CITATION

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Dr. K. VENKATARAMAN
Director
Zoological Survey of India

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Dr. K. VENKATARAMAN
Director
Zoological Survey of India

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Frequency of Publication : Quarterly – 4 parts in one volume.

Publication time : Within 3 months after final acceptance.

Categories of published material : Full paper, Interesting Case Reports, Field Reports, Taxonomic description and distributions, Description of new taxa, Short Communications, Checklists.

Instruction of submission : The article to be organized as :—1. Title; 2. Author/Authors along with address clearly mentioning the corresponding author and Affiliation, e-mail address; 3. Introduction; 4. Materials and Methods; 5. Systematic accounts; 6. Results; 7. Discussion; 8. Summary; 9. Acknowledgement, 10. References; 11. Tables and Figures with appropriate title and legends on separate sheets.

For short communication, the combination of some of the above sections is recommended.

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Introduction section should clearly describe the objectives of the study and provide enough background information to make it clear why the study was undertaken. Lengthy literature review is discouraged. Some earlier references of work may be cited.

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Under mateiral examined the following format should be followed strictly for *e.g.* :

Material Examined : Holotype : Female : India, Kerala, Calicut University campus, 3-xii-1994, coll. T.C. Narendran and Party (Reg. No. .....)

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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.

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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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Rec. zool. Surv. India : **111**(Part–4) : 1-7, 2011

SIX NEW SPECIES OF TETRASTICHINAE (HYMENOPTERA : CHALCIDOIDEA : EULOPHIDAE) FROM ARUNACHAL PRADESH (INDIA)

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INTRODUCTION

The Subfamily Tetrastichinae of the Eulophidae was recently studies by Narendran (2007) in a preliminary taxonomic revision. Since then the second author of this paper (PMS) had collected several specimens of Tetrastichinae from North eastern part of India viz. Arunachal Pradesh which belongs to the hot-spot areas of biodiversity. Among these collections six species belonging to the genera *Aprostocetus* Westwood and *Tetrastichus* Haliday are found to be new to science. These new species do not fit to the keys by Narendran (2007) and to any of the described species of Oriental and Palearctic region (Narendran, 2005, 2007, Narendran *et al.*, 2004, Graham, 1987, 1991, Noyes, 2003).

MATERIAL AND METHODS

The specimens were collected and curated by methods described by Narendran (2001). The card mounted specimens were studied in the laboratory using Leica Stereozoom microscope (MZ6). The holotypes are deposited in the Western Ghat Regional Centre, Zoological Survey of India, Kozhikode-673635, India (ZSIK).

Abbreviations used : AOL = Distance between front ocellus and hind ocellus; CC = Costal cell; EH = Eye height; EL = Eye L= Length; EPM = Epipygium (= T7) F1 to F4 = Funicular segments 1 to 4;L = Length; LOL = diameter of hind ocellus; MV= Marginal vein; MS = Malar sulcus; OOL = Ocellocular distance; OPS = Ovipositor sheath; PMV = Postmarginal vein; SLG = Sublateral groove(s) of scutellum; SMG = Submedian groove(s) of scutellum; SMV = Submarginal vein; STV = Stigmal vein; T1 to T7 = Gastral tergites 1 to 7; W = Width; WIOS = Width of interocular space.

DESCRIPTION

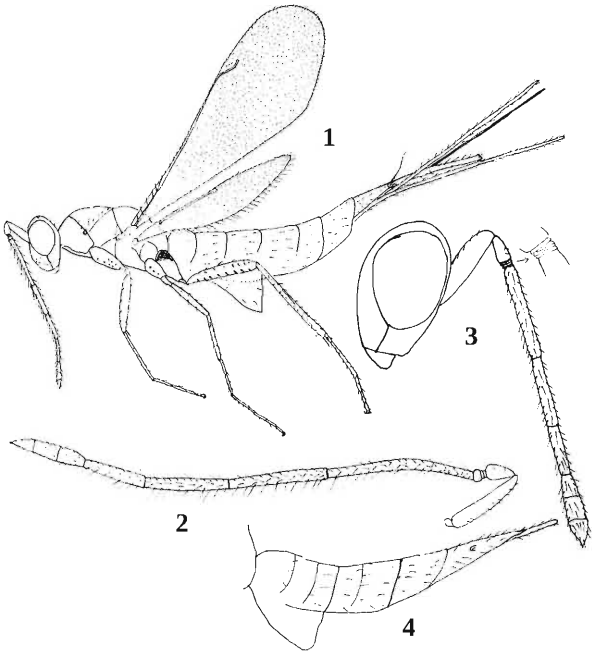
1. *Aprostocetus barnallicus* sp. nov.

(Figs. 1 & 2)

Female (Holotype) : L (including ovipositor sheath) : 5.82 mm; OPS 1.8 mm. Black with metallic green refringence except the following parts : eyes and ocelli dark brown; cervix pale yellow; posterior margin of pronotum pale; scape pale yellow; pedicel and anelli pale brownish yellow; lower margin of clypeus and gena pale brownish yellow; mandibles light brown; legs pale whitish yellow except base of hind coxa which is black with metallic green refringence; pretarsi dark brown; ovipositor sheath black; ovipositor pale brownish yellow.

Head : W in anterior view as long as its height, W in dorsal view 2x its L; frons and vertex weakly reticulate, lower margin of clypeus with two teeth medially; each mandible with two teeth visible; POL 1.75x OOL; AOL shorter than OOL; LOL slightly longer than AOL but shorter than OOL; WIOS 3.14x POL; MS distinct, 0.38x height of eye in profile; eye L in profile 0.69x its height. Antennal formula 11343; third anellus longer than first and second; scape exceeding level of vertex; relative L : W of antennal segments: scape 28 : 5; pedicel 10 : 5; F1 = 50 : 4; F2 = 35 : 4; F3 = 30 : 4; F4 = 23 : 4; clava = 28 : 5.

Mesosoma : Pronotum weakly reticulate, cross carina or ridge absent; posterior margin weakly concave with a row of 12-14 setae; 1.8x as broad as long; spiracle at joining corner with mesoscutum well visible from dorsal side; mesoscutum with 5 adnotaular setae, median longitudinal sulcus absent; surface weakly reticulate, mostly smooth and shiny, median lobe of mesoscutum slightly longer than wide; scutellum with sculpture as



Figs. 1-2. *Aprostocetus barnallicus* Narendran & Sureshan sp. nov. Female : 1. Body Profile; 2. Antenna.

Figs. 3-4. *Aprostocetus neovanilae* Narendran & Sureshan sp. nov. Female : 3. head and antenna profile; 4. Gaster.

on mesoscutum, slightly wider than long; W of space between SMG half its L; SMG deep, dorsellum mostly smooth and shiny with faint aciculations; propodeum faintly reticulate; median carina present; spiracle partly covered, separated from metanotum by a distance more than its diameter; each callus with 4-5 setae; prepectus reticulate; legs with stout setae (with their bottom (each seta arising from a slightly raised brown spot). Forewing 2.97x as long as wide; speculum closed behind cubital line of setae; forewing not exceeding beyond EPM; relative L of CC = 20; SMV = 15; MV = 43; PMV = 0; STV = 8; SMV with 4-5 dorsal setae.

Metasoma (excluding OPS and ovipositor) : 2.8x L of mesosoma; EPM relatively very long, 0.38x length of gaster, 1.2x as long as hind tibia; OPS 0.91x length of hind tibia; hypopygium not exceeding beyond T3.

Male : Unknown.

Host : Unknown.

Etymology : Named after its locality Barnalla.

Material examined : Holotype Female : India : Arunachal Pradesh, Namdapha National Park, Barnalla, N.27º 32´ 18.8", E.96°28´ 36.9" Alt. 808 mtrs; 07.xi.2009, P.M. Sureshan.

Discussion : This new species comes near *Aprostocetus percaudatus* (Silvestri) in the key to species of *Aprostocetus* by Narendran (2007) but differs from it in having : (1) antenna with 3 anelli (in *A percaudatus* antenna with 4 anelli); (2) EPM 3.5x as long as preceding tergite (in *A. percaudatus* EPM shorter than half of preceding tergite); and (3) hind coxa only basally concolorous with mesosoma (in *A. percaudatus* hind coxa completely concolorous with mesosoma).

This new species comes near *Aprostocetus vanilae* Narendran in general appearance but differs from it in having: antenna with 3 anelli (in *A.vanilae* antenna with 4 anelli); 2) distal most anellus much larger than preceding ones(in *A.vanilae* all anelli subequal or equal in size); 3) SMV with 4-5 dorsal setae (In *A.vanilae* SMV with 2 dorsal setae); and 4) General body colour more blackish with metallic refringence (in *A.vanilae* general body colour more yellowish brown with metallic green refringence on mesosoma and brightly on metasoma).

This new species comes near *A. elongatus* Graham in the key to species by Graham (1987) but differs from it in having (1) POL 1.75x OOL (in *A. elongatus* POL approximately equal to OOL); (2) pedicel 0.1x length of F1 (in *A. elongatus* pedicel 2x length of F1); (3) F1 longest (in *A. elongatus* F1 not longest); and (4) body with metallic refringence (in *A. elongatus* body without metallic refringence).

2. ***Aprostocetus neovanilae*** sp. nov.
(Figs. 3 and 4)

Female (Holotype): L : 2.85 mm (excluding ovipositor sheath and ovipositor); black with slight metallic green refringence on head and mesosoma except following parts as follows: eyes brown; ocelli pale reflecting yellow; scape, pedicel and anelli pale yellow; remaining antennal segments black; cervix pale yellow; anterior-lateral part of pronotum yellow; ventral part of promesosoma yellow; Prepectus and parts of meso and metapleura yellowish brown; legs including hind coxa completely yellow; wings hyaline, veins pale brown.

Head : W in anterior view 1.1x its height; W in dorsal view 2.46x its L; frons moderately aciculate-reticulate; vertex faintly reticulate, shiny; lower margin of clypeus bilobed; mandible bidentate; POL 2x OOL; AOL shorter than OOL; LOL slightly longer than AOL; WIOS 2.83x POL; MS distinct, 0.29x height of EH in profile; EL in profile 0.77x EH. Antennal formula 11433; scape exceeding level of vertex; relative L : W of antennal segments: scape = 31:8; pedicel = 9:5; F1 = 34:4; F2 = 24 : 4; F3 = 18 : 4; clava = 26 : 7.

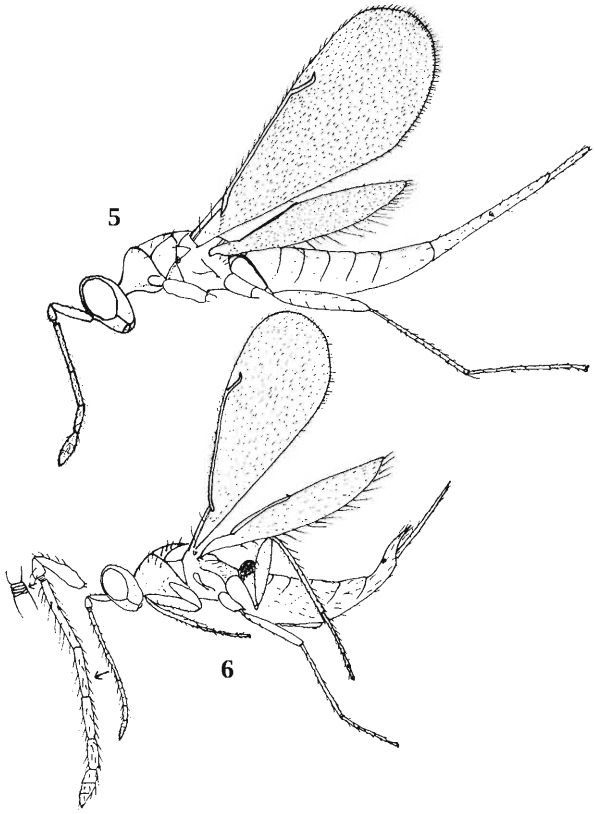


Fig. 5. *Aprostocetus arunachalicus* Narendran & Sureshan sp. nov. Female : Body Profile.

Fig. 6. *Aprostocetus namdaphicus* Narendran & Sureshan sp. nov. Female : Body profile.

Mesosoma : Pronotum weakly reticulate; cross carina or ridge absent, 1.56x as broad as long; spiracle not well visible from dorsal side; mesoscutum moderately reticulate, median sulcus absent, with 5 adnotular setae on either side; median lobe of mesoscutum as long as wide; scutellum reticulate as in mesoscutum, a little wider than long; W of space between SMG half its L, nearer to each other than to SLG; dorsellum slightly reticulate; propodeum weakly reticulate; median carina present; spiracle separated from metanotum by more than its diameter; each callus with 3-4 setae; prepectus faintly reticulate; legs with setae weaker than that of *Aprostocetus barnallicus*; forewing 2.7x as long as wide, slightly exceeding tip of ovipositor sheath; speculum relatively smaller, closed behind by cubital line of setae; SMV with 2 dorsal setae; relative L of CC = 12; SMV = 9; MV = 20; PMV = 4.

Metasoma : L (excluding ovipositor sheath and ovipositor) 2.2x length of mesosoma, EPM 0.31x length of gaster, 0.77x length of hind tibia; ovipositor sheath 0.4x as long as EPM in dorsal view, 0.44x length of hind tibia; hypopygium not exceeding T3.

Male : Unknown.

Host : Unknown.

Etymology : Named after *Aprostocetus vanilae* Narendran.

Material examined : Holotype Female, India, Arunachal pradesh, Namdapha National Park, Barnalla N27º32' 18.8" E96º26' 27.5" Alt. 808 mtrs. 07.xi.2009; P.M. Sureshan (ZSIK).

Discussion : This species comes near *Aprostocetus vanilae* Narendran in general appearance but differs from it in having : (1) mesoscutum with median sulcus absent (in *A.vanilae* mesoscutum with median longitudinal sulcus present); (2) colour black with slight metallic green refringence (in *A.vanilae* general body colour yellowish brown with metallic green refringence on mesosoma and slightly on gaster); (3) mesoscutum with 5 adnotaular setae on each side (in *A.vanilae* mesoscutum with 2 adnotaular setae on either side); and (4) POL 2x OOL (in *A.vanilae* POL 2.6x OOL).

This new species differs from *A. percaudatus* in having : (1) ovipositor sheath 0.11x length of gaster (in *A. percaudatus* ovipositor sheath 0.70x longer than whole L of body); (2) SMV with 2 dorsal setae (in *A. percaudatus* SMV with 3-5 dorsal setae; and (3) hind coxa yellow (in *A. percaudatus* hind coxa concolorus with mesosoma, not yellow).

3. ***Aprostocetus arunachalicus*** sp. nov.
(Fig. 5)

Female (Holotype) : L : 4.36 mm. Black with metallic green refringence, except the following parts : eyes grey; ocelli pale brown; scape and pedicel pale yellow, anelli and scape brown; remaining antennal segments black; cervix pale yellow; anterior-lateral part of pronotum yellow; legs including all coxae completely pale yellow; wings hyaline with veins pale yellowish brown.

Head : Width in anterior view slightly longer than its height, W in dorsal view 2.4x its L; frons and vertex faintly aciculate - reticulate, mostly shiny; lower margin of clypeus weakly bidentate; mandibles with two teeth visible; POL 1.75x OOL; AOL shorter than OOL; WIOS 3x POL; malar sulcus distinct, not curved, 0.29x height of eye in profile; L of eye in profile 0.64x its height. Antennal formula 11433; scape exceeding a little over level of vertex; relative L : W of antennal segments : scape 13 : 3; pedicel = 6 : 3; F1=15 : 2; F2=11 : 2; F3 = 8 : 2; clava = 11 : 4.

Mesosoma : Pronotum weakly reticulate, 1.57x as broad as long; cross carina or ridge absent; spiracle visible from dorsal side; mesoscutum weakly reticulate; median longitudinal sulcus absent; median lobe of mesoscutum as broad as long, with 3 stout, sub errect adnotaular setae on either side; scutellum moderately reticulate, SMG slightly nearer to SLG than each other; W of space between SMG 0.33x its L; dorsellum 0.42x as long as scutellum; propodeum weakly reticulate with a complete median carina; spiracle relatively smaller separated from metanotum by about its diameter; each callus with 3 setae; prepectus with raised reticulation; legs with weaker setae than those of *A.barnallicus* sp.nov. Forewing 2.7x as long as broad, not exceeding EPM; speculum small, closed behind by cubital line of setae; SMV with 2 dorsal setae; relative L of CC = 16; SMV = 13; MV = 39; PMV = 0; STV = 8.

Metasoma : Sessile, 2.4x as long as mesosoma (excluding OPS); EPM 0.44x length of gaster 1.31x as long as hind tibia; OPS 0.36x length of EPM, 0.43x length of hind tibia; hypopygium exceeding T3.

Male : Unknown.

Host : Unknown.

Material examined : Holotype Female, India, Arunachal Pradesh, Namdapha National Park, Barnalla, N 27º 32' 18.8" E 96º 26' 27.5" Alt. 808 mtrs., 07.xi.2009, P.M. Sureshan (ZSIK).

Discussion : This species comes near *Aprostocetus neovanilae* in general appearance but differs from it in having : (1) forewing not exceeding tip of ovipositor sheath (in *A. neovanilae* forewing not at all exceeding tip of ovipositor sheath (not even exceeding tip of epipygium); (2) mesoscutum with 3 stout adnotaular setae on each side (in *A. neovanilae* mesoscutum with 5 adnotaular setae on each side); (3) epipygium 1.31x as long as hind tibia (in *A. neovanilae* epipygium 0.77x as long as hind tibia.

This new species does not fit to the key to species of *Aprostocetus* by Narendran (2007) and Graham (1987).

4. ***Aprostocetus namdaphicus*** sp. nov.
(Fig. 6)

Female (Holotype) : L (excluding OPS) 3.8 mm. Black with slight metallic green refringence except the following parts as follows : eyes grey; ocelli dark brown; scape pale yellow with dorsal margin dark; pedicel pale yellow with dorsal part darker; remaining antennal segments black; tegula pale yellow; legs pale yellow with base of hind coxa brownish black and pretarsi dark brown; wings hyaline with veins pale brownish yellow.

Head : W in anterior view slightly more than its height (34 : 32); W in dorsal view 2x its L; frons and vertex faintly aciculate-reticulate; lower margin of clypeus distinctly bidentate; POL 2x OOL; AOL slightly shorter than OOL; LOL longer than OOL; WIOS 3.25x POL; malar sulcus distinct, 0.36x height of eye in profile; eye L in profile 0.64x its height. Antennal formula 11443; scape exceeding level of vertex; relative L : W of antennal segments : scape= 17 : 4; pedicel = 6 : 4; F1 = 21 : 3; F2 = 15 : 3; F3 = 13 : 3; F4 = 9 : 3; clava = 12 : 4.

Mesosoma : Pronotum faintly reticulate with 10 stout sub errect setae near posterior margin and some scattered setae; spiracle visible from dorsal side; pronotum 1.7x as wide as its L; mid lobe of mesosctum W subequal to its L, without a median longitudinal sulcus, with 5 adnotaular setae on either side; scutellum a little wider than long (10 : 9); SMG as nearer to SLG as each other; dorsellum weakly aciculate, 0.33x as long as scutellum; propodeum granulate, median carina complete; spiracle relatively small, rim exposed, separated from metanotum by its own diameter; each callus with 3 setae; prepectus distinctly reticulate; hind femur and tibia with stout setae; setae of fore and mid legs slender; forewing 2.75x as long as broad, a little exceeding tip of EPM; speculum closed behind by cubital line of setae; relative L of CC = 16; SMV = 14; MV = 36; PMV = 0; STV = 7.

Metasoma : 1.76x as long as mesosoma (excluding OPS); EPM 0.35x length of gaster, 0.58x length of hind tibia; ovipositor sheath 1.33x length of EPM in side view, 0.9x length of EPM in dorsal view, distinctly shorter than hind tibia in dorsal view; hypopygium distinctly exceeding T3.

Male : Unknown.

Host : Unknown.

Material examined : Holotype Female, India, Arunachal Pradesh, Namdapha, Hornbill, N 27º 32' 17.6" E 96º 26' 30.2" Alt. 585 mtrs., 04.xi.2009, P.M. Sureshan.

Discussion : This new species comes near *Aprostocetus neovanilae* in general appearance of gaster but differs from it in having : (1) antenna with 4 funicular segments (in *A. neovanilae* antenna with 3 funicular segments); (2) hind coxa with base brownish black (in *A. neovanilae* hind coxa completely yellow); (3) ventral part of promesosoma black with metallic green refringence (in *A. neovanilae* ventral part of promesosoma yellow) and (4) hypopygium exceeding T3 (in *A. neovanilae* hypopygium not exceeding T3).

5. ***Tetrastichus anamikicus*** sp. nov.
(Fig. 7)

Female (Holotype) : L : 1.29 mm. Black with following parts as follows : eyes and ocelli brown; scape pale yellow; pedicellus yellowish brown; all remaining antennal segments concolorous with head; legs pale yellow with all coxae concolourous with body except their pale apices; wings hyaline with veins pale brownish yellow.

Head : W in anterior view subequal to its height, W in dorsal view 2.17x its L; frons and vertex distinctly reticulate; lower margin of clypeus bilobed; POL 2.8x OOL; AOL subequal to OOL; LOL shorter than OOL; WIOS 2x POL; malar sulcus distinct, straight, 0.48x height of eye in profile; L of eye in profile 0.62x its height. Antennal formula 11433; scape not reaching level of vertex; relative L : W of antennal segments : scape = 34 : 8; pedicel = 16 : 8; F1 = 23 : 10; F2 = 18 : 10; F3 = 17 : 10; clava = 43 : 10.

Mesosoma : Pronotum distinctly reticulate, mesoscutum with raised reticulation, spiracle visible from dorsal side but not projecting sideward; median longitudinal sulcus complete, with 3 suberrect adnotaular setae on either side; median lobe of mesoscutum 1.25x as broad as its L; scutellum 1.33x as broad as long, with 2 pairs of stout suberrect setae; SMG nearer to SLG than to each other; W of space between SMG 0.44x its L; propodeum with median carina and bifurcated paraspiracular carina, surface distinctly reticulate on anterior part and on inner part adjoining outer branch of paraspiracular carina, remaining part mostly smooth or faintly reticulate; spiracle separated from metanotum by its own diameter; prepectus reticulate; hind coxa coarsely and irregularly carinate-reticulate on dorsal part. Forewing 2.33x as long as broad; speculum open behind, relative L of CC = 20; SMV = 18; MV = 31 : PMV = 2; STV = 9; SMV with a single dorsal seta.

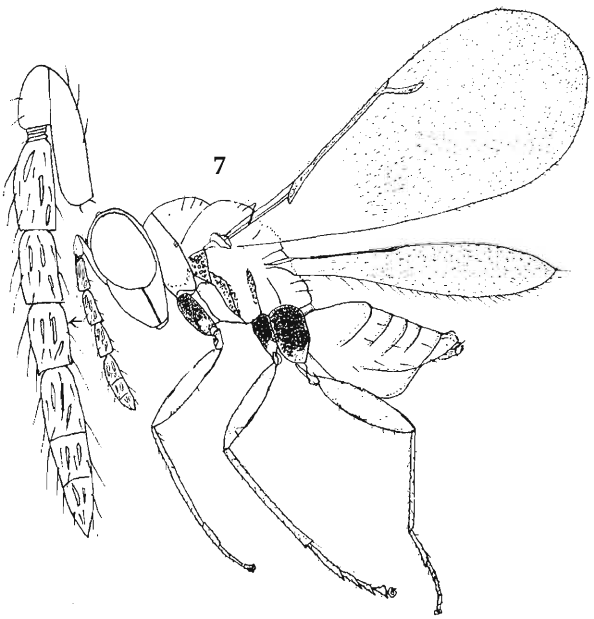


Fig. 7. *Tetrastichus anamikicus* Narendran & Sureshan sp. nov. Female : Body profile.

Metasoma : Petiolate, 0.83x length of mesosoma, petiole 0.27x length of hind coxa, broader than long; ovipositor sheath hardly visible from dorsal side; hypopygium exceeding middle of gaster.

Male : Unknown.

Host : Unknown.

Etymology : Named after area Anamika Water Falls, Arunachal Pradesh.

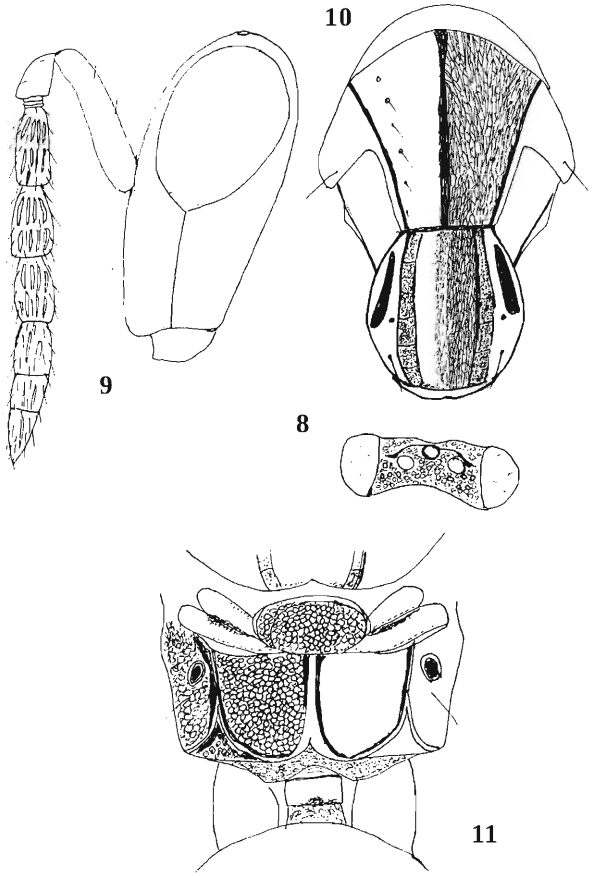
Material examined : Holotype Female, India, Arunachal Pradesh, Namdapha National Park, Deban, Anamika Falls, N 27° 29' 30" E 96° 22' 32.4" Alt. 410 mtrs., 2.xi.2009, P.M.Sureshan (ZSIK).

Discussion : This species comes near *Tetrastichus iaricus* Narendran in the key to species of *Tetrastichus* by Narendran (2007) but differs from it in having : (1) F1 distinctly longer than F2 (in *T. iaricus* F1 equal in L to F2); (2) gaster distinctly shorter than mesosoma (in *T. iaricus* gaster as long as mesosoma); (3) body without metallic refringence (in *T. iaricus* body with metallic green or blue refringence); (4) propodeal spiracle separated from metanotum by its own diameter (in *T. iaricus* propodeal spiracle almost touching metanotum); (5) MV 3.44x as long as STV (in *T. iaricus* MV 5x as long as STV) and (6) speculum open behind (speculum closed behind by setae in *T. iaricus*).

6. ***Tetrastichus ramakrishnae*** sp. nov.
(Figs. 8-11)

Female (Holotype) : L 2.43 mm. Black except following parts : eyes and ocelli brown, scape pale yellow; pedicel and anelli pale brownish yellow; remaining antennal segments black; apices of femora, tibia completely and all tarsi pale yellow, remaining parts of femora, trochanters coxae completely and pretarsi concolourous with mesosoma; wings hyaline with veins pale yellowish hyaline.

Head : W in anterior view 1.11x its height; W in dorsal view 2.6x its L; frons reticulate with shallow scattered setigerous pits on upper frons, vertex with coarse pits and reticulation; a distinct cross carina



Figs. 8-11. *Tetrastichus ramakrishnae* Narendran & Sureshan sp. nov. Female : 8. Head dorsal view; 9. Head and antenna profile; 10. Mesosoma dorsal view (partly); 11. Propodeum & Petiole dorsal view.

present on anterior half of vertex (Fig. 8) anterior to ocelli; posterior part vertical; POL 2x OOL; AOL shorter than OOL; LOL subequal to OOL; WIOS 3.25x POL; malar sulcus straight, 0.64x height of eye in profile; eye L in profile 0.67x its height; each eye with 3- 4 widely spaced short hairs. Antennal formula 11333; scape not exceeding level of vertex; relative L : W of antennal segments : scape = 39: 8; pedicel = 12 : 8; F1 = 20 : 9; F2 = 18 : 10; F3 = 16 : 10; clava = 37 : 10.

Mesosoma : Pronotum raised reticulate, spiracle visible; mesosctum with distinct longitudinal raised reticulation, with a complete deep median longitudinal sulcus, with 6 adnotaular setae on either side; W of median lobe of mesoscutum subequal to its L; scutellum similarly sculptured as in mid lobe of mesoscutum; SMG broad and foveolate (Fig. 10) nearer to SLG than to each other; W between SMG 0.4x its L; dorsellum distinctly reticulate; propodeum distinctly reticulate; spiracle separated from metanotum by a distance shorter than its diameter; prepectus with raised reticulation; hind coxa coarsely reticulate and irregularly carinate. Forewing 2.4x as long as wide, speculum open behind; relative L of CC = 24; SMV = 18; MV = 20; PMV = 0; STV = 8.

Metasoma as long as mesosoma, petiole wider than long, 0.38x length of hind coxa, anterior half of petiole smooth, posterior half reticulate; OPS not visible from dorsal side; EPM shorter than half of T6.

Male : Unknown.

Host : Unknown.

Etymology : Named after Dr. Ramakrishna, former Director, Zoological Survey of India for his encouragement and support for this work.

Material examined : Holotype Female: India, Arunachal Pradesh, Namdapha, Barnalla, N 27º 32' 18.8" E 96º 26' 27.5" Alt. 808 mtrs., 07.xi.2009, P.M. Sureshan (ZSIK).

Discussion : This species comes to *Tetrastichus vayalicus* Narendran in the key to species by Narendran (2007). However it differs from *T. vayalicus* in having : (1) body with metallic refringence absent (in *T. vayalicus* body bright metallic green or blue refringence); (2) gaster as long as mesosoma (in *T. vayalicus* gaster distinctly longer than head plus mesosoma) and (3) hypopygium exceeding middle of gaster (in *T. vayalicus* hypopygium not exceeding middle of gaster).

This new species comes near *Tetrastichus anamikicus* sp. nov. in general appearance but differs from it in having : (1) each antenna with 3 anelli (in *T. anamikicus* each antenna with 4 anelli); (2) POL 2x as long as OOL (in *T. anamikicus* POL 2.8x OOL); (3) mesoscutum with 6 adnotaular setae on either side (in *T. anamikicus* mesoscutum with 3 stout sub errect adnotaular setae on either side); (4) MV shorter 3x length of STV (in *T. anamikicus* MV longer than 3x STV); (5) metasoma as long as mesosoma (in *T. anamikicus* metasoma distinctly shorter than mesosoma) and (6) femora black with apices paler (in *T. anamikicus* femora pale brownish yellow).

SUMMARY

Six new species of *Tetrastichinae* viz *Aprostocetus barnallicus* sp. nov., *Aprostocetus neovanilae* sp. nov., *Aprostocetus arunachalicus* sp. nov., *Aprostocetus namdaphicus* sp. nov., *Tetrastichus anamikicus* sp. nov. and *Tetrastichus ramakrishnae* sp. nov. are described and compared with their nearest closely resembling species.

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STUDIES ON THE MOSQUITO FAUNA INHABITING SHORELINE HABITATS OF ORISSA COAST (CULICIDAE : DIPTERA)

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INTRODUCTION

Mosquito fauna known from the world comprises 3,500 species that are tradionally classified in to three subfamilies *viz*. Anophelinae, Culicinae and Toxorhynchitinae under the family Culicidae of the Order Diptera. (Insecta). Taxanomic studies of the mosquito fauna of Indian subcontinent were extensively studied by Barraud (1934), Christophers (1933) and their monumental works led to Nagpal and Sharma (1995) updating 320 species of mosquitoes in 37 genera so far reported from India The mosquito fauna of Orissa state was studied by Fry (1912), Nagpal and Sharma (1983), Dash *et al*. (2000). However, Rajavel *et al*. (2005 a, b) has reported recently 74 species belonging to 12 genera and 20 subgenera from Jeypore Hill tracks of Orissa and 43 species belonging to 21 subgenera and 13 genera from mangroves of Bhiterkanika. Keeping in view of the prevalence of mosquito born diseases in Orissa, an attempt has been made here to document the diversity of mosquitoes inhabiting the shoreline habitats of south Orissa coast.

The state of Orissa, the south eastern coastal state of India, is located between 17.49' N and 22.34' N and 81.27' E and 87.29' E (Fig. 1). It is bounded by the Bay of Bengal on the north east; Madhya Pradesh on the west and Andhra Pradesh on the south. The land area of the state covers 155,707 sq. kms. with a coast line of over 450 kms. On the basis of physiographical characteristics, the state has been divided into five major morphological regions viz. the Orissa Coastal Plain in the east, the Middle Mountainous and highlands, the Central plateaus, the Western rolling uplands and the major flood plains. The coastal belt of the state extends from the River Subarnarekha near West Bengal border in the north to the River Rushikulya in the south near the border of Andhra Pradesh.

Several deltas of varied sizes and shapes are formed by the major rivers of Orissa, such as the Subarnarekha, the Budhabalanga, the Baitarani, the Brahmani, the Mahanadi, and the Rushikulya. Therefore, the coastal plain of Orissa is also known as "Hexadeltaic Region" or the "Gift of Six Rivers". In addition, the largest brackish water lake of India, the Chilika is located between 85^{0}20' E and 19^{0}40' N, and is connected to the Bay of Bengal by a narrow channel 32 km long. These extensive river systems and the lakes are home of diverse faunal groups such as mosquitoes. that are adapted to survive in varied habitats like ponds, puddles, tree holes, swamps and salt marshes.

A taxonomic account of 55 mosquito species under 12 genera, 17 subgenera and 3 tribes occurring in Puri and Khurda Districts of Orissa is presented in this study along with some observations on their ecology and distribution. The species of mosquitoes which are actually collected in the present survey marked with asterisk.

MATERIALS AND METHODS

Two coastal districts of Orissa *i.e.*, Khurda and Puri have been chosen for collection of mosquito samples. The Khurda and Puri districts are located 20º 40'N and 85º 35'E and 19º 45'N and 85º 50'E respectively. Samples of adults and immature stages of mosquitos were collected from twelve villages around the Chilika Lake covering the two districts which represent diversified habitats. Random samplings were made during the period from January 2006 to September 2007 from different localities of Balugaon, Chhedapadar, Bidharpur, Pratap, Totapada villages in Khurda District and Alipara, Giqala, Sipakuda, Rambhartya Island, Ashram, Altunga, Beleswarpatna villages in Puri District (Fig. 1).

Mosquitoes were collected by employing simple standard techniques from indoor and outdoor habitats and from cattle sheds. Samples were also collected

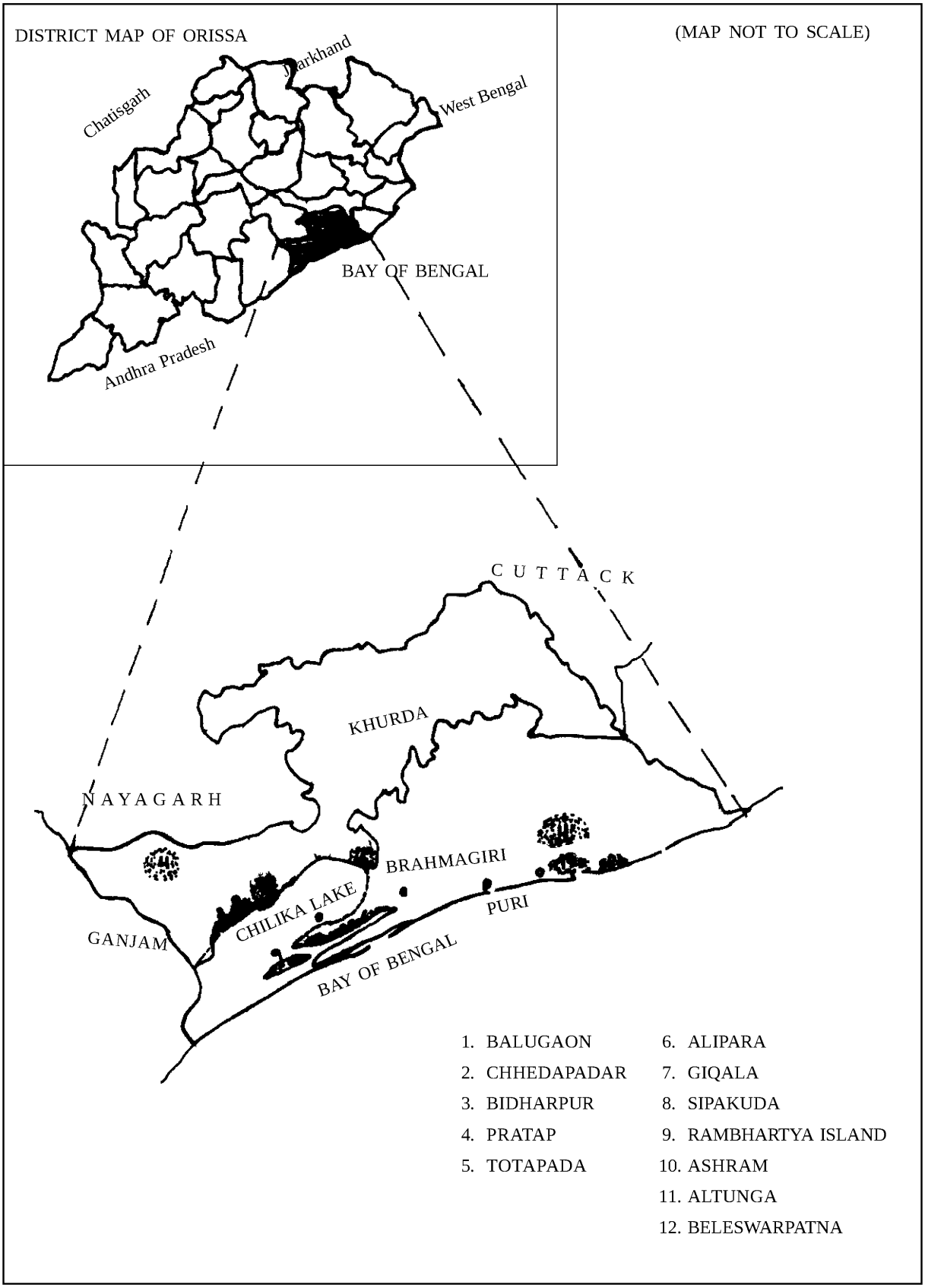

Fig. 1. Map of Orissa showing Collection sites in the Puri and Khurda district (2006-07)

during dawn and dusk while mosquitoes maximize their frequency of taking blood meal from the hosts. Mosquito repellant spray was used to paralyze the specimens. The knocked down specimens were collected by picking with the help of fine forceps and transfer them to the collection tubes to avoid breaking of legs. Suction tube was also used to collect the live mosquitoes. Resting adult mosquitoes were collected from the shrubs around the cattle sheds and human dwellings, paddy fields, and near by forest areas. Over 2000 examples of adults and immature stages of mosquitos have been collected by employing the above techniques during the survey period. Adults of male and female mosquitos and their immature stages were identified using standard literatures and the keys provided by Christopher, 1933; Barraud, 1934 and Rao, 1984. In this study 22 species of mosquitoes belonging to 7 genera were identified from the south coastal Orissa. The diagnostic characters of all the species listed here are based on the key characters of adult females. Identified specimens were registered and deposited at the museum of Zoological Survey of India, Gopalpur, Orissa.

EXTERNAL FEATURES OF A MOSQUITO

The body of the mosquito is divided in to head, thorax, and abdomen (Fig. 2). The head (Fig. 3) contains compound eyes and proboscis. The proboscis is the piercing mouthparts used to "suck" blood from the victim. The mosquito's head is mostly formed of the compound eye. Each eye (Fig. 3) is made up of many tiny lenses forming a compound eye which allows for a broad field of vision. The thorax (Fig. 4) has one pair of wings (Fig. 7) and halteres. The abdomen (Fig. 5) or gut is capable of expanding as it ingests the prey's blood. The markings present on the thorax and abdomen are useful for the identification of the species. The length of mosquitoes varies in species but is rarely greater than 16 mm and weighs up to 2.5 mg. Mosquitoes are able to continuously fly for 1 to 4 hours at a speed of 1-2 kmph and travel up to 10 km in a night. Most species are nocturnal or crepuscular (dawn or evening) feeders. During the heat of the day most mosquitoes rest in a cool place and wait for the evening. The pathogens are transmitted to victims while sucking the blood.

TAXONOMIC LIST OF MOSQUITO SPECIES RECORDED FROM THE ORISSA COAST

Family CULICIDAE

Genus ***Anopheles***

Subgenus ***Cellia***

Subgenus ***Anopheles***

1. ***Anopheles (Anophilis) aitkenii*** James

1903. *Anopheles aitkenii* James, In : Theobald, *Monogr. Cul.*, **3** : 22.

Diagnostic characters : palpi equal to the proboscis, completely dark and scales small in size; costa and subcosta are completely dark including vein 1 (R1); prescuttelar space of thorax without setae; pale ring absent at the termination of tarsi.

Distribution : In India, widely prevalent in Andaman Islands, Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Remarks : Breeds in a variety of places such as small pools and seepages, in the jungle tea garden drains which are shaded by tea plants, swamps, marshes, channels, river, rock pools, streams heavily shaded with trees, wells etc. Recorded from Mayurbhanj, Keonjhar and Koraput of Orissa.

2. ***Anopheles (Anopheles) nigerimus*** Giles*

1900. *Anopheles nigerimus* Giles. *Handbook* : 162. (as variety of *hyrcanus*).

Diagnostic characters : Four banded palpi (tip of the palpi pale); Pale area on costa and subcosta including vein 1 (R1) is less than 4, pale scale on inner costa and fringe spot on vein 5.2 (Cu2), basal dark mark on wing vein 5 (Cu) long (0.4 multiplied by length of Cu stem).

Material Examined : 3 exs. (F), Pratap, Khurda Distt., 24.i.2006 Coll. : S. Dash; 3 exs. (F) from Sipakuda, Beleswarpatna Dist. Puri, 26.i.2006, Coll. : S. Dash.

Distribution : In India, occurs in all mainlands except Himachal Pradesh.

Remarks : Breeds in standing water with good aquatic vegetation.Recorded from all over Orissa especially from coastal Orissa.

3. ***Anopheles (Anopheles) sinensis*** Wiedemann

1828. *Anopheles sinensis* Wiedemann, *Aussereurop Zweifl Insekt.*, **1** : 547.

Diagnostic characters : Pale area on costa and subcosta including vein 1 (R1) is less than 4; four banded palpi (tip of the palpi pale); size of pale bands on hind tarsomeres very small.

Distribution : In India recorded from Assam, Delhi, Manipur, Meghalaya, Mizoram, Orissa, Punjab and Tamil Nadu.

Remarks : Mainly breeds in the rice fields. Recorded from all over Orissa but especially from Koraput District.

Subgenus ***Cellia***

4. ***Anopheles (Cellia) aconitus*** Donitz*

1902. *Anopheles aconitus*, Donitz, *Z. Hyg. Infektkrankh*, **41** : 70.

Diagnostic characters : Intervening dark band on the palpi very small (in most of the specimens dark band absent); more than 4 Pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs are absent; Hind tarsomeres 5, 4, and 3 are dark; Tip of hind tarsomere and bands on legs are black.

Material Examined : 2 exs. (F) from Altunga, Puri Distt. 24.i.2006; 1 ex (F) from Tangi,. Khurda Distt., 27.i.2006. Coll. : S. Dash.

Distribution : Distributed all over India including Andaman Islands and Lakshadweep except Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajsthan.

Remarks : Species breeds in clean-water tanks with grassy edges, ponds, streams, water drains, river bed pools and rice fields (at least 45 cm long). Reported from the coastal plains of Orissa.

5. ***Anopheles (Cellia) annularis*** Van der Wulp*

1884. *Anopheles annularis* Van der Wulp. *Notes Leyden Mus.*, **6** : 249.

Diagnostic characters : Apical pale band of palpi nearly equal to the pre-apical dark band; area at the bifurcation of wing vein 5 (Cu) dark; more than 3 pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs absent; tarsomeres 5, 4 and 3 of hind leg completely pale.

Material Examined : 2 females (adult). Chhedapadar,. Khurda Distt., 23.i.2006, Coll. : S. Dash; 4 exs (F)., Alipada and Altunga of Puri Distt., 27.i.2006, Coll. : S. Dash.

Distribution : In India, very commonly found in coastal Orissa, Bihar, Maharahtra, Punjab and West Bengal.

Remarks : Mixed dwellings during day. Also found at outdoor in small numbers. Reported from Singhbhum, Chilika lake area, Puri, Keonjhar, Koraput of Orissa.

6. ***Anopheles (Cellia) culicifacies*** Giles*

1901. *Anopheles culicifacies* Giles, *Entomologist's mon. Mag.*, **37** : 198.

Diagnostic characters : Apical pale band nearly equal to the preapical dark band of palpi; more than 3 Pale area on costa and subcosta including vein 1 (R1); Fringe spot on vein 3 (R4 + 5) absent; speckling in fore and hind legs absent; hind tarsomeres 5, 4 and 3 are dark; bands on fore tarsomeres absent;.

Materials Examined : 2 exs. (F). Bidharpur, Khurda Distt., 23.i.2006, Coll. : S. Dash; 1 ex. (F) from Giqala of Puri Distt., 27 .i. 2006, Coll. : S. Dash.

Distribution : In India recorded throughout the country except Andaman & Nicobar Islands.

Remarks : It rests in cattle sheds and houses during the day. Also collected from straw, mud cakes *etc.*, near stables and from dense vegetation under the bushes and tree holes. Reported from Balangir, Balighara, Baruva, Bhadrak, Chatikona, Cuttack, Ganjam, Jeypore, Kesinga, Phulbani and Sambalpur in Orissa.

7. ***Anopheles (Cellia) fluviatilis*** James

1902. *Anopheles fluviatilis* James, *Scient. Mem Med. Sanit. Depts. India*, **2** : 31.

Diagnostic characters : Apical pale band nearly equal to the pre-apical dark band of palpi; wing with 4 or more dark spots on costa, involving costa and vein R, wing vein 3 (R4 + 5) and inner costa mostly pale and inner costa dark: speckling in legs absent; bands on fore tarsomeres absent.

Distribution : In India, occurs in all main lands.

Remarks : More percentage of adults rest at human habitats than cattle sheds in day time. The species also rests outdoors. Reported from Jeypore, Koraput, Mayurbhanj of Orissa.

8. ***Anopheles (Cellia) jeyporiensis*** James

1902. *Anopheles jeyporiensis* James, *Scient. Mem. Med. Sanit. Depts. India*, **2** : 32.

Diagnostic characters : Pre-apical dark band ¼ or 1/5 of the apical pale band of palpi; Wing with 4 or more dark spots on costa, involving costa and vein R, distance of the anterior forked cell from the base of the costa compared to that of posterior forked cell is small; speckling in legs absent; hind tarsomeres 5, 4 and 3 are dark; small bands on fore tarsomeres.

Distribution : In India, found from Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Karnataka, Kerala, Madhya Pradesh, Mahrashtra, Manipur, Meghalaya, Mizoram, Orissa, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal.

Remarks : Adults found largely in cattle sheds as well as inside houses. Found at altitudes from 2000 to 6000m. Reported from Jeypore hills of Orissa after which the species has been named.

9. ***Anopheles (Cellia) karwari*** (James)

1903. *Anopheles karwari* (James), In : Theobald. *Monogr. Cul.*, **3** : 102.

Diagnostic characters : Palpi with 4 pale-scaled bands. Wing with 4 or more dark spots on costa, involving costa and vein R, wing never all dark; only hindtarsomeres 5 and part of 4 pale-scaled.

Distribution : This species is recorded in India including Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Tamil Nadu,

Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Orissa, Rajasthan, Tripura, Uttar Pradesh, Uttarakhand, West Bengal.

Remarks : Reported all over Orissa . Breeds mainly in seepage. Not regarded as vector of Malaria.

10. ***Anopheles (Cellia) maculatus*** Theobald*

1901. *Anopheles maculatus* Theobald, *Monogr. Cul.*, **1** : 171.

Diagnostic characters : Apical pale band of palpi nearly equal to the subapical pale band; more than 4 Pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs are present; hind tarsomeres 5 and part of 4 are only pale; dark band at 4th tarsomere of hind leg are present; scales on 6 and 7 tergites are with broad golden scales.

Material Examined : 3 exs. (F), Totapada, Pratap Khurda Distt., 28.i.2006 Coll. : S. Dash.

Distribution : In India, occurs in all main lands.

Remarks : Prefers bright sunlit places for breeding and shade has a deleterious effect in breeging Breeding is more pronounced in pre- and post monsoon months. Recorded all over Orissa.

11. ***Anopheles (Cellia) majidi*** Young and Majid

1928. *Anopheles majidi* Young and Majid, *Indian. J. med. Res.*, **16** : 169.

Diagnostic characters : Apical and sub-apical pale band equal and separated by a small or same sized dark band intervening dark band of palpi; more than 4 Pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs are absent; Hind leg tarsomeres 5, 4, and 3 are dark; tip of hind tarsomere pale and bands present on legs.

Distribution : In India it is found in Arunachal Pradesh, Assam, Goa, Karnataka, Kerala, Meghalaya, Mizoram, Orissa, Tamil Nadu, Tripura and West Bengal.

Remarks : Breeds in grassy slow-running streams, breeding also recorded from open drains in tea gardens and fallow rice fields. Reported from Koraput, Orissa.

12. ***Anopheles (Cellia) minimus*** Theobald

1901. *Anopheles minimus* Theobald, *Monogr. Cul.*, **1** : 186.

Diagnostic characters : Apical and sub-apical pale band equal and separated by a small or same sized dark band intervening dark band of palpi; wing with 4 or more dark spots on costa, involving costa and vein R, inner costa interrupted; speckling in legs absent; Hind leg tarsomeres 5, 4, and 3 are dark; tip of hind tarsomere black and bands on legs absent.

Distribution : In India, widely prevalent in Arunachal Pradesh, Assam, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura. It has sporadic distribution in Andhra Pradesh, Bihar, Karnatak, Kerala, Orissa, Tamil Nadu, in the foothills of Uttar Pradesh and West Bengal.

Remarks : Breeds in burrow pits, rice fields and seepages. The species prefers shady places. Reported from all over Orissa.

13. ***Anopheles (Cellia) moghulensis*** Christophers

1924. *Anopheles moghulensis* Christophers, *Indian J. Med. Res.*, **12** : 296.

Diagnostic characters : Apical pale band nearly equal to the pre-apical dark band of palpi; pre-apical dark band ¼ or 1/5 of the apical pale band; wing with 4 or more dark spots on costa, involving costa and vein R; speckling in legs absent; hind tarsomeres 5, 4 and 3 are dark; bands on fore tarsomeres are small.

Distribution : In India recorded from Andhra Pradesh, Bihar, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu.

Remarks : Rests in human dwellings and occasionally in cattle sheds. Reported all over Orissa.

14. ***Anopheles (Cellia) pallidus*** Theobald

1901. *Anopheles fuliginosus var.* Theobald. *Monogr. Cul.*, **1** : 134.

Diagnostic characters : Apical pale band of palpi nearly equal to the pre-apical dark band; wing with 4 or more dark spots on costa, involving costa and vein R, pale area at the bifurcation of wing vein 5 (Cu); speckling in legs absent; hind leg tarsomeres 5, 4 and 3 completely pale; apex of hind tarsomere1 without any pale band.

Distribution : Found throughout India.

Remarks : Mixed dwellings. Reported all over Orissa.

15. ***Anopheles (Cellia) ramsayii*** Covell

1931. *Anopheles pseudojamesi*, Strickland and Choudhury. *Anoph. Larvae*, suppl., : 25(L.).

Diagnostic characters : Apical pale band of palpi nearly equal to the pre apical dark band Wing with 4 or more dark spots on costa, involving costa and vein R, Dark and inner costa interrupted speckling in legs present; hind tarsomeres 5, 4 and 3 completely pale.

Distribution : In India the distribution restricted to Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Maharashtra, Meghalaya, Orissa and West Bengal.

Remarks : Breeds in rainwater pools, tanks and swamps. Adults rest in houses and cattle sheds. Reported from Orissa coastal plains.

16. ***Anopheles (Cellia) splendidus*** Koidzumi*

1920. *Anopheles splendidus* Koidzumi, *Daiwan. Kenkyujo Hokoku*, **8** : 23.

Diagnostic characters : Apical pale band of palpi nearly equal to the sub apical pale band; more than 3 Pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs are present; Hind tarsomeres 5, 4 and 3 completely pale.

Material examined : 2 exs. (F), Giqala, Puri Distt., 24.iii.2007 Coll. : S. Dash; 1 ex (F) from Chhedapadar, Khurda Dist., 28.iii. 2007, Coll. : S. Dash.

Distribution : In the south eastern parts of India

Remarks : Breeds in riverbed pool, slow-moving stream, human dwelling, cattle shed. Recorded from the coastal and southern hills of Orissa.

17. ***Anopheles(Cellia) subpictus*** Grassi*

1899. *Anopheles subpictus* Grassi,. *Rc. R. Accad. Lincei,* **8** : 101.

Diagnostic characters : Apical pale band nearly equal to the preapical dark band; more than 3 pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs are absent; Hind leg tarsomeres 5,4, and 3 are dark; Band on foreleg tarsomeres are broad.

Material Examined : 25 exs (F) Chhedapadar, Bidharpur, Totapada, Pratap, Balugaon, Tangi of Khurda Distt. 24.i.2006 Coll. : S. Dash; 37 exs. (F) Alipada, Giqala, Sipakuda, Beleswarpatna, Altunga of Puri Distt., 25- 27.i. 2006, Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : Breeds in stagnant waters, clear or turbid waters, water with or without vegetation, shaded or slightly shaded places, wells, burrow pits, channels, lake margins, ponds, tanks, ground pools, fallow and freshly flooded rice fields, cement cisterns, tree-holes, fresh or brackish waters.Recorded all over Orissa.

18. ***Anopheles (Cellia) sergentii*** (Theobald)

1907. *Pyretophorus sergentii* Theobald, *Monogr. Cul.*, **4** : 68.

Diagnostic characters : Apical pale band nearly equal to the pre-apical dark band of palpi; pre-apical dark band ¼ or 1/5 of the apical pale band; wing with 4 or more dark spots on costa, presence of fringe spot on vein 3 (R4 + 5)nvolving costa and vein R; speckling in legs absent; hind tarsomeres 5, 4 and 3 are dark; bands on fore tarsomeres absent.

Distribution : In India, recorded from Jabalpur (Madhya Pradesh) and Koraput (Orissa).

Remarks : Rests in human dwellings and cattle sheds but sometimes in underground aqueducts.

19. ***Anopheles (Cellia) tessellates*** Theobald

1901. *Anopheles tessellates* Theobald, *Monogr. Cul.*, **1** : 175.

Diagnostic characters : Wing with 4 or more dark spots on costa, involving costa and vein R, speckling in legs present; Narrow banding in hind tarsomeres.

Distribution : In India, recorded from Andaman and Nicobar Islands, Andhra Pradesh., Assam, Bihar, Goa, Gujurat, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh., Uttarakhand, West Bengal.

Remarks : Reported all over Orissa, Occurring in mixed dwellings, cattle sheds and outdoors, rest particularly on the lower part of the walls.

20. ***Anopheles (Cellia) theobaldi*** Giles*

1901. *Anopheles theobaldi* Giles, *Entomologist's. Mon. mag.*, **37** : 198.

Diagnostic characters : More than 4 pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs are present; Apical pale band of palpi nearly equal to the sub apical pale band; Hind tarsomeres only 5 and part of 4 pale; The dark band at 4^{th} tarsomere of hind leg is absent.

Material Examined : 3 exs. (F) from Sipakuda, Altunga, Puri Distt., 24.i.2006, Coll. : S. Dash; 3 exs. (F) from Chhedapadar, Bidharpur, Pratap, Khurda Distt., 27.i.2006. Coll : S. Dash.

Distribution : Found all over India but concentrated mainly in central and western part of peninsula.

Remarks : Forest species and basically a stream breeder, also breeds in ponds, tanks, rice fields and riverbed pools. Reporeted all over Orissa.

21. ***Anopheles (Cellia) vagus*** Donitz*

1902. *Anopheles vagus* Donitz. *Z. Hyg. Infektkrankh.*, **41** : 80.

Diagnostic characters : Pre-apical dark band ¼ or $^1/_5$ of the apical pale band of palpi.; more than 3 pale area on costa and subcosta including vein 1 (R1); speckling in fore and hind legs are absent; Hind tarsomeres 5, 4, and 3 are dark; Band on fore tarsomeres are broad.

Material Examined : 10 exs. (F) from Chhedapadar, Bidharpur, Totapada, Pratap, Balugaon, Tangi of Khurda Distt. 24.i.2006 and 25.ii.2007 Coll. : S. Dash; 20 exs. (F) Alipada, Giqala, Sipakuda, Beleswarpatna, Altunga of Puri Distt., 27.i.2006, Coll. : S. Dash.

Distribution : In India, found throughout the country except Delhi, Himachal Pradesh, and Punjab.

Remarks : Adults rest indoors in cattle sheds and mixed dwellings. Cattle sheds are regarded more attractive. However, outdoor resting is limited. Reported from all over Orissa.

22. ***Anopheles (Cellia) varuna*** Iyengar*

1924. *Anopheles varuna* Iyengar, *Indian J. med. Res.*, **12** : 24.

Diagnostic characters : Proboscis generally dark, sometime half of it is yellow; apical and sub-apical pale band equal and separated by same sized dark band intervening dark band of palpi; more than 4 Pale area on costa and subcosta including vein 1 (R1); inner costa of wing is dark; fringe spot absent on vein 6 (Anal); vein 5.1 (Cu 1) with two dark areas;speckling in fore and hind legs are absent; Hind tarsomeres 5, 4, and 3 are dark; Tip of hind tarsomere and bands on legs are black.

Material Examined : 2 exs. (F) from Altunga, Puri Distt. 24.i.2006 Coll. : S. Dash. : 1ex (F) from Tangi, Khurda Distt., 27.i.2006 Coll : S. Dash.

Distribution : Distributed all over India including Andaman Islands, Lakshadweep, except Himachal Pradesh, Haryana, Jammu and Kashmir. Punjab, Rajsthan.

Remarks : Breeds profusely in freshwater tanks, ponds, rice fields, drains, irrigation channels, wells etc., with algal and other aquatic vegetation. Reported from Jeypore hills, Orissa.

Subfamily TOXORHYNCHITINAE

Genus ***Toxorhynchites*** Theobald

Sugenus ***Toxorhynchites*** Theobald

23. ***Toxorhynchites (Toxorhynchites) splendens*** (Wiedemann)

1819. *Culex splendens* Wiedemann, *Zool. Mag. keil*, **1** : 2.

Diagnostic characters : A small dark brown species with bright blue scales on head and pleurae, a line of flat scales in front of wing, and lateral pale spots on abdomen. Wing about 1.6 mm.

Distribution : Cosmopolitan.

Remarks : Breeds in tree holes, bamboo, and fallen log. Recorded through out Orissa.

Genus ***Aedes*** Meigen

Subgenus ***Aedimorphus*** Theobald

24. ***Aedes (Aedimorphus) caecus*** (Theobald)

1901. *Culex caecus* Theobald, *Monogr. Cul.*, **1** : 413.

Diagnostic Characters : Anterior surface of mid-femur dark brown, without speckling of pale scales.

Distribution : In northern coastal area of Orissa, Andaman Island and West Bengal.

Remarks : It breeds in Ground pool, earthen pots etc. Reported from Bhiterkanika, Orissa.

Subgenus ***Cancraedes*** Edwards

25. ***Aedes (Cancraedes) cancricomes*** Edwards

1922. *Aedes (Cancraedes) cancricomes* Edwards, *Indian J. med. Res.*, **10** : 272.

Diagnostic Characters : Scutellar scales all flat; abdomen with lateral basal creamy-white triangular patches on II-VII.

Distribution : In India Andhra Pradesh, Orissa and Andaman Island.

Remarks : It breeds in tree holes, crab holes, swamp pool.Reported from Bhitterkanika, Orissa.

Subgenus ***Diceromyia*** Theobald

26. ***Aedes (Diceromyia) iyengari*** Edwards

1923. *Aedes (D) iyengari* Edwards, *Bull. ent. Res.*, **14** : 4.

Diagnostic Characters : Head with white stripe either side of middle line; abdomen with some round white admedian spots on dorsum.

Distribution : Found throughout India.

Remarks : It breeds in tree holes, rock pool etc. Reported from Bhiterkanika coastal area of Orissa.

Subgenus ***Stegomyia*** Theobald

27. ***Aedes (Stegomyia) albopictus*** (Skuse)*

1895. *Culex albopictus* Skuse, *Indian Mus. Notes*, (1894) **3** : 20.

Diagnostic characters : Black species, with snow-white markings and white basal bands on tarsi, palpi, a narrow silvery-white median line running nearly whole length of mesonotum, scutellar scales flat and snow-white on all lobes, wide white tarsal bands on 4th hind tarsal segment, line of flat silvery scales on border of mesonotum in front of wing root, white scales on pleurae in irregular patches, white transverse bands on abdomen at bases of segment.

Material examined : 6 exs. (F), Beleswarpatna, Altunga, Puri Dist., 2.iii.2007, Coll. : S. Dash; Bidharpur and Pratap, Khurda Distt:, 25.ii.2007, Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : It breeds in tree holes, bamboo, leaf axils. Only rarely in artificial receptacles or rock-pools. Recorded widely from all parts of Orissa.

28. ***Aedes (Stegomyia) imitator*** (Leicester)

1908. *Stegomyia imitator* Leicester, *Cul. Malaya*, **1** : 89.

Diagnostic characters : Palpi slender, upturned, without distinct hair-tufts; black species, with conspicuous snow-white ornamentation. mesonotum with several white patches; mid-femur with a median white spot on anterior surface.

Distribution : Found throughout India.

Remarks : It breeds in tree hole, bamboo, forest floor etc. Recorded widely throughout the country.

29. ***Aedes (Stegomyia) novalbopictus*** Barraud

1931. *Aedes (Stegomyia) novalbopictus* Barraud, *Indian. J. med. Res.*, **19** : 224.

Diagnostic characters : Palpi slender, upturned, without distinct hair-tufts; black species, with conspicuous snow-white ornamentation. Abdomen with silvery basal bands on dorsum.

Distribution : Found throughout India.

Remarks : It breeds in tree holes, bamboo, human landing.Reported from almost all states of India.

30. ***Aedes (Stegomyia) vittatus*** (Bigot)*

1861. *Culex vittatus* Bigot, *Annls. Soc. ent. Fr.* (4), **1** : 227.

Diagnostic characters : Black species, with snow-white markings; proboscis with scattered yellow scaling ;mesonotum marked with 4-6 small white spots; femora with preapical white rings, and white basal bands on tarsi, all tibiae with white rings.

Material examined : 10 exx. (F), Alipada, Giqala, Beleswarpatna, Puri Dist., 10.vi.2007, Coll. : S. Dash; Tangi, Khurda Distt., 08.vi.2007, Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : It breeds in tree hole, bamboo, leaf axils. Rock pools etc. Recorded through out the coastal belt of Orissa.

31. ***Aedes (Stegomyia) w-albus*** (Theobald)

1905. *Stegomyia w-albus* (Theobald) *Annl. hist. nat. Mus. natn. hung.*, **3** : 74.

Diagnostic characters : Palpi slender, upturned, without distinct hair-tufts; black species, with conspicuous snow-white ornamentation ; mesonotum with several white patches; mid-tarsi with a median white spot on anterior surface;.

Distribution : Found throughout India.

Remarks : Breeds in tree hole, bamboo, forest floor etc. Reported widely throughout the country.

Genus ***Aedeomyia*** Theobald

Sub genus ***Aedeomyia*** Theobald*

1901. *Aedeomyia* Theobald, Mono.Cul. ii, p. 218.

Diagnostic characters : The material has been identified only till genus level. It is a small mosquito with comparatively short legs, ornamented with a dense covering of white, black and yellow scales, tufts of suberect scales at tip and hind femora.

Material examined : 3 females (adult) Balugaon, Distt. Khurda, 07.vi.07, Coll : S. Dash,

Distribution : Found throughout India.

Remark : Breeds in Pond with vegetation, Canal with algae.

Genus ***Armigeres*** Theobald

Sub Genus ***Armigeres*** Theobald

32. ***Armigeres (Armigeres) subalbatus*** (Coquilett)*

1898. *Armigeres subalbatus* (Coquilett), *Proc. U.S. Nat. Mus.*, xxi, p. 302.

Diagnostic characters : Palpi of female about 1/2 length of proboscis; pale margin of Mesonotum usually yellowish; Abdominal sternites III-VI with wide apical black bands.

Material Examined : 7 exs. (F), Kushbhadra Muhan, Puri Distt., 23.i.2006, Coll. : S. Dash.

Distribution : Through out India including Andaman Islands.

Remarks : Resting on vegetations, coconut shell, bamboo, septic tank. Recorded from all over Orissa.

33. ***Armigeres (Armigeres)*** theobaldi*

1934. *Armigeres theobaldi* Barraud, *Fauna Br. India*, Dipt., **5** : 319 (n.name for *apicalis* Theobald).

Diagnostic characters : Abdominal tergites with median apical yellow markings; lateral white patches, not visible dorsally; venter white scaled.

Material examined : 10 exs. (F) collected from Giqala, Puri Distt., 24.i.2006 Coll. : S. Dash.

Distribution : In India it is restricted only to Orissa.

Remarks : It breeds in bamboo stalk. Recorded all over Orissa.

Genus ***Culex*** Linnaeus

Sub-Genus ***Culex*** Linnaeus

34. ***Culex (Culex) bitaeniorhynchus*** Giles

1901. *Culex bitaeniorhynchus* Giles, *J. Bombay nat. Hist. Soc.*,**13** : 607.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; wings speckled with scales, which are usually numerous.

Distribution : Found throughout India.

Remarks : Breeds in Irrigation canal, ponds, ground pool, paddy field, slow-moving stream with algae. Recorded from all over Orissa especially from Bhitarkanika and Jeypore Hills.

35. ***Culex (Culex) cornutus*** Edwards

1922. *Culex cornutus* Edwards, *Indian. J. med. Res.*, **10** : 283.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; abdominal tergites with distinct apical pale markings.

Distribution : Found throughout India.

Remarks : The adults rest on the vegetations. Recorded from all over Orissa especially from Jeypore Hills.

36. ***Culex (Culex) fuscocephalus*** Theobald

1906. *Culex fuscocephalus* Theobald, *Monogr. Cul.*, **4** : 420.

Diagnostic characters : Proboscis without pale ring; tarsi entirely dark; lower mesepimeral bristle present. Abdomen unbanded.

Distribution : Found throughout India.

Remarks : Breeds in ground pool and Paddy field. Adults rest in human dwelling, landing on human and cattle. Recorded from all over Orissa especially from Bhitarkanika and Jeypore Hills.

37. ***Culex (Culex) gelidus*** Theobald

1901. *Culex gelidus* Theobald, *Monogr. Cul.*, **2** : 20.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; wings without unusually broad scales; tibiae not lined.

Distribution : Found throughout India.

Remarks : Breeds mainly in ground pools, having much weeds, marshy tracks, cement tanks. Adults rest mainly in cow sheds. Recorded from all over Orissa.

38. ***Culex (Culex) mimulus*** Edwards

1915. *Culex mimulus* Edwards, *Bull. ent. Res.*, **5** : 284.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; wings with three pale spots on costa (including one at tip); pale spot at middle of wing usually extending over vein1.

Distribution : All over India, mainly concentrated in Uttar Pradesh, Uttarakhand and Assam.

Remarks : Breeds in rainwater pool, ponds, stream, and riverbed pool with algae. Adults rest on vegetation. Recorded from all over Orissa, especially from Jeypore Hills.

39. ***Culex (Culex) quiquefasciatus*** Say*

1823. *Culex quiquefasciatus* Say *J. Acad, nat. Sci. Philad.*, **3** : 10.

Diagnostic characters : Integument of thoracic pleuron without dark stripe; scutal integument yellowish or pale brown.

Material Examined : 50 exs (F) collected from Balugaon, Totapada Khurda Distt., 27.i.2007, Coll. : S. Dash.

Distribution : Cosmopolitan in Distribution.

Remarks : Commonly occurring throughout Orissa mostly found in human dwelling, cattle sheds.

40. ***Culex (Culex) sinensis*** Theobald

1903. *Culex sininsis* Theobald, *Monogr. Cul.*, **3** : 180.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; abdominal tergites apically banded; mesonotal scales pale ochreous.

Distribution : Cosmopolitan in Distribution.

Remarks : Inhabiting the pond bank. Common in Coastal Orissa.

41. ***Culex (Culex) sitiens*** Wiedemann

1828. *Culex sitiens* Wiedemann *Aussereurop Zweifl. Insekt*, **1** : 542.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; femora speckled with pale scales, especially anterior surface of mid-femur.

Distribution : Cosmopolitan in Distribution.

Remarks : Breeds in swamp pool, Coir retting pit. Adults rest in vegetation, Crab hole. Common in coastal areas of Orissa.

42. ***Culex (Culec) tritaeniorhynchus*** Giles

1901. *Culex tritaeniorhynchus* Giles, *J. Bombay nat. Hist. Soc.*, **13** : 606.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; mesonotal scales uniformly dark brown.

Distribution : Cosmopolitan in Distribution.

Remarks : Breeds in irrigation canal, pond, ground pool, paddy fields. Commonly found throughout Orissa.

43. ***Culex (Culex) vishnui*** Theobald*

1901. *Culex vishnui* Theobald, *Monogr. Cul.*, **1** : 355.

Diagnostic characters : Very common small brown mosquito, with a pale band on the proboscis. Mesonotum with light and dark scales mixed in varying proportions, sometimes forming an indefinite pattern, but at least with light scales round front margin.

Material Examined : 11 exs. (Females) collected from Balugaon, Khurda Distt., 28.i.2006 and 19.i.2006 Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : It breeds in ground pools, rice fields, salt marshes etc. Recorded from rice fields, ponds and cement tanks in many localities of Orissa.

44. ***Culex (Culex) whitei*** Barraud

1923. *Culex whitei* Barraud, Indian. *J. med. Res.*, **11** : 508.

Diagnostic characters : Very common small brown mosquito, with a pale band on the proboscis. Mesonotum with light and dark scales mixed in varying proportions, sometimes forming an indefinite pattern, but at least with light scales round front margin.

Distribution : It is mainly found in the north-eastern region of India though it is cosmopolitan in habit.

Remarks : It breeds in ground pools. Recorded From shorelines of Orissa.

45. ***Culex (Culex) whitmorei*** (Giles)

1904. *Taeniorhynchus whitmorei* Giles *J. trop. Med.*, **7** : 367.

Diagnostic characters : Proboscis and tarsi with pale rings (tarsal rings sometimes faint); no lower mesepimeral bristle; wings with broad scales on veins 1.3, and 5; mid an hind tibiae with pale lines.

Distribution : In India, occurs in all main lands.

Remarks : It breeds in ground pool, cement tank. Adults rested in vegetation. Recorded mainly from hilly areas of Orissa.

Genus ***Ficalbia*** Theobald

Subgenus ***Ficalbia***

46. ***Ficalbia (Ficalbia) minima*** (Theobald)

1901. *Uranotaenia minima* Theobald, *Monogr. Cul.*, **2** : 262.

Diagnostic characters : Tarsi with narrow pale rings, most distinct on hind legs; dorsum of abdomen with transverse pale bands.

Distribution : In India recorded from West Bengal, Orissa, Assam, North-eastern states and Kerala.

Remarks : Breeds in irrigation canal, pond with floating vegetation. Resting in pond bank, vegetation. Recorded from the coastal parts of Orissa.

Genus ***Coquilletidia*** Dyar

Subgenus ***Coquilletidia*** Dyar*

1905. *Coquilletidia* Dyar, *Proc. ent. Soc. Wash.*, **7** : 47.

Diagnostic characters : These are yellowish brown mosquitoes of moderate size. The general structure is very much as in *Aedes* but there are no post spiracular bristles. Distinct from *Culex* in absence of pulvilli, wing-scales narrow and lanceolate, pleurae with only a few small patches of scales.

Materials examined : 3 exs. (F), Pratap, Totapada Distt. Khurda, 08.vi.2007, Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : Rests on the floating vegetation in pond. Found in the coastal region of Orissa. Found all over Orissa.

Genus ***Heizmannia*** Ludlow

Subgenus ***Heizmannia*** Edwards

47. ***Heizmannia (Heizmannia) chandi*** Edwards

1922. *Heizmannia (H) chandi* Edwards, *Indian. J. med. Res.*, **10** : 291.

Diagnostic characters : Postnotum having small bunch of hairs; outstanding plume-scales on veins 2.1 and 2.2 linear.

Distribution : In India it occurs only in type locality (Bhiterkanika and Singhbhum, Orissa).

Remark : Breeds in tree hole and bamboo.Endemic species from Orissa.

Genus ***Mansonia*** Blanchard

Subgenus ***Mansonioides*** Theobald

48. ***Mansonia (Manasonioides) annulifera*** (Theobald)*

1901. *Panoplites annulifera* Theobald, *Monogr. Cul.*, **2** : 183.

Diagnostic characters : Mesonotum marked with distinct round spots of white scales, Yellowish brown; mesonotum marked with 4 (or more) distinct round white spots; rather broad white scales on mid-lobe of scutellum; Abdomen : lateral chitinous hooks on tergite VIII widely and evenly spaced, much as in *indiana*, but less curved.

Material examined : 12 exs. (F) collected from Alipada, Giqala, Sipakuda, Beleswarpatna, Puri Dist. : 08.vi.07 Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : Breeds in irrigation canal Pond with floating vegetation, Light trap, and human landing. Found all over Orissa.

49. ***Mansonia (Manasonioides) dives*** (Scheiner)*

1881. *Culex longipalpis* van der Wulp, *Bijd. Fauna Mid Sumatra, Dipt.*, **4** : 9.

Diagnostic characters : Mesonotum not having so much distinct spots, Brownish-black; mesonotum marked with 2 (or 3) round white spots; scales on mid-lobe of scutellum narrow. Abdomen : Chitinous hooks on tergite VIII much as in *M. uniformis*, bur there is a more pronounced gap between the lateral and median series.

Material examined : 12 exs. (F) collected from Alipada, Sipakuda, Puri Dist.; 09.vi.2007, Coll. : S. Dash.

Distribution : Distributed throughout North-East India.

Remarks : Found in human settlements and houses. Reported from coastal Orissa.

50. ***Mansonia (Manasonioides) indiana*** Edwards*

1930. *Mansonia (Man.) indiana* Edwards, *Bull. ent. Res.*, **21** : 541.

Diagnostic characters : Mesonotum not having so much distinct spots; Mesonotum dark brown, not marked with greenish stripes; some white scales, tending to form indistinct spots or patches, in some specimens; Abdomen : Chitinous hooks on tergite VIII of female widely spaced and curved, without a definite gap between these and the median teeth.

Material examined : 10 exs (F) collected from Sipakuda, Puri Dist.,11.vi.2007, Coll. : S. Dash; Totapada, Khurda Dist., 08.vi.2007, Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : Habitated mostly in human dwelling areas. Reported from coastal Orissa.

51. ***Mansonia (Manasonioides) uniformis*** (Theobald)*

1901. *Panoplites uniformis* Theobald, *Monogr. Cul.*, **2** : 180.

Diagnostic characters : Mesonotum not having so much distinct spots; Mesonotum marked with a pair of sublateral greenish stripes on a brown ground; markings on tarsi as in annulifera but with yellowish tinge not snow-white; Abdomen : Lateral chitinous hooks on tergite VIII curved and slightly separated from median series.

Material examined : 7 exs. (F) collected from Alipada, Giqala, Sipakuda, Beleswarpatna, Altunga Puri Dist. 11.vi.2007, Coll. : S. Dash; Totapada, Tangi, Khurda Dist., 08.vi.2007, Coll. : S. Dash.

Distribution : Found throughout India.

Remarks : Breeds in irrigation canal, pond with vegetation, Cattle shed, human dwelling. Recorded all over Orissa.

Genus ***Ochlerotatus*** Lynch Arribalzaga

Subgenus ***Finalaya*** Theobald

52. ***Ochlerotatus (Finalaya) niveus*** (Ludlow)

1903. *Stegomyia niveus* Ludlow, *Monogr. Cul.*, **3** : 139.

Diagnostic characters : Segment VIII narrow and completely retractile; cerci long and narrow and projecting from ring of segment VII; one or two lower mesepimeral bristles usually present.

Distribution : In Eastern India, Andaman Island.

Remarks : Breeds in tree holes and found mostly in human dwelling. Recorded from Coastal Orissa.

Sub genus ***Rhinoskusea*** Edwards

53. ***Ochlerotatus (Rhinoskusea) longirostris*** (Leicester)

1908. *Ficalbia longirostris* Leicester, *Cul. Malaya*, : 228.

Diagnostic characters : Segment VIII narrow and completely retractile; cerci long and narrow and projecting from ring of segment VII; one or two lower mesepimeral bristles usually present.

Distribution : Andaman Island.

Remarks : Resting in Crab holes. Recorded from Coastal Orissa.

54. ***Ochlerotatus(Rhinoskusea) portonovoensis*** Tewari and Hiriyan

1996. *Ochlerotatus (Rhinoskusea) portonovoensis* Tewari and Hiriyan, *J. Am. Mosq. Control Assoc.*, **12** : 720.

Diagnostic characters : Segment VIII narrow and completely retractile; cerci long and narrow and projecting from ring of segment VII; one or two lower mesepimeral bristles usually present.

Distribution : North Eastern India.

Remarks : Crab holes, swamp pool, tree holes. Recorded from Coastal Orissa.

Genus ***Uranotaenia*** Lynch Arribalzaga

Subgenus ***Pseudoficalbia*** Theobald

55. ***Uranotaenia (Pseudoficalbia) atra*** Theobald

1905. *Uranotaenia atra* Theobald, *Ann. Mus. Nat. Hung.*, iii, p. 114.

Diagnostic characters : Hind tarsi entirely dark; lateral apical markings on abdominal tergites, no median pale markings on dorsum.

Distribution : In mainland of India as well as in Andaman Island.

Remarks : Breeds in ground pool, crab holes and root base. Recorded from Coastal Orissa.

DISCUSSION

The present study deals with 55 species of mosquitoes under 12 genera reported from coastal Orissa. Out of which over 2000 specimens belonging to 22 species under 6 genera were actually collected and studied from twelve villages of Puri and Khurda Districts of Orissa. The study proved the dominance of Culicine mosquito species (65.59%). in the coastal districts of Orissa Rao (1984) remarked that among the Indian *Anopheline* fauna, *Anopheles subpictus* Grassi complex is predominant along the coast. The present studies also proved the dominance of *Anopheles subpictus*, comprising 22.73% of all mosquito population studied and about 65.6% of the over all Anophelines fauna. The second species *Anopheles vagus* is dominated by 10.03%. The species of *C. quinquefasciatus* Say and the *C. vishnui* Theobald group are the common *Culicines* comprising 17.55% and 10.03% respectively. The species of *Armegeres* group are also equally prevalent as the Genus *Culex*.

The other species recorded in this study are *Anopheles maculates, Anopheles splendidus, Anopheles theobaldi, Anopheles acconitus, Anopheles nigerimus, Armegeres subalbatus, Manasonia annulifera, Manasonia indiana, Manasonia longipalpis, Mansonia uniformis, Aedes vittatus, Aedes albopictus, Coquillettidia*. The district wise species composition of *Mansonioides* shows that it (which species) is dominant in coastal areas like Puri district (Hazra and Dash, 1998). Although *M. uniformis, M. annulifera and M. indiana* have been found through out the districts but *M. longipalpis* is exclusively found in coastal belts. Diversity of mosquito fauna of Puri and Khurda Districts of Orissa are shown in Table-1 and 2 respectively.

To measure the species diversity of the mosquito species of the two districts, Shanon diversity index has been used. The shanon diversity index (H) is the index that is commonly used to characterize species diversity in a community (Stiling, 2002).

Hs= Pi ln Pi.

Pi- Total number of species

ln- Log in

The value of Shanons index has been depicted in the table-3. The value of Shanon diversity index for real communities is often found to fall between 1.5 and 3.5 (Stiling, 2002). From the present investigation it is clear that the mosquito species diversity (H) in the Khurda District was significantly higher than the diversity in the mosquito community of Puri District (Fig. 10).

The TMHD (Per Ten men hour Density) for both the districts, mosquito species has been calculated and is summarized in Table-3. The present findings show highest value for *Anopheles subpictus* (46.87) followed by the *Armigeres (A) subalbatus* (36.25) (Fig.11).

The well recognized malaria vectors *Anopheles culcifacies, An. annularis* are represented by less than 1%. The *Anopheles culcifacies* and *An. annularis* represent 0.15% and 0.3% respectively in the total sample. The species of *Man. indiana* and *Man. longipalpis* have not been reported earlier but are now recorded from the areas of Chilika Lake.

Filarial vector diversity of the coastal districts is very low than that of the diversity of culicine mosquitoes (Hazra and Dash, 1998) but the recent study shows the increase in diversity of filarial vector in the same districts. The low rate of diversity has been shown by Shanons index in Puri District. Seven *Anopheles* species e.g. *An. barbirostris, An. fluviatilis, An. jamesii,*

Table-1 : Diversity of mosquito fauna of Puri District (2006-07).

Sl. No.	Species	No.	Percentage
1.	*An aconitus*	3	0.28%
	An annularis	4	0.38%
	An culcifafacies	0	0
	An maculates	1	0.09%
	An nigerimus	2	0.18%
	An splendidus	0	0
	An subpictus	197	18.86%
	An theobaldi	3	0.28%
	An vagus	92	8.81%
	An varuna	1	0.09%
2.	*Cx. quinquefasciatus*	184	17.62%
	Cx. vishnui gp.	124	11.87%
3.	*Am. subalbatus*	176	16.85%
	Am. Theobaldi	63	6.03%
4.	*Mn. annulifera*	46	4.4%
	Mn. indiana	5	0.47%
	Mn. longipalpis	3	0.28%
	Mn. Uniformis	81	7.75%
5.	*Ad. Aedeimyia*	0	0
	Ad. albopictus	3	0.28%
	Ad. Vitattus	56	5.36%
6.	*Coquillettidia*	0	0
	Total	1044	

An. jeyporiensis, An. karwari, An. philippinensis, An. sundaicus found in the previous studies (Covell and Singh, 1942) are not found during the present study. The disappearance of the species *An. sundaicus* also detected during the Chilika fauna study by Dash *et al.* (2000).

The changes in mosquito fauna observed from the Orissa coastal area and Chilika lake may be associated with the major ecological changes, extensive use of insecticides and development in agricultural practices, industrial development, natural calamities like severe cyclones, after effects of tsunami etc.

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The author is grateful to the Director, Zoological Survey of India, Kolkata and officer-in-charge, EBRC, Gopalpur-on-sea (GM) for providing facilities. I am also thankful to Director, RMRC, ICMR, Bhubaneswar for providing library facilities.

Table-2 : Diversity of mosquito fauna of Khurda District (2006-07).

Sl. No.	Species	No.	Percentage
1.	*An. aconitus*	3	0.31%
	An. annularis	2	0.21%
	An. culcifafacies	3	0.31%
	An. maculates	2	0.21%
	An. nigerimus	4	0.41%
	An. splendidus	3	0.31%
	An. subpictus	253	26.63%
	An. theobaldi	3	0.31%
	An. vagus	108	11.36%
	An. varuna	2	0.21%
2.	*Cx. quinquefasciatus*	166	17.47%
	Cx. vishnui gp.	76	8.00%
3.	*Am. subalbatus*	172	18.10%
	Am. Theobaldi	69	7.26%
4.	*Mn. annulifera*	2	0.21%
	Mn. indiana	10	1.05%
	Mn. longipalpis	0	0
	Mn. Uniformis	19	2.00%
5.	*Ad. aedeimyia*	3	0.31%
	Ad. albopictus	3	0.31%
	Ad. Vitattus	44	4.63%
6.	*Coquillettidia*	3	0.31%
	Total	950	

Table-3 : Per ten men hour density (TMHD) of the mosquitoes collected from the surroundings of Chilika Lake during 2006-07.

Sl. No.	Genus	Species	No.	TMHD
1.	*Anopheles*	***An. aconitus***	3	0.62
		An. annularis	3	0.62
		An. culcifafacies	3	0.31
		An. maculates	3	0.31
		An. nigerimus	6	0.62
		An. splendidus	3	0.31
		An. subpictus	450	46.87
		An. theobaldi	6	0.62
		An. vagus	200	20.83
		An. Varuna	3	0.31
2.	*Culex*	***Cx. quinquefasciatus***	350	36.45
		Cx. vishnui gp.	200	20.83
3.	*Armegeres*	***Am. subalbatus***	348	36.25
		Am. Theobaldi	132	13.75
4.	*Manasonia*	***Mn. uniformis***	100	10.41
		Mn. annulifera	48	1.56
		Mn. Indiana	15	5
		Mn. longipalpis	3	0.31
5.	*Aedomyia*		3	0.31
6.	*Aedes*	***Ad. albopictus***	6	0.31
		Ad. Vitattus	100	10.41
7.	*Coquilettidia*		3	0.31

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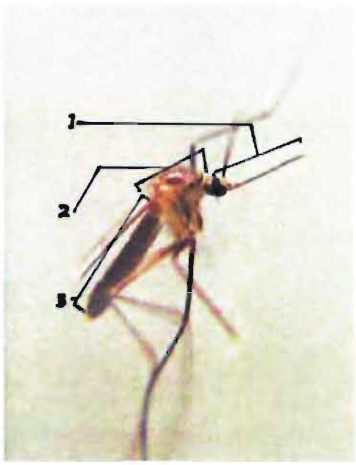

Fig. 2. An Adult Female Mosquito (1-Head, 2-Thorax, 3-Abdomen).

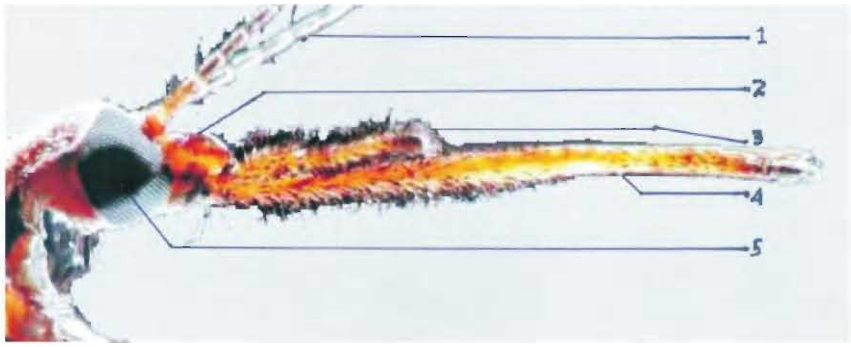

Fig. 3. Head of Adult Female Mosquito (1-Antennae, 2-Clyppeus, 3-Palps, 4-Proboscis, 5-Eye).

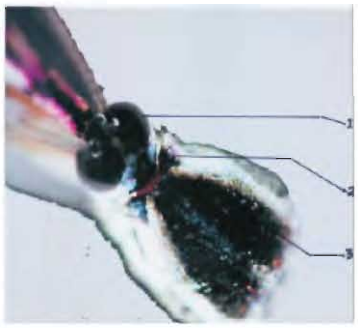

Fig. 4. Thorax of Adult Female Mosquito (1-Head, 2-Antepronotum, 3-Scutum).

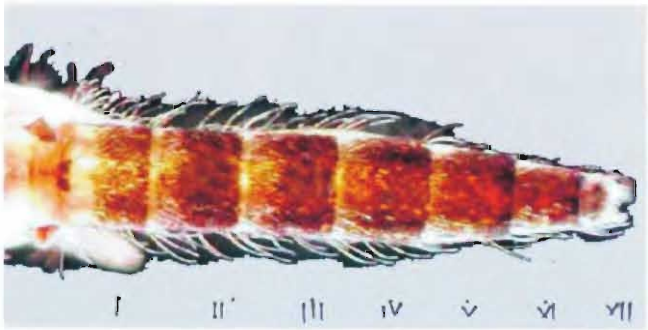

Fig. 5. Abdomen of Adult Female Mosquito.

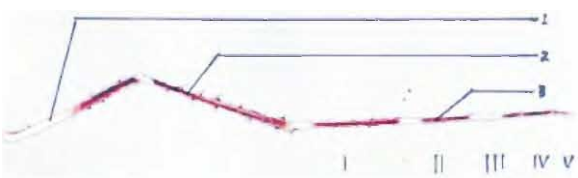

Fig. 6. Hind Leg of Adult Female Mosquito (1-Femur, 2-Tibia, 3-Tarsa).

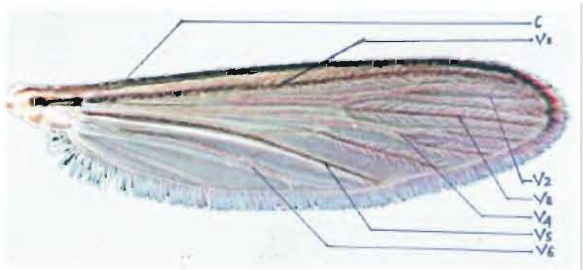

Fig. 7. Wing of Adult Female Mosquito (C-Costa, V-Vein).

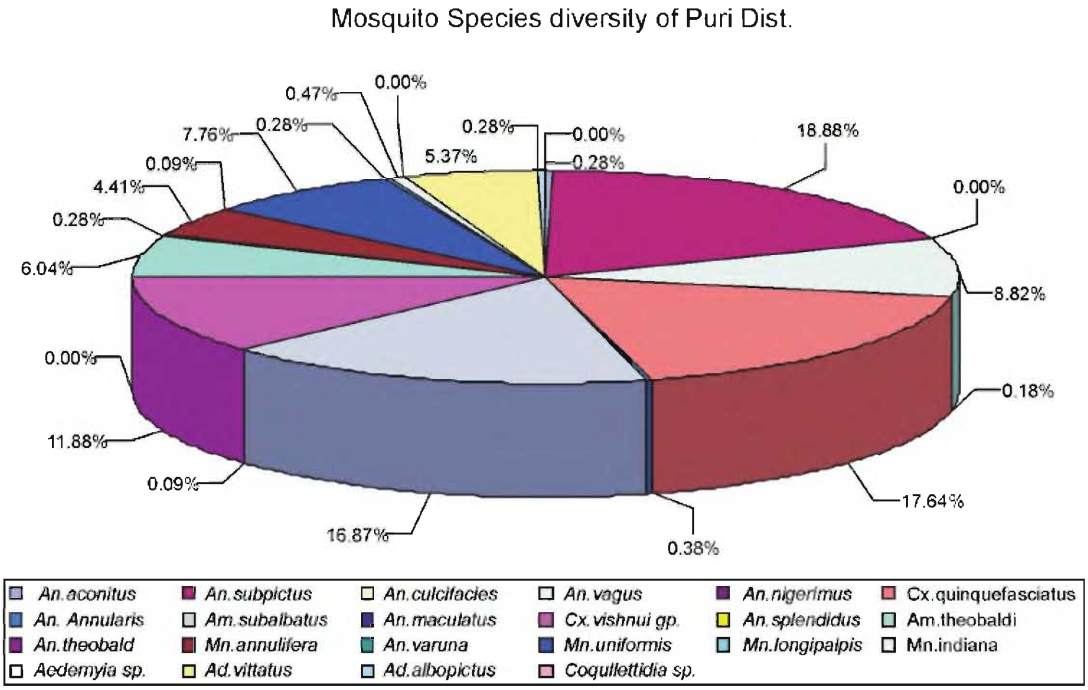

Fig. 8. Mosquito species Diversity of Puri District (2006-07).

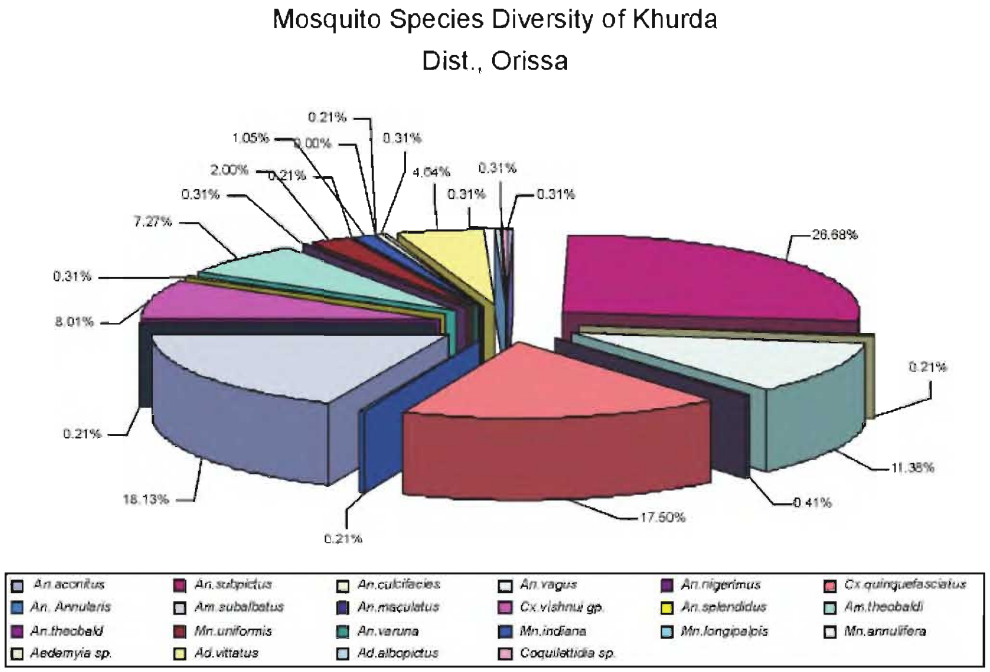

Fig. 9. Mosquito Species Diversity of Khurda District (2006-07).

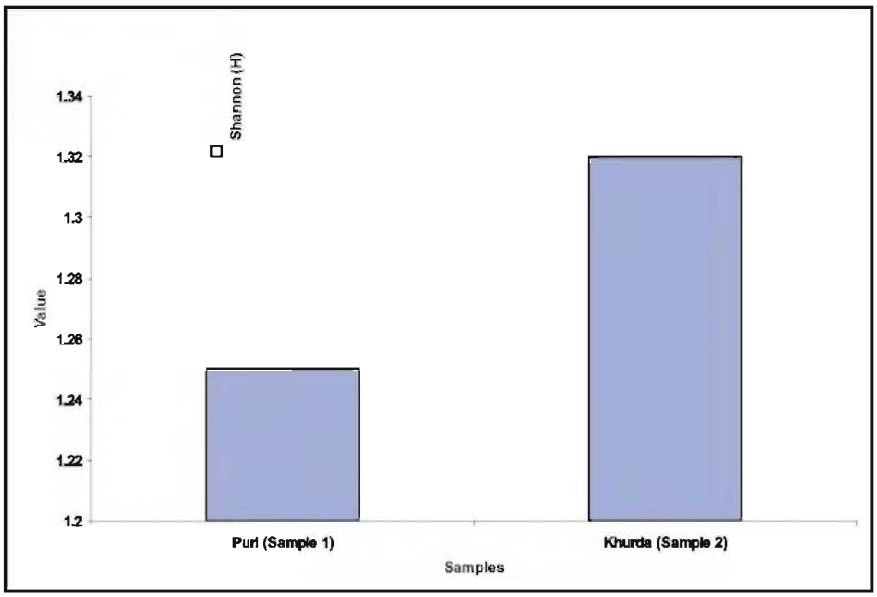

Fig. 10. Shannon mosquito species diversity in the Khurda and Puri districts of Orissa (2006-07).

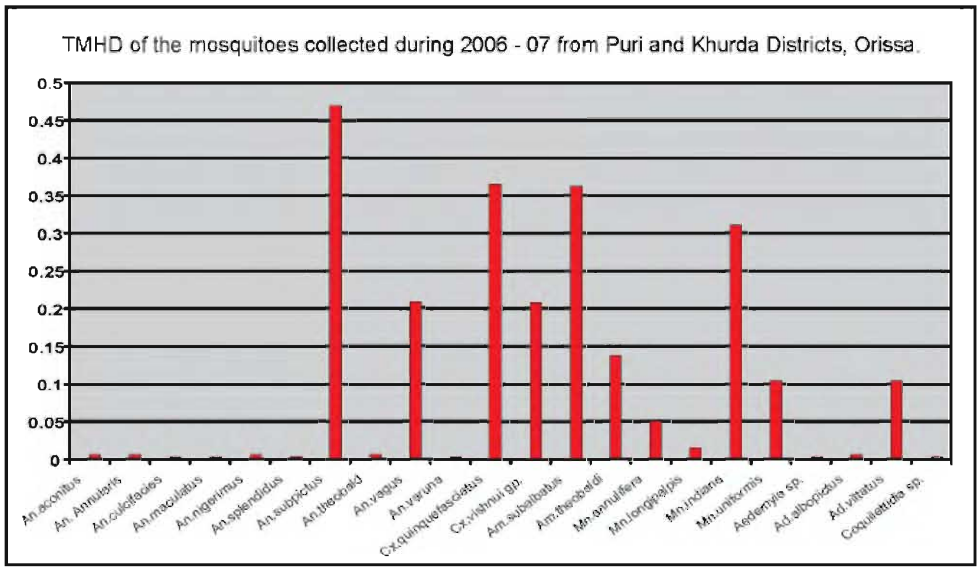

Fig. 11. Per Ten Men Hour Density of the mosquitoes collected from the surroundings of Chilika Lake (2006-07).

Rec. zool. Surv. India : **111**(Part–4) : 25-27, 2011

OBSERVATION OF JUNGLE CAT (*FELIS CHAUS*) AT TROPICAL FOREST RESEARCH INSTITUTE, CAMPUS, JABALPUR, MADHYA PRADESH

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While on a morning walk at Tropical Forest Research Institute, Campus, Jabalpur on 26th May, 2010 at about 7:00 am hours a wild cat crossed road in front of me. It suddenly jumped and disappeared in the near vicinity. The cat was chased in the nearby shrubs and the sheltered places but could not find again that day. Later, the jungle cat was regularly observed in the morning and evening hours within the TFRI campus often seen in search of prey. This cat was sighted for the first time in TFRI campus during my 4 years stay. It is not clear whether this cat was present in the TFRI campus earlier and could not be sighted or that it came from surrounding forest or protected areas recently. The wild cat was identified as jungle cat, *Felis chaus* Schreber.

Class MAMMAL

Family FELIDAE

Felis chaus Schreber, 1777, **Jungle Cat**

1777. *Felis chaus* Schreber, *Die Säugethiere*, **2**(13) : pl. 1101 B; text, **3**(24) : 414.

The Tropical Forests Research Institute's (TFRI) campus is situated on the bank of the Gour River on Mandla Road (79°59´23.50°E and 21°08´54.30°N) about 10 km south east of Jabalpur on NH-12A. The campus is spread over an area of 109 ha with various research laboratories/divisions, administrative building, scientists hostel and a guest house. The TFRI also has various experimental fields and forest nurseries amidst picturesque surroundings. The area enjoys semi-arid type of climate with mean annual precipitation of 1358 mm. The several species of shrubs and trees are either planted or naturally occur in the institute's campus area. The campus is surrounded by agricultural field with rural inhabitation. The water reservoir, poultry farm and the vegetation planted around the institute have created a very good habitat and source of attraction for number of faunal species like insects, amphibians, reptiles, birds and mammals.

The mammals are one of the most diverse and versatile class of the animal kingdom due to the highly developed brain (Primates). The cat family Felidae is an important family of the class mammal consisting of big cats like lion (*Panther leo persica*), tiger (*Panthera tigris*), leopard (*Panthera pardus*), cheetah (*Acinonyx jubatus*) and other small cats.

The jungle cat is widely observed around forest plantations and sugarcane fields that are scattered within their natural habitat in Tropical Asia (Tikader, 1983). From Madhya Pradesh the jungle cat has so far been reported from Narbada valley protected areas, Kanha National Park, Bandhvgarh National Park and Chhattishgarh (Sinha, 1977; Khajuria & Ghosal, 1981; Ghose & Bhattacharya, 1995; Kushwaha & Kumar, 1999 and Harshey and Chandra, 2002). The species of the jungle cat identified as *Felis chaus* is commonly called in different Indian languages as: in Hindi- Jungli Billi, Ban Bilao, Khattas; Bengali-Wab, Ban Beral; Tamil-Kadu Poona; Kannada-Bokana Kotti and in Marathi-Ran Manjar. Identification, classification and conservation status has been followed as per Alfred, *et al.* (2002 & 2006). Abbreviations used in the text are IWPA= Indian Wildlife Protection Act; CITES = Convention on International Trade of Endangered Species; CAMP and DD = Data Deficient.

Observation Localities : The movement of the jungle cat was mostly observed regularly in and around hostel, guest house, backside of the silviculture and extension divisions and in forest nurseries and experimental fields where human disturbance is least at TFRI campus from May 2010 to September, 2010.

Habit & Habitat : The activities of the jungle cat were observed whenever sighted in the TFRI Campus and in various sub-localities. The surrounding trees and grasses provided ideal hiding and shelter niches for the jungle cat while hunting. The cat sits near the trees or on deep slopes waiting and watch the birds and squirrels which are being preyed upon by the jungle cat as soon as they come closer and finally catch and kill the prey. Sometimes the jungle cat waits for long in their hiding places for the prey. On being disturbed they run inside the dense vegetation in the campus where they are not spotted easily.

Food : The most favourite food of the jungle cat at TFRI, Jabalpur was birds and rodents. The most preferred food was the most common birds species in and around the TFRI campus belonging to family Columbidae (Pigeon and doves) : *Columba livia* Gmelin, 1789 (Blue Rock Pigeon), *Streptopelia chinensis* Scopoli, 1786 (Spotted Dove), *Streptopelia tranquebarica* Hermann, 1804 (Red Collared-Dove), *Streptopelia decaocto* Frivaldszky, 1838 (Eurasian Collared-Dove), *Streptopelia senegalensis*, Linnaeus, 1766 (Little Brown Dove or laughing Dove) and other important bird family Phasianidae (Quail) : *Coturnix coturnix* Linnaeus, 1758 (Common Quail) and *Perdicula asiatica* Latham, 1790 (Jungle Bush Quail). The second most preferred food group of the jungle cat was *Funambulus pennanti* (Five Stripped Squirrel), a rodent belonging to family Sciuridae. The pigeons, doves, quails and squirrels often come on ground for feeding and this is the time they are easily preyed by the jungle cat.

Distribution : Throughout India. *Elsewhere* : Afghanistan, Algeria, Benin, China, Egypt, Iran, Iraq, Israel, Kenya, Malawi, Morocco, Mozambique, Myanmar, Nepal, Pakistan, Sri Lanka, Syria, Thailand, Vietnam, Yemen, Zambia Zimbabwe and Asia Minor to Transcaucasia and north along the west coast of the Caspian sea to the lower reaches of the Volga and east through Turkmenistan, Tadzhikistan, and Kazakhstan to Chinese Turkestan (Ogurlu *et al*., 2010).

Threats : The dog was major threat to jungle cat in TFRI Campus. It was observed that several times, whenever dog sighted jungle cat on road or in plantations or near the forest trees and shrubs. They were suddenly run towards jungle cat and chased long distance but dog never caught the jungle cat. The jungle cat was many times escaped and took shelter in dense vegetation to save from dog.

Conservation Status : Indian Wildlife Protection Act IWPA, Schedule-II, Part-II; CITES : Appendix-II; CAMP : LRnt (Nationally) and DD (Globally).

ACKNOWLEDGMENTS

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Ogurlu Idris, Gundogdu Ebubekir and Yildirim Ismet Ceyhun (2010) Population status of jungle cat (*Felis chaus*) in Egirdir lake, Turkey. *Journal of Environmental Biology*, **31** : 179-183.

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Fig. 1. Jungle Cat watching their preys in dense vegetation of TFRI, Campus, Jabalpur.

Rec. zool. Surv. India : **111**(Part–4) : 29-39, 2011

EUNICID POLYCHAETES (ANNELIDA) FROM GREAT NICOBAR ISLAND, INDIA : II. ORDER : EUNICIDA

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INTRODUCTION

Polychaetes collected from Great Nicobar Island (6°45´-7°15´ N lat. and 93°38´-93°55´ E long) shows a distinct distribution based on the kind of substrate like coral reefs, mangroves, sandy substrate and sea grass beds. The substrate plays an important role in determining the species composition of various habitats (Sanders, 1958). The nereids of Great Nicobar Island has been previously described (Rajasekaran & Fernando, 2009). The present paper describes representatives of the seven families namely Eunicidae, Lumbrinereidae, Arabellidae, Dorvilleidae, Oenonidae, Onuphidae and Hartmanniellidae. Eunicids occur in all benthic environments. In shallow temperate waters they are commonly encountered on rocky reefs, typical in such habitats as crevices and algal holdfasts. In the tropics they are especially common among dead corals. Many eunicids build robust parchment-like tubes which may have a complex branching shape, but other eunicid taxa, especially burrowers in soft sediments, do not construct permanent tubes. They are among the largest polychaetes and a number of species may exceed 1 m in length. As their large and complex jaws suggest, many species are carnivorous, although others apparently are omnivorous. Some species are sometimes referred to as "blood worms" for their well-developed parapodial branchiae that are often blood-red.

Great Nicobar Island has fairly rich polychaete fauna which shares with several other areas like the Gulf of Mannar, Lakshadweep, Andaman Islands and Gujarat coast which also have coral reefs (Kumaraswamy Achari, 1969; Soota, *et al.*, 1980; Soota *et al.*, 1981; Misra and Chakraborty 1983 & 1991). The rich diversity of polychaete fauna of Great Nicobar Island may probably be due to the presence of a wide range of eco-niches and practically undisturbed geographic conditions with least pollution.

METHODS

Great Nicobar Island, the southern most Island of this archipelago, in fact the southern most land piece of India, is situated between 6°45´-7°15´N lat. and 93°38´-93°55´ E long (Fig. 1). The island lies about 482 km south of Port Blair and 145 km north of the northern tip of Sumatra. The total geographical area approximates to 1044 sq. km.

The materials for the present study were collected from December 2000 the February 2004 from live corals, dead corals, beach rocks, seagrass beds and mangrove sediments of the intertidal region of 13 selected stations. The sediment samples collected were sieved through a 0.5mm sieve. Polychaetes associated with dead corals were collected by breaking them with a hammer and chisel. Before fixation, polychaetes were dropped into strong alcohol to have their pharynx everted, as it is helpful in identification of this group. They were fixed in 10% formalin diluted with seawater and later transferred to 70% ethanol. The proboscis jaws and other structures of the parapodia were examined under a microscope. The features of the polychaetes studied were drawn with a prism type Camera Lucida and the measurements were taken using a micro-occulometer.

SYSTEMATIC ACCOUNT

List of species

Family EUNICIDAE, Savigny, 1818

1. *Eunice* (*Palolo*) *siciliensis* (Grube, 1840)
2. *Eunice antennata* (Savigny, 1818)
3. *Eunice indica* Kinberg, 1865

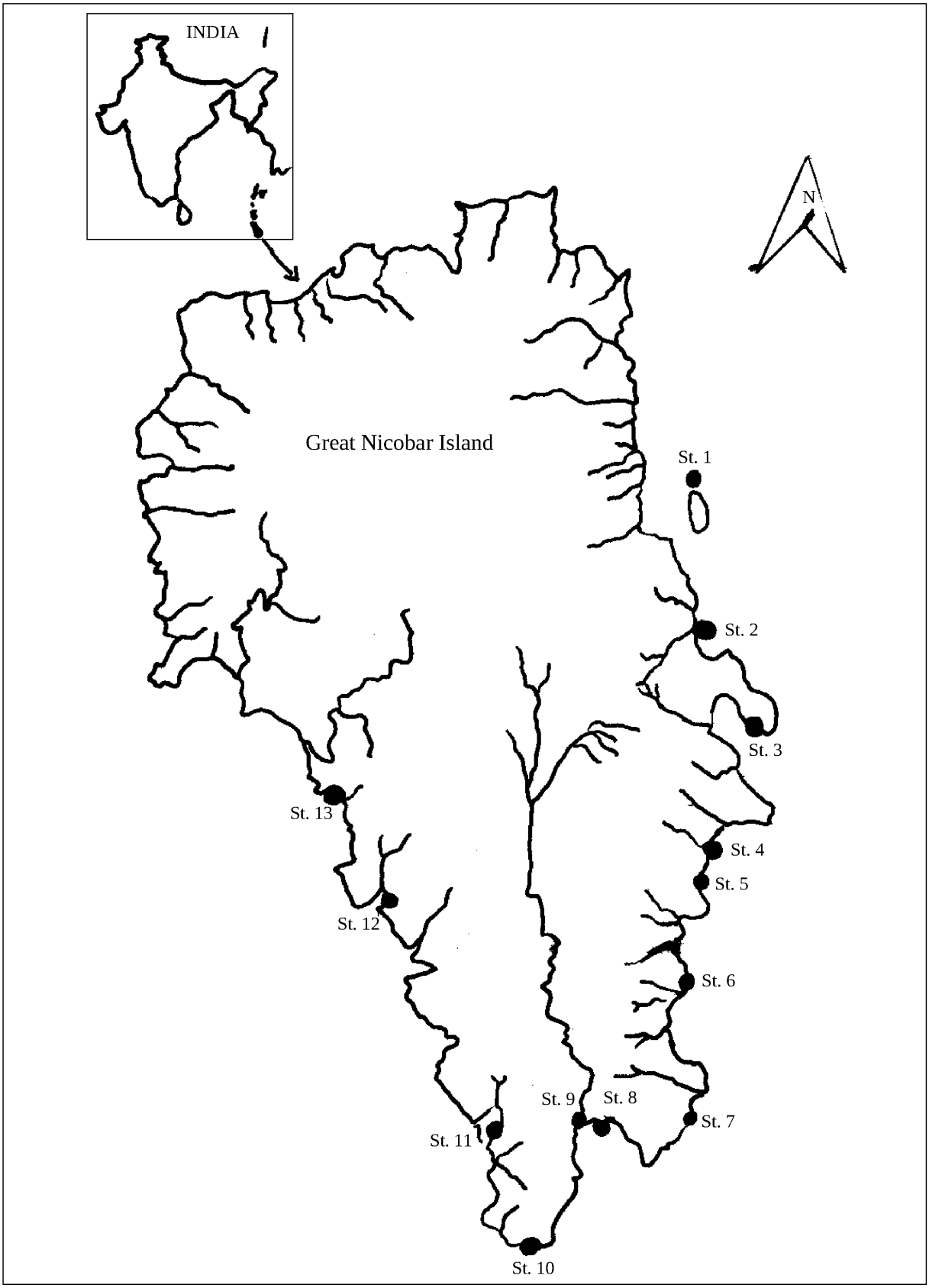

Fig. 1 : Map of Great Nicobar Island

4. *Eunice vittata* (Delle Chiaje, 1828)**
5. *Eunice savigny* Grube, 1878*
6. *Euniphysa tubifex* (Crossland, 1904)*
7. *Eunice coccinea* Grube, 1878*
8. *Eunice petersi* Fachald,1992
9. *Eunice paupera* Grube,1878
10. *Marphysa mossambica* (Peters, 1854)
11. *Marphysa macintoshi* Crossland, 1903*
12. *Marphysa corallina* (Kinberg, 1865)
13. *Lysidice collaris* Grube, 1870
14. *Lysidice ninetta* Aud. and M. Edwards, 1833
15. *Nematonereis hebes* (Grube 1840)*
16. *Lumbrineris tetraura* (Schmarda, 1861)
17. *Arabella iricolor iricolor* (Montagu,1804)

* new record from Andaman & Nicobar Islands

** new record from Indian waters

1. ***Eunice (Palolo) siciliensis*** (Grube, 1840)

1840. *Eunice sicillensis* Grube, *Actinien Echinodermen und Wiirmen des Adriatischen und Mittelmeeres* : 83; Fauvel, 1923, Polychaetes errantes. *Faune Fr*, Paris,V : 405; Gravier, 1900, Contribution a l'etude des annelids polychetes. Ist partie. *Nouv. Archs. Mus. Hist. nat., Paris* (ser. 4) **2** : 261, pl. 13 figs. 78-49, text figs. 130-133.

Material : 58 specimens collected from St. 1, 2, 4-8, 10-13 during December, 2000 to February, 2001.

Habitat : Boring into dead corals and beach rocks.

Description : Body 200-350 mm long with anterior region cylindrical and posterior region flattened. Prostomium is notched. Antennae are smooth. Anterior parapodia without branchiae. Branchiae are first present on segment 60 and usually simple filaments. Dorsal cirri are long, smooth, slender anteriorly and gradually diminish in size posteriorly. Simple capillary setae and compound falciger. There are no pectinate and subacicular setate.

Remarks : Present materials agree well with the Day (1967) description.

Distribution : India : Andaman & Nicobar Islands, Gulf of Mannar, Lakshadweep and Gujarat.

Elsewhere : Tropical Indo-west Pacific and Atlantic Oceans, Mediterranean Sea.

2. ***Eunice antennata*** (Savigny, 1818)

1818. *Leodice antennata* Savigny, Annelides. In : J.B. Lamarck ed. *Histoire naturelle des animaux sans vertebras.* 612 pp. Paris.

1904. *Eunice antennata* Crossland, On the marine fauna of Zanzibar and British East Africa from collection made by Cyril Crossland in the years 1901 and 1902. Polychaeta. Pt. III. *Proc. Zool. Soc., Lond.*, : 312, pl. 22 figs. 1-7, text figs. 56-60; Fauvel, 1953, *The fauna of India including Pakistan, Ceylon, Burma and Malaya* : 240, fig. 118 f-g.

Material : 32 specimens collected from St. 1, 2, 5, 7, 11 and 13 during December, 2000 to February, 2001.

Habitat : Boring into dead corals and beach rocks.

Description : Body 30 to 155 mm, the dorsal cirri and anal cirri are moniliform. Branchiae first start on setigerous segment 6, well developed between segments 10 and 25, where they have 6 or 7 filaments, decrease to 2 or 3 in median region; thereafter the number increases again in posterior segments. Acicular setae are first present in setigerous segment 19; they are yellow, tridentate and distally hooded. Other setae include slender capillary, bidentate compound falcigers with rounded hood, and pectinate setae with lateral.

Remarks : Present materials agree well with the earlier descriptions.

Distribution : India : Lakshadweep, Gulf of Mannar, Andaman & Nicobar Islands, Pamban, Krusadai and Shingle Island, Tuticorin and Maharashtra Coast.

Elsewhere : Red Sea, Persian Gulf, Indian Ocean, Philippine Island, Pacific Ocean, Indo-China, Ceylon (Sri Lanka).

3. ***Eunice indica*** Kinberg, 1865

1865. *Eunice indica* Kinberg, Annulata nova. *Ofvers. K. Vetensk Akad. Forh.*, **21** : 562; Crossland, 1904, On the marine fauna of Zanzibar and British East Africa from collection made by Cyril Crossland in the years 1901 and 1902. Polychaeta. Pt. III. *Proc. Zool. Soc., Lond* : 318, Pl. 21. figs. 9-12; Fauvel, 1953, *The fauna of India including Pakistan, Ceylon*, Burma and Malaya: 241, fig. 119.

Material : 21 specimens collected from St. 2, 3 and 11 during December, 2000 to February, 2001.

Habitat : Boring into dead corals.

Description : Body 20-24 mm long. A dark red spot is present on the median anterior border of each segment from the third. Prostomium in slightly notched in front. First branchiae single filament; all other branch pectinate; maximum 8 filaments. Branchiae are present from setigerous segment 3 to 23. Branchiae terminating well before posterior end, present on less than 55% of total number of setigers. Subacicular setae are yellow, distally tridentate, and occur as a transverse series of 4 in a parapodium. Compound setae distally bidentate and covered by a pointed hood.

Remarks : Present materials agree well with the original descriptions.

Distribution : India : Andaman & Nicobar Islands.

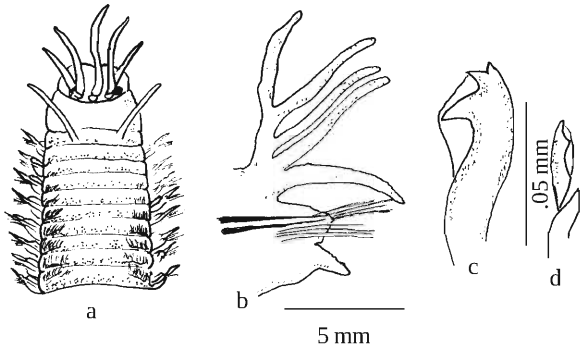

Fig. 2 : Eunice vittata

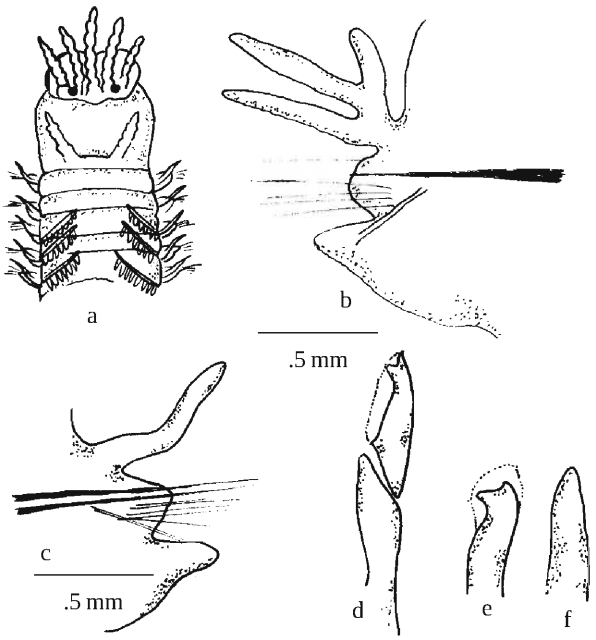

Fig. 3 : *Eunice savigny*

Elsewhere : Japan, New Calendonia, Gambier Islands, Indian Ocean, Persian Gulf, Red Sea.

4. ***Eunice vittata*** (Delle Chiaje, 1828)
(Fig. 2a-d)

1828. *Nereis vittot.*, Delle Chiaje, *Memorie sulla storia e notomia degli animali senze vertebre del regno di Napoli*, Naples, **3** : 195.

1923. *Eunice vittata*, Fauvel, 1923, Polychaetes errantes. *Faune Fr*. Paris, **V** : 404, fig. 158 h-n.

Material : 14 specimens collected from St. 2, 4 and 5 during December, 2000 to February, 2001.

Habitat : Boring into dead corals.

Description : Body 30-35 mm long. Anterior segments with red bars which fade in alcohol. Antennae and cirri smooth, without annulations; the longest or median one extends back to sixth segment. A pair of circular eyes at the outer bases of the median antenna. Tentacular cirri are smooth, extend forward not quite to the front of the prostomium. Branchiae are first present from the third parapodia and continue back to segment 45; they have 10 to 18 filaments. Acicula yellow with blunt tips, slightly curved. Acicular setae yellow and tridentate with small apical tooth. Compound setae falcigerous, distally bifid and covered with a pointed hood.

Remarks : This is the first record of the species from Indian waters.

Distribution : *Elsewhere* : Australia.

5. ***Eunice savigny*** Grube, 1878
(Fig. 3 a-f)

1878. *Eunice savigny*, Grube, Annulata Semperiana. Beitrage zur Kenntniss der Anneliden-fauna der Philippinen nach den von Herrn Prof. Semper mitgebrachten Sammlungen. *Mem. Acad. Sci. S. Peterb.*, **25** : 150; Ehlers, 1908, Die boden sassigen Annelidan aus der Sammlungen der deutschen Tiefsee-Expedition. *Wiss. Ergebn. dt. Tiefsee-Exped.*, Valdivia, **16** : 88, Pl. IX. fig. 7-13; Fauvel, 1932, Annelida polychaeta of the Indian Museum, Calcutta. *Mem. Indian Mus.*, **12** : 136.

Material : 8 specimens collected from St. 2 and 8 during December, 2000 to February, 2001.

Habitat : Boring into dead corals and beach rocks.

Description : Body 55-60 mm long. Prostomium has a deep cleft at its anterior margin. Prostomial antennae are annulated. Eyes are large, purplish brown. Branchiae first present from parapodium 3, have 6 filaments on the tenth, 8 on the twentieth, 7 on the thirtieth, 3 on the fortieth and absent after parapodium 50. Compound falcigers have a secondary tooth and distally rounded. Acicula thick and pointed. Subacicular setae are translucent yellow, distally bidentate and hooded; the subdistal tooth is large and directed laterally.

Remarks : This is the first record of the species from Andaman and Nicobar Island.

Distribution : India : Bombay.

Elsewhere : Philippines, Ceylon (Sri Lanka), Persian Gulf, South Africa.

6. ***Euniphysa tubifex*** Crossland, 1904
(Fig. 4 a-g)

1904. *Eunice tubifex* Crossland, On the marine fauna of Zanzibar and British East Africa from collection made by Cyril Crossland in the years 1901 and 1902. Polychaeta. Pt. III. *Proc. Zool. Soc., Lond* : 303, pl. 21 figs. 1-8; Day, 1951, The Polychaete fauna of South Africa. Part I: The intertidal and estuarine Polychaeta of Natal and Mosambique. *Ann. Natal. Mus.*, **12**(I) : 38.

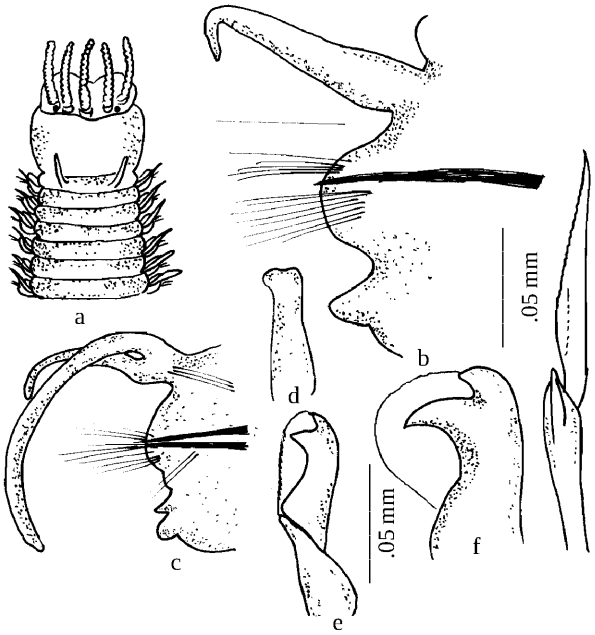

Fig. 4 : *Euniphysa tubifex*

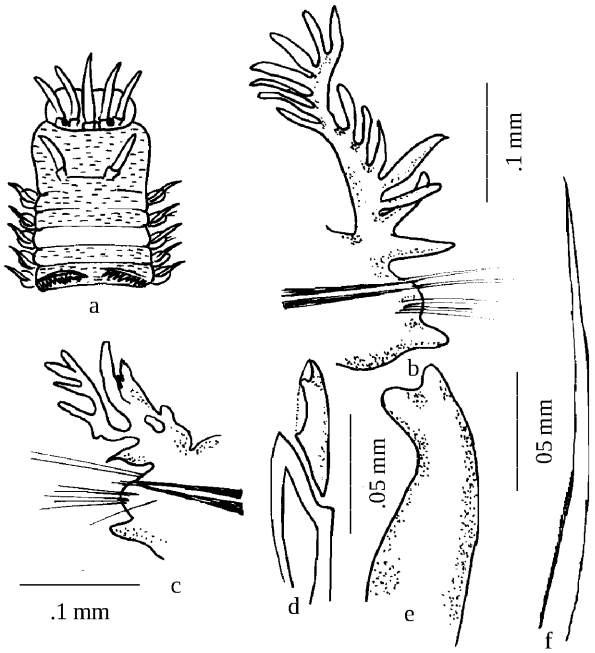

Fig. 5 : *Eunice coccinea*

Material : 21 specimens collected from St. 2 and 13 during December, 2000 to February, 2001.

Habitat : Boring into dead corals and beach rocks.

Description : Body 35-37 mm long. Antennae slender digitiform and deeply annulated. Branchiae from setigers 17 as single filament maximum 4 filaments by setiger 30; maximum number retained to posterior end of segments. Filaments longer than notoodial cirri, slender, filiform. Dorsal cirri without articulations. Limbate setae longer than all other setae, narrow, marginally smooth. Anterior parapodia with dense masses of compound spinigers. Shafts of spinigers slightly inflated, smooth, with distinct distal beaks. Spinigers replaced by compound falcigers from early branchial setigers. Shafts of falcigers inflated, marginally smooth, without distal peaks. Heads distinct, bidentate. Aciculae paired, thick, inferior aciculae black; superior aciculae light brown; all aciculae distally geniculate. Subacicular hooks slender, bidentate. Hooks first present from setiger 29.

Remarks : This is the first record of the species from Andaman & Nicobar Island.

Distribution : India : Gulf of Mannar and Krusadai Island.

Elsewhere : South Australia, Philippine Islands, Indian Ocean, Atlantic Ocean.

7. ***Eunice coccinea*** Grube, 1878

(Fig. 5 a-f)

1878. *Eunice coccinea* Grube, Annulata Semperiana. Beitrage zur Kenntniss der Anneliden-fauna der Philippinen nach den von Herrn Prof. Semper mitgebrachten Sammlungen. *Mem. Acad. Sci. S. Peterb.*, **25** : 153; Crossland, 1904, On the marine fauna of Zanzibar and British East Africa from collection made by Cyril Crossland in the years 1901 and 1902. Polychaeta. Pt. III. *Proc. Zool. Soc., Lond* : 297, Pl. 20. figs. 6-7, text figs. 46-51; *Fauvel*, 1953, *The fauna of India including Pakistan, Ceylon, Burma and Malaya* : 236, fig. 118a-e.

Material : 8 specimens collected from St. 10, 11 and 12 during December, 2000 to February, 2001.

Habitat : Crevices of both rocks and dead corals.

Description : Body 140-145 mm long. Anteriorly deep brown with white dots, a pale bar on the setiger 4. Prostomial lobes frontally rounded and dorsally inflated. Branchiae present, pectinate, distinctly longer than notopodial cirri. Branchiae from setiger 6 to end of body. Antennae and tentacular cirri smooth. First branchiae with 3 filaments; maximum 10 filaments at about setiger 15. The median and posterior acicular lobes short, rounded. Limbate setae slender. Shafts of compound falcigers tapering, marginally smooth. Acicular hooks amber colored to dark brown, bidentate hooks. Hooks first present from setiger 38-39.

Remarks : This is the first record of the species from Andaman & Nicobar Island.

Distribution : India : Lakshadweep.

Elsewhere : Red sea, Atlantic Ocean, Gulf of Guinea.

8. ***Eunice petersi*** Fauchald, 1992

1854. *Eunice punctata* Peters, Uber die Gattung *Bdella* Savigny, (*Limnatus*, Moquin-Tandon) und die in

Mossambique beobachteten Anneliden. *Mber. Akad. Wiss. Berlin*, : 611.

1957. *Eunice afra* var. *punctata* Day, The Polychaete fauna of South Africa. Part 4 : New species from Natal and Mosambique. *Ann. Natal Mus*., **14** : 89.

1992. *Eunice pertersi* Fauchald, A review of the genus Eunice (Eunicidae : Polychaeta) based upon type material. *Smithsonian Contributions to Zoology*, **523** : 267, fig. 89 a-i.

Material : 38 specimens collected from St. 1-8, 10-13 during December, 2000 to February, 2001.

Habitat : Boring into beach rocks and dead corals.

Description : Body 130-140 mm long for 181 segments, brown, dotted with tiny white punctations only over the anterior portion. Prostomial antennae smooth. Peristomial cirri about as long as the peristomial segment. Branchiae are first present from about segment 16, with 2-4 filaments; they are pectinately divided and attain a maximum of 8 filaments at setiger 30 ; the last 10 segments lack them. There are 2 acicula each of the first 28 to 30 parapodia, and only one in others. Acicular hooks are first present in segment 30; they are distally bidentate and subdistal tooth directed laterally. Other setae are of three kinds: slender capillary, pectinate, and bidentate compound falcigers in which the hood is distally rounded.

Remarks : Present material agree well with the original descriptions.

Distribution : India : Lakshadweep, Gulf of Mannar and Andaman & Nicobar Islands.

Elsewhere : South Africa.

9. ***Eunice paupera*** Grube, 1878

1878. *Eunice paupera* Grube, Annulata Semperiana. Beitrage zur Kenntniss der Anneliden-fauna der Philippinen nach den von Herrn Prof. Semper mitgebrachten Sammlungen. *Mem. Acad. Sci. S. Peterb*., **25** : 160.

1932. *Eunice afra* var. *paupera* Fauvel, Polychaeta of Indian Museum, Calcutta. *Mem. Ind. Mus.*, **12** : 135.

1992. *Eunice paupera* Fauchald, A review of the genus Eunice (Eunicidae : Polychaeta) based upon type material. *Smithsonian Contributions to Zoology*, **523** : 256-258.

Material : 45 specimens collected from St. 2-8, 11 and 12 during December, 2000 to February, 2001.

Habitat : Boring into beach rocks and dead corals.

Description : Body 100-120 mm long. Antennae smooth. Peristomial cirri short. Branchiae present from setiger 19, maximum 3-4 filaments, gradually decreasing posteriorly and completely absent on the last few setigers. Dorsal cirri long in first 4 setigers, as long as antennae, thereafter relatively short through remainder of prebranchial and early branchial setigers, increasing in length in segments with bifid and trifid branchiae, decreasing in length in far posterior setigers. Ventral cirri basally inflated in mid body, again becoming tapering in second half of body. Compound falcigers with short, bidentate appendages. Aciculae black. Subacicular hooks black, bidentate, first present from setiger 23.

Remarks : Present materials agree well with the earlier descriptions.

Distribution : India : Lakshadweep, Gujarat coast and Andaman & Nicobar Island.

Elsewhere : Red Sea, Malay Archipelago, Philippines, New Caledonia.

10. ***Marphysa mossambica*** (Peters, 1854)

1854. *Eunice mossambica* Peters, Naturwissenschaftliche Reise nach Mosambique in 1842 bis 1848 ausgeführt. Akademie der Wissenschaften zu Berlin, Monatsberichten : 610-614.

1903. *Marphysa mossambica* Crossland, On the marine fauna of Zanzibar and British East Africa from collection made by Cyril Crossland in the years 1901 and 1902. Polychaeta. Pt. I and II. *Proc. zool. Soc. Lond.*, : 139, pl. figs. 7-10.

Material : 16 specimens collected from St. 1, 4 and 13 during December, 2001 to February, 2002.

Habitat : Boring in dead corals and rocks.

Description : Body 270-350 mm in length and flattened after the first few segments, Anterior margin of head deeply bilobed. Five smooth antennae, 1.5 times prostomial length. Anterior parapodial gill absent. Gills appear on the 25th-33rd foot according to size, reach a maximum of six to eight filaments and persist to the end of the body. Setae are all simple capillaries through-out, all with very narrow striated blades. No comb-setae. Acicula shading from yellow to black with straight blunt ends. Acicula setae pale, bidentate and only half the thickness of the acicula, not present in all feet.

Remarks : Present material agree well with the earlier descriptions.

Distribution : India : Andaman & Nocobar Islands, Pondichery, Kilakarai, Gulf of Mannar, Tuticorin and Gangetic delta.

Elsewhere : Widely distributed in Indo-Pacific region, Red Sea, East Africa, Singapore, Fiji and Australia.

11. ***Marphysa macintoshi*** Crossland, 1903
(Fig. 6 a-d)

1903. *Marphysa macintoshi* Crossland, Crossland, On the marine fauna of Zanzibar and British East Africa from collection made by Cyril Crossland in the years 1901

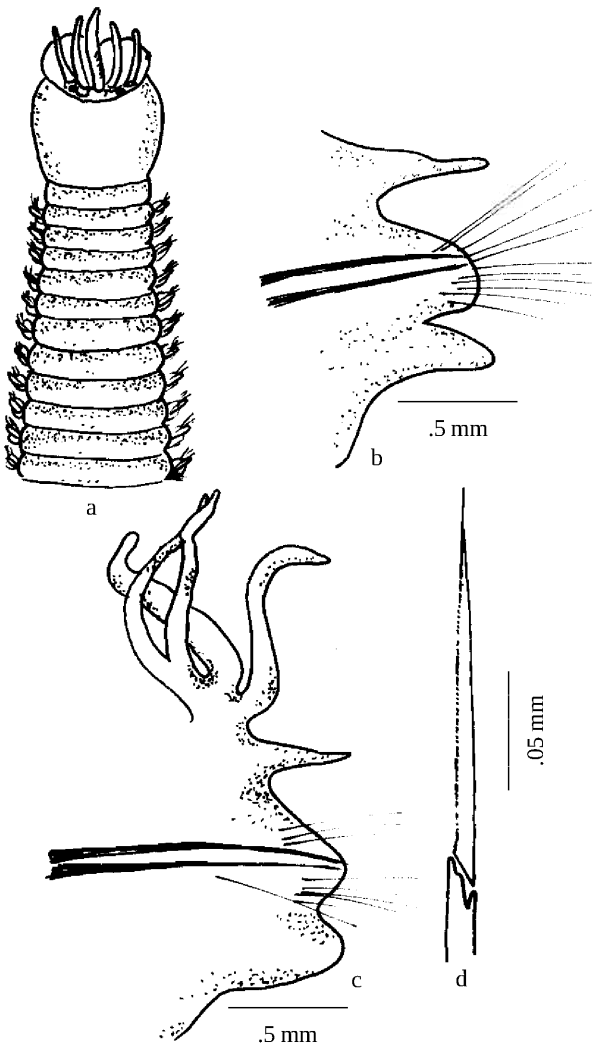

Fig. 6 : *Marphysa macintoshi*

and 1902. Polychaeta. Pt. I and II. *Proc. zool. Soc. Lond.*, : 137, pl. 14 figs. 3-6, text-figs. 12.

Material : 9 specimens collected from St. 4 and 11 during December, 2001 to February, 2002.

Habitat : Free living in sandy soil of lower littoral zone.

Description : Body 200-220 mm long, slender, rounded or somewhat flattened. Palps partially fused and the anterior margin of the head is not obviously bilobed. Antennae smooth, about as long as the prostomium. Eyes not defined. Mandibles normal. Anterior parapodial gill absent. Gills appear on 20th-50th foot according to size, reach a maximum of six filaments and gradually decrease towards the end of the body. Acicula bluntly pointed and brown with pale tips. A single brown unidentate acicula seta. Notosetae are winged capillaries and comb setae; neurosetae are compound spiniger with knife-shaped blades.

Remarks : Agrees well with the earlier description (Day, 1967). This is the first record of the species from Andaman and Nicobar Island.

Distribution : India : Krusadai Island, Pulicate Lake, Gopalpur (Orissa) and Lakshadweep.

Elsewhere : Philippnies, Australia, Singapore, Red Sea, East Africa.

12. ***Marphysa corallina*** (Kinberg, 1865)

1865. *Nauphanata corallina* Kinberg, Annulata nova. *Ofvers. K. Vetensk Akad. Forh.*, **21**(10) : 564.

1948. *Marphysa corallinaa* Hartman, The marine annelids erected by Kinberg with notes on some other types in the Sewdish State Museum. *Ark. Zool.*, **42**A(I) : 81, pl. 11 fig. 4-7.

Material : 12 specimens collected from St. 4 and 11 during December, 2000 to February, 2001.

Habitat : Boring in both beach rocks and dead corals.

Description : Body 200-220 mm long, the anterior part rounded and the posterior part flattened. Prostomium bilobed. Antennae smooth, about 1.5 times as long as prostomium. Gills star from 20th-50th foot according to size, reach a maximum of six filaments and continue to the posterior end with a reduced number of filaments. Comb setae with 20-25 teeth. Neurosetae compound falciger. Acicula dark with pale blunt tips, acicular setae pale and bidentate with small guards.

Remarks : Present material agree well with the Day (1967) descriptions.

Distribution : India : Andaman & Nicobar Islands, Visakhapatnam, Pondichery, Gulf of Mannar, Pamban, Tuticorin, Travancore, Daman, Marmagoa Bay, Gujarat, Cochin estuary. Lakshadweep and Gopalpur (Orissa).

Elsewhere : Indian and Atlantic Oceans, Mediterranean and Red Sea, Australia, New Caledonia.

13. ***Lysidice collaris*** Grube, 1870

1870. *Lysidice collaris* Grube, Beschreibung neuer oder wenig beakannten von Heron Ehrenberg gesammalter Anneliden aus den Rothen Meeres. *Mber. Akad. Wiss. Berlin*, : 495.

Material : 32 specimens collected from St. 1, 2, 5, 7, 8, 11 and 13 during December, 2000 to February, 2001.

Habitat : Boring in dead corals.

Description : Prostomium is distinctly bilobed in front and has two reniform eyes located near the outer base of the paired antennae. The 3 prostomial antennae are slender. Second dental plate with three heavy teeth. In anterior segments the dorsal cirri are slenderer than ventral ones. In posterior segments the dorsal cirri become shorter. Setae include capillary setae, bidentate

composite falcigers, comb setae and bidentate subacicular hooks are first present at setiger 21 and continue posteriorly.

Remarks : Present materials agree well with the Day (1967) descriptions.

Distribution : India : Andaman & Nicobar Islands, Kilakarai, Pamban, Gujarat coast and Gulf of Mannar.

Elsewhere : Indian Ocean, Pacific Ocean, Persian Gulf, Red Sea.

14. ***Lysidice ninetta*** Audouin & Milne Edwards, 1833

1833. *Lysidice ninetta* Audouin & Milne Edwards, Classification des Annelides et descriptions de celles qui habitent les cotes de la France. *Annls. Sci. Nat.*, **28** : 235.

Material : 23 specimens collected from St. 5, 8, 10 and 11 during December, 2001 to February, 2002.

Habitat : Boring in dead corals.

Description : Body 75-100 mm long, reddish with white spots and white bar on setiger 2 and 5. Prostomial antennae short, three in number, peristomial appendages and gills absent. Parapodia each with a bluntly conical dorsal cirrus, rounded ventral cirrus and a broad setigerous lobe. Setae include capillaries, pectinate setae, composite falcigers and bidentate acicular hooks. Acicula black with blunt tips. Bidentate subacicular hooks from setiger 22-25 onwards.

Remarks : Present materials agree well with the Day (1967) descriptions.

Distribution : India : Lakshadweep, Kilakarai, Pamban and Andaman & Nicobar Isalnds.

Elsewhere : Red Sea, Indo- West Pacific, North Atlantic, North Carolina, Mediterranean Sea, Angola.

15. ***Nematonereis hebes*** Verrill, 1900 (Fig. 7 a-e)

1840. *Lumbriconereis unicornis* Grube, *Actinien Echinodermen und Wiirmen des Adriatischen und Mittlelmeeres* : 80.

1861. *Nematonereis unicornis* Schmarda, *Neue wirbellose Thiere beobschtet und gesammelt auf einer Reise um die Erde* 1853 *bis* 1857. I. *Turbellarien, Rotatirien und Anneliden*, 164 pp.

1900. *Nematonereis hebes* Verrill, Additions to the Turbellaria, Nemertina, and Annelida of the Bermudas, with revisions of some New England genera and species. Transactions of the Connecticut Academy of Arts and Sciences, **10**(2) : 595-671.

Material : 9 specimens collected from St. 2, 5 and 12 during December, 2001 to February, 2002.

Habitat : Boring in dead corals and seagrass soft sediments.

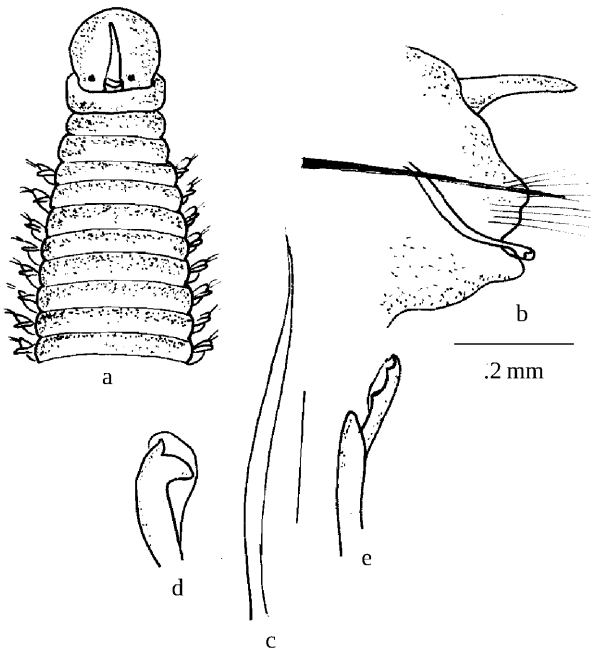

Fig. 7 : *Nematonereis hebes*

Description : The body is filiform and about 50 mm long; orange anteriorly and greenish posteriorly. The prostomium is depressed oval and has a single short antenna (Fig. 7.a). A pair of semicircular eyes located on the postlateral part of the prostomium, behind the antennal base. There are no tentacular cirri. Parapodia have digitiform dorsal cirri and short, conical ventral cirri; branchiae are lacking (Fig. 7.b). Superior setae include winged capillary (Fig. 7.c) and broad comb setae. Inferior seate bidentate hooded falcigers (Fig. 7.e). Subacicular hooks usually occur singly in a fascicle; they are black, distally bidentate and hooded (Fig. 7.d), and first present in segment 20 and continue to the end.

Remarks : This is the first record of the species from Andaman & Nicobar Islands.

Distribution : India : Gulf of Mannar, Pamban, Krusadai Island and Cheval Paar.

Elsewhere : Australia, Malay Archipelagao, Indo-China, Indian Ocean, Suez Canal, Mediterranean Sea.

16. ***Lumbrineris tetraura*** (Schmarda, 1861)

1861. *Notocirrus tetraurus* Schmarda, Schmarda, *Neue wirbellose Thiere beobschtet und gesammelt auf einer Reise um die Erde* 1853 *bis* 1857. I. *Turbellarien, Rotatirien und Anneliden* : 117, 6 figs.

1868. *Lumbriconereis impatiens* Claparede, Les Annelides chetopodes du Golfe de Naples. *Mem. Soc. Phys. Hist. nat., Geneve*, 19(2) : 445; Fauvel, 1923, Polychetes errants. *Faune Fr.*, **5** : 429, fig. 171 a-l.

1953. *Lumbriconereis tetraura* : Day, The Polychaete fauna of South Africa. Part 2 : Errant species from Cape shores and estuaries. *Ann. Natal Mus.*, **12**(3) : 435.

Material : 9 specimens collected from St. 4, 6 and 11 during December, 2002 to February, 2003.

Habitat : Littoral soft sediments.

Description : Prostomium pale, short, blunt, depressed conical. Parapodia are obvious throughout, even from the first, where they have a broad, postsetal lobe and spreading setal fascicles. Simple winged capillary, hooded hooks are present from the first segment and 3 acicula. Fifth parapodium is provided with 7 to 10 hooks in addition to superior and inferior limbate setae. The presetal lobe is a short, compressed pad. The postsetal lobe is a broad, oblique, acicular lobe, directed outward; this form is maintained through about 20 segments; after that it is elongate and more slender, erect. The parapodial base becomes elongate in a similar way further back, but directed laterally. Setae and acicula are clear yellow. The simple hooks in anterior segments shorter, stouter hooks occur between parapodia 25 and 40. Limbate setae are absent after segment 61. Posterior parapodia are provided with only simple, hooded hooks, with many small teeth distally.

Remarks : Present materials agree well with the Day (1967) descriptions.

Distribution : India : Ganjam, Andaman & Nicobar Islands, Visakhapatnam and Vellar estuary.

Elsewhere : Gulf of Mexico & South West Africa.

17. ***Arabella iricolor*** (Montagu, 1804)

1804. *Nereis irricolar* Montagu, Descriptions of several marine animals found on the south coast of Devonshire. *Trans. Linn. Soc. Lond.*, **7** : 82.

1923. *Arabella irricolar* Fauvel, Polychetes errants. *Faune Fr.*, **5** : 438, fig. 175 a-h.

Material : 11 specimens collected from St. 1 and 8 during December, 2002 to February, 2003.

Habitat : Boring in dead corals.

Description : Body color grey iridescent. Body is long, cylindrical and measures 60 mm for 100 segments. Prostomium bluntly conical with 4 eyes in a transverse row along its posterior margin, there are no appendages. First 1-2 segments achaetous, dorsal cirri rudimentary, ventral cirri absent. Parapodia bilobed with unequal lobes. Setae are only simple limbate and geniculate, with serrations at the base of the wing.

Remarks : Agrees well with the description of Day (1967).

Distribution : India : Andaman & Nicobar Islands, Gulf of Mannar, Waltair coast, Madras coast, Visakhapatanam, Krusadai island, Pamban, Shingle Island and Godavary estuary.

Elsewhere : Pacific, Atlantic and Indian Oceans, Australia, Japan, Marshall Island, Mediterranean Sea, British Channel.

DISCUSSION

In the present study 17 species were collected from the Great Nicobar Island, of which 6 species are new records to entire Andaman & Nicobar Islands of which one species is a new record to Indian waters. Earlier studies on polychaetes of Andaman and Nicobar Islands, (except for the Great Nicobar Island) has been compiled by Soota *et al.* (1980). Of the 161 species listed by him only 26 species from order Eunicida due to the fact that several different ecosystems had been sampled. Eunicida collected from Great Nicobar Island shows a distinct distribution based on the kind of substrate like coral reefs, mangroves, sandy substrate and sea grass beds. The substrates play an important role in determining the species composition of various habitats (Sanders, 1958).

One of the main problem in studying the infauna of coral reefs is taking the Eunicida out of the coral colony without damaging them which will render it difficult for identification. Eunicida are really the most important boring animals in coral rocks (Ebbs,1966). Coral destruction by polychaetes has been observed by Hutching (1986) from Great Barrier reef of Australia. In the present study, 15 species of polychaetes were collected from coral habitats. The most important coral degrading polychaete belongs to the family is Eunicidae (Hartman, 1954). Boring is effected chiefly by the abrasion action of hard pharyngeal structures, such as those possessed by nereids and eunicids (Ebbs, 1966). Although there is little published information on the polychaete fauna of coral reef present work has indicated that it supports a rich and diverse fauna of polychaetes. The importance of the boring activity of polychaetes was recognized by Hutching (1986) who regards them as the “prime and most effective agents” in the destruction of corals. This view is also being supported by Vittor and Johnson (1997).

Observations based on substratum preference by Eunicida revealed that dead corals harbored the largest number of Eunicida. This is probably because corals

are hard, stable substrates that are elevated from the sea bottom avoiding the loose sandy silty particles entering inside the tubes. Corals also provide a good protection from predators. At the time of settlement, the larvae are very much susceptible to predation and to being dislodged by water currents. Algae that are present on the dead coral also provide protection against water current and predators to the pelagic larvae of Eunicida at the time of settlement and initial penetration into coral. As these Algae are found only on the surface of dead coral, Eunicida give more preference to dead coral rather than live coral. Hutchings (1981) also observed most Eunicida in dead corals from Great Barrier Reef.

SUMMARY

The present paper deals with 17 species of polychaetes of the Order, Eunicida. Six species are recorded for the first time from entire Andaman & Nicobar Islands of which one species is a new record to Indian waters.

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STUDIES ON DIVERSITY AND DISTRIBUTION OF COLLEMBOLA IN THE MAN MADE FOREST ECOSYSTEM AT BIBHUTI BHUSHAN WILD LIFE SANCTUARY, PARMADAN, NORTH 24 PGS. DISTRICT, WEST BENGAL

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INTRODUCTION

The collembolans are small, entognathous, wingless insects possessing a spring-like forked jumping organ, the furcula underneath the fourth abdominal segment. They are minute in size (less than 6 mm in length); antennae primarily with 4 segments. The presence of antennae and absence of cerci distinguish them from the other entognathous hexapods. The collembolans have very diverse distribution occurring in all Zoo-geographical regions of the world inhabiting a wide range of ecological niche and climate. It includes a variety of habitats where they feed as scavengers on decaying vegetation and soil fungi even occurring in the vicinity of both south and north poles upto 83° south latitude in Antarctica. The collembolans are major components of terrestrial ecosystems (and particularly significant members of the soil communities), constituting a significant proportion of the animal biomass reaching densities of 200 to 1800 individuals per dm3, densities surpassed by the Acarine soil population (Handschin, 1955).

Diem (1903) was first attempt to study the soil fauna in the Alpine soil. There after a series of workers have published on ecology of collembola of different ecosystems in India and abroad *viz,* McAtee (1907), Agrell (1941), Gisin (1943 & 1955), Weis-Fogh (1948), Macfadyen (1952, 53 & 54), Murphy (1953), Haarlov (1955 &1960), Sheals (1956 & 1957), Chritiansen et al (1961 &1964), Choudhuri (1961-1983), Poole (1961), Dhilllon and Gibson (1962), Dunger (1962), Davis (1963), Clark (1965 & 1967), Hale (1967), Prabhoo (1967,71a,b,c & 76a,b), Rappoport (1967), Gujarathi (1968), Wallwork (1970), Mukherjee and Singh (1970), Curry (1971), Nijima (1971), Ashrof (1971), Singh and Mukherjee (1971 & 1973), Anderson and Healey (1972), Edwards and Lofty (1973), Choudhuri and Banerjee (1975), Singh and Pillai (1975), Gupta and Mukherjee, (1976), Crossley (1977), Singh (1978), Hazra *et al* (1976-2003), Mitra *et al* (1977-2002), Takeda (1978), Joose and Buker (1979), Bhattacharyya and Roychoudhuri (1979), Greenslade (1981), Hagvor (1982), Parkinson (1983), Bisht and Chattoraj (1986), Guru, Panda and Mahapatra (1988), Amelsovoort *et al* (1988), Veeresh (1990), Guru and Das (1991 & 91a), Sengupta and Sanyal (1991), Pal, Chottopadhyay and Roy (1992), Chakraborty and Bhattacharya (1992).

Added to this, there is growing evidence of interest from Indian workers as indicated by the proceedings of two national symposia *"Soil Biology and Ecology in India"* (Edwards & Veeresh, 1978) and *"Progress in* Soil *Biology and Ecology in India"* (Veeresh, 1981), followed by *"Applied Soil Biology and Ecology"* (Veeresh & Rajagopal, 1983) and *"Advances in Management and Conservation of Soil Fauna"* (Veeresh *et. al.* 1991), signaling the gradual maturity of soil faunal studies in India. These publications attempted to bridge the gap in the knowledge on soil biology and ecology in this country, which is, as yet insignificant compared to her vast landscape variation and severe pressures on fragile soils. Added to this venture was the launching of the *Indian Journal of Soil Biology and Ecology* in 1981.

Qualitative and quantitative studies of soil fauna, particularly the micro-arthropods from Indian soils began from the mid-sixties, although ecological studies were initiated much earlier (Trehan, 1945). However, major contributions have been from the agricultural fields, grasslands, abandoned fields and tea gardens, and very few from tropical rainforests. While the microarthropod studies from various forest floors

included those of Banerjee (1972), Hazra (1978), Annadurai *et al.* (1988), Reddy & Reddy (1996), Bisht & Chattoraj (1998). And reports from tropical forest soil and litter microarthropods are limited to the works of Singh & Singh (1975), Prabhoo (1976), Hazra (1982), Badejo & Straallen (1993), Straalen (1997), Hazra & Bhattacharyya (2003), Ghosh and Roy (2005), Hazra & Mandal (2007), Mandal *et al.* (2002, '04, '07, '09 & '10). Most of the recent literatures on Indian soil fauna are again from the agricultural fields.

From the above literature it was assumed that the research works on Soil-Biology have tried to assess the impact of different biotic and abiotic factors on the distribution and diversity of soil mesofauna with special reference to Collembola. The present project is taken to enrich the knowledge of Indian springtails and the role of edaphic factors like- Soil Temperature, Moisture, Hydrogen Ion Concentration (pH) and Organic Carbon on the distribution of soil micro-arthropod fauna specially Collembola in a forest ecosyetem.

OBJECTIVES OF THE STUDY

1. To inventories the below ground diversity of soil micro-arthropod fauna with special reference to Collembola.
2. To study the seasonal abundance and species diversity of Collembola fauna of that area.
3. To evaluate the role of edaphic factors like–Soil-Temperature, Moisture, Hydrogen Ion Concentration (pH) and Organic Carbon on the distribution of soil micro-arthropod fauna specially Collembola.
4. To know the relationship between soil parameters and soil micro-arthropod fauna especially Collembola will be analyzes statistically.

METHODS OF SAMPLING

Soil samples were collected at random at the rate of 3 samples per plot (in the four sampling site) every three month (Quarterly) during July, 2007 to December, 2009. Samples were drawn by using of a stainless steel corer (inner cross-section diameter 8.5 sq. /cm) from a depth of 5 cm. Separate soil samples units (500 gram) were taken from each site (2 packet from each site) for collection of collembolan and estimation of soil parameters like- moisture, pH, organic carbon etc. were kept immediately in sterile polythene packet in 4° C in the laboratory for estimations of soil parameters.

A total 96 sample units of core and 64 samples units of packet soil were collected and examined during the 30 months study period. All the samples collected were immediately transferred to polythene packets and labeled, taking as much as possible to prevent loss of moisture. The labeled samples were brought to the laboratory for extraction within 24 hours of their collection.

EXTRACTION OF COLLEMBOLA

Extraction of soil samples were carried out by "Expedition Funnel Apparatus" modified by Macfadyen (1953) with a 40-watt bulbs for providing heat and light. The extraction period varied from 36 hrs to 72 hours depending upon the moisture content of the soil sample (Plate 1 & 2).

ANALYSIS OF EDAPHIC FACTORS

Soil samples dried in a hot air oven at about 105°C for further bacterial action (some samples were kept separately for the estimation of soil moisture) were then allowed to cool and stored in a dessicator and dried soil was passed through the 2 mm sieve, mixed and fractionated before analysis.

Temperature

Soil-thermometer was put in use to record the temperature of the soil at 5cm depth and the temperature of air, one meter above ground level.

Moisture

Moisture of the soil sample measured by the 'Oven Dry Method' (Dowdeswell, 1959) and has been expressed in percentage of the weight difference before and after drying soil sample at 105°C for four hours.

Hydrogen Ion Concentration (pH)

A soil suspension was prepared in a glass bottle with stopper in which one part of soil was mixed with five parts of de-ionized double distilled water and was shaken in a mechanical shaker for one hour and the ratio was determined after CSIR (Piper, 1942) before taking the reading of the pH of the soil solution electronic pH meter, "WTW-pH 320" after standardizing the instrument each time with a standard Beckman buffer solution for avoiding the instrumental error.

Organic Carbon

Organic Carbon content of the soil was determined by 'Rapid Titration Method' (Walkely and Black, 1934). % C =3.951/g (1-TS). Organic matter of the soil (1 gm) was digested with excess 1 (N) K2Cr2O7 and conc. H_2SO_4 and the residual utilized dichromate is then titrated with 1(N) Fe (NH4)2SO4 using diphenyle amine indicator.

LOCATION OF STUDY AREA

Bibhutibhusan Wildlife Sanctuary is located at Parmadan in North 24 Parganas District of West Bengal. It is named after Bibhuti Bhushan Bandopadhyay, a great writer. Spread out over 640 hectares of forestland, the park lies on the banks of Ichhamati River. The highlight of the sanctuary is spotted deer. Monkeys and birds can also be seen. Children's park and the mini zoo are nearby. The sanctuary is also known as Parmadan Deer Park and is around 120 km north-east of Kolkata. It is about 30 km from Bangaon city of North 24 pgs. It is a man made forest named as Bibhuti Bhushan Wild Life Sanctuary (B.B.W.L.S), Parmadan.

LOCATION OF STUDY SITE

The total area of the Bibhuti Bhushan Wild Life Sanctuary (B.B.W.L.S) has been selected four sites, three sites are from core area which was surrounded by fencing and the core area was totally undisturbed. The other site is on the bank of Ichamoti River under the buffer area which was semi-disturbed. The names of these four sites are - Site I : 100 meters from main entry gate of the core area towards south near three Arjun tree. Site II : Beside three uprooted logs, path no.1, and 100 mts from site 1, towards East. Site III: Four way crossing path, 200mts from second site, towards Western side. Site IV : Embankment of Ichamoti River, Bibhuti Bhushan Sanctuary.

OBSERVATION

SITE WISE ANALYSIS OF COLLEMBOLAN FAUNA

The present investigation involves extraction of soil micro fauna from the sampling plots in four different sites such as :

Site I : 100 meters from main entry gate of the core area towards south near three Arjun tree.

Site II : Beside three uprooted logs, path no.1, and 100 mts from site 1, towards East.

Site III : Four way crossing path, 200mts from second site, towards Western side.

Site IV : Embankment of Ichamoti River, Bibhuti Bhushan Sanctuary.

SITE-I : 100 METERS FROM MAIN ENTRY GATE OF THE CORE AREA TOWARDS SOUTH NEAR THREE ARJUN TREE

Location and Characteristic of sampling site-I :

This locality was situated 100 meters from main entry gate of the core area of the sanctuary covered by fencing. Soil was humid and alluvial in nature. Annual rainfall of the site and its surroundings ranges from 77-84 cm and the forest comprises major trees like, *Terminalia arjuna, Shorea robusta, Tectona grandis, Ficus religiosa, Mangifera indica* and *Azadirachta indica* under growths like, *Sporobolus diander, Dichanthium annulatum, Eragrostis brachyphylla, Digitaria marginata, D. royleana, Euphorbia hirta and Lanatana camara.* The samapling site was

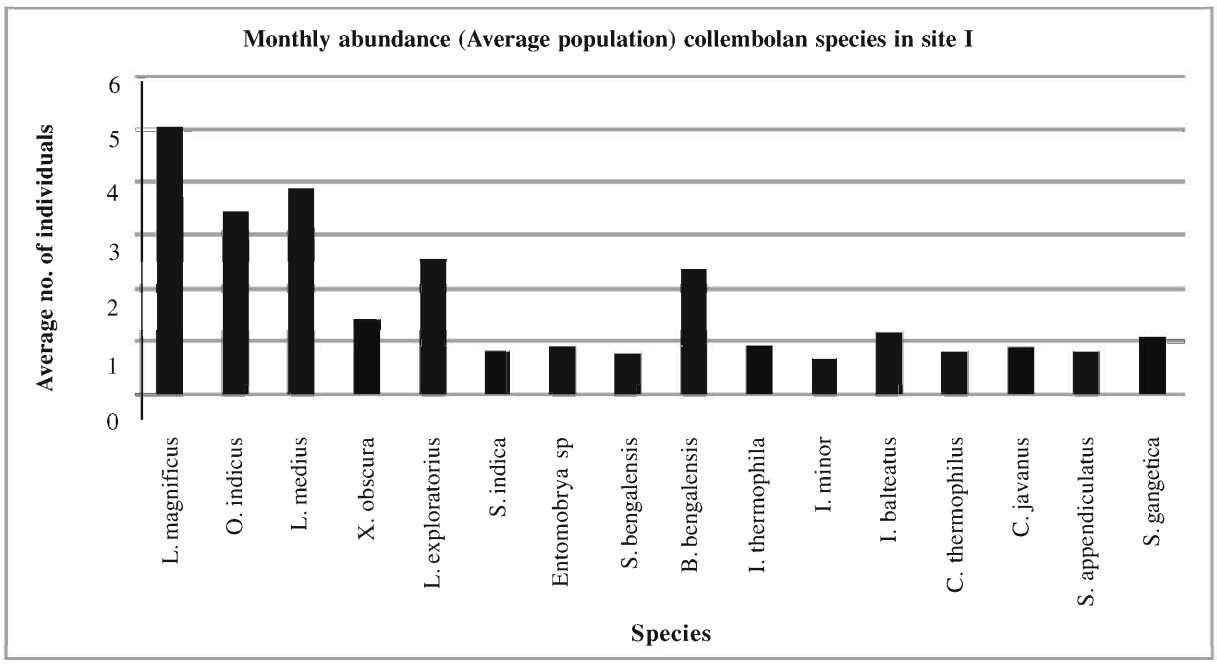

Fig. 1 : Monthly abundance (Average population) collembolan species in Site-I.

Table-1 : Values of edaphic factors per month (July, 2007- Dec, 2009) at site I, B.B.W.L.S, Parmadon

Year	Month	Temperature (0°c)	Moisture (%)	pH	Organic carbon (%)
2007	JUL	32.5	33	6.5	3.63
	AUG	30.5	35	6.1	3.95
	SEPT	31.2	33.5	6.5	3.66
	OCT	31	31.5	6.6	2.35
	NOV	29.5	30	6.4	3.52
	DEC	26	29	6.3	3.3
2008	JANU	19	28	6.4	3.4
	FEB	21	27.5	6.4	2.9
	MAR	26	29	6.3	2.7
	APRL	34	28	6.5	1.5
	MAY	35.5	25.5	6.9	1.3
	JUN	30	31.9	6.8	2.7
	JUL	30.5	33	6.2	3.9
	AUG	32	34.5	6.1	4
	SEPT	30	33	6.3	3.75
	OCT	28	31	6.5	3.2
	NOV	25	30	6.2	2.8
	DEC	23.5	28.5	6.1	3
2009	JANU	20	27.5	6.3	3.23
	FEB	21	27	6.5	3
	MAR	28	26.5	6.6	2.66
	APRL	33.5	27	6.8	2.2
	MAY	37	26.5	6.9	1.5
	JUN	33	26	6.5	2.3
	JUL	32	32	6.3	3.7
	AUG	30.5	35.5	6.1	3.95
	SEPT	31.2	33.5	6.5	3.6
	OCT	30	31.5	6.6	3.5
	NOV	28.5	29	6.4	3.6
	DEC	26	28	6.3	3.3

maintained with coverage of litter of the fallen leaves and dried twigs of the above trees.

Soil factors

Soils are alluvial, blackish brown in colour and sandy silt in texture. Mechanical analysis of soil showed maximum percentage of medium silt 33.6% and more or less equal percentage of fine sand and fine silt. During May, soil moisture content was 25.5% in 2008 and 26.5% in 2009. Maximum moisture content in soil (35.5%) was recorded in August, 2009 and 34.5% in the same period of 2008. During May, other soil factors such as temperature, pH and organic carbon were found 35.5°C, 6.9, 1.3%; 37°C, 6.9, 1.5%; in 2008 and 2009 respectively. Mean values of others revealed more or less identical characteristics (Table-1).

Collembolan Fauna

The Collembolan fauna obtained from this site belonged to 16 species in 14 genera. Amongst them, the species *Lepidocyrtus magnificus* was found most dominant and it was (18.5%) of the total fauna recorded from this site. The species *Lepidocyrtus medius* contributed (14.38%), *Onychiurus indicus* contributed (12.9%), *L. exploratorius* contributed (9.2%), *Xenylla obscura* contributed (5.16%), *Ballistrura bengalensis* contributed (7.5%), *Isotomurus balteatus* contributed (4.2%) and *Salina bengalensis* contributed (3.14%). Population of other species from this site was numerically low and highly irregular in distribution pattern in the sampling site. Percentage of springtails was found maximum in August in three consecutive years, which coincided with the maximum concentration

Table-2 : Values of edaphic factors per month (JULY, 2007- DEC, 2009) at site II, B.B.W.L.S, Parmadan

Year	Month	Temperature (0°c)	Moisture (%)	pH	Organic carbon (%)
2007	JUL	31.5	33.7	6.4	3.58
	AUG	30.9	36.5	6.1	3.95
	SEPT	31.2	34	6.3	3.66
	OCT	30	31.5	6.6	2.35
	NOV	28	30	6.4	3.52
	DEC	26.3	29	6.3	3.3
2008	JANU	19.8	27	6.5	3.1
	FEB	21	27.5	6.4	2.9
	MAR	26	29	6.3	2.7
	APRL	32.8	28	6.5	1.5
	MAY	34.5	25.5	6.9	1.3
	JUN	32	28.5	6.8	2.7
	JUL	30	33	6.2	3.9
	AUG	31	34.5	6.1	4.1
	SEPT	30	33	6.3	3.75
	OCT	28	31	6.5	3.2
	NOV	25.6	30	6.2	2.8
	DEC	24	28.5	6.1	2.9
2009	JANU	20.2	27.5	6.3	3.23
	FEB	21	27	6.5	3.12
	MAR	28	26.5	6.6	2.66
	APRL	33.5	27	6.8	2.2
	MAY	36.5	26.5	6.9	1.5
	JUN	34	27	6.5	1.9
	JUL	32	34.5	6.3	3.7
	AUG	30.5	36	6.1	3.9
	SEPT	31	33.5	6.5	3.6
	OCT	30	31.5	6.7	3.5
	NOV	28.5	29	6.4	3.6
	DEC	26	28	6.2	3.3

of soil factors like-moisture, organic carbon and other edaphic factors (Fig. 1).

Seasonal changes

Seasonal changes of each predominant species of Collembola obtained from this site revealed that *Lepidocyrtus magnificus, Lepidocyrtus medius* and *Onychiurus indicus* had reached at its peak in August in both the years, while *Lepidocyrtus exploratorius* showed maximum in January 2008 but 2009 the peak was shifted to December. It is apparently seen that, predominant forms of collembolan obtained from this site exhibited an irregular trend of fluctuation being minimum in April/May/June, slightly higher in December/January/February and higher in July/August/ Sept. In this field, the population peak of other genera/ species varied among the years as well as month of observation due to their irregular occurrence (Fig. 2).

SITE II : BESIDE THREE UPROOTED LOGS, PATH NO.1, 100 MTS FROM SITE 1, TOWARDS EAST.

Location and Characteristic of sampling site-II :

This locality is situated about 100 meters from the previous locality towards south of the core area of the sanctuary. There are few uprooted logs present in that area and underneath the logs large nos. of fungal combs were growth. The locality was also covered with large numbers of tall trees along with some herbs and shrubs. Soil was humid and large nos. of decomposed leaves was present.

Soil factors

Soils of the plots were alluvial in nature, blackish brown in colour and sandy silt in texture. Mechanical analysis of soil showed maximum percentage of medium silt 35.6% and more or less equal percentage of fine

sand and fine silt. During May, soil moisture content was 25.5% in 2008 and 26.5% in 2009. The month of August in sampling year showed maximum moisture content in soil (36.5% in 2007, 34.5% in the same period of 2008 and 36% in 2009. During May, other soil factors such as temperature, pH and organic carbon, were found 34.5°C, 6.9, 1.3%; 36.5°C, 6.9, 1.5%; in 2008 and 2009 respectively. Mean values of others revealed more or less identical characteristics (Table-2).

Collembolan Fauna

The Collembolan fauna obtained from this site belonged to 14 species under 12 genera. The species *Xenylla obscura* was the most dominant with 16.4% of the total fauna recorded from this site. The species are, *Lepidocyrtus medius, Onychiurus indicus, Lepidocyrtus exploratorius, Ballistrura bengalensis* and *Isotomina thermophila* which represented 13.58%, 12.94%, 10.76%, 8.97%, and 6.15% respectively. Population of other species from this site was

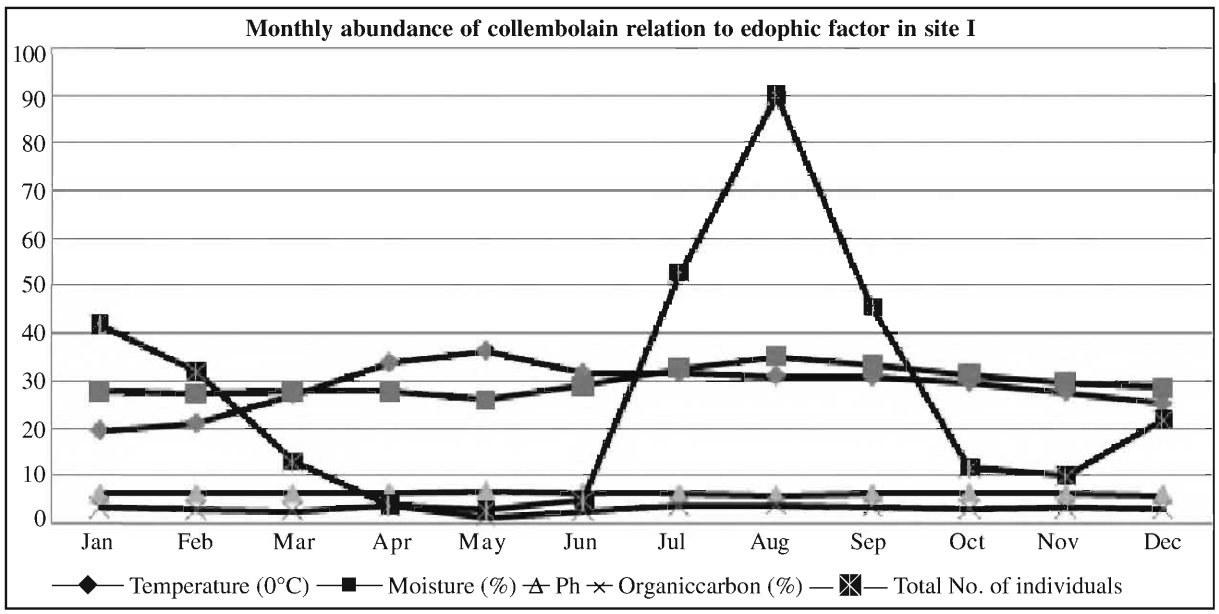

Fig. 2 : Monthly abundance of collembola in relation to edaphic factor in site-I.

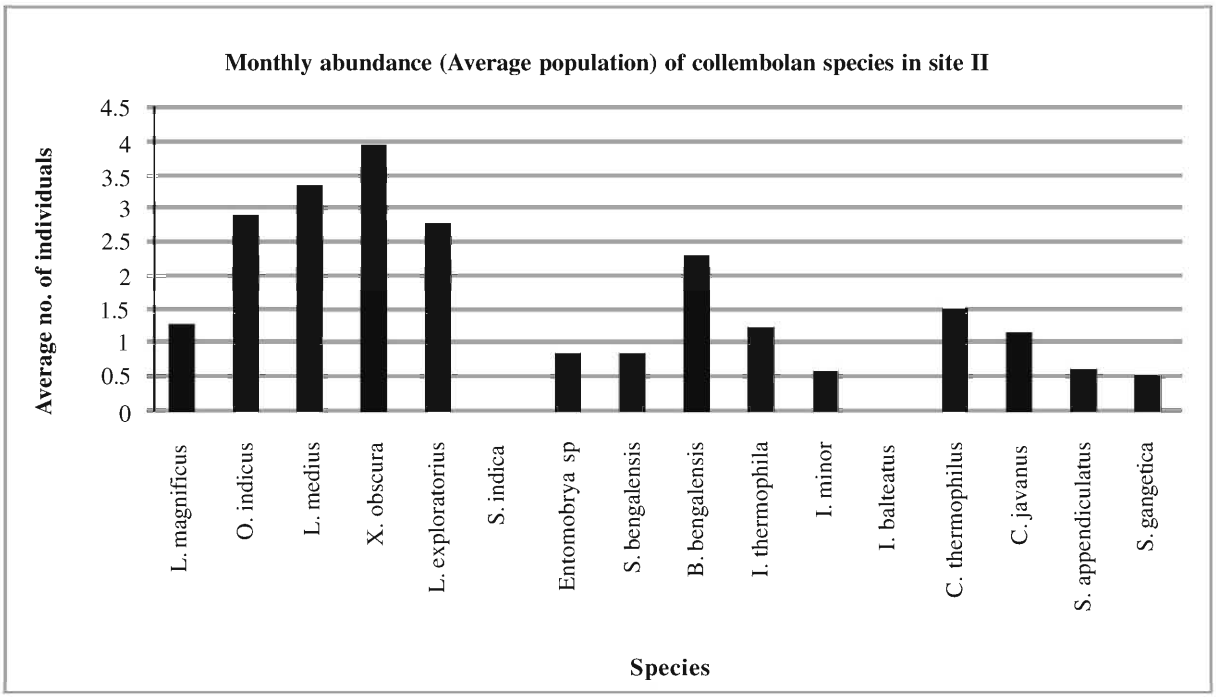

Fig. 3 : Monthly abundance (Average population) collembolan species in Site-II.

numerically low and highly irregular in distribution pattern. The population of collembola was found maximum in the month of August in both the year, which coincided with the maximum concentration of soil factors like moisture, pH and organic carbon. Partial increase in population in December- January as obtained in this site might be due to prevalence of winter maxima resulting from increased population of some species of collembolan as evident (Fig. 3).

Seasonal Changes

Number of each predominant species of collembolan insects obtained from this site revealed that *Xenylla obscura* and *Onychiurus indicus* indicating single peak in August in both the year (2008 and 2009) while *Lepidocyrtus medius* showed its peak in December, 2008 but in 2009 the peak shifted to February. *Lepidocyrtus exploratorius* and *Ballistrura bengalensis* exhibited highest peak in January (2008 & 2009) in both the year. It became apparently evident that predominant formed of collembolan obtained in this site exhibited an irregular trend of fluctuation The population maxima of other genera and species varied during the years as well as months of observation due to their irregular occurrence in this field (Fig. 4).

SITE III : FOUR WAY CROSSING PATH, 200 MTS FROM SECOND SITE, TOWARDS WESTERN SIDE.

Location and Characteristic of sampling site-III :

This locality was situated in the four way crossing path of the core area of the sanctuary. The locality was also covered with large numbers of tall trees but not thickly populated. The area also covered with large nos. of tall grasses. The soil was semi-dry and alluvial in nature. The sampling site was maintained with coverage of litter of the fallen leaves and dried twigs of the above trees.

Soil factors

Soils are alluvial, blackish brown in colour and clayey silt to silty in texture. Mechanical analysis of soil showed maximum percentage of coarse to medium silt 36.4% and more or less equal percentage of fine sand and fine silt. During May, soil moisture content was 25.5% in 2008 and 25% in 2009.The month of August in each sampling year showed maximum moisture content in soil (34.5% in 2008 and 35% in 2009). During May, other soil factors such as temperature, pH and organic carbon were found 35°C, 6.9 & 1.3%; 37°C, 6.8 & 1.5% in 2008 and 2009 respectively. The mean values of other factors revealed more or less identical characteristics (Table-3).

Collembolan Fauna

The Collembolan fauna obtained from this site belonged to 12 species under 10 genera. Amongst them, the genus *Lepidocyrtus exploratorius* was found most dominant and it was (23.3%) of the total fauna recorded from this site. The species *Lepidocyrtus medius* was recorded the second dominant (15.94%) of the total fauna recorded from this site. The species *Lepidocyrtus magnificus* represented 12.46%, *Xenylla obscura* represented 12.17%, *Ballistrura bengalensis* represented 9.56%, *Salina bengalensis* was 6.23% and *Cyphoderus javanus* 4.63%. Population of other species from this site was numerically low and highly irregular in distribution pattern in the sampling site. The percentage of springtails was found maximum in August in both the years, and second highest in the month of January in each year which coincided with the maximum concentration of soil factors like-moisture, organic

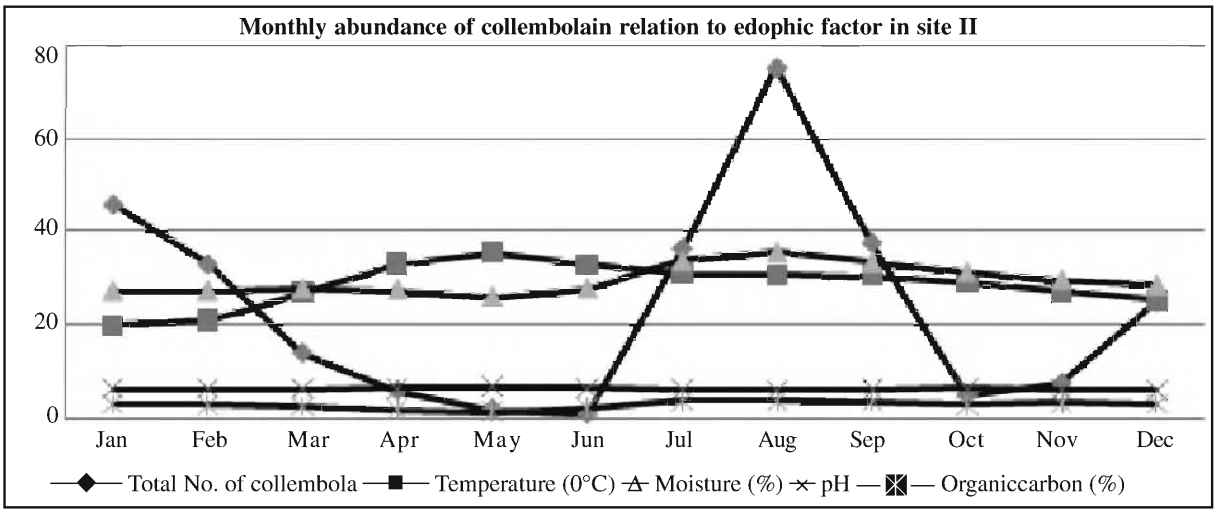

Fig. 4 : Monthly abundance of collembola in relation to edaphic factor in site-II.

Table-3 : Values of edaphic factors per month (JULY, 2007- DEC, 2009) at site II, B.B.W.L.S, Parmadan

Year	Month	Temperature (0°c)	Moisture (%)	pH	Organic carbon (%)
2007	JUL	31.8	32.8	6.5	3.63
	AUG	30.5	34.5	6.1	3.95
	SEPT	31.2	33.5	6.5	3.66
	OCT	31	31.5	6.6	2.35
	NOV	29.5	30	6.4	3.52
	DEC	26	28.5	6.3	3.3
2008	JANU	19	27.8	6.4	3.4
	FEB	21	27.5	6.4	2.9
	MAR	26	29	6.3	2.7
	APRL	34	28	6.5	1.5
	MAY	35	25.5	6.9	1.3
	JUN	30	31.9	6.8	2.7
	JUL	30.5	33	6.2	3.9
	AUG	32	34.5	6.1	4.1
	SEPT	30	33	6.3	3.8
	OCT	28	31	6.5	3.2
	NOV	25	30	6.2	2.8
	DEC	23.5	28.5	6.1	3.1
2009	JANU	20	27.5	6.3	3.23
	FEB	21	27	6.5	3
	MAR	28	26.5	6.6	2.7
	APRL	33.5	27	6.8	2.2
	MAY	37	25	6.8	1.5
	JUN	33	26	6.5	2.3
	JUL	32	32	6.3	3.7
	AUG	30.5	35	6.1	3.95
	SEPT	31.2	33.5	6.5	3.6
	OCT	30	31.5	6.6	3.5
	NOV	28.5	29	6.4	3.6
	DEC	26	27.5	6.3	3.3

carbon and minimum value of Ph and temperature (Fig. 5).

Seasonal changes

The seasonal changes in number of each predominant species of Collembola as observed in this site have been shown in figure. The most dominant species *Lepidocyrtus exploratorius* had reached at its peak in August in both the years. *Lepidocyrtus medius* showed its peak in August, 2008 but the year 2009 peak shifted to January. The population density of *Xenylla obscura* was maximum in January 2008 and it remained high during December-January in each year. *Ballistrura bengalensis* and *Isotomina thermophila* showed highest population peak during January in each year where as *Entomobrya sp*, *Cyphoderus javanus* and *Sphyrotheca gangetica* showed highest population peak during August in each year. It became apparent that predominant forms of this site exhibited an irregular trend of fluctuation being minimum in May-June slightly higher in December/January and higher in August-September. The population peak of other genera/species varied among the years as well as month of observation due to their irregular occurrence in this field (Fig. 6).

SITE IV : EMBANKMENT OF ICHAMOTI RIVER, BIBHUTI BHUSHAN SANCTUARY.

Location and Characteristic of sampling site-IV :

This locality was periphery of the river Ichamoti. This site was chosen as an experimental site for collection of soil micro-arthropods fauna because it is semi disturbed by human population. This area is under the buffer zone where large number of tall trees, herbs and shrubs were present. Soil was moist and alluvial in nature.

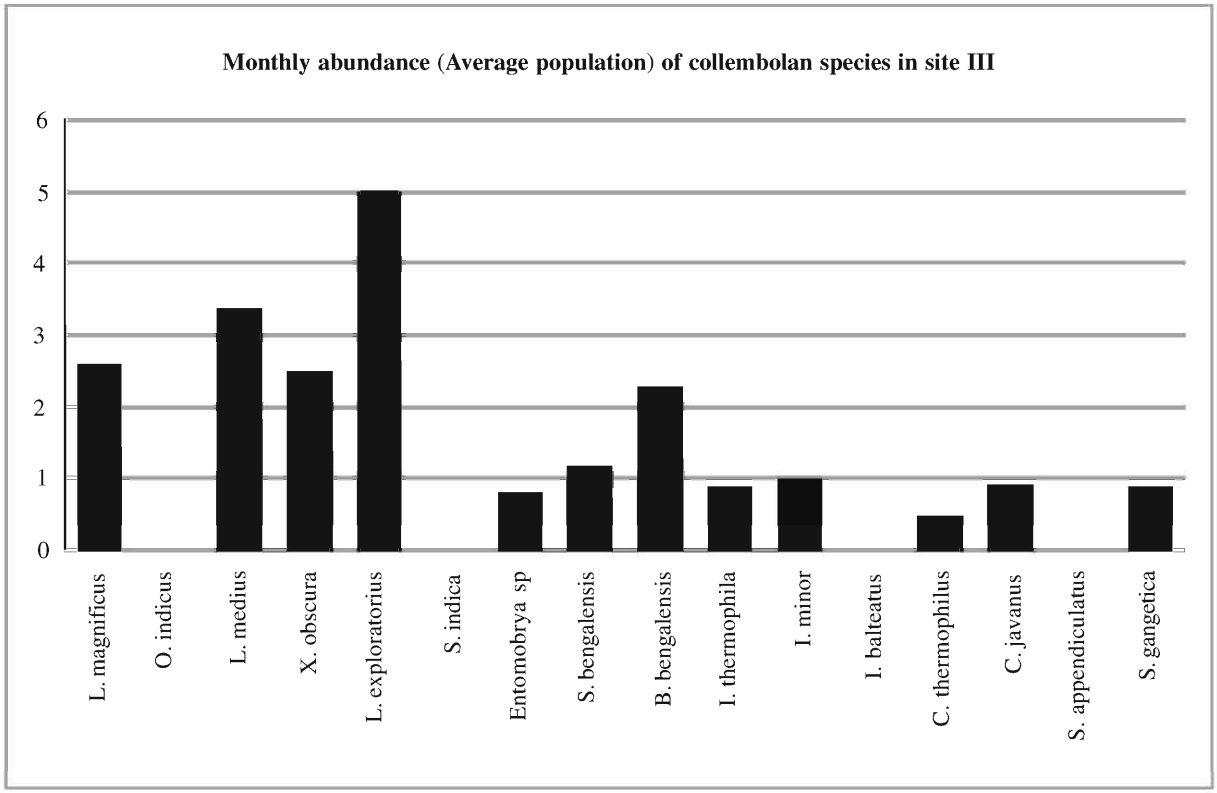

Fig. 5 : Monthly abundance (Average population) collembolan species in Site-III.

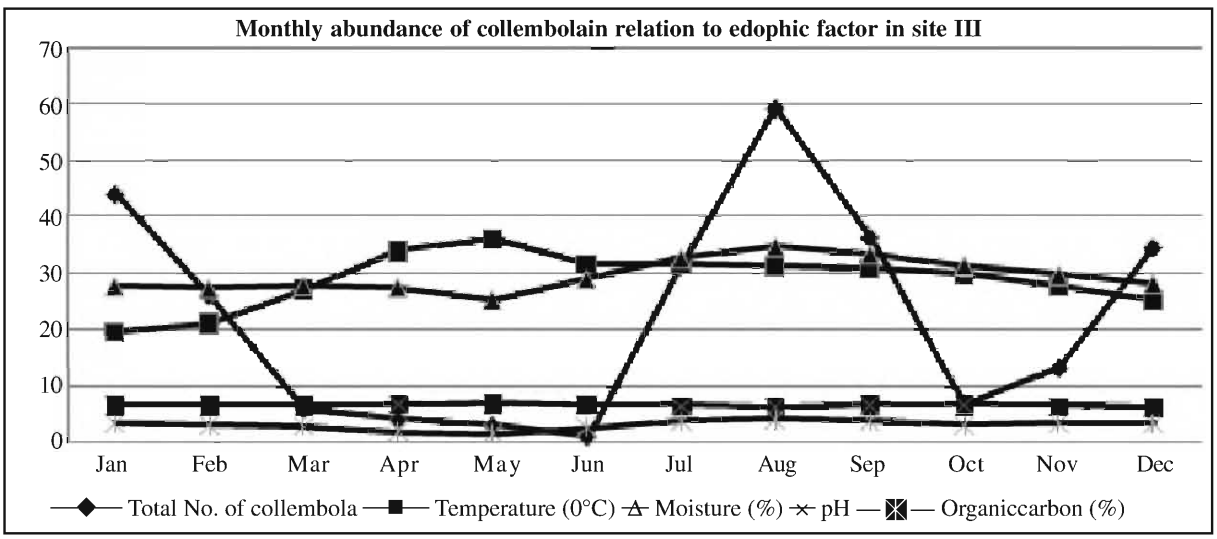

Fig. 6 : Monthly abundance of collembola in relation to edaphic factor in site-III.

Soil factors

Soils of this plot was alluvial in nature, brownish in colour and clayey silt to silty in texture. Mechanical analysis of soil showed maximum percentage of fine silt, the amount being 44.5%. During May, soil moisture content was 25.5% in 2008 and 25% in 2009. Maximum moisture content in soil (35.5%) was recorded in August, 2008; 35% and 34.8% in the same period of 2007 and 2009. Other factors like-organic carbon was found to be maximum in 4% in November, 2009, 3.95% in August, 2007 and 3.8% in the same period of 2008. Mean values of others revealed more or less identical characteristics (Table-4).

Collembolan Fauna

The Collembolan fauna obtained from this site belonged to 10 species under 9 genera. The species *Lepidocyrtus medius* was found most dominant form with 18.46%. The species *Lepidocyrtus magnificus* was

Table-4 : Values of edaphic factors per month (JULY, 2007-DEC, 2009) at site IV, B.B.W.L.S, Parmadan

Year	Month	Temperature (0°c)	Moisture (%)	pH	Organic carbon (%)
2007	JUL	32	33	6.3	3.5
	AUG	30.5	35	6.1	3.95
	SEPT	31	33.5	6.5	3.66
	OCT	30.5	31	6.4	3.5
	NOV	29.2	30	6.3	3.5
	DEC	26	29	6.5	3.3
2008	JANU	20	28	6.4	3.3
	FEB	21	27.5	6.7	2.92
	MAR	29.5	29	6.9	2.2
	APRL	34	28	6.9	2.1
	MAY	34.5	25.5	6.8	1.5
	JUN	32.5	27	6.2	1.3
	JUL	30.5	32	6.1	2.75
	AUG	32	35.5	6.5	3.8
	SEPT	30	33.5	6.6	3.6
	OCT	28	31	6.4	3.75
	NOV	26	30	6.3	3.2
	DEC	22.5	29	6.4	2.8
2009	JANU	21	28	6.4	3
	FEB	22	27	6.5	2.9
	MAR	28.5	29	6.9	3
	APRL	35	28	6.8	2.8
	MAY	37.5	25	6.2	1.6
	JUN	33.5	29.5	6.1	1.3
	JUL	32	33	6.3	2.7
	AUG	30	34.8	6.5	3
	SEPT	31.2	34	6.2	3.9
	OCT	28	31	6.3	3.95
	NOV	27.5	30	6.2	4
	DEC	22.5	28	6.1	3.2

recorded the second dominant 17.69% of the total fauna recorded from this site. The species *Isotomiella minor* contributed 12.11% followed by *Isotomina thermophila* contributed 10.38%, *Ballistrura bengalensis* contributed 9.23%, *Xenylla obscura* contributed 8.07%, *Entomobrya sp* contributed 6.9%, and *Cyphoderus javanus* contributed 6.3%, Maximum percentage of collembolan population was obtained in August of both the years followed by December-January which coincided with the maximum concentration of soil factors like-moisture, organic carbon and low concentration of soil pH (Fig. 7).

Seasonal changes

The month wise changes in abundance of individual predominant species of Collembola recorded from this site have been shown in Fig. Maximum population density of the most dominant species *Lepidocyrtus medius* was December in both the year. The second dominant species *Lepidocyrtus magnificus* exhibited its peak in August in both the years, while the highest population density of *Isotomiella minor* was in February 2008 & 2009. *Isotomina thermophila* showed population peak in November of both the year, where as *Ballistrura bengalensis* exhibited its peak in January of both the year. It became apparent that predominant forms of the site exhibited an irregular trend of fluctuation being minimum in May, slightly higher in December/January/ February and higher in August-September. The peak of population of other genera / species varied among the years as well as month of observation due to their irregular occurrence (Fig. 8).

STATISTICAL ANALYSIS OF DATA

The statistical analysis of the complex soil faunal communities has been conducted to show the

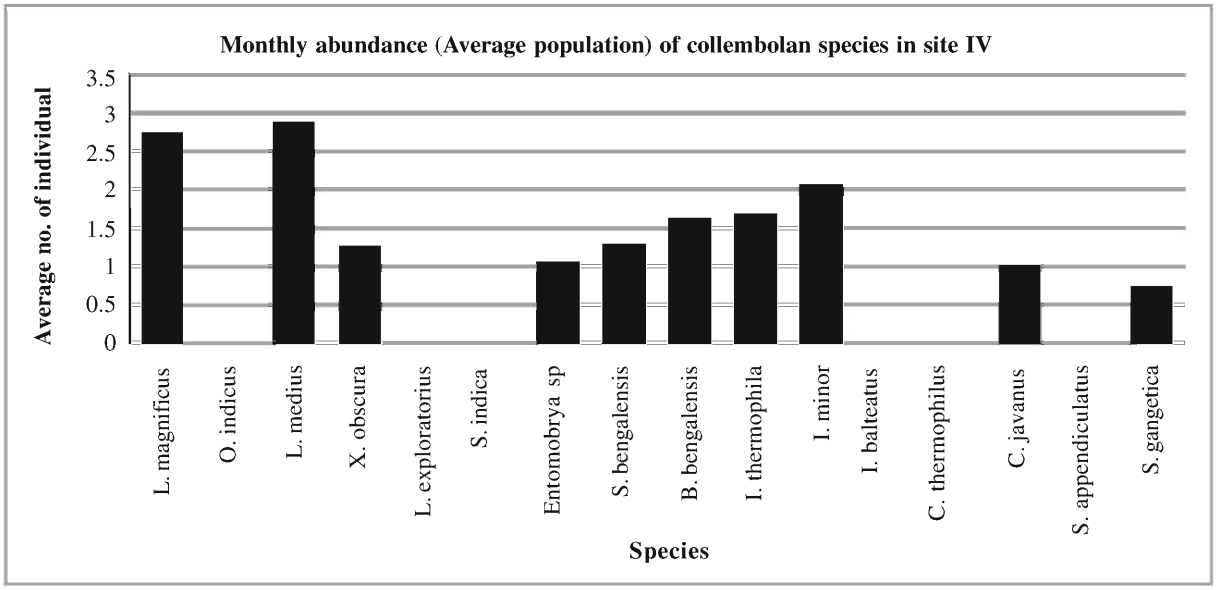

Fig.7. Monthly abundance (Average population) collembolan species in Site-IV.

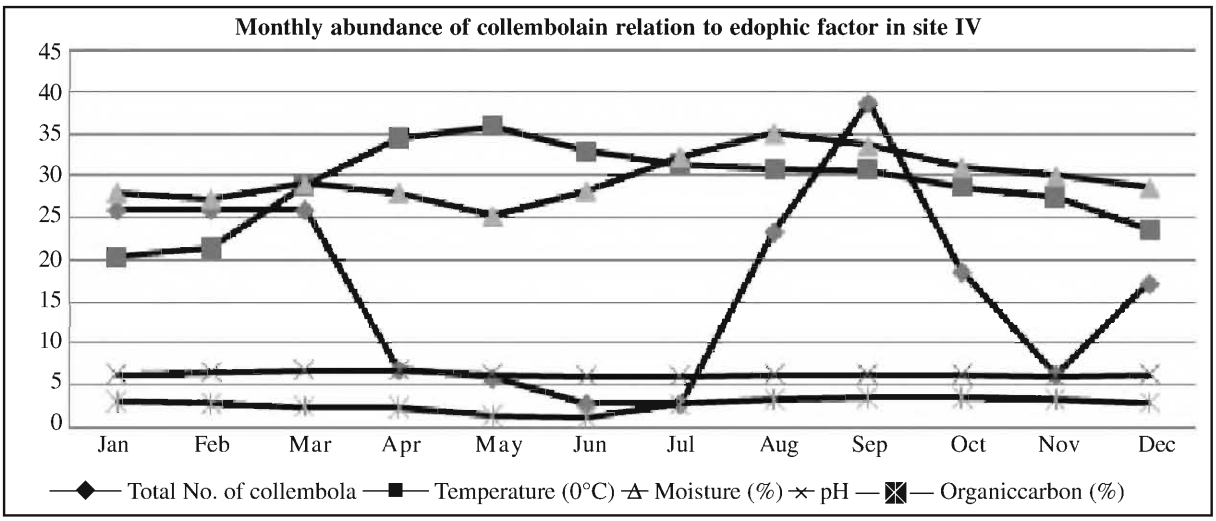

Fig. 8 : Monthly abundance of collembola in relation to edaphic factor in site-IV.

relationship between the soil factors and Collembola. The application of LINEAR CORRELATION and ANOVA (One way analysis) were undertaken in the present study involving the data of soil factors and collembolan population densities of soil separately for each site. All the analysis has been carried out by using MINITAB statistical software.

LINEAR CORRELATION

The correlation coefficient ('r' value) of each variable (i.e. total population of Collembola and four edaphic factors (temperature, moisture, pH, organic carbon) on each other in individual site were shown (Table 5-8). The correlation revealed identical relationship between the biotic variables in four sites. The correlation coefficient data mentioned in the above table broadly indicated that the edaphic factors like moisture, organic carbon with the biotic variables showed strong positive correlation in almost four sites. The correlation coefficient ('r' value) in respect of other variables like - temperature and pH with the biotic variables was found to be negatively significant correlated in all four sampling sites with the population densities of Collembola.

ANALYSIS OF VARIANCE (ANOVA) : ONE WAY ANALYSIS

An univariate analysis of variant with the month as a factor have been carried out whether any significant seasonal fluctuation exist or not in the population of individual species of collembolan in the four sampling sites. The results of analysis are represented in the tables 9-12.

Table-5 : Correlation(r value) between individual collembolan species with edaphic factors at Site-I

Name of the species	Temperature	Moisture	pH	Organic carbon
L. magnificus	-0.180147846	0.828530719	-0.652997651	0.652985415
O. indicus	0.109146027	0.872077366	-0.476077623	0.565049206
L. medius	0.11233319	0.740633265	-0.583840341	0.498988274
X. obscura	-0.1471323	0.6677209	-0.568348	0.5597715
L. exploratorius	-0.4904062	0.1977307	-0.6556189	0.4604979
Seira indica	-0.0113091	0.5849276	-0.6844386	0.479076045
Entomobrya sp	0.073256903	0.6271018	-0.5098721	0.469072044
S. bengalensis	0.1328547	0.760909	-0.6889775	0.5749779
B. bengalensis	-0.5243741	0.0777475	-0.371506	0.2472246
I. thermophila	-0.4010517	0.2774619	-0.6175193	0.427766
I. minor	-0.4397747	0.1281827	-0.3908345	0.2303874
I. balteatus	-0.2558236	0.5459557	-0.6186606	0.5190585
C. thermophilus	-0.2035165	0.2805958	-0.1707681	0.144376
C. javanus	0.312443	0.5646476	-0.2376556	0.1216208
S. appendiculatus	0.1261598	0.6036843	-0.5247406	0.372721
S. gangetica	-0.0889385	0.2606868	-0.04174	0.2815279

Table-6 : Correlation(r value) between individual collembolan species with edaphic factors at Site-II

Name of the species	Temperature	Moisture	pH	Organic carbon
Xenylla obscura	-0.160745935	0.786287817	-0.702520498	0.775227292
O. indicus	0.010067725	0.846771521	-0.645910627	0.749046149
L. medius	-0.713751666	0.235595549	-0.726386647	0.640066048
L magnificus	0.030307095	0.711675122	-0.590427574	0.603337027
L. exploratorius	-0.641062164	0.118584114	-0.562758953	0.435401949
Entomobrya sp	-0.023930549	0.634964027	-0.540389791	0.612977051
S. bengalensis	0.010436281	0.737650625	-0.746756504	0.663690309
B. bengalensis	-0.600913827	0.160241109	-0.485428386	0.449267921
I. thermophila	-0.196002606	0.600050933	-0.616270704	0.618689652
I. minor	-0.0505153	-0.175735766	0.112915938	-0.154284743
C. thermophilus	-0.178304138	0.447560095	-0.49987309	0.485600752
C. javanus	-0.270770226	0.325937808	-0.502561668	0.417739981
S. appendiculatus	0.062358655	0.5653906	-0.476560067	0.41675546
S. gangetica	-0.165588862	0.415864006	-0.337913016	0.440254448

DISCUSSION

The ecological studies of this investigation were based on the sample survey of four sites from Bibhuti Bhushan Wild Life Sanctuary (B.B.W.L.S), Parmadan, over a period of 30 months (July, 2007 to December, 2009). Three sampled sites from undisturbed core area of forest floor site and remaining one from the disturbed area of buffer zone of the sanctuary were chosen for the study. All the sites were in Gangetic plains exposed to tropical climate with humidity and temperature were comparatively low during winter months. The general natures of the soil of four sampling sites were more or less identical.

The Collembolan fauna of the four study sites belonged to 16 species under 14 genera of 5 families :

Table-7 : Correlation(r value) between individual collembolan species with edaphic factors at Site-III

Name of the species	Temperature	Moisture	pH	Organic carbon
L. exploratorius	-0.19972168	0.759832386	-0.64782442	0.766060986
L. medius	-0.22345409	0.675319364	-0.79656544	0.822330775
L magnificus	-0.46728373	0.312762165	-0.82608251	0.663508738
Xenylla obscura	-0.36449774	0.208942839	-0.63706734	0.485379347
Entomobrya sp	0.314452079	0.616396327	-0.44285257	0.454654867
S. bengalensis	0.04499953	0.614285487	-0.788804907	0.673644188
B. bengalensis	-0.573729409	0.052634449	-0.366712885	0.376901917
I. thermophila	-0.404695465	0.252999771	-0.622044443	0.537796337
I. minor	-0.374934492	0.013236549	-0.240146053	0.232201029
C. thermophilus	-0.103092716	0.276730841	-0.034946384	0.24640714
C. javanus	0.052437799	0.397337724	-0.553073922	0.388962368
S. gangetica	-0.431735679	0.129699091	-0.113793406	0.30733033

Table-8 : Correlation(r value) between individual collembolan species with edaphic factors at Site-IV

Name of the species	Temperature	Moisture	pH	Organic carbon
L. magnificus	-0.1769545	0.7930076	-0.1552162	0.6441762
L. medius	-0.5412866	0.3043318	-0.3977079	0.5057319
X. obscura	-0.0129628	0.7109205	-0.1085984	0.4338867
Entomobrya sp	-0.0682902	0.5641524	-0.2329746	0.3258003
S. bengalensis	-0.2913997	0.5334357	-0.1288971	0.45457
B. bengalensis	-0.6259028	0.0705465	-0.0677042	0.2411919
I. thermophila	-0.3531079	0.196177	-0.4460732	0.4604439
I. minor	-0.7241513	0.1795067	-0.1223435	0.1866484
C. javanus	-0.1208675	0.4982095	-0.0322146	0.3499985
S. gangetica	-0.2927487	0.30753	-0.1950678	0.3256444

Hypogastruridae, Onychiuridae, Isotomidae, Entomobryidae and Sminthuridae (Table-13).

The number of genera occurring in four different sampling sites also varied, maximum extracted from the site-I (16 species under 14 genera) and minimum from disturbed area of buffer zone of the sanctuary (10 species under 9 genera). Out of the 14 genera, the predominant genera were *Lepidocyrtus* (3 species), *Onychiurus*(1 species), *Xenylla* (1 species), *Cyphoderus* (1 species), *Cryptopygus* (1 species), *Ballistrura* (1 species), *Isotomina* (1 species) and *Salina*(1 species) *Sphyrotheca* (1 species) and *Sminthurides*(1 species) mentioned in order of dominance.

The genus *Lepidocyrtus* were represented by 3 species like, *L. exploratorius, L. medius* and *L. magnificus*. The genus was found to be widely distributed in all sampling plots comprising 31.8 % of total population of collembola and being numerically dominant over other forms. The wide distribution range and numerical dominance suggest capability of this genus to dwell in varying ecological conditions. The species, *Lepidocyrtus magnificus* was seen the most dominant taxon of this genus and occupied first position in order of dominance in respect to the total number of collembola indicating maximum genera and species in the month of August.

The second predominant genus was *Xenylla* with single species *obscura,* comprising 10.45% of the total population in all the sites. The species was recorded in maximum from the sampling site II reaching its peak in January-February.

The third numerical dominant genus *Cyphoderus* represented by single species *javanus* was extracted in maximum number (9.83%) in February from all the

Table-9 : ANOVA (One way analysis) of the collembolan species in relation to the edaphic factors in Site-I

Species	Temperature		Moisture		pH		Organic carbon	
	F value	P value*	F value	P value*	F value	P value*	F value	P value*
L. magnificus	173.97	0.000	329.54	0.000	1.57	0.224	3.16	0.089
O. indicus	179.63	0.000	316.2	0.000	5.77	0.025	0.09	0.771
L. medius	152.86	0.000	250.17	0.000	3.2	0.088	0.31	0.582
X. obscura	310.76	0.000	788.52	0.000	69.34	0.000	7.08	0.014
L. exploratorius	239.51	0.000	499.66	0.000	18.04	0.000	0.3	0.587
S.indica	358.05	0.000	1056.63	0.000	228.95	0.000	30.13	0.000
Entomobrya sp	334.22	0.000	892.93	0.000	110.23	0.000	15.25	0.001
S.bengalensis	363.33	0.000	1096.81	0.000	288.55	0.000	36.65	0.000
B. bengalensis	218.78	0.000	415.82	0.000	14.44	0.001	0.45	0.507
I. thermophila	348.82	0.000	997.9	0.000	170.54	0.000	22.17	0.000
I. minor	372.73	0.000	1162.82	0.000	454.92	0.000	54.16	0.000
I. balteatus	337.98	0.000	945.8	0.000	132.69	0.000	15.22	0.001
C. thermophilus	364.58	0.000	1111.76	0.000	319.44	0.000	38.87	0.000
C. javanus	358.58	0.000	1068.68	0.000	245.6	0.000	30.8	0.000
S. appendiculatus	324.08	0.000	818.59	0.000	86.02	0.000	13.01	0.002
S. gangetica	342.08	0.000	966.67	0.000	146.49	0.000	17.53	0.000

* < 0.05 significant

Table-10 : ANOVA (One way analysis) of the collembolan species in relation to the edaphic factors in Site-II

Species	Temperature		Moisture		pH		Organic carbon	
	F value	P value*	F value	P value*	F value	P value*	F value	P value*
X. obscura	218.3	0.000	383.15	0.000	6.77	0.016	1.12	0.301
O.indicus	221.66	0.000	372.88	0.000	11.19	0.003	0.000	0.995
L. medius	243.83	0.000	445.81	0.000	12.73	0.002	0.27	0.611
L magnificus	339.52	0.000	710.28	0.000	82.44	0.000	7.36	0.013
L. exploratorius	260.3	0.000	482.12	0.000	19.35	0.000	0.02	0.891
Entomobrya sp	380.08	0.000	866.15	0.000	211.63	0.000	22.15	0.000
S. bengalensis	381.7	0.000	873.42	0.000	223.54	0.000	23.24	0.000
B. bengalensis	246.93	0.000	430.23	0.000	18.31	0.000	0.36	0.553
I. thermophila	347.78	0.000	743.91	0.000	98.11	0.000	8.69	0.007
I. minor	404.57	0.000	969.96	0.000	564.53	0.000	51.88	0.000
C. thermophilus	359.39	0.000	813.46	0.000	148.56	0.000	9.34	0.006
C. javanus	340.48	0.000	708.68	0.000	83.05	0.000	8.11	0.009
S. appendiculatus	358.59	0.000	755.07	0.000	110.49	0.000	14.98	0.001
S. gangetica	400.56	0.000	942.44	0.000	386.96	0.000	42.87	0.000

* < 0.05 significant

sampling sites though the insects were maximum in number in March.

Another dominant genus *Ballistrura* & *Onychiurus* extracted from both the sites and comprised 8.69% and 7.28% of total population occupying fourth position in dominance.

The two genera of collembolan species, *Isotomiella minor* (6.20% of the total population) and *Salina*

Table-11 : ANOVA (One way analysis) of the collembolan species in relation to the edaphic factors in Site-III

Species	Temperature		Moisture		pH		Organic carbon	
	F value	P value*	F value	P value*	F value	P value*	F value	P value*
L. exploratorius	175.22	0.000	399.49	0.000	1.7	0.205	3.39	0.079
L. medius	210.63	0.000	580	0.000	9.04	0.006	0.16	0.693
L magnificus	263.53	0.000	475.51	0.000	25.5	0.000	0.2	0.66
Xenylla obscura	239.21	0.000	882.23	0.000	18	0.000	0.23	0.634
Entomobrya sp	342.42	0.000	879.72	0.000	121.22	0.000	14.93	0.001
S. bengalensis	341.45	0.000	910.86	0.000	132.7	0.000	12.45	0.002
B. bengalensis	223.81	0.000	416.25	0.000	15.47	0.000	0.38	0.546
I. thermophila	353.06	0.000	961.22	0.000	171.69	0.000	18.86	0.000
I. minor	335.71	0.000	855.75	0.000	106.81	0.000	11.98	0.002
C. thermophilus	371.36	0.000	1044.6	0.000	265.82	0.000	34.3	0.000
C. javanus	340.46	0.000	880	0.000	118.72	0.000	13.66	0.001
S. gangetica	338.96	0.000	868.28	0.000	113.49	0.000	13.37	0.001

* < 0.05 significant

Table-12 : ANOVA (One way analysis) of the collembolan species in relation to the edaphic factors in Site-IV

Species	Temperature		Moisture		pH		Organic carbon	
	F value	P value*	F value	P value*	F value	P value*	F value	P value*
L. magnificus	285.08	0.000	692.14	0.000	34.96	0.000	0.03	0.872
L. medius	269.22	0.000	617.08	0.000	24.95	0.000	0.000	0.972
X. obscura	339.15	0.000	898.81	0.000	112.73	0.000	8.83	0.007
Entomobrya sp	353.03	0.000	971.68	0.000	159.75	0.000	14.20	0.001
S. bengalensis	352.08	0.000	991.22	0.000	175.57	0.000	12.49	0.002
B. bengalensis	295.25	0.000	674.91	0.000	45.36	0.000	2.66	0.117
I. thermophila	330.99	0.000	885.95	0.000	100.99	0.000	5.02	0.036
I. minor	306.35	0.000	764.50	0.000	56.41	0.000	1.58	0.222
C. javanus	362.15	0.000	1033.59	0.000	221.85	0.000	19.03	0.000
S. gangetica	381.72	0.000	1155.10	0.000	523.70	0.000	41.45	0.000

* < 0.05 significant

bengalensis (4.80% of the total population) was taken out in maximum numbers of all the sites in August.

The other important genera collected there were, *Entomobrya, Isotomina, Cryptopygus, Seira, Isotomurus, Sphyrotheca and Sminthurides* constituting 3.52%, 3.48%, 3.44%, 2.86%, 2.72%, 2.57%, and 1.95% respectively.

The aforesaid variations of the faunal components might be due to the differences in the ecological conditions with some genera being wide spread occurring regularly in different sampling sites because they could tolerate wide variety of habitats and were aptly called "Ubiquist" or "ecological generalized groups". On the other hand, some forms were localized or restricted to ecological specialized group.

The nine genera of collembolans, *Xenylla, Lepidocyrtus, Salina, Entomobrya, Cyphoderus, Ballistrura, Isotomiella, Isotomina* and *Sphyrotheca* seemed to have wider tolerance to different encountered during the present discourse and they were 'Ubiquists" (Table-14.).

Addison (1980) remarked that such faunal groups had the capacity to utilize different food sources and microhabitat for their survival while five genera namely, *Onychiurus, Seira, Isotomurus, Cryptopygus* and

Sminthurides were said to be restricted and as such they were "Stenocious".

Hazra & Choudhuri (1990) studied the distribution pattern of soil arthropod particularly Collembola and Acari of 14 kinds of ecosystems of West Bengal and found 2 "ubiquists" genera *Lepidocyrtus* and *Cyphoderus* and 23 "Stenocious"species. In another observation Hazra and Sanyal (1996) recorded 4 "ubiquists" species and 11 "Stenocious" species from a deciduous reserve forest floor as well as two mangrove areas (one natural & another artificially raised) in a silt deposited island in the river Hooghly.

In the present study, the total population of collembolan of all the sampling sites showed numerical variation with the change of season with minimum in May in all four sites. Moreover, a general pattern of fluctuation with maximum in monsoon and minimum in pre-monsoon (May), which in agreement with Hazra and Choudhuri (1990) and Hazra & Sanyal (1996).

Mitra *et al.*, (1977) and Hazra and Choudhuri (1990) showed that, surface soil vegetations exert an indirect influence on the collembolan population through its effect on the porosity of soil, humus formation and soil moisture in spite of different vegetation in most of the sampling sites.

According to Wallwork (1970), the Collembolan fauna of certain locality was determined by a complex factor of both ecological and historical. Therefore, the author is of the view that the degree of similarity in species composition between two sites could be used as an index of overall ecological similarity and the influence of vegetation type indirectly exert through its effect on soil type, micro floral composition or soil moisture.

Hagvar (1982) observed increase of number of springtails with the increase of soil fertility in coniferous forest floor but the species diversity and number appeared maximum in medium rich soil. He also measured the fertility-scale in accordance to vegetation types and noted that the soil moisture,the vegetation would better indicate Collembolan fauna in more extreme environmental condition.

Hazra and Sanyal (1996) found increase of the diversity of collembolan members in artificially raised mangrove forest of an island of the river Hooghly (West Bengal) and also said that the number increased with high concentration of moisture and nitrate.

According to Curry (1971) the maximum and minimum population were confined to a particular month or season of the years of observation in particular site which appears similar to the observations of workers in different parts of world. Study of maximum population in all sampling site in August and minimum in May tally with Mukherjee and Singh (1970).

During this investigation, only three predominant species *Lepidocyrtus magnificus, L. medius* and *Isotomurus balteatus* attained maximum population in August and two species, *Xenylla obscura* and in February. *Entomobrya* sp. reached its peak in January followed by *Lepidocyrtus exploratorius, Seira indica, Isotomiella minor, Cryptopygus thermophilus, Cyphoderus javanus* in March while *Sinella curviseta* and appeared largest population in the month of August. Individuals of other species like *Ballistrura bengalensis, Onychiurus indicus, Salina bengalensis, Isotomina thermophila* were numerically low in May with a very irregular trend of fluctuation and these were altogether absent in many of the sampling months. Thus, most of the predominant forms considered here were found to exhibit a single peak in a year.

According to Straalen (1997) some species had a sharp peak of collembolan community in respective months whereas others tend to fluctuate gradually throughout the year. Existence of single peak suggested the probability of single generation per year (Bellinger, 1954 and Hale (1966).

The role of edaphic factors on the distribution and population pattern of different groups of soil inhabiting micro fauna and flora might be assumed that the factors so far analyzed in this study exerted both significant and insignificant effects either singly or in cumulative way depending on the nature of the site. The population was maximum when the factors like moisture, organic carbon were significantly high and other conditions were optimum.

Temperature and soil moisture appeared as the main driving variables for seasonal fluctuation of micro-arthropod population especially in temperature climate with dry summer period (Straalen, 1985, Satamou *et al.*, 1993). In the summer month's soil temperature was significantly high and yielded minimum population on account of lesser water content and physical stability of the humus layer in this type of climate in West Bengal.

Of the edaphic factors studied, temperature showed wide variation with the change of season, ranging between 19°C and 37.5°C (Table-1-4). Collembolan population indicated negative correlation with temperature in all four sites which confirm the study of

Table-13 : Taxonomic status of the Collembolan species from the four study sites of B.B.W.L.S, Parmadon.

ORDER	COLLEMBOLA
Suborder	Arthropleona
Family	HYPOGASTRURIDAE, Borner, 1913
Subfamily	Hypogastrurinae
Genus/species	*Xenylla obscura* Imms, 1912
Family	ONYCHIURIDAE, Borner, 1901
Subfamily	Onychiurinae
	Onychiurus indicus Choudhury & Roy, 1965
Family	ISOTOMIDAE, Borner, 1913
	Cryptopygus thermophilus (Axelson, 1900)
	Ballistrura bengalensis Yosii, 1966
	Isotomurus balteatus (Reuter, 1876)
	Isotomiella minor (Schaeffer, 1898)
	Isotomina thermophila (Axelson, 1900)
Family	ENTOMOBRYIDAE, Tomosvary, 1882
Subfamily	Entomobryinae
	Lepidocyrtus exploratorius Carpenter, 1924
	Lepidocyrtus medius Schaeffer, 1898
	Lepidocyrtus magnificus Carpenter, 1924
	Entomobrya sp
	Seira indica (Ritter, 1911)
Subfamily	Cyphoderinae
	Cyphoderus javanus Borner, 1906
Subfamily	Paronellinae
	Salina bengalensis Mitra, 1966
Sub order	Symphypleona
Family	Sminthuridae
	Sminthurides appendiculatus Imms, 1912
	Sphyrotheca gangetica Yosii, 1966

Pal *et al.* (1992) and Guru *et al.* (1988). Takeda (1978) also found both positive and negative correlation between temperature and different species of springtails. Hazra & Choudhuri (1983) commented that direct influence of temperature on the distribution pattern of Collembola was difficult to evaluate because collembolan are known to withstand a wide range of temperature, as low as -50°C (Paclt, 1956) and as high as 55°C (Dunger, 1964) and made a conclusion that temperature alone did not show significant correlation. Thus it might be noted in this connection that the direct influence of temperature on the distribution pattern of soil arthropods was difficult to evaluate. The actual influence of temperature on the soil-organisms could be evaluated in conjunction with the effect of moisture which recorded minimum in summer thereby yielding low population.

Moisture content was recorded maximum (36%) and minimum (27%) respectively in all four sites and thus a range of variation was observed in two different seasons. The value of correlation of collembola with moisture was highly significant in all four sites (Table 5-8). Mukherjee and Singh (1970), Choudhuri and Ray (1972), Hazra and Choudhuri (1983, 90) and Guru *et al.* (1988) found positive but not significant correlation between the soil organisms and moisture. Choudhuri

Table-14 : UBIQUITUS & STENOCIOUS species of Collembola from the study sites

STENOCIOUS Species (restricted to)			**UBIQUITUS Species (present in all sites)**
SITE I	**SITE II**	**SITE III**	**SITE IV**
Seira indica	*Onychiurus indicus*	*Cryptopygus*	*Lepidocyrtus magnificus*
Isotomurus balteatus	*Sminthurides*	*thermophilus*	*L. medius*
	appendiculatus		*Xenylla obscura*
			Entomobrya sp
			Salina bengalensis
			Ballistrura bengalensis
			Isotomina thermophila
			Isotomiella minor
			Cyphoderus javanus
			Sphyrotheca gangetica

and Roy (1972) and Singh and Pillai (1975) affirmed that soil humidity put its influence on micro-arthropods and collembolan in particular. Highly significant positive correlation with collembola and its monsoon population peak in all sampling sites was similar to Agrell (1941), Poole (1961), Knight (1961), Christiansen *et al.* (1961), Davis (1963), Gupta and Mukherjee (1976), Mitra *et al.*(1977), Hazra and Choudhuri (1981, '83). Haarlov (1960) considered either moisture or organic matters as an important ecological factor in the life of collembola in Danish soil. However, Choudhuri and Roy (1967) and Nijima (1971) reported significant influence of organic matter and soil moisture on the population of Collembola.

According to Singh and Pillai (1975), the ecological parameters like soil temperature, moisture, organic matter and CaCo3 content of soil influence composition of soil fauna either individually or in combination with other. Hazra (1978a, b) and Hazra & Choudhuri (1990) suggested that organic matter and water content of soil together exerted direct or indirect influence on the microbial floral and faunal population by (i) maintaining soil reaction, (ii) controlling humification and (iii) stimulating the growth of micro-macro-flora.

The content of organic carbon varied between 1.3% and 4.1% and exhibited strong positive correlations with the population densities of Collembola in all the sampling sites (Table 5-8). The concentration of large population of flora and fauna in the litter and humus layer suggested their affinity to organic matter. The high temperature and low moisture in the soil seemed to influence the amount of organic carbon as was evident here in summer during when soil contain less amount of organic because of low moisture level and ready oxidation of organic matter.

Another important variable affecting the population fluctuation of soil biota was the soil pH which read minimum of 6.1 and maximum of 6.9 (Table.1-4). However, its average value in four sites did not differ much and was more or less neutral. The statistical analysis showed strong negative correlation with the population densities of Collembola and pH at all four sites which agreed with the findings of Agrell (1941), Bellinger (1954), Choudhuri *et al.* (1978) and Pal *et al.* (1992). According to Hazra and Choudhuri (1983), more or less neutral pH was favorable to soil organisms while Dhillon and Gibson (1962) opined for very little or no direct effect of soil pH on the floral and faunal make up.

SUMMARY

The fauna of the experimental sites belong to 16 species of 14 genera of five families: Hypogastruridae, Onychiuridae, Isotomidae, Entomobryidae and Sminthuridae. Maximum species diversity came in view from the Site-I with 16 species in 14 genera and the minimum in the Site IV with 10 species in 9 genera.

The number of genera occurring in four different sampling sites also varied, maximum extracted from the site-I (16 species under 14 genera) and minimum from disturbed area of buffer zone of the sanctuary (10 species under 9 genera). Out of the 14 genera, the predominant genera were *Lepidocyrtus* (3 species), *Onychiurus* (1 species), *Xenylla* (1 species), *Cyphoderus* (1 species), *Ballistrura* (1 species), *Cryptopygus* (1 species), *Isotomina* (1 species) and

Salina (1 species), *Sphyrotheca* (1 species) and *Sminthurides* (1 species) mentioned in order of dominance.

Soil factors like temperature, moisture, hydrogen ion concentration, organic carbon and the roles of these edaphic factors of soil on the distribution of collembola in the man made forest ecosystem were taken into consideration in the study.

The peak of population also varied from site to site being minimum in pre monsoon (summer months) and maximum population during monsoon (in the month of August & September). Soil factors viz, moisture, organic carbon, also showed significant positive correlation with the Collembolan population in all the sites while negative correlation was observed in respect to temperature and pH.

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ON A NEW SPECIES *BADIS TRIOCELLUS* (PISCES : PERCIFORMES : BADIDAE) FROM NORTH EAST INDIA

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INTRODUCTION

Badids are small freshwater fish normally inhabit small streams or hill streams with slow to moderate flow. In the past, the genus *Badis* was generally treated as a member of the family Nandidae together with other genera like *Nandus*, *Polycentrus*, *Monocirrhus*, *Afronandus* and *Polycentropsis* (Ruber et al., 2004). Barlow et al. (1968) erected a separate family, Badidae for the genus *Badis* alone based on morphological and behavioral data. Following Kullander and Britz (2002), the family Nandidae is now restricted to the genus *Nandus* and the other genera like *Polycentrus*, *Monocirrhus*, *Afronandus* and *Polycentropsis* are classified in the family Policentridae.

Kullander and Britz (2002) in their taxonomic revision revealed that the family Badidae currently assigned to two genera *Badis* (with 12 species) and *Dario* (with 3 species). The distribution of the Badidae includes the Indian subcontinent, Pakistan, Nepal, Bangladesh, Myanmar, Peninsular Thailand, the Mae Khlong drainage and part of the Mekong basin in South East Asia as well as the Upper Irrawaddy in southern Yunnan, China.

Under the genus *Badis*, currently there are 13 described species known so far in the world. These are *Badis assamensis*, *Badis badis*, *Badis blosyrus*, *Badis chittagongis*, *Badis corycaeus*, *Badis ferrarisi*, *Badis kanabos*, *Badis khwae*, *Badis kyar*, *Badis pyema*, *Badis ruber*, *Badis siamensis* and *Badis tuivaiei*. Of these, 5 were described from India mostly from North East India viz. *Badis assamensis*, *Badis blosyrus*, *Badis kanabos* and *Badis tuivaiei*. *Badis badis* is cosmopolitan in distribution. *Badis chittagongis* is described from Chittagong Division, Bangladesh. *Badis corycaeus*, *Badis ferrarisi*, *Badis kyar*, *Badis pyema* and *Badis ruber* from Myanmar. *Badis ruber* was also reported to occur in Laos and Thailand. *Badis siamensis* and *Badis khwae* were described from Thailand. (Vishwanath and Shanta, 2004; Kullander and Britz, 2002).

While studying the *Badis* specimens collected from Subansiri river, Lower Subansiri district Arunachal Pradesh; Dilpai river, Dhemaji district Assam and Mynsor river, Jaintia Hills district Meghalaya, the authors came across some interesting specimens which were strikingly different from other known species of the region having three prominent spots (two on dorsal fin and one on anal fin). A detailed morphological study reveals its identity as new to science.

MATERIALS AND METHODS

The specimens are preserved in 5% formaldehyde. Twenty four morphological characters have been taken into consideration and measurements were done with a digital caliper, expressed in percentage in relation to standard length. The range, mean values and standard deviation (SD) are also incorporated. Counts and measurements were done according to Jayaram, 1999.

Badis triocellus sp. nov.
(Plate-I A, B; Table-1)

Material Examined : *Holotype* : 38.63 mm SL, India, Arunachal Pradesh, Lower subansiri district, Subansiri river below damsite, 2-vii-2007, Alt. 100 mtr. 27°32´82.0´´ N. 94°15´35.0´´ E. Coll. R. Mathew & Party (Reg. No. ERS-V/F- 2806).

Patatypes : 3 specimens, 30.73-39.09 mm TL, India, Arunachal Pradesh, Lower subansiri district, Subansiri river below damsite, 2-vii-2007, Alt. 100 mtr. 27°32´82.0´´ N. 94°15´35.0´´ E. Coll. R. Mathew & Party (Reg. No. ERS-V/F-2807).

4 specimens, 29.78 - 43.61 mm TL, India, Assam, Dhemaji District, Dilpai River, Gerukamukh, 2-vii-2007,

Alt. 106 mtr. Coll. R. Mathew & Party (Reg. No. ERS-V/F- 2808).

4 specimens, 36.67-45.27 mm TL, India, Assam, Dhemaji District, Dilpai River downstream, 3-vii-2007, Alt. 103 mtr. Coll. R. Mathew & Party (Reg. No. ERS-V/F-2809).

20 specimens, 25.42-48.74 mm TL, India, Arunachal Pradesh, Lohit District, Panbari village near Tezu, 2-vii-2007, Alt. 204 mtr. 27°54´56.7´´ N. 96°11´7.8´´ E. Coll. R. Mathew & Party (Reg. No. ERS-V/F-2810).

Diagnosis : *Badis triocellus* sp. nov. is characterized by the presence of three distinct black blotches on fins; two on anterior and posterior end of dorsal fin respectively and one on anal fin; anterior blotch on dorsal fin is present in between 3rd-5th dorsal spine, posterior one present slightly above base of last 3-4 soft rays. On anal fin, blotch is present a little above the base of last 3 soft rays. A light to dark brown blotch on middle of the opercle, a brownish blotch at middle of the base of caudal fin and a faint pattern of alternating light to brown irregular stripes along the sides of the body are additional combination of characters.

Description : D 15/9; P 12; V 1/6; A 3/8; C 14.

Body moderately elongated, slightly compressed laterally, its depth 27.67% in SL. Head laterally compressed its length 27.44%, width 16.05%, and depth 18.48% of SL. Dorsal profile gradually rising from tip of snout to the base of 3rd-4th dorsal spine, then sloping gently towards the end of dorsal fin and slightly concave or straight on caudal peduncle; ventral profile almost horizontal from end of opercle to the origin of anal fin, then almost straight on the caudal peduncle. Mouth small and slightly protrusible; lower jaw slightly projecting and maxilla extending beyond anterior margin of orbit. The eye is situated laterally in anterior half of head, its diameter 5.70%, interorbital space 8.65%, length of snout 6.86% of SL. Operculum triangular with slender spine projecting posteriorly (Table-1).

Dorsal fin single and large with the spinous portion being of much greater extent than the soft part; length of dorsal fin base 55.01%, height of spinous dorsal fin 12.89%, soft dorsal fin 17.32 % of SL. Anal fin with 3 spines, its rayed portion (17.53% of SL) similar to that of the dorsal fin; tips of soft dorsal and anal fins are rounded. Tip of pectoral fin is rounded and its length slightly shorter (22.11% of SL) than pelvic fin (23.01% of SL) which is pointed and not reaching anus. Distance between pectoral and pelvic fins (7.17%) is more than four times the distance between pelvic and anal fins (30.29%). Distance between anus and anal fin (3.13% of SL) is more than eight times the distance between pelvic fin and anus (26.22% of SL). Caudal fin is rounded, its length 21.36% of SL, length of caudal peduncle is more (16.26% of SL) than its height (14.96% of SL) (Table-1).

Lateral line scales 28; Lateral transverse scales 8; Predorsal scales 9; scales around caudal peduncle 14.

Colouration : Body brownish dorso-laterally, pale brown to white ventrally. Brownish irregular stripes present along lateral side. Thin brown preorbital stripe runs through chin. Postorbital stripe thicker and darker than preorbital stripe. Brownish suborbital stripe run across the underside of the head. A light to dark brown blotch present on middle of opercle. Spinous portion of dorsal fin dark brown, soft part lighter. One blotch present anteriorly in between the base of 3rd-5th dorsal spine and another at slightly above the base of the last 3-4 soft dorsal rays. Spinous part of anal appears lighter and paler than the soft part with a prominent black blotch a little above base of the last 3 soft anal fin rays. Caudal fin with a brown blotch at middle of its base. Pelvic fin slightly brownish (Plate-I A, B).

Etymology : The species is named based on the presence of 3 (Three) distinct blotches on fins.

Paratypes are almost similar to holotypes with a few meristic and morphological differences. D 14-16/ 8-9; P 12; V 1/5-6; A 3/6-8; C 13-14; Lateral line scales 28-29; Lateral transverse scales 8; Predorsal scales 9; scales around caudal peduncle 12-15. Other morphological measurements have been given in Table-1.

Distribution : Arunachal Pradesh, Assam and Meghalaya in North East India.

DISCUSSION

The new species has been compared with its related species of North East India including Bangladesh (Table-2 and 3).

Badis triocellus sp. nov. shares similarity with *Badis badis* (Plate-II A, B) in head length, head width, snout length, distance between tip of snout and origin of anal fin, distance between origin of pectoral and pelvic fin, distance between origin of pelvic and anal fin, anal fin base, distance between anus and anal fin and least height of caudal peduncle, but differs in head depth, eye diameter, inter orbital distance, body depth, distance between tip of snout and origin of pectoral fin, distance between tip of snout and origin of pelvic fin, height of spiny dorsal fin and height of soft dorsal fin, length of anal fin, dorsal fin base, length of pectoral fin, length

Table-1 : Proportional length (in millimeter), counts of rays and scales and different morphological measurements in percentage of Standard length in different specimens of *Badis triocellus* sp.nov.

	HOLOTYPE	**RANGE (HOLOTYPE + PARATYPES) N=32**	**Mean**	**SD**
Total Length	46.86	25.42-48.74	34.52	
Standard Length	38.63	20.66-39.84	28.16	
COUNTS				
Spinous dorsal fin rays	15	14-16		
Soft dorsal fin rays	9	8-9		
Pectoral fin rays	12	12		
Pelvic fin rays	1/6	1/6		
Anal fin rays	3/8	3/6-8		
Caudal fin rays	14	13-14		
Lateral scale rows	28	28-29		
Lateral transverse scale rows	8	8		
Predorsal scale	9	9		
Scales arround caudal peduncle	14	12-15		
MEASUREMENTS (%)				
Head Length	27.44	26.78-33.01	29.42	1.35
Head width	16.05	14.49-20.02	16.69	1.50
Head depth	18.48	13.68-26.31	19.08	2.78
Eye diameter	5.70	5.70-10.20	8.52	0.97
Inter orbital distance	8.65	7.05-10.52	8.54	0.80
Snout length	6.86	5.50-9.05	7.20	0.82
Body depth	27.67	25.47-34.97	29.16	2.18
Distance between tip of snout and origin of pectoral fin	29.87	26.67-37.08	31.49	2.16
Distance between tip of snout and origin of pelvic fin	34.84	32.70-44.16	36.32	2.37
Distance between tip of snout and origin of anal fin	64.35	62.08-70.30	65.70	2.06
Distance between origin of pectoral and pelvic fin	7.17	5.45-9.29	6.81	0.80
Distance between origin of pelvic and anal fin	30.29	23.04-33.21	28.96	2.72
Height of Spiny dorsal fin	12.89	10.14-17.85	13.80	1.76
Height of soft dorsal fin	17.32	10.74-22.09	15.38	2.19
Length of anal fin	18.20	11.67-21.46	16.80	2.22
Dorsal fin base	55.01	45.22-57.48	53.43	2.79
Anal fin base	17.53	11.91-18.80	15.29	1.63
Length of pectoral fin	22.11	18.52-26.77	22.05	1.81
Length of pelvic fin	23.01	18.45-26.57	23.03	1.58
Distance between pelvic fin and anus	26.22	16.40-31.14	24.57	3.24
Distance between anus and anal fin	3.13	1.42-6.28	3.92	0.90
Length of caudal peduncle	16.26	14.42-22.37	17.56	1.90
Least height of caudal peduncle	14.96	13.61-16.41	14.81	0.73
Length of caudal fin	21.36	17.15-25.60	21.49	1.73

of pelvic fin, distance between pelvic fin and anus, length of caudal peduncle and length of caudal fin (Table-2). Moreover, dorsal fin spines and soft rays are relatively fewer in *B. triocellus* sp. nov. than *B. badis*; depth of body, circumpeduncular scales (12-15 versus 14-20) are relatively less than that of *B. badis*. Inter orbital width is relatively more in *B. triocellus* sp. nov. than *B. badis*. The number of pectoral fin rays is generally constant (12) in *B. triocellus* sp. nov. but varies in *B. badis* (11-14) (Table-3).

Table 2 : Range and Mean value of proportional measurements in percentage of Standard length of *Badis triocellus* sp.nov. with related species from North East India.

	Range *B triocellus* (*n* = 32)	Mean %	SD	Range *B badis* (*n* = 6)	*Mean* %	SD	*Range B assamensis* (*n* = 10)	*Mean* %	SD	*Badis tuivaiei* (*n* = 1)	*Mean % B tuivai*
Standard Length	20.66-39.84	28.16	5.12	16.12-29.01	22.41	4.79	31.35-51.16	41.43	5.94	47.96	47.96
Head Length	26.78-33.01	29.42	1.35	25.12-32.13	29.19	2.17	26.60-31.24	29.02	1.63	26.67	26.67
Head width	14.49-20.02	16.69	1.50	15.48-18.22	16.68	1.13	14.43-16.85	15.56	0.69	14.66	14.66
Head depth	13.68-26.31	19.08	2.78	14.96-21.69	18.14	2.38	17.16-19.87	18.38	0.82	15.80	15.80
Eye diameter	5.70-10.20	8.52	0.97	8.35-10.73	9.47	0.79	5.75-9.25	7.18	0.89	7.21	7.21
Inter orbital distance	7.05-10.52	8.54	0.80	7.93-9.66	9.18	0.60	6.49-8.48	7.26	0.56	7.26	7.26
Snout length	5.50-9.05	7.20	0.82	5.89-7.56	6.92	0.64	5.29-8.58	7.10	1.15	7.03	7.03
Body depth	25.47-34.97	29.16	2.18	25.90-33.22	28.57	2.47	23.98-31.91	27.83	1.99	28.57	28.57
Distance between tip of snout and origin of pectoral fin	26.67-37.08	31.49	2.16	29.96-31.89	30.77	0.67	30.28-32.61	31.26	0.81	28.57	28.57
Distance between tip of snout and origin of pelvic fin	32.70-44.16	36.32	2.37	22.39-37.41	33.12	4.95	34.77-37.51	35.83	0.74	35.07	35.07
Distance between tip of snout and origin of anal fin	62.08-70.30	65.70	2.06	64.03-67.12	65.46	1.06	65.71-69.48	67.32	1.14	68.29	68.29
Distance between origin of pectoral and pelvic fin	5.45-9.29	6.81	0.80	5.72-8.93	7.13	0.97	5.15-6.87	5.98	0.53	6.26	6.26
Distance between origin of pelvic and anal fin	23.04-33.21	28.96	2.72	26.06-31.29	28.89	1.89	31.40-34.54	32.79	0.94	35.30	35.30
Height of Spiny dorsal fin	10.14-17.85	13.80	1.76	11.72-16.53	14.84	1.73	9.75-16.36	13.07	2.03	18.97	18.97
Height of soft dorsal fin	10.74-22.09	15.38	2.19	11.29-15.65	13.90	1.63	14.48-20.70	17.15	1.61	14.22	14.22
Length of anal fin	11.67-21.46	16.80	2.22	14.19-18.72	16.17	1.40	13.36-20.76	18.20	2.52	18.41	18.41
Dorsal fin base	45.22-57.48	53.43	2.79	48.78-55.92	52.00	2.62	54.74-58.39	56.66	1.25	55.73	55.73
Anal fin base	11.91-18.80	15.29	1.63	13.86-16.16	14.94	0.80	15.16-18.97	17.27	1.12	15.76	15.76
Length of pectoral fin	18.52-26.77	22.05	1.81	13.83-23.33	19.36	2.90	18.38-22.25	20.16	1.24	21.31	21.31
Length of pelvic fin	18.45-26.57	23.03	1.58	18.33-24.34	22.35	2.02	19.52-24.98	22.70	1.49	24.02	24.02
Distance between pelvic fin and anus	16.40-31.14	24.57	3.24	25.01-28.93	26.27	1.32	26.61-28.46	27.28	0.58	30.65	30.65
Distance between anus and anal fin	1.42-6.28	3.92	0.90	2.36-6.92	4.16	1.47	2.93-5.93	5.01	0.97	6.32	6.32
Length of caudal peduncle	14.42-22.37	17.56	1.90	13.40-17.18	14.70	1.26	12.01-16.52	14.08	1.35	15.39	15.39
Least height of caudal peduncle	13.61-16.41	14.81	0.73	13.21-16.31	14.42	1.15	12.81-16.04	14.56	1.19	14.45	14.45
Length of caudal fin	17.15-25.60	21.49	1.73	18.18-22.89	20.80	1.94	20.09-26.33	23.09	2.19	23.35	23.35

Table-3 : Comparison of proportional measurements in percentage of standard length and counts of *Badis triocellus* sp. nov. with related species.

Proportions	*B. triocellus sp.nov. (Range)*	*B. badis (Range)*	*B. assamen-sis (Range)*	*B. tuivaiei (Range)*	*B. chittagon-gis (Range)*	*B. kanabos (Range)*	*B. blosyrus (Range)*
Body depth	25.47-34.97	25.90-38.9	23.98-31.91	25.9-29.2	29.8-34.0	29.9-35.4	–
Interorbital width	7.05-10.52	6.50-9.66	6.49-8.48	5.60-7.26	5.5-6.7	7.3-8.6	6.4-8.0
Counts							
Dorsal fin rays (Spiny)	14-16	14-18	15-17	16-18	16-18	15-17	16-17
Dorsal fin rays (Soft)	8-9	7-10	9-11	9-9	9-11	8-10	8-11
Pectoral fin rays	12	11-14	12-14	12-14	12-14	11-13	–
Anal fin rays(soft)	6-8	6-8	6-8	6-10	6-9	6-8	7-8
Lateral scales rows	28-29	25-29	29-32	26-32	27-29	25-26	27-28
Circumpeduncular scales	12-15	14-20	12-14	14-20	20	16-17	–

Badis triocellus sp. nov. shares similarity with *Badis assamensis* (Plate-III & IV A, B) in head length, length of snout, length of pelvic fin, distance between tip of snout and origin of pectoral fin, distance between tip of snout and origin of pelvic fin and least height of caudal peduncle, but differs in head width, head depth, eye diameter, inter orbital distance, body depth, distance between tip of snout and origin of anal fin, distance between origin of pectoral and pelvic fin, distance between origin of pelvic fin and anal fin, height of spiny dorsal fin and height of soft dorsal fin, length of anal fin, dorsal fin base, anal fin base, length of pectoral fin, distance between pelvic fin and anus, distance between anus and anal fin, length of caudal peduncle and length of caudal fin (Table-2). Moreover, dorsal fin spines and soft rays are relatively less in *B. triocellus* sp. nov. than *B. assamensis*; depth of body (25.47-34.97% versus 23.98-31.91%), interorbital width (7.05-10.52% versus 6.49-8.48%) are more than that of *B. assamensis*. Lateral line scales are less (28-29 versus 29-32) in *B. triocellus* sp. nov. than *B. assamensis* (Table-3).

Badis triocellus sp.nov. shares similarity with *Badis tuivaiei* (Plate-V A, B) in length of snout, anal fin base and least height of caudal peduncle but differs in head length, head width, head depth, eye diameter, inter orbital distance, body depth, distance between tip of snout and origin of pectoral fin, distance between tip of snout and origin of pelvic fin, distance between tip of snout and origin of anal fin, distance between origin of pectoral and pelvic fin, distance between origin of pelvic fin and anal fin, height of spiny dorsal fin and height of soft dorsal fin, length of anal fin, dorsal fin base, length of pectoral fin, length of pelvic fin, distance between pelvic fin and anus, distance between anus and anal fin, length of caudal peduncle and length of caudal fin (Table-2). Moreover, dorsal fin spines (14-16 spines versus 16-18), anal fin rays, circumpeduncular scales (12-15 versus 14-20) are relatively less than *Badis tuivaiei*; depth of body, interorbital width (7.05-10.52% versus 5.60-7.26%) are relatively more than that of *B. tuivaiei*. The number of pectoral fin rays is generally constant (12) in *B. triocellus* sp. nov. but varies in *B. tuivaiei* (12-14) (Table-3).

The *Badis triocellus* sp. nov. differs from *B. kanabos* in having relatively less number of dorsal spines, less soft dorsal (9-9 versus 8-10), less body depth (25.47-34.97% versus 29.9-35.4%), less circumpeduncular scales (12-15 versus 16-17); more interorbital width and more lateral line scales (28-29 versus 25-26) (Table-3).

The *Badis triocellus* sp. nov. differs from *B. chittagongis* in having less number of dorsal spines (14-16 versus 16-18), soft dorsal fin rays (8-9 versus 9-11) and soft anal fin rays; relatively less body depth (25.47-34.97% versus 29.8-34%), less circumpeduncular scales (12-15 versus 20) and more interorbital width (7.05-10.52% versus 5.5-6.7%) (Table-3).

The *Badis triocellus* sp. nov. is similar to *B. blosyrus* in numbers of soft anal fin rays but differs from it in having more interorbital width (7.05-10.52 % versus 6.4-8.0 %), less number of dorsal spines (14-16 versus 16-17) and less number of soft dorsal fin rays. *B. triocellus* sp. nov. has relatively more number of lateral scales rows than *B. blosyrus* (Table-3).

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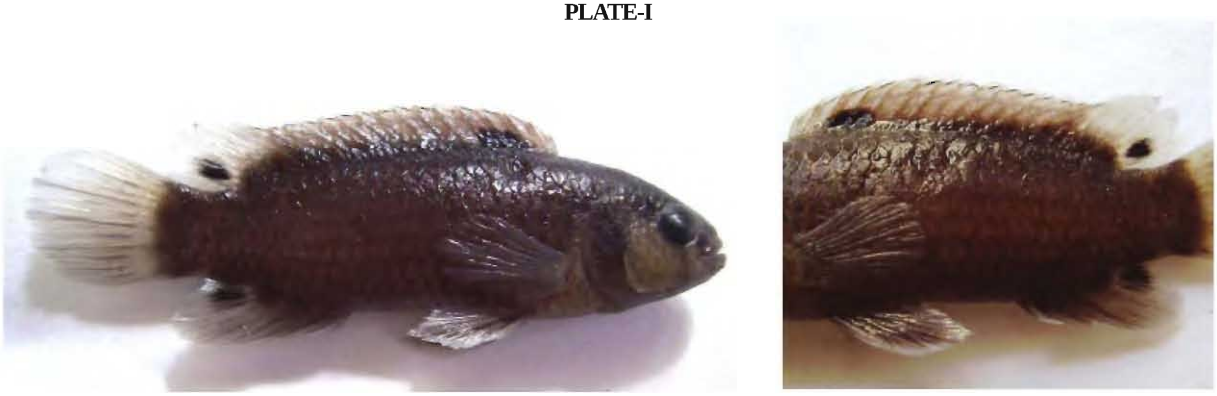
PLATE-I



A : *Badis triocellus* sp. nov. (Lateral view)

B : Dorsal and Anal fins showing three spots

PLATE-II

A

B
(Varieties of *Badis badis*)

PLATE-III

A : *Badis assamensis* (Lateral view)

B : Showing distinct caudal spot

PLATE-IV

A and B (Varieties of *Badis assamensis)*

PLATE-V

A : Lateral view of *Badis tuivaiei*

B : Showing distinct blotch above pectoral fin

Rec. zool. Surv. India : **111**(Part–4) : 73-77, 2011

NEW DISTRIBUTIONAL RECORD OF COENAGRIONIDS (ODONATA : ZYGOPTERA : COENAGRIONIDAE) FROM HIMACHAL PRADESH, INDIA

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INTRODUCTION

The family Coenagrionidae is most successful one in the whole suborder Zygoptera. Species of this family have very much identical venation but wider differences in their general appearances, although they have similar behaviour resting with their wings closely apposed over the dorsum of the thorax. The Odonata fauna of Himachal Pradesh has been studied briefly by Fraser (1933) followed by Bhasin (1953), Kumar (1978, 1982 and 2005), Prasad (1976), Kumar and Prasad (1981), Chandra (1983) and Mitra (2003). Based on the earlier workers, 14 species belonging to six genera of the family Coenagrionidae are recorded from the state of Himachal Pradesh. The present paper deals with the results of recent surveys yielded 10 species under 6 genera of the family Coenagrionidae are new records for the state of Himachal Pradesh, and increased the list to 24 species under 9 genera. Among nine genera, three genera namely *Aciagrion* Selys, *Mortonagrion* Fraser and *Rhodischnura* Laidlaw have been reported for the first time from the State. This present communication is intended to report the extended distribution of Coenagrionids in the Himachal Pradesh.

The present study is based mainly on materials collected by the author during 2006-2007, except specimens of one species which were collected by Scientists of High Altitude Regional Centre, Zoological Survey of India, Solan and deposited in the National Zoological Collections of the Zoological Survey of India, Kolkata and Solan. The specimens were studied and compared with description provided by Fraser (1933). The classification is followed by Prasad and Varshney (1995) and Mitra (2002). Updated distribution of all these species in different states within India and countries outside India is also provided (Davies and Tobin, 1984; Tsuda, 2000).

SYSTEMATIC ACCOUNT

Order ODONATA

Suborder ZYGOPTERA

Superfamily COENAGRIONOIDEA

Family COENAGRIONIDAE

Genus ***Aciagrion*** Selys

1. ***Aciagrion approximans*** (Selys)

1876. *Pseudagrion microcephalum* race *approximans* Selys, *Bull. Acad. Belg.*, (2) **42** : 507.

1891. *Aciagrion approximans* Selys, *Ann. Mus. Civ. Genova*, (2) **10** (30) : 512.

1933. *Aciagrion approximans*, Fraser, *Fauna Brit. India, Odon.*, **1** : 342-344.

1995. *Aciagrion approximans*, Prasad and Varshney, *Oriental Insects*, **29** : 389.

2002. *Aciagrion approximans*, Mitra, *Mem. zool. Surv. India*, **19** (1) : 72.

Diagnostic characters : *Male* : Labium pale yellow; labrum pale blue, narrowly black at base; frons pale blue. *Prothorax* black on dorsum, pruinosed on the sides. *Thorax* broadly black on dorsum to nearly as far lateral as the antero-lateral sutures, pruinosed below. *Legs* white, femora black on extensor surface. *Wings* hyaline, pterostigma brownish, paler at circumference. *Abdomen* : segments 1-7 broadly black on dorsum; laterally segment 1 overloaded with pruinescence, segment 2 with pale blue or bluish green, segments 3-7 with pale blue; segments 8 and 9 azure blue; segment 10 entirely black. *Anal appendages* black; superiors as long as segment 10. *Female* : Similar to male in colouring and markings; *Thorax* greenish-blue at sides, as well as the narrow antehumeral stripes. *Abdominal* segments 1-7 similar to male, segments 8 and 9 black on the dorsum, segment 10 azure blue.

Material examined : India : Himachal Pradesh : Hamirpur : Sujanpur : Tihra Water Tank, 2♂, 19.04.2006,

Sujanpur : Beas River left bank, 1♂, 1♀, 20.04.2006, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim, Uttar Pradesh and West Bengal.

Remarks : This species is reported for the first time from the outside of Eastern India.

2. ***Aciagrion azureum*** Fraser

1932. *Aciagrion azureum* Fraser, *Mem. Dept. Agri. India (Ent.)*, **7**(7) : 51.
1933. *Aciagrion azureum*, Fraser, *Fauna Brit. India, Odon.*, **1** : 339-340.
1995. *Aciagrion azureum*, Prasad and Varshney, *Oriental Insects*, **29** : 390.
2002. *Aciagrion azureum*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 73.

Diagnostic characters : *Male* : Labium whitish; labrum and frons pale yellow. *Prothorax* black on dorsum, pale blue laterally. *Thorax* broadly black on dorsum, laterally pale blue changing to pale yellow on the sides and beneath. *Wings* hyaline, pterostigma reddish brown. *Abdomen* : segment 1 azure blue with black spot; segment 2 blue at the sides with broad black band on dorsum; segments 3-7 with broad black dorsal stripes; segments 8-10 azure blue without any black markings. *Anal appendages* carneous or palest blue tipped with black.

Material examined : India : Himachal Pradesh : Hamirpur : Sujanpur : Beas River left bank, 1♂, 20.04.2006, Coll. R. Babu; Una : Rampur Kandi nallah, 1♂, 23.04.2006, Coll. R. Babu.

Distribution : India : Himachal Pradesh and Assam.

Elsewhere : Myanmar.

Remarks : This species is reported for the first time from the outside of Assam (Eastern India).

3. ***Aciagrion pallidum*** Selys

1891. *Aciagrion pallidum* Selys, *Ann. Civ. Genova*, (2) **10**(30) : 512.
1933. *Aciagrion pallidum*, Fraser, *Fauna Brit. India, Odon.*, **1** : 344-345.
1995. *Aciagrion pallidum*, Prasad and Varshney, *Oriental Insects*, **29** : 390.
2002. *Aciagrion pallidum*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 72.

Diagnostic characters : *Male* : Labium white; labrum pale brown; frons pale carneous, almost white. *Prothorax* brown on dorsum except anterior lobe, which is pale blue. *Thorax* brown on dorsum, slightly extended pale blue antehumeral stripe on dorsum and similar one lying midway between the lateral sutures, white beneath. *Legs* white. *Wings* hyaline, pointed at apices, pterostigma pale brown. *Abdomen* long and slender, dilating at the end; segment 1 very pale blue with black spot on dorsum; segment 2 with a broad black apical ring and white laterally; segments 3-7 similar to 2 but white laterally; segments 8-10 pale azure blue, unmarked. *Anal appendages* carneous. *Female*: Similar to male but only differences in the dorsal markings of the abdomen: segments 1 and 2 blue at the sides, segment 2 with an arrow-head marking on dorsum in the halo of reddish brown; segments 3-7 reddish brown on dorsum bordered with black; segments 8-10 almost white, sometimes pinkish or palest blue; segment 9 with two black basal points.

Material examined : India : Himachal Pradesh: Hamirpur : Sujanpur : Tihra Water Tank, 5♂, 6♀, 19.04.2006, Coll. R. Babu; Kangra: Palampur: Holta, HPKVK Fish Farm, 1♂, 14.04.2006; Ranital, 1♂, 28.09.2007, Coll. R. Babu; Chamba : Ravi Riverside, 2♂, 1♀, 21.09.2007, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Cambodia, Myanmar, Nepal, Taiwan, Thailand and Vietnam.

Genus ***Agriocnemis*** Selys

4. ***Agriocnemis clauseni*** Fraser

1922. *Agriocnemis clauseni* Fraser, *Mem. Dept. Agric. India (Ent.)*, **7** : 53-55.
1933. *Agriocnemis clauseni*, Fraser, *Fauna Brit. India, Odon.*, **1** : 390-392.
1995. *Agriocnemis clauseni*, Prasad and Varshney, *Oriental Insects*, **29** : 391.
2002. *Agriocnemis clauseni*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 81.

Diagnostic characters : *Male* : Labium yellow; labrum turquoise blue with base narrowly black; frons black except at the sides. *Prothorax* black on dorsum and sides. *Thorax* black on dorsum as far as lateral as midway between the humeral and lateral suture. *Legs* pale blue. *Wings* hyaline; pterostigma pale yellow, centered with greyish, framed in thick black nervures. *Abdomen*: azure blue, marked with black on segments 1-6, segment 7 blue; segments 8-10 entirely black. *Anal appendages* blue. *Female* : Similar to male : without any black at base of labrum. *Wings* with deeper yellow pterostigma. *Abdomen* : segments 1 and 2 deep azure blue, 3-7 bluish-green, 8-10 entirely black.

Material examined : India : Himachal Pradesh : Shimla: Rampur: Badrash, 2♂, 1♀, 19.10.2006, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Arunachal Pradesh, Assam, Meghalaya, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh, Myanmar, Nepal and Thailand.

5. ***Agriocnemis splendidissima*** Laidlaw

1919. *Agriocnemis splendidissima* Laidlaw, *Rec. Indian Mus.*, **16** : 181-182.
1933. *Agriocnemis splendidissima*, Fraser, *Fauna Brit. India, Odon.*, **1** : 392-394.
1995. *Agriocnemis splendidissima*, Prasad and Varshney, *Oriental Insects*, **29** : 391.
2002. *Agriocnemis splendidissima*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 81.
2007. *Agriocnemis splendidissima*, Emiliyamma *et al.*, *Rec. zool. Surv. India, Occ. Paper* No., **269** : 42-43.

Diagnostic characters : *Male* : Labium yellow; labrum pale blue; frons black. *Prothorax* black on dorsum, palest blue on lower part of sides. *Thorax* black on dorsum as far as the anterolateral suture, marked with narrow blue or pinkish antehumeral stripes. *Legs* carneous. *Wings* hyaline; pterostigma black, framed finely in pale brown or yellow. *Abdomen* blue, marked with black: segment 1with whole of dorsum black; 2 with broad dorsal marking; segments 3-7 with a broad dorsal black stripe; segments 8-10 black, 8 and 9 with a small lateral blue spot. *Anal appendages* black. *Female*: Very similar to male in colour and markings. Labrum pale green; dorsum of thorax black not extending as far laterally; pterostigma golden yellow.

Material examined : India : Himachal Pradesh : Una : Rampur Kandi nallah, 2♂, 2♀ (1 pair on copulation), 23.04.2006, Rampur Suwah Riverside, 1♂, 24.04.2006, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Andhra Pradesh, Assam, Chhattisgarh, Goa, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Tripura and West Bengal.

Elsewhere : Pakistan.

Remarks : This species is reported for the first time from Northern India.

Genus ***Enallagma*** Charpentier

6. ***Enallagma parvum*** Selys

1876. *Enallagma parvum* Selys, *Bull. Acad. Belg.*, (2) **41** : 537.
1933. *Enallagma parvum*, Fraser, *Fauna Brit. India, Odon.*, **1** : 376-378.
1995. *Enallagma parvum*, Prasad and Varshney, *Oriental Insects*, **29** : 390.
2002. *Enallagma parvum*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 76.

Diagnostic characters : *Male* : Labium white; labrum pale sky blue; frons pale blue. *Prothorax* broadly black on dorsum, sides pale blue. *Thorax* black on dorsum, broad azure blue antehumeral stripe bordered with black; laterally pale blue fading to white. *Legs* white with black line on the extensor surface of femora. *Wings* hyaline; pterostigma yellow in immature forms, blackish in adults. *Abdomen* pale sky blue, marked with black. Segment 1 with broad dorsal spot and narrow blue apical annule; whole length of segment 2 marked black; segments 3-7 with fine apical annules; segment 8-10 azure blue, segment 10 with black stripe on the middorsum. *Anal appendages* black. *Female* : In Isochrome female the ground colour of thorax greenish-yellow paling to pale blue; antehumeral stripe bordered with more broadly black, incase of heterochrome female the antehumeral stripes unenclosed with black. *Abdomen* with dorsal black stripes broader; segment 8-10 broadly black on dorsum, latter side of 10th segment blue.

Material examined : India : Himachal Pradesh : Kullu : Manikaran, Dhunkrah, 1♂, 1♀, 12.04.2006, Coll. R. Babu; Kangra : Palampur : COVAS Fish Farm, 2♀, 16.04.2006, Coll. R. Babu; Hamirpur : Sujanpur : Tihra Water Tank, 8♂, 5♀ (1 pair on copulation), 19.04.2006, Coll. R. Babu; Una : Rampur Suwah riverside, 1♂, 2♀, 22.04.2006, Coll. R. Babu; Solan : Sadhupool : Ashwini Khud, 1♀, 10.09.2007, Coll. R. Babu; Shimla : Kupvi, 2♀, 12.09.2007, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Jharkhand, Manipur, Maharashtra, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Myanmar, Nepal, Pakistan, Sri Lanka and Thailand.

Genus ***Mortonagrion*** Fraser

7. ***Mortonagrion aborense*** (Laidlaw)

1914. *Agriocnemis aborensis* Laidlaw, *Rec. Indian Mus.*, **8** : 347.
1933. *Agriocnemis aborensis*, Fraser, *Fauna Brit. India, Odon.*, **1** : 394-395.
1989. *Mortonagrion aborense*, Hämäläinen, *Indian Odonatol.*, **2** : 1-4.
1995. *Mortonagrion aborense*, Prasad and Varshney, *Oriental Insects*, **29** : 391.
2002. *Mortonagrion aborense*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 83.

Diagnostic characters : *Male* : Labium pale yellow; labrum pale blue; frons blue outwardly, black in centre. *Prothorax* black on dorsum except anterior lobe, which is pale blue. *Thorax* black on dorsum as for as the antero-lateral suture, marked with narrow pale blue antehumeral stripe. *Legs* creamy white. *Wings* hyaline; pterostigma blackish-brown. *Abdomen* : segment 1 dorsum black, sides and apical border azure blue; segment 2 with dorsum broadly black except near apical end; segments 3-6 black with narrow greenish blue lateral stripes; segment 7 with a pair of basal blue dorsal spots only; segment 8 azure blue in ventral side; segment 9 entirely blue; segment 10 azure blue. *Anal appendages* black.

Material examined : India : Himachal Pradesh : Solan : Ashwinikhud, 2♂, 10.09.2007, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Assam, Mizoram and West Bengal.

Elsewhere : Indonesia and Thailand.

Remarks : This species is reported for the first time from the outside of Eastern India.

Genus ***Pseudagrion*** Selys

8. ***Pseudagrion hypermelas*** Selys

1876. *Pseudagrion hypermelas* Selys, *Bull. Acad. Belg.*, (2) **42** : 519.
1907. *Pseudagrion bidentatum*, Mortan, *Trans. Ent. Soc. Lond.*, : 307.
1933. *Pseudagrion hypermelas*, Fraser, *Fauna Brit. India, Odon.*, **1** : 289-292.
1995. *Pseudagrion hypermelas*, Prasad and Varshney, *Oriental Insects*, **29** : 389.
2002. *Pseudagrion hypermelas*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 62.

Diagnostic characters : *Female* : Labium creamy white; labrum palest brown; frons pale olivaceous. *Prothorax* palest ochreous. *Thorax* pale olivaceous, with mid-dorsal carina and humeral suture mapped out in black. *Legs* carneous. *Wings* hyaline; pterostigma uniform yellow. *Abdomen*: Pale greenish-yellow on the basal half, palest blue on the distal segments, marked with black on dorsum. *Anal appendages* pale brown.

Material examined : India : Himachal Pradesh : Sirmaur : Renuka Lake, 1♀, 09.10.2006, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Bihar, Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Punjab, Uttar Pradesh and West Bengal.

Elsewhere : Pakistan.

Remarks : This species is reported for the first time from the Western Himalaya.

9. ***Pseudagrion microcephalum*** (Rambur)

1842. *Agrion microcephalum* Rambur, *Ins. Névrop.*, : 259.
1876. *Pseudagrion microcephalum*, Selys, *Bull. Acad. Belg.*, **2**(42) : 504.
1933. *Pseudagrion microcephalum*, Fraser, *Fauna Brit. India, OdonM.*, **1** : 278-280.
1954. *Pseudagrion microcephalum*, Lieftinck, *Treubia*, **22** (suppl.) : 57.
1995. *Pseudagrion microcephalum*, Prasad and Varshney, *Oriental Insects*, **29** : 389.
2002. *Pseudagrion microcephalum*, Mitra, *Mem. zool. Surv. India*, **19**(1) : 61.
2007. *Pseudagrion microcephalum*, Emiliyamma *et al.*, *Rec. zool. Surv. India, Occ. Paper* No. **269** : 29-30.

Diagnostic characters : *Female* : Head and upper surface of eyes with bright orange. *Prothorax* bluish-green. *Thorax* bluish-green, richly suffused with golden orange on dorsum especially in the humeral area, laterally azure blue. *Wings* hyaline; pterostigma paler brown. *Abdomen* : azure blue, marked with black : segment 1 with a quadrate spot; segment 2 with thick black mark dumbbell shaped; segment 8 with a black band; segment 9 with a bifid spot and segment 10 deeply and narrowly notched at apex.

Material examined : India : Himachal Pradesh : Kangra : Palampur : Holta, HPKVK Fish Farm 1♀, 14.04.2006, Coll. R. Babu; Hamirpur : Sujanpur : Tihra Water Tank, 2♀, 19.04.2006, Coll. R. Babu.

Distribution : India : Himachal Pradesh, Andaman & Nicobar Islands, Andhra Pradesh, Assam, Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Australia, Bangladesh, China, Hong Kong, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Taiwan, Thailand and Vietnam.

Remarks : This species is reported for the first time from the Western Himalaya.

Genus ***Rhodischnura*** Laidlaw

10. ***Rhodischnura nursei*** (Morton)

1907. *Ischnura nursei* Morton, *Trans. Ent. Soc. Lond.*, : 306-307.
1919. *Rhodischnura nursei*, Laidlaw, *Rec. Indian Mus.*, **16** : 171, 177.
1933. *Rhodischnura nursei*, Fraser, *Fauna Brit. India, Odon.*, **1** : 369-371.
1995. *Rhodischnura nursei*, Prasad and Varshney, *Oriental Insects*, **29** : 391.
2002. *Rhodischnura nursei*, Mitra, *Mem. zool. Surv. India*, **19** (1) : 76.

Diagnostic characters : *Male* : Labium bright yellow; labrum and frons pale greenish yellow. *Prothorax* broadly black on dorsum, pale greenish yellow on sides. *Thorax* broadly black on dorsum, narrow green

antehumeral stripes, laterally green, paling to yellow. *Legs* pale yellow. *Wings* hyaline; pterostigma proximal part in forewings black, costal pale yellow; red in the inner half changing to pink and hyaline; pterostigma in hindwing hyaline. *Abdomen* : Segments 1-4 bright crimson, segment 1 with two dorsal black spots; segments 5 and part of 6 with pale citron-yellow which some times become reddish; from part of segment 6 to 10 black. *Anal appendages* reddish or ochreous. *Female* : Similar to male but markings differing as follows : In isochromatic form sides of thorax yellow, stripes on the upper parts changing to rich ochreous; in heterochromatic form antehumeral stripes pale bluish green, dorsal black limited by the antehumeral stripes. *Abdomen* : In isochromatic female middorsal carinal black line on segment 2; segment 6 ochreaous; ventral borders of segment 7-10 ochreous. In heterochromatic form black on the dorsum on all segments.

Material examined : India : Himachal Pradesh : Mandi : Bijni Bridge, 1♀, 19.09.1984, Coll. Kangruram; Pandoh, 5♂, 1♀, 20.08.1986, Coll. R.K. Sharma & Subhash; Kangra : Talwara Lake, 1♂, 07.12.1987, Coll. V.P. Uniyal & Kangruram.

Distribution : India : Himachal Pradesh, Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh and Pakistan.

SUMMARY

A list of ten species under six genera of family Coenagrionidae (Zygoptera) constituting the first record from Himachal Pradesh State, along with necessary collection data and their distribution, has been provided. The distribution of three genera *Aciagrion* Selys, *Mortonagrion* Fraser and *Rhodischnura* Laidlaw are new records to Himachal Pradesh. Three species *Aciagrion approximans* (Selys), *Aciagrion azureum* Fraser, and *Mortonagrion aborense* (Laidlaw) are reported for first time from the outside of Eastern India. *Agriocnemis splendidissima* Laidlaw, *Pseudagrion hypermelas* Selys, and *Pseudagrion microcephalum* (Rambur) have been recorded for the first time from the Western Himalaya Region.

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HERPETOFAUNA OF NAGLOK REGION, JASHPUR DISTRICT, CHHATTISGARH

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INTRODUCTION

The Naglok Region (22º23´´ to 22º53´´N and 83º28´´ to 84º24´´E) in Tapkara-Pharsabahar block of Jashpur district lies in the eastern part of Chhattisgarh state adjoining the borders of Jharkhand, Orissa and Madhya Pradesh. The study area extends throughout the Naglok Region. The majorities of survey sites are primarily located within the protected areas or reserved forests of Sarapjhariya, Bansajhal, Mirigkhol, Sahilata, Ranibandh, Satpuriya, Baluabahar, Kohpani, Pharsabahar, Baro, Singibahar, Lathbhora, Jabla, Jharmuda, Bhalumuda, Kharibahar, Konpara, Tiklipara, Matipaharchharra, Lawakera, Purainbandh regions.

In the study area, there is mixed forests dominated by sal (*Sorea robusta*) spread over plains to hilly mountain ranges. A total of 211 species of plants have been recorded from the area comprising 110 species of plants and trees, 45 shrubs and scrubs, 28 Climbers, 5 bamboo, 1epiphyte, 3 parasites and 21 species of grasses (Chaudhary & Thapliyal, 2004-05, *Working Plan of Jashpur Forest Division*).

This area mainly falls under the lower ghats dominated by dry deciduous forests and Southern dry-mixed forests. In the uplands, Salai (*Terminalia serrata)*, Saja (*Terminalia tomentosa*), Mahua (*Madhuca indica*), Dhawda (*Anogeissus latifolia*), Harra (*Terminalia chebula*), Bel (*Aegle marmelos*), Pipal (*Ficus religiosa*), Kusum (*Schleicheraoneosa*), Mundi (*Mitryagyna parviflora*), Dhaman (*Grewia tiliaefolia*), Dhobin (*Dalbergia paniculata*), Aam (*Mangifera indica*), Arjun (*Terminalia arjuna*) and Sal (*Sorea robusta*) are found whereas Amla *(Emblica officinalis*), Ghont (*Zizyphus xylopara*), Bhelwa (*Semecarpus anacardium*), Char *(Buchanania lanzan*), Bhirra (*Chlorxylon swietenoides*), Kumbhi (*Careya arborea*), Tinsa (*Ougeinia oojeinensis*), Palash (*Butea monosperma*), Khair (*Acacia catechu*), Amti (*Bahunia malabariea*), are found in the low lands. Shrubs like; Chhind (*Phoenix acaulis*), Ban Tulsi (*Eranthemum puloneiium*), Pak, Khirsali also occur.

The configuration of land is diversified broadly into lower and upper ghats. The study area mainly comes under lower ghats containing medium hilly tracts comparatively with undulating and plain areas. The hills run in all direction and have slopes and valleys. The soil of study area is mainly sandy and color is brown and red.

The climate of the study area is semi tropical in general. The average annual rainfall is 1170 mm.

Fig. 1 : Map showing the location of Naglok Region, Jashpur district, Chhattisgarh, India. On the top, map of India showing Chhattisgarh state; in the middle, map of Chhattisgarh showing the location of Jashpur and Naglok Region; and on the bottom the Naglok Region with localities mentioned in the text.

December-January months are the coldest months when the temperature falls to 3°-5°C. In summer, April-May are usually the hottest months of the year when temperature raises up to 47°C.

Representative areas of different habitat of Jashpur district were selected for detailed survey. A total of about 112 localities were covered in the two areas (lower and upper ghats) under the seven blocks (Tapkara, Kunkuri, Kansabel, Duldula, Paththalgaon, Bagicha and Sanna).The surveys were conducted covering all above mentioned blocks.

1. *Tapkara* : Sarap Jharia, Samartal, Ghumara, Sundru, Mirigkhol, Bansajhal, Lawakera, Sahilata, Samdama Purainbandh, Baluabahar, Jamuna.

2. *Kunkuri* : Lotapani, Kunjara, Dhongaamba, Raikera, Babusajbahar.

3. *Kansabel* : Siharbud, Kansabel.

4. *Sanna* : Sonkiyari, Sela, Haridiya.

Table-1. Amphibian and Reptilian species of Naglok region Jashpur showing common name, localities and status

Sl. No.	Order/family/species	Common Name	Localities	Status (protected under WL(P)A,1972)
1.	**AMPHIBIANS** Order ANURA Family BUFONIDAE *Duttaphrynus melanostictus* (Schneider)	Common Asian Toad	Tapkara, Pharsabahar, Kunkuri, Kansabel block	Abundant
2.	*Duttaphrynus stomaticus* (Lutken)	Marbled Toad	Tapkara, Pharsabahar, Kunkuri block	Uncommon
3.	Family MICROHYLIDAE *Microhyla ornata* (Dum. & Bib.)	Narrow-mouthed Frog	Tapkara block	Uncommon
4.	Family RANIDAE *Hoplobatrachus tigerinus* (Daudin)	Indian Bull Frog	Pharsabahar block	Very Common
5.	Family RHACOPHORIDAE *Polypedates maculatus* (Gray)	Common Tree Frog	Tapkara block	Uncommon
6.	**REPTILES** Order TESTUDINES Family TRIONYCHIDAE *Lissemys punctata punctata* (Lacepede)	Indian Flap-shell Turtle	Tapkara, Kunkuri block	Sch. I
7.	Order SQUAMATA Suborder SAURIA Family GEKKONIDAE *Hemidactylus brookii* (Gray)	Spotted House Gecko	Tapkara, Pharsabahar, Kunkuri, Kansabel block	Abundant
8.	*Hemidactylus flaviviridis* (Ruppell)	Yellow-Bellied House Gecko	Tapkara, Bagbahar block	Abundant
9.	*Hemidactylus frenatus* (Schlegal in : Dum. & Bib.)		Kansabel, Sanna block	Not Common
10.	*Hemidactylus triedrus* (Daudin)	Termite-Hill Gecko	Tapkara, Pharsabahar, Duldula, Sanna, Kansabel block	Common
11.	*Hemidactylus maculatus* (Dum. & Bib.)	Rock Gecko	Sanna block	Common
12.	Family AGAMIDAE *Calotes versicolor* (Daudin)	Common Garden Lizard	Tapkara, Pharsabahar, Duldula, Sanna, Kansabel	Abundant
13.	*Sitana ponticeriana* (Cuvier)	Fan-throated Lizard	Tapkara, Sanna, Kansabel block	Abundant
14.	*Psammophilus blanfordanus* (Stoliczka)	Blanford's Rock Agama	Ranibandh, Sanna, Kansabel block	Abundant

Table-1. *Cont'd.*

Sl. No.	Order/family/species	Common Name	Localities	Status (protected under WL(P)A,1972)
15.	Family CHAMALEONIDAE *Chamaeleo zeylanicus* (Daudin)	Indian Chamaeleon	Sanna block	Vulnerable
16.	Family SCINCIDAE *Mabuya carinata* (Schneider)	Keeled Grass Skink	Tapkara, Paththalgaon, Duldula, Sanna, Kansabel blocks	Abundant
17.	*Riopa albopunctata* (Gray)	White-spotted supple Skink	Tapkara, Sanna, Kansabel blocks	Uncommon
18.	Family VARANIDAE *Varanus bengalensis* (Linnaeus)	Bengal Monitor	Pharsabahar, Duldula, Kansabel blocks	Sch. II
19.	Family TYPHLOPIDAE *Ramphotyphlops braminus* (Daudin)	Common Worm Snake	Tapkara, Pharsabahar, Kunkuri, Kansabel	Sch. IV
20.	*Grypotyphlops acutus* (Dumeril & Bibron)	Beaked Worm Snake	Tapkara, Pharsabahar, Kunkuri blocks	Sch. IV
21.	Family BOIDAE *Python molurus* (Linnaeus)	Indian Rock Python	Tapkara block	Sch. I
22.	*Gongylophis conicus* (Schneider)	Brown Sand Boa	Tapkara, Kansabel, Kunkuri blocks	Sch. IV
23.	*Eryx johnii* (Russell)	Red Sand Boa	Tapkara, Kansabel block	Sch. IV
24.	Family COLUBRIDAE *Ahaetulla nasuta* (Lacepede)	Green Vine Snake	Sanna block	Sch. IV
25.	*Amphiesma stolatum* (Linnaeus)	Striped Keel back	Tapkara, Pharsabahar, Kunkuri, Bagicha blocks	Sch. IV
26.	*Argyrogena fasciolata* (Shaw)	Banded Racer	Pharsabahar block	Sch. IV
27.	*Boiga trigonata* (Schneider)	Common Cat Snake	Tapkara, Pharsabahar, Kunkuri, Bagicha blocks	Sch. IV
28.	*Dendrelaphis tristis* (Daudin)	Common Bronze back Tree Snake	Bagbahar block	Sch. IV
29.	*Coelognathus helena* (Daudin)	Common Trinket	Pharsabahar block	Sch. IV
30.	*Lycodon aulicus* (Linnaeus)	Common Wolf Snake	Tapkara, Pharsabahar, Kunkuri, Bagicha blocks	Sch. IV
31.	*Macropisthodon plumbicolor* (Cantor)	Green Keel back	Pharsabahar blocks	Sch. IV
32.	*Oligodon arnensis* (Shaw)	Common Kukri Snake	Tapkara, Pharsabahar, Kunkuri, Bagicha blocks	Sch. IV
33.	*Ptyas mucosa* (Linnaeus)	Indian Rat Snake	Tapkara, Patthalgaon, Kunkuri, Bagicha blocks	Sch. II
34.	*Xenochrophis piscatoR* (Schneider)	Checkered Keelback	Tapkara, Pharsabahar, Kunkuri, Bagicha blocks	Sch. II
35.	Family ELAPIDAE *Bungarus caeruleus* (Schneider)	Common Indian Krait	Tapkara, Pharsabahar, Paththalgaon, Kunkuri Narayanpur blocks	Sch. IV
36.	*Bungarus fasciatus* (Schneider)	Banded Krait	Tapkara, Pharsabahar, Kunkuri block	Sch. IV
37.	*Naja naja* (Linnaeus)	Spectacled Cobra or Binocellate Cobra	Tapkara, Pharsabahar, Kunkuri blocks	Sch. II
38.	Family VIPERIDAE *Daboia russelii* (Shaw)	Russell's Viper	Tapkara, Kansabel block	Sch. II

Table-2. Observation of Amphibians and Reptiles (number and density) in Naglok Region, Jashpur District

Sl. No.	Order/family/species	Localities	Total No.	Density/%
	AMPHIBIANS			
	Order ANURA			
	Family BUFONIDAE			
1.	*Duttaphrynus melanostictus* (Schneider)	Tapkara, Pharsabahar, Kunkuri, Kansabel block	52	9.09
2.	*Duttaphrynus stomaticus* (Lutken)	Tapkara, Pharsabahar, Kunkuri block	36	6.29
	Family MICROHYLIDAE			
3.	*Microhyla ornata* (Dum. & Bib.)	Tapkara block	13	2.27
	Family RANIDAE			
4.	*Hoplobatrachus tigerinus* (Daudin)	Pharsabahar block	56	9.79
	Family RHACOPHORIDAE			
5.	*Polypedates maculatus* (Grey)	Tapkara block	11	1.92
	REPTILES			
	Order TESTUDINES			
	Family TRIONYCHIDAE			
6.	*Lissemys punctata punctata* (Lacepede)	Tapkara, Kunkuri block	01	0.17
	Order SQUAMATA			
	Suborder SAURIA			
	Family GEKKONIDAE			
7.	*Hemidactylus brooki* (Gray)	Tapkara, Pharsabahar, Kunkuri, Kansabel block	06	1.04
8.	*Hemidactylus flaviviridis* (Ruppell)	Tapkara, Bagbahar	04	0.69
9.	*Hemidactylus frenatus* (Schlegal in: Dum. & Bib.)	Kansabel, Sanna block	03	0.52
10.	*Hemidactylus triedrus* (Daudin)	Tapkara, Pharsabahar, Duldula, Sanna, Kansabel block	21	3.67
11.	*Hemidactylus maculatus* (Dum. & Bib.)	Sanna block	02	0.34
12.	Family AGAMIDAE *Calotes versicolor* (Daudin)	Tapkara, Pharsabahar, Duldula, Sanna, Kansabel block	16	2.79
13.	*Sitana ponticeriana* (Cuvier)	Tapkara, Sanna, Kansabel	17	2.97
14.	*Psammophilus blanfordanus* (Stoliczka)	Ranibandh, Sanna, Kansabel block	11	1.92
	Family CHAMAELEONIDAE			
15.	*Chamaeleo zeylanicus* (Daudin)	Sanna block	01	0.17
	Family SCINCIDAE			
16.	*Mabuya carinata* (Schneider)	Tapkara, Paththalgaon, Duldula, Sanna, Kansabel block	17	2.97
17.	*Riopa albopunctata* (Gray)	Tapkara, Sanna, Kansabel block	06	1.04
	Family VARANIDAE			
18.	*Varanus bengalensis* (Linnaeus)	Pharsabahar, Duldula, Kansabel	03	0.52
	Family TYPHLOPIDAE			
19.	*Ramphotyphlops braminus* (Daudin)	Tapkara, Pharsabahar, Kunkuri, Kansabel block	10	1.74
20.	*Grypotyphlops acutus* (Dumeril & Bibron)	Tapkara, Pharsabahar, Kunkuri block	03	0.52

Table-2. *Cont'd.*

Sl. No.	Order/family/species	Localities	Total No.	Density/%
	Family BOIDAE			
21.	*Python molurus* (Linnaeus)	Tapkara block	11	1.92
22.	*Gongylophis conicus* (Schneider)	Tapkara, Kansabel, Kunkuri	03	0.52
23.	*Eryx johnii* (Russell)	Tapkara, Kansabel block	02	0.34
	Family COLUBRIDAE			
24.	*Ahaetulla nasuta* (Lacepede)	Sanna block	02	0.34
25.	*Amphiesma stolatum* (Linnaeus)	Tapkara, Pharsabahar, Kunkuri, Bagicha block	70	12.23
26.	*Argyrogena fasciolata* (Shaw)	Pharsabahar block	03	0.52
27.	*Boiga trigonata* (Schneider)	Tapkara, Pharsabahar, Kunkuri, Bagicha block	42	7.34
28.	*Dendrelaphis tristis* (Daudin)	Bagbahar	04	0.69
29.	*Coelognathus helena* (Daudin)	Pharsabahar	04	0.69
30.	*Lycodon aulicus* (Linnaeus)	Tapkara, Pharsabahar, Kunkuri, Bagicha block	07	1.22
31.	*Macropisthodon plumbicolor* (Cantor)	Pharsabahar	02	0.34
32.	*Oligodon arnensis* (Shaw)	Tapkara, Pharsabahar, Kunkuri, Bagicha block	04	0.69
33.	*Ptyas mucosa* (Linnaeus)	Tapkara, Paththalgaon, Kunkuri, Bagicha block	16	2.79
34.	*Xenochrophis piscator* piscator (Schneider)	Tapkara, Pharsabahar, Kunkuri, Bagicha	25	4.37
	Family ELAPIDAE			
35.	*Bungarus caeruleus* (Schneider)	Tapkara, Pharsabahar, Kunkuri Paththalgaon, Narayanpur block	37	6.46
36.	*Bungarus fasciatus* (Schneider)	Tapkara, Pharsabahar, Kunkuri	09	1.57
37.	*Naja naja* (Linnaeus)	Tapkara, Pharsabahar, Kunkuri	31	5.41
	Family VIPERIDAE			
38.	*Daboia russelii* (Shaw)	Tapkara, Kansabel block	11	1.92
		Total	**404**	

5. *Duldula* : Nawapara, Kersai, Kinket, Sitonga.

6. *Paththalgaon* : Jhimki, Bargaon, Veldegi, Senata, Sitapur.

7. *Bagicha* : Gumhawona, Mena, Ghurdega, Dangri, Phuljhar.

The present paper is based on the study of amphibians and reptiles collected/ observed from Naglok Region and surroundings of Jashpur district during 2002 to 2006. The present studies are based on 38 species of reptiles & amphibians belonging to 15 families. The available information pertaining to Chhattisgarh is found in the works of Smith (1935, 1943) who showed the distribution of 33 species of reptiles in central India and central provinces. Daniel & Selukar (1964) reported the occurrence of *Rana malabarica* in Bastar district. Agrawal (1981) recorded 8 species of reptiles from Madhya Pradesh and Chhattisgarh. Sanyal & Dasgupta (1990) reported 19 species of reptiles from Bastar. Sanyal (1995) reported 12 species of reptiles from Indrâvati Tiger reserve. Aengals & Rajarathinam (2001) reported 11 species of reptiles from Raipur district. But these concern mainly the herpetology of Bastar, Sarguja, Bilaspur and Raipur districts. Ingle (2003) recorded 5 species of amphibians and 31 species of reptiles from Jashpur district. The present article reports the herpetofaunal diversity of Jashpur district of Chhattisgarh.

SYSTEMATIC ACCOUNT

Class AMPHIBIA

Key to orders to ANURA

Skin with numerous folds, wrinkles-warts .... Bufonidae

Body stout, flat & triangular, head small with a narrow mouth & short snout ..... Microhylidae

Skin slimy, body oval & flattened, snout broad & rounded ..... Ranidae

Body slender, eyes on side & bulging, very long & slender limbs ..... Emydidae

Class AMPHIBIA

Order ANURA

Family BUFONIDAE

1. ***Duttaphrynus melanostictus*** (Schneider)
(Common Indian Toad)

1799. *Bufo melanostictus*, Schneider, *Hist. Amph.* **1**, *Jena*, : 216.

2006. *Duttaphrynus melanostictus*, Frost, *et al.* : The Amphibian Tree of Life. *Bulletin of the American Museum of Natural History* **297** : 364-365.

Observation localities : Tapkara, Pharsabahar, Kunkuri and Kansabel.

Habit and habitat : These are slow moving and hop after small insects, earthworm and feed on them. The adults are very fond of gathering around streetlamps. These are available in any kind of habitat. They show a marked preference for human modified habits and may be seen along the edges of forests.

Diagnostic characters : The females are larger than the males and the maximum length for the adult is 15 cm. The top and sides of the head, snout and region between the eyes are smooth. The back is covered with conical warts. There are pimple like warts on the sole and toes. The juveniles lack the warts and often have a very inconspicuous eardrum.

Distribution : Throughout India.

Conservation status : Abundant.

2. ***Duttaphrynus stomaticus*** (Lutken)
(Marbled Toad)

1862. *Bufo stomaticus* Lutken, *Bulletin Chicago Herp. Soc.* 37(12) : 216-219.

2006. *Duttaphrynus melanostictus*, Frost, *et al.* : The Amphibian Tree of Life. *Bulletin of the American Museum of Natural History*, **297** : 364-365.

Observation localities : Tapkara, Pharsabahar and Kunkuri.

Habit and habitat : These are most active at night and known to be more agile than the Common Indian toad. Food consists of a variety of insects; other arthropods and snails termites are preferable. They prefer drier habitats.

Diagnostic characters : The maximum length of the adults is 9 cm. The eardrum is as large as eye; the toes are about 2/3rd webbed. The digging appendages on the sole are equal in size with sharp edges.

Distribution : India : Peninsular India : Karnataka, Maharashtra, Orissa, Bihar, West Bengal, Madhya Pradesh and Chhattisgarh.

Conservation status : Uncommon.

Family MICROHYLIDAE

3. ***Microhyla ornata*** (Dumeril & Bibron)
(Ornate Narrow-Mouthed Frog)

1841. *Engystoma ornata*, Dumeril. & Bibron, *Erp. Gen.*, 8 : 745.

1985. *Microhyla ornata*, Frost, *Amphibian species of the world* : 387.

Observation localities : Tapkara.

Habit and habitat : It is a very active frog; capable of leaping high. Feets amongst grass, but does not hesitate to enter home-steads. Feeds mainly on ants and other insects and has a wide habitat preference ranging from urban gardens to dense forests.

Diagnostic Characters : The head is small with a narrow pointed snout and eardrum is not visible. The fingers and toes do not bear enlarged discs and the webbing on the toes is rudimentary. The average length is 2.5 cm.

Distribution : India : West Bengal, Assam, Meghalaya, Mizoram, Nagaland, Manipur, Tripura and Kerala.

Conservation status : Uncommon.

Family RANIDAE

4. ***Hoplobatrachus tigerinus*** (Daudin)
(Indian Bull Frog)

1803. *Rana tigerina*, Daudin, *Hist. Rain. Gern. Crap.* : 64.

1992. *Hoplobatrachus tigerinus*, Dubois, *Bull. Mens. Soc. Linn. Lyon*, **61** : 315.

Observation localities : Pharsabahar.

Habit and habitat : It is the largest frog in India. A slow mover, but is not very shy. Feeds on almost anything from smaller individuals on its own species to small birds, rodents and snakes. It is often found in the hills, inhabiting rice plantations, irrigation channels, ponds and stream-sides.

Diagnostic characters : It is easily identified by its large size, bold finger-like stripes and spots on the pale skin. These are very bulky frogs with long and muscular limbs. The snout distinctly long and pointed. The skin on the back bears numerous folds. The toes are extensively webbed. The vocal sacs are external and blue in color. The males are smaller and darker than the females.

Distribution : All over India up to 1100 m.

Conservation status : Abundant.

Family RHACOPHORIDAE

5. ***Polypedates maculatus*** (Gray)

(Common Tree Frog)

1832. *Hyla maculate* Gray, *III. Indian Zool.*, ***1*** pl. 82, *fig.* 1.

1997. *Polypedates maculatus* : *Amph. India Sri Lanka* : 96-97.

Observation localities : Sarap Jhariya and Sanna region.

Habit and habitat : Take a shelter within crevices on rocks, between leaves, under barks on trees and exposed on tree trunks. It is famous for its fondness for inhabiting human dwellings. It is an urban tree frog; however it also occurs within secondary forests.

Diagnostic characters : The females are larger than the males and the length is 3.5 to 8.5 cm. The eardrum is distinct and is as big as eye; the nostril is closer to the tip of the snout than to the eyes. The toes are about half webbed. The first and second fingers are almost equal in length. The single internal vocal sac is clearly visible when the males call.

Distribution : India : Plains of India in general.

Conservation status : Uncommon.

Class REPTILIA

Key to orders to REPTILIA

The body is enclosed in a box-like bony or leathery shell ..... Testudines

Body not enclosed in a box-like bony/leathery shell, limbs present or absent ..... Squamata

Order TESTUDINES

Key to families of order TESTUDINES

Limbs more or less cylindrical, digits not webbed. ..... Testudinidae

Limbs paddle-shaped but more or less flattened; digits webbed ..... Emydidae

Order TESTUDINES

Family TRIONYCHIDAE

6. ***Lissemys punctata punctata*** (Lecepede, 1789)

(North-Indian Flap shell Turtle)

1931. *Lissemys punctata punctata*, Smith, *Fauna Brit. India, Reptilia & Amphibia*, 1 : 157.

1998. *Lissemys punctata punctata*, Sharma, *Fauna of India, Reptilia, Testudines and Crocodilians, I*, p. 125.

Observation localities : Tapkara and Kunkuri.

Habit and habitat : It inhabits in ponds, rivers, rice fields, muddy ditches, lakes and marshes. It is carnivorous and feeds on animal corpses, frogs, fishes, tadpoles, shrimps and snails.

Diagnostic characters : It is a doomed soft shell small, flat turtle, generally less than 24 cm. in length. The head is moderately large; the snout is very short, olive- brown above. Carapace is grey-green, with numerous black-bordered yellow spots, irregularly arranged and with a light yellow marginal rim. Plastron is cream or pale yellow.

Distribution : Throughout India.

Conservation status : Scheduled I st.

Order SQUAMATA

Key to Families of order SQUAMATA

1. Limbs present ..... suborder Sauria 2
– Limbs absent ..... suborder Serpentes 6
2. Tongue rather broad and short 3
– Tongue smooth, very long and retractile 6
3. Tongue covered with villose papillae 4
– Tongue covered with imbricate, scale-like papillae... 5
4. Tongue covered with villose papillae; eyes usually without movable eyelids; teeth are pleurodont .... Gekkonidae
– Tongue smooth or covered with villose papillae; eyes with movable eyelids; teeth are acrodont .... Agamidae
5. Tongue covered with imbricate; scale-like papillae feebly nicked anteriorly; body covered with cycloid imbricate scales, with osteodermal plates on body.. ..... Scincidae
– Tongue covered with imbricate papillae or transverse plicate, forked anteriorly; dorsal scales much differentiated from those on the belly no osteodermal plates on body ..... Lacertidae
6. Tongue bifid, retractile into a sheath at the base as in snakes; back covered with rounded scales; generally without osteodermal plates ..... Varanidae
7. No poison fangs in the front of the jaw 8
– Poison fangs in the front of the jaw 10
8. Teeth only in the upper jaw, eyes vestigial, body worm like ..... Typhlopidae
– Teeth in both jaws, eyes exposed 9
9. Ventrals narrow, but quite distinct; more than 40 scales round the body ..... Boidae
– Ventrals nearly or quite as broad as the body; tail cylindrical, pointed ..... Colubridae

10. Maxillary bone with teeth behind the fangs, pupil round ..... Elapidae

– Maxillary bone very short, bearing fangs only; pupil vertical ..... Viperidae

Suborder SAURIA

Family GECKKONIDAE

7. ***Hemidactylus brookii*** (Gray)

(Spotted House Gecko)

1845. *Hemidactylus brookii*, Gray, *Cat. Liz. Brit. Mus*, 153.

2002. *Hemidactylus brookii*, Das, *Snakes & other Reptiles of India.* p. 97.

Observation localities : Tapkara, Pharsabahar, Kunkuri, Kansabel bocks.

Habit and habitat : Largely terrestrial, inhabits parks, trees, rocks, under stones and in and around human settlements. Chiefly feeds on insects.

Diagnostic characters : Head oval; snout obtusely pointed. Head scales small; body flattened with granular scales and rows of tubercles; tail plump with it on dorsum. Belly cream.

Distribution : Throughout the Indian sub-region.

Conservation status : Very common.

8. ***Hemidactylus flaviviridis*** (Ruppell)

(Yellow-green House Gecko)

1835. *Hemidactylus flaviviridis* Ruppell, *Neue Wirb. Fauna, Abyss* : p. 18, pl. 6, Fig, 2.

2002. *Hemidactylus flaviviridis*, Das, *Snakes and other Reptiles of India*, p. 97.

Observation localities : Tapkara, Bagbahar.

Habit and habitat : Insectivorous and generally feeds on flies, bugs, mole cricket, beetles, termites, spiders and moths. Nocturnal, but can be seen during day time also. Inhabits in the buildings, most agile, and a marked climber.

Diagnostic characters : Head oval with a broad snout. Body flattened; dorsum lacking tubercles; dorsum pale-grey at night to olive by day; belly light-yellow.

Distribution : Throughout India, but widely in North India.

Conservation status : Very common.

9. ***Hemidactylus frenatus*** (Schlegal in : Dum. & Bib.)

(Asian House Gecko)

1836. *Hemidactylus frenatus* Schlegal in : Dum. & Bibr. *Erp. Gen. III*, p. 366.

2002. *Hemidactylus frenatus* Das, *Snakes and other Reptiles of India*, p. 98.

Observation localities : Kansabel, Sanna.

Habits and habitat : It inhabits man-made structures as well as forested areas. Its diet comprises of insects and spiders.

Diagnostic characters : It is a small but loud house gecko, head large, dorsal scales smooth, lack of webbing in fingers and toes, skin sides of tail showing enlarged tubercles. No flaps of skin along sides of body and at back of hind limbs, dorsum grayish brown, sometimes with darker markings, a brown streak with a light edge on the top along the side of the head. Belly un patterned cream. The average length is 7 cm.

Distribution : India.

Conservation status : Uncommon.

10. ***Hemidactylus triedrus*** (Daudin)

(Termite Hill Gecko)

1802. *Gecko triedrus* Daudin, *Hist, Nat. Rept. iv*, p. 155.

2002. *Hemidactylus triedrus* Das, *Snakes and other Reptiles of India*, p. 100.

Observation localities : Tapkara, Pharsabahar, Duldula, Sanna and Kansabel.

Habits and Habitat : Nocturnal and terrestrial; inhabits open forests and scrub land. It shelters during the day in rock cracks and rodent burrows. Its diet comprises termites, crickets, grasshoppers, spiders and beetles.

Diagnostic characters : It is a beautiful banded gecko. The head is large, and indistinct lateral skin fold present, dorsum with 16-18 rows of large, convex tubercles, color yellowish-olive with three large brown saddle-like patches edged with black. Head with yellow stripes from behind eye and across nape.

Distribution : India.

Conservation status : Very common.

11. ***Hemidactylus maculatus*** (Dumeril & Bibron)

(Spotted Rock Gecko)

1836. *Hemidactylus maculatus* Dumeril & Bibron, *Erp. Gen.*, **3** : p. 358.

2002. *Hemidactylus maculatus* Das, *Snakes and other Reptiles of India*, p. 99.

Observation localities : Sanna.

Habit and habitat : Inhabits rocky outcrops, including caves and cracks and on walls of buildings and on trees. Feeds on insects as well as other geckos.

Diagnostic characters : It is a large rock gecko with a pointed snout, forehead with large scattered scales, dorsum grayish with black blotches, ventrals smooth.

Distribution : India : Madhya Pradesh, Gujarat, Karela, Maharashtra & Tamil Nadu.

Conservation status : Common.

Family AGAMIDAE

12. ***Calotes versicolor*** (Daudin)

(Indian Garden Lizard)

1802. *Agama versicolor* Daudin, *Hist. Nat. Rep.*, **3** : 395.

2002. *Calotes versicolor*, Das, *Snakes and other Reptiles of India*, p. 74.

Observation localities : Tapkara, Pharsabahar, Duldula, Sanna and Kansabel.

Habit and habitat : Most abundant and widespread arboreal lizard found in parks, trees, shrubs etc. Chiefly feeds on insects though invertebrates are also taken.

Diagnostic characters : Head rather large; coloration variable from light-brown or grayish above, uniform or with more or less instinct dark brown transverse spots or bars upon the back and sides; or variegated with dark brown; tail with light and dark annuli. Head bright-red, a black patch on the throat. Male exceeds females in size and shows swollen cheeks and loner dorsal spines.

Distribution : India : Eastern Rajasthan, Madhya Pradesh, Northern Maharashtra and western Uttar Pradesh.

Conservation status : Very common.

13. ***Sitana ponticeriana*** (Cuvier)

(Fan Throated Lizard)

1844. *Sitana ponticeriana* Cuvier, *Guerin Icon. Reg. Anima. Rep.* : pl. 10, fig. 2.

2002. *Sitana ponticeriana*, Sharma, *Fauna of India, Reptilia, Sauria*, **II**, p. 164.

Observation localities : Tapkara, Sanna, Kansabel.

Habit and habitat : Diurnal and terrestrial and prefers rocky terrain scrub jungles and sandy areas. Diet comprises of termites, beetles and bugs.

Diagnostic characters : Snout rather acute, tympanum present, hind limbs elongated with only 4 toes; scales keeled, femoral pores absent; tail long and slender. Dorsum light/dark brown; black edged, diamond shaped marks mouth lining dark blue; belly cream.

Distribution : Throughout India except at heavy rainfall areas.

Conservation status : Common.

14. ***Psammophilus blanfordanus*** (Stoliczka)

(Blanford's Rock Agama)

1871. *Charasia blanfordanus* Stoliczka, *Asiatic. Soc. Beng.* : 194.

2002. *Psammophilus blanfordanus*, Sharma, *Fauna of India, Reptilia, Sauria*, **II**, p. 224.

Observation localities : Ranibandh, Sanna, Kansabel.

Habit and habitat : A rock dwelling species showed a marked preference for insects.

Diagnostic characters : It is olive-brown or dark-brown in dorsal coloration, spotted profusely with brown and usually with a series of large, boat shaped dark-brown spots with light brown or pale centers on the complete back and tail. In the adult male, these markings of back and tail merge-out and giving the lizard somewhat brownish appearance. Standard length: 100 mm; tail length 200 mm.

Distribution : India : Madhya Pradesh, Andhra Pradesh, Bihar, Orissa, Eastern and Western Ghats.

Conservation status : Abundant.

Family CHAMAELEONIDAE

15. ***Chamaeleo zeylanicus*** (Laurenti)

(South Asian Chamaeleon)

1836. *Chamaeleo zeylanicus* Laurenti, *Syn. Rept.* p. 46.

2002. *Chamaeleo zeylanicus* Das, *Snakes and other Reptiles of India*, p. 82.

Observation localities : Sanna.

Habits and habitat : Arboreal lizards inhabiting shrubs and trees and have a remarkable capacity to change body color from green to yellow. Feed on insects.

Diagnostic characters : Head with distinct helmet-like projection, orbit of eye large, eyeball covered with skin living a tiny aperture. Scales on body enlarged, tuberculated. A low serrated dorsal crest extending to prehensile tail. Fingers and toes opposable. Males have spur like projection on hind limbs.

Distribution : India : Gujarat, South Gangetic plains and South India.

Conservation status : Rare.

Family SCINCIDAE

16. ***Mabuya carinata*** (Schneider)

(Keeled Grass Skink)

1807. *Scincus carinata* Schneider, *Hist. Amphib.* **2** : 183.

2002. *Mabuya carinata*, Das, *Snakes and other Reptiles of India*, p. 109.

Observation localities : Tapkara, Patthalgaon, Duldula, Sanna, Kansabel.

Habit and habitat : A diurnal, terrestrial, insectivorous skink occasionally feed on small vertebrates.

Diagnostic characters : Body robust; lower eyelids scaly; vertebral scales smooth. Coloration; brown to olive or bronzy above, uniform or with dark-brown or black spots, or longitudinal streaks along the lateral margins of the scales. Sides are darker brown or chestnut, with or without light spots. A light dorso-lateral line starting from above the eye and continued to the base of the tail. Lower parts whitish or yellowish.

Distribution : Throughout India except North-west India and West Bengal.

Conservation status : Very Common.

17. ***Riopa albopunctata*** (Gray)
(Brown Dwarf Skink)

1845. *Riopa albopunctata*, Gray, *Ann. Mag. Nat. Hist.*, **18** : 430.

2002. *Riopa albopunctata*, Sharma, *Fauna of India, Reptilia, Sauria*, **II**, p. 319.

Observation localities : Tapkara, Sanna, Kansabel.

Habit and habitat : It is an insectivorous skink and prefers terrestrial habitats.

Diagnostic characters : Brown or reddish-brown above, each scale with a more or less distinct dark spot forming longitudinal series; sides on neck and anterior part of body dark brown or black, thickly spotted with white; yellowish-white below. Body scales are almost equal, dorsal may or may not be larger than the lateral scales; 26-28 scales round the middle of the body; 63-72 scales are down the middle of the back. The limbs are moderately large; digits are short, 12-15 lamellae under the fourth toe; tail swollen at the base; standard length 60 mm.

Distribution : India : Madhya Pradesh, Andhra Pradesh, Assam, Bengal, Bihar, Uttar Pradesh, and Karela.

Conservation status : Common.

Family VARANIDAE

18. ***Varanus bengalensis*** (Linnaeus)
(Common Indian Monitor)

1758. *Lacerta monitor*, Linnaeus, *Syst. Nat. ed.*, **10** : 201.

2002. *Varanus bengalensis*, Sharma, *Fauna of India, Reptilia, Sauria*, ***II***, p. 402.

Observation localities : Pharsabahar, Duldula, Kansabel.

Habit and habitat : This lizard shows burrowing habits and prefers to live in burrows, hollow old trees, nalas, under stones and boulders in dense vegetation bordering marshes, ponds, canals and tanks. Feeds mainly on insects, small mammals, snakes, lizards and vegetable matter.

Diagnostic characters : It is a medium-sized, dark-brown monitor, about 72-75 cm. in head and body length. The tail is very strong, long, compressed and measures about 100 cm. in length. The snout is convex terminally. The nostrils are oblique slits lying midway between the eye and the end of the muzzle. The tongue is very long, forked and protrusible.

Distribution : Throughout India.

Conservation status : Endangered.

Suborder SERPENTES

Family TYPHLOPIDAE

19. ***Ramphotyphlops braminus*** (Daudin)
(Brahminy Worm Snake)

1803. *Eryx braminus*, Daudin, *Hist. Nat. Rept.*, **7** : 279.

2004. *Ramphotyphlops braminus*, Whitaker & Captain, *Snakes of India*, p. 46.

Observation localities : Tapkara, Pharsabahar, Kunkuri, Kansabel.

Habit and habitat : Spends its life underground or lives beneath the soil, stones or debris. It also found under logs, moist leaves and humus in wet forests. Feeds on soft bodied larvae and eggs of ants and termites.

Diagnostic characters : Snout rounded; strongly projecting; nostrils lateral; eyes distinct, Scales in 20 rows around the body; 290-320 transverse rows of scales. Length about 150 mm. coloration brown or blackish above, lighter below, snout, anal region and end of tail usually whitish with smooth scales.

Distribution : Throughout India.

Conservation status : Common.

20. ***Grypotyphlops acutus*** (Dumeril & Bibron)
(Beaked Worm Snake)

1844. *Ongchocephalus acutus* Dum. & Bib., *Erp. Gen* .vi : 333.

2004. *Grypotyphlops acutus*, Whitaker & Captain, *Snakes of India*, p. 52.

Observation localities : Tapkara, Pharsabahar and Kunkuri.

Habit and habitat : Mainly nocturnal and very agile. Strong burrower and spends most of its life underground. Feeds on worms, soft bodied larvae and eggs of ants and termites are also taken.

Diagnostic characters : Scales smooth; head same width as body; snout pointed with large. Hooked beak-like scale. Nostrils below the 'beak'. Short tails ends in a spine. Glossy brown above, distinctly paler below.

Distribution : Peninsular India, south of Ganges Basin and south of Rajasthan, west to Baroda and east of Kolkata.

Conservation status : Uncommon.

Family: BOIDAE

21. ***Python molurus molurus*** (Linnaeus)
(Indian Rock Python)

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

2004. *Python molurus molurus*, Whitaker & Captain, *Snakes of India*, p. 74.

Observation localities : Tapkara, Kohpani.

Habit and habitat : Nocturnal; inhabits in dense as well as in open forests with rocky outcrops near to marshes or streams. Feeds mainly on warm-blooded prey ranging in size from mice and birds to jackals, civets and even deer and wild boar.

Diagnostic characters : Thick-bodied; smooth scaled. Head broader than neck; eye has vertical pupil. Upper surface of head has large scales of different size and shape. Yellowish to brown with asymmetrical dark-brown black-edged blotches. Tip of arrow-head mark on head. Two dark streaks on side of head-one below, the other through/behind eye. Underside white or yellowish.

Distribution : Throughout India (except the Islands) up to 2000 m above sea level.

Conservation status : Schedule-I st.

22. ***Gongylophis conicus*** (Schneider)
(Common Sand Boa)

1801. *Boa conica* Schneider, *Hist. Amphia, ii* : 268.

2004. *Gongylophis conicus*, Whitaker & Captain, *Snakes of India*, p. 80.

Observation localities : Tapkara, Kansabel and Kunkuri.

Habit and habitat : Mainly nocturnal and feeds on insects, lizards, snakes, birds and rodents.

Diagnostic characters : Short and thick bodied. Scales of head and tail strongly keeled. Small eye with vertical pupil. Tail very short. Coloration variable; reddish-brown; yellowish-white, dark-brown or black with irregular usually dark brown, black-edged blotches. Under part yellowish-white.

Distribution : Throughout India (excluding the Northeast, Andamans and Nicobar Islands and Lakshdwep).

Conservation status : Common.

23. ***Eryx johnii*** (Russell)
(Red Sand Boa)

1801. *Boa johnii* Russell, *Ind. Serp, ii* : 18 and 20.

2004. *Eryx johnii*, Whitaker & Captain, *Snakes of India*, p. 82.

Observation localities : Tapkara, Kansabel.

Habit and habitat : Prefers dry places, sandy soil and often lives in rodent burrows. Feeds on insects, lizards, birds and rodents.

Diagnostic characters : This is a thick-bodied snake and can be recognized by its completely blunt tail very similar to head. The scales are small and weekly keeled. It is a medium-sized, stout, heavy and muscular bodied snake. The eyes are small; with vertical pupil. Coloration variable; reddish-brown, dark-brown, speckled gray, yellow or black; belly white; spotted with brown.

Conservation status : Uncommon.

Family COLUBRIDAE

24. ***Ahaetulla nasuta*** (Lacepede)
(Common Vine Snake)

1758. *Coluber nasuta* Lacepede, *Hist. Nat. Serp.* I : 100.

2004. *Ahaetulla nastua*, Whitaker & Captain, *Snakes of India*, p. 270.

Habit and habitat : An elegant diurnal snake usually seen on low bushes or trees, rarely on the ground. Feeds mainly on lizards, frogs, small birds and mice.

Diagnostic characters : It is a long, slender, smooth-scaled snake. Extremely pointed head has extended snout; eyes large with horizontal pupil. Tail long. Uniform parrot-green back, often with a thin white or yellow line separating upper body scales from belly scales.

Distribution : Throughout India (except in the northwest and much of the Gangetic basin). Known from Bengal (Jalpaiguri); extent of distribution in the northeast uncertain.

Conservation status : Rare.

25. ***Amphiesma stolatum*** (Linnaeus)
(Striped Keel back Snake)

1758. *Coluber stolata* Linnaeus, *Syst. Nat.* : 219.

2004. *Amphiesma stolatum*, Whitaker & Captain, *Snakes of India*, p. 204.

Habit and habitat : These little and gentle snakes are quite inoffensive; frequently found in cultivated areas, grasslands and bushes and can be seen in big numbers in rains hiding in the holes in the ground.

Diagnostic characters : This is a small-sized, slender bodied snake with strongly keeled scales and long tail. The body is elongated and neck fairly evident. Eyes are large, pupil rounded, flecked with gold. Brown back

with two distinct ribbon-like yellowish stripes from neck to tip of tail. Head light-brown or olive above lips and area in front of and behind eye yellowish.

Distribution : Throughout mainland India.

Conservation status : Abundant.

26. ***Argyrogena fasciolata*** (Shaw)
(Banded Racer)

1758. *Coluber fasciolatus* Shaw (based on Russell, 1760 : 26, pl. 21).

2004. *Argyrogena fasciolata*, Whitaker & Captain, *Snakes of India*, p. 124.

Habit and habitat: Diurnal and found in rodent burrows, rock piles and heavy brush. Feeds on insects, frogs, field mice, and metad rats.

Diagnostic characters : It is small to medium-sized slender snake; body is fairly robust, elongated and cylindrical; head is moderately depressed; broadest between eye and neck. Upper jaw and snout strongly projecting. Light/dark brown in color; belly white or yellowish white.

Distribution : India : throughout most of the peninsular plains (from Baroda to Gwalior) to the Himalayas (south of Nepal); in the east to west Bengal south to Tirunevali (except southeast coast).

Conservation status : Uncommon.

27. ***Boiga trigonata*** (Schneider)
(Common Cat Snake)

1758. *Coluber trigonata* Schneider, *Bechst. Transl. Lacep.*, 4 : 256, pl. 40, fig. 1.

2004. *Boiga trigonata*, Whitaker & Captain, *Snakes of India*, p. 234.

Habit and habitat : It is a nocturnal snake; at rest, it coils into a ball rather than stretching the entire body. It is essentially an arboreal snake and prefers bushes and shrubs near the ground to high trees. They spend day light hours in a cool place in thatched roofs or under the bark of trees.

Diagnostic characters : It is a small to medium-sized snake. The head is triangular and flat, much wider than the neck. The neck is very thin and eyes are large with vertical pupil; tail very long. The scales are smooth. Body long; thin and laterally flattened. Light brown/ tan with darker zigzag markings.

Distribution : Throughout India.

Conservation status : Abundant.

28. ***Dendrelaphis tristis*** (Daudin)
(Common Bronzeback Tree Snake)

1758. *Coluber tristis* Daudin, *Hist. Nat. Rept.*, 6 : 430.

2004. *Dendrelaphis tristis*, Whitaker & Captain, *Snakes of India*, p. 158.

Habit and habitat : Diurnal, arboreal; inhabits low bushes, thorn trees. Feeds on frogs, garden lizards, geckos and small birds.

Diagnostic characters : It is a long, slender, smooth-scaled snake. Head distinctly broader than neck; snout bluntly rounded. Large eyes has round pupil. Tail very long, thin and wire-like. Vertebrates enlarge; ventrals and caudals laterally keeled. Bronze-brown or purplish-brown back with a dark-brown or black stripe on either side of body. Indistinct black streak behind eye.

Distribution : India : throughout most of peninsular India Gujarat downwards; east to Darjeeling.

Conservation status : Rare.

29. ***Coelognathus helena*** (Daudin)
(Common Trinket Snake)

1803. *Coluber helena* Daudin, *Hist. Nat. Rept.*, 6 : 277.

2004. *Coelognathus helena*, Whitaker & Captain, *Snakes of India*, p. 100.

Habit and habitat : Active both during day and night. In summer, it is found in termite mounds, rock piles and crevices and in cooler months, it may be seen on leafy trees and bushes. Feeds on rats, mice, squirrel, but also takes lizards and frogs.

Diagnostic characters : It is a medium-sized; slender bodied snake. The head is elongate and well defined. The snout is small and rounded. Nostrils are large and eyes rather large with round pupil. Body is cylindrical and tail is long. Color is mostly tan or olive, and chocolate-brown with two black stripes on neck and light bands and /or checks on fore-body; hind body has two prominent dark-brown or black stripes that continue onto tail; belly pearl-white.

Distribution : Throughout India, up to Jammu and Kashmir (Poonch) in the north, to Manipur and the Naga hills in the Northeast.

Conservation status : Rare.

30. ***Lycodon aulicus*** (Linnaeus)
(Common Wolf Snake)

1754. *Coluber aulicus* Linnaeus, *Mos. Adolph. Frider*, I : 29.

2004. *Lycodon aulicus*, Whitaker & Captain, *Snakes of India*, p. 174.

Habit and habitat : It is strictly a nocturnal snake. Found in caves, piles of stones, wells, hollow trees and often in houses. Feeds on geckos and skinks.

Diagnostic characters : It is a slender-bodied; smooth-scaled snake with a flattened head slightly

broader than neck; snout broad, projecting beyond lower jaw. Glossy grey, light/dark-brown or black above usually 10-20 narrow white or yellow bands that fork on sides of body.

Distribution : Throughout India (including Lakshdweeep but not the Andaman & Nicobar Islands).

Conservation status : Common.

31. ***Macropisthodon plumbicolor*** (Cantor)
(Green Keel back Snake)

1839. *Tropidonotus plumbicolor* Cantor, Proc. zool. Soc. London : 54 (type be, Malwa, Saugar).

2004. *Macropisthodon plumbicolor,* Whitaker & Captain, *Snakes of India,* p. 216.

Habit and habitat : Nocturnal and crepuscular. Found in grass and low vegetation. Prefers toad though frogs and rats are also taken.

Diagnostic characters : A stout bodied snake; scales on body strongly keeled. Large eyes has round pupil. Bright or dull green over all sometimes with faint irregular black bands.

Distribution : India : Whole of the mainland except the east coast, Ganges valley and the extreme north-west. Common in parts of Maharashtra.

Conservation status : Uncommon.

32. ***Oligodon arnensis*** (Shaw)
(Common Kukri Snake)

1801. *Coluber arnensis* Shaw, *Gen Zool.*, iii : 526.

2004. *Oligodon arnensis*, Whitaker & Captain, *Snakes of India*, p. 144.

Habit and habitat : Nocturnal and crepuscular. Found in termite mounds, caves, crevices, tree holes and old houses. Young feed on insects and their larvae, spiders and gecko eggs; adult eat reptile eggs, geckos, skinks and small mice.

Diagnostic characters : A small snake with a short, smooth and even sized cylindrical body. Head slightly or not broader than neck with typical shaped marks. Eyes are moderate with large rounded pupil. Short tail has pointed tip. Brown back with 10-20 distinct black or dark-brown bands and three '^' shaped marks of the same color on head.

Distribution : Throughout India (except the Andaman & Nicobar Islands and possibly the extreme Northeast).

Conservation status : Uncommon.

33. ***Ptyas mucosa*** (Linnaeus)
(Indian Rat Snake)

1758. *Coluber mucous* Linnaeus, *Mus. Ad. Frid,* 1 : 37.

2004. *Ptyas mucosa*, Whitaker & Captain, *Snakes of India*, p. 114.

Habit and habitat : A very fast, alert, active, diurnal hunter which can climb well. It has a wide range of habitats-coastal, arid, wet, mountainous, open fields as well as forests. Rat holes and termite mounds are preferred dwellings. Feeds on frogs, toads, lizards, birds, rats, bats, snakes and in one case it also shows cannibalism.

Diagnostic characters : Rat snakes are large, streamlined, with shiny scales. Dorsal rows are keeled. Thin neck and large eyes has round pupil. Head is depressed. The snout is short and blunt. Tail is short, somewhat compressed basally. Varies greatly in color; pale- yellow, olive, brown, grey and black. Body lightly or strongly marked with black; markings usually distinct on tail. Lip scales usually separated by vertical black lines.

Distribution : Throughout India.

Conservation status : Very Common.

34. ***Xenochrophis piscator*** (Schneider)
(Common Water Snake)

1799. *Hydras piscator,* Schneider, *Hist. Amph;* i : 247.

2004. *Xenochrophis piscator,* Whitaker & Captain, *Snakes of India,* p. 192.

Habit and habitat : Active by day and night. Found in and around fresh water bodies and paddy fields and hunt along the edges of ponds and rice-fields. Young feed on frog eggs, tadpoles, and water insects; older snakes eat fish, frogs, occasionally rodents and birds.

Diagnostic characters : A medium-sized snake with a stout heavy body, a pointed head and a rather long tail. The scales are strongly keeled and over all. Eyes has round pupil. Two bold black streaks-one below, the other from eye to angle of mouth. Glossy olive-green, olive-brown, yellow, brown, gray or black, usually with a checkered body pattern.

Distribution : Throughout India.

Conservation status : Very Common.

Family ELAPIDAE

35. ***Bungarus caeruleus*** (Schneider)
(Common Krait)

1801. *Pseudo boa caeruleus* Schneider, *Hist. amphib. ii* : 284.

2004. *Bungarus caeruleus*, Whitaker & Captain, *Snakes of India*, p. 290.

Habit and habitat : Nocturnal; alert and active at night. Often found in farms and gardens near water. Termite mounds, rodent's burrows, piles of brick and

rubble are other places to encounter. Feeds mainly on snakes even other kraits, sometimes rodents, lizards and frogs are also taken.

Diagnostic characters : It is a smooth-scaled snake; head slightly broader than neck; eye entirely black. Glossy black pale faded bluish-gray or dark-brownish-black above (often with blue iridescence) with narrow (sometimes paired) white bands that continue to pointed tip of short tail. Bands usually absent on fore body or they are replaced by white vertebral spots. Scales of the vertebral line six-sided, and much larger than adjacent scales.

Distribution : Most of the mainland India up to 1700 m, uncommon where the Banded Krait occurs. Probably absent in the Northeast above Assam.

Conservation status : Abundant.

36. ***Bungarus fasciatus*** (Schneider)
(Banded Krait)

1801. *Pseudoboa fasciata*, Schneider, *Hist, Amph. Ii*, p. 238.
2004. *Bungarus fasciatus*, Whitaker & Captain, *Snakes of India*, p. 288.

Habit and habitat : Nocturnal; lives in termite mounds and rodents burrows close to water. Prefers open plains country, but also found up in lower hill country. Feeds mainly snakes (even common kraits), snake eggs, skink, rats and sometimes fishes.

Diagnostic characters : It is a smooth-scaled snake; head slightly broader than neck; eye entirely black; short tail has blunt, rounded tip. Body and tail triangular in cross-section; vertebral ridge prominent. Equally spaced, wide yellow/pale-brown/white and black bands. Scales of the vertebral line six-sided and much larger than adjacent scales.

Distribution : India : West Bengal, Bihar, Orissa, Assam upwards to Arunachal Pradesh, Maharashtra, Madhya Pradesh, northern Andhra Pradesh and Uttar Pradesh.

Conservation status : Uncommon.

37. ***Naja naja*** (Linnaeus)
(Spectacled Cobra)

1758. *Coluber naja Linnaeus*, *Syst. Nat.*: 221.
2004. *Naja naja*, Whitaker & Captain, *Snakes of India*, p. 304.

Habit and habitat : Active by day and night. Seen in fields, near streams, rock piles, trees, granaries and grain shops. Often lives in rat holes or termite mounds. Feeds on rodents, toads, frogs, birds and snakes.

Diagnostic characters : It is a snake with smooth, glassy scales. Head is broad. Color, pattern and hood mark variable; hood mark sometimes absent. Shades of brown, yellow, gray or black, often with a speckled, sometimes banded pattern; the spectacled marking on hood usually makes identification easy.

Distribution : Throughout mainland India (excluding the Northeast).

Conservation status : Common.

Family VIPERIDAE

38. ***Daboia russelii*** (Shaw)
(Russell's viper)

1797. *Coluber russelli* Shaw, *Nat. Misc.*, 8 : pl. 291.
2004. *Daboia russelii*, Whitaker & Captain, *Snakes of India*, p. 332.

Habit and habitat : Usually nocturnal; found in open grassy area, scrub jungle, rocky hillocks, forest edges hillocks, dense thorny hedgerows. Feeds on rodents, including the Indian Gerbil.

Diagnostic characters : It is a stout bodied snake with strongly keeled scales. Triangular head; broader than neck; scales on upper surface of head small; nostril very large. Eye has vertical pupil. Tail short and thin. Brown or yellowish-brown with three longitudinal series of prominent large brown or black oval or round spots forming a chain-like pattern.

Distribution : Throughout India.

Status : Uncommon.

DISCUSSION

The herpetofauna of Naglok Region Jashpur is represented by 38 species/subspecies of reptiles and amphibians belonging to 15 families. The major orders of amphibians and reptiles represented in the fauna of Naglok region are :

1. Anura (Toads and Frogs)
2. Testudines (Tortoise and Turtles)
3. Squamata (Lizards, Geckos and Snakes)

Number of reptiles and amphibians observed in Naglok has been plotted in table 2nd which shows that the total number of observations is 572, the number of amphibian observations is 168 (29.36%), while the reptilian observation is 404 (70.64%).Among the amphibians Common Tree Frog (*Polypedates maculatus*, 1.92%) shows the least number of observations while Indian Bull Frog (*Hoplobatrachus tigerinus*, 9.79%) shows the highest number of observations. Among the lizards the Indian Chamaeleon (*Chamaeleo zeylanicus*, 0.17%) shows the least while the Termite Hill gecko (*Hemidactylus triedrus*, 3.67%)

shows the highest number of observations. Among the snakes, Red Sand Boa (*Eryx johnii*, 0.34%), Green Vine Snake (*Ahaetulla nasuta*, 0.34%), Green Keelback (*Macropisthodon plumbicolor*, 0.34%),) shows the least number of observations while the Striped Keelback (*Amphiesma stolatum*, 12.34%) shows the highest number of observations.

Three species of frogs and two species of toads inhabit the different area of the Naglok. These are *Duttaphrynus melanostictus, Duttaphrynus stomaticus, Microhyla ornata, Hoplobatrachus tigerinus*, and *Polypedates maculatus.*

One species of Testudines i.e. *Lissemys punctata punctata* inhabits the wetland area of Naglok.

The Gekkonids are represented by five species. These are *Hemidactylus brookii, Hemidactylus flaviviridis, Hemidactylus frenatus, Hemidactylus triedrus*, and *Hemidactylus maculatus.*

Among the lizards, there are three species commonly found and these are *Calotes versicolor, Sitana ponticeriana* and the *Psammophilus blanfordanus.* And among the Varanidae, only one species, The Bengal Monitor *(Varanus bengalensis)* is commonly found in the area.

The family Scincidae is represented by two species viz. *Eutropis carinata* and *Lygosoma albopunctata.*

Three families of non-venomous snakes and two families of venomous snakes represent the Serpentes. The Typhlopids are small worm-like creatures and represents by one species, the Common Worm Snake *Ramphotyphlops braminus*.

The Boids are represented by three species; Indian Rock Python (*Python molurus*), Common Sand Boa (*Gongylophis conicus*), and Red Sand Boa (*Eryx johnii*).

Colubrids are represented by eleven species; Green Vine Snake (*Ahaetulla nasuta*), Striped Keelback (*Amphiesma stolatum*), Banded Racer (*Argyrogena fasciolata*), Common Cat Snake (*Boiga trigonata*), Common Trinket Snake (*Coelognathus helena*), Bronzeback snake (*Dendrelaphis tristis*), Common Wolf Snake (*Lycodon aulicus*), Green Keel back (*Macropisthodon plumbicolor*), Banded Kukri (*Oligodon arnensis*), Rat Snake (*Ptyas mucosa*), Chequred Keelback (*Xenochrophis piscator*).

Family Elapidae includes three species; Common Krait (*Bungarus caeruleus*), Banded Krait (*Bungarus fasciatus*), and Common Cobra (*Naja naja).* Viperidae family represented by just one species; Russell's viper (*Daboia russelii).*

SUMMARY

The paper presents the information on herpetofauna of Naglok Region of Jashpur District of Chhattisgarh. Total 38 species/subspecies of reptiles and amphibians belonging to genera under 15 families are reported from Naglok region. All the species observed by the team of Snake Research Organization, Ujjain, Madhya Pradesh from April 2002 to March 2006 are reported for the first time form the area. The systematic list of amphibians and reptiles observed in various localities and their density along with their status have also been incorporated.

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PLATE-I

Duttaphrynus melanostictus
Common Asian Toad

Hoplobatrachus tigerinus
Indian Bull Frog

Polypedates maculatus
Common Tree Frog

Lissemys punctata punctata
Indian Flap-shell Turtle

Hemidactylus triedrus
Termite-Hill Gecko

Sitana ponticeriana
Fan-throated Lizard

PLATE-II

Psammophilus blanfordanus
Blanford's Rock Agama

Mabuya carinata
Common Skink

Varanus bengalensis
Bengal Monitor

Python molurus Indian
Rock Python

Gongylophis conicus
Brown Sand Boa

Eryx johnii
Red Sand Boa

PLATE-III

Amphiesma stolatum
Striped Keelback

Argyrogena fasciolata
Banded Racer

Boiga trigonata
Common Cat Snake

Coelognathus helena
Common Trinket Snake

Lycodon aulicus
Common Wolf Snake

Macropisthodon plumbicolor
Green Keelback

PLATE-IV

Oligodon arnensis
Common Kukri

Ptyas mucosa
Indian Rat Snake

Xenochrophis piscator
Checkered Keelback

Bungarus caeruleus
Common Krait

Naja naja
Spectacled Cobra

Daboia russelii
Russell's Viper

Rec. zool. Surv. India, **111**(Part–4) : 97-98, 2011

Short Communication

FIRST REPORT OF *EPISINUS AFFINIS* (ARANEAE : THERIDIIDAE) FROM INDIA

INTRODUCTION

Genus *Episinus*, Latreille 1809, has a world wide distribution, with 80 described species (Platnick, 2010). Spiders belonging to this genus can be easily identified from the peculiar triangular shape of their abdomen with two horny projections at the posterior end of the abdomen. They are often found on bare twigs under bushes (Murphy, 2000). Usually dusty in colour from dirty grey to pale brown. Carapace is usually oval and slightly longer than wide. Clypeus is usually projecting. Eyes eight, arranged on tubercles with distinct black markings around them. Eyes region roundly elevated or projected anteriorly. Chelicerae usually small, anterior margin of fang furrow with or without tooth while the posterior margin is always without tooth (Okuma, 1994). Colulus replaced by two setae (Yoshida, 1983). Legs formula 4123.

METHODOLOGY

Specimens were collected from Govindghat, Nanda Devi Biosphere Reserve, Uttarakhand. The collected specimens were preserved in 70% ethanol. One mature female was dissected and the epigynum was removed and kept overnight in a solution of Potassium hydroxide (KOH). This helped in removing the extra tissue attached to the epigynum (Figure. 1C) and also made the internal genitalia more prominent. Voucher specimens are deposited at Wildlife Institute of India, Dehradun, Uttarakhand, India.

ABBREVIATIONS

L = Length, W = width, AME = Anterior median eyes, ALE = Anterior lateral eyes, PME = Posterior median eyes, PLE = Posterior lateral eyes. NDBR = Nanda Devi Biosphere Reserve.

OBSERVATIONS AND DISCUSSIONS

Episinus affinis, Bösenberg et Strand, 1906

Description : *Female* : Long and slender in appearance. Cephalothorax oval and abdomen triangular in shape. Pale yellow to dirty brown in colour. Legs robust and long.

Cephalothorax : Slightly longer than broad, oval; dirty grey to pale yellowish; margined with a black lining around it. *Cephalic region* darker and semicircular. *Clypeus* slightly high and projecting. Prominent *thoracic groove* in the middle. *Chelicerae* with a very small tooth on anterior margin, without tooth on posterior margin. *Maxillae* longer than broad, pale yellow with black patches in the middle. Distal end truncated; tuft of hairs present on the distal end. Few hairs and spines scattered on the surface of the maxillae. *Labium* small about one third of the maxillae; as long as wide; pale yellow and provided with small hairs. *Sternum* longer than wide, dark brown and oval; with a pale grey band in the middle. *Eyes*: Both row of eyes procurved; anterior row of eyes more procurved than posterior row of eyes. AME very small while PME are largest. Eyes placed on raised tubercles, bordered with confluent black margins. *Fovea* prominent and deep. *Legs* robust and long; pale yellow with black patches or markings. Legs formula 4132. Femur with long dorsal hairs. Few dorsal spines present on patella and tibia. Pedipalps thin; similar to the legs in shape and colour.

Abdomen : Triangular, longer than wide; widest in the posterior end. Dorsum pale greyish brown and ventrum pale yellow with a mid-ventral grey band and lateral black patches. Posterior end of abdomen with two horny projections, spinnerets arranged in a circular manner. Epigyne with a broad median opening outside and with a pair of swollen seminal receptacles inside (Fig. 1).

Measurements (in mm) : Total length L = 5.0; carapace L = 2.0, W = 1.5; abdomen L = 3.0, W = 2.5.

Specimens examined : 2♀, 1♂ (Juvenile) Govindghat, NDBR, Uttarakhand, India, (30°39'59.8''N, Altitude 2415m), 20 September 2009, from dry vegetation and bushes of *Prencipia utilis*. Coll. Shazia Quasin.

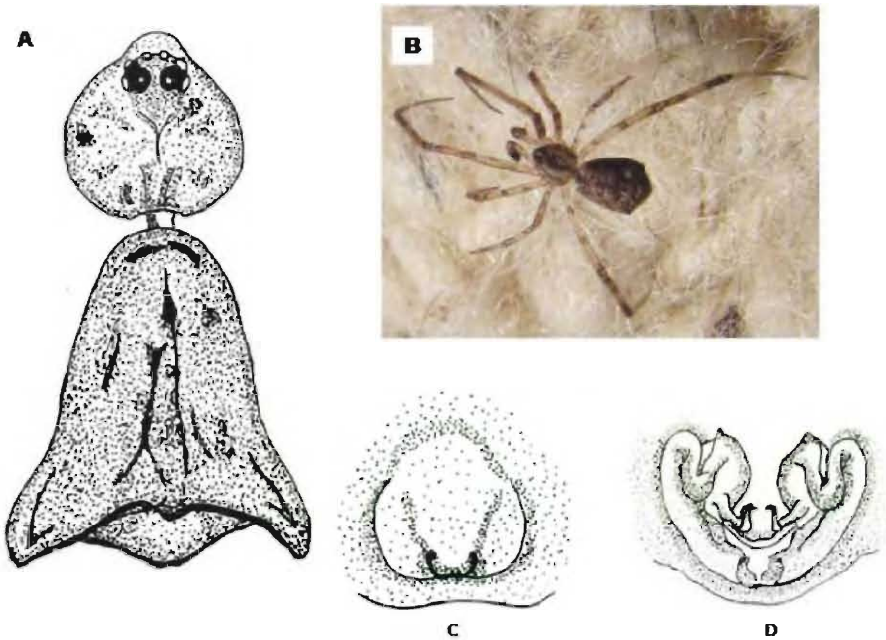

Fig. 1. A & B. Dorsal view of *Episinus affinis;* C. Epigynum; D. Internal genitalia.

Distribution : India (New record), Russia, Korea, Taiwan, Japan, Ryukyu Is.

Habitat : Specimens were collected from web built among dry vegetation and bushes. The legs were folded forming four bands while at rest. The specimens were collected by aerial hand collection method.

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Table-1 : Measurements of the leg segments of *Episinus affinis*, B□senberg et Strand, 1906 (♀) (in mm).

Legs	Femur	Patella+Tibia	Metatarsus	Tarsus	Total
I	2.85	3.05	2.95	0.50	9.35
II	1.75	1.65	1.45	0.35	5.20
III	1.30	1.15	1.10	0.30	3.75
IV	2.85	2.70	2.80	0.70	9.0

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Rec. zool. Surv. India, **111**(Part–4) : 99-100, 2011

Short Communication

SPHAENISCUS QUADRINCISUS (WIEDEMANN, 1824) (DIPTERA : TEPHRITIDAE), A NEW RECORD FROM HIMACHAL PRADESH, INDIA

INTRODUCTION

Members of family Tephritidae include several economically important pest species across the globe. 325 species of fruit flies are known to occur in the Indian subcontinent, of which 243 species in 79 genera are from India alone under four subfamilies, namely Dacinae, Phytalmiinae, Tephritinae and Trypetinae (David and Ramani, 2011; Agarwal and Sueyoshi, 2005). 40 species in 26 genera have been reported from the state of Himachal Pradesh (Agarwal and Sueyoshi, 2005). The genus *Sphaeniscus* Becker,1908 is represented by two species in India, *i.e.*, *S. quadrincisus* (Wiedemann, 1824) and *S. atilius* (Walker, 1849). The objective of this paper is to make *S. quadrincisus* known from Himachal Pradesh for the first time.

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."

1849. *Trypeta tucia* Walker, *List Dipt. Ins. Coll. Brit. Mus.*, 4 : 1021, Lectotype India (N. Bengal).

1896. *Trypeta tacia* Wulp, *Cat. Desc. Diptera South Asia, Dutch Entomol. Soc.*, P. 192. Lapsus calami.

1897. *Euxesta parvula* Wulp, *Termeszetr. Fuz.*, 20 : 141. Holotype, Sri Lanka.

1913. *Spheniscomyia quadrincisa* : Bezzi, *Mem. Indian Mus.*, 3 : 147. India (Orissa : Puri; W. Bengal : Kolkata).

1956. *Sphaeniscus quadrincisus* : Hering, *Verh. Naturforsch. Ges. Basel*, 67(1) : 67. Sri Lanka.

Material examined : 1, ♀ Regd. No. 9830/H6, Dist. Kullu, Loc. Premkhud, Lugarbhatti, 77°13´E, 31°99´N, Dt. 11.iv.06, Coll. R. Babu.

Diagnosis : Body shining black, lightly grey pollinose on mesonotum; arista short pubescent; 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; vein R4 + 5 bare except for a few setae at the basal portion, r-m crossvein situated near apex of cell 1st M2;

PLATE-I

Sphaeniscus quadrincisus (Wiedemann)

piercer thickened at base, sharply tapered at apex, ovipositor extended, spermathecae weakly sclerotized. (Plate-1).

Distribution : India : Himachal Pradesh (new record), Andaman Is., Karnataka, Maharashtra, Meghalaya, Orissa, West Bengal.

Elsewhere : China, Sri Lanka, Taiwan, Thailand.

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