.1974, T.K. Chatterjee, ZSI F 7391/2.

Distribution: India (Gangetic delta, West Bengal; Tamil Nadu), Indonesia, Thailand, Macao and China.

Remarks: This has been recorded first from Gangetic delta by Chatterjee (1981). This is a very rare species. The third author could have examined two more specimens collected from Sagar Island only recently (during May, 2010).

Genus *Parapocryptes* Bleeker

Parapocryptes serperaster (Richardson)

1846. *Apocryptes serperaster* Richardson, *Rep. Br. Ass. Advmt. Sci., 15th meet.* (1845): 206 (Macao, China).

1991. *Parapocryptes serperaster*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 957.

Material examined: 1 ex., a canal near Forest Range Office, Fraserganj, 05.ix.1974, T.K.Chatterjee, ZSI F-7361/2; 1 ex., Sagar Island, 1977, A. Khuda-Buksh, ZSI F-7351/2; 1 ex., Port Canning, 01-09.vii.1930, R. Hodgart, ZSI F-5624/2.

Distribution: Coasts of tropical Indo-Pacific: India, Myanmar, Malaysia, Indonesia, and China; entering tidal rivers.

Remarks: Mukherjee (1995) reported *Parapocryptes macrolepis* (Bleeker), which is now considered as a junior synonym of *Parapocryptes serperaster* (Richardson) (Murdy, 1989).

Genus *Periophthalmus* Bloch and Schneider

Key to species

1. (a) Basal membrane or frenum of pelvic fins absent; two halves of pelvic fins separate, not joined by membrane; first dorsal fin margin concave; thin silvery bars ventrally on sides*P. argentilineatus*
- (b) Basal membrane or frenum of pelvic fins weakly to moderately developed; two halves of pelvic fins joined by membrane to some extent; first dorsal fin margin not concave; no thin silvery bars ventrally on sides 2
2. (a) Pelvic frenum prominent; first dorsal fin spines usually X or less; longitudinal scales usually less than 70 *P. novemradiatus*
- (b) Pelvic frenum vestigial; first dorsal fin spines usually XI or more; longitudinal scales usually more than 70*P. kalolo*

Periophthalmus argentilineatus Valenciennes

1837. *Periophthalmus argentilineatus* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, **12**: 191 (Moluccas, Indonesia).
1953. *Periophthalmus vulgaris* Eggert: Koumans, *Fish. Indo-Aust. Archip.*, **10**: 210.
1993. *Periophthalmus argentilineatus*: Kottelat *et al.*, *Freshw. Fish. west. Indonesia Sulawesi*: 148, pl. 69.

Material examined: Not examined.

Distribution: Hughli-Matla estuary (West Bengal), Andhra Pradesh, Andamans; Myanmar, Thailand, Java and Australia.

Remarks: Mukherjee (1995: 367) reported it from Falta near 'Kella' as *P. vulgaris* Eggert, a junior synonym (Murdy, 1989), based on one example collected on 25.03.1985.

Periophthalmus kalolo Lesson

1830. *Periophthalmus kalolo* Lesson, *Voy. 'Coquille' Zool.*, **2**(1): 146 (Offack Harbor, Waigiou).
1935. *Periophthalmus koelreuteri kalolo*: Eggert, *Zool. Jahrb. Syst.*, **67**(1-2): 76.
1991. *Periophthalmus koelreuteri*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 965.
1993. *Periophthalmus kalolo*: Kottelat *et al.*, *Freshw. Fish. west. Indonesia Sulawesi*: 149, pl. 69.

Material examined: 1 ex., mouth of River Hooghly, Sundarbans, 1911, S. W. Kemp, ZSI 5431/2 (registered as *Periophthalmus koelreuteri*).

Distribution: Mangroves from eastern Africa to Polynesia.

Remarks: In current parlance of nomenclature, *Periophthalmus koelreuteri* (Pallas) is relegated to synonymy of *P. barbarus* (Linnaeus), an Atlantic species (Murdy, 1989). *P. barbarus* is unlikely to occur in our region. Barman *et al.*, (2007: 148), following Koumans (1953), considered the Indian species referred as to this name should be known as *P. kalolo* Lesson. Records of *P. barbarus* from Sundarbans of Bangladesh (Ahmed, 1991) may possibly referable to this species. Mukherjee (1995: 366) reported *Periophthalmus malaccensis* Eggert from Gosaba as the first record from India. The third author examined his specimen (ZSI F-8073/2) and confirmed that he was erroneous in identifying *Periophthalmus kalolo* specimens as *Periophthalmus malaccensis*. Interestingly, he has not collected any specimen of *Periophthalmus kalolo* from the region.

Periophthalmus novemradiatus (Hamilton)

1822. *Gobius novemradiatus* Hamilton, *Fish. Ganges*: 47, 366, Pl. 2, fig. 14 (Uttarbhag, Ganges delta).
2009. *Periophthalmus novemradiatus*: Jaafar, Perrig and Chou. *Zool. Sci.*, **26**: 309; fig.1-5; tab.1-2.

Material examined: 10 ex., Chamta (Sundarbans), 28.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat; 3 ex., Jharkhali, 22.iv.1984, B.P. Halder & P. Mukherjee, ZSI F-8019/2; 4 ex., Bakkhali khal, 04.iii.1987, B.P. Halder & P. Mukherjee, ZSI F-8094/2; 2 ex., Bakkhali, 07.iii.1987, B.P. Halder & P. Mukherjee, ZSI F-8059/2.

Distribution: Asia: India, Myanmar, Thailand, Malaysia, Indonesia, the Philippines and Bangladesh.

Remarks: *Periophthalmus pearsei* Eggert, described from Port Canning, is relegated to synonymy of this species (Murdy, 1989). Koumans (1941) has stated of examining specimens from Calcutta, Lower Bengal, Uttarbhag and Sunderbans. Mukherjee (1995: 356) reported *Periophthalmus chrysospilos* from Hughly-Matla estuary and recorded specimens from Basanti, Kakdwip and Saptamukhi river. On re-examination, it is found to be erroneous identification of *Periophthalmus novemradiatus*.

Genus *Periophthalmodon* Bleeker

Key to species

1. (a) Ventral fins totally united, basal membrane well developed *P. schlosseri*
- (b) Ventral fins nearly separated, basal membrane absent *P. septemradiatus*

Periophthalmodon schlosseri (Pallas)

1770. *Gobius schlosseri* Pallas, *Spicilegium Zool.*, 1 (8): 3, pl. I, figs. 3-4 (Ambon Island, Moluccas Islands, Indonesia).

1989. *Periophthalmodon schlosseri*: Murdy, *Rec. Aust. Mus.*, *Suppl.*, 11: 28.

Material examined: 3 ex., Sonakhali, 17.i.1987, B.P. Halder & P. Mukherjee, ZSI F-8003/2; 1 ex., Pergumti, 09.ix.1984, B.P. Halder & P. Mukherjee, ZSI F-8039/2.

Distribution: Mudflats in India, Bangladesh, Indonesia, the Philippines, Malaysia; Queensland and Fiji.

Remarks: Mukherjee (1995: 363) reported 3 ex. from Sonakhali and 1 ex. from Jharkhali. Mandal and Nandi (1989) has also included it in the fauna list of Sundarban.

Periophthalmodon septemradiatus (Hamilton)

1822. *Gobius septemradiatus*: Hamilton, *Fish. Ganges*: 46 (Ganges, India).

1989. *Periophthalmodon septemradiatus*: Murdy, *Rec. Aust. Mus.*, *Suppl.*, 11: 29-30.

Material examined : 2 ex., Uttarbhag, 23.v.1934, S. L. Hora, ZSI F-5655/2; 2 ex.,

Uttarbhag, 1934, S. L. Hora, ZSI F-5754/2; 1 ex., Uttarbhag, no date, S. L. Hora, ZSI F-7236/2 (registered as *Periophthalmodon tredecemradiatus*); 1 ex., Bakkhali, 076.iii.1985, B.P. Halder & P. Mukherjee, ZSI F-8133/2 (labeled as *Periophthalmodon tredecemradiatus*).

Distribution: India including Andamans; Bangladesh, Myanmar, Thailand and Sumatra.

Remarks: Talwar and Jhingran (1991: 962) treated this species as *Periophthalmodon tredecemradiatus* (Hamilton), whereas, Murdy (1989: 30) designated the neotype of *P. septemradiatus* and considered *P. tredecemradiatus* as its synonym.

Genus *Pseudapocryptes* Bleeker

Pseudapocryptes elongatus (Cuvier)

1816. *Gobius elongatus* Cuvier, *Regne animal* (ed. 1), 2: 255 (Tranquebar, Tamil Nadu).

1991. *Pseudapocryptes lanceolataus* (Bloch and Schneider): Talwar and Jhingran, *Inland Fishes of India*, 2: 958.

1995. *Pseudapocryptes elongatus*: Ferraris, *Copeia*, 1995 (4): 984 (status discussed).

Material examined: 2 ex., Port Canning, 01-09.vii.1930, R. Hodgart, ZSI F-5619/2; 2 ex., Uttarbhag, 1934, S. L. Hora, ZSI F-5820/2; 2 ex., Edward's creek, Fraserganj, 11.ix.1974, T. K. Chatterjee, ZSI F-7158/2 (all registered as *Pseudapocryptes lanceolataus*); 1 ex., Pergumti, 09.ix.1984, B.P. Halder & party, ZSI F-8042/2 (labeled as *Pseudapocryptes borneensis*).

Distribution: Indo-Pacific: India, Bangladesh to Tahiti and north to China. Found in mudflats of estuaries and the freshwater tidal zone of rivers.

Remarks: The present name is considered as a replacement name for *Eleotris lanceolatus* Bloch & Schneider, 1801, preoccupied in *Gobius* by *Gobius lanceolatus* Bloch, 1783 [synonym of *Gobionellus oceanicus* (Pallas 1770)] (Ferraris, 1995). *Gobius changua* described by Hamilton (1822) from estuaries of Ganges is referred to be this species (Murdy, 1989). *Pseuda cryptes borneensis* (Bleeker) has been recorded from Pergumti and Sonakhali in Sunderbans (Mukherjee, 1995). The specimens used by Mukherjee (1995) has been examined and

found that the specimens contain 30 anal fin rays, small eyes, about 6.8 times in head length and the membrane of first dorsal fin reaches first ray of second dorsal fin. This combination of characters goes close with *P. elongatus*, but not with *P. borneensis* (Bleeker).

Genus *Scartelaos* Swainson

Scartelaos histophorus (Valenciennes)

1837. *Boleophthalmus histophorus* Valenciennes, in Cuvier and Valenciennes, *Hist. nat. poiss.*, **12**: 210 (Bombay, India; Suarte, Ganges River).

1991. *Scartelaos histophorus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 960.

Material examined: 15 ex., Gosaba, 13.iii.1917, J. Southwell, ZSI F-5406/2; 1 ex., Sagar Island, 24.vi.1975, A. Das, (uncat. specimen in SDCMBRI); 3 ex., Jharkhali, 21.i.1987, B.P. Halder & P. Mukherjee, ZSI F-8001/2; 2 ex., Jharkhali, 24.vi.1986, B.P. Halder & P. Mukherjee, ZSI F-8083/2; 1 ex., Bakkhali, 07.iii.1989, B.P. Halder & P. Mukherjee, ZSI F-8157/2; 2 ex., Goenkakhali, 21.iii.1985, B.P. Halder & P. Mukherjee, ZSI F-8139/2; 2 ex., Basanti, 21.vi.1986, B.P. Halder & P. Mukherjee, ZSI F-8082/2.

Distribution: Mudflats from Pakistan, India, Bangladesh to Indonesia, the Philippines, Australia, north to Japan.

Remarks: Hamilton (1822) described this as *Gobius viridis* from Ganges River estuary. But since the name is preoccupied by *Gobius viridis* Otto 1821, it is considered objectively invalid (Murdy, 1989).

Subfamily: GOBIONELLINAE

Both dorsal fins separate; dorsal and anal fins not joined to caudal fin; lower jaw with more than one row of teeth; paired interorbital pores present or head pores entirely absent; if absent, pelvic frenum present, or body mostly scaly, or barbels absent.

Genus: *Awaouichthys* Chatterjee

Awaouichthys menoni Chatterjee

2013. *Awaouichthys menoni* Chatterjee, in Chatterjee and Mishra, *Rec. Zool. Surv. India*. **112** (4) : 56 (Fraserganj, Sundarbans, West Bengal).

Material examined : 1 ex., (Holtype), Patibonia Island, near Fraserganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7377/2; 3 ex. (Paratype), Podibonia Island, near frasergunj, ii.ix.1974, T.K. Chatterjee, ZSI F 7378/2.

Distribution : Podibonia Island, near frasergunj in the Gangetic delta, West Bengal.

Remarks : This species was first described by Chatterjee (1978) in his doctoral thesis and also appeared in Mandal and Nandi (1989), Talwar *et. al.*, (1992) and Sanyal *et. al.*, (2012). However, it was formally described in Chatterjee and Mishra (2013) in order to make it available as per the provisions laid down in the International code of Zoological Nomenclature.

Genus *Brachygobius* Bleeker

Brachygobius nunus (Hamilton)

1822. *Gobius nunus* Hamilton, *Fish. Ganges*: **54**, 366 (Ganges estuary below Calcutta).

1991. *Brachygobius nunus*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 930.

Material examined: 10 ex., Edward's creek, Fraserganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7156/2.

Distribution: East coasts of Africa to the Pacific, including India and Bangladesh.

Remarks: *Gobius alcockii*, described from Port Canning and Calcutta (Annandale, 1906), is considered as a synonym of this species (Larson, 2001).

Genus *Gnatholepis* Bleeker

Gnatholepis cauerensis (Bleeker)

1853. *Gobius cauerensis* Bleeker, *Natuurk. Tijdschr. Ned.-Indie*, **4**: 269 (Cauer, a village on the southwestern coast of Sumatra, 4°44' S, 103°15' E).

2007. *Gnatholepis cauerensis cauerensis*: Randall and Greenfield, *Zool. Med.*, **81**: 303.

Material examined: 16 ex., Fraserganj coast, 09.ix.1974, T.K. Chatterjee, ZSI F-7390/2 (registered as *Acentrogobius cauerensis*).

Distribution: South Africa and Seychelles to Indonesia, the Philippines, east to Hawaii and Society Islands.

Remarks: This was the first record from east coast of India by Chatterjee (1978); other Indian

records were from Andamans (Koumans, 1941) and Lakshadwip (Jones and Kumaran, 1980).

Genus *Gobiopterus* Bleeker

Gobiopterus chuno (Hamilton)

1822. *Gobius chuno* Hamilton, *Fish. Ganges* : 53 (Ganges estuary below Calcutta).

1991. *Gobiopterus chuno*: Talwar and Jhingran, *Inland Fishes of India*, 2: 967.

Material examined: No specimen from Sunderbans examined.

Distribution: India, Bangladesh, Thailand and Singapore.

Remarks: This is originally described from Ganges estuary below Calcutta [Kolkata]. Koumans (1941) too has not examined any specimen specifically from Sunderban region, but Mandal and Nandi (1989) included it in the faunal list of Sunderban.

Genus *Hemigobius* Bleeker

Hemigobius hoevenii (Bleeker)

1851. *Gobius hoevenii* Bleeker, *Nat. Tijdschr. Ned.-Indie*, 2: 426 (Sambas, western Borneo, Indonesia).

1991. *Stigmatogobius hoevenii*: Talwar and Jhingran, *Inland Fishes of India*, 2: 946.

1999. *Hemigobius hoevenii*: Larson, *Rec. Mus. Art Galler. North. Territ.*, 15: 25; fig.1-6.

Material examined: 3 ex., Edward's creek, Fraserganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7256/2.

Distribution: India- Gangetic delta and Andamans; West Pacific- Thailand, Hong Kong, Malaysia, Singapore, Philippines, Borneo, New Guinea and northern Australia. Inhabit seas, mangrove estuaries and freshwaters.

Remarks: Chatterjee (1980: 229) recorded this species for first time from Gangetic delta.

Genus *Oligolepis* Bleeker

Oligolepis acutipennis (Valenciennes)

1837. *Gobius acutipennis* Valenciennes, *Hist. nat. poiss.*, 12: 80 (Malabar, India).

1991. *Oligolepis acutipennis*: Talwar and Jhingran, *Inland Fishes of India*, 2: 939.

Material examined: 2 ex., Uttarbhag, 27.ii.1934, S.L. Hora, ZSI F-224/2.

Distribution: East coasts of Africa, to India including Andamans, Sri Lanka, through Indonesia, to Rukyu Islands; Philippines to New Hebrides. In Seas and muddy Estuaries.

Genus *Stigmatogobius* Bleeker

Stigmatogobius sadanundio (Hamilton)

1822. *Gobius sadanundio* Hamilton, *Fish. Ganges*: 52, 366 (Ganges estuary near Calcutta).

1991. *Stigmatogobius sadanundio*: Talwar and Jhingran, *Inland Fishes of India*, 2: 949.

Material examined: 1 ex., Edward's creek, Fraserganj, 11.ix.1974, T.K. Chatterjee, ZSI F-7157/2; 2 ex., Dobanki, 31.iii.2008, T.K. Chatterjee and party, ZSI-SFRS uncat.; 1 ex., Sonakhali, 02.iv.2008, T.K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: India, Bangladesh, Sri Lanka, Thailand, Malay Peninsula to Fiji Islands and Indo-Australian archipelago. Very common in fresh and brackish waters.

Subfamily GOBIINAE

Dorsal fins separate with a gape; dorsal and anal fins not confluent with caudal fin; lower jaw with more than one row of teeth; usually a single interorbital pore present; if absent, pelvic frenum absent, or body mostly naked, or barbels present.

Genus *Acentrogobius* Bleeker

Acentrogobius viridipunctatus (Valenciennes)

1837. *Gobius viridipunctatus* Valenciennes, *Hist. nat. poiss.*, 12: 62 (Bombay).

1991. *Acentrogobius viridipunctatus* : Talwar and Jhingran, *Inland Fishes of India*, 2: 926.

Material examined: 1 ex., Hooghly River, no date, Pulta Survey coll., ZSI F-1979/2.

Distribution: Africa; India including Andamans, Bangladesh, Thailand, China, Hong Kong, Indo-Australian archipelago, Philippines, Ryukyu Island. In seas and estuaries.

Genus *Amblyeleotris* Bleeker

Amblyeleotris gymnocephala (Bleeker)

1853. *Gobius gymnocephalus* Bleeker, *Natuurk. Tijdschr. Ned.-Indie*, 4: 473 (East Indies, probably Batavia).

1991. *Cryptocentrus gymnocephalus*: Talwar and Jhingran, *Inland Fishes of India*, 2: 933.

2005. *Amblyeleotris gymnocephala*: Larson and Lim. *A Guide to Gobies of Singapore*: 66.

Material examined: 1 ex., Jambu Is., Gangetic delta, 07.ix.1974, T. K. Chatterjee, ZSI F-7381/2.

Distribution: Tamil Nadu (India), Mergui Archipelago (Myanmar), Thailand, Jakarta, Hongkong. Inhabits holes in the sandy floor.

Remarks: Chatterjee (1978) first recorded this species from the Gangetic delta.

Genus *Bathygobius* Bleeker

Bathygobius fuscus (Ruppell)

1828. *Gobius fuscus* Ruppell, *Atl. Reise N. Afr. Fische*: 137 (Red Sea).

1991. *Bathygobius fuscus*: Talwar and Jhingran, *Inland Fishes of India*, 2: 929.

Material examined: 1 ex., Bakkhali coast, 06.ix.1974, T. K. Chatterjee, ZSI F-7224/2; 1 ex., a canal near Forest Range Office, Fraserganj, 05.ix.1974, T. K. Chatterjee, ZSI F-7387/2; 2 ex., Fraserganj, 09.xii.1965, K. V. Surya Rao & S. Ahmed, ZSI F-4950/2.

Distribution: Widespread throughout Indo-Pacific including the Red Sea and Hawaii.

Genus *Drombus* Jordan and Seale

Drombus globiceps (Hora)

1923. *Ctenogobius globiceps* Hora, *Mem. Indian Mus.*, 5 : 744; figs. 24–25 (Chilka Lake, Orissa).

1991. *Acentrogobius globiceps*: Talwar and Jhingran, *Inland Fishes of India*, 2: 924.

1993. *Drombus globiceps*: Kottelat et al., *Freshw. Fish. west. Indonesia Sulawesi*: 143.

Material examined: 1 ex., a canal near Forest Range Office, Fraserganj, 05.ix.1974, T. K. Chatterjee, ZSI F-7388/2 (registered as *Acentrogobius globiceps*).

Distribution: India (Gangetic delta, Chilika Lake and Ennore backwaters), Java, Borneo, Papua New Guinea and probably also Singapore.

Genus *Istiogobius* Whitley

Istiogobius ornatus (Ruppell)

1830. *Gobius ornatus* Ruppell, *Atlas Reise N. Afr. Fische*: 135 (Massawa, Eritrea, Red Sea).

1941. *Acentrogobius ornatus*: Koumans, *Mem. Indian Mus.*, 13 (3): 231.

1985. *Istiogobius ornatus*: Murdy and Hoese, *Indo-Pacif. Fish.*, (4): 9.

Material examined: 9 ex. (male), Fraserganj coast, 09.ix.1974, T. K. Chatterjee, ZSI F-7375/2; 7 ex. (female), Fraserganj coast, 09.ix.1974, T. K. Chatterjee, ZSI F-7375/2.

Distribution: Coastal waters in the entries of Indo-Pacific region excluding Hawaii.

Remarks: This is first recorded from the Gangetic delta by Chatterjee (1978: 238).

Genus *Glossogobius* Gill

Glossogobius giuris (Hamilton)

1822. *Gobius giuris* Hamilton, *Fish. Ganges*: 51, 366, pl. 33, fig. 15 (Ganges River).

1991. *Glossogobius giuris*: Talwar and Jhingran, *Inland Fishes of India*, 2: 936.

Material examined: 1 ex., Port Canning, 1-9.vii.1930, R. Hodgart, ZSI F-5624/2; 1 ex., mouth of Hooghly River, date unknown, R.I.M.S. "Investigator" coll., ZSI F-5365/2; 1 ex., Uttarbhag, 1935, S. L. Hora, ZSI F-5312/2; 3 ex., Gosaba (Sundarbans), 02.iv.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.; 1 ex., Haldibari (Sundarbans), 26.iii.2008, T. K. Chatterjee and party, ZSI-SFRS uncat.

Distribution: Throughout India, Bangladesh, Pakistan, Myanmar, Sri Lanka, East and South Africa, Mauritius, Malaya, Malay archipelago, Thailand, China, Japan, Philippines, Melanesia, Polynesia, Australia.

Remarks: Akihito and Meguro (1974) discussed the systematic status of *G. giuris* and other related species. This is a species known to inhabit marine, brackish as well as freshwater habitats, even at highlands.

Genus *Gobiopsis* Steindachner

Gobiopsis macrostoma Steindachner

1860. *Gobiopsis macrostomus* Steindachner, *Sber. Akad. Wiss. Wein*, 42 (2): 291; p1. I, fig. 6 (Bombay).

1941. *Gobiopsis macrostoma*: Talwar and Jhingran, *Inland Fishes of India*, 2: 937.

Material examined: 1 ex., Sagar Is., Gangetic delta, 10.viii.1975, A. Chowdhury, SDCMBRI uncat.

Distribution: East coasts (Hoogly estuary, Godavari estuary and Porto Novo) and west coasts of India, Bangladesh and Thailand.

Genus *Parachaeturichthys* Bleeker

Parachaeturichthys polynema (Bleeker)

1853. *Chaeturichthys polynema* Bleeker, *Verh. batav. Genoot. Kunst. Wet.*, **25**: 44, figs. 4, 4a-b (Nagasaki, Japan).

1991. *Parachaeturichthys polynema*: Talwar and Jhingran, *Inland Fishes of India*, **2**: 943.

Material examined: 1 ex., mouth of River Hooghly, Jan 1923, 'P. V. Lady Fraser' coll., ZSI F-5582/2; 1 ex., locality unknown (possibly mouth of River Hooghly), Jan 1928, P. V. 'Lady Fraser' coll., ZSI F-5586/2.

Distribution: East coast of South Africa, coasts of India, Vietnam, China, Japan, Ambon, and North-eastern and Western Australia.

DISCUSSION

Though the ecological conditions of the habitats are different, it is to be remembered that in some cases, the same species is found in more than one habitat, as there are no rigid limits of demarcation. Where two or more species of these gobioid fishes share the same habitat, such as *Eleotris fusca*, *Butis butis* and *Brachygobius nusus*; or *Odontamblyopus rubicundus* and *Apocryptes bato*, their feeding habits are different and therefore, there is no competition for food. This results in a perfect ecological segregation of the different species (Hora, 1935 b).

The main ecological factor in the Gangetic delta is the ebb and flow of the tides. The aquatic gobies cannot withstand desiccation for long though they can live out of water for a shorter or longer period depending upon the humidity of the air and the dampness of the soil. Of the semi-aquatic gobies, *Pseudapocryptes elongatus* is the best adapted to withstand drought, while the others can endure drought conditions only for a short period. *Periophthalmus* and *Periophthalmodon* can live for long period in damp situations. Both

the semi-aquatic and terrestrial species have developed the power of breathing atmospheric air. It may be pointed here that Hora (1935b) treated *Stigmatogobius sadanundio* under semi-aquatic forms, as this species is capable of breathing atmospheric air, even though it is not seen to come out of water.

In the species taking up a hole-dwelling habit (e.g. *Odontamblyopus rubicundus*, *Pseudapocryptes elongatus*), reduction in the size of air-bladder (Hora, 1941) and loss of sensory canal-pores on head are noticed. Degeneration of eyes and elongation of vertical fins are other remarkable features. For the borrowing forms (e.g. *Pseudapocryptes*, *Odontamblyopus* and *Apocryptes*) the nature of soil is an important factor. Soil in the Genetic delta contains a high water holding capacity and a fair amount of decomposed organic matter. This renders the soil porous and light for borrowing operations and the organic matters also provide nutrition to a number of mud-eating gobies.

The organs of aerial respiration are developed in connection with the buccal cavity and the gill-chambers. In the semi-aquatic and terrestrial species, the gill chambers have well developed pouches for storage for air and the gill-covers are specially modified to keep the openings tightly closed.

The survival value of terrestrial habit of the mudskippers can be well appreciated by observing their behaviour. Stebbins and Kalk (1961) discuss the role of terrestrial habit with special reference to *Periophthalmus*, in the process of evolution. In the environment under tidal influence, twice every twenty-four hours the aquatic habitat is reduced to disconnected pools and narrow channels, chances of a fish of getting trapped in an exposed location are considerable. Fishes are very often trapped after the tide recedes. Many of such isolated pools are situated far from the tide channels. The fishes are even trapped in very shallow depressions, some of which are about 2 cm deep. Chatterjee (1977) made some observations on the behaviour of the mudskippers at Fraserganj in Sundarbans.

When isolated, the threat of predation, overheating, suffocation and desiccation would be greatly increased. Under such conditions a premium would place on structural and functional changes that would make an animal adapted to terrestrial habitat. As proposed by Romer (1933) for the ancestors of amphibians, an important factor in the evolution of terrestrial habit of periophthalmids is probably, the survival value of locomotion on landing avoiding the chances of getting trapped in drying pools (Stebbins and Kalk, (1961). Other factors are possibly, the feeding opportunities on land and avoidance of interspecific competition (Pearse, 1929, 1933, Stebbins and Kalk, 1961). Inger (1952) thinks that feeding opportunities on land are decisive. From the above facts, it is evident that the mud-skippers have, thus, freed themselves from some of the limitations imposed by the aquatic habitat, yet at the same time have retained many of the features of their earlier mode of life.

SUMMARY

The present study aims at giving a preliminary account of the mangrove associate gobioid fishes of the Indian Sundarbans, where inundation and exposure occur twice in a day. This work incorporates the review of the gobioid fishes occurring in the region. Further, this work includes five species which were recorded first time from this biome by the first author, viz., *Eleotris melanosoma* Bleeker, *Gnatholepis caurensis* (Bleeker), *Gobiopsis macrostoma* Steindachner, *Hemigobius hoevenii* (Bleeker) and *Istiogobius*

ornatus (Ruppell). Earlier reports of *Pseudapocryptes borneensis* (Bleeker) and *Trypauchenichthys typus* Bleeker were found to be erroneous after re-examination and the identity is reassigned to *Pseudapocryptes elongatus* (Cuvier) and *Paratrypauchen microcephalus* (Bleeker) respectively. Similarly records of *Periophthalmus chrysospilos* and *Periophthalmus malaccensis* also based on mistaken identity. This work dealt with 45 species belonging to 37 genera under the families Eleotridae and Gobiidae found in Indian Sundarbans. Keys to the genus and species and their distributions for each species are provided. Ecology and adaptation of these gobioid fishes in Sunderbans is also discussed.

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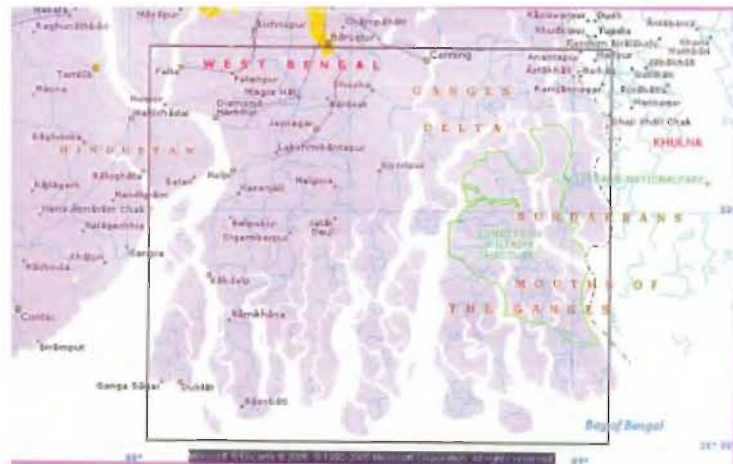


Fig. 1: Map of Sundarbans showing the study area



Fig. 2: Satellite picture of Sundarbans
(source: <http://en.wikipedia.org/wiki/Sundarban>)



Fig. 3: Most abundant mudskipper, *Boleophthalmus boddarti*, in Sundarbans



INVENTORY OF ENDEMIC FRESHWATER FISH FAUNA OF MAHARASHTRA STATE: INDIA

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INTRODUCTION

Freshwater systems are amongst the most vulnerable natural systems on the earth spread over 0.8% of Earth's surface, cover 0.01% of world's water resource. It provide sole habitat for extremely rich, endemic, and sensitive biota, estimated to harbour around 6% of all described species (Dudgeon *et. al.*, 2005; Strayer & Dudgeon, 2010). In recent times anthropogenic activities and climatological changes are driving its biodiversity under severe crises and thus making it the most endangered natural system in the world (Suski and Cooke, 2007, Sarkar *et. al.*, 2008, Woodward, 2010). In view of this, freshwater systems and its biodiversity have to be conserved and managed properly, as it incorporates an invaluable resource, in economic, cultural, aesthetic, scientific and educational terms, necessary for human health and well being (Dudgeon *et. al.*, 2005).

Maharashtra state has been blessed with rich ichthyofaunal diversity by virtue of congregation of different types of topographical, agroclimatic and hydrodynamical conditions within the state boundaries, however only one effort was made to document the fish diversity of Maharashtra state as a whole by Kulkarni and Ranade, 1975 (Acharya & Iftekhar, 2000). A through estimate of

the freshwater fish fauna of Maharashtra itself is not published and this information deficiency on the diversity and distribution of freshwater fishes, (Acharya & Iftekhar, 2000; Molur *et. al.* 2011; Jadhav *et. al.* 2011) obscure the understanding of the true patterns in fish diversity (Molur *et. al.* 2011) and becomes a hurdle in designing and implementing conservation strategies (Jadhav *et. al.*, 2011). Likewise there was no attempt to document the endemic freshwater fish fauna of Maharashtra state and the available information on endemic freshwater fishes of Maharashtra is scattered in published literature and not so far documented at one place.

The endemic fish diversity with restricted distribution need particular attention due to consequent susceptibility to endangerment, if their habitats are altered it will lead to their decline and disappearance. In the view of present background an endeavour was made to document endemic fish species found in Maharashtra state, based on the available published literature and samples collected at Zoological Survey of India Western Regional Station, Pune. To fill the information gap on endemic freshwater fish species by providing relevant data at one place suitable for use within development and conservation planning processes. The scientific literature describing the

Table 1 : Number of endemic freshwater fishes reported in India and in Western Ghats

Year	India	Source	Western Ghats	Source
1998			100	Molur and Walker
2003			116	Daniels,
			112	Rema Devi & Indra respectively
2004			118	Dahanurkar <i>et al.</i> ,
2005	225	Karmarkar and Das,		
2007	191	De Silva <i>et al.</i>	119	Sreekantha <i>et al.</i> ,
2009	192	Goyal and Arora	116	Goyal and Arora
2011	196	Fishbase	138	Molur <i>et al.</i> ,

endemic freshwater fishes of the India and Maharashtra state was reviewed and distribution was confirmed, along with threat status.

In the Asian region the knowledge of the fish faunal biodiversity and its conservation aspects are relatively less documented (Nguyen and De Silva, 2006) as it is still in exploration and discovery phase (Lundberg *et. al.*, 2000; Pinna, 2006). Similarly Indian fish fauna remains in need of in-depth systematic study (Lundberg *et. al.*, 2000) as many species are still to be described or to be discovered (Le´veˆque *et. al.*, 2008; Goyal and Arora 2009), and the available information is from a few well-studied locations only (Molur and Walker, 1998; Bhat, 2003).

India stands ninth among the mega biodiversity countries rich in freshwater ecosystems (Kar *et. al.*, 2006) and estimated to harbour 930 freshwater fishes (Jayram, 2010). Among the East, and South and South-East Asian countries, India possesses maximum number of endemic freshwater fishes (De Silva *et. al.*, 2007); comprising 225 species (Karmarkar and Das, 2005). The freshwater resources are currently experiencing an alarming rate of decline in fish diversity (Sarkar *et. al.*, 2008), with 17 species Critically endangered, 69 species under endangered and 81 species under vulnerable status in the Eastern Himalayas and Western Ghats itself (Allen *et. al.*, 2010; Molur *et. al.*, 2011). Further the endemic freshwater fishes in the Western Ghats region assessed by Molur *et. al.*, (2011) are far more threatened than the non-endemics.

Endemic Fishes in India:

A living organism restricted to a particular geographic area is recognized as endemic species, which need attention owing to limited distribution along with consequent susceptibility to endangerment, if their habitats are altered it will lead to their decline and disappearance (Young, 2007). The proper understanding of endemism facilitates precise prediction of future of biodiversity (Pimm *et. al.*, 1995) and aids in recommending conservation priorities (Myers *et. al.*, 2000). This calls attention for detailed evaluation of endemic fish fauna, which will be more relevant and crucial for developing suitable conservation strategies and management policies to ensure preservation of biodiversity (De Silva *et. al.*, 2007).

As already mentioned among the East, and South and South-East Asian countries, India possesses maximum number of endemic freshwater fishes (De Silva *et. al.*, 2007); comprising 225 species (Karmarkar and Das, 2005). Within India Peninsular India holds maximum number of endemic freshwater fishes, comprising 135 species (Karmarkar and Das, 2005) and Western Ghats in Peninsular India harbour 138 endemic fishes (Molur *et. al.*, 2011). Significant variation in the number of endemic freshwater species of India and Western Ghats is reported in different sources (Table 1).

Molur *et. al.*, (2011), reported 189 endemic freshwater fish species from Western Ghats assessment region (including Western Ghats and associated river basins; Narmada, Tapi,

Godavari, Krishna, Cauvery and all other river systems in southern India), justifying the incomplete survey work in the country as mentioned above and demands a more efficient detailed state or water-shed wise study of Indian freshwater fish fauna.

STUDY AREA

The present study focuses on the state of Maharashtra (15°35'-22°02'N and 72°36'-80°54'E) located in the North Western part of peninsular India. The state encompass three distinct physiographical regions, viz., (1) approximately 80 km wide strip of land between the Western Ghats and coastal line (Konkan), (2) 720 km of Western Ghats hill region, running parallel to the coastline and (3) the eastern plateau drained by the rivers and dotted with thousands of small reservoirs. Maharashtra (with 9.36% of the total geographic area of the country) is the third largest State in terms of area (307,713 Km²), blessed with vast freshwater resources; comprising 3.39 lakh ha of inland water bodies (SoER, 2007) and 380 rivers draining 19,269 km. Stretch (GoM, 2005).

The review of literature reveals that the five interacting freshwater biodiversity threat categories, viz: overexploitation; water pollution; flow modification; destruction or degradation of habitat; and invasion by exotic species (Dudgeon *et al.*, 2005), with more or less varying severity are observed in the freshwaters systems of the Maharashtra state (Molur *et al.*, 2011). This emphasizes the need of proper conservation and management strategies to restore the natural resources for conserving the endemic fish fauna in Maharashtra state.

Anthropogenic development and aquatic habitat loss:

Maharashtra, the second largest state in terms of population size (115.2 million), the third most urbanised state with an urban population of 45.23% (GOI Census, 2011), is one of the most industrialised state in the country (SOER, 2007), where anthropogenic activities (predominantly, industrialisation and urbanisation) have been major factor to affect the water quality of major rivers in the state (Environment monitor, 2006).

Of the 30 river basins in world prioritised for the protection of aquatic biodiversity by Groombridge and Jenkins (1998), Rivers Godavari and Krishna originate in Maharashtra and Rivers Narmada & Tapi flow from the northern border of the state. Maharashtra also has the leading number of polluted river water stretches in the country (MPCB, 2009), highest number of large dam (1693) constructed during last century (NRLD, 2009) and low forest cover compared to that at national level (SOER, 2007). These factors with added decline in Western Ghats forest area (Panigrahy *et al.*, 2010) have become responsible for natural freshwater habitat loss in the state.

Introduction of Exotic species:

Reservoir fisheries in Maharashtra use mostly transplanted Indian major carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) (Sugunan 1995) and exotic species (*Hypophthalmichthys molitrix*, *Ctenopharyngodon idella* and *Cyprinus carpio*) (Acharya & Iftekhar, 2000) as stocking material. Some of the reported exotic species in Maharashtra are *Oreochromis mossambica* (Kharat *et al.*, 2003), *Clarias gariepinus* (Sugunan, 2002; Singh & Lakra 2008), *Pangasianodon hypophthalmus* (Krishna *et al.*, 2011), *Pygocentrus nattereri* (Singh & Lakra 2011), *Gambusia affinis*, *Hypophthalmichthys nobilis* and *Pangasianodon hypophthalmus* (pers. obs.). These exotic fishes are affecting the native and endemic freshwater fishes in Maharashtra (Kharat *et al.*, 2003; Dahanukar *et al.*, 2011).

Studies on fish fauna:

Some of the notable works carried out at few localities by different workers on freshwater fishes in Maharashtra state are given in appendix 1. The review of literature suggests that the Northern parts of western Ghats situated at the western border of Maharashtra and tributaries of the west flowing rivers Godavari and Krishna have not been surveyed extensively or in some cases have not been explored at all and checklists for individual rivers are not available (Jadhav *et al.*, 2011; Molur *et al.*, 2011).

Table 2: Conservation status of endemic freshwater fish fauna in the state of Maharashtra according to IUCN Red List Category

Sr. No.	Red List Category	Number of species	Percentage
1	Extinct (EX)	0	
2	Extinct in the Wild (EW)	0	
3	Critically Endangered (CR)	2	2.74%
4	Endangered (EN)	13	17.81%
5	Vulnerable (VU)	8	10.96%
6	Near Threatened (NT)	2	2.74%
7	Least Concern (LC)	37	50.68%
8	Data Deficient (DD)	6	8.22%
9	Not Evaluated (NE)	5	6.85

METHODOLOGY

The fish species endemic to India, having distributional range in the state of Maharashtra are considered endemic species for this study. The scientific literature describing the endemic freshwater fishes of the India and Maharashtra state was reviewed (Molur and Walker, 1998; Ponniah & Gopalakrishnan 2000; Dahanurkar *et. al.* 2004; Karmarkar and Das, 2005; FishBase (<http://www.fishbase.org>); Molur *et. al.* 2011 and Jadhav *et. al.*, 2011) and list of endemic freshwater fish species was extracted. The extracted list of endemic species was checked for distribution with the available base literature (Talwar & Jhingran, 1991; Jayram, 2010, Ponnaiah & Gopalakrishnan 2000) and other published works (Kulkarni and Ranade, 1975; Yazdani and Singh, 1990; Acharya & Iftekhar, 2000; Dutta Munshi & Shrivastava, 1988; Arunachalam *et. al.*, 2000; Arunachalam *et. al.*, 2002; Daniels, 2002; Wagh & Ghate, 2003; Ghate *et. al.*, 2002; Kharat *et. al.*, 2003; Chandanshive *et. al.*, 2007; Heda 2009a; Jadhav & Yadav, 2009; Rathod, 2011; Jadhav, *et. al.*, 2011) to come up with a list of endemic fish species of Maharashtra State. The list was then checked with the available samples and locality records at Zoological survey of India, Western Regional Station, Pune. The threat status follows as per IUCN (2011).

RESULTS

The endemic freshwater fish fauna in the state of Maharashtra is reputed to consist of 73 fish

species belonging to five orders and 13 families. The family Cyprinidae has the highest number of endemic species (36) followed by Balitoridae (7), Bagridae (7), Sisoridae (6), Schilbeidae (5), Parapsilorhynchidae (4), Cobitidae (2), 6 other families with one endemic species each. Of the 73 species assessed as endemic to the Maharashtra state, fifteen species have uncertain distribution according to IUCN database, but still they are incorporated in the list as need confirmation by further studies. Further two species with taxonomic ambiguities are also listed. The inventory of endemic fish species of Maharashtra state is given in Appendix 2.

The conservation status of endemic freshwater fish fauna in the state of Maharashtra according to IUCN Red List Category is given in table 2.

DISCUSSION

The present findings are based on the available published literature and samples at Zoological survey of India, Pune suggesting that there are 73 endemic freshwater fish in the state of Maharashtra. The family Cyprinidae 62.80% and Balitoridae & Bagridae account for 9.59% of the total number of endemic species respectively. Among the species endemic to the study area ten species are not distributed beyond the boundaries of Maharashtra state. Of these ten species six species are threatened (assessed Critically Endangered, Endangered or Vulnerable) two species *Puntius deccanensis* and *Parapsilorhynchus*

Appendix 1: Some of the notable work carried on Freshwater fishes of Maharashtra

Sr. No.	Year	Author	Area of work
1	1841	Sykes	Deccan
2	1876	Day	Deccan
3	1919	Annandale	Satara and Pune districts
4	1937 & 1939	Hora and Misra	Deolali
5	1942 a. & b.	Fraser	Pune
6	1942	Hora & Misra	Pune
7	1944	Suter	Pune
8	1947	Kulkarni	Bombay
9	1953	Silas	Mahabaleshwar and Wai
10	1955	Kalawar & Kelekar	Kolhapur
11	1963	David A	Godavari and Krishna Rivers
12	1963	Tonapi & Mulherkar	Pune
13	1975	Kulkarni and Ranade	Compilation of fishes of Maharashtra
14	1976	Tilak & Tiwari	Pune district
15	1976	Yazdani & Mahabal	Indrayani River
16	1987	Singh & Kamble	Jalgaon district
17	1988	Singh & Yazdani	Sanjay Gandhi National Park
18	1990	Singh	Dhulia district
19	1990	Yazdani & Singh	Ujni wetland, Solapur
20	1992	Ghate & Pawar	Neera river, Pune
21	1992	Singh	Nashik
22	1992	Singh & Pradhan	Tansa Wildlife Sanctuary
23	1993	Yazdani & Singh	Konkan Region of Maharashtra
24	1997	Pradhan	Wardha River basin
25	2000	Acharya & Iftekhar,	Note on Some of the freshwater fishes of Maharashtra
26	2002	Arunachalam <i>et. al.</i>	Konkan region
27	2002	Yazdani & Singh	Ujani Wetland
28	2003	Wagh & Ghate	Mula and Mutha Rivers Pune
29	2003	Yadav	Northern parts of Western Ghats
30	2004	Dahanurkar <i>et al.</i>	Western Ghats including Northern parts
31	2004	Yadav	Pench National Park
32	2005	Yadava.	a. Melghat Tiger Reserve b. Nathsagar wetland Jaikwadi
34	2005	Khedkar	Nathsagar Reservoir Paithan
35	2005	Khedkar & Gynanath	Issapur Reservoir Yeotmal
36	2006	Yadav	Tadoba Andhari Tiger Reserve
37	2007	Hirware	Four districts of Marathwada region
38	2008	Tijare & Thosar	Lakes of Gadchiroli district
39	2009	Jadhav & Yadav	Solapur district
40	2009	Yadav	Bhimashankar Wildlife Sanctuary
41	2009	Heda	Adan River, and, Kathani River of Godavari basin
42	2011	Molur <i>et al.</i>	Western Ghats ecoregion, including Maharashtra
43	2011	Jadhav <i>et al.</i>	Koyna River
44	2011	Dahanurkar <i>et al.</i>	Indrayani River
45	2012	Katwate	Raigad District
46	2012	Kharat	Krishna River at Wai

Appendix 2: Inventory of endemic fishes of Maharashtra state

Sr. No.	Scientific Name	IUCN Categories	EN-IS
A.	Order Cypriniformes	I.	Family Cyprinidae
1	<i>Salmophasia acinaces</i> (Valenciennes, 1844)	LC	EN-I
2	<i>Salmophasia boopis</i> (Day, 1874)	LC	EN-I
3	<i>Salmophasia horai</i> (Silas 1951)	VU	EN-I
4	<i>Salmophasia novacula</i> (Valenciennes, 1840)	LC	EN-I
5	<i>Barilius evezardi</i> Day, 1872	DD	EN-WGM
6	<i>Barilius gatensis</i> (Valenciennes, 1844)	LC	EN-WG
#7	<i>Chela dadiburjori</i> (Menon)	LC	EN-I
8	<i>Devario fraseri</i> (Hora, 1935)	VU	EN-WG
9	<i>Rasbora labiosa</i> Mukerji, 1935	LC	EN-WG
10	<i>Thynnichthys sandkhol</i> (Sykes, 1839)	EN	EN-I
11	<i>Tor kulkarnii</i> Menon, 1992	EN	EN-WGM
12	<i>Osteobrama cotio peninsularis</i> Silas, 1952	DD	EN-I
13	<i>Osteobrama neilli</i> (Day, 1873)	LC	EN-WG
14	<i>Osteobrama vigorsii</i> (Sykes, 1839)	LC	EN-I
15	<i>Rohitee ogilbii</i> Sykes, 1839	LC	EN-WG
16	<i>Puntius deccanensis</i> Yazdani & Babu Rao, 1976	CR	EN-WGM
17	<i>Puntius fasciatus</i> (Jerdon, 1849)	LC	EN-I
18	<i>Puntius fraseri</i> (Hora & Misra, 1938)	EN	EN-WGM
19	<i>Puntius jerdoni</i> (Day, 1870)	LC	EN-WG
20	<i>Puntius mahecola</i> (Valenciennes, 1844)	DD	EN-WG
21	<i>Puntius narayani</i> (Hora, 1937)	LC	EN-WG
22	<i>Puntius parrah</i> Day, 1865	LC	EN-WG
23	<i>Puntius sahyadriensis</i> Silas, 1953	LC	EN-WG
24	<i>Puntius sarana subnasutus</i> (Valenciennes, 1842)	LC	EN-WG
25	<i>Hypselobarbus kolus</i> (Sykes, 1839)	VU	EN-I
26	<i>Hypselobarbus mussullah</i> (Sykes, 1839)	EN	EN-I
*27	<i>Osteochilichthys godavariensis</i> Rao	NE	EN-WGM
28	<i>Osteochilus nashii</i> (Day, 1869)	LC	EN-WG
29	<i>Cirrhinus cirrhosus</i> (Bloch, 1795)	VU	EN-I
30	<i>Cirrhinus fulungee</i> (Sykes, 1839)	LC	EN-I
31	<i>Labeo kawrus</i> (Sykes, 1839)	LC	EN-I
32	<i>Labeo potail</i> (Sykes, 1839)	EN	EN-I
33	<i>Schismatorhynchus nukta</i> (Sykes, 1839)	EN	EN-I
34	<i>Garra bicornuta</i> Narayan Rao, 1920	NT	EN-WG
35	<i>Garra gotyla stenorhynchus</i> Jerdon, 1849	NE	EN-WG
#36	<i>Garra mclellandi</i> (Jerdon)	LC	EN-WG
II.	Family Parapsilorhynchidae		
37	<i>Parapsilorhynchus discophorus</i> Hora, 1921	VU	EN-WGM

Sr. No.	Scientific Name	IUCN Categories	EN-IS
38	<i>Parapsilorhynchus prateri</i> Hora & Misra, 1938	CR	EN-WGM
39	<i>Parapsilorhynchus elongatus</i> Singh, 1994	EN	EN-WGM
40	<i>Parapsilorhynchus tentaculatus</i> (Annandale, 1919)	LC	EN-I
III. Family Balitoridae			
41	<i>Balitora laticauda</i> Bhoite, Jadhav, Rahul Kumar & Dahanukar, 2012	NE	EN-WGM
42	<i>Acanthocobitis mooreh</i> (Sykes, 1839)	LC	EN-I
43	<i>Nemacheilus anguilla</i> Annandale, 1919	LC	EN-WG
44	<i>Schistura denisoni</i> (Day, 1867)	LC	EN-I
45	<i>Longischistura striatus</i> (Day, 1867)	EN	EN-WG
46	<i>Nemacheilus rueppelli</i> (Sykes, 1839)	LC	EN-WGM
47	<i>Indoreonectes evezardi</i> (Day, 1872)	LC	EN-I
IV. Family Cobitidae			
*48	<i>Botia macrolineata</i> Teugels, De Vos & Snoeks, 1986	NE	EN-I
49	<i>Botia striata</i> Narayan Rao, 1920	EN	EN-WG
B. Order Siluriformes		I.	Family Bagridae
50	<i>Rita gogra</i> (Sykes, 1839)	LC	EN-I
51	<i>Rita kuturnee</i> (Sykes, 1839)	LC	EN-I
52	<i>Mystus malabaricus</i> (Jerdon, 1849)	NT	EN-WG
53	<i>Mystus montanus</i> (Jerdon, 1849)	LC	EN-I
54	<i>Mystus seengtee</i> (Sykes, 1839)	LC	EN-I
#55	<i>Mystus oculatus</i> (Val.)	LC	EN-WG
56	<i>Hemibagrus maydelli</i> (Rössel, 1964)	LC	EN-WG
II. Family Siluridae			
57	<i>Ompok malabaricus</i> (Val.)	LC	EN-WG
III. Family Schilbidae			
58	<i>Clupisoma bastari</i> Datta & Karmakar, 1980	DD	EN-I
#59	<i>Eutropiichthys goongwaree</i> (Sykes, 1839)	DD	EN-I
60	<i>Neotropius khavalchor</i> Kulkarni, 1952	DD	EN-WG
61	<i>Proeutropiichthys taakree</i> (Sykes, 1839)	LC	EN-WG
62	<i>Silonia childreni</i> (Sykes, 1839)	EN	EN-I
IV. Family Sisoridae			
63	<i>Gagata itchkeea</i> (Sykes, 1839)	VU	EN-I
#64	<i>Glyptothorax housei</i> Herre	EN	EN-WG
65	<i>Glyptothorax lonah</i> (Sykes, 1839)	LC	EN-I
66	<i>Glyptothorax madraspatanum</i> (Day, 1873)	EN	EN-WG
67	<i>Glyptothorax poonaensis</i> Hora, 1938	EN	EN-WG
68	<i>Glyptothorax trewavasae</i> Hora, 1938	VU	EN-WG

Sr. No.	Scientific Name	IUCN Categories	EN-IS
C.	Order Beloniformes		
I.	Family Adrianichthyidae		
69	<i>Oryzias setnai</i> (Kulkarni, 1940)	LC	EN-I
D.	Order Synbranchiformes		
I.	Family Synbranchidae		
70	<i>Monopterus indicus</i> (Silas & Dawson, 1961)	VU	EN-WG
II.	Family Mastacembelidae		
71	<i>Macrognathus guentheri</i> (Day)	LC	EN-WG
E.	ORDER PERCIFORMES		
I.	Family Pristolepididae		
72	<i>Pristolepis marginata</i> Jerdon, 1849	LC	EN-WG
II.	Family Channidae		
**73	<i>Channa leucopunctatus</i> Sykes	NE	EN-I

Abbreviations: EN-I: Endemic to India, EN-WG: Endemic to Western Ghats, EN-WGM: Endemic to Western Ghats of Maharashtra

* Synonymy doubtful hence treated as separate species following Jayaram (2010)

** This species treated as synonym of *Channa marulius* (Ham), but our study indicates that *C. leucopunctatus* is a distinct species. The detailed study will be published separately.

Occurrence doubtful needs confirmation.

prateri are under Critically Endangered category. One of the authors (SJ) conducted a survey of Deolali & surrounding areas repeatedly during last three years, for the collection of *P. prateri*. Finally, the collection was made in stream, near Trimbakeshwar, Nasik district after a long gap. The detailed study of this species will published separately. Urgent need is felt to take up proper steps for conservation of these species.

Among the total endemic species in Maharashtra state 31.51% species are under threatened category (two species are Critically Endangered, thirteen species are Endangered and eight species are Vulnerable). Two species are under near threatened category and 6 species are under Data Deficient category. Hence almost 49% of endemic fish fauna falls under Threatened, Near Threatened, and Data Deficient and Not Evaluated category.

CONCLUSION

The present work essentially consists of distillations of the text and illustrations of earlier works as mentioned by Kottelat and Whitten, (1996). Even then, the generated information on endemic freshwater fish biodiversity of Maharashtra will help the student, researchers, planners and policy makers to frame conservation and management strategies. The present work will form a basis for further studies. Probable additions and / or deletions in the number of species are possible after detailed field surveys and after resolving taxonomic ambiguities. The authors are of the opinion that stream wise detailed surveys are necessary for documenting the diversity and understanding of resource for proper planning, sustainable utilisation and conservation.

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AQUATIC BEETLES OF NAYACHAR ISLAND, EAST MIDNAPORE DISTRICT, WEST BENGAL, INDIA

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INTRODUCTION

The present account is based on a collection of Coleoptera (Gyrinidae, Dytiscidae and Hydrophilidae) obtained from Nayachar Island of West Bengal which includes the report of 7 species under 6 genera of 3 families. The diagnostic characters and detailed distribution of each species are provided. Nayachar is an island located at the confluence of the Hooghly River and the Haldi River at the northern extent of the Bay of Bengal in the East Midnapore district of West Bengal state of India. It is a small island with an area of 64 square kilometers located at 22°02' N 88°04' E coordinates.

SYSTEMATIC ACCOUNT

Order COLEOPTERA

Family GYRINIDAE

Subfamily ENHYDRINAE

Genus : *Dineutus* Macleay, 1825

1825. *Dineutus* Macleay, *Annulosa javanica* ed., 1: 30.

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

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

Material examined : India: West Bengal, East Midnapore district, Nayachar Island, 18.VIII.1993, S.C. A.K. Hazra & Party, 3ex.

Diagnosis : Elytra without any spines-epipleural or parasutural.

Distribution : India (Andhra Pradesh, Assam, Bihar, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Pondicherry, West Bengal), Pakistan.

Family DYTISCIDAE

Subfamily DYTISCINAE

Tribe ACILIINI

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.

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

Material examined : India : West Bengal, East Midnapore district, Nayachar Island, 18.VIII.1993, S.C. A.K. Hazra & Party, 2ex.

Diagnosis : Middle femora with short thorn-like bristles usually reaching one fourth the length of the tronchanters.

Distribution : India (Andhra Pradesh, Arunachal Pradesh, Delhi, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Orissa, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal), Bangladesh, Nepal, China, Japan, Madagaskar, Philippines, Saudi Arabia, Sunda Islands, Taiwan, Afrotropical region, Australian region, North Africa.

Genus *Sandracottus* Sharp, 1882

1882. *Sandracottus* Sharp, *Sci. Trans. R. Dublin Soc.*, 2: 672.

3. *Sandracottus mixtus* (Blanchard, 1843)

1843. *Hydaticus mixtus* Blanchard, *Atlas d'histoire naturelle zoologie*, pl. 4.

Material examined : India : West Bengal, East Midnapore district, Nayachar Island, 18.VIII.1993, S.C. A.K. Hazra & Party, 2ex.

Diagnosis : Middle femora with few long ciliae not or scarcely shorter than trochanters. Elytra reddish yellow, with brown markings on each elytron essentially consisting of two transverse black bands.

Distribution : India (Andhra Pradesh, Nagaland, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal), Myanmar, China, Indonesia, Japan, Vietnam.

Tribe HYDATICINI

Genus *Hydaticus* Leach, 1817

1817. *Hydaticus* Leach, *zool. Miscell.* **3**: 69.

4. *Hydaticus (Prodaticus) mexaformis*

Wewalka, 1979

1979. *Hydaticus mexaformis* Wewalka, *Koleopterologische Rundschau*, **54**: 129.

2012. *Hydaticus (Prodaticus) mexaformis*, Ghosh & Nilsson, *Skorvoppn supplement*, **3**: 26.

Material examined : India : West Bengal, East Midnapore district, Nayachar Island, 19.VIII.1993, S.C. A.K. Hazra & Party, 1ex.

Diagnosis : Head brown with transverse black band on the posterior border of vertex, pronotum similarly with a transverse median black band along the posterior corneae.

Distribution : India : Delhi.

Remarks : This species is first time reported from West Bengal.

5. *Hydaticus (Prodaticus) satoi satoi*

Wewalka, 1975

1975. *Hydaticus satoi* Wewalka, *Koleopterologische Rundschau*, **52**: 91.

2012. *Hydaticus satoi satoi*, Ghosh & Nilsson, *Skorvoppn supplement*, **3**: 27.

Material examined : India : West Bengal, East Midnapore district, Nayachar Island, 18.VIII.1993, S.C. A.K. Hazra & Party, 4ex.

Diagnosis : Humeral and sub marginal yellow stripes narrow and joined together posteriorly after the middle.

Distribution : India : Kerala, Sikkim, Tamil Nadu, West Bengal.

Elsewhere : Bhutan, Myanmar, Nepal, Sri Lanka; China, Indonesia, Japan, Philippines, Saudi Arabia, Taiwan, Thailand.

Family HYDROPHILIDAE Subfamily HYDROPHILINAE Tribe HYDROPHILINI

Genus : *Hydrophilus* Muller, 1764

1764. *Hydrophilus* Muller, *Fauna Ins. Fridrichsdalina*, p. 16.

6. *Hydrophilus olivaceus* Fabricius, 1781

1781. *Hydrophilus olivaceus* Fabricius, *Spec. ins.*, **1**: 289.

Material examined : India : West Bengal, East Midnapore district, Nayachar Island, 18.VIII.1993, S.C. A.K. Hazra & Party, 1ex.

Diagnosis : The anterior femora only are clothed with pubescence at base. Antenna club perfoliate and asymmetrical.

Distribution : India (Andhra Pradesh, Madhya Pradesh, Maharashtra, Manipur, West Bengal).

Genus : *Sternolophus* Solier, 1834

1834. *Sternolophus* Solier, *Ann. Soc. ent. Fr.*, **3**: 302, 310.

7. *Sternolophus rufipes* (Fabricius, 1792)

1792. *Hydrophilus rufipes* Fabricius: *Entom. Syst.*, **1**: 183.

Material examined : India : West Bengal, East Midnapore district, Nayachar Island, 18.VIII.1993, Coll. A.K. Hazra & Party, 3ex.

Diagnosis : All femora clothed at base with a silky procumbent and dense pubescence. Antenna with normal club.

Distribution : India (Andhra Pradesh, Bihar, Jammu & Kashmir, Maharashtra, Meghalaya, Manipur, Punjab, Sikkim, Tripura, Uttar Pradesh, West Bengal), Sunda Is., Myanmar, Philippines, Japan, Formosa, Indonesia, Indochina, China, Sri Lanka.

SUMMARY

The paper reports of 7 species of aquatic beetles under 6 genera of 3 families, Gyrinidae, Dytiscidae, Hydrophilidae and which from first report of these taxa from Nayachar Island.

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SEAGRASS ASSOCIATED MARINE SPONGES IN PALK BAY

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INTRODUCTION

Seagrass, though one of the predominant and specialized group of marine flora, are poorly known in India, compared to other similar ecosystems such as mangroves. It occurs in all the coastal areas of the world except the Polar Regions because of ice scouring. It represents one of the highly productive coastal ecosystems of the world and protects the shorelines against erosion in the middle and lower intertidal and subtidal zones. India is home to more than fifteen species of seagrasses found in different coastal areas of Eastern, Southern and Western parts of India. Most of the species are found in healthy numbers along the Southeast Coast (which is the Gulf of Mannar and the Palk Bay), of Tamil Nadu, and the sporadic islands of Lakshadweep and Andaman & Nicobar.

Most of the earlier seagrass studies in the Palk Bay have focused only on their quantitative, taxonomic and structural components, Hence the present study was carried out to collect distribution, diversity of seagrasses in the Palk Bay area between Mandapam and Thondi that are colonized by seagrasses support rich and diverse fauna like Corals, sea anemones, molluscs, sea cucumbers, small macroalgae and epiphytic organisms such as sponges, bryozoans, foraminiferans, other taxa like star fishes and sea urchins. It serves as feeding and nursery habitat for endangered species like dugong and turtles and also many commercial and recreationally important fishes. Fishing pressure has resulted in overexploitation of marine resources, especially

the benthic assemblages. Sponges, being sedentary, are easily landed as a by catch discard in most of the bottom targeting fishing gears.

So far about 11,000 species have been formally described of which 8553 are valid species of sponges world over. In India marine sponges constitute 451 species. Out of which the Gulf of Mannar and Palk Bay consists of 313 species belonging to 137 genera and 12 orders of demospongiae and 5 species of class Hexactinellida and 1 species of class calcarea were recorded. (Pattanayak, 2001). Fossil sponges are among the oldest known animal fossils, dating from the late precambrian. Since then sponges have been conspicuous members of many fossil communities and the number of described fossil communities and the number of described fossil genera exceeds 900. (www.ucmp.berkeley.edu/porifera). Over exploitation for commercial purposes have resulted in the depletion of the sponge fauna with a few species being included under Schedule 1.

The history of sponge study of the Indian Ocean starts from 1765 onwards. A perusal of literature reveals that 451 species of marine sponges are known to occur in India (Pattanayak, 1999) through the works of Sollas (1884), Dendy (1887-1989), Annandale (1914-1915), Burton (1930) and Ali (1954-56). An exhaustive survey of the marine sponges with special reference to the Gulf of Mannar and Palk Bay has been studied during the years 1964-67 by Thomas (1968-2006). Coral boring sponges of the Gulf of Mannar and Palk Bay were studied by Thomas (1969). The

fauna of West coast of India is partly worked out when compared to that of the east coast.

Sponges have played a critical role in shaping the basic form of the Phanerozoic biosphere. Archaeocyaths and perhaps even some Calcareous formed the first major biological reef systems in the middle Tommotian. Sponges seemed to have played an important role in most reef systems thereafter, and have been critical in maintaining reef systems during certain times of biological crisis (Vishnevskaya *et al.*, 2002 - Late Devonian).

MATERIAL AND METHOD

Palk Bay is located on the northern side of Mandapam (Long. 79° 09' E and Lat. 09° 16' N) a coastal town on the southeast coast of India on a small peninsular extension of the main land leading to Rameswaram (Long. 79° 09' E and Lat. 09° 17' N).

Materials for the present study were collected from 23.7.11 to 29.7.11 2011 in the seagrass area of Olaikuda, Dhanushhkodi, Chinnapalam in Gulf of Mannar and Devipattinam, Thondi, Mallipattinam. During low tide samples were handpicked from the inter-tidal region and samples were also collected from bottom set gill nets used in crab fishery. The samples of sponges thus collected were preserved in 70% Ethyl Alcohol. Clearing of the hand sections were done in carbol- xylol and mounted in glycerine. Spicules were boiled in nitric acid and mounted were done in the euparal.



Map showing the study area

Sponge distribution; During the survey on seagrass associated sponge resources of Palk Bay, 9 species under seven genera and six families are recorded in these areas. Out of 7 genera *Axinella*, *Sigmadocia* and *Haliclona* were found to be dominant in the Thondi area. Higher sponge species diversity was found in Pamban area and the lower diversity in Mallipattinam area.

RESULTS

List of Sponge species of Palk Bay identified during the study period

Phylum PORIFERA
Class DEMOSPONGIAE
Order HADROMERIDA
Family SPIRASTRELLIDAE

1. *Spirastrella inconstans* (Dendy)

Family CLIONIDAE

2. *Cliona celata* Grant

Order HALICHONDRIIDA
Family AXINELLIDAE

3. *Axinella flabelliformis* Hentschel

4. *Axinella durissima* (Dendy)

Order HAPLOSCLERIDA
Family CALLYSPONGIDAE

5. *Callyspongia diffusa* (Ridley)

Family NYPHATIDAE

6. *Gelliodes fibrosa* (Dendy)

Family Chalinidae

7. *Sigmadocia fibulata* (Schmidt)

8. *Haliclona implexa* (Schmidt)

9. *Haliclona exigua* (Kirkpatrick)

1. *Spirastrella inconstans* (Dendy)

1902. *Spirastrella inconstans* Sollas, p.216, pl.14, fig.3
Spirastrella inconstans Thomas, 1985, p. 305, pl.v, fig. 23.

Material examined: 1 exs, sta: Olaikuda and Thondi, 24.7.11. Reg. No. S-49. Coll. Dr.V. Deepak Samuel and Party. Sponges were found among *Cymodocea serrulata*, *Halophila ovalis*, *Syringodium isoetifolium*

Distribution: In India, Gulf of Mannar, Palk Bay and Andamans.

2. *Cliona celata* Grant

1972, *Cliona celata* Thomas, p.344, pl.1, figs.5A (synonymy)

Material examined: 2 exs, sta: Devipattinam, Olaikuda, and Pamban. 26.7.11. Reg.No. S-206. Coll. Dr.V.Deepak Samuel and Party. Sponges were found among *Halophila ovalis* in the intertidal area

Distribution : In India, Gulf of Mannar, Palk Bay and Andamans.

3. *Axinella flabelliformis* Hentschel

Material examined : 2 exs, sta: Devipattinam, Thondi, Olaikuda and Pamban 24.7.11. Reg.No.S-204. Coll. Dr.V. Deepak and Party. Sponges were found among seagrass meadows like *Syringodium isoetifolium*

Distribution: In India, Gulf of Mannar, Palk Bay and Andamans.

4. *Axinella durissima* (Dendy)

1905, *Thrinacophora durissima* Dendy, p.187, pl.12, fig.5

Material Examined : 1 exs, sta Thondi, Devipattinam and Olaikuda), 24.7.11. Reg. No. S-203. Coll. Dr.V. Deepak and Party. Sponges were found among seagrass meadows *Cymodocea serrulata*.

Distribution : Widely distributed in the Indian Ocean.

5. *Callyspongia diffusa* (Ridley)

1884, *Cladochalina diffusa* Ridley, p.672, pi.41, fig. D.

1934, *Callyspongia diffusa* Burton, p. 541, fig. 6 Thomas 1968, Ph.D. Thesis.

Material Examined : 2 exs, sta: Mallipattinam, Thondi, Devipattinam, Olaikuda, Chinnapalam and Pamban), 27.7.11. Reg.No. S-202. Coll. Dr.V. Deepak and Party. Sponges were found in the roots of *Syringodium isoetifolium*.

Distribution: Indian Ocean.

6. *Gelliodes fibrosa* (Dendy)

1905, *Gelliodes petrosioides var. fibrosa* Dendy, p.139.

Material examined : 1 ex, sta: Mallipattinam, Thondi, Devipattinam, Olaikuda, Chinnapalam and Pamban), 28.7.11. Reg.No. S-203.

Dr.V.Deepak Samuel & Party. Sponges were found among *Cymodocea serrulata*.

Distribution : In India, Gulf of Mannar, Palk Bay, Andamans.

7. *Sigmatocia fibulata* (Schmidt)

1880, *Renicra fibulifera* Carter, p. 48.

1884, *Gellius fibulatus* Ridley, p. 424.

1973, *Sigmatocia fibulata* Thomas, p. 21, pi. 1, fig. 9

Material Examined: 2 exs, sta: Olaikuda), 25.7.11. Reg.No. S-199. Coll. Dr.V. Deepak Samuel & Party. Sponges were found among *Halophila ovalis*.

Distribution: Atlantic Ocean, Mediterranean Sea, Indian Ocean, Australian region.

8. *Haliclona implexa* (Schmidt, 1868) (figs. 6, 7)

1868, *Reniera implexa* Schmidt, 27; Ridley & Dendy, 1887: 15, pi. 14; Topsent, 1904:244;

1978, Griessinger, 1971: 133, figs 5c, 6d, 6k; Pulitzer-Finali, 72.

1956, *Haliclona coriacea* Burton, 123 (Not: *Siphonochalina coriacea* Schmidt, 1868).

Material examined: 1 ex, sta: Thondi and Olaikuda), 24.7.11. Reg. No. S-49. Dr. V. Deepak & Party. Sponges were found in the roots of *Cymodocea serrulata* *Halophila ovalis*.

Distribution : In India, Gulf of Mannar, Palk Bay and Andamans.

9. *Haliclona exigua* (Kirkpatrick)

1937, *Haliclona exigua* Burton, p.17 (Synonymy)

Material examined : 1 ex, sta: Thondi and Olaikuda), 24.7.11. Reg.No. S-49. Dr.V.Deepak & Party. Sponges were found among *Cymodocea serrulata*.

Distribution : In India, Gulf of Mannar, Palk Bay and Andamans.

Sea Grass Associated Sponges

Seagrasses are attached with filter feeding animals like bryozoans, sponges, and hydroids as well as the eggs of ascidians and molluscs. These plants and animals provide food for small fish that live in the seagrass. However, it is important to care for all organisms that live in seagrass

habitats because as they are part of the food web that produces the fish. As humans have encroached on the marine environment, there have been some dramatic effects on coastal ecosystems. Many human activities threaten or destroy seagrass habitats. They are an essential part of the marine environment. The following species are associated in the seagrass are *Hercina fusca*, *Dysidea fragilis*, *Spirastrella inconstans* and *Callyspongia diffusa* like branching sponges are fairly common at the bottom. The vegetation is composed of *Cymodocea sp*, *Halophila ovalis* and *Cymodocea serrulata*. Boring sponges was the major group among the marine organisms causing considerable destruction to the reef system. There are 20 species of boring sponges now known from the Gulf of Mannar and Palk Bay falling into 9 genera. The most conspicuous genus is *Cliona* both in number of species and in distribution (Thomas, 1969).



Seagrasses washed ashore in Palk Bay - shows the presence of dense meadows and increase in fishery activities

It is known fact that there has been steady decline in the sea-grass population around the world. It is estimated that around 30,000 kilometers of sea grass has been lost in last ten years. The accelerated damage is due to man – mechanical destruction of the habitat and over-fishing. The bigger threat to seagrass is not from the environment but from the humans. Coastal activities such as ports, harbours, construction, garbage dumps, urban pollution, industrial dumps, terrestrial erosion, coastal development, breakwaters, fish farming, aquaculture,

eutrophication, siltation, dredging, anchoring, are taking heavy toll on the fragile plants. Seagrass habitat is critical for a number of threatened species, including sirenians (dugong and manatee), sea turtles and sea horses, all widely perceived to have high cultural, aesthetic or intrinsic values.

Threats to seagrass associated sponges in Palk Bay

Natural factors like storms, cyclones and flood are the primary cause for mass degradation of sponge habitat in these seagrass ecosystem.

Sedimentation : Sedimentation due to river run off and pressure during Sethu Samudram excavation has caused the seagrass beds and its sponge associates in stress finally leading to mortality. (Ishrath, 2008). The seaweed and sea grass ecosystem between Rameshwaram and Kanyakumari have either been uprooted or submerged, 'dislocating many associated organisms and changing the species composition'. A huge population of sponges has been affected and animals such as crabs, lobsters and stomatopods displaced from their coral homes. [Ramesh, 2005].

Predation : Predation by spongivorous fishes clearly limits the distribution and abundance of sponge species. Most importantly fish predators have a major impact on the distribution & abundance of sponges on Caribbean reefs because fish predatory activities restrict some sponge species to stable. Fish predation on Caribbean sponges comes from an exhaustive study of fish gut contents conducted by Randall & Hartman (1968).

Anthropogenic Impacts : The main threat to seagrass ecosystem in these regions include usage of trawlers and other destructive practices leading to the up- rooting of seagrass with their sponge associates causing further stress.

SUMMARY

In the Palk Bay a total of 16 specimens as belonging to 9 species of sponges as seven genera and six families were recorded from the Seagrass

beds. Genus *Spirastrella* was dominant and seems to be an integral part of sea grass ecosystems. Fishing pressure through bottom set gill nets and trawling were identified as major threats to sponges and other associated organisms in the seagrass communities.

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PLATE



Fig.1 : *Spirastrella inconstans*



Fig.2 : *Cliona celata*



Fig.3 : *Axinella flabelliformis*



Fig.4 : *Axinella durissima*



Fig.5 : *Callyspongia diffusa*



Fig.6 : *Gelliodes fibrosa*



Fig.7 : *Sigmatocia fibulata*



Fig.8 : *Haliclona exigua*



SIGHTING OF *LIBYTHERA MYRRHA* GODART (LEPIDOPTERA: LIBYTHERIDAE) IN PUNJAB, INDIA

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Libytheidae is a small family of butterflies characterized by enormous prolongation of the palpi giving an appearance of a beak in front of head and hence commonly known as the "Beaks". The members of this family have small and angular fore wings, and reduced fore legs in males but fully developed in females.

This family is closely related to the family Lycaenidae. However, different workers have given different taxonomic treatment to this family for example de Niceville (1886) classified it as a subfamily Libytheinae under the family Lemoniidae; Evans (1932) and Arora *et al.*, (2009) incorporated it as a genus *Libythea* Fabricius under family Erycinidae; Wynter-Blyth (1957) included it as a subfamily Libytheinae under family Erycinidae; while Haribal (1992) and Kehimkar (2008) treated it as a separate subfamily Libytherinae under the family Nymphalidae.

It is represented by a single genus *Libythea* Fabricius. The type genus *Libythea* is represented by 12 species through out the world (Varshney 2010). The different species of *Libythea* are generally uniform in size, peculiar and strongly falcated outline, and in colouration except the specific distinction in the markings of the upperside. Their size usually varies from a little under two inches to a little over two inches in expanse. The upperside is brown with some tawny or whitish markings on wings and the variations in these markings are the diagnostics for different species. The underside is clouded

and striated with similar protective colouration, varying in tone in each species but uniform in style throughout the genus.

Of these 12, only four species, viz., *Libythea myrrha* Godart, *L. lepita* Moore, *L. celtis* Laicharting, and *L. narina* Godart occur in India Kehimkar (2008), while Varshney (2010) included *L. geopffroyi* Godart also along with these four species.

DISTRIBUTION

In India, *Libythea myrrha* Godart 1819 is distributed between about 3,000' and 9,000' in the NW Himalayas; Kullu to Assam & Sikkim; Northeast; Western India (Bombay); and South India (higher hills) (de Niceville 1886; Bingham 1905; Evans 1932; Wynter-Blyth 1957; Haribal 1992; and Kehimkar 2008). *Elsewhere*: Burma (now Myanmar), China, Upper Tenasserim, Java, Borneo, Malayan Subregion, and Ceylon (now Sri Lanka). It is found around streams in forest and settles very readily on damp patches. It is wary and easily frightened and if disturbed flies off rapidly but not far, either returning soon or settling at the end of a twig where it exactly resembles a leaf.

The species is easily recognized by upper forewing cell tawny streak joined to spot beyond, making a continuous club-like marking and apical spots joined to form a band. upper hindwing has broad yellow band touching the base. Hindwing costa and termen are straight on either side of apex (Photo).



Libythea myrrha Godart at Kathlaur-Kaushlian Wildlife Sanctuary, Pathankot, Punjab

Recently, while conducting 'General Faunistic Survey' of Punjab under the mandates of the Zoological Survey of India in districts, *viz.*, Kapurthala, Amritsar, Gurdaspur, Pathankot, Hoshiarpur and Rupnagar (Ropar) (3-20 November 2011), we came across one example of the species *Libythea myrrha* Godart in scrubby habitat at Kathlaur-Kaushlian Wildlife Sanctuary (KKWLS) in District Pathankot, Punjab in the forenoon of 11th November 2011. Observations were made in the compartment nos. 5&6 of the sanctuary with GPS reading on Oregon 550 GPS of Garmin make N 32° 14.936'; E 075°26.967'; Accuracy 10'; Elevation 852'.

The sanctuary is primarily a riverine ecosystem. The vegetation of the sanctuary is mainly comprised of grasses such as: Sarkanda, Kana, Kahi (*Saccharum spontaneum*, *S. officinalis*, *S. munja*, etc); young plantations of the trees, *viz.*, Khair (*Acacia catechu*), Shisham (*Dalbergia sissoo*), Kikar (*A. nilotica*), Amla (*Emblica officinalis*), Bamboo (*Bambusa bambos* and *Dendrocalamus strictus*), Amrud (*Psidium guvava*), Safeda (*Eucalyptus* hybrid), Willow (*Salix* sp.); and a variety of shrubs, herbs and weeds.

Material examined: India: Punjab: Distt. Pathankot: Compartment nos. 5&6 of KKWLS, 1 ♂ (Regd. No. A-11088), 11.xi.2011, Coll. P.C. Tak & party. The material has been deposited in the National Zoological Collection (NZC), ZSI, Dehradun.

According to Wynter-Blyth (1957) the species in the Himalayas is reported only to fly up to circa 5000' and in NW Himalayas its range is between c. 3000' and 9000'. However, during the present survey it was recorded at the altitude of 852' only.

Further, although butterfly fauna of Punjab have been studied from different localities by the workers such as: Rose and Sidhu (2001); Arora *et al.*, (2006); Sharma and Joshi (2009); including a checklist of butterflies of Punjab available on the website of Punjab ENVIS Centre and also the above quoted workers. But none of them have made any mention of this species in their studies, therefore, the present record of *Libythea myrrha* Godart from KKWLS (Distt. Pathankot) can be treated as an addition to the butterfly fauna of Punjab.

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DIVERSITY AND ECOLOGY OF PLANT MITES AND DAMAGES CAUSED BY THEM ON ORNAMENTAL AND GARDEN PLANTS IN SOUTH BENGAL

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INTRODUCTION

Flowers and leafy ornamentals have in India immense values in socio-cultural-religious aspects apart from having a good deal of commercial values both in domestic and export markets. India has 2,32,540 ha under flower cultivation with production of 4,59,156 tonnes of loose flowers and 1,15,613 cut flowers (Chadha, 2010 and Gupta, 2012). The huge garden in the Ashrama of the Narendrapur Ramakrishna Mission has a very rich collection of both flowers and leafy ornamentals and those are regularly infested with a large variety of insects and mites which have not so far been explored, studied and documented. In view of this, the present study was undertaken to explore the mites both phytophagous and predatory species infesting these plants, their importance as pests or beneficial predators, if any, and some information has also been provided as to their management mostly by herbal pesticides as application of synthetic chemical pesticides are environmentally unfriendly.

MATERIAL AND METHODS

The collection of mite specimens both phytophagous and predatory forms was made from the garden of the Ramakrishna Mission Ashrama, Narendrapur, 16 kms south of Rajbawan, Kolkata during the period from August, 2007 to July, 2009 at monthly intervals.

The mites were collected mainly by hand picking method and also by separation of mite specimens from leaves through Tullgren funnels. Those were preserved in 70% ethyl alcohol and were studied after mounting in Hoyer's medium. Most of those were identified by the second author (SKG) by examining the specimens under Olympus research microscope and consulting the updated literature.

RESULTS AND DISCUSSION

The identification of the collected mite specimens from 25 types of flowers and ornamental plants from the garden of the Ramakrishna Mission revealed the occurrence of 21 species under 14 genera belonging to 8 families and 2 orders as given in Table – 1 with their hosts, nature of association, status as pests/predators and period of occurrence. At the end, a paragraph has been devoted suggesting management of the pest species and profitable utilization of the predatory mites for biocontrol.

MANAGEMENT OF MITE PESTS

Chemical Method : For management of injurious tetranychid mites some of the chemical pesticides which have been found effective are : wettable sulphur (0.14%), difenturon (0.1% @ 300 gm/ha), bromoproflate (0.1%), monocrotophos (0.036%) + hippe (*Madhuca latifolia* oil 0.04%), dicofol (0.02%) + pongamia oil (0.04%), abamectin (1.9% EC @ 2 ml/l of water).

Table-1 : List of mite species collected on floricultural and leafy ornamental plants at Ramakrishna Mission Ashrama, Narendrapur

Family/Order/Species	Hosts/Habitats	Nature of association	Remarks (Nature of damage / Predatory importance, etc.)
ORDER I: PROSTIGMATA			
Family 1: Tetranychidae			
1. <i>Tetranychus urticae</i> Koch	Rose (<i>Rosa centifolia</i>), Zinia (<i>Zinia elegans</i>), Marigold (<i>Tagetes patula</i>), Dahlia (<i>Dahlia</i> sp.), Sunflower (<i>Helianthus annuus</i>), Aparajita (<i>Clitoria ternatea</i>), Siuli (<i>Nyctanthes arbortristis</i>)	Phytophagous, occurs on undersurface of leaves in colony covered with thin webs.	It is a serious pest of rose, dahlia and aparajita. Infested leaves become yellow, later brown and finally fall off. Consequently the plant becomes unhealthy, affects flower production. This mite is available throughout the year on one or the other ornamental plant but its attack is more serious during May-June and relatively less during rainy season.
2. <i>Tetranychus biharensis</i> Hirst	Rose	-do-	Occasionally attacks, no serious damage is done. It occurs during May-June and none during rest of the year.
3. <i>Tetranychus macfarlanei</i> Pritchard & Baker	Chrysanthamum (<i>Chrysanthamum coronaria</i>), Champa (<i>Magnolia champaca</i>)	-do-	As above. This mite also occurs throughout the year but its population remains at high level during April-May and occasionally during October-November, absent during monsoon months.
4. <i>Tetranychus ludeni</i> Zacher	Marigold, Dahlia	-do-	As above
5. <i>Tetranychus neocaledonicus</i> Andre	Jasmine (<i>Jasminum sambac</i>), Rose	-do-	As above
6. <i>Eutetranychus orientalis</i> (Klein)	Sthal Padma (<i>Hibiscus mutabilis</i>), Rose, Oleander (<i>Nerium indicum</i>), Snflower, Kolke (<i>Thevetia peruviana</i>)	Phytophagous, occurs on upper surface of leaves	Very serious pest especially of Sthal padma and Oleander, the infested leaves develop brownish patch, such leaves gradually dry up. This mite infests one or the other ornamental plant all through the year. However it assumes serious status during May-June and again during October -November. It is rarely seen during monsoon months when these are washed away because of its occurrence on upper leaf surface.
Family 2: Tenuipalpidae			
7. <i>Brevipalpus californicus</i> (Banks)	Bougainvillea (<i>Bougainvillea spectabilis</i>), <i>Tabernae montana coronaria</i> , Jaba (<i>Hibiscus rosa-sinensis</i>), Sunflower	Phytophagous, occurs on undersurface along mid- ribs	Seriously attacks all these plants, infested leaves turn pale yellow, later dry. This is available all through the year but its population reaches to an alarming stage during April -July and again during October to early part of December.
8. <i>Brevipalpus phoenicis</i> (Geijskes)	Rose, Oleander, Zinia	As above	As above
9. <i>Brevipalpus obovatus</i> Donnadieu	Coleus, Canna (<i>Canna indica</i>), Croton	As above	As above This is rather uncommon mite on ornamental plants, population always remains low hence causes no economic damage to the host plant.

Family 3: Tarsonemidae			
10. <i>Polyphagotarso-nemus latus</i> (Banks)	Marigold	As above	The attacked young apical leaves turn crinkled/curled. This mite occurs on ornamental plants especially during dry months and scares during monsoon months. During winter it occurs on young marigold leaves.
Family 4: Eriophyidae			
11. <i>Aceria jasmini</i> Channa Basavanna	Jasmine	Phytophagous, occurs on upper surface of leaves	No apparent damage symptoms noticed. Population never attains any alarming state to inflict economic damage though in other parts of India it is quite a serious pest.
Family 5: Cunaxidae			
12. <i>Dactyloscirus</i> sp.	Cosmos (<i>Cosmos sulphureus</i>)	Predatory	Very low population, no predatory importance noticed.
13. <i>Cunaxa capreolus</i> (Berlese)	Atashi (<i>Crotalaria sericea</i>)	-do-	As above
Family 6: Stigmaeidae			
14. <i>Agistemus terminalis</i> (Quayle)	Kadamba (<i>Neolamarckia cadamba</i>), Codaeum, Chhatim (<i>Alstonia scholaris</i>)	-do-	As above This mite was found in field associated with <i>Brevipalpus</i> mite. However feeding was not observed.
15. <i>Agistemus</i> sp. nr. <i>hystrix</i> Gupta	Akanda (<i>Calotropis procera</i>)	-do-	As above
Family 7: Tydeidae			
16. <i>Pronematus fleschneri</i> Baker	Gandharaj	-do-	This mite was quite common on this host as well as several other crop plants. Elsewhere it was found feeding upon eggs of tetranychid mites (Gupta, 2012).
ORDER II: MESOSTIGMATA			
Family 8: Phytoseiidae			
17. <i>Neoseiulus longispinosus</i> (Evans)	Rose, Siuli, Aparajita	-do-	Very efficient predator of <i>Tetranychus urticae</i> on rose, aparajita, found feeding in the field the immature stages of this mite, consequently the body colour turned red.
18. <i>Ablyseius largoensis</i> (Muma)	Rose, Bougainvillea, Kamini (<i>Murraya exotica</i>)	-do-	Very effective predator of <i>Brevipalpus</i> sp. on Tagar. It is more common on fruit trees than on ornamental plants where it feeds on adults and immatures of <i>Tetranychus</i> sp.
19. <i>Euseius coccineae</i> Gupta	Tagar, Marigold	-do-	Good predator of <i>T. urticae</i> on marigold
20. <i>Typhlodromips suknaensis</i> Gupta	Kolke	-do-	Good predator of <i>Eutetranychus orientalis</i>
21. <i>Paraphytoseius multidentatus</i> (Swirski & Shechter)	Sunflower, Siuli	-do-	Good predator of <i>Brevipalpus californicus</i> on sunflower. This species is quite common on several fruit trees as well as on weeds.

Some botanical pesticides like leaf extracts of karanja, neem, nishinda and tulsi, rhizome extracts of turmeric and garlic may also be used at 3-5% levels. In addition some commercially available botanical pesticides like Replin, Aza - 3000, Econeem plus are also useful if used at early stage of infestation.

Cultural Method : Using of resistant varieties and adopting barrier crop, intercropping, etc. will also be effective in management of mite pests.

Biological Method : Using and conserving biological agents like Coccinellid beetles, Chrysopids and predatory mites belonging to Phytoseiidae will also be effective.

It is also to be borne in mind that indiscriminate spraying of synthetic chemical

pesticides especially at their sublethal doses should be avoided as it leads to pest resistance and resurgence. Therefore, attempts to be made to take up spraying programme at early stage of pest infestation and conserve the natural enemies mentioned earlier which can keep the pest mite population below EIL.

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DIVERSITY AND DISTRIBUTION OF SEA-ANEMONES (CNIDARIA : ACTINIARIA) IN THE ESTUARIES AND MANGROVES OF ODISHA, INDIA

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INTRODUCTION

Actinarians, popularly called as 'Sea-Anemones', belongs to the phylum Cnidaria form an important group of intertidal invertebrate distinguished by their habit, habitat and beautiful colouration. This group was not elaborately studied from India. However Annandale (1907 & 1915), Carlgren (1925 & 1949), Parulekar (1968 & 1990), Seshyia and Cuttress (1971), Misra (1975 & 1976) and Bairagi (1998, 2001) worked on this group and a total 40 species of sea anemones belongs to 33 genera and 17 families so far recorded from India. During the recent faunal survey (2010-2011) of Estuaries and Mangrove fringed coastal districts of Odisha, the authors encountered a quite good number of specimens of this group. After proper identification these reveals 5 species belonging to 4 genera and 3 families. Earlier recorded four species are also included in this paper. A short description, habitat-choice and distribution of a total of 9 species are provided in this paper.

MATERIALS AND METHODS

As the species are burrowing, the collection was done by inserting spade into the muddy or sandy substrata without disturbing the animals and lever up to the mud along with the Anemone. Specimens were picked up carefully and brought to the camp laboratory in estuarine water. Giant

anemone *Paracondylactis sinensis* (Carlgren) was collected by digging the sandy mud 20-25 cm around the specimens up to depth of about 70-120 cm depending on the size of the anemone. The animals were detached from the substratum by lifting the basal disc manually and narcotized with 1% formalin for the period of 6-8 hours. The narcotized anemones with fully expanded condition were preserved in 10% formalin for further studies.

SYSTEMATIC ACCOUNTS

Phylum CNIDARIA

Class ANTHOZOA

Subclass HEXACORALLIA

Order ACTINIARIA

Family EDWARDSIIDAE

1. *Edwardsia jonesii* Seshaiya & Cuttress, 1969

2. *Edwardsia tinctoria* Annandale, 1915

Family HALIACTIIDAE

3. *Pelocoetes exul* Annandale, 1915

4. *Phytocoetes gangeticus* Annandale, 1915*

Family DIADUMENIDAE

5. *Diadumene schilleriana* (Stoliczka, 1869)

Family HALCAMPIDAE

6. *Mena limnicola* (Annandale, 1915)*

7. *Mena chilkaeae* (Annandale, 1915)*

Family NEVADNEIDAE

8. *Nevadne glauca* (Annandale, 1915)*

Family ACTINIIDAE

9. *Paracondylactis sinensis* (Carlgren, 1949)

* Not collected by the authors, diagnosis is given here from the literature.

Key to the Species

- Scapus covered by rusty-red cuticle.....1
 cuticle absent.....2
1. Tentacles 12*Edwardsia jonesii*
 Tentacles 16.....*Edwardsia tinctoria*
2. Tentacles branched.....*Pelocoetes exul*
 Tentacles simple.....3
3. Column short*Diadumene schilleriana*
 Column narrow and slender.....4
4. Column smooth and elongated 5
 Column short and rough.....6
5. Tentacles 36 in number, base narrow, physa like
*Phytocoetes gangeticus*
 Tentacles 96 in number, base flattened and distinct
*Paracondylactis sinensis*
6. Columns with no stinging warts.....*Nevadne glauca*
 Columns with stinging warts 7
7. Stinging warts arranged in 12-16 longitudinal
 rows*Mena limnicola*
 Stinging warts arranged in 24 longitudinal rows
*Mena chilkaeae*

1. *Edwardsia jonesii* Seshaiya & Cuttress, 1969

1971. *Edwardsia jonesii* Sheshaiya & Cuttress, 1969.
J. mar. biol. Ass. India, **11**(1 & 2): 73, Figs.1, 2.

1995. *Edwardsia jonesii* Misra, *Wetland Ecosystem Series I*
: Fauna of Chilka Lake : 230.

1998. *Edwardsia jonesii* Bairagi, *Cnidaria: Sea anemone.*
Fauna of West Bengal, state fauna series, **3**(Part-11):33.

2001. *Edwardsia jonesii* Bairagi, *Cnidaria: Sea anemone.*
Fauna of Godavari Estuary, Estuarine ecosystem series,
4:12.

Material examined : 3 ex; Balaramgadi, Burha
 Balanga estuary, Balasore District, Odisha;
 13.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No.
 P3628/1; 2 ex, Talsari, Subarnarekha estuary,
 Balasore District, Odisha; 16.iv.2011, S. Mitra &
 J.G. Pattanayak, Reg. No. P3629/1.

Diagnosis : Tentacles 12, smooth and arranged
 in two cycles of six each. Body distinctly divided

into capitulum, scapulus, scapus and inflatable
 physa without cuticle. Capitulum thin-walled,
 almost transparent, smooth and without cuticle.
 Scapus thick-walled, covered with thick shaggy
 rusty-red cuticle. Actinopharynx with 8
 longitudinal ridges, siphonoglyph indistinct.

Habitat : Burrowing forms in soft muddy
 substratum of Intertidal zone.

Distribution : India : East coast : Subarnarekha
 estuary, Chilika Lake (Odisha), South 24 Parganas
 (West Bengal), Andhra Pradesh, Tamilnadu; West
 coast : Sunkeri (middle reaches of Kali river
 estuary), Karnataka.

Remarks : *Edwardsia jonesii* Seshaiya &
 Cuttress, 1969 is fairly distributed in east coast of
 India.

2. *Edwardsia tinctoria* Annandale, 1915

1915. *Edwardsia tinctoria* : Annandale, *Mem. Indian Mus.*,
5:92, pl. 16, fig. 3; pl.7, fig. 55a; pl.7a, fig. 5; text figs.
 7a-c.

1968. *Edwardsia tinctoria* : Perulekar, *J. Bombay nat. Hist.*
Soc., **65**(1): 140, pl. figs. 1.

1995. *Edwardsia tinctoria* : Misra, *Wetland Ecosystem Series*
I : Fauna of Chilka Lake : 229.

Material examined : 1 ex, Subarnapur,
 Subarnarekha estuary, Balasore District, Odisha;
 15.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No.
 P3630/1

Diagnosis : Tentacles 16, smooth and arranged
 in two cycles of six each. Body distinctly divided
 into capitulum, scapulus, scapus and inflatable
 physa well developed at the aboral end.
 Capitulum thin-walled, almost transparent,
 smooth and without cuticle. Scapus thick-walled,
 covered with thick shaggy rusty-red cuticle.
 Actinopharynx with 8 longitudinal ridges,
 siphonoglyph indistinct. Nemathoboms in 8
 longitudinal rows on the column.

Habitat : Burrowing forms in soft muddy
 substratum of Intertidal zone.

Distribution : Endemic in India : East coast :
 Subarnarekha estuary, Chilika lagoon (Odisha),
 Hugli-Matla Estuary(West Bengal) ; West coast :
 Goa and Maharashtra; Sunkeri (middle reaches of
 Kali river estuary), Karnataka.

Remarks : *Edwardsia tinctoria* Annandale, 1915 is fairly distributed in east coast and west coast of India.

Family HALIACTIIDAE

3. *Pelocoetes exul* Annandale, 1915

1915. *Pelocoetes exul* Annandale, *Mem. Ind. Mus.*, 5:86, pl.6, fig.1; pl.7, figs.3, 3a, 3b; text fig.5.

1995. *Pelocoetes exul* : Misra, *Wetland Ecosystem Series I : Fauna of Chilka Lake* : 230-231.

2001. *Pelocoetes exul* : Bairagi, *Estuarine Ecosystem Series, 4: Fauna of Godavari Estuary* : 12

Material examined : 2 ex; Bandar, Devi river estuary, Puri District, Odisha; 02.iv. 2011, S. Mitra & J.G. Pattanayak, Reg. No. P3631/1; 2 ex; Balaramgadi, Burha Balanga estuary, Balasore District, Odisha; 13.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. P3632/1; 4 ex, Subarnapur, Subarnarekha estuary, Balasore District, Odisha; 15.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. P3633/1.

Diagnosis : Basal disc reduced. Bluntly tapering and without physa. Column elongated. Longitudinal rows of nematocyst batteries alternating with cinclides on column. Tentacles are branched hexamerously arranged (6 + 6+12+24+48, the last cycle more or less complete) oral discloded.

Habitat : Soft mud burrowing form in the Intertidal zone, found at mudflat just beside the narrow creeks of the middle tidal area.

Distribution : India: Subarnarekha estuary (Odisha), South 24 parganas and Gangetic delta (West Bengal), Tamilnadu., Maharastra, Kerala, Goa.

Remarks : This species is very common in the estuaries and found in the muddy shore near the estuarine mouth.

4. *Phytocoetes gangeticus* Annandale, 1915*

1915. *Phytocoetes gangeticus* Annandale, *Mem. Ind. Mus.*, 5: 79, pl.7a, fig.3, 3a & 3b.

1968. *Edwardsia tinctoria* : Perulekar, *J. Bombay nat. Hist. Soc.*, 65(1): 141, pl.1, fig.4.

1995. *Phytocoetes gangeticus* : Misra, *Wetland Ecosystem Series I : Fauna of Chilka Lake* : 231.

Diagnosis : Tentacles simple, slender, 36 in number. Column narrow and slender, smooth with longitudinal rows of cinclides, sphincter not visible. Base narrow physa-like.

Distribution : India : Chilka lagoon (Orissa); South 24 parganas and Gangetic delta (West Bengal), Tamilnadu, Kerala, Goa and Maharastra.

Remarks : This species is very common in the estuaries and found in the muddy shore near the estuarine mouth. But this species is not collected during the present surveys. Diagnosis is incorporated from the literature.

Family DIADUMENIDAE

5. *Diadumene schilleriana* (Stoliczka, 1869)

1869. *Sagaritta schilleriana* Stoliczka, *J. Asiat. Soc. Bengal*, 38(2): 31, pls. 10, 11.

1915. *Metridium schillerianum* : Annandale, *Mem. Ind. Mus.*, 5:76, pl.7 fig.1

1998. *Diadumene schilleriana* : Bairagi, *Fauna of West Bengal*, Part-11 : 37-38, fig. 1-A, B.

Material examined : 1 ex; Bandar, Devi river estuary, Puri District, Odisha; 02.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. P3634/1; 1 ex; Balaramgadi, Burha Balanga estuary, Balasore District, Odisha; 13.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. P3635/1; 3 ex, Subarnapur, Subarnarekha estuary, Balasore District, Odisha; 15.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. P3636/1. 2 ex; Hukitola Light house, Mahanadi Estuary, Cuttack District, Odisha; 02.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. P3637/1.

Diagnosis : Body divided into Scapus and Capitulum. Capus with Cinclides and Capitulum with collar. Body very short, 12-19 mm. in length and diameter greater than that of column and provided with longitudinal rows of warts, tentacles long and numerous inner tentacles thicker than outer tentacles. Basal disc strong and adhesive. Column divided into scapus and capitulum, tentacle long, numerous, more or less regularly arranged and inner tentacles thicker than the outer, distinct sphincter absent.

Habitat : Occurring in gregarious population on rocks and boulders and submerged trunk of mangroves.

Distribution : India : Devi river estuary, Burhabalanga estuary, Mahanadi estuary and Subarnarekha estuary (Odisha); Canning, Dimond harbour, Sagar Island (West Bengal); Maharastra.

Remarks : This species often found on living animals like hermit Crabs, horse-shoe crab and sometimes also on plastics bags which are occasionally found as floating in waters.

6. *Mena limnicola* (Annandale, 1915)*

1915. *Halianthus limnicola* Annandale, *Mem. Ind. Mus.*, 5: 89, pl.6 fig.2, pl.7 fig.4, 4a, 4b, text fig. 6.

1925. *Mena limnicola* : Carlgren, *Ark zool.*, 17A(21) : 11, fig.8-11.

1995. *Mena limnicola*: Misra, *Wetland Ecosystem Series I : Fauna of Chilka Lake*: 232.

Diagnosis : Tentacles 12 in number; stinging warts large, arranged in 12-16 longitudinal rows, more scattered and variable in size in the lower part of the column, also present in the central part of the physa; Sphincters very weak; six pairs of macrocnemies, fifth and sixth pairs weaker than the others.

Distribution : Chilka lagoon (Odisha).

Remarks : This species is Endemic to Chilka lagoon (Odisha). But this species is not collected during the present surveys. Diagnosis is incorporated from the literature.

7. *Mena chilkaeae* (Annandale, 1915)*

1915. *Phytocoetes chilkaeus* Annandale, *Mem. Ind. Mus.*, 5:82, pl.7 fig.2, pl.8a fig.4, text-fig. 4.

1925. *Mena chilkaeae* : Carlgren, *Ark zool.*, 17A(21) : 9, fig.4-7.

1995. *Mena chilkaeae* : Misra, *Wetland Ecosystem Series I : Fauna of Chilka Lake*: 232

Diagnosis : Tentacles 24 in number; lower sphincter more alveolar with fewer meshes; stinging warts large, arranged in 24 longitudinal rows, more scattered in the lower most part of the column, and absent in the central part of the physa; six pairs of strong macrocnemies.

Distribution : Chilka lagoon (Odisha).

Remarks : This species is Endemic to Chilka lagoon (Odisha). But this species is not collected

during the present surveys. Diagnosis is incorporated from the literature.

Family NEVADNEIDAE

8. *Nevadne glauca* (Annandale, 1915)*

1915. *Gyrostoma glaucum* Annandale, *Mem. Ind. Mus.*, 5:70, pl.7a fig.1, text-figs. 1a,b.

1925. *Nevadne glauca* : Carlgren, *Ark. zool.*, 17A(21) : 3, fig.1-3.

1995. *Nevadne glauca* : Misra, *Wetland Ecosystem Series I : Fauna of Chilka Lake* : 233.

Diagnosis : Pedal disc small; tentacles about 144 in number, arranged in 6 cycles, 4th and 6th cycles being exocoel tentacles. Actinopharynx well developed with weak siphonoglyphes. Mesenteries arranged in four cycles (6+6+12+48), last cycle only in uppermost part of the body. Mesenteries of the three first cycles perfect but those of the second and third order perfect only in uppermost part of actinopharynx.

Distribution : Chilka lagoon (Orissa), Hugli – Matla estuary (West Bengal), Tamilnadu.

Remarks : This species is Endemic Indian in Indian waters. This species is not collected during the present surveys. Diagnosis is incorporated from the literature.

Family ACTINIIDAE

9. *Paracondylactis sinensis* (Carlgren, 1949)

1957. *Paracondylactis indicus* Dave, Study of anthozoa, M.Sc. thesis, Univ. Of Bombay (un published).

1968. *Paracondylactis indicus* Perulakar, Sea-Anemones of Bombay. *J. Bombay. nat. Hist. Soc.* 65:143, pl. II, fig.10.

1998. *Paracondylactis indica* Bairagi, Cnidaria: Sea anemone. *Fauna of West Bengal*, State Fauna Series, 3(Part-11):38.

Material examined : 1 ex; Balaramgadi, Budha Balanga estuary, Balasore District, Odisha; 15.xii.2009, S. Mitra & J.G. Pattanayak, Reg. No.P3638/1; 2 ex, Subarnapur, Subarnarekha estuary, Balasore District, Odisha; 15.iv.2011, S. Mitra & J.G. Pattanayak, Reg. No. P3639/1.

Diagnosis : column elongated and tapering. Pseudospherules present on columns. Pedal disc flattend and distinct. Tentacles 96, arranged in 5

Distribution of Sea Anemones in Mamngroves and Estuaries of Odisha

Sl. No.	Name of The Species	Mahanadi Estuary	Devi River estuary	Subarnarekha estuary	Chilka Lagoon	Budha Balanga estuary
1.	<i>Edwardsia jonesii</i>	+	-	+	+	+
2.	<i>Edwardsia tinctoria</i>	-	-	+	+	-
3.	<i>Pelocoetes exul</i>	-	+	+	+	+
4.	<i>Phytocoetes gangeticus</i>				+	
5.	<i>Diadumene schilleriana</i>	+	+	+		+
6.	<i>Mena limnicola</i>				+	
7.	<i>Mena chilkaeae</i>				+	
8.	<i>Nevadne glauca</i>				+	
9.	<i>Paracondylactis sinensis</i>			+		+

cycles. Colour of the tentacles and oral disc are white to colourless.

Habitat: Intertidal Sand and sandy mud area.

Distribution : India : East coast: Subarnarekha Estuary, Budha Balanga Odisha, West Bengal; West coast: Maharastra and Karnataka

Remark : This species is endemic to Indian coast.

SUMMARY

The present paper deals with the diagnostic features of 9 species of sea anemones available in

the estuaries and mangroves of Odisha. Chilka lagoon is most diverse in respect of Actinarians concern, where as Subarnarekha estuary is the second in position.

ACKNOWLEDGEMENTS

The authors wish to express their deep felt gratitude and thanks to Dr. K. Venkatraman, Director, Zoological Survey of India, Kolkata, for providing facilities to complete this work. All staffs of General Non- Chordata section and Publication division of Zoological Survey of India also acknowledged for their sincere help.

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A TAXONOMIC REVISION OF *PHIMENES* GIORDANI SOIKA (HYMENOPTERA : VESPIDAE : EUMENINAE) OF INDIAN SUBCONTINENT

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INTRODUCTION

In 1855, de Saussure erected the name *Phi* for division IV of the genus *Eumenes* Latrielle. The type species of this division is *Vespa arcuata* Fabricius, 1775, by the subsequent designation of Bequaert (1926). Since the name *Phi* is preoccupied by a subgenus of a New World polistine genus *Mischocyttarus*, Giordani Soika (1992) proposed a new name *Phimenes* for *Phi* de Saussure.

The genus *Phimenes* Giordani Soika is widely distributed in Australian and Oriental region. At present, 19 species and 38 subspecies are recorded from the world (Source: Global Names Index BETA website http://gni.globalnames.org/data_sources) and this group requires a thorough revisionary work for assessing the exact species number. The species *Phimenes flavopictum* (Blanchard, 1845) is the only species distributed in the Indian subcontinent with its four subspecies namely *Phimenes flavopictum flavopictum* (Blanchard, 1845), *Phimenes flavopictum andamanicum* (Zimmermann, 1931), *Phimenes flavopictum continentale* (Zimmermann, 1931) and *Phimenes flavopictum nicobaricum* (Meade-Waldo, 1910). After a detailed study based on a large number of specimens collected from different localities of India and Sri Lanka, I proposed a new synonymy for the subspecies *Phimenes flavopictum continentale* (Zimmermann, 1931) under the nominate species *Phimenes flavopictum* (Blanchard, 1845) and the subspecies *Phimenes*

flavopictum andamanicum (Zimmermann, 1931) and *Phimenes flavopictum nicobaricum* (Meade-Waldo, 1910) are elevated into distinct species status namely *Phimenes andamanicum* (Zimmermann, 1931) and *Phimenes nicobaricum* (Meade-Waldo, 1910). Hence, three valid species, namely, *Phimenes flavopictum* (Blanchard), *P. andamanicum* (Zimmermann) and *P. nicobaricum* (Meade-Waldo) are present in the Indian subcontinent.

Since the earlier descriptions were not sufficient for the identification, detailed redescriptions with sufficient illustrations and photographs are provided here. The detailed synonymical references and a key to separate the Indian subcontinent species were also provided. During the present study it is found out that the species *Phimenes flavopictum* (Blanchard) is newly recorded from Delhi, Manipur, Mizoram, Nagaland and Tripura and *P. andamanicum* (Zimmermann) is newly recorded from Nicobar Islands.

MATERIAL AND METHODS

This study is based on a large number of specimens present in the Hymenoptera Section of the Zoological Survey of India, Kolkata. All the specimens were properly curated, registered and deposited at the 'National Zoological Collections' of the Zoological Survey of India, Kolkata (NZSI).

Abbreviations used for the Museums: BMNH = British Museum of Natural History, London, England; MP = Museum National d'Histoire

Naturelle, Geneve, Paris, France; NZSI = 'National Zoological Collections' of Zoological Survey of India, Kolkata, India; ZMB = Zoologisches Museum der Humboldt Universitat, Berlin, Germany.

Abbreviations used for the terms: H = Head; M = Mesosoma; OOL = Ocellocular length; POL = Postocellar length; T1-T2 = Gastral tergites 1 and 2.

RESULTS

Genus *Phimenes* Giordani Soika

Phimenes Giordani Soika, 1992, *Lavori Soc. Ven. Sci. Nat.*, 17: 41, 66, genus, replacement name for *Phi* de Saussure, 1855, not de Saussure, 1854. Type species: *Vespa arcuata* Fabricius, 1775, by subsequent designation of Bequaert, 1926, *Ann. S. Afr. Mus.*, 23: 487, as type species of *Phi* de Saussure, 1855.

Diagnosis: Clypeus subpyriform; cephalic fovea absent; occipital carina strong, complete and narrowed ventrally; antenna farther from each other than from eyes; last antennal segment of male hooked apically; anterior face of pronotum almost smooth; pronotum with distinct pretegular carina; parategula exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; median groove of propodeum distinct, complete; midtibia with one spur; second sub marginal cell of forewing acute basally; petiole length 1.25x or more than 1.25x the length of mesosoma in lateral view; second gastral tergum without lamellae separated by apical thickening.

Distribution: Australian, Oriental.

1. *Phimenes flavopictum* (Blanchard, 1845) (Figs. 1-20; photo 1)

Eumenes "arcuata" Fabricius; Donovan, 1804, *Epit. Nat. Hist. Ins. India*: pl. 57 ("54") fig. 3 (Madras?). Additional citations: Westwood, 1842, in Donovan, *Nat. Hist. Ins. India*, ed. 2: 90, pl. 57 fig. 3; Smith, 1861, *J. Linn. Soc. (Zool.)*, 5: 126 (*arcuatus*); Smith, 1865, *J. Linn. Soc. (Zool.)*, 11: 372 (cat.) (*arcuatus*); Smith, 1871, l. c., vol. ii, p. 372 (cat. as 1861); Smith, 1878, *J. Asiat. Soc. Beng.*, 47: 168 (*arcuatas*; Moulmein, Tenasserim); Bingham,

1897, *Fauna Brit. India, Hym.*, vol. 1, p. 346, ♀ ♂ (*arcuatus*); Rothney, 1903, *Trans. Entomol. Soc. Lond.*, 106 (*arcuata*; Barrackpore, Bengal); Bingham, 1905, *Fasc. Malay., Zool.*, 3: 47 (Malaya; Burma); Dover and Rao, 1922, *J. Proc. Asiat. Soc. Beng. (n. s.)*, 18: 238 (*arcuata*; Lebong, Moulmein, Burma; note on nest); Dover, 1925, *J. Proc. Asiat. Soc. Beng. (n. s.)*, 20: 296, fig. 6 (*arcuata*; *flavopicta* is a colour var.); Dover, 1926, *China J. Sci. Arts*, 4: 233 (Hong Kong); Dover, 1929, *Bull. Raffles Mus.*, 2: 44 (*arcuata*; Malaya) [incorrectly recorded from Sarawak, Borneo, New Guinea]; Dover, 1931, *J. Fed. Malay St. Mus.*, 16: 253 (*arcuata*; Malaya); Giordani Soika, 1935, *Ann. Mus. Civ. Stor. Nat. Genova*, 57 (1934): 133 (syn.: *formosanus* Zimm. and *continentalis* Zimm.).

Eumenes flavopictus Blanchard, 1841-49, in Ch. d'Orbigny, *Dict. Univ. Hist. Nat., Planches*, vol. 2, Ins., Hym., pl. 2, fig. 21, Type locality Unknown (MP?). Additional citations: Saussure, 1852, *Et. Fam. Vesp.*, 1: 65, ♀, pl. IV, figs. 3a, 3b, (*flavopicta*), "Indes Orientales" (MP); de Saussure, 1855, l. c., 3: 132, description of ♂; Smith, 1857, *Cat. Hym. Brit. Mus.*, 5: 22 (cat., *flavopicta*); Smith, 1858, *J. Linn. Soc. (Zool.)*, 2: 108 (*flavopicta*; Singapore); Smith, 1871, *J. Proc. Linn. Soc. Zool.*, 2: 371 (cat., *flavo-picta*); Maindron, 1882, *Ann. Soc. Ent. France*, ser. 6, vol. 2, p. 272 (*flavopicta*; syn. of *E. arcuata*); Bingham, 1888, *J. Bombay Nat. Hist. Soc.*, 3: 187 (*flavopicta*, Burma); Bingham, 1896, *Proc. Zool. Soc. Lond.*, p. 448 (*flavopicta*; Ceylon); Bingham, 1897, *Fauna Brit. India, Hym.*, 1: 345, ♀ ♂ (*flavopicta*); Rothney, 1903, *Trans. R. Ent. Soc. Lond.*, p. 106 (*flavopicta*; Barrackpore, West Bengal, common); Stebbing, 1905, *J. Bombay Nat. Hist. Soc.*, 16: 674 (*flavopicta*, Burma); Strand, 1910, *Jahrb. Nass. Ver. Naturk*, 63: 49 (*flavopicta*; Ceylon); Annandale, 1912, *Rec. Indian Mus.*, 7: 39 (*flavopicta*; Parésnath, India, 4000-4400 ft); Dover & Rao, 1922, *J. As. Soc. Bengal, new ser.*, 18: 238 (*flavopicta*; India; Ceylon); Dover, 1925 (1924), *ibid.*, 20: 296, fig. 6 (*flavopicta*).

Eumenes arcuata var. *flavopicta* Dalla Torre, 1894, *Cat. Hym.*, 9: 18 (cat.). Additional citations: Dalla Torre, 1904, *Gen. Insect.*, 19: 21 (cat.); von Schulthess, 1914, *Zool. Jahrb. Syst.*, 37: 263 (*arcuatus*

var. *flavopictus*, Sumatra); Zavattari, 1911, *Ann. Mus. Zool. Univ. Nap.*, new ser., vol. 3, no. 19, p.2 (*flavopictus*; Ceylon); Dusmet, 1930, *Bol. Soc. Ent. Esp.*, 13: 102 (*flavopictus*; Khandala, India).

Eumenes arcuatus var. *praslinius* (Guerin): Bequaert, 1928, *Ann. Mag. Nat. Hist.*, ser. 10, vol. 2, p. 169 (in key; syn.: *flavopictus* Blanch.).

Eumenes arcuata flavopicta Zimmermann, 1931, *Zeitschr. Morph. Oek. Tiere*, 22: 205, fig. 26, no. 1 (Ceylon; wrongly reported from Sumatra and Java).

Eumenes arcuatus continentalis Zimmermann, 1931, *Z. Morph. Ökol. Tiere*, 22: 205, 224, 226, fig. 26 no. 3, ♀ ♂ *arcuata continentalis* - "Sikkim"; India to Canton; Sumatra (♀, ZMB) [erroneously recorded from Borneo]; Giordani Soika, 1934, *Boll. Soc. Venez. Stor. Nat.*, 1: 42 (not a separate var.); Giordani Soika, 1935, *Ann. Mus. Civ. Stor. Nat. Genova*, 57 (1934): 133 (syn. of *arcuatus arcuatus*); van der Vecht, 1937, *Treubia*, 16: 268, fig. 3a (Sumatra; erroneously recorded from Borneo); Dammerman, 1948, *Verh. K. ned. Akad. Wet.*, (2) 44: 364 (Krakatau).

Eumenes flavopictus flavopictus Blanchard: in van der Vecht, 1959, *Zool. Verh. Leiden*, 41: 32.

Eumenes flavopictus continentalis Zimmermann: in van der Vecht, 1959, *Zool. Verh. Leiden*, 41: 15. Additional citation: Iwata, 1965, *Mushi* 38: 105, pl. 9 fig. 9 (anat. ovary), pl. 10 fig. 11 (egg). New synonymy.

Delta arcuata (Fabricius): in Gupta, 2007, *Zool. Surv. India, Faunal Diversity Western Doon Shiwaliks*, p. 37 (recorded from Tiparpur in Dehradun).

Based on the detailed examination of specimens from various localities of Indian subcontinent, reached the conclusion that *Phimenes flavopictus continentalis* (Zimmermann, 1931) based on the type species from Sikkim is no more than a local colour variation of the nominate species *Phimenes flavopictum flavopictum* (Blanchard, 1845). Hence, herewith propose to synonymise *Phimenes flavopictus continentalis* (Zimmermann, 1931) under the nominate species

Phimenes flavopictum flavopictum (Blanchard, 1845).

Redescription: Female: Body length (H+M+T1+T2) 24-26 mm; forewing length 17.5-19.5 mm. Black with the following yellow markings: clypeus, an interantennal mark, a line at the inner orbits, a narrow line at the outer orbits (in some specimens more extensive yellow markings; yellow lines at inner and outer orbits almost coalescent or narrowly or widely interrupted on the vertex, line at the outer orbit more widened and extends posteriorly); a transverse band on the pronotum (in brightly coloured forms yellow maculation more extended, sometimes a yellow spot at variable size present posteriorly near tegulae); four spots on the mesoscutum (in some brightly coloured forms connected to form two lyre-shaped markings), a small mark on the lateral areas of the scutellum (in brightly coloured forms scutellum almost entirely except peripheral areas), marks behind axillary fossa near base of hind wing, a vertical band on the mesepisternum, a band on outer margin of tegulae, a band on the postscutellum, two large marks on posterior area of propodeum (leaving a median, cross shaped area black, in some brightly coloured forms yellow maculation more extensive except a longitudinal black marking medially and two minute black spots inside the yellow area); marks on outer side of mid and hind coxae, a line at the inner side of fore femora, most of the fore tibiae (leaving a brown line on the inner side), a line on the outer side of mid and hind tibiae; three pairs of spots on the gastral petiole (anterior pair sometimes coalescent or separated or absent, posterior pair also sometimes coalescent); a pair of transverse spots at the base of tergite 2, forming an interrupted band, narrowly interrupted bands at the apex of tergites 2-5, a pair of small spot at apex of 6th tergite and widely interrupted bands at the apex of sternites 2-5 (in some specimens a pair of spot on second sternite medio-laterally). Brown markings as follows: labrum brown; mandible blackish brown (in some specimens a very small yellow spot near base of mandible). Wings fusc-hyaline.

PLATE I

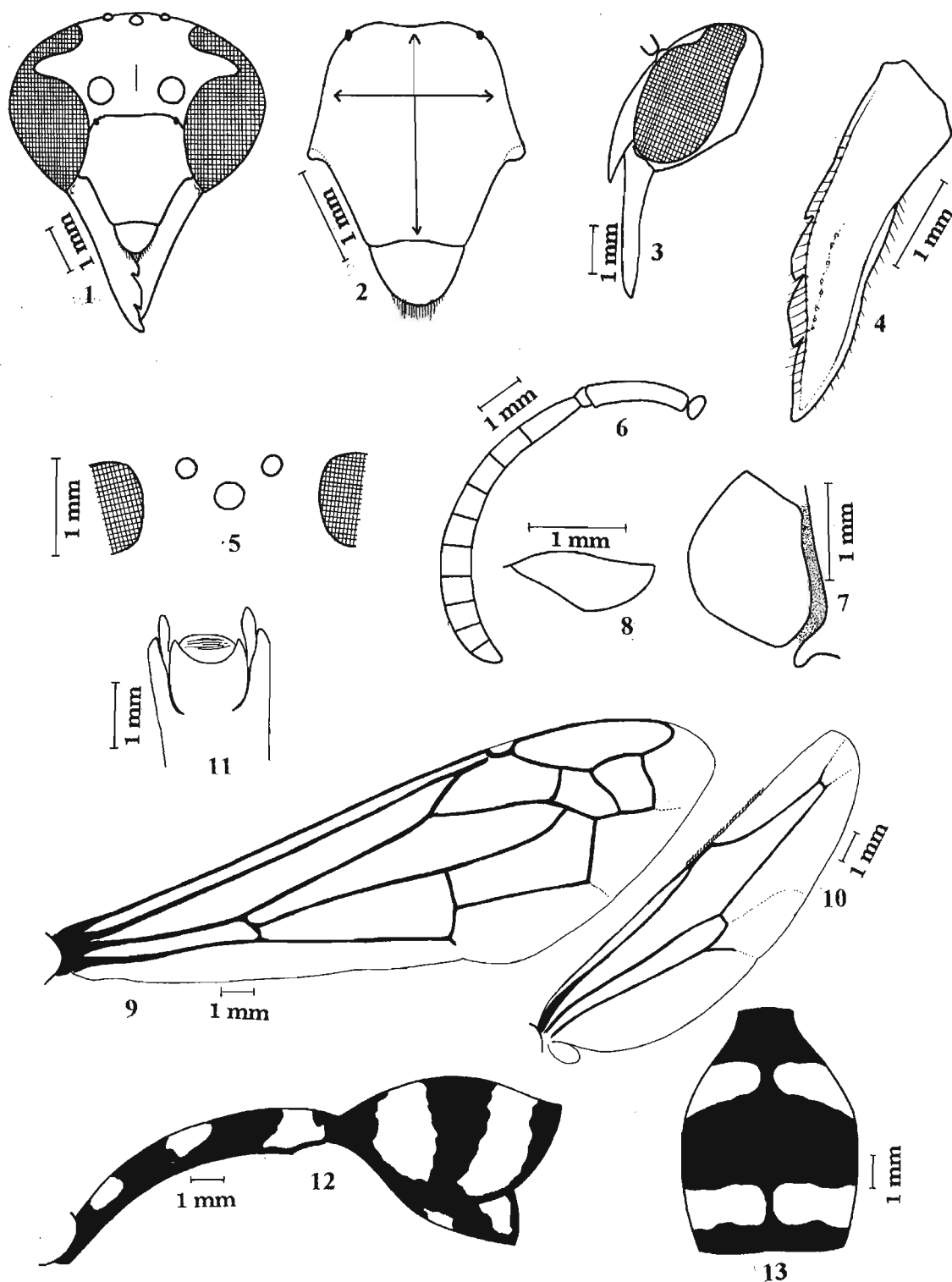


Plate 1: *Phimenes flavopictum* (Blanchard) Female. 1. Head front view; 2. Clypeus; 3. Head lateral view; 4. Left mandible; 5. Ocellar area; 6. Antenna; 7. Tegula and parategula; 8. Propodealvalvula; 9. Forewing; 10. Hindwing; 11. Apical portion of ventral side of petiole; 12. Petiole and second gastral segment in lateral view; 13. Second gastral tergite dorsal view.

PLATE II

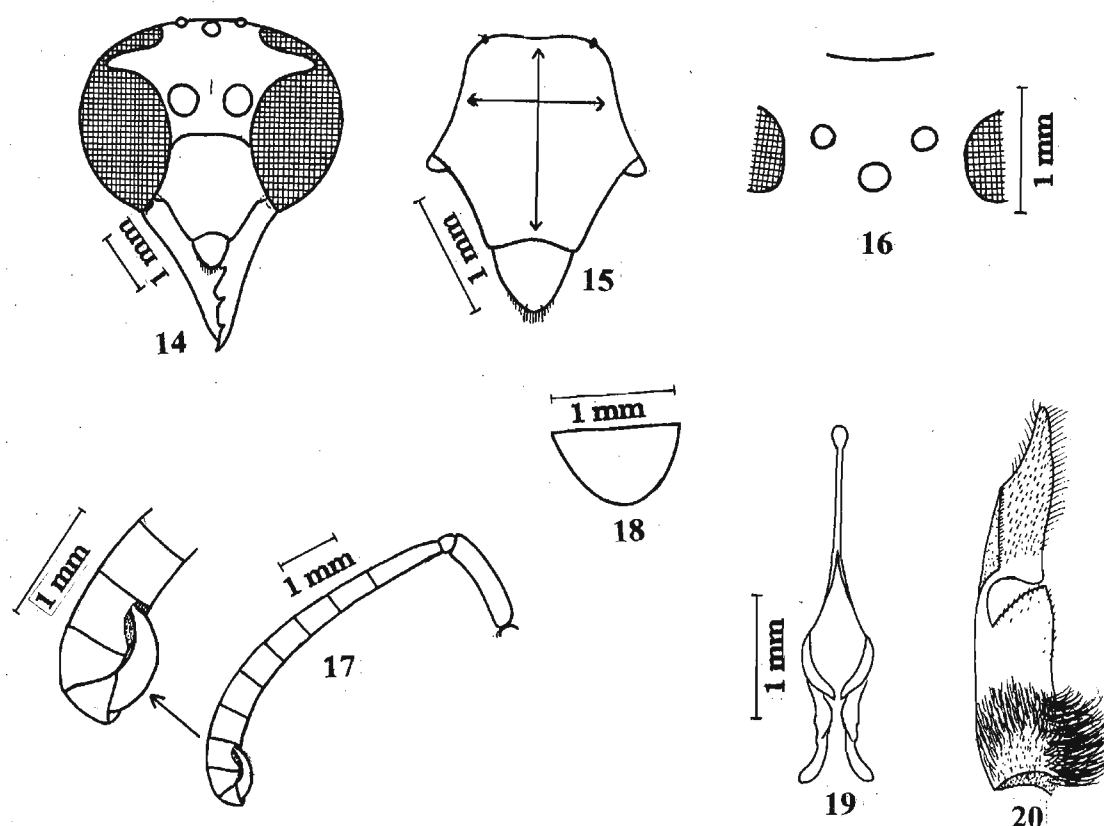


Plate II : *Phimenes flavopictum* (Blanchard) Male. 14. Head front view; 15. Clypeus; 16. Ocellar area; 17. Antenna; 18. Last gastral sternite; 19. Aedeagus dorsal view; 20. Volsella.

Head: Width in front view (Fig. 1) 1.30x as long as distance between front ocellus and clypeal margin medially; clypeus (Fig. 2) subpyriform, the apex widely truncate, raised at base and sides, anterior margin moderately emarginate (Fig. 1), width 0.86x its length medially, sparsely punctate, the punctures not well defined; mandible (Fig. 4) long and moderately stout with four distinct teeth on inner side; labrum (Fig. 2) rounded at apex; supraclypeal area smooth; frons and ocular sinus closely and strongly punctured, interspaces distinctly less than diameter of punctures; area in front of median ocellus smooth; vertex and temple with scattered minute punctures; occiput almost smooth with fine scattered minute punctures; cephalic fovea absent; POL (Fig. 5) 1.68x OOL; diameter of anterior ocellus slightly longer than the distance between anterior ocellus and posterior ocelli; interocular distance almost equal on vertex and at

clypeus (37:37.5); temple (Fig. 3) distinctly narrower (0.67x) than eye in profile (measured through its ocular sinus); occipital carina strong, complete and narrowed ventrally. Antenna farther from each other than from eyes (12:4); scape length 1.69x length of F1 (Fig. 6); F1 1.62x as long as F2, 3.25x as long as wide, flagellar segments slightly widening towards apex as in figure 6; apical antennal segment slightly longer than wide (23:21).

Mesosoma: Pronotum strongly and closely punctured except anterior face almost smooth, anterolateral angle with scattered punctures; mesoscutum, scutellum and metanotum strongly and closely punctured; propleuron smooth with minute scattered punctures; mesepisternum densely, in the upper part above the transverse suture almost reticulately punctate, the interspaces much smaller than the punctures; anterior, posterior and lower sides of

PLATE III

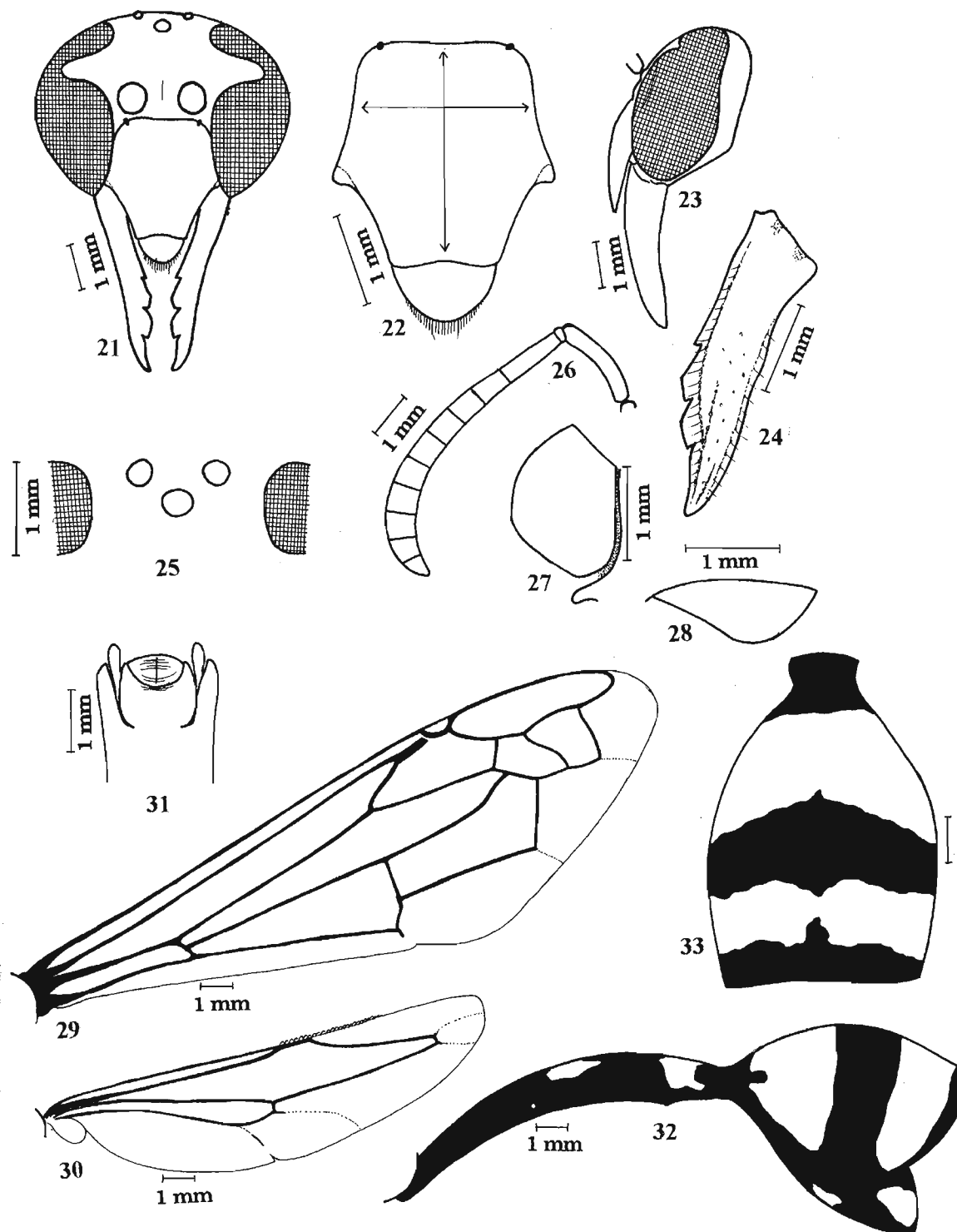


Plate III : *Phimenes andamanicum* (Zimmermann) Female. 21. Head front view; 22. Clypeus; 23. Head lateral view; 24. Left mandible; 25. Ocellar area; 26. Antenna; 27. Tegula and parategula; 28. Propodealvalvula; 29. Forewing; 30. Hindwing; 31. Apical portion of ventral side of petiole; 32. Petiole and second gastral segment in lateral view; 33. Second gastral tergite dorsal view.

mesopleuron below transverse suture smooth; metapleuron almost smooth except few punctures in the middle of dorsal metapleuron; propodeal dorsum strongly punctured except at dorsolateral angle almost smooth; ventral area of propodeum strongly punctured except the inner concavity almost smooth; lateral areas of propodeum entirely smooth; median groove of propodeum distinct, punctured and complete; pronotum with distinct pretegular carina; median length of mesoscutum slightly longer than its maximum width (1.04x); pretegula (Fig. 7) exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; propodeal valvula as in figure 8. Midtibia with one spur. Forewing and hind wing as in figures 9 & 10; fore wing with prestigma 1.31x pterostigma, second submarginal cell acute basally.

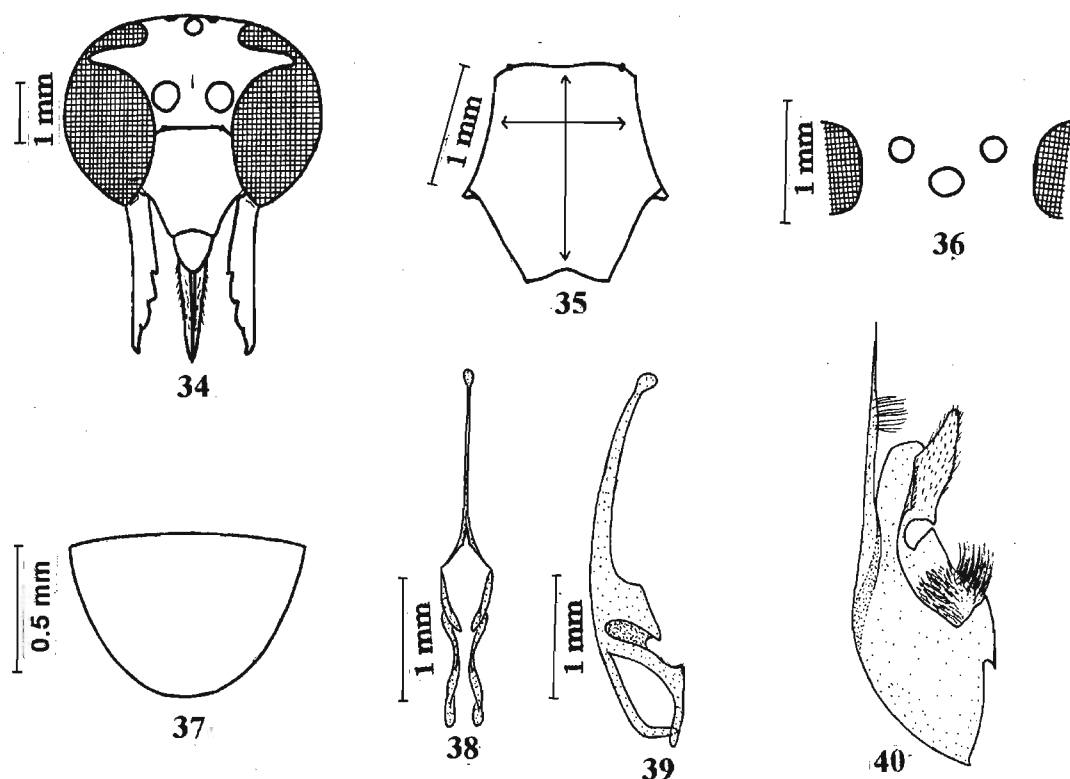
Metasoma: Petiole length 1.25x than mesosoma in lateral view, 1.37x second gastral tergite (Fig. 12); apex of petiole on ventral side as in figure 11; petiole and gaster almost smooth; second gastral tergum (Fig. 13) without lamellae separated by apical thickening, slightly curved inwards medially at apex, almost straight, 1.44x as long as broad; posterior apices of 3rd-5th tergites and 2nd-5th sternites distinctly curved inward at middle.

Male: Body length (H+M+T1+T2) 16-20 mm; forewing length 13.5-14.5 mm. Head width in front view (Fig. 14) 1.30x distance between front ocellus and clypeal margin medially; median length of clypeus (Fig. 15) 1.26x its width; POL (Fig. 16) 2.60x OOL; Antenna as in figure 17; last antennal segment (Fig. 17) hooked apically, hook long, curved and pointed, in curved position it almost reaches the apex of ninth antennal segment; 3rd-6th gastral sternites with dense hairs; 7th sternite almost flat, rounded apically (Fig. 18) without dense hairs except at apical margin, apical margin with dense hairs; Genitalia as in figures 19 & 20; apical tip of aedeagus bulb-like; pubescence of base of volsella long and dense; digitus of volsella wider, densely pubescent at base, dorsally with distinct blunt angle;

parameral spine elongate with moderately large hairs. Other characters almost same as in female.

Material examined: **India**: Arunachal Pradesh, West Kameng dist., Bhalukpong, 1 ♀, 7.ix.1998, Coll. A. R. Lahiri & Party (NZSI Reg. No. 12631/H3); Assam, Tinsukia dist., Sadiya, Abor Expedition, 1 ♂, 28.xi.1911, Coll. Kemp (NZSI Reg. No. 12632/H3); Delhi, Janakpuri, 1 ♂, 21.xii.1975, Coll. Anita (NZSI Reg. No. 12633/H3); Jharkhand, Giridih dist., Parasnath Hills, 1 ♀, 12.iv.1909, Coll. Annandale (NZSI Reg. No. 12634/H3); Karnataka, Bengaluru, 2 ♀, date of collection unknown, Coll. Cameron (NZSI Reg. Nos. 12635/H3 & 12636/H3); Kerala, Thiruvananthapuram, 1 ♂, v.1888, Collector unknown (NZSI Reg. No. 12637/H3); Thiruvananthapuram dist., Nedumangad, 1 ♀, 14.xi.1908, Collector unknown (NZSI Reg. No. 12638/H3); Thrissur dist., Chalakkudi, 1 ♂, 14-30.ix.1914, Coll. F. H. Gravely (NZSI Reg. No. 12639/H3); Maharashtra, Satara dist., Mahabaleswar, 1 ♀, date of collection unknown, Coll. F. H. Gravely (NZSI Reg. No. 12640/H3); Bhimashankar Wildlife Sanctuary, 9 ♀, 3.v.1965, Coll. B. S. Lamba (NZSI Reg. Nos. 12641/H3 to 12649/H3); Kolhapur dist., Mahalewadi, 1 ♀, 14.i.1998, Coll. A. K. Hazra & Party (NZSI Reg. No. 12650/H3); Manipur, Imphal West dist., Kanchipur, 1 ♀, 8.x.1976, Coll. Tyagi (NZSI Reg. No. 12651/H3); Meghalaya, East Khasi Hills dist., Dawki, 1 ♀, 12.iv.1966, Coll. V. K. Gupta (NZSI Reg. No. 12652/H3); Ri-Bhoi dist., Nongpoh, 1 ♂, 16.x.1975, Coll. V. K. Gupta (NZSI Reg. No. 12653/H3); Jaintia Hills dist., Umkiang, Narpuh Reserve Forest, 1 ♀, 14.ix.1998, Collector unknown (NZSI Reg. No. 12654/H3); Mizoram, Lunglei dist., Hnahchang, 1 ♀, 13.xi.1995, Coll. P. H. Roy & Party (NZSI Reg. No. 12655/H3); Nagaland, Naga Hills, 2 ♀ & 1 ♂, date of collection unknown, Coll. Robertson (NZSI Reg. Nos. 12656/H3 to 12658/H3); Sikkim, 1 ♀, vii.1898, Coll. Dudgeon (NZSI Reg. No. 12659/H3); 2 ♀ & 5 ♂ (old specimens without further collection data), (NZSI Reg. Nos. 12660/H3 to 12666/H3); Tamil Nadu, Nilgiri Hills, 1 ♀, v.1904, Coll. W. Rowson (NZSI

PLATE IV



Plater IV : *Phimenes andamanicum* (Zimmermann) Male. 34. Head front view; 35. Clypeus; 36. Ocellar area; 37. Last gastral sternite; 38. Aedeagus dorsal view; 39. Aedeagus lateral view; 40. Inner side of right paramere with volsella.

Reg. No. 12667/H3); Kanyakumari Wildlife Sanctuary, Alagiapandipur Range, 1 ♂, 11.vi.2007, Coll. S. Prabakaran & Party (NZSI Reg. No. 12332/H3); Tripura, West Tripura dist., Teliamura, 1 ♀, 18-20.v.1978, Coll. J. K. Jonathan & Party (NZSI Reg. No. 12668/H3); Uttarakhand, Nainital dist., Corbett National Park, Garjia, 1 ♂, 21.iv.1967, Coll. V. K. Gupta (NZSI Reg. No. 12669/H3); Almora dist., Dunagiri, 1 ♂, 12.x.1973, Coll. Girish (NZSI Reg. No. 12670/H3); Dehradun dist., Rishikesh, 1 ♀ & 1 ♂, 5.xi.1978, Coll. R. K. Varshney & Party (NZSI Reg. Nos. 12671/H3 & 12672/H3); West Bengal, Darjeeling dist., Singla, 12 ♀ & 5 ♂, iii.1913, Coll. Lord Carmichael (NZSI Reg. Nos. 398/H3 to 411/H3 and 418/H3). Sri Lanka: Central Province, Kandy dist., Paradeniya, 1 ♀, 21.v.1910, Coll. Unknown (NZSI Reg. No. 12694/H3); Kandy, 1 ♀, vi.1910, Coll. Unknown (NZSI Reg. No. 12695/H3).

Distribution: India: Arunachal Pradesh, Assam, Delhi (new record), Jharkhand, Karnataka, Kerala, Maharashtra, Manipur (new record), Meghalaya, Mizoram (new record), Nagaland (new record), Sikkim, Tamil Nadu, Tripura (new record), Uttarakhand, West Bengal.

Elsewhere: China, Hong Kong, Indonesia, Malaysia, Myanmar, Singapore, Sri Lanka, Thailand.

Discussion: *Phimenes flavopictum* (Blanchard) has been considered conspecific with *P. arcuatum* (Fabricius) for a long period of time and several earlier workers had misidentified it as *P. arcuatum*. But *P. flavopictum* distinctly differs from *P. arcuatum* in having: (1). Anterior margin of clypeus of female very shallowly emarginate (in *P. arcuatum*, the emargination of anterior margin of clypeus deeper); (2). Mesepisternum of female densely punctate with upper part above

transverse suture almost reticulately punctate and the interspaces much smaller than punctures (in *P. arcuatum*, mesepisternum more sparsely punctate, the punctures partly arranged in irregular rows, interspaces between these rows usually larger than the punctures, below the transverse suture the punctures even more sparse); (3). Posterior area of propodeum in female densely punctate, rather sharply separated from the impunctate lateral areas, the transition being distinctly angular (in *P. arcuatum* posterior area of propodeum less sharply separated from the lateral areas, the transition being rounded, except close to the apex where it is slightly angular); (4). In female, pubescence of head and mesosoma not much longer and denser (in *P. arcuatum*, pubescence of head and mesosoma comparatively longer and denser); (5). Basal part of volsella in male genitalia densely clothed with long hairs (*P. arcuatum*, basal part of volsella in genitalia densely clothed with short hairs). The geographical distributions of these two species are also different. *Phimenes flavopictum* distributed throughout south-eastern part of continental Asia, in the Western half of the Indo-Australian archipelago (except in most of the Philippine Islands and in Celebes) and in the Islands of the Sunda arc up to Tenimber and perhaps also in the Kei Islands. But *Phimenes arcuatum* distributed in the Moluccas, New Guinea and neighbouring Islands, New Britain and north Australia and perhaps also in the Kei Islands (van der Vecht, 1959).

Remarks: New record for Delhi, Manipur, Mizoram, Nagaland, Tripura.

2. *Phimenes andamanicum* (Zimmermann, 1931) status nova
(Figs. 21-40; Photo 2)

Eumenes arcuata andamanica Zimmermann, 1931, *Zeitschr. Morph. Oek. Tiere*, vol. 22, p. 207, ♀, fig. 26, no. 6, Andaman Islands (ZMB). Additional citation: Giordani Soika, 1934 (1933), *Mem. Soc. Ent. Ital.*, vol. 12, p. 224 (*arcuatus andamanicus*, description of ♂).

Eumenes flavopictus andamanicus Zimme-

rmann : in van der Vecht, 1959, *Zool. Verh. Leiden*, 41: 40, ♀ ♂, fig. 4 (21). Additional citation: van der Vecht, 1961, *Evolution* 15: fig. 4A (p. 472, colour pattern), table 1 (distribution).

The colour form *Phimenes flavopictus andamanicus* (Zimmermann, 1931) is endemic to Andaman & Nicobar Islands and remain a distinct colour form, distinctly differ from all other colour forms of *Phimenes flavopictum* (Blanchard, 1845). Hence, herewith propose to elevate this colour form to a specific rank as *Phimenes andamanicum* (Zimmermann, 1931).

Redescription: Female: Body length (H+M+T1+T2) 24-27 mm; forewing length 20-20.5 mm. Head black, with a narrow line at inner orbit from clypeus to centre of eye emargination and a short and narrow line on the temple pale yellow (in one specimen two small yellow spots present near middle of clypeus and another one spot at supraclypeal area; in another specimen a very small yellow spot at middle of frons posteriorly at the level antennal scrobe); antenna black, apical segments brownish on ventral side; labrum blackish brown; mandible black to blackish brown; mesosoma black (in one specimen a very small yellow spot on metanotum posteromedially; in another specimen a yellow stripe at angle between posterior and lateral sides of propodeum at its posterior half); metasoma black, extensively marked with yellow: first pair of petiolar spots lacking (in some specimens first pair of petiolar spots vaguely present), second pair elongate, third pair confluent, forming a preapical yellow band (in some specimens third pair not confluent and forms either two, four or six distinct yellow spots of variable size); second tergite yellow, narrowly black at the base and on the lateral and apical margins, and with a small black spot on each side near the middle (in some specimens black maculation highly variable especially on posterolateral margin and at middle; at middle it forms bands in some specimens or almost absent in some other specimens); following tergites with well-developed spots, not fused in the middle, sixth tergite with a pair of spots (size of the spot

PLATE V

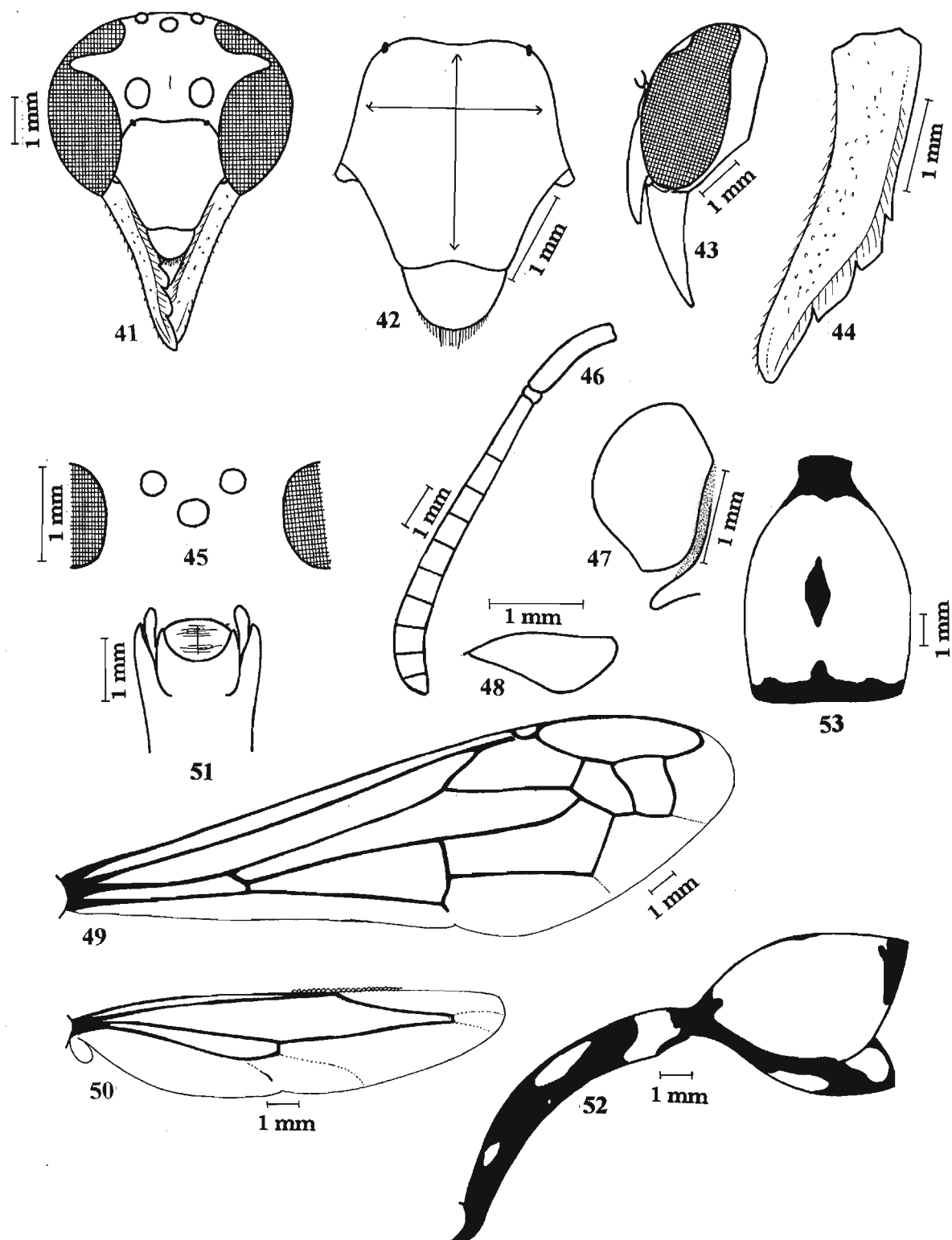


Plate V : *Phimenes nicobaricum* (Meade-Waldo) Female. 41. Head front view; 42. Clypeus; 43. Head lateral view; 44. Right mandible; 45. Ocellar area; 46. Antenna; 47. Tegula and parategula; 48. Propodealvalvula; 49. Forewing; 50. Hindwing; 51. Apical portion of ventral side of petiole; 52. Petiole and second gastral segment in lateral view; 53. Second gastral tergite dorsal view.

variable); sternites black, second sternite with a pair of small lateral spots near the middle (absent in some specimens), sternites 2-5 each with a pair of small spots in the posterolateral angles. Legs black to brownish black. Wings fusco-hyaline.

Head: Width in front view (Fig. 21) 1.24x as long as distance between front ocellus and clypeal margin medially; clypeus (Fig. 22) subpyriform, the apex widely truncate, raised at base and sides, anterior margin moderately emarginate, width 0.83x its length medially, sparsely punctate, the punctures not well defined; mandible (Fig. 24) long and moderately stout with four distinct teeth on inner side; labrum (Fig. 22) rounded at apex; supraclypeal area smooth; frons and ocular sinus closely and strongly punctured, interspaces distinctly less than diameter of punctures; area in front of median ocellus smooth; vertex and temple with scattered minute punctures; occiput almost smooth with fine scattered minute punctures; cephalic fovea absent; POL (Fig. 25) 1.37x OOL; diameter of anterior ocellus slightly longer than the distance between anterior ocellus and posterior ocelli; interocular distance almost equal on vertex than at clypeus (39:40); temple (Fig. 23) distinctly narrower (0.70x) than eye in profile (measured through its ocular sinus); occipital carina strong, complete and narrowed ventrally. Antenna farther from each other than from eyes (15:4); scape length 1.43x length of F1 (Fig. 26); F1 2x as long as F2, 3.75x as long as wide, flagellar segments slightly widening towards apex as figure 26; apical antennal segment slightly longer than wide (23:20).

Mesosoma: Pronotum strongly and closely punctured except anterior face almost smooth, anterolateral angle with scattered punctures; mesoscutum, scutellum and metanotum strongly and closely punctured; propleuron smooth with minute scattered punctures; mesepisternum densely, in the upper part above the transverse suture almost reticulately punctate, the interspaces much smaller than the punctures; anterior, posterior and lower sides of mesopleuron below transverse suture smooth; metapleuron almost smooth except few punctures in the middle of dorsal metapleuron;

propodeal dorsum strongly punctured except at dorsolateral angle almost smooth; ventral area of propodeum strongly punctured except the inner concavity almost smooth; lateral areas of propodeum entirely smooth; median groove of propodeum distinct, punctured and complete; pronotum with distinct pretegular carina; median length of mesoscutum longer than its maximum width (1.13x); pretegula (Fig. 27) exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; propodeal valvula as in figure 28. Midtibia with one spur. Forewing and hind wing as in figures 29 & 30; fore wing with prestigma 1.33x pterostigma, second submarginal cell acute basally.

Metasoma: Petiole length 1.36x than mesosoma in lateral view, 1.42x second gastral tergite (Fig. 32); apex of petiole on ventral side as in figure 31; petiole and gaster almost smooth; second gastral tergum (Fig. 33) without lamellae separated by apical thickening, slightly curved inwards medially at apex, almost straight, 1.40x as long as broad; posterior apices of 3rd - 5th tergites and 2nd - 5th sternites distinctly curved inward at middle.

Male: Body Length (H+M+T1+T2) 20-22 mm. Forewing length 14.5 mm. Colour almost same as that of female except the following yellow markings: a broad U-shaped yellow marking at the middle of clypeus, a short interantennal mark from base of clypeus to level of upper margin of antennal sockets. Head width in front view (Fig. 34) 1.25x distance between front ocellus and clypeal margin medially; median length of clypeus (Fig. 35) 1.30x its width; POL (Fig. 36) 2.3x OOL; 3rd - 6th gastral sternites with dense hairs; 7th sternite almost flat, rounded apically (Fig. 37) without dense hairs except at apical margin, apical margin with dense hairs; Genitalia as in figures 38, 39 & 40; apical tip of aedeagus bulb-like; pubescence of base of volsella long and dense; digitus of volsella wider, densely pubescent at base, dorsally with distinct blunt angle; parameral spine elongate with moderately large hairs as in figure 40. Other characters almost same as in female.

Material examined: India: Andaman & Nicobar Islands: Andaman Islands, Hope Town, 1 ♀, 27.viii.1928, Coll. R. B. S. Sewell (NZSI Reg. No. 12673/H3); North Bay Island, 2 ♀ & 1 ♂, 29.viii.1928, Coll. R. B. S. Sewell (NZSI Reg. Nos. 12674/H3 to 12676/H3); Long Island, 1 ♀, vii.1931, Coll. R. Hodgart (NZSI Reg. No. 12677/H3); Port Blair, Delanipur, 1 ♀, 11.vii.1980, Coll. V. Arumugam (NZSI Reg. No. 12678/H3); **Nicobar Islands**, South Bay, 1 ♀, 27.vi.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12679/H3); Swaroop Nallah, 3 ♀, 20.vii.1984, Coll. S. S. Saha & Party (NZSI Reg. Nos. 12680/H3 to 12682/H3); South Nicobar, 1 ♀, 31.vii.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12683/H3); Cheema Nallah, 1 ♀, 3.viii.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12684/H3); South Bay, 1 ♀, 19.viii.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12685/H3).

Distribution: India: Andaman & Nicobar Islands: Andaman Islands, Nicobar Islands (new record).

Remarks: New record for Nicobar Islands.

3. *Phimenes nicobaricum* (Meade-Waldo, 1910)
status nova
(Figs. 41-60; Photo 3)

Eumenes nicobarica Meade-Waldo, 1910, *Ann. Mag. Nat. Hist.*, ser. 8, vol. 5, p. 41, "♂" [recte: ♀!], Nicobar Islands (BMNH).

Eumenes arcuata race *nicobarica* Dover, 1925, *J. As. Soc. Bengal*, new ser. Vol. 22, p. 296.

Eumenes arcuatus var. *nicobaricus* Bequaert, 1928, *Ann. Mag. Nat. Hist.*, ser. 10, vol. 2, p. 168, 169.

Eumenes arcuata nicobarica Zimmermann, 1931, *Zeitschr. Morph. Oek. Tiere*, vol. 22, p. 205, fig. 26 no. 2 (Nicobar Islands).

Eumenes flavopictus nicobaricus Meade-Waldo: in van der Vecht, 1959, *Zool. Verh. Leiden*, 41: 41: 15 (key), 41, fig. 4 (22), 7 (22). Additional citation: van der Vecht, 1961, *Evolution* 15: fig. 4B (p. 472, colour pattern), table 1 (distribution).

Meade-Waldo in 1910 originally described this species as *Eumenes nicobarica*. But most of the

later workers considered it as a colour form of *flavopictum*. The colour form is endemic to Andaman & Nicobar Islands and remains a distinct colour form, distinctly differ from all other colour forms of *Phimenes flavopictum* (Blanchard). Hence, herewith propose to elevate this colour form to a specific rank as *Phimenes nicobaricum* (Meade-Waldo, 1910)

Redescription: Female: Body length (H+M+T1+T2) 23-25 mm; forewing length 19-20 mm. Black with the following yellow markings: clypeus except at anterior and lateral borders, an interantennal mark, a line at the inner orbits; a narrow line at the outer orbits; a transverse band on the pronotum (sometimes interrupted in the middle); four spots on the mesoscutum, a small mark on the lateral areas of the scutellum, marks behind axillary fossa near base of hind wing, a vertical band on the mesepisternum, a band on outer margin of tegulae, a band on the postscutellum, two large marks on posterior area of propodeum (leaving a median, cross shaped area black); apical half of fore femora beneath, fore tibiae on outer side, mid and hind coxa on outer side (sometimes reduced or absent), sometimes a line on the outer side of mid and hind tibiae; three pairs of spots on the gastral petiole (anterior pair sometimes absent); second tergite almost entirely except at base, three by fourth of lateral sides, at apex and a small spot dorsomedially; narrowly interrupted bands at the apex of tergites 3-5, a pair of small spot at apex of 6th tergites, and widely interrupted bands at the apex of sternites 2-5 (in some specimens a pair of spot on second sternite mediolaterally). Brown markings as follows: labrum brown; mandible blackish brown. Wings fusco-hyaline.

Head: Width in front view (Fig. 41) 1.24x as long as distance between front ocellus and clypeal margin medially; clypeus (Fig. 42) subpyriform, the apex widely truncate, raised at base and sides, anterior margin moderately emarginate, width 0.95x its length medially, sparsely punctate, the punctures not well defined; mandible (Fig. 44) long and moderately stout with four distinct teeth on inner side; labrum (Fig. 42) rounded at apex; supraclypeal area smooth; frons and ocular sinus

PLATE VI

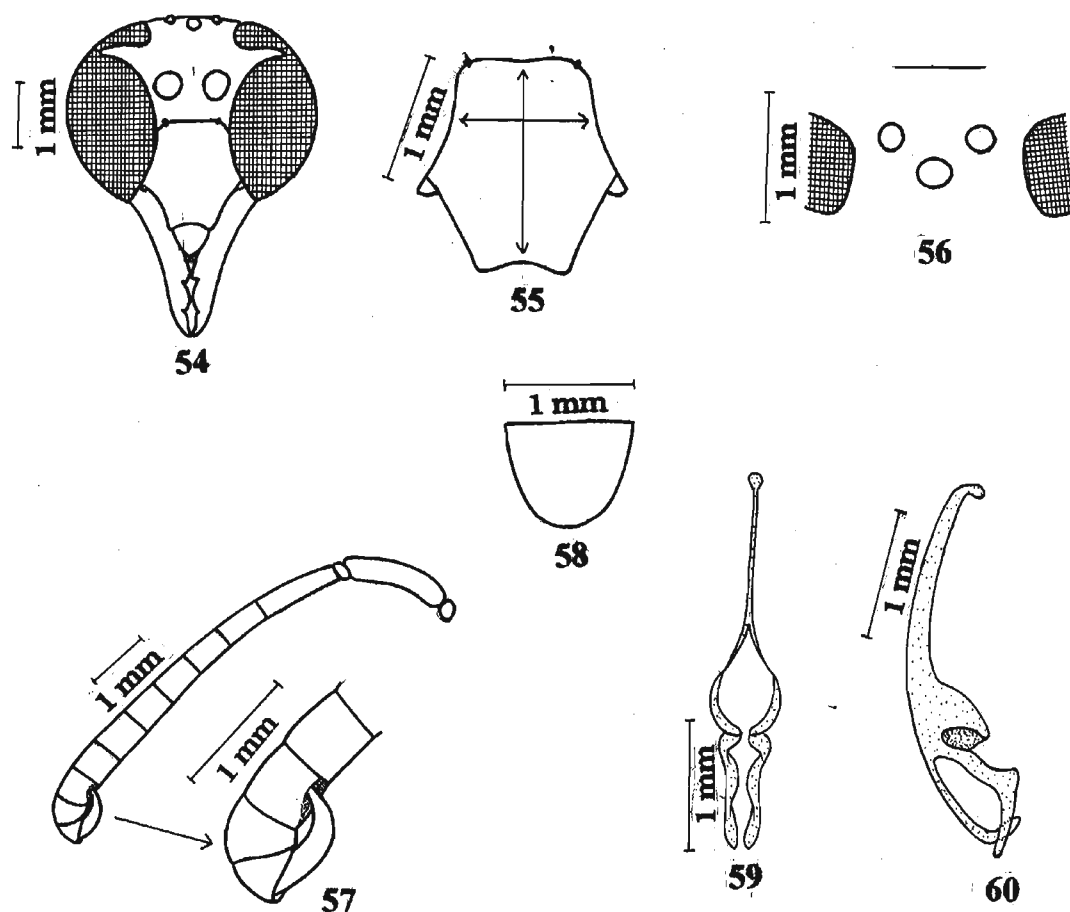


Plate : VI *Phimenes nicobaricum* (Meade-Waldo) Male. 54. Head front view; 55. Clypeus; 56. Ocellar area; 57. Antenna; 58. Last gastral sternite; 59. Aedeagus dorsal view; 60. Aedeagus lateral view.

closely and strongly punctured, interspaces distinctly less than diameter of punctures; area in front of median ocellus smooth; vertex and temple with scattered minute punctures; occiput almost smooth with fine scattered minute punctures; cephalic fovea absent; POL (Fig. 45) 1.50x OOL; diameter of anterior ocellus slightly longer than the distance between anterior ocellus and posterior ocelli; interocular distance almost equal on vertex than at clypeus (39:42); temple (Fig. 43) distinctly narrower (0.80x) than eye in profile (measured through its ocular sinus); occipital carina strong, complete and narrowed ventrally. Antenna farther from each other than from eyes (13:4.5); scape length 1.47x length of F1 (Fig. 46); F1 1.88x as long as F2, 3.75x as long as wide, flagellar segments slightly widening towards apex as figure 46; apical antennal segment slightly longer than wide (25.5:21).

Mesosoma: Pronotum strongly and closely punctured except anterior face almost smooth, anterolateral angle with scattered punctures; mesoscutum, scutellum and metanotum strongly and closely punctured; propleuron smooth with minute scattered punctures; mesepisternum densely, in the upper part above the transverse suture almost reticulately punctate, the interspaces much smaller than the punctures; anterior, posterior and lower sides of mesopleuron below transverse suture smooth; metapleuron almost smooth except few punctures in the middle of dorsal metapleuron; propodeal dorsum strongly punctured except at dorsolateral angle almost smooth; ventral area of propodeum strongly punctured except the inner concavity almost smooth; lateral areas of propodeum entirely smooth; median groove of propodeum distinct, punctured and complete;

pronotum with distinct pretegular carina; median length of mesoscutum longer than its maximum width (1.11x); pretegula (Fig. 47) exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; propodealvalvula as in figure 48. Midtibia with one spur. Forewing and hind wing as in figures 49 & 50; fore wing with prestigma 1.15x pterostigma, second submarginal cell acute basally.

Metasoma: Petiole length 1.58x than mesosoma in lateral view, 1.63x second gastral tergite (Fig. 52); apex of petiole on ventral side as in figure 51; petiole and gaster almost smooth; second gastral tergum (Fig. 53) without lamellae separated by apical thickening, slightly curved inwards medially at apex, almost straight, 1.45x as long as broad; posterior apices of 3rd-5th tergites and 2nd-5th sternites distinctly curved inward at middle.

Male: Body length (H+M+T1+T2) 18-18.5 mm. Forewing length 14.5 mm. Head width in front view (Fig. 54) 1.26x distance between front ocellus and clypeal margin medially; median length of clypeus (Fig. 55) 1.35x its width; POL (Fig. 56) 2.50x OOL; Antenna as in figure 57; last antennal segment hooked apically, hook long, curved and pointed, in curved position it almost reaches the apex of ninth antennal segment; 3rd-6th gastral sternites with dense hairs; 7th sternite almost flat, rounded apically (Fig. 58) without dense hairs except at apical margin, apical margin with dense hairs; Genitalia as in figures 59 & 60; apical tip of aedeagus bulb-like; pubescence of base of volsella long and dense; digitus of volsella wider, densely pubescent at base, dorsally with distinct blunt angle; parameral spine elongate with moderately large hairs. Other characters almost same as in female.

Material examined: India: Andaman & Nicobar Islands, Nicobar Islands, Nancowry Island, Champin, 2 ♀ & 1 ♂, 10.ii.1993, Coll. D. V. Rao & Party (NZSI Reg. Nos. 12687/H3 to 12689/H3); Katchal Island, 1 ♂, 14.ii.1993, Coll. D. V. Rao & Party (NZSI Reg. No. 12690/H3); Great Nicobar, Trinket Island, 1 ♂, 17.ii.1993, Coll. D. V. Rao &

Party (NZSI Reg. No. 12691/H3); 1 ♂, Nicobar (old specimen without further collection data) (NZSI Reg. No. 12686/H3).

Distribution: India: Andaman & Nicobar Islands: Nicobar Islands.

Key to species of *Phimenes* Giordani Soika of Indian subcontinent

1. Mesosoma almost entirely black (rarely a very small yellow spot posteromedially on metanotum and sometimes a vague yellow stripe at angle between posterior and lateral sides of propodeum at its posterior half).....*P. andamanicum* (Zimmermann)
- Mesosoma black with strong yellow maculations. 2
2. Second gastral tergite black with a pair of transverse yellow spots at the base forming an interrupted band and narrowly interrupted bands at the apex (Fig. 13).*P. flavopictum* (Blanchard)
- Second tergite almost entirely yellow except at base, three by fourth of lateral sides, at apex and a small spot dorsomedially black (Fig. 53).*P. nicobaricum* (Meade-Waldo)

SUMMARY

The genus *Phimenes* Giordani Soika is taxonomically revised from Indian subcontinent. The subspecies *Phimenes flavopictum continentalis* (Zimmermann, 1931) is synonymised under the nominate species. The other two subspecies namely *Phimenes flavopictum andamanicum* (Zimmermann, 1931) and *Phimenes flavopictum nicobaricum* (Meade-Waldo, 1910) are elevated into distinct species rank namely *Phimenes andamanicum* (Zimmermann) and *Phimenes nicobaricum* (Meade-Waldo). All these three species are redescribed here. The species *Phimenes flavopictum* (Blanchard) is newly recorded for Delhi, Manipur, Mizoram, Nagaland and Tripura. The species *Phimenes andamanicum* (Zimmermann) is a new record for Nicobar Islands. A key to species of *Phimenes* Giordani Soika of Indian subcontinent is also provided.

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Photo 1. : *Phimenes flavopictum* (Blanchard) Female.



Photo 2. : *Phimenes andamanicum* (Zimmermann) Female.



Photo 3. : *Phimenes nicobaricum* (Meade-Waldo) Female.



ON SOME MEGAINVERTEBRATE (MOLLUSCA, ECHINODERMATA AND BRACHIOPODA) FOSSILS FROM BAGH BEDS, MADHYA PRADESH

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INTRODUCTION

Marine Cretaceous deposits have been recorded in large part of the Extra-peninsular belt of the Indian Subcontinent. A condensed sequence form of this type of deposit has also been recognised in the Narmada Valley of Central India. Less thick marine Cretaceous deposits came up in the vicinity of Bagh, a township in Dhar District of Madhya Pradesh, on the western portion of the Narmada Valley. The Bagh beds, in fact stretch from Rajpipla about 35 miles (56 km.) west of Gulf of Cambay in Gujarat eastwards as far as Barwaha, about 240 miles (386 km.) from the coast of Gulf (Pascoe, 1959). The Bagh beds though contain comparatively thin sedimentary strata but possess substantive diversity of faunal elements. Eventually, the beds have long been an important focus of attention of the geologists and palaeontologists for their rich fossil faunal material. Dangerfield (1818) pioneered the detailed geological investigation on a regional scale of the Bagh beds. Later, Carter (1854), Keatinge (1856) and Oldham (1858) commented upon the age of the Formations in Bagh beds. Carter (*loc. cit.*) assigned a Neocomian age of the Formation but Oldham (*loc. cit.*) had certain disagreement with the view of Carter. Keatinge (*loc. cit.*) however, assigned a general Cretaceous age for the fossiliferous beds. Bose (1884) assigned an Albian to Turonian age for the nodular limestones on the basis of recovered molluscs and echinoderm material, and a Campanian to Maestrichtian age for coralline limestone on the basis of recovered

echinoids, brachiopods, gastropods and lamellibranch material. Fourteau (1918) assigned upper Albian age of the beds on the basis of recovered echinoid fauna of the beds. Mukherjee (1935, 1936, 1938) opined that the Bagh beds range in age from the Cenomanian to the upper Senonian. Spath (1927-33) was of opinion that the Bagh ammonites belong to Turonian age. Chiplonkar (1939) on the basis of bivalves of the beds assigned an age from Albian to Senonian, with Cenomanian as the more dominant aspect. Roychaudhuri & Sastri (1962) proposed a stratigraphic classification of the Bagh beds. Dassarma & Sinha (1966) recorded shark teeth and other marine animal forms of Cretaceous affinity in the Nimar Sandstone horizon of the Bagh beds. Pal (1970) made a review of the fossil forms explored from the Bagh beds of the Man river section. Chiplonkar & Badve (1973) made taxonomic assessment of an extensive collection of bivalve molluscs of Bagh beds including several new forms. This fauna demonstrated an affinity to the fauna of the Mediterranean palaeozoogeographic province and assigned an age from Cenomanian to Turonian. Subsequently, Chiplonkar & Badve (1976) and Chiplonkar & Ghare (1977) worked out the ammonoid fossils, and trace fossils and palaeoecological conditions of the Bagh beds. In the background of the potentiality of Bagh beds as a fossil storehouse; it was thought that a lot more interesting forms could be recovered from the area. Hence, the field works were carried out recently by the ZSI in this

Table 1 : Stratigraphic succession of Bagh beds: Development of concepts

Stratigraphic Units (after Rode & Chiplonkar, 1935)	Stratigraphic Units (after Chiplonkar, Badve & Ghare 1975)
Upper coralline limestone	Upper coralline limestone with oyster bed at top
Deola and Chirakhan Marl	Upper <i>Inoceramus</i> bed Deola & Chirakhan Marl with <i>Hemiaster</i>
Lower coralline limestone (c. 1.0 m.)	Lower Coralline Limestone
Nodular limestone	Lower <i>Inoceramus</i> bed Nodular Limestone
Nimar Sandstone	<i>Astarte-Turritella</i> bed Oyster bed with shark teeth Trace fossil horizon Lower portion of Nimar sandstone with oyster bed

area for exploration of the nature of the fossil faunal content, especially the megainvertebrates. The collection made during the field works has been worked out and the result of the study is presented here in the background of the lithostratigraphy of the Bagh beds.

STRATIGRAPHY

The Bagh beds comprised depositional strata of relatively small depth but contain heterogeneous composition. This heterogeneous nature within short depth point out to rapidly changing depositional conditions. Accession and recession of the transgressing waters of the marine regime were the frequent occurrences and the phenomena influenced substantially over the times which thrived in the Narmada basin during the depositional phases. Rode & Chiplonkar (1935) proposed a stratigraphical sequence which was modified later on by Chiplonkar *et al.*, (1973) with incorporation of some more details *viz.*, Oyster beds, *Inoceramus* beds, *Astarte-Turritella* beds, etc., (see Table-1).

Stratigraphically, the layer containing oysters becomes the lowest horizon, and which is encountered in the ferruginous shaly band of the Nimar sandstone. It ranges in thickness from about 0.5 to 1.0 meter and is situated slightly above the local base of the section, or otherwise the actual base of the Nimar sandstone which is not exposed. Another oyster bed of about 1.5 meter thickness was recognised to the west of

Bagh cave over an interval of about 15 meter above the lowest oyster-bearing horizon. Subsequently, gradual decline in oyster shells and appearance of *Astarte*-shells give rise to *Astarte*-bed. Sandstone horizon succeeds in a gradual manner into the Nodular limestone. *Astarte*-bed bears representatives of *Turritella* spp. It has been shown by Chiplonkar & Badve (1980) that setting of immature stages was induced by dense population of sessile epifauna like, *Ostrea*. Other species of oysters also flourished well. Infrequent occurrences of oysters shells were recorded in the lower and upper coralline horizons. Near the top of the upper coralline limestone layer dense population of oysters further point out to another distinct oyster bed. The two *Inoceramus* bearing horizons had similar lithic characteristics, *viz.*, marly limestone, but were well separated from one another (Chiplonkar & Badve, 1976).

It has been apparent that the Bagh Formation contains at least two major depositional hiatuses. Kennedy *et al.* (2003) assigned a late Turonian age to the Bagh Formation on the basis of findings of ammonite from the upper Nodular limestone, several kilometres to the west of Man River section. While on the basis of findings of inoceramid bivalves Gangopadhyay & Bardhan (2000) claimed to support a Coniacian age. As the late Turonian ammonite dating comes from high in the succession, it is perceived that the lower beds in the Formation might extend down to the Cenomanian.

SYSTEMATIC PALAEONTOLOGY

Phylum MOLLUSCA
Class CEPHALOPODA
Order AMMONOIDEA
Suborder AMMONITINA
Family ASPIDOCERATIDAE Zittle 1895

Genus *Paraspidoceras* Spath, 1925

1. *Paraspidoceras* sp.

Diagnosis: Whorls very depressed, coronate and spinous from early stage, outer row of spines more or less clavate, inner row recessive or absent.

Material: 1 example

Locality: Awlida, (Seetapur) village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus *Peltoecras* Waagen, 1871

2. *Peltoecras* sp.

Diagnosis: Evolute whorls hardly overlapping ; ribs strong bifurcating and trifurcating on ventral margin. Venter nearly flat, outer row with 2 rows of massive lateral, tubercles, outer row developing first.

Material: 1 example

Locality: Awlida, (Seetapur) village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus *Metapeltoceras* Spath, 1931

3. *Metapeltoceras* sp.

Diagnosis: Differs from *Peltoecras* in developing inner lateral tubercles before outer.

Material: 1 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus *Peltomorphites* Buckman, 1925

4. *Peltomorphites* sp.

Diagnosis: Inner whorls as in *Peltocerotides*; outer whorls became trituberculate and spinous with ventral as well as lateral tubercles .
Comprises "eugenii group"

Material: 1 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Family: PLACENTIRCERATIDAE Hyath, 1900

1. Genus *Placenticerus* Minitoi,

Diagnosis: Very involute, with slightly convex sides and very narrow venter with faint falcoid ribs umbilical tubercles of early whorls move upto mid sides on lateral whorls normally with lower and fine upper ventra-lateral clavi, ornamental weakens in adult and last whorls may be smooth and with narrowly rounded Venter. Suture with many auxiliaries.

Material: 12 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus *Placenticerus* Kaffrorium

2. *Placenticerus* sp.

Diagnosis : Rare kind of ornament that is seldom seen because it is apparently confined to the structure of the inner shell layers occurs on all of the whorl sides, chiefly in oxycones, the consist of a band of delicate, forwardly directed chevrons, standing in scarcely perceptible relief and thus generally visible only by low angle lighting. It has been figured in some cretaceous pseudocerites and main species is *Placenticerus kaffrorium*. Radial strips have been noticed other bolder size pattern occur in Palaeozoic Straight.

Material: 35 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Class GASTROPODA
Order ARCHAEOGASTROPODA
Family PLETHOSPIRIDAE

Genus *Gyrodoma* Etheridge, 1898

1. *Gyrodoma* sp.

Diagnosis: Relatively high spired, with rounded whorls and deep sutures; selenizone

broad, flat, ornament numerous spiral threads except on Selenizone little is known apertural margin.

Material: 1 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Class BIVALVIA
Order OSTRAEACEA
Family OSTREIDAE

Genus *Turkostrea* Vyalov, 1936

1. *Turkostrea* sp.

Diagnosis: Having strong chomata and many strong continuous, fairly narrow radial ribs on LV and tendency of ligmental area to turn in posthogyral spiral fashion.

Material: 3 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Order PTERIOIDA
Family LIMIDAE

Genus *Aviculolima*, E. Philippi, 1900

1. *Aviculolima* sp.

Diagnosis: Body of shell recalling that of Pteria, but obliquely elongated in anterior instead of posterior direction, posterior wing acutely pointed, anterior wing rounded, cardinal area wide, with broad posteriorly directed ligament pit.

Material: 6 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus *Limatulella* Sacco, 1898

2. *Limatulella* sp.

Diagnosis: Without appreciable gaps ornament of weak unequal radial riblets. Posterior view bivalve shells.

Material: 4 example

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous.

Genus *Regalilima* Cox, 1943

3. *Regalilima* sp.

Diagnosis: Large traplzifrom, unequilateral, without anterior auricle, anterior umboral ridge well developed and extended, with flattened area in front of it. Cardinal area broad, anterior gap wide, ornament of broad flat ribs, obscure in some specimens.

Material: 3 example

Locality: Seetapuri, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Order UNIONODA
Family ARCHNODONTIDAE

Genus *Anthracosphaerium* Trueman & Weir, 1946

1. *Anthracosphaerium* sp.

Diagnosis: Subovate inflated equivalved with gibbons contiguous umbones, internal characters unknown.

Material: 16 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Order UNIONIDA
Family ACTINODONTOPHORIDAE

Genus *Actinodontophora* Ichikawa, 1951

1. *Actinodontophora* sp.

Diagnosis: With several radial cardinals anterior elements of which are relatively long and massive, garding posteriorly to short and thin, anterior tooth of cardinal series occurring RV.

Material: 3 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

COORDINATES OF THE FOSSIL LOCALITIES:

Places	Latitude (North)			Longitude (East)		
Amba Dongar	21°	59'	00"	74°	04'	00"
Badia	22°	21'	50"	75°	04'	00"
Bagh	22°	21'	30"	74°	47'	30"
Barwah	22°	15'	30"	76°	02'	00"
Mongra	22°	00'	30"	74°	02'	30"
Motichikli	22°	01'	00"	74°	05'	00"
Phata	22°	15'	00"	74°	37'	00"
Mathsar	21°	46'	30"	73°	33'	30"
Sitapuri	22°	21'	50"	75°	04'	30"

Order OSTRECEA

Family OSTREIDAE Rafineque, 1815

Genus *Flemingostrea* Vredenburg, 1916

1. *Flemingostrea* sp.

Diagnosis: Medium size to large; overall shape flattised, valves subequal, neither highly convex nor compressed in antero-posterior direction. LV umbo not prominent or hook shaped, terebratuloid fold broad and gentle arising gradually at later growth stage than roof like fold does in Odonatogryphaea. No radial sulcus delimiting fold on its posterior flank which has gradually slope. Calcite prisms long and well developed in prismatic shell layer top. Many species with regularly spaced concentric imbrications on RV recalygryphaeostrea, imbrications composed of prismatic shell layers and separated from each other by smooth concentric bands with sigmoidal profiles. Chomata may be present. Ligament growing rapidly in length, but not in height in earlier resulting in some what shouldered appearance of RV with shoulders at ends of ligamental area approaching rectangular shape. It has several features and it distinguished from other genera e.g. i) LV umbo not prominent and not beaked. ii) Shell not as highly convex. iii) Shell shape less globose, tending to be flattish. iv) Valves more nearly equal in size. v) Terebratuloid fold appearing later and very gradually lower down. These features are more primitive than corresponding ones in other genera of the tribe, because they more nearly approach those of the normal, overage ostreine prototype.

Material: 6 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Phylum BRACHIOPODA

Class ARTICULATA

Order RHYNCHONELLIDA

Family RHYNCHONELLIDAE

Genus *Burmihynchia* Buckman, 1918

1. *Burmihynchia* sp.

Diagnosis: Large sized shell, globose, with many rounded costae, flabellate; beak massive, gibbons incurved, with a long apex, overhanging a small foramen that hardly touches umbo; ventral sulcus less marked than dorsal fold, fold highest along middle and anteriorly protruding.

Material: 94 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Genus *Gibbirhynchia* Buckman, 1917

2. *Gibbirhynchia* sp.

Diagnosis: Shell large, roundly triangular with very high valve thickness; Incurved beak; costal strong, angular.

Material: 15 examples

Locality: Bariha village, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

Family WELLERELLIDAE
Genus *Kallirhynchia* Buckman, 1917

1. *Kallirhynchia* sp.

Diagnosis: Shell medium sized, almost convex planate, well developed uniplication, multicostate; beak stout, rather flattened, sub erect, rarely incurving, apex short with distinct foramen, elliptical; slightly trilobite median flat fold more or less angulated, dental plates strong and divergent.

Material: 35 examples

Locality: Awalda, Thana-Manawar, District: Dhar, M.P.

Geological age: Middle Jurassic

Phylum ECHINODERMATA
Class ECHINODEA
Order SPATANGOIDA
Family HEMIASTERINA Clarke, 1917

Genus *Hemiaster*

1. *Hemiaster* sp.

Diagnosis: Star fish like structure, apparel rib sutures pointed ends in each finger rays, edging roundly, central point round with circle, upper part star fish like, beak portion plane round shape, solid and medium in size.

Material: 580 examples

Locality: Chakrud, Thana-Manawar, District: Dhar, M.P.

Geological age: Cretaceous

DISCUSSION

During the current study the stratigraphic set up of the Bagh beds, worked out by earlier workers, was testified and realized. The author also made a substantive collection of fossil faunal forms. A systematic analysis of these faunal material enabled the author to understand the biozonations and age of the beds.

It was realized during the present investigation that the fossils were not distributed evenly in all beds and hence well organized biozonations become an inconvenient task. Different forms of ammonites demarcate to some extent finer zones as Nodular limestone, Marl and

Coralline limestones etc. The upper part of upper coralline limestone showed presence of plenty of brachiopods. Different forms of *Hemiasters* showed differential distribution in different beds. Eventually, the understanding of the study may be summarized as follows:

- I. The fossiliferous strata of the Bagh beds range tentatively in age from Aptian to Maestrichtian; the Nimar rocks range down to Neocomian or further little more.
- II. Unique biozonations of the Bagh beds are not ascertained without the thorough analysis of fauna of different invertebrate groups encountered in the beds.
- III. The faunal similarity vis-a-vis distribution in geological time scale point out to some correlation with the Cretaceous Formations of south India. This was envisaged long back by Bose (1884).
- IV. The close similarity between the echinoid forms of the Bagh Formation and the echinoid fauna of the late Turonian of Madagascar provides convincing evidence that the bulk of Bagh Formation was deposited during the Turonian (Smith, 2010)

SUMMARY

The Bagh beds in the Narmada Valley of Madhya Pradesh, India yielded a rich and varied invertebrate fossil fauna. During the mid Cretaceous Period Marine conditions intruded far into the Indian craton, and the tectonic breakup of the greater Gondwana super continent gave rise to linear intracratonic basinal belts across the region. The lower Narmada basin is one Cretaceous seaway along the Narmada-son graben. The Bagh Group comprises a series of limestone and Marls deposited in Shallow marine environment that have become richly fossiliferous in places. The recent collection of fossils from Bagh beds have yielded 6 species of Ammonoidea, 7 species of Bivalvia, 1 species of Gastropoda, 2 species of Brachiopoda, 1 species of Echinoida. A few species show affinities to the forms ranging up in the Senonian while some species bear affinities to forms ranging down into

Aptian. However, majority of the recovered fauna demonstrated an age from Cenonian to Turonian.

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NEW RECORDS OF FRUIT FLIES (DIPTERA: TEPHRITIDAE) FROM RENUKA WETLAND AND WILDLIFE SANCTUARY, HIMACHAL PRADESH

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INTRODUCTION

The fruit flies (Diptera : Tephritidae) represent one of the largest families of Diptera with about 4,500 species, including some of the world's most destructive agricultural pests. Besides causing direct losses to a wide variety of fruit, vegetable and flower crops (e.g., citrus, apple, mango, sunflower), they limit the development of agriculture in many countries because of the strict trade quarantines imposed to prevent their spread. Fruit flies are also among the most attractive and biologically interesting Diptera having patterned wings and often brightly colored and/or patterned bodies, which may be used in mimicry of jumping spiders or wasps (L.E. Carroll, 1999). Among the species reported worldwide, 325 species of fruit flies are known to occur in the Indian subcontinent, of which 243 in 79 genera are from India alone under four subfamilies, namely Dacinae, Phytalmiinae, Tephritinae and Trypetinae (Bezzi, 1913, 1916; Agarwal and Sueyoshi, 2005; Evenhuis *et. Al.*, 2008; Pape & Thomson, 2012). 40 species under 26 genera under three subfamilies namely Dacinae, Tephritinae and Trypetinae has been reported from Himachal Pradesh, (Brunetti, 1917), (Parui and Mukherjee, 2000), (Mitra *et. al.*, 2004), (Parui *et. al.*, 2006), (Bhattacharya *et. al.*, 2012).

The Renuka wetland which covers an area of about 30 hectares (longitude 77°27'E, latitude 30°36'N), is located at an altitude of 645 m and is in

Sirmour district of Himachal Pradesh. Mythologically the lake symbolizes the body of Goddess Renuka, mother of Lord Parashuram, (due to its oblong shape) and hence is of immense religious importance in those locales. Due to the biological richness of the wetland and its fringing areas, it is included in the **list of Ramsar Sites (related to wetland) on 8th of November, 2011**, and the area comprising 402 ha. in and around this wetland, has been declared as an Wild Life Sanctuary.

Though 14 species of Diptera under 14 genera under 9 families have been reported from the Renuka Lake (Parui and Mukherjee, 2000), before it was declared as an wetland and wildlife sanctuary, no record exists on the fruit-flies of the Renuka wetlands and the present paper is the first report on the Tephritidae from the Renuka wetland and wildlife sanctuary.

Family TEPHRITIDAE
Subfamily DACINAE
Tribe DACINI

Genus *Bactrocera* Macquart

1835. *Bactrocera* Macquart, *Hist. nat. Ins. Dipt.*, 2: 452, 453.

Type-species, *Bactrocera longicornis* Macquart.

Subgenus : *Bactrocera* Macquart

Bactrocera (Bactrocera) dorsalis (Hendel)

1794. *Musca ferruginea* Fabricius, *Ent. Syst.*, 4: 342.
Preoccupied by *Musca ferruginea* Scopoli, 1763.

Entomol. Carn., 340. Type-locality : "India Orientali".

Material examined : 1 ♀, Sirmour dist., Renuka Wetland, Latitude 30°37'N, Longitude 77°25'E, 8.iv.11, coll. D. Banerjee.

Diagnosis : Face with a pair of large black spots; 2 broad yellow postsutural vittae on mesonotum and dorsum of thorax marked with black; a narrow costal band, not extending below vein R_{2+3} except around wing margin; abdomen rufous, terga 2 and 3 with black basal bands and with a narrow longitudinal black vittae extending down median portion of 3 to 5; the apex of piercer narrowed to a slender point and extended ovipositor measures 4.5-4.7 mm.

Distribution: India: Himachal Pradesh, Andaman & Nicobar Island, Assam, Bihar, Delhi, Jammu & Kashmir, Kerala, Karnataka, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere: Bhutan, Cambodia, Nepal, Sri Lanka, China, Myanmar, Thailand, Laos, Vietnam, Taiwan, Mauritius, Hawaii, Nauru, Guam, Ryukyu Islands, N. Marianas.

Remarks: These flies are active throughout the year, except winter season. Its host includes a number of fruits, e.g. mango, apple, litchi, guava, peach, citrus, pear, cashew etc. and is known to attack young and ripe fruits. (Fig.1: Habitus)

Subfamily TEPHRITINAE
Tribe PLIOMELAENINI

Genus *Pliomelaena* Bezzi

1918. *Pliomelaena* Bezzi, *Bull. ent. Res.*, 8:220. Type species, *Pliomelaena brevifrons* Bezzi.

Pliomelaena zonogastra (Bezzi)

1913. *Tephritis zonogastra* Bezzi, *Mem. Indian Mus.*, 3:164. Type-locality: India (Orissa: Puri).

Material examined : 2 ♀, Sirmour dist., Renuka Wetland, Latitude 30°36'N, Longitude 77°27'E, 8.iv.11, coll. T.K. Mondal.

Diagnosis: Head and thoracic bristles yellow, anterior dorsocentral bristles situated in line with

supraalars, gena setose; thorax black, grey pollinose; scutellum dark brown but yellow around margin; legs yellow to rufous; wing normal in shape, mostly brown with hyaline wedges on both margins, vein R_{4+5} setose to $\frac{1}{2}$ distance to r-m crossvein; abdomen brown, tinged rufous of first two terga and yellow at apex of 5th tergum. (Fig.2: Wing)

Distribution: India: Himachal Pradesh, Andaman & Nicobar Island, Assam, Bihar, Gujarat, Karnataka, Orissa, Punjab, Uttarakhand, Uttar Pradesh.

Elsewhere: China.

Tribe TEPHRELLINI
Subtribe TEPHRELLINA

Genus *Sphaeniscus* Becker

1908. *Sphaeniscus* Becker, *Mitt. Zool. Mus. Berl.*, 4:138. Type-species, *Sphaeniscus brevicauda* Becker.

Sphaeniscus quadrincisus (Wiedemann)

1824. *Trypeta quadrincisus* Wiedemann, *Analecta Ent.*, 55. Type-Loc: "Ost Indien."

Material examined : 1 ♀, Sirmour dist., Renuka Wetland, Latitude 30°32'N, Longitude 77°25'E, 8.iv.11, coll. R.S. Mridha.

Diagnosis: Body shining black, lightly grey pollinose on mesonotum; wings predominantly dark brown, base hyaline with a hyaline wedge in middle of anterior margin, 3 hyaline wedges extending across the wing from the hind margin; arista short pubescent; vein R_{4+5} bare except for a few setae at the basal portion, r-m crossvein situated near apex of cell 1st M₂; piercer thickened at base, sharply tapered at apex, ovipositor extended, spermathecae are weakly sclerotized. (Fig.3: Wing).

Distribution: India : Himachal Pradesh, Andaman & Nicobar Island, Karnataka, Meghalaya, Orissa, West Bengal.

Elsewhere: China, Sri Lanka, Taiwan, Thailand.

Remarks: Flies of this genus infests the flower heads of both Compositae and Labiatae.

Tribe : **TEPHRITINI**Genus : *Spathulina* Rondani1856. *Spathulina* Rondani, *Dipterol. Ital. Prodr.*, 1:113.Type-species, *Spathulina sicula* Rondani.*Spathulina acroleuca* (Schiner)1868. *Tephritis acroleuca* Schiner, *Reise der oesterreichischen Fregatten Novara, Zool.*, 2:268. Type-loc: Australia: Sydney.*Material examined* : 1 ♀, Sirmour dist., Renuka Wetland , Latitude 30°36'N, Longitude 77°27'E, 8.iv.11, coll. R.S. Mridha.*Diagnosis*: Dark coloured species with brown-black wings, hyaline spots along margin, apical portion of wing completely hyaline with a tiny brown spot at extreme apex of cell R3 and with 2 or 3 isolated hyaline spots in wing field, vein R4+5

bare except for a few inconspicuous setae at base; ovipositor short. (Fig.4: Wing)

Distribution : India: Himachal Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Orissa, Punjab, Rajasthan, West Bengal.*Elsewhere* : Widespread Oriental; Afrotropical; Southern Palaearctic; Australasian Region.*Remarks* : Flies of this species breeds in flower heads of various Compositae.**ACKNOWLEDGEMENTS**

The authors are indebted to Dr. K. Venkataraman, Director, Zoological Survey of India, for his kind support and help, to Sri P. Parui, Retd. Scientist, for his guidance, Sri Atanu Naskar and Surajit Hazra for their help with the photographs.

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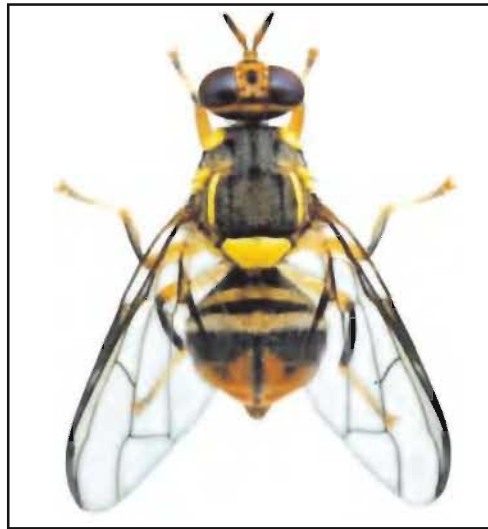


Fig. 1 : *Bactrocera (Bactrocera) dorsalis* (Hendel, 1794)



Fig. 2 : *Pliomelaena zonogastra* (Bezzi, 1913)

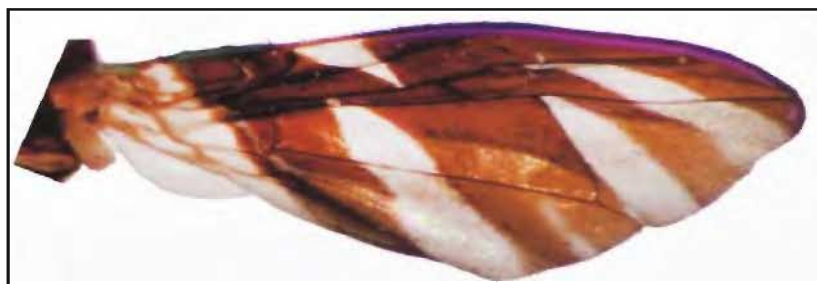


Fig. 3 : *Spheniscus quadrincisus* (Wiedemann, 1824)



Fig. 4 : *Spathulina acroleuca* (Schiner, 1868)



TWO NEW RECORDS OF THE GENUS *POLINICES* AND ONE OF THE *NATICA* (NATICIDAE: GASTROPODA: MOLLUSCA) FROM INDIA

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INTRODUCTION

The Naticidae is a cosmopolitan family of sand-dwellers Mesogastropods under the Phylum Mollusca. This family is well represented and morphologically homogenous group of marine gastropods, living in habitats from the intertidal zone to deep sea.

The work of Indian naticids very scarce and so far from the available literature and reports of the faunistic surveys the first collection of Indian Naticids started through Investigator I (1908-1911) and Investigator II (1908-1911 & 1921-1926). Among the important earlier workers, Comber (1906) listed 7 species from Bombay coast; Crichton (1940) recorded 4 species, Gravely (1942) reported 17 species of Naticids from the Madras coast; Hornell (1951) recorded 7 species from the coast of Bombay; Satyamurti (1952) reported 12 species from Krusadai Island; Menon *et al.*, (1961) listed 4 species from Gulf of Kutch; Subramuniam *et al.*, (1952) reported 12 species of Naticids from Bombay Coast. Mookherjee (1985) reported 24 species of Naticids along with the other mesogastropods from Coromandal Coast. Tikadar *et al.*, (1986) recorded 10 species from the Andaman and Nicobar Islands. Pinn (1990) reported 14 species from the coast of Puducherry. Subba Rao (1990) reported 15 species of naticids from the coast of Odisha. Subba Rao and Surya Rao (1991) recorded 7 species of Naticids from Lakshadweep. Subba Rao *et al.*, (1992) recorded 8 species of naticids from West

Bengal. Apte (1998) recorded 12 species of *Natica* from Indian coast. Subba Rao and Dey (2000) catalogued 24 species from Andaman and Nicobar Islands. Subba Rao (2003) reported about 23 species under 5 genera in his book Indian Sea Shell (Part-I). Venkataraman *et al.*, (2005) listed 37 species of Naticids from Gulf of Kutch, Gulf of Manner, Lakshadweep and Andaman and Nicobar Islands. Subba Rao *et. al.*, (2005) listed 3 species from Gulf of Kachchh, Ramakrishna *et.al.*, (2007) recorded 9 from Andhra Pradesh. Surya Rao and Sastry (2008) listed 5 species from Gujarat. During our recent works of Indian Naticids the authors came across of three species of naticids brought by the different survey parties from Tamil Nadu and Andhra Pradesh which are new record from India.

The classification adopted here Vaught (1989)

Class GASTROPODA
Subclass PROSOBRANCHIA
Order MESOGASTROPODA
Superfamily NATICOIDEA
Family NATICIDAE

Genus *Polinices* Montfort, 1810
Polinices (Lunatia) catena (de Costa)
Subgenus *Lunatia* Gray, 1847

Common Name: Necklace Moon
Fig. 1-3

1778. *Euspira catena* de Costa, *Historia Naturalis Testaceorum Britanniae*, 12:254, pl17.

1983. *Polinices catena* : Abbott and Dance, *Compendium of Seashell* 411, p 105.

Material Examined: Andhra Pradesh: (i) 1 ex., Surya Lanka beach, near Kakinada, Coll. S. Barua and party, 2.i.2002.

Measurement: (in mm)

Length	Width	Height
27.50	24.50	19.10

Diagnosis: Shell moderate in size, spire moderately elevated, suture deep, subsutural area with low concavity, penultimate whorl is 5, sculptures with very faint axial growth striae; aperture semi-ovate, parietal callus prominent and anterior of its partly folded over the umbilicus; umbilicus grooves deep and slender. Shell without operculum.

Light brownish or purplish brown in colour.

Remark: A rare species recorded from Surya Lanka beach, near Kakinada, Andhra Pradesh is a new record from India. Earlier recorded from N.W. Europe; Mediterranean Sea. It is commonly found in sand in shallow water.

Sub Genus *Mammilla* Schumacher, 1817

Polinices (Mammilla) fibrosa (Gray)

Common Name: **Breast-Shaped Moon**

Fig. 4-5

1850. *Polinices (Mammilla) fibrosa* Gray, *Eydoux*, 82 pl. 122 fig. 4.

1972. *Polinices (Mammilla) fibrosa* Cernohorsky, *Marine Shells of the Pacific*, 101, pl. 27, fig. 3.

2000. *Polinices (Mammilla) fibrosa* Kabat, *Zool. Med. Leiden* 73(25), 354, figs 2-3.

Material Examined : Tamil Nadu: 1 ex., Tuticorin fishing harbour, Coll. A. K. Mukhopadhyay and Party, 12.ix.2006, Regd.No.M26185/5.

Measurement: (in mm)

Length	Width	Height of Aperture
21.55	16.80	10.10

Diagnosis: Shell 21.55 mm in length, pyriformly-ovate, light in weight, smooth with a dull surface texture apart from fine axial growth-striae; aperture wide and semi-ovate, outer lip is frequently angulated at the lower third; parietal

callus folded over the umbilicus without completely covering the deep umbilicus groove; nuclear whorls white.

Operculum is corneous and orange brown. Cream in colour ornamented with 3 board dark brown bands. Parietal callus is dark chocolate brown.

Remarks: This species is uncommon and first record from India (Tamil Nadu).

Elsewhere: Indonesia Philippines, and Papua New Guinea, Suva, Fiji and Pago Pago, Samoa. Japan, Australia.

Genus *Natica* Scopoli, 1777

Naitica stellata Hedley

Common Name : Starry Moon

Fig. 6

1913. *Natica stellatus* Hedley, *Proc. Linn. Soc.(N.S.W)* 38, 20:299.

1956. *Natica stellata* : Kaicher, *Indo-Pacific sea-shells*, pl. fig.5.

1961. *Natica stellata* : Rippingale & Mc Michael, *Great Barrrier reefshells*, p.92, pl.11, fig.16.

1971. *Natica stellata* : Cernohorsky, *Rec. Auckland Inst. Mus.* 8:176

Material Examined: Tamil Nadu: (i) 2 exs, China mutton fishing harbour near Kanyakumari, Coll. A.K. Mukhopadhyay, 8.ix.2006, Regd.No.M-26149/5.

Measurements: (in mm)

Length	Width	Height of Aperture
31.10	31.65	20.90
28.50	29.10	20.85

Diagnosis: Shell up to 31 mm in length, width of the shell is higher than the length; spire exerted, solid, smooth apart from fine growth striae which is prominent at sutures; aperture semi-ovate, pink parietal callus forms a tongue shaped extension over the umbilicus leaving only a small transverse umbilical opening.

Operculum calcareous with 2-3 marginal ribs. Orange in colour, ornamented with one dark orange central zone and two spiral rows or irregular white blotches.

Remarks: This species is very uncommon and a new record from India: Elsewhere: Indo-Pacific.

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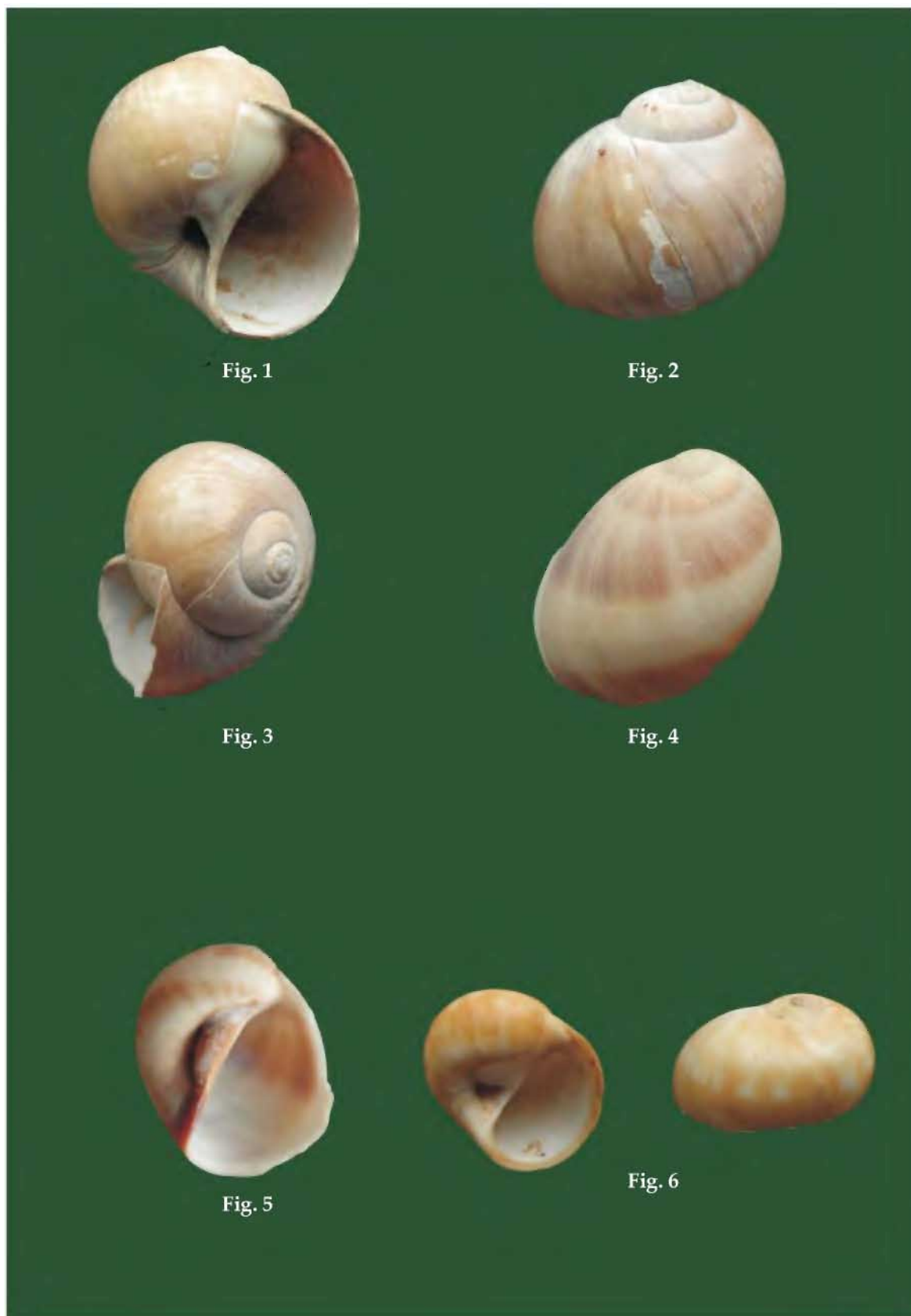


Fig. : 1-3. *Polinices (Iunatia) catena* (De costal) ; **Fig. 4-5.** *Polinices (Mammilla) fibrosa* (Gray) ; **Fig. 6.** *Natica stellata* (Hedley)

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DR. K. VENKATRAMAN
Director
Zoological Survey of India

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Silas, E.G. 1961. Occurrence of the Sea-cow *Halicore dugong* (Erxl) off Saurashtra coast. *J. Bombay nat. Hist. Soc.*, **58**(1): 263-266.

State Fauna/Conservation Areas : Mukhopadhyay, S.K. 1999. Fresh water Oligochaetes. *Fauna of West Bengal, State Fauna Series*, 3(Part-10) : 95-123. Published by Zool. Surv. India.

Radhakrishna, C. 2007. Amphibia. In : *Fauna of Kudermukh National Park, Karnataka, Conservation Area Series*, **32** : 20-25, Published by Zool. Surv. India.

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