

Volume 104 (Part 3-4)

**Records of the
Zoological Survey of India**

A JOURNAL OF INDIAN ZOOLOGY

**Zoological Survey of India
2005**

Volume 104 (Part 3–4)

**Zoological Survey of India
Kolkata
2005**

CITATION

Editor—Director. 2005. *Rec. zool. Surv. India*, Volume **104** (Part 3–4) : i-vi, 1-166 (Published by the Director, *Zool. Surv. India*, Kolkata)

Published : April, 2005

© *Government of India*, 2005

ALL RIGHTS RESERVED

- No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.
- This book is sold subject to the condition that it shall not, by way of trade, be lent, re-sold hired out or otherwise disposed of without the publisher's consent, in any form of binding or cover other than that in which it is published.
- The correct price of this publication is the price printed on this page. Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

PRICE

India : Rs. 500.00

Foreign : \$ 35.00; £ 20.00

Published at the Publication Division by the Director, Zoological Survey of India, 234/4, A J C Bose Road, 2nd MSO Building, (13th Floor), Nizam Palace, Kolkata-700 020 and printed at East India Photo Composing Centre, Kolkata-700 006.

RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA

Vol. 104 (Part 3-4)

2005

Pages 1-166

CONTENTS

	<i>Pages</i>
Ramakrishna, Mitra, S. C. and Mukherjee, A. K. — Mollusca fauna of Itanagar Wildlife Sanctuary, Arunachal Pradesh	1-12
Chakraborty, Rina and De, J. K. — Identification of dorsal guard hairs of nine Indian species of the family Viverridae (Carnivora : Mammalia)	13-21
Mitra, Bulganin, Parui, P., Banerjee, D. and Ghosh, A. — Studies on the Dipteran pollinators of medicinal plants in India	23-39
Sharma, B. K. and Sharma, Sumita — Freshwater Rotifer taxocoenosis (Rotifera : Eurotatoria) of Orissa, with remarks on composition and distribution	41-55
Podder, S., Saha, G. K. and Gupta, S. K. — Some new species and new records of dust mites from Kolkata, India	57-62
Chandrasekhar, S. V. A. and Siddiqi, S. Z. — Kondakarla lake, Andhra Pradesh — <i>A Taxoecological profile</i>	63-76
Bastawade, D. B., Sureshan, P. M. and Radhakrishnan, C. — A new subfamily, genus and species of Scorpion (Arachnida : Scorpionida) from Kerala	77-82
David, Patrick and Mathew, Rosamma — Notes on some noteworthy snake specimens deposited in the collections of Eastern Regional Station of the Zoological Survey of India	83-90
Korad, V. S., Gaikwad, M. C. and Yardi, K. D. — Extension in the distribution of Burmese Whiskered Bat <i>Myotis montivagus</i> (Dobson, 1874) in the Northern Western Ghats range Maharashtra, India	91-97
Hazra, A. K., Dey, M. K. and Mandal, G. P. — Diversity and distribution of Arthropod fauna in relation to mangrove vegetation on a newly emerged island on the river Hooghly, West Bengal	99-102

Biswas, V. and Raychaudhuri, D. — Huntsman spiders of Bangladesh : genus <i>Heteropoda</i> Latreille and <i>Olios</i> Walckenaer (Araneae : Sparassidae)	103-109
Ghosh, Suchitra and Sharif Siddique — Butterfly diversity in and around urban Kolkata	111-119
Khanna, Vinod — Scolopendrid centipedes of Desert National Park, Rajasthan (Chilopoda : Scolopendromorpha)	121-127
Sanyal, A. K. and De, S. K. — Status of ticks (Acari : Metastigmata) of Rajasthan	129-136
Roy, P. H. — Distributional pattern of termites (Isoptera : Insecta) in Maharashtra, India	137-141
Mukherjee, T. K., Das, B. C. and Hazra, A. K. — Types of Mantodea (Insecta : Mantodea) in the collection of Central Entomological Laboratory of Zoological Survey of India, Kolkata, India	143-149
Chaudhury, S., Roy, I., Podder, S., Gupta, S. K. and Saha, G. K. — Diversity of Synanthropic mites in Kolkata Metropolis, India	151-159
<i>Short Communication</i>	
Mitra, Tridib Ranjan — <i>Calicnemia miniata doonensis</i> Sangal & Tyagi A synonym of <i>Calicnemia carminea pyrrhosoma</i> Lieftinck (Insecta : Odonata : Plalyncnemididae)	161-162
Rema Devi, K., Alex Eapen, and Das, M. K. — On a report of <i>Redigobius bikolanus</i> (Herre) (Pisces : Gobiidae) from India	163-166

COMPUTERISED DATA ON NATIONAL ZOOLOGICAL COLLECTION

The National Zoological Collections comprising nearly 15,000 types are housed in the Zoological Survey of India, Calcutta and are properly maintained. All these specimens have Registration numbers and are readily available for study as and when required. Data pertaining to locality, date of collection, name of collector, sex, up to date valid species name, name of the host (for parasite) etc., of each *type of collection* have already been computerised. The computerised data are stored in the computer centre of Zoological Survey of India. Scientists/Naturalists interested for any information on type species present in Zoological Survey of India may contact the *Director, Zoological Survey of India, 'M' Block, New Alipore, Kolkata-700 053.*

Dr. J. R. B. ALFRED
Director
Zoological Survey of India

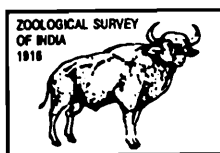
AN APPEAL

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

Officer in Charge, Identification and Advisory Section,
Zoological Survey of India, 2nd M. S. O. Building, Nizam Palace,
234/4, A. J. C. Bose Road, Kolkata-700 020.

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

Dr. J. R. B. ALFRED
Director
Zoological Survey of India



Rec. zool. Surv. India : 104 (Part 3–4) : 1-12, 2005

MOLLUSCA FAUNA OF ITANAGAR WILDLIFE SANCTUARY, ARUNACHAL PRADESH

RAMAKRISHNA, S. C. MITRA AND A. K. MUKHERJEE

Zoological Survey of India, Kolkata

INTRODUCTION

The state of Arunachal Pradesh is an important constituent of the 'Seven Sisters' of north-east India, one of the designated rich biodiversity zones in the World. The relative isolation of the region together with high rainfall, lush-green forests and less vigorous temperature extremities, makes it an ideal habitat for the land and freshwater mollusca. Approximately one third of the total Indian fauna is represented here with above 70% endemism (Ramakrishna & Mitra, 2002). Apart from its proximity to the Himalaya, surroundings of Arunachal Pradesh (being bordered by Bhutan, China and Myanmar on three sides) add to its Zoogeographical significance. Though a consolidated report on the mollusca as a whole is still not available, the rich malacofauna of the state has been thoroughly explored and worked out from time to time. Over 100 new species and genera have been described. Important works are from Dey *et al.*, 1985, Ghosh, 1913, Godwin-Austen, 1876, 1876a; 1914–1918; Gude, 1915; and Preston, 1915.

The present report is based on material collected from Itanagar Wildlife Sanctuary area by the Itanagar Field Station of Zoological Survey of India during 1986–1996.

The classification followed here is that of Vaught, 1989.

SYSTEMATIC ACCOUNT

Freshwater Mollusca

Key to the families

1. Shell univalve 2
- Shell with two valves PISIDIIDAE
2. Shell elongate 3
- Shell depressed PLANORBIDAE

3. Shell without an operculum. Spire much shorter than body whorl in length, columella twisted LYMNAEIDAE
 — Shell with an operculum, spire equal or longer than body whorl, columella not twisted 4
 4. Shell with circular aperture, operculum with concentric growth-lines VIVIPARIDAE
 — Shell with ovate aperture, operculum with spiral growth-lines THIARIDAE

Class GASTROPODA

Order MESOGASTROPODA

Family VIVIPARIDAE

Genus *Bellamya* Jousseaume, 1886

Bellamya bengalensis f. annandalei (Kobelt)

1909. *Paludina bengalensis f. annandalei* Kobelt, *Nachr. Malak. Ges.*, **60** : 16.

1989. *Bellamya bengalensis f. annandalei* : Subba Rao, *Handbook, Freshwater Molluscs of India*, zool. Surv. India : p. 46, fig. 57.

Material examined : 12 exs., Tamin, L. Subansiri, Coll. G. Thirumalai; 3 exs., Bolong village, Dibang valley, 8.4.1993, Coll. P. T. Bhutia.

Diagnosis : Shell thin, rather conical, with dark spiral; bands, whorls 5–6, flat-sided, slowly increasing, aperture sub-circular, operculum thin.

Distribution : INDIA : Arunachal Pradesh, Andhra Pradesh, Tamil Nadu and West Bengal.

Family THIARIDAE

Key to the genera

- Shell rounded or ovate, body whorl usually longer than spire, whorls up to 5 *Paludomus*
 — Shell elongated, body whorl shorter than spire, whorls more than 5 *Brotia*

Genus *Brotia* H. & A. Adams, 1866

Sub-genus *Antimelania* Crosse and Fischer, 1892

Brotia (Antimelania) costula (Rafinesque)

1833. *Melania costula* Rafinesque, *Atlantique J.*, **5** : 166.

1989. *Brotia (Antimelania) costula* : Subba Rao, *Handbook, Freshwater Molluscs of India*, zool. Surv. India : p. 108, figs. 142-194, 197, 198.

Material examined : 2 exs., Pakhui, E. Kameng, 31.3.1995, Coll. P. T. Bhutia; 6 exs., Doimuk, Papum Pare, 19.11.1996, Coll. G. Thirumalai; 1 ex., Ganga river, 6.4.1998, Coll. P. T. Bhutia.

Diagnosis : Shell thick, large, elongate turreted with 10–12 whorls; distinctly sculptured with spiral nodulose ridges and axial ribs, sometimes with spines; aperture ovate, angularly produced below; columellar margin broad and curved. A highly variable species includes a number of varieties and subvarieties.

Distribution : INDIA : Arunachal Pradesh, Andhra Pradesh, Assam, Manipur, Meghalaya, Mizoram and West Bengal. *Elsewhere* : Indonesia, Malaysia, Myanmar and Thailand.

Genus *Paludomus* Swainson, 1840

Sub-genus *Paludomus* s. str.

Paludomus (Paludomus) conica (Gray)

1834. *Melania conica* Gray, *Griffith Cuvier Moll.*, pl. 14, fig. 5.

1989. *Paludomus (Paludomus) conica* : Subba Rao, *Handbook, Freshwater Molluscs of India*, p. 113, figs. 227, 228.

Material examined : 15 exs., River Ganga. Arunachal Pradesh, 14.8.1987. Coll. P. K. Chakravarty.

Diagnosis : Shell thick and strong, globosely conical, dark brown; whorls 4½–5 rounded, body whorl large and twice as long as spire, shell finely sculptured by spiral striae, a few spiral ridges also present at the sutural region; aperture ovate, columella thickened.

Distribution : INDIA : Widely distributed throughout north-eastern region. *Elsewhere* : Bangladesh, Bhutan.

Order BASOMMATOPHORA

Family LYMNAEIDAE

Genus *Lymnaea* Lamarck, 1799

Sub-genus *Pseudosuccinea* Baker, 1908

Lymnaea (Pseudosuccinea) acuminata f. typica Lamarck

1822. *Limnaea acuminata* Lamarck, *Hist. Nat. Anim. Sans. Vert.*, 6(2) : 160.

1989. *Lymnaea (Pseudosuccinea) acuminata f. typica* : Subba Rao, *Handbook, Freshwater Molluscs of India, zool. Surv. India* : p. 127, figs. 258-259.

Material examined : 1 ex., Pakhui, E. Kameng, 31.3.1995, Coll. P. T. Bhutia; 19 exs., Likabali, W. Siang, 22.11.1997, P. T. Bhutia; 38 exs., Bolong village, Dibang valley, 8.4.1993, Coll. P. T. Bhutia.

Diagnosis : Shell large, thin, ovate with an inflated body whorl and a very short and acutely pointed spire, aperture large, outer lip widely expanded, columella twisted. Shows variation in general shape.

Distribution : INDIA : Common throughout, abundantly occurs in freshwater bodies with vegetations. *Elsewhere* : Bangladesh, Myanmar and Pakistan.

Lymnaea (Pseudosuccinea) luteola f. ovalis Gray

1822. *Limnaea luteola f. ovalis* Gray, in *Sowerby's Genera Rec. Foss. Shells*, 1 : 178, fig. 4.

1989. *Lymnaea (Pseudosuccinea) luteola f. ovalis* : Subba Rao, *Handbook, Freshwater Molluscs of India*, zool. Surv. India : p. 129, figs. 266, 267 & 284.

Material examined : 1 ex., Pakhui, E. Kameng, 31.3.1995, Coll. P. T. Bhutia.

Diagnosis : Shell thin, sub globosely inflated, bodywhorl large and rounded, spire short and pointed; aperture rather large, outer lip not much expanded, rather straight. Differs from the above species in the body whorl being more rounded, and the outer lip being rather straight and not widely convex.

Distribution : INDIA : Common throughout. *Elsewhere* : Myanmar and Sri Lanka.

Family PLANORBIDAE

Genus *Indoplanorbis* Annandale & Rao, 1921

Indoplanorbis exustus (Deshayes)

1834. *Planorbis exustus* Deshayes, in *Belanger, voy. Index Orientales*, p. 417, pl. 1, figs. 11-13.

1989. *Indoplanorbis exustus* : Subba Rao, *Handbook, Freshwater Molluscs of India*, zool. Surv. India : p. 147, figs. 326-327.

Material examined : 1 ex., Doimuk, Papum Pare, Coll. P. T. Bhutia.

Diagnosis : Shell moderately large, depressedly coiled, with a sunken spire, thick, sinistral, sutures deeply impressed, aperture ear shaped.

Distribution : INDIA : Very widely distributed throughout the country, abundantly occurring in all types of freshwater, ponds, ditches, canals, drains; with or without vegetations. *Elsewhere* : Bangladesh, Celebes, Indonesia, Malaysia, Myanmar, Pakistan, Thailand and Vietnam.

Remarks : This species is a known vector snail, serving as intermediate host of a large number of cattle-infecting parasites.

Class BIVALVIA

Order VENEROIDA

Family PISIDIIDAE

Genus *Sphaerium* Scopoli, 1777

Sphaerium indicum Deshayes

1854. *Sphaerium indicum* Deshayes, *Proc. zool. Soc. London*, **22** : 342.

1989. *Sphaerium (Sphaerium) indicum* : Subba Rao, *Handbook, Freshwater Molluscs of India*, *zool. Surv. India* : p. 213, figs. 600, 610, 612, 613.

Material examined : 11 exs., Tamin, L. Subansiri, Coll. G. Thirumalai; 3 exs., Hapoli, L. Subansiri, 16.11.1995, Coll. G. Thirumalai.

Diagnosis : Shell minute, fairly thick, oval, slightly inequilateral, ventral margin roundly curved; finely concentrically striate, a single cardinal on the right valve, lateral teeth well developed.

Distribution : INDIA : Fairly commonly distributed in large ponds, lakes with vegetations, on plains as well as high altitudes.

Land Mollusca

Key to the families

(basing on the material included in the report)

1. Shell with an operculum *Cyclophoridae*
- Shell without an operculum 2
2. Shell elongate, higher than broad 3
- Shell depressed, broader than high 4
3. Shell broad and large to very large, seldom below 40 mm. in length; with coloured markings. *Achatinidae*
- Shell narrower and smaller, seldom reaching 20 mm. in length; without coloured markings. *Subulinidae*
4. Shell more depressed, height-diameter ratio approx. 1 : 3; *Helixarionidae (Sivella)*
- Shell less depressed, height-diameter ratio approx. 1 : 2. 5
5. Shell imperforate or narrowly perforate; outer lip simple *Ariophanitidae*
- Shell openly perforate; outer lip reflected 6
6. Interior of body whorl with a number of folds and plates *Plectopylididae (Plectopylis)*
- Interior of body whorl without folds or plates *Bradybaenidae*

Order MESOGASTROPODA

Family CYCLOPHORIDAE

Key to the genera

- Shell larger, globosely turbate, without sutural tube *Cyclophorus*
- Shell smaller, depressed, with sutural tube *Pearsonia*

Genus *Cyclophorus* Montfort, 1810Sub-genus *Glossostylus* Kobelt & Moellendorff, 1899*Cyclophorus sidiensis* Godwin-Austen

1915. *Cyclophorus (Glossostylus) sidiensis* Godwin-Austen, *Rec. Indian Mus.*, 8 : 495, pl. 38, fig. 3.

1921. *Cyclophorus (Glossostylus) sidiensis* : Gude, *Fauna British India, Mollusca*, III : 67.

Material examined : 1 ex., Midpu, Doimuk, Papum Pare, 19.11.1996, Coll. G. Thirumalai.

Diagnosis : Shell moderately large, conically turbate, narrowly umbilicate, keeled at the periphery; with distant raised spiral lirae, finer lirae in between; brownish in colour; whorls 5, flatly convex on sides; aperture suboblique, circular, peristome rather thin, reflected, columellar margin vertically curved; finely sculptured on base.

Distribution : INDIA : Arunachal Pradesh (Abor hills).

Remarks : Known from Arunachal Pradesh only.

Genus *Pearsonia* Kobelt, 1902Sub-genus *Pearsonia* S. St.*Pearsonia oakesi* (Godwin-Austen)

1915. *Spiraculum oakesi* Godwin-Austen, *Rec. Indian Mus.*, 8 : 496, pl. 39, fig. 3.

1921. *Pearsonia (Pearsonia) oakesi* : Gude, *Fauna British India, Mollusca*, III : 124.

Material examined : 1 ex., Kebali to Chidu village, Dibang valley, 21.12.1996, Coll. G. Thirumalai.

Diagnosis : Shell moderately large, depressedly coiled, very widely umbilicate, fairly thick, greyish with dark brown markings (mostly in zig-zag patterns) throughout, narrow band of same colour on the periphery; spire depressed, scarcely raised above; whorls 5; the last large, slightly descending in front, provided with an unusually long sutural tube which originates a little distance behind the aperture and is directed obliquely backward; aperture circular, peristome double, the

outer reflected and produced at the upper inner angle forming a 'silt' adhering to the penultimate whorl; inner peristome continuous with a slight notch at the upper inner angle.

Distribution : INDIA : Arunachal Pradesh.

Remarks : Known from Arunachal Pradesh only. The present report is the first subsequent record of this species after Godwin-Austen (1915). The sutural tube and the 'silt' in the outer peristome are among the shell modifications commonly exhibited by many of the land operculates and are used as breathing devices (Subba Rao *et al.*, 1987).

Order STYLOMMATOPHORA

Family SUBULINIDAE

Genus *Glessula* von Martens, 1860

Glessula crassula (Reeve)

(pl. fig.)

1850. *Achatina crassula* (Benson) Reeve, *Conch. Icon.*, 5 : *Achatina*, pl. 22, fig. 12.

1914. *Glessula crassula* : Gude, *Fauna British India, Mollusca*, 2 : 429.

Material examined : 1 ex. Anini Road, Dibang valley, 14.12.1986, Coll. G. Thirumalai.

Diagnosis : Shell rather small, pyramidal, light brownish, vertically striate, with 7 whorls, flatly convex, suture deeply impressed; aperture small, ovate, outer lip thin, columellar margin concavely arched and abruptly truncate below.

Distribution : INDIA : Hills of north-east India, Arunachal Pradesh, Meghalaya, Nagaland and Darjeeling in West Bengal.

Glessula crassilabris (Benson)

1836. *Achatina crassilabris* Benson, *J. Asiat. Soc. Bengal*, 5 : 353.

1914. *Glessula crassilabris* : Gude, *Fauna British India, Mollusca*, 2 : 426.

Material examined : 1 ex., Kimin, Papum Pare, 12.2.1996, Coll. G. Thirumalai.

Diagnosis : Shell elongate – turreted, rather thin, straw-coloured, finely sculptured with vertical striae; spire conical, apex blunt, suture deep, excavated; whorls 7–8, convex; aperture ovate, outer lip slightly thickened inside; columella arched and truncated below. Differs from the above being longer and proportionately narrower.

Distribution : INDIA : Hills of north-east India, Arunachal Pradesh, Meghalaya, Nagaland and Darjeeling in West Bengal. *Elsewhere* : Myanmar.

Family ACHATINIDAE

Genus *Achatina* Lamarck, 1799*Achatina fulica fulica* Bowdich1822. *Achatina fulica* Bowdich, *Elements of Conchology*, 1 : pl. 13, fig. 3.1950. *Achatina (Lissachatina) fulica fulica* : Bequart, *Bull. Mus. Comp. Zool. Harvard*, 105(1) : 216, pl. 8.*Material examined* : 7 exs., Lichi, Subansiri, Coll. G. Thirumalai.

Diagnosis : Shell large to very large, often reaching 100 mm. in length, ovately conical, strongly inflated, light yellowish or whitish with brown markings throughout; whorls 8, rounded and rapidly increasing, last whorl large exceeding half of total shell length; suture deep-impressed with a number of spiral striae just below; aperture large, ovate, outer lip simple, thin, columella strongly arched and truncate.

Distribution : INDIA : Abundantly occurs throughout including the Andaman and Nicobar Islands, except the dry north-west part of the country. *Elsewhere* : Malaysia, Mauritius, Scyhelles, Singapore and Zanzibar.

Remarks : Though known to be abundant throughout eastern India, it is for the first time recorded from Arunachal Pradesh; Raut & Ghosh (1984) or Dey *et al.*, (1985) did not record this species from the state.

Family HELIXARIONIDAE

Genus *Sivella* Blanford, 1863*Sivella castra* (Benson)1852. *Helix castra* Benson, *Ann. Mag. Nat. Hist.*, (2)10 : 349.1914. *Trochomorpha (Sivella) castra* : Gude, *Fauna British India, Mollusca*, 2 : 3.1995. *Sivella castra* : Subba Rao *et al.*, *State Fauna Series* 4, (8) *zool. Surv. India*, 67 : pl. 14, figs. 182.*Material examined* : 4 exs., Yazali, L. Subansiri, 10.11.1996, Coll. G. Thirumalai.

Diagnosis : Shell medium sized, depressedly conical, umbilicate, apex obtuse; obliquely striate, whorls 5–6, rather flattened above, last whorl keeled at the periphery, flat on base; suture shallow, marginate; aperture oblique, subquadrate, outer lip thin.

Distribution : INDIA : Arunachal Pradesh, Assam, Meghalaya, Mizoram, Sikkim and West Bengal. *Elsewhere* : Malaysia, Myanmar and Thailand.

Family ARIOPHANTIDAE

Key to the genera

- Shell imperforate, whorls less than 5, rapidly increasing in size *Cryptaustenia*
- Shell perforate, whorls above 5, slowly increasing in size *Macrochlamys*

Genus *Cryptaustenia* Cockerell, 1891*Cryptaustenia silcharensis* (Godwin-Austen)

1907. *Austenia silcharensis* Godwin-Austen, *Land & Freshwater Moll. India*, **2** : 107, figs. 1-3c.
1908. *Cryptaustenia silcharensis* : Blanford & Godwin-Austen, *Fauna British India Mollusca, (Testacellidae & Zonitidae)* p. 186
1995. *Cryptaustenia silcharensis* : Subba Rao *et al.*, *State Fauna Ser.* 4(8), *zool. Surv. India* : 68, pl. 14, figs. 5, 6.

Material examined : 1 ex., Jairampur, Changlang, 8.11.1995, Coll. Ram Sevak; 1 ex., Rima Village, Changlang, 10.11.1995, Coll. Ram Sevak; 2 exs., Deomali, Tirap, 14.11.1995, Coll. Ram Sevak; 1 ex., Lichi, L. Subansiri, Coll. Thirumalai; 2 exs., Banderawa, Papum Pare, 14.7.1998, Coll. P. T. Bhutia.

Diagnosis : Shell small, depressed, very thin, straw-coloured, faintly striate, spire flattened, not rising above the level of body whorl; suture impressed; whorls 3 rapidly increasing, the last much wider than the rest, rounded at periphery and below; aperture oblique, widely lunate, peristome simple thin, columellar margin strongly curved.

Distribution : INDIA : Arunachal Pradesh, Assam, Meghalaya. New record for Arunachal Pradesh.

Cryptaustenia sp.

Material examined : 1 ex., Lichi, L. Subansiri, Coll. G. Thirumalai; 2 exs., Banderdewa, Papum Pare, 14.7.1988, Coll. P. T. Bhutia.

Remarks : The shells were damaged and could not be identified up to the species.

Genus *Macrochlamys* Benson, 1832*Macrochlamys atricolor* Godwin-Austen

1875. *Helix-Nanina atricolor*, Godwin-Austen, *J. Asiat. Soc. Beng.*, **2** : 2, pl. 1, fig. 2.
1908. *Macrochlamys atricolor* : Blanford & Godwin-Austen, *Fauna British India, Mollusca, (Testacellidae & Zonitidae)*, p. 99, test-fig. 44.
1995. *Macrochlamys atricolor* : Subba Rao *et al.*, *State Fauna Ser.* 4(8), *zool. Surv. India*, : 73, pl. 16, figs. 1, 2.

Material examined : 10 exs., Midpu, Doimuk, Coll. G. Thirumalai.

Diagnosis : Shell large, depressed, fairly thick, perforate, smooth, polished, yellowish-brown; faintly and minutely striate; spire low-conoid, scarcely raised; suture shallow, whorls 6, convex, the last rounded at the periphery and below, slightly impressed at umbilical region; aperture oblique, lunate, peristome thinly labiate inside, basal margin arcuate, columellar margin reflected at the perforation.

Distribution : INDIA : Arunachal Pradesh, Assam, Meghalaya, Manipur, Nagaland.
Elsewhere : Myanmar.

Remarks : New record for Arunachal Pradesh.

***Macrochlamys* sp.**

Material examined : 1 ex., Lichi, L. Subansiri, Coll. G. Thirumalai; Banderdewa, Papum Pare, 14.7.1988, Coll. P. T. Bhutia.

Remarks : Damaged shells, could not be identified up to the species.

Family PLECTOPYLIDIDAE

Genus *Plectopylis* Benson, 1860

Sub-genus *Endothyrella* Zilch, 1960

***Plectopylis (Endothyrella) plectostoma* (Benson)**

1836. *Helix Plectostoma* Benson, *J. Asiat. Soc. Beng.*, **5** : 351.

1914. *Plectopylis plectostoma* : Gude, *Fauna British India, Mollusca*, **2** : 81.

1995. *Plectopylis plectostoma* : Subba Rao *et al.*, *State Fauna Ser. 4*(8), *zool. Surv. India*, : 61, pl. 10, figs. 1, 2.

Material examined : 1 ex., Yazali, L. Subansiri, 8.4.1999, Coll. P. T. Bhutia.

Diagnosis : Shell small, sinistral, depressedly conoid, narrowly umbilicate, spire slightly raised, apex obtuse, plaitedly sculptured by oblique striae and spiral plications above, smoother below; whorls 5, narrowly coiled, last whorl compressed and distinctly descending in front; aperture oblique, lunate, outer lip thickened and reflected; parietal callus with a raised ridge; a number of plates, folds and denticles (parietal armature) present on the inner wall of the last whorl.

Distribution : INDIA : Hills of north-east India, Arunachal Pradesh, Assam, Meghalaya, Mizoram, Nagaland, Sikkim and Darjeeling in West Bengal. *Elsewhere* : Myanmar.

Family BRADYBAENIDAE

Key to the genera

- Shell strongly sculptured, last whorl descending in front *Aegista*
- Shell weakly sculptured, last whorl straight in front *Bradybaena*

Genus *Aegista* Albers, 1850

Sub-genus *Plectotropis* Von Martens, 1860

***Aegista (Plectotropis) tapeina* (Benson)**

1836. *Helix tapeina* Benson, *J. Asiat. Soc. Beng.*, **5** : 352.

1914. *Plectotropis tapeina* : Gude, *Fauna British India Mollusca*, 2 : 214.

1995. *Plectotropis tapeina* : Subba Rao *et al.*, *State Fauna Ser.* 4(8), *zool. Surv. India* : 83, pl. 24, figs. 2, 3.

Material examined : 1 ex., Yazali, L. Subansiri, 10.1.1988, Coll. G. Thirumalai.

Diagnosis : Shell moderately large, sublenticular, widely umbilicate, thick, greenish, with distinct oblique striae, spiral sculpture weak; spire conoidly raised; whorls 7, flattened above, last whorl angulate at the periphery, fairly convex below, descending near the aperture; aperture oblique, subcircular, peristome thin, reflected, columellar margin reflected. Shows variation in height-diameter ratio and also in angulation of the last whorl.

Distribution : INDIA : Common throughout north-eastern region, Arunachal Pradesh, Assam, Meghalaya, Mizoram and northern parts of West Bengal. *Elsewhere* : Myanmar.

Genus *Bradybaena* Beck, 1837

Bradybaena similaris (Ferussac)

1822. *Helix (Helicella) similaris* Ferussac, *Tabl. Syst. Limacons*, 1822, No. 262.

1914. *Eulota similaris* : Gude, *Fauna British India Mollusca*, 2 : 200.

Material examined : 6 exs., Yazali, L. Subansiri, 8.4.1999, Coll. P. T. Bhutia; 6 exs., Anini Road, Dibang Valley, 14.12.1986, Coll. G. Thirumalai.

Diagnosis : Shell depressedly globose, umbilicate, rather thin, brownish; or pale whitish, often with a brown band around the periphery; spire convex, apex pointed, decussately sculptured above and also below, whorls 5–6 convex, last whorl rounded or subangulate at the periphery, convex below; aperture oblique, peristome thin, reflected, columellar margin reflected. Also a variable shell, varies in height of spire or angulation of the last whorl.

Distribution : INDIA : Arunachal Pradesh, Assam, Manipur, Mizoram. *Elsewhere* : One of the very widely distributed species. Argentina, Australia, Brazil, China, Cuba, Japan, Indonesia, Malaysia, Myanmar, Sri Lanka, Thailand, West Indies and various Pacific Islands.

GENERAL DISCUSSION

The material collected from Itanagar Wild Life Sanctuary includes 18 species under 16 genera and 12 families. All the species of freshwater molluscs (7 species under 5 genera and 5 families) have all India range of distribution. Most of the 11 species of landforms are Indo-Malayan in distribution. The two land operculates (*Pearsania oakesi* and *Cyclophorus sidiensis*) are endemic to Arunachal Pradesh. Two of the Pulmonates (*A. fulica* and *B. similaris*) are among the ubiquitous species occurring in many parts of the world. Of the seven remaining species, three species (including *A. fulica*) are for the first time recorded from Arunachal Pradesh and the remaining are confined to the hills of north east India extending to Myanmar.

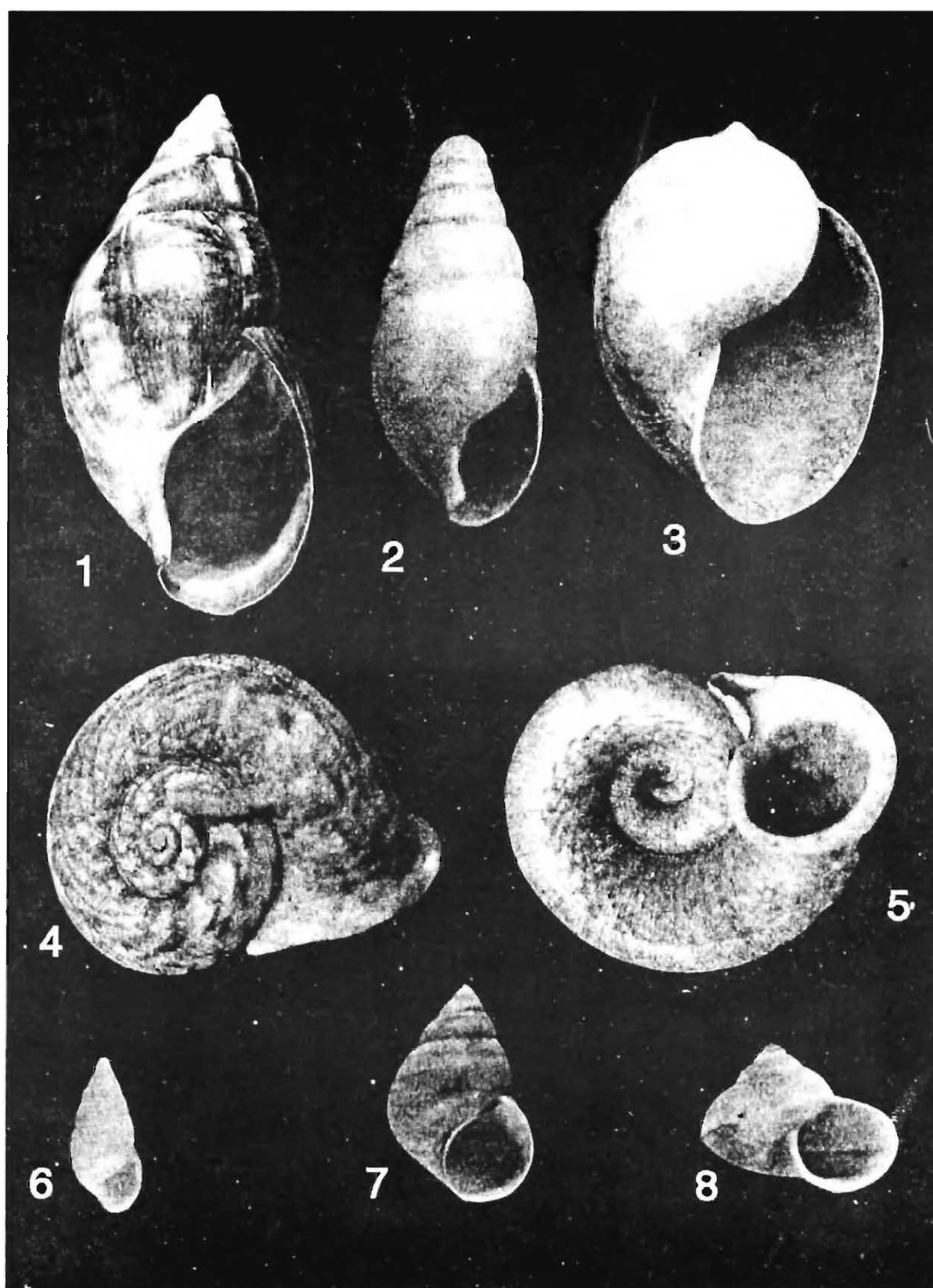
ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, for the facilities to work and also to Dr. P. T. Bhutia, Officer-in-Charge, Itanagar Field Station, Arunachal Pradesh, for making the material available for study.

REFERENCES

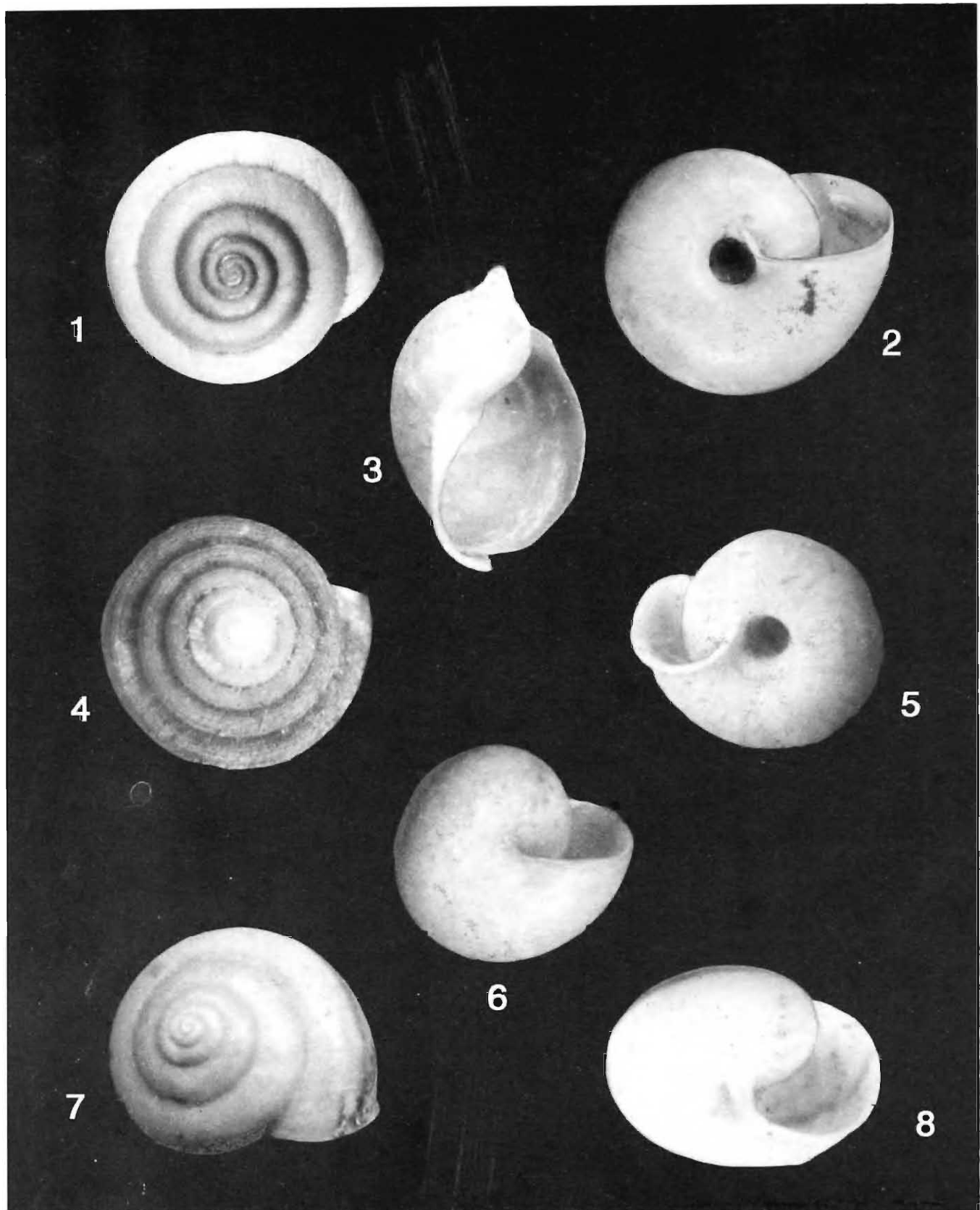
- Dey, A., Barua, S. and Mitra, S. C. 1985. Mollusca of Proposed Namdapha Biosphere Reserve, *Rec. zool. Surv. India*, **82**(1-4) : 263-274.
- Ghosh, E. N. 1913. Zoological Results of the Abor Expedition (1911-1912), Mollusca-1. *Rec. Indian Mus.*, **8** : 209-227.
- Godwin-Austen, H. H. 1876. On the Cyclostomacea of the Dafla hills, Assam, *J. Asiat. Soc. Beng.*, **45**(2) : 171-184, pls. 7-8.
- Godwin-Austen, H. H. 1876a. On the Helicidae, collected during the Expedition into the Dafla hills, Assam. *J. Asiat. Soc. Beng.*, **45**(2) : 311-318.
- Godwin-Austen, H. H. 1914-1918. Zoological Results of the Abor Expedition (1911-1912) Mollusca, 2, 3, 6-9. *Rec. Indian Mus.*, **8** : 359-363; 493-503; 547-559; 569-580; 581-600; 601-621.
- Gude G. K. 1915. Zoological Results of the Abor Expedition. (1911-1912). Mollusca. 4, *Rec. Indian Mus.*, **8** : 505-513.
- Preston, H. B. 1915. Zoological Results of the Abor Expeditions (1911-1912). Mollusca. 5, *Rec. Indian Mus.*, **8** : 537-541
- Ramakrishna and Mitra, S. C. 2002. Endemic land molluscs of India. *Rec. zool. Surv India, Occ. Paper* 196 : 1-50, pls. 1-13.
- Subba Rao, N. V., Raut, S. K. and Mitra, S. C. 1987. Shell modifications in Indian land operculates and their significance. *Bull. zool. Surv. India*, **8**(1-3) : 33-37, pls. I-II, text-figs. 1-3.
- Vaught, K. C. 1989. A classification of the living Mollusca (1-189) (ed.) Tucker Abbott & K. J. Boss. American Malacologists, Inc. Melbourne, Florida, USA.

PLATE I



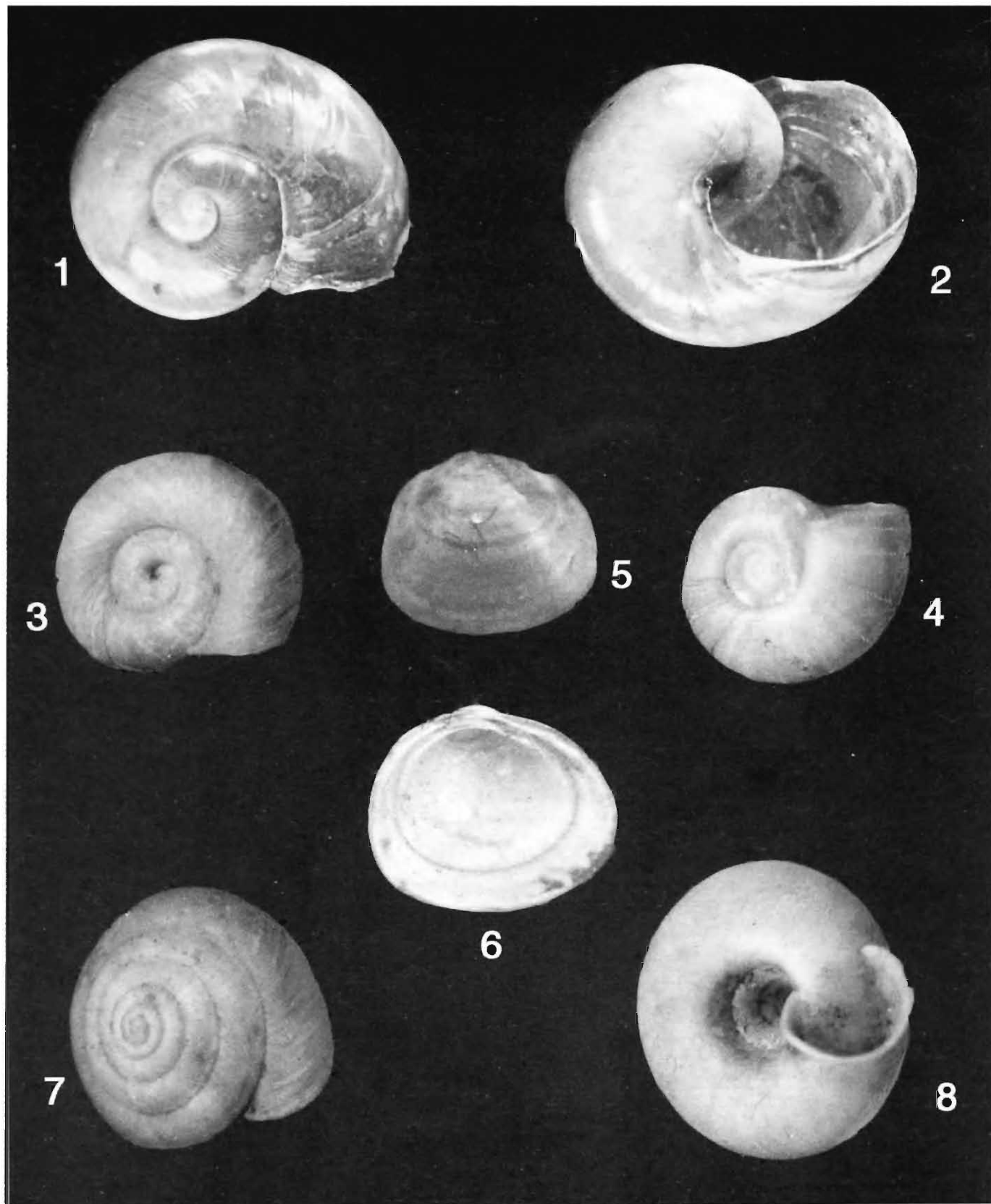
Figs. 1-8. : 1. *Achatina fulica fulica* Bowdich; 2. *Glessula crassilabris* (Benson); 3. *Lymnaea* (*Pseudosuccinea*) *acuminata* f. *typica* Lamarck; 4. *Pearsonia oakesi* (Godwin-Austen) (Dorsal); 5. *Pearsonia oakesi* (Godwin-Austen) (Ventral); 6. *Glessula crassula* (Reeve); 7. *Bellamya bengalensis* f. *annandalei* (Kobelt); 8. *Cyclophorus* (*Glossostylus*) *sidiensis* Godwin-Austen.

PLATE II



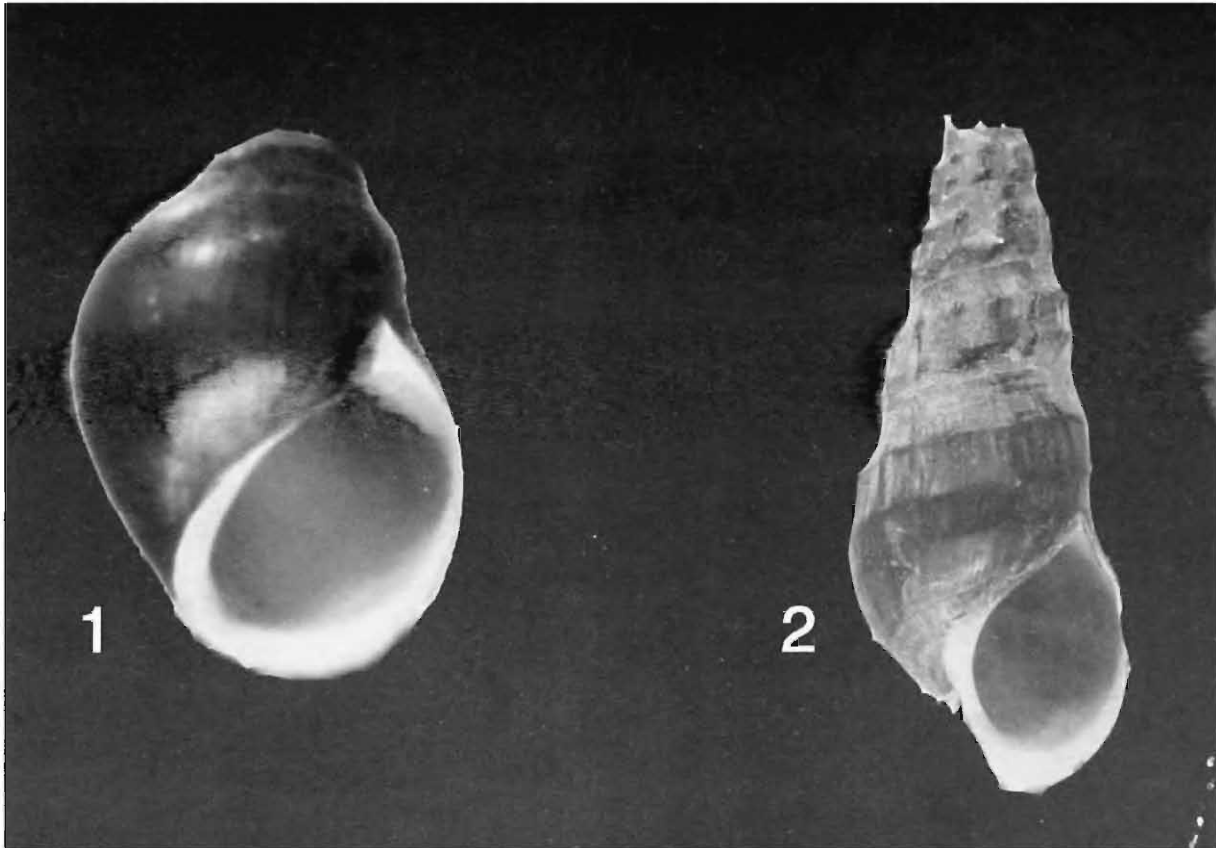
Figs. 1-8. : 1. *Sivella castra* (Benson) (Dorsal); 2. *Sivella castra* (Benson) (Ventral); 3. *Lymnaea* (*Pseudosuccinea*) *acuminata* Lamarck; 4. *Plectopylis* (*Endothyrella*) *plectostoma* (Benson) (Dorsal); 5. *Plectopylis* (*Endothyrella*) *plectostoma* (Benson) (Ventral); 6. *Macrochlamys atricolor* Godwin-Austen; 7. *Bradybaena similaris* (Ferussac) (Dorsal); 8. *Bradybaena similaris* (Ferussac) (Ventral).

PLATE III

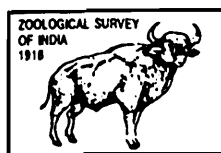


Figs. 1-8. : 1. *Cryptaustenia silcharensis* (Godwin-Austen) (Dorsal); 2. *Cryptaustenia silcharensis* (Godwin-Austen) (Ventral); 3. *Indoplanorbis exustus* (Deshayes) (Dorsal); 4. *Indoplanorbis exustus* (Deshayes) (Ventral); 5. *Sphaerium indicum* Deshayes (Dorsal); 6. *Sphaerium indicum* Deshayes (Ventral); 7. *Aegista (Plectotropis) tapeina* (Benson) (Dorsal); 8. *Aegista (Plectotropis) tapeina* (Benson) (Ventral).

PLATE IV



Figs. 1-2. : 1. *Paludomus (Paludomus) conica* (Gray);
2. *Brotia (Antimelania) costula* (Rafinesque).



Rec. zool. Surv. India : **104** (Part 3–4) : 13-21, 2005

IDENTIFICATION OF DORSAL GUARD HAIRS OF NINE INDIAN SPECIES OF THE FAMILY VIVERRIDAE (CARNIVORA : MAMMALIA)

RINA CHAKRABORTY AND J. K. DE*

Zoological Survey of India, 27, J. L. Nehru Road, Kolkata-700 016

INTRODUCTION

Study of hair structure of a number of mammalian species had been worked out (Hausman 1920, Brunner and Coman 1974, Moore *et al.* 1974, Koppiker and Sabnis 1976, 1977, Keller 1981, Debrot *et al.* 1982, Teerink 1991, Wallis 1993, Venkatraman *et al.* 1994, De and Chakraborty 1995, 2002, Chakraborty *et al.* 1996, 1999, De *et al.* 1998, Chakraborty and De 2001, 2002, Toth, A. M. 2002) but knowledge on trichotaxonomy of many species is still wanting. Study of hairs of the species belonging to the family Viverridae have almost not been worked out except cuticular structure of *Arctogalidia fusca* by Hausman 1920.

Nine species of Viverrids have been identified from the Indian region (Alfred *et al.* 2002) and commercial exploitation and habitat destruction accelerate their enlistment as Schedule I and II in the list of Wildlife (Protection) Act., 1972 as well as appendices of CITES (Table 2). Of the nine species *Paradoxurus hermaphroditus* (Pallas) and *Viverricula indica* (Desmarest) are distributed almost throughout the country in suitable habitat, but the former is not reported from desert part of Rajasthan and Gujarat. *Paradoxurus jerdoni* Blanford and *Viverra civettina* Blyth are endemic to southern India. The other species *Arctictis binturong* (Raffles), *Arctogalidia trivirgata* (Gray), *Prionodon pardicolor* Hodgson, *Viverra zibetha* Linnaeus and *Paguma larvata* (Hamilton-Smith) are mostly denizens of north eastern Himalayan region and the distributional range of *Paguma larvata* is extended through Uttar Pradesh upto Himachal Pradesh and also in Andaman Islands.

Of the nine species *Prionodon pardicolor*, *Arctictis binturong* and *Viverra civettina* are placed under Schedule I of Wildlife (Protection) Act., 1972 and the status is given as 'Endangered'

*Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

All the other species are placed under Schedule II (Table 2). Though Pocock (1939) provided identification keys to the different species of the Indian carnivores yet it is not sufficient for identification of pieces of skins or products for which the animals are poached. In the present paper an attempt has been made to reveal the structure of dorsal guard hairs of the above mentioned species.

MATERIAL AND METHODS

Five tufts of guard hairs were collected from the mid-dorsal region of three dry preserved specimens of each species present in the National Zoological collection of the Zoological Survey of India, Kolkata. Samples were processed for study according to the method of Chakraborty *et al.* (1996). The surface structure, medullary configuration and cross sectional details of dorsal guard hairs were studied microscopically followed after Brunner and Coman (1974), Teerink (1991) and Chakraborty *et al.* (1996). Diameter and length of hair were measured with dial callipers, measuring scale (mm) respectively. Medullary index was calculated as $k = m/h$ where m = width of medulla and h = width of hair. It is also to be noted that, in case of 'Transitional' scale pattern, 'PD' and 'SS' were measured only at shield region.

Nomenclature of colour is followed after Ridgway (1886) and structural nomenclature of cuticular as well as medullary configuration is followed after Brunner and Coman (1974), Moore *et al.* (1974) and Teerink (1991). Classification was followed after Alfred *et al.* (2002).

OBSERVATION

Findings have been summarised in Table 1 and 2 and Plates I–IX.

RESULT AND DISCUSSION

From the observations it could be said that hair profiles of the Indian Viverrids is 'Spatulate' and 'Shielded' except in *A. binturong* which is 'Rod' like. At the same time the basic coat colour of the body possess different shades of 'Brown' whereas the same in *A. binturong* is 'Black'. Average hair length varies greatly among the species of the family Viverridae being (18 ± 6.82) mm as minimum in *P. pardicolor* and (76 ± 8.2) mm as maximum in *A. trivirgata*. Similarly average diameter varies from (52 ± 8.08) μ as minimum in *A. trivirgata* to (120 ± 10.6) μ as maximum in *V. indica* (Table 1). From the study, it is clear that in all the species, range of hair length and diameter vary greatly not only in between the species of the family Viverridae but among the same species also. So, these two characters may not be treated exclusively as family or species characters but it may be considered along with other characters at the time of identification.

The average scale count per millimeter of hair length was noted (205 ± 12.86) as minimum in *P. pardicolor* as well as (400 ± 17.6) and (400 ± 10.7) as maximum in *V. indica* and *P. jerdoni* respectively. Though the average scale count among the species varies greatly yet it hardly exceed 240 (212–267) in five species, only the same in *A. trivirgata* and *P. hermaphroditus* is 331 ± 18.72 and 325 ± 16.47 respectively (Table 1).

Among the nine species 'Scale Pattern' is 'Irregular wave' in *P. larvata*, *A. binturong*, *A. trivirgata*, *V. civettina*, *P. jerdoni* and *P. hermaphroditus* and in other three species it is 'Transitional' In shield region, it is 'Regular Petal', 'Narrow Diamond Petal' and 'Regular mosaic' in *V. indica*, *P. pardicolor* and *V. zibetha* respectively as well as in basal region, the same is 'Irregular wave' in *P. larvata* and 'Regular wave' in *P. pardicolor* and *V. zibetha* (Table 1, Plates I–IX). Hausman (1920) noted 'Intermediate-ovate' type cuticular scale in *Arctogalidia fusca* but nothing was mentioned about scale pattern. Thus, it may be opined that, the above mentioned characters may be one of the key character for identifying Viverrid hairs.

The scale margin is 'Crenate' in *P. larvata*, *A. binturong*, *A. trivirgata*, *V. civettina*, *P. jerdoni* and *P. hermaphroditus* where as scale margin distance is 'Close' only in *P. larvata* and *P. hermaphroditus* and 'Intermediate' in other four species. It is also noted that the scale margin is 'Dentate' at shield region and 'Crenate' and 'Smooth' at basal in *V. indica* and *P. pardicolor* respectively. Where as in *V. zibetha* scale margin is 'Smooth' throughout but scale margin distance is same as *P. pardicolor* (Table 1).

The mean 'SS' were observed maximum in *V. civettina* as (80.75 ± 9.21) μ and minimum in *P. pardicolor* as (18.5 ± 2.52) μ (Table 2). It was noted that 'SS' varied greatly not only in between the different genera but also in between the species of the same genus. Likely, the maximum 'SS' observed in *V. civettina* while the same in the other species *V. zibetha*, it is only (37 ± 2.04) μ . The same is true in *P. jerdoni* and *P. hermaphroditus*, where mean 'SS' measured (45.25 ± 4.8) μ and (35.5 ± 3.1) μ respectively. It is obvious that, owing to the scale pattern and arrangement, 'PD' differs greatly from species to species. It was measured maximum as (62.5 ± 5.21) μ in *P. pardicolor* and minimum as (8.75 ± 2) μ in *P. hermaphroditus* (Table 2). The proximodistal measurements vary so greatly, probably because mostly of 'Transitional' scale pattern. But in those species where the scale pattern is 'Irregular wave', the average 'PD' ranges from (8.75 ± 2) μ to (16.5 ± 3.46) μ only (Table 2).

Except *A. binturong*, the medullary configuration in all the species is 'Unbroken vacuolated' and tranverse section is 'Ovate' or 'Circular' But in *A. binturong* the medullary configuration is 'Simple' and tranverse section is 'Reniform' (Table 2, Plates I–IX). It is also noted that, medullary index is > 0.80 in *P. larvata* and *V. zibetha* whereas the same is < 0.80 in the rest of the Indian species of the family Viverridae except *A. binturong* which is > 0.90 (Table 2). In *A. binturong* the cortex is so thin that it makes a different identifying character for the species. Usually the medullary index is always species specific but while the same overlaps, like in *P. pardicolor* and *P. jerdoni*, then the other characters become of great support for the identification of the species.

From the study it is clear that the identification of species from the hair sample of the family Viverridae could not be possible with one or two characters but obviously it could be done with a group of characters. Again, from the hair profile, colour, medullary configuration, transeverse section and medullary index of *A. binturong*, it seems quite different from the other species of the family Viverridae. Pocock (1939) placed *A. binturong* under sub-family Paradoxurinae along with the species *A. trivirgata*, *P. larvata*, *P. hermaphroditus* and *P. jerdoni*. But from the present study, it could be opined that *A. binturong* may demand a different taxonomic status, at least at sub-family level.

Accordingly, based on the characteristics of the dorsal guard hairs, keys to the identification of different species of the Indian Viverridae are presented below.

Key to the Indian species of the family VIVERRIDAE

- 1a. Colour Black; medullary configuration 'Simple'; T. S. Reniform; hair 'Rod' like; length (55 ± 11.21) mm; diameter (110 ± 8.76) μ ; scale pattern 'Irregular wave'; scale margin distance 'Intermediate'; scale margin 'Crenate'; 'SS' (56.5 ± 6) μ ; 'PD' (15 ± 2.96) μ ; medullary index 0.93 ± 0.001 *Arctictis binturong*
- 1b. Colour Claret Brown, Bay or Burnt Sienna; medullary configuration 'Unbroken vacuolated'; T. S. Ovate or circular 2
- 2a. Medullary index > 0.80 ; T. S. Ovate 3
- 2b. Medullary index < 0.80 4
- 3a. Buff band at subshield; scale pattern 'Irregular wave'; scale margin 'Crenate'; scale margin distance 'Close'; 'SS' at shield (47.7 ± 3.94) μ ; 'PD' at shield (16.5 ± 3.46) μ ; medullary index 0.826 ± 0.01 *Paguma larvata*
- 3b. Band if present at subshield, not more than 4 mm in width; scale pattern 'Transitional'; 'Regular mosaic' at shield and 'Regular wave' at basal; scale margin 'Smooth'; scale margin distance 'Distant' at shield and 'Intermediate' at basal; 'SS' at shield (37 ± 2.04) μ ; 'PD' at shield (39 ± 3.52) μ ; medullary index 0.89 ± 0.01 *Viverra zibetha*
- 4a. T. S. Ovate 5
- 4b. T. S. Circular 6
- 5a. Buff band at shield; length (23.83 ± 2.12) mm; diameter (120 ± 10.6) μ ; scale count (400 ± 17.6); scale pattern 'Transitional', 'Regular Petal' at shield, 'Irregular wave' at basal; scale margin and scale margin distance 'Dentate' and 'Distant' at shield and 'Crenate' and 'Close' at basal respectively; 'SS' (22 ± 1.6) μ ; 'PD' (53.5 ± 4.66) μ ; medullary index 0.769 ± 0.02 *Viverricula indica*

- 5b. Length (34 ± 3.42) mm; diameter (100 ± 6.18) μ ; scale count (240.8 ± 14.12); scale pattern 'Irregular wave'; scale margin distance 'Intermediate'; scale margin 'Crenate'; 'SS' (80.75 ± 9.21) μ ; 'PD' (11.25 ± 1.85) μ ; medullary index 0.62 ± 0.09 *Viverra civettina*
- 5c. Length (31 ± 7.25) mm; diameter (92 ± 10.76) μ ; scale count (325 ± 16.72); scale pattern 'Irregular wave'; scale margin distance 'Close'; scale margin 'Crenate'; 'SS' (35.3 ± 3.1) μ ; 'PD' (8.75 ± 2) μ ; medullary index 0.72 ± 0.02 *Paradoxurus hermaphroditus*
- 6a. Length (18 ± 6.82) mm; diameter (63 ± 5.21) μ ; scale count (205 ± 12.86); scale pattern 'Transitional', 'Narrow Diamond Petal' at shield; 'Regular wave' at basal; scale margin and scale margin distance 'Dentate' and 'Distant' at shield and 'Smooth' and 'Intermediate' at basal respectively; 'SS' (18.5 ± 2.52) μ at shield; 'PD' (62.5 ± 5.21) μ at shield; medullary index 0.64 ± 0.08 *Prionodon pardicolor*
- 6b. Length (76 ± 8.2) mm; diameter (52 ± 8.08) μ ; scale count (331 ± 18.72); scale pattern 'Irregular wave'; scale margin 'Crenate'; scale margin distance 'Intermediate'; 'SS' (68.6 ± 8.96) μ ; 'PD' (13.8 ± 2.35) μ ; medullary index 0.66 ± 0.02 *Arctogalidia trivirgata*
- 6c. Length (30 ± 8.81) mm; diameter (90 ± 12) μ ; scale count (400 ± 10.7); scale pattern 'Irregular wave'; scale margin 'Crenate'; scale margin distance 'Intermediate'; 'SS' (45.25 ± 4.8) μ ; 'PD' (11.25 ± 1.16) μ ; medullary index 0.64 ± 0.03 *Paradoxurus jerdoni*

SUMMARY

Nine Indian species of the family Viverridae, *Viverricula indica*, *Paguma larvata*, *Prionodon pardicolor*, *Arctictis binturong*, *Arctogalidia trivirgata*, *Viverra zibetha*, *Viverra civettina*, *Paradoxurus jerdoni* and *Paradoxurus hermaphroditus* had been worked out. From the study it is clear that identification of the species from the hair sample is possible, with the help of a group of characters. However, no character could be placed as family character but except *A. binturong* all the other eight species possess 'Unbroken vacuolated' medullary configuration, shielded and spatulate hair profile as well as 'ovate or circular' T. S. But the same characters in *A. binturong* noted as 'Simple' medullary configuration, 'Rod' like hair profile and 'Reniform' T. S. Thus, from this study, it could be reveal that *A. binturong* is little different from the other eight Indian species of the family Viverridae. So, it may demand a different taxonomic status at least at sub-family level.

ACKNOWLEDGEMENTS

Authors are thankful to Dr. J. R. B. Alfred, Director, Zoological Survey of India for his kind permission and facilities provided for this work and also to Dr. S. Chakraborty Jt. Director (Retd.) for critically going through the manuscript.

Table 1. : Comparative account of the characteristics of the guard hairs of nine Indian species of the family Viverridae (Mean and SD given in Parenthesis); 'SS' = Side to side cuticular scale length; 'PD' = Poximodistal cuticular scale length; B = Basal; S = Shield; Sh = Subshield; EN = Endangered; Sch = Schedule; VU = Vulnerable.

Sl. No.	Name of the Species	Profile	Colour	Length (mm)	Diameter (μ)	Scale count/mm of hair length	Scale Pattern	Scale margin distance	Scale margin
1.	<i>Viverricula indica</i> Desmarest	Spatulate, Straight, Shielded, Banded	Claret Brown with Buff Band and Shield	20–29 (23.83 $\pm$ 2.12)	100–150 (120 $\pm$ 10.6)	372–418 (400 $\pm$ 17.6)	Transitional S : Regular Petal B : Irregular wave	S : Distant B : Close	S : Dentate B : Crenate
2.	<i>Paguma larvata</i> Hamilton-Smith	Spatulate, Straight or little wavy, shielded, Banded	Claret Brown with lighter basal, dark apical and single broad Buff band at subshield	30–45 (38 $\pm$ 3.86)	50–80 (60 $\pm$ 8.72)	221–247 (231 $\pm$ 8.71)	Irregular wave	Close	Crenate
3.	<i>Prionodon pardicolor</i> Hodgson	Spatulate, Straight, Shielded, Band may or may not present	Claret Brown, Broad Buff band at subshield, if present	10–25 (18 $\pm$ 6.82)	50–70 (63 $\pm$ 5.21)	176–221 (205 $\pm$ 12.86)	Transitional S : Narrow Diamond Petal B : Regular wave	S : Distant B : Intermediate	S : Dentate B : Smooth
4.	<i>Arctictis binturong</i> Raffles	Rod like, Little wavy, non banded	Black	40–70 (55 $\pm$ 11.21)	100–130 (110 $\pm$ 8.76)	204–236 (218 $\pm$ 10.38)	Irregular wave	Intermediate	Crenate
5.	<i>Arctogalidia trivirgata</i> Gray	Spatulate, Straight or little wavy, Shielded, non-banded	Burnt Sienna, lighter at basal	60–85 (76 $\pm$ 8.2)	40–60 (52 $\pm$ 8.08)	287–356 (331 $\pm$ 18.72)	Irregular wave	Intermediate	Crenate
6.	<i>Viverra zibetha</i> Linnaeus	Spatulate, Straight, Shielded, Band may or may not present	Claret Brown, narrow Buff band not more than 4 mm at sub shield, if present	30–40 (33 $\pm$ 5.8)	80–110 (95 $\pm$ 9.36)	217–254 (234 $\pm$ 11.72)	Transitional S : Regular mosaic B : Regular wave	S : Distant B : Intermediate	Smooth
7.	<i>Viverra civettina</i> Blyth	Spatulate, Straight Shielded, Band may or may not present	Dark Bay, Broad Buff band at sub shield, if present	30–40 (34 $\pm$ 3.42)	80–110 (100 $\pm$ 6.18)	212–267 (240 $\pm$ 14.12)	Irregular wave	Intermediate	Crenate
8.	<i>Paradoxurus jerdoni</i> Blanford	Spatulate, Straight, Shielded, non banded	Claret Brown, lighter at basal	20–40 (30 $\pm$ 8.81)	70–110 (90 $\pm$ 12)	396–423 (400 $\pm$ 10.7)	Irregular wave	Intermediate	Crenate
9.	<i>Paradoxurus hermaphroditus</i> Pallas	Spatulate, Straight, Shielded, non-banded	Dark Bay, either in whole or at apical, basal lighter	20–40 (31 $\pm$ 7.25)	70–110 (92 $\pm$ 10.76)	291–347 (325 $\pm$ 16.47)	Irregular wave	Close	Crenate

Table 2. : Comparative account of the characteristics of the guard hairs of nine Indian species of the family Viverridae (Mean and SD given in Parenthesis); 'SS' = Side to side cuticular scale length; 'PD' = Poximodistal cuticular scale length; B = Basal; S = Shield; Sh = Subshield; EN = Endangered; Sch = Schedule; VU = Vulnerable; T.S. = Transverse Section.

Sl. No.	Name of the Species	SS (μ)	PD (μ)	Medullary Configuration	Medullary Index	T. S.	Remarks
1.	<i>Viverricula indica</i> Desmarest	S : 20–25 (22 $\pm$ 1.6)	S : 43–60 (53.5 $\pm$ 4.66)	Unbroken vacuolated	0.76–0.78 (0.769 $\pm$ 0.02)	Ovate	Sch. II CITES; APPENDIX III
2.	<i>Paguma larvata</i> Hamilton-Smith	42–57 (47.7 $\pm$ 3.94)	13–21 (16.5 $\pm$ 3.46)	Unbroken vacuolated	0.81–0.83 (0.826 $\pm$ 0.01)	Ovate	Sch. II CITES; APPENDIX III
3.	<i>Prionodon pardicolor</i> Hodgson	S : 15–22 (18.5 $\pm$ 2.52)	S : 56–71 (62.5 $\pm$ 5.21)	Unbroken vacuolated	0.62–0.66 (0.64 $\pm$ 0.08)	Circular	Sch. I; EN CITES; APPENDIX I
4.	<i>Arctictis binturong</i> Raffles	47–66 (56.5 $\pm$ 6)	10–19 (15 $\pm$ 2.96)	Simple	0.926–0.931 (0.93 $\pm$ 0.001)	Reniform	Sch. I; EN CITES; APPENDIX III
5.	<i>Arctogalidia trivirgata</i> Gray	50–80 (68.6 $\pm$ 8.96)	11–19 (13.8 $\pm$ 2.35)	Unbroken vacuolated	0.60–0.69 (0.66 $\pm$ 0.02)	Circular	VU
6.	<i>Viverra zibetha</i> Linnaeus	32–49 (37 $\pm$ 2.04)	33–45 (39 $\pm$ 3.52)	Unbroken vacuolated	0.88–0.896 (0.89 $\pm$ 0.01)	Ovate	Sch. II CITES; APPENDIX III
7.	<i>Viverra civettina</i> Blyth	69–98 (80.75 $\pm$ 9.21)	8–15 (11.25 $\pm$ 1.85)	Unbroken vacuolated	0.60–0.65 (0.62 $\pm$ 0.09)	Ovate	Sch. I; EN CITES; APPENDIX III
8.	<i>Paradoxurus jerdoni</i> Blanford	37–51 (45.25 $\pm$ 4.8)	9–14 (11.25 $\pm$ 1.16)	Unbroken vacuolated	0.60–0.68 (0.64 $\pm$ 0.03)	Circular	Sch. II; VU CITES; APPENDIX III
9.	<i>Paradoxurus hermaphroditus</i> Pallas	28–39 (35.5 $\pm$ 3.1)	6–11 (8.75 $\pm$ 2)	Unbroken vacuolated	0.70–0.78 (0.72 $\pm$ 0.02)	Ovate	Sch. II

REFERENCES

- Alfred, J. R. B., Sinha, N. K. and Chakraborty, S. 2002. Checklist of Mammals of India. *Rec. zool. Surv. India, Occ. Paper* No. 199 : 1-289.
- Brunner, H. and Coman, B. J. 1974. The identification of mammalian hair. Inkata Press, Victoria, Australia. 196 p.
- Chakraborty, R., De, J. K. and Chakraborty, S. 1996. Identification of dorsal guard hairs of Indian species of the genus *Panthera* Oken (Carnivora : Felidae). *Mammalia*, **60** : 473-480.
- Chakraborty, R., Chakraborty, S. and De, J. K. 1999. Identification of dorsal guard hairs of the species of Indian Lesser Cats (Carnivora : Felidae). *Mammalia*, **63** : 93-104.
- Chakraborty, R. and De, J. K. 2001. Identification of dorsal guard hairs of five Indian species of the family Canidae (Carnivora : Mammalia). *Mammalia*, **64**(4) : 483-493.
- Chakraborty, R. and De, J. K. 2002. Structure of mid-dorsal guard hairs of hunting leopard, *Acinonyx jubatus venaticus* (Griffith) and Lesser Panda, *Ailurus fulgens* F. Cuvier (Mammalia : Carnivora). *Rec. zool. Surv. India*, **100**(1-2) : 131-136.
- De, J. K. and Chakraborty, R. 1995. Structure and pattern of guard hairs of Crab eating mongoose, *Herpestes urva* (Hodgson) (Mammalia : Carnivora : Herpestidae). *Proc. zool. Soc. Calcutta*, **48** : 33-36.
- De, J. K. and Chakraborty, R. 2002. Identification of dorsal guard hairs of striped Hyena *Hyaena hyaena* (Linnaeus, 1758) (Hyaenidae : Carnivora : Mammalia). *J. Bombay nat. Hist. Soc.*, **99**(3) : 502-506.
- De, J. K., Chakraborty, S. and Chakraborty, R. 1998. Identification of dorsal guard hairs of five Indian species of Mongoose, *Herpestes Illiger* (Mammalia : Carnivora). *Mammalia*, **62** : 1-11.
- Debrot, S., Fivaz, G., Mermoud, C. and Weber, J. M. 1982. Atlas des Poils de Mammifères d'Europe *Institut de Zoologie de l' Université de Neuchâtel*.
- Hausman, L. A. 1920. Structural characteristics of the hair of mammals. *Am. Nat.*, **54** : 496-523.
- Keller, A. 1981. Détermination des mammifères de la Suisse par leur pelage : V. Carnivora, VI. Artiodactyla. *Revue suisse de Zoologie Annales de la Société suisse de Zoologie et du Muséum d' Histoire Naturelle de Genève*. **88** : 803-820.
- Koppiker, B. R. and Sabnis, J. H. 1976. Identification of hairs of some Indian mammals. *J. Bombay nat. Hist. Soc.*, **73** : 5-20.
- Koppiker, B. R. and Sabnis, J. H. 1977. Further studies on the identification of hairs of some Indian mammals. *J. Bombay nat. Hist. Soc.*, **74** : 50-59.
- Moore, T. D., Spence, L. E. and Dugnolle, E. E. 1974. Identification of the dorsal guard hairs of some mammals of Wyoming. *Wyoming Game and Fish Dept. Bull.* No. 14, Cheyenne, 77 p.

- CHAKRABORTY & DE. : Identification of dorsal guard hairs of nine Indian species etc. 21
- Pocock, R. I. 1939. The Fauna of British India, including Ceylon and Burma. *Mammalia*, Vol. I. Primates and Carnivora (in part). London. (Tailor and Francis).
- Ridgway, R. 1886. Nomenclature of colors. University Press, John Wilson and son, Cambridge. 129 p.
- Teerink, B. J. 1991. Hairs of West European Mammals. Cambridge University Press, Cambridge, 223 p.
- Toth, A. M. 2002. Identification of Hungarian Mustelidae and other small carnivores using guard hair analysis. *Acta Zoologica Academiae Scientiarum Hungaricae*, **48**(3) : 237-250.
- Venkatraman, K., De, J. K. and Tandon, S. K. 1994. Ultrastructure studies of hairs of seventeen species of carnivore mammals using scanning electron micrographs. *Rec. zool. Surv. India*, **94** : 145-149.
- Wallis, R. L. 1993. A key for the identification of guard hairs of some Ontario mammals. *Can. J. Zool.*, **71** : 587-591.

PLATE I

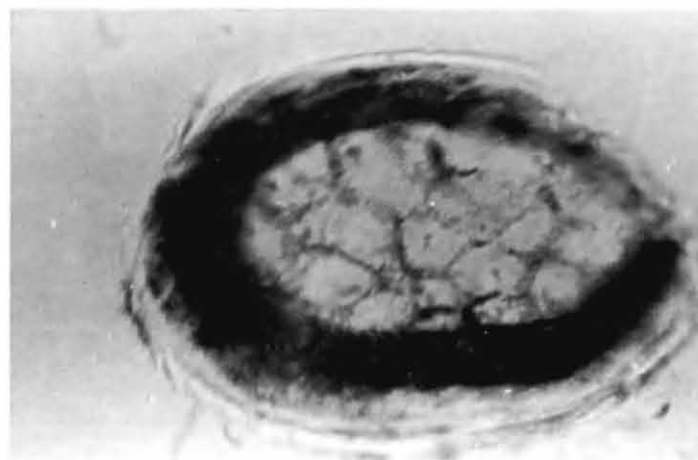
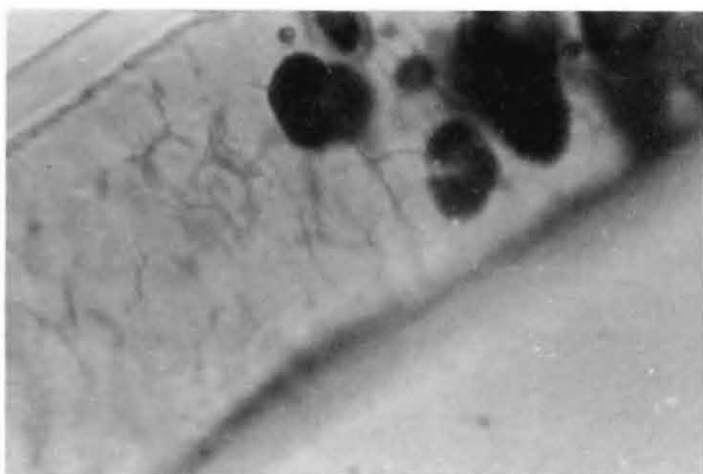
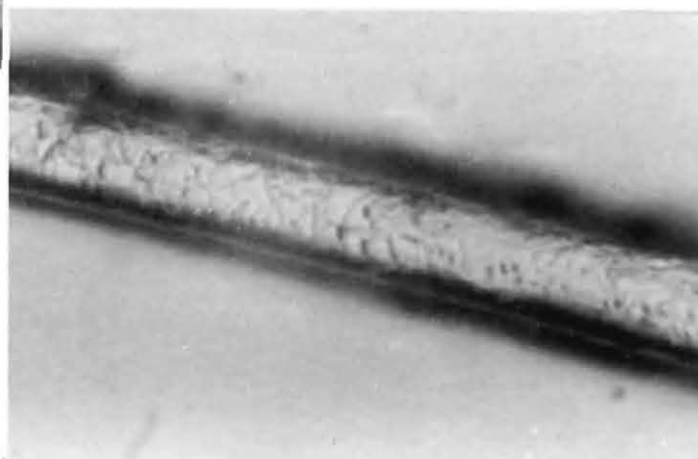
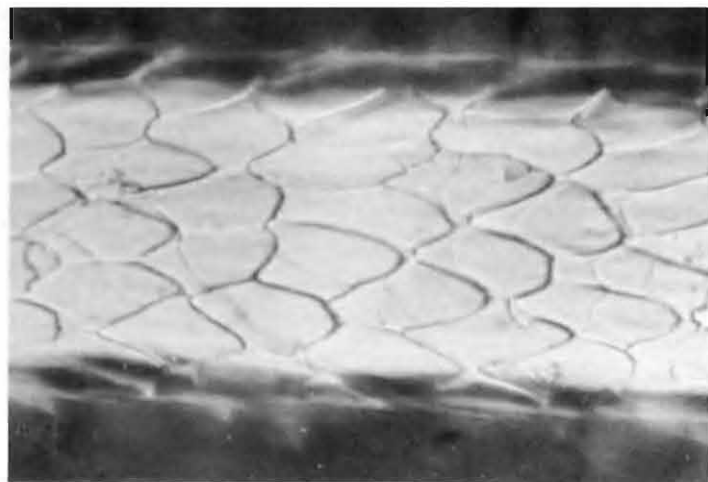


Plate I. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Viverricula indica* : 1. Cuticle at shield; 2. Cuticle at Basal; 3. Medulla; 4. T. S.

PLATE II

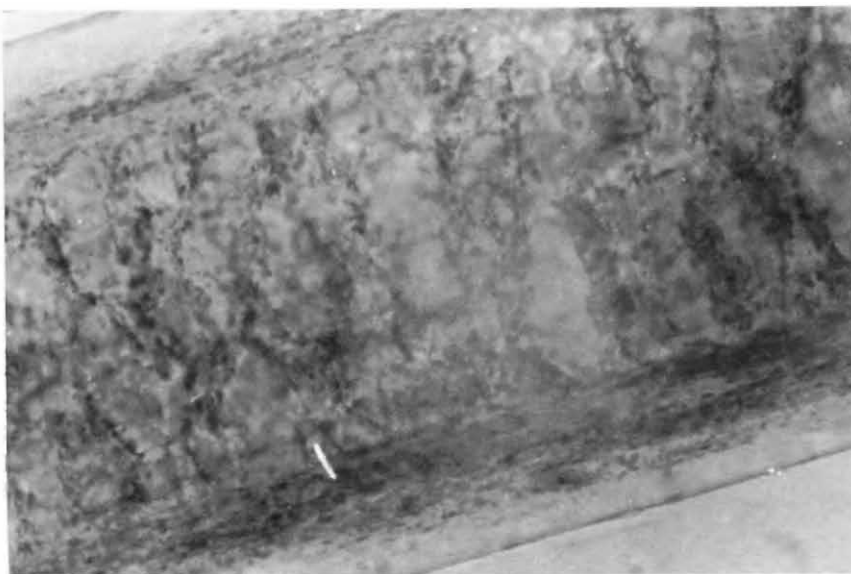
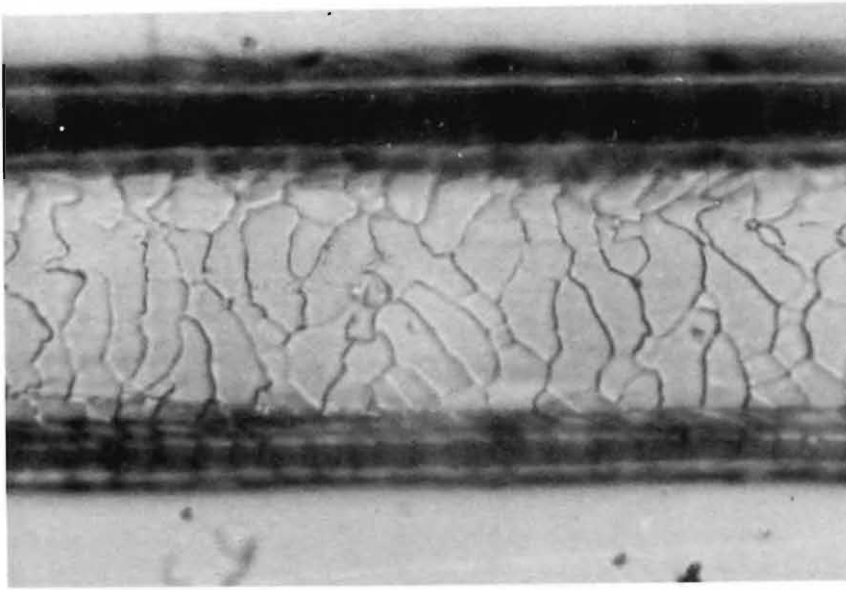


Plate II. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Paguma larvata* : 1. Cuticle; 2. Medulla and T. S.; 3. Medulla.

PLATE III

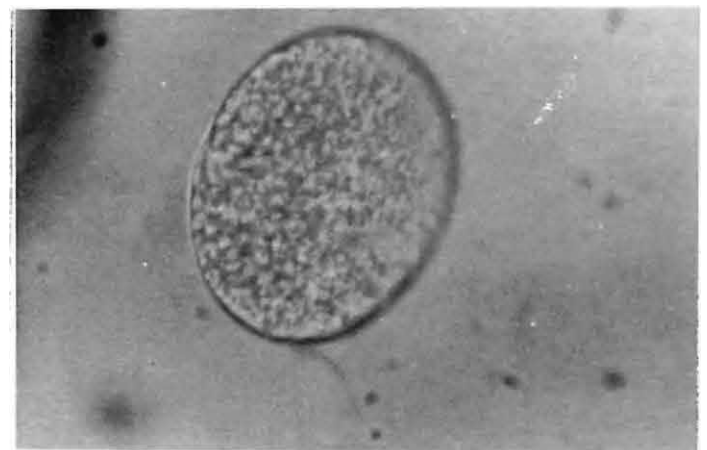
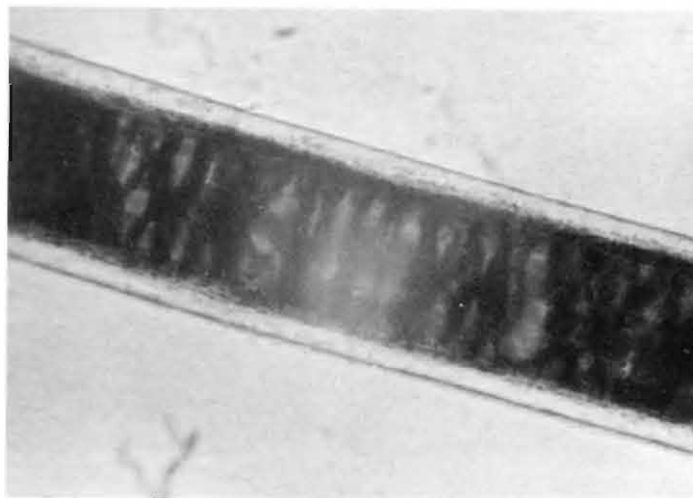
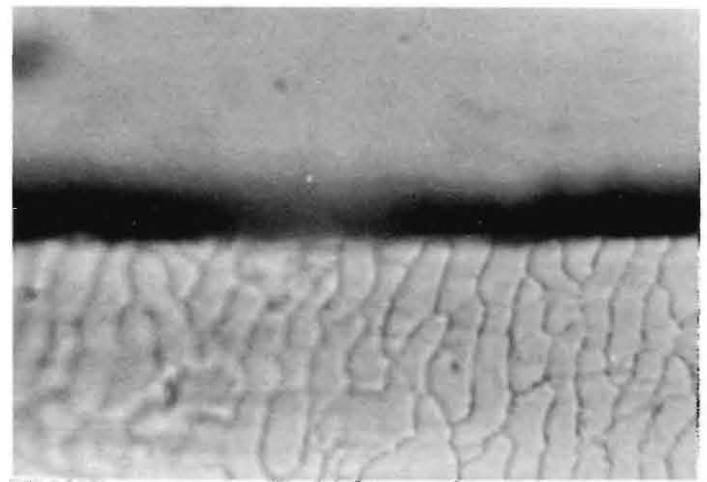
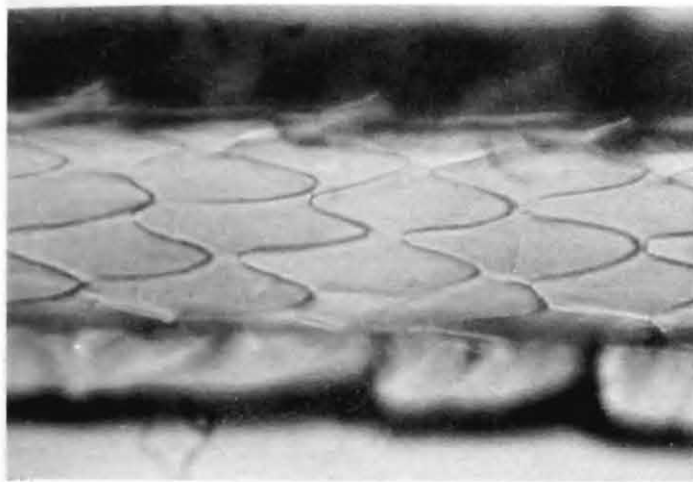


Plate III. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Prionodon pardicolor* : 1. Cuticle at shield; 2. Cuticle at Basal; 3. Medulla; 4. T. S.

PLATE IV

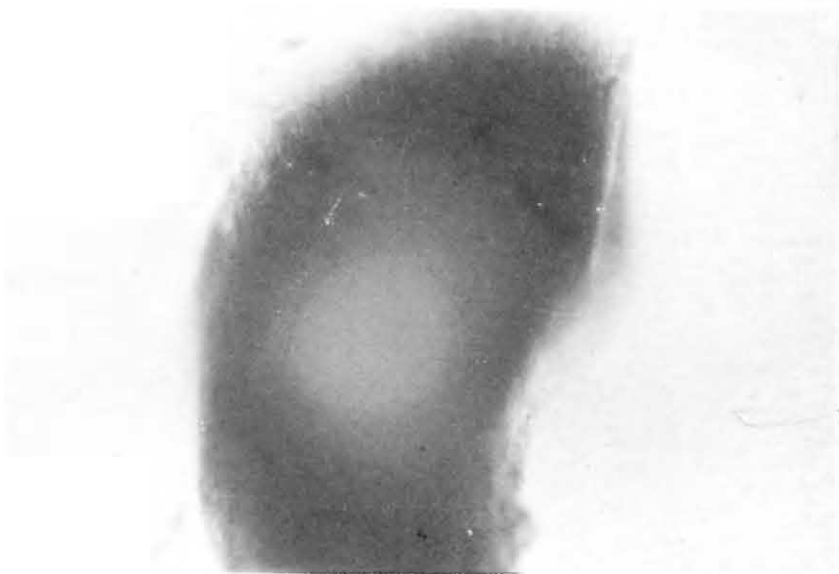
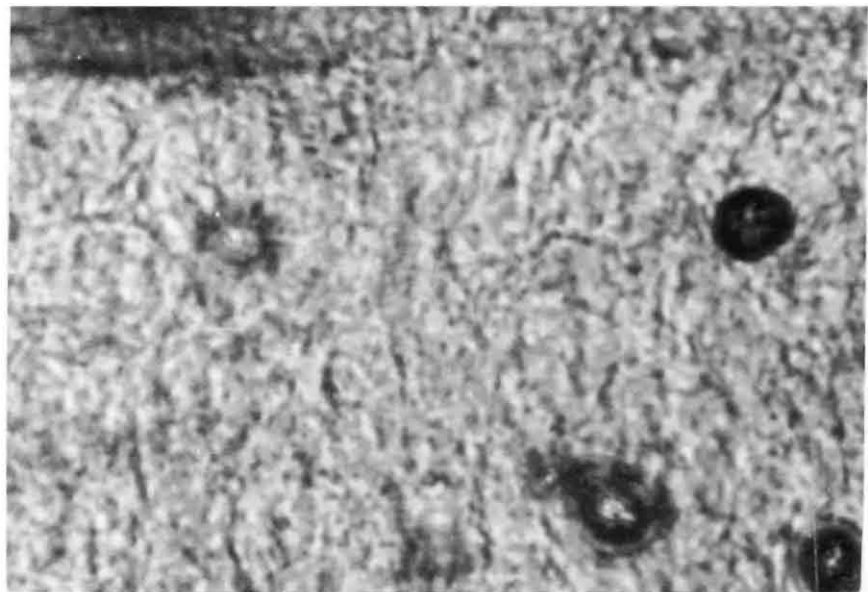
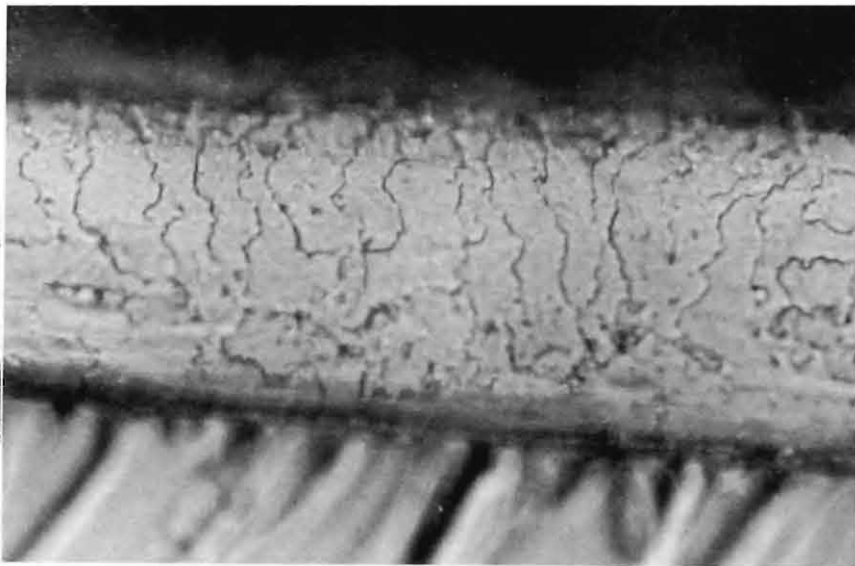


Plate IV. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Arctictis binturong* : 1 Cuticle; 2. Medulla; 3. T. S.

PLATE V

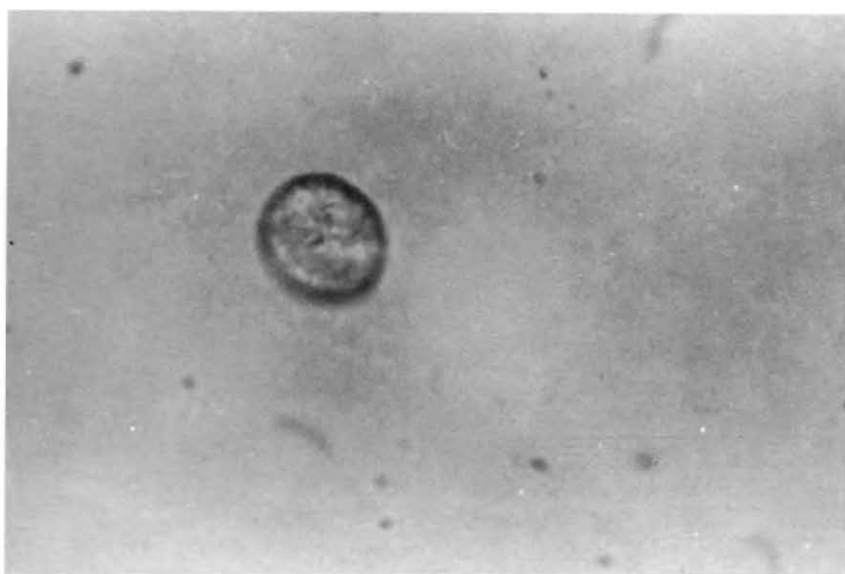
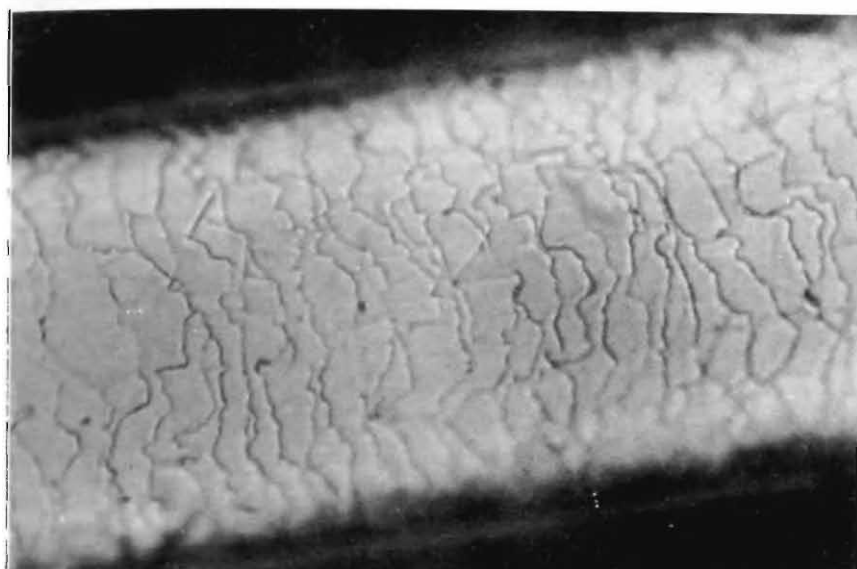


Plate V. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Arctogalidia trivirgata* : 1. Cuticle;
2. Medulla; 3. T. S.

PLATE VI

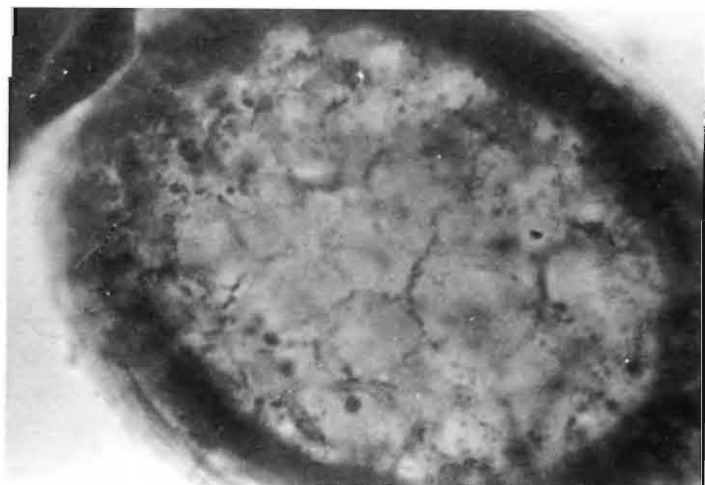
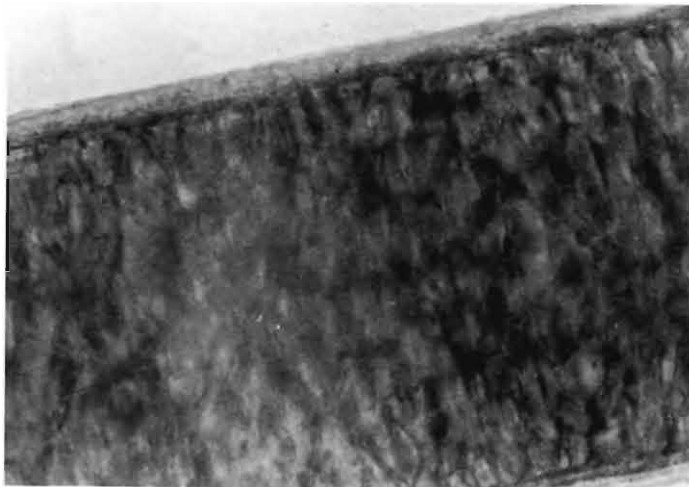
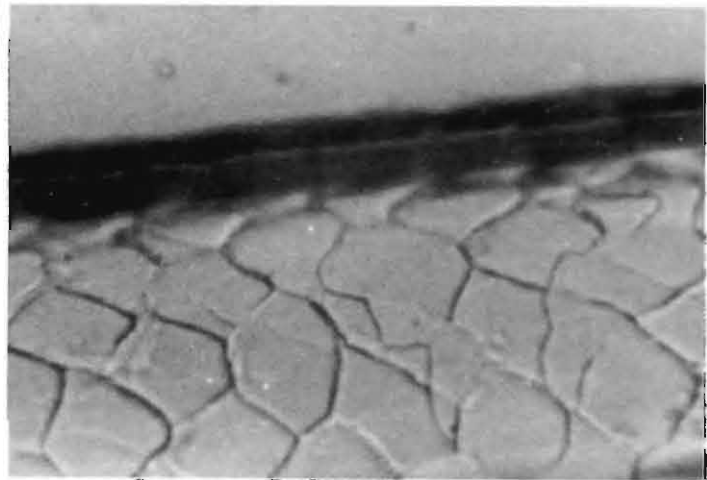
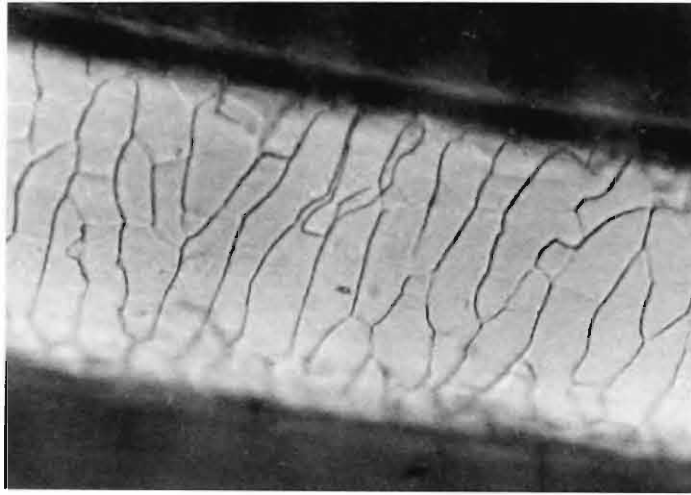


Plate VI. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Viverra zibetha* : 1. Cuticle at Basal; 2. Cuticle at shield; 3. Medulla; 4. T. S.

PLATE VII

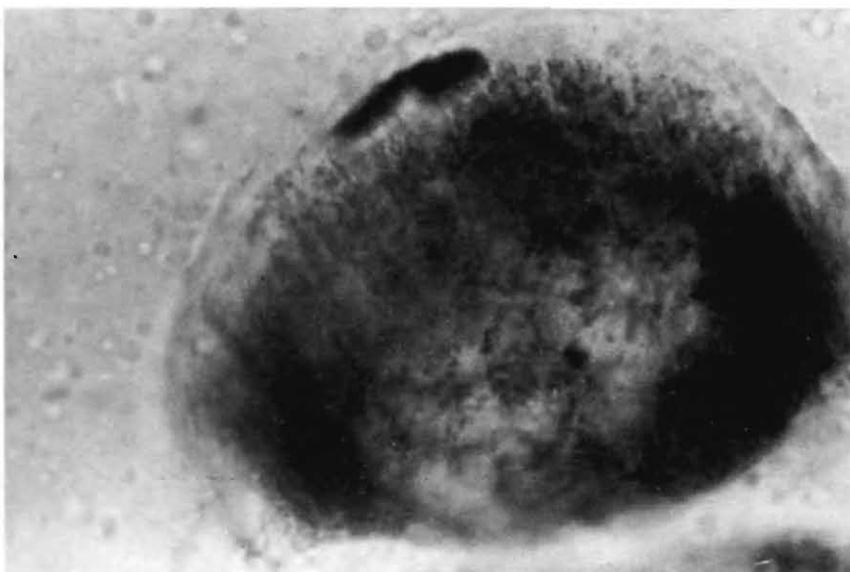
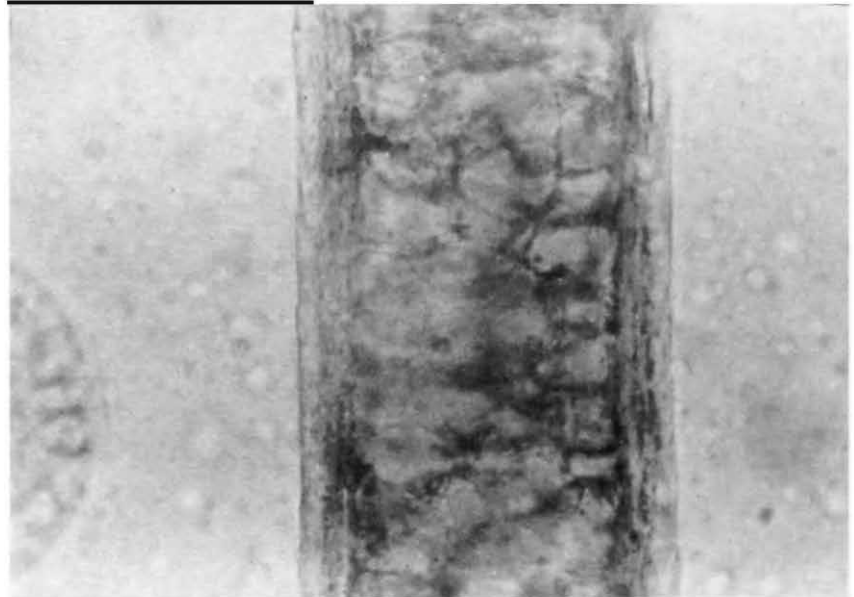
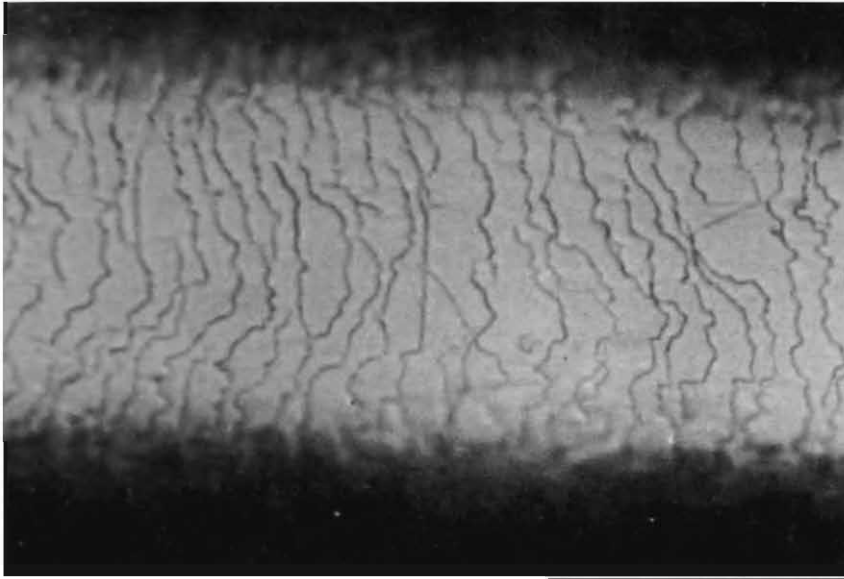


Plate VII. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Viverra civettina* : 1. Cuticle; 2. Medulla; 3. T. S.

PLATE VIII

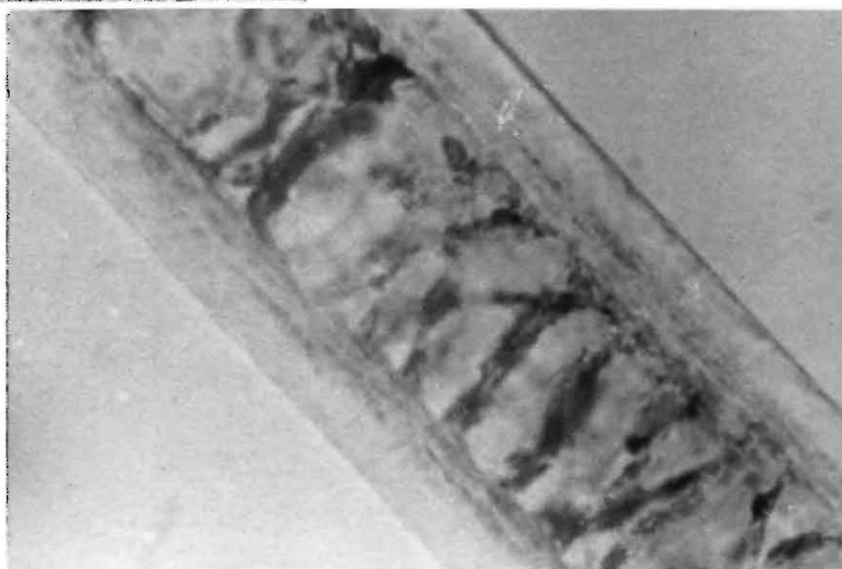
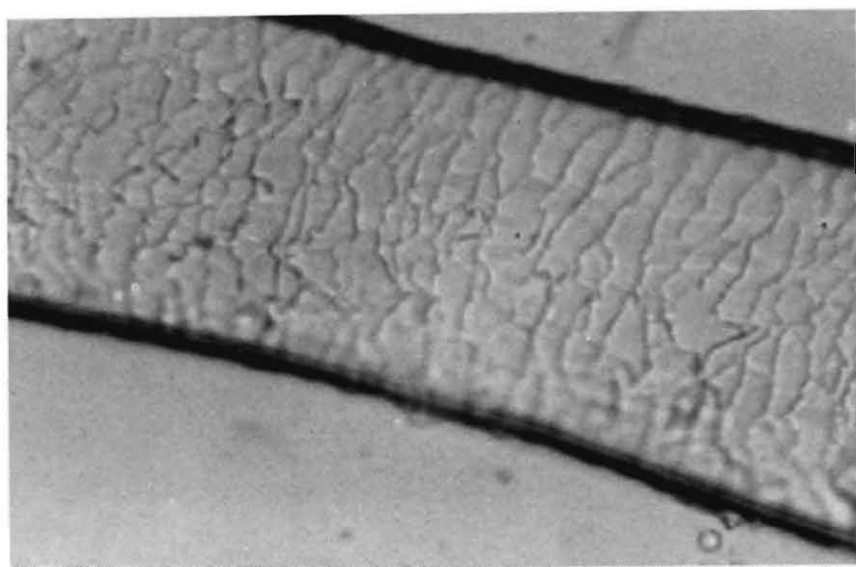


Plate VIII. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Paradoxurus jerdoni* : 1. Cuticle
2. Medulla; 3. T. S.

PLATE IX

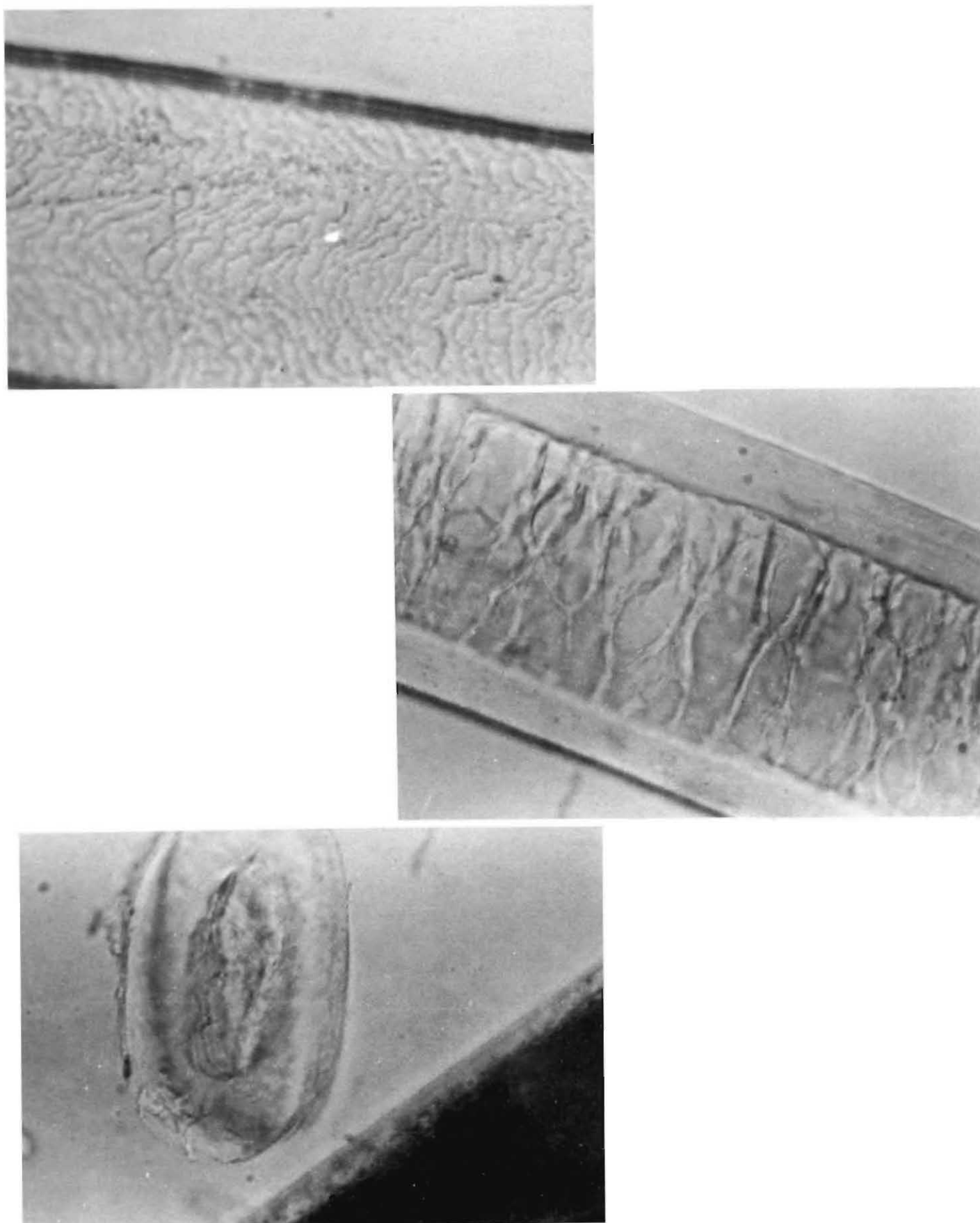
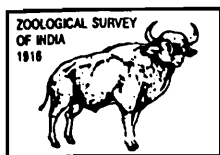


Plate IX. Cuticular scale, medulla and T. S. of mid-dorsal guard hairs of *Paradoxurus hermaphroditus* :
1. Cuticle; 2. Medulla; 3. T. S.



Rec. zool. Surv. India : 104 (Part 3–4) : 23-39, 2005

STUDIES ON THE DIPTERAN POLLINATORS OF MEDICINAL PLANTS IN INDIA

BULGANIN MITRA, P. PARUI, D. BANERJEE AND A. GHOSH¹

Diptera Section, Zoological Survey of India, Kolkata

¹*Post Graduate Student, University of Calcutta*

INTRODUCTION

In the recent past, medicinal plants constitute a group of industrially crops, which are of great value for domestic use and for export. As such there is no information on insect pollinators of medicinal plants in the literature particularly on flies. Interesting to know that, great varieties of methods and habits of pollination are found among Diptera. Flies may be important pollinators under certain climatic conditions; because they are present at all times of the year unlike the strictly periodic & more demanding bumble bees & honey bees. Though the study of dipteran pollinators of medicinal plants are recent one, but some preliminary reports made by Mitra & Parui (2002), Mitra *et al.* (2002), Mitra *et al.* (2003) & Mukherjee *et al.* (2002) from India.

The present communication is the first attempt to make a preliminary report on dipteran pollinators of medicinal plants along with their visited plant species and the localities where from it is collected. Moreover, the diagnostic characters of the pollinator species and their distribution in India are also dealt herewith. Present investigation reveals the presence of 38 dipteran pollinator species of medicinal plants belonging to 26 genera of 6 families in India.

Family STRATIOMYIDAE

1. *Microchrysa flaviventris* (Wiedemann)

1824. *Sargus flaviventris* Wiedemann, *Analecta Ent.*, : 31.

Diagnosis : This species is a small green metallic species with upper facets much larger than lower one; legs pale yellow, hind femora with a broad median band and hind tibia with a broad apical band.

Visiting plant species : *Tagetes patula* Linnaeus (West Bengal).

Distribution : West Bengal.

2. *Oplodontha rubrithorax* (Macquart)

1838. *Odontomyia rubrithorax* Macquart, *Mém. Soc. Agric. Lille.*, : 189.

Diagnosis : The fly is small in size, with black thorax and yellowish abdomen; legs orange yellow with a brown ring on fore femora and brown streak on underside of middle femur.

Visiting plant species : *Tagetes patula* Linnaeus (West Bengal).

Distribution : Uttar Pradesh, West Bengal.

3. *Adoxomyia heminopla* (Wiedemann)

1819. *Clitellaria heminopla* Wiedmann, *Zool. Mag.*, 1(3) : 30.

Diagnosis : Medium, black fly with reddish brown to yellow third antennal segment; all femora and tibiae anteriorly and posteriorly brownish orange, rest black; wings grey, yellowish brown at centre.

Visiting plant species : *Zizyphus* sp. & *Nerium indicum* Mill. (Gujarat).

Distribution : Bihar, Gujarat, Madhya Pradesh, Punjab, Tamil Nadu, Uttar Pradesh.

Family TABANIDAE

4. *Hybomitra hirta* (Walker)

1850. *Tabanus hirta* Walker, *Insecta Saundersiana*, 1 : 2.

Diagnosis : A robust species with black abdomen largely yellowish at sides; frontal callus triangular with its apex continues in a spindle shaped line; thorax with 3 grayish or yellowish stripes; legs blackish with all tibiae at base dull reddish.

Visiting plant species : *Anacardium occidentale* Linnaeus, *Coriandrum sativum* Linnaeus, (Himachal Pradesh).

Distribution : Throughout India.

Family BOMBYLIIDAE

5. *Petrorossia nigrofemorata* (Brunetti)

1909. *Argyramoeba nigrofemorata* Brunetti, *Rec. Indian Mus.*, 3 : 219.

Diagnosis : A small blackish grey species with their soft white hairs; thorax with a long and a short spiny yellow bristles in front of each wing; femora black with base and apex reddish yellow, tibiae uniformly reddish yellow.

Visiting plant species : *Coriandrum sativum* Linnaeus (Gujarat).

Distribution : Gujarat, Uttar Pradesh.

6. *Argyramoeba duvaucelii* (Macquart)

1840. *Anthrax duvaucelii* Macquart, *Dipt.exot.*, 2(1) : 63.

Diagnosis : A medium sized blackish species; anterior part of thorax with a dense fringe of narrow long grayish white scales; legs black with coxae long silky white haired; wing almost clear with small suffusion at base of second vein, at fork of third vein, on outer cross vein and at inner side of discal cell.

Visiting plant species : *Cassia tora* Linnaeus (Gujarat).

Distribution : Gujarat, Himachal Pradesh, Uttar Pradesh, West Bengal.

7. *Villa panisca* Rossi

1790. *Bibio paniscus* Rossi, *Fauna Etrusca*, 2 : 256.

Diagnosis : A large black species; face with long yellow or orange setae; first four segments of abdomen densely covered with reddish scales, and seventh segment with snow—white scales.

Visiting plant species : *Tagetes patula* Linnaeus (Arunachal Pradesh).

Distribution : Arunachal Pradesh, Uttaranchal.

8. *Thyridanthrax (Exhyalanthrax) absalon* (Wiedemann)

1828. *Anthrax absalon* Wiedemann, *Analecta Ent.* : 24.

Diagnosis : A medium sized species with porrect antennae, second antennal joint cup shaped, third segment onion-shaped; thorax quadrate; abdomen flat, oblong; wings brown with hyaline spots.

Visiting plant species : *Cassia tora* Linnaeus (Gujarat).

Distribution : Maharashtra, Orissa and Tamil Nadu.

9. *Exoprosopa (Exoprosopa) insulata* (Walker)

1852. *Anthrax insulata* Walker, *Insecta Saundersiana*, 1 : 72.

Diagnosis : A medium sized blackish species; lateral portion of thorax with long black bristly hairs but dorsum with short black pubescence and minute yellow scales; with a broad oblique dark brown band extending from costa to middle of axillary cell embracing basal third of discal cell.

Visiting plant species : *Cassia tora* Linnaeus (Gujarat).

Distribution : Assam, Bihar, Gujarat, Himachal Pradesh, Madhya Pradesh, Karnataka, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Family SYRPHIDAE

10. *Asarkina (Asarkina) ericetorum* (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Insekt.*, 2 : 425.

Diagnosis : A medium sized yellowish species; frons yellow, vertex black but both with black pubescence; thorax and scutellum covered with bright yellow pubescence; abdomen orange yellow with all the segments black banded at posterior margin; legs yellow.

Visiting plant species : *Cassia tora* Linnaeus (Gujarat), *Solanum nigrum* Linnaeus and *Amaranthus spinosa* Linnaeus (Jammu and Kashmir).

Distribution : Arunachal Pradesh, Assam, Gujarat, Jammu and Kashmir, Meghalaya, Sikkim, Tamil Nadu, Tripura and West Bengal.

11. *Episyrphus balteatus* (De Geer)

1776. *Musca balteata* De Geer, *Mem pour Serv. Hist. Ins.*, 6 : 116.

Diagnosis : A medium sized yellowish species; antennal prominence yellowish with a small black dot above base of antennae; thorax blackish with 2 greyish stripes on fore part; scutellum covered with partly yellow & partly black pubescence. Abdomen wholly orange with second to fifth segment indistinctly median spotted or black banded.

Visiting plant species : *Solanum nigrum* Linnaeus, *Foeniculum vulgare* Gaertn., *Cannabis sativa* Linnaeus, *Nicotiana plumbaginifolia* Viv. (Jammu and Kashmir).

Distribution : Assam, Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu and West Bengal.

12. *Ischiodon scutellaris* (Fabricius)

1805. *Scaeva scutellaris* Fabricius, *Syst. Antliat.* : 252.

Diagnosis : A medium sized blackish species with frons and face bright sulphur yellow; thorax shining black, side margins bright yellow from anterior margin of wing; abdomen black with a pair of yellow spots on second segment, and one yellow band on third & fourth; fifth segment mostly orange; legs yellow with a broad subapical black ring on hind femora.

Visiting plant species : *Cassia tora* Linnaeus (Gujarat).

Distribution : Andhra Pradesh, Assam, Delhi, Gujarat, Meghalaya, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura and West Bengal.

13. *Metasyrphus (Metasyrphus) latifasciatus* (Macquart)

1829. *Syrphus latifasciatus* Macquart, *Ins. Dipt. N. Fr.*, 4 : 94(242).

Diagnosis : A medium sized black species; face yellow with black pubescence; antenna reddish brown; thorax black with sides and lateral regions yellow; legs orange yellow with all femora blackish at base; abdomen black, second segment with a pair of yellow spots, third and fourth segment with a yellow band behind anterior margin, fifth segment orange with an oval black spot at middle.

Visiting plant species : *Cannabis sativa* Linnaeus (Jammu and Kashmir).

Distribution : Himachal Pradesh, Jammu and Kashmir.

14. *Scaeva latimaculata* Brunetti

1923. *Lasiopticus latimaculata* Brunetti, *Fauna, Brit. India, Dipt.* 3 : 68.

Diagnosis : A medium blackish species; thorax black with yellow side margins entirely; abdomen black with 3 pairs of subequal orange spots on second to fifth segment; legs orange yellow with anterior and hind femora black on basal half.

Visiting plant species : *Melilotus officinalis* Linnaeus (Himachal Pradesh).

Distribution : Himachal Pradesh, Punjab, Rajasthan and Uttar Pradesh.

15. *Sphaerophoria scripta* (Linnaeus)

1758. *Musca scripta* Linnaeus, *Syst. Nat. Ed.*, 10 : 594.

Diagnosis : A small linear black and yellow species; face with antennae yellowish; thoracic dorsum black with lateral sides yellow, striped; scutellum yellow; abdomen black with yellow transverse bands; legs yellow with dark tarsi.

Visiting plant species : *Solanum nigrum* Linnaeus, *Foeniculum vulgare* Gaertn., *Chrysanthemum* sp., *Cannabis sativa* Linnaeus, *Nicotiana plumbaginifolia* Viv., *Chenopodium ambrosioides* Linnaeus (Jammu and Kashmir).

Distribution : Jammu and Kashmir.

16. *Melanostoma orientale* (Wiedemann)

1824. *Syrphus orientalis* Wiedemann, *Analecta Ent.* : 36.

Diagnosis : A small blackish species; face with central bump and moderately produced upper mouth edge; thorax and scutellum blackish with soft yellowish to brownish pubescence; second to fourth abdominal segments each with a pair of orange yellow spots of varying shape; basal half of

anterior and posterior femora wholly black, rest yellow, hind tibia with a broad black median band, rest of all tibiae orange.

Visiting plant species : *Solanum nigrum* Linnaeus, *Rubus* sp. (Jammu and Kashmir), *Digitalis purpurea* Linnaeus (Himachal Pradesh).

Distribution : Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Karnataka, Meghalaya, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

17. *Chrysotoxum baphyrus* Walker

1849. *Chrysotoxum baphyrus* Walker, *List Dipt. Colln. Br. Mus.*, **3** : 542.

Diagnosis : A robust black and yellow species; first and second antennal joints orange brown, third black; thoracic dorsum black with two yellowish grey median stripes, abdomen yellowish with some black pattern; legs mainly yellowish.

Visiting plant species : *Ipomea* sp. (Jammu and Kashmir).

Distribution : Arunachal Pradesh, Maghalaya, Himachal Pradesh, Jammu and Kashmir, Tamil Nadu, Uttar Pradesh and West Bengal.

18. *Paragus (Paragus) serratus* (Fabricius)

1805. *Mulio serratus* Fabricius, *Syst. Antliat* : 186.

Diagnosis : A small black species; eyes with three longitudinal stripes of white pubescence; thorax blue black with a pair of longitudinal grey stripes; scutellum black with serrated hind margin; abdominal segments reddish brown and black patterned; legs black & brown.

Visiting plant species : *Solanum nigrum* (Jammu and Kashmir).

Distribution : Assam, Bihar, Delhi, Goa, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

19. *Paragus (Pandasyophthalmus) atratus* de Meijere

1906. *Paragus atratus* de Meijere, *Nova Guinea* **1** : 85

Diagnosis : A small black species with eyes sparsely hairy in male, bare in female; thorax, scutellum and abdomen shining black; legs yellow with basal half of anterior and hind femora black, hind metatarsi distinctly incrassated.

Visiting plant species : *Solanum nigrum* Linnaeus (Jammu and Kashmir).

Distribution : Jammu and Kashmir, Uttar Pradesh, West Bengal.

20. *Paragus (Pandasyophthalmus) rufiventris* Brunetti

1913. *Paragus rufiventris* Brunetti, *Rec. Indian Mus.*, 8 : 157.

Diagnosis : A small black species; hind orbit of eye bears a fringe of white hairs; thorax and scutellum shining black with fine black pubescence; basal half of abdomen blue-black, rest reddish brown; femora black on basal half, rest brownish yellow.

Visiting plant species : *Solanum nigrum* Linnaeus (Jammu and Kashmir).

Distribution : Assam, Bihar, Jammu and Kashmir, Sikkim, Tripura, Uttar Pradesh, West Bengal.

21. *Paragus (Pandasyophthalmus) tibialis* (Fallen)

1817. *Pipizia tibialis* Fallen, *Syrphici Sveciae* : 60.

Diagnosis : A small black species with yellow face and a black line on it; thorax black, covered with long pale yellow pubescence; abdomen shining black; basal half of anterior and little more of hind tibia black, rest bright orange.

Visiting plant species : *Solanum nigrum* Linnaeus, *Amaranthus spinosa* Linnaeus (Jammu and Kashmir).

Distribution : Assam, Bihar, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Meghalaya, Punjab, Sikkim, Tripura, Uttar Pradesh and West Bengal.

22. *Eristalinus aenus v. taphicus* (Wiedemann)

1830. *Eristalis taphicus* Wiedemann, *Aussereurop. zweiffl. Insekt.*, 2 : 191.

Diagnosis : A medium blackish species; face bears inconspicuous white hairs; third antennal segment reddish brown, rest black; thorax with four longitudinal black stripes; scutellum with dense yellowish brown pubescence; abdomen with dense brown pubescence but whitish on sides; all femora black with orange brown tips.

Visiting plant species : *Tagetes patula* Linnaeus (Jammu and Kashmir).

Distribution : Jammu and Kashmir, Maharashtra, Uttar Pradesh.

23. *Eristalinus (Eristalinus) arvorum* (Fabricius)

1787. *Syrphus arvorum* Fabricius, *Mantissa Insect.*, 2 : 336.

Diagnosis : A large yellow and black species; frons covered with black pubescence and face with pale yellow pubescence; thorax with four longitudinal black stripes, whole thorax and scutellum covered with pale yellow pubescence; abdomen black, second and third segments with a pair of yellow spots; all tibiae black basally to a varying extent.

Visiting plant species : *Tagetes patula* Linnaeus (West Bengal).

Distribution : Arunachal Pradesh, Jammu and Kashmir, Meghalaya, Orissa, Sikkim, Tripura and West Bengal.

24. *Eristalinus (Eristalinus) laetus* (Wiedemann)

1830. *Eristalis laetus* Wiedemann, *Aussereurop. zweiffl. Insekt.*, 2 : 191.

Diagnosis : A small blackish species; face black with whitish grey pubescence; thorax and scutellum black with brownish grey pubescence; abdomen black with brownish grey pubescence on dorsum, whitish towards margin.

Visiting plant species : *Tagetes patula* Linnaeus (West Bengal).

Distribution : Andhra Pradesh, Maharashtra, Meghalaya, Bihar, Jammu and Kashmir, Karnataka, Rajasthan, Tamil Nadu and West Bengal.

25. *Eristalinus (Eristalinus) obscuritarsis* de Meijere

1908. *Eristalis obscuritarsis* de Meijere, *Tijdschr. Ent.*, 52 : 250.

Diagnosis : A medium black species with reddish antennae; thorax black with 3 yellow longitudinal stripes; scutellum yellowish; third abdominal segment with a pair of quadrate yellowish spot on each side; tip of all femora yellow, front, mid and hind tibiae at base yellow, rest black.

Visiting plant species : *Tagetes patula* Linnaeus, *Aegle marmelos* Linnaeus (West Bengal).

Distribution : Gujarat, Jammu and Kashmir, Karnataka, Kerala, Maharashtra, Orissa, Sikkim and West Bengal.

26. *Eristalinus (Eristalinus) quinquestratus* (Fabricius)

1794. *Syrphus quinquestratus* Fabricius, *Ent. Syst.*, 4 : 289.

Diagnosis : A medium sized yellow and black species; frons and face with yellowish grey pubescence, antenna and arista brownish orange, thoracic dorsum with four black longitudinal stripes; scutellum yellowish; abdominal segments yellow and black patterned; all femora black except tip of fore and hind femora orange or yellow.

Visiting plant species : *Tagetes patula* Linnaeus (West Bengal).

Distribution : Assam, Meghalaya, Bihar, Karnataka, Kerala, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal.

27. *Eristalinus (Eristalodes) paria* (Bigot)

1880. *Eristalomyia paria* Bigot, *Annls Soc. Ent. Fr.*, (5)10 : 218.

Diagnosis : A large yellow and black species; eyes with 6 narrow more or less parallel longitudinal dark stripes and dark brown pubescent on front part; dorsum of thorax with 4 black longitudinal stripes; abdomen black and yellow patterned; legs mainly blackish.

Visiting plant species : *Helianthus* sp. (Jammu and Kashmir).

Distribution : Himachal Pradesh, Jammu and Kashmir, Karnataka, Meghalaya, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

28. *Eristalis (Eristalis) tenax* (Linnaeus)

1758. *Musca tenax* Linnaeus, *Syst. Nat. Ed.*, 10 : 591.

Diagnosis : A large black and yellow species; eyes with 2 longitudinal stripes of dense brown hairs; thorax brownish black with a tuft of pale hairs on post alar calli; first abdominal segment black, second and third segments brownish orange; legs black with basal third of fore and basal half of middle tibiae yellow, a small quadrate dark brown spot below tip of axillary vein.

Visiting plant species : *Helianthus* sp., *Tagetes patula* Linnaeus, *Chrysanthemum* sp. (Jammu and Kashmir).

Distribution : Nearly cosmopolitan.

29. *Eristalis (Eoseristalis) arbustorum* (Linnaeus)

1758. *Musca arbustorum* Linnaeus, *Syst. Nat. Ed.*, 10 : 591.

Diagnosis : A medium black and yellowish species; antennae black with orange arista; thorax and scutellum covered with brownish yellow pubescence; abdomen orange yellow with black pattern; tips of femora, basal $\frac{2}{3}$ rd. Anterior tibiae & basal half of hind tibiae orange; rest of legs black.

Visiting plant species : *Chrysanthemum* sp. *Tagetes patula* Linnaeus (Jammu and Kashmir).

Distribution : Meghalaya, Jammu and Kashmir, Sikkim and West Bengal.

30. *Eristalis (Eoseristalis) cerealis* Fabricius

1805. *Eristalis cerealis* Fabricius, *Syst. Antliat.* : 232.

Diagnosis : A large blackish species; frons black with blackish-brown pubescence; thorax with a broad transverse stripe along suture; second abdominal segment with a pair of triangular yellow spots; legs shining black, tips of all femora and basal half of all tibiae yellow.

Visiting plant species : *Xanthium strumarium* Linnaeus, *Chrysanthemum* sp., *Tagetes patula* Linnaeus, (Jammu and Kashmir), *Melilotus officinalis* Linnaeus (Himachal Pradesh).

Distribution : Assam, Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Meghalaya, Mizoram, Nagaland, Sikkim and West Bengal.

31. *Mesembrius quadrivittatus* (Wiedemann)

1819. *Eristalis quadrivittatus* Wiedemann, *Zool. Mag.*, 1 : 17.

Diagnosis : A large yellow and black species; eyes not touching at any point; thorax yellow with three longitudinal black stripes; abdomen orange with black patterns; femora black with tip brownish tinge, anterior and middle tibiae orange yellow on basal half.

Visiting plant species : *Rauvolfia serpentina* Benth., *Aegle marmelos* Linnaeus (West Bengal).

Distribution : Assam, Bihar, Gujarat, Karnataka, Madhya Pradesh, Tamil Nadu and West Bengal.

32. *Syritta orientalis* Macquart

1824. *Syritta orientalis* Macquart, *Dipt. Exot.*, 2(2) : 76(136).

Diagnosis : A medium blackish species; antennae orange with black arista; thorax black with humeri, lateral sides and pleura wholly yellow or whitish grey; second and third abdominal segments wholly with complete yellow bands; hind femora normally wholly yellow.

Visiting plant species : *Ephedra geardiana* Wall. (Himachal Pradesh).

Distribution : Bihar, Himachal Pradesh, Pondicheij, Tamil Nadu and West Bengal.

33. *Syritta pipiens* (Linnaeus)

1758. *Syritta pipiens* Linnaeus, *Syst. Nat. Ed.*, 10 : 594.

Diagnosis : A medium blackish species with humeri and pleura yellowish to whitish grey; second and third abdominal segments with a pair of yellowish spots.

Visiting plant species : *Solanum nigrum* Linnaeus, *Amaranthus spinosus* Linnaeus, *Nicotiana plumbaginifolia* Viv., *Cannabis sativa* Linnaeus (Jammu and Kashmir).

Distribution : Himachal Pradesh, Jammu and Kashmir.

Family MUSCIDAE

34. *Orthellia timorensis* (Robineau-Desvoidy)

1830. *Orthellia timorensis* Robineau-desvoidy, *Mem. Pres. Div. Sav. Acad. Sci. Inst. Fr.*, 2 : 460.

Diagnosis : A medium metallic colored species; in male inner facets of eye markedly enlarged; thorax with 2 pairs of presutural dorsocentrals; mid tibia with an ad seta only; discal cell of wing with a bare longitudinal stripe, close to $M_3 + Cu_1$.

Visiting plant species : *Scaevola sericea* Vahl (West Bengal).

Distribution : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Kerala, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

35. *Orthellia viridis* (Wiedemann)

1824. *Idia viridis* Wiedemann, *Analecta Ent.*,: 50.

Diagnosis : A medium metallic green, blue-green or brassy-green; eyes rather densely short haired; thorax shining, the thin grayish dust becoming evident only in a tangential view; 4th abdominal segment more brassy or bronze, wings with light brown veins and wholly hairy membrane; coxae and femora with slight metallic green reflections.

Visiting plant species : *Aesculus indica* Colebr.ex Comb., *Castanea sativa* Mill. (Himachal Pradesh).

Distribution : Chandigarh, Himachal Pradesh, Jammu and Kashmir, Punjab, Sikkim, Tripura, Uttar Pradesh and West Bengal.

Family CALLIPHORIDAE**36. *Lucilia porphyria* (Walker)**

1856. *Musca porphyria* Walker, *J. Proc. Linn. Soc. Lond., Zool.*, 1 : 24.

Diagnosis : A small green to purple coloured fly; third antennal segment 5 times of 2nd; wing tinged brown, subcostal sclerite with stiff black hairs; squama dark brown.

Visiting plant species : *Scaevola sericea* Vahl (West Bengal).

Distribution : Arunachal Pradesh, Assam, Jammu and Kashmir, Himachal Pradesh, Sikkim and West Bengal.

37. *Chrysomya megacephala* (Fabricius)

1794. *Musca megacephala* Fabricius, *Syst. Ent.*, 4 : 317.

Diagnosis : A medium blue or green coloured fly with upper eye facets greatly enlarged than lower third in male; wing hyaline, slightly dark at base; legs black.

Visiting plant species : *Holarrhena antidysenterica* Wall. (Gujarat).

Distribution : Throughout India.

38. *Stomorhina discolor* (Fabricius)

1794. *Musca discolor* Fabricius, *Ent. Syst.*, 4 : 320.

Diagnosis : A small species with green coloured thorax and blackish abdomen; face, epistome and anterior half of gena shining black; anterior and middle femora black, rest of legs otherwise coloured.

Visiting plant species : *Zizyphus* sp. (Gujarat), *Syzygium jambos* Alston, *Callistemon citrinus* (Curtis), *Tagetes patula* Linnaeus (West Bengal), *Taraxacum officinale* Wigg. (Himachal Pradesh).

Distribution : Arunachal Pradesh, Assam, Bihar, Kerala, Manipur, Meghalaya, Tripura, Uttar Pradesh and West Bengal.

SUMMARY

Altogether 38 species of 26 genera under 6 families of Diptera are reported here as pollinator of medicinal plants. Of them the family Syrphidae shares maximum number of species (24 species), followed by Bombyliidae (5 species), Stratiomyidae (3 species), Calliphoridae (3 species), Muscidae (2 species) and Tabanidae (1 species) (Table 1). These pollinator species were found to visit 28 species of medicinal plants. Of them maximum number of pollinator species were found in *Tagetes patula* (12 species), *Solanum nigrum* (9 species), *Cassia tora* (5 species), *Chrysanthemum* sp. (4 species) and *Cannabis sativa* (4 species) (Table 2).

ACKNOWLEDGEMENTS

We wish to express our thanks to Dr. J. R. B. Alfred, Director, Zoological Survey of India, Kolkata for the necessary facilities and encouragement. Thanks are also due to Dr. A. K. Hazra, Scientist 'E', Z.S.I., Kolkata, for kindly going through the manuscript and making useful suggestions.

REFERENCES

- Bhattacharjee, S. K. 2000. Hand Book of Medicinal Plants, pp. 1-474, Pointer publishers, Jaipur.
- Chauhan, N. S. 2000. Medicinal & Aromatic plants of Himachal Pradesh. Indus Pub. Co., New Delhi, 1-449.
- Mitra, B. and Parui, P. 2002. Dipteran flower visitors (Diptera) in Jessore Sloth Bear and Balaram-Ambaji Wildlife Sanctuaries, North Gujarat. *BIONOTES*, 4(2) : 45.
- Mitra, B., Bhattacharjee, K., Parui, P. and Mukherjee, M. 2002. Insect pollinators of Sarpagandha plant from South 24 Parganas, West Bengal. *BIONOTES*, 4(3) : 67.
- Mukherjee, S., Chowdhury, R., Ghosh, A. and Mitra, B. 2002. Notes on flower flies (Syrphidae : Diptera) visiting Compositae. *Insect Environment*, 8(1) : 27-28.
- Mukherjee, S., Chowdhury, R., Ghosh, A. and Mitra, B. 2002. A list of "Hover flies" (Syrphidae : Diptera) on *Solanum nigrum* L. *Insect Environment*, 8(1) : 35-36.
- Mitra, B., Bhattacharjee, K., Parui, P. and Ghosh, A. 2003. Insect pollinators of *Scaevola sericea* Vahl. (Fan flower) from South 24 Parganas, West Bengal. *BIONOTES*, 5(4) : 90.
- Mitra, B., Bhattacharjee, K., Mukherjee, M. and Parui, P. 2003. On a collection of flies from Yellow Genda. *Insect Environment*, 9(1) : 15-16.

Table 1. : List of Insect Pollinators with their visited plant species.

Species	Family	Plant species	Family	Color of the flower	Medicinal use
1	STRATIOMYIDAE	<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
2		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
3		<i>Zizyphus sp.</i>	RHAMNACEAE	Greenish-Yellow	Sore throat, dysentery
		<i>Nerium indicum</i>	APOCYANACEAE	Red-rose	Skin disease, ophthalmic
4	TABANIDAE	<i>Anacardium occidentale</i>	ANACARDIACEAE	White	Intermittent fever, skin disease
		<i>Coriandrum sativum</i>	UMBELLIFERAE	White	Abdominal pain for indigestion
5	BOMBYLIIDAE	<i>Coriandrum sativum</i>	UMBELLIFERAE	White	Abdominal pain for indigestion
6		<i>Cassia tora</i>	FABACEAE	Yellow	Ring worm, itch
7		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
8		<i>Cassia tora</i>	FABACEAE	Yellow	Ring worm, itch
9		<i>Cassia tora</i>	FABACEAE	Yellow	Ring worm, itch
10	SYRPHIDAE	<i>Cassia tora</i>	FABACEAE	Yellow	Ring worm, itch
		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
		<i>Amaranthus spinosa</i>	AMARANTHACEAE	Greenish	Colic pain, leucorrhoea
11		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
		<i>Foeniculum vulgare</i>	UMBELLIFERAE	Yellow	Stomachic, purgative
		<i>Cannabis sativa</i>	CANNABIACEAE	Yellow-green	Depression, gonorrhoea
		<i>Nicotiana plumbaginifolia</i>	SOLANACEAE	Rose	Scabies, hernia, constipation
12		<i>Cassia tora</i>	FABACEAE	Yellow	Ring worm, itch
13		<i>Cannabis sativa</i>	CANNABIACEAE	Yellow-green	Depression, gonorrhoea
14	SYRPHIDAE	<i>Melilotus officinalis</i>	LEGUMINOSAE	Yellow	Externally, windy colic
15		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
		<i>Foeniculum vulgare</i>	UMBELLIFERAE	Yellow	Stomachic, purgative
		<i>Cannabis sativa</i>	CANNABIACEAE	Yellow-green	Depression, gonorrhoea

Table 1. : (Contd.).

Species	Family	Plant species	Family	Color of the flower	Medicinal use
15		<i>Nicotiana plumbaginifolia</i>	SOLANACEAE	Rose	Scabies, hernia, constipation
		<i>Chrysanthemum</i> sp.	ASTERACEAE	White/ yellow	Indigestion, bad colds
		<i>Chenopodium ambrosioides</i>	CHENOPODIACEAE	Greenish	Gynecology problems
16		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
		<i>Rubus</i> sp.	ROASACEAE	White	Dysentery
		<i>Digitalis purpurea</i>	SCROPHULARIACEAE	Rosy-purple	Healing wounds and burns
17		<i>Ipomoea</i> sp.	CONVOLVULACEAE	Purple	Purgative
18		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
19		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
20		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
21		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and skin diseases
		<i>Amaranthus spinosa</i>	AMARANTHACEAE	Greenish	Colic pain, leucorrhoea
22		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
23		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
24		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
25	SYRPHIDAE	<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
		<i>Aegle marmelos</i>	RUTACEAE	Greenish-white	Antibiotic properties, dysentery
26		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
27		<i>Helianthus</i> sp.	ASTERACEAE	Yellow	Diabetic disease
28		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
		<i>Helianthus</i> sp.	ASTERACEAE	Yellow	Diabetic disease
		<i>Chrysanthemum</i> sp.	ASTERACEAE	White/ yellow	Indigestion, bad colds

Table 1. : (Contd.).

Species	Family	Plant species	Family	Color of the flower	Medicinal use
29		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
		<i>Chrysanthemum</i> sp.	ASTERACEAE	White / yellow	Indigestion, bad colds
30		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
		<i>Chrysanthemum</i> sp.	ASTERACEAE	White / yellow	Indigestion, bad colds
		<i>Xanthium strumarium</i>	ASTERACEAE	Greenish	Skin, bladder infection, bleeding
		<i>Melilotus officinalis</i>	LEGUMINOSAE	Yellow	Externally, windy colic
31		<i>Rauvolfia serpentina</i>	APOCYANACEAE	Reddish-white	Insanity & high blood pressure
		<i>Aegle marmelos</i>	RUTACEAE	Greenish-white	Antibiotic properties, dysentery
32		<i>Ephedra geardiana</i>	EPHEDRACEAE		Epilepsy, asthma
33		<i>Solanum nigrum</i>	SOLANACEAE	White	Ulcers and Skin diseases
		<i>Cannabis sativa</i>	CANNABINACEAE	Yellow-green	Depression, gonorrhoea
		<i>Nicotiana plumbaginifolia</i>	SOLANACEAE	Rose	Scabies, hernia, constipation
		<i>Amaranthus spinosa</i>	AMARANTHACEAE	Greenish	Colic pain, leucorrhoea
34	MUSCIDA	<i>Scaevola sericea</i>	GOODENIACEAE	White	Heal fractures, breathing problem
35		<i>Aesculus indica</i>	HIPPOCASTANACEAE	White	Rheumatic, gouty
		<i>Castania sativa</i>	FAGACEAE		Lumbago in Homeopathy
36	CALLIPHORIDAE	<i>Scaevola sericea</i>	GOODENIACEAE	White	Heal fractures, breathing problem
37		<i>Holarrhena antidysenterica</i>	APOCYANACEAE	White	Dysentery, vaginitis
38		<i>Zizyphus</i> sp.	RHAMNACEAE	Greenish-yellow	Sore throat, dysentery
		<i>Syzygium jambos</i>	MYRTACEAE	Greenish	Sore throat, ulcers, diabetic
		<i>Callistemon citrinus</i>	MYRTACEAE	Red	Essential oil
		<i>Tagetes patula</i>	ASTERACEAE	Yellow	Wound healing, bleeding
		<i>Taraxacum officinale</i>	ASTERACEAE	Yellow	Liver disease, hepatic disease

Table 2. : Medicinal plant species and their Dipteran Pollinators.

<i>Aegle marmelos</i>	<i>Eristalinus (Eristalinus) obscuritarsis</i> , <i>Mesembrius quadrivittatus</i>
<i>Aesculus indica</i>	<i>Orthellia viridis</i>
<i>Amaranthus spinosa</i>	<i>Asarkina (Asarkina) ericetorum</i> , <i>Paragus (Pandasyophthalmus) tibialis</i> , <i>Syrirta pipiens</i>
<i>Anacardium occidentale</i>	<i>Hybomitra hirta</i>
<i>Callistemon citrinus</i>	<i>Stomorphina discolor</i>
<i>Cannabis sativa</i>	<i>Episyrphus balteatus</i> , <i>Metasyrphus (Metasyrphus) latifastictus</i> , <i>Sphaerophoria scripta</i> , <i>Syrirta pipiens</i>
<i>Castania sativa</i>	<i>Orthellia viridis</i>
<i>Cassia tora</i>	<i>Argyramoeba duvaucelli</i> , <i>Thyridanthrax (Exhyalanthrax) absalon</i> , <i>Exoprosopa (Exoprosopa) insulata</i> , <i>Asarkina (Asarkina) ericetorum</i> , <i>Ischiodon scutellaris</i>
<i>Chenopodium ambrosoides</i>	<i>Sphaerophoria scripta</i>
<i>Chrysanthemum sp.</i>	<i>Sphaerophoria scripta</i> , <i>Eristalis (Eristalis) tenax</i> , <i>Eristalis (Eoseristalis) arbustorum</i> , <i>Eristalis (Eoseristalis) cerealis</i>
<i>Coriandrum sativum</i>	<i>Hybomitra hirta</i> , <i>Petrorossia nigrofemorata</i>
<i>Digitalis purpurea</i>	<i>Melanostoma orientale</i> , <i>Ephedra geardiana</i> , <i>Syrirta orientalis</i>
<i>Foeniculum vulgare</i>	<i>Episyrphus balteatus</i> , <i>Sphaerophoria scripta</i>
<i>Helianthus sp.</i>	<i>Eristalinus (Eristalodes) paria</i> , <i>Eristalis (Eristalis) tenax</i>
<i>Holarrhena antidysenterica</i>	<i>Chrysomya megacephala</i>
<i>Ipomoea sp.</i>	<i>Chrytoxum baphyrus</i>
<i>Nerium indicum</i>	<i>Adoxomyia heminopla</i>
<i>Nicotiana plumbaginifolia</i>	<i>Episyrphus balteatus</i> , <i>Sphaerophoria scripta</i> , <i>Syrirta pipiens</i>
<i>Meliolotus officinalis</i>	<i>Scaeva latimaculata</i> , <i>Eristalis (Eoseristalis) cerealis</i>
<i>Meliolotus alba</i>	<i>Eristalis (Eoseristalis) cerealis</i>
<i>Rauvolfia serpentina</i>	<i>Mesembrius quadrivittatus</i>
<i>Rubus sp.</i>	<i>Melanostoma orientale</i>
<i>Scaevola sericea</i>	<i>Orthellia timorensis</i> , <i>Lucilia porphyria</i>

Table 2. : (Contd.).

<i>Solanum nigrum</i>	<i>Syrirta pipiens</i> , <i>Paragus (Pandasyophthalmus) tibialis</i> , <i>Paragus (Pandasyophthalmus) rufiventris</i> , <i>Paragus (Paragus) atratus</i> , <i>Paragus (Paragus) serratus</i> , <i>Melanostoma orientale</i> , <i>Sphaerophoria scripta</i> , <i>Episyrphus balteatus</i> , <i>Asarkina (Asarkina) ericetorum</i>
<i>Syzygium jambos</i>	<i>Stomorphina discolor</i>
<i>Taraxacum officinale</i>	<i>Stomorphina discolor</i>
<i>Tagetes patula</i>	<i>Microchrysa flaviventris</i> , <i>Oplodontha rubrithorax</i> , <i>Villa panisca</i> , <i>Eristalinus aenus v. taphicus</i> , <i>Eristalinus (Eristalinus) arvorum</i> , <i>Eristalinus (Eristalinus) laetus</i> , <i>Eristalinus (Eristalinus) obscuritarsis</i> , <i>Eristalinus (Eristalinus) quinquestriatus</i> , <i>Eristalis (Eristalis) tenax</i> , <i>Eristalis (Eoseristalis) arbustorum</i> , <i>Eristalis (Eoseristalis) cerealis</i> , <i>Stomorphina discolor</i>
<i>Xanthium strumarium</i>	<i>Eristalis (Eoseristalis) cerealis</i>
<i>Zizyphus sp.</i>	<i>Adoxomyia heminopla</i> , <i>Stomorphina discolor</i>

PLATE I



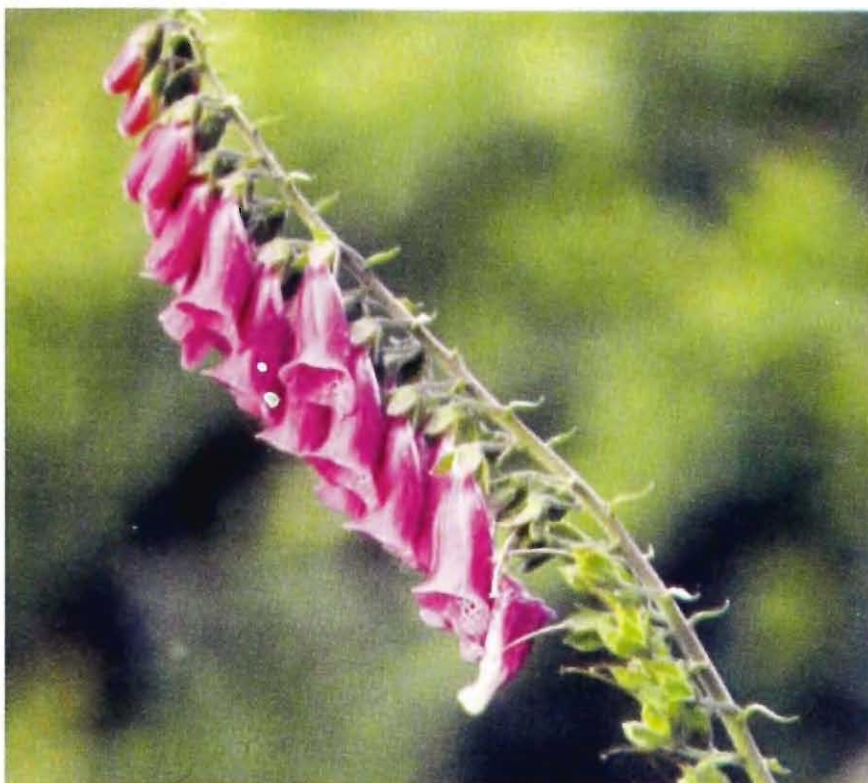
Figs. 1-4. : 1. Flowers of the Marigold, *Tagetes patula*; 2. Flowers of the *Scacvola sericea* Vahl; 3. Flower fly, *Eristalis* (*Eristalis*) *tenax* (Linnaeus); 4. Flower fly in the search of nectar.

PLATE II



Figs. 5-10. : 5. Flower fly, *Eristalinus (Eristalinus) laetus* (Wiedemann); 6. Flower fly, *Mesembrius quadrivittatus* (Wiedemann); 7. Flower fly, *Eristalinus aenus* v. *taphicus* (Wiedemann); 8. Flower fly, *Eristalinus (Eristalinus) quinquestriatus* (Fabricius); 9. Flower fly *Asarkina (Asarkina) ericetorum* (Fabricius); 10. Flower fly, *Eristalinus (Eristalinus) obscuritarsis* de Meijere.

PLATE III



Figs. 11-14. : 11. Flowers of the Sarpagandha, *Rauvolfia serpentina* Benth; 12. Flowers of the Foxglove, *Digitalis purpurea*; 13. Horse fly, *Hybomitra hirta* (Walker); 14. Muscid fly, *Orthellia timorensis* (Robineau-Desvoidy).

PLATE IV



Figs. 15-17. : 15. Bee-fly, *Exoprosopa (Exoprosopa) insulata* Walker; 16. Bee-fly, *Villa panisca* (Rossi); 17. Bee-fly, *Argyramoeba duvaucelii* (Macquart).



Rec. zool. Surv. India : **104** (Part 3–4) : 41-55, 2005

FRESHWATER ROTIFER TAXOCOENOSIS (ROTIFERA : EUROTATORIA) OF ORISSA, WITH REMARKS ON COMPOSITION AND DISTRIBUTION

B. K. SHARMA AND SUMITA SHARMA*

Department of Zoology, North-Eastern Hill University, Shillong-793 022, Meghalaya

INTRODUCTION

Although taxonomic studies on the Indian freshwater Rotifera began more than one century ago, adequate information about bio-diversity of the members of this phylum from different regions/ states of this country is hitherto lacking (Sharma, 1996, 1998). This generalization also holds true to the rotifer fauna of Orissa; the earlier contributions from this state are so far restricted to the works of Sharma (1977, 1980, 1987). The present study is, therefore, an attempt to fill up the stated lacuna and it deals with 104 species (114 taxa). Various interesting species are briefly diagnosed and illustrated. Remarks are made on the general nature and composition of Orissa Rotifera and on the distribution of different taxa.

MATERIALS AND METHODS

The present observations are based on the material collected by the authors from the following localities (Fig. 1) of Eastern Orissa :

Gopalpur-on-sea	(Lat. : 19°16' N; Long. : 84°57' E)
Berhampur	(Lat. : 19°18' N; Long. : 84°51' E)
Ganjam	(Lat. : 19°22' N; Long. : 85°06' E)
Puri	(Lat. : 19°48' N; Long. : 85°32' E)
Bhubaneswar	(Lat. : 20°15' N; Long. : 85°52' E)
Khurda	(Lat. : 20°11' N; Long. : 85°40' E)

**Eastern Regional Station, Zoological Survey of India, Fruit Gardens, Risa Colony, Shillong-793 003, Meghalaya.*

Cuttack	(Lat. : 20°28' N; Long. : 85°54' E)
Kendrapara	(Lat. : 20°30' N; Long. : 86°28' E)
Dhenkanal	(Lat. : 20°40' N; Long. : 85°38' E)

Qualitative plankton samples were collected from various ephemeral and perennial aquatic biotopes of the mentioned major localities and their adjacent areas by towing a nylobolt plankton net (No. 25) and were preserved in 5% formalin. In all, about 118 samples were examined for this study. Various rotifer taxa were screened, isolated, mounted in Polyvinyl alcohol-lactophenol mixture and identified following the works of Kutikova (1970), Koste (1978), Sharma (1983) and Segers (1995). All the drawings are made with a Leitz-Dialux phase contrast stereoscopic microscope with a drawing-tube attachment and the measurements are given in micrometers (μm). The system of classification followed in this account is after Sharma (2001). The reference collections are deposited in Freshwater Biology Laboratory, Department of Zoology, North-Eastern Hill University, Shillong.

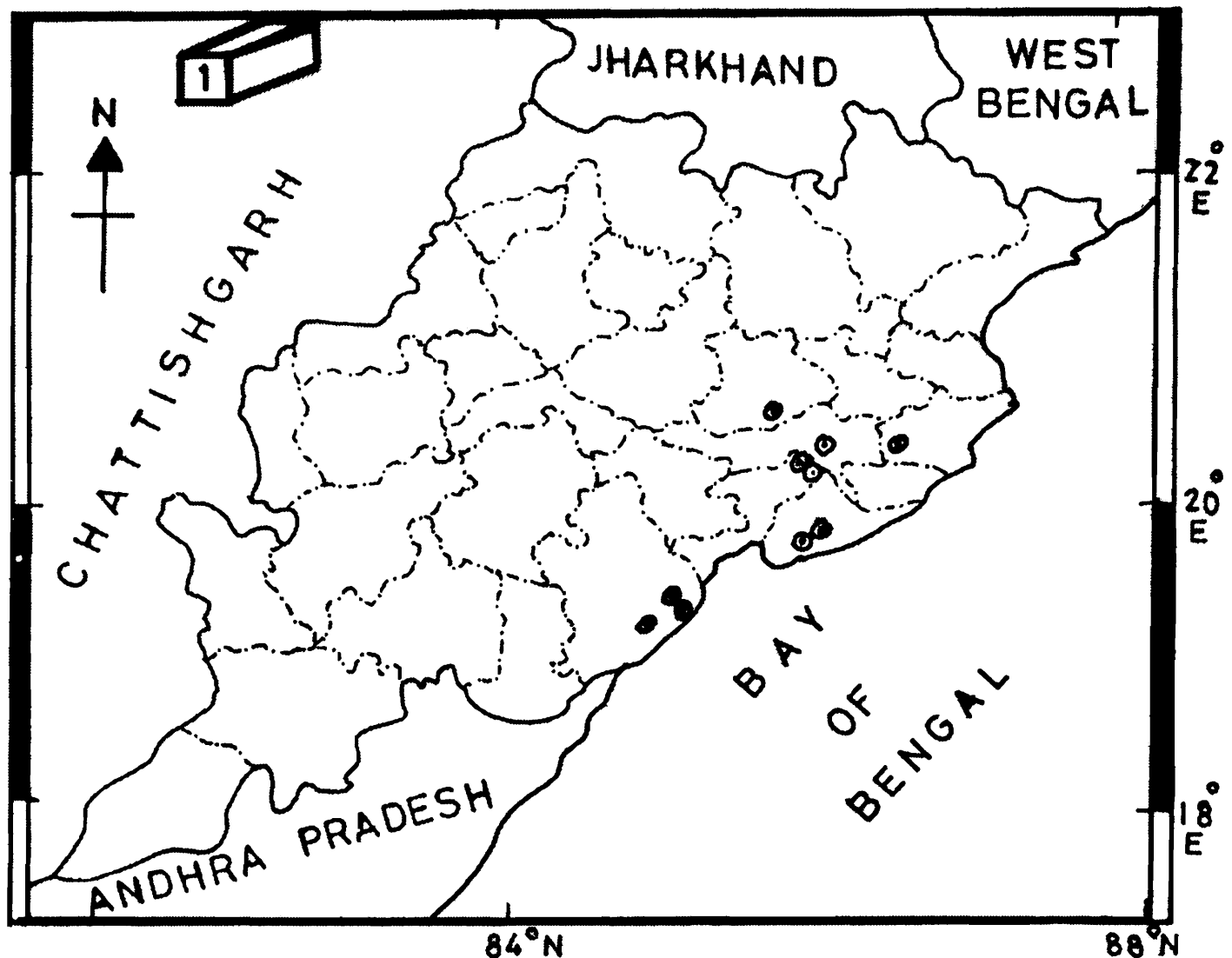


Fig. 1. : Map of Orissa showing the sampling sites.

LIST OF THE EXAMINED TAXA

Phylum ROTIFERA

Super-class EUROTATORIA

Class MONOGONONTA

Order PLOIMIDA

Family BRACHIONIDAE

1. *Anuraeopsis coelata* (De Beauchamp, 1932)
2. *A. fissa* (Gosse, 1851)
3. *Brachionus angularis* Gosse, 1851
4. *B. bidentatus bidentatus* Anderson, 1889
B. bidentatus testudinarius (Jakubski, 1912)*
5. *B. budapestinensis* Daday, 1885
6. *B. calyciflorus f. anuraeiformis* (Brehm, 1909)
B. calyciflorus f. amphiceros (Brehm, 1909)
B. calyciflorus f. dorcias (Gosse, 1851)
7. *B. caudatus aculeatus* (Hauer, 1937)
B. caudatus personatus (Ahlstrom, 1940)
B. caudatus vulgatus Ahlstrom, 1940
8. *B. diversicornis* (Daday, 1883)
9. *B. durgae* Dhanapathi, 1974*
10. *B. falcatus* Zacharias, 1898
11. *B. forficula* Wierzejski, 1891
B. forficula minor (Voronkov, 1913)
12. *B. mirabilis* Daday, 1897*
13. *B. plicatilis* (O. F. Müller, 1786)
14. *B. quadridentatus* (Hermann, 1783)
B. quadridentatus brevispinus (Ehrenberg, 1832)
B. quadridentatus cluniorbicularis (Skorikov, 1894)
B. quadridentatus rhenanus (Lauterborn, 1893)
15. *B. rubens* Ehrenberg, 1838
16. *Keratella edmondsoni* (Ahlstrom, 1943)**
17. *K. lenzi* Hauer, 1953
18. *K. procurva* (Thorpe, 1891)
19. *K. quadrata* (O. F. Müller, 1786)*
20. *K. tropica* (Apstein, 1907)
21. *Platytias quadricornis* (Ehrenberg, 1832)
22. *Platinous patulus* (O. F. Müller, 1786)
P. patulus macracanthus (Daday, 1905)

Family EUCHLANIDAE

- 23. *Euchlanis dilatata* Ehrenberg, 1832
- 24. *E. triquetra* Ehrenberg, 1838
- 25. *Dipleuchlanis propatula* (Gosse, 1886)
- 26. *Tripleuchlanis plicata* (Levander, 1894)
- 27. *Beauchampiella eudactylota* (Gosse, 1886)*

Family MYTILINIDAE

- 28. *Mytilina acanthophora* Hauer, 1938
- 29. *M. bisulcata* (Lucks, 1912)*
- 30. *M. ventralis* (Ehrenberg, 1832)

Family TRICHOTRIDAE

- 31. *Macrochaetus sericus* (Thorpe, 1893)
- 32. *Trichotria tetractis* (Ehrenberg, 1830)

Family COLURELLIDAE

- 33. *Colurella obtusa* (Gosse, 1886)*
- 34. *C. sulcata* (Stenroos, 1898)
- 35. *C. uncinata* (O. F. Müller, 1773)
- 36. *Lepadella acuminata* (Ehrenberg, 1834)
- 37. *L. apsida* Harring, 1916*
- 38. *L. costatoides* Segers, 1992**
- 39. *L. cristata* (Rousselet, 1893)*
- 40. *L. ovalis* (O. F. Müller, 1786)
- 41. *L. patella* (O. F. Müller, 1773)
- 42. *L. rhomboides* (Gosse, 1886)
- 43. *L. rhomboidula* (Bryce, 1890)*
- 44. *L. triptera* Ehrenberg, 1830
- 45. *L. (Heterolepadella) apsicora* Myers, 1934*
- 46. *L. ehrenbergi* (Perty, 1850)
- 47. *L. heterostyla* (Murray, 1913)

Family LECANIDAE

- 48. *Lecane aculeata* (Jakubski, 1912)
- 49. *L. arcula* Harring, 1914*
- 50. *L. curvicornis* (Murray, 1913)
- 51. *L. crepida* Harring, 1914
- 52. *L. flexilis* (Gosse, 1886)
- 53. *L. hornemanni* (Ehrenberg, 1834)*

54. *L. inermis* (Bryce, 1892)
55. *L. lateralis* Sharma, 1978
56. *L. leontina* (Turner, 1892)
57. *L. ludwigii* (Eckstein, 1883)
58. *L. luna* (O. F. Müller, 1776)
59. *L. nana* (Murray, 1913)*
60. *L. ohioensis* (Herrick, 1885)*
61. *L. papuana* (Murray, 1913)*
62. *L. signifera* (Jennings, 1896)*
63. *L. sola* Hauer, 1936**
64. *L. unguolata* (Gosse, 1887)
65. *L. (Hemimonostyla) inopinata* Haring & Myers, 1926
66. *L. (Monostyla) acanthinula* (Hauer, 1938)
67. *L. (M.) bulla* (Gosse, 1851)
68. *L. (M.) closterocerca* (Schmarda, 1898)
69. *L. (M.) bifurca* (Bryce, 1892)*
70. *L. (M.) decipiens* (Murray, 1913)
71. *L. (M.) furcata* (Murray, 1913)
72. *L. (M.) hamata* (Stokes, 1896)
73. *L. (M.) lunaris* (Ehrenberg, 1882)*
74. *L. (M.) obtusa* (Murray, 1913)*
75. *L. (M.) pyriformis* (Daday, 1905)
76. *L. (M.) quadridentata* (Ehrenberg, 1832)
77. *L. (M.) stenroosi* (Meissner, 1908)
78. *L. (M.) thienemanni* (Hauer, 1938)*
79. *L. (M.) unguitata* (Fadeev, 1925)

Family NOTOMMATIDAE

80. *Cephalodella forficula* (Ehrenberg, 1832)*
81. *C. mucronata* Haring & Myers, 1921
82. *Scaridium longicaudum* (O. F. Müller, 1786)

Family GASTROPODIDAE

83. *Ascomorpha ovalis* (Bergendal, 1892)*

Family TRICHOCERCIDAE

84. *Trichocerca bicristata* (Gosse, 1887)*
85. *T. cylindrica* (Imhof, 1891)
86. *T. flagellata* Hauer, 1938
87. *T. longiseta* (Schränk, 1802)*

88. *T. rattus* (O. F. Müller, 1786)

89. *T. similis* (Wierzejski, 1893)

Family ASPLANCHNIDAE

90. *Asplanchna brightwelli* Gosse, 1850

Family SYNCHAETIDAE

91. *Polyarthra vulgaris* Carlin, 1943

Order FLOSCULARIACEA

Family CONOCHILIDAE

92. *Conochilus unicornis* Rousselet, 1892*

Family HEXARTHRIDAE

93. *Hexarthra mira* (Hudson, 1871)*

Family FILINIIDAE

94. *Filinia longiseta* (Ehrenberg, 1834)

95. *F. opoliensis* (Zacharias, 1898)

96. *F. pejleri* Hutchinson, 1964

97. *F. saltator* (Gosse, 1886)*

Family TESTUDINELLIDAE

98. *Testudinella emarginula* (Stenroos, 1898)*

99. *T. parva* (Ternetz, 1892)**

100. *T. patina* (Hermann, 1783)

101. *Pompholyx sulcata* Hudson, 1885

Family TROCHOSPHAERIDAE

102. *Horaella brehmi* Donner, 1949

Super-class DIGONONTA

Class BDELLOIDEA

Order PHILODINIDA

Family PHILODINIDAE

103. *Rotaria neptunia* (Ehrenberg, 1832)*

104. *R. rotatoria* (Pallas, 1766)*

* New record from Orissa.

** New record from Eastern India; the term 'form' has been used in 'non-taxonomic' sense to indicate cyclomorphic variations in *B. calyciflorus*.

SYSTEMATIC NOTES

Thirty-six species (37 taxa) are new to Orissa; the following systematic notes, however, deal only with some interesting species reported presently :

Brachionus durgae Dhanapathi, 1974

(Fig. 2)

Diagnosis : Characterised by large lorica, distinct occipital margin and thread-like processes for egg attachment with lorica. Rare in the present study; examined specimens agree with those described from Andhra Pradesh (Dhanapathi, 1974).

Distribution : INDIA – Andhra Pradesh. *Elsewhere* – Cosmo(sub)tropical.

Brachionus mirabilis Daday, 1897

(Fig. 3)

Diagnosis : Ventral plate of lorica produced into two posterior spines extending backwards at an angle of 45° Foot-opening situated between the bases of ventral spines and surrounded by a sheath.

Distribution : INDIA – Meghalaya, Assam, Tripura, West Bengal. *Elsewhere* – Tropics and subtropics.

Keratella edmondsoni (Ahlstrom, 1943)

(Fig. 4)

Diagnosis : Lorica granulated, with characteristic pattern of carinal plaques on dorsum and divergent posterior spines. Specimens from Orissa identical with those reported by Sanoamuang *et al.* (1995).

Distribution : INDIA – Rajasthan, Assam. *Elsewhere* – Oriental region.

Mytilina bisulcata (Lucks, 1912)

(Fig. 5)

Diagnosis : Lorica thin, transparent and without anterior spines; dorsal sulcus indistinct. Toes long, slender and ending into slender, curved spines.

Distribution : INDIA – Meghalaya, West Bengal, Tripura, Orissa. *Elsewhere* – Cosmopolitan.

Lepadella apsida Harring, 1916

(Fig. 6 & 7)

Diagnosis : Lorica small, nearly circular; without dorsal sinus, ventral sinus circular and dorsal plate arched. Foot-groove rounded U-shaped; toes short and pointed.

Distribution : INDIA – West Bengal, Punjab, Meghalaya. *Elsewhere* – Pantropics, reported from China, America, Central and Eastern Asia, India.

Lepadella costatoides Segers, 1992

(Fig. 8)

Diagnosis : Dorsum with three pairs of longitudinal ridges. Lorica with symmetrical postero-lateral projections.

Distribution : INDIA – Kerala. *Elsewhere* – Tropics and subtropics.

Lepadella cristata (Rousselet, 1893)

(Fig. 9 & 10)

Diagnosis : Lorica with a dorsal median keel and a distinct posteriorly directed dorsal crest. Toes long and pointed.

Distribution : INDIA – Meghalaya, West Bengal. *Elsewhere* – Cosmopolitan.

Lepadella rhomboidula (Bryce, 1890)

(Fig. 11 & 12)

Diagnosis : Lorica rhomboidal; median dorsal keel moderately high and with concave sides. Dorsal sinus lacking, ventral sinus semicircular. Foot-groove inverted U-shaped; toes long and pointed.

Distribution : INDIA – West Bengal. *Elsewhere* – Cosmopolitan.

Lepadella (Heterolepadella) apsicora Myers, 1934

(Fig. 13)

Diagnosis : Lorica oval, with shallow dorsal and V-shaped ventral sinus. Toes unequal; right toe longer than the left and often twisted.

Distribution : INDIA – West Bengal, Meghalaya. *Elsewhere* – Tropics and subtropics.

Lecane sola (Hauer, 1936)

(Fig. 14)

Diagnosis : Lorica small, oval, with straight and coincident anterior margins. Dorsal plate with distinct pattern. Ventral plate smaller than dorsal plate and with small spines at its external angles. Second foot-segment elongated, projecting beyond posterior end of lorica. Toes parallel-sided for about half of their length and then tapering to pointed tips.

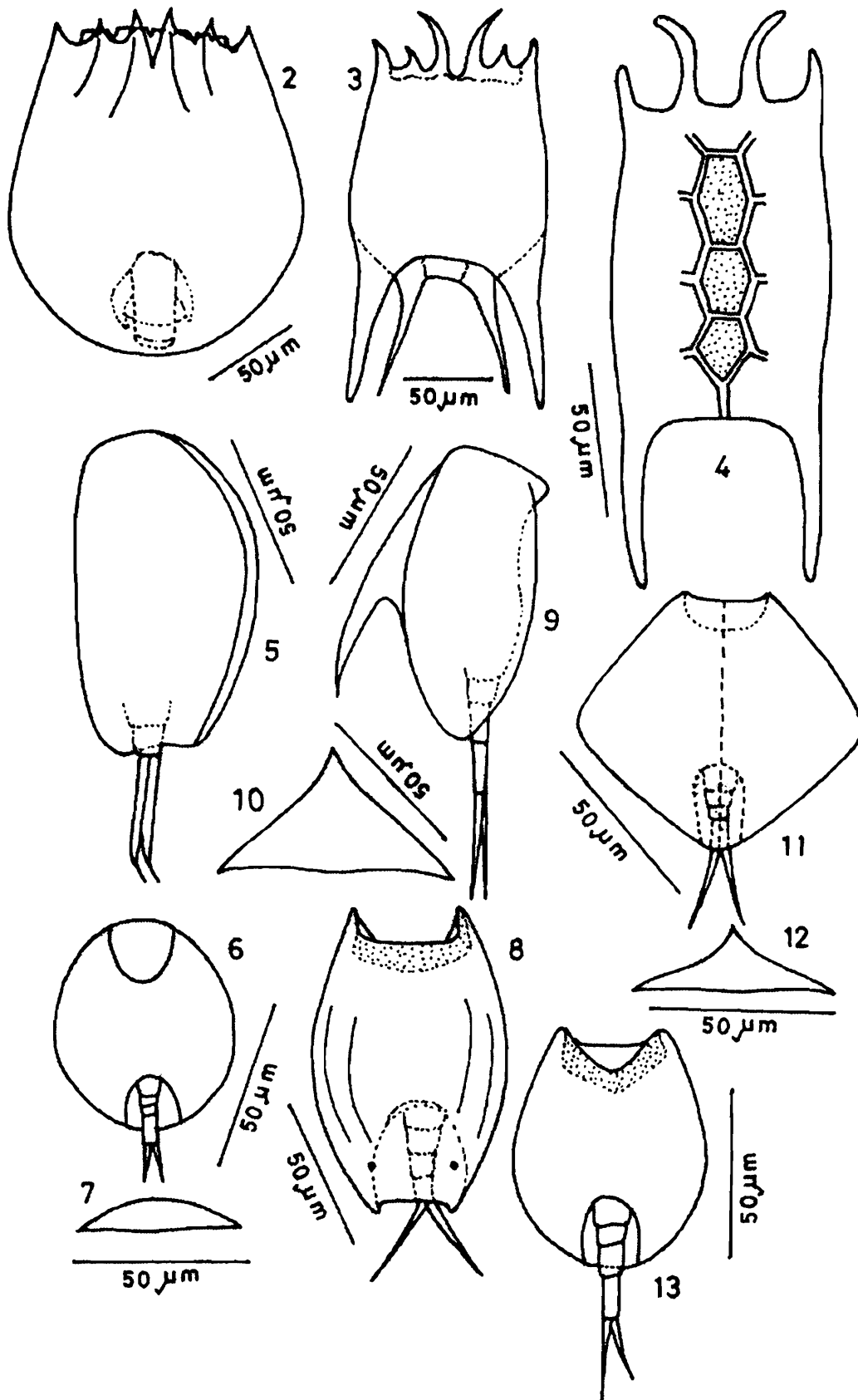
Distribution : INDIA – Tamil Nadu, Tripura. *Elsewhere* – Pantropical.

Lecane (Monostyla) acanthinula (Hauer, 1938)

(Fig. 15)

Diagnosis : Lorica oval and with straight anterior margins. Dorsal plate ovate, ventral plate narrower than dorsal plate and with small spines at external angles. Toe parallel-sided for half of its length, then slightly narrowing and with two claws; each claw with a small basal spine.

Distribution : INDIA – Kerala and Tripura. *Elsewhere* – Oriental region.



Figs. 2-13. : 2. *Brachionus durgae* Dhanapathi, dorsal view; 3. *B. mirabilis* Daday, dorsal view; 4. *Keratella edmondsoni* (Ahlstrom), dorsal view; 5. *Mytilina bisulcata* (Lucks), lateral view; 6 & 7. *Lepadella apsida* Haring, ventral view and cross-section; 8. *L. costatoides* Segers, dorsal view; 9 & 10. *L. cristata* (Rousselet), lateral view and cross-section; 11 & 12. *L. rhomboidula* (Bryce), dorsal view and cross-section; 13. *L. apsicora* Myers, ventral view.

Lecane (Monostyla) bifurca (Bryce, 1892)

(Fig. 16)

Diagnosis : Lorica small, oval and without any markings. Ventral plate slightly narrower than dorsal plate and with small posterior projections. Toe small, claws divergent.

Distribution : INDIA – Delhi. *Elsewhere* – Cosmopolitan.

Lecane (Monostyla) obtusa (Murray, 1913)

(Fig. 17)

Diagnosis : Lorica oval, without surface makings; anterior margins straight, coincident and with minute spines at external angles. Ventral plate narrow than dorsal plate. Toe cylindrical, slightly swollen in its middle region; claw pointed, with basal spicules.

Distribution : INDIA – Tripura, West Bengal, Andhra Pradesh. *Elsewhere* – Tropics and subtropics.

Lecane (Monostyla) thienemanni (Hauer, 1938)

(Fig. 18)

Diagnosis : Lorica elongate-oval, anterior dorsal margin straight, anterior ventral margin with a shallow sinus and its external angles produced into two stout triangular spines. Dorsal plate broader than ventral plate. Toe parallel-sided for about half of its length and then tapering to an acute point.

Distribution : INDIA – Meghalaya, Tripura, West Bengal and Gujarat. *Elsewhere* – S. E. Asia.

Trichocerca bicristata (Gosse, 1887)

(Fig. 19)

Diagnosis : Lorica with two characteristic distinct keels extending upto $2/3$ the length of dorsum. Left toe longer than body, right toe reduced; substyles present.

Distribution : INDIA – Bihar. *Elsewhere* – Cosmopolitan.

Filinia saltator (Gosse, 1886)

(Fig. 20)

Diagnosis : Body cylindrical, with two long movable antero-lateral setae; caudal seta lacking.

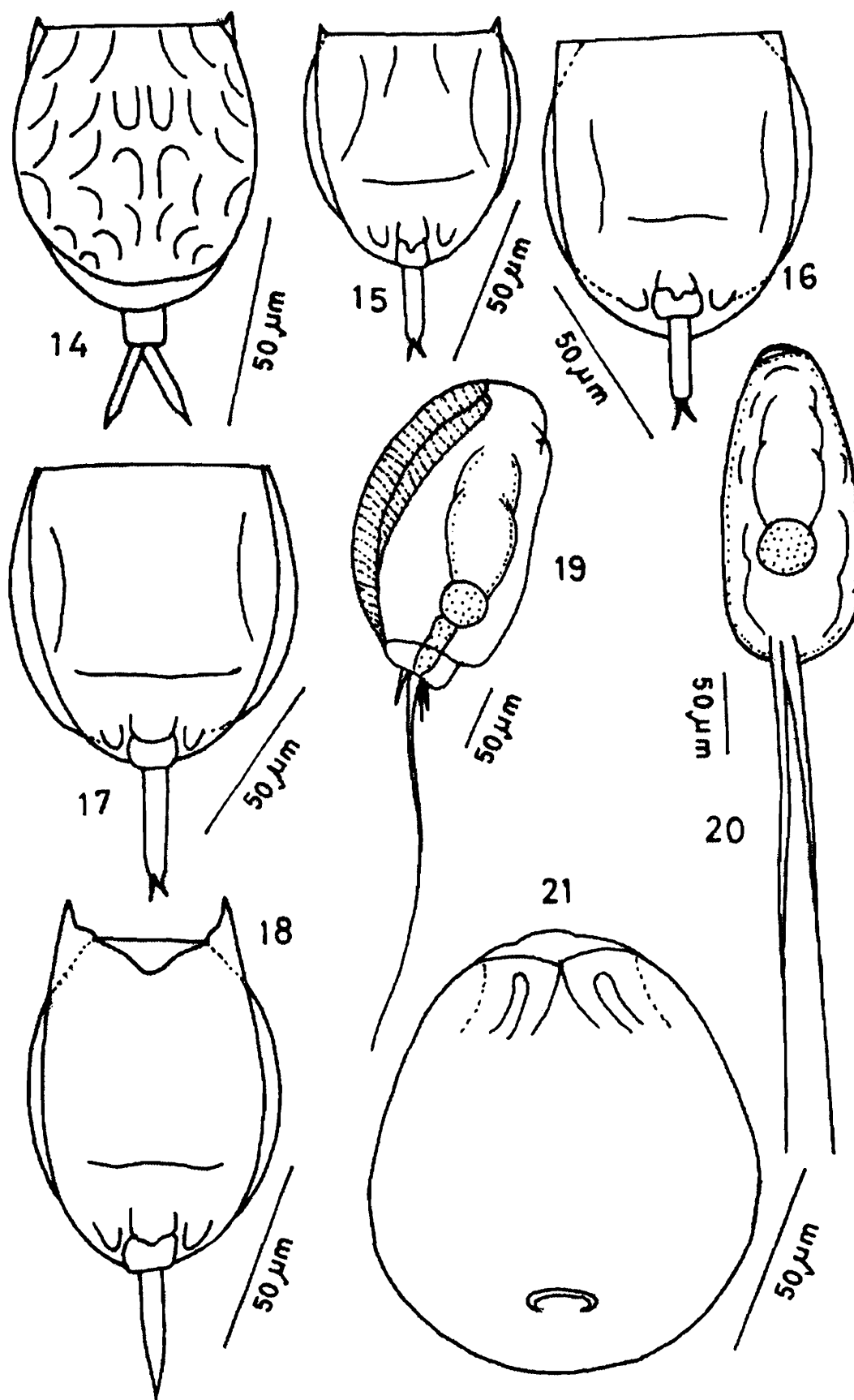
Distribution : INDIA – Tripura and Bihar. *Elsewhere* – Tropicopolitan.

Testudinella parva (Temetz, 1892)

(Fig. 21)

Diagnosis : Lorica pear-shaped and with maximum width in the posterior region; convex in cross-section. Anterior dorsal margin slightly elevated and with a shallow depression; anterior ventral margin with median notch. Lateral antennae located behind the middle region of lorica. Foot-opening elliptical and located at a short distance from posterior margin of lorica.

Distribution : INDIA – Meghalaya, Assam, Tripura. *Elsewhere* – Cosmopolitan.



Figs. 14-21. : 14. *Lecane sola* (Hauer), dorsal view; 15. *L. (Monostyla) acanthinula* (Hauer), ventral view; 16. *L. (M.) bifurca* (Bryce), ventral view; 17. *L. (M.) obtusa* (Murray), ventral view; 18. *L. (M.) thienemanni* (Hauer), ventral view; 19. *Trichocerca bicristata* (Gosse), lateral view; 20. *Filinia saltator* (Gosse), ventral view; 21. *Testudinella parva* (Ternetz), ventral view.

REMARKS

The rotifer fauna of Orissa has so far been inadequately studied and an earlier report (Sharma, 1987) documented only 69 species from freshwater environs of this state. The present study dealing with 104 species (114 taxa) has, hence, reasonably enriched overall species richness of Rotifera of Orissa which, in turn, now follows the faunas of West Bengal (148 species) > Tripura (112 species) > Meghalaya (111 species). In general, the examined taxocoenosis is fairly rich and diversified and the reported species comprise about 30.1% of the Indian Rotifera. Of the 25 families and 63 genera of Eurotatoria known from India (Sharma, 1998), 17 families and 28 genera recorded in this account exhibit fairly good diversity of the higher categories of phylum Rotifera. *Keratella edmondsoni*, *Lepadella costatoides*, *Lecane sola*, *Lecane (Monostyla) acanthinula* and *Testudinella parva* are new records from Eastern India and 37 taxa (36 species) represent new reports from Orissa. In addition, some rare and interesting species (including new species) are awaiting examination of more specimens and will be dealt with separately.

The monogononts comprise bulk of the reported species (98%) while the bdelloids include only two species. The stated pattern agrees with the composition of rotifer taxocoenosis of the Oriental region (Sudzuki, 1989) and India (Sharma, 1996, 1998) in general and that of relatively well explored faunas of the states of West Bengal (Sharma, 1995), Meghalaya (Sharma and Sharma, 1999) and Tripura (Sharma and Sharma, 2000) in particular. Such a generalization again highlights general paucity of information on the bdelloid rotifers. The monogonont rotifers are, however, predominated by members of order Ploimida (91 species, 87.5%) and the examined collections include only 11 species (10.6%) belonging to order Flosculariacea.

Cosmopolitan (52.5%) > Cosmotropical and Pantropical (28.5%) elements comprise significant fraction of the recorded species. On the contrary, biogeographically interesting taxa constitute only 6.7%; these include three Oriental species namely *Keratella edmondsoni*, *Lecane acanthinula* and *Trichocerca flagellata*; South-East Asian *Mytilina acanthophora* and *Lecane thienemanni*; plaeo(sub)tropical *Lecane lateralis* and *L. unguolata* and cosmo(sub)tropical *Brachionus durgae*. However, the paucity of the taxa of this category in the examined material presents a misleading picture but is apparently attributed to the fact that a number of eurotatorien families containing periphytic, littoral, sessile and colonial taxa are not yet adequately represented in the sampled collections. In addition, various species of regional or local distributional interest are represented by *Lepadella costatoides*, *L. rhomboidula*, *Lecane bifurca*, *L. sola*, *Horaella brehmi*, *Testudinella parva* and *Filinia saltator*.

Lecanidae (32 species) > Brachionidae (22 species) > Colurellidae (15 species) altogether comprise important component (66.3%) of the documented species; the observed trend of dominance of these monogonont families corresponds with the composition of the rotifer faunas of India

(Sharma, 1998) and the Oriental region (Sudzuki, 1989) in general and those of West Bengal (Sharma, 1995), Meghalaya (Sharma and Sharma, 1999) and Tripura (Sharma and Sharma, 2000) in particular. Besides, other qualitatively important rotifer families include Trichocercidae (6 species) > Euchlanidae (5 species) > Filiniidae (4 species) = Testudinellidae (4 species). Higher species richness of two 'tropic-centred' genera namely *Lecane* (32 species) and *Brachionus* (13 species) imparts general 'tropical character' to the rotifer taxocoenosis of Orissa. The stated aspect is further supported by fewer number of species of 'temperate-centred' *Keratella* (5 species). Besides, these generalizations corroborate with salient features of many tropical rotifer faunas from different parts of the globe (Green, 1972; Pejler, 1977; Fernando, 1980; Fernando and Zankai, 1981; Dumont, 1983; Dussart *et al.* 1984; Sanoamuang *et al.* 1995; Segers, 1995, 1996; Sharma, 1996, 1998; Sanoarnuang, 1998; Sharma and Sharma, 1997, 2001).

Among various recorded species of regional/local distributional importance, *Keratella edmondsoni* is so far known in India from Rajasthan and N. E. region; *Lepadella costatoides* from Kerala; *Lecane acanthinula* from Tripura; *L. sola* from Tamil Nadu and Tripura; and *Testudinella parva* from N. E. region. The present report of these species from Orissa, therefore, extends their distributional ranges to Eastern India. Other interesting elements include three species believed earlier to be the Indian endemics *i.e.*, cosmo(sub)tropical *B. durgae*, palaeo(sub)tropical *Lecane lateralis* and pantropical *Horaella brehmi* which were originally described from Andhra Pradesh (Dhanapathi, 1974), West Bengal (Sharma, 1978) and Bihar (Donner, 1949), respectively. Besides, cosmopolitan *Lepadella rhomboides*, *Lecane bifurca*, *Trichocerca bicristata* and *F. saltator* exhibit restricted occurrence in India; the first two species are examined so far from Bihar and Delhi respectively while the last two species are recorded exclusively from Bihar.

To sum up, the rotifer fauna of Orissa reflects fairly rich species, generic and family diversity. Planktonic taxa are well documented in the studied taxocoenosis which, in turn, also depicts reasonably good number of littoral or periphytic species but shows distinct lack of sessile, colonial and bdelloid taxa. This fauna, therefore, still provides scope for updating with special emphasis on sampling of the members of specified communities and on their general composition and richness of Rotifera in different freshwater ecosystems of this state.

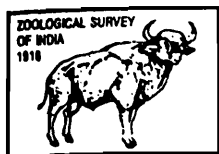
ACKNOWLEDGMENTS

Thanks are due to the Head, Department of Zoology, North-Eastern Hill University, Shillong, the Director, Zoological Survey of India, Kolkata and the Officer-in-Charge, Eastern Regional Station, Zoological Survey of India, Shillong for necessary facilities for the study.

REFERENCES

- Dhanapathi, M. V S. S. 1974. Rotifers from Andhra Pradesh, India. I. *Hydrobiologia*, **45** : 357-372.
- Dornner, J. 1949. *Horaella brehmi* nov. gen. nov. sp. eine neue Rädertiere aus Indien. *Hydrobiologia*, **2** : 304-308.
- Dumont, H. J. 1983. Biogeography of rotifers. *Hydrobiologia*, **104** : 19-30.
- Dussart, B. H., Fernando, C. H., Matsumura-Tundisi, J. and Shiel, R. J. 1984. A review of systematics, distribution and ecology of tropical freshwater zooplankton. *Hydrobiologia*, **113** : 77-91.
- Fernando, C. H. 1980. The freshwater zooplankton of Sri Lanka, with a discussion of tropical freshwater zooplankton composition. *Int. Rev. ges. Hydrobiol.*, **65** : 411-426.
- Fernando, C. H. and Zankai, N. P. 1981. The Rotifera of Malaysia and Singapore with remarks on some species. *Hydrobiologia*, **78** : 205-219.
- Green, J. 1972. Latitudinal variation in associations of planktonic Rotifera. *J. Zool. London*, **167** : 31-39.
- Koste, W. 1978. *Rotatoria*. Die Rädertiere Mitteleuropas, begründet von Max Voigt. Überordnung Monogononta. Gebrüder Borntraeger, Berlin, Stuttgart. I. Text. (673 pp) U. II. Tafelbd. (T. 234).
- Kutikova, L. A. 1970. The rotifer fauna of the USSR. *Fauna SSSR* 104, Academia Nauk, 744 pp (in Russian).
- Pejler, B. 1977. On the global distribution of the family Brachionidae (Rotatoria). *Arch. Hydrobiol. Suppl.*, **53** : 255-306.
- Sanoamuang, L. 1998. Rotifera of some freshwater habitats in the floodplain of the River Nan, northern Thailand. *Hydrobiologia*, **387/388** : 27-33.
- Sanoamuang, L., Segers, H. and Dumont, H. J. 1995. Additions to the rotifer fauna of south-east Asia : new and rare species from north-east Thailand. *Hydrobiologia*, **313/314** : 35-45.
- Segers, H. 1995. Rotifera 2 : Lecanidae. *Guides to identification of the Microinvertebrates of the Continental waters of the world*. **6** : 1-226. H. J. Dumont and T. Nogrady (eds.). SPB Academic Publishing bv. Amsterdam, The Netherlands.
- Segers, H. 1996. The biogeography of littoral *Lecane* Rotifera. *Hydrobiologia*, **323** : 169-197.
- Sharma, B. K. 1977. On some collection of rotifers (Class : Rotifera) from Orissa. *Newsl. zool. Surv. India*, **3** : 189-190.
- Sharma, B. K. 1978. Two new lecanid rotifers from India. *Hydrobiologia*, **60** : 191-192.
- Sharma, B. K. 1980. Contributions to the rotifer fauna of Orissa, India. *Hydrobiologia*, **70** : 225-233.

- Sharma, B. K. 1983. The Indian species of the genus *Brachionus* (Eurotatoria : Monogononta : Brachionidae). *Hydrobiologia*, **104** : 31-39.
- Sharma, B. K. 1987. Rotifera : Eurotatoria : Monogononta (Freshwater). In : *Fauna of Orissa : State Fauna Series*, **1**(1) : 323-340. Publ. by Zool. Surv. India, Calcutta.
- Sharma, B. K., 1995. Freshwater Rotifers (Rotifera : Eurotatoria). In : *Fauna of West Bengal. State Fauna Series*, **3**(13) : 1-121. Publ. by Zool. Surv. India, Calcutta.
- Sharma, B. K. 1996. Biodiversity of Freshwater Rotifera in India – a status report. *Proc. zool. Soc. Calcutta*, **49** : 73-85.
- Sharma, B. K. 1998. Faunal diversity of India : Rotifera. In : *Faunal diversity of India. A commemorative volume in the 50th year of India's independence* (Eds. J. R. B. Alfred, A. K. Das & A. K. Sanyal) : 57-70. Publ. by ENVIS Centre, Zool. Surv. India, Calcutta.
- Sharma, B. K. 2001. Zooplankton diversity of freshwater planktonic and semi-planktonic Rotifera. In : *Water quality assessment, Biomonitoring and Zooplankton diversity* (Ed. B. K. Sharma), 190-215. Department of Zoology North-Eastern Hill University, Shillong.
- Sharma, B. K. and Sharma, S. 1997. Lecanid rotifers (Rotifera : Monogononta : Lecanidae) from North-Eastern India. *Hydrobiologia*, **356** : 159-163.
- Sharma, B. K. and Sharma, S. 1999. Freshwater Rotifers (Rotifera : Eurotatoria). *Fauna of Meghalaya : State Fauna Series*, **4**(9) : 11-161. Publ. by Zool. Surv. India, Calcutta.
- Sharma, B. K. and Sharma, S. 2000. Freshwater Rotifers (Rotifera : Eurotatoria). In : *Fauna of Tripura : State Fauna Series*, **7**(4) : 163-224. Publ. by Zool. Surv. India, Calcutta.
- Sharma, B. K. and Sharma, S. 2001. Biodiversity of Rotifera in some tropical floodplain lakes of the Brahmaputra river basin, Assam (N. E. India). *Hydrobiologia*, **446/447** : 305-313.
- Sudzuki, M. 1989. Rotifera from the Oriental region and their characteristics. *Special issue Cent. Ann. Nihon Daigaku*, **3** : 301-343.



Rec. zool. Surv. India : 104 (Part 3–4) : 57-62, 2005

SOME NEW SPECIES AND NEW RECORDS OF DUST MITES FROM KOLKATA, INDIA

S. PODDER, G. K. SAHA AND S. K. GUPTA

*Entomology & Wildlife Biology Research Unit, Department of Zoology,
University of Calcutta, 35 Ballygunge Circular Road, Kolkata-700 019, West Bengal, India*

INTRODUCTION

This paper deals with description of two new species belonging to genera *Mediolata* Canestrini (Family : Stigmaeidae) and *Chelacaropsis* Baker (Family : Cheyletidae) along with another four species occurring in dust from Kolkata metropolis. The occurrence of these species are being recorded here for the first time from dust. All the measurements given here in the text are in microns. The holotype of the new species described here are presently in the collection of Entomology Research Unit, Calcutta University, which in due course will be deposited in the Zoological Survey of India, Kolkata. The entire collection was made by the senior author.

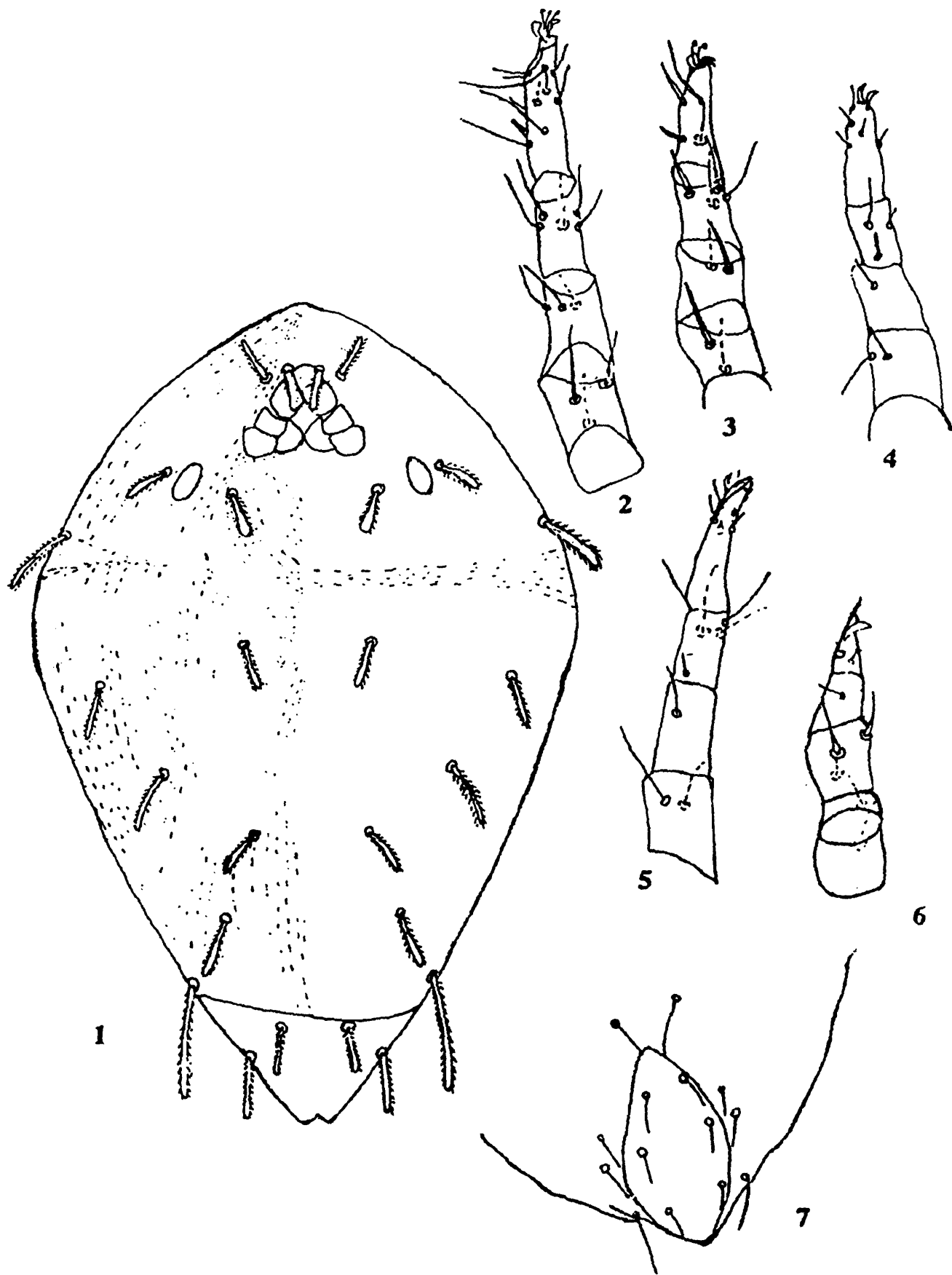
Family 1. STIGMAEIDAE Oudemans

Genus 1. *Mediolata* Canestrini

1. *Mediolata serrata* sp. nov.

(Figs. 1-7)

Female : Body measures 540 long (from tip of the chelicerae upto posterior tip of the body), 300 wide (maximum width). Chelicerae prominent, fixed digit ensheathing stylets, free. Rostrum conical, rostral setae as figured. Palp 4 segmented, setae on different palp segments as figured, tibial claw shorter than tarsus, palp tarsus cylindrical, trifold terminal tarsal sensillum present as usual. Idiosoma with 2 plates, with transverse striations in between two plates. Propodosomal plate with 4 pairs of setae measuring ae–32, be–40, ce–25, de–40, all propodosomal setae thick, serrate marginally as figured. Post ocular body longer than wide. The ratios of propodosomal setae : ae/ae–ae = 0.71, be/be–be = 0.5, ce/ce–ce = 2.9. Humeral setae he = 44 long. Hysterosomal plate



Figs. 1-7. : *Mediolata serrata* sp. nov. [Female]; 1. Dorsal surface; 2. Terminal segments of Leg I; 3. Terminal segments of leg II; 4. Terminal segments of leg III; 5. Terminal segments of leg IV; 6. Terminal segments of palp; 7. Opisthosomal region.

with 6 pairs of setae measuring : $a = 40$, $b = 40$, $c = 44$, $la = 32$, $lm = 40$, $li = 60$, other posterodorsal setae measure $e = 36$, $le = 44$. The ratios of hysterosomal setae : $a/a-a = 0.3$, $b/b-b = 0.2$, $c/c-c = 0.47$. Hysterosomal striation as figured. Ventrally, opisthosomal region as figured, Paragenital setae measure $pg_1 = 36$, $pg_2 = 29$, $pg_3 = 36$. Genital setae 3 pairs, all almost of same length, never reach bases of the following setae. Leg chaetotaxy as figured. All tarsi end in a pair of claws and empodium with tenent hairs.

Male : Not known.

Holotype : FEMALE : INDIA : West Bengal, Kolkata, ex. floor dust, 15.09.2003.

Remarks : This species is very close to *Mediolata simplex* Wood, 1967 but differs from that in having dorsal idiosomal setae a , b , c much shorter and those do not touch the bases of the following setae; ae , be , ce also being shorter as compared to those of *M. simplex*. Besides, both the species differ in relative ratios of dorsal idiosomal setae, in leg chaetotaxy and in reticulation pattern of dorsum. This new species is also close to *Mediolata granaria* Gonzalez-Rodriguez, 1965 but can be distinguished from that by absence of notch in propodosomal plate of the new species and humeral setae are not present on platelet as in *M. granaria*. In addition, both the species differ in relative ratios of dorsal idiosomal plate.

Genus 2. *Cheylostigmaeus* Willmann

2. *Cheylostigmaeus* sp.

Material examined : 1 Female, Kolkata, Sealdah, ex. house dust, 23.11.2003.

Remarks : Due to damaged condition of the specimen, this could not be identified upto species level. Earlier, only one species of this genus was recorded from birds' nests in West Bengal (Gupta and Paul, 1985).

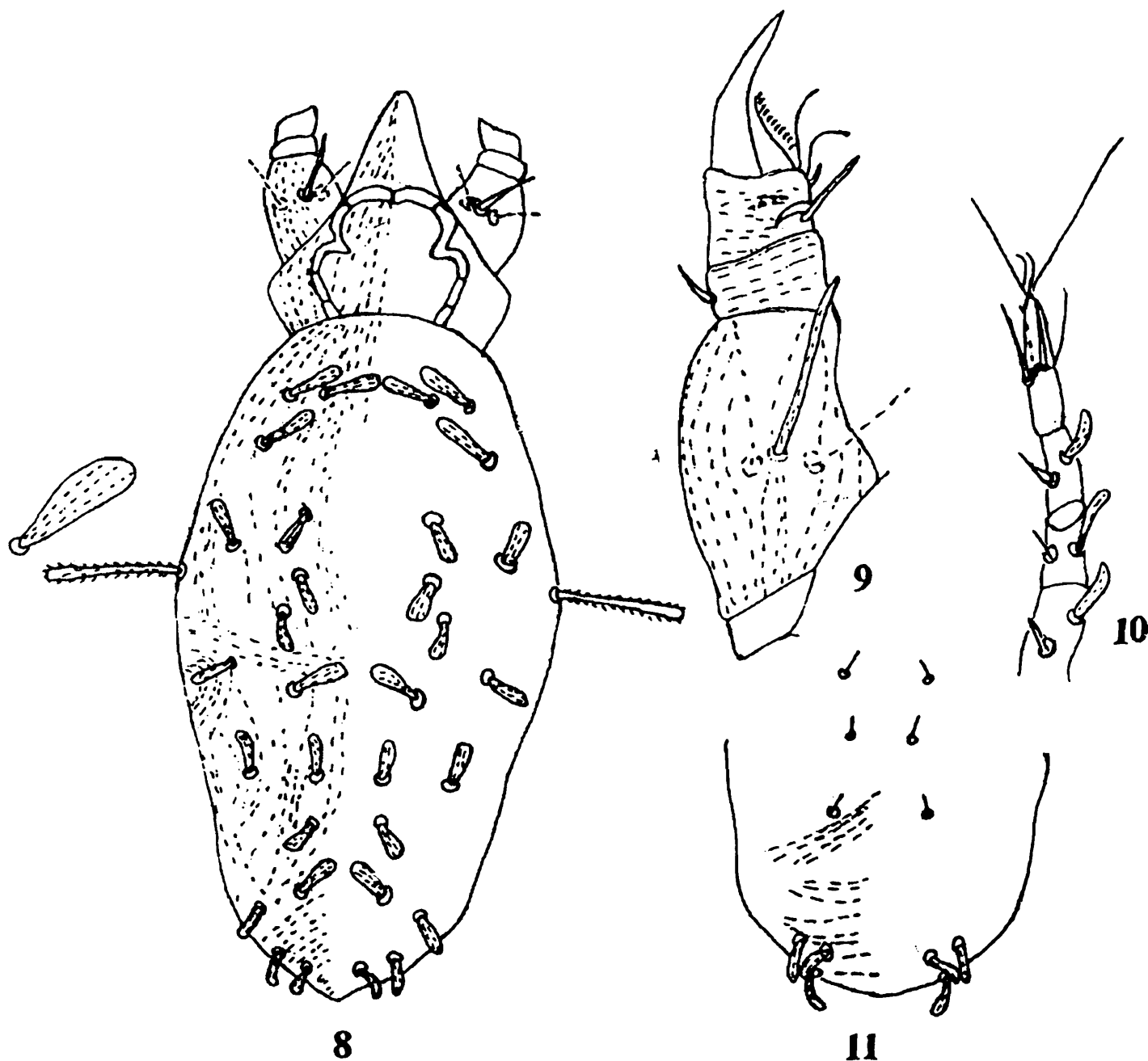
Family 2. CHEYLETIDAE Leach

Genus 3. *Chelacaropsis* Baker

3. *Chelacaropsis neomoorei* sp. nov.

(Figs. 8-11)

Female : Body 520 long (from tip of gnathosoma upto posterior tip of body), 188 wide (maximum width). Propodosoma with longitudinal striation, with 7 pairs of setae, measuring 22–24 long, shaped as figured, tip spatulate. Rostrum longitudinally striated. Peritreme 5 segmented. Ventral region of gnathosoma with 1 pair of setae, present medially, 1 pair at the tip, humeral seta—40 long, apparently pubescent. Hysterosoma without shield, with longitudinal striations



Figs. 8-11. : *Chelacaropsis neomoorei* sp. nov. [Female]; 8. Dorsal surface; 9. palp; 10. Terminal segments of leg I; 11. Opisthosomal region.

anteromedially, irregular striation laterally and roundish transverse striations posteriorly, with 9 pairs of setae, almost of same length as those present on propodosomal region. Ventrally, hysterosoma with 3-4 pairs of setae. Palp femur with 1 strong seta exceeding length of segment present dorsally and 2 setae present ventrally; palp tibial claw 28 long, longer than segment, palp tarsus with 1 comb-like and 2 sickle-like setae, comb-like setae with 10-14 combs; tibial claw without basal teeth. Legs measure I-204, II-90, III-90, IV-204, tarsus I with 2 long setae, larger one -60 long, smaller one -52 long; claw 1 paired, guard seta-32, trochanter and femur each with 1 spatulate serrate seta. Leg chaetotaxy as given in next page :

Leg	Femur	Genu	Tibia	Tarsus
I	2	2	2+1 solenidion	5+1 solenidion
II	2	1	1	5+1 solenidion
III	2	2	1	5
IV	2	2	1	5

Male : Unknown.

Holotype : FEMALE : INDIA : West Bengal, Kolkata, ex. house dust, 23.10.2003.

Remarks : This new species differs from the only known species of this genus, viz. *Chelacaropsis moorei* Baker (1949) in lacking small platelets carrying the dorsal idiosomal setae as in *C. moorei*, peritreme only 5 segmented (against 7 segmented in *C. moorei*), by having venter of rostrum with 2 setae in *C. neomoorei*, palpal claw lacking teeth (4 teeth present in *C. moorei*), propodosomal and hysterosomal regions having 6 and 8 pairs of setae respectively (7 and 6 pairs of setae respectively present in *C. moorei*) and in having sensory seta on tarsus I almost as long as the segment.

Family 3. TARSONEMIDAE Kramer

Genus 4. *Fungitarsonemus* Cromroy

4. *Fungitarsonemus* sp.

Material examined : 1 Female, Kolkata metropolis, Gorabazar, ex. house dust. 15.12.2003.

Remarks : The specimen was in badly damaged condition and therefore specific identification was not possible. This is the first record as regards occurrence of this genus from India and is being recorded for the first time on house dust in the world.

Family 4. PHYTOSEIIDAE Berlese

Genus 5. *Typhlodromus* Scheuten

5. *Typhlodromus* sp.

Material examined : 1 Female, Kolkata metropolis, Durganagar, ex. house dust, 23.10.2003.

Remarks : This is the first record of phytoseiid mite in house dust. However its occurrence appears to be accidental because it is more prevalent on plants, stored products, litter etc.

Family 5. RAPHIGNATHIDAE Kramer

Genus 6. *Raphignathus* Koch6. *Raphignathus* sp.

Material examined : 1 Female, Kolkata, Durganagar, ex. house dust. 11.08.2003.

Remarks : The species of this genus was earlier recorded from house dust.

SUMMARY

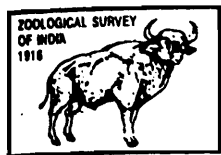
Two new species, viz. *Mediolata serrata* sp. nov. and *Chelacaropsis neomoorei* sp. nov. are described. In addition, another four unidentified species viz. *Cheylostigmaeus* sp., *Fungitarsonemus* sp., *Typhlodromus* sp. and *Raphignathus* sp. are recorded here for the first time from house dust.

ACKNOWLEDGEMENTS

The authors are thankful to the University Grants Commission, New Delhi for the financial help and to the Head, Zoology Department, Calcutta University for laboratory facilities.

REFERENCES

- Baker, E. W. 1949. A review of mite family Cheyletidae in United States National Museum. *Proc. U.S. Nat. Mus.*, **99**(3238) : 267-320.
- Gonzalez-Rodriguez, R. H. 1965. A taxonomic study of the genera *Mediolata*, *Zetzellia* and *Agistemus*. (Acarina : Stigmaeidae). *Univ. Calif. Pub. Ent.*, **41** : 1-65.
- Gupta, S. K. and Paul, K. 1985. Some mites associated with birds' nests in West Bengal, with description of eleven new species. *Bull. zool. Surv. India*, **7** : 1-23.
- Wood, T. G. 1967. New Zealand mites of the family Stigmaeidae (Acari : Prostigmata) *Trans. Roy. Soc. N.Z.*, **9**(9) : 93-139.



Rec. zool. Surv. India : 104 (Part 3–4) : 63-76, 2005

KONDAKARLA LAKE, ANDHRA PRADESH — A TAXOECOLOGICAL PROFILE

S. V. A. CHANDRASEKHAR AND S. Z. SIDDIQI*

*Freshwater Biological Station, Zoological Survey of India,
1-1-300/B, Ashoknagar, Hyderabad-500 020*

INTRODUCTION

Kondakarla 'ava', a freshwater lake, located north-east of Kondakarla village, lies between latitudes 17°35'30" and 17°36'02" N, and longitudes 82°01'0" E, *Ca.* 18 Kms from Anakpalle, Visakhapatnam District, was taken up for detailed limnological investigations, including observations on its plankton diversity.

The 'ava' has been focus of attention in past through studies on Aquatic productivity (Seshavatharam, 1982), Phytoplankton production (Murthy & Seshavatharam, 1988) decomposition studies on macrophytes (Seshavatharam, 1989), Protozoan fauna associated with macrophytes (Jayaraju and Kalavathi, 1986) besides detailed limnological studies (Seshavatharam and Chandramohan 1978-1982, Unpublished). The other academic endeavors include Vijaya Kumari, 1996), Sankara Rao (1982), Ratna Rao (1984) and Venu (1981) (Unpublished).

MATERIAL AND METHODS

The water spread area of the lake is about 6.5 km. The shape of the lake can best be described as irregular resembling a many pronged rhizome. It roughly measures *Ca.* 3 km in North-South direction and about 2.5 kms in the East-West direction. The lake has a relatively small catchment area, *Ca.* 20 km. It is also mostly fed by hill stream and supply channel from river Sarada. The Munagapaka channel in Munagapaka mandal, serve as inlet for inflows into the 'ava' from the Sarada river. An outlet, permitting outflow of surplus water into the Bay of Bengal.

**Estuarine Biological Station, Zoological Survey of India, Berhampore-760 005.*

Several small villages exist surrounding the 'ava' on the south-western side. The village skirting the 'ava' is Kondakarla and therefore it draws its name. The surrounding topography – minor hills and hillocks provide shelter to the lake by way of little wind action in its surface. The air water inter phase is normally placid with little water movement. The altitude range of these hills lie between 100–300 meters (Seshavathram, 1982). The lake is surrounded by undulating plains of sandy to loamy soils save the north-western flank where the river-built plain and sandy-silting loam soil of Sarada river abuts it.

There are extensively cultivated marginal areas of the lake with lush green paddy and sugar cane fields, besides small villages all around lake's fringes. As a result the lake receives significant inputs – surface run off from field around, besides allochthonous material, rendering it fertile, rich with luxuriant growth of aquatic macrophytes both within the lake and extensive swampy margins all around. In fact, the extensive weeds and rampant reeds have assumed nuisance proportion, hindering fish culture and inland navigation. The lake is also 'home' to winged visitors and is a feeding, breeding habitat to 'migratory birds' besides residential avifauna.

Taxonomic treaties (Pennak, 1989; and Thorp and Cooch, 1991) including Indian literature (Michael and Sharma, 1988; and Battish, 1992, Cook, 1996) were used as desk manuals for identification of zooplankton as well as aquatic plants.

The 'ava' (Telugu), or currently wetland, was limnologically surveyed using indigenous country 'boats', in reality hollow logs of palm tree-trunk, that serve as substitutes for traditional boats. The wetland is accessible by road from Kondakarla village and surveys/sampling for limnological investigations were initiated from the macrophyte-choked shallow waters around the village. The country boats were slowly towed from shallow, littoral regions to waters off or around Haripalem Village and measurements of subsurface water temperature, pH, conductivity *etc* made besides measurements of Sacchi Disc Transparency or visibility (Z_s , m) and depth (using lead weight). Samples for netzooplankton (using towing plankton net No.25 Nylon Bolt with a 100 ml PVC bottle tied at its extreme end) for qualitative studies, were collected from each sampling site. An Indianised version of Kemerler-Type lake water/lake plankton from desired depth at each sampling points were carried back (Hyderabad) for analysis of different forms of Phosphorous (P) and Nitrogen (N) and other ions-Silica, Sulphate *etc*.

RESULTS AND DISCUSSION

WATER QUALITY :

During the period of study, the air temperature ranged between 23–32°C and water temperature from 22–31. No definite pattern was noticed between these two factors. pH values ranged between 6.9 and 8.9, the maximum (8.9) was noticed in monsoon at Kondakarla village (may be due to the inflows of domestic sewage into the water body) and minimum (6.9) was

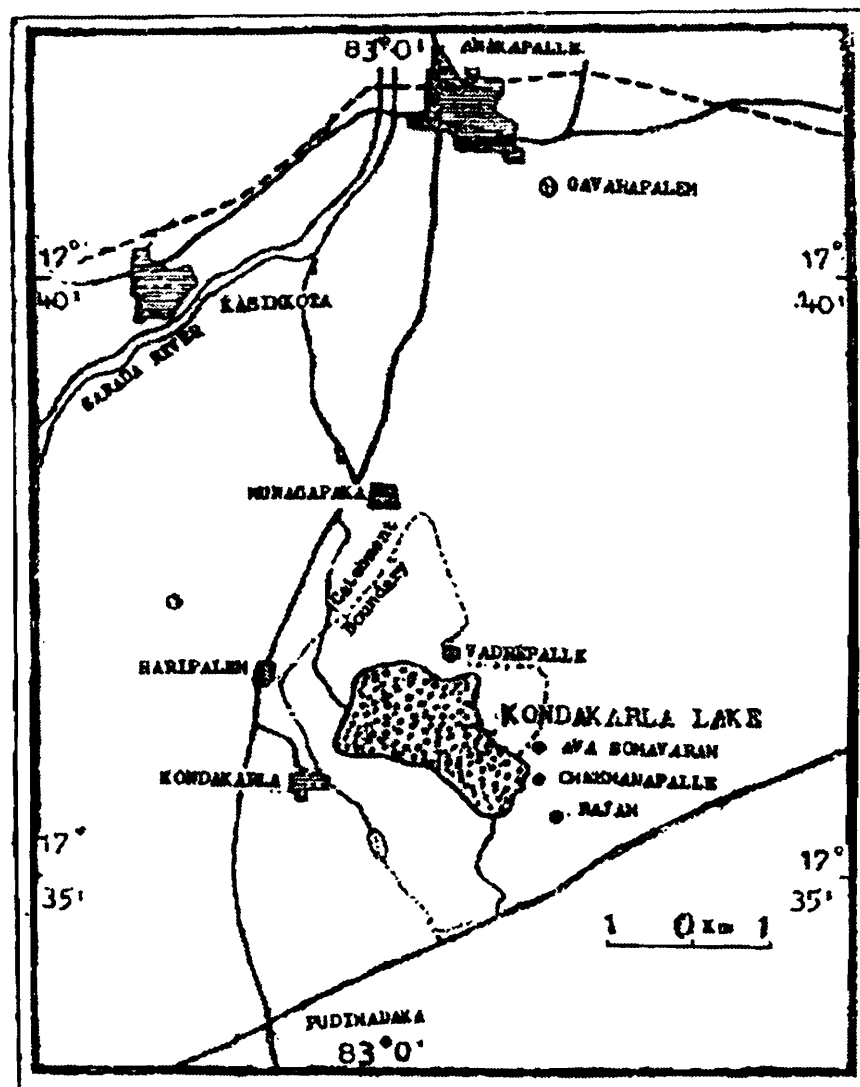
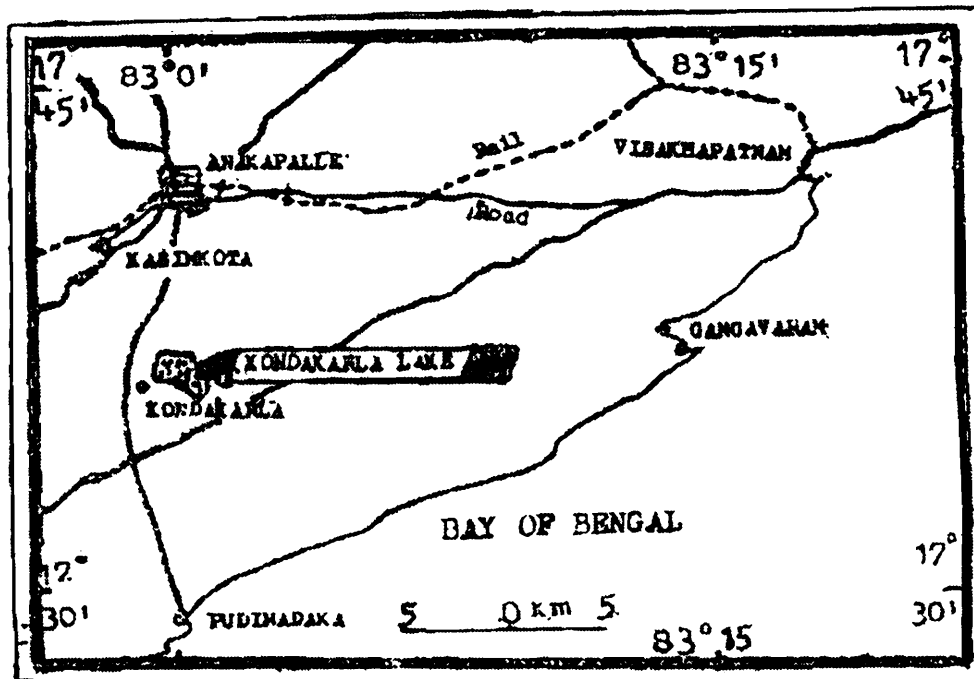
Table 1. : PHYSICO CHEMICAL PARAMETERS OF KONDAKARLA LAKE

S. No.	Parameter	Cheemanapalle			Avasomavaram			Rajam			Centre Point			Kond Village			Vadrepalle			Haripalem		
		S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W
1	Temp. (Air) C	32	31	23	32	-	25.5	32	31	26	32	31	26.5	31	31	23	32	31	28	32	31	29
2	Temp. (Water) C	29	29	22.5	29	-	24	29	29	24	29	31	24	29	29	22	29	30	25	29	30	25
3	pH	7.5	8.5	7.5	7.2	-	7.5	7.4	8.5	7.5	6.9	8.5	7.5	7.3	8.9	7.0	7.2	8.5	7.0	7.1	8.5	8.0
4	E. Cond.	840	1340	780	730	-	630	810	860	540	810	860	540	560	960	830	430	1090	510	960	1720	830
5	Turbidity (NTU)	6	60	8	540	-	6	5	50	8	5	50	8	5	50	8	20	10	8	4	60	8
6	Dis. Oxygen mg. lr	7.6	8.2	3.2	7.2	-	5.8	7.9	12.2	6.6	7.9	12.2	6.6	2.4	5.6	3.0	2.8	9.2	6.0	3.4	9.8	5.0
7	Carbonates "		70	9	35	-	80	45	20	NIL	45	20	NIL	NIL	NIL	NIL	45	60	NIL	NIL	20	NIL
		71	0	NIL																		
8	Bicarbonates "	190	185	295	200	-	135	155	255	230	155	255	230	430	290	300	235	210	180	280	315	350
9	Free Co2 "	NIL	NIL	NIL	NIL	-	NIL	NIL	NIL	NIL	NIL	NIL	4.8	9.0	6.0	4.0	NIL	NIL	1.6	0.6	NIL	8.0
10	Chloride "	149	170	110	142	-	80	142	175	75	142	175	75	184	210	70	156	145	55	160	185	70
11	Total Hardness "	140	80	165	125	-	155	135	210	155	135	210	155	185	430	200	120	280	150	175	295	270
12	Calcium "	46	17	48	38	-	40	40	34	42	40	34	42	59	92	61	40	52	40	36	50	59
13	Magnesium "	7	10	12	9	-	15	10	31	13	10	31	13	11	51	13	6	38	13	22	38	32
14	Nitrate-N	1	2	2	1	-	2	1	1	2	1	1	2	1	4	3	1	3	3	1	5	3
15	Amm. Nitrogen "	NIL	NIL	NIL	NIL	-	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
16	Total Nitrogen "	NIL	NIL	NIL	NIL	-	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
17	Phosphorous "	NIL	15	10	Traces	-	15	NIL	10	NIL	Trace	5	5	NIL	5	10	Traces	40	5	Traces	10	10
18	Silica "	30	40	25	25	-	20	25	35	25	30	25	20	25	30	25	20	30	20	25	35	25
19	Sulphates "	10	250	40	10	-	10	10	260	40	15	240	10	70	190	40	10	300	10	25	220	40

S-Summer

M-Monsoon

W-Winter



MANDAL HEAD
QUARTERS

LAKE

VILLAGES

found at Centre Point in summer. Electric Conductivity ranged between 430 and 1720 micro siemens/cm and Turbidity values found between 4 and 540 N.T.U. Dissolved Oxygen was noticed between 0.8 and 16.2 mg/litre and both the values were found Centre Point in winter and monsoon respectively. Carbonate values in the ecosystem were absent in all the seasons at Kondakarla village spot and partially in other places. This parameter ranged from 20 to 90 mg/litre and no specific pattern is noticed. Bicarbonates were observed in the range from 120 to 430 mg/litre. The lower and higher values were found in summer at Centre Point and Kondakarla village respectively. Accumulation of large quantities of bicarbonates during summer may be due to liberation of Carbon-di-oxide in the process of decomposition of bottom sediments with resultant conversion of insoluble carbonates to bicarbonates. Free carbon-di-oxide was found ranged between 0.4 and 9.0 mg/litre and this factor also has not shown any specific pattern. Occurrence of its maximum value (9.0) in summer may be due to increased decomposition of dead organic matter with the rise in temperature. Chloride quantities were observed from 45 to 210mg/Lit in the present investigation. During summer it was around 150 in almost all the spots of the water body. Comparatively, its maximum values were found in monsoon. Both the maximum (430) and minimum (80) values of Total Hardness were found in monsoon seasons at Kondakarla village and Chemanapalle respectively. The values of Calcium and Magnesium were found ranged between 17–92 and 6–51 mg/lit. respectively. Nitrate values in the lake waters ranged between 1 and 5 mg/litre. Mostly lower value (1) had been noticed in summers and higher ones (5) in monsoon. These values are far below the maximum permissible limits for drinking water (50). Ammonia nitrogen and Total nitrogen values were totally absent in the ecosystem. Phosphates were found absent and as traces in summer. The maximum value (40) was noticed in monsoon at Vadrepalle which may be attributed to letting in the agricultural run off into the water body. The value of silicates were found ranged from 20 to 40 mg/litre. The values of sulphates were noticed between 10 and 300 mg/litre. In summer, the values were found less and the higher values were in monsoon. The maximum value (300) was found in monsoon at Vadrepalle, the reason may be attributed to heavy load of domestic sewage from the surrounding colonies into the lake.

Table 1. : List of different types of aquatic plants observed in Kondakarla Lake.

I. Wetland Plants attached to substratum

A) Emergent forms

Family JUNACEAE

1. *Typha aungustata* Bory and Chaub
-

Family CYPERACEAE

2. *Cyperus* sp.*
 3. *Elacocharis* sp.
-

Family POLYGONACEAE

-
4. *Polygonum glaberrimum* Willd.
-

Family CONVULVACEAE

5. *Ipomoea fistula* Martius ex Choisy
6. *Ipomoea* sp.
-

B) Floating leaved Macrophytes

Family APONOGETONACEAE

1. *Aponogeton crispum* Thunberg**
(= *A. echinatum* Ruxburgh)
-

Family NYMPHACEAE

2. *Nymphaea nouchali* Burm
-

Family MENYANTHACEAE

3. *Nymphoides indicum* (Linnaeus) O. Kuntze
4. *Ipomoea aquatica* Forsk
(*I. reptans* auct. Ind. non Linnaeus)
-

Family FEBACEAE

5. *Neptunia oleracea* Lour
-

Family ONAGRACEAE

6. *Ludwigia adscendens* (L.) H. Hora
(= *Jussiaea repens* Linnaeus)
-

C) Submerged macrophytes

Family HYDROCHARITACEAE

1. *Hydrilla verticillata* (Linnaeus fil.) Royle
2. *Ottelia alismoides* (Linnaeus) Pers.
-

Family NAJADACEAE

3. *Najas graminea* Del.
-

Family FABACEAE

- Neptunia oleracea* Lour
4. *Chara vulgaris* Linnaeus
-

Family AMARANTHACEAE

Alternanthera sessilis (Linnaeus) R. Broron***

ex A. P. de. Condolle

(A. *triandra* Lamarck, *Achyranthes prostrata* D. Don)

Family PONTEDERIACEA

Eicchornia crassipes (Martius) Solus Lauback**II. Free floating macrophytes**

Family SALVINIACEAE

- 1.
- Salvinia*
- sp. (
- molesta*
- Mitchell) cf.****

Family AZOLLACEAE

- 2.
- Azolla filiculoides*
- am.

Family LEMNAEAE Duckweeds

- 3.
- Lemna acuinotralis*
- Welwitsch
-
- (=
- Lemna perpusilla*
- Torrey auct Ind.)

Family POACEAE (GRAMINAE)

- 4.
- Echinochloa stagnina*
- (Retz.)
-
- 5.
- Pseudoraphis spinescens*
- (R. Br.) Vickery

Family LENTIBULARIACEAE

- 6.
- Utricularia aureo*
- Loureiro
-
- (=
- Utricularia flexuosa*
- Venl)
-
- 7.
- U.stellaris*
- Linnaeus fil.

Family ARACEAE

- 8.
- Pistia stratiotes*
- Linnaeus

*1. Seshavatharam, 1982 records *Scirpus articulatus* Linn. According to Cook, 1996 *Scirpus* strictly is Restricted P. 181 to Himalayas, and not down South in Peninsular India.

**2. Exclusive to South India/Sri Lanka (Cook,1996).

***3. Essentially terrestrial, wetland sp. often partly floating, partly submerging.

****4. Seshavatharam, 1982 reports *S. auriculata* Cook, 199 records *C. cucullata* Roxburgh and *S. molesta* Mitchell from Peninsular India, excluding *S. nataris* (Linn.) restricted to Himalayas.

Table 3. : Systematic list of different genera/species and sub-species of major zooplankter groups from littoral and limnetic regions in Kondakarla lake.

ROTIFERA	
Order BDELLOIDEA	
Family PHILODINIDAE Bryce	
Genus <i>Philodina</i> (Ehbg., 1980)	
<i>Philodina citrina</i> (Ehbg., 1832)	
Order FLOSCULARIACEA	
Family FILINIDAE	
Genus <i>Filinia</i> Boryde St. Vincent, 1824	
<i>Filinia longiseta</i> (Ehrenberg, 1834)	
<i>F. opoliensis</i> (Zacharias, 1898)	
<i>F. terminalis</i> (Plate, 1886)	
Family TERSTUDINELLIDAE	
Genus <i>Testudinella</i> Bory de st. Vincent, 1826	
<i>Testudinella patina</i> (Hermann, 1783)	
Order PLOIMIDA	
Family ASPLANCHNIDAE	
Genus <i>Asplanchna</i> Gosse, 1850	
<i>Asplanchna intermedia</i> Hudson, 1886	
<i>Asplanchnopus</i> sp.	
Family BRANCHIONIDAE	
Genus <i>Brachionus</i> Pallas, 1776	
<i>Brachionus falcatus</i> Zacharias, 1898	
<i>B. falcatus</i> var. <i>lyratus</i> Lammerman, 1908	
<i>B. forficula</i> Wierzesker, 1891	
<i>B. forficula</i> f. <i>typica urawensis</i> Sudzuki, 1965	
<i>B. calyciflorus</i> Pallas, 1766	
<i>B. calyciflorus</i> var. <i>dorcas</i> (Gosse, 1851)	
<i>B. angularis</i> Gosse, 1851	
<i>B. caudatus</i> Barrois and Daday, 1894	

- B. caudatus personatus* Ahlstrom, 1940
B. quadridentatus (Hermann, 1783)
B. quadridentatus f. cluniorbicularis (Skorikov, 1879)
B. quadridentatus f. metheni (Barrois & Daddy, 1894)
B. patulus (O. F. Muller, 1786)
B. patulus macranthus
-

Genus *Keratella* Bory de st. Vincent, 1822

- K. cochlearis* Gosse, 1851
K. procurva (Thorpe, 1891)
K. quadrata (Muller, 1786)
K. tropica (Apstein, 1907)

Genus *Platylas* Haring, 1914

- P. quadricornis* Ehrb. 1882
Notholca striata (Muller, 1786)

Genus *Anuraeopsis* Lauterborn, 1900

- A. navicula* Rousselet, 1892
-

Family COLURELLIDAE

Sub family COLURINAE

Genus *Lepadella* Bory de st. Vincent, 1826

- Lepadella acuminata* (Ehrb. 1834)
L. heterostyla (Murray, 1917)
L. patella (Muller, 1786)

Genus *Colurella* Bory de st. Vincent, 1826

- Colurella obtusa* (Gosse, 1886)
-

Family LECANIDAE

Genus *Lecane* Nitzsh, 1827

- Lecane papuana* (Murray, 1913)
L. curvicorins Murray, 1913
L. luna (Muller, 1776)

Genus *Monostyla* Ehrenberg, 1830

- Monostyla hamata* (Stokes, 1896)
M. quadridentata (Ehrenberg, 1832)

M. obtusa (Murray, 1913)

M. lunaris (Ehrenberg, 1832)

M. bulla (Gosse, 1851)

M. clostocerca (Schmarda, 1859)

Family MYTILINIDAE

Genus *Mytilina* Bory de st. Vincent, 1826

Mytilina ventralis Ehrenberg, 1832

Family TRICHOCERCA

Genus *Trichocerca* Lamarck, 1801

Trichocerca longiseta (Sehran, K. 1802)

T. ratus (Muller, 1776)

Family TRICHOTRIIDAE

Genus *Trichotria*

Trichotria tetractis (Ehrb. 1832)

CLADOCERA

Family SIDDIAE Baird, 1830

Genus *Diaphanosoma* Fischer, 1850

Diaphanosoma sarsi Richard, 1895

Family DAPHNIDAE Straus, 1820

Genus *Ceriodaphnia* Dana, 1853

Ceriodaphnia cornuta Sars 1885

Family MOINIDAE Goulden, 1968

Genus *Moina* Baird, 1850

Moina brachiata (Jurine, 1820)

Family BOSMINIDAE Sars, 1965

Genus *Bosminopsis* Richard, 1895

Bosminopsis deitersi (Richard, 1895)

Family MACROTHRICIDAE Norman & Brady, 1867

Genus *Macrothrix* Baird, 1843

Macrothrix Spinosa King, 1853

Family CHYDORIDAE Stebbing, 1902

Subfamily CHYDORINAE

Genus *Chydorus* Leach, 1816

Chydorus reticulatus Daddy, 1898

C. parvus (Daday, 1898)

Genus *Dunhevedia* King, 1853

Dunhevedia serrata Daday, 1898

Subfamily ALONINAE Frey, 1967

Genus *Alona* Baird, 1843 emend Smirnov, 1971

Alona davidi davidi Richard, 1895a

A. davidi punctata (Daday, 1895)

A. rectangula rectangula Sars, 1862a

A. rectangula rechardi (Stingelin, 1895)

Genus *Dadaya* Sars, 1901

Dadaya macrops (Daday, 1898)

Genus *Biapertura* Smirnov, 1971

Biapertura karua (King, 1853)

Subclass COPEPODA

Order CALANOIDA Sars, 1903

Family DIAPTOMIDAE Baird, 1850

Subfamily DIAPTOMIDAE Kiefer, 1932

Genus *Heliodiaptomus* Kiefer, 1932

Heliodiaptomus viduus

Heliodiaptomus sp.

Genus *Phyllodiaptomus* Kiefer, 19368

Phyllodiaptomus sp. 88/8

(Plus) Nauplius (N'-N6) Copepodid (1-L6) Stages

Suborder CYCLOPOIDA

Family CYCLOPOIDA Dana, 1853

Genus *Mesocyclops* Claus, 1893*Mesocyclops leuckarti* (Clause, 1857)*M. varicans* Sars, 1863

(Plus) Nauplius (N'-N6)/Copepodid (C'-C6) stages

Subfamily EUCYCLOPINAE Kiefer, 1929

Genus *Eucyclops* Claus, 1893

Class OSTRACODA (Latreille, 1802)

Subclass PODOCOPA (Muller, 1894)

Order PODOCOPSDIA Sars, 1866

Super Family CYPRIDIDAE Baird, 1854

Genus *Cypris* O. F. Muller, 1776*Cypris* sp.Genus *Stenocypris* Sars, 1889*Stenocypris major* (Baird, 1859)*S. malcomsoni* Brady, 1886Genus *Strandesia* Stauhlmann, 1888*Strandesia elongata* Hartmann, 1964Genus *Centrocypris* Vavra, 1895*Centrocypris* sp.

SUMMARY

Kondakarla 'ava' a 600 ha. perennial freshwater wetland, is a relatively less known, non-descript lake, despite its good taxonomic potential from view point of diversity and distribution of zooplankton elements, besides overall wetland biodiversity. Observations on the lake dimensions, ambient lake water quality, its trophic status *vis-à-vis* plant nutrients, general/composition and ecology of the zooplankton community and macrophytes have been incorporated. In all, > 71 species under five major zooplankter – groups – Rotifera (44 sp), Cladocera (14 sp), Copepoda (5 sp.) Ostracoda (5 sp) and others (1 sp.) were identified. While Copepods predominate, rotifers and cladoceran fauna exhibit rich diversity, in their overall species content, in this primarily Oligotrophic lake type.

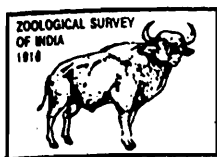
ACKNOWLEDGEMENTS

The authors owe their sincere thanks to Dr. J. R. B. Alfred, Scientist 'SH' and Director, Zoological Survey of India (ZSI), Calcutta 7 00 053 and (late) Dr. Kaza V. Ram Rao, (Retd.) Scientist 'SF' and Officer-in-Charge, Fresh water Biological Station (FBS), ZSI, Hyderabad 500 020 for providing facilities and permission. We are also thankful to Drs. R. Kameswara Rao and L.M. Rao, Readers, Department of Zoology, Andhra University, Visakhapatnam-530 003 for access to unpublished reports M. Phil theses *etc.*

REFERENCES

- Battish, S. K. (1992). *Freshwater Zooplankton of India*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 233 pp. Cook, Christopher.
- Cook, S. E. K. (1976). Quest for an index for community structure sensitive to water pollution. *Environ. Pollut.*, **11** : 269-88.
- Jayaraju, P. and Kalavathi, C. (1986). Ecological studies on the ciliates associated with Hydrophytes in a freshwater lake, Kondakarla (Visakhapatnam District). *Uttar Pradesh J. Zool.* **6**(2) : 201-206.
- Lind, O. T. (1979). *Handbook of common methods in Limnology*. C. V. Mosby Company, St. Louis 199 pp. -2/e.
- Michael, R. G. and Sharma, B. K. (1988). *Fauna of India : Indian, Cladocera* Zoological Survey of India Publ. Calcutta. pp. 262.
- Murthy, K. S. M. and Seshavatharam, V. (1988). Diurnal and seasonal variations in phytoplankton production of lake Kondakarla. *Proc. Indian Acad. Sci. (Plant Sciences)*, **98**(2) : 99-109.
- Murthy, K. S. M. and Seshavatharam, V. (1988). Decomposition studies on two floating leaved macrophytes, *Nymphaea nouchali* and *Nymphoides indica*, of lake Kondakarla, India. *Proc. Indian Acad. Sci. (Plant Sciences)*, **99**(5) : 473-483.
- Pennak, Robert W. (1989). *Freshwater Invertebrates of the United States – Protozoa to Mollusca*. John Wiley & Sons, INC New York pp. XVI+ 628, 3/e.
- Ratna Rao, (1984). Studies on limnological aspects of lake Kondakarla (Visakhapatnam) with special reference to plankton and periphyton. *Ph.D. Thesis* Andhra University. Visakhapatnam.
- Seshavatharam, V. (1982). An Ecological Study of Fresh Water Wetlands in relation to lake Kolleru and lake Kondakarla. *Proc. Seminar on Resources Development and Environment in Eastern Ghats*, March 24–27, 1982 Andhra University, Visakhapatnam.
- Seshavatharam, V. and Chandramohan, P. (1978-82). Limnological studies on Kondakarla lake—A freshwater body near Visakhapatnam. Technical Report of U.G.C. Research Scheme, Andhra University, Waltair.

- Thorp, James H. and Conch, Alan P. (1991). Eds. *Ecology and Classification of North American Freshwater Invertebrates*. Academic Press, INC San Diego pp. x + 911.
- Venu, P. (1981). A limnological aspects of lake Kondakarla. *Ph.D. Thesis*, Andhra University, Visakhapatnam.
- Vijaya Kumari, K. (1996). Fauna associated with aquatic weeds (Periphyton) and their ecological importance in Kondakarla lake, Visakhapatnam. *M.Phil Thesis*. Andhra University.
- Wetzel, Robert G. and Gene E. Likens (1979). *Limnological Analysis*. W. B. Saunders Company, Philadelphia 357 pp.



Rec. zool. Surv. India : 104 (Part 3–4) : 77-82, 2005

A NEW SUBFAMILY, GENUS AND SPECIES OF SCORPION (ARACHNIDA : SCORPIONIDA) FROM KERALA

D. B. BASTAWADE, P. M. SURESHAN AND C. RADHAKRISHNAN*

Zoological Survey of India, Western Regional Station, Pune-411 044

INTRODUCTION

Scorpion fauna of India consists of 5 families, 18 genera and 102 species. There is no separate compilation on state wise fauna yet, but stray reports are available after the Fauna of India : Scorpions by Tikader and Bastawade (1983). The scorpion fauna of Kerala state has recently been studied and reported to constitute 3 families, 7 genera and 16 species (Bastawade *et al.*, 2004). While studying the above collection we came across an interesting specimen belonging to the family Scorpionidae which was not fitting into the only known subfamily Scorpioninae and genus *Heterometrus* from Kerala state and India as a whole. Our studies thus propose to describe a new subfamily, Rugodentinae with the type genus *Rugodentus* gen.nov. and the type species *Rugodentus keralaensis* sp.nov. to the science of Indian scorpology. The present communication deals with the full description, illustrations and photograph of the specimen on which the investigations are based.

Subfamily RUGODENTINAE nov.

Characters : Pedipalp fingers with rugously granular dentition spread over in a band along the interior surface (Fig. 2); prosoma weakly incised in the anterior median margin, prosomal and mesosomal tergites I–VI finely and evenly granular on lateral portion. Metasomal segments short and strongly carinated, carinae granular; telson with shorter vesicle, coarsely granular on ventral portion, aculeus stout, broad at base, not much acutely pointed. Lateral margins of metatarsi of legs I–IV each partially overlapping base of the claw.

Type genus : *Rugodentus* gen. nov.

Distribution : Kerala, India.

Etymology : The genus is named on the basis of rugous nature of dentition on fingers of pedipalps, gender masculine.

**Zoological Survey of India, Western Ghats Field Research Station, Calicut-673 002*

Rugodentus gen. nov.

Characters : Pedipalp segments not flat dorsoventrally, but robust and globular, patella without basal process on inner margins, granular on inner portion; manus smooth, globular on dorsal portion, only one smooth external carina developed, fingers short, with inner basal, dorsal and external obsolete carinae, dentition arranged in a band of rugously granular zone without marked triangular outer or inner lateral teeth; trichobothridia of 'C' type.

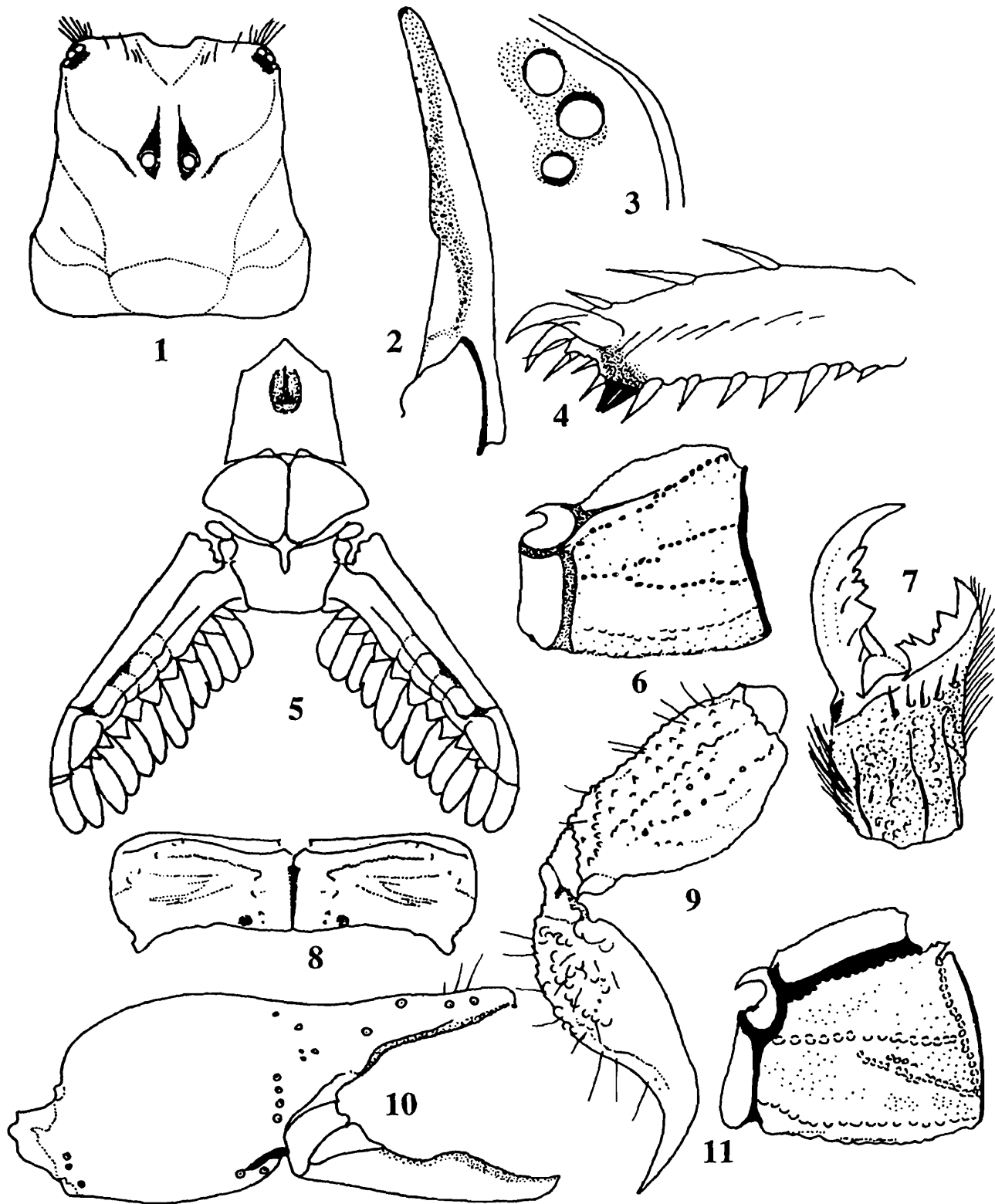
Rugodentus keralaensis sp. nov.

(Figs. 1-16, photo 1)

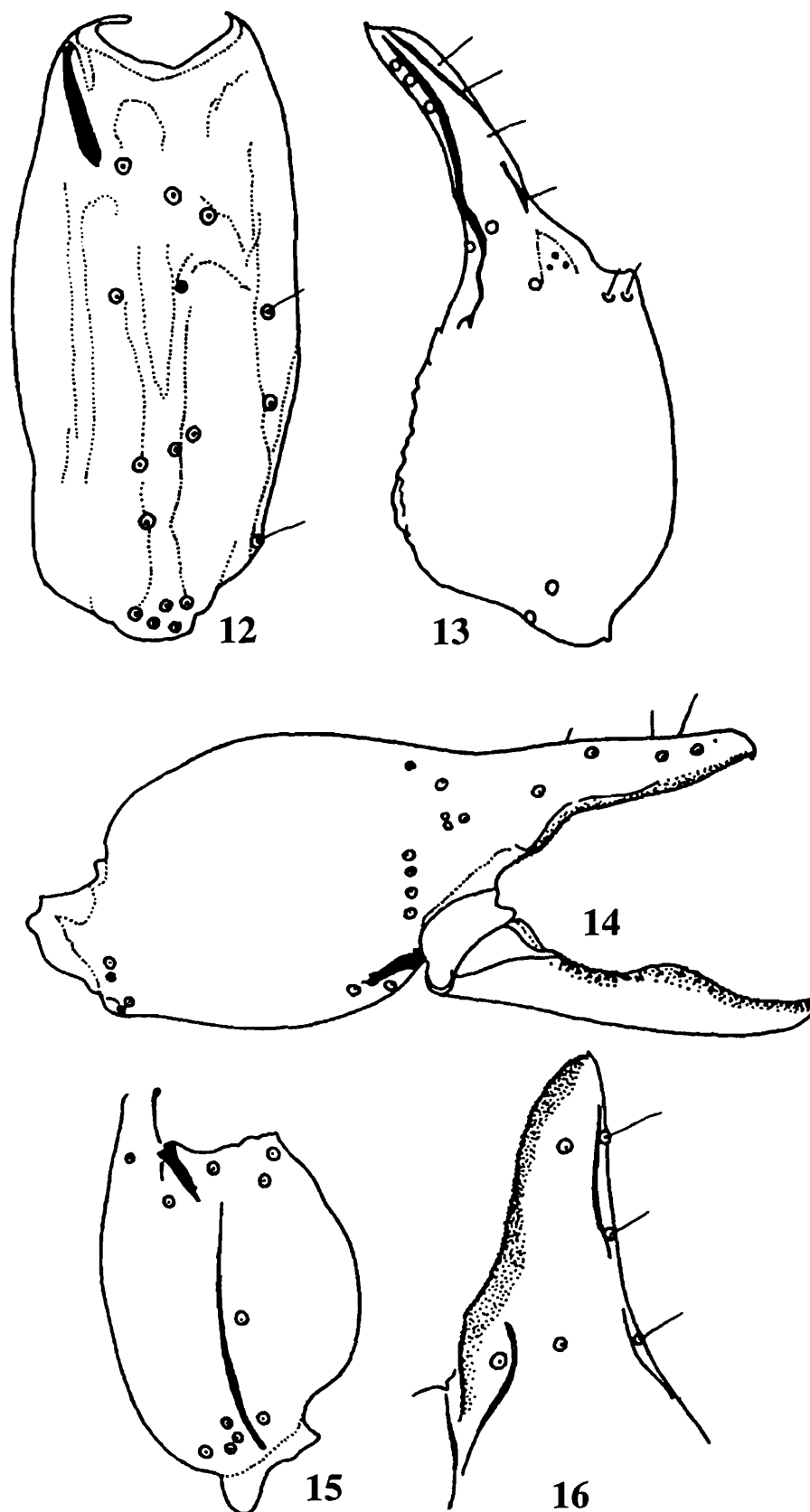
General : Male of medium size, body finely granular on lateral portions of prosoma and mesosomal tegites I–VII, blackish in color except reddish on pedipalp manus. Metasomal segments short, robust, strongly carinated; telson globular, granular on ventral portion with a minute sub-aculear granule, aculeus stout, as long as vesicular length. Legs granular on femur, light in color dorsally; metatarsi with lateral distal margin partially overlapping on claw base. Cephalothoracic sternum pentagonal, pectines well developed with 12/12 teeth.

Measurements (in mm) : Total length 40.75, prosoma 7.50 long, 5.50 anterior width, 7.00 posterior width; mesosoma 13.50 long; metasoma 19.75.

Prosoma (Cephalothorax) : Slightly longer than wide, smooth on middle portion but finely and closely granular on mid-lateral portions, margins smooth, anterior margin weakly raised on middle portion, lateral margin with a notch on anterior portion and finely granular, a pair of median eyes situated anteriorly in the ratio 1 : 1.5 (Fig. 1); three pairs of lateral eyes contiguously placed on smooth, obsolete tubercles (Fig. 3); posterior lateral furrow distinct and more shallow, median furrow deep posteriorly but indistinct around median eyes, continued anterior margin through deep median furrow into median incision. Median ocular tubercle smooth, continued anteriorly into smooth superciliary crest. Chelicerae smooth on basal segment, yellowish with black reticulation, darker on anterior portion, armed with 2 longer and 2 shorter setae dorsally; a tuft of setae covers the ventral portion. Fingers darker on outer portion, movable finger with a reduced dorso-distal fang forming a distal tooth (Fig. 7), anterior ventral margin smooth, ventral fang pointed and curved; immovable finger short with five flat teeth in row, proximal three in a group and distal placed separately distal being more robust (Fig. 7). Pedipalps comparatively stout but not much strong; reddish brown on manus and fingers; femur shorter than carapace, carinated, external carinae granular and distinct than interior, exterior surface tuberculately granular; patella longer than femur but shorter than carapace, smoother, carinae obsolete on external portion but interiors weakly and sparsely granular, exterior surface flat smooth except two groups of granules at the middle portion; carinated exterior-dorsal and inferior granular but inferior carinae smooth and obsolete; manus almost as long as wide, entirely smooth on dorsal surface, weakly and sparsely granular on inner portion, carinae (Fig. 10) smooth and obsolete, immovable finger shorter than under hand length, carinated but smooth, inner margin scalloped at the base and lined with irregularly spread granular



Figs. 1-11. *Rugodentus keralaensis* gen. et sp. nov. Male. 1. Dorsal aspects of cephalothorax (Carapace); 2. Dorsal aspects of movable finger of pedipalp; 3. Lateral aspects of cephalothorax showing lateral eyes; 4. Lateral (outer) aspects of tarsus showing ventral spination and lateral distal margin partly overlapping the base; 5. Ventral aspects of cephalothoracic sternum, genital operculum and pectines; 6. Lateral aspects of metasomal segment I showing different carinal positions; 7. Ventral aspects of chelicera showing dentition on both fingers and spination on basal segment; 8. Dorsal aspects of mesosomal tergite showing carinae; 9. Lateral aspects of metasomal segment V and telson showing carination and granulation; 10. Lateral aspects of pedipalp manus and fingers showing details; 11. Lateral aspects of metasomal segment II showing carination.



Figs. 12-16. *Rugodentus keralaensis* gen. et sp. nov. Male. 12. Exterior aspects of patella of pedipalp showing arrangement of trichobothridia; 13. Dorsal aspects of manus and immovable finger of pedipalp showing trichobothridia; 14. Lateral aspects of manus and both fingers of pedipalp showing arrangement of trichobothridia; 15. ventral aspects of manus of pedipalp showing arrangement of trichobothridia; 16. Interior aspects of immovable finger of pedipalp showing trichobothridia.

teeth in a band (Fig. 16); movable finger longer than carapace, carinated but obsolete, inner surface with a band of granular dentition, scalloped deeply at the base (Fig. 2). Trichobothridial pattern of 'C' type, with a change in position of placements (Figs. 12-16).

Legs I–IV thickly but finely granular on each femora and patella, more granular external surface, femur with granular carinae but carinae smooth or weakly granular on patellae, tibiae, metatarsi and tarsi smooth, metatarsi each with a distal moderate pedal spur and a pair of sub-distal spines and few spines on inner surface (Fig. 4), tarsi each with a pair of spined rows, and spine formula on I–IV 9/5 9/5, 9/5 9/5, 9/6 9/6, 9/6 9/6. Cephalothoracic sternum pentagonal with deep notch in the middle and a central longitudinal furrow on posterior median surface; genital operculum wider than long, a pair of operculi divided on middle portion (Fig. 5), a pair of male genital papillae seen under operculi; pectines 3.5 times longer than wide, lamellae divided, middle lamellae weakly divided, 11 fulcra, sub triangular between the bases of 12 pectinal teeth. Basal piece sub rectangular, deeply notched on anterior median portion (Fig. 5).

Mesosoma : Tergites I–VI thickly but finely granular throughout, each tergite provided with a weak, median somewhat obsolete carina, each tergite also possesses with a pair of larger obsolete granules at lateral carinal position on posterior margins (Fig. 8); pretergal portion almost smooth, tergite VII granular with two pairs of lateral granular carinae, median carinae weak, traceable only on anterior portion. Sternites III–VI entirely smooth, each provided with a pair of slit like book-lungs. Sternite VII finely granular on lateral portion with weakly crenulate lateral posterior margin, provided with 2 pairs of sub lateral and sub-median smooth but distinct carinae.

Metasoma : Slightly more than 2.5 times as long as prosoma, all segments strongly carinated, segment I wider than long, with eight carinae, dorsal granular weakly tuberculate on posterior end, superior lateral and lateral granular and lateral carinae anteriorly shift upward and merge into dorso lateral, forming a triangle with posterior margin (Fig. 6); Inferior lateral and inferior carinae smooth, segment II & III same in length, wider than long, with dorsal carinae granular, slightly raised posterior and more spiniform on II, dorsolaterals also granular and tuberculate on posterior end, laterals short, represented as granular on posterior 1/2 to 1/3 portions respectively, inferior lateral and inferiors weakly granular (Fig. 11). Segment IV as long as wide, carinated all carinae granular, dorsals tuberculate posteriorly, laterals represent on 1/3 posterior portion. Segment V shorter than prosoma, but almost as long as pedipalp femur; carinated, dorsal sparsely granular, dorsolateral present 1/2 anterior portion, sparsely granular, laterals absent, inferior lateral strongly granular and tuberculate on posterior portion; single inferior median granular, ending 1/3 portion before the granular posterior margin, a typical granular transverse sub-marginal ridge present only on inferior portion and also setose. Telson as long as carapace, vesicle longer than segment IV but shorter than V, less than as wide and deep as segment V, strongly granular on ventral surface, with a median and 2 pairs of submedian sparsely granular rows, median row tuberculate at the base of aculeus, setose ventrally (Fig. 9), aculeus almost as long as half the vesicular length, not much bent but sharply pointed (Fig. 9).

Type specimen : Holotype, male (in spirit).

Type locality : INDIA : Kerala : Ernakulam district, Kodanad, Mallana Reserve forest, 12.ii.1999, coll. P. M. Sureshan. (Reg. No. 11002).

Etymology : The species is named after the state name of type locality.

Discussion : *Rugodentus keralaensis* is described as a new species under a new genus and a new subfamily on the basis of the peculiar granular dentition on pedipalp fingers, which is apparently unknown in the known subfamily Scorpioninae. None of the Indian species show such character. Based on the pedipalp character, a new subfamily Rugodentinae is described with the new type genus *Rugodentus*. The genus has been designated based on a new type species *Rugodentus keralaensis*.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. J. R. B. Alfred, Director, Zoological Survey of India, Kolkata and to the Officer-in-charge, Zoological Survey of India, Western Regional Station, Pune for providing facilities and encouragement.

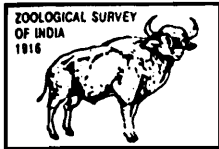
REFERENCES

- Tikader, B. K. and Bastawade, D. B. 1983. Fauna of India. Scorpions. III. Calcutta. I-xiii & 1-671.
- Bastawade, D. B., Sureshan, P. M. and Radhakrishnan, C. 2004. An illustrated key to the Identification of scorpions (Scorpionida : Arachnida) of Kerala and notes on some Interesting new records. *Rec. zool. Surv. India*. **103**(1-2) : 43-58.

PLATE I



Rugodentus keralaensis sp. nov.



Rec. zool. Surv. India : **104** (Part 3–4) : 83-90, 2005

NOTES ON SOME NOTEWORTHY SNAKE SPECIMENS DEPOSITED IN THE COLLECTIONS OF EASTERN REGIONAL STATION OF THE ZOOLOGICAL SURVEY OF INDIA

PATRICK DAVID AND ROSAMMA MATHEW*

*Département Systématique et Evolution, USM, 602 Taxonomie-collection
Reptiles & Amphibiens, Case Postale 30, Muséum National d'Histoire Naturelle,
57 rue Cuvier, F-75321 Paris Cedex 05, France*

INTRODUCTION

The collection of snakes deposited in the Eastern Regional Station of the Zoological Survey of India, Shillong, (below referred to as ZSI/ERS) holds 303 specimens (as on December 1st, 2002). This collection was dealt with by Mathew (1983). Most specimens originating from the State of Meghalaya were also cited by Mathew (1995) in an in-depth survey of the herpetofauna of this state, which was shown to hold 56 snake species. Although the herpetological survey of this state is far from complete, especially in hilly tracts, this state is herpetologically rich. Besides specimens from Meghalaya, the collection of the ZSI/ERS contains also a good number specimens from other States of Northeast India, especially from Arunachal Pradesh.

A recent re-examination of the snake collection by the authors revealed a few inaccuracies in the determination of some specimens reported by Mathew (1983, 1995), or the occurrence of specimens in Meghalaya and other states of India which were not in the recorded works cited, but which are of taxonomical and biogeographical importance. In the present paper, these additional/missing specimens are discussed, their identification corrected where necessary and most importantly they are adequately described.

Abbreviations are as follows :

Morphology : SVL : snout-vent length; TaL : tail length; TL : Total length; TaL/TL : ratio tail length/total length (all measures being in millimeters).

*Eastern Regional Station, Zoological Survey of India, Risa Colony, Shillong-793 003

Scalation : Ate : anterior temporals; Cep : cephalic scales, intersupraocular scales (counted on a straight line between the two supraoculars); DSR : dorsal scale rows (number of DSR counted at one head length behind head, at midbody [i.e. at the level of the ventral plate corresponding to half of the total ventral number], and at one head length before vent, respectively); IL : infralabials; InN : internasal scale; KSR : keeling of dorsal scale rows (0 : none, + moderately, ++ strongly); Lor : loreal scale; MSR : number of dorsal scale rows at midbody (see above); PoO : postocular; PrO : preoculars; PSR : number of dorsal scale rows before vent (see above); SC : subcaudals; SL : supralabials; SL/Or : Numbers of SL entering orbit; Te : temporals; VEN : ventrals.

Museums and Institutions : BMNH : Natural History Museum, London, UKI; NHMW : Naturhistorisches Museum Wien, Wien, Austria; ZSI/ERS : Zoological Survey of India, Eastern Regional Station, Shillong, India.

SYSTEMATIC ACCOUNT

Order SQUAMATA

Suborder SERPENTES

Family COLUBRIDAE

1. *Amphiesma parallelum* (Boulenger)

1890. *Tropidonotus parallelus* Boulenger, *F.B.I.*, p. 345.

1999. *Amphiesma parallelum* (Boulenger), David *et al.*, *J. Taiwan Mus.*, 15(2) : 92.

Material examined : ZSI/ERS 3077, Risa Colony, Shillong, Meghalaya; ZSI/ERS 9059, Tripura Castle Road, Shillong, Meghalaya; ZSI/ERS 9060, Selbelgiri, Garo Hills, Meghalaya; ZSI/ERS 9070, a stream near Fruit Garden, Shillong.

Amphiesma parallelum, described as *Tropidonotus parallelus* by Boulenger (1890 : 345; Type locality : Sikkim, now State of Sikkim, India, by lectotype designation [Kramer, 1977 : 728]) has largely been confused with several other members of the genus *Amphiesma*. The taxonomy of this group, which includes also *Amphiesma bitaeniatum* (Wall, 1925), *Amphiesma octolineatum* (Boulenger, 1904), *Amphiesma platyceps* (Blyth, 1854) and *Amphiesma sieboldii* (Günther, 1860), and their respective diagnostic characters will be addressed in another paper (David *et al.*, in prep.). It should be noted that the gender of the genus *Amphiesma* being neutral, the specific epithet should appear as *parallelum* (see David *et al.*, 1999).

The ZSI/ERS collection holds nine specimens of *Amphiesma parallelum*. While working on a revision of several subgroups of the genus *Amphiesma*, the senior author examined four specimens, which proved to be typical specimens of *Amphiesma parallelum*. As detailed descriptions of specimens of *Amphiesma parallelum* are not well known, we give in Table 1 the major morphological features of the specimens under discussion.

Table 1. : Main morphological characters found in four specimens of *Amphiesma parallelum*.

Nr	Sex	SVL	TAL	TaI/T	VEN	SC	MS	KS	SL	SL/O	Pr	Po	AT	IL
3077	M	346	118	0.254	168	72	19	+++	8/8	3-5	2/2	3/3	2/1	2/1
9059	M	416	144	0.257	161	74	19	+++	8/8	3-5	2/2	3/3	1/1	1/1
9060	F	440	147	0.250	160	74	19	+++	8/8	3-5	2/2	3/3	2/2	2/2
9070	F	583	154	0.209	163	72	19	+++	8/8	3-5	2/2	2/3	2/2	2/2

It is noteworthy to mention that specimen ZSI/ERS 9070 is by far the longest known individual, with a record total length of 737 mm. The maximal size cited by Smith (1943), who did not distinguish *Amphiesma parallelum* from *Amphiesma bitaeniatum*, was 635 mm.

The specimen ZSI/ERS 3077 and some others from the Khasi Hills deposited in the ZSI/ERS collection have a rather pale background colour, very light beige brown, with a well-defined light, black-edged dorsolateral stripe, whereas the three other specimens cited above, as well as most of those from the Eastern Himalaya regions are quite dark, with a more subdued dorsolateral pattern (David *et al.*, in prep.). All ZSI/ERS specimens show the prominent black lateral stripe interrupted at the level of the neck, (Wall (1925)), and in three of the specimens for which the dental formula was examined, the diastema between the two enlarged posterior maxillary teeth and other teeth was clearly visible.

2. *Boiga ocellata* Kroon, 1973

1973. *Boiga ocellata* Kroon, *Copeia*, 1973(3) : 581; Figs. 1-2.

Material examined : ZSI/ERS 8135, Nampong, Arunachal Pradesh; male.

This species was described by Kroon (1973) to accommodate northern populations previously referred to as *Boiga cynodon* (Boie, 1827), restricted to Indonesia, West Malaysia and South Thailand, with a northern limit located in provinces of Phang Nga and Prachuap Khiri Khan, on the Isthmus of Kra (Pauwels *et al.*, unpublished). As a consequence, Indian populations of “*Boiga cynodon*” cited by previous authors (for example Smith, 1943; Das, 1996) should be referred to *Boiga ocellata*.

The collection of the ZSI/ERS contains one specimen from India. As the examples of *Boiga ocellata* are rarely reported from India, a full and detailed account of the species is presented below.

TL 1579 mm, SVL 1201 mm, TaL 378 mm. Ratio TaL/TL : 0.239.

DSR : 23-23-15, all smooth.

VEN 249 (plus 1 prefrontal), strongly angulate; SC 124, all paired : anal shield entire.

Teeth : 3 posterior maxillary teeth strongly enlarged.

Rostral wider than high; nasal entire, subrectangular; $\frac{1}{2}$ Lor (a large pentagonal scale at left, two superposed small scales at right); 8/8 SL, 1-2/1-2 in contact with nasal, 3-6/3-6 entering orbit; no subocular, 1/1 PrO; 2/2 PoO; 2 + 3/2 + 3 Te; 12/14 IL, 1-4/1-5 in contact with anterior chin shields.

The background colour of the body and tail is brownish grey, with a complex and intricate pattern made up of dark oblique crossbars on the anterior part of body, turning as dark blotches posteriorly, separated by light, diffuse, interrupted irregular blotches; dark blotches at mid-height of flanks and conspicuous white ocelli on half of the underside. The top of the head and temporal regions are dark grayish-brown, strongly vermiculated with brown; supralabials and lower sides of head are rusty brown; a very well defined black postocular streak extends from the eye to the angle of the mouth.

The chin, throat and anterior part of the underside are lead grey and paler posteriorly.

The specimen agrees perfectly with the description given by Kroon (1973).

Family CROTALIDAE

3. *Trimeresurus medoensis* Djao in Djao & Jiang, 1977

1977. *Trimeresurus medoensis* Djao in Djao & Jiang, *Acta Zool. Sinica*, **23**(1) : 66; Pl. 2 : Figs. 9-1 to 9-5.

2002a. *Trimeresurus medoensis* Djao in Djao & Jiang : David *et al.*, *Hamadryad*, **26**(2) : 210.

Material examined : ZSI/ERS 468, "70 km from Zero Point towards Sebla, Kameng District, NEFA", now in East Kameng District, State of Arunachal Pradesh; female.

The presence in India of this species described in Djao & Jiang (1977) from Medog (or Motuo), Xizang Province, People's Republic of China, was confirmed by David *et al.*, (2002a). The first definitely known locality in India is Gandhigram village (also known as Shidi), at 27°26'27"N, 96°54'55", in Changlang district, state of Arunachal Pradesh. Literature records this species from northern Myanmar and China. The specimen under discussion is, therefore, certainly the second record from India.

Description follows :

TL 615 mm, SVL 501 mm, TaL 114 mm, Ratio TaL/TL 0.185.

DSR : 17-17-13, moderately keeled, smooth on the first outer row.

VEN 146 (plus 2 preentrals), SC 61, all paired : anal shield entire.

Rostral wider than high; nasals entire, subrectangular; 1 pair of enlarged InN, separated each from another by 2 small scales; scales on upper snout surface smooth, juxtaposed, distinctly enlarged; 1/1 triangular loreal between upper preocular and nasal; 2/2 PoO; 1 entire SpO on each side, short and broad, wider than InN; 8 Cep in a line between SpO, small, irregular, juxtaposed, smooth and flat; occipital scales flat, slightly keeled backward; temporals large, unequal, in 3 rows, smooth,

the lower row much larger than others; one thin, elongated, crescent-like subocular; 9/9 SL, 1st SL, short, totally separated from the nasal, 2nd SL high, forming the anterior border of loreal pit, 3rd SL larger than the other SL, high and long, in contact with subocular on both sides, 4th SL as high as 3rd, in contact with subocular on both sides; 10/10 IL, those of the first pair in contact with each other, the first three pairs in contact with the chin shield.

The overall colour is uniformly dark green; a well defined bicoloured ventrolateral stripe extends from the angle of the mouth to the base of the tail; on the first and second dorsal scale rows, rusty red on its lower half, mainly on lower half of 1st dorsal scale row, whitish-yellow above, on upper half of 1st and lower third of second dorsal scale rows. The tail surface is same coloured as dorsum, with the whole length of its upper part irregularly marked with reddish-brown.

The top of the head and temporal regions are of the same colours as the dorsum; no postocular streak; supralabials paler than upper head surface.

The belly, chin and throat are green but slightly lighter than the dorsum.

The present specimen extends the known range of *Trimeresurus medoensis* by about 350 airline kilometers southwestwards from Medog and about 375 airline km westwards from the previously known Indian locality. It is likely to occur in other parts of Arunachal Pradesh, Nagaland and Bhutan as well.

4. *Trimeresurus gumprechtii* David, Vogel, Pauwels & Vidal, 2002

2002. *Trimeresurus gumprechtii* David, Vogel, Pauwels & Vidal, *Nat. Hist. J. Chulalongkorn Univ.*, 2(1) : 7; Figs. 1-8.

Material examined : ZSI/ERS 486, "Arbuthnot Rd., in front of Assam Fiffles Office, Shillong" Meghalaya; male.

This specimen was reported by Mathew (1995) as *Trimeresurus stejnegeri*. David *et al.*, (2002b) described *Trimeresurus gumprechtii* from northern Thailand, a species closely related to *Trimeresurus stejnegeri* Schmidt, 1925. These authors suggested that the populations from India and Myanmar referred in literature to *Trimeresurus stejnegeri* or *Trimeresurus yunnanensis* with 21 MSR, cited for example, by Smith (1943), should in fact be referred to *Trimeresurus gumprechtii*. The examination of the ZSI/ERS specimen, a typical specimen of *Trimeresurus gumprechtii*, undistinguishable from Thai specimens, confirms the occurrence of *Trimeresurus gumprechtii* both in the state of Meghalaya and in India. The species is described below :

TL 583 mm, SVL 486 mm, TaL 97 mm, Ratio TaL/TL 0.166.

DSR : 21-21-15, distinctly keeled, smooth on the first outer row.

VEN 159 (plus 2 preventrals), SC 59, all paired; anal shield entire.

Hemipenis short and strongly spinose, extending in situ up to 15th SC (presence of spines checked by dissection).

Rostral wider than high; nasals entire, subrectangular; 1 pair of enlarged internasals, separated each from another by 3 scales (2 enlarged and a smaller central one); scales on upper snout surface smooth, juxtaposed, distinctly enlarged; 1/1 triangular loreal between upper preocular and nasal; 2/2 PoO; 1 entire SpO on each side, long and narrow, not wider than InN; 10 Cep in a line between SpO, small, irregular, juxtaposed, smooth and flat; occipital scales flat, slightly keeled backward; temporals unequal, in 3 rows, smooth, the lower row larger than others; one thin, elongated, crescent-like subocular; 9/9 SL, 1st SL, short, totally separated from the nasal, 2nd SL high, forming the anterior border of loreal pit, 3rd SL the largest, high and long, in contact with subocular on both sides, 4th SL shorter, separated from subocular by 1 scale; 11/11 IL, those of the first pair in contact with each other, the first three pairs in contact with the chin shield.

The background colour is dark green. A well defined bicoloured ventrolateral stripe, red or chocolate red below, white above, extends on the 1st DSR from the angle of the mouth up to first third of the tail (at about 20th SC). The tail surface is of the same colour as that of the dorsum, with the whole length of its upper part irregularly mottled with reddish-brown, which forms backwards a continuous stripe. The underparts, chin, and throat are grass green.

The top of the head and temporal regions are of the same colour as that the dorsum; slightly paler in the region of supralabials. A bicoloured; red above, white below postocular streak extends on 2nd and 3rd rows of temporals from behind the eye to the corner of the mouth; the upper red part is wide and broad, the lower white part is narrow and paler.

If this specimen confirms the occurrence in India of *Trimeresurus gumprechtii*, other recently examined specimens originating from Northeast India, Myanmar and northern Thailand – recently collected or long preserved but erroneously identified – largely extend or/and confirm the range of *Trimeresurus gumprechtii*. This data will be presented elsewhere (David *et al.*, in prep.). As explained in David *et al.*, (2002b), *Trimeresurus stejnegeri* is not definitely known from India, which is inhabited by both *Trimeresurus yannanensis* and *Trimeresurus gumprechtii*. Nevertheless, Malhotra & Thorpe (2004) suggested the occurrence of *Trimeresurus stejnegeri* in Northeast India. We examined three specimens listed by these authors (BMNH 60-3-19-1121, BMNH 1907.12.16.27 [incorrectly listed as 107.12.16.27] and NMW 23805). On the basis of the morphology and scalation, we identify all of them as *Trimeresurus gumprechtii*.

CONCLUSION

The records published earlier (Mathew (1983, 1995)) should be modified deleting *Trimeresurus stejnegeri* from both Meghalaya and Arunachal Pradesh and including *Trimeresurus gumprechtii* in the fauna of the state of Meghalaya and of India.

It is noteworthy that the sole specimen of *Amphiesma khasiense* (Boulenger, 1890) cited by Mathew (1995) as present in the ZSI/ERS collection (ERS/ZSI 400), proved to be in fact a misidentified specimen of *Xenochrophis piscator* (Schneider, 1799). As a matter of fact there does not exist a representative of this species in the ophidian collection of the ERS/ZSI. The paucity of the material might suggest either that populations are very localized, occurring in the higher elevations of the Khasi Hills, or that this species is very secretive. It may also be due to the lack of intensive investigations of the areas.

ACKNOWLEDGEMENTS

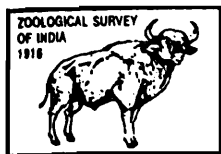
The authors are indebted to Dr. J. R. B. Alfred (Director, Zoological Survey of India) and Mr. S. J. S. Hattar, Officer-in-charge of Eastern Regional Station, Zoological Survey of India, Shillong for permission to study the material, and for providing the senior author laboratory facilities and extending the courtesies for the paper under report.

We also thank warmly Indraneil Das (Universiti Malaysia Sarawak, Kota Samarahan, Malaysia) and Gernot Vogel (Society for Southeast Asian Herpetology, Heidelberg, Germany) for their critical reading of the manuscript and their constructive comments.

REFERENCES

- Boulenger, G. A. 1890. *The fauna of British India, including Ceylon and Burma. Reptilia and Batrachia*. London, Taylor & Francis : i-xviii + 1-541.
- Das, I. 1996. *Biogeography of Reptiles of South Asia*. Malabar (Florida), Krieger Publishing Company : 1-87.
- David, P., Captain, A. & Bhatt, B. B. 2002a. On the occurrence of *Trimeresurus medoensis* Djao in Djao & Jiang, 1977 (Serpentes, Viperidae, Crotalinae) in India, with redescription of this species and notes on its biology. *Hamadryad*, **26**[2001](2) : 222-238.
- David, P., Vogel, G. & Pauwels, O. 1999. *Amphiesma optatum* (Hu & Djao, 1966), (Serpentes, Colubridae) : an addition to the snake fauna of Vietnam, with a list of the species of the genus *Amphiesma* and a note on its type species. *J. Taiwan Mus.*, **15** [1998](2) : 83-92.
- David, P., Vogel, G., Pauwels, O. S. G. & Vidal, N. 2002b. Description of a new species of the genus *Trimeresurus* from Thailand, related to *Trimeresurus stejnegeri* Schmidt, 1925 (Serpentes, Viperidae, Crotalinae). *Nat. Hist. J. Chulalongkorn Univ.*, Bangkok, **2**(1) : 5-19.
- Djao, E. M. & Jiang, Y. M. 1977. A survey of reptiles in Xizang Autonomous Region, with faunal analysis and descriptions of new forms. *Acta. zool. Sinica*, **23**(1) : 64-71, pls. 1-2. (In Chinese, English summary).
- Kramer, E. 1977. Zur Schlangenfauna Nepals, *Rev. Suisse Zool.*, **84**(3) : 721-761.

- Kroon, C. 1973. A new colubrid snake (*Boiga*) from Southeastern Asia. *Copeia*, **1973**(3) : 580-586.
- Malhotra, A. & Thorpe, R. S. 2004. Maximizing information in systematic revisions : a combined molecular and morphological analysis of a cryptic green pitviper complex (*Trimeresurus stejnegeri*). *Biol. J. Linnean Soc.*, **82** : 219-235.
- Mathew, R. 1983. On a collection of snakes from North-east India (Reptilia : Serpentes). *Rec. Zool. Surv. India*, **80** : 449-458.
- Mathew, R. 1995. Reptilia. In : A. K. Ghosh (Ed.), *Fauna of Meghalaya, Part I. Vertebrates*. Calcutta, Zoological Survey of India, *State Fauna Series*, **4** : 379-454, map, Figs. 1-4, Pls. 1-38.
- Smith, M. A. 1943. *The Fauna of British India, Ceylon and Burma, including the whole of the Indo-chinese subregion. Reptilia and Amphibia. Vol. III, Serpents*. London, Taylor & Francis : i-xii + 1-583.
- Wall, F. 1925. Notes on snakes collected in Burma in 1924. *J. Bombay Nat. Hist. Soc.*, **30**(3-4) : 805-821.



Rec. zool. Surv. India : **104** (Part 3–4) : 91-97, 2005

EXTENSION IN THE DISTRIBUTION OF BURMESE WHISKERED BAT *MYOTIS MONTIVAGUS* (DOBSON, 1874) IN THE NORTHERN WESTERN GHATS RANGE MAHARASHTRA, INDIA

V. S. KORAD, M. C. GAIKWAD AND K. D. YARDI

Department of Zoology, Fergusson College, Pune, Maharashtra-411 004

INTRODUCTION

Among the evening bats (Vespertilionidae, Chiroptera), the genus *Pipistrellus* is common in the urban area and in the spurs of Western Ghats region. While surveying the bats in the Western Ghats region, it was noticed that as compared to the *Pipistrellus*, *Myotis* bats require more specific roosting sites and high humidity in the surrounding.

In Indian subcontinent *Myotis montivagus peytoni* is endemic subspecies and reported at the high altitude, from 1300 feet (390 m) to 3490 feet (1047 m) (Bates & Harisson, 1997). Previously it was reported from Eastern Ghats region near Vishakhapatnam (Ghosh, 1989) and Western Ghats region of Karnataka (Wroughton, 1913i) and Kerala states (Bates & Harrison, 1997).

METHODS

The Central Western Ghats of Maharashtra state, India (approximately N 19°30'–E 74° 20' to N 17°56' E 73°42') was surveyed for the assessment of bat fauna. During this survey, the bat species were identified, the permanent roosting sites were recorded and other ecological details were noted down.

Each of the colonies of the Burmese Whiskered bat, *Myotis montivagus* (Dobson, 1874) was found out during day time observing the heaps of fecal matter on the floor of the roosting site. One mature male bat was collected from the crevices in which they were resting. The taxonomy was confirmed by external cranial and dental measurements.

For the study of the feeding habit of the species under study, the fecal matter analysis was performed as described by Whitaker Jr. J. O., (1998).

OBSERVATIONS

While surveying the bat fauna in the Western Ghats region, two male Burmese Whiskered bats, *Myotis montivagus* (Dobson, 1874) (Registration No. M/653, Zoological Survey of India, Western Region, Akurdi-Pune) were reported at two different places in Mahabaleshwar region. The taxonomical details of the specimens are as follows :

Class MAMMALIA
 Order CHIROPTERA
 Suborder MICROCHIROPTERA
 Family VESPERTILIONIDAE
 Genus *Myotis*
 Species *Montivagus*

1874c. *Vespertilio montivagus* Dobson, 237 : Type locality : Hotha, Yunnan, China.

Diagnosis of genus : The ears are comparatively tall, with spear shaped and straight tragus. The tail is enclosed in the inter-femoral membrane. The rostrum is about equal in length to the braincase.

$$\text{Dental formula : } i \frac{-2 \ 3}{1 \ 2 \ 3} c, \frac{1}{1} pm, \frac{-2 \ 3 \ 4}{-2 \ 3 \ 4} m, \frac{1 \ 2 \ 3}{1 \ 2 \ 3} = 38$$

Diagnosis of species : The medium sized bat with forearm length ranging between 44.5 mm and 46.3 mm. The pelage is soft and black with brown and white tips on the dorsal side. On the ventral side the tips of hair are paler, almost brownish white with dark base. The second upper premolar (Pm³) is small. The second lower premolar (Pm₃) is small and consists about half the crown area of the first (Pm₂). The anteorbital foramen is widely separated from the anterior rim of the orbit.

Taxonomic remarks : The specimens from southern India are larger in size than that of Myanmar specimens. The present bat specimens from the Northern Western Ghats resemble the specimens of Southern India, which are referred to *M. m. peytoni*. The subspecies is endemic to the Indian subcontinent.

External, Cranial and Dental measurements (in mm) of *Myotis montivagus peytoni*.

HB	52.5	GTL	17.5
HF	9.4	CCL	15.2
T	35.3	PC	3.9
FA	45.4	ZB	12.0
E	14.5	BB	8.0

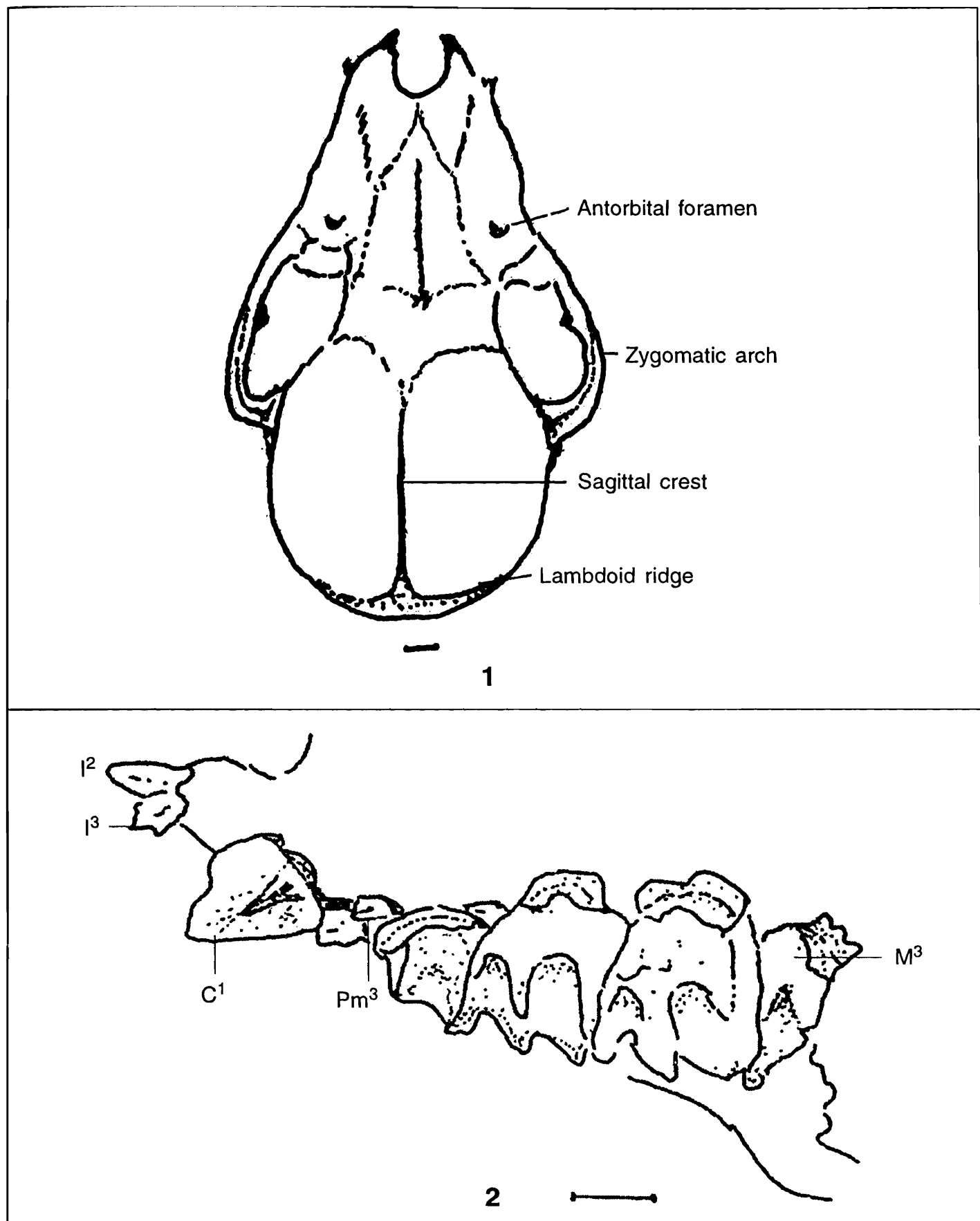


Fig. 1. : The camera lucida sketch of the skull (dorsal view) of *Myotis montivagus* showing flaring of the zygomatic arches and wide space between the antorbital foramen and the orbital fossa. Bar = 1 mm.

Fig. 2. : The cameralucida drawing of the maxillary teeth of *Myotis montivagus*. Bar = 1 mm.

TIB	18.3	CM ³	6.3
5MT	39.7	CM ₃	7.0
4MT	40.6	M ³ –M ³	7.0
3MT	41.6	M	13.1
RW	6.8	C ¹ –C ¹	4.8

n = 2, Sex – male

HB : Head and Body length, HF : Foot length, T : Length of Tail, FA : Length of Forearm, E : Length of Ear, TIB : Length of Tibia, 5MT : Length of 5th Metacarpal, 4MT : Length of 4th Metacarpal, 3MT : Length of 3rd Metacarpal, RW : Width of Rostrum, GTL : Greatest length of skull, CCL : Condylar-canine length, PC : Post-orbital constriction, ZB : Zygomatic breadth, BB : Breadth of braincase, CM³ : Maxillary tooth row, CM₃ : Mandibular tooth row, M³–M³ : Posterior palatal width, M : Mandibular length, C¹–C¹ : Anterior palatal width.

GENERAL COMMENTS

The wing membranes are naked and uniformly dark brown. The ear is comparatively short and its tip is bluntly round. The anterior surface of the pinna is smoothly concave and the posterior margin has a shallow concavity below the tip.

Cranial characters : The cranium is relatively robust and broad with an average condylar-canine length of 15.3 mm and the breadth of the brain case is 8.0 mm. The sagittal ridge lacks post-orbital ridges in front, but the lambdoid ridges are well marked. The nasals show gradual gradient from posterior to the anterior end, the bones are almost flat anteriorly. The zygomatic arches are strong and much flared. The palatal region is longer, but relatively less concave.

Dentition : Both the upper and lower canines are strong, short, with broad base and blunt tip. When compared with the corresponding canine, the third premolar (Pm⁴ and Pm₄) is strong and slightly less in height and crown area.

Both first (Pm²) and second upper premolars (pm³) are minute, the second upper premolar (pm³) is intruded, but the first (Pm²) and third upper premolars (pm⁴) are not in contact. M³ is less than half the size of M². M¹ is relatively short and broad as compared to M².

On the lower jaw all the three premolars are in tooth row. The first two incisors are tricuspid, but the third one has four cusps. The coronoid process of mandible is much elevated.

Ecological remarks : The Burmese Whiskered bat, *Myotis montivagus* were collected from Mahabaleshwar area (N 17°56' – E 73°42') at two different places, about 15 km – 20 km away from each other. One male bat was collected in late October 2002 and the other of same sex in late February 2004. Both were mature and roosting in isolation in the shallow holes in the basalt rock. The rock was dripping continuously even in the dry winter in the first case and early summer in the latter. The heaps of fecal matter under the roosting site indicated the use of site for considerably long period. The temperature of the microhabitat was 20°C and humidity recorded was 110%.

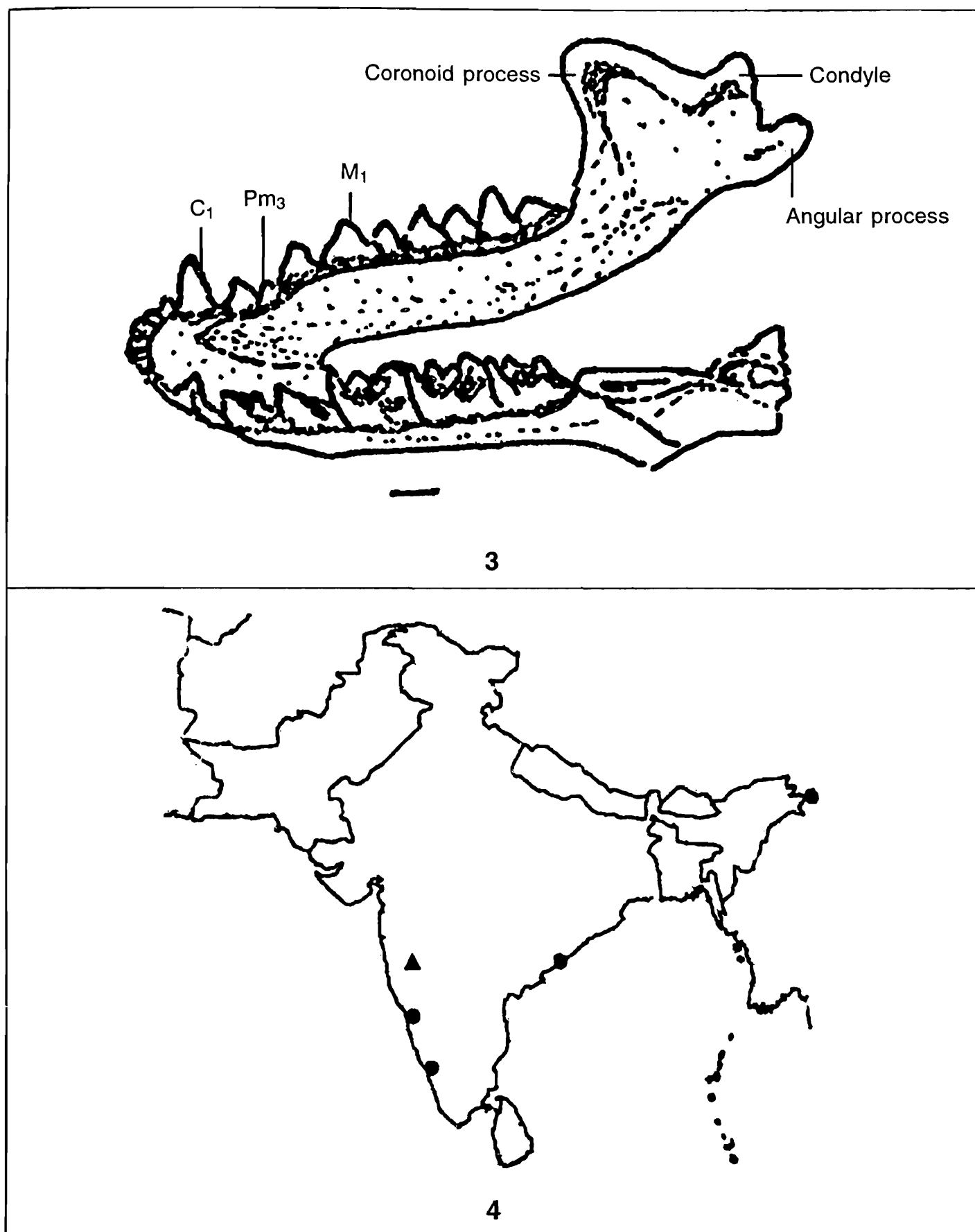


Fig. 3. :The camera lucida drawing of the lower jaw of *Myotis montivagus*. Bar = 1 mm.

Fig. 4. :Distribution of *Myotis montivagus* in India. ● Previous records (as mentioned by Bates & Harrison, 1997) and ▲ the recently found out location in the northern part of the Western Ghats.

Nothing could be known about the reproductive cycle, since female bats were not found. But the maternity colony is assumed in the nearby place, as most of the evening bats reproduce in post winter season in India and parturition occurs just before monsoon.

Feeding habits : The fecal analysis showed remnants of exoskeleton of hard shelled beetles, scales of moths, parts of antennae, wings, mouth-parts, legs and cornea of beetles and moths.

Beetles dominated the fecal matter visually and comprised about 98% of fecal matter, remaining was of soft bodied moths. The results indicate preference of bats towards hard shelled insects.

DISCUSSION

Myotis montivagus is reported from China, Myanmar, Western Malaysia, Indonesia and India. In the Indian subcontinent it is reported at Gersoppa falls (Type locality of *M. montivagus peytoni* in Karnataka state, India) and Anakkampoye (Kerala state, India) in the Western Ghats region and two additional localities in the Vishakhapatnam district of the Eastern Ghats of India. Their distribution ranges from the altitude 400 meters (Wroughton, 1913i, at Gersoppa) to 1052 meters (Ghosh, 1989, at Eastern Ghats). The present study reports the extension in the distribution of this species towards northern part of the Western Ghats region and again at the altitude 1340 meters at two places in the Mahabaleshwar region (Maharashtra state, India). Preference for roosting site at high altitude in the vicinity of the running streams or big falls for the present species, therefore is clearly evident. Not much is known about the reproduction of this species till now.

CONSERVATION STATUS

Myotis montivagus is included as "Lower Risk, Near Threatened" in the 1996 IUCN Red List of Threatened Animals (Baillie & Groombridge, 1996). In India the species is considered Vulnerable (C.A.M.P. 2002, workshop for Chiroptera of south Asia, Madurai), due to restricted area and continuing decline in quality of habitat (B2ab-iii; D2). The occurrence of the species in the Northern Western Ghats seemed to be rare.

SUMMARY

The evening bats belonging to genus *Myotis* are found restricted to rich water sources in the Western Ghats region of Maharashtra state, India. While surveying the bat species in this region, two colonies of the Burmese Whiskered bat, *Myotis montivagus* were reported from Mahabaleshwar region (N 17°56' – E 73°42').

The sites were located at high altitude (1340 meters) in the crevices and holes on the slope of the hilly region. The basalt rocks were falling in the path of the running streams and were wet in the early hot summer days. Isolated mature male bats were trapped from each of the sites and measured for taxonomical studies.

The fecal analysis revealed that these bats thrive on hard shelled insects and moths. Nothing could be known about the reproductive cycle.

Myotis montivagus is assessed as vulnerable taxon in South Asia. The present record is the first report from the northern Western Ghats, previously it was recorded in 1913 and the last decade of twentieth century in the southern part of Western Ghats. *Myotis montivagus peytoni* is the endemic subspecies of the Indian subcontinent, and seemed to be rare in occurrence.

ACKNOWLEDGEMENT

The recent survey is funded by the Ministry of Environment and Forests, Government of India. Authors are thankful to Mr. Wagh V. K. (Principal, Fergusson College, Pune) and Mr. Momin M. M. (Head of the Zoology Department, Fergusson College, Pune -Maharashtra, India) for providing the laboratory facilities and hearty cooperation. Thanks are due to Dr. Mahabal A. S. (Officer In Charge, Zoological Survey of India, Western Region, Akurdi-Pune) for moral support and encouragement and Dr. Pradhan M. S. (Scientist D, Zoological Survey of India- Western Region, Akurdi-Pune) for confirming the taxonomical status of the specimens and valuable suggestions for preparing the manuscript.

REFERENCES

- Baillie, J. and Groombridge, B. 1996. 1996 IUCN Red List of Threatened Animals. The IUCN Species Survival Commission, Gland & Washington, 368 pp.
- Bates, P.J.J. and Harrison, D.I. 1997. *Bats of Indian Subcontinent*. Harisson Zoological Museum Publication. Bowerwood House, St. Botolph's Road. Sevenoaks, Kent TN 13 3AQ, England. Pp. 258.
- Corbet, G.B. and Hill, J.E. 1986. *A world list of Mammalian species*. British Mus. (Nat. Hist.), London. 226 pp.
- Ellerman, J.R. and Morrison-Scott, T.C. 1951. *Checklist of Palaearctic and Indian Mammals 1758 to 1946*. British Mus. (Nat. Hist.), London. 810 pp.
- Ghosh, M.K. 1989. New locality records for *Myotis montivagus peytoni* Wroghton & Reley, 1913, and *Murina cyclotis cyclotis* Dobson, 1872 (Chiroptera : Vespertilionidae) in the Eastern Ghats of Andhra Pradesh, India. *J. Bombay nat. Hist. Soc.*, **86** : 93-94.
- Whitaker Jr., J.O. (1998). Food Habits Analysis of Insectivorous Bats. In : *Ecological and Behavioral Methods for the Study of Bats*. Pp. 171-189.
- Wroughton, R.C. 1913i. Report No. 6 : Kanara. Bombay Natural History Society's Mammal Survey of India. *J. Bombay nat. Hist. Soc.*, **22** : 29-44.
- Wroughton, R.C. and Ryley, K.V 1913. Scientific results from the Mammals Survey, III. *J. Bombay nat. Hist. Soc.*, **22** : 13-21.

PLATE I



Fig. 1. : The Burmese Whiskered bat, *Myotis montivagus*, showing head region, note the pinna and tragus.



Fig. 2. : The natural habitat of *Myotis montivagus* in the Mahabaleshwar region of northern Western Ghats.

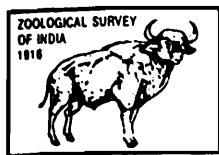
PLATE II



Fig. 3. : The roosting site of *Myotis montivagus* the holes in the basalt rocks.



Fig. 4. : The Burmese Whiskered bat *Myotis montivagus* resting in the day roost.



Rec. zool. Surv. India : 104 (Part 3–4) : 99-102, 2005

DIVERSITY AND DISTRIBUTION OF ARTHROPOD FAUNA IN RELATION TO MANGROVE VEGETATION ON A NEWLY EMERGED ISLAND ON THE RIVER HOOGHLY, WEST BENGAL

A. K. HAZRA, M. K. DEY AND G. P. MANDAL

Zoological Survey of India, Kolkata-700 053

INTRODUCTION

In the reservation and management of land for conservation, decisions on the size of areas required for maintaining species in sustainable populations is an important issue. The reverse problem is that of assessing a species, ability to persist after habitat fragmentation. In an attempt to investigate these topics an experiment was established in a newly emerged Island. The ecology of the forest ecosystem in India was mainly projected to a study of the community structure and composition, succession and management. Few of the studies from dry deciduous and pine forests soil have however, been restricted to one aspect, that is mainly on the forest ecosystem (Prabhoo 1976, Mahajan and Singh 1978, Hazra 1978, Reddy and Alfred 1978) But so far the effects of planted mangrove area and natural mangrove area of the same Island and same environmental area have not been made, whereas the present paper focuses upon the quantitative account of soil fauna and their similarity index in a planted mangrove and natural mangrove area of the newly emerged Island at Haldia in West Bengal.

Key words : Mangrove, Soil arthropods.

MATERIAL AND METHODS

A total of 192 soil samples were drawn from planted mangrove area and natural mangrove area of the Island at every month for a period of one year. Samples were drawn at randomly. The extraction of soil samples was carried out by the expedition faunal apparatus modified by Macfadyen (1953). A 40 W bulb was used for heating and as light source. Index of similarity is established by the Bray and Curty (1957).

LOCATION AND CHARACTERISTICS OF SAMPLING SITES

The Island lies on the river Hooghly opposite to the port of Haldia in West Bengal. The Island is spindle shaped with total area of about 29.38 sq km. The Island is flat with an average height of 3' to 5' from riverbed. The formation of these Islands is the out come of the high tide and low tide action of river water since 1988. These Islands formed out of sediment deposition during the past several decades, started accreting from 1945.

Between 1967 and 1977 the Island progressively enlarged. The Calcutta port Trust started revegetating the erosion prone Island with mangroves in collaboration with ZSI at its western tip covering an area of about 4 sq km during 1991, whereas other part of the 15 sq km and 10.39 sq km made for fishing and human habitat. The fishery and human habitat area are natural mangrove area. In the periphery of the Island *Sonneratia* was first planted mangrove followed by *Avicenni marina*, *A officinalis*, *Nipa fruticans*, *Exococcaria sp*, *Xyllocarps mollscensis*. The core mangroves species belonging to genera *Rhizophore apiculata*.

RESULT AND DISCUSSION

The soil arthropod fauna obtained from both the sites are presented in Tables 1 & 2, including their number of each group (12 No) from planted mangrove area and natural mangrove area. The Mites were most dominant group where the total arthropods population collected from both the site followed by collembola. The quantitatively artificial raised mangroves sites bound maximum population of all the arthropod faunal groups except Hymenoptera and Arnae (spider) population were maximum in Meen Dweep area. The third dominant group was coleoptera. The following similarity index formula has been used to analyze the similarity between faunal groups in two different habitats with the help Bray and Curty (1957) formula. The formula is

$$CN = 2JN / (aN + bN),$$

aN = Total no of individual of all the sp present in 1st habitat, bN = Similar to a N but in 2nd habitat, JN = Sum of lesser value of sp which are common in both the habitat.

The index varies from 0–1. Here three comment given below :

- (1) If CN = 0, no similarity
- (2) If CN = <0.5, dissimilar
- (3) If CN = >0.5 similar

Here the CN = 0.2.

Therefore, it may be concluded from the above study that although the two habitats are in same environmental condition but the composition of fauna are not similar in two sites of the island (Planted mangrove area & Natural Mangrove area) in this regards.

Table 1. : Soil arthropods in Nayachar (Planted forest).

Sl. No.	Groups/Order	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
1.	Mites	60	77	55	42	21	26	80	89	60	26	27	46	609
2.	Collembola	30	48	27	32	20	12	39	56	20	22	18	19	343
3.	Coleoptera	3	9	11	7	0	7	6	18	2	3	0	5	71
4.	Diptera Larvae	3	6	7	0	8	11	0	0	6	0	3	2	46
5.	Orthoptera	0	1	3	0	0	2	0	0	4	0	1	0	11
6.	Hymenoptera	7	0	7	0	6	0	0	6	0	4	0	0	30
7.	Hemiptera	0	0	1	0	0	0	1	0	0	2	0	0	4
8.	Isopoda	3	5	0	6	0	2	2	0	0	0	3	0	21
9.	Sand Flea	0	0	0	1	0	0	0	0	0	0	0	0	1
10.	Centiped	2	2	7	12	0	0	2	2	0	4	2	3	36
11.	Milliped	1	5	0	2	0	4	4	6	0	2	2	3	29
12.	Spider	0	0	3	0	0	2	0	1	0	1	0	0	7

Table 2. : Soil arthropods in Meen Dweep (Natural Mangrove).

Sl. No.	Groups/Order	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
1.	Mites	7	12	13	8	7	10	17	19	11	16	6	8	137
2.	Collembola	5	6	6	7	4	8	16	11	12	8	5	3	91
3.	Coleoptera	2	0	3	1	1	2	0	1	2	0	0	0	12
4.	Diptera Larvae	2	1	0	0	2	0	0	3	0	0	0	0	8
5.	Orthoptera	1	0	0	0	0	1	0	0	0	2	0	0	4
6.	Hymenoptera	5	2	1	0	4	0	7	2	0	7	8	10	39
7.	Hemiptera	0	1	0	0	0	2	0	0	0	0	0	0	3
8.	Isopoda	2	0	3	0	3	0	2	0	0	0	0	2	12
9.	Sand Flea	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	Centiped	1	2	0	1	0	2	0	3	2	0	0	0	11
11.	Milliped	0	3	0	0	0	1	1	0	1	0	0	0	6
12.	Spider	0	0	0	3	3	2	0	2	1	0	0	0	11

Table 3. : Soil arthropods in Nayachar (Planted mangrove) and Meen Dweep (Natural mangrove) 2003.

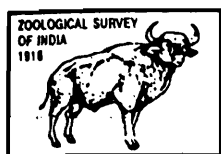
Sl.-No.	Groups/Order	Nayachar	Meen Dweep
1.	Mites	609	137
2.	Collembola	343	91
3.	Coleoptera	71	12
4.	Diptera Larvae	46	8
5.	Orthoptera	11	4
6.	Hymenoptera	30	39
7.	Hemiptera	4	3
8.	Isopoda	21	12
9.	Sand Flae	1	0
10.	Centiped	36	11
11.	Milliped	29	6
12.	Spider	7	11
13.	Total	1201	334

SUMMARY

Altogether 12 groups of arthropods were obtained and majority of these fauna were insects. An index of similarity followed by Bray and Curty method (1957) have been analysed to know the relationship between the faunal components of two sites in spite of their presence in the same island and environmental condition. The study was conducted in a newly emerged island in the river Hooghly, Haldia. A total of 192 soil samples were drawn from two different chosen localities of the Island from (January 2003 to December 2003). One of the localities was covered with natural mangrove vegetation (Meen Dweep) and other site was covered with artificially raised mangroves (Nayachar). There results have been discussed in detail in this paper.

REFERENCES

- Bray, J. R. and Curty, J. T. (1957). An ordination of the upland forest communities of Southern Wisconsin. *Ecol. Monogr.*, **27** : 325-349.
- Hazara, K. A. (1978). *Oriental Ins.*, **12**(2) : 265-274.
- Mahajan, S. V. and Sing, J. (1978). Newsletter Soil Biology and Ecology, **1**(2) : 5-7.
- Macfadyen, A. (1953). *J. Anim. Ecol.*, **22** : 65-67.
- Prabhoo, N. (1976). *Oriental Ins.*, **10**(3) : 435-442.
- Reddy, M. V. and Alfred, J. R. B. (1978). In Soil Biology and Ecology in India. C. A. Edwards and G. K. Veeresh (eds). *U.A.S. Tech. Ser.*, **22** : 236-243.



Rec. zool. Surv. India : 104 (Part 3–4) : 103-109, 2005

HUNTSMAN SPIDERS OF BANGLADESH : GENUS *HETEROPODA* LATREILLE AND *OLIOS* WALCKENAER (ARANEAE : SPARASSIDAE)

V. BISWAS* AND D. RAYCHAUDHURI

*Entomology Laboratory, Department of Zoology, University of Calcutta,
35, Ballygunge Circular Road, Kolkata-700 019*

INTRODUCTION

Huntsman spiders (Family : SPARASSIDAE) of Bangladesh are so far known only by one species of genus *Heteropoda* Latreille and one species of *Macrommata* Latreille (Begum & Biswas, 1997; Okuma, *et al.*, 1993). Several species, on the other hand, are reported from countries like — India (Pocock, 1900; Patel & Patel, 1973; Shethi & Tikader, 1988; Biswas & Biswas, 1992; Saha, *et al.*, 1994 & '95; Kundu, *et al.*, 1999), Pakistan (Dyal, 1935), China (Chen & Zhang, 1991; Song & Chen, 1992; Song, *et al.*, 1999), Korea (Paik, 1978), Japan (Yaginuma, 1986), The Philippines (Barrion & Litsinger, 1995), Australia (Davies, 1994; Hickman, 1967; Hirst, 1989) and U.S.A. (Edwards, 1979; Roth, 1988).

The present paper contains a description of two species of the genera *Heteropoda* Latreille and *Olios* Walckenaer of which *O. durlaviae* is being described as new to science.

The materials were studied in the laboratory using stereozoom binocular microscope (model Zeiss, SV–8). The status of the species has been identified following Pocock (1900), Tikader (1987), Shethi and Tikader (1988), Biswas and Biswas (1992), Davies (1994) and Kundu *et al.*, (1999). The identity of the species was later confirmed from the 'Zoological Survey of India' Kolkata.

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

*Present Address : Department of Zoology, Govt. B. L. College, Khulna-9202, Bangla Desh

SYSTEMATICS

Genus *Heteropoda* Latreille

1804. *Heteropoda* Latreille, *Nouv. Dict. d'Hist. Nat.*, **34** : 135.
 1900. *Heteropoda* : Pocock, *Fauna of Brit. Ind., Arachn.*, : 259.
 1977. *Heteropoda* : Tikader, *Rec. zool. Surv. India*, **72** : 189.
 1986. *Heteropoda* : Yaginuma, *Spiders of Japan in colour* : 199.
 1988. *Heteropoda* : Shethi & Tikader, *Rec. zool. Surv. India*, Occ. Pap. No. **93** : 9.
 1991. *Heteropoda* : Chen & Zhang, *Fauna of Zhejiang, Araneida* : 262.
 1992. *Heteropoda* : Biswas & Biswas, *Fauna of West Bengal, Araneae* : 413.
 1993. *Heteropoda* : Davies, *Mem. Qld. Mus.*, **35**(1) : 78.
 1994. *Heteropoda* : Saha, *et al.*, *Acta arachnol.*, **43**(1) : 43.
 1995. *Heteropoda* : Barrion & Litsinger, *Riceland Spiders of South and South East Asia* : 274.
 1997. *Heteropoda* : Platnick, *Advances in Spider Taxonomy* : 799.
 1999. *Heteropoda* : Song, *et al.*, *The Spiders of China* : 467.

Diagnosis : Cephalothorax nearly as long as wide, cephalic region slightly depressed or in some raised medially and posteriorly sometimes very high. Eyes prominent; anterior row straight or little procurved; posterior row of eyes recurved; lateral eyes prominent and larger than others; anterolaterals larger than the anteromedian.

Abdomen broad, elongate or oval, clothed with hairs and spine-like pubescence. Epigynum with a pair of lobes, usually separated by a septum.

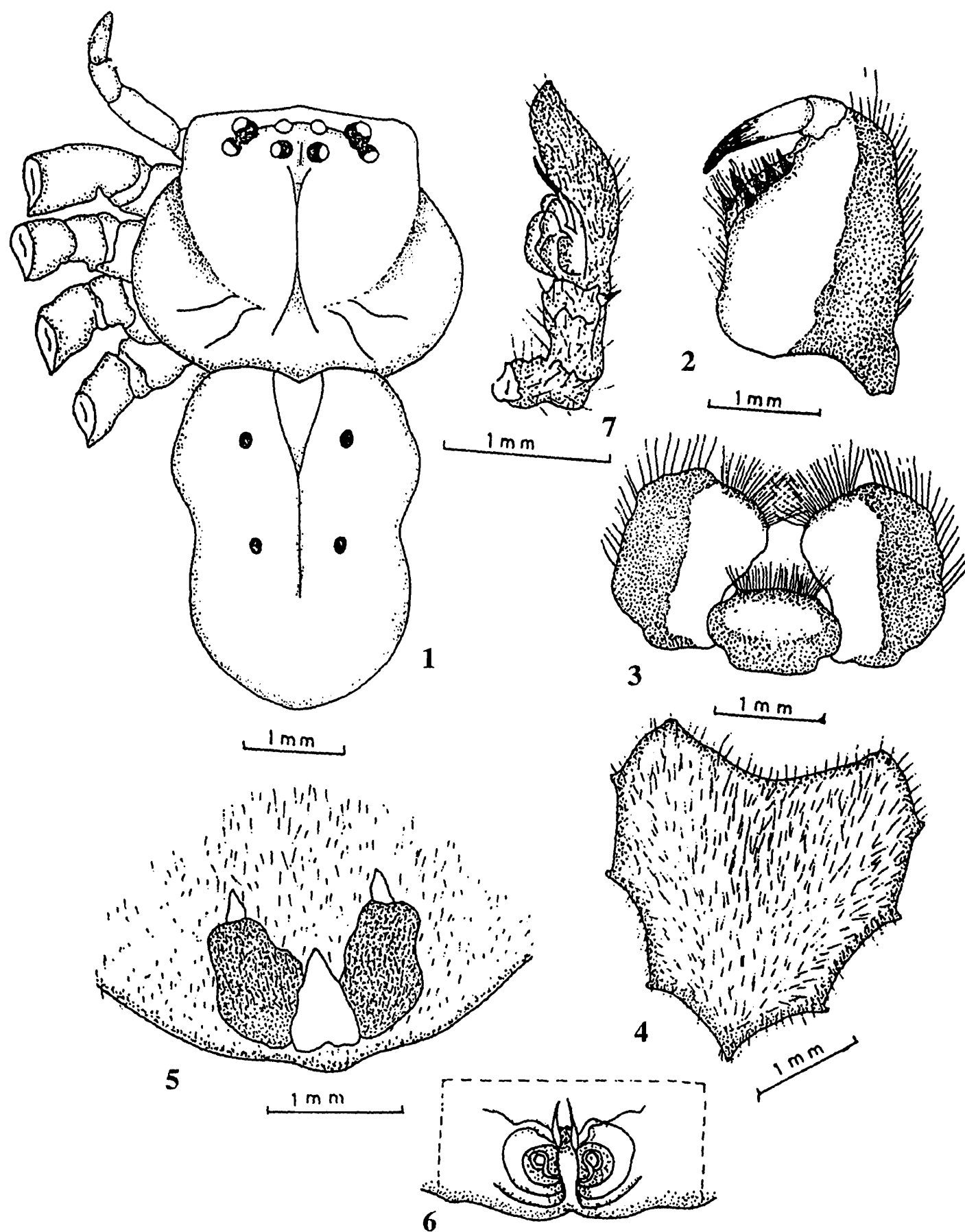
Type-species : *Heteropoda venatoria* (Linnaeus).

Distribution : AMERICA; ASIA; AUSTRALIA and EUROPE.

Heteropoda venatoria (Linnaeus)

(Figs. 1-7)

1767. *Aranea venatoria* Linnaeus, *Syst. Nat.*, (XII. ed) : 1035.
 1793. *Aranea regia* : Fabricius, *Ent. Syst.*, **2** : 408.
 1798. *Aranea pallens* : Fabricius, *Suppl. Ent. Syst.*, : 291.
 1804. *Heteropoda venatoria* : Latreille, *Nouv. Dict. Hist. Nat.*, **24** : 135.
 1836. *Ocypete setulosa* : C. L. Koch, *Die Arachn.*, **3** : 40.
 1837. *Olios leucosius* : Walckenaer, *Hist. Nat. Ins. Apt.*, **1** : 566.
 1878. *Heteropoda venatoria* : Thorell, *Ann. Mus. Civ. Genova*, **13** : 191.
 1900. *Heteropoda venatoria* : Pocock, *Fauna of Brit. Ind. Arachn.*, : 260.
 1988. *Heteropoda venatoria* : Shethi & Tikader, *Rec. zool. Surv. India*, Occ. Pap. No. **93** : 16.
 1993. *Heteropoda venatoria* : Davies, *Mem. Qld. Mus.*, **35**(1) : 83.
 1997. *Heteropoda venatoria* : Platnick, *Advances in Spider Taxonomy* : 802.



Figs. 1-7. *Heteropoda venatoria* (Linnaeus). 1. Female dorsal view (legs omitted); 2. Chelicerae; 3. Maxillae and Labium; 4. Sternum; 5. Epigynum; 6. Internal genitalia; 7. Male palp.

Material examined : 1♂ Bagerhat, 1.X.1991, Coll. V. Biswas; 2♀ Barisal, 18.V.1992, Coll. V. Biswas; 1♂ Faridpur, 13.II.1992, Coll. V. Biswas; 1♀ Jhenidah, 1.II.1992, Coll. V. Biswas; 1♀ Pabna, 19.XI.1993, Coll. V. Biswas; 1♀ Rangpur, 24.II.1993, Coll. V. Biswas.

Distribution : BANGLADESH : Bagerhat, Barisal, Faridpur, Jhenidah, Pabna, Rangpur; AUSTRALIA; BURMA; CHINA; HONG KONG; JAPAN; JAVA; SRI LANKA; SUMATRA; U.S.A. (Shethi & Tikader, 1988).

Genus *Olios* Walckenaer

1837. *Olios* Walckenaer, *Hist. Nat. Ins. Apt.*, 1 : 574.
 1880. *Midamus* : Simon, *Act. Soc. Linn. Bordeaux* : 311.
 1887. *Macrinus* : Simon, *Bull. Soc. zool. Fr.*, : 470.
 1902. *Neosparassus* : Hogg, *Proc. Zool. Soc. London*, : 423.
 1935. *Olios* : Dyal, *Fauna of Lahore-4* : Spiders of Lahore : 206.
 1988. *Olios* : Shethi & Tikader, *Rec. zool. Surv. India*, 93 : 30.
 1995. *Olios* : Barrion & Litsinger, *Riceland spiders of South and South East Asia* : 281.
 1997. *Olios* : Platnick, *Advances in Spider Taxonomy* : 805.
 1999. *Olios* : Song, *et al.*, *The Spiders of China* : 468.

Diagnosis : Cephalothorax distinctly elevated and convex; thoracic groove or fovea indistinct or may be absent. Anterior row of eyes straight; anteromedians largest and larger than the laterals; posterior row of eyes slightly procurved; ocular quad square. Clypeus very long. Labium broad, rounded at the apex. 2nd leg longer than the first. Tibia I armed with 2 pairs of small spines.

Type-species : *Olios argelasius* (Walckenaer)

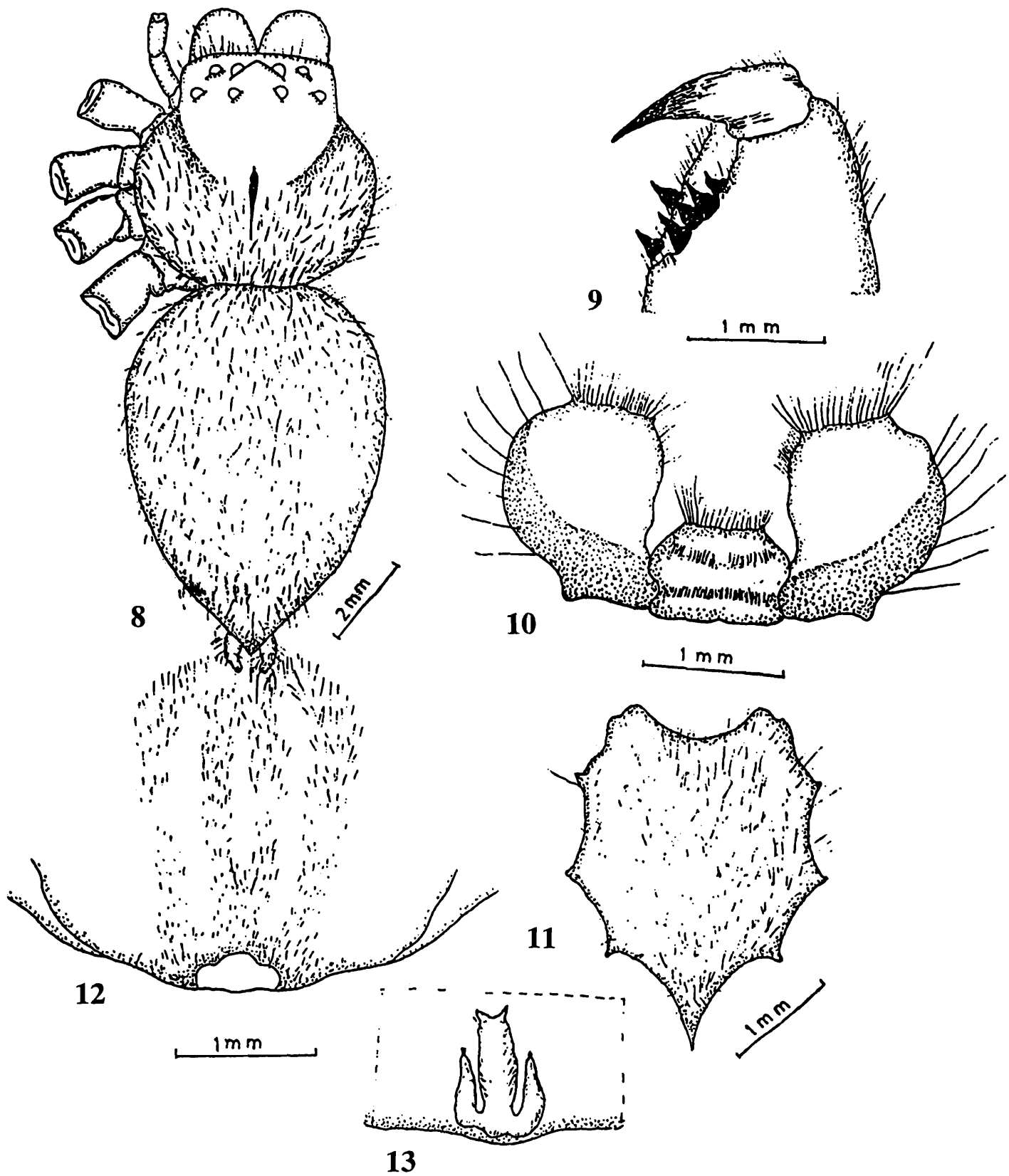
Distribution : All tropical countries of the world.

Olios durlaviae n. sp.

(Figs. 8-13)

General : Cephalothorax and legs dark brown; abdomen light brown with brown pubescence and hairs. Total body length 32.50 mm. Carapace 14.00 mm long and 13.50 mm wide; abdomen 18.50 mm long and 11.20 mm wide.

Cephalothorax : Longer than wide, nearly rounded posteriorly, anteriorly constricted, anterior margin straight (fig. 8). Cephalic region raised with distinct cervical furrows, medially with a distinct brown, longitudinal fovea. Thoracic region clothed with haphazardly arranged brown hairs and pubescence. Eyes brown, nearly similar; anterior row little procurved while posterior row straight. Chelicerae dark brown, strong, clothed with sharp hairs; inner and outer margins respectively with 4 and 2 teeth, fung basally wide (fig. 9). Maxillae brown, broad, longer than wide, medially wide, anteriorly scopulate (fig. 10). Labium brown, vase-shaped, medially wide, posteriorly constricted, anteriorly scopulate (fig. 10). Sternum dark brown, elongate, posteriorly narrowed,



Figs. 8-13. *Olios durlaviae* n. sp. 8. Female dorsal view (legs omitted); 9. Chelicerae. 10. Maxillae and Labium; 11. Sternum; 12. Epigynum; 13. Internal genitalia.

produced and pointed, anterior margin concave (fig. 11). Legs long and strong; leg formula 2143 and the measurements (in mm) as in Table 1.

Table 1. : Measurements (in mm) of different parts of legs of *Olios durlaviae* n. sp.

Leg	Femur	Patella & Tibia	Metatarsus	Tarsus	Total
I	7.00/7.00	9.00/9.00	6.00/6.00	3.00/3.00	25.00/25.00
II	8.50/8.50	10.50/10.50	7.00/7.00	3.00/3.00	29.00/29.00
III	6.50/6.50	7.00/7.00	4.00/4.00	2.00/2.00	19.50/19.50
IV	7.00/7.00	7.00/7.00	5.00/5.00	2.50/2.50	21.50/21.50

Abdomen : Broadly oval, anteriorly wide, posteriorly narrowed and with a pointed tip; dorsum clothed with hairs, spines and pubescence; ventrally pale brown; lateral spinnerets elongate and inwardly curved. Epigyne and internal genitalia as in Figs. 12 and 13.

Male : Unknown.

Holotype : Female in spirit.

Type-locality : Jhenidah, Bangladesh, 08.V.1992, Coll. V. Biswas.

Etymology : The species has been named after my beloved grand mother late Smt. Durlavi Rani Biswas.

Remarks : Following the key to the species of *Olios* Walckenaer (Shethi & Tikader, 1988), the new species approaches close to *O. milleti/obesulus* group but none of the species can be related to the present species because of the presence of posteriorly narrowed abdomen, only 4 teeth on the inner margin of chelicerae and very typical epigynum and internal genitalia.

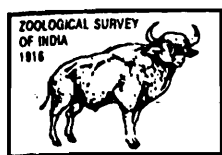
ACKNOWLEDGEMENTS

The authors are grateful to Dr. S. C. Majumder, Scientist-SD, Sunderban Field Research Station, Zoological Survey of India, Canning, West Bengal, for the confirmation of the identity of the species and the Head, Department of Zoology, University of Calcutta, for providing laboratory facilities during the study.

REFERENCES

- Barrion, A. T. and Litsinger, J. A. 1995. Riceland spiders of South and South East Asia. CABI-IRRI, 700 pp.
- Begum, A. and Biswas, V. 1997. A list of spider fauna of Barisal division, Bangladesh (Araneae : Arachnida). *Bangladesh J. Zool.*, **25**(2) : 207-210.

- Biswas, B. and Biswas, K. 1992. Fauna of West Bengal, Araneae, Part-3 : 357-500.
- Chen, Z. F. and Zhang, Z. H. 1991. Fauna of Zhejiang, Araneida. Zhejiang Sci. and Tech. Pub. House, 356 pp.
- Davies, V. T. 1994. The huntsman spiders *Heteropoda* Latreille and *Yiinthi* gen. nov. (Araneae : Heteropodidae) in Australia. *Mem. Qld. Mus.*, **35**(1) : 75-122.
- Dyal, S. 1935. Fauna of Lahore. Spiders of Lahore-1. *Bull. Dept. Zool. Panjab Univ.* : 1-252.
- Edwards, G. B. 1979. The giant crab spider *Heteropoda venatoria* (Linnaeus) (Araneae : Sparassidae). *Fla. Dept. Agric. & Consumer Service. Entom. Circular no.* **205** : 1-2.
- Hickman, V. V. 1967. Some common spiders of Tasmania. *Tasmanian Mus. Art. Gallery*, 112 pp.
- Hirst, D. B. 1989. A revision of the genus *Pediana* Simon (Heteropodidae : Araneae) in Australia. *Rec. South Aust. Mus.*, **23**(2) : 113-126.
- Kundu, M., Biswas, V. and Raychaudhuri, D. 1999. New huntsman spiders (Heteropodidae : Araneae) from Buxa Tiger Reserve, Jalpaiguri, West Bengal. *J. Bombay nat. Hist. Soc.*, **96**(1) : 98-105.
- Okuma, C., Kamal, N. Q., Hirashima, Y., Alam, Z. and Ogata, T. 1993. Illustrated Monograph on the rice-field spiders of Bangladesh. IPSA-JAICA, Salna, Gazipur, 93 pp.
- Paik, K. Y. 1978. Araneae. Illustrated Fauna Flora Korea, **21** : 1-548.
- Patel, B. H. and Patel, H. K. 1973. Descriptions of some new species of spiders from India. *Oriental Insects*, **7**(1) : 127-132.
- Pocock, R. I. 1900. Fauna of British India, Arachnida. Taylor & Francis, London, 279 pp.
- Roth, V. D. 1988. American Agelenidae and some misidentified spiders (Clubionidae, Oonopidae and Sparassidae) of E. Simon in Meseum national d'Histoire naturelle. *Bull. Mus. natn. Hist. nat. Paris*, (4)**10**(A) : 25-37.
- Saha, S., Biswas, V. and Raychaudhuri, D. 1994. Heteropodidae and Lycosidae of Buxa Tiger Reserve, West Bengal. *Acta arachnol.*, **43** : 43-48.
- Saha, S., Biswas, V. and Raychaudhuri, D. 1995. A new name for *Heteropoda acuta* Saha, Biswas et Raychaudhuri (Araneae : Heteropodidae). *Acta arachnol.*, **44**(1) : 15-16.
- Shethi, V. D. and Tikader, B. K. 1988. Studies on some giant crab-spiders of the family Heteropodidae from India. *Rec. zool. Surv. India, misc. Publ. Occ. Pap. No.* **93** : 1-94.
- Song, D. X. and Chen, X. E. 1992. Descriptions of two heteropodid spiders from Sichuan, China (Araneae : Heteropodidae). *Acta zootaxon. sin.*, **17** : 119-121.
- Song, D. X., Zhu, M. S. and Chen, J. 1999. The spiders of China. *Hebei Sci. & Tech. Pub. House*, 640 pp.
- Tikader, B. K. 1987. Hand book Indian Spiders. Zoological Survey of India, Kolkata, 251 pp.
- Yaginuma, T. 1986. Spiders of Japan in colour. Hoikusha Pub. Co. Ltd., Osaka, 305 pp.



Rec. zool. Surv. India : **104** (Part 3–4) : 111-119, 2005

BUTTERFLY DIVERSITY IN AND AROUND URBAN KOLKATA

SUCHITRA GHOSH AND SHARIF SIDDIQUE*

Principal Investigator, Reader in Zoology, Bangabasi College, Kolkata-700 009

INTRODUCTION

Butterflies are good indicators of environmental alterations as they are sensitive and are directly affected by changes in the habitats, atmosphere, temperature and the weather conditions. The present work is on variation in diversity of butterflies in different impact zones across natural and semi-natural vegetation types in and around the Kolkata metropolis. Though India hosts 1,501 species of butterflies (Gaonkar 1996), in West Bengal Papilionids are represented by 26 species in 6 genera, Danainae by 17 species in 5 genera (Mondal and Maulik, 1997), Hesperidae by 32 species in 29 genera (Ghosh and Chaudhury, 1997), Pieridae by 25 species and 23 subspecies (Ghosh and Chaudhury, 1997), Satyridae by a total of 39 species and subspecies (Bhattacharya, 1997) and Lycaenidae by 83 species distributed over 47 genera. These reports were from 11 out of 17 districts of this state. Of all the aforementioned species, Kolkata harboured 40 species (Gupta, 1997). Ghosh (1991) reported as well that 'the city of Calcutta, within its limit, exhibits at least 40 species of butterflies' We, therefore, intended to obtain the present status of butterflies in urban Kolkata during the period of our study *i.e.*, April 2002 to May 2004.

STUDY AREA

We have explored 11 sites intensely, given their contrasting vegetation types and level of disturbance. The sites include— **Ia** = Shyamkhola, **Ib** = Narendrapur WLS, **II** = IIM Joka, **III** = East Calcutta Wetlands, **IVa** = Banobitan, **IVb** = Subhas Sarobar, **Va** = Tala Park, **Vb** = ISI Baranagore, **VIa** = Maidan, **VIb** = Eden Gardens, **VII** = Brace Bridge Wetlands, **VIII** = Tollygunge Golf Club, **IXa** = Agri-Horticultural Society of India, **IXb** = Alipore Zoological Garden, **Xa** = Esplanade, **Xb** = Raj Bhavan, **XI** = Rabindra Sarobar.

All the areas lie between longitude 88°26'09 E–88°17'63 E; latitude 22°38'47 N–22°25'24 N.

*Former Project Fellow, Bangabasi College, Kolkata-700 009.

SITE DESCRIPTION

Narendrapur, IIM Joka, Shyamkhola are well wooded with profusion of old trees (both native and exotic), surrounded by a mosaic of concrete buildings. The marshes, wetlands and scrubs along part of Eastern Calcutta Wetlands, Subhas Sarobar and Rabindra Sarobar have patches of grasslands which are subjected to grazing. The sites like Tollygunge Golf Club, Banobitan, Eden Gardens, Agri-Horticultural Society of India, Alipore Zoological Garden, Indian Statistical Institute, Raj Bhawan and Brace Bridge are well maintained, protected places where human interferences are relatively low. Sites like Maidan, Esplanade and Tala Park, although are rich with old and new trees, but these areas are very much disturbed by continuous human interferences and activities. Most of the sites face vehicular pollution apart from other hazards (see Table II).

METHOD

The observations here are based on the seasonal visits. Butterflies were counted along definite paths in each site and their relative abundance has been recorded in accordance with the following scale (Clench 1979) :

Code	No. of specimens seen
0	125–625 specimens in 1 hr
1	25–125 specimens in 1 hr
2	5–25 specimens in 1 hr
3	1–5 specimens in 1 hr
4	1 specimen in 1 hr
5	1 specimen in 1–5 hr
6	1 specimen in 5–25 hr
7	1 specimen in 25–125 hr
8	1 specimen in 125–625 hr

The classified habitats :

Low impact zone		Moderate impact zone		Influenced zone
Suburban Orchard	Wetland	Urban Greenery	Agriculture	Built up areas with vegetation
Ia, Ib, II	III, VII	IVa, IXa, IXb, VIII, Xb, Vb, VIb	VII, Ia	Xa, VIa, IVb, XI, Va

RESULT

Distribution : Table 1 depicts the checklist of 68 butterfly species recorded and identified so far.

- The orchards and the scrubs appear to be the most species rich habitat (nearly 57 spp).
- The woodland harbours nearly 4 species that are unique to it.
- The vegetation along the built up areas along with the agricultural land also harbour about 50% of the total identified species, and these are mostly danuids.

Flight period : Butterflies in all habitats have distinct flight periods.

- Single, short flight period – Rounded Pierrot at Shyamkhola.
- Multiple peaks (*e.g.*, Tailed Jay, Grey Pansy *etc.*).
- One, but fairly long flight period (*e.g.* Chocolate Pansy, Blue Mormon at Narendrapur WLS).
- Among the whites, the Cabbage White shows the most erratic flight.
- Psyche is the weakest flier, flapping within a range up to 1 metre above grass level.

Note : A curious behavior has been observed in Evening Brown, when disturbed it settles among dry leaves nearly horizontally. When they are not disturbed, settle with their wings vertically.

Seasonality : During three years' (April 2002 to March 2004) study of the behavior of butterfly, it has been observed that in Kolkata urban area most of the butterflies were active during April-May-June (*i.e.*, summer) and October-November (*i.e.*, post-monsoon), while activities were fairly low during monsoon and winter.

- Species seen throughout the year with a short population peak in a specific season—Tawny Coster at IIM, Joka, in summer (April-May), Common Jezebel at AHSI in winter (December), Blue Tiger in IIM Joka and Shyamkhola in summer.
- Species occur only for a few months, viz, Commander at IIM Joka, Tollygunge Golf Club, ISI Baranagore, recorded during the post monsoon and winter seasons only; the Common Gull is recorded at most of the sites during pre and post monsoon months.
- Species like Psyche, Peacock Pansy, Plain Tiger, Common Emigrant, etc. have similar abundance throughout the year with little fluctuations.

Note : There was a case of population explosion in Common Banded Awl (*Hasora chromus*) might have resulted from its synchronous egg laying activity. A large number of individuals

gathered on Divi-Divi *Caesalpinia coriaria* (Caesalpinaceae) on a cloudy forenoon (July 27, 2003) at Eden Gardens.

Table II presents proportion of total species recorded at 11 sites across the seasons with their vegetation assemblage.

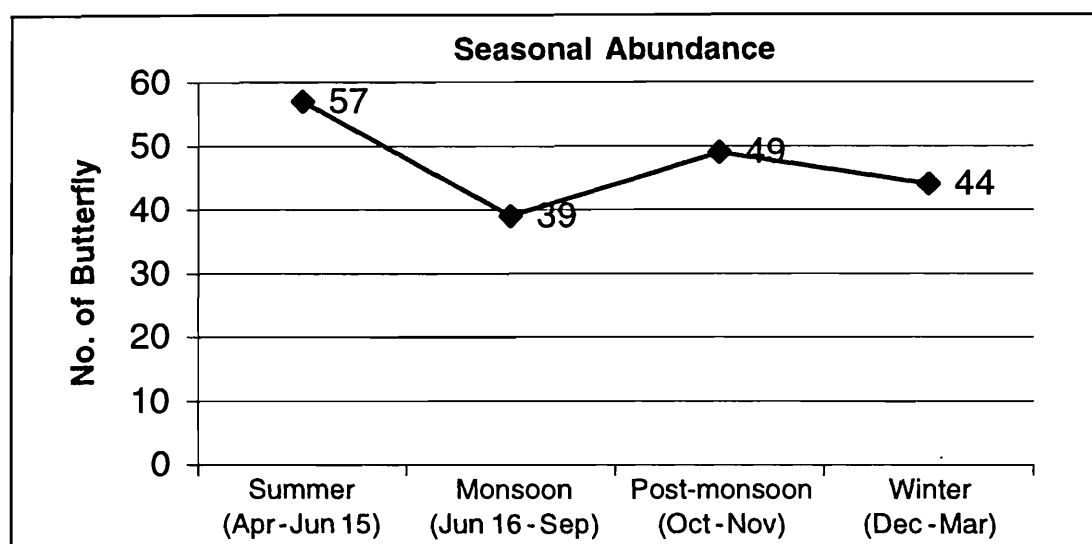


Fig. 1. : Seasonal abundance of butterfly.

Limitations :

- Many species evaded detection or precise field identification.
- The survey on Swifts and Skippers is yet to be completed due to some constraints.
- The data is based on morning observations (6 : 30 – 12 noon). Therefore, many nocturnal and crepuscular species may have evaded detection.

Table I : Checklist of butterflies (identified spp.).

Sl. No.	Common name*	Scientific name*	Relative abundance during peak seasons
01.	Family : PAPILIONIDAE		
	Tailed Jay	<i>Graphium agamemnon</i>	2
02.	Spot Swordtail	<i>Graphium nomius</i>	8
03.	Common Mime	<i>Papilio dissimilis</i>	5
04.	Lime Butterfly	<i>Papilio demoleus</i>	4
05.	Common Mormon	<i>Papilio polytes</i>	3
06.	Blue Mormon	<i>Papilio polymnestor</i>	8
07.	Common Rose	<i>Pachliopta aristolochiae</i>	8
08.	Crimson Rose	<i>Pachliopta hector</i>	6
09.	Common Bluebottle	<i>Graphium sarpedon</i>	3
10.	Common Jay	<i>Graphium doson</i>	2

Table I : (Cont'd.).

Sl. No.	Common name*	Scientific name*	Relative abundance during peak seasons
	Family : PIERIDAE		
01.	Mottled Emigrant	<i>Catopsilia pyranthe</i>	3
02.	Common Emigrant	<i>Catopsilia pomona</i>	2
03.	Common Jezebel	<i>Delias eucharis</i>	3
04.	Psyche	<i>Leptosia nina</i>	1
05.	Indian Cabbage White	<i>Pieris canidia</i>	2
06.	Common Gull	<i>Cepora nerissa</i>	2
07.	Common Albatross	<i>Appias albina</i>	2
08.	Common Wanderer	<i>Pareronia valeria</i>	5
09.	Common Grass Yellow	<i>Eurema hecabe</i>	1
10.	Spotless Grass Yellow	<i>Eurema laeta</i>	7
11.	Small Grass Yellow	<i>Eurema brigitta</i>	8
12.	Yellow Orange Tip	<i>Ixias pyrene</i>	6
13.	Great Orange Tip	<i>Hebomoea glaucippe</i>	8
14.	Striped Albatross	<i>Appias libythea</i>	8
	Family : LYCAENIDAE		
01.	Zebra Blue	<i>Leptotes plinius</i>	8
02.	Common Hedge Blue	<i>Actolepis puspa</i>	1
03.	Rounded Pierrot	<i>Tarucus nara</i>	4
04.	Yamfly	<i>Loxura atymnus</i>	6
05.	Common Acacia Blue	<i>Surendra quercetorum</i>	4
06.	Common Cerulean	<i>Jamides celeno</i>	3
07.	Common Silverline	<i>Spindasis vulcanus</i>	5
08.	Pale Grass Blue	<i>Pseudozizeeria maha</i>	3
09.	Dark Grass Blue	<i>Zizeeria karsandra</i>	2
10.	Lime Blue	<i>Chilades laius</i>	4
11.	Gram Blue	<i>Euchrysops cnejus</i>	4
12.	Monkey Puzzle	<i>Rathinda amor</i>	7
13.	Dark Cerulean	<i>Jamides bochus</i>	7
	Family : NYMPHALIDAE		
01.	Common Bushbrown	<i>Mycanitis perseus</i>	5
02.	Common Five-ring	<i>Ypthima baldus</i>	4
03.	Common Four-ring	<i>Ypthima huebneri</i>	4
04.	Common Three-ring	<i>Ypthima asterope</i>	3

Table I : (Cont'd.).

Sl. No.	Common name*	Scientific name*	Relative abundance during peak seasons
05.	Tawny Coster	<i>Acraea violae</i>	2
06.	Common Palmfly	<i>Elymnias hypermenstra</i>	4
07.	Common Leopard	<i>Phalanta phalantha</i>	8
08.	Common Sailer	<i>Neptis hylas</i>	4
09.	Commander	<i>Moduza procris</i>	8
10.	Grey Pansy	<i>Junonia atlites</i>	3
11.	Common Baron	<i>Euthalia aconthea</i>	7
12.	Angled Castor	<i>Ariadne ariadne</i>	5
13.	Common castor	<i>Ariadne merione</i>	3
14.	Lemon Pansy	<i>Junonia lemonias</i>	6
15.	Peacock Pansy	<i>Junonia almana</i>	2
16.	Chocolate Pansy	<i>Precis iphita</i>	8
17.	Danaid Eggfly	<i>Hypolimnas misippus</i>	4
18.	Blue Tiger	<i>Tirumala limniace</i>	1
19.	Striped Tiger	<i>Danaus genutia</i>	2
20.	Plain Tiger	<i>Danaus chrysippus</i>	2
21.	Common Indian Crow	<i>Euploea core</i>	3
22.	Common Evening Brown	<i>Mycaenitis leda</i>	3
23.	Great Eggfly	<i>Hypolimnas bolina</i>	6
24.	Painted Lady	<i>Cynthia cardui</i>	8
25.	Blue Pansy	<i>Junonia orithya</i>	8
26.	Small Leopard	<i>Phalanta alicippe</i>	6
	Family : HESPERIIDAE		
01.	Common Small Flat	<i>Sarangesa dasahara</i>	
02.	Indian Palm Bob	<i>Suastus gremius</i>	
03.	Common Banded Awl	<i>Hasora chromus</i>	
04.	Grass Demon	<i>Udaspes folus</i>	
05.	Indian Skipper	<i>Spialia galba</i>	

*the classification is per Ackery (1986). The common and Scientific names are adopted from Haribal (1992) and Kunte (2000).

Table II : Description of the sampling sites.

Name of the Site	Vegetation assemblage (Flowering Plants)	No. of identified spp. of Butterflies	Remarks on Vegetation
Rajbhawan	Approximately 220 species	28	Exotic and indigenous plants are in the ratio of 50 : 50. Many of them are introduced in recent past.
Narendrapur WLS	Approximately 110 species	55	Well wooded with profusion of old trees, native trees, besides exotic ones. Most of them are natural vegetations.
Brace Bridge Wetland	Approximately 218 species	38	Marshes, wetlands and scrubs along with indigenous species. Very few exotics were seen. As much as 85% species have been planted in recent past. Garden varieties are prevalent.
Tollygunj Golf Club	Approximately 170 species	46	Mostly Exotic and indigenous plants in the ratio of 50 : 50.
IIM Joka	Approximately 230 species	52	Mostly indigenous species. Very few exotics were seen. Almost natural, except the garden & agricultural variety.
Shyamkhola	Approximately 187 species	43	Mostly indigenous species. Very few exotics were seen. Most of them are natural vegetations.
ISI Baranagar	Approximately 130 species	34	Mostly horticultural plants with a few old fruit trees.
Bonobitan	Approximately 128 species	34	Mostly horticultural plants.
Nalban	Approximately 207 species	39	Marshes, wetlands and scrubs along with indigenous species; prone to little grazing.
Tala Park	Approximately 128 species	38	Old trees, native trees, besides exotic ones.
AHSI	Approximately 135 species	35	Well maintained protected place mostly with horticultural plants.
Maidan	Approximately 79 species	35	Good number of indigenous species besides the exotic one.
Subhas Sarovar	Approximately 129 species	29	Water body surrounded by a few old native & exotic species, prone to little grazing.
Eden Gardens	Approximately 107 species	38	Mostly horticultural plants with a few old native & exotic species.
Rabindra Sarovar	Approximately 101 species	28	Water body surrounded by many exotic species; prone to little grazing.
Zoo Garden	Approximately 89 species	38	Exotic and indigenous plants are in the ratio of 50 : 50.
Total	370 species	68 species	

SUMMARY

The present butterfly diversity study within Kolkata urban area have generated a comprehensive baseline data, which will help in future assessment of biodiversity and any impact on the habitat of the present study area. Identification of any change in environment of Kolkata and its surroundings, would generate sharp, firm, healthy and emphatic argument that will help proper land use planning and hence sustainable development. Drastic change in land use pattern associated with urbanization in Kolkata or in such areas, would result in an immense impact on the concerned wildlife of the area. As many as 75% of the species are recorded from moderate impact zone; many of them are dependant on natural vegetation surrounding Kolkata for their survival. About 6% of the species are recorded exclusively from the low impact zone, thus are more vulnerable to any further destruction.

ACKNOWLEDGEMENTS

The study was supported by the University Grants Commission as a major research project. We gratefully acknowledge the assistance provided by Sarvasri N. N. Chatterjee, Kushal Mookherjee and Partha Sarathi Ghose in the field.

REFERENCES

- Ackery, P. R. (1984). Systematic & Faunistic Studies on Butterflies, page 9-21, in Vane Wright, R.I. & P.R. Ackery (eds.) *The Biology of Butterflies*, Symp. of Royal Entom. Soc. of London, No. 11, Academic Press.
- Bhattacharya, D. P. (1997). State Fauna Series 3 : Fauna of West Bengal, Part 7, page 729-753, Zoological Survey of India.
- Clench, H. K. (1979). How to make regional list of butterflies : some thoughts. *J. Lep. Soc.*, **33**(4), page 261-281.
- Gaonkar, H. (1996). Butterflies of the Western Ghats with notes on those of Sri Lanka, Centre for Ecological Sciences, Indian Institute of Science, Bangalore.
- Ghosh, A. K. (1991). Ecology and Environment of Calcutta in "Calcutta's Urban Future" Government of West Bengal.
- Ghosh, S. K. and Choudhury, M. (1997). *Fauna of West Bengal, State Fauna Series, 3* (Part 7) : 275-318, Zoological Survey of India.
- Gupta, I. J. (1997). *Fauna of West Bengal, State Fauna Series, 3* (Part 7) : 429-489, Zoological Survey of India.

- Haribal, M. (1992). *Butterflies of Sikkim Himalaya and their natural history*, Natraj Publishers, Dehradun.
- Kunte, K. J. (2000). *Butterflies of Peninsular India*. Indian Academy of Sciences, Bangalore and Universities Press, Hyderabad.
- Mondal, D. K. and Maulik, D. R. (1997). *Fauna of West Bengal, State Fauna Series, 3* (Part 7) : 755-793, (Published Zoological Survey of India).
- Rothney, G. A. J. (1882). A list of the Butterflies captured in Barrackpore park during the month of September, 1880 to August, 1881; *Entomologists, Mon Mag-19* : page 33-36.
- Sanders, D. F. (1944). A list of and Notes on the Butterflies of Calcutta, *J. Beng Nat. Hist. Soc.*, 19(1) : page 29-41.

PLATE I

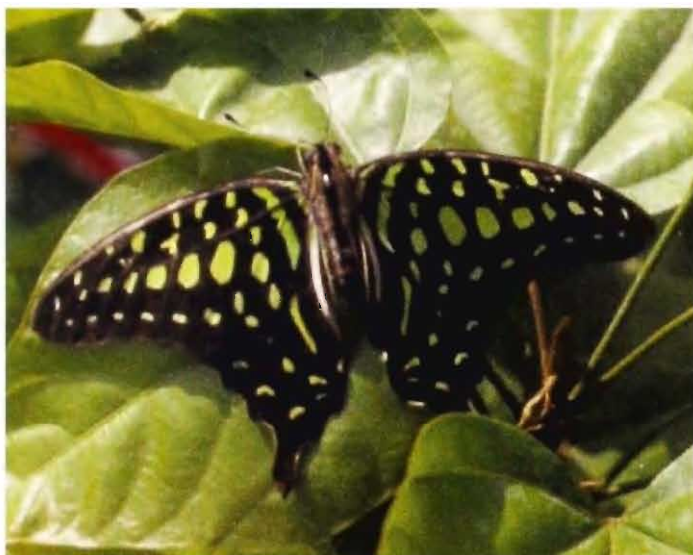


Fig. 1. : Photograph of *Graphium agamemnon*,
Tailed Jay



Fig. 2. : Photograph showing *Papilio polytes* ssp.
romulus

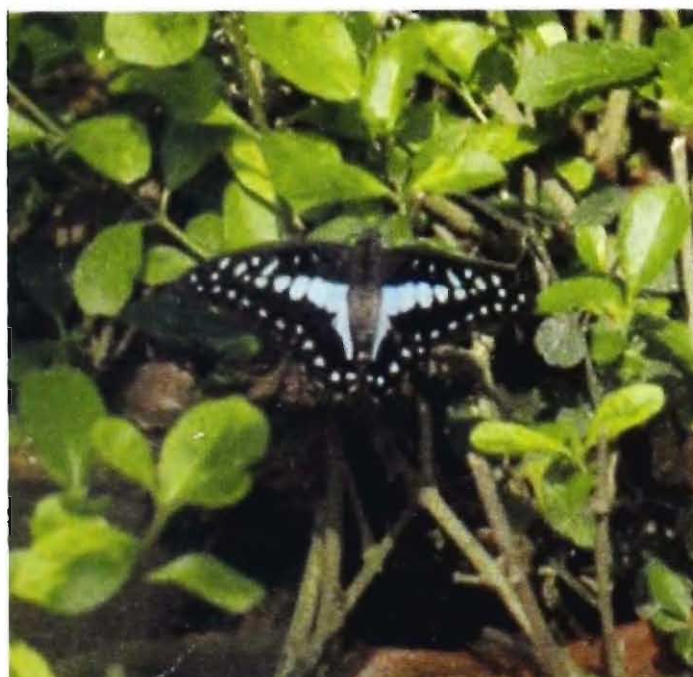


Fig. 3. : Photograph of *Graphium doson*,
Common Jay



Fig. 4. : Photograph of *Cepora nerissa*
Common Gull

PLATE II



Fig. 5. : Photograph of *Tarucus nara*,
Rounded Pierrot



Fig. 6. : Photograph of *Mycanitis perseus*,
Common Bush-brown



Fig. 7. : Photograph of *Ypthima asterope*,
Common Three-ring

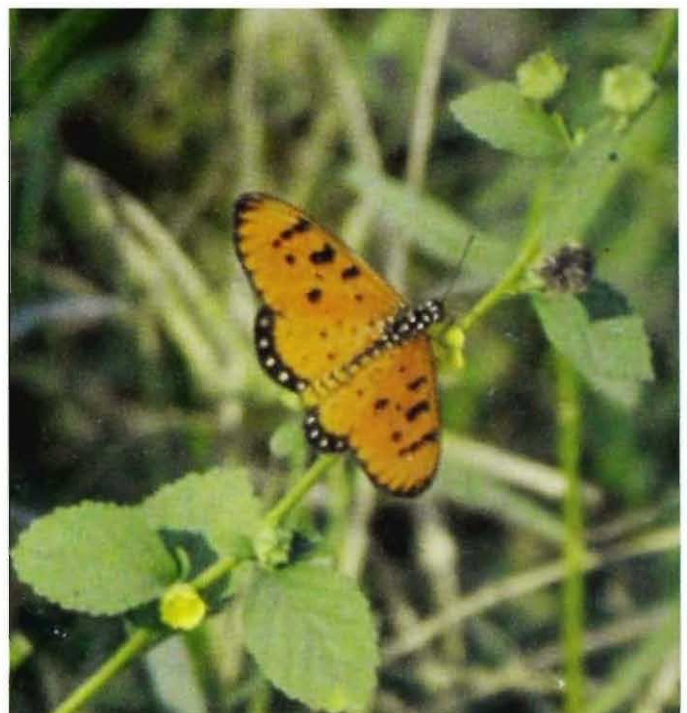


Fig. 8. : Photograph of *Acraea violae*,
Tawny Coster

PLATE III



Fig. 9. : Photograph of *Elymnias hypermenstra*, Common Palm fly



Fig. 10. : Photograph of *Neptis hylas*, Common Sailer

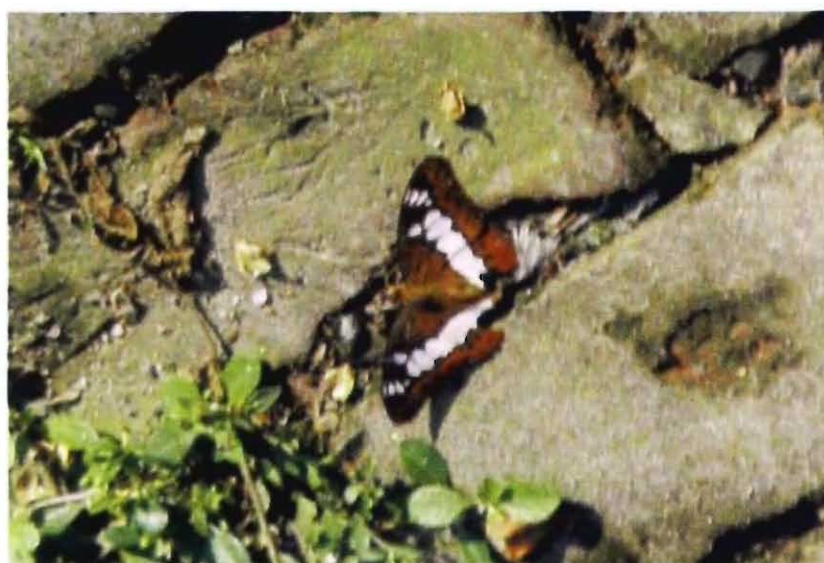


Fig. 11. : Photograph of *Moduza procris*, Commander

PLATE IV



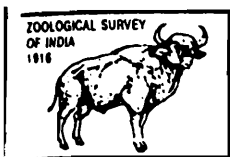
Fig. 12. : Photograph of *Ariodne merione*, Common Castor



Fig. 13. : Photograph of *Junonia almana*, Peacock Pansy



Fig. 14. : Photograph of *Tirumala limniace*, Blue Tiger



Rec. zool. Surv. India : 104 (Part 3–4) : 121-127, 2005

SCOLOPENDRID CENTIPEDES OF DESERT NATIONAL PARK, RAJASTHAN (CHILOPODA : SCOLOPENDROMORPHA)

VINOD KHANNA

*Zoological Survey of India, Northern Regional Station,
218 Kaulagarh Road, Dehra Dun-248 195, Uttarnchal*

INTRODUCTION

The centipede fauna of Rajasthan has not yet been adequately documented. The reconnoiter of the available literature reveals the occurrence of six species of Scolopendrid centipedes from Rajasthan, namely, *Scolopendra morsitans* Linnaeus (Khanna, 1977a and Jangi and Dass, 1980), *Scolopendra valida* Lucas (Khanna, 1977b), *Scolopendra indiae* (Chamberlin) (= *Trachycephalus indiae* Chamberlin) (Vazirani and Khanna, 1977), *Scolopendra mirabilis* (Porath) (= *Trachycormocephalus mirabilis*) (Khanna 1977a and Jangi and Dass, 1980), *Cormocephalus pygmaeus* Pocock (Vazirani and Khanna, 1976) and *Asanada brevicornis* Meinert (Khanna, unpublished record).

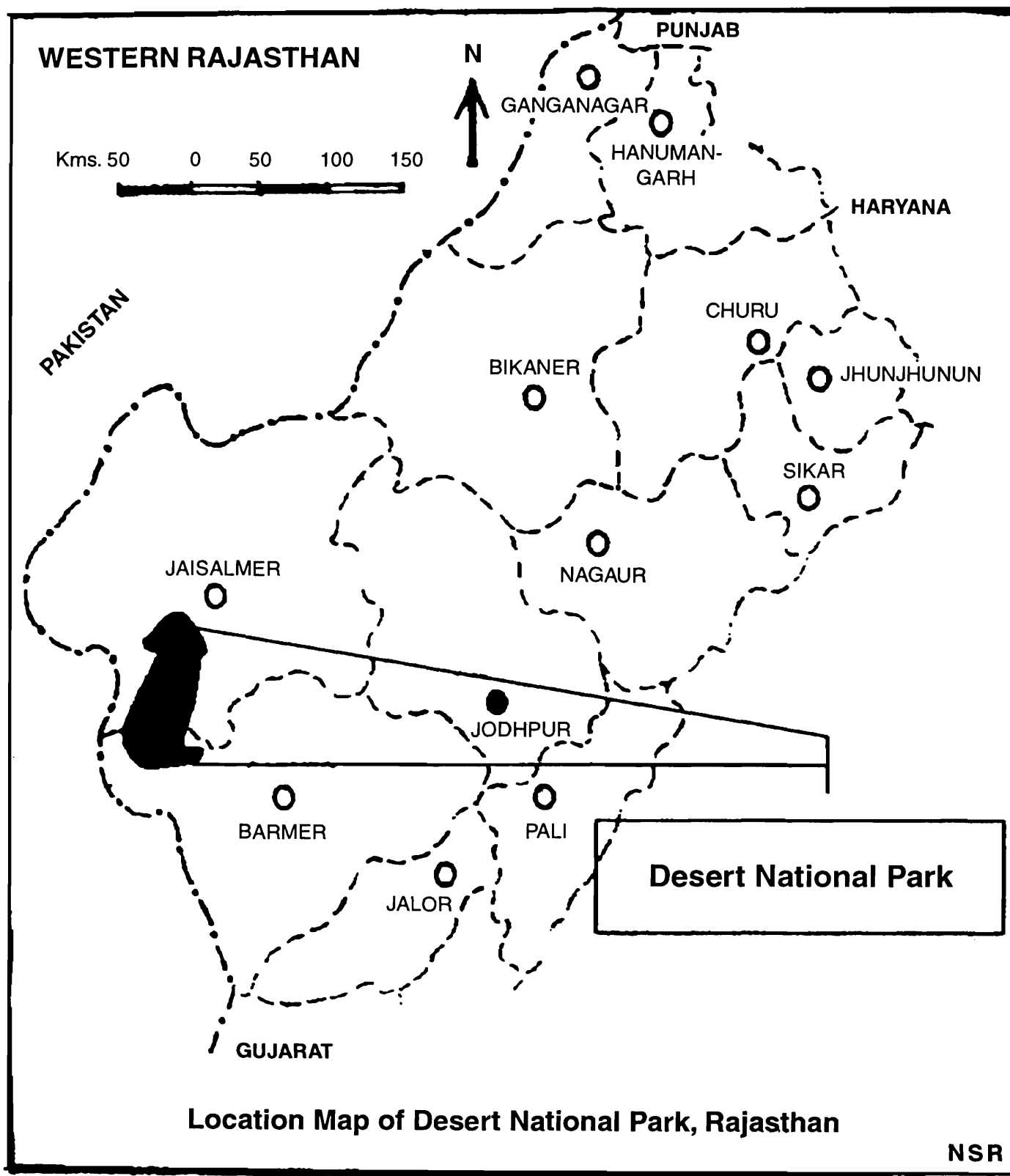
The present studies, based on a small collection of the centipedes of Desert National Park (a proposed Biosphere Reserve), made by the scientists of the Zoological Survey of India, Desert Regional Station, Jodhpur, records following five species, four (*) of which are addition to the known centipede fauna of Rajasthan.

1. *Scolopendra amazonica* Bucherl*
2. *Scolopendra morsitans* Linnaeus
3. *Asanada indica* Jangi and Dass*
4. *Asanada brevicornis* Meinert*
5. *Rhysida nuda immarginata* (Porath)*

Desert National Park : Situated Ca. 45 km NW of Jaisalmer, the Desert National Park, Rajasthan covers an area of about 3162 km², located at 26°-30'54 NL and 70°0'55 NE, in the main Thar

Desert with an average elevation of about 242 m ASL. The maximum temperature is 50°C and the minimum reaching -4°C. The land is arid with sand dunes and the vegetation is typical arid type.

Barring *Scolopendra mirabilis*, which is of Ethiopian origin, all other species are very well distributed in India and Oriental region (Khanna, 2001).



SYSTEMATIC ACCOUNT

Class CHILOPODA

Order SCOLOPENDROMORPHA

Family SCOLOPENDRIDAE

Subfamily 1. SCOLOPENDRINAE

Tribe 1. SCOLOPENDRINI

1. *Scolopendra amazonica* Bucherl, 19461946. *Scolopendra morsitans amazonica* Bucherl, *Mem. Inst. Butantan*, **19** : 135-137.1968. *Scolopendra amazonica*, Lewis, *J. Linn. Soc.*, **47** : 315-326.1969. *Scolopendra amazonica* Lewis, *J. Linn. Soc.*, **48** : 49-57.*Type locality* : Manaus, Amazona, Brazil.

Material examined : BARMER : Harsani Village, 19.vii.1995, 2 exs, 11.ii.1995, 2 exs.; JAISELMER, Bhopa Village, ca. 31 kms from Jaisalmer, 25.vii.1995, 4 exs.; Pithla area on Khuni Road, ca 28 kms from Jaisalmer, 21.vii.1995, 11 exs., All N. S. Rathore Coll.

Remarks : This species is widely distributed in India especially in Thar Desert and Aravalli ranges upto Delhi and Haryana. The species differs from *Scolopendra morsitans* only in the absence of a tarsal spur on 20th pair of walking legs. The rest of the characters are same. The species occur sympatrically with its sibling *S. morsitans* without hybridization. This is a first record of the species from Rajasthan.

Distribution : INDIA : Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Uttar Pradesh, Uttarnchal, Delhi, Himachal Pradesh and Andaman and Nicobar Islands.

2. *Scolopendra morsitans* Linnaeus1758. *Scolopendra morsitans* Linnaeus, *Syst. Nat.*, Ed. **10** : 638.

Material examined : JAISELMER, Khuni River, DNP Area, 49 kms from Jaisalmer, 27.vii.1995, 5 exs.; BARMER, Balewa Village, ca. 73 kms from Khuni to Phoolia, 25.ix.1996, 2 exs., All N. S. Rathore Collection.

Remarks : The species occurs in various color forms, shapes and sizes.

Distribution : Widely distributed in India. Cosmopolitan species.

Tribe 2. ASANADINI

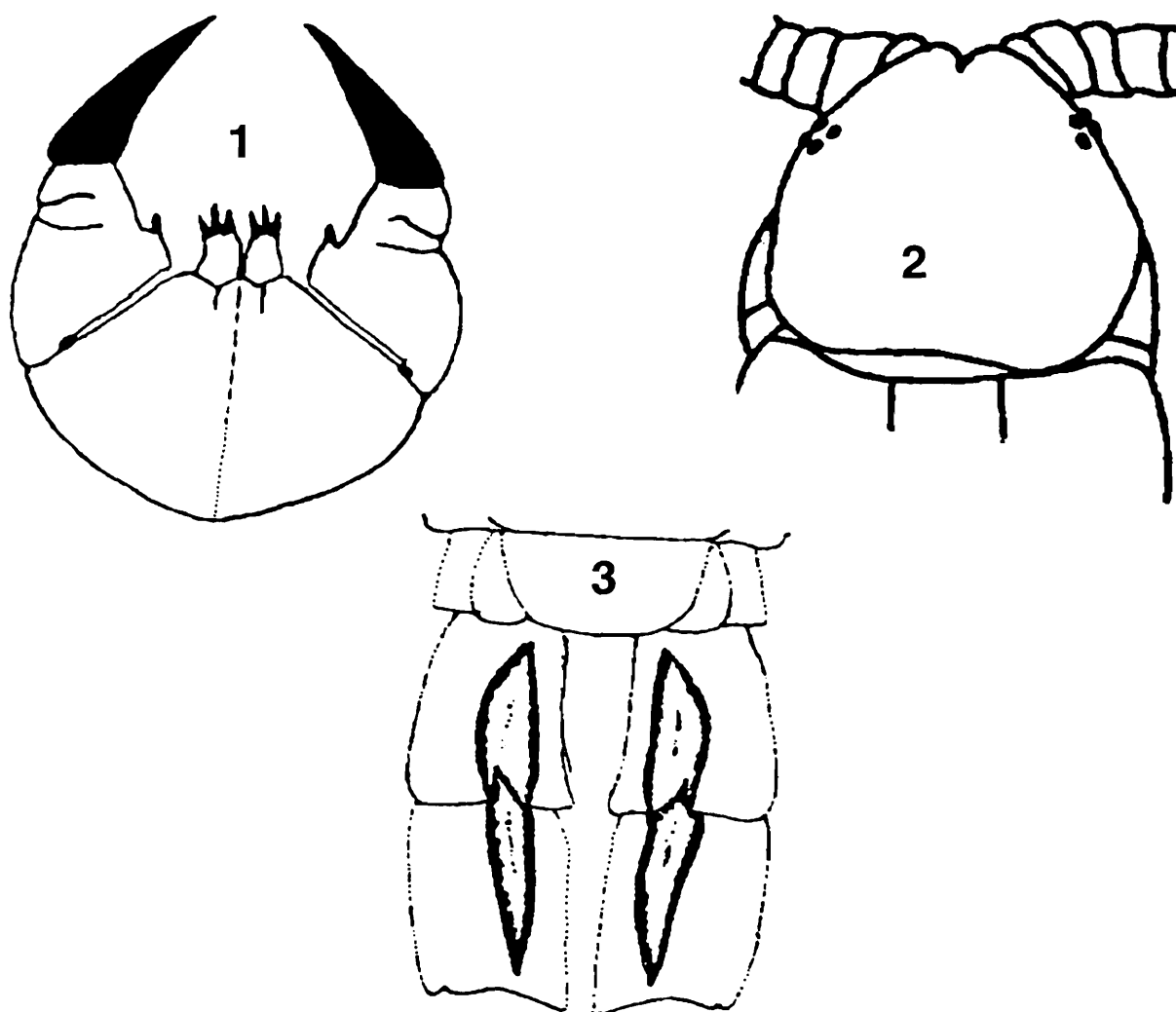
3. *Asanada indica* Jangi and Dass, 19841984. *Asanada indica* Jangi & Dass, *J. Scient. Indl. Res.*, **43** : 38.

Type locality : Urlikanchan, Pune, Maharashtra.

Material examined : JAISELMER, Nahar Singh Ki Dhani, ca. 9 km from Jaisalmer, 6.ii.1995, 2 exs., BARMER, Harsani Village, ca. 85 kms NW of Barmer, 11.ii.1995, 1 ex., All N. S. Rathore Collection.

Remarks : The specimen of this species collected from Uttar Pradesh, Uttaranchal and Delhi shows certain variations in the characters of taxonomic importance as described by Jangi and Dass (1984) and so is the case with the specimen from Desert National Park, Rajasthan and Haryana. These variations are briefly described and illustrated here (Fig. 1-3) to append to the original description and to avoid arising anomaly and undue creation of new taxa.

Tergite up to 20th segment with a pair of paramedian longitudinal furrows represented only anteriorly in 1st, posteriorly in 3rd, absent in 2nd and complete from 4–20th tergal segment. Endsternite with a median notch. Base of the coxosternum with a complete median furrow running all along its length upto 1st sternal segment. Anal leg prefemur and femur also with deep longitudinal and confluent groove. Pretergite visible between cephalic plate and 1st tergal segment.



Figs. 1-3. : 1. Coxosternum; 2. Cephalic plate with 1st Tergite showing Pretergite; 3. Anal leg prefemur and femur with confluent groove.

Remarks : This is a first record of the species from Rajasthan.

Distribution : Rajasthan, Maharashtra, Delhi.

4. *Asanada brevicornis* Meinert, 1886

1886. *Asanada brevicornis* Meinert, *P. Amer. Phil. Soc.*, **23** : 189.

Type locality : Kulu, Himachal Pradesh.

Material examined : JAISELMER, Pithia area, ca. 28 km from Jaisalmer, 24.vii.1995, 4 exs., N. S. Rathore Coll.

Remarks : This is a first record of the species from Rajasthan.

Distribution : Andaman and Nicobar, Maharashtra, Tamil Nadu, Gujarat and Himachal Pradesh.

Subfamily 2. OTOSTIGMINAE

Tribe 3. OTOSTIGMINI

5. *Rhysida nuda immarginata* (Porath), 1876

1876. *Branchiostoma immarginatum*, Porath, *Bih. svenska. Ak.*, **4(7)** : 24.

1910. *Rhysida immarginata* Kraepelin, *Mit. Mus.*, Hamburg, **20** : 143.

Type locality : Manilla, Philippines.

Material examined : BARMER, Turvi, ca. 93 kms NW of Barmer, 20.vii.1995, 2 exs., N. S. Rathore Coll.

Remarks : Since the species described earlier by various authors lack detailed taxonomic description and illustrations, Khanna (1997) redescribed the species with illustrations. It is a first record of the species from Rajasthan.

Distribution : Andaman and Nicobar Islands, Gujarat, Uttar Pradesh, Uttaranchal, Maharashtra, Madhya Pradesh, Himachal Pradesh and Delhi.

Key to the subfamily, tribes, genera and species of the

Family Scolopendridae from Rajasthan

1. Spiracle triangular, with its cavity divided into an inner and an outer atrium by a tripartite valve Subfamily : SCOLOPENDRINAE : 2
- Spiracle oval or round with undivided and fully exposed spiracular cavity
..... Subfamily : OTOSTIGMINAE;
Tribe : OTOSTIGMINI

Rhysida nuda immarginata (Porath)

2. Endsternite with coxopleural process, pores and spines Tribe : SCOLOPENDRINI : 3
Endsternite without coxopleural process, pores and spines Tribe : ASANADINI : 8
3. All legs without spurs to the first tarsal segment Genus : *Cormocephalus*
Legs mostly with tarsal spurs Genus : *Scolopendra* : 4
4. Base of the coxosternum with a median furrow below the dental plate and a pair of paramedian furrows with zigzag sutures 5
Base of the coxosternum smooth, without such sutures 6
5. Only endtergite laterally emarginate *Scolopendra indiae*
Tergite between 17–21st emarginate *Scolopendra mirabilis*
6. 1st tergal segment smooth 7
1st tergal segment with a ring furrow *Scolopendra valida*
7. Analleg prefemur, femur and tibia in adult males dorsally flat and marginate, and prefemur of anal legs with 9 spines generally in 3 rows of 3 each; 20th pair of walking legs with a tarsal spur *Scolopendra morsitans*
20th pair of walking legs without tarsal spur *Scolopendra amazonica*
8. Anallegs long and slender, paired longitudinal median sutures may or may not be complete on 20th tergite; 21st tergite and sternite 1–1/2 times as broad as long; longitudinal median groove present posteriorly on anal leg prefemur, femur and tibia *Asanada brevicornis*
Anal leg short and thick. Paired median longitudinal sutures always complete on 20th tergal segment; 21st tergite more than double in width than long; longitudinal median groove present on analleg prefemur and femur almost throughout its length *Asanada indica*

SUMMARY

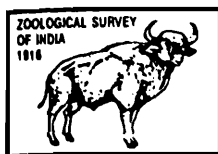
Five species of Scolopendrid centipedes have been recorded from Desert National Park, four of which are a first record from Rajasthan. With the present studies the number of known species of Scolopendrid centipedes from Rajasthan has been raised to nine with four species as first record from the state.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Kolkata for his kind permission to undertake the studies, to Dr. Arun Kumar, Additional Director-in-Charge, Northern Regional Station, Dehra Dun for facilities and to Dr. Q. H. Baqri, the then Additional Director-in-Charge, Desert Regional Station, Jodhpur for placing his material at the disposal of the author.

REFERENCES

- Jangi, B. S. and Dass, C. M. S. 1980. A new species of *Trachycormocephalus* Kraepelin (Chilopoda : Scolopendridae) from India. *Ent. Mon. Mag.*, **116** : 67-70.
- Jangi, B. S. and Dass, C. M. S. 1984. Scolopendridae of Deccan. *J. Scient. Indl. Res.*, **43**(2) : 27-54.
- Khanna, V. 1977a. Studies on the centipede genus *Trachycormocephalus* (Myriapoda : Scolopendridae) from Rajasthan, India *Orient. Ins.*, **11**(1) : 151-156.
- Khanna, V. 1977b. Observations on the food and feeding habits of *Scolopendra valida* Lucas. *Geobios*, **4** : 51-53.
- Khanna, V. 1997. Chilopoda : Scolopendromorpha. In : *Fauna of Delhi, State Fauna Series*, **6** : *Zool. Surv. India*, : 468-475.
- Khanna, V. 2001. A checklist of Scolopendrid centipedes from India (Chilopoda : Scolopendromorpha). *Annals of Forestry*, **9**(2) : 199-219.
- Lewis, J. G. E. 1968. Individual variations in the populations of centipede *Scolopendra amazonica* from Nigeria and its implications for methods of taxonomic discrimination in Scolopendridae. *J. Linn. Soc.*, **47** : 315-326.
- Vazirani, T. G. and Khanna, V. 1976. First record of the centipede *Cormocephalus* (*s. str.*) *pygmaeus* Pocock, from Rajasthan, India. *Newslett. Zool. Surv. India*, **2** : 25-26.
- Vazirani, T. G. and Khanna, V. 1977. First record of the centipede *Trachycormocephalus indiae* Chamberlin from Rajasthan, India. *Newslett. zool. Surv. India*, **3**(4) : 41-42.



Rec. zool. Surv. India : **104** (Part 3–4) : 129-136, 2005

STATUS OF TICKS (ACARI : METASTIGMATA) OF RAJASTHAN

A. K. SANYAL AND S. K. DE

Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053

INTRODUCTION

Ticks are of great medical and veterinary importance. They live as ectoparasites of vertebrates and obligatorily on the blood of mammals, reptiles and birds. Ticks surpass all other arthropods in the variety of diseases of man and domestic animals.

Although a number of tick species (108) are known from India, only 24 species have so far been reported from Rajasthan. The tick fauna of Rajasthan was first studied by Joshi (1943) who recorded *Ornithodoros savignyi* from Marwar. Later several workers (Hoogstraal and Trapido, 1963; Wattal and Srivastava, 1967; Miranpuri *et al.*, 1975; Kaul *et al.*, 1978; Advani and Vazirani, 1981; Miranpuri and Gill, 1983; Geeverghese and Dhanda, 1987; Frazier and Keirans, 1989 and Sanyal and De, 1996, in press) described and recorded 21 species of ticks from the state. The present study records three species as new to the state. Thus the total number of species so far known from the state stands at 24 under 9 genera (Table 1).

Recently the present authors received several tick specimens collected from different areas of Rajasthan and while going through the specimens, three species were recorded as new to the state. To record these species and to meet the need present paper is prepared. It includes a list (Table 1) of total of 24 species under 9 genera so far known from Rajasthan giving their distribution and hosts from which recorded in the state. The status of ticks also showed that two species viz., *Argas (Carios) indicus* and *A. (Chiropteragus) wilsoni* were recorded as new to science from the state and till date they are not known from outside the state. The species viz., *Ixodes vespertilionis* and *Argas reflexus hermanni* are known in India from Rajasthan only. Material presently studied are deposited in the National Zoological Collection of Zoological Survey of India, Kolkata.

Table 1. : List of Ticks known from Rajasthan and their distribution in India.

Sl. No.	Species of Ixidid tick	Distribution in Rajasthan	Host in Rajasthan	Distribution in other Indian states
1.	<i>Amblyomma clypeolatum</i>	Udaipur	Star Tortoise (<i>Geochelone elegans</i>)	Gujarat, West Bengal
2.	<i>A. javanense</i>	Udaipur	<i>Python morulus</i>	Bihar, Gujarat, Karnataka, Maharashtra, Orissa, U.P.
3.	<i>Aponomma gervaisi</i>	Udaipur Ganganagar	Common monitor lizard	Assam, Maharashtra, Manipur, Orissa, U.P., W.B.
4.	<i>Boophilus microplus</i>	Ganganagar	Cattle, Camel	All most all states
5.	<i>Haemaphysalis indica</i>	Shamghar	Small & large mammals	Bihar, Gujarat, Karnataka, Orissa, W.B.
6.	<i>H. kutchensis</i>	Kota, Jalore, Alwar, Barmer, Pilani	Hare	Gujarat, Maharashtra
7.	<i>Hyalomma antolicum anatolicum</i>	Jaisalmer	Cattle, Camel	All most all states
8.	<i>H. detritum</i>	Alwar	Small mammals	Delhi, H.P., Haryana, J & K, Maharashtra, Punjab, U.P.
9.	<i>H. dromedarii</i>	Jaisalmer	Cattle, Camel	Andhra Pradesh, Delhi, Gujarat, Orissa
10.	<i>H. hussaini</i>	Kota	Small & large mammals	Cosmopoliton
11.	<i>H. Kumari</i>	Kota, Jalore, Sirchi	Small & Large mammals	Most of the states
12.	<i>H. marginatum isaaci</i>	Jalore, Sirchi	Small & large mammals	Cosmopoliton
13.	<i>Hyalomma</i> sp.	Sam, Jaisalmer	Camel	—
14.	<i>Rhipicephalus haemaphysaloides</i>	Ganganagar	Small & large mammals	Cosmopoliton
15.	<i>R. ramachandrai</i>	Udaipur	Small & large mammals	W.B., Himachal Pradesh
16.	<i>R. sanguineus</i>	Alwar	Dog	Cosmopoliton
17.	<i>R. turanicus</i>	Pilani, Suratgarh, Ganganagar	Dog	Andhra Pradesh, Gujarat, J & K, Maharashtra, T.N., W.B.
18.	<i>Ixodes vespertilionis</i>	Kota	<i>Taphozous kacchensis</i>	—
19.	<i>Argas (carios) indicus</i>	Jodhpur	Bat (<i>Tadarida aegyptiaca thomsai</i>)	—
20.	<i>A. reflexus hermanni</i>	Udaipur	Blue rock pigeon	—
21.	<i>A. (Chiropteragus) wilsoni</i>	Jhalawar	Bat (<i>Rhinopoma microphyllum microphyllum</i>)	—
22.	<i>A. vespertilionis</i>	Jodhpur	Bat (<i>Pipistrella dormeri dormeri</i>)	Kashmir
23.	<i>Argas persicus</i>	Jaipur	Soil litter	A.P., Bihar, Haryana, H.P., Maharashtra, J & K, U.P.
24.	<i>Ornithodoros savignyi</i>	Marwar, Jodhpur	Cattle	A.P., M.P., Maharashtra, Gujarat, Karnataka, Punjab

SYSTEMATIC ACCOUNT

Family I : IXODIDAE

Genus 1. *Amblyomma* Koch

1844. *Amblyomma* Koch, *Arch. Naturg.*, **10**(1) : 223-231.

1. *Amblyomma clypeolatum* Neumann

1899. *Amblyomma clypeolatum* Neumann, *Mem. Soc. Zool. France*, **12** : 257-258.

1908. *Amblyomma atrogenatum* Nuttall and Warburton, *Proc. Camb. Phil. Soc. Math. Phys. Sci.*, **14** : 392-416.

1926. *Amblyomma clypeolatum*, Robinson, *Cambridge Univ. Press*, 302.

1928. *Amblyomma clypeolatum*, Sharif, *Rec. Indian Mus.*, **30**(3) : 217-344.

1989. *Amblyomma clypeolatum*, Frazier and Keirans, *Journal Bombay Natural Hist. Society*, **87** : 247.

Material examined : 1 ♀, Jhadola forest, Udaipur, 1.viii.1998, from *Geochelone elegans*, coll. S. K. Sharma.

Remark : Only one male of the species was recorded by Frazier and Keirans (1980) from Motinagar Snake Park, Udaipur, parasitizing *Geochelone elegans*.

2. *Amblyomma javanense* (Supino)

1897. *Rhipicephalus javanensis* Supino, *Atti. Soc. Veneto-Trent. Sci. Nat.*, **3**(1) : 233.

1908. *Aponomma javanense* Cooper and Robinson, *Proc. Camb. Philos. Soc.*, **14** : 464-466.

1968. *Amblyomma javanense* (Supino), Hoogstraal *et al.*, *Ann. ent. Soc. Am.*, **61**(3) : 722.

Material examined : 1 ♀, 2 ♂♂, Jhadole forest, Udaipur, 16.viii.1998, from *Python molurus*, coll. S. K. Sharma.

Remark : This species mainly attacks wild animals but not much important as a disease carrier. The species is recorded here for the first time from Rajasthan.

Genus 2. *Aponomma* Neumann

1899. *Aponomma* Neumann, *Mem. Soc. Zool. France*, **12** : 180.

3. *Aponomena gervaisi* (Lucas)

1847. *Ixodes gervaisi* Lucas, *Ann. Soc. Ent. Fr.*, **5**(7) : 259-261 (Abstract).

1899. *Aponomma gervaisi* (Lucas), Neumann, *Mem. Soc. Zool. France*, **12** : 180.

Material examined : 3 ♀♀, 1 ♂, Jhadole forest, Udaipur, 2.viii.1994, from common monitor lizard, coll. S. K. Sharma.

Remark : The species is reported here for the first time from Rajasthan.

Genus 3. *Boophilus* Curtice

1891. *Boophilus* Curtice, *Journ. Compar. Med. Veter. Arch.*, **12** : 313.

4. *Boophilus microplus* (Canestrini)

1887. *Haemaphysalis micropla* Canestrini, *Atti. Soc. Veneto-Trent. Sci. Nat.*, **11** : 104.
 1890. *Rhipicephalus micropla* Canestrini, Padova, **4** : 493.
 1943. *Boophilus microplus*, Fairchild, *Am. J. Trop. Med.*, **23**(6) : 586.
 1975. *Boophilus microplus*, Miranpuri *et al.*, *Intl. J. Acar.*, **1**(1) : 34.
 1978. *Boophilus microplus*, Kaul *et al.*, *Indian J. Parasit.*, **2**(1) : 19-25.

Remark : The domestic and wild animals are attacked by this species of tick causing red-water fever and *anaplasmosis* to cattle and sheep.

Genus 4. *Haemaphysalis* Koch

1844. *Haemaphysalis* Koch, *Arch. Naturg.*, **10**(1) : 217-239.

5. *Haemaphysalis indica* Warburton

1910. *Haemaphysalis indica* Warburton, *Parasitology*, **3** : 395.
 1978. *Haemaphysalis indica*, Kaul *et al.*, *Indian J. Parasit.*, **2**(1) : 19-25.

Remark : The species is widely distributed mainly as carnivore parasite in India.

6. *Haemaphysalis kutchensis* Hoogstraal and Trapido

1963. *Haemaphysalis kutchensis* Hoogstraal and Trapido, *J. Parasit.*, **49**(3) : 489.

Remark : The species was described by Hoogstraal and Trapido (1963) from Gujarat. They reported the species from the dry areas of Rajasthan.

Genus 5. *Hyalomma* Koch

1984. *Hyalomma* Koch, *Arch. Naturg.*, **10**(1) : 220.

7. *Hyalomma anatolicum anatolicum* Koch

1844. *Hyalomma anatolicum anatolicum* Koch, *Arch. Naturg.*, **10**(1) : 220.
 1975. *Hyalomma anatolicum anatolicum*, Miranpuri *et al.*, *Intl. J. Acar.*, **1**(1) : 44.
 1978. *Hyalomma anatolicum anatolicum* Koch *et al.*, *Indian J. Parasit.*, **2**(1) : 19-25.

Material examined : 3 ♀♀, 5 ♂♂, Lunia Para, Abu Road, 23.ii.1981, from cow, coll. Y. N. Gupta; 2 NN, Dabok, Udaipur, 1.iii.1981, from cow, coll. Y. N. Gupta; 1 ♀, 3 ♂♂, Artya Kola, Jodhpur, 19.ix.2000, from cow, coll. A. K. Bhattacharyya; 1 ♀, 1 ♂, Bodona Ki Dha, Jodhpur, 20.ix.2000, from buffalo, coll. A. K. Bhattacharyya; 2 NN, Jalore, 6.xii.2000, from buffalo, coll. A. K. Bhattacharyya.

Remark : The species is known to occur in many states of India infesting cattle, camel, donkey, goat, horse, sheep and occasionally dog.

8. *Hyalomma detritum* Schulze

1919. *Hyalomma detritum* Schulze, *Sitzungsab. Ges. Naturf. Freunde Berlin. Jahrg.*, 189-196.

1967. *Hyalomma detritum* Wattal and Srivastava, *Bull. Indian Soc. Malaria and Communicable diseases*, 4 : 191.

Remark : *Hyalomma detritum* has been reported from Alwar infesting small mammal.

9. *Hyalomma dromedarii* Koch

1844. *Hyalomma dromedarii* Koch, *Arch. Naturg.*, 10(1) : 220.

1978. *Hyalomma dromedarii*, Kaul et al., *Indian J. Parasit.*, 2(1) : 19-25.

Material examined : 3 ♀♀, 10 ♂♂, from cow, 4 ♀♀, from buffalo, 3 ♀♀, 5 ♂♂ from camel, Dera village, Jodhpur, 20.xi.2000, coll. C. Singh.

Remark : The species has been recorded from other Indian states infesting buffalo, camel, cattle, goat and horse.

10. *Hyalomma hussaini* Sharif

1928. *Hyalomma hussaini* Sharif, *Rec. Indian Mus.*, 30(3) : 314.

1978. *Hyalomma hussaini*, Kaul et al., *Indian J. Parasit.*, 2(1) : 19-25.

Remark : The species has been known to infest mainly domestic animals.

11. *Hyalomma kumari* Sharif

1928. *Hyalomma kumari* Sharif, *Rec. Indian Mus.*, 30 : 319.

1978. *Hyalomma kumari*, Kaul et al., *Indian J. Parasit.*, 2(1) : 19-25.

Remark : *Hyalomma kumari* has been reported from other parts of India infesting buffalo, camel, cow, dog, goat, horse, sheep, wild goat, tiger, barking deer and Indian muntjak.

12. *Hyalomma marginatum isaaci* Sharif

1928. *Hyalomma marginatum isaaci* Sharif, *Rec. Indian Mus.*, 30 : 307.

1978. *Hyalomma marginatum isaaci*, Kaul et al., *Indian J. Parasit.*, 2(1) : 19-25.

Remark : The species has been reported from other Indian states from buffalo, cow, horse, sheep and brahmyn myna. The nymph of this species carries Crimean haemorrhagic fever virus.

13. *Hyalomma* sp.

Remark : The species was reported from Sams, Jaisalmer by Sanyal and De (1996). The only specimen collected from camel could not be identified as a single one.

Genus 6. *Ixodes* Latreille

1795. *Ixodes* Latreille, *Mag. Encycl. J. Sci. Lett. Arts.*, 4 : 15-20.

14. *Ixodes vespertilionis* Koch

1844. *Ixodes vespertilionis* Koch, *Arch. Naturg.*, 10(1) : 232.

1981. *Ixodes vespertilionis*, Advani and Vazirani, *Rec. zool. Surv. India*, Occ. Paper No. 22 : 112.

Remark : *I. vespertilionis* is known only from Rajasthan state in India.

Genus 7. *Rhipicephalus* Koch

1844. *Rhipicephalus* Koch, *Arch. Naturg.*, 10(1) : 238.

15. *Rhipicephalus haemaphysaloides* Supino

1897. *Rhipicephalus haemaphysaloides* Supino, *Atti. Soc. Veneto-Trent. Sci. Nat.*, 2s, 3(1) : 234.

1978. *Rhipicephalus haemaphysaloides*, Kaul *et al.*, *Indian J. Parasit.*, 2(1) : 19-25.

Remark : This species is known to infest varieties of small and large mammals. Sharif (1928) suspected that this species plays some role in transmission of tick typhus fever in India.

16. *Rhipicephalus ramachandrai* Dhanda, Hoogstraal and Bhat

1970. *Rhipicephalus ramachandrai* Dhanda *et al.*, *J. Parasit.*, 56(4) : 823.

1978. *Rhipicephalus ramachandrai*, Kaul *et al.*, *Indian J. Parasit.*, 2(1) : 19-25.

Remark : This species was described from West Bengal, Himachal Pradesh and Rajasthan.

17. *Rhipicephalus sanguineus* (Latrielle)

1806. *Rhipicephalus sanguineus* Latrielle, *Genera Crustaceorum et. Insectorum*, 1 : 157.

1844. *Rhipicephalus sanguineus*, Koch, *Arch. Naturg.*, 10(1) : 238.

Remark : The species is commonly known as dog tick. Besides dog, it infests cattle, horse, donkey, goat, wild boar, bear, fox, rat, *Felis marmorada*, *Felis viverrina* and *Canis aureus*.

18. *Rhipicephalus turanicus* Pomerantzev

1940. *Rhipicephalus turanicus* Pomerantzev, *Mag. Parasit.*, 7 : 113.

1975. *Rhipicephalus turanicus*, Miranpuri *et al.*, *Intl. J. Acar.*, 1(1) : 48.

1978. *Rhipicephalus turanicus*, Kaul *et al.*, *Indian J. Parasit.*, 2(1) : 19-25.

Remark : This species is known to infest buffalo, cat, dog, donkey, goat, rat and sheep in different states in India.

Family II : ARGASIDAE**Genus 8. *Argas* Latreille**

1795. *Argas* Latreille, *Precis des caracteres generiques des insects disposes dans un ordre naturel*, 302 pp.

19. *Argas (Carios).indicus* Advani and Vazirani

1981. *Argas (Carios) indicus* Advani and Vazirani, *Rec. zool. Surv. India*, Occ. Pap. No. 22 : 105.

Remark : *A (C) indicus* was described by Advani and Vazirani (1981) from Rajasthan. This species is still not known from outside the state.

20. *Argas persicus* (Oken)

1818. *Rhynchoprion persicus* Oken, *Isis*, 1567.

1823. *Argas persicus* Fischer de Waldheim, *Mem. Soc. imp. De nat. de Moscow*, 6 : 269.

Material examined : 1 ♂, Bassi, Jaipur, 8.iii.1981, from soil and litter, coll. Y N. Gupta.

Remark : This species is reported here as new to the state.

21. *Argas reflexus hermanni* Audouin

1827. *Argas reflexus hermanni* Audouin, *Descrip. Egypt*, 2nd ed., 22 : 183.

1978. *Argas reflexus hermanni*, Kaul *et al.*, *Indian J. Parasit.*, 2 : 19-25.

Remark : The species was reported by Kaul *et al.* (1978) from Rajasthan infesting blue rock pigeon. It is known in India from Rajasthan only.

22. *Argas (Carios) vespertilionis* (Latreille)

1802. *Carios vespertilionis* Latreille, *Histoire naturelle generale elparticuliere des crustaces et des insects (etc.) Paris*, 3 : 468 pp.

1958. *Argas (Carios) vespertilionis*, Hoogstraal, *Ann. Entomol. Soc. Amer.*, 15 : 20.

1981. *Argas (Carios) vespertilionis*, Advani and Vazirani, *Rec. zool. Surv. India*, Occ. Pap. No. 22 : 99.

Remark : Advani and Vazirani (1981) recorded the species from Rajasthan infesting bat.

23. *Argas (Chiropteragus) wilsoni* Advani and Vazirani

1981. *Argas (Chiropteragus) wilsoni* Advani and Vazirani, *Rec. zool. Surv. India*, Occ. Pap. No. 22 : 108.

Remark : Advani and Vazirani (1981) described the species as new to science from Rajasthan. The species is still not known from outside the state.

Genus 9. *Ornithodoros* Koch

1844. *Ornithodoros* Koch, *Arch. Naturg.*, 1 : 219.

24. *Ornithodoros savignyi* (Audouin)

1827. *Argas savignyi* Audouin, *Descrip Egypte.*, 2nd ed. 22 : 183.

1896. *Ornithodoros savignyi* Neumann, *Mem. Soc. Zool. France*, 9 : 27.

1943. *Ornithodoros savignyi*, Joshi, *Indian Fmg.*, 4(3) : 141-142.

Material examined : 7 NN, Dera village, Jodhpur, 20.xi.2000, from cattle, coll. C. Singh.

Remark : This species is a common ectoparasite of animals in India.

SUMMARY

The studies on ticks of Rajasthan was initiated by Hoogstraal and Trapido (1963). Later Wattal and Srivastava (1967), Kaul *et al.* (1978), Advani and Vazirani (1981), Geeverghese and Dhanda (1987) and Frazier and Keirans (1989) described and reported ticks from different hosts and habitats like snake, monitor lizard, chelonia, cow, bat and soil and litter in Rajasthan.

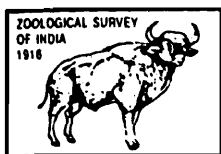
A total of 24 species including 18 ixodids and 6 argasids are known from the state. Of these, two species were described as new to science from the state and till date they are not known from outside the state. Three of the total number of species are recorded here as the first record from Rajasthan.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. J. R. B. Alfred, Director, Zoological survey of India, Kolkata for facilities. Thanks are also due to Dr. A. K. Bhattacharyya, Research Associate, ZSI, DRS, Jodhpur for collection of Tick specimens for the study.

REFERENCES

- Advani, R. and Vazirani, T. G. 1981. Studies on ectoparasites of bats of Rajasthan and Gujarat, India. *Rec. zool. Surv. India*, Occ. Paper No. **22** : 1-155.
- Frazier, J. G. and Keirans, J. E. 1989. Ticks (Acari : Ixodidae) collected on chelonians (Reptilia) from India and Burma. *Journal Bombay Nat. Hist. Soc.*, **87** : 287-289.
- Geeverghese, G. and Dhanda, V. 1987. The Indian *Hyalomma* ticks (Ixodidea : Ixodidae). ICAR, New Delhi, 1-119.
- Hoogstraal, H. and Trapido, H. 1963. *Haemaphysalis kutchensis* sp. n. a common larval and nymphal parasite of birds in north western India (Ixodoidea : Ixodidae). *J. Parasit.*, **46**(3) : 459-497.
- Joshi, B. B. 1943. The tampan ticks of Marwar. *Indian Fmg.*, **4**(3) : 141-142.
- Kaul, H. N., Mishra, A. C., Dhanda, V., Kulkarni, S. M. and Guttikar, S. N. 1978. Ectoparasitic arthropods of birds and mammals from Rajasthan State, India. *Indian J. Parasit.*, **2**(1) : 19-25.
- Miranpuri, G. S., Bindra, O. S. and Prasad, V. 1975. Tick fauna of North – Western India (Acarina : Metastigmata). *Intl. J. Acar.*, **1**(1) : 31-54.
- Miranpuri, G. S. and Gill, H. S. 1983. Ticks of India. Lindsay and Macleod, Edinburgh, iv + 125 pp.
- Sanyal, A. K. and De, S. K. 1996. Ticks (Acarina : Metastigmata) fauna in the Thar Desert. *Gaps in Research* (eds. Ghosh, A. K. *et al.*) : 81-87.
- Sanyal, A. K. and De, S. K. (in press). Tick fauna in Jaisalmer and Barmer Districts, Western Rajasthan.
- Wattal, L. and Srivastava, S. P. 1967. Ectoparasitic forms of small mammals and domestic animals in the neighbourhood of Alwar city/Rajasthan. *Bull. Indian Soc. Malaria and Communicable diseases*, **4** : 191-192.



Rec. zool. Surv. India : **104** (Part 3–4) : 137-141, 2005

DISTRIBUTIONAL PATTERN OF TERMITES (ISOPTERA : INSECTA) IN MAHARASHTRA, INDIA

P. H. Roy

Zoological Survey of India, Kolkata-700 053

INTRODUCTION

Termites occur in abundance in the circumtropics, more abundance in the humid tropics and very sparse so in the warm temperate regions. India, being a vast tropical country, supports more than 300 species (Maiti, 1991) of termites. In contrasting richness and paucity in its different physiographic units. In considering the vastness of the country, a number of attempts have been made to explore State-wise termite fauna and to enumerate their distribution pattern (Roonwal and Chhotani, 1962—Assam region; Roonwal and Bose, 1964—Rajasthan; Maiti, 1983—West Bengal; and Bose, 1984—South India).

The State of Maharashtra with its contrasting land elevation in the Western Ghats, stretches of pluvial coastal plains and dry Deccan plateau remains unexplored from termite point of view, although stray reports are not uncommon (Snyder, 1949). A detailed collection and study of termites have been made by the author to record 28 species from the State. The analysis of the distribution pattern of these termites in relation to different physiography, climate, vegetation, etc. of three units namely, Konkan Coastal Plain, Sahyadri Western Ghats and Maharashtra Plateau is the main purpose of the present paper. Such an ecological analysis will never be satisfactory, unless it takes into account of the physiography, climate, vegetation, etc. of the area studied. Reasonably, these factors are briefly incorporated in the paper.

PHYSIOGRAPHY, CLIMATE, VEGETATION, ETC.

The State of Maharashtra is situated within the Peninsular plateau in the western fringe of India. The Arabian Sea and the Sahyadri range or the Western Ghats are the dominating feature of this region. The Sahyadri range, much older than the mighty Himalaya, runs north to south close to the western coast and presides over the climate of the area. However, the state is divided into three

distinct physiographic sub-divisions, *i.e.*, the Konkan Coastal Plain, Sahyadri range (western ghat) and Maharashtra plateau.

In the Western Ghat most of the high peaks rise above 1400 m and the highest peak is Kalsubia (1646 m) near Igatpuri. Nearly whole of the Maharashtra plateau is formed of plateau basalt which on weathering has given rise to rolling surface with intervening shallow valleys.

The Konkan coast is generally cliffy. The rain receives highest in the ghat area (Mahabaleswar 630 mm) and medium in coastal plains (Bombay 180 mm) and minimum in the Decan plateau (60–78 mm).

The topical evergreen forest is the characteristic vegetation in western slope of the ghat, while the eastern slope and the Decan plateau support mostly dry deciduous and thorn forest in succession from west to east. The soil is mainly three types, namely, coastal alluvial, hill soil and deep black soil in successive subdivisions from west to east.

MATERIAL AND METHOD

The study is based on a fairly good collections of termites from all over the State made by the author during the last few years. Such huge collection was augmented by further collection made by the staff-members of the Western Ghat Regional Station, Pune, as well as by those from the Zoological Survey of India, Head quarter, Kolkata. The study of these termites has resulted in the recognition of 28 species from nenerous localities of Maharashtra. The distribution data have been tabulated in three major physiographic units. All the material preserved in alcohol were studied under a Sterioscopic Binocular Microscope.

OBSERVATION (FAUNAL COMPOSITION)

A total of 28 species of termites were recognised belonging to 13 genra under two families, namely, Rhinotermitidae (2 species only) and Termitidae (26 spp.). The members of the former family are partially wood and soil-inhabiting, while those of the latter are purely soil-inhabiting species. Interestingly enough, the purely wood-inhabiting species belonging to the families, Kalotermitidae and Hodotermitidae being so common all over the country, are altogether absent, in spite of unique ecological habitats available in the evergreen rain forest in the Ghat area. However, the soil-inhabiting species (26 species out of 28) have outnumbered other species in the area, of which 8 species represent in all the physiographic units. Of course, a single species, *Coptotermes heimi* (Wasm.) inhabiting primarily in wood with mixture of soil, also occur throughout the State. Thus eight species spread in all the physiographic units.

Fauna of the Kokan Coastal Plain

This area contains 15 species of termites including all two Rhinotermitidae species (Table 1). Maximum number of 7 species belonging to the genus, *Odontotermes* is recorded from the area. Out of this, 5 species are found in two other units and none restricts itself in the area, 4 species are common to Coastal and its adjacent tract of Western Ghat area. Only single species, *Microcerotermes tenuignathus* is upto now known from the coastal plain. However, more than 50% of the fauna is the soil-inhabiting species.

Fauna of the Sahyadri Hill Range (Western Ghats)

This hilly tract is the richest in supporting as many as 22 species, of which 7 species spread in all the units, 6 restrict itself in the area and 4 species are common to coastal area and 7 to Ghat and Deccan Plateau (Table 1).

Fauna of the Maharashtra Plateau

The vast Deccan tract supports minimum number of 14 species. Out of these, 4 species restrict to the area, eight species shares both the Ghats and the Plateau areas. There is not a single species common to Coastal and Plateau units. However, only 5 genera could be recorded from the area with their representative species (Table 1).

DISCUSSION

The termite fauna of Maharashtra may not be considered as very rich in considering its contrasting physiography creating some ideal ecological habits especially in the Ghat area with its luxuriant evergreen forest grown by the influences of contrasting land elevation, high rain fall, humidity etc. No doubt the Western Ghat area is more rich in containing 22 species in comparison to two other physiographic units. The richest concentration of soil-inhabiting species as listed in the table 1 is due to high precipitation retaining sufficient moisture in the soil under the shade of the forests. The coastal plain and the vast Deccan trap do not share any species except a single species probably due to existences of hilly tract (Ghat) serving as an effective barrier for easy dispersal of these weak flying insects. The Western slope of the Ghats area including the coastal plain receiving highest rainfall supports more species to thrive. The eastern slope including the vast stretches of Deccan trap being in the rain shadow. The area is hot and less humid supporting less number of species in the barren soil condition with less concentration of forest.

ACKNOWLEDGEMENT

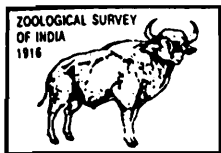
The author is indebted to Dr. J. R. B. Alfred, Director, Zoological Survey of India, Kolkata for extending all facilities for the work. Acknowledgement is also made to Dr. A. K. Hazra, Scientist-SE for manifold help.

Table 1. : Distribution pattern of termites in different physiographic units ('+' = Present & '-' = Absent) of Maharashtra.

Sl. No.	Name of the species	Konkan Coastal Plains	Western Ghats	Maharashtra Plateau	Common in Maharashtra
1.	<i>Heterotermes indicola</i> (Wasmann)	+	+	+	+
2.	<i>Coptotermes heimi</i> (Wasmann)	+	+	+	+
3.	<i>Speculitermes cyclops</i> (Wasmann)	-	+	-	-
4.	<i>Microcerotermes annandalei</i> Silvestri	-	-	+	-
5.	<i>Microcerotermes beelsoni</i> Snyder	-	-	+	-
6.	<i>Microcerotermes fletcheri</i> Holmgren & Holmgren	+	-	+	-
7.	<i>Microcerotermes tenuignathus</i> Holmgren	+	-	-	-
8.	<i>Microtermes deoriensis</i> n. sp.	-	+	-	-
9.	<i>Microcerotermes heimi</i> Wasmann	-	-	+	-
10.	<i>Angulitermes fletcheri</i> Holmgren & Holmgren	-	+	-	-
11.	<i>Dicuspitermes gravelyi</i> (Silvestri)	-	+	-	-
12.	<i>Dicuspitermes incola</i> (Wasmann)	+	+	-	-
13.	<i>Dicuspitermes cornutella</i> (Silvestri)	+	+	-	-
14.	<i>Pseudocapritermes fletcheri</i> Holmgren & Holmgren	-	+	-	-
15.	<i>Pericapritermes perparvus</i> Holmgren	-	+	-	-
16.	<i>Odontotermes assmuthi</i> Holmgren	-	+	+	-
17.	<i>O. feae</i> (Wasmann)	+	+	+	+
18.	<i>O. bellahunisensis</i> Holmgren & Holmgren	+	+	-	-
19.	<i>O. horni</i> (Wasmann)	+	+	+	+
20.	<i>O. gurdaspurensis</i> Holmgren & Holmgren	+	+	-	+
21.	<i>O. obesus</i> Rambur	+	+	+	+
22.	<i>O. wallonensis</i> (Wasmann)	+	+	+	+
23.	<i>O. loknandi</i> Chatterjee & Thakur	-	-	+	-
24.	<i>O. brunneus</i> Hagen	+	+	+	+
25.	<i>Microtermes obesi</i> Holmgren	-	+	+	-
26.	<i>Trinervitermes biformis</i> (Wasmann)	+	+	-	-
27.	<i>T. nigrirostris</i> Mathur & Sen-Sarma	-	+	-	-
28.	<i>Macrotermes convulsionarius</i> (König)	+	+	-	-
	Total	15	22	14	8

REFERENCES

- Bose, G. 1984. Termite fauna of South India. *Occ. Pap., Rec. zool. Surv. India*, No. **49** : 1-270.
- Chhotani, O. B. 1997. *Fauna of India, Isoptera (Termites)*, Vol. II, xx + 800 pp. (*Publ. Zool. Surv. India*).
- Maiti, P. K. 1983. Termite fauna (Isoptera) of West Bengal, India, their recognition, biology and ecology. *Rec. zool. Surv. India, Occ. Pap.* No. **42** : 1-152.
- Maiti, P. K. 1991. Isoptera : *In Animal Resources of India*, ZSI, Publication pp. 301-307, Calcutta.
- Roonwal, M. L. and Bose, G. 1969. Termite fauna of Rajasthan, India, *Zoologica*, **40**(3) (Heft 113) : 1-58.
- Roonwal, M. L. and Chhotani, O. B. 1962. Termite fauna of Assam region, eastern India, *Proc. nat. Inst. Sci. India (B)*, **28**(4) : 281-406.
- Roonwal, M. L. and Chhotani, O. B. 1987. *Fauna of India, Isoptera (Termites)*, Vol. I, viii + 672 pp. (*Publ. Zool. Surv. India*).
- Snyder, T. E. 1949. Catalogue of the termites (Isoptera) of the world, *Smiths. misc. Coll.* **112** : 2-490 pp.



Rec. zool. Surv. India : 104 (Part 3–4) : 143-149, 2005

TYPES OF MANTODEA (INSECTA : MANTODEA) IN THE COLLECTION OF CENTRAL ENTOMOLOGICAL LABORATORY OF ZOOLOGICAL SURVEY OF INDIA, KOLKATA, INDIA

T. K. MUKHERJEE*, B. C. DAS** AND A. K. HAZRA**

**Department of Zoology, Presidency College, Kolkata*

***Zoological Survey of India, Kolkata*

INTRODUCTION

The Central Entomological Laboratory (C.E.L.) of Zoological Survey of India (Z.S.I.), Kolkata preserves the types of mantids described by Wood-Mason, J. (1878, 1982, 1989), Chopard, L. (1924) and Serville, J. G. A. (1869, 1931). Mukherjee *et al.* (1983, 1985) and Mukherjee (1995). Several types of mantids were traced in the 'General Collection' of the Orthoptera Section of Z.S.I., Kolkata and their type status were fixed by Mukherjee *et al.* (1992). These were transferred to the C.E.L. The earlier specimens that already bear "Type" label are considered as "Holotype" of respective species as there is no confusion about their type status. Here the word "Type" has been retained to conform to the label present with the specimens to avoid future confusion. Many other type specimens are reported to be in ZSIC (Ehrmann, 2002). These are yet to be traced and will be published.

Thus it became necessary to publish a detailed account of all the types present in the C.E.L. along with the condition of the specimen, type of preservation and other available data on the types. At present there are 48 specimens (dry 30 and in spirit 18, belonging to 26 genera and 37 species) in the type collections of C.E.L., Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053, India.

1. *Acromantis nicobarica* Mukherjee, 1995. "Holotype" ♀, Regd. No. 8632/H5, Great Nicobar Expedition, Great Nicobar Island, Galathea Bay, stn. 6, coll. 487, Daniel and Bhowmick, 21.iii.1966 (DRY).
2. *Acromantis nicobarica* Mukherjee, 1995. "Allotype" ♂, Regd. No. 8633/H5, Great Nicobar Expedition, Campbell Bay, stn. 3, coll. 312, Daniel and Bhowmick, 03.iii.1966 (dry).

3. *Acromantis nicobarica* Mukherjee, 1995. "Paratype" ♂, Regd. No. 9497/H5, Great Nicobar Expedition, Campbell Bay, stn. 1, coll. 105, Daniel and Bhowmick, 03.iii.1966 (dry).
4. *Anaxarcha intermedia* Mukherjee, 1995. "Holotype" ♂, Regd. No. 8634/H5. Deban, Tirap, Arunachal Pradesh, S. Srivastava & party, 04.xii.1983 (dry).
5. *Aethalochroa spinipes* Wood-Mason, 1889. "Type" ♂, Regd. No. 9382/6, Karachi (in spirit).
6. *Aethalochroa affinis* Wood-Mason, 1889. "Type" ♂, Regd. No. 4374/4, Sind, J. A. Murray (dry).
7. *Archimantis armatus* Wood-Mason, 1877. "Type" ♀, North Australia, C. French, Regd. No. 587/1 (broken into three parts, in spirit).
8. *Choeradodis brunneri* Serville, 1882. "Type" ♀, Regd. No. 9918/6, Bogota, New Granada, purchased, Santha Fe de (dry).

Remarks : According to Ehrmann (2002) present name is *Choeradodis rhombicollis* (Latreille, 1833). Wood-mason described this species based on this one adult female (Regd. No. 9918/6, ZSIC) and a male nymph (Regd No. 1093/1, ZSIC) and the latter is yet to be traced.

Another synonym *Choeradodis servillei* of Wood-Mason (1880 : 83) was described on the basis of the holotype female (Regd. No. 4544/4, Costa Rica, ZSIC), one female ('in the collection of Messrs. Godman and Salvin') and a male (nymph, Regd. No. 772/1, Chiriqui, ZSIC, dry). These two (ZSIC) are yet to be traced. In later publications Wood-Mason worked on several male and female.

9. *Choeradodis laticollis* Serville, 1831. "Type" ♂, Regd. No. 6620/1, Ecuador, Buckley, purchased (abdomen lost, dry).
10. *Choeradodis laticollis* Serville, 1831. "Type" ♀, Regd. No. 6621/1, Ecuador, Buckley, purchased (broken, dry).

Remarks : According to Ehrmann (2002) the holotype ♂ is in MNHN (Natural History Museum of Paris). According to Wood-Mason (1889), there are five males and five females in ZSIC. Above two (Sl. No. 9 & 10) belong to those ten examples. Clearly these two cannot be the type of *Choeradodis laticollis*. However there is 'type' label on these two specimens and kept as such.

11. *Comptothespis australiensis* Wood-Mason, 1889. "Holotype" ♀, Regd. No. 4323/4, Australia, Westwood (E), (dry, broken).
12. *Dysaules himalayanus* Wood-Mason, 1889. "Type" ♂, Regd. No. 6527/1, Kulu (dry).
13. *Dysaules himalayanus* Wood-Mason, 1889. "Type" ♀, Regd. No. 6526/1, Kulu (entire, dry).

Remarks : Ehrmann (2002) mentioned "Type" ♂ as holotype and "Type" ♀ as allotype.

14. *Elmantis nira* Mukherjee and Hazra, 1983. "Holotype" ♂, Regd. No. 7854/H5, Nira, Pune, India, M. B. Rao, 11.v.1972 (dry).
15. *Elmantis nira* Mukherjee and Hazra, 1983. "Paratype" ♂, Regd. No. 7855/H5, WRS, Pune, Kamthodi, 07.viii.1969, B. S. Lamba (dry).
16. *Euthyphleps rectivenis* Wood-Mason, 1889. 'Holotype' ♀, Regd. No. 6557/1, Kulu, Kangra, N. W. Himalayas, 3600 ft., A. G. Young (total length 86.05 mm, broken, dry).
17. *Gimantis authaemon* Wood-Mason, 1882. "Type" ♀, Regd. No. 2056/2, Mergui Expedition, Minthantoung, on the Tenasserim River, near Mergui, Dr. J. Anderson, 22.xii.1882 (in spirit).

Remarks : Ehrmann (2002) mentioned "Type" ♀ as holotype.

18. *Hapalopeza periyara* Mukherjee and Hazra, 1985. "Holotype" ♀, Regd. No. 8631/H5, ZSI/SRS/Madras, Mullaperiyar Expedition, 1981, Periyar Lake, stn. 1, lot. 2, 11.ii.1981, alt. 880 m, K. Mathew and party, ZSI lot no. 92/81, 3/MPR, Kerala, India, (in spirit).

Remarks : According to Ehrmann (2002) present name is *Hapalopeza (Hapalopeza) periyara* Mukherjee and Hazra 1985.

19. *Hestias pictipes* Wood-Mason, 1879. "Type" ♂, date and locality unknown; Regd. No. 1253/1, donor J. Wood-Mason (in spirit).
20. *Hestias pictipes* Wood-Mason, 1879. "Type" ♀, Regd. No. 1254/1, Marble Rock, Jabbalpur, museum collector (in spirit).

Remarks : According to Ehrmann (2002) the male is holotype and the female is allotype. The present name of the species is *Ephestiasula pictipes* (W.-Mason, 1879).

21. *Heterochaetula tricolor* Wood-Mason, 1876. "Type" ♀, Regd. No. 9556/6, Calcutta (Kolkata), (dry).
22. *Hierodula (Rhombodera) atricoxis* Wood-Mason 1878. "Lectotype" ♂, Regd. No. 767/1, Rev. MacFarlane, 'one of the island of Torres Strait' (Murray Island), purchased, (broken, in spirit).
23. *Hierodula (Rhombodera) atricoxis var. grandis* Wood-Mason 1882. "Holotype" ♀, Regd. No. 677/1, Murray island, Torres Strait (in spirit).

Remarks : According to Ehrmann (2002) :

- (i) present name of both the above species (Sl. Nos. 21 & 22) is *Tamolanica atricoxis* (Wood-Mason, 1878).
- (ii) Holotype ♂ and allotype ♀ of *Hierodula (Rhombodera) atricoxis* are said to be in ZSIC. Therefore holotype ♂ is the "Lectotype" ♂, Regd. No. 767/1 and the allotype ♀ is the "Holotype" ♀, Regd. No. 677/1.

24. *Hierodula doveri* Chopard, 1924. "Type", ♀ Barkuda Island, Chilka Lake, Ganjam District, Orissa, Regd. No. 5906/H2, 25.iv.1920 (entire, in spirit; also labeled as 'Madras Presidency' as the locality previously belonged to that old division which is actually now Orissa).
25. *Hierodula (Rhombodera) pustulifera* Wood-Mason, 1878. "Lectotype" ♀, Regd. No. 4287/4, purchased, Rev. MacFarlane, 'one of the island of Torres Strait' (total length 80 mm, broken into several pieces, in spirit).

Remarks : According to Ehrmann (2002) this is a syntype and present name is *Hierodula pustulifera* Wood-Mason 1878. Mukherjee *et al.* (1992) designated it as lectotype.

26. *Hierodula sternostriata* Wood-Mason 1882. "Lectotype" ♀, Regd. No. 8447/H5, Trinity Bay, Australia (in spirit, femora, tibiae and tarsi of anterior legs lost).
27. *Hierodula sternostriata* Wood-Mason 1882. "Paralectotype" ♀, Regd. No. 2031/2, Trinity Bay, Australia (dry, mentioned as 'Type' on card).

Remarks : According to Ehrmann (2002) present name is *Hierodula sternosticta sternosticta* (Wood-Mason 1882) and holotype (male), allotype (female) and paratypes (male and female) are in ZSIC. So "Lectotype" ♀, Regd. No. 8447/H5 is actually the allotype ♀ and holotype ♂ is yet to be traced. Mukherjee *et al.* (1992) mentioned Regd. No. 10346/H5 which is now rejected. Wood-Mason (1882) described this species as *Parhierodula sternosticta*.

28. *Hierodula (Hierodula) assamensis* Mukherjee, 1995. "Paratype" ♀, Regd. No. 8637/H5. Deomali forest, Tirap, Arunachal Pradesh, 11.xi.1971, 250 mt., G. S. Arora (dry).

Remarks : According to Ehrmann (2002) present name is *Hierodula assamensis* Mukherjee, 1995 and holotype ♀ and paratype ♀ are in ZSIC. However the holotype ♀ could not be traced.

29. *Hierodula (Hierodula) beieri* Mukherjee, 1995. "Holotype" ♂, Regd. No. 8638/H5. NEFA Survey, stn.32, 31.x.1966, Bame village, Siang, Arunachal Pradesh, 600 m., S. K. Tandon and G. S. Arora (dry).

Remarks : According to Ehrmann (2002) present name is *Hierodula beieri* Mukherjee, 1995.

30. *Hierodula (Hierodula) nicobarica* Mukherjee, 1995. "Holotype" ♂, Regd. No. 91/1. Nicobar Island, F. De Roepstroff (in spirit).
31. *Hierodula (Hierodula) nicobarica* Mukherjee, 1995 "Allotype" ♀, Regd. No. 91A/1, Nicobar Island, F. De Roepstroff (in spirit).

Remarks : According to Ehrmann (2002) present name is *Hierodula nicobarica* Mukherjee, 1995.

32. *Iris orientalis* Wood-Mason, 1882. "Lectotype" ♂, Regd. No. 6508/1, Kulu, Kangra, N. W. Himalayas, A. G. Young, 1880 (dry, broken).

Remarks : Mukherjee *et al.* (1992) designated it as lectotype.

33. *Leptomantis nigrocoxata* Mukherjee, 1995. "Holotype" ♀, Regd. No. 8635/H5. Alubocri, Arunachal Pradesh, J. M. Julka, 800 ft., 13.xi.1969 (dry).
34. *Leptomantis nigrocoxata* Mukherjee, 1995. "Paratype" ♀, Regd. No. 5093/9 (dry, other data not available).

Remark : According to Ehrmann (2002) present name is *Leptomantella (Leptomantella) nigrocoxata* (Mukherjee, 1995).

35. *Mantis indica* Mukherjee, 1995. "Holotype" ♀, Regd. No. 8639/H5, Chail, Himachal Pradesh, M. Chandra, 04.vi.1971 (dry).
36. *Mantis indica* Mukherjee, 1995. "Allotype" ♂, Regd. No. 8640/H5, Renuka Lake, Himachal Pradesh, A. Kumar, 30.xi.1975 (dry).
37. *Mesopteryx robusta* Wood-Mason, 1882. "Holotype" ♀, Regd. No. 44/1, Naga Hills, Assam, 'one of the Museum Collector under Captain J. Butler' or 'probably by Wood-Mason 'on the South Andaman Island in 1872' (Wood-Mason, 1882). (Abdomen broken, in spirit).

Remark : Mukherjee *et al.* (1995) wrongly mentioned it as male on page 304.

38. *Nanomantis lactea* Mukherjee, 1995. "Holotype" ♀, Regd. No. 5727/4, Conoor, South India, Lindsay (in spirit).
39. *Oxyophthalma engaea* (Wood-Mason, 1889). "Holotype" ♂, Regd. No. 9370/6, Nilgiri Mountains, South India, G. F. Hampson ('the broken specimen', in spirit).

Remarks : According to Ehrmann (2002), along with holotype ♂, allotype ♀ and paratypes ♂ ♀ are in ZSIC and these are yet to be traced.

40. *Parananomantis brevis* Mukherjee, 1995. "Holotype" ♂, Regd. No. 8636/H5 Jhargram, Midnapur, T. Mukherjee, 06.ix.1986 (dry).
41. *Phyllothelys westwoodi* Wood-Mason, 1877. "Type" ♂, Regd. No. 178/1, Bhutan, Dooars (broken, in spirit).

Remarks : According to Ehrmann (2002) this is paratype ♂. The rest syntypes (♂ ♀) mentioned by Ehrmann are yet to be traced in ZSIC.

42. *Phyllothelys malayae* Wood-Mason, 1889. "Type" ♂, Regd. No. 9799/6, Perak (dry).

Remarks : According to the literature, the species was published in Ann. Mag. Nat. Hist. Nov. 1889, p. 367 (from Perak, Malay Peninsula, coll. W. Doherty, male). The broken parts of the specimen (fore wing, part of abdomen and process of vertex) are mounted on card. Ehrmann (2002) did not mention this species.

43. *Polyspilota insignis* Wood-Mason, 1882. "Type" ♂, Regd. No. 9610/6, Cameroon, Africa (broken, dry).

44. *Pseudothespis meghalayensis* Mukherjee, 1995. "Holotype" ♂, E.R.S. Regd No. 16929 (A1/5941). Fruit Gardens, Meghalaya, M. S. Jyrwa, dry, (it does not bear any other Regd. No.)
45. *Sphodromantis arabica* Wood-Mason, 1882. "Type" ♀, Osman, Arabia, Regd. No. 647/1, coll. Miles (entire, in spirit).

Remarks : According to Ehrmann (2002) *Sphodromantis arabica* is a synonym of *Sphodromantis trimacula* (Saussure, 1870).

46. *Toxoderopsis spinigera* Westwood & Wood-Mason, 1889, "Holotype" ♀, Regd. No. 8145/H5, Mumbai (Bombay) (broken, dry).

Remarks : The specimen already bears older Regd. No. 8145/H5 and thus Regd. No. 10044/H5 (Mukherjee *et al.* 1992) is invalid. According to Ehrmann (2002) holotype is ♂ and allotype is ♀ But according to literature the holotype is ♀ So far no ♂ has been traced in ZSIC. Mukherjee *et al.* (1992) designated it as holotype.

47. *Toxoderopsis taurus* Wood-Mason, 1889. "Lectotype" ♀, Regd. No. 9534/6, Khurda, Orrisa, W. C. Taylor (broken, dry).

Remarks : Mukherjee *et al.* (1992) designated it as lectotype.

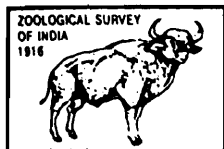
48. *Toxoderopsis taurus* Wood-Mason, 1889. "Paralectotype" ♂, Regd. No. 8146/H5, Sind, W. C. Taylor (broken, dry).

Remarks : Mukherjee *et al.* (1992) designated it as paralectotype. Since the specimen already bears older Regd. No. 8146/H5, the Regd. No. 10045/H5 (Mukherjee *et al.*, 1992) is invalid.

REFERENCES

- Chopard, L. 1924. The fauna of an Island in the Chilka Lake. The Dermaptera and Orthoptera of Barkuda Island. *Rec. Indian Museum, Calcutta*. **26**(2) : 165-191, 38 abb.
- Ehrmann, R. 2002. *Mantodea Gottesanbeterinnen der Welt*. Natur und Tier-Verlag, Munster, Germany, pp 519.
- Giglio-Tos, E., 1915 (volume date 1914). Mantidi Esotici. Generi specie nuove. *Bull. Soc. Entomol. Ital.*, **46** : 134-200.
- Giglio-Tos, E., 1927. *Das Tierreich. Lief. 50*. Walter de Gruyter & Co. 707 pp.
- Kirby, W. F., 1904. *A Synonymic Catalogue of Orthoptera*, Vol. 1, London. British Museum (Natural History), pp 207-316.
- Mukherjee, T. K., Hazra, A. K. 1983. On a small collection of Mantidae (Dictyoptera) from Maharashtra, India with the description of a new species. *Rec. zool. Surv. India*, **80** : 459-465.

- Mukherjee, T. K., Hazra, A. K. 1985. On some little known and a new praying mantid (Mantodea) from Mulla-Periyar Tiger Reserve, Kerala, India. *Entomon*, **10**(4) : 255-259.
- Mukherjee, T. K., Hazra, A. K. and Balderson, J. 1992. Type specimens of mantodea in the Zoological Survey of India collections, Calcutta, India. *Raffles Bulletin of Zoology*, **40**(1) : 65-68.
- Mukherjee, T. K., Hazra, A. K. and Ghosh, A. K., 1995. The Mantid Fauna of India (Insecta : Mantodea). *Oriental Insects*, **29** : 185-358.
- Saussure, H. De., 1861. Etudes sur quelques Orthopteres du Musee deGeneve. Nouveaux ou imparfaitement connus. *Ann. Soc. Ent. Fr.*, **14**(4) : 469-494.
- Saussure, H. De., 1869. Essai d'un systeme des mantides. *Mitt. Schweiz. Entomol. Ges.*, **3** : 49-73.
- Serville, J. G. A. 1931. Revue methodique des insectes de l'ordre des Orthopteres. *Ann. Sci. Nat.*, **22** : 28-65.
- Wood-Mason, J. 1878. On new and little known Mantidae. *Proc zool. Soc. London*, **38** : 580-587.
- Wood-Mason, J. 1882. On new and little known Mantidae. *J. Asiat. Soc. Bengal*, **51** : 21-36.
- Wood-Mason, J. 1889a. A Catalogue of Mantodea with description of new genera and species and an enumeration of the specimens in the Indian Museum, Calcutta. No. **1** : 48 pp.
- Wood-Mason, J. 1889b. The Ethiopian and Oriental representatives of the mantodean subfamily Vatidae. *J. Asiat. Soc. Bengal*, **58**(3) : 306-326.



Rec. zool. Surv. India : **104** (Part 3–4) : 151-159, 2005

DIVERSITY OF SYNANTHROPIC MITES IN KOLKATA METROPOLIS, INDIA

S. CHAUDHURY, I. ROY, S. PODDER, S. K. GUPTA AND G. K. SAHA*

Entomology & Wildlife Biology Research Laboratory,

Department of Zoology, University of Calcutta,

35, Ballygunge Circular Road, Kolkata-700 019

INTRODUCTION

The synanthropic mites are those which regularly inhabit human settlements and human constructions where they form permanent or intermittent, independent or semi independent population (Kucheruk, 1965 and Rosicky, 1991). The group chiefly consisting of mite fauna inhabiting house dust (floor dust and bed dust), stored product, house hold storages and granaries, bird's nest, cattle sheds and those occurring in roof gardens. The dust mites are of great concern to human health as they are directly responsible for causing nasobronchial allergic disorders like allergic rhinitis, eczema, bronchial asthma etc. Stored product mites are important as majority of those directly feed upon the grain contents or on food stuffs making those unsuitable for human consumption or make those unmarketable. Some of the mites inhabiting cattle sheds cause nuisance and are of great veterinary importance. The nest associated mites may act as vectors of some viral diseases while roof garden mites cause damage to ornamental plants.

Despite the manifold importance of synanthropic mites, no holistic approach has so far been made in India to explore these mites, though, of course, efforts were made by a number of workers to study separately either the house dust mites (Saha, 1994, 1997; Saha *et al.*, 1995; Modak *et al.*, 1991, 2004) or nest mites (Gupta and Paul, 1989; Bhattacharya, 1995) or stored product mites (Nangia and Channa Basvanna 1989; Putatunda *et al.*, 1999; Gupta and Chatterjee 2004). The present work was undertaken to explore the diversity of synanthropic mites from Kolkata metropolis and adjoining areas.

*Corresponding Author : Dr. G. K. Saha, Department of Zoology, University of Calcutta, Kolkata-700 019.

MATERIAL AND METHODS

The methodologies which were adopted in this study for collecting synanthropic mites from five different habitats associated with human dwellings like house dust, stored products, bird nests, cattle sheds and roof gardens in Kolkata metropolis and adjoining areas during the period from July, 2001 to December, 2003 are as below :

Dust mites : The dust samples from bed and bedroom floor were collected periodically by dusting the mattresses, bed linens and pillows on clean sheets of newspaper and by sweeping the floor. The dust samples were directly examined under stereobinocular microscope and mites were picked up by a fine sable hair brush moistened with 70% alcohol.

Storage mites : Samples of stored grains (wheat, rice, pulses), bakery products (biscuits, breads crump, cakes), other food stuff stored in houses (sujii, potato chips, puffed rice, pressed rice, papad, etc.) were brought to the laboratory and examined under stereobinocular microscope. Mites were picked up by fine sable hair brush moistened with alcohol.

Cattle shed mites : The debris of cattle sheds, hay, dry dung, cattle food *etc.* were examined for mites and collection was made by subjecting those to heat desiccation method in Tullgren Funnel Apparatus using 40 w electric bulb as heat and light source. The mites were collected in the collecting vial containing 70% alcohol fitted with the stem of the funnel.

Birds nest mites : Four nests of birds one each of Baya (*Ploceus manyar flaviceps*) and Bulbul (*Pycnonotus cafer*) and two of Crow (*Corvus splendens*) which were constructed inside buildings were brought to the laboratory and were subjected to heat treatment in Tullgren Funnel Apparatus as described earlier.

Roof garden mites : Leaves from ornamental plants *viz.* rose, dahlia, china rose, chrysanthemum *etc.* which were maintained in roof gardens were plucked, brought to the laboratory in polythene bags, examined under stereo binocular microscope and mites were picked up with moistened sable hair brush.

Temporary mounting was done in lactic acid on microslide covered with broken piece of cover slip and then heated gently over an electric bulb (40 w) for clearing and stretching of appendages. For permanent mounting in all cases, Heinze's medium was used. Taxonomic identification was done under a good research microscope and, wherever necessary, illustrations of body parts of taxonomic importance were prepared.

RESULTS AND DISCUSSION

The identification of all the groups of mites revealed the occurrence of 88 species belonging to 56 genera and 25 families under 3 orders as given in Table I. Among those, ten species marked

Table 1. : List of synanthropic mite species distributed in five different habitats in Kolkata metropolis.

	HD	SP	BN	CS	RG
Order : ASTIGMATA					
Acaridae					
<i>Suidasia medanensis</i> Oudemans		+	+		
<i>S. nesbitti</i> Hughes		+			
<i>Tyrophagus putrescentiae</i> (Schrank)	+	+	+		
<i>T. longior</i> (Gervais)	+	+			
<i>Tyroborus lini</i> Oudemans	+				
<i>Acarus siro</i> Linn.	+				
<i>Caloglyphus</i> sp.					+
Pyroglyphidae					
<i>Hirstia domicola</i> Hughes	+	+			
<i>Dermatophagoides farinae</i> Hughes	+	+		+	
<i>D. pteronyssinus</i> (Trouessart)	+	+		+	
Glycyphagidae					
<i>Glycyphagus ornatus</i> (Kramer)	+	+	+	+	
<i>Glycyphagus</i> sp.	+	+	+		+
* <i>Blomia tropicalis</i> Bronswijk <i>et al.</i>	+	+		+	
* <i>B. kulagini</i> Zachvatkin	+	+			
* <i>B. tijiboda</i>	+	+			
<i>Austroglycyphagus geniculatus</i> (Vitzthum)	+	+		+	+
Anoetidae					
<i>Histiostoma</i> sp.				+	
Order : MESOSTIGMATA					
Ascidae					
<i>Melichares</i> sp. (nymph)			+	+	
<i>Blattisocius dentriticus</i> (Berlese)		+		+	
<i>B. tarsalis</i> (Berlese)		+		+	
<i>Lasioseius</i> sp.	+		+	+	+
<i>L. mcgregori</i> Chant	+		+	+	
<i>L. berlesei</i> (Oudemans)				+	
* <i>L. ometes</i> (Oudemans)			+	+	
* <i>L. americanus</i> Chant	+		+	+	
* <i>L. phytoseioides</i> Chant				+	
** <i>Leioseius</i> sp.			+		
<i>Asca biswasi</i> Bhattacharya				+	
* <i>Proctolaelaps scolyti</i> Evans				+	
* <i>P. pygmaeus</i> (Muller)				+	
<i>P. curtispilis</i> (Chant)				+	
<i>Antennoseius</i> sp.				+	

Table 1. : (Cont'd.).

	HD	SP	BN	CS	RG
Macrochelidae					
<i>Macrocheles indicus</i> Bhattacharya			+	+	
<i>M. palniensis</i> Roy				+	
Laelapidae					
<i>Hypoaspis vacua</i> (Michael)			+	+	
<i>Ololaelaps veneta</i> (Berlese)				+	
<i>Ololaelaps</i> sp.				+	
<i>Hirstionyssus</i> sp. (deutonymph)				+	
Uropodidae					
** <i>Trematura</i> sp.				+	
<i>Fuscuropoda marginata</i> (Koch)				+	
* <i>Uroseius acuminatus</i> (Koch)				+	
<i>Uroseius</i> sp.				+	
Parasitidae					
* <i>Eugamasus butleri</i> Hughes				+	
Ameroseiidae					
<i>Ameroseius</i> sp.		+			
<i>Kleemania plumigera</i> (Oudemans)				+	
<i>K. plumosus</i> (Oudemans)				+	
Protodinychidae					
** <i>Protodinychus</i> sp.				+	
Phytoseiidae					
<i>Amblyseius alstoniae</i> Gupta					+
Eviphidae					
<i>Eviphis</i> sp.				+	
Order : PROSTIGMATA					
Tydeidae					
<i>Pronematus elongates</i> Baker		+	+	+	
<i>P. bengalensis</i> Gupta & Paul		+	+	+	
<i>P. fleschneri</i> Baker					+
<i>P. mcgregori</i> Baker					+
<i>Lorryia</i> sp.					+
<i>Tydeus</i> sp.				+	+
<i>T. cumini</i> Gupta			+	+	
Stigmaeidae					
<i>Cheyllostigmaeus</i> sp.	+				
<i>Mediolata</i> sp.	+				
<i>Mediolata simplex</i> Wood	+				
<i>Stigmaeus petilus</i> Ueckermann & Smith-Meyer				+	
<i>Stigmaeus raneyi</i> Summers				+	
<i>Agistemus edulis</i> Gupta					+

Table 1. : (Cont'd.).

	HD	SP	BN	CS	RG
Tetranychidae					
<i>Tetranychus ludeni</i> Zacher					+
Cheyletidae					
<i>Cheyletus aversor</i> Rohdendorf	+				
<i>C. fortis</i> Oudemans	+				
<i>Cheyletus</i> sp.	+				
<i>C. trouessarti</i> Oudemans	+				
<i>C. malaccensis</i> Oudemans	+				
<i>Chelacaropsis moorei</i> Baker	+				
<i>Acaropsis sollers</i> Kuzin			+		
<i>Eucheyletia womersleyi</i> Volgin				+	
Cunaxidae					
<i>Cunaxa womersleyi</i> Baker & Hoffmann			+		
<i>C. setirostris</i> (Hermann)				+	
<i>Neocunaxoides biswasi</i> Gupta & Chattopadhyay				+	
<i>N. andrei</i> (Baker & Hoffmann)				+	
** <i>Pulaeus americanus</i> (Baker & Hoffmann)				+	
Trombidiidae					
<i>Trombidium</i> sp.				+	
Raphignathidae					
<i>Raphignathus</i> sp.		+			
Tarsonemidae					
<i>Tarsonemus</i> sp.				+	
Pyemotidae					
<i>Acarophenax triboli</i> Newstead & Duvall		+			
** <i>Siteroptes</i> sp.				+	
<i>S. reniformis</i> Krantz				+	
<i>Pyemotes herfsi</i> Oudemans				+	
** <i>Resinacarus</i> sp.				+	
Eriophyidae					
<i>Aceria</i> sp.					+
Tenuipalpidae					
<i>Brevipalpus cucurbitae</i> Mohansundaram					+
<i>B. chilensis</i> Baker					+
Syringophilidae					
<i>Syringophilus</i> sp.			+		

HD = House dust; SP = Stored product; BN = Bird nest; CS = Cattle shed; RG = Roof garden.

* New species reported from India.

** New genera reported from India.

with asterisks and six genera marked with double asterisks are reported here for the first time from India. Regarding faunal composition, the maximum taxal diversity and density were seen in cattle shed, wherefrom 52 species (57%) belonging to 34 genera and 18 families under 3 orders could be recorded. This was followed by house dust (25 species (28%) under 13 genera, 6 families and 3 orders), stored products (20 species (23%) belonging to 12 genera, 8 families and 3 orders), bird nests (18 species (20%) belonging to 13 genera, 9 families and 3 orders) and roof gardens (14 species (16%) under 12 genera, 9 families and 3 orders).

So far as novelty with regard to genus is concerned, six genera viz. *Leioseius*, *Trematura*, *Protodinychus*, *Pulaeus*, *Resinacarus* and *Siteroptes* could be recorded which were hitherto unreported from India. Ten species, viz. *Blomia tropicalis* (from house dust, stored product and cattle shed), *B. tijiboda* (house dust and stored product), *B. kulagini* (house dust and stored product), *Lasioseius americanus* (house dust, nest and cattle shed), *L. phytoseioides* (cattle shed), *L. ometus* (nest and cattle shed), *Proctolaelaps scolyti* (cattle shed), *P. pygmaeus* (cattle shed), *Uroseius acuminatus* (cattle shed) and *Eugamasus butleri* (cattle shed) were new records from India. None could be recorded from all the five habitats, however, 4 species, viz. *Glycyphagus omatus*, *Glycyphagus* sp., *Austroglycyphagus geniculatus* and *Lasioseius* sp. were recorded from four out of five habitats studied. There were 63 species (73%) which could be recorded only from a single habitat, of those the cattle shed harboured the maximum number of such species 34 (39%) followed by house dust 11 (13%), roof garden 10 (11%), stored products and bird nest 4 each (5%). Among the ten species recorded here for the first time from India, 8 were from cattle shed, 3 from stored products, 4 from house dust and 2 from bird nests. It may be noted that out of these ten species, there were 5 species which were found in more than one habitats, though in different combinations.

Among the orders, Prostigmata is represented by the maximum number of species, families and genera (39 species, 12 families, 25 genera) followed by Mesostigmata (32 species, 9 families, 20 genera) and Astigmata (17 species, 4 families, 11 genera). Although several specimens of Cryptostigmata were in the collection, their identification is still not complete and will be reported later in the subsequent papers.

Dust mites : Among the 25 species of mites encountered from house dust, *Cheyllostigmaeus* sp., *Mediolata* sp., *Chelacaropsis moorei*, *Glycyphagus* sp. were not recorded earlier in house dust in India. Family Pyroglyphidae (*Dermatophagoides pteronyssinus* and *D. farinae*), *Glycyphagidae* (*Blomia tropicalis*, *Austroglycyphagus geniculatus*), *Acaridae* (*Tyrophagus putrescentiae*) and *Cheylitidae* (*Cheyletus* sp.) were dominant. The pyroglyphids are known to be responsible for causing respiratory allergies in Kolkata (Saha, 1993, 1994, 1997). Preliminary observations indicate the abundance of pyroglyphids in the houses of asthmatic patients as compared to those of normal persons, which corroborated well with the earlier observations (Modak *et al.*, 2004). The cheyletids, stigmatids, cunaxids and ascids were predatory mites and mainly fed upon acarids and pyroglyphids.

Surprisingly, some of the other common house dust mites like Chortoglyphidae, Pyemotidae, Tydeidae, Bdellidae, Raphignathidae, Scutacaridae, Tarsonemidae, Anotidae, *etc.* which were earlier recorded from India, could not be encountered so far in the present study. Among the 25 species of house dust mites recorded in this study, the relative number of Astigmata mites was more (13 spp.) followed by Prostigmata (9 spp.) and Mesostigmata (3 spp.).

Stored product mites : A total of 20 species of mites were collected from various stored products, of which, *Hirstia domicola*, *Pronematus elongates*, *P. bengalensis* and *Raphignathus* sp. are recorded here for the first time in India from stored products. In some of the samples examined, the acarids were found in astronomical numbers specially on potato chips, rice, wheat etc. doing considerable damage. The glycyphagids were mostly fungal feeders while Cheyletidae and Ascidae were main predators of acarid mites. Astigmata represented the highest number of species (13 spp.) followed by Prostigmata (4 spp.) and Mesostigmata (3 spp.).

Nest mites : Among the 18 species recorded from nests, the occurrence of *Suidasia medanensis*, *Hypoaspis vacua*, *Cunaxa womersleyi*, *Pronematus elongates*, *Lasioseius mcgregori*, *L. ometus*, *L. americanus* and *Macrocheles indicus* were earlier not known in India from bird nests. The occurrence of Macrochelidae in nest can be explained by the fact that these mites entered into the nests through flies, on whose body the macrochelids attached themselves for dispersal. The other mites like Tydeidae, Cunaxidae, which are common predators of Psocid insects were available abundantly in nests. The sole species of Laelapidae occurred in nest is an ectoparasitic species and got detached from bird's body while fluttering the wings. Since only four nests could be examined in the present study, many of the other groups of mites earlier recorded in India (Gupta and Paul 1989; Bhattacharya 1995) could not be collected. The number of species of different orders as was seen in this study was Astigmata (4 spp.), Prostigmata (6 spp.) and Mesostigmata (8 spp.) indicating dominance of Mesostigmata in the habitat.

Cattle shed mites : Out of 52 species recorded from cattle sheds, the occurrence of the *Dermatophagoides pteronyssinus*, *D. farinae*, *Austroglycyphagus geniculatus* appear to be unknown from cattle sheds in the world. The occurrence of most of the other species belonging to family Tydeidae, Cunaxidae, Pyroglyphidae, Glycyphagidae, Ascidae, Parasitidae, Ameroseiidae and Phytoseiidae recorded here were earlier not known in this habitat from India. The dominant groups were Ascidae, Laelapidae, Uropodidae and Macrocheleidae. Some of these mites *viz.* Uropodidae and Macrocheleidae are common inhabitants of dung; Laelapidae are parasitic group while Ascidae occur in cosmopolitan habitats. The occurrence of other mites like Tydeidae, Cunaxidae *etc.* are accidental and entered in cattle sheds through fodder and hay. The number of species represented by 3 different orders *viz.* Prostigmata, Astigmata and Mesostigmata were 17, 6 and 29 respectively, indicating the abundance of Mesostigmatid mites in this habitat.

Roof garden mites : Altogether 14 species were collected of which 9 species represented the order Prostigmata and 3 to Astigmata and 2 to Mesostigmata. The Prostigmata comprising of

phytophagus (Tetranychidae, Tenuipalpidae and Eriophidae), predatory (Tydeidae, Stigmaeidae and Phytoseiidae) and fungivorous mites (Acaridae and Glycyphagidae).

SUMMARY

This paper reports the occurrence of 88 species of mites belonging to 56 genera and 25 families under 3 orders from five different habitats inside human settlements, viz. house dust, stored products, bird's nest, cattle sheds and roof gardens, discusses their relative abundance, nature of association and provides information as to their novelty, if any, regarding their occurrence in five selected habitats in relation to West Bengal and India. Ten species and six genera are reported first time from India. The present study further indicates that among five different habitats examined, taxal diversity and relative abundance of different mites species were higher in cattle sheds followed by house dust and stored products.

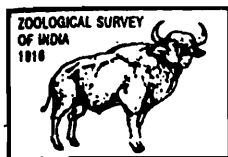
ACKNOWLEDGEMENTS

The authors are grateful to the University Grants Commission for providing Financial assistance. Special thanks are also due to The Head, Department of Zoology for providing laboratory facilities.

REFERENCES

- Bhattacharya, S. 1995. Survey of nest associated acarine fauna in West Bengal. *Env. & Ecol.*, **13**(3) : 547-564.
- Gupta, A. and Chatterjee, M. 2004. Some new records of mites infesting stored grains in Kolkata and its neighbourhood. *Rec. zool. Surv. India*, **102**(1-2) : 77-82.
- Gupta, S. K. and Paul, K. 1989. Nest associated acarines of birds in India. *Progress in Acarology*. (Eds. Channa Basvanna, G. P. and Virakamath, C. A.), **2** : 315-321.
- Kucheruk, V. V. 1965. Theoretical questions of natural foci of disease. (In : Eds. Rosicky, B. and Heyberger, K.), Pub House, Czech. Acad. Sci. Prague, pp. 353-366.
- Modak, A., Saha, G. K., Tandon, N. and Gupta, S. K. 1991. Dust mite fauna in houses of bronchial asthma patient – a comparative study of three zones of West Bengal, India. *Entomon*, **16**(7) : 115-120.
- Modak, A., Saha, G. K., Tandon, N. and Gupta, S. K. 2004. Faunal diversity and habitat preference of house dust mites in West Bengal in relation to nasobronchial allergic disorders. *Rec. zool. Surv. India*, **102**(1 & 2) : 137-146.

- Nangia, N. and ChannaBasvanna, G. P. 1989. Acarines associated with stored products in Karnataka, India. In : Progress in Acarology (Eds. G. P. ChannaBasvanna and C. A. Viraktamath), Oxford IBH Pub. Co. New Delhi, 241-248.
- Putatunda, B. N., Mathur, S. and Mathur, R. B. 1999. Mites associated with some stored food products in Haryana. *J. Acar.*, **15**(1-2) : 64-67.
- Rosicky, B. 1991. Acarology and environment, In : *Modern Acarology*, Vol 1. (Eds. Dusbabek, F. and Bukva, V.), Pub House, Czech. Acad. Sci. Prague, pp. 17-25.
- Saha, G. K. 1993. House dust mite allergy in Calcutta, India : Evaluation by RAST. *Ann. Allergy*, **70** : 305-309.
- Saha, G. K. 1994. Relationship between Dermatophagoides mite density and specific immune response in asthmatic patients. *Ann. Allergy*, **73** : 429-433.
- Saha, G. K. 1997. House dust mite sensitivity among rural and urban asthmatics of West Bengal, India : a comparison. *Aerobiologia*, **13** : 269-273.
- Saha, G. K., Modak, A., Tandon, N. and Choudhuri, D. K. 1995. Prevalence of house dust mites (*Dermatophagoides* spp.) in homes of asthmatic patients of Calcutta. *Ann. Entomol.*, **12**(2) : 21-25.



Rec. zool. Surv. India : 104 (Part 3–4) : 161-162, 2005

Short Communication

***CALICNEMIA MINIATA DOONENSIS* SANGAL & TYAGI A SYNONYM OF *CALICNEMIA CARMINEA PYRRHOSOMA* LIEFTINCK (INSECTA : ODONATA : PLALYCNEMIDIDAE)**

INTRODUCTION

Sangal and Tyagi (1984) in the abstract of the First Indian Symposium of Odonatology reported “*Calicnemia miniata doonensis* is the only subspecies now known for the species. The subspecies clearly differs from the species in the following characters : the shape of the pterostigma, shape and arrangements of the spear shaped spines in the prothoracic legs, the relatively shorter hind-wings and the colour of the eyes.” The full description of the taxon was published in the year 1985 by Sangal and Tyagi in the proceedings of the symposium. Lieftinck (1984) stated, yet another named taxon of quite uncertain status is the recently published, “*Calicnemia miniata doonensis*”, new subspecies of Sangal and Tyagi (1984) from the Doon Valley, also in the Dehra Dun area. As no description of this insect is given, it should be considered a nomen nudum for a race (?) of *miniata*” Hämäläinen (1989) remarked on the contents of the abstract of 1984, “Although inadequate for identification, the above sentences must be considered as a valid description, since the hind-wing of the new taxon is stated to be shorter than in *C. miniata*.” Thus the abstract can be accepted as the primary description of the species and, consequently, the name *Doonensis* has priority over Lieftinck’s name. Lieftinck’s (1984) nominate subspecies of *Calicnemia carminea carminea* from Nepal will consequently fall to a subspecies of *doonensis*. Hämäläinen (1989) again stated. “However, *C. doonensis* is incorrectly associated with *C. miniata* (Selys, 1886). These taxa are not even closely related. *C. miniata* belongs to a species group in which recurved penis lobe is broad and expanded, whereas in *doonensis* the penis lobe ends ribbon-like branches” Stating identification of *C. m. doonensis* was wrong by Sangal and Tyagi, even then Hämäläinen advocated for the priority of *C. m. doonensis* over *C. carminea pyrrhosoma* Lieftinck. It is appearing that Hämäläinen was advocating in favour of *C. doonensis*. Moreover, Hämäläinen presented me one male example of *Calicnemia* labelling *C. doonensis doonensis* (ZSI Reg. No. 4705/H13). Unfortunately Sangal and Tyagi could not identify the species status of the taxon they described.

*Present Address : 208/K/8, Raja Ram Mohan Roy Road, Netaji Sarak, Pin-700 008, India.

It is clear from the above that *Calienemia miniata doonensis* was a wrongly determined taxon. A wrongly determined taxon has no status as far as nomenclature is concerned. Tsuda (1991, 2000), Mitra (2002) followed Liefstinck (1984).

It is, therefore, concluded that *Calicnemia carminea pyrrhosoma* Liefstinck is the correct name for the taxon Sangal and Tyagi described; while *Calienemia miniata doonensis* Sangal and Tyagi is the junior synonym for *C. carminea pyrrhosoma* Liefstinck.

SUMMARY

Taxonomic status of *Calicnemia miniata doonensis* Sangal & Tyagi has been discussed; and contended that *C. m. doonensis* Sangal & Tyagi is the junior synonym of *C. carminea pyrrhosoma* Liefstinck.

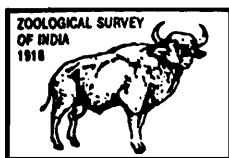
ACKNOWLEDGEMENTS

The author is thankful to Dr. J. R. B. Alfred, Director, Zoological Survey of India for facilities, Dr. M. Hämäläinen for material and Dr. B. Kiauta, Editor, *Odonatologica* for several courtesies.

REFERENCES

- Hämäläinen, M. 1989. Odonata from the Dehra Dun valley (Uttar Pradesh) with a note on synonymy of some West Himalayan species. *Odonatologica* **18** : 13-20.
- Liefstinck, M. A. 1984. Further notes on specific characters of *Calicnemia* strand, with a key to the males and remarks on some larval forms (Zygoptera : Platynemididae) *Odonatologica* **13** : 351-375.
- Mitra, T. R. 2002. Edemic odonata of India, *Rec. zool. surv. India*, **100** : 189-199.
- Sangal, S. K. and Tyagi, B. K. 1984. *Calicnemia miniata doonensis* a new subspecies from the Dehra Dun Valley (Dehra Dun, India) (Zygoptera : Platynemididae). *Abstr. First Indian Symp. Odonatol. Madurai* P. 2 (From Hämäläinen, 1989).
- Sangal, S. K. and Tyagi, B. K. 1985. *Calicnemia miniata doonensis*, a new subspecies from the Dehra Dun Valley (Dehra Dun, India) (Zygoptera : Platynemididae). *Proc. First Indian Symp. Odonatol. Madurai* pp. 193-197 (From Hämäläinen, 1989).
- Tsuda, S. 1991. A distributional list of World Odonata, 1991. pp. 362. Osaka.
- Tsuda, S. 2000. A distributional list of World Odonata, 2000. pp. VI + 439. Osaka.

TRIDIB RANJAN MITRA
Zoological Survey of India, M-Block,
New Alipore, Kolkata-700 053



Rec. zool. Surv. India : 104 (Part 3–4) : 163-166, 2005

Short Communication

ON A REPORT OF *REDIGOBIUS BIKOLANUS* (HERRE) (PISCES : GOBIIDAE) FROM INDIA

INTRODUCTION

In a recent survey of the Andamans by the third author, an interesting gobiid fish was collected. This on detailed study turned out to belong to the species *bikolanus* hitherto unknown to India. The species is hence reported here.

Material examined : 1 ex., 26 mm SL., F.7391 ZSI/SRS, Middle Andaman, 26.4.2002, Coll. M. K. Das.

Order PERCIFORMES

Suborder GOBIOIDEI

Family GOBIIDAE

Redigobius bikolanus (Herre)

(Fig. 1)

1927. *Vaimosa bikolana* Herre, Monogr. 23, *Bur. Sci. Manila*, P. 151, pl. 11, fig. 2.

1984. *Redigobius bikolanus* (Herre), Masuda *et al.*, *The Fishes of the Japanese Archipelago*, p. 269.

Description : D.1.VI; D.2.I/7; A.I/6 : P.17; C.7/13/7; L.1.26; L.tr.7½; Predorsal scales 7.

Body slightly elongate, compressed, height 3.81 in standard length (SL) and 4.84 in total length (TL). Head compressed, 3.17 in SL, 4.02 in TL; its depth 1.41 and width 1.56 in its length. Profile almost straight. Eyes large, 3.39 in length of head; interorbital width narrow, 2.52 in eye diameter. Snout obtuse 1.22 in eye. Mouth large, subequal, tip before lower margin of eye, maxillary curves down abruptly and extends to below posterior margin of eye. Teeth in several rows in both jaws, no prominent canines. Tongue emarginate. Two longitudinal incomplete rows of mucous canals on cheek and sensory pores as in Masuda *et al.*, 1984, (fig. 150). Head scaled above from behind the eyes, the first median scale scarcely larger than the following predorsal scales. Preopercle

naked, opercle with some large cycloid scales, scales of body faintly ctenoid; on head and behind eyes cycloid. Pectoral base scaled with large scales. Gill openings extend to below base of pectoral fin. Dorsal fins separate by a distance of two scales. First dorsal fin 1.39 in body depth, second dorsal 1.36 in depth of body. Pectoral elongate extending beyond pelvic tip, reaching 3rd anal ray, its length 1.13 in head length, 3.58 in SL; pelvic fin shorter, reaching beyond anus, 1.24 in head length; caudal fin rounded, 1.17 in head length.



Fig. 1. : Lateral view of *Redigobius bikolanus* (Herre)

Each scale with small dots, darker along the edges. Head and body mottled, alternating rows of blotches on sides; an oblique bar behind opercle and a vertical bar before anal on the sides, extending to the ventral side, the latter meeting its counter part from the other side. Also four spots on median ventral side on the anal base and caudal peduncle. Three dark stripes radiating from below the eye, one to the upper jaw, one near corner of mouth and an oblique one across opercle forming a 'γ' shaped marking on cheek. First dorsal fin dark at its posterior base and tip, enclosing a paler area, edges black with a white rim; three rows of dark spots on second dorsal fin and about 6 rows of spots restricted to the upper two thirds in caudal fin. Membranes between rays of pelvic and anal fins black.

Distribution : Borneo N., Sulawesi, Philippines and India.

DISCUSSION

Koumans (1953) in his revisionary work included the species *Vaimosa bikolana* Herre under the species *Redigobius chrysosoma* (Bleeker). However, Masuda *et al.*, (1984) and Kottelat *et al.*, (1993) have treated *bikolanus* and *chrysosoma* as separate species, the former author provides a description of the species along with an illustration of the cephalic sensory pore system & the latter provides differentiating biometric characters and colour photographs. It is observed that *bikolanus* is distinguished from *chrysosoma* by an additional branched second dorsal ray 1.7 (vs.1.6), more L.1.scales 26–27 (vs.25), three radiating black bars below eyes vs. one vertical bar below eye : difference in the position and extent of dark colour in the first dorsal and a bright yellow patch in *chrysosoma* in live specimens.

Based on the study of the various morphometric and meristic characters and from the colour pattern the present specimen collected from Middle Andaman has been identified as *bikolanus*. Since this species has not so far been described from Indian waters by earlier workers viz. Herre 1941; Koumans, 1941, 1953; Talwar and Jhingran, 1991 and Rao *et al.*, 2000, it is reported here as new to India.

SUMMARY

The gobiid fish *Redigobius bikolanus* (Herre) is reported here for the first time from India. This species known so far from Borneo N., Sulawesi and Philippines has recently been collected from the Middle Andamans, India.

ACKNOWLEDGEMENTS

The first author is grateful to the Director, Zoological Survey of India and the Officer-in-charge, Southern Regional Station, Zoological Survey of India for providing necessary facilities. Special thanks are due to Dr. D. V Rao, Scientist, Andaman and Nicobar Regional Station, Z.S.I. for providing valuable literature on gobioids.

REFERENCES

- Herre, A. W. C. T. 1941. A list of the Fishes known from the Andaman Islands. *Mem. Indian Mus.*, 13 : 331-403.
- Kottelat, M., Whitten, Anthony, J., Kartikasari, Sri Nurani and Wirjoatmodjo, Soetikno. 1993. *Fresh water Fishes of Western Indonesia and Sulawesi*, 221 pp., pls. 1-84. Periplus Editions (HK) Ltd.

- Koumans, F. P. 1941. Gobioid Fishes of India. *Mem. Indian Mus.*, **13** : 205-329.
- Koumans, F. P. 1953. Gobiioidea. In : *The Fishes of the Indo-Australian Archipelago*. Eds. Weber & De Beaufort. Vol. X Gobiioidea, 423 pp.
- Masuda, H., Amaoka, K., Araga, C., Uyeno, T. and Yoshino, T. 1984. *The Fishes of the Japanese Archipelago*, Tokai University Press, Tokyo.
- Rao, D. V. Kamala Devi and Rajan, P. T. 2000. An account of Ichthyofauna of Andaman and Nicobar Islands, Bay of Bengal. *Rec. zool. Surv. India, Occ. Pap.* No. **178** : 1-434.
- Talwar, P. K. and Jhingran, Arun, G. 1991. *Inland Fishes of India and Adjacent Countries*, Vol. I & II, 1158 pp.

K. REMA DEVI

*Zoological Survey of India,
Southern Regional Station,
Chennai*

ALEX EAPEN AND M. K. DAS
*Malarial Research Centre,
Chennai*