

## NEW SPECIES OF *STRIATOPPIA* BALOGH, 1958 (ACARI: ORIBATIDA) FROM LAKSHADWEEP, INDIA

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### INTRODUCTION

Lakshadweep, one of the smallest Union Territories of India, consists of 12 atolls, three reefs and five submerged banks and 10 of its 36 Islands (area 32 sq.km.) are inhabited. Though the islands are unique in their ecosystem, no extensive faunal survey has yet been undertaken. Considering the fact, a survey was undertaken in Agatti Island, Lakshadweep for short duration and collected insects and mites. The study of soil inhabiting acarines revealed 10 species of oribatid mites including one new species of the genus *Striatoppia* Balogh, 1958 which is described here.

Out of 24 species of the genus *Striatoppia* Balogh, 1958 (Subias, 2009; Murvanidze and Behan-Pelletier, 2011), 6 were recorded previously from India (3 species from West Bengal and 3 species from Tripura). This is the first record of this genus from Lakshadweep.

### DESCRIPTION OF SPECIES

#### *Striatoppia milii*

(Figs. 1-2)

*Sex:* Female.

*Measurement:* Length: 207  $\mu\text{m}$ , Breadth: 110  $\mu\text{m}$ .

*Prodorsum:* Prolamellae very conspicuous, thick and bifurcated at the apex. Rostral hair originate from the anterior margin of prolamellae. Rostral setae robust and setiform. Lamellar costulae short with well developed, concave translamellae and 2 curved lamellae directed

toward pseudostigma. 1 pair well developed, branched costular portion, unconnected with lamellar costulae, situated in the interbothridial region enclosing 4 large foveolae. Interlamellar setae, originate from costular ridge, appear as hardly discernible stumps. Lamellar setae barbed, phylliform and originate from the inner wall of lamellae. Granulation present in the interbothridial region, translamellar region and in the prolamellae. Granules in the interlamellar region being elongated. Sensillus pro- to exclinate, its widened outer boarder densely ciliated. Lateral longitudinal ridges of prodorsum well developed.

*Notogaster:* Anterior margin of notogaster narrowed and medially pointed. Notogaster only with 4 to 5 pairs of longitudinal striations which extending from anterior margin to one third length of notogaster i.e upto setae *te* and *ti*. 10 pairs of notogastral hair; 9 pairs widened, barbed and phylliform.  $p_1$  is smaller than other and not phylliform.

*Ventral plate:* Ventral plate with 2 to 3 pairs of longitudinal striae, all of them restricted near the genital plate. Anogenital region contains 5 pairs of genital, 1 pair of aggenital, 2 pairs of anal and 3 pairs of adanal setae. Genital setae fine and short;  $g_1$ - $g_3$  positioned anteriorly along median margin of ventral plate;  $g_4$  and  $g_5$  positioned obliquely on the posterior part of the plate. Aggenital setae fine, smooth and simple. Anal setae smooth and simple. Adanal setae  $ad_3$  simple;  $ad_2$  slightly thickened and  $ad_1$  slightly ciliate. Lyrifissure *iad* adjacent and parallel to the anal plate.

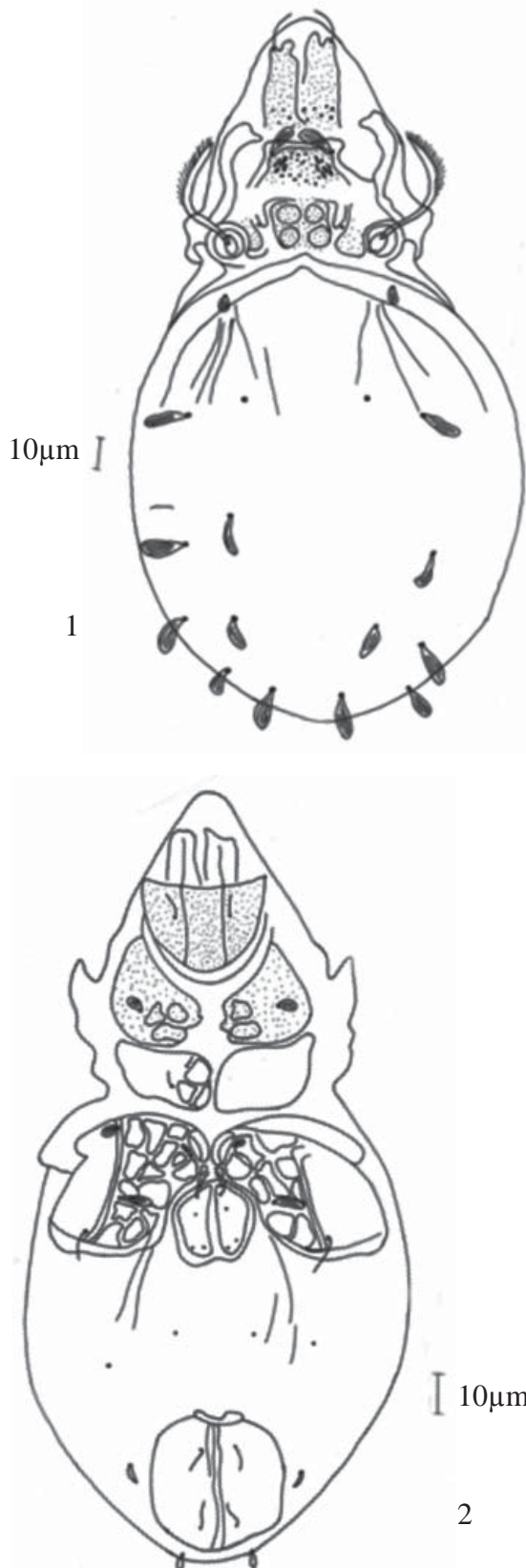


Fig. 1-2. *Striatoppia milii* sp. nov. 1. Dorsal view of the body; 2. Ventral view of the body.

Mentum and anterior part of epimeral surface with granulations. Epimeral setal formula 3-1-3-3. Epimeral setae of different types, *1b*, *3b* and *4a* broad, lanceolate and ciliate and others thin and simple. Setae *1b* and *3b* rounded and *4a* elongated. Epimeral surface ornamented with scattered large spots.

*Material examined:* Holotype: ♀, India: Lakshadweep: Agatti Island: Agricultural Office garden, 7 kms north of Airport, 02. vii. 2011, from soil mixed with semidecomposed coconut leaves, coll. M. Sanyal. Paratype: 1♀, data same as the holotype. Both the specimens have been deposited in the National Zoological Collection, Zoological Survey of India, Kolkata. The holotype Registration No. 4258/17 and paratype Registration No. 4259/17.

*Remarks:* *Striatoppia milii* sp. nov. differs from 4 closely related species by the range of characters indicated in Table 1. The new species is related to *S. baloghi* Mahunka, 1974, reported from Cameroun. The similarities between two species are pro-to exclinate sensillus, well developed prolamellae, shape of costular ridge in interbothridial region, widened and ciliated notogastral setae and slightly ciliated *ad*<sub>3</sub>. It can be separated easily from the *S. baloghi* by few numbers of lines in notogaster and ventral plate. The sculpture in the interlamellar region is different. Epimeral setae *1b*, *3b* and *4a* rounded in *S. baloghi* but in the present species *4a* elongated. There are no granulations in prolamellar region and no translamellae in *S. baloghi*.

The new species also goes near to *S. modesta* Mahunka, 1988, collected from Sabah, Malaysia by having very few notogastral striations, granulation in mentum and anterior part of epimeral surface and similar shape of *1b*, *3b* and *4a*. Beside these, *S. modesta* possesses no translamellae, prolamellae is not well developed, the shape of the sensillus is different than the new species and have no ventral striation.

This species also shows similarity with *S. quadrilineata*, Hammer, 1982, reported from Bali,

**Table 1.** Similarities and dissimilarities between *S. baloghi*, *S. modesta*, *S. lanceolata*, *S. quadrilineata* and *S. milii* sp. nov.

	<i>S. baloghi</i>	<i>S. modesta</i>	<i>S. lanceolata</i>	<i>S. quadrilineata</i>	<i>S. milii</i>
Body length	192-195µm	198-221µm	0.215mm	0.23mm	207 µm
Striation in notogaster	Numerous	Few	Few	Numerous	3-5 pairs
Striation in ventral plate	Numerous, transverse and longitudinal	Nil	Few, longitudinal	Numerous, transverse and longitudinal	2-3 pairs, longitudinal
Sensillus	Pro to exclinate, distal part densely ciliate	Proclinate to inclinate, apically strongly incrassate	Proclinate to inclinate, apically strongly incrassate	Club shaped, outer boarder densely ciliated	Pro to exclinate, distal part densely ciliate
Shape of Notogastral setae	Dialated and ciliate	Dialated and ciliate	Lanceolate	Broad lanceolate ciliate	Dialated and ciliate

Indonesia by having distinct prolamellae, well developed translamellae, distinct costular ridges in the interbothridial region and slightly ciliated  $ad_3$ . In *S. quadrilineata* granulations are present only in the prolamellar region, sensillus is club shaped, some notogastral striae reaching beyond  $ms$ , notogastral setae are broad lanceolate, ciliate. Epimeral setae  $1b$ ,  $3b$  and  $4a$  lanceolate and ciliate and the ventral striae halfway surrounding the genital plate and almost reaching the anal plate.

The new species also stands near to *S. lanceolata* Hammer, 1972, from Tahiti. The similarities are well developed prolamellae, translamellae and interbothridial costular ridge, few longitudinal striae in ventral plate and notogastral plate, and the notogastral striae does not exceed  $ta$  and  $te$ . The major dissimilarities are lanceolate lamellar and notogastral setae and shape of sensillus.

**Etymology :** The species is named after the collector's name Mili Sanyal.

#### SUMMARY

Lakshadweep is one of the smallest Union

Territories of India. The first ever study of soil inhabiting oribatid mites from Lakshadweep revealed 10 species including few interesting ones, of which, one species under the genus *Striatoppia* Balogh, 1958 is described here as new to science. This genus is reported for the first time from Lakshadweep.

The new species of *Striatoppia milii* sp. nov. (Acarina: Oribatida) from the soil of Lakshadweep can be distinguished readily from all other known species in its possession of 3-5 pairs of longitudinal striation in notogaster, 2-3 pairs of longitudinal striation in ventral plate, 4 large foveolae in the interbothridial region, etc.

#### ACKNOWLEDGEMENTS

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#### REFERENCES

- Hammer, M. 1972. Investigation on the oribatid fauna of Tahiti, and on some oribatids found on the Atoll Rangiroa. *Biol. Skr. Dan. Vid. Selsk.*, **19**(3): 6-65.

- Hammer, M. 1982. On a collection of Oribatid Mites on Bali, Indonesia (Acari: Cryptostigmata). *Ent. Scand.*, **13**: 445-464.
- Mahunka, S. 1974. Neue und interessante Milben aus dem Genfer Museum. Data to the oribatid (Acari) fauna of Cameroun. I. *Ann. de la Fac. des Sciences du Cameroun*, **18**: 43-70.
- Mahunka, S. 1988. New and interesting mites from the Geneva Museum LXI. Oribatids from Sabah (East Malaysia) III (Acari: Oribatida). *Revue. Suisse. Zool.*, **95**(3): 817-888.
- Murvanidze, M. and Behan-Pelletier, V. M. 2011. A new species of *Striatoppia* (Acari: Oribatida) from the Caucasus Region with remarks on the familial placement of the genus. *Internat. J. Acarol.*, **37**(1): 53-59.
- Subías, L. S. 2009. Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes: Oribatida) del mundo (Excepto fósiles). Publicado originalmente en *Graellsia* 60 (número extraordinario): 3-305 (2004). Actualizado en junio de 2006, en abril de 2007, en mayo de 2008 y en abril de 2009. 1-547.



## ADDITIONAL RECORDS OF ODONATA (INSECTA) FROM PARAMBIKULAM WILDLIFE SANCTUARY, KERALA, INDIA.

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### INTRODUCTION

Emiliyamma and Radhakrishnan (2000) reported 25 species of Odonata (Insecta) from Parambikulam Wildlife Sanctuary, Kerala, India. A subsequent survey in the Sanctuary yielded information on 14 more species of Odonata (Table-1), thus expanding the list up to 39 species under 26 genera and 7 families. The study reveals the occurrence of four species viz., *Agriocnemis pieris*, *Pseudagrion indicum*, *Caconeura risi* and *Epithemis mariae*, which are endemic to Western Ghats (Subramanian, 2007), in the Sanctuary. A systematic list and a key of all the species hitherto known from the Sanctuary are provided.

### SYSTEMATIC LIST

#### Order ODONATA

#### Suborder ANISOPTERA

#### Family AESHNIDAE

1. *Anax immaculifrons* Rambur, 1842#

#### Family LIBELLULIDAE

2. *Brachythemis contaminata* (Fabricius, 1793)#
3. *Cratilla lineata* Foerster
4. *Crocothemis servilia* (Drury, 1770)
5. *Diplacodes trivialis* (Rambur, 1842)
6. *Epithemis mariae* (Laidlaw, 1915)\*
7. *Neurothemis fulvia* (Drury, 1773)

8. *Neurothemis intermedia* (Rambur, 1842)
9. *Neurothemis tullia* (Drury, 1773)
10. *Orthetrum chrysis* (Selys, 1891)#
11. *Orthetrum glaucum* (Brauer, 1865)#
12. *Orthetrum luzonicum* (Brauer, 1868)#
13. *Orthetrum pruinosum neglectum* (Rambur, 1842)
14. *Orthetrum sabina* (Drury, 1770)
15. *Palpopleura sexmaculata* (Fabricius, 1787)
16. *Pantala flavescens* (Fabricius, 1798)
17. *Potamarcha congener* (Rambur, 1842)
18. *Rhodothemis rufa* (Rambur, 1842)#
19. *Rhyothemis variegata* (Linnaeus, 1763)
20. *Tholymis tillarga* (Fabricius, 1798)
21. *Tramea limbata* (Desjardins, 1832)#
22. *Trithemis aurora* (Burmeister, 1839)
23. *Trithemis festiva* (Rambur, 1842)
24. *Trithemis kirbyi* Selys, 1891
25. *Zygonyx iris malabarica* Fraser, 1926

#### Suborder ZYGOPTERA

#### Family CALOPTERYGIDAE

26. *Neurobasis chinensis* (Linnaeus, 1758)
27. *Vestalis apicalis* Selys, 1873
28. *Vestalis gracilis* (Rambur, 1842)

29. *Vestalis gracilis montana* (Fraser, 1934)

Family CHLOROCYPHIDAE

30. *Rhinocypha bisignata* Hagen in Selys, 1853

Family COENAGRIONIDAE

31. *Agriocnemis pieris* Laidlaw, 1919\*, #

32. *Agriocnemis pygmaea* (Rambur, 1842)

33. *Ceriagrion coromandelianum* (Fabricius, 1798)#

34. *Pseudagrion indicum* Fraser, 1924\*, #

35. *Pseudagrion rubriceps* Selys, 1876 #

Family PLATYCNEMIDIDAE

36. *Copera marginipes* (Rambur, 1842)#

37. *Copera vittata deccanensis* Laidlaw

Family PROTONEURIDAE

38. *Caconeura risi* (Fraser, 1931)\*, #

39. *Prodasineura verticalis annandalei* (Fraser, 1921)#

\* Endemic to Western Ghats

# Additional records

## SYSTEMATIC ACCOUNT

### 1. *Anax immaculifrons* Rambur, 1842

*Material examined:* 1 Male, Venkoli, 10-xii-2007, Coll. K.G. Emiliyamma and party. *Male:* Thorax pale bluish green dorsally, turquoise blue on sides with a broad black stripe; 1<sup>st</sup> abdominal segment jet black, segments 2 & 3 turquoise blue, remaining segments black on apical half, pale reddish brown towards base; wings colored with amber yellow from tip to base of discoidal cell. *Female:* similar to the Male, but the turquoise blue replaced by pale greenish yellow on thorax and base of abdomen; segment 1 warm reddish brown instead of black; wings palely tinted.

*Distribution:* Throughout India and Oriental Region.

### 2. *Brachythemis contaminata* (Fabricius, 1793)

*Material examined:* 1 Female, Thellickal, 9-xii-2007, Coll. K.G. Emiliyamma and Party.

This species is recognized by its wing colouration. *Male:* wings having a reddish reticulation with bright orange broad band extending from wing base to pterostigma in forewing and hindwing, this band variable in extent and depth of colour according to the age of specimen. *Female:* hind wings very palely tinted with yellow at base, bright orange band seen in the *Male* absent; abdomen with a narrow black stripe on middorsal carina extending from segment 2 to 10.

*Distribution:* All over India and Oriental region.

### 3. *Orthetrum chrysis* (Selys, 1891)

*Material examined:* 1 *Male*, Kariyilathodupalam, 8-xii-2007; 1 *Male*, Thellickal, 9-xii-2007, coll. K.G. Emiliyamma and party. *Male:* Bright red; eyes, frons and abdomen bright red; thorax dark reddish brown; wings with a dark golden-brownish yellow spot at base of hind wing extending to the first antenodal nervure. *Female:* the red colour replaced by bright brownish yellow throughout; wings without yellow basal marking.

*Distribution:* Himachal Pradesh, Orissa, south Andaman Islands and Western Ghats.

### 4. *Orthetrum glaucum* (Brauer, 1865)

*Material examined:* 1 Male, Thellickal, 9-xii-2007; 1 Female, Muthuvan's Colony, 11-xii-2007, coll. K.G. Emiliyamma and party. *Male:* labium, labrum and frons glossy black; thorax pruinosed dark blue or black; extreme base of wings with dark yellowish brown; abdomen pruinosed blue from segment 1 to 8, segments 9 and 10 black. Sub adults Male and Female: labium, labrum, and face olivaceous brown; thorax olivaceous on mid dorsum, bordered by reddish brown humeral stripe; laterally reddish brown with two yellowish white narrow stripes; wings similar to the *Male*; abdomen reddish brown with two yellowish white narrow stripes; wings similar to the *Male*; abdomen reddish brown with a broad greenish yellow stripe on mid dorsum extending from segments 1 to 7; segments 8, 9 and bases of 10 black on mid dorsum.

*Distribution:* Oriental Region.

5. *Orthetrum luzonicum* (Brauer, 1868)

*Material examined:* 1 Male, Thellickal, 9-xii-2007, coll. K.G. Emiliyamma and party. *Male:* labrum, face and frons pale bluish or greenish yellow; thorax pale olivaceous green dorsally, a broad reddish brown humeral stripe bordered in front with black; laterally three brown stripes; wings hyaline, *Cui* in hind wing arising well away from the posterior angle of discoidal cell; abdomen pruinosed blue, the sides of segments 1, 2 and base of 3 bright yellow. Female and sub-adult Male: sides of thorax palest green with fine black sutures lateral brown stripes absent; wings similar to the *Male*; abdomen greenish yellow, with black markings, a broad black stripe on each side of segments 4 to 8, segments 9 and 10 black or 10 with an oval yellow dorsal spot.

*Distribution:* Throughout india and south East Asia.

6. *Tramea limbata* (Desjardins, 1832)

*Material examined:* 1 Male, Venkoli, 10-xii-2007, coll. K.G. Emiliyamma and party. *Male:* This species can be easily separated from other species of the genus by its hindwing base with a narrow, single black spot, not invading base of anal loop; nervures in this area are reddish; the spot is not surrounded by golden areola; thorax with a reddish tinge on dorsum; abdomen blood red, marked with black on last three segments.

*Female:* Exactly similar to Male; balck markings of abdomen broad.

*Distribution:* Throughout India, Oriental region.

7. *Rhodothemis rufa* (Rambur, 1842)

*Material examined:* 1 Female, Muthuvan's colony, 11-xii-2007, coll. K.G. Emiliyamma and party. *Male:* Eyes, frons and vesicle blood red; thorax reddish-brown; wings with a dark amber yellow spot at base of fore and hindwings; costa and basal neuration reddish; abdomen and anal appendages brilliant scarlet red. *Female:* A bright

citron yellow stripe starting from prothorax, running through thorax (split into two antehumeral stripes), between the root of wings and ends on the abdominal segment 4. Eyes reddish-brown above, olivaceous below; frons bright citron yellow; thorax golden-golden-brown laterally, blackish brown dorsally; abdomen dark golden-brown, segments 5 to 9 with a pair of citron yellow spots.

*Distribution:* Oriental region.

8. *Agriocnemis pieris* Laidlaw, 1919

*Material examined:* 3 Male, Thellickal, 9-xii-2007; 2 Male, Venkoli, 10-xii-2007, Coll. K.G. Emiliyamma and party. *Male:* thorax black, marked with pink antehumeral stripe; laterally blue with black spot; wings hyaline, pterostigma pale yellow or pink with the center black or gray enclosed in thick black nervures; abdomen pale blue, deepening on the distal four segments, marked with black; segment 2 with an anchor shaped dorsal marking, sometimes the flukes of anchor enclosed two small blue spots. *Female:* More robust than Male, wings with pterostigma golden yellow, abdomen broadly marked with black from segments 1 to 9, segments 8 and 9 entirely black with a narrow blue stripe on 8, segment 10 with a square shaped black mark.

*Distribution:* Endemic to Western Ghats.

9. *Ceriagrion coromandelianum*  
(Fabricius, 1798)

*Material examined:* 1 Female, Thellickal, 9-xii-2007, coll, K.G. Emiliyamma and party. *Male:* This species can easily be distinguished by the bright citron yellow abdomen, without marking; thorax uniformly olive-green, tinted with ochreous on dorsum, citron-yellow on sides, Female: more robust and dull coloured than male; thorax golden olivaceous brown, paler at the sides and beneath; abdomen uniformly olivaceous, with golen brown tint on dorsum, which deepens on the hinder segments.

*Distribution:* Widely distributed in Oriental Region.

10. *Pseudagrion indicum* Fraser, 1924

*Material examined:* 1 Male, Thellickal, 9-xii-2007, coll. K.G. Emiliyamma and party. *Male:* thorax green on dorsum, azure blue on sides, marked with medial and humeral black stripes; beneath white; abdomen azure blue on segments 1, 2 and basal half of 3, 3 to 7 greenish laterally; 8 to 10 azure blue; segment 2 with a goblet shaped black mark; 3 to 7 with broad dorsal stripe, 8 to 9 azure blue, with broad dorsal annules and segment 10 black. *Female:* Differs from the male in colour and markings, thorax grass green on dorsum, pale yellowish green on sides; three fine parallel black lines on mid dorsal carina and a fine black humeral line; abdomen azure blue, markings similar to Male; segment 2 with a thistle head marking on dorsum; segments 8 and 9 black with fine blue rings, segment 10 entirely blue.

*Distribution:* Endemic to Western Ghats.

11. *Pseudagrion rubriceps* Selys, 1876

*Material examined:* 1 Male, 1 Female, Thellickal, 9-xii-2007 1 Female, Venkoli, Coll. K.G. Emiliyamma and party. *Male:* This species can be easily recognized by the reddish orange colour on labrum, face, vertex and frons; thorax golden green on dorsum, azure blue on sides, dorsum with two thick black stripe; humeral stripe narrow and sinuous; abdomen marked with black on dorsum; segment 2 with a goblet shaped marking on dorsum. *Female:* Differs in colour and markings from the male: labrum, face, vertex and occiput uniform dark olivaceous thorax with markings similar to the male, but the ground colour of the dorsum dull bluish green; posterior lobe of prothorax with two short forwardly directed spines at the base; abdomen with dorsal markings broader.

*Distribution:* Oriental Region.

12. *Copera marginipes* (Rambur, 1842)

*Material examined:* 1 Female, Thellickal, 9-xii-2007, coll. K.G. Emiliyamma and party. *Male:* The two hind pairs of tibiae bright orange, moderately dilated; superior anal appendage only one fourth

the lengths of inferiors; female with posterior lobe of prothorax without spines.

*Distribution:* Throughout India and Oriental Region.

13. *Caconeura risi* (Fraser, 1931)

*Material examined:* 2 Male, Muthuvan's colony, 11-xii-2007, coll. K.G. Emiluyamma and party. *Male:* Small species, under surface of head azure blue; abdominal segments 3 to 7 with narrow blue basal annules; superior anal appendage with a tiny sub basal tooth or spine. Abdomen black, marked with blue as follows; segment 1 almost entirely blue, marked on the dorsum with a broad black band; segment 2 unmarked on dorsum, broadly blue at the sides; segments 3 to 7 with narrow blue basal annules; segments 8 to 10 entirely blue.

*Distribution:* Western Ghats, Northeast India extending to Southeast Asia.

14. *Prodasineura verticalis annandalei* (Fraser, 1921)

*Material examined:* 1 Male, Kariyilathodupalam, 8-xii-2007, coll. K.G. Emiliyamma and party. The key characters are wings with Cuii vein extending only 4 cells in length; Iriii arising distal to the subnode. *Male:* thorax velvet black, marked with very narrow brick red antehumeral stripes; abdomen black, marked with pale. *Female:* More robust than the Male, and markings pale creamy white instead of bright red or ochreous; posterior lobe of prothorax armed with 1 or 2 pairs of strongly curved hooks; thorax black with yellow antehumeral stripes; abdomen similar to the Male, but the sides of all segments rather broadly yellow.

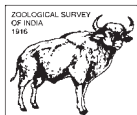
*Distribution:* Western Ghats, Northeast India extending to Southeast Asia.

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**REFERENCES**

- Fraser, F.C. 1933. The Fauna of British India, including Cylon and Burma, Odonata, Vol. **1**, pp XII+428. Taylor and Francis Ltd., London.
- Fraser, F.C. 1934. The Fauna of British India, including Cylon and Burma, Odonata, Vol. **2**, pp XII+398. Taylor and Francis Ltd., London.
- Fraser, F.C. 1936. The Fauna of British India, including Cylon and Burma, Odonata, Vol. **3**, pp XII+461. Taylor and Francis Ltd., London.
- Emiliyamma, K.G. and Radhakrishna, C. 2000. Odonata (Insecta) of Parambilulam Wildlife Sanctuary, Kerala, India. *Rec. zool. Surv. India*, **98**(Part-1): 157-167.
- Subramanian, K.A. 2007. Endemic Odonates of the Western Ghats: Habitat, distribution and conservation. In : *Biology of Odonata* (Ed. Tyagi, B.K.) : 257-271. Published by Scientific Publisher, Jodhpur, India.



## A REVIEW OF THE GENUS *Chlorion* LATREILLE, 1802 (HYMENOPTERA: SPHECIDAE) FROM THE INDIAN SUBCONTINENT

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### INTRODUCTION

Latrielle (1802) erected the genus *Chlorion* (Hymenoptera: Sphecidae) based on the type species *Sphex lobatus* Fabricius, 1775. This is a widely distributed genus all over the world except Australia and Europe (Bohart & Menke, 1976). Twenty species with additional three subspecies are recorded under this genus worldwide (Pulawski, 2009) of which three species namely *Chlorion lobatum* (Fabricius, 1775), *C. regale* Smith, 1873 and *C. splendidum* Fabricius, 1804 are recorded from the Indian subcontinent. In this paper, the genus *Chlorion* is reviewed with several new distributional records.

### MATERIAL AND METHODS

This study is based on about 76 specimens present in the Hymenoptera Section of the Zoological Survey of India, Kolkata, collected from various localities of the Indian subcontinent. The specimens were studied and photographed by using a Leica Stereo microscope with LAS software version 3.6.0. All the specimens were properly preserved and added to the 'National Zoological Collections' of the Hymenoptera Section of the Zoological Survey of India, Kolkata (NZC).

*Abbreviations used for the Museums:* BMNH = The Natural History Museum, formerly British Museum (Natural History), London, England; NZC = 'National Zoological Collections' of Zoological Survey of India, Kolkata, India; ZMK = Zoological Museum, Copenhagen, Denmark.

*Abbreviations used for the terms:* H = Head; M = Mesosoma; T1-T2 = Metasomal terga 1 to 2.

### RESULTS

#### Genus *Chlorion* Latrielle, 1802

1802. *Chlorion* Latrielle, 333. Type species: *Sphex lobatus* Fabricius, 1775, by monotypy.

*Diagnosis:* Claw tooth usually mesal; female clypeus usually with five large teeth, rarely only two or four teeth; antennal sockets contiguous with frontoclypeal suture in female, separated by less than a socket diameter in male; male sterna IV and V at most sparsely setose; second recurrent vein received by third submarginal cell; spiracular groove present; female with a foretarsal rake; propodeum with U-shaped dorsal enclosure defined posterad by a semicircular furrow; body often metallic blue or green.

*Distribution:* Widely distributed except Australia and Europe.

#### 1. *Chlorion lobatum* (Fabricius, 1775)

(Figs. 1-4)

1775. *Sphex lobatus* Fabricius, 348, sex not indicated (as *lobata*, incorrect original termination). Lectotype: ♀, Africa, actually India or China: no specific locality, designated by Vecht, 1961: 37 (BMNH).

1804. *Chlorion lobatum*: Fabricius, 217 (new combination and redescription by Fabricius).

*Diagnosis: Female* (Fig. 1). Length (H+M+T1+T2): 19-24 mm. Head, mesosoma and metasoma brilliantly polished, smooth and shining; head and mesosoma with a very few scattered,

shallow punctures; clypeus transverse, very much broader than high (Fig. 2), convex in the middle, its anterior margin wavy and emarginated, with 5 tooth-like structures; propodeum (Fig. 3) long, cylindrical, not much sloped posteriorly, with transverse striations; legs long slender, tibiae and tarsi with spines, the spines long; metasoma petiolate, the petiole short, about the length of metacoxa. Body brilliant bluish green. Antennae, mandible, tibiae below and the tarsi opaque black (sometimes brown); the clypeus and sides of the face with silvery pile.

Male: Length (H+M+T1+T2): 13-18. mm. Similar but smaller and more slender; clypeus triangular, not transverse, convex in the middle, its anterior margin with a rounded arch (in some specimens slightly emarginated at middle) (Fig. 4). Wings in both sexes yellowish hyaline, in certain lights iridescent, the apical margin lightly fuscous; veins brown.

*Variation:* In some specimens, body with more bluish reflections.

*Material examined:* INDIA: Arunachal Pradesh: Papumpare district, Kimin, 1 ♂, 9.v.1966, Coll. A.N.T. Joseph & Party, NZC Regd. No. 5689/H3; Papumpare district, Itanagar, 1 ♂, 27.v.2000, K. Bhattacharya & Party, 14749/H3; Papumpare district, Itanagar, ZSI Complex, 1 ♀, 5.v.2003, P.T. Bhutia & Party, 14750/H3. Assam: Udalgiri district, Bhairabkunda, 1 ♂, 20.v.1961, K.C.J., 3301/H3; Golaghat district, Dijoo, Naoboisa Village, 1 ♂, 10.V.1966, A.N.T. Joseph & Party, 5688/H3. Chhattisgarh: Koriya district, Guru Ghasidas National Park, Khirki, 1 ♂, 12.v.2013, A. Raha & Party, 14795/H3; 1 ♂, 12.v.2013, A. Raha & Party, 14796/H3; 1 ♂, 12.v.2013, A. Raha & Party, 14797/H3; 1 ♀, 12.v.2013, A. Raha & Party, NZC Regd. No. 14798/H3; 1 ♀, 12.v.2013, A. Raha & Party, 14799/H3; 1 ♀, 12.v.2013, A. Raha & Party, 14800/H3. Jharkhand: West Singhbhum district, Saranda Forest, 1 ♀, 28.x.1990, S.S. Saha & Party, 14751/H3. Karnataka: Bangalore, 10 ♀, date of collection Unknown, Cameron, 3356/H3, 3358/H3 to 3362/H3, 14753/H3 to 14756/H3; Mysore, 1 ♀, 4.x.1976, Coll. Unknown, 14757/

H3; Coorg, 1 ♀, date of collection Unknown, F. Hannington, 14758/H3. Madhya Pradesh, Shivpuri district, Surwaya, 1 ♂, 16.v.1975, S.K. Gupta & Party, 14759/H3. Meghalaya: East Garo Hills district, Dainadubi, 3 ♂, 13.v.1979, S.B. Roy & Party, 14761/H3 to 14763/H3; 2 ♀, 13.v.1979, S.B. Roy & Party, 14760/H3 & 14801/H3; East Garo Hills district, Darugiri, 1 ♂, 20.v.1979, S.B. Roy & Party, 14764/H3. Nagaland: Naga hills, 1 ♀, date of collection Unknown, Captain Butler, 14765/H3. Odisha: Bhadrak district, Dhamara, 1 ♂ & 1 ♀, date of collection and name of collector Unknown, 14766/H3 & 14767/H3. Tamil Nadu: Theni district, Periyakulam, 1 ♀, ii.1969, O.B. Chhotani, 14772/H3. Tripura: North Tripura district, Manu Riverside, 1 ♀, 10.vi.1988, V.T. Darlong & Party, 14768/H3; South Tripura district, Garjee, 1 ♀, 15.v.1978, J.K. Jonathan & Party, 14769/H3. Sikkim: East Sikkim district, Rangpoo, 1 ♀, 3.x.1993, B.N. Das & Party, 14770/H3; 1 ♀, Dudgeon, Oct.1897, 14771/H3. Uttarakhand: Rudraprayag district, Khantra, 1 ♀, 27.vi.2004, S.K. Chakraborty & Party, 14773/H3. Uttar Pradesh: Lakhimpur kheri district, Mailani, 1 ♀, 30.iv.2008, Coll. Unknown, 14774/H3; Mirzapur district, Rihand River (Dam Site), 1 ♀, 13.iv.1947, H.A. Hafiz, 14775/H3. West Bengal: Kolkata, 1 ♂, 25.v.1909, Coll. Unknown, 14776/H3; Jalpaiguri district, Alipurduar, Samuktala, 1 ♂, 26.iv.1986, Coll. B.C. Das & Party, 14777/H3; Murshidabad district, 1 ♀, 1921, Dover, 14778/H3; Kolkata, 1 ♀, 26.iii.1907, Coll. Unknown, 14779/H3; Kolkata, 1 ♀, 1.vi.1907, Coll. Unknown, 14780/H3; Kolkata, Eden Garden, 1 ♀, 7.v.1965, A.N.T. Joseph, 14781/H3; Kolkata, Dhapa, 1 ♂, 5.v.1961, H.N.S., 14782/H3; Darjeeling district, Takdah, 1 ♀, 24.iii.1973, P.K. Maity & Party, 14783/H3; Midnapore district, Tamluk, 1 ♀, 10.vi.1975, S.K. Banerjee & Party, 14784/H3; Murshidabad district, Farakka, 1 ♀, 14.v.1975, S.K. Banerjee & Party, 14785/H3; Kolkata, 1 ♀, 4.vi.1907, Coll. Unknown, 14786/H3; Darjeeling, 1 ♀, 27.iv.1986, B.C. Das & Party, 14802/H3. MYANMAR: Tenasserim, 1 ♀, date of collection and name of collector Unknown, 14787/H3, Tenasserim Valley, 1 ♀, date of collection Unknown, W. Doherty, 14788/H3, Yenangyaung

Megwe, 1 ♀, Aug-Sept. 1911, J. Coggin Brown, 14788/H3. NEPAL: Monda, 3 ♀, 12.v.1908, Coll. Unknown, 14790/H3 to 14792/H3. SRI LANKA: Jafna, 2 ♂, June. 1910, Coll. Unknown, 14793/H3 & 14794/H3.

*Distribution: Indian Subcontinent.* India: Arunachal Pradesh, Assam (new record), Chhattisgarh (new record), Jharkhand (new record), Karnataka (new record), Madhya Pradesh (new record), Maharashtra, Meghalaya, Nagaland (new record), Odisha (new record), Tamil Nadu (new record), Tripura, Uttarakhand, Uttar Pradesh (new record), West Bengal; Sri Lanka: Pundaluoya, Weligma; Bangladesh: Dhaka; Myanmar: Tenasserim Province, Minhla; Nepal (new record): Monda. *Elsewhere:* China, Indonesia (Sumatra), Malaysia, Vietnam, West Indies. (Christ, 1791; Smith, 1878; Gribodo, 1884; Bingham, 1896; Cameron, 1901, 1905; Lefroy, 1904; Strand, 1915; Berland, 1926; Giner Mari, 1945; Begum & Bose, 1976; Begum *et al.*, 1995; Gupta, 1995; Jonathan *et al.*, 2000; Jonathan & Kundu, 2003; Hua, 2006; Kundu *et al.*, 2006).

## 2. *Chlorion regale* Smith, 1873

(Figs. 5-8)

1873. *Chlorion regale* Smith, 291, ♀ (as *regalis*, incorrect original termination). Syntypes: ♀, Afghanistan, Baluchistan, and Pakistan: Sind: no specific localities (BMNH).

*Diagnosis: Female* (Fig. 5). Length (H+M+T1+T2): 18-25 mm. Head broad, broader than mesosoma, somewhat square above in dorsal view, opaque; clypeus transverse, very much broader than high, convex at the middle, its anterior margin waved with 5 tooth-like structures (Fig. 6); the face on each of the base of antennae sulcate and vertically impressed line before and behind the anterior ocellus; propodeum (Fig. 7) long, posteriorly rounded truncate, transversely striate; metasoma polished and shining. Head, pronotum, mesoscutum, scutellum, tegula, femora (except hind femur sometimes more blackish), tibiae and tarsi of all legs dull brick red; tarsi somewhat fuscous; propodeum, coxae, trochanters and metasoma brilliant blackish brown with purple

reflections; wings dark brown with a purple reflection, forewing broadly fuscous at apex, apex and posterior margin of hind wing hyaline.

*Male:* Length (H+M+T1+T2): 20.5 mm. Similar but smaller and more slender; clypeus as in Fig. 8, convex at middle, its anterior margin with three tooth like projections.

*Material examined:* PAKISTAN: Karachi, 5 ♀, 02.viii.1889, Coll. W.D. Cumming, NZC Regd. Nos. 14870/H3 to 14874/H3; Baluchistan, 1 ♀ & 1 ♂, 10.v.1931, A.C. Sen, 14875/H3 & 14876/H3; Baluchistan, Quetta, 1 ♀, 07.iii.1936, Dudgeon, 14877/H3.

*Distribution: Indian Subcontinent:* India (Rajasthan), Pakistan (Karachi, Baluchistan, Quetta). *Elsewhere:* Afghanistan, Iran, Kazakhstan, Kuwait, Saudi Arabia, Somalia, Turkmenistan, Uzbekistan. (Bingham, 1893; Berland, 1926; Tiwary *et al.* 2004).

## 3. *Chlorion splendidum* Fabricius, 1804

(Figs. 9-12)

1804. *Chlorion splendidum* Fabricius, 218, sex not indicated. Holotype: ♂, India: no specific locality (ZMK).

*Diagnosis: Female* (Fig. 9). Length (H+M+T1+T2): 21-34 mm. Head, mesosoma and metasoma smooth and shining; metasoma brilliantly polished, head and mesosoma with a very few nearly obsolete shallow punctures; head large, much broader than mesosoma in dorsal view; clypeus vertically very narrow, transverse, slightly convex at the middle, with irregular tooth-like projections at apex (Fig. 10); base of antennae placed in a deep hollow above the clypeus, above which the front somewhat closely punctured and studded with some scattered long hairs; pronotum deeply notched at the middle; propodeum (Fig. 11) long with very little slope posteriorly, the apex roundly truncate, everywhere closely striate; legs long, tibiae and tarsi with spines, spines short and stout; metasoma petiolate, petiole short. Head, mesosoma and legs dull brick red, propodeum with a brilliant golden coppery reflection; metasoma brilliant purplish blue, petiole reddish; wings yellow, apex of fore wing and apex and posterior

margin of hind wing broadly fuscous with purple reflections.

*Male:* Length (H+M+T1+T2): 19 mm. Similar but smaller and slender; clypeus triangular (Fig. 12) with three strong tooth-like structures at apex.

*Material examined:* INDIA: Karnataka, Bangalore, 1 ♂ & 1 ♀, 1945, Coll. Cameron, NZC Regd. Nos. 14805/H3 & 14806/H3; Maharashtra, Ratnagiri district, Marleshwar, 1 ♀, 23.v.1912, F.H. Gravely, 14807/H3; Chhattisgarh, Koriya district, Guru Ghasidas National Park, 2 ♀, 12.v.2013, A. Raha & Party, 14808/H3 & 14809/H3.

*Distribution: Indian Subcontinent:* India: Chhattisgarh (New record), Karnataka (New record), Maharashtra (New record), Pondicherry; Myanmar (Minhla). *Elsewhere:* Egypt, Eritrea or Ethiopia, Hungary, Iran, Madagascar, Philippines, Saudi Arabia, Turkmenistan, Sudan (Smith, 1856; Costa, 1864; Gribodo, 1884; Berland, 1926).

## SUMMARY

The genus *Chlorion* Latrille, 1802 from the Indian subcontinent is reviewed, recognizing 3 species from the subcontinent. The species *Chlorion lobatum* (Fabricius, 1775) is reported here for the first time from Assam, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Nagaland, Odisha, Tamil Nadu and Uttar Pradesh. The species *C. splendidum* Fabricius, 1804 is reported here for the first time from Chhattisgarh, Karnataka and Maharashtra. The species *C. lobatum* is herewith recorded for the first time from Nepal also.

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## REFERENCES

- Begum, A. and Bose, S.K. 1976. A systematic account of the solitary wasps of Dacca City and its suburbs (Hymenoptera: Sphecidae). *J. Asiat. Soc. Bangladesh, Sci.*, **2**: 25-27.
- Begum, A., Khan, H.R. and Bose, S.K. 1995. Sphecid wasps in Dhaka University Campus. *Bangladesh J. Zool.*, **23**: 173-178.
- Berland, L. 1926. Les Sphegidae (Hyménoptères) du Muséum National de Paris. *Bull. Mus. Natl. Hist. Nat.*, **32**: 163-170.
- Bingham, C.T. 1893. On new and little-known Hymenoptera from India, Burma, and Ceylon. *J. Bombay Nat. Hist. Soc.*, **8**: 378.
- Bingham, C.T. 1896. A contribution to the knowledge of the hymenopterous fauna of Ceylon. *Proc. General Meetings for Scientific Business Zool. Soc. London*, **1896**: 401-459, pl. XV.
- Bohart, R.M and Menke, A.S. 1976. Sphecid wasps of the world. A generic revision. University of California Press, Berkeley, Los Angeles, London. 1 colour plate, IX + 695 pp.
- Cameron, P. 1901. On the Hymenoptera collected during the "Skeat Expedition" to the Malay Peninsula, 1899-1900. *Proc. General Meetings for Scientific Business Zool. Soc. London*, **1901**(2): 16-44.
- Cameron, P. 1905. On the Malay fossorial Hymenoptera and Vespidae of the Museum of the R. Zool. Soc. "Natura Artis Magistra" at Amsterdam. *Tijdschrift voor Entomologie*, **48**: 48-78.
- Christ, J. L. 1791. Naturgeschichte, Klassifikation und Nomenclatur der Insekten vom Bienen, Wespen und Ameisengeschlecht; als der fünften Klasse fünfte Ordnung des Linneischen Natursystems von den Insekten: Hymenoptera. Mit häutigen Flügeln. Hermannische Buchhandlung, Frankfurt am Main. 535 pp., 60 colour pls.

- Costa, A. 1864 (1862). Specie immesse per effetto di doni o cambii. *Annuario del Museo Zoologico della R. Università di Napoli*, **2**: 94-118.
- Fabricius, J.C. 1775. Systema Entomologiae, sistens Insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus. Kortii, Flensburgi et Lipsiae [= Flensburg and Leipzig]. [1-32], 1-832 pp.
- Fabricius, J.C. 1804. Systema Piezatorum secundum ordines, genera, species adiectis synonymis, locis, observationibus, descriptionibus. Carolum Reichard, Brunsvigae [= Braunschweig]. I-XIV, 15-440, 1-30 pp.
- Giner, Mari. J. 1945. Resultados científicos de un viaje entomológico al Sáhara español y zona oriental del Marruecos español. Familias Sphecidae y Mutillidae (Hym. Sphec. y Mut.). *Eos. Revista Española de Entomología*, **20**: 351-385.
- Gribodo, G. 1884. Sopra alcuni Imenotteri raccolti a Minhla nel regno di Birmania dal Cap. G. B. Comotto. *Annali del Museo Civico di Storia Naturale di Genova*, **21**: 349-368.
- Gupta, S.K. 1995. Hymenoptera. In: *Zool. Surv. India, Himalaya Ecosystem Series: Fauna of Western Himalaya*, Part 1, Uttar Pradesh: 81-89.
- Hua, L. 2006. Superfamily Apoidea (Sphecoidea), pp. 274-299 in L. Hua. List of Chinese insects. Vol. IV. Sun-Yat-sen University Press, Guangzhou, 539 pp.
- Jonathan, J.K. and Kundu, B.G. 2003. Insecta: Hymenoptera: Sphecidae. *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, **9**(Part-4): 417-446.
- Jonathan, J.K., Ray, K.K. and Kundu, B.G. 2000. Insecta: Hymenoptera: Sphecidae: *Zool. Surv. India, State Fauna Series* **4**: *Fauna of Meghalaya*, Part 7: 161-222.
- Kundu, B.G., Ghosh, S.N. and Tiwary, R. 2006. Insecta: Hymenoptera: Aculeata: Sphecidae. *Zool. Surv. India, Fauna of Arunachal Pradesh, State Fauna Series*, **13**(Part-2): 399-426.
- Latrielle, P.A. 1802. Histoire naturelle générale et particulière des Crustacés et des Insectes. Ouvrage faisant suite à l'Histoire Naturelle générale et particulière, composée par Leclercq de Buffon, et rédigée par C.S. Sonnini, membre de plusieurs Sociétés savantes. Vol. 3. Imprimerie F. Dufart, Paris. I-XII, 13-467 pp. Dating after Griffin, 1938, and Dupuis, 1986:205.
- Lefroy, M. 1904. A note on the habits of *Chlorion (Spheg) lobatus*. *J. Bombay Nat. Hist. Soc.*, **15**: 531-532.
- Pulawski, W.J. 2009. Catalog of Sphecidae. Available on: [http://research.calacademy.org/ent/catalog\\_sphecidae](http://research.calacademy.org/ent/catalog_sphecidae).
- Smith, F. 1856. Catalogue of hymenopterous insects in the collection of the British Museum. Part IV. Sphegidae, Larridae and Crabronidae. Taylor and Francis, London. 207-497 pp.
- Smith, F. 1873. Descriptions of new species of fossorial Hymenoptera in the collection of the British Museum, and of a species of the rare genus *Iswara*, belonging to the Family Dorylidae. *Ann. Mag. Nat. Hist.* (Series 4) **12**: 253-260 (Sept.), 291-300 (Oct.), 402-415 (Oct.).
- Smith, F. 1878. List of Hymenoptera obtained by Mr. Ossian Limabord east of Maulamin, Tenasserim Provinces, during the months of December 1876, January, March and April 1877, with description of new species. *J. Asiat. Soc. Bengal*, **47**, Part II- Physical Science: 167-169.

- Strand, E. 1915. Ueber einige orientalische un paläarktische Crabroniden der Gattungen *Sphex*, *Sceliphron* und *Ammophila* im Deutschen Entomologischen Museum. *Archiv für Naturgeschichte, Abteilung A*, **81**(5): 88-97.
- Tiwary, R.N., Kundu, B.G., Roychowdhury, S and Ghosh, S.N. 2004. Insecta: Hymenoptera: Aculeata. *Zool. Surv. India, Conservation Area Series*, **19**: 91-99.
- Vecht, Van der. 1961. Hymenoptera Sphecoidea Fabriciana. *Zoologische Verhandelingen*, **48**: 1-85.

**PLATE I**

*Chlorion lobatum* (Fabricius)



1. Female. Body profile



2. Female. Head frontal view



3. Female. Propodeum dorsal view



4. Male. Head frontal view

*Chlorion regale* Smith



5. Female. Body profile



6. Female. Head frontal view

**PLATE II**  
*Chlorion regale* Smith



7. Female. Propodeum dorsal view



8. Male. Head frontal view

*Chlorion splendidum* Fabricius



9. Female. Body profile



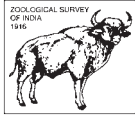
10. Female. Head frontal view



11. Female. Propodeum dorsal view



12. Male. Head frontal view



## FREE LIVING AND PLANT PARASITIC SOIL NEMATODES (ORDERS DORYLAIMIDA AND TYLENCHIDA) OF HIMACHAL PRADESH, INDIA

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### INTRODUCTION

Himachal Pradesh is a state in Northern part of India with Shimla as the state capital. It is spread over 21,495 sq miles (55,670 km<sup>2</sup>), and is bordered by the states of Jammu and Kashmir on the north, Punjab on the west and south-west, Haryana and Uttar Pradesh on the south, Uttarakhand on the south-east. Himachal Pradesh is located between 30°10' to 33°12' north latitude and 75°47' to 79°04' east longitude. The state comprises of twelve districts – Shimla, Solan, Chamba, Hamirpur, Bilaspur, Kangra, Kullu, Mandi, Sirmour, Una, Kinnaur and Lahaul and Spiti. There are major divisions: the middle or central Himalayas comprising of Kinnaur, Kullu, Lahaul and Spiti and Pangi areas, the lesser Himalayas of Dhauladhar ranges and Shimla hills, Shivaliks of Sirmour, Bilaspur, Solan and Hamirpur districts and river terraces of different valleys like Kullu valley, and Una districts. It is a mountainous state with altitudes ranging from 350 to 69750 meters above the sea level. This wide variation in altitude with mountains, hills and valleys provides different climatic conditions leading to the cultivation of varieties of crops. Based on altitude, rainfall, temperature, humidity and topography, Himachal Pradesh has been divided into four agro-climatic Zones: subtropical sub-mountain and low hills, sub-temperate sub-humid hills, wet temperate high hills and dry temperate high hills and cold desert. The temperature and relative humidity range from 0-35°C and 50-80% respectively. Rainfall varies in between 350-1500 mm in different areas. Soil

type is mostly loamy sand, sandy loam, clay loam and silt loam.

Himachal Pradesh is a land of jade forests and fresh air. As much as 68% of the land area is covered with jungles. While the foothills and valleys are a refreshing green, the areas above the snow line are almost bare and desert type. The southernmost tracts are dominated by sal (*Shorea robusta*), sisham, chir pine, dry deciduous and moist broad-leaved forests. The temperate region above this grows oaks, deodar, blue pine, fir and spruce. In the uppermost climes, trees are sturdy with a vast network of roots (to help them tide over the weeks of burial under heavy snow). Alders, birches, rhododendrons and moist alpine scrubs are found in the name of vegetation. The tough rhododendron is an amazing plant of terrific importance in the ecological chain. About 70-80% population of the state are dependent on farming. The major agricultural crops are sub-tropical and temperate fruits among which apple is one of the most economically important fruit crop. Maize, rice, wheat, ginger, cucurbits, peas, potato, tomato, barley are grown in different seasons.

Among the soil-borne pests, soil free-living and plant-parasitic nematodes are generally overlooked due to their hidden nature and microscopic size. They multiply in millions and spread from place to place by different agricultural practices, causing great damage to the agricultural crops. They inhibit root growth, growth of plants affecting crop production and are thus responsible for massive yield losses. Due to this lack of awareness in

common people and farmers; the importance of nematodes in agriculture was overlooked in this state till 1951. Thirumalachar (1951) first recorded the occurrence of root-knot nematode on potato tubers for the first time from Shimla.

After 1951, extensive studies on taxonomy of tylenchid nematodes were done and several new species from Himachal Pradesh were described by different nematologists (Jairajpuri and Siddiqi, 1963a; Khan, 1964; Jairajpuri & Baqri, 1973; Saha *et al.*, 1973; Khan & Singh, 1974; Jairajpuri and Siddiqi, 1979; Sultan & Jairajpuri, 1978, 1979; Sultan, 1980; Khan & Khan, 1982; Khurma & Gupta, 1988 a, b; Sharma *et al.*, 1986). On the other hand, the study on nematodes belonging to the order Dorylaimida from Himachal Pradesh is comparatively less, although several new species have been described from the state (Jairajpuri & Siddiqi, 1963b; Ali *et al.*, 1974; Ahmad & Jairajpuri, 1979, 1980 and 1982; Baqri & Jairajpuri, 1974, 1975; Jairajpuri & Coomans, 1977).

Nematodes associated with different fruit plants in Himachal Pradesh have been studied by Mukhopadhyaya (1970), Bhardwaj & Sharma (1971), Chandel (1986) and by Sharma & Kaur (1986, 1987). Association of nematodes with mushroom was observed by Bhardwaj *et al.*, (1973) and Chandel (1982). A detailed information on plant nematology of Himachal Pradesh has been provided (Sharma & Gupta, 1998). Extensive work on the host record, occurrence, distribution and association of nematodes with different economically important agricultural and horticultural crops was done (Thirumalachar, 1951; Mukhopadhyaya, 1970; Dalal & Bhatti, 1983; Sharma *et al.*, 1984; Kaur, 1987; Sharma *et al.*, 1988; Khurma, 1989; Kaur *et al.*, 1989; Kaur *et al.*, 1990; Kaur & Sharma, 1990; Chandel, 1993)

The present study includes two systematic lists of soil free-living and plant-parasitic nematodes belonging to the orders Dorylaimida Pearse, 1942 and Tylenchida Thorne, 1949 from Himachal Pradesh. 34 species under 18 genera and 9 families of Dorylaimida and 83 species under 35 genera and

13 families of Tylenchida have been compiled and reported in this report. Among these, *Dorylaimus neominimus* Gantait *et al.* 2010, *Aporcelaimellus heynsi* Baqri and Jairajpuri, 1968., *Labronema glandosum* Rahman *et al.*, 1986, *Thonus garhwaliensis* Ahmad *et al.*, 1986, and the genera *Actinolaimoides* Meyl, 1957, *Laimydorus* Siddiqi, 1969 and *Indokochinema* Darekar and Khan, 1979 are new records from Himachal Pradesh. *Dorylaimus thornei* Andrassy, 1969 is the first report from India. Five species of Tylenchida i.e. *Polenchus shamimi* Baqri, 1991, *Rotylenchoides neoformis* (Siddiqi and Husain, 1964) Sher, 1966, *Rotylenchulus reniformis* Linford and Oleiveira, 1940. *Tylenchorhynchus cylindricus* Cobb, 1913 and the genus *Filenchus* (Meyl, 1961) Andrassy, 1954 are new records from Himachal Pradesh. The respective species of the genera *Actinolaimoides*, *Laimydorus*, *Indokochinema* and *Filenchus* could not be confirmed. The classification proposed by Jairajpuri and Ahmad (1992) and by Siddiqi (2000) have been followed to arrange the available genera and species of Dorylaimida and Tylenchida respectively from Himachal Pradesh and to indicate their present taxonomic status.

## MATERIALS AND METHODS

*Processing of soil samples and extraction of nematodes:*

The collected soil samples were processed by Cobb's sieving and decantation technique (Cobb, 1918) followed by modified Baermann funnel technique (Christie and Perry, 1951) for extraction of nematodes. Soil sample of about 500gms was taken in a bucket of 10 liter capacity. The bucket was filled with clean water up to half of its capacity. The soil and water were thoroughly mixed by hand to make a homogeneous suspension. Stones and plant debris were removed. The muddy suspension was stirred very well by hand and left undisturbed for 20-30 seconds allowing the heavier particles to settle down at the bottom of the bucket while the nematodes and fine soil particles remained suspended in water. This suspension was passed through a coarse sieve and was collected in another bucket. The entire process was repeated thrice to

get a muddy suspension quite free from stones, large soil particles and other undesirable organic matter. This suspension was subjected to similar filtration, but through a fine sieve of 325 meshes. Most of the fine soil particles passed through this sieve but the nematodes and larger soil particles were retained on the surface of the sieve. This was again washed thoroughly with running water within the sieve to get rid of the soil particles as far as possible without losing the nematodes. Then the entire content of the sieve was collected in a beaker of 250 ml, by washing the sieve repeatedly with water, so that all nematodes could be collected.

Then a double layer of tissue paper was placed on an aluminium net of 2 mm pore size and was made moist by applying water gently without leaving any air gap or bubble between the layers of the tissue paper. Now, the aliquot, previously collected in the beaker, was poured gently on this moist double tissue paper supported by 2 mm pore size aluminium net and was further suspended in clean water in a petri dish. The aliquot on the tissue paper was covered by another petri dish to prevent evaporation and desiccation. The whole arrangement was left undisturbed for at least 24 hours.

The nematodes migrated downward through the tissue paper in the clear water of petri dish. This clear water containing nematodes was taken in a big test tube with the help of a dropper by washing the petri dish several times with clean water, so that no nematodes were left out in the petri dish. The water in test tubes, along with nematodes, was kept undisturbed for 2-3 hours, so that the nematodes in the water could settle down at the bottom of the test tube. Then most of the water in the test tube was withdrawn very carefully without disturbing the nematodes. Finally the entire nematode population along with 3-4 ml of water was taken after decantation of water.

#### *Fixation and Preservation of Nematodes:*

The nematodes, kept in 3-4 ml of water in the test tube, were killed and fixed instantly in their characteristic body posture by Seinhorst's method

(Seinhorst, 1966) in hot FA (formalin-acetic acid 4:1) solution, the composition of which was as follows:

Formalin (40% formaldehyde)	: 08 ml
Glacial acetic acid	: 02 ml
Distilled water	: 90 ml

These fixed nematodes were preserved in the same solution in properly labeled specimen tubes.

## RESULT

### List 1: Systemic Index of Dorylaimid Nematodes Available from Himachal Pradesh

- Phylum NEMATODA Rudolphi, 1808  
(Lankester, 1877)
- Order DORYLAIMIDA Pearse, 1942
- Suborder DORYLAIMINA Pearse, 1936
- Superfamily DORYLAIMOIDEA De Man, 1976
- 1. Family DORYLAIMIDAE De Man, 1976
- Subfamily DORYLAIMINAE De Man, 1976
- 1. Genus *Dorylaimus* Dujardin, 1845
- 1. *Dorylaimus innovatus* Jana and Baqri, 1982
- 2. *D. neominimus* Gantait *et al.*, 2010
- 3. *D. thornei* Andrassy, 1969
- Subfamily LAIMYDORINAE Andrassy, 1969
- 2. Genus *Laimydorus* Siddiqi, 1969
- 4. *Laimydorus* sp.
- 2. Family APORCELAIMIDAE Heyns, 1965
- Subfamily APORCELAIMINAE Heyns, 1965
- 3. Genus *Aporcelaimellus* Heyns, 1965
- 5. *Aporcelaimellus* sp.
- 6. *A. conicaudatus* (Altherr, 1953) Monterio, 1970
- 7. *A. heynsi* Baqri and Jairajpuri, 1968
- 3. Family QUDSIANEMATIDAE  
Jaurajpuri, 1965
- Subfamily QUDSIANEMATINAE  
Jaurajpuri, 1965
- 4. Genus *Indokochinema* Darekar and  
Khan, 1979

8. Genus *Indokochinema* sp.  
 5. Genus *Labronema* Thorne, 1939
9. *L. glandosum* Rahman *et al.*, 1986  
 6. Genus *Thonus* Thorne, 1974
10. *T. garhwaliensis* Ahmad *et al.*, 1986  
 4. Family NORDIIDAE Jairajpuri and Siddiqi, 1964  
 Subfamily PUNGENTINAE Siddiqi, 1969
7. Genus *Pungentus* Thorne & Swanger, 1936
11. *Pungentus clavatus* Ahmad & Jairajpuri, 1979  
 8. Genus *Enchodelus* Thorne, 1939  
 Subgenus *Enchodelus* Thorne, 1939
12. *Enchodelus (Enchodelus) distinctus* Ahmad & Jairajpuri, 1980
13. *E. (E.) microdoroides* Baqri & Jairajpuri, 1974  
 Subgenus *Nepalus* Ahmad & Jairajpuri, 1980
14. *Enchodelus (Nepalus) maximus* Baqri & Jairajpuri, 1974  
 Subgenus *Paraenchodelus* Ahmad & Jairajpuri, 1980
15. *Enchodelus (Paraenchodelus) longidens* Jairajpuri & Loof, 1968
16. *E. (P.) satendri* Baqri & Jairajpuri, 1968
17. *E. (P.) thornei* Baqri & Jairajpuri, 1974  
 Subgenus *Rotundus* Ahmad & Jairajpuri, 1980
18. *Enchodelus (Rotundus) parateres* Baqri & Jairajpuri, 1974  
 Subfamily ACTINOLAIMOIDINAE Meyl, 1957  
 9. Genus *Actinolaimoides* Meyl, 1957
19. Genus *Actinolaimoides* sp.  
 Superfamily LONGIDOROIDEA Thorne, 1935  
 5. Family LONGIDORIDAE Thorne, 1935  
 Subfamily LONGIDORINAE Thorne, 1935
10. Genus *Paralongidorus* Siddiqi, Hooper & Khan, 1963
20. Species *Paralongidorus citri* (Siddiqi, 1959) Siddiqi, Hooper & Khan, 1963  
 Syn. *Xiphinema citri* Siddiqi, 1959
11. Genus *Longidorus* Micoletzky, 1922
21. Species *Longidorus himalayansis* (Khan, 1986) Jairajpuri & Ahmad, 1992  
 Syn. *Neolongidorus himalayansis* Khan, 1986
22. *Longidorus elongates* (De Man, 1876) Thorne & Swanger, 1936  
*Dorylaimus elongatus* De Man, 1876
6. Family XIPHINEMATIDAE Dalmaso, 1969  
 Subfamily XIPHINEMATINAE Dalmaso, 1969  
 12. Genus *Xiphinema* Cobb, 1913
23. *Xiphinema* sp.
24. *Xiphinema americanum* Cobb, 1913
25. *X. basiri* Siddiqi, 1959  
 Syn. *X. cobbi* Sharma & Saxena, 1981  
 Syn. *X. hayati* Javed, 1983
26. *X. bergeri* Luc, 1973  
 Superfamily BELONDIROIDEA Thorne, 1939  
 7. Family BELONDIRIDAE Thorne, 1939  
 Subfamily BELONDIRINAE Thorne, 1939  
 7.13. Genus *Axonchium* Cobb, 1920  
 Subgenus *Axonchium* Cobb, 1920
27. *Axonchium (Axonchium) manalicum* Ali, Jairajpuri & Coomans, 1975  
 Subfamily DORYLAIMELLINAE Jairajpuri, 1964
14. Genus *Dorylaimellus* Cobb, 1913  
 Subgenus *Dorylaimellus* Cobb, 1913
28. *Dorylaimellus (Dorylaimellus) himalayansis* Ali, Jairajpuri & Coomans, 1974  
 Superfamily TYLENCHOLAIMOIDEA Filipjev, 1934  
 8. Family TYLENCHOLAIMIDAE Filipjev, 1934  
 Subfamily TYLEPTINAE Jairajpuri, 1964
15. Genus *Gymnotyleptus* Ahmad & Jairajpuri, 1982
29. *Gymnotyleptus gymnochilus* (Loof, 1964) Ahmad & Jairajpuri, 1982  
 Syn. *Tyleptus gymnochilus* Loof, 1964

30. *Gymnotyleptus indicus* Ahmad & Jairajpuri, 1982  
Superfamily NYGOLAIMOIDEA Thorne, 1935  
9. Family NYGOLAIMIDAE Thorne, 1935  
Subfamily NYGOLAIMINAE Thorne, 1935  
16. Genus *Aquatides* Heyns, 1968  
31. *Aquatids christicki* Ahmad & Jairajpuri, 1982  
32. *A. deconincki* Jairajpuri & Coomans, 1977  
17. Genus *Clavicaudoides* Heyns, 1968  
33. *Clavicaudoides tenuicaudatum* Ahmad & Jairajpuri, 1982  
18. Genus *Paravulvulus* Heyns, 1968  
34. Species *Paravulvulus papillatus* Ahmad & Jairajpuri, 1982

**List 2: Systemic Index of Tylenchid Nematodes Available From Himachal Pradesh**

- Class SECERNENTEA von Linstow, 1905  
Subclass TYLENCHIA Inglis, 1983  
Order TYLENCHIDA Thorne, 1949  
A] Suborder TYLENCHINA Chitwood in Chitwood Chitwood, 1950  
Infraorder TYLENCHATA Siddiqi, 2000  
Superfamily TYLENCHOIDEA Örley, 1880  
1. Family TYLENCHIDAE Örley, 1880  
Subfamily TYLENCHINAE Örley, 1880  
1. Genus *Tylenchus* Bastain, 1865  
1. Species *Tylenchus arcuatus* Siddiqi, 1963  
2. *T. elegans* De Man, 1876  
3. *T. magnus* Khurma & Gupta, 1988  
2. Genus *Aglenchus* Andrassy, 1954 (Meyl, 1961)  
4. Species *Aglenchus agricola* (De Man, 1884) Meyl, 1961  
5. *A. muktii* Phukan & Sanwal, 1980  
3. Genus *Coslenchus* Siddiqi, 1978  
6. Species *Coslenchus capsici* Khurma & Gupta, 1988

7. *C. costatus* (De Man, 1921) Siddiqi, 1978  
8. *C. indicus* (Khan, Chawla & Prasad, 1969) Siddiqi, 1978  
Syn. *Tylenchus (Aglenchus) indicus* Khan, Chawla & Prasad, 1969  
4. Genus *Filenchus* Andrassy, 1954 (Meyl, 1961)  
9. Species *Filenchus* sp.  
5. Genus *Polenchus* Andrassy, 1980  
10. Species *Polenchus shamimi* Baqri, 1991  
Subfamily BOLEODORINAE Khan, 1964  
6. Genus *Boleodorus* Thorne, 1941  
11. Species *Boleodorus mirus* Khan, 1964  
Subfamily DUOSULCIINAE Siddiqi, 1979  
7. Genus *Malenchus* Andrassy, 1968  
Subgenus *Malenchus* Andrassy, 1968  
12. Species *Malenchus (Malenchus)* sp.  
8. Genus *Ottolenchus* Husain & Khan, 1967 (Golden, 1971)  
13. Species *Ottolenchus eqisetus* (Husain & Khan, 1967) Wu, 1970  
Syn. *Ottolenchus purvus* (Siddiqi) Siddiqi, 1979  
Subfamily PLEUROTYLENCHINAE Andrassy, 1976  
9. Genus *Cephalenchus* Goodey, 1962 (Geraert, 1968)  
14. Species *Cephalenchus leptus* Siddiqi, 1963  
Infraorder ANGUINATA Siddiqi, 2000  
Superfamily ANGUINOIDEA Nicoll, 1935 (1926)  
2. Family ANGUINIDAE Nicoll, 1935 (1926)  
Subfamily ANGUININAE Nicoll, 1935 (1926)  
10. Genus *Ditylenchus* Filipjev, 1936  
15. Species *Ditylenchus myceliophagus* Goodey, 1958  
11. Genus *Nothotylenchus* Thorne, 1941  
16. Species *Nothotylenchus* sp.

12. Genus *Safianema* Siddiqi, 1980
17. Species *Safianema* sp.
- B] Suborder Hoplolaimina Chizhov & Berezina, 1988
- Superfamily HOPLOLAOMOIDEA Filipjev, 1934 (Paramonov, 1967)
3. Family HOPLOLAIMIDAE Filipjev, 1934
- Subfamily HOPLOLAIMINAE Filipjev, 1934
13. Genus *Hoplolaimus* von Daday, 1905
- Subgenus *Basirolaimus* Shamsi, 1979
18. Species *Hoplolaimus* (*Basirolaimus*) *chambus* Jairajpuri & Baqri, 1973
- Syn. *Hoplolaimus chambus* Jairajpuri & Baqri, 1973
- Syn. *Basirolaimus chambus* (Jairajpuri & Baqri, 1973) Siddiqi, 1986
19. *Hoplolaimus* (*Basirolaimus*) *indicus*
- Syn. *Hoplolaimus indicus* Sher, 1963
20. *Basirolaimus indicus* (Sher, 1963)
- Shamsi, 1979
14. Genus *Scutellonema* Andr assy, 1958
21. Species *Scutellonema brachyurus* (Steiner, 1938) Andr assy, 1958
- Syn. *Rotylenchus brachyurus* Steiner, 1938
- Subfamily ROTYLENCHOIDINAE Whitehead, 1958
15. Genus *Rotylenchoides* Whitehead, 1958
22. *Rotylenchoides neoformis* (Siddiqi and Husain, 1964) Sher, 1966
16. Genus *Helicotylenchus* Steiner, 1945
23. Species *Helicotylenchus borinquensis* Rom n, 1965 (*sp. inq.* For Fortuner *et al.*, 1981)
24. *H. girus* Saha *et al.*, 1973
25. *H. goldeni* Sultan & Jairajpuri, 1979
26. *H. rohtangus* Jairajpuri & Baqri, 1973 (Syn. of *H. retusus* for Lal & Khan, 1997)
27. *H. rotundicaudata* Sher, 1966 (Syn. Of *H. dihystra* for Fortuner *et al.*, 1981)
28. *H. shakili* Sultan, 1981
29. *H. vulgaris* Yuen, 1964
17. Genus *Orientylus* Jairajpuri & Siddiqi, 1977
30. Species *Orientylus geraerti* Jairajpuri & Siddiqi, 1979
- Syn. *Rotylenchus geraerti* (Jairajpuri & Siddiqi) Zancada & Lima, 1986
18. Genus *Rotylenchus* Filipjev, 1936
- Subgenus *Rotylenchus* Filipjev, 1936
31. Species *Rotylenchus* (*Rotylenchus*) *dalhousiensis* Sultan & Jairajpuri, 1979
32. *R. (R.) indorobustus* Jairajpuri & Baqri, 1973 (Syn. of *R. robustus* for Brzeski, 1998)
33. *R. (R.) neorobustus* Sultan & Jairajpuri, 1979
34. *Rotylenchus* (*Rotylenchus*) sp.
4. Family ROTYLENCHULIDAE Husain and Khan, 1957 (Husain, 1976)
- Subfamily ROTYLENCHULINAE Husain and Khan, 1967
19. Genus *Rotylenchulus* Linford and Oleiveira, 1940
35. Species *Rotylenchulus reniformis* Linford and Oleiveira, 1940
5. Family PRATYLENCHIDAE Thorne, 1949 (Siddiqi, 1963)
- SubFamily PRATYLENCHINAE Thorne, 1949
20. Genus *Pratylenchus* Filipjev, 1936
36. Species *Pratylenchus coffeae* (Zimmermann, 1898) Filipjev & Schurr. Stekh., 1941
- Syn. *Tylenchus coffeae* Zimmermann, 1898
37. *P. neglectus* (Rensch, 1924) Filipjev & Sch. Stekh., 1941
- Syn. *Aphelenchus neglectus* Rensch, 1924
- Syn. *Tylenchus neglectus* (Rensch) Steiner, 1928.
38. *P. neocapitatus* Khan & Singh, 1975
39. *P. penetrans* (Cobb, 1917) Filipjev & Sch. Stekh., 1941
- Syn. *Tylenchus penetrans* Cobb, 1917

40. *P. zae* Graham, 1951  
Syn. *P. impar* Khan & Singh, 1975
41. *Pratylenchus* sp.  
Subfamily HIRSCHMANNIELLANAE  
Fotedar & Handoo, 1978  
21. Genus *Hirschmanniella* Luc & Goodey, 1964
42. Species *Hirschmanniella mucronata* (Das, 1960) Khan, Siddiqi, Khan, Husain & Saxena, 1964  
Syn. *Radhopholus mucronata* Das, 1960
43. *H. oryzae* (Van Breda de Hann, 1902) Luc & Goodey, 1964  
Syn. *Tylenchus oryzae* Van Breda de Hann, 1902
6. Family MELOIDOGYNIDAE Skarbilovich, 1959 (Wouts, 1973)  
Subfamily MELOIDOGYNIDAE  
Skarbilovich, 1959  
22. Genus *Meloidogyne* Goeldi, 1892
44. Species *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1949  
Syn. *Anguina arenaria* Neal, 1889
45. *M. graminicola* Goloden & Birchfield, 1965
46. *M. hapla* Chitwood, 1949
47. *M. incognita* (Kofoid & White, 1919) Chitwood, 1949  
Syn. *Oxyuris incognita* Kofoid & White, 1919  
Syn. *Heterodera incognita* (Kofoid & White) Sandground, 1923
48. *M. javanica* (Treub, 1885) Chitwood, 1949  
Syn. *Heterodera javanica* Treub, 1885  
7. Family HETERODERIDAE Filipjev & Schurr. Stekh., 1941 (Skarbilovich, 1947)  
Subfamily HETERODERINAE Filipjev & Schurr. Stekh., 1941  
23. Genus *Heterodera* Schmidt, 1871
49. Species *Heterodera avenae* Wollenweber, 1924
50. *H. trifolii* Goffart, 1932  
24. Genus *Globodera* Skarbilovich, 1959
51. Species *Globodera pallida* (Stone, 1973) Behrens, 1975  
Syn. *Heterodera pallida* Stone, 1973
52. *G. pseudorostochiensis* (Kirjanova, 1963) Mulvey & Stone, 1976  
Syn. *G. rostochiensis* Krall, 1978  
Syn. *Heterodera pseudorostochiensis* Kirjanova, 1963  
Superfamily DOLICHODOROIDEA Chitwood in Chitwood & Chitwood, 1950 (Siddiqi, 1968)
8. Family TELOTYLENCHIDAE Siddiqi, 1960  
Subfamily TELOTYLENCHINAE Siddiqi, 1960  
25. Genus *Quinisulcius* Siddiqi, 1971
53. Species *Quinisulcius capitatus* (Allen, 1955) Siddiqi, 1971  
Syn. *Tylenchorhynchus capitatus* Allen, 1955
54. *Q. indicus* Luqman & Khan, 1986  
26. Genus *Tylenchorhynchus* Cobb, 1913
55. Species *Tylenchorhynchus clarus* Allen, 1955
56. *T. cylindricus* Cobb, 1913
57. *T. mashhoodi* Siddiqi & Basir, 1959  
Syn. *Macrorhynchus mashhoodi* (Siddiqi & Basir) Sultan, Singh & sakuja, 1991
58. *Tylenchorhynchus* sp.  
27. Genus *Bitylenchus* Filipjev, 1934  
Syn. *Tylenchus* (Bitylenchus) Filipjev, 1934
59. Species *Bitylenchus brevilineatus* (Williams, 1960) Jairajpuri, 1982  
Syn. *Tylenchorhynchus brevilineatus* Williams, 1960
60. *Bitylenchus* n. sp.  
Subfamily MERLINIINAE Siddiqi, 1971  
28. Genus *Merlinius* Siddiqi, 1970
61. Species *Merlinius nothus* (Allen, 1955) Siddiqi, 1970  
Syn. *Tylenchorhynchus nothus* Allen., 1955

62. *M. nizami* Luqman & Khan, 1986
63. *Merlinius* sp.
9. Family PSILENCHIDAE Paramonov, 1967  
(Khan, 1969)
- Subfamily PSILENCHINAE Paramonov, 1967
29. Genus *Psilenchus* De Man, 1921
64. Species *Psilenchus aestuarius* Andr ssy, 1962
65. *P. hilarulus* De Man, 1921
66. *P. hilarus* Siddiqi, 1963
- Syn. *Psilenchus neoformis* Jairajpuri & A.  
H. Siddiqi, 1963
- C] Suborder CRICONEMATINA Siddiqi, 1980
- Superfamily CRICONEMATOIDEA Taylor,  
1936 (1914) Geraert, 1966
10. Family CRICONEMATIDAE Taylor, 1936  
(1914) Thorne, 1949
- Subfamily CRICONEMATINAE Taylor, 1936  
(1914)
30. Genus *Ogma* Southern, 1914
- Subgenus *Ogma* Southern, 1914
67. Species *Ogma (Ogma) simlaensis* (Jairajpuri,  
1963) Andr ssy, 1979
- Syn. *Variasquamata rhosimum* Khan, Chawla  
Chawla & Saha., 1976
31. Genus *Macroposthonia* De Man, 1880
68. Species *Macroposthonia bilaspurensis*  
Gupta & Gupta, 1981
69. *M. curvata* (Raski, 1952) De Grisse &  
Loof, 1965
- Syn. *Criconemella curvata* Raski, 1952
70. *M. xenoplax* (Raski, 1952) De Grisse &  
Loof, 1965
- Syn. *Criconemoides xenoplax* Raski., 1952
- Subfamily HEMICRICONEMOIDINAE  
Andr ssy, 1979
32. Genus *Hemicriconemoides* Chitwood &  
Birchfield, 1957
71. Species *Hemicriconemoides gaddi* (Loos,  
1949) Chitwood & Birchfield, 1957
- Syn. *Criconemoides gaddi* Loos., 1949
72. *H. mangiferae* Siddiqi, 1961
- Syn. *H. litchi* Edward & Misra., 1964
- Syn. *H. aberrans* Phuukan & Sanwal., 1983
- Superfamily HEMICYCLIOPHOROIDEA  
Skarbilovich, 1959 (Siddiqi, 1980)
11. Family HEMICYCLIOPHOROIDEA  
Skarbilovich, 1959 (Geraert, 1966)
- Subfamily HEMICYCLIOPHOROINAE  
Skarbilovich, 1959
33. Genus *Hemicycliophora* De Man, 1921
73. Species *Hemicycliophora subaolica*  
Jairajpuri & Baqri, 1973
74. *Hemicycliophora* sp.
- Superfamily TYLENCHULOIDEA  
Skarbilovich, 1947 (Raski & Siddiqi, 1975)
12. Family TYLENCHULOIDEA Skarbilovich,  
1947 (Kirjanova, 1955)
- Subfamily TYLENCHULOINAE Skarbilovich,  
1947
34. Genus *Tylenchulus* Cobb, 1913
75. Species *Tylenchulus semipenetrans* Cobb,  
1913
13. Family PARATYLENCHIDAE Thorne,  
1949 (Raski, 1962)
- Subfamily PARATYLENCHINAE  
Thorne, 1949
35. Genus *Paratylenchus* Micoletzky, 1922
- Subgenus *Gracilacus* Raski, 1962  
(Siddiqi, 1986)
- Syn. *Gracilpaurus* Ganguly & Khan., 1990
76. Species *Paratylenchus (Gracilacus) aonli*  
Misra & Edward, 1971
- Syn. *Gracilacus aonli* (Misra & Edward)  
Raski., 1976
- Subgenus *Paratylenchus* Micoletzky, 1922
77. *Paratylenchus (Paratylenchus) colbrani*  
*colbrani* Raski, 1975

78. *P. (P.) elachistus* Steiner, 1949  
 79. *P. (P.) lepidus* Raski, 1975  
 80. *P. (P.) minor* Sharma & Khan, 1986  
 81. *P. (P.) nanus* Cobb, 1923  
 82. *P. (P.) runii* Sharma & Khan, 1986  
 83. *P. (P.) vandenbrandei* De Grisse, 1962

### DISCUSSION

The study on nematodes started in Himachal Pradesh with the report of Thirumalahar (1951) about the infestation of root-knot nematode on potato tubers for the first time from Shimla and subsequently, the first nematology unit was established at Central Potato Research Institute, Shimla. A total of 138 nematode species under 63 genera belonging to Dorylaimida, Tylenchida and other nematode orders have been reported from Himachal Pradesh of which 45 species were described as new (Sharma & Gupta, 1998). Sharma & Kaur (1987) observed the parasitism of root-knot nematode *Meloidogyne* sp. on apple which is one of the most economically important cash crops of Himachal Pradesh. The species of root-knot nematodes like *Meloidogyne incognita*, *M. hapla* and *M. javanica* are the most prominent pest of potato and this nematode has been found to be prevalent in about 60% of the potato growing areas of Himachal Pradesh (Krishna Prasad, 1986) and prevalence and intensity of root-knot nematode infection on potato has also been observed (Krishna Prasad & Rajendran, 1986). *Quinisulcius capitatus* has also been suspected as potential pest of potato (Krishna Prasad, 1986; Khan *et al.*, 1990). The infestation of *Meloidogyne* spp. on tomato in Solan area has also been observed (Bharadwaj *et al.*, 1974). *Meloidogyne incognita* and *M. hapla* are the only recognized pests of vegetable crops in the state and these nematodes have been reported to occur in 50 – 100% of vegetable fields of Himachal Pradesh (Bharadwaj *et al.*, 1974; Reddy, 1989). *Tylenchorhynchus* and *Helicotylenchus* have been reported to occur on ginger being highly prevalent (Kaur *et al.*, 1989). Saharan and Chohan (1972) surveyed the disease of plants due to nematodes in Kangra district of

the state. *Tylenchorhynchus* spp., *Macroposthonia xenoplex*, *Meloidogyne incognita*, *Pratylenchus pratensis*, *Helicotylenchus* spp., *Paratylenchus* sp. and *Xiphinema* sp. have been observed to occur on agricultural, horticultural and forest trees (Sharma *et al.*, 1982, Anonymous, 1993; Chandel, 1993). *Meloidogyne incognita*, *M. hapla*, *Pratylenchus penetrans*, *P. coffeae*, *Paratylenchus prunii*, *Tylenchulus semipenetrans*, *Macroposthonia xenoplex* and *Ditylenchus myceliophagus* are the most important nematode species which cause enormous yield losses in various economically important agricultural and horticultural crops and the wide spread occurrence of *Heterodera zae*, *Quinisulcius capitatus*, *Tylenchorhynchus*, *Helicotylenchus* and *Xiphinema* in a number of agricultural and horticultural crops also cause direct or indirect crop losses (Sharma & Gupta, 1998). In the present study, 34 species under 18 genera and 9 families of Dorylaimida and 83 species under 35 genera and 12 families of Tylenchida have been compiled and reported. Among these, *Dorylaimus neominimus* Gantait *et al.* 2010, *Laimydorus* sp., *Aporcelaimellus heynsi* Baqri and Jairajpuri, 1968., *Indokochinema* sp., *Labronema glandosum* Rahman *et al.*, 1986, *Thonus garhwaliensis* Ahmad *et al.*, 1986, *Actinolaimoides* sp. are new rerecords from Himachal Pradesh and *Dorylaimus thornei* Andrassy, 1969 is the first report from India. Five species of Tylenchida i.e. *Polenchus shamimi* Baqri, 1991, *Filenchus* sp., *Rotylenchoides neoformis* (Siddiqi and Husain, 1964) Sher, 1966, *Rotylenchulus reniformis* Linford and Oliveira, 1940 and *Tylenchorhynchus cylindricus* Cobb, 1913 are new records from Himachal Pradesh.

### SUMMARY

The present study includes two systematic lists of soil free living and plant parasitic nematodes belonging to the orders Dorylaimida Pearse, 1942 and Tylenchida Thorne, 1949 from Himachal Pradesh. 34 species under 18 genera and 9 families of Dorylaimida and 83 species under 35 genera and 13 families of Tylenchida have been compiled and reported. Among these, *Dorylaimus neominimus* Gantait *et al.* 2010, *Laimydorus* sp.,

*Aporcelaimellus heynsi* Baqri and Jairajpuri, 1968., *Indokochinema* sp., *Labronema glandosum* Rahman *et al.*, 1986, *Thonus garhwaliensis* Ahmad *et al.*, 1986, *Actinolaimoides* sp. are new rerecords from Himachal Pradesh and *Dorylaimus thornei* Andrassy, 1969 is the first report from India. Five species of Tylenchida i.e. *Polenchus shamimi* Baqri, 1991, *Filenchus* sp., *Rotylenchoides neoformis* (Siddiqi and Husain, 1964) Sher, 1966, *Rotylenchulus reniformis* Linford and Oliveira, 1940 and *Tylenchorhynchus cylindricus* Cobb, 1913 are new records from Himachal Pradesh.

#### ACKNOWLEDGEMENT

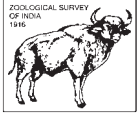
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#### REFERENCES

- Ahmad, M and Jairajpuri, M.S. 1979. Nematodes from high altitude in India. VIII. *Pungentus clavatus* n. sp. with a key to species of the genus *Pungentus* (Nematoda: Dorylaimida). *Revue de Nematologie*, **2**(2): 185-189.
- Ahmad, M and Jairajpuri, M.S. 1980. A review of the genus *Enchodelus* Thorne, 1939 with description of species from India. *Records of Zoological Survey of India, Occasional Paper No.*, **15**: 1-42.
- Ahmad, M and Jairajpuri, M.S. 1982. Some studies on Tyleptinae Jairajpuri, 1964 with a proposal of *Gymnotyleptus* n. gen. (Nematoda: Dorylaimida) *Kanpur University Research Journal* (1980), **1**: 70-76.
- Ali, S.S., Jairajpuri, M.S. and Coomans, A. 1974. Nematodes of high altitude in India. IV. Two new species of Belondiridae Thorne, 1939 (Dorylaimida). *Nematologica*, **19**(1973): 498-507.
- Anonymous, 1993. Annual Report. Reg. Hort. Res. Sta. (UHF) Jachh (Nurpur), Kangra (HP).
- Baqri, Q.H. and Jairajpuri, M.S. 1974. Nematodes of high altitudes in India. V. Five new species of the genus *Enchodelus* Thorne, 1939 (Dorylaimida). *Nematologica*, **20**(2): 131-136.
- Baqri, Q.H. and Jairajpuri, M.S. 1975. Nematodes of high altitudes in India. VI. *Enchodelus thornei* sp. n. and relationship of the genera *Enchodelus*, *Oonaguntus* and *Malekus*. *Indian J. Nematol.*, **5**(2): 185-188.
- Bhardwaj, A.K. and Sharma, P.L. 1971. Preliminary studies on nematodes associated with fruit plants in H.P. *Himachal J. Agric. Res.*, **1**: 53-54.
- Bhardwaj, A.K., Sharma, P.L. and Phunchog, S. 1974. Root knot nematodes (*Meloidogyne* sp.) infestation on tomato in Solan area of Himachal Pradesh. *Indian J. Nematol.*, (1972), **2**: 197-198.
- Bhardwaj, A.K., Sharma, P.L. and Thakur, J.R. 1973. Mushroom nematodes. *Curr. Sci.*, **42**(7): 257-258.
- Chandel, Y.S. 1982. Studies on nematodes associated with mushroom and their control. *M.Sc. Thesis*, HPKV, Solan, H.P.
- Chandel, Y.S. 1986. Studies on the nematodes associated with citrus in Himachal Pradesh. *Ph.D. Thesis*, UHF, Solan (H.P.).
- Chandel, S.S. 1993. Studies on the nematodes associated with *Gladiolus hortulances* L. *M.Sc. Thesis*, UHF, Solan (H.P.).
- Christie, J.R. and Perry, V.G. 1951. Removing nematodes from soil. *Proceedings of Helminthological Society of Washington*, **17**: 106-108.

- Cobb, N.A. 1918. Estimating the nema population of soil. *Agric. Tech. Cir. US Dept. Agric.*, **1**: 48pp.
- Dalal, M.R. and Bhatti, D.S. 1983. Dhaincha (*Sesbania aclecuca*) an additional host of *Heterodera cajini* Koshy, 1967. *Proc. 3rd. Nematol. Symp.*, Himachal Pradesh Krishi Viswa Vidlaya, Solan (India). May 26-29, 1983: 10.
- Jairajpuri, M.S. and Ahmad, W. 1992. *Dorylaimida. Freelifving, Predaceous and Plant parasitic Nematodes*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 458pp.
- Jairajpuri, M.S. and Baqri, Q.H. 1973. Nematodes of high altitude in India. I. Four new species of Tylenchida. *Nematologica*, **19**: 19-30.
- Jairajpuri, M.S. and Coomans, A. 1977. Nematodes from high altitude of India. VII. *Aquatides deconicki* sp. n. (Dorylaimida: Nematoda). *Indian J. Nematol.* (1975), *Indian J. Nematol.* **5**: 243-246.
- Jairajpuri, M.S. and Siddiqi, A.H. 1963a. On *Psilenchus neoformis* n. sp. (Nematoda: Tylenchida) from Solan (H. P.), North India. *Curr. Sci.*, **32**: 318-319.
- Jairajpuri, M.S. and Siddiqi, A.H. 1963b. *Xiphinema brevicole* Lordello & Da costa, 1961 (Nematoda: Dorylaimoidea) from Dalhousie (H. P.), North India. *Curr. Sci.*, **32**: 508.
- Jairajpuri, M.S. and Siddiqi, M.R. 1979. Observation on the nematode genera *Orientylus* and *Calvitylus* (Rotylenchoidinae: Hoplolaimidae) with description of three new species. *Indian J. Nematol.*, **7**: 101-111.
- Kaur, D.J. 1987. Studies on nematodes associated with ginger (*Zingiber officinale* Rosc.) in Himachal Pradesh. *Ph.D. Thesis*, HPU, Shimla (H.P.).
- Kaur, D.J. and Sharma, N.K. 1990. A new report of *Pratylenchus coffeae* – A cause of ginger yellows. *Int. Nematol. Network Newsl.* **7**(1): 15-16.
- Kaur D.J., Sharma, N.K. and Kalia, D.C. 1989. Nematodes associated with ginger (*Zingiber officinale* Rosc.) in Himachal Pradesh. *Indian J. Hill Farmg.* **3**(1): 49-51.
- Kaur D.J., Sharma, N.K. and Khan, M.L. 1990. Occurrence of *Pratylenchus zae* Graham, 1951 on ginger (*Zingiber officinale* Rosc.) in Himachal Pradesh. *Indian J. Nematol.*, **19**: 68.
- Khan, E. 1964. *Boleodorus mirus* n. sp. (Tylenchida: Boleodorinae n. subfam.) from Kufri, Simla (H. P.), India with a key to species of the genus *Boleodorus* Thorne, 1941 *Zool. Anz.*, **179**: 336-341.
- Khan, E., Ganguly, S. and Lalitha, Y. 1990. *Quinisulcius capitatus* - a potential pest of potato in Himachal Pradesh, India. *Int. Nematol. Network Newsl.* **7**(4): 22-24.
- Khan, E. and Singh, D.B. 1974. Five new species of *Pratylenchus* (Nematoda: Pratylenchidae) from India. *Indian J. Nematol.*, **4**(2): 199-211.
- Khan, M.L. and Khan, S.H. 1982. Three new species of the genus *Orientylus* Jairajpuri and Siddiqi, 1977 associated with fruit trees in India (Rotylenchoidinae: Nematoda). *Indian J. Nematol.*, **12**(1): 111-117.
- Khurma, U.R. 1989. Plant parasitic nematodes from some hilly areas of North India. *Indian J. Nematol.*, **18**: 132-133.
- Khurma, U.R. Gupta, N.K. 1988a. Description of *Tylenchus magnus* n. sp. (Nemata: Tylenchidae). *Revue de Nematologie*, **11**(1): 35-37.
- Khurma, U.R. Gupta, N.K. 1988b. *Coslenchus capsici* n. sp. (Nematoda: Tylenchidae) from India. *Systematic Parasitology*, **11**(3): 227-229.

- Krishna Prasad, S.K. 1986. Problems of potato. In: *Plants Parasitic Nematodes of India – Problems and Progress* (Edited by G. Swarup and D.R. Dasgupta). IARI, New Delhi, India : 350-370.
- Krishna Prasad, S.K. and Rajendran, T.P. 1986. Prevalence and intensity of root-knot nematode infection on potato in Himachal Pradesh. *Indian Int. Nematol. Network Newsl.*, **3**(3): 13-15.
- Mukhopadhyaya, M.C. 1970. Nematodes associated with fruit trees and vegetable crops in Himachal Pradesh. *J. Res.*, PAU, **7**: 656-658.
- Reddy, M.C.M. 1989. Fungi as biological control agents of root-knot nematodes. *Ph.D. Thesis*, UHF, Solan (H.P.).
- Saha, M, Chawla, M.L. and Khan, E. 1973. Two new species of *Helicotylenchus* Steiner, 1947 from North India. *Indian J. Nematol.*, **3**(2): 83-87.
- Saharan, G.S. and Chohan, J.S. 1972. A survey of disease of plants in Kangra district, Himachal Pradesh. *J. Res.*, **9**: 68-73.
- Seinhorst, J.W. 1966. Killing nematodes for taxonomic study with hot f. a. 4:1. *Nematologica*, **1**: 178.
- Sharma, G.C., Khan, E. and Sharma, N.K. 1986. Two new species of the genus *Paratylenchus* Micoletzky, 1922 (Nematoda: Paratylenchidae) from Himachal Pradesh, India. *Indian J. Nematol.*, **16**: 231-235.
- Sharma, G.S., Sharma, N.K. and Khan, M.L. 1988. Plant parasitic nematodes of plum (*Prunus domestica*) in Himachal Pradesh. *Indian J. Hort.* **45**: 355-358.
- Sharma, N.K., Damanjeet and Sharma, S.B. 1984. Incidence of maize cyst nematodes, *Heterodera zae* in Himachal Pradesh. *Indian J. Nematol.*, **14**: 198.
- Sharma, N.K. and Gupta, R. 1998. Plant nematology in Himachal Pradesh: An overview. In: *Phytonematology in India* (edited by Pravin Chandra Trivedi), CBS Publishers and Distributors, New Delhi, India : 33-46.
- Sharma, N.K. and Kaur, D.J. 1986. Nematodes associated with temperate fruit crops in Himachal Pradesh. In: *Advances in Research on temperate fruit* (edited by Chadha, T.R., Bhutani, V.P., Kaul, J.L.), Solan, Himachal Pradesh, India, Dr. Y.S. Parmar Univ. of Horticulture and Forestry: 359-362.
- Sharma, N.K. and Kaur, D.J. 1987. Parasitism of root-knot nematode. *Meloidogyne* sp. on apple in Himachal Pradesh (India). *Indian J. Hill. Farmg.* **1**: 69.
- Sharma, N.K., Nath, A. and Thapa, C.D. 1982. Nematodes associated with forest nurseries. *Proc. Improvement in Forest Biomass*, UHF, Solan (HP) : 459-461.
- Siddiqi, M.R. 2000. *Tylenchida, parasites of plants and insects*, 2nd. edition. CABI Publishing, CAB International, Wallingford, U.K. xvii + 833pp.
- Sultan, M.S. 1980. Two new species of the genus *Orientalylus* Jairajpuri and Siddiqi, 1977 (Tylenchida: Rotylenchoidinae). *Revue de Nematologie*, **3**(2): 227-229.
- Sultan, M.S. and Jairajpuri, M.S. 1978. Nematodes of high altitude in India. III. *Helicotylenchus goldeni* n. sp. (Nematoda: Tylenchida). *Indian J. Nematol.*, **8**(2): 169-171.
- Sultan, M.S. and Jairajpuri, M.S. 1979. Nematodes of high altitude in India. IX. Description of two new species of *Rotylenchus* (Nematoda: Tylenchida). *Revue de Nematologie*, **2**(2): 191-196.
- Thirumalachar, M.J. 1951. Root-knot nematode on potato tubers in Shimla. *Curr. Sci.*, **20**(4): 104.



## INTERESTING OBSERVATION ON MICRO-ADAPTATION AND APPROACH OF RETREAT AGAINST ANY MOVABLE OBJECT BY ONE HERSILIID SPIDER (*HERSILIA SAVIGNYI* LUCAS, 1836) IN DIVERSE ENVIRONMENT OF THE WETLAND ECOSYSTEM OF GANGETIC MARSHLAND OF NORTH 24 PARGANAS, WEST BENGAL

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### INTRODUCTION

Studies on feeding behaviour of Araneid spiders from India were available with Tikader (1961, 1982), Kumar *et al.* (1977), published a note on dragonflies caught in spider web. Recently Majumder (2001), Talukdar and Majumder (2006, 2007 and 2008), Majumder and Talukdar (2006) and Talukdar (2008) did some interesting observation on food and feeding behaviour of four Araneid species of the genus *Argiope* and *Neoscona* belong to family Araneidae, genus *Leucauge* belongs to family Tetragnthidae and genus *Pholcus* belongs to family Pholsidae from West Bengal. Information on behavioral observation of Hersilid spider from Gangetic

wetlands of North 24 Parganas, West Bengal is not available and also scanty in spider science.

During August,2008 while the authors were carrying out the behavioral studies on a spider named *Hersilia savignyi* Lucas, 1836 came across a male Hersilid displaying its feeding behaviour on a comparatively large cockroach, *Blatella germanica* Linnaeus, 1757 near the undistinguished cocoon built in a concrete shed near a paddy field of North 24 Parganas district, a potential wetland area in the history of Gangatic estuarine system of West Bengal.

The present paper deals with the micro-adaptive predated behaviour of *Hersilia savignyi* Lucas, 1836 along with its short instinctive memorizing



Fig. 1. Study area

capability, the interesting distinguishable pattern of retreat which support their natural history towards the evolution of intelligence in Animalia in-between the heart of very important ecological condition of nature from where the spider predate its prey in the different seasons.

**Abbreviation used in the text:** c: clockwise rotation; a: anti-clockwise rotation; +: presence of data; -: absence of data; appx.: approximately.

### MATERIALS AND METHOD

**The Study Area:** Ecologically the study area is considered to be the part a large wetland of about 50km. stretch of Gangatic marsh area crept up on several agricultural and fishing villages situated between  $22^{\circ}40' 09.01''$  to  $22^{\circ}43' 29.7''$  of North and  $88^{\circ}24' 27.03''$  to  $88^{\circ}22' 22.6''$ -  $88^{\circ}28' 44.2''$  of East between the altitude of 6.00m -15.00m in several assembly segment of Jagaddal, Panihati, Khordaha, Amdanga, Naihati and Barasat. In bird view the actual study area is situated in and around, a "L" shaped water body, known as Karna Madhabpur Bil area, at the grid between the co-ordinate of  $22^{\circ}40'09.01''$  N and  $88^{\circ}24'27.03''$  E at an altitude of 15.00 m. situated between the Kalyani high way extension and Sealdah-Ranaghat railway route under the jurisdiction of Panihati municipality which is perhaps one of the remnants of the large connected wetland between Vidyadhari and Noai River of the past history Gangatic wetlands (Figure 1).

**Climate:** Monsoon prevails for about four months from mid of June to mid of October with high humidity. Annual humidity ranges between 85-95%. July–August are the heavy rainfall months with precipitations as high as 400mm., maximum temperature reaches up to  $45^{\circ}\text{C}$  in May while the mean maximum temperature is  $30^{\circ}\text{C}$ . Observed in June. On the other hand the minimum temperature drops up to  $8^{\circ}\text{C}$  in January and the mean minimum temperature  $20^{\circ}\text{C}$ .

**Collection:** Spiders were collected from the study areas by hand picking method by forceps with soft-tension and small sable brush. Sunca electronic emergency lamp has been used. Taxonomic studies have been made by an Olympus

dissecting type binocular microscope with ocular micrometer while behavioral observations were performed by a Sony Mini DV DCR-HC42E, Canon Power Shot SX100IS and an electronic stop watch. Black velvet paper and tabulated data sheets were used. Web threads were collected in black velvet paper pieces. Collected spider specimens were anaesthetized, killed in a killing jar and preserved in Oudman's preservative (90 parts 70% ethanol, 5 parts glycerol and 5 parts glacial acetic acid) in glass vials.

**Identification:** Well preserved spider specimens were sorted transferred in ethyl alcohol and studied under binocular microscope. Species level identifications was done based on Tikader (1987), Sebastian et al. 2009 and Baehr & Baehr (1987 &1993). The up to date scientific name of the spider by evolutionary sequence have been followed as per the standardized scientific names from the Indian and World catalog of Spiders (Platnick, 2014).

**Euthanized specimens:** To mimic the food item Hymenopteran ants were euthanized for spiders on the distal end of thin twig except otherwise stated. In case of unpalatable food item only thin twig with no ants were used.

### OBSERVATION

**Territoriality:** *Hersilia savignyi* Lucas, 1836 commonly known as "two tailed spider", is generally found to our surroundings. Geological changes have great impact on the adaptive mode of life of this spider.



**Fig. 2.** *Hersilia savignyi* Lucas, 1836 besides its cocoon case.

They camouflage with their surroundings and remain in one particular position for many days waiting for their prey. They do not make web in hanging condition like many other spiders. Their web extends over their niche substratum made up of very thin silk thread, so unnoticed by many eyes. In case of rearing the spider lings or keeping the prey they also make case like cocoon (Figure 2). They stick themselves with the substratum with their forceps like appendages. Female spider guards the nest. Male-Female pair always lives together. Under an experimental condition if such pair is released to the territory of another adult male spider of same kind, the pair just leaves that place very quickly and search for another suitable place for them. Small spider lings like 4 mm in length can cross maximum 10 cm distance in 1 second at threatening condition.

**Food and Feeding habit:** While the most spider species generally hunt at night here our observation supports the fact of *H. savignyi* predating behaviour exclusively extends both day and night. In the experimental time period it was observed that a fasting *H. savignyi* predated on *Blattella germanica* Linnaeus, 1757, *Tetraponerarufonigra* Jerdon, 1851, *Camponotus angusticollis sanguinolentus* Forel, 1895, *Camponotus compressus* (Fabricius, 1787), *Camponotus* (*Orthonotomyrmex sericeus* (Fabricius) and Dipteran flies as food source.



**Fig. 3.** *Hersilia savignyi* Lucas, 1836 carries *Tetraponerarufonigra* Jerdon, 1851 after predation within a silk case.

**Hunting technique:** *H. savignyi* notably first attacks on any movable palatable object that approaches toward its territory. After immobilizing the prey using poison and silk both male and

female carry the item (Figure 3 & 4) to a suitable place, preferably near or into the cocoon, then suck the juice from the food. If movable object is unpalatable or stronger than the spider, it retreats backward. A schematic technique of Prey capturing process of *H. savignyi* drawn as per observation (Figure 5) is pertained.



**Fig. 4.** *Hersilia savignyi* Lucas, 1836 predates on a comparatively large prey *Blattella germanica* Linnaeus, 1757.

In this kind of behaviour, first hersilid spider attacks on that prey and very quickly crawls forward of it and start spinning around it both in clockwise and anti-clockwise direction until the prey is entangled totally. In the present study 15 observations have been carried out for 10 consecutive days on 6 specimens to attain and draw the inferences on the behaviour of *Hersilia savignyi* Lucas, 1836 which is highly significant regarding evolution of memory among the invertebrates. In 29% (appx.) of cases hersilid spiders attack the unpalatable object otherwise avoid. In case of palatable object attack readily happens in 75% (appx.) situations. This was also found from the present study that the hersilid spider made about 55%-70% ( $61.4\% \pm 5.5\%$ ) clockwise and 30%-45% ( $38.6\% \pm 5.5\%$ ) anticlockwise rotation to entangle its prey completely. Details of 15 observations are given in Table 1. Out of fifteen observations only eight times spiders attacked and entangled the items which are already shown in Table 1. Activity Budget estimation of this circular movement to entangle the prey is given in Figure 6. In this figure percentage of clockwise and anti-clockwise movements are plotted in 100% stacked column graph with number of observations made with or without feed (prey items) during eight observational accounts are depicted.

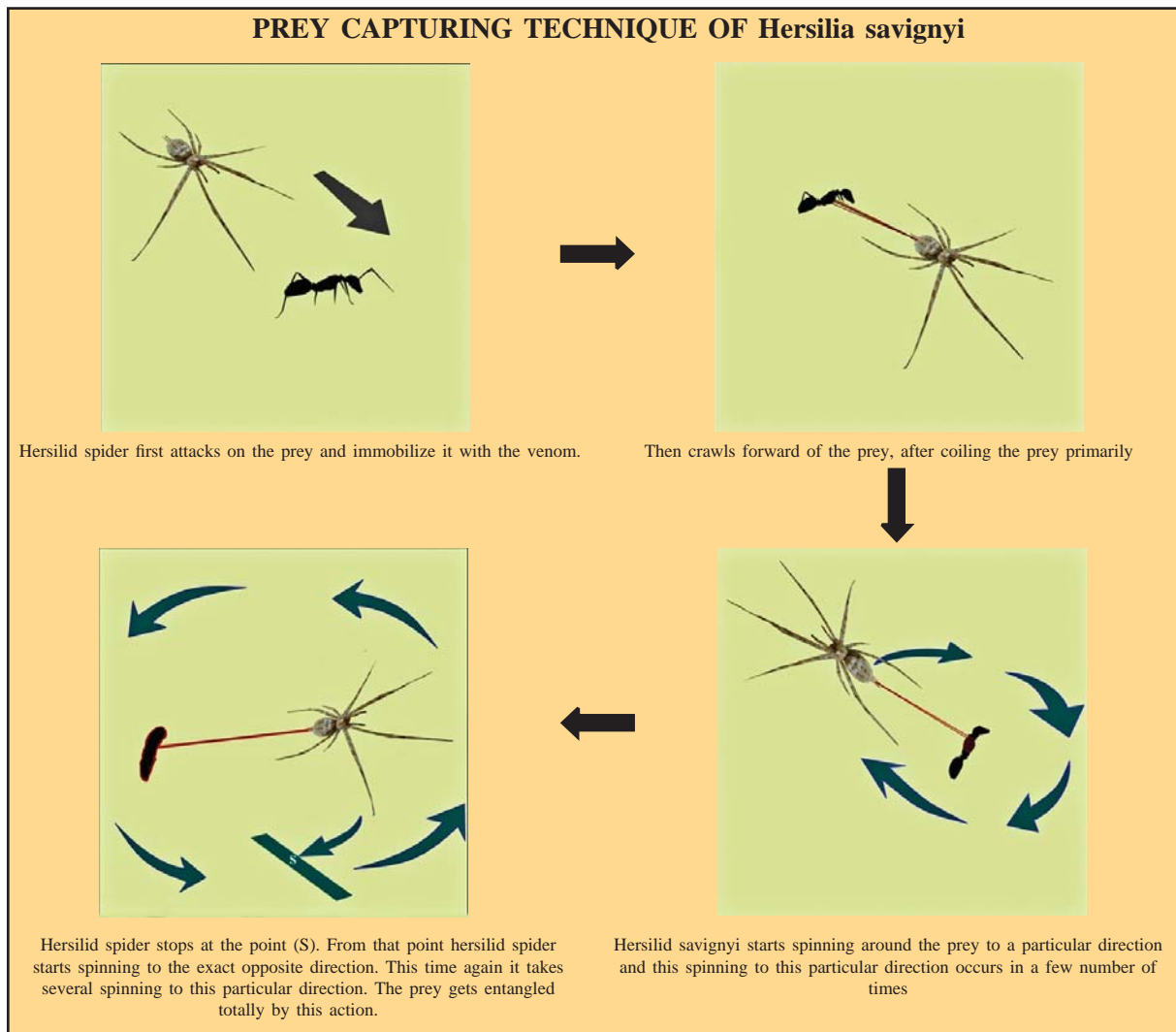


Fig. 5. Scheme showing Prey capturing process of *H. savignyi*.

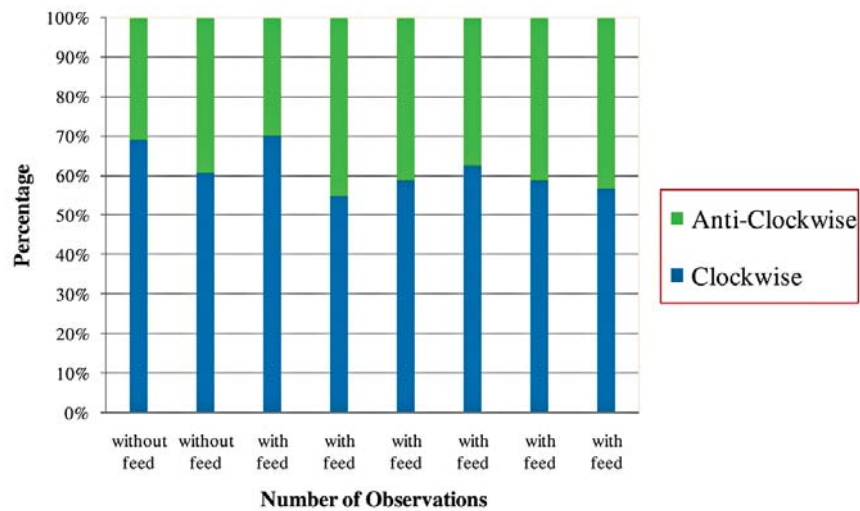


Fig. 6. Clockwise and anti-clockwise activity budget estimation during focal sampling in different observational cases at the time of capturing prey items for *Hersilia savignyi* Lucas, 1836.

**Table 1.** Details of observation for the predatory behaviour of *Hersilia savignyi* Lucas, 1836. Circular movement around the object by hersilid spider are represented within brackets.

Observation no.	Day no.	Specimen No.	With Feed		Without Feed	
			Attack	Retreat	Attack	Retreat
O1	1	1	–	–	–	+
O2	1	1	–	–	–	+
O3	2	1	–	–	+ (9c; 4a)	–
O4	2	1	–	–	–	+
O5	3	1	–	–	+ (17c; 12a)	–
O6	3	1	–	–	–	+
O7	4	2	–	–	–	+
O8	4	3	+ (7c; 3a)	–	–	–
O9	5	4	+ (11c; 9a)	–	–	–
O10	6	4	+ (37c; 26a)	–	–	–
O11	7	4	–	+	–	–
O12	8	5	+ (5c; 3a)	–	–	–
O13	8	6	+ (27c; 19a)	–	–	–
O14	9	6	–	+	–	–
O15	10	6	+ (17c; 13a)	–	–	–

This image of action for unpalatable object may remain in its mind for 24 hrs. (approximate). Within this time period if that unpalatable moving object is placed in front of it again, it retreats backward rather attacking that object. With time this activity gets gloomy. After one day period if the same object is placed in front of that spider again, it repeats the same behaviour as it did at the first time when that object was placed in front of it.

### DISCUSSION

Animals receive floods of information from the environment through their sense organs, much more than their brains can process at a given moment (Dukas 2004). Small animals such as spiders, behavioral decisions are sometimes influenced by multiple cues. Orb webs constitute exquisitely precise records of the stimuli the spider experienced and the decisions that it made while building its web (Ederhard and Hesselberg, 2012). It is thus reasonable to expect that animals may

bias which subsets are processed and acted upon at any given moment. If an animal can bias input and processing of information appropriately ('pay attention'), it can respond more consistently and more efficiently to the particular subsets of stimuli that are most relevant to its current behavioral context (Shettleworth 2010). Attention is a well-established phenomenon in vertebrates, and there are indications that insects and spiders also present 'attention-like' phenomena (Shettleworth 2010). Study of attention, and of possible behavioral errors that are associated with changes in attention, has important implications. Orb webs constitute exquisitely precise records of the stimuli the spider experienced and the decisions that it made while building its web. In addition, because spiders appear to sense their webs largely by touch, direct behavioral observations can determine which stimuli they probably sense (Ederhard and Hesselberg, 2012).

From the experiment it can be drawn that

*Hersilia savignyi* Lucas, 1836 generally makes more clockwise rotation than anti-clockwise rotation to entangle its prey. In both cases of web building and predation animals learn either by the process of cultural transmission invested by parents or by instinct in the process of natural selection. The recognition of an object and memorization can only be achieved by multiple exposures of that very object or object-like things. The interesting action pattern of *Hersilia savignyi* for unpalatable object recognition can be considered as “Short Term Memory” (STM), a memory don’t last in mind for all time. Cognitive psychology distinguishes short term memory and long term memory. Short term memory (STM) or Working Memory (WM) refers to the memory trace that is maintained during the psychological present, and long term memory (LTM) is the storage of past experiences (Sougné, 2002). During predation, hersilid spider literally takes many behavioral

decisions and gets attention to multiple cues from the environmental cues. From this context it can readily be concluded that STM plays a significant role in the predating behaviour of hersilid spider. It can also be concluded that in its small niche by this adaptive predating activity (micro-adaption) hersilid spiders also regulate the population of insects in the house and surroundings. So it can be considered as a potentially bio-controlling natural agent in the related environment of agriculture and domestic fields. Further study on this spider may open many unknown windows in the science of neurology.

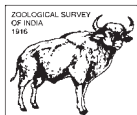
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#### REFERENCES

- Baehr, B. and Baehr, M. 1987. The Australian Hersiliidae (Arachnida: Araneae): Taxonomy, Phylogeny, Zoogeography. *Invertebrate Taxonomy*, **1**(4): 351-437.
- Baehr, B. and Baehr, M. 1993. The Hersiliidae of the Oriental Region including New Guinea. Taxonomy, phylogeny, zoogeography (Arachnida, Araneae), *Spixiana. Supplement*, **19**: 1-96.
- Dukas, R. 2004. Causes and consequences of limited attention. *Brain Behav. Evol.* **63**: 197-210.
- Eberhard, W.G. and Hesselberg, T. 2012. Cues that Spiders (Araneae: Araneidae, Tetragnathidae) Use to Build Orbs: Lapses in Attention to One Set of Cues Because of Dissonance with Others? *Ethology*, **118**: 1-11.
- Kumar, A. and Prasad, M. 1977. A note on dragonflies caught in spider webs. *Odonatologica*, **6**(1): 19-20.
- Majumder, S. 2001. Observations on predation of damselflies by spiders in the Sunderland, West Bengal. *Bionotes*. **3**(3): 65.
- Majumder, S.C. & Talukdar, S. 2006. Some Interesting observation on Food & Feeding behaviour of a true weaving spider [*Neoscona nautical* (L. Koch)] from BortiBeel, North 24 Parganas, West Bengal. *Proceeding of the 93rd Session of Indian Science Congress (Hyderabad, 3-7 January): Animal, Veterinary and Fishery Sciences*, (Advance Abstract), **133**:100.
- Platnick, N. I. 2014. The world spider catalog, version 14.5. American Museum of Natural History, online at <http://research.amnh.org/entomology/spiders/catalog/index.html> DOI: 10.5531/db.iz.0001.
- Sebastian, P. A. and Peter, K. V. 2009. *Spiders of India*: 1- 614.+170 plates. Published by Universities Press, India.
- Shettleworth, S. J. 2010. *Cognition, evolution, and behavior (2nd ed.)*: 700. Published by Oxford University Press, New York.

- Sougné, J.P. 2002. Short Term Memory in a Network of Spiking Neurons. In: J. A. Bullinaria & W. Lowe (Eds). *Connectionist Models of Cognition and Perception*, pp 131-142. Published by World Scientific Press, Singapore.
- Talukdar S. 2008 Interesting observation on the gregarious and diverse mode of feeding habit by a Pholcid spider [*Pholcus phalangioides*, (Fuesslin, 1775)] an inclusion with the paddy field ecosystem of BortiBeel, North 24 Parganas, West Bengal. Proc. 95<sup>th</sup> Ind. Sc. Cong. Par III (Advance Abstract), **80**: 61-62.
- Talukdar Sankar & Majumder, S.C. 2006. Some Aspects of Web Building Mechanism by an Araneid Spider (*Argiope pulchella* Thorell) from BortiBeel, North 24 Parganas, West Bengal. Proc. 93<sup>rd</sup> Ind. Sc. Cong. Part III (Advance Abstract) Sec-XVI, Published 93<sup>rd</sup> Indian Science Congress Association. No. **132**, P. 99.
- Talukdar, S. and Majumder, S.C. 2007. Interesting Observation on Food & Feeding Behavior of a True Weaving Spider (*Neoscona mukherjei* Tikader) from BortiBeel, North 24 Parganas, West Bengal Sent for publication in *Rec, Zool. Surv India* : **107**(3) : 39 – 44.
- Talukdar, S. and Majumder, S.C. 2007. Some Interesting observation on Food & Feeding Behavior of a True Weaving Spider From Lopchu, Darjeeling District, West Bengal. Published in the proceeding of 94<sup>th</sup> Indian Science Congress, Par IV (Advance Abstract), **87**: 79.
- Talukdar, S. & Majumder, S.C. 2008 Interesting observation on the art of feeding behavior of an orb weaving spider [*Leucauge decorata* (Blackwall)] from Borti Beel wetland, North 24 Parganas, West Bengal. Proc. 95<sup>th</sup> Ind. Sc. Cong., Par III (Advance Abstract), **79**: 60-61.
- Tikader, B.K. 1987. *Hand Book of Spiders*, 251 pp. Published by Zool. Surv. India, Kolkata.
- Tikader, B.K. 1961. Protective device of some Orb-weaving spiders from India. *J. Bombay. Nat. hist. Soc.*, **58**(3): 825-829.
- Tikader, B.K. 1982. Fauna of India: (Araneidae and Gnaphosidae). **2**(2): 1-533.



## ORIBATID MITES (ACARI: ORIBATIDA) OF LAKSHADWEEP

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### INTRODUCTION

Oribatid mites are one of the major components of soil microarthropod groups. They are classified as class arachnida and subclass acari. The body generally divisible into two distinct regions like the cephalothorax and abdomen which possesses 4 pairs of jointed legs and have no wings and antennae. These mites take part in soil organic matter decomposition, nutrient cycling, etc. and thus increase the soil fertility.

Lakshadweep as a smallest union territory of India comprised of several small islands in the Arabian Sea near the south-western coast of India. Agatti Island, one of the inhabited islands of the Lakshadweep, is a small island with 5.6 km length and 2.7 km<sup>2</sup> surface area and is inhabited by nearly 8000 people, according to the last census of 2001. Soil of the island was mainly sandy with very less organic matter content.

A total of 8 soil samples were collected from the different habitats of Agatti Island, Lakshadweep, during a tour conducted by the first author in July, 2011. 53 specimens of oribatid mites were extracted from the soil samples. A total of nine species belonging to nine genera under seven families were identified. Of these, two were newly described species to science, one was first time recorded species from India and other six species and genera were recorded first

time from Lakshadweep. The specimens were deposited in the National Zoological Collection, Zoological Survey of India, Kolkata. Previously during an expedition to Lakshadweep Haq and Ramani (1997) explored one new species of the genus *Lepidacarus* which is incorporated in the present paper.

### MATERIALS AND METHODS

For taxonomic studies of oribatid mites, litter, soil and humus samples from all possible habitats from the Agatti Island of Lakshadweep were collected by shovel from upper 10 cm soil profile and kept in polythene bags. The samples were extracted by using modified Tullgren funnel apparatus and extracted mite specimens were collected in glass tubes containing 70% alcohol.

The body of most of the oribatid mite is heavily sclerotized and opaque. The extracted material were made ready for taxonomic study following the usual procedure of keeping the specimen in solution of 90% alcohol and lactic acid (v/v) as advocated by Balogh (1965). For microscopic observations, Balogh's (1965) method of temporary mounting in lactic acid was followed. After necessary microscopic observations the specimen was transferred in small glass vials containing 90% alcohol. The vials were then properly labeled and stored.

## SYSTEMATIC ACCOUNT

Family PHTHIRACARIDAE Perty, 1841

1. Genus *Hoplophorella* Berlese, 1923

1923. *Hoplophorella* Berlese, *Redia*, **25**: 260.

1. *Hoplophorella (Hoplophorella) singularis*  
Sellnick, 1959

1959. *Hoplophorella (Hoplophorella) singularis* Sellnick,  
*Occ. Pap. Bernice P. Bishop. Mus.*, **XXII**: 148.

1990. *Hoplophorella sunderbanensis* Sanyal and Bhaduri,  
*Indian J. Acarol.*, **6**(1 & 2): 35.

*Diagnosis*: Rostral setae moderately long, stout, directly outward; interlamellar setae long, thick and pilose; very minute lamellar setae present between the region of interlamellar setae and pseudostigmata; sensillus moderately long with rounded head and devoid of bristles; notogastral setae thick, long and pilose; setae  $ad_2$  larger and thickened than  $ad_1$ ,  $an_1$  and  $an_2$ ;  $ad_3$  thick and pilose.

*Material examined*: Lakshadweep: Agatti Island: Tangi Palli, near Mosque, 5 ♀, 02. vii. 2011, from sandy soil, under banana plant, coll. A. K. Sanyal.

*Distribution*: India: West Bengal, Lakshadweep.

*Remarks*: The species is recorded here for the first time from Lakshadweep.

Family ORIBOTRITIDAE Grandjean, 1967

2. Genus *Indotritia* Jacot, 1928

1928. *Indotritia* Jacot, *Psyche*, **35**: 213.

2. *Indotritia lakshadweepensis* Sanyal and Basu  
(in press)

*Diagnosis*: Rostral, lamellar and interlamellar setae smooth; lamellar setae longer than rostral setae and rostral setae longer than interlamellar setae; sensillus smooth, setiform, pointed; anterior margin of aspis with fine lineation; irregular granulations in aspis; notogastral setae smooth, fairly strong, sickle shaped; length of  $an_2$  and  $ad_2$  more or less same with  $an_1$  and  $ad_1$  respectively; single solenidia in genu I and no solenidia in genu IV; genito-aggenital suture reaching up to the middle of  $g_6$  and  $g_7$  and bent inward.

*Material examined*: Lakshadweep: Agatti Island: Agricultural Office garden, 7 kms north of Airport, 10 ♀♀, 02. vii. 2011, from soil with semidecomposed banana plant, coll. A. K. Sanyal.

*Distribution*: India: Lakshadweep (Agatti Island).

*Remarks*: The species is recorded as new to science.

Family LOHMANNIIDAE Berlese, 1916

3. Genus *Heptacarus* Piffel, 1963

1963. *Heptacarus* Piffel, *Anz. Ost. Akad. Wiss.*, **2**: 24.

3. *Heptacarus hirsutus* Wallwork, 1964

1964. *Heptacarus hirsutus* Wallwork, *Rev. Zool. Bot. Afr.*, **70**(3-1): 358.

*Diagnosis*: Rostral setae relatively slender, divergent and finely pilose; lamellar setae slightly longer and thicker than rostral setae and barbed conspicuously; sensillus pectinate; notogaster with strong neothichy, a total of 120 to 140 slender and conspicuously barbed notogastral setae observed, progressively longer toward posterior region.

*Material examined*: Lakshadweep: Agatti Island: 6 kms north of Airport, 6 ♀♀, 02. vii. 2011, from sandy soil with dry semidecomposed leaves, coll. A. K. Sanyal.

*Distribution*: India: Kerala, Rajasthan, Andhra Pradesh, Gujarat, Lakshadweep.

*Remarks*: The species is recorded here for the first time from Lakshadweep.

4. Genus *Lepidacarus* Csiszar, 1961

1961. *Lepidacarus* Csiszar, *Acta. Zool. Sci. Hung.*, **7**: 345-366.

4. *Lepidacarus ennarpi* Haq and Ramani, 1997

1997. *Lepidacarus ennarpi* Haq and Ramani, *Entomon.*, **22**(2): 119.

*Diagnosis*: Prodorsum punctuated; all prodorsal setae toothed, broad and palmate; rostrum pointed; sensillus clavate with an inner rachis, barbed distally; distinct lateral prodorsum tooth just above *exa*; 16 pairs of spoon shaped notogastral setae with inner rachis and distinct spines;  $c_3$  longest and  $d_1$  shortest setae; punctation present in notogaster.

*Distribution:* India: Lakshadweep (Bengarum Island).

Family TRHYPOCHTHONIIDAE  
Willmann, 1931

5. Genus *Archegozetes* Grandjean, 1931

1931. *Archegozetes* Grandjean, *Bull. Mus. Hist. Nat. Paris*, **3**(2): 144.

5. *Archegozetes longisetosus* Aoki, 1965

1965. *Archegozetes longisetosus* Aoki, *Nat. Life Southeast Asia*, **4**: 147.

*Diagnosis:* Prodorsum punctated; prodorsal and notogastral setae long, fine, densely beset with fine bristles; sensillus long, fine, densely covered with bristles;  $d_1$  longer than their mutual distance; genital setae 7 pairs;  $4a$  about  $1/2$  as long as  $4b$ ; solenidia on palp sharp.

*Material examined:* Lakshadweep: Agatti Island: Agricultural Office garden, 7 kms north of Airport, 12♀♀, 02. vii. 2011, compost mixed soil from the tub of ornamental plants, coll. A. K. Sanyal.

*Distribution:* India: West Bengal, Assam, Kerala, Tripura, Lakshadweep.

*Remarks:* The species is recorded here for the first time from Lakshadweep.

Family TECTOCEPHEIDAE Grandjean, 1954

6. Genus *Tectocephus* Berlese, 1913

1913. *Tectocephus* Berlese, *Redia*, **9**: 91.

6. *Tectocephus sarekensis* Tragardh, 1910

1910. *Tectocephus sarekensis* Tragardh, *Naturw. Unterr. Sarekgeb in Schw.-Lapland*, **4**: 567.

*Diagnosis:* Rostrum rounded with tendency to be trilobite; lamellae rounded and extended upto the rostrum; pteromorph obtuse-angled; sensillus with discoid head and densely covered with spinules; lamellar setae weakly serrated at base and smooth distally and curved towards the apex; rostral setae similar in length and shape with lamellar setae but directed anteriorly.

*Material examined:* Lakshadweep: Agatti Island: 6 kms north of Airport, 1♀, 02. vii. 2011, from sandy soil with dry and decomposed leaves, coll. A. K. Sanyal.

*Distribution:* India: West Bengal, Uttar Pradesh, Lakshadweep.

*Remarks:* The species is recorded here for the first time from Lakshadweep.

Family OPPIIDAE Grandjean, 1954

7. Genus *Oppiella* Jacot, 1937

1937. *Oppiella* Jacot, *J. New York Entomol. Soc.*, **45**(3 & 4): 356.

7. *Oppiella suramericana* (Hammer, 1958)

1958. *Oppia suramericana* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10**(1): 48.

*Diagnosis:* Prodorsum slender; rostral setae smooth and longer than their mutual distance; lamellae almost parallel to each other and connected with thin translamellae; sensillus with long, broad, rounded head and furnished with 7-8 stiff bristles; one pair of short cristae, originate from anterior margin of notogaster, continue longitudinally on notogaster; notogastral setae thin and moderately long.

*Material examined:* Lakshadweep: Agatti Island: Agricultural Office garden, 7 kms north of Airport, 3♀♀, 02. vii. 2011, from soil with semidecomposed coconut leaves, coll. A. K. Sanyal.

*Distribution:* India: Lakshadweep (Agatti Island).

*Remarks:* The species is recorded here for the first time from India.

8. Genus *Ramusella* Hammer, 1962

1962. *Ramusella* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **13**(2): 50.

8. *Ramusella chulumaniensis* (Hammer, 1958)

1958. *Oppia chulumaniensis* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10**(1): 48.

*Diagnosis:* Sensillus strongly setiform with 7-10 branches and distal part slightly dilated; 3<sup>rd</sup> and 4<sup>th</sup> branches of sensillus much longer; rostral setae bent anteriorad, proximal half thick and barbed while distal half thin and smooth; interlamellar setae thicker and longer than lamellar setae and directed outward; notogastral setae stiff, almost equal in length.

*Material examined:* Lakshadweep: Agatti Island: Tangi Palli, near Mosque, 4♀♀, 02. vii. 2011, from sandy soil under banana plant, coll. A. K. Sanyal.

*Distribution:* India: Tripura, Uttarakhand, Lakshadweep.

*Remarks:* The species is recorded here for the first time from Lakshadweep.

9. Genus *Striatoppia* Balogh, 1958  
1958. *Striatoppia* Balogh, *Rev. Zool. Bot. Afr.*, **58**(1&2): 16.

9. *Striatoppia milii* Sanyal and Basu (in press)

*Diagnosis:* Prolamellae well developed; rostral setae robust and setiform; lamellar costulae short with well developed translamellae; 4 large foveolae present in interbothridial region and enclosed by 2 branched costular portion; lamellar setae barbed, phylliform; interlamellar setae hardly discernible stumps; sensillus pro- to exclinate with densely ciliated border; 4 to 5 pairs of longitudinal striations present in notogaster; 9 pairs of notogastral setae widened, barbed and phylliform but  $p_1$  is smaller than other and not phylliform.

*Material examined:* Lakshadweep: Agatti Island: Agricultural Office garden, 7 kms north of Airport, 02. vii. 2011, 2♀♀, from soil mixed with semidecomposed coconut leaves, coll. M. Sanyal.

*Distribution:* India: Lakshadweep (Agatti Island).

*Remarks:* The species is recorded as new to science.

Family ORIBATELLIDAE Jacot, 1925

10. Genus *Lamellobates* Hammer, 1958  
1958. *Lamellobates* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10**(1): 100.

10. *Lamellobates palustris* Hammer, 1958  
1958. *Lamellobates palustris* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, **10**(1): 100.

*Diagnosis:* Inner cuspides of lamellae rounded, outer lamellar cuspides tapering into a short and sharp point; lamellar setae equally very thick throughout, rough; interlamellar setae long, rough; sensillus club-shaped, tip pointed, beset with short setae; notogastral setae 9 pairs; genital setae 6 pairs.

*Material examined:* Lakshadweep: Agatti Island: Tangi Palli, near Mosque, 10♀♀, 02. vii. 2011, from sandy soil under banana plant, coll. A. K. Sanyal.

*Distribution:* India: Uttar Pradesh, Bihar, Tripura, West Bengal, Lakshadweep.

*Remarks:* The species is recorded here for the first time from Lakshadweep.

## SUMMARY

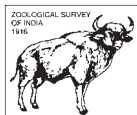
The paper deals with the Oribatid fauna collected from Agatti Island, Lakshadweep. Altogether ten species of oribatid mites belonging to ten genera under seven families have been recorded from Lakshadweep. The present study recorded nine species, nine genera and six families as the first record from Lakshadweep. Of these, two species were described as new to science from the island.

## ACKNOWLEDGEMENT

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## REFERENCES

- Balogh, J. 1965. A Synopsis of World Oribatid (Acari) Genera. *Acta Zoologica Academiae Scientiarum Hungarica*, **11**(1-2): 1-99.
- Haq, M. A. and Ramani, N. 1997. Oribatid Mites from Lakshadweep- 1. A New Species of *Lepidacarus* Csiszar, 1961 (Acari: Lohmanniidae). *Entomon*, **22**(2): 119-123.



## LIMNOLOGICAL VARIATIONS OF TWO KRISHNA RIVER TRIBUTORIES IN KHAMMAM DISTRICT, TELANGANA STATE

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### INTRODUCTION

Wyra and Palair lakes are two small tributaries of Krishna river, located in Khammam District of Andhra Pradesh, and these two are located respectively at northern and southern sides of Khammam town of the district, each at approximately of 30 kms on either side. Khammam town is situated at about 225 kms from Hyderabad in its northern side.

Some of the notable contributions on limnology in the state include Zafar (1966), Venkateswarlu (1969), Munawar (1970), Venu (1981), Ratna Rao (1984), Jaya Devi (1985), Chandrasekhar (1966, 2006), Chandrasekhar and Nageswara Rao (2006), Patil and Panda (2003), Malathi *et al.* (2003) Anitha *et al.* (2005), Siddiqi and Khan (2002). In an aquatic ecosystem, water quality influences its biotic components like diversity, biomass and distribution. The physico-chemical parameters exert their influence both individually and collectively and their interaction produces abiotic environment which conditions the origin, development and finally succession of biotic communities. Further, biotic communities in turn, continuously goes on in a dynamic ecosystem.

The Present study was undertaken to assess the physico-chemical and biological conditions of two Deccan tributaries of Krishna river *viz.*, Wyra lake (17° 15'N & 80°25'E) with 19.16 sq. kms. of water spread area and Palair lake (17° 15'N & 80°25'E) in Andhra Pradesh, which has

got water spread area of 19.16 and 17.25 sq. kms respectively, which also differed significantly in their limnological aspects and trophy (nutrient status) with emphasis on the structure and composition of zooplankton particularly Rotifera and Cladocera.

### MATERIAL AND METHODS

The studies on Wyra lake have been carried out during 2006-07, while on Palair lake it was 2009-10 (July, 2009-monsoon; January, 2010-winter; April, 2010-summer). In order to have a complete limnologic scenario of the two water bodies 9 localities on Wyra and 8 on Palair lake have been chosen, undertook the surveys, and the results were given in the tables 1-3 in detail. For the analysis of Dissolved Oxygen, water samples were collected in DO bottles of 300 ml. capacity and brought to the field laboratory after fixation, together with water samples in 1000 ml PVC containers for the analysis of titrimetric parameters and analysed there itself. Water samples in separate 1000 ml PVC containers were brought to the Head Quarters (Hyderabad) and were given to the local private laboratory for analyzing the rest of the parameters *i.e.*, nutrients and some light metals. Plankton samples were collected by diving the plankton net (No.25) on the sub-littoral regions of the lake waters and the preserved in 4 % formaldehyde solution and the identification of rotifer and cladoceran fauna was done with the aid of standard literature on these two groups.

**Table 1.** Showing the over all ranges and mean values of physico-chemical parameters of two tributaries

Sl. No	Parameter	Wyra lake		Palair Lake	
		Range	Mean	Range	Mean
1.	pH	7.0 – 8.7	7.57	7.1-8.4	7.8
2	EC (micro siemens/cm)	360-700	542	350-940	563
3	Turbidity (NTU)	5 -184	53	1-120	15
4.	DO (mg/L)	1.0 – 8.0	4.55	1-5.4	2.9
5	Total Alkalinity (-do-)	145- 485	272	122-397	183
6	Chloride (-do-)	27 - 110	64	24-105	62
7	Total Hardness (-do-)	95 – 245	149	100-320	148
8	Calcium (-do-)	21 – 88	29	24-92	35
9	Phosphates (-do-)	0.01 -0.28	0.86	0.02-1.45	0.15
10	Nitrates (-do-)	1.0 – 10.0	3.7	0.1-3.39	0.4
11	Silicates (-do-)	3.0 – 16.0	10.5	3.4-20	9.4
12	Sulphates (-do-)	16 – 97	39.1	29-87	52
13	Sodium (-do-)	30 – 92	61.3	27-108	59.5
14	Potassium (-do-)	2.0 -7.0	3.1	1-6	2.6

## RESULTS AND DISCUSSION

Limnological investigations were restricted to the three major seasonal surveys *i.e.*, November–January (winter), March–April (summer) and July–August (monsoon) on both the tributaries. The ranges and mean station-wise / overall values of different physico-chemical parameters of all the stations of both the water bodies during the study period (s) have been tabulated.

The **pH** values during the study periods varied between 7.0–8.7 with mean value of 7.57 at Wyra lake where as in Palair, it was 7.1-8.4 with mean value of 7.8 indicating the general alkaline tendency of waters. The higher pH values may be attributed to the carbonates/ bicarbonates and higher photosynthetic activities. Both the higher and lower values of pH of Wyra lake were found at Reddygudem while its higher (8.4) was noticed at Palair and the lower one (7.1) was at Annarigudem and Thummalagudem. Locality-wise the lower mean value (7.3) was noticed at Siddikhnagar of Wyra lake and Narasimhulugudem of Palair lake (7.7). Its higher mean values (7.8 and 8.0) were observed respectively at Reddigudem/

Brahmanapalli of Wyra and Neredvai of Palair. The **electric conductivity** was observed with a range of 360-700 micro siemens / cm and 350-940 with mean values 542 and 563 in Wyra and Palair lakes respectively. Locality wise the lower and higher mean valueS (290 & 660) of Wyra lake was noticed respectively at Narayanapuram and Siddikhnagar of Wyra lake where as it was 492 (lower) at Nayakangudem and 678 (higher) at Neredvai of Palair lake. The **turbidity** values of Wyra lake fluctuated between 5-184 NTU with mean value of 53, where as in Palair lake it was 1-120 with a mean value of 15. Locality wise the mean value was minimum (18) at Lallurugudem and maximum (82) at Siddikhnagar of Wyra lake where as its minimum (10.2) was at Palair and maximum (29.5) in Neredvai of Palair lake. Its higher values are known to affect the primary productivity by restricting the light penetration and photosynthesis. The **Dissolved Oxygen** (DO) profile revealed a variation between 1.0 and 8.0 with average value of 4.55 in Wyra while it was 1 to 5.4 with a mean value of 2.9 in Palair lake. The lower one (1.0) was observed at Singarayapalem

and the higher one was (8.0) at Mallavaram of Wyra lake where as it was Narasimhulugudem (1.5) and Palair (5.4) of Palair lake. Here the higher values of Dissolved Oxygen may be due to comparatively clear zones and increased photosynthetic activity by phytoplankton. In the case of Wyra lake **total alkalinity** has fluctuated between 145 (Lallapuram) and 485 mg/L (Singarayapalem) with an average of 272 when it was between 122 (Annarigudem) and 397 (Kotturu) at Palair lake with mean value of 183. The **chloride** content at different stations of Wyra lake it was 27- 110 with an average value of 64, while at Palair lake it was 24 to 105 with a mean value of 62. Locality-wise the minimal value (27) in Wyra lake was noticed its Wyra locality and the maximum 110 was observed in Reddigudem. Similarly, the lower one (24) was found at Neredvai and higher (105) at Annarigudem. The peak in chloride values may be related to evotranspiration and high evaporation due to the prevailing high temperature. The chloride content further indicates the presence of organic matter of animal origin. Lower chloride values in the water body were probably due to its distant location and natural elevation that gives protection from inflows of domestic wasters and cattle feeding. The values of **total hardness** varied between Wyra lake it was between 95 (Narayanapuram) - 245 mg /L (Singarayapalem) with a mean value of 149 where as it was 100 (Nayakangudem) to 320 (Neredvai) with the4 mean value of 148 in the case of Palair lake. The ranges of hardness values recorded were comparatively lesser in the case of Wyra lake, than the other, indicating the presence of other ions and therefore all excess hardness can be termed as **carbonate** hardness and bothe lake water may be classified as moderately hard to hard and indicate no physico-chemical deterioration. The **calcium** hardness in the case of Wyra lake it was between 21 – 88 (29) while it was 24-92 in Palair lake (mean 35). Higher concentration of calcium was observed was at Lallurugudem of Wyra lake in monsoon. and Neredvai of

Palair. In general, aquatic ecosystems receive excess of **nutrients** through untreated domestic sewage and agriculture run off. **Phosphate** acts as a limiting nutrient responsible for the process of eutrophication and leads to ultimate degradation of an aquatic ecosystem. During the course of study on Wyra lake it was 0.01 to 0.28mg/L with a mean of 0.86 and at Palair the range was 0.02- 1.45 with a mean value of 0.15 was observed. The minimal value was noticed at at Wyra locality of Wyra lake and several localities of Palair lake and the maximums were at Siddikhnagar and Narasimhulugudem of Wyra and Palair lakes respectively. The higher phosphate content indicate the loading in of domestic sewage and agricultural run off from the surrounding colonies and agricultural fields respectively. The **Nitrate** quantity of Wyra lake is ranged from 1.0 – 10.0 mg /L with a mean value of 3.27, but the minimum was found at Wyra locality and maximum was at Siddikhnagar of Wyra lake where as at Palair lake the range was 0.1 (several localities) to 3.39 mg/L (Narasimhulugudem) with a mean value of 0.4. The **silicate** values were more or less equal in both Wyra and Palair lakes with mean values respectively 10.5 and 9.4. High concentration of **sulphates** stimulates the action of sulphur reducing bacteria, which produce hydrogen sulphide, a gas highly toxic to fish life. Sulphates of Wyra lake water was observed from 16 – 97 mg /L with an average value of 39.1, and of Palair it was 29 - 87 mg/L with a mean value of 52. **Sodium** which can also be called as conservative metal, showed its variation in Wyra lake between 30 and 92 with a mean value of 61.3 while in the case of Palair it was between 27 and 108 with a mean value of 59.5. The quantity of **potassium** in Wyra lake was between 2.0 – 7.0 with a mean value of 3.1, where as it was from 1 to 6 with an average of 2.6. The minimal concentration of both the lakes were observed in several places, but the higher 7.0 and 6.0 mg/lit. were found at Siddikhnagar and Annarigudem of Wyra lake and Palair lake respectively.

**Table 2.** showing the ranges of physic-chemical parameters and its mean values in each locality

Localities	pH		EC		Turb.		DO		Total Alk.		Chloride		T.Hardness		Calcium		Phosphates		Nitrates		Silicates		Sulphates		Sodium		Potassium		
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
WYRA LAKE																													
Siddiknagar	7.2-7.6	7.3	580-510	660	15-170	82	2.2-5.5	4.5	180-500	328	44-93	64	100-160	137	21-50	32	0.03-0.28	0.21	2-10	4.9	5.7-28	12	34-97	53	64-90	73.4	3-7	4	
Lallapuram	7.3-7.7	7.6	520-700	603	12-128	56	2.5-5.5	3.7	145-310	249	43-65	57	140-200	157	21-40	27	0.04-0.13	0.7	3-8	4.8	3.3-22	11	16-46	32	46-92	69	3-5	3.5	
Wyra	7.1-7.9	7.5	420-590	507	6-61	27	1.3-6.0	4.1	170-235	248	27-88	54	140-255	184	21-53	32	0.01-0.12	0.06	1.0-6.2	3.1	5.2-14	9	19-43	33	30-79	60	2-4	3.2	
Singarayapalem	7.1-7.9	7.6	490-620	513	15-184	54	1-6	4.3	230-485	318	43-73	54	125-245	171	25-50	32	0.03-0.1	0.06	2-3.15	2.8	5-16	8	25-42	34	38-68	58	2-3	2.2	
Lallurugudem	-	-	-	-	-	18	3.3-5.2	3.3	195-365	262	40-48	44	140-260	200	26-88	63	0.02-0.07	0.04	2-6	4.0	9-10	10	40-46	43	55-75	65	2-3	2.5	
Mallavaram	7.4-7.7	7.5	440-560	333	12-64	31	5-8	5.6	185-310	245	44-98	58	105-210	152	21-48	30	0.02-0.13	0.06	2-6	3.8	5-13	9.25	30-46	38	30-68	59	3-4	3.5	
Narayanaapuram	7.3-7.6	7.4	360-510	290	15-54	30	1.8-5.8	4.3	175-325	306	38-95	54	95-200	150	27-55	32	0.02-0.09	0.05	2-8	4.3	4-12	8.5	13-48	32	40-68	60	3-4	3.5	
Reddygudem	7.0-8.7	7.8	440-600	523	6-57	25	3.8-5.4	4.5	200-295	256	43-110	68	125-200	163	25-50	36	0.02-0.11	0.05	2-5	3.2	3-15	10	18-90	45	42-69	61.4	2-4	2.8	
Brahmanapalli	7.3-8.2	7.8	440-580	513	5-24	15.4	3.9-5.6	4.4	175-250	239	38-65	47	125-160	143	28-50	36	0.02-0.11	0.05	2-3	2.4	6-14	9.6	23-45	34	40-67	59	2-3.2	2.6	
PALAIR LAKE																													
Annariugudem	7.1-8.3	7.8	350-840	552	3-62	15	2.3-4.4	3.2	122-213	167	30-105	53	105-270	151	24-76	40	0.03-0.77	0.2	0.1-1.03	0.1	3.8-15	10	32-87	58	32-67	57	1-6	3	
Nayakangudem	7.5-8.3	7.8	360-590	492	2-28	8.3	2-4	2.8	128-189	154	30-55	44	100-165	133	26-32	30	0.02-0.15	0.1	0.1-0.67	0.4	3.8-15	8	30-60	52	36-69	52	1-3	2	
Palair	7.5-8.4	7.9	460-580	512	1-43	10.7	1.6-5.4	3.3	146-192	166	35-54	47	110-140	129	28-38	31	0.02-0.21	0.1	0.1-0.67	0.3	4.5-16	10	29-61	51	47-67	57	1-3	2	
Narasimhugudem	7.3-8.1	7.7	490-670	547	1-40	12.8	1.5-4.4	2.7	140-250	180	35-65	50	115-205	144	24-44	32	0.02-1.45	0.3	0.1-3.39	0.8	3.7-13	8	32-63	49	49-69	58	2-3	3	
Kotturu	7.4-8.3	7.8	380-850	555	1-25	10.2	2.0-4.8	2.9	134-397	204	32-52	47	105-265	148	28-52	36	0.03-0.22	0.1	0.1-0.9	0.4	3.4-12	8	26-65	45	38-73	58	1-4	3	
Erragadda Thanda	7.4-8.3	7.9	480-590	520	2-33	12.4	1.8-4.8	3	134-183	162	38-75	53	115-160	131	28-36	32	0.03-0.21	0.1	0.1-0.5	0.3	4.4-16	10	36-66	50	38-69	58	1-3	2	
Neredvai	7.6-8.3	8	530-890	678	3-120	29.5	1.8-3.8	2.3	128-311	210	24-90	60	110-320	181	24-92	40	0.02-0.29	0.1	0.1-1.12	0.6	4-20	10	38-79	61	27-99	64	1-4	3	
Thummalagudem	7.1-8.2	7.8	500-940	650	4-50	21.3	1.8-4.2	2.7	159-354	223	47-74	61	120-235	167	24-56	36	0.02-0.5	0.2	0.1-1.35	0.6	4-16	11	30-65	52	49-108	72	1-5	3	

I – Ranges, II – Mean values [EC is expressed in micro mhos/cm and all the other values are in mg/L except pH]

**BIOTIC PROFILE**

While going through the rotatorian and cladoceran diversity of the two tributaries, the following results have been observed.

**Table 3.** Showing the occurrence of Zooplankton communities (Rotifera and Cladocera) :

S. No.	Species	Wyra Lake	Palair Lake
<b>ROTIFERA</b>			
1	<i>Brachionus angularis</i> (Gosse,1851)	-	+
2	<i>B. calyciflorus</i> var. <i>dorcas</i> Gosse, 1851	+	+
3	<i>B. calyciflorus</i> var. <i>hymani</i> Dhanapathi, 1974	+	+
4	<i>B. caudatus</i> Barrois, 1894	+	+
5	<i>B. diversicornis</i> (Daday, 1883)	+	+
6	<i>B. durgae</i> Dhanapathi, 1974	-	+
7	<i>B. falcatus</i> Zacharias, 1898	+	+
8	<i>B. forficula</i> Wierzeski, 1898	+	+
9	<i>B. patulus</i> (Muller, 1786)	+	-
10	<i>B. quadridentatus</i> Hermann, 1783	+	+
11	<i>Keratella tropica</i> Apstein, 1907	+	+
12	<i>Platylas quadricornis</i> (Ehrenberg, 1832)	-	+
13	<i>Euchlanis dilate</i> Ehrenberg, 1832	-	+
14	<i>Mytilina ventralis</i> Ehrenberg, 1832	+	+
15	<i>Macrochaetus sericus</i> Thorpe, 1893	+	-
16	<i>Lepadella ovalis</i> (Muller, 1786)	+	-
17	<i>Lecane (Monostyla) bulla</i> (Gosse, 1851)	+	+
18	<i>L. (M) clostocerca</i> (Schmarda, 1898)	+	+
19	<i>L. (M) eswari</i> Dhanapathi 1976	-	+
20	<i>L. (M.) obtuse</i> (Murray, 1851)	+	-
21	<i>L. (M) papuana</i> (Murray, 1913)	-	+
22	<i>L. (M) tethis</i> Harring & Myers, 1921	+	-
23	<i>Lecane (Lecane) curvicornis</i> (Murray, 1913)	+	-
24	<i>L. (L) leotina</i> (Turner, 1892)	+	+
25	<i>L. (L) luna</i> (Muller, 1776)	-	+
26	<i>Cephalodella forficula</i> (Ehrenberg, 1832)	+	-
27	<i>C. hiulca</i> Myers, 1924	-	+
28	<i>Scaridium longicaudum</i> (Muller, 1786)	+	-

Table 3. contd.

29	<i>Filinia longiseta</i> Ehrenberg, 1834	-	+
30	<i>F. opeliensis</i> (Zacharias, 1898)	-	+
31	<i>F. pejleri</i> Hurchinson, 1964	+	+
32	<i>Testudinella patina</i> (Hermann, 1783)	+	-
33	<i>T. mucronata</i> (Gosse, 1786)	+	+
34	<i>Trichocerca rattus</i> (Muller, 1776)	-	+
<b>CLADOCERA</b>			
1	<i>Pseudosida bidentata</i> Herrick, 1884	-	+
2	<i>Diaphanosoma sarsi</i> Richard, 1895	+	-
3	<i>D. excism</i> Sars, 1885	-	+
4	<i>Ceriodaphnia cornuta</i> Sars, 1885	+	+
5	<i>Scapheloberis kingi</i> Sars, 1903	+	-
6	<i>Moina micrura</i> Kurz, 1874	-	+
7	<i>M. brachiata</i> (Jurine, 1820)	-	+
8	<i>Macrothrix spinosa</i> King, King, 1853	+	+
9	<i>M. laticornis</i> (Jurine, 1820)	+	-
10	<i>Echinisca triserialis</i>	+	-
11	<i>Chydorus sphaericus</i> (Muller, 1776)	+	+
12	<i>C. barroisi</i> Richard, 1894	+	+
13	<i>C. ventricosus</i> Daday, 1898	+	-
14	<i>Alona rectangula rectangula</i> Sars, 1862	+	+
15	<i>A. rectangula richardi</i> (Stingelin, 1895)	+	-
16	<i>A. davidi davidi</i> Richard, 1895	+	-
17	<i>A. davidi punctata</i> (Daday, 1898)	+	+
18	<i>A. pulchella</i> King, 1853	+	+
19	<i>Ilyocryptus spinifer</i> Herrick, 1882	+	-
20	<i>Camptocercus rectirostris</i> Schoedler, 1862	+	+

Detailed studies have been carried out on the diverse rotifer and cladoceran faunal assemblage in Wyra lake and Palair lake during the study periods and given in a Table -4 wherein the occurrences of the species of these two groups were compared. The shallow littoral regions and also near by limnetic zones play a host to a wide variety of the two zooplankton communities

under study viz., Rotifera and Cladocera. Rotifera (34 species) ranked one in order of abundance followed by cladocerans (20 species) in both the lakes. There are 34 species belonging to 13 genera of Rotifera and 20 species belonging to 11 genera in both the lakes. In Wyra lake 20 species belonging to 10 genera of rotifers and 16 species belonging to 9 genera of cladocera were

noticed where as in the case of Palair lake it was 25 species belonging to 16 genera spread over 8 families in 2 orders of rotifers and 12 species belonging to 8 genera in 5 families of Cladocera were observed. There are also 14 species of Rotifers and 8 species of cladocerans that are commonly available in both the lakes. Nine species of rotifers 8 of cladocera are exclusively available in Wyra lake while 11 species of Rotifera and 4 of Cladocera are exclusively available in Palair lake. It is showing their uniqueness and its adaption to the water quality of these two water bodies.

As is quite obvious from the above results that these two impoundments differed significantly in their limnological attributes and these two can be categorized as oligotrophic lakes but it is slightly getting polluted. In general, these two lake waters showed seasonality in most of the physico-chemical factors which mainly depend on the monsoon *i.e.*, insufficient rains or heavy rains in the preceding periods. The physico-chemical parameters of both the lakes are also indicating that these two are clean waters, but abnormal values of the nutrients indicate that these are slightly polluted and the reason can be attributed to agricultural run off or anthropogenic activities. Both the lakes were characterized by highly alkaline, soft to hard, moderate turbidity and the chloride content of these two water bodies are indicating their potability.

Among the physical parameters, pH of both the water bodies is more or less equal while Electric Conductivity is slightly at higher side in Palair lake while the turbidity is at Wyra lake. Among the chemical factors, DO, Total Alkalinity Nitrates, Sulphates are comparatively at higher side in Wyra lake whereas the rest of the parameters are either to some extent more or profoundly more in Palair lake. The reasons for the variations in the

levels of ranges of physico-chemical parameters of both the lakes, can be attributed to the differences in the quantum of rain fall, domestic sewage that is letting into the water bodies, agricultural run off, anthropogenic activities at the lake basins... *etc.*, during the study periods. The authors intends to concludes that not much variation is involved in these two tributaries with minor exceptions both biotic and abiotic factors, but the quantum of nutrient and light metals indicate that these two are slightly getting polluted and the reason may be attributed to either agricultural run off or anthropogenic factors.

### SUMMARY

Studies on the comparative study on physico-chemical and biological characteristics with special reference to Rotifera and Cladocera of two deccan wetlands *viz.*, Wyra and Palair lakes which are the tributaries of Krishna river located in Khammam District of Telangana state during 2006-2007 and 2009-10 respectively. These studies were conducted on seasonal basis *i.e.*, winter, summer and monsoon during the periods. The studies have indicated that, not much variation is involved in these two tributaries with minor exceptions in both biotic and abiotic factors, but the quantum of nutrient and light metals indicate that these two are getting slightly polluted and the reason may be attributed to either agricultural run off or anthropogenic factors. The studies on biotic factors revealed the presence of 34 species of rotatorians and twenty of cladocerans.

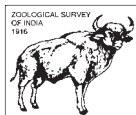
### ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India (Z.S.I.), Kolkata and Officer-in-Charge, Hyderabad and for extending facilities in writing this paper.

### REFERENCES

- Anitha, G., S.V.A. Chandrasekhar and M.S. Kodarkar (2005) Hydrography in relation to benthic Macro-invertebrates in Mir Alam Lake, Hyderabad, Andhra Pradesh. *Rec. zool. Surv. India* Occ. Paper No. 235.
- Chandrasekhar, S.V.A. (1996) Ecological studies on Saroornagar lake, Hyderabad. *Ph.D. Thesis*, Osmania University, Hyderabad.

- Chandrasekhar, S.V.A and C.A. Nageswara Rao 2006 Introduction and Limnology : Pocharam lake, Andhra Pradesh. *Zoological Survey of India* publ., *Wetland Ecosystem Series*, **13**: 29–36.
- Chandrasekhar, S.V.A 2006 Zooplankton : Pocharam lake, Andhra Pradesh. *Zoological Survey of India* publ., *Wetland Ecosystem Series*, **13**: 1-28.
- Jaya Devi M. (1985) Ecological studies of Limnoplankton of three fresh water bodies of Hyderabad *Ph. D. thesis*. Osmania University, Hyderabad.
- Munawar. M. (1970) Limnological studies on freshwater ponds of Hyderabad I. The biotope. *Hydrobiologia*, **25**(1): 127-162.
- Patil, S.G. and P. Panda (2003) Limnological Studies of a Freshwater Fish Tank, Bibi Nagar tank Part–I. Abiotic factors. *Rec. zool. Surv. India*, **96**(1-4): 173-178.
- Ratna Rao. (1984) Studies on limnological aspects of lake Kondakarla ((Visakhapatnam) with special reference to plankton and perphyton. *Ph.D. Thesis* Andhra University, Visakhapatnam.
- Siddiqi. S.Z. and R.A. Khan 2002 Comparative Limnology of few-man-made lakes in and around Hyderabad, India. *Rec. zool. Surv. India, Occ. Paper No. 203*: 1-64
- Venkateswarlu, V. (1969) An ecological study of algae of Musi, Hyderabad with special reference to water Pollution II factors including distribution of algae *Hydrobiologia*, **33**(3-4): 352-363.
- Venu. P. (1981) A Limnological aspects of lake Kondakarla. *Ph.D Thesis*, Andhra University, Visakhapatnam.
- Zafar A.R. (1966) Limnology of Hussainsagar lake of Hyderabad. *Phykos*, **5**(1&2): 115-126.



## ORTHOPTERA: INSECTA OF CHANDIGARH (UT) AND SURROUNDING AREAS

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### INTRODUCTION

Grasshoppers species vary in densities and dominance depending on the soil, vegetation, topography and use of a habitat. Grasshopper infestations or assemblages consist of the individuals of several species that live together in the same habitat of competing for available food and space. Grass feeding species of grasshoppers are the most numerous in the present study. Approximately 20,000 species are known from the world and are nearly 10% are known from India (Tandon & Hazra, 1998). Shishodia *et al.*, 2010 studied the 1033 species of Orthoptera from India out of approximately 24,000 species from World. The well-planned town of Chandigarh (altitude 347 m asl) is located between longitude 76°43' and 76°51'E, and between latitude 30°40' and 30°47'N at the base of the Shiwalik range of the Himalaya. It is sandwiched between the states of Punjab and Haryana. Sukhna lake bounds it in the east, while Patiali Rao rivulet lies on its western border. The Union Territory of Chandigarh also includes low Shiwalik hills in the northern part of the city. These Shiwalik hills comprise the catchments of manmade Sukhna Lake, formed by the impoundment of Sukhna Choe.

The city of Chandigarh is bestowed with a wide variety of ecological niches like thick forests of Shiwaliks, Sukhna wetland, ornamental trees, orchards, soil binding weeds and grasses, and ponds around. The Union Territory of Chandigarh

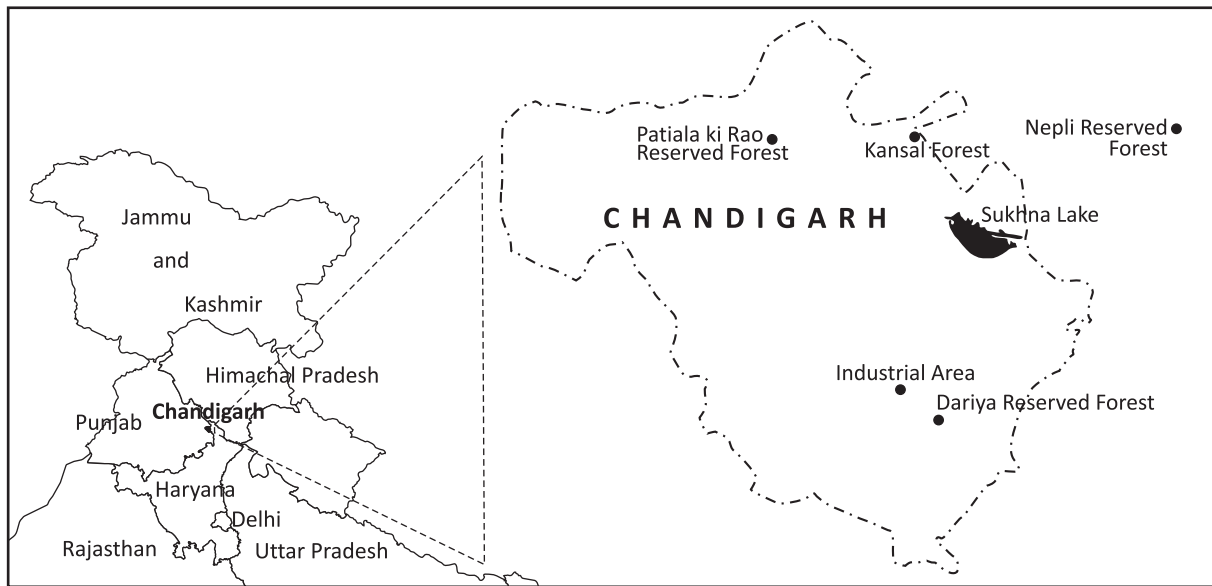
falls under hot and dry foothill bioclimatic zone (Duggal, 1968). The area enjoys a semi-arid monsoon type of climate, characterized by three seasons, namely winter, summer and rainy. The climate remains dry for 7 months, sub humid in October, humid in January and per humid in July to September. Total normal annual rainfall is about 1,000 mm. Most of the rainfall occurs during the monsoon season from July to September.

Orthopterans are important pests of some crops, vegetables and forests and cause considerable damage. The studies on this group of insect dates back to Serville (1831) and gained importance with the further contributions of Kirby (1914), Uvarov (1927) Chopard (1969), Tandon(1976), Bhowmik and Halder (1983), Bhowmik (1985) and Shishodia *et al.*, 2010.

### MATERIALS AND METHODS

Twelve extensive (7-12 days each) and intensive (1-2days) surveys were undertaken from time to time representing different seasons covering various localities (Map 1) and ecological niches as follows: Northern side which is part of Shiwalik hills, with forests and typical hill streams in Kansal, Nepli and feeders of Sukhna lake. Eastern side of Sukhna lake, Southwest overflow drain and waste water drain upto Zirakpur.

The present study is based on the collection of Orthoptera brought by various survey parties of Zoological Survey of India, Solan, India.



**Map-1** Showing the collection localities in Chandigarh (UT) & surrounding area.

Specimens are generally killed in killing bottle. After killing the specimens are removed from the bottle within half an hour or so to avoid damage to coloration and are kept in paper envelopes. Some soft body specimens are preserved in 90 % ethyl alcohol. The collection brought from the field has to be made ready for pinning and permanent storage in National Zoological Collection. Classification followed here is after Drish (1965) and Uvarov

(1966). Bhowmik (1985) is also a useful guide for family Acrididae.

## RESULTS

The present paper enumerates 58 species (Table-1) of Orthoptera from the area. All material studied here in under are deposited in the National collection of the Zoological Survey of India, Solan.

**Table 1.** Represents the species with % relative abundance

S. No.	Species	% Relative Abundance
1	<i>Acrida exaltata</i> (Walker, 1859: 222)	9.88
2	<i>Phlaeoba infumata</i> Brunner von Wattenwyl, 1893: 124	4.06
3	<i>Phlaeoba panteli</i> Boliver, 1902: 581.	1.74
4	<i>Ceracris nigricornis nigricornis</i> Walker, 1870: 791.	4.65
5	<i>Trilophidia annulata</i> (Thunberg, 1815: 234)	1.74
6	<i>Pusana leavis</i> (Uvarov, 1921: 491)	13.95
7	<i>Oedaleus abruptus</i> (Thunberg, 1815: 233)	1.74
8	<i>Gastrimargus africanus africanus</i> (Saussure, 1888:39)	1.16
9	<i>Gastrimargus marmoratus</i> (Thunberg,1815:232)	1.74
10	<i>Acrotylus humbertianus</i> Saussure, 1884:189	0.58
11	<i>Acrotylus insupircus inficita</i> (Walker, 1870:742)	0.58
12	<i>Scintharista notables blachardiana</i> (Saussure, 1888:35)	1.74
13	<i>Gonista sagitita</i> (Uvarov, 1912:10)	0.58

Table 1. contd.

S. No.	Species	% Relative Abundance
14	<i>Mesopsis cylindricus</i> (Kirby, 1914: 101)	0.58
15	<i>Aulacobothrus socius</i> Boliver, 1902 :599	0.58
16	<i>Aulacobothrus luteipes luteipes</i> (Walker, 1871 :82)	1.16
17	<i>Aulacobothrus sinensis</i> (Uvarov, 1925 :318)	0.58
18	<i>Gelastorhinus laticornis</i> (Serville,1838: 590)	0.58
19	<i>Spathosternum prasiniferum prasiniferum</i> (Walker, 1871 :65)	1.74
20	<i>Hieroglyphus banian</i> (Fabricius, 1798 :194)	3.48
21	<i>Hieroglyphus concolor</i> (Walker, 1870 :646)	1.16
22	<i>Oxya hyla hyla</i> Serville, 1831 :287	6.39
23	<i>Oxya fuscovittata</i> (Marschall, 1836 :211)	2.9
24	<i>Eyprepocnemis alacris alacris</i> (Serville, 1839 :682)	1.16
25	<i>Eyprepocnemis roseus</i> Uvarov, 1942 : 597	0.58
26	<i>Tylotropidius varicornis</i> (Walker, 1870 :667)	1.16
27	<i>Xenocatantops humilis humilis</i> (Serville, 1839 :662)	1.16
28	<i>Pachyacris vinosa</i> (Walker, 1870: 587)	1.16
29	<i>Choroedocus illustris</i> (Walker, 1870 :663)	0.58
30	<i>Diaboloecatantops innotabilis</i> (Walker, 1870 :629)	2.9
31	<i>Aularches miliaris miliaris</i> (Linnaeus, 1758:432)	1.16
32	<i>Atractomorpha crenulata</i> (Fabricius, 1793: 28)	1.74
33	<i>Chrotogonus tr. trachypterus</i> (Blanchard, 1836:618)	3.48
34	<i>Poecillocerus pictus</i> (Fabricius, 1775 :289)	0.58
35	<i>Hedotettix costatus</i> Hancock, 1912: 147	0.58
36	<i>Hedotettix gracilis</i> (Haan, 1842:169)	1.74
37	<i>Ergatettix dorsiferus</i> (Walker, 1871 :825)	0.58
38	<i>Ergatettix guenthari</i> Steinmann, 1970 :234	1.16
39	<i>Euparatettix histricus</i> Stal, 1861 : 347	0.58
40	<i>Gryllotalpa africana</i> Beauvois, 1805 :229	0.58
41	<i>Loxoblemmus detectus</i> (Servile, 1838:356)	1.16
42	<i>Gryllus bimaculatus</i> De Geer, 1773 :521	0.58
43	<i>Acheta domesticus</i> (Linnaeus, 1758 :428)	1.16
44	<i>Plebeigryllus gutteventris gutteventris</i> (Walker, 1871 :6)	1.74
45	<i>Teleogryllus(Macroteleogryllus) mitratus</i> (Burmeister, 1838 :34)	1.74
46	<i>Teleogryllus (Brachyteleogryllus) occipitalis</i> (Serville, 1838 :339)	0.58
47	<i>Turanogryllus histrio</i> (Saussure, 1877:229)	0.58
48	<i>Dianemobius fascipes</i> (Walker, 1869 :67)	1.16

Table 1. contd.

S. No.	Species	% Relative Abundance
49	<i>Dianemobius csikii</i> (Boliver, 1901:248)	0.58
50	<i>Meloimorpha cincticornis</i> (Walker, 1870 :469)	0.58
51	<i>Euscyrthus hemelytrus</i> (Hann, 1842 :231)	0.58
52	<i>Trigonidium humvertianum</i> (Saussure, 1878 :468)	0.58
53	<i>Letana megastridula</i> Ingrisch, 1990 :258	0.58
54	<i>Letana linearis</i> Walker, 1869 :278	0.58
55	<i>Elimaea securigera</i> Brunner von Wattenwyl, 1878 :93	0.58
56	<i>Isopsera pedunculata</i> Brunner von Wattenwyl, 1878 :220	0.58
57	<i>Sathrophyllia femorata</i> (Fabricius, 1787 :233)	0.58
58	<i>Mecopoda elongate elongate</i> (Linnaeus, 1758 :429)	1.74

**SYSTEMATIC LIST**

Order ORTHOPTERA

Sub order CAELIFERA

Infraorder ACRIDIDEA

Super Family ACRIDOIDEA

Macleay, 1821: 2.

Family ACRIDIDAE Macleay, 1821: 2.

Sub family ACRIDINAE Macleay, 1821: 2.

Genus *Acrida* Linnaeus, 1758: 427.1. *Acrida exaltata* (Walker, 1859: 222)1859. *Truxalis exaltata* Walker, F. *Ann. Mag. nat. Hist.*, **34**: 2222008. *Acrida exaltata* Ganguly, Malakar, Anand, S. Das & Haldar. *Jour. Orth. Res.*, **17**(1): 972010. *Acrida exaltata* Azim & Reshi. *Acta Zool. Mex. (n.s.)* **26**(1): 2202012. *Acrida exaltata* Nayeem & Usmani. *Munis Entomology & Zoology*, **7**(1): 404

*Material examined:* 1♂, Patiali Rao Reserve Forest, 27.VIII.2000, M.L. Thakur. 2♂, 3♀, Daryuia Forest, Nr. Ind. Area, 04.X.2001; 4♂, 2♀, 3♂, Kansal forest, 12.IX.2000; 1♂, Patiali Rao Reserve Forest, Nepali forest, 5.IV.2000, T.R. Sharma, 1♂, Nepali forest, 26.VI.2000, Dr. H.S. Mehta.

*Distribution:* India: Andaman & Nicobar Islands, Arunachal Pradesh, Andhra Pradesh,

Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujrat, Haryana, Jammu & Kashmir, Kerala, Maharashtra, Manipur, Meghalaya, Nagaland, Madhya Pradesh, Orissa, Rajasthan, Sikkim, Tamilnadu, Tripura, Uttarakhand, Himachal Pradesh, Punjab, Uttar Pradesh, West Bengal. *Elsewhere:* Bangladesh, Pakistan, Srilanka, South East Tibet, Iran, Saudi Arabia, Yemen, Afghanistan, SE Persia, Arabia & West Aden.

Genus *Phlaeoba* Stal, 1860:360.2. *Phlaeoba infumata* Brunner von Wattenwyl, 1893: 124.1893. *Phlaeoba infumata* Brunner von Wattenwyl. *Ann. Mus. Civ. Stor. Nat. Genova*, **33**(2): 1242010. *Phlaeoba infumata* Tan, M.K. *Nature in Singapore*, **3**: 245, 249 (photo)2012. *Phlaeoba infumata* Tan, M.K., Ngiam & Ismail. *Nature in Singapore*, **5**: 662012. *Phlaeoba infumata* Nayeem & Usmani. *Munis Entomology & Zoology*, **7**(1): 405

*Material examined:* 2♀, Dayuia Forest, 04.X.2001; 1♀, 2♂, Kansal Forest, 12.IX.2000, M.S.Thakur 1♂, Patiali Rao Reserve Forest, 27.VIII.2000, M.S. Thakur, 1♂, 1.X.2002 Kansal, M.S. Shishodia.

*Distribution:* India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Mizoram, Tripura, Meghalaya, Manipur, Madhya Pradesh, Nagaland, Orissa, Himachal

Pradesh, Panjab, Rajasthan, Sikkim, Tamil Nadu, Tripura Uttar Pradesh, West Bengal. *Elsewhere*: Bangladesh, East Nepal, Borneo, China, Hainan Island, Malaya Peninsula, Myanmar, Penang, Sumatra, Thailand, Taiwan, Yunnan.

3. *Phlaeoba panteli* Boliver, 1902: 581.

1902. *Phlaeoba panteli* Bolivar, I. *Annla. Soc. Ent. Fr.*, **70**: 581  
 1986. *Phlaeoba panteli*, Bhowmik. *Zool. Surv. India, Tech. Monogr.*, **14**: 41  
 1995. *Phlaeoba panteli* Otte, D. *Orthoptera Species File.*, **5**: 263  
 2007. *Phlaeoba panteli* Chandra *et al.*, *Zool. Print Journal*, **22**(5): 2685

*Material examined*: 1 ♀, 1 ♂ Kansal Forest, 12.IX.2001; 1 ♂, Patiali Rao Reserve Forest, 27.VIII.2000, M.S.Thakur

*Distribution*: India: Andhra Pradesh, Arunachal Pradesh, Bihar, Himachal Pradesh, Madhya Pradesh, Manipur, Meghalaya, Tripura, Uttarakhand, Tamil Nadu, West Bengal, Punjab. *Elsewhere*: Afghanistan

**Subfamily: Oedipodinae** Walker, 1871: 102.

Genus *Ceracris* Walker, 1870: 790;  
 Uvarov, 1925: 11.

4. *Ceracris nigricornis nigricornis*  
 Walker, 1870: 791.

1870. *Ceracris nigricornis* Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, **4**: 791  
 1914. *Ceracris nigricornis* Kirby, W.F. *Fauna of British India, including Ceylon and Burma. Orthoptera (Acrididae)* 110  
 1998. *Ceracris nigricornis nigricornis* Jiang, G. & Z. Zheng. *Grasshoppers and Locusts from Guangxi*, 219  
 2001. *Ceracris nigricornis nigricornis* Ingrisch & Garai. *Esperiana*, **8**: 763

*Material examined*: 1 ♀, 1 ♂ Forest rest house Chandigarh, 04.X.2001; 2 ♀, 1 ♂, Kansal Forest, 12.IX.2000, M.L.Thakur, 1 ♀, Patiali Rao Reserve Forest, Nepali forest, 27.VIII.2000, M.S. Thakur, 2 ♀, Kansal forest, 13.IX.2000, M.S. Thakur.

*Distribution*: India: Arunachal Pradesh, Assam, Bihar, Haryana, Maharashtra, Manipur, Meghalaya,

Nagaland, Sikkim, Uttarakhand, Tamil Nadu, Himachal Pradesh, Panjab, Uttar Pradesh, West Bengal. *Elsewhere*: Afghanistan, South China, Myanmar, Taiwan, Thailand, Vietnam.

Genus *Trilophidia* Stal, 1873: 117, 131.

5. *Trilophidia annulata* (Thunberg, 1815: 234)

1815. *Gryllus annulatus* Thunberg. *Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg*, **5**: 234.  
 1986. *Trilophidia annulata*, Bhowmik. *Zool. Surv. India, Tech. Monogr.*, **14**:79  
 2005. *Trilophidia annulata* Kim, T.W. & J.I. Kim. *Entomological Research (Seoul)*, **35**(2): 90.  
 2008. *Trilophidia annulata*, Shishodia, *Faunal Diversity of Jabalpur district, M.P., (Zool. Surv. India)*: 98

*Material examined*: 1 ♂, Daryua Forest, 04.X.2001; 1 ♂, 1 ♀, Patiali Rao Reserve Forest, (SWLS), 05.IV.2000 T.R. Sharma

*Distribution*: India: Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Himachal Pradesh, J&K, Kerala, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Rajasthan, Tamilnadu, Sikkim, Tripura, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Bangladesh, Bangladesh, Borneo, Hong Kong, China, Japan, Jawa, Korea, Malaya, Mangolia, Myanmar, Nepal, Philippines, Pakistan, Malayasia, Singa Pore, Sri Lanka, Sumatra, Taiwan, Thailand & Vietnam.

Genus *Pusana*, Uvarov, 1940: 117.

6. *Pusana laevis* (Uvarov, 1921: 491)

1921. *Pusa laevis* Uvarov. *Annals and Magazine of Natural History, London*, **7**(9): 491  
 1984. *Pusana laevis*, Bhowmik *et al.*, *Bulletin of the Zoological Survey of India*, **6**(1-3): 319  
 2007. *Pusana laevis*, Saini & Mehta, *Bionotes*, **9**(3): 76.

*Material examined*: 4 ♂, 13 ♀, 9.II.2002, Nepali Forest; 1 ♀, 13.II.2002, Dhanas, T.R.Sharma, 3 ♀, 3 ♂, Kansal forest, 1.X.2002, Dr. H.S. Mehta.

*Distribution*: India: Bihar, Himachal Pradesh, Sikkim. *Elsewhere*: Bangladesh.

Genus *Oedaleus* Fieber, 1853 : 126.

7. *Oedaleus abruptus* (Thunberg, 1815: 233)

1815. *Gryllus abruptus* Thunberg. *Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg*, **5**:233.

2005. *Oedaleus abruptus*, Kulkarni & Shishodia, *Conservation Area Series*, **24**: Fauna of Melghat Tiger Reserve, *Zool. Surv. India*, : 332

2007. *Oedaleus abriptus*, Chandra et al., *Zoos Print Journal*, **22**(5): 2685

*Material examined*: 2♂, 1♀, Forest Near Industrial Area Chandigarh, 04.X.2001, H.S. Mehta.

*Distribution*: India: Andhra Pradesh, Arunachal Pradesh, Bihar, Chhattisgarh, Chandigarh, Delhi, Goa, Himachal Pradesh, Haryana, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Orissa, Pondicherry, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. *Elsewhere*: Afghanistan, Bangladesh, Burma, China, Hawaiian Islands, Pakistan, Sri Lanka, Thailand, Nepal, Taiwan & Vietnam.

Genus *Gastrimargus* Saussure, 1884 : 109-110

#### 8. *Gastrimargus africanus africanus*

(Saussure, 1888 : 39)

1888. *Oedaleus (Gastrimargus) marmoratus africana* Saussure, *Mem. Soc. Phys. Hist. Nat. Geneve*, **30**(1): 39

1970. *Gastrimargus africanus* Rowell. *Anti-locust Bulletin*, London, **47**: 48 pp.

2001. *Gastrimargus africanus*, Ingrisch & Garai. *Esperiana*, Schwanfeld, **8**: 763

2004. *Gastrimargus africanus africanus* Baccetti. *Redia.*, **86**: 32.

2008. *Gastrimargus africanus africanus*, Gupta et al., *Natl. J. Life Sci.*, **5**(1): 121

*Material examined*: 1♀, 1♂. Forest rest house Chandigarh, 04.X.2001; 2♂, 1♀, Forest rest house Chandigarh, 27.VIII.2000 M.S. Thakur.

*Distribution*: India: Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Chandigarh, Delhi, Goa, Himachal Pradesh, J&K, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal *Elsewhere*: Africa, Myanmar, Comoro Island, Myanmar, Nepal, Pakistan, Saudi Arabia, Sri Lanka, Thailand, Tibet, Yaman.

#### 9. *Gastrimargus marmoratus*

(Thunberg, 1815 : 232)

1815. *Gryllus marmoratus*, Thunberg, *Mem. Acad. Sci. St. Petersb.*, **5**: 232.

2005. *Gastrimargus marmoratus*, Kim, T.W. & J.I. Kim, *Entomological Research (Seoul)*, **35**(2): 89.

2007. *Gastrimargus marmoratus*, Saini & Mehta, *Bionotes*, **9**(3): 76

*Material examined*: 2♀, 1♂. Nepli Forest, Chandigarh., 26.VI.2000, H.S.Mehta

*Distribution*: India: Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, west Bengal. *Elsewhere*: Bangladesh, Borneo, Celebes, China, Japan, Hong Kong, Java, Korea, Lombok, Malaysia, Myanmar, Nepal, New Guinea, Philipines, Sulawesi, Sumatra, Taiwan, Thailand & Vietnam.

Genus *Acrotylus* Fieber, 1853: 125.

#### 10. *Acrotylus humbertianus*

Saussure, 1884:189.

1884. *Acrotylus humbertianus* Saussure, *Mem. Soc. Phys. Hist. Nat. Geneve*, **28**(9): 189

2007. *Acrotylus humbertianus*, Chandra, et al., *Zoos' Print Journal*, **22**(5): 2685

*Material examined*: 1♂, Nepli Forest, Chandigarh. 04. X.2001 H.S. Mehta

*Distribution*: India: Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Haryana, Goa, Lakshadweep Island, Tamil Nadu, Himachal Pradesh, Madhya Pradesh, Maharashtra, Punjab, Tripura, Rajasthan, Uttar Pradesh, and West Bengal. *Elsewhere*: Sri Lanka, Nepal, Bangladesh, Pakistan, Afghanistan

#### 11. *Acrotylus insupircus inficita*

(Walker, 1870:742)

1870. *Oedipoda inficita* Walker, *Cat. Derm. Salt. Brit. Mus.*, **4**: 742

1914. *Acrotylus inficita*, Kirby, *Fauna Brit. India, Orth.*, 152

1993. *Acrotylus insubricus inficita*, Hazra et al., *State Fauna series*, **3**: Fauna of West Bengal Part 4, *Zool. Surv. India*, :301

*Material examined:* 1♂, Kishan Garh, 24.I.2002, Santosh Thakur

*Distribution:* India: Himachal Pradesh, Orissa & West Bengal. *Elsewhere:* Afghanistan, Srilanka, Africa, Central Asia, Russia.

Genus *Scintharista* Saussure, 1884: 121.

12. *Scintharista notabiles blachardiana* (Saussure, 1888:35)

1888. *Quiroguesia brullei blanchardiana* Saussure. *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, **30**(1): 35.

1910. *Quiroguesia blanchardiana* Kirby, W.F. *Synonymic Catalogue of Orthoptera (Orthoptera Saltatoria, Locustidae vel Acridiidae)*, **3**(2): 217.

1999. *Scintharista Blachardiana* Ingrisch. *Esperiana, Schwanfeld*, **7**: 356.

*Material examined:* 2♂, 1♀, Kansal Forest, 13.IX.2000, M.L.Thakur

*Distribution:* India: Himachal Pradesh and Maharashtra. *Elsewhere:* Aden, Arabia, Palestine and Somalia.

Subfamily GOMPHOCERINAE  
Fieber, 1853: 90-104

Genus *Gonista* Bolivar, 1898: 92.

13. *Gonista sagittata* (Uvarov, 1912:10)

1912. *Gelastorhinus sagitta* Uvarov. *Horae Soc. Ent. Ross., St. Petersburg*, **40**(3): 10

1992. *Gonista sagittata*, Shrinivasan & Murlirangan, *Hexapoda*, **4**(1): 15

2003. *Gonista sagittata*, Shishodia *et al.*, State Fauna Series, **9** Fauna of Sikkim, Part 2 *Zool. Surv. India*,: 180

2007. *Gonista sagittata*, Saini & Mehta, *Bionotes*, **9**(3): 76.

*Material examined:* 1♀, Kansal forest, 1.X.2002, H.S. Mehta.

*Distribution:* India: Andhra Pradesh, Himachal Pradesh, Karnataka, Manipur, Sikkim & Tamil Nadu. *Elsewhere:* Afganistan, Northern Iran, Srilanka, Myanmar.

Genus *Mesopsis* Bolivar, 1906: 392;  
Jago, 1971: 236

14. *Mesopsis cylindricus* (Kirby, 1914: 101)

1914. *Aswatthamanus cylindricus* Kirby, W.F. *Fauna of British India, including Ceylon and Burma. Orthoptera (Acrididae)*, 101

1971. *Mesopsis cylindricus* Jago. *Proceedings of the Academy of Natural Sciences, Philadelphia*. **123**(8): 237.

2007. *Mesopsis cylindricus*, Mandal & Yadav, *State Fauna Series, 5: Fauna of Andhra Pradesh, Part 3, Zool Surv. India*,: 196.

*Material examined:* 1♂, Kishangarh, Chandigarh. 24.I.2002, Santosh Thakur.

*Distribution:* India: Andhra Pradesh, Arunachal Pradesh, Bihar, Madhya Pradesh, Orisa, Punjab, Sikkim and West Bengal.

Genus *Aulacobothrus* Bolivar, 1902: 597

15. *Aulacobothrus socius* Boliver, 1902:599

1902. *Aulacobothrus socius* Bolivar, I. *Annales de la Société Entomologique France*. **70**: 599.

1993. *Aulacobothrus socius* Ingrisch *Entomologica Scandinavica*. **24**(3): 331.

1996. *Aulacobothrus socius* Jago *Journal of Orthoptera Research*. **5**: 75.

2007. *Aulacobothrus socius*, Mandal & Yadav, *State Fauna Series, 5: Fauna of Andhra Pradesh, Part 3, Zool Surv. India*,: 193.

*Material examined:* 1♂. Daryua Forest, 04.X.2001. Santosh Thakur

*Distribution:* India: Andhra Pradesh, Arunachal Pradesh, Maharashtra, Himachal Pradesh, Karnataka, Orisa, Tamil Nadu and Haryana.

16. *Aulacobothrus luteipes luteipes* (Walker, 1871:82)

1871. *Stenobothrus luteipes* Walker, *Cat. Derm. Salt.Br. Mus.*, **5**: 82.

1971. *Dnopherula (Aulacobothrus) luteipes*: Jago, *Proc. Sci. Nat. Philad.*, **123**(8): 243.

2007. *Dnopherula (Aulacobothrus) luteipes* Mandal *et al.*, *Pictorial handbook on Indian short horned grasshopper pests (Acridoidea: Orthoptera) (Zool. Surv. India)*,: 37.

*Material examined:* 2♂, Kansal forest, 1.X.2002, Dr. H.S. Mehta.

*Distribution:* India: Andaman & Nicobar Island, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Himachal Pradesh, J&K, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orisa, Rajasthan, Sikkim, Tamil Nadu & West Bengal. *Elsewhere:* Bangladesh, Pakistan, Sri Lanka, Myanmar,

China, Japan, Europe, North America, Taiwan & Thailand.

17. *Aulacobothrus sinensis* (Uvarov, 1925:318)

1925. *Dnopherula sinensis* Uvarov. *Jour. Asiat. Soc. Bengal*, **20**(6): 318.

1996. *Aulacobothrus sinensis* Jago. *Journal of Orthoptera Research*, **5**: 69-124.

2007. *Aulacobothrus sinensis* Saini & Mehta, *Bionotes*, **9**(3): 76.

*Material examined*: 1 ♀, Kansal forest, 1.X.2002, Dr. H.S. Mehta.

*Distribution*: India: Himachal Pradesh. *Elsewhere*: Eastern Nepal, Yunnan, Myanmar, China.

Genus *Gelastorhinus* Brunner von Wattenwyl, 1893:137.

18. *Gelastorhinus laticornis*

(Serville, 1838: 590)

1838. *Opomala laticornis* Serville *Histoire naturelle des insectes. Orthoptères*, 590.

1910. *Gelastorhinus laticornis* Kirby, W.F. *Synonymic Catalogue of Orthoptera (Orthoptera Saltatoria, Locustidae vel Acridiidae)*, **3**(2): 409.

2009. *Gelastorhinus laticornis*, Gupta, *Bionotes*, **11**(1): 28.

*Material examined*: 1 ♂; Nepli forest. 04.X.2001; Santosh Thakur.

*Distribution*: India: Bihar, Chhattisgarh, Himachal Pradesh, Madhya Pradesh, Maharashtra, West Bengal. *Elsewhere*: Bangladesh.

Subfamily SPATHOSTERNINAE

Rehn, 1957: 93

Genus *Spathosternum* Krauss, 1877:44

19. *Spathosternum prasiniferum prasiniferum*

(Walker, 1871:65)

1871. *Heteracris prasinifera*; Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, **5**: 65.

1996. *Spathosternum prasiniferum*; Sharma, B. & Gupta, N. *Journal of Insect Science*, **9**(2): 156.

2006. *Spathosternum prasiniferum prasiniferum* Hsia et al., *Fauna Sinica, Insecta*, **43**: 179.

*Material examined*: 2 ♀, 1 ♂, Kansal Forest, 12.IX.2000, M.L. Thakur.

*Distribution*: India: Andaman & Nicobar Island, Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Sikkim, Rajasthan, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Burma, Bangladesh, Hainan, Myanmar, Nepal, Pakistan, South & East China, Sri Lanka, Thailand, Vietnam & West Malaysia.

Subfamily HEMIACRIDINAE

Drish, 1956: 121-272

Genus *Hieroglyphus* Krauss, 1877:41.

20. *Hieroglyphus banian*

(Fabricius, 1798:194)

1798. *Gryllus banian* Fabricius, *Supplementum Entomologiae Systematicae*: 194.

1986. *Hieroglyphus banian*, Bhowmik, *Zool. Surv. India, Tech. Monogr.*, **14**: 99.

1998. *Hieroglyphus banian* Jiang, G. & Z. Zheng. *Grasshoppers and Locusts from Guangxi*, 110.

2008. *Hieroglyphus banian*, Shishodia, *Faunal Diversity of Jabalpur district, MP.*, (*Zool. Surv. India*): 99.

*Material examined*: 2 ♂, 1 ♀, Nepli Forest, 05.X.2001; 2 ♀, Daryua Forest, Chandigarh. 04.X.2001; 1 ♀, Patiali Rao Reserve Forest (WLS), 27.VIII.2000 M.S. Thakur.

*Distribution*: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh & West Bengal, Tamil Nadu, Punjab, West Bengal. *Elsewhere*: Afghanistan, Bangladesh, Bhutan, Burma, China, Nepal, Thailand, Vietnam.

21. *Hieroglyphus concolor*

(Walker, 1870:646)

1870. *Oxya concolor* Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, **4**: 646.

1973. *Hieroglyphus concolor* Mason, J.B. *Bulletin of the British Museum (Natural History) Entomology*, **28**(7): 521 Lectotype.

2008. *Hieroglyphus concolor*, Shishodia, *Faunal Diversity of Jabalpur district, MP.*, (*Zool. Surv. India*): 99.

*Material examined:* 1♂, Daryua Forest, Chandigarh 04.X.01 Santosh Thakur 1♀, Nepli Forest, (WLS), 18.VIII.2000 M.S. Thakur.

*Distribution:* India: Assam, Delhi, Maharashtra, Himachal Pradesh, Madhya Pradesh, Sikkim, Punjab. *Elsewhere:* Bangladesh & China.

#### Subfamily OXYINAE

Brunner von Wattenwyl, 1893: 1-230.

Genus *Oxya* Serville. 1831:286; Usmani & Shafee, 1985: 311

#### 22. *Oxya hyla hyla* Serville, 1831:287

1831. *Oxya hyla* Serville. *Annales des Sciences Naturelles, Paris*, **22**: 287.

2006. *Oxya hyla hyla* Shishodia, *Bionotes*, **8**(1): 11.

2008. *Oxya hyla hyla*, Gupta *et al.*, *Natl. J. Life Sci.*, **5**(1): 123.

*Material examined:* 3♂, 3♀, Nepli Forest, (WLS), 05.X.2001; 3♂, 2♀, Forest rest house Chandigarh, 31.X.2000 M.S. Thakur.

*Distribution:* India: Andaman & Nicobar Island, Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, J & K, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamilnadu, Tripura, Uttar Pradesh, West Bengal. *Elsewhere:* Afghanistan, Africa, Ahgola, Bangladesh, Benin, Cameroun, Chad, Central Africa Republic, Iran, Fernandopo, Gabon, Gambia, Ghana, Giunea, Kenya, Liberia, Madagascar, Maldiv Island, Mali, Malawi, Nepal, Niger, Nigeria, Pakistan, Sao Thome, Senegal, sierra Leone, Sudan, Srilanka Tanzania, Uganda, Zaire & Zambia.

#### 23. *Oxya fuscovittata* (Marschall, 1836:211)

1836. *Gryllus fuscovittata* Marschall. *Annalen des Naturhistorischen Museums in Wien.*, **1**(2): 211.

1963. *Oxya fuscovittata* Shumakov. *Trudy Vsesoyeznogo Entomologicheskogo Obshchestva, Moskva.*, **49**: 88

1986. *Oxya fuscovittata* Bhowmik. *Zool. Surv. India, Tech. Monogr.*, **14**: 109.

2007. *Oxya fuscovittata*, Mandal *et al.*, *Pictorial handbook on Indian short horned grasshopper pests (Acridoidea: Orthoptera)* (*Zool. Surv. India*),: 22.

*Material examined:* 3♂, Nepli Forest, Chandigarh. 05.X.2001 Santosh Thakur, 2♂ Industrial Area Chandigarh., 26.IX.2000 M.L. Thakur.

*Distribution:* India: Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Afghanistan, Bangladesh, Nepal, Pakistan & USSR (South West).

#### Subfamily EYPREPOCNEMIDINAE

Brunner von Wattenwyl, 1893:150.

Genus *Eyprepocnemis* Fieber, 1853:98; Kirby, 1914:267.

#### 24. *Eyprepocnemis alacris alacris* (Serville, 1839:682)

1839. *Acridium alacre* Serville, *Ins Orth.*,: 682.

1990. *Eyprepocnemis alacris alacris*, Bhowmil *et al.*, *Rec. zool. Surv. India*, **86**: 222.

2007. *Eyprepocnemis alacris alacris* Mandal & Yadav, *State Fauna Series*, **5**: *Fauna of Andhra Pradesh, Part 3, Zool Surv. India*,: 211.

*Material examined:* 2♂, Kansal Forest, (WLS) Chandigarh. 13. IX.2000, M.L.Thakur.

*Distribution:* India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Manipur, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Tamilnadu, Tripura, Uttarakhand, Uttar Pradesh & West Bengal. *Elsewhere:* Afghanistan, Bangladesh, Iran, Iraq, East Persia, Pakistan, Sri Lanka.

#### 25. *Eyprepocnemis roseus* Uvarov, 1942:597

1942. *Eyprepocnemis roseus* Uvarov. *Annals and Magazine of Natural History, London*, **9**(11):5 97.

1982. *Eyprepocnemis roseus*, Julka *et al.*, *Oriental Insect*, **63**: 67.

2007. *Eyprepocnemis roseus*, Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2686.

*Material examined:* 1♂, Kansal Forest 13.IX.2002. M.L. Thakur.

*Distribution:* India: Andhra Pradesh, Himachal Pradesh, J & K, Madhya Pradesh, Meghalaya, Uttarakhand, Uttar Pradesh. *Elsewhere:* Bangladesh, Myanmar, Pakistan & Thailand.

Genus **Tylotropidius** Stal, 1860:74;  
Kirby, 1914:256.

26. **Tylotropidius varicornis**  
(Walker, 1870:667)

1870. *Heteracris varicornis* Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, **4**: 667.
1986. *Tylotropidius varicornis* Bhowmik. *Zool. Surv. India, Tech. Monogr.*, **14**: 168.
1998. *Tylotropidius varicornis* Jiang, G. & Z. Zheng *Grasshoppers and Locusts from Guangxi.*, 182.
2007. *Tylotropidius varicornis* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2686

*Material examined:* 2 ♀, Sukhna Lake, 03.VII.2001, T.R. Sharma.

*Distribution:* India: Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttarakhand & West Bengal. *Elsewhere:* Myanmar, Sri Lanka.

Subfamily CATANTOPINAE  
Brunner von Wattenwyl, 1893:144.

Genus **Xenocatantops**  
Drish & Uvarov, 1953:237

27. **Xenocatantops humilis humilis**  
(Serville, 1839:662)

1839. *Acridium humile* Serville, *Ins. Orth.*: 662.
1953. *Xenocatantops humilis humilis* Drish and Uvarov, *Tijdschr. Ent.*, **96**(3): 237.
2007. *Xenocatantops humilis humilis* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2686.

*Material examined:* 2 ♂, Nepli Forest (WLS), 04.IV.2000, M.L. Thakur.

*Distribution:* India: Andaman & Nicobar Island, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Himachal Pradesh, West Bengal. *Elsewhere:* Bangladesh,

Borneo, Burma, Indo China, Java, Malaya, Nepal, New Guinea, Philippines, Sri Lanka, Sumatra, Thailand, Tibet, Yunnan.

Genus **Pachyacris** Uvarov, 1923:140.

28. **Pachyacris vinosa** (Walker, 1870: 587)

1870. *Acridium vinosum* Walker, *Cat. Derm. Salt. Brit. Mus.*, **4**: 587.
1922. *Pachyacris vinosa* Uvarov, *Ann. Mag. Nat. Hist.*, **11**(9): 478.
2000. *Pachyacris vinosa* Shishodia, *Rec. zool. Surv. India*, **98**(1): 58.
2007. *Pachyacris vinosa* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2686.

*Material examined:* 1 ♀, 1 ♂ Patiali Rao Reserve Forest, Chandigarh., 14.IX.2000, M.L. Thakur.

*Distribution:* India: Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Nagaland, Orissa, Tripura, Uttar Pradesh, West Bengal. *Elsewhere:* China, Myanmar, Nepal, Thailand & Tongking.

Genus **Choroedocus** Bolivar, 1914:5-8:  
Tandon, 1976:12.

29. **Choroedocus illustris** (Walker, 1870:663)

1870. *Heteracris illustris* Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, **4**: 663.
1984. *Choroedocus illustris* Bhowmik & Halder. *Records of the Zoological Survey of India, Calcutta*, **81**(1-2): 182.
2008. *Choroedocus illustris*, Gupta, *Bionotes*, **10**(3): 89.

*Material examined:* 1 ♂, Kansal Forest (WLS) Chandigarh. 13.IX.2000, M.L. Thakur.

*Distribution:* India: Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu & Uttarakhand.

Genus **Diabolocatantops** Jago, 1984:295

30. **Diabolocatantops innotabilis**  
(Walker, 1870:629)

1870. *Acridium innotabile* Walker, *Cat. derm. salt. Br. Mus.*, **4**: 629
1935. *Catantops pinguis innotabilis* Dirsh and Uvarov, *Tijdschr. Ent.*, **96**(3): 233.

2000. *Catantops pinguis innotabilis* Shishodia, *Rec. zool. Surv. India*, **98**(1): 61.

2007. *Catantops pinguis innotabilis* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2686.

*Material examined*: 3♂, 2♀ Kansal (WLS), 13.IX.2000, M.L. Thakur.

*Distribution*: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, J & K, Karnataka, Kerala, Lakshadweep Island, Madhya Pradesh, Maharashtra, Meghalaya, Manipur, Nagaland, Rajasthan, Sikkim, Tamilnadu, Uttar Pradesh, Orissa, West Bengal. *Elsewhere*: Afghanistan, Bangladesh, Borneo, Cambodia, China, Hong Kong, Indo-china, Japan, Java, Korea, Maldiv Island, Malaysia, Myanmar, Nepal, New guinea, Pakistan, Philippines, Sri Lanka, Sumatra, Tiber & Thailand.

#### Family PYRGOMORPHIDAE

Brunner von Wattenwyl, 1874:225

#### Subfamily PYRGOMORPHINAE

Brunner von Wattenwyl, 1874:78,85,184

Genus *Aularches* Stal, 1873:51

#### 31. *Aularches miliaris miliaris* (Linnaeus, 1758:432)

1758. *Gryllus (Locusta) miliaris* Linnaeus. *Systema Naturae per Regna tria naturae* (10th ed.). **1**: 432

1963. *Aularches miliaris* Kevan, *Ark. Zool. (Ser.2)*, **16**: 75

2007. *Aularches miliaris miliaris*, Mandal & Yadav, *State Fauna Series*, **5**: *Fauna of Andhra Pradesh, Part 3, Zool Surv. India.*: 190

*Material examined*: 2♂, Patiali Rao Reserve Forest, Nepli Forest, 14.IX.2000, M.L. Thakur

*Distribution*: India: Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Bangladesh, Cambodia, Indonesia, Java, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Tibet, South Vietnam and West Malaysia.

Genus *Atractomorpha* Saussure, 1862:474

#### 32. *Atractomorpha crenulata* (Fabricius, 1793:28)

1793. *Truxalis crenulatus* Fabricius. *Supplementum Entomologiae Systematicae*, **2**: 28.

2001. *Atractomorpha crenulata* Ingrisch & Garai. *Esperiana, Schwanfeld*, **8**: 761.

2007. *Atractomorpha crenulata*, Mandal & Yadav, *State Fauna Series*, **5**: *Fauna of Andhra Pradesh, Part 3, Zool Surv. India.*: 189.

*Material examined*: 1♀, 2♂. Nepli Forest, 08.VI.2000, M.L. Thakur.

*Distribution*: India: Andaman & Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Lakshadweep Island, Orissa, Rajasthan, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere*: Bangladesh, Cambodia, Laos, Maldiv Island, Malaya, Myanmar, Nepal, Pakistan, Srilanka, Sumatra, South Vietnam and Tahiland.

Genus *Chrotogonus* Serville, 1838:702

#### 33. *Chrotogonus tr. trachypterus* (Blanchard, 1836:618)

1836. *Ommexecha trachypterus* Blanchard, E. *Annales de la Société Entomologique de France*, **5**: 618.

2001. *Chrotogonus tr. trachypterus* Ingrisch *Senckenbergiana biologica*, **81**: 155.

2007. *Chrotogonus tr. trachypterus* Mandal & Yadav, *State Fauna Series*, **5**: *Fauna of Andhra Pradesh, Part 3, Zool Surv. India.*: 188.

*Material examined*: 3♂, 3♀, Patiali Rao Reserve Forest, Nepli Forest, 05.VI.2000, T.R.S harma.

*Distribution*: India: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Madhya Pradesh, Maharashtra, Meghalaya, Jammu & Kashmir, Karnataka, Tamilnadu, Sikkim, Uttar Pradesh, Orissa, Punjab, Uttarakhand, West Bengal. *Elsewhere*: Bangladesh, Nepal, Pakistan, Afghanistan, Iran.

Genus *Poecilocerus* Serville, 1832:275

#### 34. *Poecilocerus pictus* (Fabricius, 1775:289)

1775. *Gryllus pictus*, Fabricius, *Syst. Ent.* pp. 289.

1831. *Poecilocerus pictus*, Serville, *Ann. Sci. Nat.* xxxii, pp. 276.

2000. *Poecilocerus pictus* Shishodia, *Rec. zool. Surv. India*, **98**(1): 41.

*Material examined:* 1 ♀, Sukhna Lake, Chandigarh., 03.VII.2001 Santosh Thakur.

*Distribution:* India: Andhra Pradesh, Assam, Bihar, Chhatisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Punjab, Orissa, Maharashtra, Uttar Pradesh, Tamil Nadu, Rajasthan, West Bengal. *Elsewhere:* Pakistan, Afghanistan, Bangladesh, Nepal.

Family TETRIGIDAE, Serville, 1838:570

Subfamily TETRIGINAE  
Serville, 1838:570, 754

Genus *Hedotettix* Bolivar, 1887:283

35. *Hedotettix costatus* Hancock, 1912:147

1912. *Hedotettix costatus* Hancock, J.L. *Mem. Dept. Agric. India (Ent. Ser.)*, Calcutta, 4(2): 147.

2001. *Hedotettix costatus* Ingrisch. *Spixiana (Munich)*, 24(2): 149.

2007. *Hedotettix costatus* Saini & Mehta, *Bionotes*, 9(3): 76.

*Material examined:* 1 ♀, Forest rest house Chandigarh., 20.VIII.2000, M.S. Thakur.

*Distribution:* India: Assam, Bihar, Uttar Pradesh, Punjab, Himachal Pradesh Meghalaya, Sikkim, Tripura & West Bengal. *Elsewhere:* Nepal, Bangladesh & Sulawesi.

36. *Hedotettix gracilis* (Haan, 1842:169)

1842. *Acridium (Tetrix) gracilis* Haan. In *Temminck. Verhandelingen over de natuurlijke geschiedenis der Nederlandsche overzeesche bezittingen. Zoologie 2*: 167.

2002. *Hedotettix gracillis*; Zheng, Z. & G. Jiang. *Dong wu xue yan jiu [Zoological Research]*, 23(5): 414.

2007. *Hedotettix gracilis* Chandra *et al.*, *Zoos' Print Journal*, 22(5): 2686.

*Material examined:* 2 ♂, 1 ♀, Nepali forest, 30.I.2002, H.S. Mehta.

*Distribution:* Andaman & Nicobar Island, Arunachal Pradesh, Assam, Chhatisgarh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orisa, Rajasthan, Sikkim, Tripura, Manipur, Meghalaya, Uttarakhand, Uttar Pradesh & West Bengal. *Elsewhere:* Pakistan, Bangladesh, Celebes, China,

Sulawesi, Thailand Sri Lanka, Myanmar, Thailand, Sumatra, Java, Vietnam, Taiwan.

Genus *Ergatettix* Kirby, 1914:69

37. *Ergatettix dorsiferus* (Walker, 1871:825)

1871. *Tettix dorsiferus* Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, 5: 825.

2005. *Ergatettix dorsiferus*. Zheng, Z. *Fauna of Tetrigoidea from Western China*, 422.

2007. *Ergatettix dorsiferus* Chandra *et al.*, *Zoos' Print Journal*, 22(5): 2686.

*Material examined:* 1 ♀, Kansal Forest, 12.IX.2000 M.S. Thakur.

*Distribution:* India: Andaman & Nicobar Island, Arunachal Pradesh, Assam, Chhatisgarh, Delhi, Himachal Pradesh, Sikkim, Manipur, Bihar Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Tamilnadu, Uttar Pradesh, Sikkim, Tripura, Meghalaya, Orissa, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Afghanistan, Bangladesh, Nepal, Srilanka, Central Asia, Iran, Indonesia, Turkmenia, Taiwan, South China, Greater Sunda Island, Sumatra.

38. *Ergatettix guenthari* Steinmann, 1970:234

1970. *Ergatettix guenthari* Steinmann, *Acta Zool. Hung.*, 16(1-2): 234

2000. *Ergatettix guenthari* Shishodia, *Rec. zool. Surv. India*, 38(1): 39

2007. *Ergatettix guenthari* Chandra *et al.*, *Zoos' Print Journal*, 22 (5): 2686

*Material examined:* 1 ♂, 1 ♀, Nepali forest, 30.I.2002, Santosh Thakur.

*Distribution:* India: Arunachal Pradesh, Assam, Bihar, Chhatisgarh, Himachal Pradesh, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Orisa, Tripura, Uttar Pradesh, & West Bengal. *Elsewhere:* Bangladesh, Sri Lanka & Nepal.

Genus *Euparatettix* Hancock, 1904:108.

39. *Euparatettix histricus* Stal, 1861:347

1861. *Tetrix histricus* Stal. *Kongliga Svenska fregatten Eugenie Resa omkring jorden under befäl af C.A. Virgin aren 1851-1853 (Zoologi)*, 2(1): 347

1937. *Euparatettix histricus* Günther, K. *Revue Suisse de Zoologie*, 44: 133.

2005. *Paratettix histricus* Zheng, *Z. Fauna of Tetrigoidea from Western China*, 377.

*Material examined*: 1♂. Kansel Forest, Chandigarh, 12.IX.2001, M.L. Thakur.

*Distribution*: India: Andaman Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Himachal Pradesh, Sikkim, Maharashtra, Manipur, Bihar, Karnataka, Kerala, Madhya Pradesh, Tamilnadu, Uttar Pradesh, Meghalaya, Orissa, West Bengal. *Elsewhere*: Australia, Borneo, Caledonia, Celebes, East Africa, East Afghanistan, Holland, Indonesia, Iran, Java, Malaysia, Myanmar, Nepal, New Ireland, Pakistan, Philippines, Queensland, Saudi Arabia, Solomon Island, South China, Sumatra, Sri Lanka & Taiwan.

#### Sub Order ENSIFERA

#### Family GRYLLOTALPIDAE

Blanchard, 1845:246

#### Subfamily GRYLLOTALPINAE

Blanchard, 1845:246

#### Genus *Gryllotalpa* Latreille, 1802:275

#### 40. *Gryllotalpa africana* Beauvois, 1805:229

1805. *Gryllotalpa africana* Beauvois, *Ins. Afr. Amer.*, 229.

1967. *Gryllotalpa africana* Chopard, *Orthopterorum Catalogus*, Part 12: 449.

2000. *Gryllotalpa africana* Shishodia, *Rec. zool. Surv. India*, **98**(3): 1.

2007. *Gryllotalpa africana* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2686.

*Material examined*: 1♀, Forest rest house Chandigarh. 24. VI.2000 H.S. Mehta.

*Distribution*: India: Andaman & Nicobar Island, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Jammu & Kashmir, Karnataka, Kerala, Tamilnadu, Madhya Pradesh, Pondicherry, Rajasthan, Uttar Pradesh, Himachal Pradesh, Meghalaya, Orissa, West Bengal. *Elsewhere*: Africa, Bhutan, Australia, Iran, Madagascar, Malaya, Myanmar, Nepal, Pakistan, Singapore, South Spain, Sri Lanka.

#### Family GRYLLIDAE Laicharding, 1781:1

#### Subfamily GRYLLINAE Laicharding, 1781:1

#### Genus *Loxoblemmus* Saussure, 1877:249

#### 41. *Loxoblemmus detectus* (Servile, 1838:356)

1838. *Platyblemmus detectus*, Servile, *Ins. Orth.*, 356.

1969. *Loxoblemmus detectus*, Chopard, *Fauna Ind Grylloidea*, **2**: 123.

2000. *Loxoblemmus detectus* Shishodia, *Rec. zool. Surv. India*, **98**(3): 3.

*Material examined*: 1♀, 1♂, Forest rest house Chandigarh. 21. VIII.2000 M.S. Thakur.

*Distribution*: India: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Bihar, Himachal Pradesh, Mizoram, Orissa, Sikkim, Uttar Pradesh, Uttarakhand and West Bengal. *Elsewhere*: China, Java, Johore, Kuala Lumpur, Pinang, Singapore, Sri Lanka, Sumatra & Taiwan.

#### Genus *Gryllus* Linnaeus, 1758:425

#### 42. *Gryllus bimaculatus* De Geer, 1773:521

1773. *Gryllus bimaculatus*, De Geer, *Mem. Ins.*, **3**: 521.

1964. *Gryllus bimaculatus*, Bandell, *Canad. Ent.*, **96**: 1592.

2000. *Gryllus bimaculatus* Shishodia, *Rec. zool. Surv. India*, **98**(1): 65.

*Material examined*: 1♀, Daruyua Forest, 04.X.2001 Santosh Kumar.

*Distribution*: India (Widely distributed all over the country.) *Elsewhere*: Africa, Malaysia, Mediterranean Region, Myanmar, Nepal, Pakistan, Singapore & Sri Lanka.

#### Genus *Acheta* Fabricius, 1775:279

#### 43. *Acheta domesticus* (Linnaeus, 1758:428)

1758. *Gryllus (Acheta) domesticus*, *Syst. Nat. 10<sup>th</sup> ed.* **1**: 428.

1961. *Acheta domesticus* Chopard, *Eos.*, **37**: 271

1998. *Acheta domesticus* Schmidt, *J. Ent. Res. Soc.*, **1**(1): 42.

2007. *Acheta domesticus* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2684.

*Material examined*: 1♀, 1♂, Forest rest house Chandigarh, 20.VIII.2000, M.S. Thakur.

*Distribution:* India: Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Kerala, Maharashtra, Madhya Pradesh, Punjab, Rajasthan, Uttarakhand, Uttar Pradesh and West Bengal.

*Elsewhere:* Pakistan.

Genus *Plebeigryllus* Randell, 1964:1597

44. *Plebeigryllus gutteventris gutteventris*  
(Walker, 1871:6)

1871. *Gryllus gutteventris*, Walker, *Cat. Derm. Salt. Br. Mus.*, 5: 6.

1967. *Plebeigryllus gutteventris*, Chopard, *Orth. Cat.*, 10: 94.

2000. *Plebeigryllus gutteventris* Shishodia, *Rec. zool. Surv. India*, 98(1): 66.

*Material examined:* 1 ♀, 2 ♂, Forest rest house Chandigarh., 21.VIII.2000, M.S. Thakur.

*Distribution:* India: Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Uttar Pradesh, Maharashtra, Manipur, Goa, West Bengal, Orissa, Pondichery, Rajasthan, Karnataka, Kerala, Tamil Nadu. Uttarakhand, Uttar Pradesh and West Bengal. *Elsewhere:* Myanmar and Srilanka.

Genus *Teleogryllus* (Chopard, 1961:277)

Subgenus *Macroteleogryllus*  
Gorochov, 1988:88-103

45. *Teleogryllus (Macroteleogryllus) mitratus*  
(Burmeister, 1838:34)

1838. *Gryllus mitratus* Burmeister. *Handbuch der Entomologie*. 2(2): I-VIII:734

2001. *Teleogryllus mitratus* Ingrisch & Garai. *Esperiana, Schwanfeld*, 8: 758

2007. *Teleogryllus testaceus* Chandra *et al.*, *Zoos' Print Journal*, 22 (5): 2684

*Material examined:* 2 ♀, 1 ♂, North East Sukhna Lake, 19.VII.2000, M.S. Thakur.

*Distribution:* India: Andaman & Nicobar Island, Arunachal Pradesh, Assam, Bihar, Delhi, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Orissa, Pondicherry, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Annam, Bangkok, Borneo, Bhutan, China, Indo-China,

Indonesia, Japan, Java, Johore, Kuala Lumpur, Malaysia, Myanmar, Nepal, Philippines, Pinanag, Sarawak, Singapore, Sri Lanka, Sumatra, Taiwan, Tenasserin, Thailand and Vietnam.

Subgenus *Brachyteleogryllus*  
Gorochov, 1988: 88-103

46. *Teleogryllus (Brachyteleogryllus) occipitalis*  
(Serville, 1838:339)

1838. *Gryllus occipitalis* Serville, *Ins. Orth.*, 339.

1980. *Teleogryllus occipitalis*: Townsend, *J. nat. Hist.*, 14: 154.

2007. *Teleogryllus occipitalis* Chandra *et al.*, *Zoos' Print Journal*, 22(5): 2684.

*Material examined:* 1 ♀, Kansal forest, 1.X.2002, Dr. H.S. Mehta.

*Distribution:* India: Andaman & Nicobar Island, Arunachal Pradesh, Assam, Bihar, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Manipur, Meghalaya, Orissa, Pondicherry, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Annam, Bangladesh, Bangkok, Bhutan, Borneo, Celebes, China, Indo-China, Indonesia, Japan, Java, Laos, Kuala Lumpur, Malaysia, Myanmar, Nepal, Philippines, Sarawak, Singapore, Sri Lanka, Sumatra, Sulawesi, Taiwan, Tibet, Thailand and Vietnam.

Genus *Turanogryllus* Tarbinskii, 1940:115

47. *Turanogryllus histrio* (Saussure, 1877:229)

1877. *Gryllodes histrio* Saussure, *Mem. Soc. Phys. Hist. nat. Geneve*, 25: 357.

1975. *Turanogryllus histrio* Bhowmik, *J. Bombay nat. Hist. Soc.*, 72(2): 378.

2001. *Turanogryllus histrio* Shishodia & Vasanth, *Fauna of Conservation area series*, 11: *Fauna of Nilgiri Biosphere Reserve, Zool. Surv., India*,: 67.

*Material examined:* 1 ♀, Dauryua Forest Chandigarh, 04.X.2001, Santosh Thakur.

*Distribution:* India: Assam, Bihar, Punjab, Himachal Pradesh, Meghalaya, Tamil Nadu Uttarakhand and West Bengal.

Subfamily *Nemobiinae* Saussure, 1877:75

Genus *Dianemobius* Vickery, 1973:421

48. *Dianemobius fascipes* (Walker, 1869:67)  
1869. *Eneoptera fascipes* Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, 1: 67  
2001. *Dianemobius fascipes* Ingrisch. *Senckenbergiana biologica*, 81: 154.  
2007. *Pteronemobius fascipes* Chandra *et al.*, *Zoos' Print Journal*, 22(5): 2684.
- Material examined*: 2 ♀, Forest rest house Chandigarh, 11.IX.2000, M.L.Thakur.
- Distribution*: India: Andaman & Nicobar Island, Arunachal Pradesh, Bihar, Chhattisgarh, Delhi, Goa, Assam, Himachal Pradesh, Meghalaya, Orissa, Sikkim, Uttar Pradesh, Madhya Pradesh, Maharashtra, Haryana, Jammu & Kashmir, Kerala, Karnataka, Tamilnadu, Tripura, West Bengal. *Elsewhere*: Myanmar, China, Indonesia, Malaysia, Philippines, Singapore, Sri Lanka & Taiwan.
49. *Dianemobius csikii* (Boliver, 1901:248)  
1901. *Nemobius csikii* Bolivar, I. In *Zichy. Zoologische Ergebnisse der dritten Asiatischen Forschungsreise des Grafen Eugen Zichy*, 2: 243.  
1967. *Pteronemobius csikii* Chopard. In *Beier [Ed.]. Orthopterorum Catalogus*, 10: 170.  
2004. *Dianemobius csikii* Storozhenko. *Dlinousye pryamokrylye nasekomye (Orthoptera: Ensifera) asiatskoi chasti Rossii [Long-horned orthopterans (Orthoptera: Ensifera) of the Asiatic part of Russia]*, 224.  
2007. *Pteronemobius csikii* Chandra *et al.*, *Zoos' Print Journal*, 22(5): 2684.
- Material examined*: 1 ♂, Forest rest house Chandigarh. 11.IX.2000, M.L. Thakur
- Distribution*: India: Arunachal Pradesh, Bihar, Assam, Chhattisgarh, Himachal Pradesh, Meghalaya, Orissa, Sikkim, Uttar Pradesh, Madhya Pradesh, Maharashtra, Haryana, Jammu & Kashmir, Kerala, Karnataka, Tamilnadu. *Elsewhere*: Bhutan, China, Myanmar, Siberia, Sri Lanka.
- Subfamily CACHOPLISTINAE  
Saussure, 1877:325
- Genus *Meloimorpha* Walker, 1870:468
50. *Meloimorpha cincticornis*  
(Walker, 1870:469)  
1870. *Meloimorpha cincticornis*, Walker, *Cat. Derm. Salt. Br. Mus.*, 3: 469.
1969. *Homoegryllus cincticornis*, Chopard, *Fauna of India, (Orthoptera: Grylloidea)*, 2: 242.  
2007. *Homoegryllus cincticornis*, Chandra *et al.*, *Zoos' Print Journal*, 22(5): 2685
- Material examined*: 1 ♀, Forest rest house Chandigarh, 11.IX.2000, M.L. Thakur.
- Distribution*: India: Chhattisgarh, Maharashtra, Himachal Pradesh, Madhya Pradesh, Meghalaya, Tamil Nadu & Uttarakhand. *Elsewhere*: Pakistan.
- Subfamily EUSCYRTINAE Otte, D. 1994:70  
Genus *Euscyrtus* Guerin-Meneville, 1844:334
51. *Euscyrtus hemelytrus* (Hann, 1842:231)  
1842. *Gryllus hemelytrus* Haan. In *Temminck. Verhandelingen over de natuurlijke geschiedenis der derlandsche overzeesche bezittingen. Zoologie*: 231.  
1987. *Euscyrtus (Osus) hemelytrus* Gorochov. In *Medvedev, L.N. [Ed.]. Entomofauna V'etnama [Entomofauna of Vietnam]*. 9.  
2000. *Euscyrtus hemelytrus* Shishodia, *Rec. zool. Surv. India*, 98(3): 7.
- Material examined*: 1 ♀, Forest rest house Chandigarh, 04.VIII.2001, Santosh Thakur.
- Distribution*: India: Andaman & Nicobar Island, Assam, J&K, Kerala, Orissa, Tamil Nadu, Tripura, Uttarakhand & West Bengal. *Elsewhere*: China, Japan, Korea, North America, Australia, Batavia, Kuala Lumpur, Korea, Taiwan, Asia Tropical, Burma, Malaysia, Java, Sri Lanka.
- Family TRIGONIDIIDAE Daussure, 1874:361  
Genus *Trigonidium* Rambur, 1838:349
52. *Trigonidium humbertianum*  
(Saussure, 1878:468)  
1878. *Homoeoxiphus humbertianum*, Saussure, *Mem. Soc. Geneve*, 25: 468.  
1969. *Trigonidium humbertianum*, Chopard, *Fauna Ind. Grylloidea*, 2: 305.  
2000. *Trigonidium humbertianum* Shishodia, *Rec. Zool. Surv. India*, 98(3): 5.
- Material examined*: 1 ♂, 1.X.2002, Kansal forest, Dr. H.S. Mehta.
- Distribution*: India: Andaman & Nicobar Island, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Karnataka,

Kerala, Manipur, Maharashtra, Madhya Pradesh, Meghalaya, Orissa, Tamil Nadu, Tripura, Uttar Pradesh & West Bengal. *Elsewhere*: Sri Lanka, Malaysia, widely distributed in oriental region.

Family TETTIGONIIDAE Krauss, 1902:541

Subfamily PHANEROPTERINAE

Burmeister, 1838:684

Genus *Letana* Walker 1869:277

53. *Letana megastridula* Ingrisch, 1990:258

1990. *Letana megastridula* Ingrisch, *Entomologica Scandinavica*, **21**(3): 258.

2007. *Letana megastridula* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2684.

*Material examined*: 1♂, Forest rest house Chandigarh, 09.IV.2000, T.R. Sharma

*Distribution*: India: Bihar, Chhattisgarh, Himachal Pradesh, Maharashtra and Tamil Nadu.

54. *Letana linearis* Walker, 1869:278

1869. *Letana linearis* Walker, F. *Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum*, **2**: 278.

2000. *Letana linearis* Ingrisch & Shishodia. *Mitteilungen der Münchner Entomologischen Gesellschaft*, **90**: 16.

2004. *Letana linearis*, Shishodia & Barman, *State Fauna Series*, 10: *Fauna of Manipur, Zool. Surv. India*,: 140.

*Material examined*: 1♀, Industrial Area, Chandigarh, 09.IV.2000, T.R. Sharma.

*Distribution*: India: North West and North East Himalaya. *Elsewhere*: Nepal.

Genus *Elimaea* Stal 1874:27

55. *Elimaea securigera* Brunner von Wattenwyl, 1878:93

1878. *Elimaea securigera* Brunner von Wattenwyl. *Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien*, **28**: 93.

2007. *Elimaea securigera* Chandra *et al.*, *Zoos' Print Journal*, **22**(5): 2684.

*Material examined*: 1♀, Forest rest house Chandigarh, 01.VIII.2000, M.S. Thakur.

*Distribution*: India: Assam, Andaman &

Nicobar Island, Andhra Pradesh, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Karnataka, Orisa, Rajasthan, Meghalaya, Nagaland, Himachal Pradesh, Sikkim, Tripura, West Bengal. *Elsewhere*: Australia, Indonesia, Java, Nepal, Philippines and Sri Lanka.

Genus *Isopsora* Brunner von Wattenwyl, 1878:218

56. *Isopsora pedunculata* Brunner von Wattenwyl, 1878:220

1878. *Isopsora pedunculata* Brunner von Wattenwyl. *Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien*. **28**: 220.

2000. *Isopsora pedunculata* Ingrisch & Shishodia. *Mitteilungen der Münchner Entomologischen Gesellschaft*. **90**: 7.

*Material examined*: 1♂, Forest rest house Chandigarh, 01.VIII.2000, M.S. Thakur.

*Distribution*: India: Assam, Delhi, Himachal Pradesh, Orissa, Rajasthan, Tamil Nadu and West Bengal. *Elsewhere*: Myanmar.

Subfamily PSEUDOPHYLLINAE  
Burmeister, 1838:695

Genus *Sathrophyllia* Stal 1874:54

57. *Sathrophyllia femorata*  
(Fabricius, 1787:233)

1787. *Locusta femorata* Fabricius, *Mantissa Insectorum stens eorum species nuper detectas adjectis characteribus genericis, differentiis specificis, emendationibus, observationibus*,: 233.

1927. *Sathrophyllia femorata punctifrons* Karny. *Arkiv för Zoologi*, **19A**(12): 8.

2003. *Sathrophyllia femorata*, Barman, *State Fauna series*, **9**: *Fauna of Sikkim, Part 2, Zool Surv. India*, 197.

*Material examined*: 1♂, Forest rest house Chandigarh, 20.VIII.2000, M.S. Thakur.

*Distribution*: India: Karnataka, Maharashtra, Sikkim, Tamil Nadu and West Bengal. *Elsewhere*: Borneo, Cambodia, Java, Malaysia, Myanmar and Sumatra.

SubFamily MECOPODINAE Walker, 1871:101

Genus *Mecopoda* Serville, 1831:154

58. *Mecopoda elongate elongate*  
(Linnaeus, 1758:429)

1758. *Gryllus (Tettigonia) elongatus* Linnaeus. *Systema Naturae per Regna tria naturae (10th ed.)*. 1: 429.

1993. *Mecopoda elongate*, Barman, *State Fauna Series*, 3: *Fauna of West Bengal, Part 4, Zool. Surv. India*: 363.

2007. *Mecopoda elongate* Chandra *et al.*, *Zoos' Print Journal*, 22(5): 2684.

*Material examined*: 2 ♀, Forest rest house, Chandigarh, 18.VIII.2000, M.L. Thakur 1 ♂, Daurya Forest, Chandigarh, 18.VIII.2000 M.L. Thakur.

*Distribution*: India: Andaman & Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orisa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh & West Bengal. *Elsewhere*: Australia, Aru Islands, Borneo, Celebes, China, Indonesia, Japan, Malacca, Malaysia, Moluccas, New Guinea, Philippines, Singapore, Sunda Islands, Taiwan, Thailand & Tonkin.

### DISCUSSION

Pajni and Shaila, 1983 studied (1976-77) 44 species of short horned grasshopper, out of which three species are reported from out of Chandigarh at that time and two sub families i.e. Scelimeninae and Metrodorinae are not observed in present

study. Similarly the Grylloidea of Chandigarh was studied (1877-78) by Pajni and Kalra, 1986. At that time they studied 51 species out of which 09 species are reported out of Chandigarh and families Eneopteridae, Mogoplistidae and Scleropteridae represented 08 species are not reported present study. Thakur and Thakur (2011) reported 19 species of long horned grasshopper from Sukhna catchment area, Chandigarh.

### SUMMARY

Present study represents the 58 valid species with accepted nomenclature and upto date classification. A total of 3 families from suborder Califera represent 39 species and Suborder Ensifera have 4 families and 19 species. The largest family is the Acrididae represents 30 species under 8 sub families. The present works provide the concrete information of Orthoptera of Chandigarh and surrounding area. The work would also helpful in further ecological studies and socioeconomic development of the country.

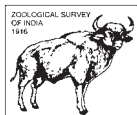
### ACKNOWLEDGEMENTS

The authors are grateful to Director, Zoological Survey of India, Kolkata for providing encouragement and facilities during the surveys. The authors are also thankful to the Officer-in-Charge, HARC, Solan and team member of surveys and insect setter of the department. It's our owe duty to thanks Late Dr H.S.Mehta (Retired Scientist) for initiation of this study and his valuable guidance during the surveys.

### REFERENCES

- Bhowmick, H.K. 1985. Contribution to the Gryllidae fauna of the Western Himalayas (Orthoptera: Gryllidae) *Rec. zool. Surv. India, Occ. Paper*, 73: 1-74.
- Bhowmick, H.K. and Halder, P. 1983. Preliminary distribution with remarks on little known species of Acrididae (Orthoptera: Insecta) from the Western Himalayas (Himachal Pradesh). *Rec. zool. Surv. India*, 18(1 & 2): 167-191.
- Chopard, L. 1969. Fauna of India, Orthoptera Grylloidea. 2: 1-421. Zoological Survey of India Calcutta.
- DIVA-GIS 7.1.7 website (<http://www.diva-gis.org>).
- Drish, V.M. 1965. The African genera of Acridoidea. University Press Cambridge, 579pp +8.

- Duggal, S.L. 1968. Bioclimatic region of Punjab, Haryana, Himachal Pradesh, and the Union Territory of Chandigarh and Delhi: 114-137. In: Mishra, R. and Gopal, B. (eds.). *Proceedings of the symposium in recent advances in tropical ecology, part I*. International Society for Tropical Ecology, Varanasi.
- Kirby, W.F. 1914. Orthoptera Vol. 1 Acrididae The Fauna of British India including Ceylon and Burma. *Today and Tomorrow's Printers & Publisher, New Delhi, 276pp.* (reprinted edition).
- Pajni, H.R. and Kalra, M. 1986. A report on the Grylloidea of Chandigarh and surrounding areas (Orthoptera). *Res. Bull. (Science) Panjab Univ.*, **37**: 119-125.
- Pajni, H.R. and Shaila, A. 1983. A report on the short horned grass hoppers of Chandigarh and surrounding areas (Acridoidea : Orthoptera). *Res. Bull. (Science) Panjab Univ.*, **34**: 1-6.
- Serville, J.G.A. 1831. Revue methodique des Insectes des l' Ordre des Orthopteres. Deuxieme Sections, sauteurs, Saltatoria. *Ann. Sci. nat. (Zool.) Paris*, **22**: 134-162, 262-292.
- Shishodia, M.S., Chandra, K. and Gupta, S.K. 2010. An annotated Checklist of Orthoptera (Insect) from India. *Rec. Zool. Surv. India, Occ. Paper No. 314*: 1-366, (Published by the Director, *Zool. Surv. India*, Kolkata).
- Tandon, S.K. 1976. A check list of the Acridoidea (Orthoptera) of India. Occasional Paper. **3**: 1-48. Zoological Survey of India, Calcutta.
- Tandon, S.K. and Hazra, A.K. 1998. Faunal Diversity in India: Orthoptera. In Faunal Diversity of India, Editors-Alfred *et al.*, ZSI, Calcutta.
- Thakur, S.K. and Thakur, M.S. 2011. Long horned grasshoppers (Orthoptera: Ensifera) Diversity from Sukhna Wildlife Sanctuary Chandigarh, India. *Int. jr. of Agri., Env. And Biotech.* Vol. **4**(2): 119-120.
- Uvarov, B.P. 1927. Distributional Records of Indian Acrididae. *Rec. Indian Mus.*, **28**: 233-240.
- Uvarov, B.P. 1966. Grasshoppers and locusts. A Handbook of General Acridology, Vol.1 University Press, Cambridge, 1-481, 245 fig.



## FIRST RECORD OF *ANISOPS TAHITIENSIS* LUNDBLAD (HEMIPTERA: NEPOMORPHA: NOTONECTIDAE) FROM MAINLAND INDIA

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### INTRODUCTION

The Notonectidae is one of the largest families of the Nepomorpha with eleven genera and 400 described species (Henry, 2009), represented well in both temperate and tropical areas of the World (Nieser, 2004). The genus *Anisops* Spinola, 1837 is characterized by hair-lined pit on the hemelytral commissure, one segmented fore tarsi on both the sexes and the presence of rostral prong as well as stridulatory comb on fore tibia of males. They are adapted to swim with their back, thus bearing the common name back swimmers and some species are generally attracted to light. Thirumalai (2007) recorded 19 species of *Anisops* from India, subsequently Jehamalar and Chandra (2013) added one more species to the Indian fauna by recording *Anisops occipitalis* from Great Nicobar Island. Out of the 20 species, 19 species including the present record of *A. tahitiensis*, are known from mainland India, out of which 14 species of *Anisops* including the new record are known from West Bengal that contributes about 70 percent of *Anisops* from India. Distribution records are highly essential to understand the zoogeography, interestingly the present record of *Anisops tahitiensis* from mainland India is very important to understand the distribution, dispersion and the intrusion of southeast Asian elements into India.

Backswimmers (Notonectidae) are very aggressive predators, that attack many pelagic and benthic invertebrates, including their own larvae, invertebrates that fall onto the water surface

(larvae and adults of various insects, mites, small crustaceans, annelids, and molluscs), and small vertebrates like fish larvae and amphibian tadpoles (Giller, 1986). They are predators of mosquito and some other blood-sucking Diptera (e.g., Ceratopogonidae) larvae and pupae, which they attack as surface prey (Papáček, 2001).

### MATERIALS AND METHODS

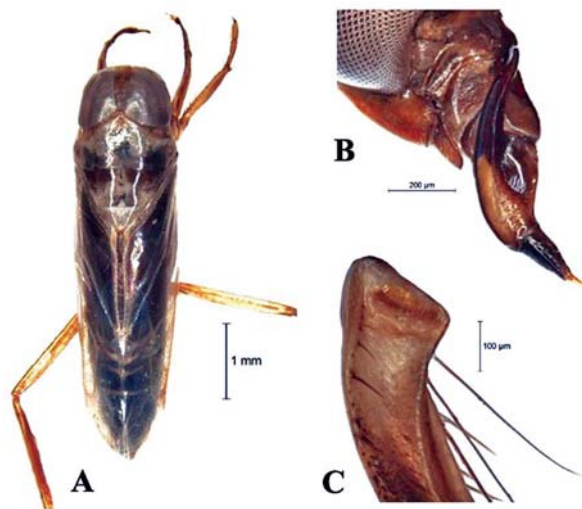
In the present study, the specimens have been collected by using aquatic insect net from a sewage fed pond (a part of East Kolkata wetlands) at Anandapur, Kolkata, West Bengal. The specimens were preserved in 75 percent ethanol, studied and photographed through Leica Stereozoom microscope using the software Leica Application Suite (Las V 3.8). The studied materials are deposited in National Zoological Collection, Hemiptera Section, ZSI, Kolkata.

### RESULTS

- Infraorder NEPOMORPHA Popov, 1968  
Superfamily NOTONECTOIDEA Latreille, 1802  
Family NOTONECTIDAE Latreille, 1802  
Subfamily ANISOPINAE Hutchinson, 1929  
Tribe ANISOPINI Hutchinson, 1929  
Genus *Anisops* Spinola, 1837  
*Anisops tahitiensis* Lundblad, 1934  
1934. *Anisops tahitiensis* Lundblad, *Bull. Bishop. Mus. Honolulu*, **113**: 121.  
2013. *Anisops tahitiensis* Lundblad: Jehamalar & Chandra, *Rec. zool. Surv. India*, **113** (Part-2): 57.

**Material examined:** INDIA, West Bengal, Kolkata, Anandapur, East Kolkata Wetlands, 22.xi.2012, (2♂, 1♀ exs.), Coll. Paulami Maiti and Durba Bhattacharya.

**Diagnosis:** (Figs. 1A–C) **Male:** Length, 5.27 – 5.40 mm; colour: yellowish white to black, wings yellowish white to hyaline; synthlipsis about one third the anterior width of vertex (Fig. 1A); head anteriorly slightly truncate; tylus slightly swollen with blunt carina, rostral prong longer than third rostral segment, originating middle of the segment, tip of the prong anteriorly curved upward (Fig. 1B); stridulatory comb on fore tibia of males with 23–34 teeth (Fig. 1C); scutellum often with three dark brown longitudinal rectangular bands, prominent in alcohol. **Female:** Length, 5.56 mm; tylus slightly convex; females slightly larger than males.



**Fig. 1.** A–C *Anisops tahitiensis*: A, male, dorsal view; B, male head tip, showing rostral prong; C, base of male fore tibia, showing stridulatory comb.

**Distribution:** INDIA: Andaman and Nicobar Islands and West Bengal. *Elsewhere:* Australia, French Polynesia, Japan, Malaysia, Singapore, Solomon Islands and Vietnam.

**Remarks:** Yang & Kovac, 1995 and Nieser (2004) remarked that this species is found only in lentic waters, but the first author collected this species from slow flowing forest streams of Great Nicobar Island and in the present study, it has been collected from a sewage-fed pond of the East Kolkata Wetlands, West Bengal. *Anisops tahitiensis* can be easily distinguished from the other closely resembling species *Anisops paranigrolineatus* by its smaller anterior width of vertex, pale colour of scutellum and the long and apically curved rostral prong.

## DISCUSSION

A total of 20 species of the genus *Anisops* are known from India. Last revisionary work on this genus was done by Brooks (1951), where in 19 species were included from India and later on no species has been newly described from India despite of thorough surveys undertaken throughout the country. So, the knowledge on *Anisops* of India is quite good. The present finding of *A. tahitiensis* is a quite interesting because it has been reported from Kolkata, a place which is considered as a well explored area on water bugs. This study reveals that faunal surveys are essential even for the areas considered to an explored one, which will help in understanding faunal distribution and dispersal patterns. Although *A. tahitiensis* Lundblad is distributed throughout the Great Nicobar Biosphere Reserve, yet it has been rarely recorded from Andaman Islands. This species shows a discontinuous distribution and it is thus important to study its dispersal route.

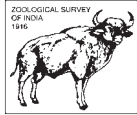
## ACKNOWLEDGEMENT

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## REFERENCES

- Brooks, G.T. 1951. A revision of the genus *Anisops* (Notonectidae, Hemiptera). *Kans. Univ. Sci. Bull.*, **34**(8): 301–519.
- Giller, P.S. 1986. The natural diet of the Notonectidae: field trials using electrophoresis. *Ecol. Entomol.* **11**: 163–172.

- Henry, T.J. 2009. Biodiversity of Heteroptera. *In: Insect Biodiversity: Science and Society* (eds. Footitt, R.G. and Adler, P.H.). Wiley-Blackwell, A John Wiley & Sons, Ltd., Publication. 632 pp.
- Jehamalar, E.E. and Chandra, K. 2013. On the genus *Anisops* (Heteroptera: Nepomorpha: Notonectidae) from Andaman and Nicobar Islands, with a new record to India. *Records of Zoological Survey of India*, **113**(Part-2): 55–59.
- Nieser, N. 2004. Guide to aquatic Heteroptera of Singapore and peninsular Malaysia III. Pleidae and Notonectidae. *Raff. Bull. Zoology*, **52**(1): 79–96.
- Papáček, M. 2001. Small aquatic and ripicolous bugs (Heteroptera: Nepomorpha) as predators and prey: The question of economic importance. *Eur. J. Entomol.*, **98**: 1–12.
- Thirumalai, G. 2007. A synoptic list of Nepomorpha (Hemiptera: Heteroptera) from India. *Rec. zool. Surv. India. Occ. Paper No.*, **273**: 1–84.
- Yang, C. M. & D. Kovac, 1995. A collection of aquatic and semiaquatic bugs (Insecta: Hemiptera: Gerromorpha and Nepomorpha) from Temengor Forest Reserve, Hulu Perak, Malaysia. *Malayan Nature Journal*, **48**: 287–295.



## “TAXONOMIC STUDIES ON ANURAN AMPHIBIANS OF NORTH EAST INDIA PRESENT IN THE UNIDENTIFIED COLLECTION OF NERC/ZSI, SHILLONG”

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### INTRODUCTION

North East India comprises of eight hilly states. These are Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, Sikkim and Assam. This region is bordered by five countries viz. China, Myanmar, Bangladesh, Bhutan and Nepal. The topography of the entire region consists of tall, snow clad mountains of Arunachal to the floodplains of the mighty Brahmaputra River in Assam to the rain lashed hills of Meghalaya. The region varies not only in topography but in tribes, customs and wildlife. At the centre of a major biodiversity region, North East India is also known for its varied amphibian diversity. In fact, North East India falls under two biodiversity hotspots: Himalaya & Indo-Burma (<http://www.conservation.org>). Altogether, 119 species of amphibians were reported from the region recently (Mathew & Sen, 2010), which is increasing year after year.

In recent times many new amphibian species were discovered from North East India. The most prominent among these that caught the attention of common people were those of legless amphibians (caecilians) found in this region, including the discovery of a new amphibian family (Chikilidae) that has an African link (Kamei et. al., 2012).

The present study was undertaken to clear the back log collection of unidentified amphibian specimens present at the holdings of North Eastern Regional Centre of Zoological Survey of India in

Shillong. During the year 2011-12 and 2012-13, taxonomic studies were done on 399 specimens belonging to the Order Anura. These anurans were identified into 19 species belonging to 11 genera and 6 families. A new district record of *Amolops assamensis* Sengupta, Hussain, Choudhury, Gogoi, Ahmed and Choudhury, 2008 was confirmed from Janitia Hills and Ri-Bhoi districts of Meghalaya during the study. Classification followed after Frost (2014). IUCN status followed after <http://www.iucnredlist.org>.

### SYSTEMATIC LIST

Class AMPHIBIA

Order ANURA

Family BUFONIDAE

*Duttaphrynus melanostictus* (Schneider, 1799)

Family DICROGLOSSIDAE

*Euphlyctis cyanophlyctis* (Schneider, 1799)

*Euphlyctis hexadactylus* (Lesson, 1834)

*Zakerana limnocharis* (Gravenhorst, 1829)

*Zakerana nepalensis* (Dubois, 1975)

*Zakerana pierrei* (Dubois, 1975)

*Zakerana syhadrensis* (Annandale, 1919)

*Zakerana teraiensis* (Dubois, 1984)

*Hoplobatrachus tigerinus* (Daudin, 1802)

Family MEGOPHRYIDAE

*Megophrys robusta* (Boulenger, 1908)

## Family MICROHYLIDAE

*Microhyla ornata* (Dumeril & Bibron, 1841)

## Family RANIDAE

*Amolops assamensis* Sengupta, Hussain, Choudhury, Gogoi, Ahmed and Choudhury, 2008\**Amolops formosus* (Gunther, 1876)*Amolops gerbillus* (Annandale, 1912)*Clinotarsus alticola* (Boulenger, 1887)*Hylarana erythraea* (Schlegel, 1937)

## Family RHACOPHORIDAE

*Polypedates leucomystax* (Gravenhorst, 1829)*Rhacophorus bipunctatus* Ahl, 1927*Rhacophorus maximus* Gunther, 1858

## Class AMPHIBIA

## Order ANURA

## Family BUFONIDAE

1. *Duttaphrynus melanostictus*  
(Schneider, 1799)

## Common Indian Toad (Fig. 1)

1799. *Bufo melanostictus* Schneider, *Hist. Amph.*, 1: 216  
(Type locality: "Ex India Orientalis")

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1050) Daribokgre IB compound, East Garo Hills dist., Meghalaya, 25.06.2008; 1 ex. (Regd. no. V/A/NERC/1077), Rekdekon vill., Kolasib dist., Mizoram, (night collection), Alt. 890m asl, 25.09.2005, coll. R. Mathew & party; 1 ex. (Regd. no. V/A/NERC/1078), Chamata, Nalbari, Assam, 29.08.2004, coll. Riyaz uddin Ahmed; 2 exs. (Regd. no. V/A/NERC/1079), Zero, 13 Kms from Circuit House, Tlangung, Lunglei dist., Mizoram, Alt. 103m asl, 9.06.2006, coll. R. Mathew & party; 1 ex. (Regd. no. V/A/NERC/1039), MeECL IB, Kyrdem kulai, Ri-Bhoi dist, Meghalaya, Alt. 771m asl, 18.06.2012, coll. Dr. D. Khyrniam & party; 2 exs (Regd. no. V/A/NERC/1149), Nokrek Biosphere Reserve, Manchuri Chiring, West Garo Hills, Meghalaya, Alt. 650m asl, 23.06.2008, coll. R. Mathew & party.

*Distribution:* INDIA: Meghalaya, Assam, Arunachal Pradesh, Manipur, Mizoram, Nagaland,

Sikkim, Tripura in NE India and also throughout India. *Elsewhere:* Bali, Borneo, China, Hong Kong, Indonesia, Java, Malaysia, Myanmar, Nepal, Pakistan, The Philippines, Sumatra, Thailand, Sri Lanka.

*Remarks:* Widely distributed species. *IUCN Status:* Least Concern.

## Family DICROGLOSSIDAE

2. *Euphlyctis cyanophlyctis* (Schneider, 1799)

## Indian Skipper Frog (Fig. 2)

1799. *Rana cyanophlyctis*, Schneider, *Hist. Amph.*, 8: 137  
(Type locality: "Eastern India")

*Material Examined:* 12 exs. (Regd. no. V/A/NERC/1041), Goirangre, West Garo Hills dist., Meghalaya, 1.10.2008, coll. R. Mathew & party; 3 exs. (Regd. no. V/A/NERC/1042), Rongram Causeway over Rongram river, West Garo Hills, Meghalaya, Alt. 466m asl, 18.6.2008, coll. R. Mathew & party; 1 ex. (Regd. no. V/A/NERC/1043), Didari Chiring and around, East Garo Hills, Meghalaya, 28.9.2008, coll. R. Mathew & party; 3 exs. (Regd. no. V/A/NERC/1046), Forest area behind NHPC Guest House, Ziro-Hapoli, Subansiri dist, Arunachal Pradesh, 2.6.2007, coll. R. Mathew & party; 6 exs. (Regd. no. V/A/NERC/1047), Near river Bairang, Mawbang vill., East Khasi Hills dist, (on the way to Shella), Meghalaya, 28.8.2009, coll. A. Rana & party; 1 ex. (Regd. no. V/A/NERC/1058), Nokrek Biosphere Reserve, Shrut Majang sill, Fishery compound, East Garo Hills, Meghalaya, Alt. 854m asl, 12.2.2008, coll. R. Mathew & party; 1 ex. (Regd. no. V/A/NERC/1060), Stream, Nongstoin vill., West Khasi Hills dist., Meghalaya, coll. J. Lyngdoh & party; 14 exs. (Regd. no. V/A/NERC/1081) Chisobibra from stream flowing to Samsang river, Nokrek BR, Meghalaya, 27.06.2008, coll. R. Mathew & party; 17 exs. (Regd. no. V/A/NERC/1082), Dilpai river downstream, Gerukamukh, Dhemaji, Assam, 3.07.2007, coll. coll. R. Mathew & party; 1 ex. (Regd. no. V/A/NERC/1091), Near Kanchakhuli, East Khasi Hills, Meghalaya, 7.09.2011, coll. A. Rana & party; 5 exs. (Regd. no. V/A/NERC/1092), Near Dharam Basti area, East Khasi Hills,

Meghalaya, 7.09.2011, coll. A. Rana & party; 6 exs. (Regd. no. V/A/NERC/1093), Near Dharam Basti area, East Khasi Hills, Meghalaya, coll. A. Rana & party; 1 ex. (Regd. no. V/A/NERC/1115), Ialong paddy field, Jaintia Hills district, Jowai, Meghalaya, Alt. 1363m asl, 16.06.2005, J. Lyngdoh & party; 13 exs. (Regd. no. V/A/NERC/1116), Theobonggre Soil Conservation Farm, on Rongram-Dadengiri Road, West Garo Hills, Meghalaya, 23.03.2007, J. P. Sati & party; 5 exs. (Regd. no. V/A/NERC/1117), Mandalgre (paddy field), East Agro Hills, Meghalaya, Alt. 934m asl, 19.01.2008, Dr. D. Khyntiam & party; 20 exs. (Regd. no. V/A/NERC/1118), Dilpai river above bridge, Gerukamukh, Assam, 2.07.2007, R. Mathew & party; 6 exs. (Regd. no. V/A/NERC/1120), Near river Bairong, Mawbong vill., East Khasi Hills, Meghalaya, on the way to Shella, 28.8.2009; 1 ex. (Regd. no. V/A/NERC/1132), Wah Umdap, Shakhoikuna vill., Ri-Bhoi dist., Meghalaya, Alt. 172m asl, 27.02.2012, J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1133), Umtyilli Str (II), Diwon vill., Ri-Bhoi, Meghalaya, Alt. 509m asl, 1.03.2012; 2 exs. (Regd. no. V/A/NERC/1138), Umbagor stream, Nongkyllerm RF, Ri-Bhoi, Meghalaya, Alt. 609m asl, 20.06.2012, Dr. D. Kynriam & party; 4 exs. (Regd. no. V/A/NERC/1146), Munglai Nadi, Talukie, Peren Dist., Nagaland, Alt. 394 m asl, 12.09.2006, R. Mathew & party; 3 exs. (Regd. no. V/A/NERC/1150), Amjalong, Umjalong Kyrweng vill., Jaintia Hills dist., Meghalaya, Alt. 25m asl, 18.10.2006, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1152), Umsharhei, Tasku, Lailad, Ri-Bhoi dist., Meghalaya, Alt. 873 ft. asl, 20.09.2012, coll. Dr. D. Khyntiam & party; 3 exs. (Regd. no. V/A/NERC/1155), Nokrek Biosphere Reserve, West Garo Hills, Selbalgre Chirang, Meghalaya 26.04. 2008, coll. R. Mathew & party; 8 exs. (Regd. no. V/A/NERC/1157), Rynku area, Indo-Bangladesh border, East Khasi Hills, Meghalaya, 24.03. 2012, coll. A. Rana & party; 1 ex. (Regd. no. V/A/NERC/1158), Umsahong, Mawshainam village, Ri-Bhoi dist., Meghalaya, Alt. 781m asl, 6.11. 2012, coll. J. Lyngdoh & party; 5 exs. (Regd. no. V/A/NERC/1159), Umtarku stream, Them-Pahambir village, Ri-Bhoi dist., Meghalaya, Alt.

536m asl, 7.11. 2012, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1161), Bansada Stream, Sohriewblei village, Ri-Bhoi dist., Meghalaya, Alt. 870m asl, 8.11. 2012, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1166), Umdu stream, Umdu village, Ri-Bhoi dist., Meghalaya, Alt. 285m asl, 6.12. 2012, coll. D. Khyntiam & party; 1 ex. (Regd. no. V/A/NERC/1168), Wah Kynshi, Vill. Ranikor, West Khasi Hills dist., Meghalaya, Alt. 9m asl, 05.03. 2013, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1169), stream, Vill. Gumaghat, West Khasi Hills dist., Meghalaya, Alt. 14 m asl, 04.03. 2013, coll. J. Lyngdoh & party; 2 exs. (Regd. no. V/A/NERC/1170), Wah Pathar, Vill. Pyndengrei, West Khasi Hills dist., Meghalaya, Alt. 1312m asl, 08.03. 2013, coll. J. Lyngdoh & party.

*Distribution:* INDIA: Meghalaya, Assam, Arunachal Pradesh, Manipur, Mizoram, Nagaland, Tripura in NE India and also throughout India. *Elsewhere:* Afghanistan; Bangladesh; Bhutan; Malaya, Myanmar; Nepal, Pakistan, Saudi Arabia; Sri Lanka

*Remarks:* Widely distributed species. *IUCN Status:* Least Concern.

### 3. *Euphlyctis hexadactylus* (Lesson, 1834)

Indian Pond Frog (Fig. 3 (A) & 3 (B))

1834. *Rana hexadactylus* Lesson, *Voy. Ind. Or. Rept.*,: 331 (Type locality: "South India")

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1043), Didari Chiring and around, East Garo Hills, Meghalaya, 28.9.2008, coll. R. Mathew & party; 73 exs. (Regd. no. V/A/NERC/1048), Paomari stream, Walong, Anjaw district, Arunachal Pradesh, 10.03.2007 coll. R. Mathew & party; 7 exs. (Regd. no. V/A/NERC/1059), Thebonggre, Soil Conservation Farm, on Rongram-Dadengiri Road, West Garo Hills, Meghalaya, 23.03.2007; J. P. Sati & party; 3 exs. (Regd. no. V/A/NERC/1080), Stream, Lamsaki village, Jaintia Hills dist., Meghalaya, 4.02.2007, J. Lyngdoh & party; 3 exs. (Regd. no. V/A/NERC/1089), Near Lyngkyrdem vill., on the way to Pynursla, Meghalaya, 9.09.2011,

coll. A. Rana & party; 2 exs. (Regd. no. V/A/NERC/1090), Near Ischamati, Beltoli area, East Khasi Hills, Meghalaya, 7.09.2011, coll. A. Rana & party; 1 ex. (Regd. no. V/A/NERC/1104), Forest area of Doguria Baba Mandir, Pasighat, Arunachal Pradesh, 15.07.2010, donated by K. K. Jha; 3 exs. (Regd. no. V/A/NERC/1119), Thelenchee river, 3 Kms South-West of Kherapara, West Garo Hills, Meghalaya, 24.03.2007, coll. J. P. Sati & party; 1 ex. (Regd. no. V/A/NERC/1034), Wah Umling (upstream), Umling vill., Ri-Bhoi, Meghalaya, Alt. 246m asl, 26.02.2012, coll. J. Lyngdoh & party; 5 exs. (Regd. no. V/A/NERC/1035), Umdo stream, Umdo vill., Ri-Bhoi, Meghalaya, Alt. 296m asl, 26.02.2012, coll. J. Lyngdoh & party; 5 exs. (Regd. no. V/A/NERC/1036), Beltoli area, East Khasi Hills, Meghalaya, Alt. 29m asl, 22.03.2012, coll. A. Rana & party; 4 exs. (Regd. no. V/A/NERC/1037), Mawblei area (near Indo Bangla Border), East Khasi Hills, Meghalaya, Alt. 50m asl 22.03.2012, coll. A. Rana & party; 3 exs. (Regd. no. V/A/NERC/1147), Umnlai, Pysadwar, Jaintia Hills, Meghalaya, Alt. 21m asl, 17.10.2006, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1162), Stream, Mawhati village, Ri-Bhoi dist., Meghalaya, Alt. 1040m asl, 6.11. 2012, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1163), Stream-2, Umbir village, Ri-Bhoi dist., Meghalaya, Alt. 1116m asl, 9.11. 2012, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1167), Umdu Stream, Umling Nongkhyllum RF, Ri-Bhoi dist., Meghalaya, Alt. 246m asl, 6.12. 2012, coll. D. Khyndriam & party; 2 exs. (Regd. no. V/A/NERC/1171), Stream, Rajai (A) Vill. West Khasi Hills Dist., Meghalaya, Alt. 13m asl, 05.03. 2013, coll. J. Lyngdoh & party.

*Distribution:* INDIA: Meghalaya, Assam, Arunachal Pradesh, Manipur, Mizoram, Nagaland, Tripura in NE India and also throughout India. *Elsewhere:* Bangladesh; Myanmar; Pakistan; Sri Lanka

*Remarks:* Predominantly a peninsular India species, Sen & Mathew (2004) reported its presence in North East India. *IUCN Status:* Least Concern.

#### 4. *Zakerana limnocharis* (Gravenhorst, 1829)

##### Cricket Frog

1829. *Rana limnocharis* (Gravenhorst), *Del. Mus. Zool.*, : 42 (Type locality: "Java", Indonesia).

*Material Examined:* 3 exs. (Regd. no. V/A/NERC/1072), Sonaichori, Riangpara, Belonia, South Tripura, Alt. 24m asl, 16.09.2005, coll. R. Mathew & party; 2 exs. (Regd. no. V/A/NERC/1083), Kharsand, Arunachal Pradesh, Alt. 167m asl, 2.06.2005, coll. R. Mathew & party.

*Distribution:* INDIA: Assam, Manipur, Nagaland, Arunachal Pradesh, Manipur, Mizoram, Tripura in NE India and Rest of India. *Elsewhere:* Nepal; Borneo; China; Japan; Malaya Peninsula; Myanmar; Pakistan; Philippines; Sri Lanka; Indonesia; Taiwan; Thailand; Vietnam.

*Remarks:* Population trend stable. *IUCN Status:* Least Concern.

#### 5. *Zakerana nepalensis* (Dubois, 1975)

##### Nepal Warty Frog

1975. *Rana nepalensis* Dubois, *C. R. Acad. Sc.*, Paris, t. (D) 281: 1771-1720.

*Material Examined:* 4 exs. (Regd. no. V/A/NERC/1073), Sonaichori, Riangpara, Belonia, South Tripura, Alt. 24m asl, 16.09.2005, coll. R. Mathew & party; 3 exs. (Regd. no. V/A/NERC/1113), Ialong paddy field, Jaintia Hills district, Jowai, Meghalaya, Alt. 1363m asl, 16.06.2005, coll. J. Lyngdoh & party; 2 exs. (Regd. no. V/A/NERC/1156), Nokrek Biosphere Reserve, West Garo Hills, Selbalgre Chirang, Meghalaya, 26.04. 2008, coll. R. Mathew & party.

*Distribution:* INDIA: Assam, Manipur, Nagaland, Arunachal Pradesh, West Bengal, Uttar Pradesh, Uttrakhand. *Elsewhere:* Nepal.

*Remarks:* Population trend stable. *IUCN Status:* Least Concern

#### 6. *Zakerana pierrei* (Dubois, 1975)

##### Pierre's Cricket Frog

1975. *Rana pierrei* Dubois, *C. R. Acad. Sc.*, Paris, t. (D) 281: 1771-1720.

*Material Examined:* 4 exs. (Regd. no. V/A/

NERC/1074), Sonaichori, Riengpara, Belonia, South Tripura, Alt. 24m asl, 16.09.2005, coll. R. Mathew & party; 3 exs. (Regd. no. V/A/NERC/1108), Nongmynsong – Polo, East Khasi Hills, Shillong, 15.07.2004, coll. R. Mathew & N. Sapkota; 1 ex. (Regd. no. V/A/NERC/1109), District Park, Lunglei, Mizoram, Alt. 1128m asl, 3.06.2006, coll. R. Mathew & party; 2 exs. (Regd. no. V/A/NERC/1111), Risa Colony Forest area, Shillong, East Khasi Hills, Meghalaya, 13.05.2007, coll. N. Sapkota; 1ex. (Regd. no. V/A/NERC/1114), Ialong paddy field, Jaintia Hills district, Jowai, Meghalaya, Alt. 1363m asl, 16.06.2005, coll. J. Lyngdoh & party; 1 exs. (Regd. no. V/A/NERC/1148), Umnlai, Pysadwar, Jaintia Hills, Meghalaya, Alt. 21m asl, 17.10.2006, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1160), Umtarku stream, Them-Pahambir village, Ri-Bhoi dist., Meghalaya, Alt. 536m asl, 7.11. 2012, coll. J. Lyngdoh & party.

*Distribution:* INDIA: Assam, Manipur, Nagaland, Meghalaya, Mizoram, Arunachal Pradesh, West Bengal, Bihar, Uttar Pradesh, Uttrakhand. *Elsewhere:* Nepal.

*Remarks:* Common species. *IUCN Status:* Least Concern.

#### 7. *Zakerana syhadrensis* (Annandale, 1919)

Syhadra Frog (Fig. 4)

1919. *Rana limnocharis syhadrensis* Annandale, *Rec. Indian Mus.*, 16: 123.

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1049), Daribokgre IB compound, East Garo Hills dist., Meghalaya, Nokrek BR Survey, 25.06.2008, coll. R. Mathew & party; 6 exs. (Regd. no. V/A/NERC/1061), Umsohthiang, Warsohthiang vill., West Khasi Hills dist., Meghalaya, 2.08.2011, coll. J. Lyngdoh & party; 18 exs. (Regd. no. V/A/NERC/1075), Sonaichori, Riengpara, Belonia, South Tripura, Alt. 24m asl, 16.09.2005, coll. R. Mathew & party; 3 exs. (Regd. no. V/A/NERC/1084), Kharsand, Arunachal Pradesh, Alt. 167m asl, 2.06.2005, coll. R. Mathew & party; 7 exs. (Regd. no. V/A/NERC/1160), Srilake, near Kibali Village, 5 kms after Roing, Arunachal Pradesh 6.3.2007, coll. R. Mathew

& party; 4 exs. (Regd. no. V/A/NERC/1107), Nongmynsong – Polo, East Khasi Hills, Shillong, 15.07.2004, coll. R. Mathew & N. Sapkota; 3 exs. (Regd. no. V/A/NERC/1110), District Park, Lunglei, Mizoram, Alt. 1128m asl, 3.06.2006, coll. R. Mathew & party; 3 exs. (Regd. no. V/A/NERC/1112), State Agricultural Research Station, Yisemyong, Mokokchung, Nagaland, Alt. 1042m asl, 08.08.2005, coll. R. Mathew & party; 1 ex. (Regd. no. V/A/NERC/1151), Umsharhei, Tasku, Lailad, Ri-Bhoi dist., Meghalaya, Alt. 873 ft. asl, 20.09. 2012, coll. Dr. D. Khyntiam & party; 1 ex. (Regd. no. V/A/NERC/1164), Stream, Umraling village, Ri-Bhoi dist., Meghalaya, Alt. 851m asl, 8.11. 2012, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1172), Birbah Lake, Nonkhyllum WLS, Ri-Bhoi dist., Meghalaya, Alt. 649m asl, 13.13 2013, coll. Dr. D. Khyntiam & party.

*Distribution:* INDIA: Assam, Manipur, Meghalaya in NE India and Northern India. *Elsewhere:* Nepal; Bangladesh; Pakistan.

*Remarks:* Fairly common. *IUCN Status:* Least Concern.

#### 8. *Zakerana teraiensis* (Dubois, 1984.)

Terai Warty Frog

1984. *Rana (Fejervarya) teraiensis* Dubois, *Alytes*, 3: 143-159.

*Material Examined:* 2 exs. (Regd. no. V/A/NERC/1076), Sonaichori, Riengpara, Belonia, South Tripura, Alt. 24m asl, 16.09.2005, coll. R. Mathew & party; 2 exs. (Regd. no. V/A/NERC/1085), Kharsand, Arunachal Pradesh, Alt. 167m asl, 2.06.2005, coll. R. Mathew & party.

*Distribution:* INDIA: Meghalaya, Mizoram, Manipur, Tripura, Nagaland, Arunachal Pradesh, Assam in NE India, West Bengal, Bihar, Uttar Pradesh, Uttrakhand. *Elsewhere:* Nepal.

*Remarks:* Not common in the area under report. *IUCN Status:* Least Concern.

#### 9. *Hoplobatrachus tigerinus* (Daudin, 1803)

Indian Bull Frog (Fig. 5)

1803. *Rana tigerina* Daudin, *Hist. Rain. Gren. Crap.*: 64. (Type Locality: "Bengal").

*Material Examined:* 4 ex. (Regd. no. V/A/NERC/1086), Kharsand, Arunachal Pradesh, Alt. 167m asl, 2.06.2005, coll. R. Mathew & party,

*Distribution:* INDIA: Meghalaya, Assam, Arunachal Pradesh, Manipur, Mizoram, Nagaland, Tripura in NE India and also throughout India  
*Elsewhere:* Bangladesh; China; Madagascar (Introduced); Myanmar; Nepal, Pakistan, Sri Lanka

*Remarks:* Not common in occurrence. *IUCN Status:* Vulnerable

#### Family MEGOPHRYIDAE

##### 10. *Megophrys robusta* (Boulenger, 1908)

White lipped horned toad (Fig. 6)

1908. *Megalophrys robusta* Boulenger, *Proc. Zool. Soc. London*: 418 (Type locality: "Darjeeling", West Bengal, India).

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1051), War Umsning, East Khasi Hills, Meghalaya, 19.8.2006, coll. S. Swell.

*Distribution:* INDIA: Assam, Nagaland, Meghalaya, Arunachal Pradesh, Sikkim in NE India and West Bengal. *Elsewhere:* China; Myanmar; Vietnam; Hong Kong; Bangladesh; Nepal.

*Remarks:* Rarely found. *IUCN Status:* Data deficient.

#### Family MICROHYLIDAE

##### 11. *Microhyla ornata* (Dumeril & Bibron, 1841)

Ornate Narrow Mouthed Frog

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

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1094), Near Tyrna area, East Khasi Hills, Meghalaya, 8.09.2011, coll. A. Rana & party.

*Distribution:* INDIA: Throughout India.  
*Elsewhere:* China; Japan; Taiwan; Malaysia; Myanmar; Bangladesh; Bhutan; Nepal; Pakistan.

*Remarks:* Not very common in the area under report. *IUCN Status:* Least Concern.

#### Family RANIDAE

##### 12. *Amolops assamensis* Sengupta, Hussain, Choudhury, Gogoi, Ahmed and Choudhury, 2008

Sengupta's Cascade frog (Fig. 7)

2008. *Amolops assamensis* Sengupta, Hussain, Choudhury, Gogoi, Ahmed and Choudhury, *Hamadryad*, **32**(1): 5-12 (Type locality: "Mayeng Hill Reserve Forest, Kamrup District, Assam, north-eastern India").

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1052), Krem Umshangkhet, Thangski vill., Janitia Hills Dist., Meghalaya, 1.02.2007, coll. I. J. Kharkongor & party; 1 ex. (Regd. no. V/A/NERC/1163), Stream, Ummyrkng village, Ri-Bhoi dist., Meghalaya, Alt. 905m asl, 9.11. 2012, coll. J. Lyngdoh & party.

*Distribution:* INDIA: Assam, Meghalaya in NE India. *Elsewhere:* Nil.

*Remarks:* Both the specimens are new district records. *IUCN Status:* Data deficient.

##### 13. *Amolops formosus* (Gunther, 1876)

Assam Cascade Frog

1876. *Polypedates formosus* Gunther, *Proc. Zool. Soc., London*: 570. (Type locality: "Khasya" India)

*Material Examined:* 2 exs. (Regd. no. V/A/NERC/1053), Krem Umshangkhet, Thangski vill., Janitia Hills Dist., Meghalaya, 1.02.2007, coll. I. J. Kharkongor & party; 2 exs. (Regd. no. V/A/NERC/1055), Krem Ummadoh, Lumshnong vill., Jaintia Hills dist., Meghalaya, 2.02.2007, coll. I. J. Kharkongor & party.

*Distribution:* INDIA: Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Sikkim in NE India and Punjab, West Bengal, Uttar Pradesh.  
*Elsewhere:* Nepal.

*Remarks:* Population trend decreasing. *IUCN Status:* Least Concern.

##### 14. *Amolops gerbillus* (Annandale, 1912)

Gerbil's Stream Frog

1912. *Rana gerbillus* Annandale, *Rec. Indian Mus.*, **8**(1): 10 (Type Locality: Yembung, Abor foothills at an altitude of 1100 feet, Arunachal Pradesh).

*Material Examined:* 4 exs. (Regd. no. V/A/NERC/1054), Krem Umshangkhet, Thangski vill., Janitia Hills Dist., Meghalaya, 1.02.2007, coll. I. J. Kharkongor & party, 4 exs. (Regd. no. V/A/NERC/1056), Krem Ummadoh, Lumshnong vill., Janitia Hills dist., Meghalaya, 2.02.2007, coll. I. J. Kharkongor & party, 5 exs. (Regd. no. V/A/NERC/1057), Ganol river, Nokrek BR, East Garo Hills dist., Meghalaya, Alt. 964 m asl 13.02.2008, coll. R. Mathew & party, 1 ex. (Regd. no. V/A/NERC/1153), Um-mluh river, Nongkhyllum WLS, Lailad, Ri-Bhoi dist., Meghalaya, Alt. 951 ft. asl, 19.09. 2012, coll. Dr. D. Khyntiam & party.

*Distribution:* INDIA: Arunachal Pradesh, Meghalaya, Assam, Mizoram, Manipur, Nagaland, Sikkim in NE India and West Bengal. *Elsewhere:* China; Myanmar.

*Remarks:* Fairly common. *IUCN Status:* Least Concern.

15. *Clinotarsus alticola* (Boulenger, 188)

High altitude frog

1882. *Rana alticola* Boulenger, *Cat. Batr. Sal. Brit. Mus.*: 62

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1062), Umkyllain, Urkali vill., West Khasi Hills, Meghalaya, 1.08.2011, coll. J. Lyngdoh & party; 1 ex. (Regd. no. V/A/NERC/1087), Kharsand, Arunachal Pradesh, Alt. 167m asl, 2.06.2005, coll. R. Mathew & party.

*Distribution:* INDIA: Arunachal Pradesh, Meghalaya, Assam, Mizoram, Manipur, Nagaland NE India and West Bengal. *Elsewhere:* China; Myanmar; Bangladesh.

*Remarks:* Rarely found. *IUCN Status:* Least Concern.

16. *Hylarana erythraea* (Schlegel, 1937)

Green Paddy Frog

1837. *Hyla erythraea* Schlegel, *Abbild. Neuer Unvollst. Amph.*, 1: 27.

*Material Examined:* 1 ex. (V/A/NERC/ZSI/1173), Umrah huleng, Nongkhyllum WLS, Ri-Bhoi dist., Meghalaya, Alt. 422 m asl 13.03.2013, coll. Dr. D. Khyntiam & party.

*Distribution:* INDIA: Manipur, Arunachal Pradesh, Assam, Meghalaya, Mizoram, Nagaland in NE India. *Elsewhere:* Cambodia; Laos; Indonesia; Malaysia; Singapore; Thailand; Vietnam; Bangladesh.

*Remarks:* Rarely found. *IUCN Status:* Least Concern.

17. *Polypedates leucomystax*  
(Gravenhorst, 1829)

Common Tree Frog (Fig. 8)

1829. *Hyla leucomystax* Gravenhorst, *Syst. Rept.*: 31 (type Locality: "Java")

*Material Examined:* 1 ex. (V/A/NERC/ZSI/1070), Lawngtlai (2 Km from PWD Rest House) dist., Mizoram (night collection), Alt. 834 m asl 7.06.2006, coll. R. Mathew & party; 5 ex. (V/A/NERC/ZSI/1088), Kharsand, Arunachal Pradesh, Alt. 167m asl, 2.06.2005, coll. R. Mathew & party.

*Distribution:* INDIA: Manipur, Mizoram, Assam, Meghalaya, Arunachal Pradesh, Tripura, Sikkim in NE India, Nicobar island, West Bengal. *Elsewhere:* Bangladesh; Cambodia; China; Indonesia; Laos; Malaysia; Myanmar; Nepal; The Philippines; Thailand; Singapore; Vietnam.

*Remarks:* A species complex. *IUCN Status:* Least Concern.

18. *Rhacophorus bipunctatus* Ahl, 1927

Double Spotted Red Webbed Tree Frog  
(Fig. 9)

1927. *Rhacophorus bipunctatus* Ahl, *Sitzungsber. Ges. Naturforsch. Freunde Berlin*, 1927: 46.

*Material Examined:* 4 exs. (Regd. no. V/A/NERC/1045), Motinagar forest area, Shillong, East Khasi hills, Meghalaya. 21.5.2007, coll. R. Mathew: 4 exs. (Regd. no. V/A/NERC/1071), ERS/ZSI Qtr. Forest area, Risa colony, Shillong, 09.05.2007, coll. J. P. Sati & party: 4 exs. (Regd. no. V/A/NERC/1145), Motinagar forest area, Shillong, East Khasi Hills, Meghalaya, 21.05.2007, coll. R. Mathew.

*Distribution:* INDIA: Manipur, Assam, Meghalaya, Arunachal Pradesh, Tripura, Nagaland in NE India. *Elsewhere:* Bangladesh; China; Indonesia; Malaysia; Myanmar; Thailand.

*Remarks:* Commonly found. *IUCN Status:* Least Concern.

19. *Rhacophorus maximus* Gunther, 1858

Large Tree Frog

1858. *Rhacophorus maximus* Gunther, *Arch. Naturgesch.*, **24**: 325.

*Material Examined:* 1 ex. (Regd. no. V/A/NERC/1105), from the tank of the Department of Zoology, J. N. College, Pasighat, Arunachal Pradesh, 25.03.2011, donated by K.K.Jha.

*Distribution:* INDIA: Manipur, Arunachal Pradesh, Assam, Meghalaya, Mizoram, Nagaland in NE India. *Elsewhere:* Bangladesh; China; Nepal; Myanmar; Thailand.

*Remarks:* Population trend decreasing. *IUCN Status:* Least Concern.

### SUMMARY

Altogether 399 specimens of anuran amphibians were studied. They were identified into 19 species belonging to 11 genera and 6 families. A new district record of *Amolops assamensis* Sengupta *et. al.*, 2008 was confirmed from Jaintia Hills and

Ri-Bhoi districts of Meghalaya during the study. The number of species in terms of examples studied is less, as two major taxonomic works were done by Mathew and Sen (2009 & 2010) on amphibia before this project, where many new amphibian species including new India records were reported. Therefore, this project got to study what was left unidentified and hence resulted in not any exciting findings. However, with the recent discoveries of many new records and new species from this region by Mathew & Sen (2009 & 2009a), Kamei *et. al.* (2012), Das *et. al.* (2013) and others, the region promises of many new future findings.

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### REFERENCES

- [http://www.conservation.org/where/priority\\_areas/hotspots/asia-pacific/Pages/asia-pacific.aspx](http://www.conservation.org/where/priority_areas/hotspots/asia-pacific/Pages/asia-pacific.aspx)  
<http://www.iucnredlist.org/>
- Frost, D. R. 2014. Amphibian Species of the World: an Online Reference. Version 6.0 (10 June, 2014). Electronic Database accessible at <http://research.amnh.org/herpetology/amphibia/index.html>. American Museum of Natural History, New York, USA.
- Das, A., Chetia, M., Dutta, S. K. and Sengupta, S., 2013. A new species of *Duttaphrynus* (Anura: Bufonidae) from Northeast India. *Zootaxa*, **3646**(4): 336-348.
- Kamei, R. G., Mauro, D. S., Gower, D. J., Bocxlaer, I. V., Sherratt, E., Thomas, A., Babu, S., Bossuyt, F., Wilkinson, M., Biju, S. D., 2012. *Pr. R. Soc.*: doi:10.1098/rspb.2012.0150 (Published online).
- Mathew, R. and Sen, N, 2009. *Studies on little known amphibian species from North East India*: 1-64 (Published by the Director, *Zool. Surv. India*, Kolkata).
- Mathew, R. and Sen, N, 2009a. Studies on Caecilians (Amphibia: Gymnophiona: Ichthyophiidae) of North East India with description of three new species of *Ichthyophis* from Garo Hill, Meghalaya and additional information on *Ichthyophis garoensis* Pillai and Ravichandran, 1999. *Rec. zool. Surv. India, Occ. Paper No.*, **309**: 1-56 (Published by the Director, *Zool. Surv. India*, Kolkata).
- Mathew, R. and Sen, N, 2010. *Pictorial Guide to Amphibians of North East India*: 1- 144 (Published by the Director, *Zool. Surv. India*, Kolkata).
- Sen, N. and Mathew, R. 2004. Occurrence of *Euphyllctis hexadactylus* (Lesson, 1834) (Amohibia: Anura: Ranidae) in North East India with notes on its morphological characters. *Cobra*, Vol. **5**: 1-6.

PLATE-I



Fig. 1. *Duttaphrynus melanostictus* (Schneider, 1799)



Fig. 2. *Euphlyctis cyanophlyctis* (Schneider, 1799)



Fig. 3(A). *Euphlyctis hexadactylus* (Lesson, 1834)



Fig. 3(B). *Euphlyctis hexadactylus* (Lesson, 1834), showing the large inner metatarsal tubercle.



Fig. 4. *Zakerana syhadrensis* (Annandale, 1919)

## PLATE-II



Fig. 5. *Hoplobatrachus tigerinus* (Daudin, 1802)



Fig. 6. *Megophrys robusta* (Boulenger, 1908)



Fig. 7. *Amolops assamensis* Sengupta et al., 2008

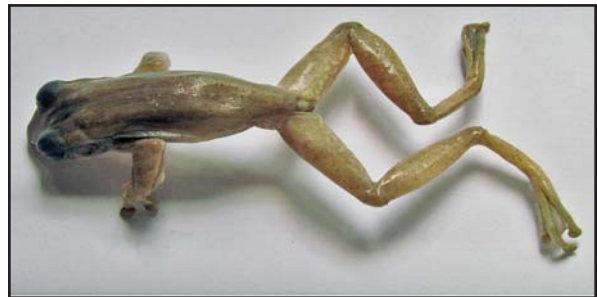
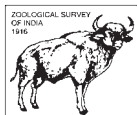


Fig. 8. *Polypedates leucomystax* (Gravenhorst, 1829)



Fig. 9. *Rhacophorus bipunctatus* Ahl, 1927



## STATUS SURVEY OF INDIAN GOLDEN GECKO, *CALODACTYLODES AUREUS* (BEDDOME, 1870) IN EASTERN GHATS, INDIA

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### INTRODUCTION

The Eastern Ghats are isolated hill ranges spreading across states of Andhra Pradesh, Odisha, Tamil Nadu and Karnataka in Peninsular India and covers an area of about 1750 km. It lies in 11° 30' to 21° 0' N Latitudes and 77° 22' to 85° 20' E Longitudes. It is included under 6°C eastern highlands of the Deccan plateau and one of the biologically richest biogeographic zones of India (Rodgers *et al.*, 2008).

Golden Geckos are distributed throughout the world and belong to the family Gekkonidae under the Genus *Calodactylodes*. The Genus *Calodactylodes* consists of two species namely, Indian Golden Gecko, *Calodactylodes aureus* (Beddome, 1870) and Sri Lankan Golden Gecko, *Calodactylodes Illingworthorum* (Deraniyagala, 1953). The Indian Golden Gecko was discovered by Beddome, 1870 and Boulenger, 1890 and it was rediscovered after 115 years in Tirupati Hills, Chittoor District, Andhra Pradesh by Daniel and Bhusan (1985).

The Indian Golden Gecko is a protected species and included under Schedule I (part-II) of IWPA, 1972 and had long been considered rare and poorly studied. The Golden Gecko inhabits rocky area with deep stream valleys and has been found to occur at an elevations between 50 to 1000 meters. Present study reports current status along with its conservation, ecology, threats and recent distribution patterns in Eastern Ghats. The study was designed to throw light on (i) present status and population of Indian Golden Gecko and (ii) recent threat and distribution of Indian Golden Gecko in Eastern Ghats.

### TAXONOMY

#### Systematic position of Indian Golden Gecko

Phylum CHORDATA

Sub Phylum VERTEBRATA

Class REPTILIA

Order SQUAMATA

Sub order SAURIA

Family GEKKONIDAE

Genus *Calodactylodes*

Species *Calodactylodes aureus*  
(Beddome, 1870)

*Common Name:* Indian Golden Gecko

*Field Notes:* It has pronounced yellowish or dark brown colour with large oviform head distinct from neck and a strong, rounded supraorbital and canthal ridge. Limbs are long and slender. Head covered with small granules. Digits are slender and clawed. Tail is long cylindrical and slender covered with squarish scales.



Fig. 1. Adult Golden Gecko on rock at Maredumilli, East Godavari

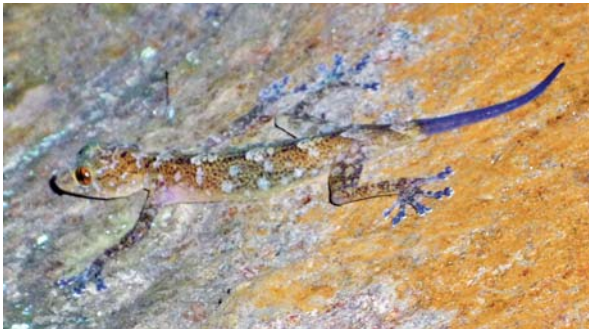
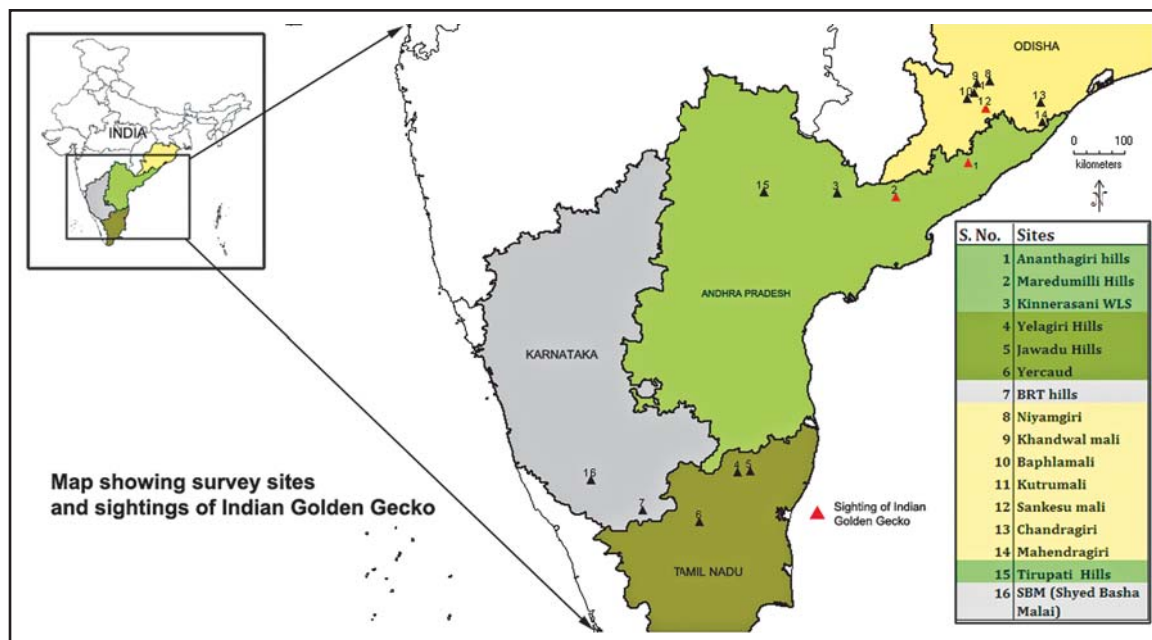


Fig. 2. Adult Golden Gecko on rock of Sankesumali Rayagada

**Known distribution:** The Golden Gecko *Calodactylodes aureus* were recorded from Tirupati hills, Chittoor District, (Daniel *et al.*, 1986); in Araku valley (Chettri & Bhupathy, 2010) recently from Sheshachalam and Velikonda ranges (Guptha *et al.*, 2012) and also reported from Perantalapally (Papikonda hills) in Khammam District (Javed *et al.*, 2007), Maredumill hills in Rajamundry District, Ananthagiri hill in Vishakhapatnam District, Andhra Pradesh (Sreekar *et al.*, 2010); It has been reported and photographed from Castle rock, Karnataka; Balamadi hill, Vellore and Vellore hill fort, North Arcot District, Tamil Nadu; Valli Malai and Sathgar hill in Vellore District, Shyed Basha Malai in Krishangiri district from Tamil Nadu

(Kalaimani & Nath, 2012). Niyamgiri hill ranges of Rayagada, Kalahandi District of Odhisha (Dutta *et al.*, 2005).

**Study areas:** The study was carried out in Eastern Ghats spread over four states and survey carried out at different localities which are as follows; 1. Andhra Pradesh: Ananthagiri hills, Visakhapatnam District ( $18^{\circ} 14' N$  &  $82^{\circ} 50' E$ , elevation above 1000 meters), Maredumill hills, Rajamundry District ( $17^{\circ} 56' N$  &  $82^{\circ} 23' E$ , elevation 900 meters) and Kinnerasani Wildlife sanctuary, Khammam District ( $17^{\circ} 40' N$  &  $80^{\circ} 39' E$ ); 2. Tamil Nadu: Yelagiri hills ( $17^{\circ} 40' N$  &  $80^{\circ} 53' E$ ) and Jawadu hills, Vellore District ( $12^{\circ} 42' N$  &  $70^{\circ} 06' E$ ), Yercaud hills, Salem District ( $11^{\circ} 44' N$  &  $78^{\circ} 12' E$ ); 3. Karnataka: Biligiri Rangaswamy hills, Chamarajanagara District ( $11^{\circ} 59' N$  &  $77^{\circ} 8' E$ ); 4. Odisha : Niyamgiri Hills ( $19^{\circ} 33' N$  &  $83^{\circ} 25' E$ ), Khandwalmali Hills ( $19^{\circ} 29' N$  &  $83^{\circ} 10' E$ ) and Karlapat from Kalahandi District; Baphlamali Hills ( $19^{\circ} 18' N$  &  $82^{\circ} 56' E$ ), Kutrumali Hills ( $19^{\circ} 28' N$  &  $83^{\circ} 06' E$ ) and Sankesumali ( $19^{\circ} 11' N$  &  $83^{\circ} 18' E$ ) from Rayagada District; Chandragiri Hills ( $19^{\circ} 17' N$  &  $84^{\circ} 17' E$ ) and Mahendragiri Hills ( $18^{\circ} 58' N$  &  $84^{\circ} 24' E$ ) from Gajapati District; 5. Tirupati Hills ( $13^{\circ} 42' N$   $79^{\circ} 21' E$ ), Chittoor



Map 1. Map showing the study areas and sighting localities of Indian Golden gecko

District from Andhra Pradesh and Shyed Basha Malai (12° 32' 44.5" N and 78° 12' E), Krishnagiri District from Tamil Nadu.

## TOPOGRAPHY AND CLIMATE OF THE STUDY AREAS

### (i) Anantagiri Hills

*Nature of Terrain:* It comprises of undulating hilly terrain.

*Elevation:* 1000 meters.

*Climate:* Ananthagiri Hills enjoy mild and moderate climate throughout the year.

*Temperature:* The temperatures rarely cross 32° C and are never below 7° C.

*Rainfall range:* The hill receives approximately 900-1700 mm rainfall.

*Type of Vegetation:* The vegetation is of mixed deciduous forest with orchids and ferns as undergrowth. The forests are of secondary types due to shifting cultivation and comprises of rocks and streams.

### (ii) Maredumilli Hills

*Nature of Terrain:* It comprises of undulating hilly terrain

*Elevation:* 900 meters

*Climate:* It is hot during summer and temperature varies between 34-44° C.

*Temperature:* Average ranges between 23.5-43° C

*Rainfall range:* Average rainfall is 100-140 cm

*Type of Vegetation:* The vegetation are characterised by dry deciduous with patches of moist deciduous forests intermingled with scrub.

### (iii) Kinnersani Wildlife Sanctuary

*Elevation:* It has an elevation of 12-600 meters

*Climate:* It is cool, fresh and pleasant and typical Indian climatic condition where summer is dry and hot, temperature rose 50° C and in

monsoon little rain, winter is cold and temperature averages from 28-34° C.



Habitat: Tropical moist deciduous and semievergreen Forest

*Temperature:* The temperature ranges from 10-49° C

*Rainfall range:* Average rainfall is 1334 mm.

*Type of Vegetation:* It is of tropical dry deciduous, tropical moist deciduous, tropical semi evergreen, dry teak, and tropical thorn forest types.

### (iv) Yelagiri Hills

*Nature of Terrain:* It comprises of hilly terrain

*Elevation:* It is located at an elevation of 1050 meters above the sea level.

*Climate:* The weather consists of summer, South East monsoon, North West monsoon and winter. Summer begins from March and it is very hot. Winter is very cool and relatively warmer. The weather remains moderate and pleasant throughout the year.

*Temperature:* The temperature varies between maximum of 30° C and minimum is 18° C.

*Rainfall range:* It receives annual rainfall of 800-900 mm.

*Type of vegetation:* The vegetation is herbs, shrubs and trees and many ethnobotanical plants were also noticed.

### (v) Jawadu Hills

*Nature of Terrain:* It comprises of hilly terrain

*Elevation:* 1100-1150 meters

*Climate:* Subtropical

*Temperature:* 17<sup>0</sup> to 36.5<sup>0</sup> C

*Rainfall range:* The average rainfall is 1100 mm

*Type of Vegetation:* The hill consists of dense forest.

#### (vi) Yercaud Hills

*Nature of Terrain:* It comprises of hilly terrain.

*Elevation:* It is located at an altitude of 1,515 metres above sea level.

*Climate:* The climate is moderate and pleasant, winters are fairly mild, starting in September and ending in December. During winter, the hills are covered in mist.

*Temperature:* The temperature ranges from 15<sup>0</sup> C to 30<sup>0</sup> C throughout the year.

*Rainfall range:* Rainfall is 1500–2000 mm.

*Type of Vegetation:* The Shevaroy range is covered with green grasses and has not any considerable growth of forests. In addition, coffee and citrus fruits, most notably oranges, are grown in abundance apart from bananas, pears and jackfruit in the hill.

#### (vii) Biligiri Rangaswamy Temple Hills

*Nature of Terrain:* It comprises hilly and rocky terrain



Habitat: Evergreen deciduous Forest

*Elevation:* 1400-1800 meters

*Climate:* There is a wide range of climatic condition

*Temperature:* 9 to 16<sup>0</sup> C and 20 to 38<sup>0</sup> C

*Rainfall range:* average rainfall is 600-3000 mm

*Type of Vegetation:* The Hills has evergreen, deciduous, dry and scrub and even high-altitude vegetation.

#### (viii) Niyamgiri Hills

*Nature of Terrain:* It forms a distinct phyto-geographical zone because of its height and its highly precipitous topography.

*Elevation:* It runs in a southwest alignment with a maximum elevation of 1306 meters.

*Climate:* It is pleasant and tropical climate

*Temperature:* 15-45<sup>0</sup> C

*Rainfall range:* 115-145 cm

*Type of Vegetation:* It also has most pristine forests and tropical deciduous type.

#### (ix) Khandualmali Hills

*Nature of Terrain:* It comprises of mountain, hilly interspersed with rivers and valleys.

*Elevation:* It is lying at an elevation of 2310 meters above sea level.

*Climate:* It consist of all five season namely summer, rainy, autumn, winter and spring summer is hot and dry.

*Temperature:* 15-45<sup>0</sup> C

*Rainfall range:* 115-145 cm.

*Type of Vegetation:* It is one of a wealthy reservoir of natural resources like bauxite. The hill comprises of tropical deciduous forests, there is occurrence of semi evergreen, moist deciduous, moist peninsular, sal type and grasslands in different parts of the hill.

#### (x) Baphlamali Hills

*Nature of Terrain:* It comprises of rocky terrain.

*Elevation:* It has highest peak of 1056 meters.

*Climate:* The relative humidity is normally high during the monsoon and post-monsoon months sometimes being more than 85% which favours growth of bryophytes in the hills.

*Temperature:* the maximum temperature goes up to 42<sup>o</sup> C and the minimum drops to 5<sup>o</sup> C.

*Rainfall range:* The average annual rainfall is 1485 mm.

*Type of Vegetation:* It is one of the rich bauxite deposit areas in the Eastern Ghats of India. It is basically of tropical moist deciduous type with many riparian evergreen elements, patchy bamboo thickets and shrub.

#### **(xi) Kutrumali Hills**

*Nature of Terrain:* It comprises of rocky terrain

*Elevation:* It has an elevation of 850 meters.

*Climate:* It is humid and pleasant.

*Temperature:* It ranges from 42-5<sup>o</sup> C

*Rainfall range:* The average rainfall is 1440 mm

*Type of Vegetation:* Kutrumali consists of tropical moist deciduous type of plants. There is occurrence of semi-evergreen moist deciduous, moist peninsular sal type of grasslands at different parts of the hill

#### **(xii) Sankesumali/Hills**

*Nature of Terrain:* It is a hilly range abounds with meandering waterfalls.

*Elevation:* It lies at an elevation of 400-600 meters

*Climate:* The climate in the area is extreme in summer and reaches 36<sup>o</sup> C and in winter dropping to 13<sup>o</sup> C with ample rainfall during monsoon.

*Temperature:* 13-36<sup>o</sup> C

*Rainfall range:* Ample rainfall

*Type of Vegetation:* The forest is deciduous type.

#### **(xiii) Chandragiri Hills**

*Nature of Terrain:* It comprises of hilly terrain

*Elevation:* 1350 meters.

*Climate:* It is moderate and pleasant

*Temperature:* 16-45<sup>o</sup> C

*Rainfall range:* 1403.30 mm

*Type of Vegetation:* The hill comprises of tropical deciduous type of vegetation with moist peninsular sal and dry deciduous forest type.

#### **(xiv) Mahendragiri Hills**

*Nature of Terrain:* It comprises of hilly terrain with undulating topography

*Elevation:* The hill had elevation of 1500 meters above mean sea level.

*Climate:* It is moderate and pleasant.

*Temperature:* 16-45<sup>o</sup> C

*Rainfall range:* The annual rain fall is 1551.6 mm.

*Type of Vegetation:* The hill comprises of grasses, charanockites and khondalites. The forest comprises of tropical moist deciduous and tropical dry deciduous type and the vegetation can be classified broadly into four types-Sal, mixed deciduous, grasslands and scrub forests.

#### **(xv) Tirupati Hills**

*Nature of Terrain:* It comprises of undulating with terrain covered valleys.

*Elevation:* It varies from 150 -1130 meters.

*Climate:* The rain fall received from northeast monsoon and southwest monsoon.

*Temperature:* It varies from 12<sup>o</sup> to 44<sup>o</sup> C.

*Rainfall range:* The average rainfall is 900 mm

*Type of Vegetation:* Vegetation is of mixed dry deciduous and moist deciduous types.

#### **(xvi) Shyed Basha Hills**

*Nature of Terrain:* It comprises of rocky terrain

*Elevation:* It has elevation of 700-1200 meters

*Climate:* It experiences tropical climate during the summer and is generally warm and dry. Monsoon season brings substantial amount of rainfall and experiences a long monsoon. Winters are generally pleasant and comfortable. There are three distinct seasons that can be seen in the region.

*Temperature:* The temperature ranges from 38° C to 28° C

*Rainfall range:* the average rainfall ranges from 55-150 mm

*Type of Vegetation:* Vegetation consist of grasses, small scrub and trees

### STUDY PERIOD

First survey was undertaken to Ananthagiri hills, Vishakhapatnam District; Maredumilli hills, Rajamundry District and Kinnerasani Wildlife Sanctuary, Khammam District from Andhra Pradesh for the period from 16.9.2011 to 5.10.2011 (20 days); second survey was undertaken to Yercaud hills, Salem District; Yelagiri hills and Jawadu hills, Vellore District from Tamil Nadu and Biligiri Rangaswamy hills, Chamarajanagara District from Karnataka for the period from 13.8.2012 to 1.9.2012 (20 days); third survey was undertaken to Niyamgiri and Khandwalmali hills, Kalahandi District, Baphlamalai, Kutrumali hills and Sankesumali, Rayagada District and Chandragiri and Mahendragiri hills, Gajapati District from Odisha for the period from 12.7.2012 to 03.08.2012 (22 days) and fourth survey was undertaken to Tirupati hills, Chittoor District from Andhra Pradesh and Shyed Basha Malai, Krishnagiri District from Tamil Nadu for the period from 18.11. 2013 to 09.12. 2013 (22 days).

### METHODOLOGY

The study is an outcome of four surveys carried out in different localities of Eastern Ghats for the period from 2011 to 2013 (three years). Each survey comprises of twenty days each in the field with a team of four personnel. The study was carried out using visual encounter survey method

where transects of 1000 meter length were laid randomly in and around covering different habitats. The areas with different habitats like rocky crevices, rock boulders, water bodies with rocky surfaces, scrub jungle, dense forest, open forest, high elevated area with rocky habit, etc were covered during the survey.

The data collected during day time was confined to number of individuals, number of un-hatched eggs, number of egg deposition sites, nearest habitats, other species in the same habitat etc. The geckos were photographed using a Panasonic Lumix DMC-FZ 10 Digital camera, geographical coordinates and altitude were also recorded using GPS-16

### ECOLOGY AND BEHAVIOUR

*Habit and Habitat:* It is diurnal, active during day and night. It inhabits rocky crevices, rock boulders, it prefers rocky area with deep stream valleys and high elevated rocky hills.

*Food and feeding Habit:* Indian Golden Gecko feeds on insects such as crickets, mealworms and wax worms.

*Distribution:* India: *Calodactylodes aureus* recorded from southern Andhra Pradesh, from Sheshachalam and Velikonda ranges; Vellore region of North Arcot District of Tamil Nadu, recently been reported and photographed from Castle rock, Karnataka and Niyamgiri Hills of Kalahandi and Rayagad District of Odisha.

*Notable behaviour:* During the survey it has been observed that the Indian Golden Gecko always skip from one rock to another and enters in between crevices of rocks to avoid the notice of the observer. It also prefers single rock/boulder at a high elevation.

### RECENT OBSERVATIONS AND RESULTS

The survey was carried out in 16 localities under 11 Districts of four states namely Andhra Pradesh, Odisha, Tamil Nadu and Karnataka. Out of which four Districts from Andhra Pradesh, three Districts from Odisha, three Districts from Tamil Nadu and

one District from Karnataka respectively were surveyed from Eastern Ghats. The Golden Gecko was encountered in rocky caves and crevices of large boulders during day time and it was recorded at an elevation of 200-950 meters.

During the survey we encountered a total of 22 Golden Gecko in rocky caves and rock boulders. Out of these only four were bright golden yellow which were recorded at Sankesumali, Rayagada, Odisha and the rest were dark brown recorded from Ananthagiri and Maredumilli Hills of Andhra Pradesh. The highest number of Geckos were recorded from Ananthagiri Hills, Vishakhapatnam District, followed by Maredumilli Hills, Rajamundry District and Sankesumali, Rayagada District of Odisha. In addition we also recorded 42 egg deposition sites at different localities. The Geckos were found in both vertical and horizontal crevices in the rocks and caves. The Gecko always prefers undisturbed locality where there are less human activities. We encountered them on large rock builders, rocky caves and moist habitat where it always tries to skip from one rock to another and in between rocky caves.

The Golden Gecko is active and in good number nearby deep stream valleys and rocky area. It always runs/skips to hide in between the rocks. Sometimes it enters between the rocks and makes it difficult to locate its presence. The Gecko found to lay eggs attached on the vertical and horizontal roof of caves and rock boulders. During the survey we recorded 42 egg deposition sites at different localities.

In addition to Golden Gecko sympatric reptilian species were also observed commonly during the survey. Among these *Psammophilus dorsalis* were common at Yelagiri Hills, Jawaadu Hills, Yercaud hills BRT hills and Borighat and *Hemidactylus sp.* *Eutropis carinata*, *Sitana ponticeriana* and *Gecko gecko* were also encountered frequently during the survey.

The present study indicates presence of a small population of Golden Gecko in the study areas where we encountered the species from three localities out of 16 study areas. In this study we recorded 12 examples from Ananthagiri Hills, 6 from Maredumilli Hills, Andhra Pradesh and four examples from Sankesumali, Rayagada District of Odisha. For the first time we recorded four examples of Golden Gecko from Sankesumali. During the survey at Tirupati Hills, we had an opportunity to survey at Malwadigundam, it was also called as home of Golden Gecko as per the Biolab Scientist at Alipiri. The habitat seems very suitable for Gecko where large rock, caves, deep stream valley. However, we did not encounter single specimen of Golden Gecko during whole day survey. It indicates Golden Gecko appear to have shifted to safer habitat due to local disturbance.

The present study also shows that the distribution range of Indian Golden Gecko is larger than the previously known. This study adds a new locality for this species at Sankesumali, Rayagada District from Odisha. It also infers that the species may change the habitat or extending its distribution due to habitat loss and human habitation.

### TABULATION OF OBSERVATIONS AND RESULTS

**Table 1.** Number of individual and locality where Indian Golden Gecko sighted during survey.

State/District	Locality	Status of area	No. of individual recorded	No. of egg attachment site sighted
Andhra Pradesh/ Vishakhapatnam	Ananthagiri hill	Forest/hill	12	22
Andhra Pradesh/ Rajamundry	Maredumilli hill	Forest/hill	06	14
Odisha/Rayagada	Sankesu mali	Forest /hill	04	12

**Table 2.** Showing the Description of sites where Indian Golden Gecko was encountered

Name of the Site	Habitat Type	No. of Individual	Latitude N	Longitude E	Altitude (in Meters)
Ananthagiri Hills	Natural Forest/ Hill/Rock	02	18° 13' 978"	68° 00' 375"	756
		03	18° 13' 493"	86° 00' 529"	894
		01	18°13' 970"	83° 00' 320"	826
		02	18°15' 503"	83° 00' 258"	890
		04	18° 14' 549"	83°01' 032"	724
Maredumilli Hills	Natural Forest / Hill /Rock	01	17° 36' 063"	81° 42' 300"	486
		02	17° 36' 064"	81° 42' 305"	426
		02	17 ° 36' 060"	81° 42' 300"	430
		01	17° 36' 068"	81° 42' 468"	434
Sankesumali Hill	Natural Forest/ Hill/Rock	02	19° 11' 179"	83° 18' 905"	248
		02	19° 11' 182"	84° 17' 305"	258

#### PRESENT STATUS OF INDIAN GOLDEN GECKO IN EASTERN GHATS

Indian Golden Gecko was discovered in the year 1870 by Beddome and it was rediscovered after 115 years by Daniel (1986). Later many studies have been conducted by researchers and reported new localities of the species. In the present study a viable but small population of Indian Golden Gecko were recorded from Ananthagiri Hills, Visakhapatnam District. Maredumilli Hills, East Godavari District also provided suitable habitat for the species and observed six examples in the areas. In addition, four examples of Indian Golden Gecko were recorded for the first time from Sankesu Mali, Rayagada District of Odisha.

The previous studies recorded a small population of Golden Gecko in South Odisha such as Karlapat, Niyamgiri and Mahendragiri. Two specimens of Indian Golden Gecko were recorded from the rock crevices found near Shova village in Araku valley (Chettri and Bhupathy, 2010), one specimens of Golden Gecko was recorded from Seshachalam Biosphere Reserve (Gupta *et*

*al.*, 2012), and small population of Geckos were reported from Ananthagiri, Maredumilli and Peantalapally (Sreekar *et al.*, 2010). Studies by Kalaimani and Nath (2012, 2013) reported good breeding population of Golden Gecko from Tamil Nadu, Eastern Ghats.

#### PRESENT THREATS TO THE SPECIES IN EASTERN GHATS

The Indian Golden Gecko is under threat due to mining activities at Niyamgiri Hills of Odisha and Shyed Basha Malai, Krishnagiri District of Tamil Nadu, construction factories at Niyamgiri Hills namely Vedanta and fruit juice factory at Shyed Basham Malai. In Shyed Basha Malai, Krishnagiri District foothills are surrounded by human habitations, caves and rock boulders are polluted by continuous human activities. Ananthagiri Hills and Maredumilli Hills of Andhra Pradesh are also surrounded by human habitations and deforestation activities for cultivation. At Mahendragiri and Chandragiri hills, Gajapati District, Odisha foot hills are surrounded by human habitation and disturbances due to

human activity such as man-made fire, where we noticed burning of trees to remove forest and using lands for cultivation. At Baphlamali and Kutrumali Hills, Rayagada District major threat of the habitat is cattle grazing. At Tirupati Hills, Chittoor District, Andhra Pradesh disturbances are due to continuous influx of pilgrimage throughout the year. At Yelagiri hills, where cultivation of coffee and other commercial plantation resulted in loss of habitat. At Jawadu and Yercaud Hills we observed man made activities such a fire to remove forest and using land for agricultural purposes.

Previous studies by Rajashekhar and Nandakumar (2007) reported that rock boulders are being blasted for construction of roads and buildings near Vellore town in Tamil Nadu. Trade was considered to be the major threat to the Indian Golden Gecko (Molur and Walker, 1998), but we have not come across any such incidence during our survey in these areas. However, we come across the inhabitants at Niyamgiri Hills who told us that they were killing the Golden Gecko because there was an old belief that seeing it indicate bad incidences. Hence they kill Golden Gecko, one inhabitant showed us the tail of Golden Gecko killed four days back.

#### **CONSERVATION MEASURES SO FOR TAKEN AND RECOMMENDATIONS:**

Destruction and fragmentation of habitats is one of the main threats to the survival of the many species on earth. In addition, trade on endangered species and climate change are also cause threat and these are directly caused by human action. Prevention of disappearance of species is a priority goal at local, regional and national level.

No conservation measures so far initiated to protect the Indian Golden Gecko and its habitat. Therefore, it is time to initiate conservation measures. The two important conservation measures are (i) Conservation of habitats of the species focussing on maintenance and restoration of the habitats by establishing protected sites (ii) dealing with direct influence of the species as well as their eggs, breeding sites and resting places-it is not only on geographical area where species lives but refers to the whole of the territory of the species. Identification of breeding sites and resting places are very important in the light of conservation and protection of the species because these are crucial in the life cycle of the animal. In addition, the species can be protected by (i) building special water tanks around human habitations, so that it can lay eggs (ii). Creation of awareness among public to protect the habitat and (iii) Initiation of long term management plan where the species can be protected in the wild without harming the habitat of the species.

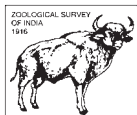
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#### **REFERENCES**

- Beddome, R. H. 1870. Description of some new lizards from the Madras Presidency. *Madras Monthly Journal of Medical Science*, **1**: 30-35.
- Boulenger, G.A. 1890. The Fauna of British India, including Ceylon and Burma. *Reptilia and Batrachia*, Taylor and Francis, London. xviii+541 pp.
- Chettri, B. and Bhupathy. 2010. Three little known reptile species from the Araku valley, Eastern Ghats with notes on their distribution. *Journal of Threatened Taxa*, **2**(8): 1109-1113.

- Daniel, J. C. and Bhushan. 1985. The Golden Gecko of Tirumalai Hills. *Hornbill*, 1985(3): 1718+1 Pl.
- Daniel, J. C., Bhushan, B. and Sekar, A. G. 1986. Rediscovery of the Golden Gecko *Calodactylodes aureus* (Beddome) in the Eastern Ghats of Andhra Pradesh. *Journal of Bombay Natural History Society*, **83**: 15-16.
- Deraniyagala, P. E. P. 1953. A Coloured Atlas of some Vertebrates from Ceylon. Vol. 2. *Tetrapod Reptilia*, Ceylon Government Press. Colombo, 11+35 Pls. 101 pp.
- Dutta, S.K., Mohanty, B. and Mohapatra, P. P. 2005 Niyamgiri unravelled. *Sanctuary Asia*, **25**(5): 56-57, 59.
- Gupta, M. B., Rao, P.V.C., Prasad, N.V.S., Maddala, S.R.S.C.S., Babu, P.M. and Reddy, D.S. 2012. Status of Herpetofauna in Seshachalam Biosphere Reserve, Eastern Ghats, Andhra Pradesh, India. *World Journal of Zoology*, **7**(2): 131-134.
- Javed, S.M.M., Waran, A. and Tampal, F. 2007. On the occurrence of Golden Gecko *Calodactylodes aureus* in Papikonda Hills, Eastern Ghats, India. *Zoos Print Journal*, **22**(6): 2727-2729.
- Kalaimani, A. and Nath, A. 2012. A new locality and micro habitat usage by *Calodactylodes aureus* (Beddome, 1870) from Tamil Nadu, Eastern Ghats, Southern India, *Herpetropicos*, **8**(1-2): 49-54.
- Molur, S. and Walker. 1998. Report of the Workshop 'Conservation Assessment and Management Plan for Reptiles of India. Zoo Outreach Organisation and Conservation Breeding Specialised Group, Coimbatore, India, 175 pp.
- Rajashekhar, M. and Nanda Kumar N. V. 2007. A new finding on the occurrence of Golden Gecko (*Calodactylodes aureus*) in rock boulders near Vellore town. *The Bioscan*, **2**(1): 61-62.
- Rodgers, W.A., Panwar, H.S. and Mathur, V.B. 2008. *Wildlife Protected Areas in India: A Review* (Executive summary): Wildlife Institute of India, Dehradun, 44 pp.
- Sreekar, R., Srinivasulu, C., Seetharamaraju, M. and Srinivasulu, C.A. 2010. Selection of egg attachment sites by the Indian Golden Gecko *Calodactylodes aureus* (Beddome, 1870) (Reptilia : Gekkonidae) in Andhra Pradesh, *Indian Journal of Threatened Taxa*, **2**(11): 1268-1272.



## PRELIMINARY STUDIES ON THE AQUATIC INSECT DIVERSITY OF ACHARYA JAGADISH CHANDRA BOSE INDIAN BOTANIC GARDEN (AJCBIBG), WEST BENGAL

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### INTRODUCTION

Study of aquatic insects has been proceeding for centuries, possibly millennia. Freshwater habitats from puddles to rivers to lakes, including both lentic (still water) and lotic (running water) habitats, can be home to various species of aquatic insects (Cheng, 1985; Daly, *et al.*, 1998; Glausiusz, 1997). This specially adapted group of insects makes up only 3-5 percent of all insect species, but is very taxonomically diverse (Daly *et al.*, 1998).

Aquatic insects are important as they form an important link in many food chains. They consume other invertebrates, small fish, aquatic plants, algae, detritus, and decaying matter and on the other hand, they are also an important food sources for birds, fishes, reptiles, and amphibians. Aquatic insects are also often used to determine water quality based on type and number of species present.

Several works on aquatic fauna have been published in India of them some works are those by Vazirani (1969, 1984), Sharma and Rai (1991), Sivaramakrishnan *et al.*, (1995, 1996, 2000), Thirumalai (1999), Anbalagan *et al.* (2004), Subramanian and Sivaramakrishnan (2005), Anbalagan and Dinakaran (2006), Dinakaran & Anbalagan (2007) and Ghosh & Nilsson (2012).

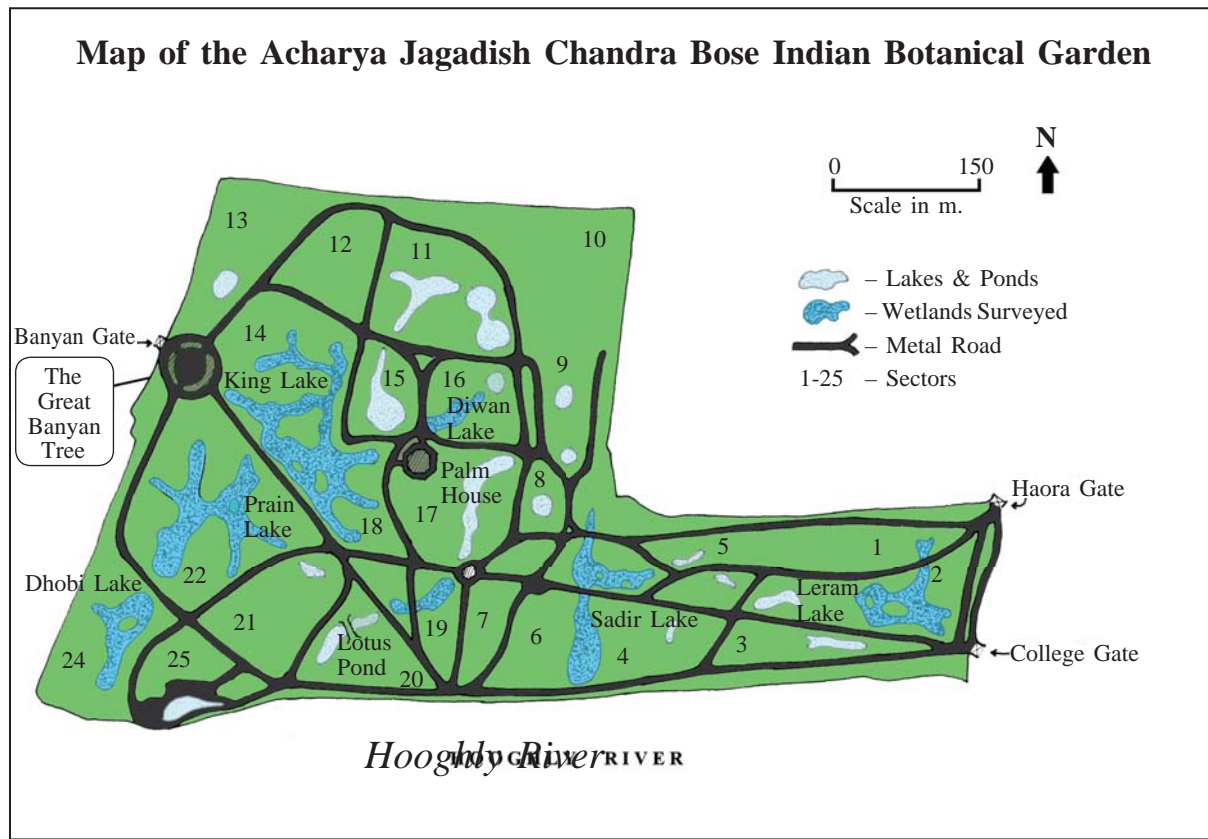
Aquatic insects of West Bengal has been investigated by Bhattacharya and Gupta (1991), Srivasatava and Sinha (1995), Bal and Basu

(1994a,b), Biswas *et al.*, (1995a,b,c), Biswas and Mukhopadhyay (1995), Choudhury and Chattopadhyay (1997), Bhattacharya (2000), De (Pal) and Sengupta 1993, Srivastava, 1993, Pal *et al.*, (2000), Khan and Ghosh (2001), Saha *et al.*, (2007), Nandy *et al.*, (2001), Srivastava (1993).

But nothing has been known about the aquatic insect diversity of Acharya Jagadish Chandra Bose Indian Botanic Garden (AJCBIBG) except Nandi *et al.*, (2001). This present work was aimed to study the faunal diversity of aquatic insects and associated floral components in the water bodies of the Indian Botanic Garden, Shibpur, West Bengal.

All over the world about 45000 species of insects are known to inhabit diverse freshwater ecosystem (Balaram, 2005). This present study recorded the colonization of 70 species under 24 families of 5 orders in the seven water bodies of AJCBIBG, with the highest number species (28 species) of aquatic insects from the family Hemiptera (Table. 2). Among the 70 species reported from this garden, *Amphiops pedestris* Sharp, the only lone species was found reported from all the seven water bodies (Table. 2).

These seven water bodies were also enriched with 37 species under 20 families of floral components. Of them, *Lemna perpusilla*, *Wolffia arrhinza*, *Alternanthera philoxeroides* and *Alternanthera sessilis* were the most abundant species and recorded from all the water bodies of AJCBIBG (Table. 3).



**Fig. 1.** Map of AJCBIBG and the study areas

## MATERIALS AND METHODS

The study was conducted in Acharya Jagadish Chandra Bose Indian Botanic Garden (Map.1). With an area of 109 hectare. Acharya Jagadish Chandra Bose Indian Botanic Garden (AJCBIBG) is lying in between 22° 25' N latitude and 88° 26' E longitude in Howrah district of West Bengal. The land is formed by alluvial deposits laid down by the river Hooghly and fresh water flood plains, lakes, ponds which dominate the area under study. Among the 24 water bodies (small to large) of AJCBIBG seven sampling sites/lakes/water bodies were selected for the study of aquatic insect faunal diversity in respect to their sizes, vegetative components and also their distances from the river Hooghly (Map.1).

According to the size of the water bodies, King

Lake got rank 1, followed by Prain (2), Sadir (3), Leram (4), Dhobi (5), Diwan (6) and Lotus (7). Considering the closeness of the water bodies from the river Hooghly, Sadir Lake got rank 1, followed by Leram (2), Dhobi (3), Lotus (4), Prain (5), King (6) and Diwan (7). But on the basis of vegetative cover on the water bodies, Dhobi Lake got rank 1, followed by King (2), Prain (3), Leram (4), Lotus (5), Sadir (6) and Diwan (7) (Table.1).

The insect collections have been made using drag net of one sq. mt. (75 – 80 mesh / cm.<sup>2</sup>), aquatic insect collecting net with six feet long handle, box type sampler (20 X 20 X 40 cu. cm., Pal and Nandi, 1997). The study was conducted from December 2002 to 2004. The detail description of sampling sites are given below (Table.1)

**Table 1.** Description of sampling sites of AJCBIBG

No	Name of the site/ lakes/ water bodies	Rank given as per closeness to river Hoogly	Rank given as per size of the water bodies	Rank given as per vegetative components	Description of the water bodies
1	<b>King Lake</b>	6	1	2	This lake is situated in between Sector- 14 and 18. The area of the lake is about 26,875 sq. mts. More than 60% of the lake area is covered with <i>Eichhornia</i> , <i>Victoria amazonica</i> (leaf diameter is about 1.5 mt), <i>Pistia</i> , <i>Spirodella</i> , <i>Lemna</i> , <i>Wolfia</i> , <i>Azolla</i> , <i>Najas</i> , <i>Alternanthera</i> , <i>Hydrilla</i> , <i>Marsilia</i> and aquatic grass etc.
2	<b>Prain Lake</b>	5	2	3	This lake is situated at Sector 22 and area is about 24,600 sq. mt. The lake is more or less clear and sparsely vegetated with <i>Pistia</i> , <i>Azolla</i> , <i>Salvinia</i> , <i>Hrydrilla</i> , <i>Lemna</i> , <i>Nymphaea</i> , <i>Typha</i> , <i>Wolfia</i> , <i>Spirodella</i> , <i>Ipomoea</i> etc.
3	Leram Lake	2	4	4	This lake is situated at Sector 2 and area is about 13,600 sq. mt. Mostly, <i>Eichhornia</i> , <i>Pistia</i> , <i>Alternanthera</i> , <i>Lemna</i> , <i>Spirodella</i> , <i>Wolfia</i> , and few marginal grasses etc. were enriched the floral components of this lake.
4	Dhobi lake	3	5	1	This lake is situated at Sector 24 and the area is about 10,350 sq. mt. The entire lake is covered with aquatic vegetations. The major floral components are <i>Eichhornia</i> , <i>Pistia</i> , <i>Spirodella</i> , <i>Typha</i> etc.
5	<b>Sadir Lake</b>	1	3	6	This lake is situated at Sector 5 and 6 and area is about 15,600 sq. mt (Map.1). Most of the portion of this lake is covered with <i>Pistia</i> , <i>Lemna</i> , <i>Alternanthera</i> , <i>Spirodella</i> , <i>Wolfia</i> , <i>Ipomoea</i> etc. Aquatic grass is also present in the marginal area of this lake.
6	<b>Diwan Lake</b>	7	6	7	This pond is situated at Sector 16 with an area of 3,600 sq. mt. The pond is more or less clear. <i>Victoria amazonica</i> , <i>Spirigyra</i> , <i>Lemna</i> , <i>Spirodella</i> , <i>Wolfia</i> , <i>Alternanthera</i> , <i>Hydrilla</i> , <i>Potamogeton</i> , <i>Najas</i> etc. are the only plant species found in this pond.
7	<b>Lotus Pond</b>	4	7	5	This pond is the smallest among the seven water bodies studied here and situated at Sector 19 and area is about 3,500 sq. mt. Eastern zone of this pond is covered with <i>Nelumbo</i> and <i>Nymphaea</i> of aquatic plants. The rest of the portion of this pond is covered with <i>Spirodella</i> , <i>Lemna</i> , <i>Wolfia</i> , <i>Pistia</i> , <i>Hydrilla</i> , <i>Najas</i> etc like vegetative components.

**RESULTS & DISCUSSION**

Altogether 70 species under 59 genera of 24 families belonging to 5 orders of aquatic insects

along with 34 species under 26 genera of 19 families has been reported from the seven lakes of AJCBIBG (Table.2).

**Table. 2.** Order, Family and species of aquatic insects reported from seven water bodies

Sl. No.	Family	Species	King Lake	Prain lake	Leram lake	Dhobi Lake	Sadir lake	Lotus pool	Diwan Lake	Total
A.	<b>Order Ephemeroptera</b>									
1	Family Baetidae	<i>Cloeon kimminsi</i> Hubbard		+			+	+	+	4
2	Family Caenidae	<i>Caenis</i> sp.						+		1
B.	<b>Order Odonata</b>									
3	Family Libellulidae	<i>Orthetrum sabina sabina</i> (Drury)	+	+		+	+		+	5
4		<i>Brachydiplax sordina</i> (Rambur)	+				+			2
5		<i>Neurothemis tullia tullia</i> (Drury)			+					1
6		<i>Crocothemis servilia servilia</i> (Drury)	+					+		2
7		<i>Brachithemis contaminata</i> (Fabricius)	+	+				+	+	4
8	Family Gomphidae	<i>Ictinogomphus rapax</i> (Rambur)	+							1
9	Family Coenagrionidae	<i>Ceriagrion coromondelianum</i> (Fabrius)		+			+		+	3
10		<i>Pseudagrion australasiae</i> Selys	+		+		+			3
11		<i>Agriocnemis pygmaea</i> (Rambur)				+				1
12		<i>Ischnura aurora aurora</i> (Brauer)	+					+		2
C.	<b>Order Hemiptera</b>									
13	Family Belostomidae	<i>Diplonychus annulatus</i> (Fabricius)						+		1
14		<i>Diplonychus molestus</i> (Dufour)						+		1
15		<i>Diplonychus rusticus</i> (Fabricius)	+	+	+		+			4
16		<i>Lethocerus indicus</i> (Lepeletier & Serville)	+						+	2
17	Family Micronectidae	<i>Micronecta scutellaris scutellaris</i> (Stal)	+					+		2
18	M. haliploides	<i>Micronecta haliploides</i> Horvath					+			1
19	Family Corixidae	<i>Sigara (Tropocorixa) distorta</i> (Distant)	+							1

Table 2. contd.

Sl. No.	Family	Species	King Lake	Prain lake	Leram lake	Dhobi Lake	Sadir lake	Lotus pool	Diwan Lake	Total
20	Family Pleidae	<i>Paraplea liturata</i> (Fieber)	+	+		+	+		+	5
21		<i>Paraplea frontalis</i> (Fieber)	+		+		+	+		4
22	Family Helotrephidae	<i>Tiphotrephes indicus</i> (Distant)	+	+			+			3
23	Family Gerridae	<i>Aquarius adelaidis</i> (Dohrn)		+			+			2
24		<i>Limnagonous (s. str.) fossarum fossarum</i> (Fabricius)	+	+	+		+		+	5
25		<i>Limnagonous (s. str.) nitidus</i> (Mayr)	+	+			+		+	4
26		<i>Neogerris parvulus</i> (Stal)	+							1
27		<i>Rhagadotarsus (s. str.) kraepelini</i> Breddin	+	+			+	+	+	5
28	Family Notonectidae	<i>Anisops breddini</i> Krikaldy		+						1
29		<i>Anisops bouvieri</i> Krikaldy	+	+	+	+	+	+		6
30		<i>Anisops sardeus sardeus</i> Herrich-Shaffer	+	+			+		+	4
31		<i>Anisops barbatus</i> Brooks	+	+				+		3
32		<i>Nychia sappho</i> Krikaldy					+			1
33	Family Nepidae	<i>Ranatra filiformis</i> Fabricius	+	+			+	+	+	5
34		<i>Ranatra digitata</i> Hafiz & Pradhan	+							1
35		<i>Ranatra varipes varipes</i> Stal	+	+	+		+	+	+	6
36		<i>Laccotrophes griseus</i> (Guerin- Meneville)	+						+	2
37	Family Mesoveliidae	<i>Mesovelia vittigera</i> Horvath	+	+	+		+	+		5
38		<i>Mesovelia horvathi</i> Lundblad						+		1
39	Family Veliidae	<i>Microvelia (s.str.) diluta</i> Distant	+	+						2
40	Family Hydrometridae	<i>Hydrometra greeni</i> Kirkaldy	+	+	+			+		4

Table 2. contd.

Sl. No.	Family	Species	King Lake	Prain lake	Leram lake	Dhobi Lake	Sadir lake	Lotus pool	Diwan Lake	Total
D.	<b>Order Coleoptera</b>									
41	Family Haliplidae	<i>Haliplus (Liaphlus) angustifrons</i> Regimbart							+	1
42	Family Noteridae	<i>Neohydrocoptus subvittulus</i> (Motschulsky)	+		+			+	+	4
43		<i>Canthydrus angularis</i> Sharp	+	+	+		+	+	+	6
44		<i>Canthydrus laetabilis</i> (Walker)	+	+					+	3
45		<i>Canthydrus luctuosus</i> (Aube)	+	+	+		+	+		5
46	Family Dytiscidae	<i>Hydroglyphus signatellus</i> (Klug)		+				+	+	3
47		<i>Cybister limbatus</i> (Fabricius)	+						+	2
48		<i>Leiodytes orissaensis</i> (Vazirani)	+			+				2
49		<i>Laccophilus sharpi</i> Regimbert	+							1
50		<i>Laccophilus anticatus</i> Sharp	+	+		+	+	+	+	6
51		<i>Laccophilus flexucus</i> Aube	+				+		+	3
52		<i>Laccophilus parvulus</i> Sharp	+				+		+	3
53		<i>Hydrovatus sinister</i> Sharp	+							1
54		<i>Hydrovatus castaneus</i> Motschulsky	+							1
55		Family Hydrophilidae	<i>Hydrophilus indicus</i> (Bedal)	+						
56	<i>Helochares anchoralis</i> Sharp		+		+					2
57	<i>Helochares lentus</i> Sharp		+							1
58	<i>Helochares pallens</i> Macleay		+							1
59	<i>Sternolophus rufipes</i> (Fabricius)			+					+	2
60	<i>Berosus indicus</i> Motschulsky		+							1
61	<i>Regimbertia actenuata</i> Fabricius									
62	<i>Amphiops pedestris</i> Sharp		+	+	+	+	+	+	+	7
63	<i>Amphiops simplex</i> Sharp		+			+				2
64	<i>Enochrus esuriens</i> (Walker)		+							1

Table 2. *contd.*

Sl. No.	Family	Species	King Lake	Prain lake	Leram lake	Dhobi Lake	Sadir lake	Lotus pool	Diwan Lake	Total
65	Family Gyrinidae	<i>Dineutus indicus</i> Aube					+			1
66		<i>Orectochilus (Patrus) productus</i> Regimbart	+							1
67	Family Curculionidae	<i>Bagous</i> sp.	+				+			2
E.	<b>Order Diptera</b>									
68	Family Chironomidae	<i>Chironomus striatipennis</i> Keiffer					+	+		2
69	Family Culicidae	<i>Anopheles annularis</i> Van der Wulp	+			+			+	3
70		<i>Culex (Culex) bitaeniorhynchus</i> Giles	+				+			2
Total number of insect species = 70			53	27	14	9	31	23	25	

Among the seven water bodies studied here, the King Lake (75% insect species and 76.48% plant species) is more diverse than others in relation to both fauna and flora. This may be due to its size, over 60% vegetative cover and highest number of aquatic plant species. Korkeamaki & Suhonen (2002) study also support that the faunal distribution and their assemblage are strongly dependent on the composition and structure of vegetation (Fig. 2).

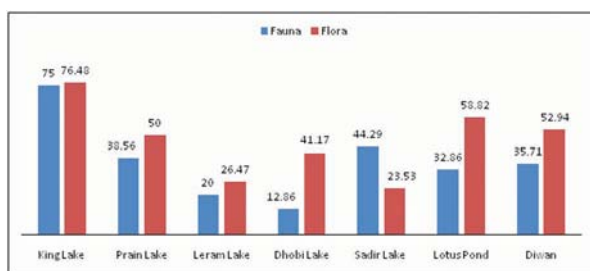


Fig.2. Percentage (%) composition of aquatic insects and plants in seven sites of AJCBIBG

Among the five orders of aquatic insects reported in this study, the predominant order of AJCBIBG was Hemiptera, followed by Coleoptera, Odonata, Diptera and Ephemeroptera respectively (Figure 1).

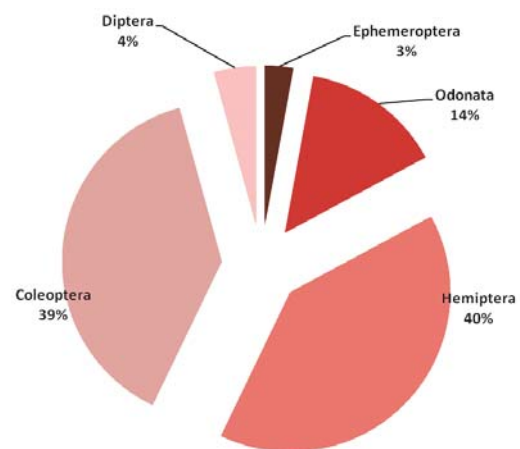


Fig.1. Distribution of aquatic insect species (in percent) in seven sites of AJCBIBG

Of them, the most dominant family of this garden was Hydrophilidae of the order Coleoptera and the ten families with single species, namely, Baetidae, Caenidae, Gomphidae, Corixidae, Helotrephidae, Veliidae, Hydrometridae, Curculionidae, Haliplidae, Chironomidae (Fig.3).

Abbreviations used: 1: Ephemeroptera, 2: Odonata, 3: Hemiptera, 4: Coleoptera, 5: Diptera.

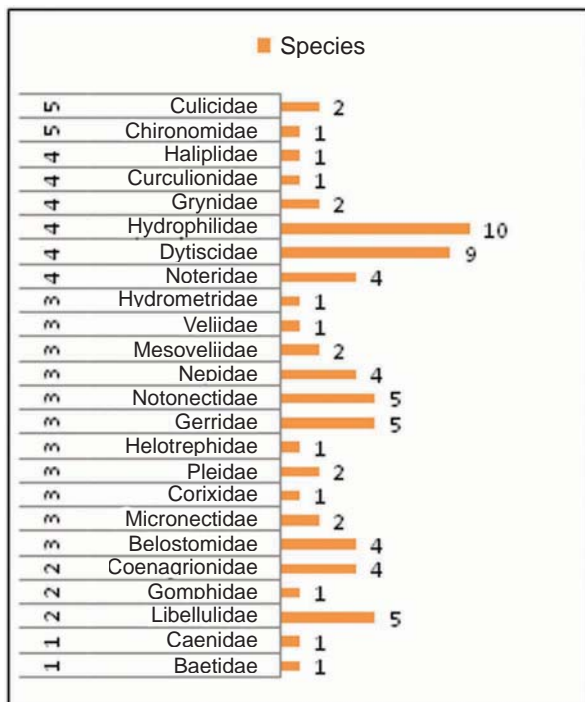


Fig.3. Number of aquatic insect species (Family-wise) reported from seven sites of AJCBIBG

Altogether, 28 species under 11 families of Hemiptera or water bugs were reported from seven water bodies of AJCBIBG during this study (Table.2). Of them, only *Anisops bouvieri* Krikaldy of the family Notonectidae (5species) was found to distribute in majority of the water bodies (6) studied during this present survey. A lone species of the family Corixidae, *Sigara (tropocorixa) distorta* (Distant) was reported only from King Lake of this garden during this survey. During this study, only four species of the family Nepidae were reported, of them, *Ranatra varipes varipes* Stal was found as very common water scorpions in AJCBIBG. With four species of two genera of Belostomatidae were enriched the aquatic insect fauna of AJCBIBG. Of them, *Diplonychus rusticus* (Fabricius) was found the most dominant species and reported from 4 water bodies of this garden. *Limnagonous (s.str.) fossarum fossarum* (Fabricius) and *Rhagadotarsus (s.str.) kraepelini* Breddin of the family Gerridae and *Mesovelia vittigera* Horvath of the family Mesoveliidae were the predominant species and reported from most of the water bodies in AJCBIBG. During this present study, two species of the family Pleidae were also

found well distributed in seven water bodies. Only two species of the family Micronectidae of this order were rarely reported from this garden. The members of this family were not well distributed rather rarely found in this garden (Table.2).

A total of 27 species of aquatic beetles of the six families of the order Coleoptera is the second largest order among the five orders found in seven water bodies of AJCBIBG. Among them, the family Hydrophilidae shared maximum number of species. *Amphiops pedestris* Sharp was the only species of the family Hydrophilidae distributed in all the water bodies studied in AJCBIBG. The next largest family of this garden of Coleoptera was Dytiscidae with nine species. During this present study, all the species were distributed more than one water body except, *Hydrovatus sinister* Sharp, *Hydrovatus castaneus* Motschulsky and *Laccophilus sharpi* Regimbert. The most common species was *Laccophilus anticatus anticatus* Sharp reported from six water bodies of this garden. During this study, all the four species of the family Noteridae was found to distribute in all the water bodies of AJCBIBG. Only two species of the family Gyrinidae were encountered. Of them, *Dineutus indicus* Aube only reported from Sadir Lake and *Orectochilus (Patrus) productus* Regimbart from King Lake. But the curculionids were reported from both the King and Sadir lakes .Only one species of the family Haliphidae or crawling water beetles of the order Coleoptera was collected from the aquatic vegetation of the Diwan Lake (Table.2).

During this present study, 10 species of damsel and dragon flies of the three families were reported from the seven water bodies of AJCBIBG. Of them, *Orthetrum sabina sabina* (Drury) was the dominant species and reported from the five water bodies and *Neurothemis tullia tullia* (Drury) reported only from Leram Lake of this garden (Table.2).

Only three species of true flies, one from family Chironomidae and two from family Culicidae were reported from more than one water bodies during this survey (Table.2).

PLATE I



Collect specimens from King Lake



Collect specimens from Diwan Lake



Collect specimens from Dhobi Lake

PLATE II



Prain Lake



Lotus Pond



Sadir Lake



Leram Lake

Only two species of Mayflies under two families were reported from this garden. Among them, *Cloeon kimminsi* Hubbard was more abundant and distributed in more Water bodies (4) than *Caenis* sp. (1) (Table.2).

During this study, Only 34 species under 19 families of aquatic plants were reported from the seven water bodies of Acharaya Jagadish Chandra

Bose Botanic garden. Of them, *Lemna perpusilla*, *Wolffia arrhinza*, *Alternanthera philoxeroides* and *Alternanthera sessilis* were very common and found all the water bodies under studied (Table. 3). It is also evident from the table.3, that King lake shared maximum number of floral species (26), followed by Lotus (20), Diwan (18), Prain (17), Dhobi (14), Leram 99) and Sadir Lake (8) (Table.3).

**Table. 3.** Floral species reported from the seven sites of AJCBIBG

Sl. No.	Family	Species	King Lake	Prain Lake	Leram Lake	Dhobi Lake	Sadir Lake	Lotus pond	Diwan lake	Total
1	Zygnemataceae	<i>Spirogyra</i> sp.				+		+	+	3
2	Aroideae	<i>Pistia stratiotes</i>	+	+	+	+		+	+	6
3	Lemnaceae	<i>Lemna minor</i>	+	+	+	+		+	+	6
4		<i>Lemna perpusilla</i>	+	+	+	+	+	+	+	7
5		<i>Spirodella polyrrhinza</i>	+		+	+	+	+	+	6
6		<i>Wolffia arrhinza</i>	+	+	+	+	+	+	+	7
7	Pontedesia	<i>Eichhornia christata</i>	+	+	+	+		+		5
8		<i>Eichhornia crassipes</i>	+	+		+	+			4
9	Salviniaceae	<i>Azolla bipinnata</i>	+	+				+		3
10		<i>Azolla pinnata</i>	+	+						2
11		<i>Salvinia cuculata</i>		+						1
12	Hydrochorideae	<i>Hydrilla verticillata</i>	+					+	+	3
13		<i>Hydrilla dentana</i>	+					+	+	3
14		<i>Vallisneria spiralis</i>	+					+		2
15	Naiadaceae	<i>Potamogeton crispus</i>	+							1
16		<i>Aponogeton nallans</i>	+							1
17	Najadaceae	<i>Najas minor</i>							+	1
18		<i>Najas indica</i>	+						+	2
19	Scrophularineae	<i>Limnophila</i> , sp. <i>heterophylla</i> , sp.	+							1
20	Ceratophyllaceae	<i>Ceratophyllum demersum</i>	+	+	+	+		+	+	6
21	Lentibulariaceae	<i>Utricularia stellaris</i>	+	+						2
22	Amarantaceae	<i>Alternanthera philoxeroides</i>	+	+	+	+	+	+	+	7
23		<i>Alternanthera sessilis</i>	+	+	+	+	+	+	+	7
24	Cyperaceae	<i>Cyperas compressus</i>	+	+			+		+	4

Table. 3. contd.

Sl. No.	Family	Species	King Lake	Prain Lake	Leram Lake	Dhobi Lake	Sadir Lake	Lotus pond	Diwan lake	Total
25	Nymphaeaceae	<i>Nelumbo nucifera</i>						+		1
26		<i>Nymphaea rubra</i>	+					+		2
27		<i>Nymphaea lotus</i>						+		1
28		<i>Victoria amazonica</i>	+						+	2
29	Alismaceae	<i>Sagittaria sagittifolia</i>	+					+	+	3
30	Cyperaceae	<i>Cyperus exaltatus</i>		+		+	+			3
31	Hydrophyllaceae	<i>Ipomoea aquatica</i>		+		+		+	+	4
32	Marsiliaceae	<i>Marsilea minuta</i>	+						+	2
33		<i>Marsilea quadrifoliata</i>	+					+		2
34	Typhaceae	<i>Typha angustata</i>		+		+				2
Total number of Plant species = 34			26	17	9	14	8	20	18	

During this present study, among the five orders of aquatic insects the members of the orders Hemiptera (28 species) and Coleoptera (26 species) were found as most successful colonizer and *Amphiops pedestris* Sharp was only species found from seven water bodies of AJCBIBG. From this analysis this can be said that, the member of these two orders may get a suitable habitat for their colonization than other insect groups in these water bodies.

Because, we know colonization is taken to be the end product of a series of steps in an individual insect's behavior. According to Fernando (1959), these steps are (i) dispersal, (ii) location of new habitat, (iii) selection of a new habitat and (iv) colonization itself. These steps have evolved as a result of two types of stimuli: proximate factors, such as environmental temperature and photoperiod, and ultimate factors, such as presence and availability of suitable food and substrate or suitable oviposition sites.

However, we have shown that the diversity of aquatic insects of these seven water bodies of AJCBIBG which may serve as a baseline data for future workers. Therefore, more analysis on water quality, vegetative quality, food sources of

these water bodies will definitely bring interesting results.

### SUMMARY

The study revealed the colonization of 70 species under 24 families of 5 orders in the seven water bodies of Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah, West Bengal. Of the five orders reported from this Botanic garden, Hemiptera shared maximum number of species (28 species). Among the 70 species reported from this garden, *Amphiops pedestris* Sharp of the order Coleoptera was found common form all the seven water bodies. Considering the floral diversity, altogether 37 species under 19 families were reported from these seven water bodies. Of them, *Lemna perpusilla*, *Wolffia arrhinza*, *Alternanthera philoxeroides* and *Alternanthera sessilis* were the most abundant species and recorded from all the water bodies of AJCBIBG.

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## REFERENCES

- Anbalagan, S. and Dinakaran, S. 2006. Seasonal variation of diversity and habitat preferences of aquatic insects along the longitudinal gradient of the Gadana river basin, South-West Ghats, (India). *Acta Zoologica Bulgarica.*, **58**: 253-264.
- Anbalagan, S., Kaleeswaran, B. and Balasubramanian, C. 2004. Diversity and Trophic categorization of aquatic insects of Courtallam hills of Western Ghats. *Entomon.*, **29**: 1-6.
- Balaram, P. 2005. Insect of tropical streams. *Curr. Sci.*, 89, 914.
- Bal, A., Basu, R.C. 1994a. Fauna of West Bengal. Insecta: Hemiptera: Mesoveliidae, Hydrometridae, Veliidae and Gerridae. *State Fauna Series*, **3(5)**: 511 – 534. ZSI, Calcutta.
- Bal, A., Basu, R.C. 1994b. Fauna of West Bengal. Insecta: Hemiptera: Belostomatidae, Nepidae, Notonectidae and Pleidae. *State Fauna Series*, **3(5)**: 535–558. ZSI, Calcutta.
- Bhattacharya, D.K. 2000. Insect fauna associated with large water hyacinth in freshwater Wetlands of West Bengal. Diversity and Environment. Proc. Nat. Seminar on Environ. Biol. (Eds.: A.K. Aditya and P. Haldar), Daya Publishing House, Delhi. pp.165-169.
- Bhattacharya, D.K. and Gupta, B. 1991. Freshwater wetland inhabiting insects of West Bengal. *Environ. Ecol.*, **9**: 995-998.
- Biswas, S., Mukhopadhyay, P. and Saha, S.K. 1995a. Fauna of West Bengal. Insecta: Coleoptera: Adephaga: Family Gyrinidae and Haliplidae. *State Fauna Series*, **3(6A)**: 121–141, ZSI, Calcutta.
- Biswas, S., Mukhopadhyay, P. and Saha, S.K. 1995b. Fauna of West Bengal. Insecta: Coleoptera: Adephaga: Family Dytiscidae. *State Fauna Series*, **3 (6A)**: 77-120, ZSI, Calcutta.
- Biswas, S., Mukhopadhyay, P. and Saha, S.K. 1995c. Fauna of West Bengal. Insecta: Coleoptera: Family Hydrophilidae. *State Fauna Series*, **3(6A)**: 143- 168, ZSI, Calcutta.
- Biswas, S. and Mukhopadhyay, P. 1995 Insecta: Coleoptera: Hydrophilidae. *State fauna Series*, **5**: Fauna of West Bengal, Part 6a, Zoological Survey of India, Calcutta. 143-168.
- Chaudhuri, P. K. and Chattopadhyay, S. 1997. Fauna of West Bengal. Insecta: Diptera: Chironomidae. *State Fauna Series*, **3(7)**:163-227, ZSI, Calcutta.
- Cheng, L. 1985. Biology of Halobates (Heteroptera: Gerridae). *Annual review of entomology.* **30**: 111-135.
- Daly, H.V., Doyen, J.T., Purcell, A.H. 1998. *Introduction to insect biology and diversity*. 2nd Ed. New York: Oxford University Press, Inc.
- De (Pal), M., Sengupta, T. 1993. Beetles (Coleoptera: Insecta) of wetlands of Calcutta and its surroundings. *Rec. zool. surv. India.* **93(1-2)**: 103–138.
- Dinakaran, S. and Anbalagan, S. 2007. Anthropogenic impacts on aquatic insects in six streams of south Western Ghats. *J. Insect Science.* **7**: 1-7.
- Fernando, C.H. 1959. The colonization of small freshwater habitats by aquatic insects. 2. Hemiptera (the water bugs). *Ceylon Journal of Science (Biological Science)* **2**: 5–32.
- Ghosh S.K. & Nilsson A.N. 2012: Catalogue of the diving beetles of India and adjacent Countries (Coleoptera: Dytiscidae). *Skorvnopparn Supplement* **3**: 1-77.

- Glausiusz, J. 1997. Where insects fear to tread. *Discover*. **18**: 26.
- Khan, R.A. and Ghosh, L.K. 2001. Faunal diversity of aquatic insects in freshwater wetlands of South Eastern West Bengal. Z.S.I. Kolkata. 104 pp.
- Korkeamaki, E. and Suhonen, J. 2002. Distribution and habitat specialization of species affect local extinction in dragonfly odonata populations. *Ecography*. **25**: 459–465.
- Nandi, N. C., Venkataraman, K., Das, S.R., Bhuinya, S. 2001. Faunal diversity of wetlands in the Indian Botanical Garden, Howrah, West Bengal. *Rec. Zool. Surv. India*. **99**(1): 111–129.
- Pal, S. and Nandi, N.C. 1997. A simple device for quantitative sampling of macrofauna from littoral macrophytes. *J. Freshwater Biol.* **9**(3–4): 114–121.
- Pal, S., Dey, S.R., Bhattacharya, Das, S.K. and Nandi, N.C. 2000. Macrophyte preference and insect diversity of freshwater wetlands in south-eastern Bengal. Diversity and Environment, Proc. Nat. Seminar on Environ. Biol. (Eds. A.K. Aditya and P. Haldar). *Daya Publishing House*, Delhi. 165-169.
- Saha, N., Aditya, G., Bal, A. and Saha, G.K. 2007. Comparative study of functional response of common hemipteran bugs of east Calcutta wetlands, India. *International Review of Hydrobiology*. **92**: 242-257.
- Sharma, U.P. and Rai, D.N. 1991. Seasonal Variations and species diversity of coleopteran insects in a fish pond of Bhagalpur. *J. Freshwater Biol.* **3**: 241-246.
- Sivaramkrishnan, K.G., Venkataraman, K., Sridhar, S. and Marimuthu, M. 1995. Spatial patterns of benthic macroinvertebrate distributions along river Kaveri and its tributaries (India). *Int. J. Ecol. Environ. Sci.* **21**: 141-161.
- Sivaramkrishnan, K.G., Morgan, H.J. and Vincent, R.H. 1996. Biological assessment of the Kaveri river catchment, South India, and using benthic macroinvertebrates: Applicability of water quality monitoring approaches developed in other countries. *Int. J. Ecol. Environ. Sci.* **32**: 113-132.
- Sivaramkrishnan, K.G., Venkataraman, K., Moorthy, R.K., Subramanian, K.A. and Utkarsh, G. 2000. Aquatic insect diversity and ubiquity of the streams of the Western Ghats, India, *J. Indian Inst. Sci.* **80**: 537-552.
- Srivastava, V.D. 1993. Fauna of West Bengal, Insecta: Ephemeroptera. *State Fauna Series*, **3**(4): 51-1668, ZSI, Calcutta.
- Srivastava, V.D. and C. Sinha. Insecta: Odonata, State fauna Series 3: Fauna of West Bengal, Part 4, *Zoological Survey of India*, Calcutta. 163-224 (1995).
- Subramanian, K.A. and Sivaramkrishnan, K.G. 2005. Habitat and microhabitat distribution of stream insect communities of the Western Ghats. *Curr. Sci.*, **89**: 976-987.
- Thirumalai, G. 1999. In: *Aquatic and semi-aquatic heteroptera of India*. Indian Association of Aquatic Biologists, Hyderabad, India. 7-74 .
- Vazirani, T.G. 1969: Contribution to the study of aquatic beetles (Coleoptera). 2. A review of the subfamilies Noterinae, Laccophilinae, Dytiscinae and Hydroporinae (In part) from India. *Oriental Ins.* **2**(3 & 4): 221-341.
- Vazirani, T.G. 1984: *The Fauna of India*. Coleoptera, Family Gyridae and Family Haliplidae; Zoological Survey of India, Calcutta, Pp. 140.



## STATUS SURVEY OF WETLAND BIRDS IN THE RUTLAND ISLAND, ANDAMAN

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### OVERVIEW

The Andaman and Nicobar archipelago consists of 572 islands and extending over 800 km (Fig. 1). These islands were once a part of the Asian mainland but got detached some 100 million years ago during the Upper Mesozoic Period due to geological upheaval. The existing groups of islands constitute the physiographic continuation of the mountainous ranges of Naga and Lushai Hills and Arakan Yoma of Burma through Cape Negrais to the Andaman and Nicobar Islands and southeast of Sumatra. The chains of these islands are in fact the camel backs of the submerged mountain ranges projecting above the sea level running north to south between 6° 45' and 13° 30' N latitudes and 90° 20' and 93° 56' E longitudes with an extent of 8,249 km<sup>2</sup>.

The Andaman and Nicobar islands can be broadly divided into two groups, namely, the Andamans and the Nicobars. These two groups are separated by the Ten-degree Channel which is about 150 km wide 400 fathoms deep. The average annual temperature varies from 24° to 28° C. The elevations range from 0 to 732 m at Saddle Peak in North Andaman and 642 m at Mount Thulier in Great Nicobar Island. The rainfall is slightly higher in Nicobar with an annual average of 3000 to 3500 mm.

### HISTORY

The Andaman and Nicobar groups of islands belong to a geosynclinal basin. The sediments of this region have gradually changed their

characters, according to tectonic movements, to which they have been subjected to from time to time; as such the rocks are highly folded. The six distinct geological formations consisting of various groups of rocks, from these islands were reported.

These formations include Older Sedimentaries, Ophiolite Suite, Mithakhari Group, Andaman Flysch, Archipelago series and the Rutland Shell-Limestone. They represent a period of sedimentation, from Cretaceous (about 100 million years) to Sub-Recent (less than 10,000 years). The surface deposits of gravel beds and raised soil covers, on the other hand, are of very late origin, *i.e.*, Recent to Sub-Recent (*i.e.*, less than 10,000 years). In general, it is believed, that the mountain ridges of the island were formed at the expanse of a narrow but deep oceanic furrow during Late Mesozoic Period (100 million years). The older sediments of Mesozoic formed the basement for younger deposits. The history of later deposition is that of an inconsistent basin *i.e.* associated with movement, volcanism and deposition, side by side with igneous intrusions. Over the older sediments, at the deeper part of the sea bottoms, there was rich accumulation of siliceous tests of radiolarians, possibly and deposition of sediments of late Cretaceous to Oligocene.

During Oligocene, the islands faced a tremendous earth movement resulting in mountain ridges, although well within the sea. Some of the ridges were suited for the growth of corals and also had the rising tendency for developing

the reef islands. The present configuration was, however, achieved by these islands only about 26 million years ago. The Narcondam Island and Barren Island are of volcanic origin. The former is an apparently extinct, while the latter is still active.

### ZOOGEOGRAPHY

Zoogeographically, Andaman and Nicobar Islands occupy a unique position. These are close to the "Indo-Malayan region," which is considered to be a "faunistic centre" from which other subdivisions of the Indo-west Pacific Region recruited their fauna (Ekman, 1953). Although a certain degree of endemism is known among a few groups of terrestrial animals, the among marine animals is not known, since our knowledge on many groups is far from satisfactory. Some of the typical Indo-West Pacific groups of shore animals are found in these islands. Giant clams (Tridacnidae) among molluscs and fishes such as sea moths (Pegasidae), hitings (Silliginidae), rabbit fishes (Siganidae) and plesiopids (Plesiopidae) which are restricted to the Indo-West Pacific region are found in these Islands. Out of 50 species of sea snakes from the Indo-Pacific region 26 are reported from the waters off these islands. Dugong, a marine mammal which is endemic to Indo-West Pacific is recorded off these Islands. There are many more such marine animals which are typical of Indo-West Pacific and occur in these islands. Although the Islands have a great diversity of marine fauna many groups are yet to be worked out in detail.

### BIOGEOGRAPHIC CLASSIFICATION

The biogeographic history of the Andaman and Nicobar Islands indicates their uniqueness. The scattered islands, covering a small area, have been divided into 11 biogeographic subdivisions (Rodgers and Panwar, 1988). There are two levels of variation in the Andaman and Nicobar Islands. One is an ecological separation into different biomes: beach and reef systems, mangroves, littoral forests, deciduous forests, semi-evergreen, valley evergreen and hill slope evergreen forests,

with further variation between calcium-rich and calcium-poor strata. The second is a separation by species composition, with each island having its own characteristic community composition, with its own proportion of endemics.

### ECOSYSTEMS

An extraordinary variety of habitat types, ranging from sandy beaches to coral reefs, mangroves and mountains with dense forests, characterize the Andaman and Nicobar Islands. They are located in the equatorial belt and have been endowed with an abundance of flora and fauna. A number of species are endemic and restricted to small areas because of the islands geographic isolation.

The land area of the island chain is restricted but the diversity of forest types, each with its own distinctive floral and faunal composition, is staggering. Some of the larger islands display a veritable mosaic of forest types. The tropical forest ecosystem continuously recycles water. Since most of the islands have very few perennial rivers and streams, the inland wetlands are restricted. Basically, small ponds formed by rainwater accumulate inside the forests. The ponds are valuable sources of freshwater for wildlife and they also serve as a refuge for endangered species, such as the Andaman Teal and several endemic amphibians that are habitat specialists. The least disturbed and the best preserved, mangroves in India can be found in the Andaman and Nicobar Islands. Along with the inland forests, the mangroves are the predominant terrestrial ecosystem of the islands. These mangroves support a rich diversity of fauna and in particular provide breeding and spawning habitats for many aquatic species, the saltwater crocodile, several species of birds and reptiles (Rao and Khan, 1990).

The Andaman and Nicobar coral reefs are the second richest found in the world (Turner *et al.*, 2001). They consist mainly of fringing reefs with a barrier reef only on the western side. Seagrass beds occur in shallow coastal waters and sheltered bays, where clear water allows light penetration. Highly

threatened marine animals, such as dugongs and marine turtles, use this habitat essentially as a feeding ground (Das, 1996).

## **RUTLAND ISLAND**

### **LOCATION AND TOPOGRAPHY**

Rutland Island lies south east of Little Andaman and 55 km south of South Andaman across the Duncan passage; and is an area of high biological productivity (Fig. 2; Plate 1). It is located between latitude 11° 28' 00" to 11° 20' 00" and longitude 92° 35' 00" to 92° 45' 00" E. It occupies an area of 140.27 km<sup>2</sup> with an average altitude of 224 meters and a shore length of 98.2 km. Highest peak in Rutland is Mt. Ford - 435m. Rutland with its diverse forest habitats is an important ecotourists paradise. The forests are rich in faunal diversity with birds, and are an ideal place for the bird watchers. The island is partially populated but largely virgin. The island has fresh water streams running throughout the year. Geology of Rutland Island is mainly with basic and ultra-basic igneous rocks. The underlying rocks are essentially sandstone. Rutland is dominantly with rugged terrain, N-S folded structure that is longitudinal to the eastern and western coasts and transverse to northern and southern coasts. The mountainous origin of the islands also gives rise to an extremely convoluted coastline especially on the east with innumerable coves, deep inlets and wide bays. The higher ground is near the eastern shores.

### **HISTORY**

The island was formerly home to the Jangil, one of the indigenous Andamanese groups. The Jangil (also called "Rutland Jarawa" since they were thought to have been related to the Jarawa of south Andaman) occupied much of the interior of the island according to mid 19<sup>th</sup> century British accounts, however their interactions with outsiders were few. Up to the early 20<sup>th</sup> century there are only a handful of documented encounters with Jangil individuals. The last documented encounter was in 1907, and when in the 1920s a more

extensive expedition to the island's interior was conducted, no traces of their active habitation were found; the Jangil had become extinct. From time to time other indigenous Andamanese, such as the Onge from Little Andaman Island to the south and Great Andamanese tribes to the north had also set up fishing communities on Rutland. However, with the great reduction in numbers of these peoples, and their (enforced) relocations to more restricted areas, the island is presently without any permanent indigenous settlement.

### **CLIMATE**

The climate is wet tropical. It is warm and humid for most of the year. The seasons can be divided into dry and rainy seasons. The extreme winter and summer are practically unknown, but there is a general nip in the air during December, January and February. Months of March, April, May and October can be uncomfortable due to high humidity although the temperature is not high. The average annual temperature ranged from 26.85 - 33.5°C. The humidity varies from 65 to 91 per cent. The highest humidity is experienced from May to November during the southwest monsoon. The southwest monsoon which brings most of the precipitation normally begins in the month of May and ends in October. The northeast monsoon starts during November and ends in December. The annual average rainfall recorded in south Andaman has been presented in Fig. 3.

### **FLORA OF RUTLAND ISLAND**

The Rutland Island is covered with luxuriant, almost dense growth of tropical rain forest, characteristic of warm, humid and wet tropics. The dense forest consists of tangled mass of climbers, lianas, canes and bamboos. The trees grow in an intimate mixture of different species in all type of forests excluding mangroves. The mangrove forests make the border in low-lying banks of creeks and sheltered portions of coastal line subject of tidal action. The vegetation is composed of five major natural classes adapted according to the nature of the soil, elevation, topographical structure and edaphic factors.

Andaman Evergreen forests are most luxuriant type of forest, with canopy formed by giant *Dipterocarpus* sp. Tropical semi evergreen forests include both evergreen and deciduous species. The mangrove forest, which confines to sea washes soil is dominated by *Rhizophora* species while the littoral forest is dominated by *Manilkara littoralis* that forms a pure fringe on sandy beaches. Some of the important tree species are *Dipterocarpus gracilis*, *Atrocarpus chaplasha*, *Dipterocarpus grandiflorus*, *Hopea odorata*, *Pterospermum acerifolium*, *Calamus palustris*, *Dipterocarpus costatus*, *Cryptocarya ferrarsi*, *Pterocarpus dalbergioides*, *Dillenia pentagyna*, *Xanthophyllum andamanicum*, *Pongamia pinnata*, *Calophyllum inophyllum* and *Terminalia catappa*. The mangrove species are *Rhizophora mucronata*, *Bruguiera conjugate*, *Bruguiera cylindrical*, *Bruguiera parviflora*, *Avicennia officinalis* and *Kandelia candel*.

#### FAUNA OF RUTLAND ISLAND

This island is rich in fauna in diversity and abundance. Almost all the major fauna reported from Andaman and Nicobar Islands are observed in this Island. The area has a good population of Andaman Wild Pig (*Sus scrofa andamanensis*),

Spotted Deer (*Axis axis*), Barking Deer (*Muntiacus muntjak*), Saltwater Crocodile (*Crocodilus palustris*), Water Monitor Lizard (*Varanus salvator*) and pretty number of bird species.

#### STUDY PERIOD

The study was conducted from April 2008 - April 2012 and it was mainly based on direct observational methods (Altman, 1974). The following points were surveyed namely Mitta Nalah, Komeo, Padauk Dikri, Chain Nalah, Surumai Dikri, Arom Point, Aam Dera and Kumda Nalah.

#### OBJECTIVES

There is not sufficient data available on the wetland birds of Rutland Island. Therefore, an attempt has been made to fill the gap on the wetland birds in this Island. The objectives of this study were to document the status, distribution and population dynamics of wetland birds in this island.

#### COORDINATES OF DIFFERENT BLOCKS IN RUTLAND ISLAND

The coordinates of the study blocks are given in Table 1.

**Table 1.** Coordinates of different blocks in Rutland Island

Location	Coordinates	
	Latitude	Longitude
Mitta Nalah	11° 28.541'	92° 40.371'
Komeo	11° 24.314'	92° 39.780'
Padauk Dikri	12° 29.288'	92° 40.141'
Chain Nalah	12° 08.522'	93° 06.551'
Surumai Dikri	11° 25.504'	92° 40.301'
Arom Point	11° 30.541'	92° 38.769'
Aam Dera	11° 24.664'	92° 37.456'
Kumda Nalah	11° 27.091'	92° 36.928'

## WETLAND BIRDS OF RUTLAND ISLAND

### INTRODUCTION

The major wetland types observed in the Rutland Island are Mangroves, Intertidal Mudflats, Sandy Beaches, Rivers and Streams. Besides there are Inland wetlands are also found in this Island. According to the "Ramsar Convention", the waterbirds are broadly defined as "*the birds depend on the wetlands for their living*", including ducks and geese, shorebirds and waders, and some other species living depend on wetlands, such as kingfishers, raptors and some passerines. However, there are only 20 families of birds are included in the Species List of "Ramsar Convention" namely, Gaviidae, Podicipedidae, Phalacrocoracidae, Pelecanidae, Aredeidae, Ciconiidae, Threskiornithidae, Phoenicopteridae, Anatidae, Gruidae, Rallidae, Heliornithidae, Jacanidae, Dromadidae, Haematopidae, Recurvirostridae, Glareolidae, Charadriidae, Scolopacidae and Laridae. In these 20 families, there are at least 404 species occurring in Asia-Pacific region and 243 species are migratory. Wetlands are particularly important since 20 per cent of the threatened bird species in Asia inhabit wetlands. Ornithological studies indicate that, of the 1230 species found in the Indian sub-continent, about 350 species are migrants which include both terrestrial and waterbirds. Out of 310 Indian wetland birds 107 species are winter migrants. Most of these bird breed outside the subcontinent in the Palaearctic region.

Wetlands have long attracted the attention of public and scientists because of the charm, copiousness, visibility and social behavior of the waterbirds, as well as for their recreational and economic importance. Recently, waterbirds have become of interest as indicators of wetland quality and as parameters of restoration success and regional biodiversity. Each year, a large number of water birds that breeds in areas of Europe and North and Central Asia in summer undertake migratory journey along major river valleys to

spend the winter in more hospitable shelters in southerly latitudes. As the wetlands in northern areas become frozen due to the onset of winter and the food disappears under snow cover.

### STUDIES IN ANDAMAN AND NICOBAR ISLANDS

The study on birds in the Andaman and Nicobar Islands has been initiated by Beavan (1867) listing the avifauna of Andaman Islands followed by Hume (1873, 1874 a, b, 1876). Many researchers have listed the birds of Andaman & Nicobar Islands and few studies on individual species *e.g.* Nicobar Magapode (Sankaran, 1995a), Andaman Teal (Vijayan, 1996), Edible-Nest Swiftlet (Sankaran, 2001), Narcondam Hornbill (Yahya and Zarri, 2003). Only, a few of studies have been conducted on the community ecology.

Although considerable amount of general information is available on the avifauna of Andaman and Nicobar Islands, quantitative studies on wetland bird communities of Rutland Island are entirely lacking. Therefore, the following objectives were formulated to address the lack of information about this resource in order to document the status, distribution, abundance and relative density of wetland birds.

### MATERIALS AND METHODS

The study was mainly based on direct observational methods (Altman, 1974) and area was surveyed on foot, and boot and all the important areas were visited. Total count and Point count methods were used for census the birds (Burnham *et al.*, 1980; Hoves and Bakewell, 1989). In this method, representative blocks were identified and birds in the blocks were counted using a telescope (15x - 45x). The census was conducted from 0700 to 1000 hour. Birds were identified based on physical features with the help of field guides and reference books (Ali and Ripley, 1983; Tikader, 1984; Grimmett *et al.*, 1998; Kumar *et al.*, 2005).

Species richness and species composition of

birds were computed from the data obtained through census and field observations. Birds were classified as migratory and resident species based on the occurrence data and published literature. Globally threatened species of birds were identified based on BirdLife International (2001). Feeding and guild composition were collected from the available literature (Ali and Ripley, 1983). Bird species have been categorised as aquatic feeders, insectivores, granivores, nectar-frugivores, carnivores, frugivores and omnivores.

### SURVEY EFFORT

The approximate percentage of all survey hours involved in wetland bird surveys each location is shown in Fig. 4. Total of 106 hours spent between 2008 and 2012, conducting ground surveys. More effort was focussed on September to March during the migratory season.

### QUALITATIVE ANALYAIS

#### *Species richness and abundance*

Species richness and abundance of birds were calculated from the census data and field observations. Margalef Index (R1) and Menhinick Index (R2) were calculated using the formula given by Magurran (1988) to find out the species richness.

#### *Species diversity indices*

Shannon-Weiner ( $H'$ ), Simpson's ( $\lambda$ ), and Hill's diversity number  $N1$  and  $N2$  were calculated using the computer program SPDIVERS.BAS developed by Ludwig and Reynolds (1988).

#### *Similarity measures*

Jaccard similarity index between the different islands were calculated using the formula of Magurran (1988).

#### *Dominance Index*

The dominance of the each bird species in the Rutland Island was calculated using the dominance index.

#### *Distribution models*

Species-abundance model was constructed as explained in Magurran (1988). Species of birds were ranked in order of abundance, as represented by individuals seen for each species and this was plotted in decreasing order for all species against the number of individuals for the whole area. Truncated lognormal distribution was fitted to species-abundance data, using maximum likelihood estimation (Slocomb *et al.*, 1977).

### RESULTS

#### *Occurrence of species*

Forty three wetland bird species and eighteen wetland dependant species were recorded from the Rutland Island and these belong to 11 Families under 7 Orders (Table 2; Plate 2-5). Of the 61 species, 40 species were resident, 20 migrants and one species vagrant. Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*), Median Egret (*Mesophoyx intermedia*), Pacific Golden-Plover (*Pluvialis fluva*) and Lesser Crested Tern (*Sterna bengalensis*) were the most abundant species in the Rutland Island.

**Table 2.** Species of birds recorded from Rutland Island.

Sl. No.	Common Name	Scientific Name	Status
	<b>Ciconiiformes</b>		
	<b>Ardeidae</b>		
1.	Little Egret	<i>Egretta garzetta</i> (Linnaeus)	R
2.	Pacific Reef-Egret	<i>Egretta sacra</i> (Gmelin)	RM
3.	Large Egret	<i>Casmerodius albus</i> (Linnaeus)	RM
4.	Median Egret	<i>Mesophoyx intermedia</i> (Wagler)	RM
5.	Indian Pond-Heron	<i>Ardeola grayii</i> (Sykes)	R
6.	Little Green Heron	<i>Butorides striatus</i> (Linnaeus)	R

Table 2. contd.

Sl. No.	Common Name	Scientific Name	Status
7.	Great-billed Heron	<i>Ardea sumatrana</i> Raffles,	V
8.	Purple Heron	<i>Ardea purpurea</i> Linnaeus	RM
9.	Grey Heron	<i>Ardea cinerea</i> Linnaeus	RM
10.	Cattle Egret	<i>Bubulcus ibis</i> (Linnaeus)	RM
11.	Yellow Bittern	<i>Ixobrychus sinensis</i> (Gmelin)	RM
	<b>Anseriformes</b>		
	<b>Anatidae</b>		
12.	Lesser Whistling-Duck	<i>Dendrocygna javanica</i> (Horsfield)	R
13.	Cotton Teal	<i>Nettapus coromandelianus</i> (Gmelin)	R
14.	Andaman Teal	<i>Anas gibberifrons</i> (Muller)	R
	<b>Falconiformes</b>		
	<b>Accipitridae</b>		
15.	Brahminy Kite	<i>Haliastur indus</i> (Boddaert)	R
16.	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i> (Gmelin)	R
17.	Andaman Serpent-Eagle	<i>Spilornis cheela davisoni</i> Hume	R
18.	Greater Grey-headed Fish Eagle	<i>Ichthyophaga ichthyaetus</i> (Horsfield)	R
19.	Western Marsh-Harrier	<i>Circus aeruginosus</i> (Linnaeus)	M
20.	Eurasian Sparrowhawk	<i>Accipiter nisus</i> (Linnaeus)	M
	<b>Gruiformes</b>		
	<b>Rallidae</b>		
21.	Andaman Crake	<i>Rallina canningi</i> (Blyth)	R
22.	Blue-breasted Rail	<i>Gallirallus striatus</i> Linnaeus	R
23.	Andaman White-breasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant)	R
24.	Water Cock	<i>Gallicrex cinerea</i> (Gmelin)	R
25.	Common Moorhen	<i>Gallinula chloropus</i> (Linnaeus)	RM
26.	Purple Moorhen	<i>Porphyrio porphyrio</i> (Linnaeus)	R
	<b>Charadriiformes</b>		
	<b>Charadriidae</b>		
27.	Pacific Golden-Plover	<i>Pluvialis fulva</i> (Gmelin)	M
28.	Kentish Plover	<i>Charadrius alexandrinus</i> Linnaeus	RM
29.	Little Ringed Plover	<i>Charadrius dubius</i> Scopoli	RM
30.	Lesser Sand Plover	<i>Charadrius mongolus</i> Pallas	RM
	<b>Scolopacidae</b>		
31.	Pintail Snipe	<i>Gallinago stenura</i> (Bonaparte)	M
32.	Eurasian Curlew	<i>Numenius arauata</i> (Linnaeus)	M
33.	Whimbrel	<i>Numenius phaeopus phaeopus</i> (Linnaeus)	M

Table 2. contd.

Sl. No.	Common Name	Scientific Name	Status
34.	Spotted Redshank	<i>Tringa erythropus</i> (Pallas)	M
35.	Common Redshank	<i>Tringa totanus</i> (Linnaeus)	M
36.	Marsh Sandpiper	<i>Tringa stagnatilis</i> (Bechstein)	M
37.	Common Greenshank	<i>Tringa nebularia</i> (Gunner)	M
38.	Green Sandpiper	<i>Tringa ochropus</i> Linnaeus	M
39.	Wood Sandpiper	<i>Tringa glareola</i> Linnaeus	M
40.	Common Sandpiper	<i>Actitis hypoleucos</i> Linnaeus	M
41.	Ruddy Turnstone	<i>Arenaria interpres</i> (Linnaeus)	M
42.	Little Stint	<i>Calidris minuta</i> (Leisler)	M
43.	Temminck's Stint	<i>Calidris temminckii</i> (Leisler)	M
44.	Great Knot	<i>Calidris tenuirostris</i> (Horsfield)	M
45.	Bar-tailed Godwit	<i>Limosa lapponica</i> (Linnaeus)	M
	<b>Laridae</b>		
46.	Gull-billed Tern	<i>Gelochelidon nilotica</i> (Gmelin)	RM
47.	Black-naped Tern	<i>Sterna sumatrana</i> Raffles	R
48.	Lesser Crested Tern	<i>Sterna bengalensis</i> Lesson	R
49.	White-winged Black Tern	<i>Chlidonias leucopterus</i> (Temminck)	M
	<b>Coraciformes</b>		
	<b>Alcedinidae</b>		
50.	Small Blue Kingfisher	<i>Alcedo atthis</i> (Linnaeus)	RM
51.	Stork-billed Kingfisher	<i>Halcyon capensis</i> (Linnaeus)	R
52.	White-breasted Kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus)	R
53.	Black-capped Kingfisher	<i>Halcyon pileata</i> (Boddaert)	R
54.	Andaman Collared Kingfisher	<i>Halcyon chloris davisoni</i> Sharpe	R
	<b>Meropidae</b>		
55.	Small Bee-eater	<i>Merops orientalis</i> Latham	R
56.	Blue-tailed Bee-eater	<i>Merops philippinus</i> Linnaeus	RM
57.	Chestnut-headed Bee-eater	<i>Merops leschenaultia</i> Vieillot	R
	<b>Passeriformes</b>		
	<b>Hirundinidae</b>		
58.	House Swallow	<i>Hirundo tahitica</i> Gmelin	R
	<b>Motacillidae</b>		
59.	Large Pied Wagtail	<i>Motacilla maderaspatensis</i> Gmelin	R
60.	Yellow Wagtail	<i>Motacilla flava</i> Linnaeus	RM
61.	Grey Wagtail	<i>Motacilla cinerea</i> Tunstall	M

R = Residents, RM = Resident migrants, M = Trans-continental migrants, V = Vagrant

### ***Order wise classification and feeding guild composition of bird species***

The order wise classification of wetland birds species observed in Rutland Island is given in Table 3. The Order Charadriiformes had the highest percentage (37.7 per cent) of species followed by Ciconiiformes (18.03 per cent) and Coraciiformes (13.11 per cent). Feeding guild analysis showed that majority of species were aquatic feeders (73.77 per cent) followed by Carnivores and Omnivores (8.8 per cent) respectively (Table 3).

### ***Waders***

Waders constitute an important group of wetland species in the Rutland Island. These birds depend heavily on mud flats and shallow water, normally recorded during September to March in the Rutland Island. Details on the occurrence of waders in the intensive study sites are presented in Table 4. The highest number of species of waders was recorded from Komeo and Surmai Dikri (18) followed by Chain Nalah (16), Arom Point (15). Pacific Golden Plover (*Pluvialis fluva*), Little Ringer Plover (*Charadrius dubis*), Lesser Sand Plover (*Charadrius mongolus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*) and Eurasian Curlew (*Numenius arauata*) were recorded from all study block during the migratory seasons.

### ***Comparative occurrence of bird species***

A comparison of number of bird species recorded from the Rutland Island with those from Andaman and Nicobar Islands, India, Asia and World is given in Table 5.

### ***Endemic and globally threatened species***

Out of the 20 species of birds, which are endemic to Andaman Islands (Jathar and Rahmani, 2006), the Andaman Teal *Anas gibberfrons* was recorded from Rutland Island. According to BirdLife International (2001), one hundred and twenty nine threatened bird species occur in India, the following species were recorded from the Rutland Island namely, Andaman Serpent-Eagle, Greate Grey-headed Fish-Eagle, Andaman Crane, Eurasian Curlew, and Great Knot.

### ***Species abundance relations***

#### ***Species richness and abundance wetland birds***

Species richness of birds varied in different locations in the study area. Highest number of species richness and abundance was recorded at Mitta Nallah, followed by Padauk Dikri, Chain nalah and Komeo (Fig. 5 and Table 6).

#### ***Overall diversity indices***

The overall diversity Index ( $H'$ ) was 3.51, and ( $\lambda$ ) 0.04. Species Richness Index ( $R1$ ) was 6.89 and ( $R2$ ) was 0.92. Similarly, high values were obtained for Hill's number ( $N1$ ) and ( $N2$ ). Hill's number ( $N1$ ) was 33.39 and Hill's numbers ( $N2$ ) was 26.27. Evenness index ( $E1$ ) was 0.86 and ( $E2$ ) 0.58.

#### ***Diversity indices of birds in differnt locations***

Most widely used diversity indices like Shannon-Weiner Index, Simpson's Index, Hill's numbers ( $N1$  and  $N2$ ) and Richness Indices ( $R1$  and  $R2$ ) were estimated for the birds of Rutland Island. During the period of the study, the highest diversity index ( $H'$ ) was recorded at Komeo (3.21), followed Padauk Dikri (3.20), and lowest ( $H'$ ) was (2.87) at Mitta Nallah (Table 7).

#### ***Similarity Index***

Jaccard similarity index was calculated, it is an alternative approach to measure the similarity of different sites is using similarity indices. Similarity index between the different locations was computed using qualitative data (Table 8). Similarity index showed high values between Komeo and Padauk Dikri (76.38 per cent) followed by Padauk Dikri and Chain Nalah (72.17 per cent); and Komeo and Chain Nallah (71.09 per cent).

#### ***Abundance and dominance of bird species***

Of the recorded species of wetland birds observed in the Rutland Island, Wood Sandpiper (6.22 per cent) was highest in dominance followed by Cattle Egret (5.32 per cent), Lesser Whistling Duck (5.29), Median Egret (4.96), Little Egret (4.82 per cent) and Indian Pond Heron (4.54 per cent) (Table 9). Thirty three species were represented in less than 0.1 per cent.



Table 4. contd.

Sl. No.	Common Name	Mitta Nalah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam dera	Kumda Nalah
10.	Marsh Sandpiper	√	√	√	√	√	√	√	
11.	Common Greenshank		√			√			√
12.	Green Sandpiper		√		√			√	
13.	Wood Sandpiper	√	√	√	√	√	√	√	√
14.	Common Sandpiper	√	√	√	√	√	√	√	√
15.	Ruddy Turnstone					√			
16.	Little Stint	√	√	√	√	√	√	√	√
17.	Temminck's Stint		√		√	√	√		
18.	Great Knot					√			
19.	Bar-tailed Godwit			√				√	
20.	Gull-billed Tern	√	√		√	√	√		√
21.	Black-naped Tern	√	√	√	√	√	√	√	√
22.	Lesser Crested Tern	√	√	√	√	√	√	√	√
23.	White-winged Black Tern	√	√			√	√		

Table 5. Comparative occurrence of wetland bird species in the Rutland Island.

Sl. No.	Order and Family	World <sup>1</sup>	Asia <sup>1</sup>	India <sup>2</sup>	A & N Islands <sup>3</sup>	Rutland Island*
1.	<b>Ciconiiformes</b>					
	Ardeidae	65	33	20	15	10
2.	<b>Anseriformes</b>					
	Anatidae	158	81	41	7	3
3.	<b>Falconiformes</b>					
	Accipitridae	235	103	56	22	6
4.	<b>Gruiformes</b>					
	Rallidae	130	45	17	9	5
5.	<b>Charadriiformes</b>					
	Charadriidae	66	32	19	8	4
	Scolopacidae	89	72	42	24	16
	Laridae	99	65	32	10	4
6.	<b>Coraciiformes</b>					
	Alcedinidae	92	59	12	10	5
	Meropidae	93	34	5	6	3
7.	<b>Passeriformes</b>					
	Hirundinidae	100	24	15	3	1
	Motacillidae	62	27	19	11	3

1 - Gill and Donsker (2012); 2 - Ali and Ripley (1983); 3 - Tikader, 1984; 4 - Present study

**Table 6.** Percentage of species abundance of wetland birds in different locations in Rutland Island

Commn Name	Mitta Nallah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam Dera	Kumda Nallah
Little Egret	6.67	3.50	3.16	2.97	3.61	3.66	2.78	12.95
Pacific Reef-Egret	0.12	0.73	0.00	0.16	0.00	0.00	0.00	0.68
Large Egret	0.25	0.73	0.00	1.09	3.13	1.57	0.69	0.45
Median Egret	4.20	5.26	5.49	5.47	7.47	3.92	5.09	2.73
Indian Pond Heron	2.96	2.34	3.02	2.81	10.12	6.53	5.32	8.18
Little Green Heron	0.25	0.44	0.69	0.47	0.24	0.52	0.00	0.00
Great-billed Heron	0.12	0.29	0.00	0.00	0.00	0.00	0.00	0.00
Purple Heron	1.48	0.00	0.55	0.47	0.00	1.04	0.00	0.00
Grey Heron	0.86	0.00	1.10	0.00	0.72	0.00	0.46	0.00
Cattle Egret	3.95	4.09	5.08	4.22	5.78	3.13	10.19	8.41
Yellow Bittern	0.12	0.29	0.00	0.00	0.00	0.00	0.23	0.23
Lesser Whistling Duck	8.64	4.38	5.35	8.59	0.00	0.00	8.33	13.64
Cotton Teal	0.00	0.29	0.27	1.88	0.00	0.00	0.00	0.00
Andaman Teal	1.60	0.00	0.00	2.34	0.00	0.00	0.00	0.00
Brahminy Kite	0.86	0.73	0.55	0.63	0.00	0.00	0.00	0.68
White-bellied Sea-Eagle	1.48	0.58	0.82	2.03	3.37	4.44	0.46	1.82
Andaman Serpent-Eagle	0.25	0.29	0.14	0.16	0.00	0.00	0.23	0.23
Greater Grey-headed Fish Eagle	0.74	0.29	0.00	0.63	1.93	0.00	0.00	0.45
Western Marsh-Harrier	0.25	0.00	0.00	0.00	0.00	0.00	0.46	0.45
Eurasian Sparrowhawk	0.49	0.00	0.41	0.31	0.00	0.00	0.00	0.00
Andaman Crake	0.25	0.29	0.27	0.00	0.00	0.00	0.00	0.00
Blue-breasted Rail	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Andaman White-breasted Waterhen	0.49	0.58	0.41	0.31	0.24	2.61	1.16	0.45
Water Cock	0.49	0.29	0.14	0.00	0.00	0.00	0.00	0.00
Common Moorhen	0.62	5.26	1.51	4.06	0.00	0.78	0.46	0.45
Purple Moorhen	0.00	9.93	8.23	0.00	7.95	0.00	2.78	0.00
Pacific Golden-Plover	1.60	1.46	3.57	1.72	0.00	10.70	6.25	3.18
Kentish Plover	0.00	0.44	0.00	0.94	0.00	0.00	1.85	0.00
Little Ringed Plover	0.00	0.00	1.65	2.81	0.00	4.18	0.00	3.41
Lesser Sand Plover	3.83	1.75	2.19	1.56	2.65	3.66	2.31	1.36
Pintail Snipe	31.85	17.23	17.97	21.09	0.00	1.04	2.31	1.36
Eurasian Curlew	1.60	0.73	2.19	0.47	0.48	1.04	1.85	2.73
Whimbrel	0.00	0.44	0.00	0.16	0.48	0.00	0.00	0.00
Spotted Redshank	1.60	0.00	2.19	0.00	0.00	0.00	0.00	0.00
Common Redshank	3.46	2.63	3.29	2.66	6.75	7.57	6.25	2.95

Table 6. contd.

Commn Name	Mitta Nallah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam Dera	Kumda Nallah
Marsh Sandpiper	0.74	2.63	2.33	1.09	0.72	2.35	3.01	0.00
Common Greeshank	0.00	1.31	0.00	0.00	1.45	0.00	0.00	1.14
Green Sandpiper	0.00	0.44	0.00	0.31	0.00	0.00	0.93	0.00
Wood Sandpiper	2.59	3.94	2.61	7.97	7.95	6.79	8.10	13.64
Common Sandpiper	1.23	4.38	3.84	5.63	3.61	5.22	6.25	2.05
Ruddy Turnstone	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00
Little Stint	0.74	2.34	3.29	1.88	0.72	0.52	0.46	0.91
Great Knot	0.00	0.88	0.00	0.16	0.72	0.52	0.00	0.00
Bar-tailed Godwit	0.00	0.00	0.82	0.00	0.00	0.00	1.85	0.00
Gull-billed Tern	2.96	1.75	0.00	0.00	10.60	2.87	0.00	1.82
Black-naped Tern	3.46	0.58	2.47	3.28	4.10	4.96	7.41	2.05
Lessser Crested Tern	1.23	6.13	2.19	0.94	1.20	3.66	2.78	2.50
White-winged Black Tern	0.99	1.46	0.00	0.00	0.72	0.78	0.00	0.00
Small Blue Kingfisher	0.37	0.29	0.00	0.31	0.24	0.26	0.46	0.68
Stork-billed Kingfisher	0.49	0.58	0.82	0.00	0.48	0.52	0.00	0.00
Black-capped Kingfisher	0.12	0.00	0.27	0.00	0.00	0.00	0.00	0.23
Andaman Collared Kingfisher	1.23	2.92	2.47	2.50	3.61	5.22	3.94	2.05
Small Bee-eater	0.49	0.73	0.82	1.88	1.20	0.78	2.78	1.82
Chestnut-headed Bee-eater	0.86	2.34	1.65	1.25	5.06	2.35	0.93	1.59
House Swallow	0.74	1.17	4.39	1.25	1.45	5.74	0.93	1.59
Large Pied Wagtail	0.00	0.58	1.10	1.25	0.00	0.00	0.00	0.00
Yellow Wagtail	0.00	0.00	0.27	0.31	0.48	0.52	0.46	0.91
Grey Wagtail	0.25	0.29	0.41	0.00	0.00	0.52	0.23	0.23

Table 7. Diversity indices of bird species in different Islands

Location	Richness indices		Diversity indices		Hills' indices		Evenness indices	
	R1	R2	$\lambda$	H'	N1	N2	E1	E2
Mitta Nallah	6.72	1.62	0.12	2.87	17.65	8.04	0.75	0.38
Komeo	6.89	1.76	0.06	3.21	24.88	16.25	0.84	0.54
Padauk Dikri	6.07	1.52	0.06	3.20	24.54	16.47	0.86	0.60
Chain Nalah	6.19	1.62	0.07	3.08	21.69	13.38	0.83	0.53
Surumai Dikri	5.31	1.62	0.06	3.04	20.89	17.34	0.87	0.63
Arom Point	5.38	1.69	0.05	3.16	23.61	20.64	0.90	0.72
Aam Dera	5.60	1.68	0.05	3.12	22.72	19.07	0.88	0.65
Kumda Nallah	5.75	1.72	0.07	2.96	19.32	13.46	0.83	0.54

**Table 8.** Similarity indices for different islands in Rutland Island

Locations	Mitta Nallah	Komeo	Padauk Dikri	Chain Nalah	Surumai Dikri	Arom Point	Aam Dera	Kumda Nallah
<b>Mitta Nallah</b>	0	58.86	65.11	66.07	45.06	44.93	50.08	55.68
<b>Komeo</b>		0	76.38	71.09	52.91	48.50	55.51	47.82
<b>Padauk Dikri</b>			0	72.17	48.43	54.86	62.02	50.47
<b>Chain Nalah</b>				0	48.91	52.39	60.07	59.26
<b>Surumai Dikri</b>					0	62.91	58.09	52.16
<b>Arom Point</b>						0	65.28	55.41
<b>Aam Dera</b>							0	63.07
<b>Kumda Nallah</b>								0

**Table 9.** Abundance and dominacne of bird species recorded in Rutland Island

Common Name	Abundance	Dominance
Wood Sandpiper	282	6.22
Cattle Egret	241	5.32
Lesser Whistling Duck	240	5.29
Median Egret	225	4.96
Little Egret	218	4.81
Indian Pond Heron	206	4.54
Common Redshank	184	4.06
Common Sandpiper	175	3.86
Purple Moorhen	173	3.82
Black-naped Tern	148	3.26
Pacific Golden-Plover	142	3.13
Andaman Collared Kingfisher	125	2.76
Lessser Crested Tern	116	2.56
Lesser Sand Plover	110	2.43
Pintail Snipe	102	2.25
Gull-billed Tern	99	2.18
House Swallow	93	2.05
Common Moorhen	85	1.87
Chestnut-headed Bee-eater	84	1.85
White-bellied Sea-Eagle	76	1.68
Marsh Sandpiper	73	1.61
Little Stint	69	1.52
Eurasian Curlew	63	1.39

Table 9. contd.

<b>Common Name</b>	<b>Abundance</b>	<b>Dominance</b>
Little Ringed Plover	61	1.35
Small Bee-eater	55	1.21
Large Egret	38	0.84
Andaman White-breasted waterhen	31	0.68
Spotted Redshank	29	0.64
Andaman Teal	28	0.62
White-winged Black Tern	24	0.53
Purple Heron	23	0.51
Brahminy Kite	23	0.51
Greater Grey-headed Fish Eagle	22	0.49
Grey Heron	20	0.44
Common Greenshank	20	0.44
Large Pied Wagtail	20	0.44
Stork-billed Kingfisher	18	0.40
Kentish Plover	17	0.37
Little Green Heron	16	0.35
Cotton Teal	16	0.35
Bar-tailed Godwit	14	0.31
Small Blue Kingfisher	14	0.31
Yellow Wagtail	14	0.31
Great Knot	12	0.26
Grey Wagtail	11	0.24
Pacific Reef-Egret	10	0.22
Eurasian Sparrowhawk	9	0.20
Green Sandpiper	9	0.20
Andaman Serpent-Eagle	8	0.18
Water Cock	7	0.15
Western Marsh-Harrier	6	0.13
Andaman Crake	6	0.13
Whimbrel	6	0.13
Yellow Bittern	5	0.11
Black-capped Kingfisher	4	0.09
Great-billed Heron	3	0.07
Blue-breasted Rail	3	0.07
Ruddy Turnstone	3	0.07

**Table 10.** Truncated lognormal distribution at Rutland Island ( $\chi^2$  test)

Class interval	Upper boundary	Observed	Expected
1	2.5	0	14.05
2	4.5	4	5.44
3	8.5	6	5.88
4	16.5	10	6.07
5	32.5	12	6.06
6	64.5	4	5.85
7	128.5	10	5.35
8	256.5	9	4.44
9	512.5	3	3.78
10	1024.5	0	0
$\chi^2$	18.23	df	7

### SUMMARY

Of the 61 species recorded in Rutland Island, 40 species are residents (66 per cent) and 20 species are migrant (35 per cent) and one species is vagrant. The most abundant species in Rutland Island were egrets and herons, followed by shorebirds, and terns. The most widespread and abundant species was Little Egret (*Egretta garzetta*) followed by Cattle Egret (*Bubulcus ibis*), Median Egret (*Mesophoyx intermedia*), Pacific Golden-Plover (*Pluvialis fluva*) and Lesser Crested Tern (*Sterna bengalensis*). The site wise species abundance and species richness was highest in Mitta Nallah, Padauk Dikri, Chain nalah and Komeo. There appear to be differences during migratory season some migratory species, especially shorebirds showed abundance. The Pacific Golden Plover (*Pluvialis fluva*), Little Ringer Plover (*Charadrius dubis*), Lesser Sand Plover (*Charadrius mongolus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*) and Eurasian Curlew (*Numenius arauata*) were recorded in quite good numbers in the different locations of Rutland Island during migratory season.

The abundance and distribution of bird species in Rutland Island have been examined and the results of this study support that this area

represents a unique and important habitat type. The large areas are likely to encompass a greater variety of habitat types and hence to offer suitable habitat for a greater variety of species (Case, 1975 and Lack, 1976), though the size of the Rutland Island is small in size, because of the availability of varies micro habitat this island also support higher number of species. The species richness results from the dynamic equilibrium between immigration and extinction rates, which are dependent on island isolation and area respectively (MacArthur and Wilson, 1967). The bird species richness and diversity may be influenced by factors such as the composition of plant communities, forest type and other environmental factors (Wiens and Rottenberry, 1981). The availability of micro habitats in the study area may influence the species diversity of Rutland Island. Diversity indices are extensively used in environmental monitoring and conservation. As the objective of the world conservation strategy is to maximize diversity of habitats, these indices are extensively used to monitor and evaluate habitats. According to a study conducted by Usher (1986) among the criteria used for evaluation of conservation schemes, diversity is the most frequently adopted criteria. The diversity indices directly correlated with the stability of the ecosystem and it will be higher in biologically controlled ecosystem like tropical

forests and low in disturbed ecosystem. The nature and extent of adjacent habitat might be more important for most species than the existence of forest edge itself (Freemark *et al.*, 1995). The local ecological factors are important in determining diversity and abundance of birds. The different features may influence the species distribution in this archipelago *viz.*, the vegetation structure or the floristic richness may explain specific habitat preference, this was not observed in the temperate archipelago (Martin and Lepart, 1989 and Martin *et al.*, 1995), the number of habitat types on an islands or habitat diversity, is often considered a determinant of species richness (Murphy and Wilcox, 1986).

The presence of high species diversity and occurrence of many threatened species shows the need for continued protection and preservation of the Tropical Island ecosystem. Although this study was limited in duration and geographic area, our observations of Rutland Island specific bird species suggest that the increase the regional avifaunal diversity by providing abundant resources, unique microhabitats and landscape level habitat heterogeneity that attract a diversity of bird species. Future studies comprising larger samples and censuses throughout the year are important and unique feature of the Rutland Island. The result shows that Rutland Island support

unique avian assemblages, comprising of many rare and endemic species and therefore it could be considered as an important birding ground in this archipelago. In conclusion, the community composition appeared to be determined primarily by forest type and patchiness of Islands area.

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#### REFERENCES

- Ali, S. and S.D. Ripley 1983. Hand Book of the Birds of India and Pakistan. Oxford University Press, Oxford. 737 p.
- Altman, J. 1974. Observational study of behaviour: sampling methods. *Behaviour* **49**: 227-267.
- Beavan, R.C. 1867. The avifauna of the Andaman Islands. *Ibis* **3**(3): 314-334.
- BirdLife International 2001. Threatened Birds of Asia. The BirdLife International Red Data Book. Cambridge, UK, BirdLife International.
- Burnham, K.P., D.R. Anderson and J.L. Laake. 1980. Estimation of density from line transect sampling of biological populations. *Wildlife Monograph* No. **72**, PP. 202.
- Case, T.J. 1975. Species numbers, density compensation and colonizing ability of lizards on islands in the Gulf of California. *Ecology*, **56**: 3-18.
- Ekman, S. 1953. Zoogeography of the Sea. 417 p.

- Freemark, K.E., J.B. Dunning, S.J. Hejl and J.R. Probst 1995. A landscape ecology perspective for research, conservation, and management. pp. 381-421 In: Ecology and management of neotropical migratory birds. T. E. Martin and D. M. Finch. Eds. Oxford Univ. Press, New York, N.Y. 489 p.
- Gill, F. and D. Donsker 2012. IOC World Bird Names (v 2.11). Available at <http://www.worldbirdnames.org/> [Accessed "26.03.2012"].
- Grimmett, R., C. Inskipp, and T. Inskipp 1999. Pocket Guide to the Birds of Indian Subcontinent. Christopher Helm, 384 p.
- Hoves, J.G. and D. Bakewell 1989. Shore bird studies manual AWB. Publications No. 55 Kula Lumpur. 362 p.
- Hume, A.O. 1873. Notes. Avifauna of the Islands of the Bay of Bengal. *Stray Feathers* (5): 421–423.
- Hume, A.O. 1874a. Additional notes on the avifauna of the Andaman Islands. *Stray Feathers*, II (6): 490–501.
- Hume, A.O. 1874b. Contributions to the ornithology of India. The Islands of the Bay of Bengal. *Stray Feathers*, II (1, 2 & 3): 29–324.
- Hume, A.O. 1876. Additional notes on the avi-fauna of the Andaman Islands. *Stray Feathers*, IV (4, 5 & 6): 279–294.
- Jathar, G.A. and A.R. Rahmani 2006. Endemic birds of India. *Envis Newsletter: Avian Ecology & Inlands*, 11(2 & 3): 1-53.
- Kumar, A., J.P. Sati, P.C. Tak, and J.R.B. Alfred 2005. Handbook on Indian Wetland Birds and their conservation. Zoological Survey of India, Kolkata. 468 p.
- Lack, D.L. 1976. Island biology, illustrated by the land birds of Jamaica. Blackwell Scientific, Oxford.
- Lamshead, P.J.D., G.L.J. Paterson and J.D. Gage 1997. Bio Diversity Professional Beta. The Natural History Museum and The Scottish Association for Marine Science.
- Mac Arthur, R.H. and Mac Arthur, J.W. 1967. On bird species diversity. *Ecology*, 50: 793-801.
- Magurran, A. E. 2004. *Measuring biological diversity*. Oxford: Blackwell Publishing.
- Magurran, A.E. 1988. Ecological Diversity and its Measurement. Croom Helm Ltd., London, 179 p.
- Martin, J. L. and J. Lepart 1989 Impoverishment in the bird community of a Finnish archipelago: the role of island size, isolation and vegetation structure. *J. Biogeogr.* 16: 159–172.
- Martin, J. L., A. J. Gaston, and S. Hitier. 1995. The effect of island size and isolation on old growth forest habitat and bird diversity in Gwaii Haanas (Queen Charlotte Islands, Canada). *Oikos*, 72: 115–131.
- Murphy, D.D. and B.A. Wilcox 1986. On island biogeography and conservation. *Oikos*, 47(3): 385-387.
- Rao, G.C. and I.H. Khan 1990. *On the Present Status of the Marine Fauna of the Andaman Sea*. Zoological Survey of India and Zoological Garden, Port Blair, India.

- Rodgers, W.A. and H.S. Panwar 1988. *Planning a Wildlife Protected Area Network in India. Vol. 2: State Summaries*, Wildlife Institute of India, Dehradun, India.
- Saldhana, C.J. 1989. Andaman and Nicobar and Lakshadweep: An Environmental Impact Assessment. Oxford University Press, New Delhi.
- Sankaran, R. 1995a. Distribution, status and conservation of the Nicobar Megapode. In: *Avian Conservation in India*. 43–44. Vijayan, L. (ed.) Coimbatore: SACON. Sankaran, R. 1995. The distribution, status and conservation of the Nicobar Megapode *Megapodius nicobariensis*. *Biological Conservation*, **72**: 17–26.
- Sankaran, R. 2001. The status and conservation of the Edible-nest Swiftlet (*Collocalia fuciphaga*) in the Andaman & Nicobar islands. *Biological Conservation*, **97**: 283-294.
- Slocumb, J., B. Stauffer and K.L. Dickson 1977. On fitting the truncated lognormal distribution to species abundance data using maximum likelihood estimation. *Ecology* **58**: 693-696.
- Tikader, B.K. 1984. Birds of Andaman and Nicobar Islands. Zoological Survey of India, Kolkata. 167 p.
- Usher, M.B. 1986. Wildlife conservation evaluation: Attributes, criteria and values. In: Usher M.B. (Ed.). *Wildlife Conservation Evaluation*. (1986) Chapman and Hall, London. 3-44.
- Vijayan, L. 1996. Status and conservation of the Andaman Teal (*Anas gibberifrons albogularis*). *Gibier Faune Sauvage*, **13**: 831–842.
- Wiens, J.A. and J.T. Rottenberry 1981. Habitat associations and Community structure of birds in shrub steppe environments. *Ecol. Monogr.*, **51**: 21-41.
- Yahya, H.S.A. 1980. A comparative study of ecology and biology of barbets, *Megalaima* spp. (Capitonidae: Piciformes) with special reference to (*Megalaima viridis*) (Boddaert) and (*M. rubricapilla malabarica*) (Blyth) at Periyar Tiger Reserve, Kerala. Ph.D. Dissertation, University of Bombay, Bombay, 210 p.
- Yahya, H.S.A. and A.A. Zarri 2003. Status, ecology and behaviour of Narcondam Hornbill, (*Aceros narcondami*) in Narcondam Island, Andaman and Nicobar Islands, India. *J. Bombay Nat. Hist. Soc.*, **99**(3): 434–445.
- Yoganand, K. and P. Davidar 2000. Habitat preferences and distributional status of some forest birds in Andaman Islands. *J. Bombay Nat. Hist. Soc.*, **97**(3): 375–380.
- Zacharias, V.J. 1979. Ecology and biology of certain species of Indian Babblers (*Turdoides* spp.) in Malabar. Ph.D. Dissertation, University of Calicut, Kerala, India, 196 p.
- Zacharias, V.J. and A.J. Gaston 1999. The recent distribution of endemic, disjunct and globally uncommon birds in the forest of Kerala, State, South-west India. *Bird Conservation International*, **9**: 191-225.

## APPENDIX - I

## List of spider species recorded in Rutland Island

Sl. No.	Family	Species name
1.	Araneidae	<i>Argiope aemula</i> (Walckenaer)
2.		<i>Argiope catenulata</i> (Doleschall)
3.		<i>Gasteracantha cancriformis</i> (Linnaeus)
4.		<i>Nephila maculata</i> (Fabricius)
5.		<i>Nephila kuhlii</i> (Doleschall)
6.		<i>Ctenus andamanensis</i> (Gravely)
7.	Sparassidae	<i>Heteropoda andamanensis</i> Tikader
8.	Tetragnathidae	<i>Tetragnatha andamanensis</i> Tikader
9.		<i>Tetragnatha parvula</i> Thorell
10.	Thomisidae	<i>Thomisus andamanensis</i> Tikader
11.	Salticidae	<i>Plexippus andamanensis</i> (Tikader)
12.		<i>Bianor incitatus</i> Thorell
13.		<i>Pseududicius andamanicus</i> (Tikader)
14.	Hersiliidae	<i>Hersilia savignyi</i> Lucas
15.	Pholcidae	<i>Pholcus kapuri</i> Tikader
16.		<i>Artema atlandta</i> Walckenaer
17.	Oxyopidae	<i>Oxyopes javanus</i> Thorell

## APPENDIX - II

## List of Odonata recorded in Rutland Island

Sl. No.	Family	Species Name
1.	Aeschnidae	<i>Anax guttatus</i> (Burmeister)
2.		<i>Gynacantha hyalina</i> Selys
3.	Libellulidae	<i>Acisoma panorpoides panorpoides</i> Rambur
4.		<i>Brachydiplax chalybea chalybea</i> Brauer
5.		<i>Crocothemis servilia servilia</i> (Drury)
6.		<i>Diplacodes nebulosa</i> (Fabricius)
7.		<i>Indothemis carnatica</i> (Fabricius)
8.		<i>Lathrecista asiatica asiatica</i> (Fabricius)
9.		<i>Neurothemis fulvia</i> (Drury)
10.		<i>Orthetrum sabina sabina</i> (Drury)
11.		<i>Trithemis aurora</i> (Brumeister)
12.		<i>Rhyothemis variegata variegata</i> (Linnaeus)
13.		<i>Tholymis tillarga</i> (Fabricius)
14.		<i>Zyxomma petiolatum</i> Rambur
15.	Calopterygidae	<i>Vestalis gracilis gracilis</i> (Rambur)
16.	Coenagrionidae	<i>Aciagrion pallidum</i> Selys
17.		<i>Pseudagrion pruinosum</i> (Burmeister)
18.	Lestidae	<i>Lestes praemorsa praemorsa</i> Selys

## APPENDIX - III

## List of Butterflies recorded in Rutland Island

Sl. No.	Family / Common Name	Species Name
	<b>Hesperiidae</b>	
1.	Common Snow Flat	<i>Tagiades japetus</i> (Stoll)
2.	Common Awl	<i>Hasora badra</i> (Moore)
3.	Common Spotted Flat	<i>Celaenorrhinus leucocera</i> (Kollar)
	<b>Papilionidae</b>	
4.	Great Jay	<i>Graphium eurypylus</i> (Linnaeus)
5.	Andaman Mormon	<i>Papilio mayo</i> Atkinson
6.	Great Mormon	<i>Papilio memnon</i> Linnaeus
7.	Common Mormon	<i>Papilio polytes</i> (Linnaeus)
8.	Lime Butterfly	<i>Papilio demoleus</i> (Linnaeus)
9.	Crimson Rose	<i>Atrophaneura hector</i> (Linnaeus)
10.	Common Rose	<i>Atrophaneura aristolochiae</i> (Fabricius)
	<b>Pieridae</b>	
11.	Three Spot Grass Yellow	<i>Eurema blanda</i> (Boisduval)
12.	Common Grass Yellow	<i>Eurema hecaba</i> (Linnaeus)
13.	Tree Yellow	<i>Gandaca harina</i> (Horsfield)
14.	Common Emigrant	<i>Catopsilia pomona</i> (Fabricius)
15.	Mottled Emigrant	<i>Catopsilia pyranthe</i> (Linnaeus)
16.	Yellow Orange Tip	<i>Ixias pyrene</i> Linnaeus
17.	Great Orange Tip	<i>Hebomoia glaucippe</i> (Linnaeus)
18.	Andaman Wanderer	<i>Pareronia ceylanica</i> (C. & R. Felder)
19.	Striped Albatross	<i>Appias libythea</i> (Fabricius)
20.	Chocolate Albatross	<i>Appias lyncida</i> (Cramer)
21.	Orange Albatross	<i>Appias nero</i> (Fabricius)
22.	Common Albatross	<i>Appias albina</i> Felder
23.	Large Cabbage White	<i>Pieris brassicae</i> (Linnaeus)
24.	Lesser Gull	<i>Cepora nadina</i> (Lucas)
25.	Pysche	<i>Leptosia nina</i> (Fabricius)
	<b>Lycaenidae</b>	
26.	Indian Sunbeam	<i>Curetis thetis</i> (Drury)
27.	Yamfly	<i>Loxura atymnus</i> (Stoll)
28.	Leaf Blue	<i>Amblypodia anita</i> Hewitson

Sl. No.	Family / Common Name	Species Name
29.	Forget-Me-Not	<i>Catochrysops strabo</i> (Fabricius)
30.	Lesser Grass Blue	<i>Zizina otis</i> (Fabricius)
31.	Dark Blue Royal	<i>Pratapa icetas</i> (Hewitson)
32.	Plains Cupid	<i>Chilades pandava</i> (Horsfield)
33.	Leaf Blue	<i>Amblypodia anita</i> Hewitson
34.	Apefly	<i>Spalgis epius</i> (Westwood)
35.	Dark Grass Blue	<i>Zizeeria karsandra</i> (Moore)
36.	Common Tit	<i>Hypolycaena erylus</i> (Godart)
37.	Silverstreak Blue	<i>Iraota timoleon</i> Stoll
	<b>Nymphalidae</b>	
38.	Striped Tiger	<i>Danaus genutia</i> Cramer
39.	Dark Glassy Tiger	<i>Prantica ageloides</i> (C & R. Felder)
40.	Plain Tiger	<i>Danaus chrysippus</i> (Linnaeus)
41.	Blue Tiger	<i>Tirumala limniace</i> Cramer
42.	Glassy Tiger	<i>Parantica aglea</i> (Stoll)
43.	Spotted Black Crow	<i>Euploea crameri</i> Lucas
44.	Andaman Crow	<i>Euploea andamanensis</i> Atkinson
45.	Tree Nymph	<i>Idea agamarschana</i> (C & R. Felder)
46.	Palmking	<i>Amathusia phidippus</i> (Linnaeus)
47.	Common Evening Brown	<i>Melanitis leda</i> (Linnaeus)
48.	Long-Brand Bush Brown	<i>Mycalesis visala</i> Moore
49.	Andaman Chestnut Palmfly	<i>Elymanias cottonis cottonis</i> Hewitson
50.	Leopard Lacewing	<i>Cethosia cyane</i> (Drury)
51.	Cruiser	<i>Vindula erota</i> Fabricius
52.	Common Sergeant	<i>Athyma perium</i> (Linnaeus)
53.	Common Sailer	<i>Neptis hylas</i> Linnaeus
54.	Clipper	<i>Parthenos Sylvia</i> (Cramer)
55.	Hewitson Andaman Viscount	<i>Tanaecia cibaritis</i> Hewitson
56.	Peacock Pansy	<i>Junonia almana</i> (Linnaeus)
57.	Yellow Pansy	<i>Junonia hierta</i> (Fabricius)
58.	Blue Pansy	<i>Junonia orithya</i> (Linnaeus)
59.	Peacock Pansy	<i>Junonia atlites</i> (Linnaeus)
60.	Yellow Pansy	<i>Junonia hierta</i> (Fabricius)
61.	Grey Pansy	<i>Precis atlites</i> (Linnaeus)
62.	Great Egg fly	<i>Hypolimnas bolina</i> (Linnaeus)
63.	Danaid Eggfly	<i>Hypolimnas misippus</i> (Linnaeus)

## APPENDIX - IV

## List of Reptiles and Amphibians recorded in Rutland Island

Family	Species Name
Gekkonidae	<i>Cnemaspis kandianus</i> (Kelaart)
	<i>Cosymbotus platyurus</i> (Schneider)
	<i>Gecko gecko</i> (Linnaeus)
	<i>Gecko verreauxi</i> (Tytler)
	<i>Gecko smithii</i> (Gray)
	<i>Hemidactylus frenatus</i> (Dumeril & Bibron)
	<i>Phelsuma andamanense</i> (Blyth 1860 )
Agamidae	<i>Calotes andamanensis</i> (Boulenger)
	<i>Calotes emma alticristatus</i> (Schmidt)
	<i>Calotes mystaceus</i> (Dumeril & Bibron)
	<i>Coryphophylax subcristatus</i> (Blyth)
	<i>Calotes versicolor</i> (Daudin)
Scincidae	<i>Dasia olivacea</i> (Gray)
	<i>Eutropis andamanensis</i> (Smith)
	<i>Eutropis tyleri</i> (Theobald)
	<i>Eutropis rudis</i> (Boulenger)
	<i>Eutropis rugifera</i>
	<i>Eutropis multifasciata</i> (Kuhl)
Varanidae	<i>Varanus salvator</i> (Laurenti)
Typhlopidae	<i>Ramphotyphlops braminus</i> (Daudin)
	<i>Typhlops andamanensis</i> (Laurenti)
Colubridae	<i>Dendrelaphis pictus andamanensis</i> (Anderson)
Elapidae	<i>Bungarus andamanensis</i> (Biswas & Sanyal)
	<i>Ophiophagus hannah</i> (Cantor)
Viperidae	<i>Trimeresurus purpureomaculatus andersoni</i> (Theobald)

**Amphibians**

**Ranidae:** *Hylarana erythraea* (Schlegel, 1837)

## APPENDIX - V

## Checklist of birds species recorded in Rutland Island

Sl. No.	Common Name	Scientific Name
	<b>Ardeidae</b>	
1.	Little Egret	<i>Egretta garzetta</i> (Linnaeus)
2.	Purple Heron	<i>Ardea purpurea</i> Linnaeus
3.	Grey Heron	<i>Ardea cinerea</i> Linnaeus
4.	Median Egret	<i>Mesophoyx intermedia</i> (Wagler)
5.	Cattle Egret	<i>Bubulcus ibis</i> (Linnaeus)
6.	Indian Pond-Heron	<i>Ardeola grayii</i> (Sykes)
	<b>Anseriformes</b>	
	<b>Anatidae</b>	
7.	Andaman Teal	<i>Anas gibberifrons</i> (Muller)
	<b>Falconiformes</b>	
	<b>Accipitridae</b>	
8.	Brahminy Kite	<i>Haliastur indus</i> (Boddaert)
9.	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i> (Gmelin)
10.	Greater Grey-headed Fish Eagle	<i>Ichthyophaga ichthyaetus</i> (Horsfield)
11.	Andaman Serpent-Eagle	<i>Spilornis cheela davisoni</i> Hume
12.	Western Marsh-Harrier	<i>Circus aeruginosus</i> (Linnaeus)
	<b>Gruiformes</b>	
	<b>Rallidae</b>	
13.	Blue-breasted Rail	<i>Gallirallus striatus</i> Linnaeus
14.	Andaman White-breasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant)
15.	Water Cock	<i>Gallicrex cinerea</i> (Gmelin)
16.	Common Moorhen	<i>Gallinula chloropus</i> (Linnaeus)
	<b>Charadriiformes</b>	
	<b>Charadriidae</b>	
17.	Pacific Golden-Plover	<i>Pluvialis fulva</i> (Gmelin)
18.	Little Ringed Plover	<i>Charadrius dubius</i> Scopoli
19.	Lesser Sand Plover	<i>Charadrius mongolus</i> Pallas
	<b>Scolopacidae</b>	
20.	Pintail Snipe	<i>Gallinago stenura</i> (Bonaparte)
21.	Jack Snipe	<i>Lymnocyptes minimus</i> (Brunnich)
22.	Bar-tailed Godwit	<i>Limosa lapponica</i> (Linnaeus)
23.	Whimbrel	<i>Numenius phaeopus phaeopus</i> (Linnaeus)
24.	Eurasian Curlew	<i>Numenius arauata</i> (Linnaeus)
25.	Common Redshank	<i>Tringa totanus</i> (Linnaeus)
26.	Common Greenshank	<i>Tringa nebularia</i> (Gunner)

Sl. No.	Ciconiiformes	Scientific Name
27.	Green Sandpiper	<i>Tringa ochropus</i> Linnaeus
28.	Wood Sandpiper	<i>Tringa glareola</i> Linnaeus
29.	Common Sandpiper	<i>Actitis hypoleucos</i> Linnaeus
30.	Ruddy Turnstone	<i>Arenaria interpres</i> (Linnaeus)
31.	Great Knot	<i>Calidris tenuirostris</i> (Horsfield)
32.	Little Stint	<i>Calidris minuta</i> (Leisler)
	<b>Laridae</b>	
33.	Gull-billed Tern	<i>Gelochelidon nilotica</i> (Gmelin)
34.	Black-naped Tern	<i>Sterna sumatrana</i> Raffles
35.	Lesser Crested Tern	<i>Sterna bengalensis</i> Lesson
36.	White-winged Black Tern	<i>Chlidonias leucopterus</i> (Temminck)
	<b>Colimbiformes</b>	
	<b>Columbidae</b>	
37.	Blue Rock Pigeon	<i>Columba livia</i> Gmelin
38.	Andaman Wood-Pigeon	<i>Columba palumboides</i> (Hume)
39.	Emerald Dove	<i>Chalcophaps indica</i> (Linnaeus)
40.	Andaman Green Imperial-Pigeon	<i>Ducula aenea andamanica</i> Abdulali
	<b>Psittaciformes</b>	
	<b>Psittacidae</b>	
41.	Indian Hanging-Parrot	<i>Loriculus vernalis</i> (Sparman)
42.	Red-breasted Parakeet	<i>Psittacula alexandri</i> (Linnaeus)
43.	Red-cheeked Parakeet	<i>Psittacula longicauda</i> (Boddaert)
	<b>Cuculiformes</b>	
	<b>Cuculidae</b>	
44.	Asian Koel	<i>Eudynamys scolopacea</i> (Linnaeus)
45.	Andaman Coucal	<i>Centropus andamanensis</i> Beavan
	<b>Apodiformes</b>	
	<b>Apodidae</b>	
46.	Common Edible-nest Swiftlet	<i>Collocalia fuciphaga</i> Thunberg
	<b>Coraciformes</b>	
	<b>Alcedinidae</b>	
47.	Small Blue Kingfisher	<i>Alcedo atthis</i> (Linnaeus)
48.	Stork-billed Kingfisher	<i>Halcyon capensis</i> (Linnaeus)
49.	White-breasted Kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus)
50.	Black-capped Kingfisher	<i>Halcyon pileata</i> (Boddaert)
	<b>Meropidae</b>	
51.	Chestnut-headed Bee-eater	<i>Merops leschenaultia</i> Vieillot

Sl. No.	Ciconiiformes	Scientific Name
	<b>Piciformes</b>	
	<b>Picidae</b>	
52.	Fulvous-breasted Pied Woodpecker	<i>Dendrocopos macei</i> (Vieillot)
53.	Andaman Black Woodpecker	<i>Dryocopus hodgei</i> (Blyth)
	<b>Passeriformes</b>	
	<b>Motacillidae</b>	
54.	Large Pied Wagtail	<i>Motacilla maderaspatensis</i> Gmelin
55.	Yellow Wagtail	<i>Motacilla flava</i> Linnaeus
56.	Grey Wagtail	<i>Motacilla cinerea</i> Tunstall
	<b>Campephagidae</b>	
57.	Scarlet Minivet	<i>Pericrocotus flammeus</i> (Forster)
	<b>Pycnonotidae</b>	
58.	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i> (Linnaeus)
	<b>Muscicapinae</b>	
59.	Asian Brown Flycatcher	<i>Muscicapa dauurica</i> Pallas
	<b>Monarchinae</b>	
60.	Asian Paradise-Flycatcher	<i>Terpsiphone paradisi</i> (Linnaeus)
61.	Blacknaped Monarch-Flycatcher	<i>Hypothymis azurea</i> (Boddaert)
	<b>Dicaeidae</b>	
62.	Andaman Flowerpecker	<i>Dicaeum concolor virescens</i> Hume
	<b>Nectariniidae</b>	
63.	Olive-backed Sunbird	<i>Nectarinia jugularis andamanica</i> Linnaeus
64.	Crimson Sunbird	<i>Aethopyga siparaja</i> (Raffles)
	<b>Zosteropidae</b>	
65.	Oriental White-eye	<i>Zosterops palpebrosus</i> (Temminck)
	<b>Sturnidae</b>	
66.	Asian Glossy Starling	<i>Aplonis panayensis</i> (Scopoli)
67.	White-headed Starling	<i>Sturnus erythropygius</i> (Blyth)
68.	Common Hill-Myna	<i>Gracula religiosa</i> Linnaeus
	<b>Oriolidae</b>	
69.	Eurasian Golden Oriole	<i>Oriolus oriolus</i> (Linnaeus)
70.	Andaman Black-naped Oriole	<i>Oriolus chinensis andamansis</i> Tytler
	<b>Dicruridae</b>	
71.	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i> (Linnaeus)
	<b>Corvidae</b>	
72.	Andaman Treepie	<i>Dendrocitta bayleyi</i> Tytler
73.	Jungle Crow	<i>Corvus macrothynchos</i> Wagler

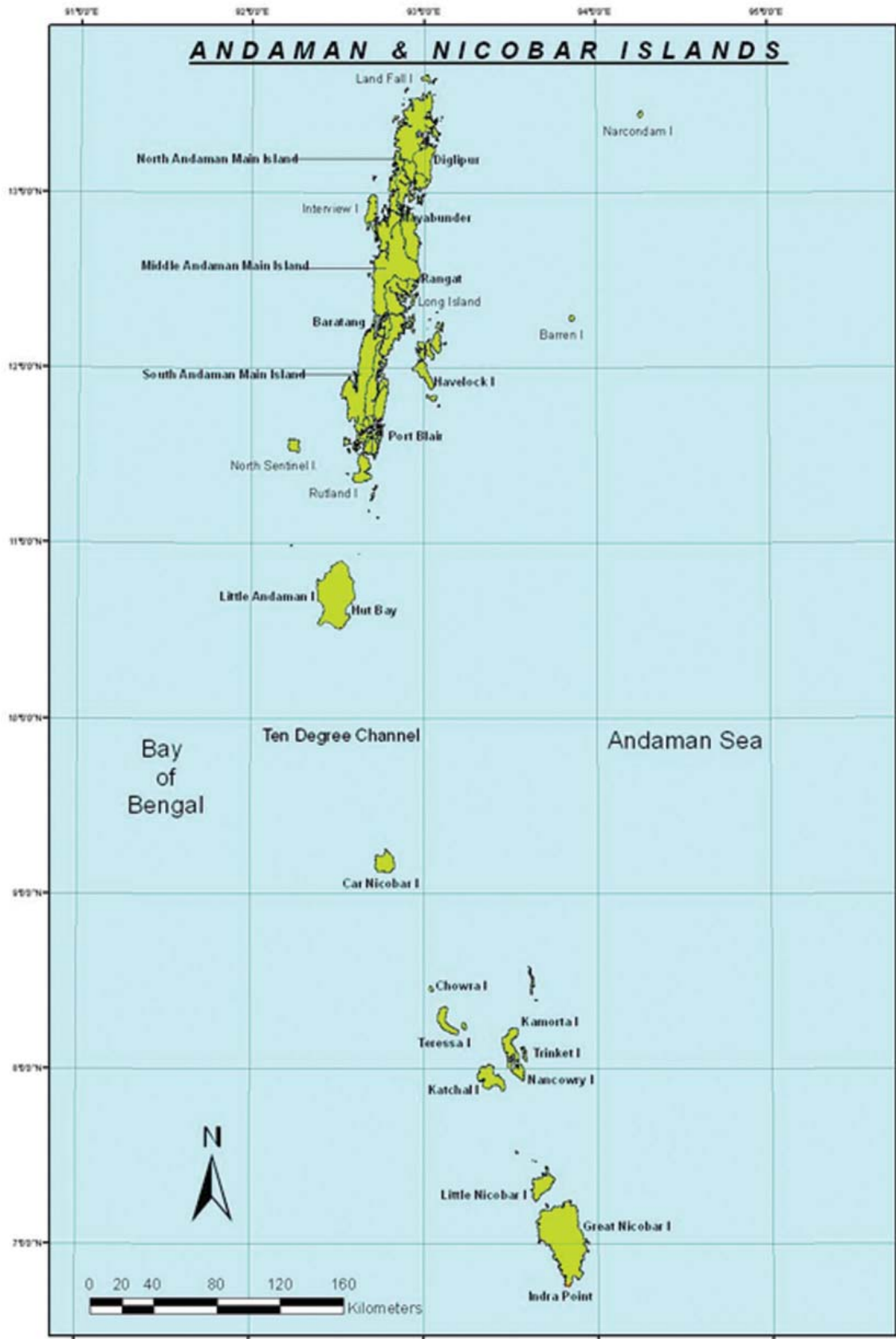


Fig. 1. Andaman and Nicobar Islands

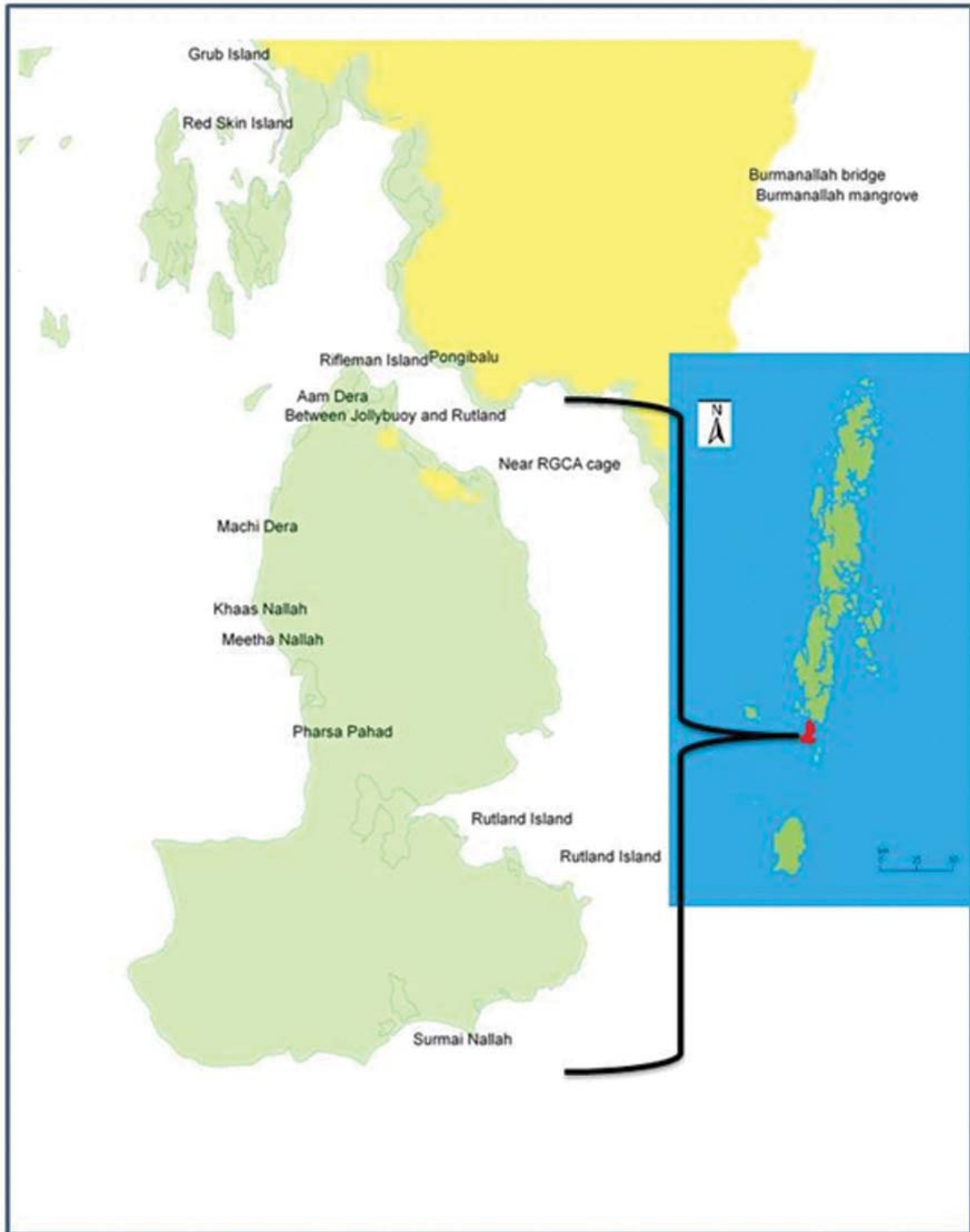


Fig. 2. Rutland Island, Andaman & Nicobar Islands

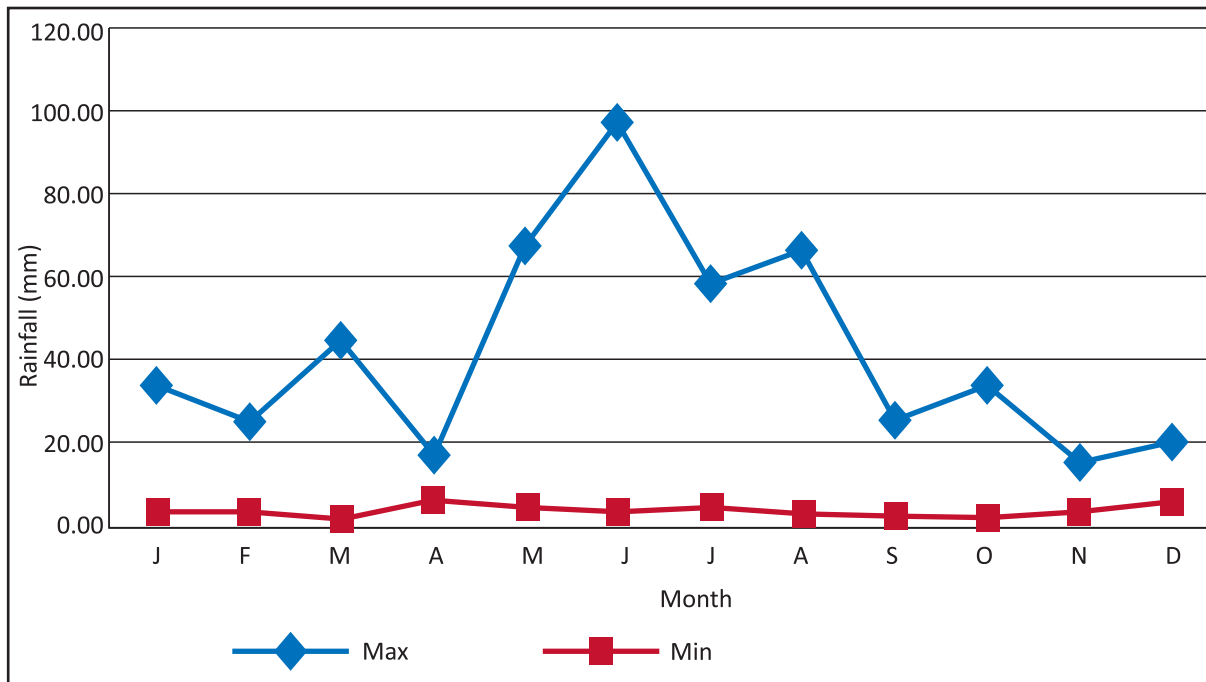


Fig. 3. Annual average rainfall recorded in south Andaman (2009-2011)

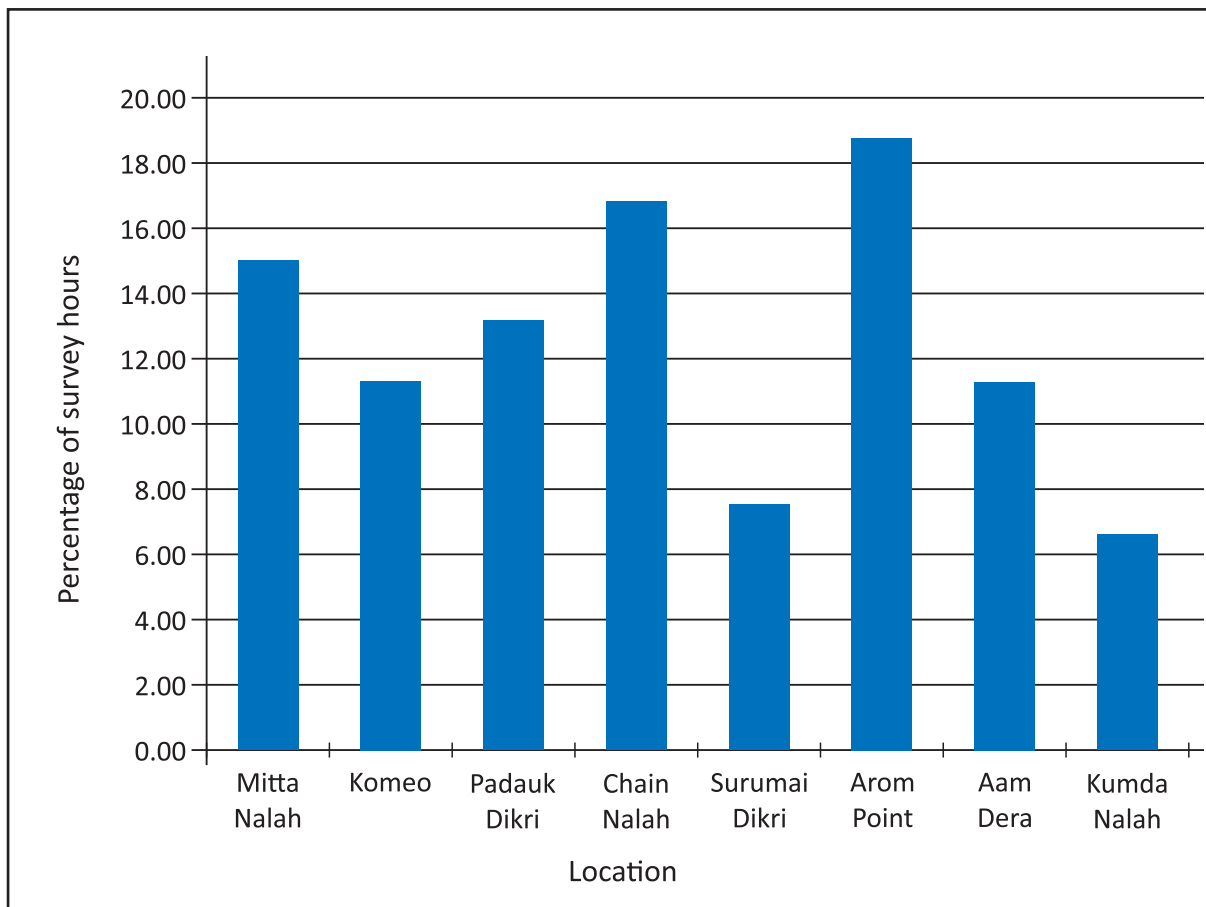


Fig. 4. Percentage of total survey hours for each location (n = 30)

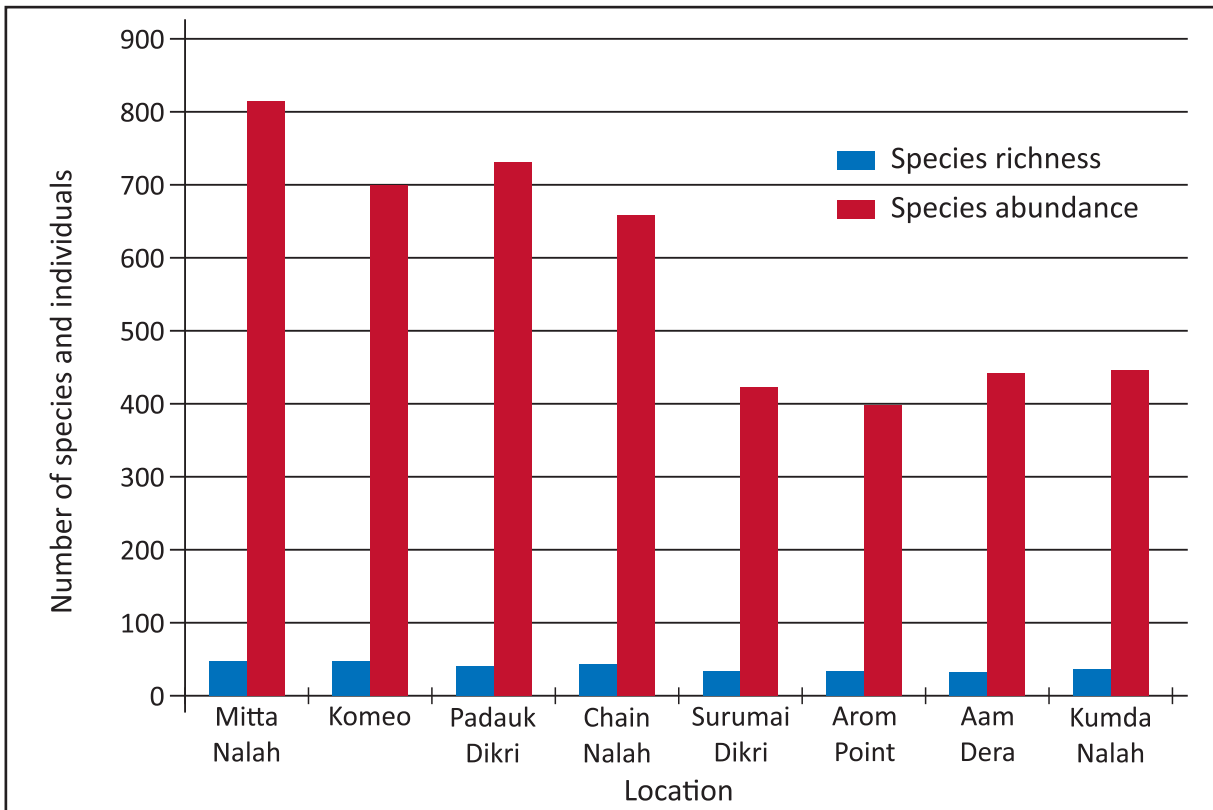


Fig. 5. Species richness and abundance in different locations in Rutland Island

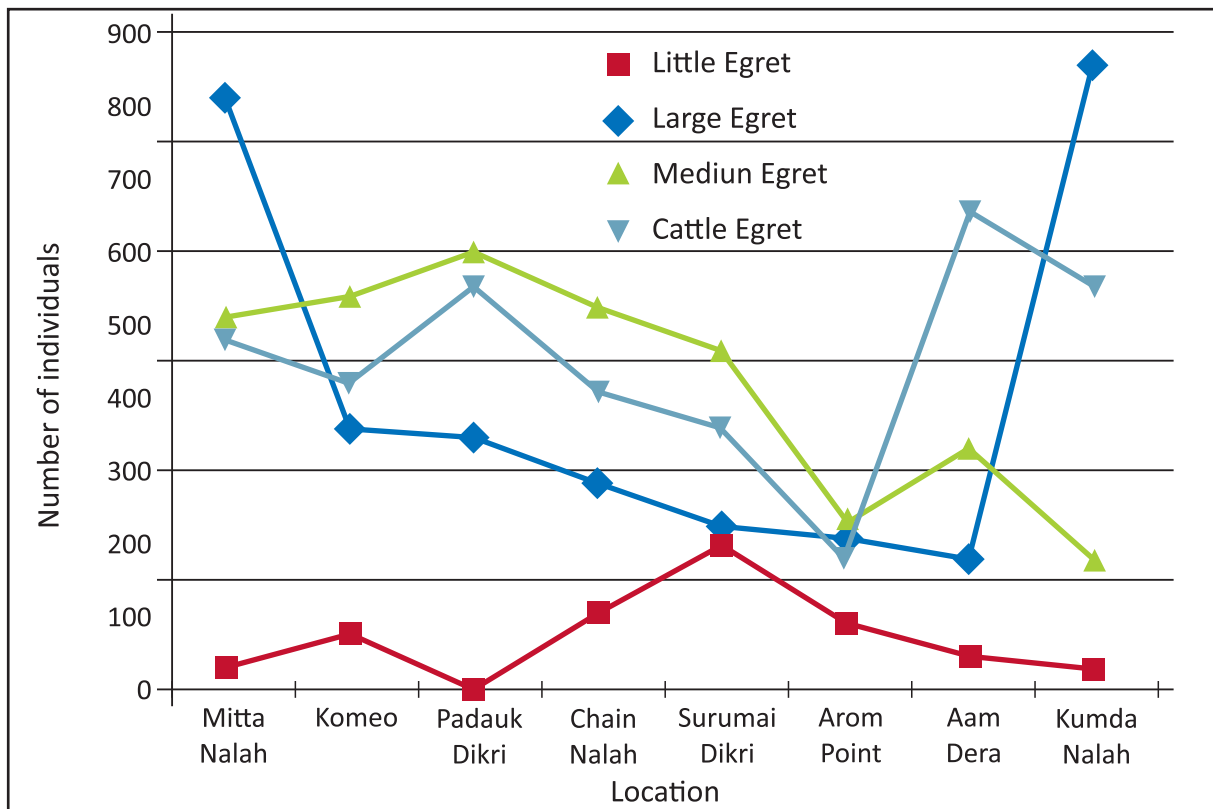


Fig. 6. Population fluctuations of Little Egret, Large Egret, Median Egret and Cattle Egret in Rutland Island (n = 30)

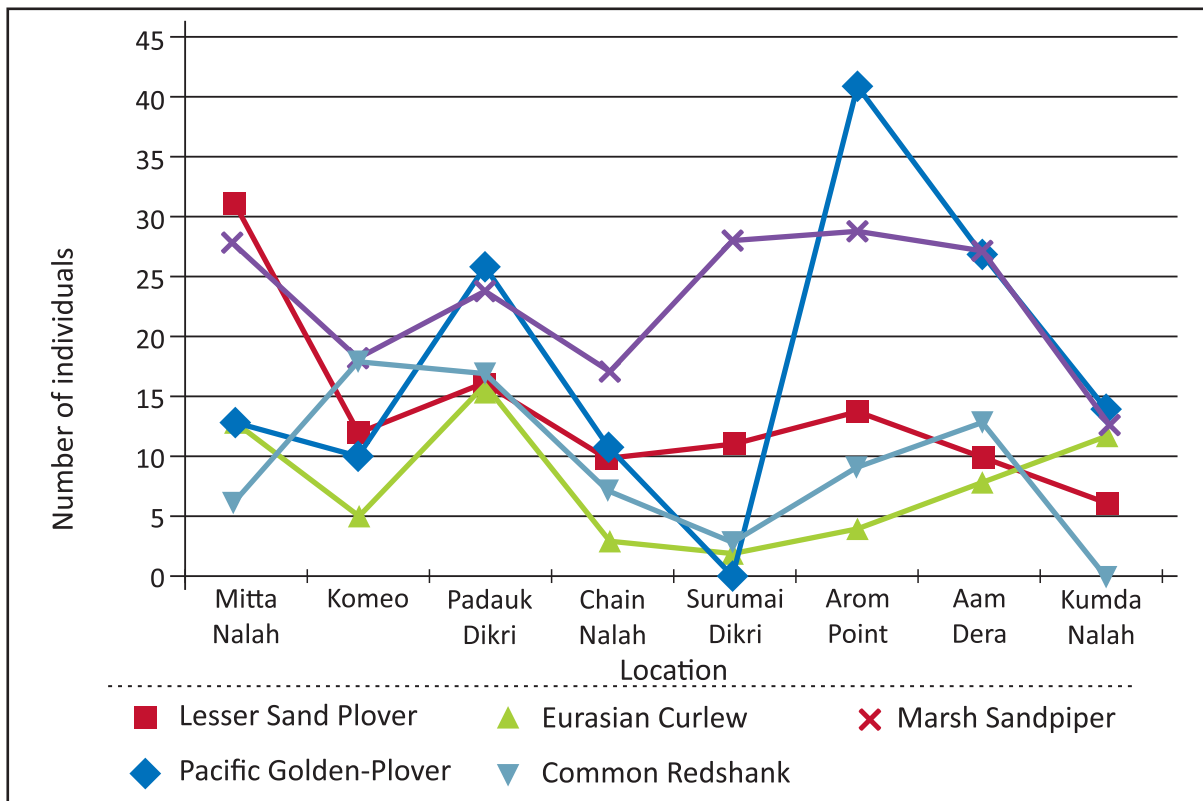


Fig. 7. Population fluctuations of Pacific Golden-Plover, Lesser Sand Plover, Eurasian Curlew, Common Redshank, and Marsh Sandpiper in Rutland Island (n = 30)

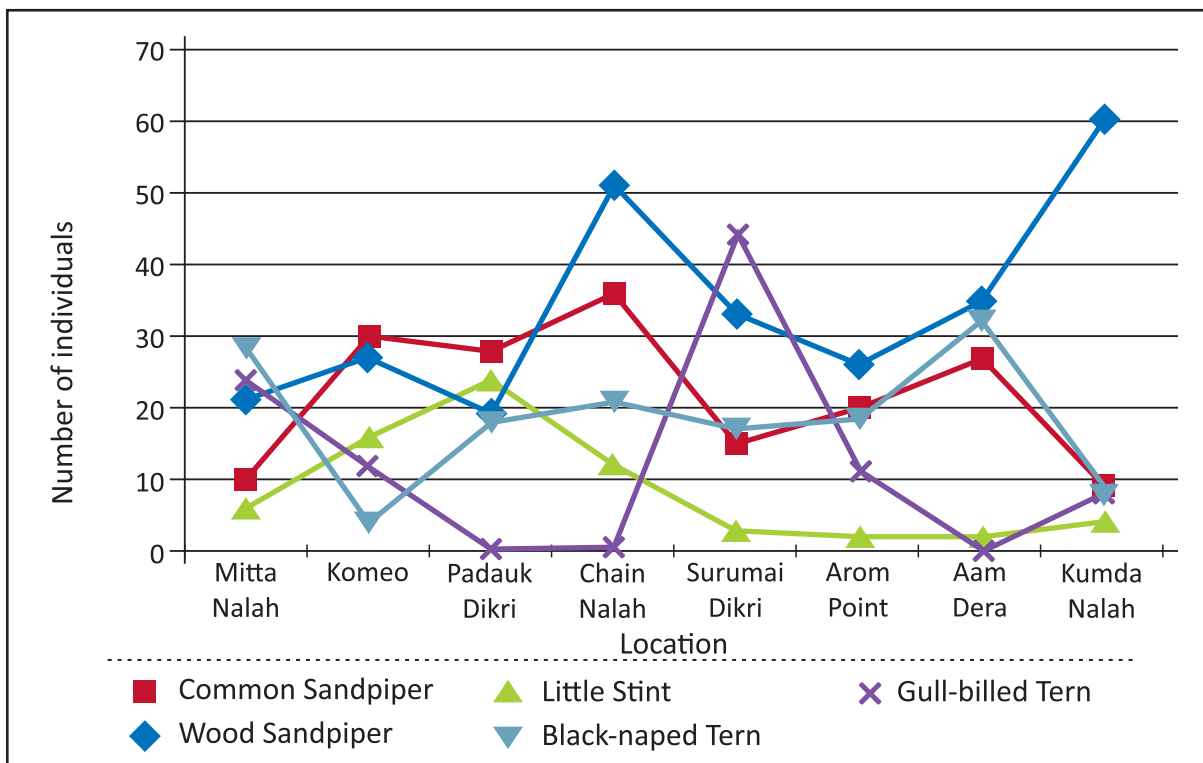


Fig. 8. Population fluctuations of Wood Sandpiper, Common Sandpiper, Little Stint, Gull-billed Tern and Black-naped Tern in Rutland Island (n = 30)

**PLATE 1**  
**Rutland Island, South Andaman**



**PLATE 2**

**Wetland birds of Rutland Island, South Andaman**



Andaman Teal *Anas gibberifrons* (Muller)



Common Moorhen *Gallinula chloropus* (Linnaeus)



Water Cock *Gallixrex cinerea* (Gmelin)



Purple Moorhen *Porphyrio porphyrio* (Linnaeus)



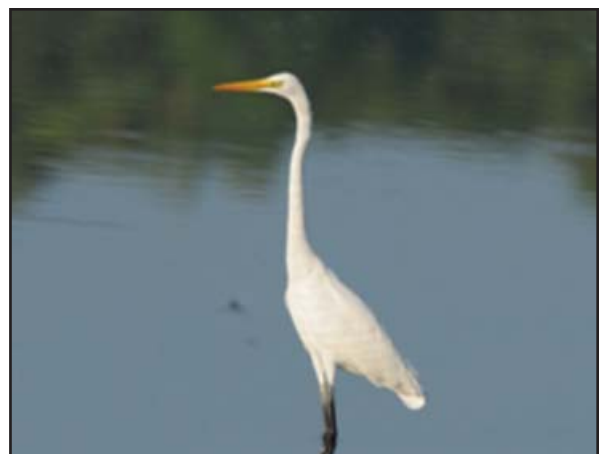
Andaman Teal *Anas gibberifrons* (Muller)



Common Moorhen *Gallinula chloropus* (Linnaeus)

## PLATE 3

## Wetland birds of Rutland Island, South Andaman

Little Egret *Egretta garzetta* (Linnaeus)Large Egret *Casmerodius albus* (Linnaeus)Pacific Reef-Egret *Egretta sacra* (Gmelin)Cattle Egret *Bubulcus ibis* (Linnaeus)Grey Heron *Ardea cinerea* LinnaeusMedian Egret *Mesophoyx intermedia* (Wagler)

**PLATE 4**

**Wetland birds of Rutland Island, South Andaman**



Wood Sandpiper *Tringa glareola* Linnaeus



Common Redshank *Tringa totanus* (Linnaeus)



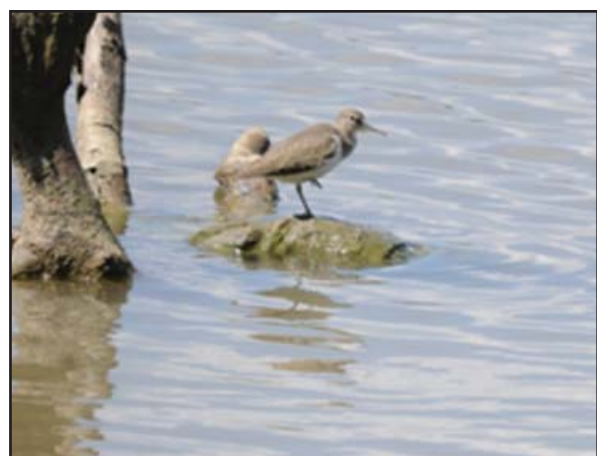
Lesser Sand Plover *Charadrius mongolus* Pallas



Eurasian Curlew *Numenius arauata* (Linnaeus)



Pacific Golden-Plover *Pluvialis fulva* (Gmelin)

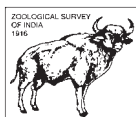


Common Sandpiper *Actitis hypoleucos* Linnaeus

## PLATE 5

## Wetland birds of Rutland Island, South Andaman

White-breasted Kingfisher *Halcyon smyrnensis* (Linnaeus)Stork-billed Kingfisher *Halcyon capensis* (Linnaeus)Andaman Collared Kingfisher *Halcyon chloris davisoni* SharpeYellow Bittern *Ixobrychus sinensis* (Gmelin)White-bellied Sea-Eagle *Haliaeetus leucogaster* (Gmelin)Lesser Whistling-Duck *Dendrocygna javanica* (Horsfield)



## STATUS OF EDIBLE HOLOTHURIANS ON THE FRINGING REEF FLATS OF NICOBAR ISLANDS, INDIA

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### INTRODUCTION

Holothurians, especially Holothuriidae and Stichopodidae, form an important part of multi-species invertebrate fisheries that has been in existence in the Indo Pacific for traditional and subsistence uses for over 1000 years. In India, about 200 species of holothurians have been reported at earlier of which 75 species are found in shallow water depth. Of these only 12 species are commercially important. The commercially important holothurians are found from the intertidal region to a depth of 20m. At earlier, James (1973, 1983) provides the documentation on the holothurians resources of India chiefly based on the intensive surveys along the Gulf of Mannar and Andaman and Nicobar Islands. The harvesting of this resources have developed throughout the Indo- West Pacific and beyond for the preparation and sales of beche-de-mer (MacKnight, 1976; Conand and Tuwo, 1996). This beche-de-mer industry has collapsed throughout the Indo Pacific with many holothurian species now commercially extinct due to over exploitation (Sitwell, 1993; Jenkins and Mulliken, 1999). The potential for over-exploitation is exacerbated by the fact that most countries are currently exploiting the resource without management plans. As a result whole populations have been depleted in many areas (Uthicke, 1996). Very little information is available on holothurians status in Nicobar Islands of Indian subcontinent. The main objective of the present study is to provide a

compiled quantitative data on the present status of commercially important holothurians of commonly edible holothurians around Nicobar Islands.

### MATERIALS AND METHODS

Nicobar Islands are an archipelagic island chain in the eastern part of Indian Ocean. The coral reef ecosystem of Nicobar Islands is quite adequate in its nature. All reef areas are of fringing type. We selected seven sites named as Western Entrance (Lat. 93°30'37.38E; Long. 07°59'57.72N), Safed



Fig.1. Study area

Balu (Lat. 08°06'56.7N; Long. 93°33'42.00E), Trinket I (Lat. 08°06'26.04N; Long. 93°33'23.58E), Trinket II (Lat. 08°02'08.34N; Long. 93°36'32.64E), Alukia (Lat. 07°59'50.22N; Long. 93°29'49.38E) and Kardwip (Lat. 08°02'17.82N; Long. 93°33'10.38E).

An extensive field survey was made from July' 2011-February' 2012. To assess the holothurians, 50m transect was employed and recorded information 2.5m either side of the transect line. Length and weight of commercially important holothurians species have also been measured. The transects were positioned at 1m, 5m and 10m depth. In addition, the length of each of the holothurian species was measured and noted the habitat information. Each survey site was geo-referenced using a hand-held Global Positioning System (GPS) device. The relative abundance and observation frequency of each species were also calculated (Rilov and Benayahu, 1998).

Relative abundance = no of individuals from one species / total no. of holothurian specimens.

Observation frequency = no. of stations where the species has been observed/total no. of stations.

## RESULTS AND DISCUSSION

12 species of sea cucumbers were investigated during the sampling carried out on the fringing reef flat of Nicobar Islands. *Holothuria atra* and *Holothuria edulis* are most commonly abundant that possess the relative proportion of 19.34% and 20.28% respectively (Table 1). These two species were also those with the highest observation frequencies: *H. atra* and *H. edulis* were observed at 27.11% and 20.31% of sampling stations, respectively (Table 1). Among the 7 sampling stations, Western Entrance (24.53%) and Trinket Island I (18.40%) showed higher percentage of species abundance than other sampling stations (Fig. 2). Conversely, Trinket II and Safed Balu represent less abundance of holothurian species with proportion of 2.83% and 7.08% respectively. Out of these 12 species, four species, *Holothuria atra*, *Holothuria edulis*, *Actinopyga mauritiana*, *Stichopus variegatus* are mostly dominant at each

station. In terms of abundance, *Holothuria atra* (17 indiv/10m<sup>2</sup>) and *Holothuria edulis* (8 indiv/m<sup>2</sup>) are most densely distributed than other species of holothurians. *Bohadschia graeffei* (2%) and *Stichopus vastus* (1%) can be considered as scarce species in the fringing reef flats of Nicobar Islands (Fig.4). According to the depth-wise distribution, *H. edulis* mostly found in 5m and 10m depths where as *H. atra* distributed maximum in 10m depths (Fig. 3). *A. mauritiana* and *B. graeffei* showed moderate distribution in the depth of 1m. Fig. 5 shows the heterogenous distribution of the four most frequent species (*H. atra*, *H. edulis*, *Stichopus variegatus* and *A. mauritiana*) at the various sampling stations. Only 3 of the 7 stations were concerned by the presence of these each species (Fig. 5). The species *H. atra* shows maximum densities of 30 specimens/10m<sup>2</sup> areas in Kardwip Island whereas in Trinket Island, *H. edulis* shows the mean density of 26 specimens/10m<sup>2</sup> (Fig. 5). The *S. variegatus* are most dominant species found in Western Entrance (10 indiv/10m<sup>2</sup>).

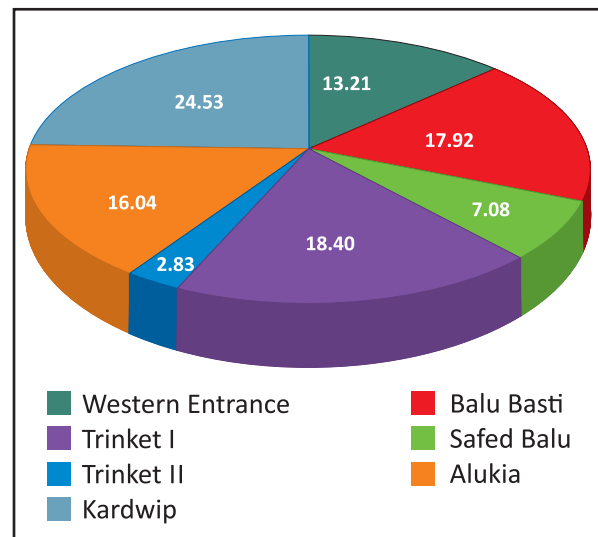


Fig. 2. Percentage abundance of Holothurian species from Nicobar group of Islands.

The present study encountered only edible holothurians whose status is quite vulnerable due to over exploitation by the poachers. Soota *et al.*, (1983) first listed 11 species as economically important for beche-de-mer industry. In Nancowry group of Nicobar Islands,

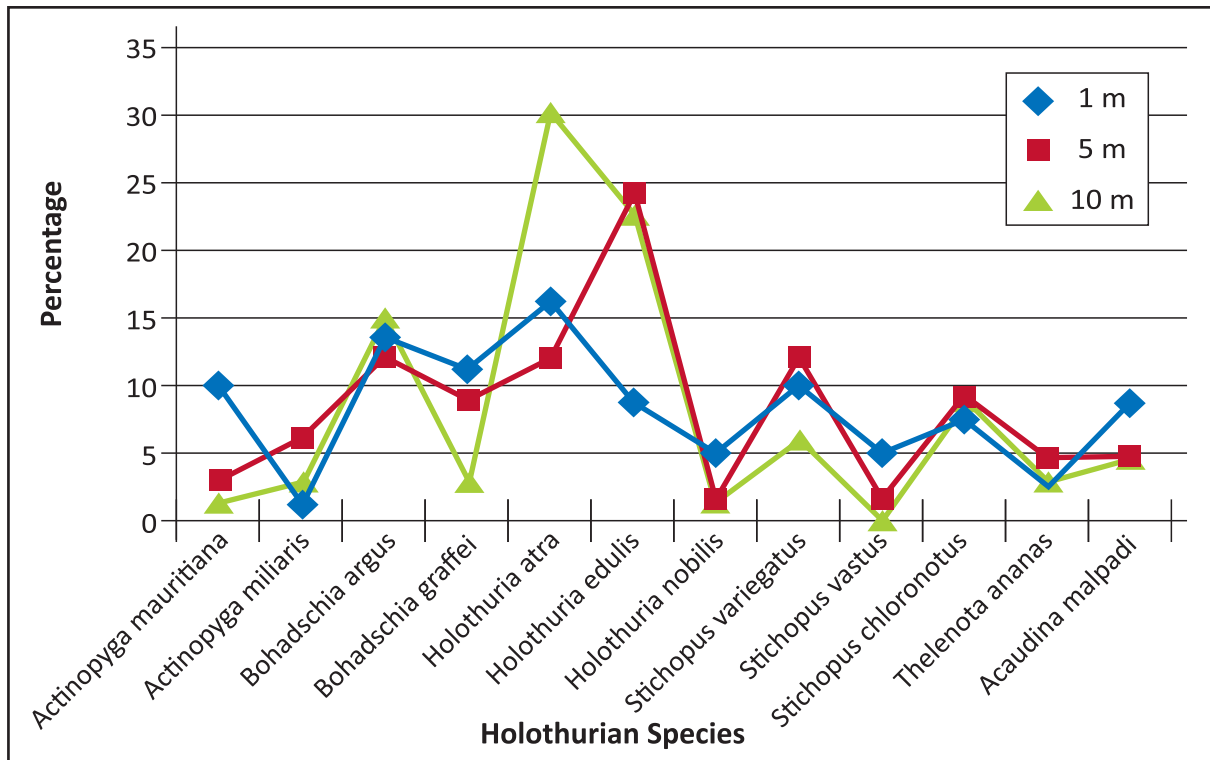


Fig. 3. Depth-wise distribution of Holothurian species

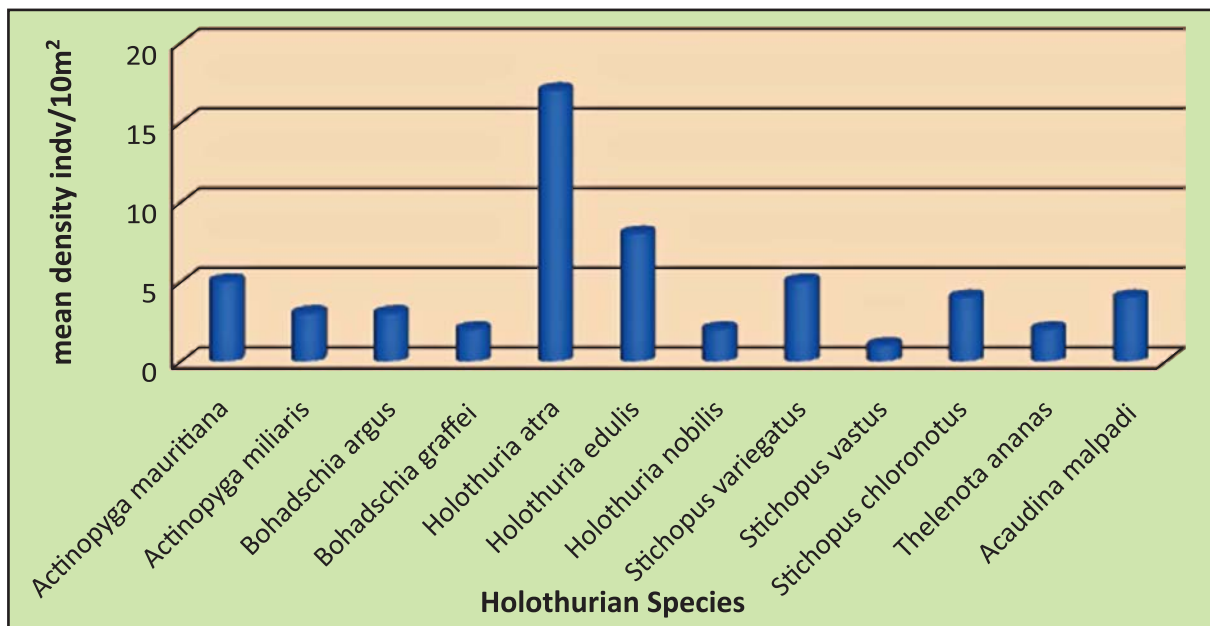


Fig. 4. Density of Holothurian species (individual/10m²)

present study reported 12 species of which 8 species are commercially more important. The holothurian densities observed during the survey appears to be lower than those recorded from other islands of Nicobar. The densities and abundance of holothurians species are higher in Kardwip

area of Nancowry Islands with proportion of 56 individuals/10m² and 24.53%. During 1990-1994, Holothurian species *Holothuria scabra*, *Actinopyga mauritiana*, *Actinopyga echinites* were harvested for using in beche-de-mer industry (James & James, 1994). But *Holothuria scabra*

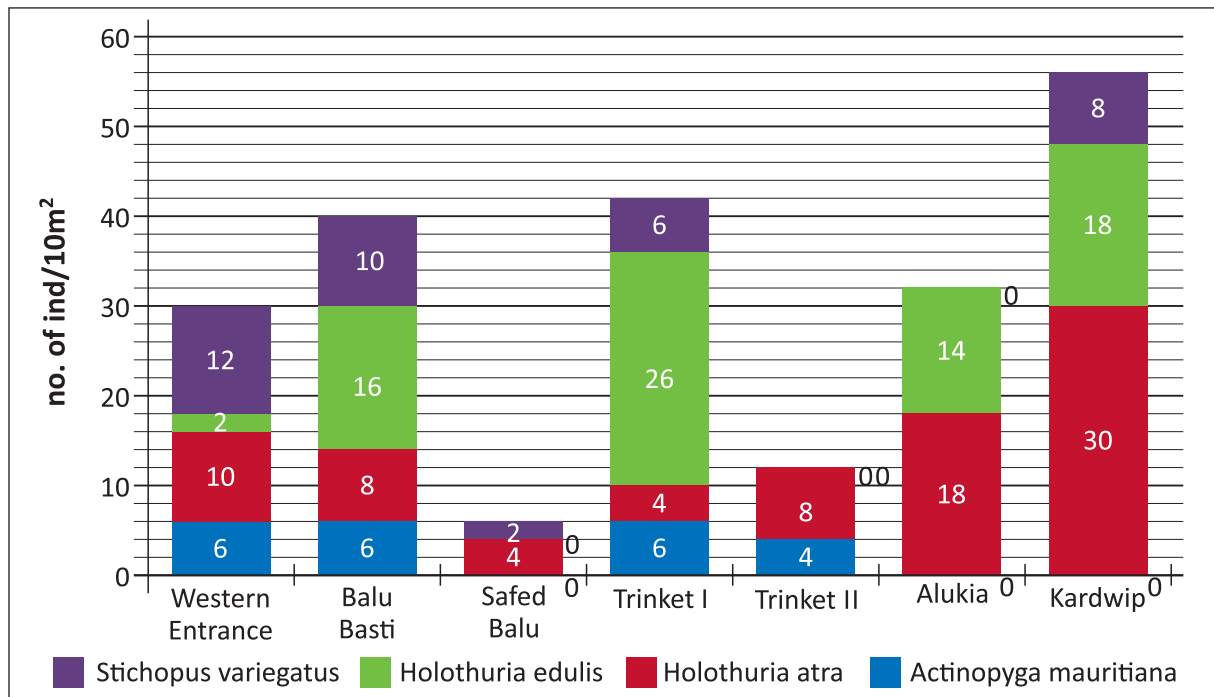


Fig. 5. Distribution of dominant species at different sites of Nicobar group of Islands.

and *Actinopyga echinites* have not been found in Nicobar Islands during our survey. The depth wise distribution of dominant species like *Holothuria atra*, *Actinopyga mauritiana*, *Holothuria edulis* are found in between 5m-10m. Among all the Holothurians found in Nancowry group of Nicobar Islands the genus *Stichopus* found density of very less. The mainly prefers sea bottom (James, 1994) with algae cover, but in Nicobar Islands, most of

the area are fully rocky sea bottoms which is the suitable habitat for the species *Holothuria edulis*, *Actinopyga mauritiana*, *Bohadschia graffei*. The species *Stichopus variegatus* are equally distributed at each depth of the study sites. The holothurian resources in the seas around India are varied and diversified in species. *Holothuria scabra* and *Holothuria spinifera* are the two important species which are abundant in Gulf of Manner and

Table 1. Relative and Observation frequency of Holothurian species.

Species	Relative frequency	Observation frequency
<i>Actinopyga mauritiana</i>	5.19	3.00
<i>Actinopyga miliaris</i>	3.30	5.71
<i>Bohadschia argus</i>	13.68	11.52
<i>Bohadschia graffei</i>	8.02	10.00
<i>Holothuria atra</i>	19.34	27.11
<i>Holothuria edulis</i>	20.28	20.31
<i>Holothuria nobilis</i>	2.83	11.41
<i>Stichopus variegatus</i>	9.43	15.10
<i>Stichopus vastus</i>	2.36	6.35
<i>Stichopus chloronotus</i>	8.49	6.11
<i>Thelenota ananas</i>	3.30	2.58
<i>Acaudina malpadiodes</i>	6.13	3.79

Palk Bay (James, 1994). *Bohadschia argus* and *Stichopus chloronotus* are exceedingly abundant in some of the lagoons in the Lakshadweep. The species *Holothuria edulis* and *Holothuria atra* is commonly distributed in Nancowry group of Nicobar Islands.

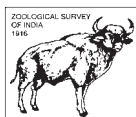
### SUMMARY

This survey, carried out on the fringing reef of the Nicobar Islands, revealed the presence of 12 species, of which *Holothuria atra* and *Holothuria edulis* were sub tropic. Sea cucumbers are important components of the food chain in temperate and coral reef ecosystems, and they play an important role as deposit feeders and suspension feeders. Rapid declines in populations may have

serious consequences for the survival of other species that are part of the same complex food web, as the eggs, larvae and juveniles constitute an important food source for other marine species including crustaceans, fish and molluscs. The edible holothurian status in Nicobar group of Islands is still stable with composition of 8 species. Research on the population structures (weighing and measuring animals) and regular monitoring would make it possible to introduce sustainable management measures for this resource. The use of a larger number of transects or quadrates along radials perpendicular to the shore might make it possible to gain a better picture of the abundance of these animals on the reef flat.

### REFERENCES

- Conand, C and Tuwo, A. 1996. Commercial holothurians in South Sulawesi, Indonesia. Fisheries and mariculture. *Beche-de-mer Information Bulletin*, **8**: 17-21.
- James, D.B. 1973. *Beche-de-mer* resources of India. *Proc.symp. Living Resources*. Pt. **3**: 706-711.
- James, D.B. 1983. Sea cucumber and sea urchin resources. *Bull. cent. mar. Fish. Res. Inst.*, No. **34**: 85-93.
- James, D.B. 1994. Holothurian resources from India and their exploitation. *Bull. cent. mar. Fish. Res. Inst.*, No. **46**: 27-31pp.
- James, D.B and James, P.S.B.R. 1994. Resource, Exploitation, Conservation and Management of Holothurians. *Bull. cent. mar. Fish. Res. Inst.*, No. **46**: 17-22pp.
- Jenkins, M and Mulliken, T.A. 1999. Evolution of exploitation in the Galapagos Islands: Ecuador's sea cucumber trade. *Traffic Bull.* **17**(3).
- Macknight, C.C. 1976. The voyage to Marege: Macassan trepangers in northern Australia. Melbourne University Press. 175pp.
- Rilov, G and Benayahu, Y. 1998. Vertical artificial structures as an alternative habitat for coral reef fishes in disturbed environments. *Mar Env. Res.* **45**(4): 431-451.
- Sitwell, N. 1993. The grub and the Galapagos. *New Scientist*, 11 December.
- Soota, T. D., S. K. Mukhopadyay and t. K. Samanta 1983. On some hlothurians from the Andaman and Nicobar Islands. *Rec. Zool. Surv. India*, **80**: 507-524.
- Uthicke, S. 1996. *Beche-de-mer: a literature review on Holothurian fishery and ecology*. AIMS, Townsville, 45pp.



## Short Communication

### LIST OF BUTTERFLIES (INSECTA : LEPIDOPTERA) OBSERVED IN BOR WILDLIFE SANCTUARY, MAHARASHTRA

#### INTRODUCTION

Bor Wildlife Sanctuary is located in Wardha District in the state of Maharashtra. The Sanctuary covers an area of 121.1 km<sup>2</sup>, which includes the drainage basin of the Bor Dam. The Sanctuary is located at a distance of around 60 km from Nagpur city. It is situated in the Vidarbha region of Maharashtra, which is characterized by mild winters and extremely hot summers. The Sanctuary has South Deccan Plateau dry deciduous forests.

Many species of animals including major species such as the Bengal Tiger and the Indian Leopard are found here. Among invertebrate fauna, butterflies are probably the most conspicuous. They are mostly diurnal in habit and are well admired for their striking colours and flight. Many species of butterflies play an important role in nature by pollinating various species of plants and a few species are economically important as pests of cultivated plants.

The Vidarbha region of Maharashtra has some important conservation areas. Tiple (2011) has listed the butterflies of Vidarbha region. Sharma and Radhakrishnan (2005, 2006) have reported the Lepidoptera of Pench National Park and Tadoba Andhari Tiger Reserve, respectively. Chandrakar *et al* (2007) have studied the butterflies of Melghat region.

Currently no information is available regarding the butterflies of Bor Wildlife Sanctuary. During the present study, 33 species of butterflies belonging to 22 genera of 5 families of order Lepidoptera, observed in and around Bor Wildlife Sanctuary are reported. The study was carried out during the year 2013. The butterflies were observed around road-side vegetation in the buffer zone of the Sanctuary and were identified using the handbook by Kehimkar (2008).

#### A Checklist of Butterflies found in Bor Wildlife Sanctuary, Maharashtra

##### Family HESPERIIDAE (SKIPPERS)

- |                      |  |
|----------------------|--|
| 1. Common Banded Awl | <i>Hasora chromus</i> (Cramer)             |
| 2. Dark Palm Dart    | <i>Telicota ancilla</i> (Herrich-Schäffer) |

##### Family PAPILIONIDAE (SWALLOWTAILS)

- |                   |   |
|-------------------|---|
| 3. Common Rose    | <i>Atrophaneura aristolochiae</i> (Fabricius) |
| 4. Tailed Jay     | <i>Graphium agamemnon</i> (Linnaeus)          |
| 5. Common Jay     | <i>Graphium doson</i> (C. & R. Felder)        |
| 6. Lime Butterfly | <i>Papilio demoleus</i> Linnaeus              |
| 7. Common Mormon  | <i>Papilio polytes</i> Linnaeus               |

## Family PIERIDAE (WHITES AND YELLOWS)

- |                         |                                       |
|-------------------------|---------------------------------------|
| 8. Lemon Emigrant       | <i>Catopsilia pomona</i> (Fabricius)  |
| 9. Mottled Emigrant     | <i>Catopsilia pyranthe</i> (Linnaeus) |
| 10. Common Gull         | <i>Cepora nerissa</i> (Fabricius)     |
| 11. Common Jezebel      | <i>Delias eucharis</i> (Drury)        |
| 12. Small Grass Yellow  | <i>Eurema brigitta</i> (Cramer)       |
| 13. Common Grass Yellow | <i>Eurema hecabe</i> (Linnaeus)       |

## Family LYCAENIDAE (BLUES)

- |                     |                                      |
|---------------------|--------------------------------------|
| 14. Common Pierrot  | <i>Castalius rosimon</i> (Fabricius) |
| 15. Common Cerulean | <i>Jamides celeno</i> (Cramer)       |

## Family NYMPHALIDAE (BRUSH-FOOTED BUTTERFLIES)

- |                          |                                       |
|--------------------------|---------------------------------------|
| 16. Tawny Coster         | <i>Acraea violae</i> (Fabricius)      |
| 17. Common Castor        | <i>Ariadne merione</i> (Cramer)       |
| 18. Plain Tiger          | <i>Danaus chrysippus</i> (Linnaeus)   |
| 19. Striped Tiger        | <i>Danaus genutia</i> (Cramer)        |
| 20. Common Indian Crow   | <i>Euploea core</i> (Cramer)          |
| 21. Baronet              | <i>Euthalia nais</i> (Forster)        |
| 22. Great Eggfly         | <i>Hypolimnas bolina</i> (Linnaeus)   |
| 23. Danaid Eggfly        | <i>Hypolimnas misippus</i> (Linnaeus) |
| 24. Grey Pansy           | <i>Junonia atlites</i> (Linnaeus)     |
| 25. Peacock Pansy        | <i>Junonia almana</i> (Linnaeus)      |
| 26. Yellow Pansy         | <i>Junonia hierta</i> (Fabricius)     |
| 27. Chocolate Pansy      | <i>Junonia iphita</i> (Cramer)        |
| 28. Lemon Pansy          | <i>Junonia lemonias</i> (Linnaeus)    |
| 29. Blue Pansy           | <i>Junonia orithiya</i> (Linnaeus)    |
| 30. Common Evening Brown | <i>Melanitis leda</i> (Linnaeus)      |
| 31. Common Sailer        | <i>Neptis hylas</i> (Linnaeus)        |
| 32. Common Leopard       | <i>Phalanta phalantha</i> (Drury)     |
| 33. Blue Tiger           | <i>Tirumala limniace</i> (Cramer)     |

**SUMMARY**

In this faunistic study, 33 species of butterflies belonging to 22 genera of 5 families of order Lepidoptera have been reported from Bor Wildlife Sanctuary, Maharashtra.

**ACKNOWLEDGEMENT**

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### REFERENCES

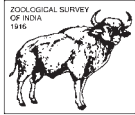
- Chandrakar, M., Palekar, S. & Chandrakar, S. 2007. Butterfly Fauna of Melghat Region, Maharashtra. *Zoos' Print Journal*, **22**(7): 2762-2764.
- Kehimkar, I. 2008. The Book of Indian butterflies. *Published by Bombay Natural History Society and Oxford University Press, Mumbai*, 497 pages.
- Sharma, R.M. & Radhakrishnan, C. 2005. Insecta: Lepidoptera (Rhopalocera and Grypocera). Fauna of Pench National Park. Zoological Survey of India. *Conservation Area Series*, **20**: 251-274.
- Sharma, R.M. & Radhakrishnan, C. 2006. Insecta: Lepidoptera (Rhopalocera and Grypocera). Fauna of Tadoba Andhari Tiger Reserve. Zoological Survey of India. *Conservation Area Series*, **25**: 255-277.
- Tiple, A.D. 2011. Butterflies of Vidarbha region, Maharashtra State, Central India. *Journal of Threatened Taxa*, **3**(1): 1466-1474.

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## Short Communication

### FIRST RECORD OF THE GENUS *SIPHONARIA* SOWERBY, 1823 (MOLLUSCA: GASTROPODA: SIPHONARIIDAE), AN ASSOCIATED ORGANISM OF OYSTER FROM COASTAL ZONE OF SUNDARBANS, WEST BENGAL, INDIA

#### INTRODUCTION

The Sundarbans is bestowed with a wide range of natural forest and aquatic resources, offering the largest mangrove concentration with a great biodiversity and the only mangrove tiger-land in the world. A number of rare and endangered species have been recorded in this region. The Sundarban Biosphere Reserve is one amongst the three marine biosphere reserves in the country. The main objective of the marine biosphere reserve is protection, conservation and judicious utilization of the marine environment. The reserve has an area of 4,263 sq. km of mangrove forest. The Sundarbans Tiger Project and National Park and the Wildlife Sanctuaries are located within the area. Molluscan resources exist at innumerable places along the coasts of India and are exploited in varying degree of intensity but the diversity and biological aspects of the major species of molluscs of economic importance have been studied only at a few areas in the last few years. Very limited studies have been attempted on *Crassostrea gryphoides* Schlotheim, 1813 and *Saccostrea cucullata* Born, 1778 from mangrove and in the vicinity regions of Sundarbans.

*Siphonaria* is a genus of marine pulmonate gastropod mollusc in the family Siphonariidae, the air-breathing sea snails or false limpets (Rosenberg and Gofas, 2012). Members of the Siphonariidae family are not true limpets. They are a distinct gastropod family exhibiting an evolutionarily

convergent where unrelated species exhibit similar form and function. The finding is the outcome of an investigation into the edible oyster reef of Kaikhali in Sundarbans region of West Bengal coast. *Crassostrea gryphoides* was present in both the sites but *Saccostrea cucullata* was found only in Frasergunj. Kaikhali (22°02'14"N, 88°61'55"E) is at the confluence of mighty rivers of Matla and Bidya, opposite to Jharkhali. It is located in the central sector of Indian Sundarbans. This area is noted for its wilderness and mangrove diversity. Frasergunj (21°57'94"N, 88°25'08"E) is a fishing harbor and located near Bakkhali. Frasergunj is situated at the confluence of the river Muriganga and the Bay of Bengal in the western sector of Indian Sundarbans. Various associated organisms are observed within oyster reef providing high biodiversity. *Siphonaria siphonaria* Sowerby, 1830

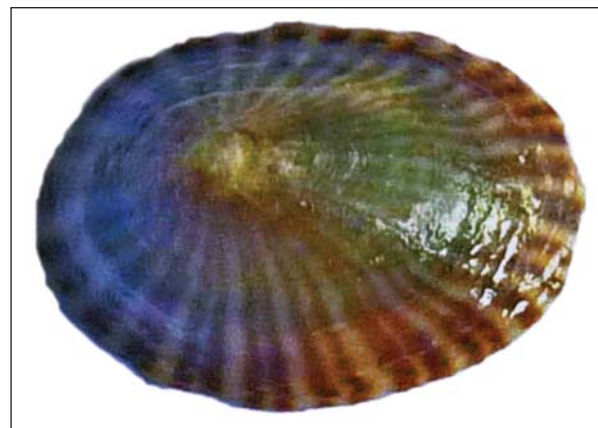


Fig. 1. Dorsal view of the *Siphonaria siphonaria* Sowerby, 1830

have been recorded from the Indian Sundarbans region along the several associated organisms of edible oyster. Although the genus of *Siphonaria* is common along the Indian shore but nothing is known regarding its distribution around the coast of West Bengal. This paper deals with the description of genus *Siphonaria* found from the West Bengal coast and it is the first record in West Bengal.

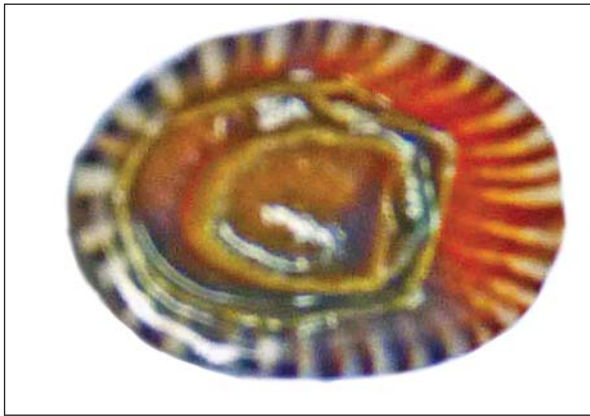


Fig. 2 Ventral view of the *Siphonaria sipho* Sowerby, 1830

### METHODOLOGY

A systematic monitoring practice undertaken for a period of three years during 2009–2012, revealed certain alarming facts. Samples of oyster were collected randomly during low tide along three prominent season, pre-monsoon, monsoon, post-monsoon from the two selected study sites namely Frasergunj and Kaikhali of Sundarbans region during the study period. The collection of the hosts was started in September, 2009 and continued up to August, 2012. Stainless steel hammer and rod were used to separate oysters from their surrounding cliffs. Both *Crassostrea gryphoides* and *Saccostrea cucullata* were collected from Frasergunj and *Crassostrea gryphoides* only collected from Kaikhali.

The *Siphonaria* were collected from the oyster reef along intertidal zone in the field as well as in the laboratory. The isolated organisms were then fixed in 10% buffered formalin for a minimum of forty eight hours prior to sorting and identification of organisms at the lowest

practical taxonomic level. Following identification, organisms were then preserved in 70% ethanol for further examination (Bondad-Reantaso *et al.*, 2001). Specimens have been documented and photographs of the organisms were taken with Panasonic DMC-FZ35 digital camera.

## RESULTS

### SYSTEMATIC POSITION

Kingdom ANIMALIA  
 Phylum MOLLUSCA  
 Class GASTROPODA  
 Subclass HETEROBRANCHIA  
 Superfamily SIPHONARIOIDEA  
 Family SIPHONARIIDAE  
 Genus *Siphonaria* Sowerby, 1823

### DISTRIBUTION

The Siphonariidae (Gastropoda: Pulmonata) is a diverse family which includes about seventy five species occurring globally (Rehder, 1981). The majority of the genus including the *Siphonaria* is found in the Indo-Pacific region especially in the southern hemisphere (Hubendick, 1946). *Siphonaria* species reported from the rocky coasts of Karachi, Pakistan (Northern Arabian Sea) (Bano *et al.*, 2011). This genus *Siphonaria* occurs worldwide in most tropical and temperate seas with the exception of the northern Atlantic. Several species of *Siphonaria* are occurring along the shores of the India. The genus includes atleast fifteen species namely *Siphonaria acuta*, *Siphonaria aspera*, *Siphonaria basseinensis*, *Siphonaria funiculata*, *Siphonaria kurracheensis*, *Siphonaria laciniosa*, *Siphonaria plana*, *Siphonaria savignyi*, *Siphonaria sipho*, *Siphonaria sipho* var. *exigua*, *Siphonaria Siphonaria basseinensis*, *Siphonaria Siphonaria kurracheensis*, *Siphonaria siquijorensis*, *Siphonaria zebra* and *Siphonina reticulata* (Bio search, 2012). Rao (1991) reported *Siphonaria sipho* Sowerby, 1830 from the rocky sea shores of Andaman and Nicobar Islands. The

animals clamped by means of their strong foot with other sedentary, air-breathing animals which are common on intertidal rocks. In the present investigation *Siphonaria siphon* Sowerby, 1830 (Sea Snail) had been observed from the upper surface of the shell of edible oyster, *Crassostrea gryphoides* at Kaikhali in Sundarbans region of West Bengal coast.

### DIAGNOSIS

*Siphonaria* is a genus of gastropod molluscs, one of the three genera in the family Siphonariidae. Siphonariids resemble true limpets (family Acmaeidae), but do not have true gills. Instead, siphonariids have either secondary gills in the mantle cavity or the mantle cavity serves as both a lung and a generalized gill. Siphonariids live on rocks close to the high tide line, where they can remain wet. Siphonariid eggs are laid in jellylike strings near the water's edge. Upon hatching, the young pass through a brief free-swimming stage before settling on rocks near the high tide line (Rehder, 1981). Outline of the shell, in dorsal view, not symmetrical, the apex slightly to the right of the midline; muscle scar often indistinct. Shell morphology well suited for life on wave-swept rocky intertidal shorelines.

The genus *Siphonaria*, erected by Sowerby in 1823, is one of the most naturally occurring molluscs. Shell normally almost circular, depressed conical and usually solid, porcellanous and thin. The apex is sub-central, smooth in the youngest specimens but in older specimen it is somewhat eroded. The upper surface marked with from twenty five to forty five elevated radiating ribs or ridges, which are reticulated by the coarse, somewhat elevated lines of growth. The interior is usually polished, except on the muscular impressions, which are granulous and strongly impressed. There is a scar interior of the shell indicating an attachment of the mantle to the shell. The pulmonary cavity of *Siphonaria* opens through a siphon located on the right side, often marked externally by a lateral siphonal expansion

and internally by a gap in the right arm of the horseshoe-shaped muscle scar.

The species of *Siphonaria* (Fig. 1 and Fig. 2) were identified on the basis of shell color and structure, and were found to comprise the species, *Siphonaria siphon* Sowerby, 1830 (Sea Snail), (WoRMS, 2012). In the present study the specimen measures 9-10mm in length, 6.5-8 mm in width and 4-5.5 mm in height. The specimen has been deposited in the Mollusc section of Zoological Survey of India, Kolkata (Registration number M27269/5).

### REMARKS

*Siphonaria siphon* co-occurs with other rocky intertidal species such as oyster in the intertidal zone of Sundarbans. With the combination of a gill and a pulmonary cavity enables *Siphonaria siphon* to respire both in and out of water.

### SUMMARY

The genus *Siphonaria* belongs to the Kingdom Animalia, Phylum Mollusca, Class Gastropoda, Subclass Heterobranchia, Superfamily Siphonarioidea, Family Siphonariidae. They are often called false limpets to distinguish them from the Patellogastropoda or true limpets which are one of the most basal branches of the gastropod tree. The distribution and diversity of molluscan fauna around the West Bengal coast had been well studied by Subba Rao *et al.* (1992) and various workers but no report on *Siphonaria* has been recorded till now. The study provides for the first time, the basic knowledge about the presence of the marine mollusc of genus *Siphonaria* from West Bengal coast.

In the present study *Siphonaria siphon* was found as associated organisms of edible oysters which create a complex matrix of structured habitat, not unlike coral reefs, important to many fish and invertebrate species, which enhance estuarine biodiversity (Wells, 1961; Breitburg, 1992). The loss of oysters and the associated

structured habitat has cascading negative consequences on the biodiversity of the estuarine ecosystem. Regardless of composition, structure or size, the creation of oyster reefs results in the placement of new, uncolonized habitat into the natural environment (Osman and Whitlatch, 1999). Increasing urbanization raises many concerns about sustainability of biodiversity in terrestrial (Laurie, 1979; Breuste et al., 1998; McIntyre, 2000) and marine (Suchanek, 1994; Smith *et al.*, 2000) habitats. Though the economic impacts of *Siphonaria siphon* Sowerby, 1830 has been deemed

negligible in the Indian Sundarbans region of the West Bengal coast but studies on its distribution, biology and population trends are to be needed.

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#### REFERENCES

- Bano, A., Moazzam, M., Ayub, Z. and Siddiqui, Z. 2011. First report of *Siphonaria* (Mollusca: Gastropoda) species from the rocky coasts of Karachi, Pakistan (Northern Arabian Sea). *Pakistan J. Zool.*, **43**: 602-604.
- Bio search. 2012. Marine biodiversity database of India, Available from: <http://www.biosearch.in/public/AdvanceSearchList.php> (01.12.2012).
- Bondad-Reantaso, M.G., McGladdery, S.E., East, I. and Subasinghe, R.P. 2001. (eds.) Asia Diagnostic Guide to Aquatic Animal Diseases. FAO Fisheries Technical Paper No. 402, Supplement 2. Rome, FAO. 108-152.
- Breitburg, D.L. 1992. Episodic hypoxia in Chesapeake Bay: interacting effects of recruitment, behavior, and physical disturbance. *Ecol. Monog.*, **62**: 525-546.
- Breuste, J., Feldmann, H. and Uhlmann, O. 1998. *Urban ecology*. Springer Verlag, Berlin, 714 pp.
- Hubendick, B. 1946. Systematic monograph of the platelliformia. Kungl. Svenska Vetenskapsakad. *Handl. Tredj. Series*, **23**: 5-93.
- Laurie, M. 1979. *Nature and city planning in the nineteenth century*. In: Laurie IC (ed) *Nature in cities*. John Wiley and Sons, Chichester, 37-63.
- McIntyre, N.E. 2000. Ecology of urban arthropods: a review and call to action. *Ann. Entomol. Soc. Am.*, **93**: 825-835.
- Osman, R.W. and Whitlatch, R.B. 1999. Processes controlling local and regional patterns of invertebrate colonization: applications to the design of artificial oyster habitat. In: M. W. Luckenbach, R. Mann and J. A. Wesson (editors). *Oyster reef habitat restoration: a synopsis and synthesis of approaches*. Virginia Institute of Marine Science Press, Gloucester Point, USA, 179-197.
- Rao, G.C. 1991. Distribution of plants and animals on the rocky sea shores of Andaman and Nicobar Islands. *J. Andaman. Sci. Assoc.*, **7**(2): 30-42.
- Rehder, H.A. 1981. *The Audubon Society Field Guide to North American Seashells*. New York: Alfred A. Knopf., 894 pp.
- Rosenberg, G. and Gofas, S. 2012. *Siphonaria* Sowerby I, 1823. Accessed through: *World Register of Marine Species*. Available from: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=138489> (2012-11-25).

- Smith, C.R., Austen, M.C., Boucher, G., Heip, C. and others 2000. Global change and biodiversity linkages across the sediment- water interface. *Bio. Sci.*, **50**:1108–1120.
- Subba Rao, N.V., Dey, A. and Barua, S. 1992. Estuarine and marine molluscs. *State Fauna Series, 3. Fauna of West Bengal*, **9**: 129-168.
- Suchanek, T.H. 1994. Temperate coastal marine communities: biodiversity and threats. *Am. Zool.*, **34**: 110–114.
- Wells, H.W. 1961. The fauna of oyster beds, with special reference to the salinity factor. *Ecol. Monog.*, **31**: 239-266.
- Worms. 2012. *Siphonaria siphonaria*. Accessed through: *World Register of Marine Species*, Available from: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=215299> (2012-11-25).

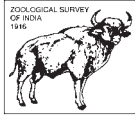
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## Short Communication

### THE FIRST RECORD OF THE KING COBRA *OPHIOPHAGUS HANNAH* (CANTOR, 1836) (REPTILIA: ELAPIDAE) FROM CHHATTISGARH, CENTRAL INDIA

#### INTRODUCTION

The King Cobra, *Ophiophagus hannah* (Cantor) is rare, but, widespread throughout South and Southeast Asia. It is reported from Bali, Bangladesh, Borneo, Cambodia, China, India, Java, Laos, Malaysia, Philippines, Singapore, Sulawesi, Sumatra and Thailand (Iskandar and Colijn, 2002). In India, it has a patchy distribution covering the Western Ghats, Shiwalik and Terai regions of Uttarakhand and Uttar Pradesh, Karnataka, Bihar, Odisha, West Bengal, North-east India and the Andaman Islands (Das, 2002; Whittaker and Captain, 2004) (Fig. 1). The species is known to inhabit a wide altitude range as well, from 150

m to 1530 m in Nepal (Selich and Kestle, 2002) and from the coasts of Orissa and West Bengal up to a height of 1840 m in Sikkim (Bashir *et al.*, 2010) and 2181 m in Mussoori Hills in India (Waltner, 1975). Due to its patchy distribution, the snake shows considerable geographic variation in colouration, size and scalation suggesting the genus as a complex of several species (Vogel, 2006).

*Ophiophagus hannah* is known to inhabit thick vegetation of evergreen and semi-evergreen forests or estuarine mangrove swamps with heavy rainfall (Whittaker and Captain, 2004). It prefers humid jungles particularly with thick undergrowths, cool swamps and bamboo patches (David and Vogel,

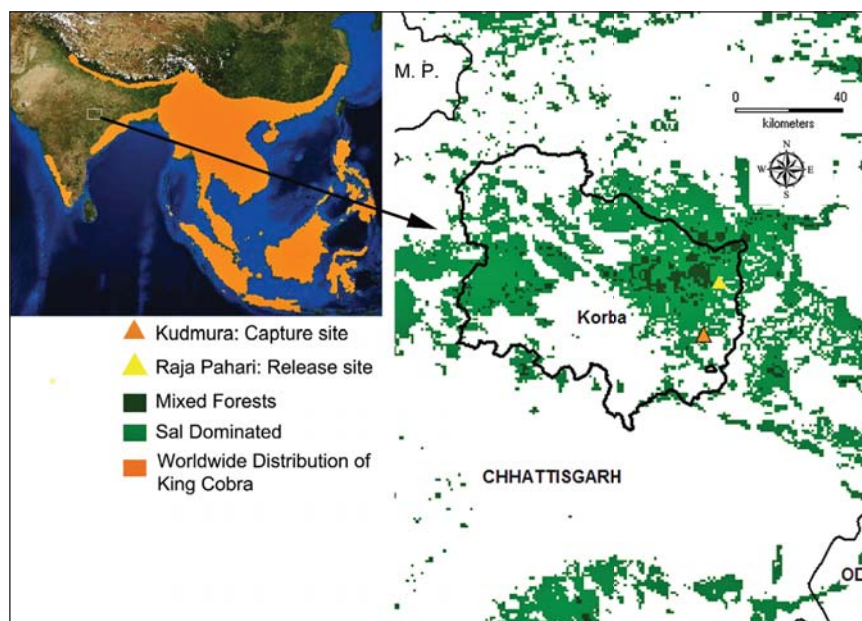


Fig. 1. Map showing sites of observation and release of the King Cobra in the present study. Inset showing the worldwide distribution of King Cobra (Inset map source: IUCN, 2013).

1996; Selich and Kestle, 2002; Das *et al.*, 2008). The present communication reports the occurrence of King Cobra for the first time from the dry habitats of Chhattisgarh state of Central India. The snake was found at the forest range office campus (22°25'13.9"N and 83°06'27.6"E) of Kudmura range, Korba Forest Division on 22<sup>nd</sup> February 2014 (Fig. 1). It was an adult female snake measuring to a length of nearly 3.6 m. The snake was captured and released to a site named Raja Pahari nearly 20 kms from the Kudmura village (Fig. 2A, 2B). Raja Pahari was selected as the release site primarily due to its dense and less disturbed forest patch and secondarily because of verbal interactions with villagers who mentioned that similar kind of snakes were seen on several occasions at that site.



A

Chhattisgarh is a tribal dominated state with extensive forested areas of nearly 44% of the total area of the state. Kudmura range of Korba district, Chhattisgarh, harbours Tropical Dry Deciduous Forest characterised by Sal (*Shorea robusta*), Saja (*Terminalia tomentosa*), Mahua (*Madhuca indica*), Tendu (*Diospyros melanoxylon*), etc. which is interspersed by Bamboo (*Dendrocalamus strictus*) patches. King Cobra hitherto being reported from wet and humid habitats, the present sighting may indicate the emergence of its potential habitat in the dry Central Highland province of Deccan Peninsula biogeographic zone,



B

**Fig. 2.** The King Cobra recorded in the present study from Chhattisgarh. The King Cobra snake released at Raja Pahari (A & B).

The herpetofauna of Chhattisgarh is poorly documented. The number of previous literatures is hand countable including Ingle (2003), Chandra and Gajbe (2005), Chakraborty *et al.*, (2008) and Chandra *et al.* (2013). In 2005, Chandra and Gajbe provided the only consolidated checklist of 45 species of reptiles under 29 genera of 11 families from Chhattisgarh. King Cobra is considered extremely rare and is listed under CITES Appendix II and IUCN Red List of Threatened Species 2013.2 as Vulnerable. Its unusual sighting gives justification for immediate protection of the forests of that region. Besides, an intensive herpetofaunal survey of Chhattisgarh is highly recommended before substantial portion of the fauna become extinct from the area without even being documented.

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## REFERENCES

- Bashir, T., Poudyal, K., Bhattacharya, T., Sathyakumar, S. and Subba, J. B. 2010. Sighting of King Cobra *Ophiophagus hannah* in Sikkim, India: a new altitude record for the northeast. *Journal of Threatened Taxa*, **2**(6): 990-991.
- Chakraborty, R., Gayen, N.C. and Kar, S. 2008. *Vertebrate Fauna of Kangerghati, Guru Ghasidas and Sanjay National Park. Reptilia. Conservation Area Series*, **36**: 181-208. (Zool. surv. India)
- Chandra, K., Gajbe, P.U. 2005. An inventory of Herpetofauna of Madhya Pradesh and Chhattisgarh. *Zoo's Print Journal*, **20**(3): 1812-1819.
- Chandra, K., Raha, A., Majumder, A., Parida, A and Sarsavan, A. 2013. First record of Banded Krait, *Bungarus fasciatus* (Schneider, 1801), (Reptilia: Elapidae), from Guru Ghasidas National Park, Koriya district, Chhattisgarh, India. *Rec. zool Surv. India*, **113**(2): 77-80.
- Das, A., Nair, M.V., Ahmed, M.F., Sharma, P. K. 2008. Distribution of King Cobra (*Ophiophagus hannah*) in northeastern India with new altitudinal record and notes on its habitat. *Tiger Paper*, **35**(4): 1-6.
- Das, I. 2002. *A Photographic Guide to Snakes and Other Reptiles of India*. New Holland Publishers Ltd., London, UK, 144 pp.
- David, P. and Vogel, G. 1996. *The Snakes of Sumatra: An Annotated Checklist and Key with Natural History Notes*. Edition Chimaira, Frankfurt-am-Main, Germany, 260 pp.
- Ingle, M. 2003. A preliminary survey of the herpetofauna of Naglok area, Jashpur, Chhattisgarh state. *Cobra*, **54**: 1-5.
- Iskandar, D.T. and Colijn, E. 2002. *A Checklist of Southeast Asian and New Guinean Reptiles*. Part 1: Serpentes. Biodiversity Conservation Project (Indonesian Institute of Sciences—Japan International Cooperation Agency—The Ministry of Forestry), The Gibbon Foundation and Institute of Technology, Bandung, 195 pp.
- Selich, H. and Kästle, W. 2002. *Amphibians and Reptiles of Nepal*. Gantner, A.R.G., V.G. Verlag and Ruggell (distributed by Koeltz, Koenigstein, Germany), 1201 pp.
- Vogel, G. 2006. Terralog Vol. **14**: *Venomous Snakes of Asia*. Edition Chimaira/Aqualog Verlag, Frankfurt, Germany, 148 pp.
- Waltner, R.G. 1975. Geographical and altitudinal distribution of Amphibians and reptiles in the Himalayas - Part IV. *Cheetal*, **16**: 12-17.
- Whitaker, R. and Captain, A. 2004. *Snakes of India: The Field Guide*. Draco Books, Chennai, India, 481 pp.

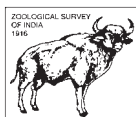
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## Short Communication

### ***DICRANOCENTRUS CERCIFER* (IMMS, 1912) MARI MUTT, 1979 (COLLEMBOLA : ENTOMOBRYIDAE) NEW RECORD FROM JHARKHAND, INDIA**

#### INTRODUCTION

The genus *Heteromuricus* described by Imms (1912) with *Heteromuricus cercifer* as its type species. Imms erected this new genus due to presence of a single median circus to the fifth abdominal segment which separates this genus from other known genera of Collembola. The other characters of this genus include: 1) Antennae 5-6 segmented; 2) 8+8 eyes; 3) body and furcula covered by apically rounded scales. Mari Mutt (1979) synonymized *Heteromuricus cercifer* Imms, 1912 as *Dicranocentrus cercifer* (Imms) owing to the similar characters of the genus *Dicranocentrus*.

Imms(1912) described this species from Calcutta on the basis of collection of 13 examples, taken under dead leaves at Calcutta (Indian Museum Collector, Jan. 14<sup>th</sup>-20<sup>th</sup>, 1908 and Feb, 18<sup>th</sup>, 1910). Imms described five-jointed antennae and did not mention about the presence of dental spines. Handschin (1929) recorded it from several localities in the Nilgiris (1600 to 2590 m) and described six jointed antennae and two rows of dental spines. After that Prabhoo (1971) recorded several examples from Wyanad, Kerala and described both five and six jointed antennae and four to five rows of dental spines.

The present collection is made from Pakur district, Jharkhand state as a part of Annual Action Plan of Research Work by Apterygota section.

*Dicranocentrus cercifer* (Imms, 1912) Mari Mutt, 1979

1912. *Heteromuricus cercifer* Imms, *Proc. Zool. Soc. London.*, 80-125  
1929. *Heteromuricus cercifer* Handschin, *Rev. Suisse. Zool.*, **36**: 256.  
1971. *Heteromuricus cercifer* Prabhoo, *Oriental Insects*, **5**: 1-46.

*Material examined*: Tussar Plantation garden, Littipada, Pakur distt., Jharkhand, 27.viii.2013, 6 exs., altitude: 69 meters (226 ft.), co-ordinates, Lat: 24°42'35.3" N and Long: 87°36'51.8"E, habitat: under leaf litter.

*Diagnostic characters*: Coloration: Ground colour of the body and furcula varies from whitish to dull ochre-yellow; the legs, antennae bluish-violet. The eyes on a black patch on each side of the head.

*Head*: Inclined at an angle of 45° with the long axis of the body; invested with scales and scattered setae. The eyes eight in number on each side; post antennal organs wanting.

*Antennae*: Equal in length to the furcula; five jointed, relative length index of Ant. I: II: III: IV: V as 1:10:12:25:14. The basal joint small and annular, provided with a whorl of short spine like setae ; the second and third joint scaled; the fourth and fifth joints clothed with closely-set whorls of short, curved hairs.

*Body*: Densely clothed with scales. The segments

mutually related in length as 6:6:5:6:8:12:4:1. Arising from the dorsal aspect of the fifth abdominal segment is a prominent median cercus nearly equal in length to the third abdominal segment. The cercus densely clothed with scales and provided ventrally with long slender setae. Possibly sensory, along the anterior border of the mesothorax is a "collar" or "frill" of stout setae, and a tuft of similar setae at the extremity of the abdomen.



*Dicranocentrus cercifer* (Imms, 1912) Mari Mutt, 1979

*Furcula*: The dentes related in length to the manubrium as 4:3. Dentes having spines. The mucrones small, armed with a curved terminal tooth, a single dorsal tooth and a basal spiniform tooth.

*Distribution*: Pakur (Jharkhand), Calcutta (W.B), Nilgiris (Tamil Nadu) and Wynad (Kerala).

*Remarks*: Imms(1912) described this species from Calcutta, West Bengal. After a long period nearly above 100 years, we have collected from Eastern India, Pakur district of Jharkhand state.

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#### REFERENCES

- Handschin, E.1929. Beitrage zur Collembolen fauna von Sud Indien. *Rev. Suisse., Zool., Geneva*, **36**: 229-262.
- Imms, A.D., 1912. On some Collembola from India, Burma and Ceylon with a catalogue of the Oriental species of the order. *Proc. Zool. Soc., London*, 1912: 80-125.
- Mari Mutt, J.A. 1979. A Revision of Genus *Dicranocentrus* Schott(Insecta: Collembola: Entomobryidae), University of Puerto Rico, Mayaguez Campus, College of Agricultural Sciences, *Agricultural Experiment Station, Bulletin* **259**, February 1979, p. 1-79.
- Prabhoo, N.R 1971. Soil & litter Collembola of South India. I. Arthropleona. *Oriental Insects*, **5**: 1-46.

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