BULLETIN

OF THE

ZOOLOGICAL SURVEY

OF INDIA

Volume 4
Number 1
1981

BULLETIN OF THE ZOOLOGICAL SURVEY OF INDIA

Volume 4

Number 1

1981

सत्यमेव जयते

Edited by the Director,
Zoological Survey of India, Calcutta.

Published : Oct. 31, 1981

Price :

Rs. 25/- or £ 2/- or $ 4/-

Printed by Doorga Prosad Mitra, at The Elm Press, 63, Beadon Street, Calcutta-700 006, and Published by the Controller of Publications, New Delhi.

BULLETIN OF THE ZOOLOGICAL SURVEY OF INDIA

CONTENTS

SHORT COMMUNICATION

Bull. zool. Surv. India 1—2, 4 (1) : 1981

HEMIDACTYLUS PORBANDARENSIS, A NEW GECKONID LIZARD FROM GUJARAT, INDIA

R. C. SHARMA

Zoological Survey of India, Calcutta

ABSTRACT

Hemidactylus porbandarensis, a new species of lizard belonging to the family Geckonidae inhabiting the saline areas near Porbandar port, Gujarat, India is described. It is nocturnal in habit. During the day it hides under the huge boulders, scattered all over the port area of Porbandar.

INTRODUCTION

While surveying the coastal area of Gujarat in September 1975, I came across this new Geckonid lizard of genus *Hemidactylus* Oken (1817). The lizards were found to be inhabiting the marshy coastal areas with dense xerophytic vegetation. The above material was collected by tilting huge boulders lying scattered on the bank of saline water pools in the port area of Porbandar.

Hemidactylus porbandarensis n. sp.

Material : 5 ex., Surroundings of port, Porbandar, Gujarat, collected on 21.IX.1975 by *R. C. Sharma.*

DESCRIPTION

Light gray above, with dark-brown irregularly arranged spots on the complete dorsum including the tail and limbs. Maximum concentration of such spots is on the neck region ; a dark streak along each side of head passing through the eyes ; yellowish-white below.

Body slender, slightly depressed. Head narrow (17 mm. long and 9 mm. wide), twice as long as broad, snout obtusely pointed, longer than the distance between the eye and the ear-opening, which is small, subcircular, with a diameter 1/3 that of eye, upper labials 9-11 ; lower labials 7-8 ; mental large, triangular, twice as long as the adjacent labials ; two pairs of post-mentals, the inner one is at least two times larger than the outer (Fig. IB), gular region with small flat, rounded scales ; rostral broader than high, nostril between the rostral and seven small scales ; top of head covered with small juxtaposed scales, intermixed with large rounded flat ones ; back with small irregular scales and with 16-17 longitudinal series of more or less round or oval strongly keeled tubercles ; belly with large flat round imbricate scales. Digits free, dilated ; lamellae under first toe 5-6 ; lamellae under fourth toe

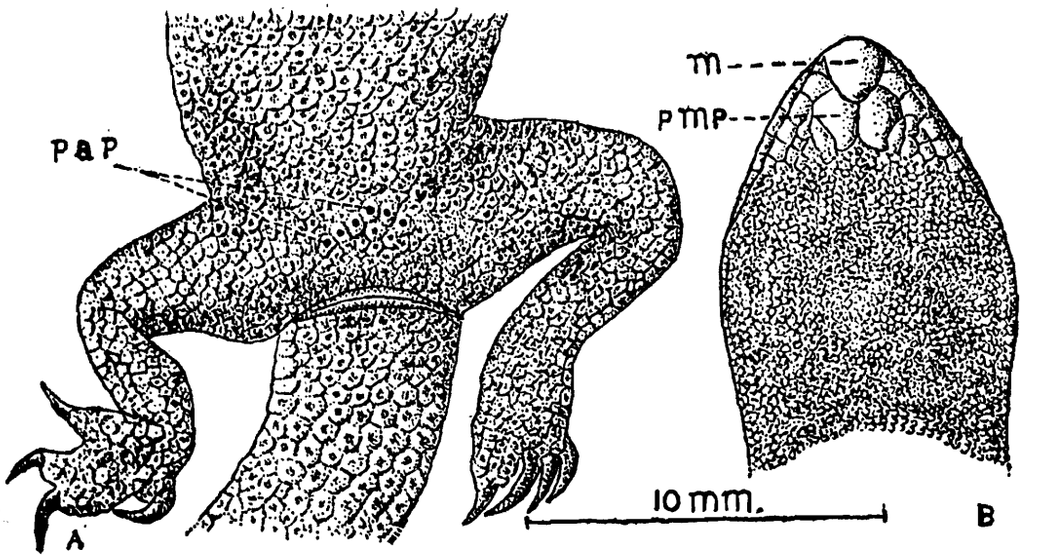


Fig. 1. A. Inguinal region of *Hemidactylus porbandarensis* n. sp showing preanal pores.
B. Ventral aspect of head showing the postmental shields.

9-10 ; the adpressed hind limb hardly reaching the axilla. Tail moderately depressed, verticillate, oval in section, its upper side covered with round smooth or feebly keeled scales and a series of 6 strongly keeled pointed tubercles ; below with imbricate, smooth scales with a median series of transversely enlarged plates. The tail could be examined in the holotype only, for in all the four paratypes tails are entirely missing. Holotype has an angular series of 6 preanal pores (Fig. 1A).

Measurements : Snout to vent length 31-45 mm. (holotype 40 mm.). Tail length in holotype 30 mm. (broken at the tip).

Type-specimens : Holotype : ♂ adult, vide "Material" above D.R.S.,Z.S.I., Reg. No. V/2152, deposited in National Zoological Collections, Zoological Survey of India, Calcutta. *Paratypes :* 4 ♀ ♀, from the same lot of holotype, D.R.S., Z.S.I., Reg. No. V/2125, also in Z.S.I., Jodhpur. All preserved in alcohol.

Type-locality : Port area, Porbandar, Junagadh District, Gujarat.

Distribution : Known only from the type locality.

Comparison : Hemidactylus porbandarensis n. sp. comes closer to *Hemidactylus gracilis* Blanford from Madhya Pradesh and Maharashtra but differs from the latter as follows : (i) 9-11 upper labials (*vs.* 9 or 10), (ii) 7-8 lower labials (*vs.* always 7), (iii) inner pair of post-mentals is at least two times larger than the outer pair (*vs.* the inner pair is not much larger than the outer pair), (iv) Back with 16 or 17 longitudinal series of strongly keeled more or less round or oval scales (*vs.* back with 10 or 12 longitudinal series of more or less oval strongly keeled tubercles), (v) 5 or 6 lamellae under the first toe, all are divided except the anterior and posterior most (*vs.* 5 lamellae only, only the anterior ones divided), (vi) 9 or 10 lamellae under the fourth toe, all are divided except the anterior and posterior mosts (*vs.* 8 or 9 lamellae, only the anterior ones divided).

Bull. zool. Surv. India, 4(1) : 3—6, 1981

CRASIELLA INDICA N. SP. (GASTROTRICHA, MACRODASYIDA) FROM ORISSA COAST, INDIA

G. CHANDRASEKHARA RAO

Zoological Survey of India, Calcutta

ABSTRACT

A new interstitial species of macrodasyid gastrotrich, *Crasiella indica*, is described from Orissa coast (Bay of Bengal), India.

INTRODUCTION

Recent studies of the marine interstitial meiofauna carried out by the author in the intertidal sands of Orissa coast, have revealed the occurrence of some interesting gastrotrichs and the results are being published. The description of a new macrodasyid gastrotrich belonging to the genus *Crasiella* Clausen, encountered in the collections is given here. The genus is recorded for the first time from Indian Ocean.

SYSTEMATIC ACCOUNT

Order : MACRODASYIDA

Family : PLANODASYIDAE Rao & Clausen, 1970

Genus : *Crasiella* Clausen, 1968

Crasiella indica n. sp. (Fig. 1, A-D).

Description : Adult specimens are of medium size, 430-500 µm long and 50-70 µm wide. Body transparent, elongated, dorsoventrally flattened, widest in the middle and slightly tapers towards the posterior end. Anterior end truncate. Head not distinct. Posterior end terminates in two symmetrical tail lobes characteristic of the genus. Tail lobes somewhat triangular in outline and reach about 16 µm in length. Cuticle thin and finely granular, without any dorsal armament as papillae, scales, hooks, spines, etc. Epidermis contains numerous small and round dorsolateral glands measuring about 2-4 µm in size. Head with two shallow lateral pits, each carrying a tuft of long cilia about 25 µm in length. Anterior and lateral margins of head bear short sensory hairs 10-15 µm long. Lateral sensory hairs 15-25 µm long occur on the trunk. Ventral surface is flat, with ciliation entire and nearly uniform.

Adhesive tubes, anterior, lateral and posterior, present. Anterior tubes occur in a slightly diagonal row on the ventral surface just behind buccal cavity and are directed forwards. Nine tubes occur on each side in two groups of 4 + 5 and measure about 10 µm in length. Lateral tubes arranged in two longitudinal rows, extending just behind the anterior tubes to close to the posterior tubes. About 30-36 pairs of lateral tubes present. The tubes are nearly even distributed and 10-15 µm long. Each tail lobe

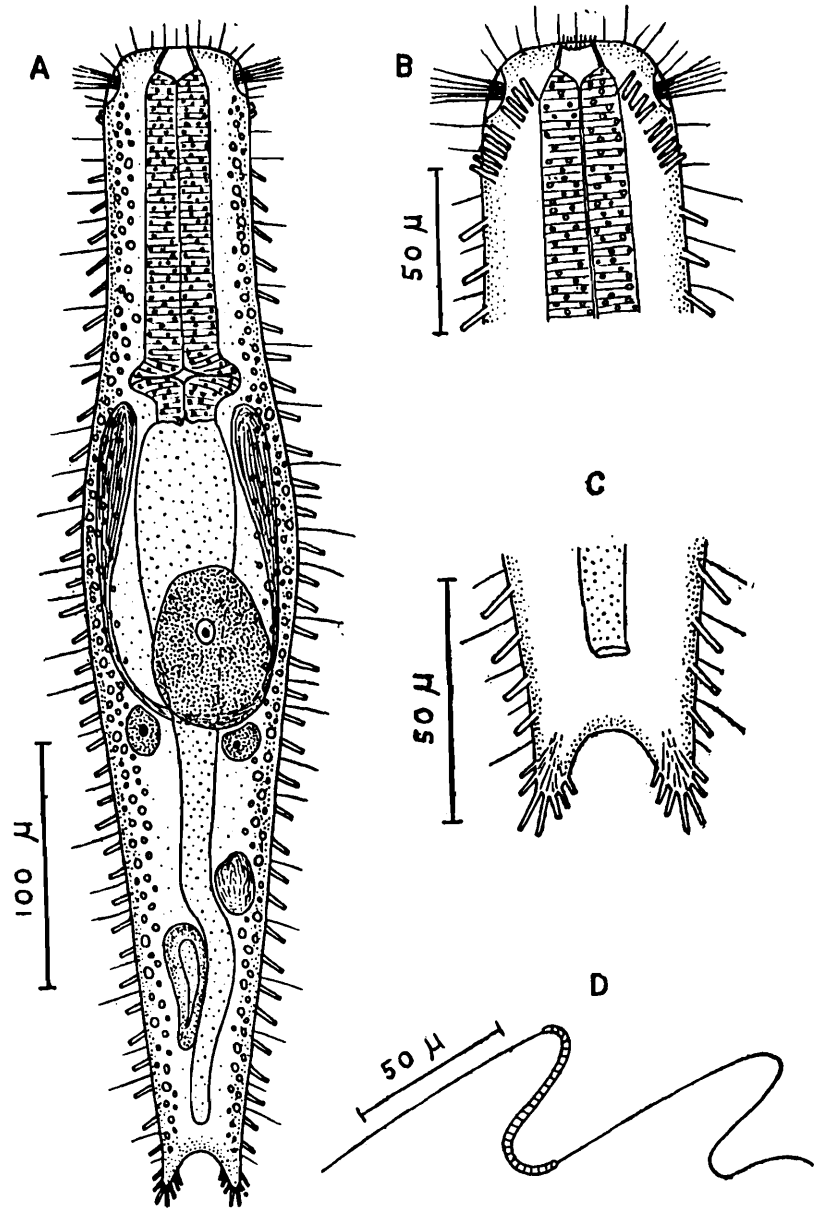


Fig. 1. *Crasiella indica* n. sp. A-Entire, dorsal view. B — Anterior region, ventral view. C—Posterior region, ventral view. D—Spermatozoon.

bears 7 posterior tubes disposed on its inner and outer edges. The tubes are directed backwards and attain 5-10 μm long, the two distant ones located at the tip being the longest. Adhesive tubes absent on posterior border between the two tail lobes.

Mouth is about 10 μm wide, terminal and slightly inclined to Ventral side. It is surrounded by a corona of short sensory setae 2-3 μm long. Buccal cavity with cuticularized walls, 10×15 μm in size and widest at its base. Pharynx contains numerous small refringent granules, attains a length of about 145 μm and makes up nearly 1/3 of the total gut length. Pharyngeal pores conspicuous and occur close to the posterior end of pharynx. Intestine about 300 μm long, granular and divisible into a broad anterior region and a narrower posterior region with subterminal bent. Anus

subterminal and opens on ventral surface about 15 μm from posterior border.

Reproductive system consists of paired testes extending laterally from behind pharyngeal knobs to the anterior part of intestine. Vasa deferentia coverage just behind the stomach, forming a single transverse seminal vesicle ; thus making the male genital system look typically U-shaped. Penis absent. Structure of spermatazoon is shown in Fig. 1. It is thread-like and reaches a total length of about 300 μm. Sperm head is about 150 μm long, with a thin anterior part and a beaded thickening at its proximal part. Tail thin, 150 μm long and occupies about 1/2 of total length. Paired dorsal ovaries occur just behind testes. Egg attains about 65×45 μm in size. A granular and elongated copulatory bursa about 50 μm in length occurs on left side adjacent to curved intestinal region. An oblong seminal receptacle about 25×15 μm in size is seen on right side of intestine just anterior to bursa.

Holotype : Specimen 480 μm long, with gonads, collected by the author on 31st January, 1977. Deposited with the Zoological Survey of India Calcutta. Regd. No. P 3038/1.

Type locality : Medium sand, 5 cm below surface, intertidal zone, Gopalpur Beach (Lat. 19°15′28″ N and Long. 84°55′ 14″ E), Orissa, India.

Remarks : Until now, the genus *Crasiella* Clausen is reported to contain three species, *viz. C. diplura* Clausen (1968, type species), *C.* (?) *oceanica* d'Hondt (1970, *nomen nudum*) and *C. pacifica* Schmidt (1974). Among these species, *C. indica* n. sp. approaches *C. diplura* in the structure of buccal cavity, tail lobes, seminal receptacle and the disposition of posterior adhesive tubes. However, the new species is clearly distinguished from both the known species by the number and disposition of anterior adhesive tubes and the structure of bursa and spermatozoon.

Diagnostic features : Shape of body typical of genus. Body up to 500 μm long, 70 μm wide and dorsoventrally flattened. Head indistinct, anteriorly truncate and with lateral sensory pits. Hind end bilobed. Cuticle thin and granular. Dorsal armament absent. Numerous small dorsolateral epidermal glands present. Ventral ciliation entire and nearly uniform. Nine (4+5) pairs of anterior adhesive tubes disposed in a diagonal row, 30-36 pairs of lateral adhesive tubes and 7 pairs of posterior adhesive tubes present. Buccal cavity wide and cuticularized. Pharynx / total gut length about 1/3. Conspicuous pharyngeal pores close to the posterior end of pharynx. Intestine bent subterminally. Anus subterminal. Gonads paried. Penis absent. Elongated copulatory bursa and oblong seminal receptacle present.

Ecological notes : The specimens of *Crasiella indica* were collected in clean medium sands 5-10 cm. below surface between the low and half-tide levels of the intertidal zone. The sands are brown, silicious and angular, with a mean diameter of 300-500 μm. At the time of collection, temperature in the habitat was read 27.6°C, while the salinity of interstitial water indicated 32.5‰. The gastrotrich is agile and a ciliary glider. The species is highly thigmotactic and sensitive to external stimuli. Other interstitial meiofauna collected in association with the gastrotrich included ciliates, turbellarians, nematodes, gestrotrichs, polychaetes, ostracods, copepods and halacarids.

ACKNOWLEDGEMENTS

The author is grateful to the Director,

Zoological Survey of India, for the facilities provided to carry out this work.

REFERENCES

CLAUSEN, C. 1968. *Crasiella diplura* gen. et sp. nov. (Gastrotricha Macradsyoidea). *Sarsia*, 33 : 59-64.

D'HONDT, J. L. 1970. Inventaire de la faune marine de Roscoff. Gastrotriches, kinorhynques, rotiferes tardigrades. *Ed. Sta. Biol. Roscoff*, 29 pp.

RAO, G. C. and CLAUSEN, C. 1970. *Planodasys marginalis* gen. et sp. nov. and Planodasyidae fam. nov. (Gastrotricha, Macrodasyoidea). *Sarsia*, 42 : 73-82.

SCHMIDT, P. 1974. Interstitielle fauna von Galapagos IV. Gastrotricha. *Mikrofauna Meeresboden*, 26 : 1-76.

Bull. zool. Surv. India, 4 (1) : 7—8, 1981

ON SOME ANOMALIES IN THE ABDOMINAL REGION OF *NICHOLLSIA MENONI* TIWARI 1955 (ISOPODA : PHREATOICOIDEA)

LAKSHMAN PRASAD GUPTA

Zoological Survey of India, Gangetic Plains Regional Station, Patna-800016

ABSTRACT

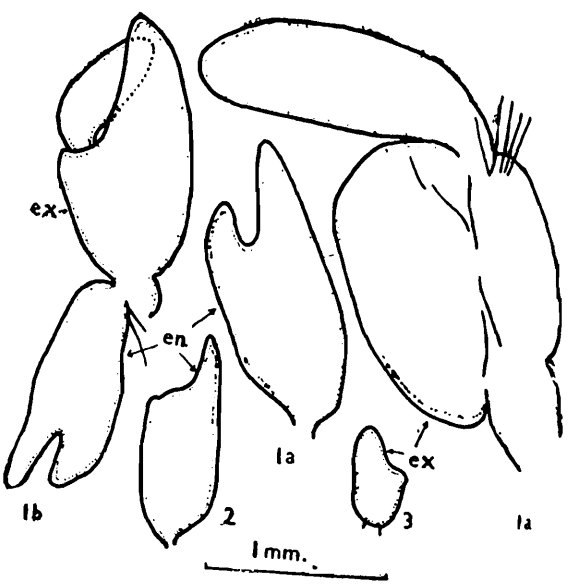
Some morphological anomalies of *Nichollsia menoni* Tiwari, in five specimens have been dealt with.

References to morphological anomalies in Crustacea are abundantly available in literature. Ram (1972) for the first time reported abnormality in the cephalothoracic appendages of *Nichollsia kashiense* Chopra and Tiwari 1950, belonging to the Suborder Phreatoicoidea. There appears to be no further record of abnormality among the Phreatoicoidea.

During the course of studies on a small collection of *Nichollsia menoni* the author was confronted with a few abnormal abdominal appendages in some specimens. Out of 30 specimens collected from two wells in the same locality, 5 were found to have anomalies and reported below :

Specimen No. 1 : Adult male has both pleopods abnormal in the third abdominal segment. The exopod of right pleopod (fig. 1a) possess normal inner lobe but the outer lobe is underdeveloped. It is reaching a little beyond the origin of inner lobe. Similarly the endopod has slightly underdeveloped outer lobe.

The left pleopod has a normal endopod but the atrophied (fig. 1b) exopod is nearly equal to the endopod in size and shape. The second abdominal segment on its right side has emarginate lower margin and its posterior corner is rounded.



1a. Right pleopod of third segment
1b. Left pleopod of third segment
2. Endopod of first right pleopod
3. Right exopod of fourth segment

Abreviation : en. endopod ; ex. exopod.

Specimen No. 2 : Subadult female has the inner lobe of endopod (2 in fig.) of first right pleopod absent.

Specimen No. 3 : Subadult female :

In the second segment, the right endopod is normal in shape but half in size compared to the normal left one.

Specimen No. 4 : Adult female :

In the first segment the right endopod is atrophied and nearly half the size of normal left endopod. In the second segment the right endopod is devoid of outer lobe.

Specimen No. 5 : Young female (3 in fig.) :

Both the exopod and endopod of right side in the fourth segment are atrophied and are nearly equal. The inner lobe of exopod is absent and endopod is nearly half to that of left side.

From the above descriptions it is evident that anterior abdominal appendages are mostly affected on right side. In the case of *Nichollsia kashiense* additional appendages were reported (Ram 1972) on the left side. In the present case the anomalies do not represent extra growth but atrophied appendages. Thin asymmetry in the micromorphology of appendages in *N. kashiensis* has been found very common (Ram unpublished data).

At this stage it is difficult to state whether these anomalies are of embryonic or of later period in the life of individuals.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, Calcutta and to Dr. P. D. Gupta, Officer-in-Charge, Zoological Survey of India, Gangetic Plains Regional Station, Patna for facilities and encouragement.

REFERENCES

CHOPRA B. and TIWARI, K. K. 1950, On a new genus of Phreatoicid Isopoda from wells in Banaras. *Rec. Indian Mus.*, **47** : 277-289, pl. 17-20.

RAM, L. 1972. A note on an abnormality in *Nichollsia kashiense* Chopra & Tiwari, 1950. (Isopods, Phreatoicoidea). *Crustaceana*, Suppl. 3 : 17-10.

TIWARI, K. K. 1955. Another new species of *Nichollsia*. (Crustacea : Isopoda : Phreatoicoidea). *Rec. Indian Mus.*, **53** (3 & 4) : 379-381.

Bull. zool. Surv. India 4 (1) : 9—12, 1981

THE PRESENT SUSCEPTIBILIY STATUS OF *ARMIGERES SUBALBATUS* TO HYDROCHLORIN AND DIFFERENT ORGANOPHOSPHORUS INSECTICIDES

SARBANI BHATTACHARYA (MUKHERJEE)

Zoological Survey of India, Calcutta

ABSTRACT

The *Armigeres subalbatus* mosquitoes both adults and larvae from Calcutta and its suburbs were tested against DDT and organophosphorus insecticides respectively according to standard WHO techniques and both the adults and larvae were found to be resistant against those insecticides.

INTRODUCTION

After introduction of potent synthetic insecticides into public health programmes at the close of Second World War, the main technical problem was the development of resistance to them by the insects they formally collected. Upto 1956, it was by no means accepted by all workers that the increasing failures of control was due to the development of resistance. In 1947 resistance to DDT was first discovered in house fly and in *Culex molestus* in Italy.

Armigeres mosquitoes are not only painful biters but also they occupy the second position among the man biting mosquitoes in Calcutta and suburbs (Das, Hati and Chawdhury—1971). Adult *Armigeres obturbans* is resistant to DDT, Dieldrin/HCH and organophosphorus insecticides in Srilanka, that of *Armigeres subalbatus* to DDT, Dieldrin/HCH and organophosphorus in Japan and DDT and organophosphorus insecticides in Malayasia (WHO Te : Rep : Ser : 585 ; 1976). Lc_{50} of larvae of *A. obturbans* was recorded to be 0.028 ppm with Fenthion by Kurihara in 1966. The insecticidal resistance study was also carried out by Suzuki *et al.*, (1962) in Japan. Macdonald in 1972 studied the susceptibility status of this mosquitoes against Abate. In the present note the results of our study on the present susceptibility status of *Armigeres subalbatus* against DDT and organophosphrous insecticides (Fenthion, Malathion Dursban and Abate) in Calcutta is recorded.

MATERIALS AND METHODS

(1) *Adults :*

Armigeres subalbatus larvae were collected from the natural breeding places in and around Calcutta with the help of laddles. They were reared into adults in the Laboratory and batches of resin fed 2-5 days old female *A. subalbatus* were exposed at different times to 4% DDT impregnated papers supplied by WHO, following instructions of WHO test kits manual (1970). Ten mosquitoes were tested at a time for each timing. Appropriate controls were set up. Death amongst the mosquitoes 24 hours after

exposure was noted. Twelve such observations were recorded for each exposure (*i.e.*, 15 minutes exposure, one hour exposure, etc.) in 4% DDT.

(2) *Larvae :*

Armigeres subalbatus larvae were collected from different natural breeding places in Calcutta and suburbs. They were maintained in the laboratory, all living in water collected from the source.

Batches of 3rd or 4th instar healthy larvae were kept in beakers (100 ml capacity), each containing 25 ml water. 44 beakers, 500 ml capacity, were taken. Ten beakers were allotted for Abate and same numbers for Malathion and Dursban while 14 for Fenthion. The beakers were labelled indicating the name and concentration of the insecticides. Into each breaker, 224 ml tap water was added. The concentration of test solutions in the beakers was adjusted by adding 1 ml of appropriate insecticides solution obtained from WHO. Two replicates of each concentrations were prepared. Ethanol was used as controls. The larvae with water from small beakers were then added to test solutions in large labelled beakers. The results were noted after 24 hours according to the standard WHO techniques following instructions given with WHO Tests kits mannual (1970).

Results

The results were noted in tabular forms :

Thus it will be seen that

(1) One hour exposure to 4% DDT kills 50.8% and two hours exposure kills 83.3% of adult *Armigeres subalbatus*. Thus Lt_{50} (lethal time) value calculated one hour.

(2) With Abate (organophosphorus larvaecide) 66% larvae were knocked down after 24 hours at .025 ppm of Abate and 4% were knocked down at 0.005 ppm. Thus Lc_{50} value was calculated 0.014 ppm.

(3) With Malathion 50% *A. subalbatus* larvae were knocked down after 24 hours at 0.625 ppm of Malathion and 90% were knocked down at 3.155 ppm. Thus Lc_{50} value was 0.625 ppm.

(4) 36% of the *A. subalbatus* larvae were knocked down at 0.005 ppm of Dursban and in 0.025 ppm 100% mortality was observed. Thus Lc_{50} value of *A. subalbatus* larvae against Dursban was greater than 0.005 ppm.

(5) With Fenthion 96% mortality occurs in 0.1 ppm and 16% mortality found at 0.02 ppm of Fenthion. Thus Lc_{50} value was calculated at 0.035 ppm.

Conclusion

LT_{50} in case of adult *Armigeres subalbatus* being one hour is a sufficiently long time. Thus it is presumed that *Armigeres subalbatus* adults are resistant to 4% DDT in and around Calcutta. It is accepted that if an insecticide at a concentration above .002 ppm fails to knock down larvae in 24 hours, it is regarded as resistant. So in our experiments all organophosphorus compounds showed resistance to the larvae of *A. subalbatus* at concentration above .002 ppm. Thus it may be concluded that *Armigeres subalbatus* of Calcutta and suburbs are resistant to DDT and Organophosphorus insecticides mentioned previously.

Acknowledgements

Author is grateful to the Director, Zoological Survey of India, Calcutta, for kindly

(1) *Adults*

TABLE I - Susceptibility status of *Armigeres subalbatus* adults against DDT

Time of exposure.	Knock down after 24 hours.	Percentage of knock down after 24 hours.	LT_{50}
15 minutes	10/120	8.3%	
30 minutes	31/120	25.9%	*One hour.*
1 hour	61/120	50.8%	
2 hours	100/120	83.3%	

(2) *Larvae*

TABLE II—Susceptibiliy of *Armigeres subalbatus* larvae to Abate.

Concentration of Abate.	Knock down after 24 hours	LC_{50} ppm
0.0002 ppm	0/100	
0 001 ppm	1/100	
0.005 ppm	4/100	0.014 ppm
0.025 ppm	66/100	
Control	1/100	

TABLE III—Susceptibility of *A. subalbatus* larvae to Malathion.

Concentration of Malathion.	Knock down after 24 hours	LC_{50} ppm
0.025 ppm	1/100	
0.125 ppm	3/100	
0.625 ppm	50/100	0.625 ppm
3.155 ppm	90/100	
Control	0/100	

TABLE IV—Susceptibility of *A. subalbatus* larvae to Dursban.

Concentration of Dursban.	Knock down after 24 hours	LC_{50} (ppm)
0.0002 ppm	0/100	
0.001 ppm	4/100	
0.005 ppm	36/100	Greater than
0.025 ppm	100/100	0.005 ppm
Control	0/100	

Table V—Susceptibllity of *A. subalbatus* Larvae to Fenthion.

Concentration of Fenthion	Knock down after 24 hours	LC_{50} (ppm)
0.0008 ppm	0/100	
0.004 ppm	1/100	
0 02 ppm	16/100	
0.1 ppm	96/100	.035 ppm
0.5 ppm	100/100	
2.5 ppm	100/100	
Control	1/100	

allowing me to publish this paper. The author is also grateful to Dr. A. N. T. Joseph for his constant encouragement and guidance to carry on the work. My thanks are due to Dr. A. K. Hati, Head, Department of Entomology, School of Tropical Medicine, Calcutta, for allowing me to use the Laboratory.

REFERENCES

DAS, U. P., HATI, A. K. and CHAWDHURY, A. B. 1971. "Nocturnal man biting mosquitoes of urban and rural areas". *Bull. Cal. Sch. Trop. Med.*, **19**: 80.

KURIHARA, T. 1965. Unpublished reports to WHO.

SUZUKI, T. and MIZUTANI, K. 1962. "Studies on insecticide resistance in mosquitoes in Japan". *Jap. J. Exp. Med.*, **32**, no. 4 : 297.

"Resistance of vectors and Reservoirs of Disease to Pesticides". —*Tech. Rep. Ser.*, no. 585, 1976.

World. Health. Org. Tech. Rep. Ser., Geneva, no. 125, 1957.

WHO Technical Report Series, No 443, 1970, 1970. Anuexure 2A & 2B.

Bull. zool. Surv. India, 4(1) : 13—15, 1981

SEX RATIO IN *VIVIPARUS BENGALENSIS* (LAMARCK) (GASTROPODA : VIVIPARIDAE)

S. K. RAUT

Zoological Survey of India, Calcutta

ABSTRACT

Sex ratio in *Viviparus bengalensis* varies with the size-groups of the species. Up to 25 mm. shell length the percentage of males and females are almost equal while 41.5% male and 50.3% female, and 36.98% male and 63.02% female were observed in 26 to 34 mm. and 35 to 40 mm. size-groups respectively.

INTRODUCTION

In population biology sex ratio plays an important role. The significance of study of sex ratio for any beneficial species lies with the fact that it serves as the basis of estimating gains precisely. There are a good number of edible molluscs in India of which *Viviparus bengalensis*, a banded pond snail is avidly consumed by animals as well as man. Different aspects of bioecology of this snail species have been studied by Annandale and Sewell (1921), Raut and Ghose (1976) and Raut (1978, 1980).

The ratio of males to female in *V. bengalenis* as presented by Annandale and Sewell (1921), however, differs significantly with the present study and is presented in this paper for a better understanding on the said problem.

MATERIALS AND METHODS

Viviparus bengalenis of different size composition were collected at random from a pond near Port Canning, West Bengal, for a period of one year, March 1977 to February, 1978. On the 15th day of each month 500 specimens were brought to the laboratory and released in a large tray with sufficient amount of water. Males and females were counted based on the character of tentacle. Of the two tentacles, in male the right one is recurved and the left is straight while in females both are straight. To study the sex ratio in different age-groups the length of shell of the specimens collected was measured and grouped under size-groups, viz., 6 to 10 mm., 11 to 18 mm., 19 to 25 mm., 26 to 34 mm. and 35 to 40 mm. according to their shell length. It has been noticed that in this part of West Bengal *V. bengalensis* usually does not grow beyond 40 mm. in shell length.

OBSERVATIONS

In the period of 12 months a total of 6,000 specimens were collected and examined. Of the total snails 922 (441 ♂ and 481 ♀) were 6 to 10 mm., 1,383 (680 ♂ and 703 ♀) were 11 to 18 mm., 1,830 (880 ♂ 950 ♀) were 19 to 25 mm., 1135 (471 ♂ and 664 ♀) were

26 to 34 mm and 730 (270 ♂ and 460 ♀) were 35 to 40 mm. Out of 6,000 snails 2742 (45.7%) were males and 3,258 (54.3%,

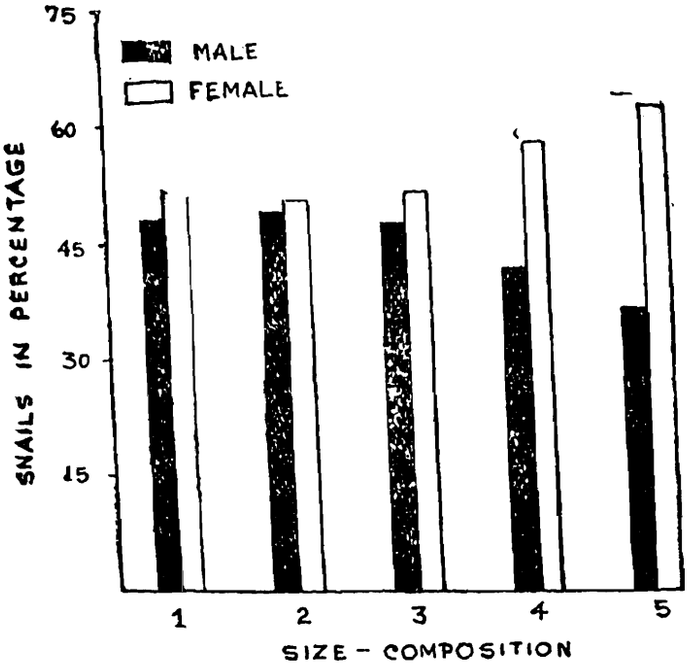


Fig. 1. Sex ratio in different size-composition of *Viviparus bengalensis*. (1=6 to 10 mm. 2=11 to 18 mm. 3=19 to 25 mm. 4=26 to 34 mm 5=35 to 40 mm.).

were females. A comparative account of the sex ratio in terms of percentage in different size-groups has been shown in Fig. I. The distribution of males and females in different size-groups was also different in different months of the year (Table I). But the impact of seasons on the sex ratio could not be detected which may be observed also from Table I. However, it is observed that the number of females, in general, is always higher than the males. In the younger size-group, i.e. 6 to 10 mm the females were higher only by 4.27% while in 11 to 18 mm. and 19 to 25 mm. size-groups the differences were by 1.66% and 3.84% respectively. Surprisingly, the females were 16.8% and 26.4% higher than those of males of 26 to 34 mm. and 35 to 40 mm. size-groups respectively. In over all, irrespecrive of size-groups, the females were 8.6% higher in occurrence.

Discussion

Prosobranchs, in general, are thought to be dioecious but in fact they are protandric hermaphrodites (Orton, 1909 ; Bacci, 1947 a, b, 1948). They function first as males, then pass through a transitional phase, and

Table I. Distribution of males and females in various size groups of *Viviparus bengalensis* in different months in a pond near Port Canning. West Bengal.

Size groups	Sex	MONTHS Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
6-10 mm	Male	10	10	28	40	70	52	48	51	40	34	31	27	441
	Female	15	10	32	43	79	59	52	51	40	37	33	30	481
11-18 mm	Male	20	30	48	60	88	74	76	61	60	62	61	40	680
	Female	24	32	50	70	90	75	76	60	61	63	62	40	703
19-25 mm	Male	34	46	64	90	106	88	87	82	76	70	70	67	880
	Female	40	51	72	94	112	97	96	86	80	74	76	72	950
26-34 mm	Male	12	13	30	50	71	55	54	43	43	36	34	30	471
	Female	20	22	44	60	85	72	69	65	65	63	55	47	664
35-40 mm	Male	8	11	19	26	39	34	30	42	22	15	14	10	270
	Female	12	13	30	48	61	54	55	44	42	36	34	31	460

subsequently function as females for the rest of life (Hyman, 1967). Recently, Wells and Lalli (1977) have given a detailed account of the sex ratio in two Caribean gastropods, *Coralliophila abberviata* and *C. caribaea*. However, these studies are restricted to estuarine and marine forms. In *Viviparus bengalensis*, according to Annandale and Sewell (1921) the number of males and females prior to the attainment of sexual maturity is almost equal like that of present study while they reported the ratios of females to males were 4 : 1 and 8 : 1 at the end of first and second year respectively. The present study did not support Annandale and Sewell (1921) with the point in terms of proportion of females to males. In general females are always more than 50% and maximum females (63.02%) are found in the older size-groups. From the present study it appears that the ratio of female is never double or even nearer to that of male. According to Orton (1920) larger specimens of *Patella vulgata* were 64% females while Wells and Lalli (1977) observed 51.9% males and 47.0% females in *Coralliophila abbreviata*.

It is evident that in most prosobranchs the number of females is at an increasing rate with the increase of age. This indicates that the life-span of females is somewhat longer than the males and the mortality rate in males is increasingly higher with the age. The higher precentage of females may be explained as an adaptation for maintaining a high population level so that they may represent themselves as a dominative malacofauna in competition over others.

ACKNOWLEDGEMENT

The author is thankful to the Director, Zoological Survey of India, for facilities provided and to Dr. N. V. Subba Rao for encouragement.

REFERENCES

ANNANDALE, N. AND SEWELL, R. 1921. The banded pond snail of India (*Viviparus bengalensis*). *Rec. Indian Mus.*, **22** : 215-242.

BACCI, G. 1947a. Recerche sul sesso de *Patella coerulea*. *Arch. Zool. Italiano*, **31** : 293-310.

BACCI, G. 1947 b. Osservazioni sulla sessualita degli Archaeogastropoda. *Arch. Zool. Italiano*, **32** : 329-341.

BACCI, G. 1948. L'Inversione del sesso ed il ciclo stagionale della gonade in *Patella coepulea* L. *Pubbl. Staz. Zool. Napolia*, **21** : 183-217.

HYMAN, L. H. 1967. The Invertebrates. **6**, Mollusca I : Vii *McGraw Hill Book Co., N. Y., St. Louis*, London.

ORTON, J. 1920. Sex phenomena in *Patella vulgata*. *Nature*, London, **104** : 220-221.

RAUT, S. K. 1978. Population interaction among freshwater snails. (Abstract, paper in Press) *Proc. Symposium on Ecology of Animal Populations, Zoological Survey of India*, Calcutta. pp. 91-92.

RAUT, S. K. 1980. Preliminary observations on the breeding of the banded pond snail, *Viviparus bengalensis* (Lamarck), (Gastropoda : Viviparidae) in West Bengal. *Bull. zool. Surv. India*, 3, (122) : 47-50.

RAUT, S. K. AND GHOSE, K. C. 1980. Influence of unfavourable environment on oviposition in some gastropods. *Indian J. Anim. Sci.*, **50** (12) : 1121—1 23.

WELLS, F. E. AND LALLI C. M. 1977. Reproduction and brood protection in the Cariban gastropods *Coralliophila abbreviata* and *C. caribaea*. *J. moll Stud.*, **43** (1) : 79-87.

Bull. zool. Surv. India, 4 (1) : 17—21, 1981

ON THE OCCURRENCE OF *ANCHITREMA SANGUINEUM* (SONSINO, 1894) LOOSS, 1899 (TREMATODA : ACHITREMATIDAE MEHRA, 1935) FROM *SUNCUS MURINUS* (LINNAEUS, 1766) (SORICIDAE : MAMMALIA)*

R. K. GHOSH

Zoological Survey of India, Calcutta.

ABSTRACT

Anchitrema sanguineum **(Sonsino) Loss. is recorded for the first time from an Insectivore *Suncus murinus* from Bankura, West Bengal.**

While studying the helminth parasites of rats from West Bengal a single specimen of *Anchitrema sanguineum* (Sonsino, 1894) Looss, 1899 was obtained from *Suncus murinus* from the vicinity of Veterinary hospital compound, Bankura, West Bengal. This parasite has so far been reported only from bats and reptilian hosts. This record from *Suncus* is interesting and forms the subject matter of the present communication.

All the measurements are in millimeters

Family ANCHITREMATIDAE Mehra, 1935
Sub-family ANCHITREMATINAE Mehra, 1935

Anchitrema sanguineum (Sonsino, 1894) Looss, 1899 (Fig. 1)

Small distome, tongue-shaped, spinose anteriorly, 1.16 in length and 0.29 in maximum width at antero-testicular, acetabular level. Terminal oral sucker 0.1×0.13. No prepharynx, pharynx globular 0.06×0.05. Oesophagus narrow, 0.09 in length and bifurcates above the acetabulam in two narrow caeca which run almost upto the posterior end. Globular acctabulum (009×0.07), slightly smaller than oral sucker, placed just above the equatorial level.

Testes extra-caecal, placed in distinctive notch of the caecum of respective side, symmetrical and equatorial in position. Right testis 0.2×0.13 slightly bigger than left testis 0.18×0.09. Vasa efferentia and vas deferens could not be traced. Coiled seminal vesicle enclosed in globular sac 0.09×0.08, pre-acetabular and below the intestinal bifurcation. Genital pore median, pre-acetabular.

Ovary median immediately post-testicular in position, inter-caecal 0.09×0.07. Vitelline glands consisting of small follicles, extra-ceacal, extend laterally in post-testicular field some distance short of posterior end. Uterine coils poorly developed, containing very few matured eggs. Eggs yellowish, oval 0.016—0.024×0.009—0.015.

Excretory vesicle 'Y' shaped. Arms long witn short stem. Excretory pore terminal.

Discussion : The species was first recorded by Sonsino (1894) as *Distoma sanguineum*

* Abstract of this paper has been Published in Asian Congress of Parasitology, 1978 (23—26 Feb.) Bombay, 240. (Abs.)

from a reptile host. *Chamaeleo vulgaris* Gunther, 1864 from Tunisia (Africa). Looss (1899) erected the genus *Anchitrema* with this species as type. Subsequently this species was recorded from bats of Africa, Europe, Asia, and Australia.

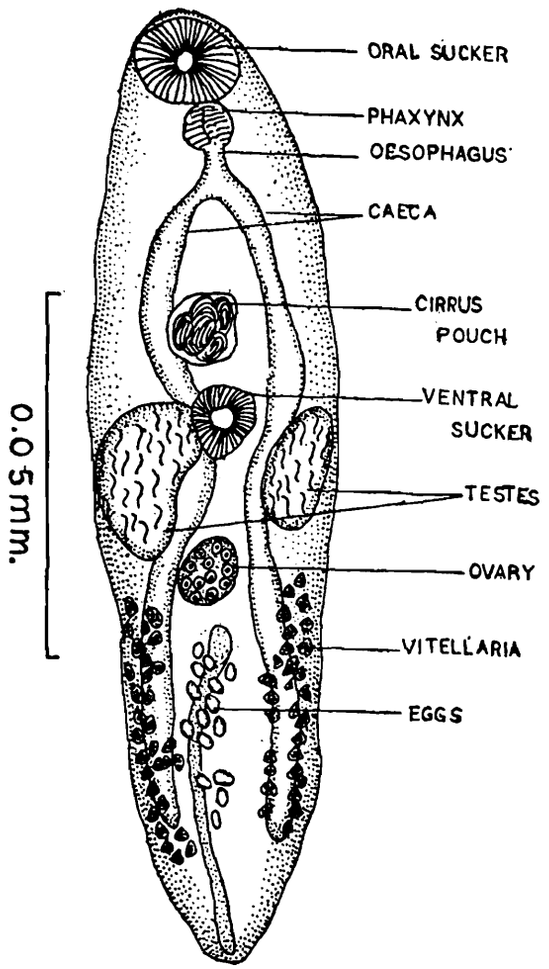


Fig. 1. *Anchitrema sanguineum* (Sonsino) Loss,

From India Pande (1935) described this species from *Nycticejus kuhli* (=*Scotophilus kuhli*), Allahabad. He also considered the genus *Exorchocoelium* Thapar, 1931 described from *Nycticejus kuhli* (=*Scotophilus kuhli*) from Lucknow as synonym of *Anchitrema*. Thapar (1956) eontradicted the opinion of pande (1935) and revalidated his genus. Simha (1960) recorded *A. sanguineum* from *Chameleon zeylanicus* from Hyderabad. Gupta (1962) recorded this species from *Taphozous kachensis kanchensis* from Jaisalmer (Rajasthan). Dwivedi and Chauhan (1970) described this species from *Chameleon zeylanicus* from Jabalpur and Chindwara (Madhya Pradesh), Gupta and Mehta (1970) recorded this species, from *Scotophilus hespeti* from Punjab. Srivastava and Ghosh (unpublished account) obtained this species from *Pipistrellus mimus*, Cumbum (Andhra Pradesh) ; and Ramtek (Madhya Pradesh). From Calcutta they recorded this species from distribution of *Anchitrema sanguineum* in India is given in Fig. 2.

Agrawal (1966) described a new species *A. lucknowensis* from *Nycticejus kuhli* (=*Scotophilus kuhli*) from Lucknow, India. She (1969) published the description of the same new species again. Agrawal (1966, 1969) supported the synonymy proposed by Pande (1935) for *Exorchoeoelium indicum* described by Thapar (1931) revalidated in 1956, with *A. sanguineum*. This synonymy is fully justified and supported by Pande (1935) and Yamaguti (1971).

Agrawal (1966, 1969) differentiated the species *A. lucknowensis* mainly on the basis of presence of spines in the body extension of vitellaria, position of genital pore, shape of cirrus pouch, smaller size of eggs, etc. All these characters are variable in *A. sanguineum* as observed by Rodhe (1966), Odening (1968) and other workers. As such the species described by Agrawal (1966) is considered synonym of *A. sanguineum*.

Rodhe (1966) recognised only the genotype *Anchitrema sanguineum* as valid species under the genus. He considered *A. phillippinorum* (Tubangui, 1928) and *A. congolensis* (Sandground, 1937) as synonyms of *A. sanguineum*.

Fig. 2. Distribution of *Anchitrema sanguineum* in India.

Higher taxonomy of the genus : Looss (1899) and Odhner (1910) placed the genus *Anchitrema* under the family Lecithodendriidae Odhner, 1911. Mehra (1935) proposed a new sub-family Anchitreminae under the family Lecithodendriidae to accommodate the genus *Anchitrema*. Pande (1935) and Skarbitovich (1948) placed the genus under sub-family Lecithodendriidae Looss, 1902. Yamaguti (1958) included the genus *Anchitrema* under the sub-family Anchitrematinae Mehra, 1935 (spelling amended) and family Dicrocoellidae Odhner 1911. Macy et al (1961), Gupta and Mehta (1970, Manning and Viyaant (1971) maintained this arrangement.

Cabellero (1961) proposed a new family Anchitremidae and maintained the sub-family named Anchitreminae Mehra, 1935 suppressing the amendment by Yamaguti

(1958). Odening (1968) recognised the family Anchitrematidae Caballero, 1961, amending the spelling Anchitremidae Caballero, 1961. Yamagvti (1971) also recognised the family Anchitrematidae apparently amending the status and spelling of Anchitreminae Mehra, (1935) but kept the name of Mehra (1935) in parenthesis after the family name. According to the rules of Zoological Nomenclature (Article 36) the authorship should go exclusively to the author of the sub-family if the status of sub-family is raised to the family rank afterwards. As such Mehra (1935) is the author of the family and not Cabellero, 1961.

The affinities of the genus *Anchitrema* with that of families Lecithodendriidae and Dicrocoelidae and also the status of the family Anchitrematidae Mehra, 1935 will remain an open question till the life history of the species *Anchitrema sanguineum* is known.

Host Parasite relationship : This genus has so far recorded only from Chiropteran and reptilian hosts and this is the first record of this species from an Insectivore. Out of about forty shrews examined from different parts of West Bengal only one shrew was found infected on a single occasion with one parasite, so it can be assumed to be an accidental host. The host might have been infected by devouring the second intermediate host (insect), containing metacercarial stage of this parasite. This assumption gets further support from the fact that the specimen is smallest of all the record of this species. Further, reproductive organs specially the uterus are poorly developed and contained very few matured eggs. Mention may be made that this reduction in size may be due to host incompatibility (reaction). It has been observed by many workers that when the parasite is found in an unusual host the size remains small and fertility restricted. Bauer (1958) observed that *Azygia lucii* reaches large size and is very fertile in *Esox lucious* (its normal host) while in *Perca acernia* and *Luciperca* (unusual hosts) it is much smaller in size and reproduces less vigorously. Layman (1949) made this observation in case of *Bunodera lucipercae* from the gut of *Luciperca* (the normal host) and *Acernia* (the unusual host). Srivastava and Ghose (1969), recorded progenetic development of a snake parasite *Proalarioides tropidonotis* Vidyarthi, 1937 in *Rana tigrina* with much less number of eggs in the uterus. They presumed that one of the reasons of such low fecundity may be due to imperfect adaptation in intermediate host.

The other probability in this case is that the parasite *Anchitrema sanguineum* is extending its host range and facing the usual hazard, i.e., low intensity, retarded development and fecundity.

ACKNOWLEDGEMENT

Thanks are due to Director, Zoological Survey of India, for providing laboratory facilities. I am also grateful to Dr. C. B. Srivastava for critically going through the manuscript.

REFERENCES

AGRAWAL, V. 1966. Two new trematodes from the intestine of a yellow bat *Nycticejus kuhlii* from Lucknow, India. *Trans. Am. microsc. Soc.*, **85** (4) : 559-563.

AGRAWAL, V. 1969. Two new trematodes from the intestine of a yellow bat *Nycticejus kuhlii* from Lucknow, India. *Revta. Biol. trop., Costa Rica.*, **15** (2) [1967] : 207-219.

BAUER, O. N. 1958 Relationships between host fish and their parasites. In Dogeil et. al. ed. *Parasitology of fishes* (English Translation by Kabata, 1961). Oliver & Boyd, London.

CABALLERO, Y. C. E. 1961. Trematodes de los murcielagos de Mexico VIII Catalogo taxonomico de los trematodes que parasitan a los murcielagos (Mammalia, Chiroptera Blumenbach) 1774. An. *Inst. Biol.* (Mexico). **31** : 215-287.

DWIVEDI, M. P. and CHAUHAN, B. S. 1970. On some Digenetic trematodes Part I. *J. zool. Soc, India,* 21 (1). 1969 : 141-148.

GUPTA, N. K. and MEHTA, S. 1970. Observation on *Anchitrema sanguineum* Sonsino, 1895 (Trematode : Dievocoeliidae) from bat — *Scotophilus hesthei* Herrfield, 1831 *Proc. 2nd Int. Congr. Parasit* (Washington 6-12 Sept, 1970). *J. Parasit.,* 56 (4) Sect, 2(1) : 129.

GUPTA, P. D. 1970. Fauna of Rajasthan, India. Part 8. Trematoda. *Rec. zool. Surv. India,* 62 : 171-190.

LAYMAN, E. M. 1949. Manual of Fish diseases. Publ. *Pischepromizdat.*

MACY, R. W., HEYNEMAN, D. and KUNTZ, R. E. 1961 Records of the trematodes of the families Lecithodendriidae, Dicrocoeliidae and Heterophidae from Chiroptera in Egypt and Yemen, S. W. Arabia. *Proc. helminth. Soc. Wash.,* 28 (1) : 13-17.

MANNING, G. S. and VIYANANT, V. 1971. New host and distribution record for *Anchitrema sanguineum* (Sousino, 1894) Looss, 1899, *J. Parasit.*. 57 (1) : 184.

MEHRA, H. R. 1935. New trematodes of the family Lecithodendriidae Odhner, 1911 with a discussion on the classification of the family. *Proc. Acad. Sci. U. P. India,* 5 (1) ; 99-121.

ODENING. K. 1968. Trematoden aus vietnamesischen Chiropteren. *Zool. Abh. Sl. Mus. Tierk. Dresden,* 29 (12) : 119-157.

ODHNER, T. 1911. Nordostafrikanische Trematoden, grosstenteils von Weissen Nil. Results Swedish Zoological Expt. to *Egypt and the White Nile,* 1901 *U. Direct, I. A. Jagerskiold.* Part IV. 1-166.

PANDE, B. P. 1935. Contributions to the digenetic trematodoes of the Microchiroptera from Northern India. Part I. New species of the genus *Pycnoporus* with a note on *Anchitrema. Proc. Acad. Sci. U. P. India,* 5 (4) : 371-380.

PETRUSHEVSKI, G. K. 1940. Contributions to Parasitology of fihes of Kerelia II. Fish parasites of lake Onega Uch. *Zap. len. gos ped in-tain,* Gertsevar. 30.

RODHE, K. 1966. On the trematode genera *Lutztrema* Travassos, 1941 and *Anchitreme* Looss, 1899 from Malayan Bats, with with a discussion on Allometric growth in helminths. *Proc. helminth. Soc. Wash.,* 33 : 184-199.

SIMHA, S. S. 1960. Observations on *Anchirema sanquineum* (Sonsino, 1894). *J. biol. Sci.,* 3 (1) : 46-47.

SKARBILOVICH, T. S. 1947. Lecithodendriidae Odhner, 1911. En K. I. Skrjabin. *Trematodes of animal and man.* vol. 2. 1-600 Moscow.

SRIVASTAVA, C. B. and GHOSE, R. K. 1968. On a new host of *Proalaroides tropidonotis* Vidyarthi, 1937 (Trematode : Proterodiplostomidae). *Indian J. Helminth.,* 21 (1) : 13-17.

THAPAR, G. S. 1931. On a new trematode from the intestine of yellow bat, *Nycticejus Kuhli. Proc.* 18 *Indian Science Congress.,* 220.

THAPER, G. S. 1958. On the morphology and systematic position of a new genus of trematodes from the intestine of the yellow bat, *Nycticejus kuhli. Indian J. Helminth.,* 8 (2) [1956] : 85-91.

YAMAGUTI, S. 1958. *Systema Helminthum.* vol. 1 digenetic trematodes of vertebrates London. 1-1575.

YAMAGUTI, S, 1971. *Synopsis of digenetic trematodes of vertebrates* Vol. 1. Keigaku Publishing Co. Tokyo. 1—1074.

Bull. zool. Surv. India, 4 (1) : 23—26, 1981

AMBLYOMMA JAVANENSE (SUPINO, 1897) FROM A NEW HOST, *MANIS CRASSICAUDATA* GRAY TOGETHER WITH A DESCRIPTION OF ITS NYMPH FROM GOA, INDIA.

N. C. NANDI

Zoological Survey of India, Calcutta

ABSTRACT

Occurrence of an ixodid tick, *Amblyomma javanense* (Supino, 1897) is recorded herein for the first time from the Indian Pangolin, *Manis crassicaudata* Gray from Molem, Goa along with the description of nymph, hitherto unknown for this species.

On December 21, 1973, one male and one nymph of *Amblyomma* tick were collected on careful examination of the skin of the Indan Pangolin, *Manis crassicaudata* Gray from Molem, Goa, shot dead on December 12, 1973. The specimens were identified as *Amblyomma javanense* (Supino, 1897) and were subsequently confirmed by Dr. Vijai Dhanda of Virus Research Centre, Poona, who also suggested describing the nymph stage for this species. Incidentally, this constitutes the first record of this species from Goa and from a new host, *Manis crassicaudata*. The nymph of *A. javanense* is hereunder described for the first time.

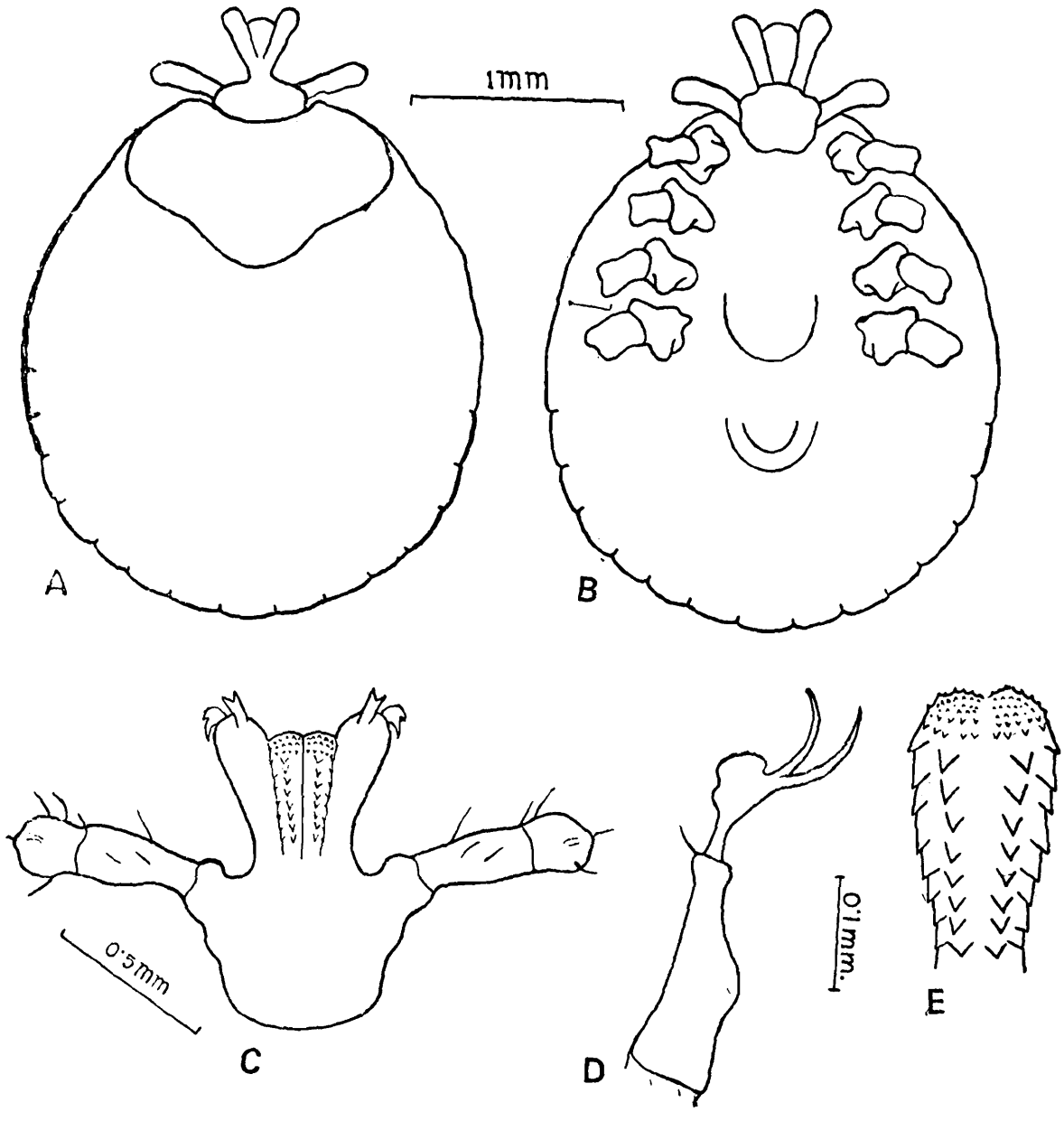
The specimens were found dead sticking to the fold of the fore-leg when collected. Measurements were made in millimeters and were taken at the longest or widest points. Illustrations of the nymph were made from unengorged, unmounted alcohol-preserved specimen, with the help of a camera-lucida.

Description Of The Nymph ; (Figs. 1A—E

Body subcircular measuring 1.5 in length and 2.1 in width (an unengorged specimen).

Capitulum : Basis capitulum dorsally more than twice as wide as long, .475 × .450 ; lateral margins convex and converging anteriorly ; posterior margin straight. *Basis capitulum* ventrally subrectangular, lateral margins slightly converging posteriorly. *Palps* slender, 0.48 long ; segment 2 less than twice that of 3. Segment 2 with two supra-internal and one infrainternal setae. Segment 3 with two suprainternal and two infrainternal setae, *Hypostome* long, narrow ; cornu moderate ; dental formula 2/2 ; eight denticles in each file, 4 strong teeth and 4 scale-like teeth. *Cheliceral articles* two ; inner one with 3 small cusps, outer one with 2 large cusps.

Scutum : Subcordiform, reddish brown, broadest in the anterior half ; length (including scapulae) 0.80, slightly greater than two-third width 1.10, widest at the level of coxae II ; lateral margins subparallel



Figs. 1. *Amblyomma javanense* (Supino,, 1807), nymph off *Manis crassicaudata* from Goa : A & B. Dorsal and ventral views of nymph. C. Ventral view of capitulum. D. Tarsi of nymph. E. Hypostome of nymph.

converging anteriorly and also somewhat convergent posteriorly ; posterior margin convex. Cervical grooves short, distinct and slightly narrower posteriorly ; outer margins slightly convex, extending more than one-fourth the length of the scutum. *Eyes* flat, non-orbital situated at the level of 1st coxae along the anterior outer margins of the cervical grooves.

Dorsum : Middle yellowish, near margins reddish brown and margins pale yellow. Striations fine and almost at regular space of 0.01-0.015, including festoons, like a spider-web. *Punctations* numerous, small and moderate, scattered almost evenly over the dorsum. *Festoons* wide 0.23, 13 in number, well marked.

Venter : Yellowish with fine superficial

striations as in the dorsum. Anal aperture 0.91 from the posterior end of the body ; anal groove rounded. *Spiracular plate* indistinct.

Legs : Coxa I with two short subequal spurs ; Coxae II to IV each with a single short triangular spur, the spur at the coxa IV relatively larger. *Claws* well developed, 0.09 long. *Pulvilli* small 0.04, less than half the length of the claw.

Brief Description of The Male :

Body yellow-brown in colour measuring 5.6 in length and 4.1 in width (at the level of 1st of festoon) and with no hairs at the margins. Basis capitulum dorsally (0.5×0.9) a little less than twice as wide as long ; lateral margins convex, anteriorly covering to a broadly rounded apex, and subparallel posteriorly ; posterior margin nearly straight. Basis capitulum ventrally subrectangular, outer posterior angles rounded ; lateral margins anteriorly forming angles with the straight anterior margin. Dorsal and ventral ridge straight, ventral ridge reaches upto anus. Palps (1.05×0.30) club-shaped, more than thrice as long as wide. Segment 2 (0.6× 0.22) with 3 setae on both supra-external and infra-external margins. Segment 3 slightly longer than wide. Hypostome with 3/3 rows of teeth, 7 strong teeth in each row followed posteriorly by 4/4 unequal rows of scale-like teeth. Scutum inornate ; venter punctate, broadest at the level of 1st festoon. Anal groove rounded ; anal aperture at the level of 1st festoon ; genital aperture at the level of 2nd coxae. Two short, subequal, broadly rounded spurs at the 1st coxae ; 2nd and 3rd coxae with one flat short spur ; 4th coxae with one distinct blunt spur, slightly longer than those of 2nd and 3rd coxae.

Remarks : Ixodid ticks belonging to the genus *Amblyomma* Koch, 1844 are represented by more than 100 species all over world (Robinson, 1926 ; Rao *et al.*, 1964). While there are only nine species viz., *Amblyomma clypeolatum* Neumann, 1899 ; *A. habraeum* Koch, 1844 ; *A. helvolum* Koch, 1844 ; *A. integrum* Karsch, 1879 ; *A javanense* (Supino, 1897) (previously referred to as *A. sublaeve*) ; *A. mudaliari* Rao, Hiregauder and Alwar, 1964 ; *A. nitidum* Hirst and Hirst, 1910 ; *A. supinoi* Neumann, 1905 and *A. testudinarium* Koch, 1844 occurring in India (Jagannath *et al.*, 1973). *Amblyomma crenatum* Neumann, 1899, though mentioned by Patton and Cragg (1913) and Rao *et al.*, 1964 as occurring in South India, considered by Robinson (1926) as an African species off Rhinoceros. This species has not been encountered from Madras State so far (Alwar. 1960).

Of the nine species of *Amblyomma* occurring in India, *A, javanense* and three other species viz., *A. integrum*, *A. mudaliari* and *A. testudinarium* are known sometimes to attack domestic animals (Rao *et al.*, 1964). Sharif (1928) in his revision of the Indian Ixodidae, had reported the occurrence of *A. sublaeve*, now synonymised with *A. javanense*, from various hosts *viz., Nicoria tricarinata, Vesperugo abranus*, including *Manis pentadactyla*, from Calcutta Zoological Gardens and *Manis* sp. from Nagpur of Central Province, now in Maharashtra State.

From a perusal of literature it has been revealed that the immature stages of *Amblyomma integrum*, *A. nitidum* and *A. testudinarium* are known so far as the Indian species of *Amblyomma* are concerned. The present author enjoys the previlege of describing the nymph stage for the fourth Indian species. *A. javanense*, from Goa.

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India for facilities

provided. Thanks are also due to Drs. B. K. Tikader and B. S. Lamba of this department for their various help and interest in this study. He is indebted to Dr. V. Dhanda, Virus Research Centre, Poona, for his suggestion and confirming the species and to Shri S. K. Chanda for his technical assistance.

REFERENCES

ALWAR, V. S. 1960, Notes on the incidence of the sub-family Amblyomminae Salmon et, Stiles, 1901, in Madras. *Indian vet. J.* 37 : 433-435.

JAGANNATH, M. S., ALWAR, V. S. and LALITHA, C. M. 1973. Ixodid ticks of domestic stock in Tamil Nadu. *Indian J. Anim. Sci.* 43 (2) : 119-124.

PATTON, W. S. and CRAGG, F. W. 1915. *A text book of medical Entomology.* Christan Literature Soceity of India, Madras and Calcutta.

RAO, S. R., HIREGAUDER. L. S. and ALWAR, V. S. 1964. Ticks of the genus *Amblyomma* occurring in India together with a description new species *A. mudaliar. Indian vet. J.*, 41 (2) : 89-93.

ROBINSON, L. E. 1926. The genus *Ambloomma* : in Nuttal, Warburton and Robinsou : A monograph of the Ixodoidea II (Part 4). Cambridge.

SHARIF, M, 1928. A revision of the Indian Ixodidae with special reference to the collection in the Indian Museum. *Rec. Indian Mus.*, 30 : 217-344.

Bull. zool. Surv. India, 4 (1) : 27-35 1981

TAXONOMIC STUDIES ON THE MEMBRACIDS COLLECTED FROM SILENT VALLEY, KERALA (INSECTA : HOMOPTERA)

G. THIRUMALAI

Zoological Survey of India, Southern Regional Station, Madras

AND

K. S. ANANTHASUBRAMANIAN

Department of Zoology, Loyola College, Madras.

ABSTRACT

A new genus, *Neocentrus* and four other new species of Membracidae collected from Silent Valley, Kerala, are described.

(Key words : Taxonomy, Silent Valley Membracidae).

The material which forms the subject of the present study includes four new species and a new genus of Membracidae collected during a multidisciplinary expedition to the Silent Valley, Kerala (April-May 1980), sponsored by the Department of Science and Technology, in which the senior author has also participated. It is doubtless that more species of membracids, hitherto unknown, are likely to be discovered in future surveys to from this valley of faunistically little explored forests.

Subfamily Centrotinae.

Tribe Leptocentrini.

Genus Lanceonotus Capener 1968.

Lanceonotus malabaricus sp. nov.
(Fig. I)

Female ; General colour shining brown ; vertex brown, twice as wide as long, finely punctate with silvery hairs, upper margin slightly arched, lower margin obliquely rounded to frontoclypeus ; eyes reddish ; subglobate ; ocelli silvery white, small, nearer to eyes than to each other and situated slightly above the centro-ocular line ; frontoclypeus dark brown, extending to three-fourths of its length beyond lower margins of vertex, hairy, tip broadly rounded. Pronotum shining black, strongly punctate, with short sparse silvery hairs, metopidium slightly oblique from its base, about 1.7 times as wide as high, supraocular callosities black, not divided, nearly rounded, humeral angles dark brown, prominent ; suprahumeral horns jet black, broadbased, tricarinate, about 1.4 times as long as distance between their bases, sparsely pilose with silvery hairs, viewed from sides strongly obliquely curved backwards, viewed from above directed lateral upto three-fourths of their length and then turned backwards, viewed from front

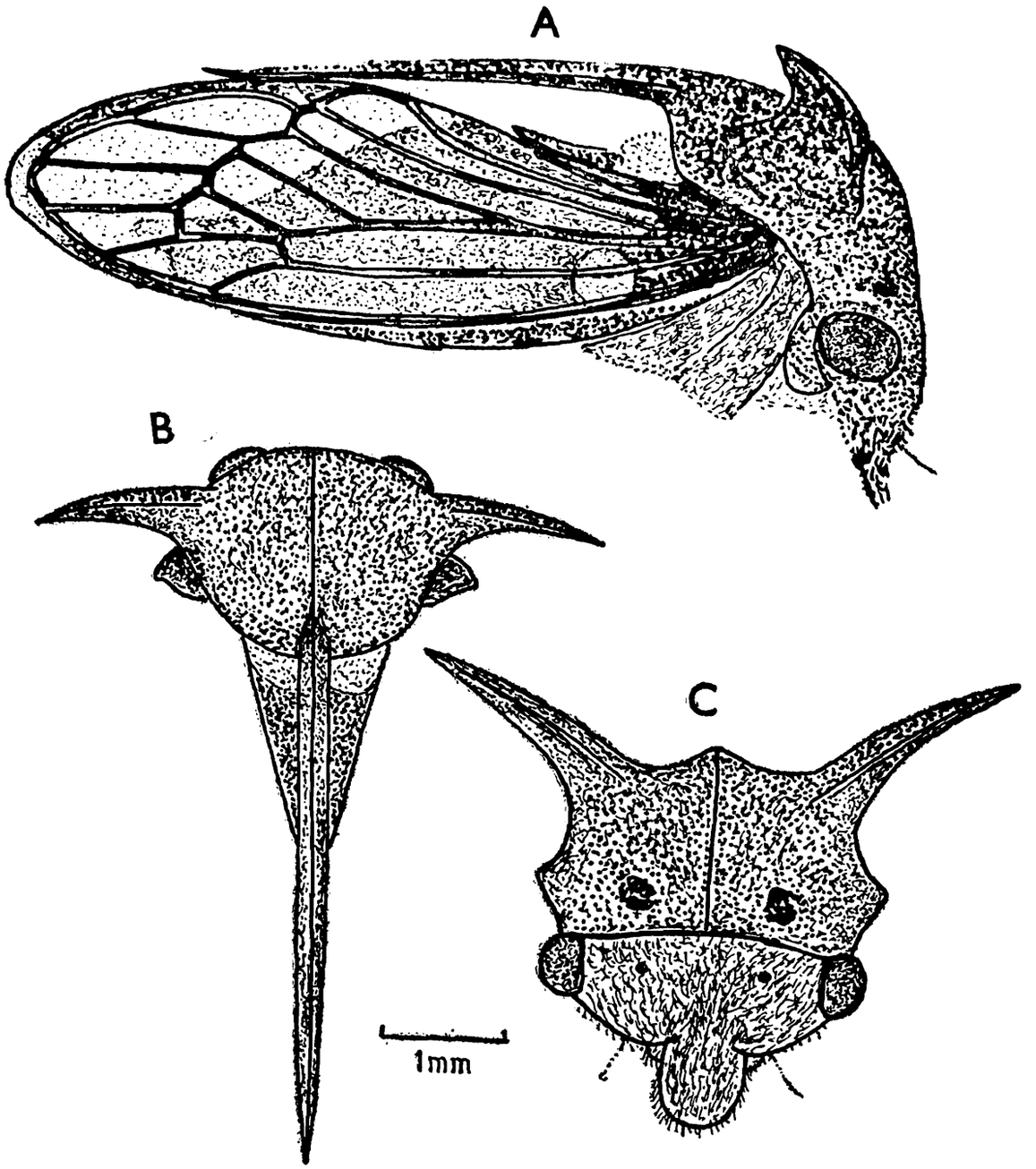


Fig. 1. *Lanceonotus malabaricus* sp. nov.
A. Lateral view of female. B. Dorsal view of Pronotum. C. Frontal view.

directed obliquely outwards and upwards, tips acute ; posterior process emerging from the posterior regions of disc, well remote from scutellum, directed horizontally and gradually tapering to the tip, impinging on the margins of the tegmina and passing beyond the anal angles as far as the middle of fifth apical cell, tip slightly elevated, ventral carina pitch black ; scutellum 1.5 times longer than wide, basal one-fourth white tomentose, tip emarginate, black ; lateral aspects of pterothorax cretaceously sericeous. Tegmina brownish, thrice as long as wide, basal fifth black and coriaceous, apical limbus moderately wide, inner margin opposite to 4th and 5th apical cells black, first apical cells wedge-shaped, nearly 3.5 times as long as its greatest width, 2nd dis-

coidal cell larger than first. Abdomen black. Tarsi light brown, rest of the legs brown.

Measurements : Length from frontal margin to the tips of tegmina 7.5 mm., to the tip of posterior process 5.8 mm. ; width across tips of suprahumeral horns 5 mm., at humeral angles 2.8 mm., at eyes 2.5 mm.

Male : Similar to female in general colouration and size, but the suprahumeral horns are shorter and more slender.

Measurements : Length from frontal margin to tips of tegmina 7.4 mm., to tip of posterior process 5.7 mm. ; width across tips of suprahumeral horns 3.5 mm., at humeral angles 2.75 mm., at eyes 2.5 mm.

Material examined : Holotype female, two male paratypes, collected from Kumattamthodu, Silent Valley, Kerala, 880 metres height ; collected by *Dr. R. S. Pillai and party*, 22.iv.1980. zsi/srs. Reg. No. I/H.

This species is closely related to *cinnamomi* Ananthasubramanian with which it resembles in the general colouration of body, eyes and in the position of ocelli, but differs in the shorter posterior process, which impinges on the tegminal inner margin, longer suprahumerals, scutellum longer than wide, and in the broader apical limbus.

Telingana majuscula sp. nov.
(Fig. 2)

Male : General colour piceous black : vertex dark brown, thrice as wide as long, sprinkled with long thickly crowded golden hairs, upper margin of vertex more or less planate, lower margins obliquely continued to frontoclypeus ; eyes large, subglobate, marooned with black ; ocelli shining black, conspicuous, near to eyes than to each other and situated well above the centro-ocular line ; frontoclypeus dark brown, extending three-fourths of its length beyond lower margins of vertex, long thickly hairy, tip rounded, frontoclypeal lobes distinct. Pronotum piceous black, strongly granulate, with long golden hairs thickly crowded at bases of horns and around suprahumeral callosities ; metopidium vertical, convex, about 1.3 times as wide as high, supra-ocular callosities black, entire, humeral angles black ; superahumeral horns black, robust, with long, golden pilosity, 2.75 times as long as distance between their bases, viewed from sides directed forwards and strongly recurved, viewed from above centrally and laterally carinate and strongly recurved, viewed from front directed obliquely upwards and outwards, lateral and posterior surfaces planate. Posterior process emerging obliquely behind disc and vertically from posterior margins, basally curved and directed almost horizontally caudad high above scutellum and tegmina, slender and gradually acuminate to a sharp tip which reaches as far as the 4th apical cell of the tegmina. Scutellum triangular, almost as long as wide, base swollen and densely covered with white tomentum, apical two-thirds almost planate, punctate with sparse pilosity, tip with a U-shaped emargination, apices acute. Tegmina nearly 3.5 times as long as wide, brownish amber hyaline, basal fifth and costal area coriaceous, punctate, dark ; costal radial, median, cubital, 1st and 2nd apical cells and three-fourths of discoidal cells dark brown, punctate, apical limbus moderately broad, bronzy, tip acutely rounded ; R1 oblique, first apical cell based on radial sector, about 6 times as long as greatest width, 2nd discoidal twice as long as 1st ; legs black except tarsi which are light brown.

Measurements : Length from frontal margin to tips of tegmina 7.1 mm., to tip of posterior process 5.7 mm. ; width across tips of suprahumeral horns 5 mm., at humeral angles 3 mm., at eyes 2.4 mm.

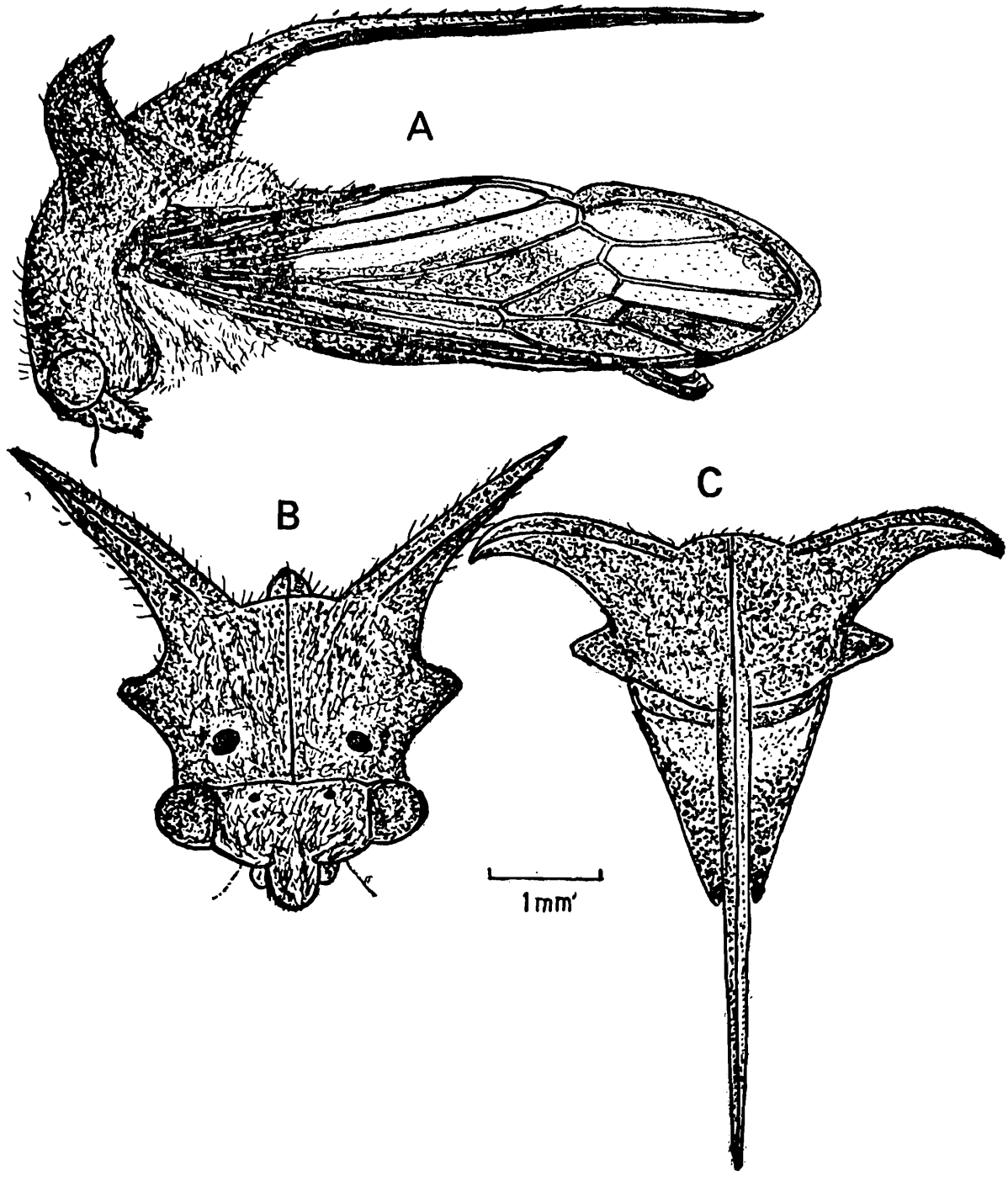


Fig. 2. *Telingana majuscula* sp. nov.
A. Lateral view of male. B. Frontal view. C. Dorsal view of Pronotum

Female : Unknown.

Material examined : Holotype male from the road leading to Valiyaparathodu, Silent Valley, Kerala, 920 metres height ; collected by *Dr. R. S. Pillai and party,* 23.iv.1980. Reg. No. zsi/srs I/H.

Remarks : Telingana majuscula is closely allied to *capistrata* Distant in the general colouration of the body and tegmina and in

the nature of the posterior process which is high above scutellum and tegmina, but differs in the shape of the frontoclypeus, in the non-arched horizontal posterior process and scutellum as wide as long.

Neocentrus gen. nov.

This genus may be distinguished by the absence of suprahumeral horns, the somewhat declivous short posterior process emerging more or less horizontally from the posterior margin of pronotum, almost contiguous with scutellum, its apex scarcely passing the apex of claval area and never reaching the claval suture, and the long, narrow first apical cell of tegmina based on the very short radial sector.

Head vertical, about thrice as wide across extremities of eyes as length of vertex ; upper margin very weakly arcuate and sinuate, situated on the centro-ocular line ; frontoclypeus declivous, distinctly broader than length, tip broadly rounded, frontoclypeal lobes moderately prominent with sutures indistinct. Pronotum convex, median carina percurrent, metopidium more than twice as wide as high, obliquely curving backwards to disc, humeral angles moderately developed, blunt ; suprahumeral horns absent ; posterior process short, declivous, emerging from the posterior margin of pronotum more or less horizontal, almost contiguous with scutellum, strongly tricarniate, rather slender, apex sharp, scarcely passing the entire length of clavus, never reaching the claval suture. Scutellum triangular, wider than long, weakly convex, apex emarginate, Tegmina nearly three times as long as wide, without pterostigma, with five apical and two discoidal cells, R1 oblique to subcosta, first apical cell about seven times as long as its greatest width and based on the radial sector; radial sector very short, apical limbus moderately broad. Hind wings with four apical cells.

Type of the genus *Neocentrus rufus* sp. nov.

3. Neocentrus rufus sp. nov.
(Fig. 3)

As in generic description, with the following additional characters :

Female : General colour dull brown. Vertex brown, finely punctate with long golden hairs ; eyes dull brownish ; ocelli jet black ; frontoclypeus extending two-thirds of its length beyond lower margins of vertex, covered with long adpressed golden hairs. Pronotum coarsely punctate with long adpressed golden pilosity ; supraocular callosities divided ; posterior process long sparsely hairy, dorsally keeled, a little elevated from scutellum, and then contiguous with the inner tegminal margin, posterior three-fourths black. Tegmina yellowish brown, basal fifth corioceous, veins thick, reddish brown, 1st discoidal cell more or less elliptical, somewhat shorter than 2nd discoidal, R 2+3, M1 and M2 slightly curved. Abdomen black with shades of brown, ovipositor jet black ; legs black upto middle of tibia, rest light brown.

Measurements : Length from frontal margin to tips of tegmina 7.3 mm., to tip of posterior process 4.2 mm, ; width across tips of humeral angles 3.6 mm., at eyes 3.2 mm.

Male unknown.

Material examined : Holotype female, collected from Silent Valley, Kerala, halfway to Valiyaparathodu, Alt. 1000 metres ; collected by *Dr. R. S. Pillai and party*, 27.iv.1980. Reg. No. zsi/srs I/H.

Tribe Tricentrini Ahmad and Yasmeen **1974.**

Genus **Tricentrus** Stal 1866,

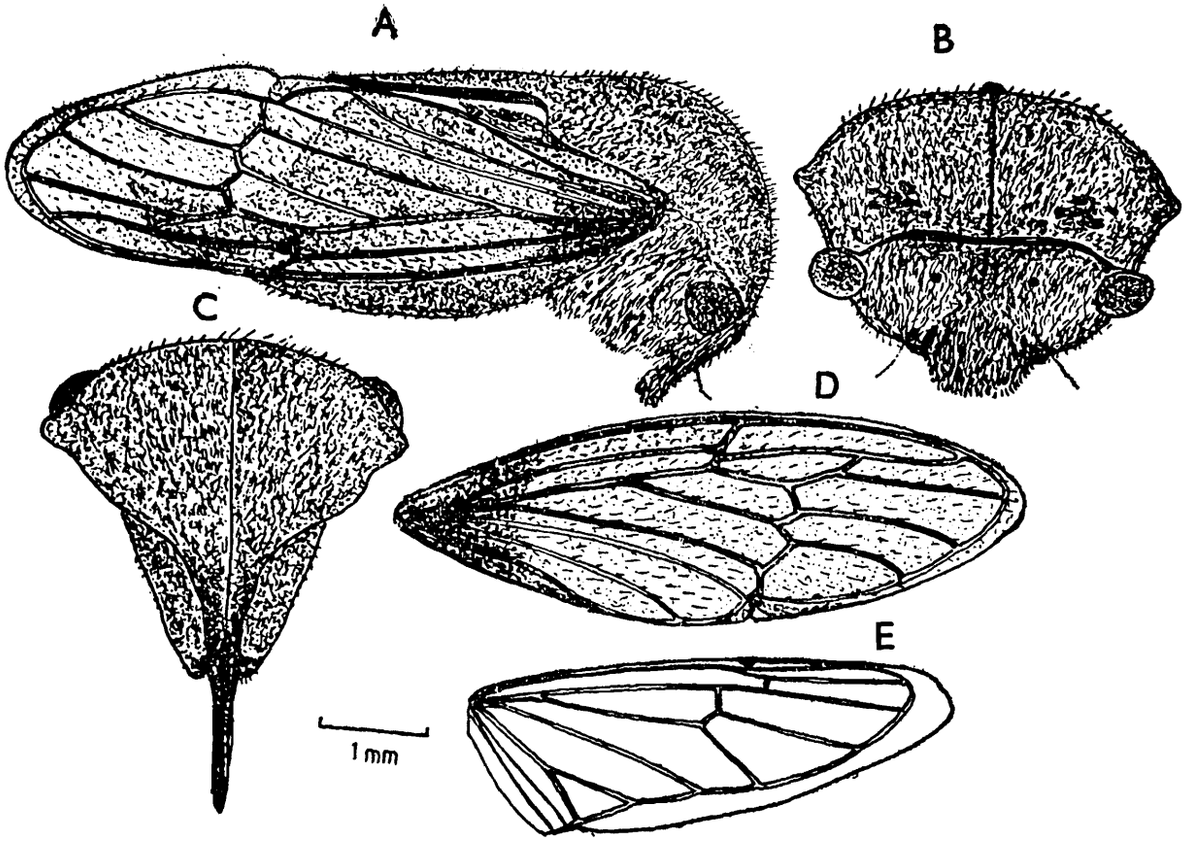


Fig. 3. *Neocentrus rufus* sp. nov.
A. Lateral view of female. B. Frontal view. C. Dorsal view of Pronotum. D. Tegmina of female. E. Hind wing.

4. Tricentrus congestus (Walker) 1870.

One female, from Kumattamthodu, Silent Valley, Kerala, altitude 880 metres ; collected by *Dr. R. S. Pillai and party*, 22.lv.1980. Reg. No. zsi/srs I/H.

5. Tricentrus purpureus Ananthasubramanian and Ananthakrishnan 1975.

Two females, from Kumattamthodu, Silent Valley, Kerala, altitude 900 metres, collected by R. S. Pillai and party, 30.iv.1980. Reg. No. zsi/srs I/H.

6. Tricentrus sp.

Two specimens highly damaged, without abdomen and with broken horns, from Kumattamthodu, silent Valley, Kerala, altitude 900 metres, collected by Dr. R. S. Pillai and party, 30.iv.1980. Reg. No. zsi/srs I/H.

7. Tricentrus syrandrikae sp. nov.

(Fig. 4)

Female : General colour black shaded with brown ; head vertical, vertex about 1.6 times wider than long, finely punctate with short adpressed silvery hairs, upper margin strongly arcuate and sinuate, lower margins obliquely curved to frontoclypeus ; eyes subglobate, light brown ; ocelli black, a little closer to eyes than to each other and situated well above the centro-ocular line ; frontoclypeus extending slightly more than half of its length beyond lower margins of vertex and covered with silvery pilosity. Pronotum black, finely punctate with short suberect silvery pilosity, median carina percurrent, metopidium slightly obumbrant and vertical,

more than 2.5 times as wide as high, humeral angles prominent ; suprahumeral horns robust and broadly based, jet black, longer than the distance between their bases, lateral carina inconspicuous, tips sharply acute, viewed from lateral aspects directed upwards and strongly recurved, viewed from front directed obliquely upwards and outwards, pilosity at bases denser ; posterior process emerging behind disc, contiguous with scutellum, basal part reddish brown, terminal part jet black, tip acuminate, reaching a little beyond claval suture, strongly tricarinate ; tegmina pale brown, 3 times as long as wide, basal one-fourth coriaceous, black, a pale white fascia beyond the basal coriaceous area, veins brownish, tip acutely rounded, apical limbus broad, 1st aapical cell about 7 times as long as its greatest width, 1st discoidal cell not petiolate, nearly as long as the 2nd ; lateral aspects of thorax white tomentose ; legs darkbrown upto tibiae, tibiae and tarsi yellowish brown, hind trochanters prominently toothed on the dilated inner surface ; abdomen dark brown with white pubescence, ovipositor pitch black.

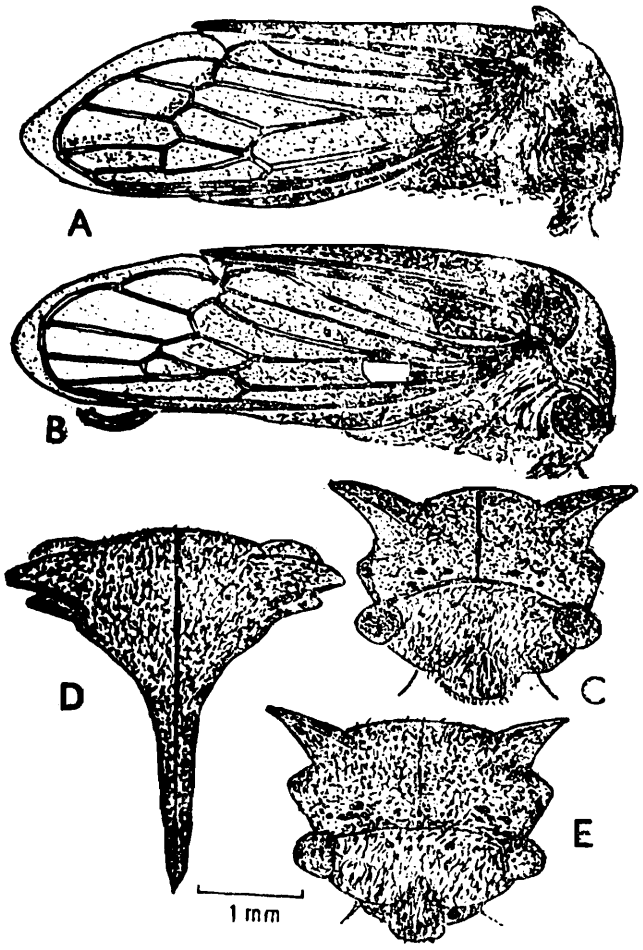


Fig. 4. *Tricentrus syrandrikae* sp. nov.
A. Lateral view of female.
B. Lateral view of male,
C. Frontal view of female.
D. Dorsal view of Pronotum.
E. Frontal view of male.

Measurements : Length from frontal margin to tips of tegmina 5.7 mm., to tip of posterior process 4 mm. ; width across tips of suprahumeral horns 3 mm., at humeral angles 2.4 mm., at eyes 2.4 mm.

Male : Similar to female in general coloration and measurements, but suprahumeral horns less curved and shorter than the distance between their bases ; 1st discoidal cell of tegmina petiolate, and much smaller than the 2nd.

Material examined : Holotype female, paratype male, collected from halfway to Valiyaparathodu, Silent Valley, Kerala, altitude 1005 metres, collected by *Dr. R. S. Pillai and party*, 3.v.1980. Reg. No. zsi/srs I/H.

Remarks : T syrandrikae is closely related to *T fairmarei* Stal in the general size, colouration and in the disposition of the horns and posterior process, but differs in the distinctly shorter suprahumeral horns, and in the marked sexual dimorphism.

Tribe Coccosterphini Goging.

Genus **Parayasa** Distant 1616

Parayasa variegata sp. nov.
(Fig. 5)

Female : General colour ochraceous brown ; head declivous, vertex brownish ochraceous, nearly twice as wide as long, finely punctate with short dense golden hairs, upper margin strongly carinate and arcuate, lower margins obliquely leading to frontoclypeus ; eyes pale reddish brown, oval in frontal view ; ocelli black, not very prominent, nearer to eyes than to each other and situated just on the centro-ocular line ; frontoclypeus light brown, extending to three-fourths of its length beyond lower margins of vertex, long thickly hairy, tip broadly rounded ; pronotum reddish brown, strongly punctate

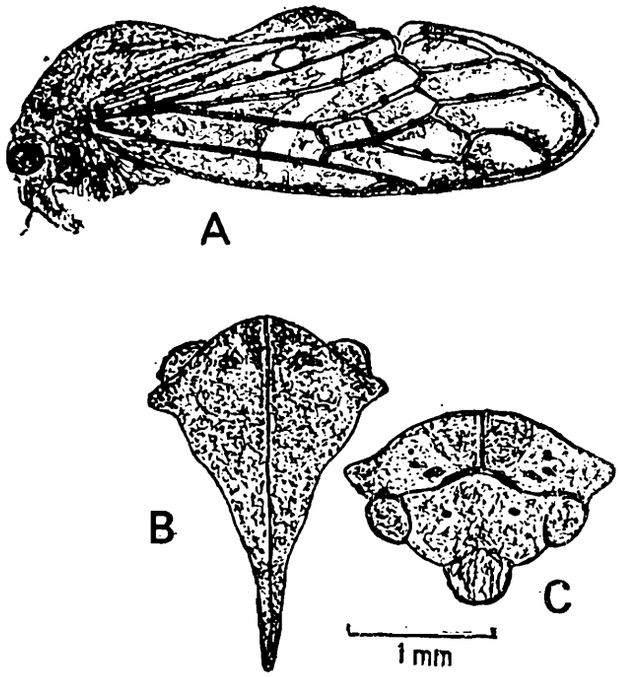


Fig. 5. *Parayasa variegata* sp. nov.
A. Lateral view of female.
B. Dorsal view of pronotum,
C. Frontal view.

with short adpressed golden pilosity, metopidium about thrice as wide as high, strongly obliquely directed to disc which shows a pair of broad carinate areas of reddish brown colour, supraocular callosities black, divided, humeral angles prominent ; posterior process concavely sinuate, slightly convex gibbous at apex which is black and does not reach the posterior angle of the inner tegminal margin, dorsal carina strongly percurrent to metopidium ; lateral aspects of thorax brownish with shades of black, thickly pilose ; tegmina thrice as long as wide, pale ochraceous, basal sixth black, coriaceous, a transparent fascia at about the middle and another obliquely transverse fascia at about two-third distance from base, rest palely virescent, a distinct brown patch extending into the 5th apical cell near to claval suture, veins ochraceous with tubercles at intervals, an incipient pterostigma partly absorbing R1, first apical cell 5.5 times as long as its greatest width, first discoidal cell large, elliptical, 2nd discoidal cell divided by a transverse vein, R4+5 strongly curved, apical limbus narrow ; abdomen black, reaching about the tip of tegmina ; legs brownish ochraceous, tibiae light brown, hind tibiae a little curved.

Measurements : Length from frontal margin to tips of tegmina 4 mm., to tip of posterior process 2.4 mm., width across tips of humeral angles 1.8 mm., at eyes 1.5 mm.

Male unknown.

Material examined : Holotype female, one paratype female, collected from halfway to Valiyaparathodu, Silent Valley, Kerala, 1,005 metres elevation, collected by *Dr. R. S. Pillai and party*, 2.v.1980. Reg. No. zsi/srs I/H.

Remarks : This species is closely related to *P. elegantula* Distant and *P. affixa* Distant in the general colouration, length and in the disposition of the posterior process, but it differs from *P. elegantula* in the absence of an incipient pterostigma, and from *P. affixa* in the nature of the frontoclypeus and in the oblique backwardly directed metopidium.

All the type-materials are deposited in Zoological Survey of India, Southern Regional Station, Madras. They will be in due

course transferred to National Collections of Zoological Survey of India, Calcutta.

ACKNOWLEDGEMENTS

We are grateful to Dr. R. S. Pillai, Deputy Director, Zoological Survey of India, Southern Regional Station, Madras for his interest in this study and one of us (G. T) thanks the Director, Zoological Survey of India, Calcutta and The Deputy Director, Zoological Survey of India, Southern Regional Station, Madras for the facilities provided.

REFERENCES

AHMAD, I., and YASMEEN, N. (1974). A new tribe of the snb-family Centrotinae Amyot & Serville (Homoptera : Membracidae). *Mitt. Hamburg. Zool. Mus. Inst.*, **71** : 175-191.

ANANTHASUBRAMANIAN, K. S., and ANANATHAKRISHNAN, T. N. 1975. Taxonomic, Biological and eccological studies of some Indian Membracidae (Insecta : Homoptera). Pt. 1. *Rec. zool. Surv. India*, **68** : 161-272.

ANANTHASUBRAMANIAN, K. S. 1980. Taxonomic studies on Indian Membracidae (Insecta : Homoptera). *Entomon.*, **5**(2) : 113-129.

CAPENER, A. L.. 1968. The Taxonomy of the African Membracidae, Part 2, The Centrotinae. *Repub. S. Afr. Depl. Agr. Tech. Serv. Ent, Mem.*, **17** : 1-123.

DISTANT, W. L.. 1908. *The Fauna of British India including Ceylon and Burma, Rhynchota, Homoptera*, **4** : 1-78.

DISTANT, W. L., 1916. *The Fauna of British India including Ceylon and Burma*, Rhynchota, Homoptera, *Appendix*, **6** : 146-182.

STAL, C. 1866, *Hemiptera Africana*, **4** : 1-276.

WALKER, F., 1858. *Homoptera, Insecta Saundersiana or Characters of undescribed insects in the collection of William Wilson Saunders*, P. 79.

Bull. zool. Surv. India, 4(1) : 37—39, 1981

A NEW SPECIES OF THE GENUS *PARALONGIDORUS* (LONGIDORIDAE : NEMATODA)

QAISER H. BAQRI

Zoological Survey of India, Calcutta

AND

M. SHAMIM JAIRAJPURI

Section of Nematology, Department of Zoology, Aligarh Muslim University, Aligarh (U. P.)

ABSTRACT

A new species of the genus *Paralongidorus*, *P. distinctus*, belonging to the family Longidoridae (Nematoda) is being described from Rohtang Pase, district Kulu, Himachal Pradesh. *Paralongidorus distinctus* n. sp. is characterized by having 7.35 mm long body, odontostyle 161 µm, odontophore 86 µm, guiding ring 45 µm from anterior end and tail less than one anal body-width long.

INTRODUCTION

The present paper reports a new species of plant parasitic nematode, *Paralongidorus distinctus* n. sp. collected from Rohtang Pass, Kulu, Himachal Pradesh, India. The type locality is situated at an altitude of 14,000 ft. and remains under snow during the major part of the year.

MATERIAL AND METHODS

Collected by the second author in October, 1970 ; fixed in hot 4% formalin and mounted on slide H. A. 5/*Paralongidorus distinctus*/1, juveniles on slides H. A. 5/*Paralongidorus distinctus*/2-3 ; deposited with the Museum of Department of Zoology, Aligarh Muslim University, Aligarh (U. P.).

Paralongidorus distinctus n. sp.

Measurements :

Female (*Holotype*) : L=7.35 mm ; a=86 ; b=11.6 ; c=223 ; $V=^{10.7}48^{9.6}$.

Juveniles (3) : L=1.71—3.33 mm ; a=49—72 ; b=5.1—7.0 ; c=43—77 ; odontostyle=82—111 µm ; odontophore=40—66 µm ; guiding ring from anterior end=24—34 µm.

Description : Body ventrally curved in posterior two-thirds of its length, tapering slightly towards extremities. Cuticle smooth except at tail end where it is marked with fine transverse striations. The thickness of the cuticle varies from 4-10 µm on different partl of body (6 µm at head end and 10 µm on tai

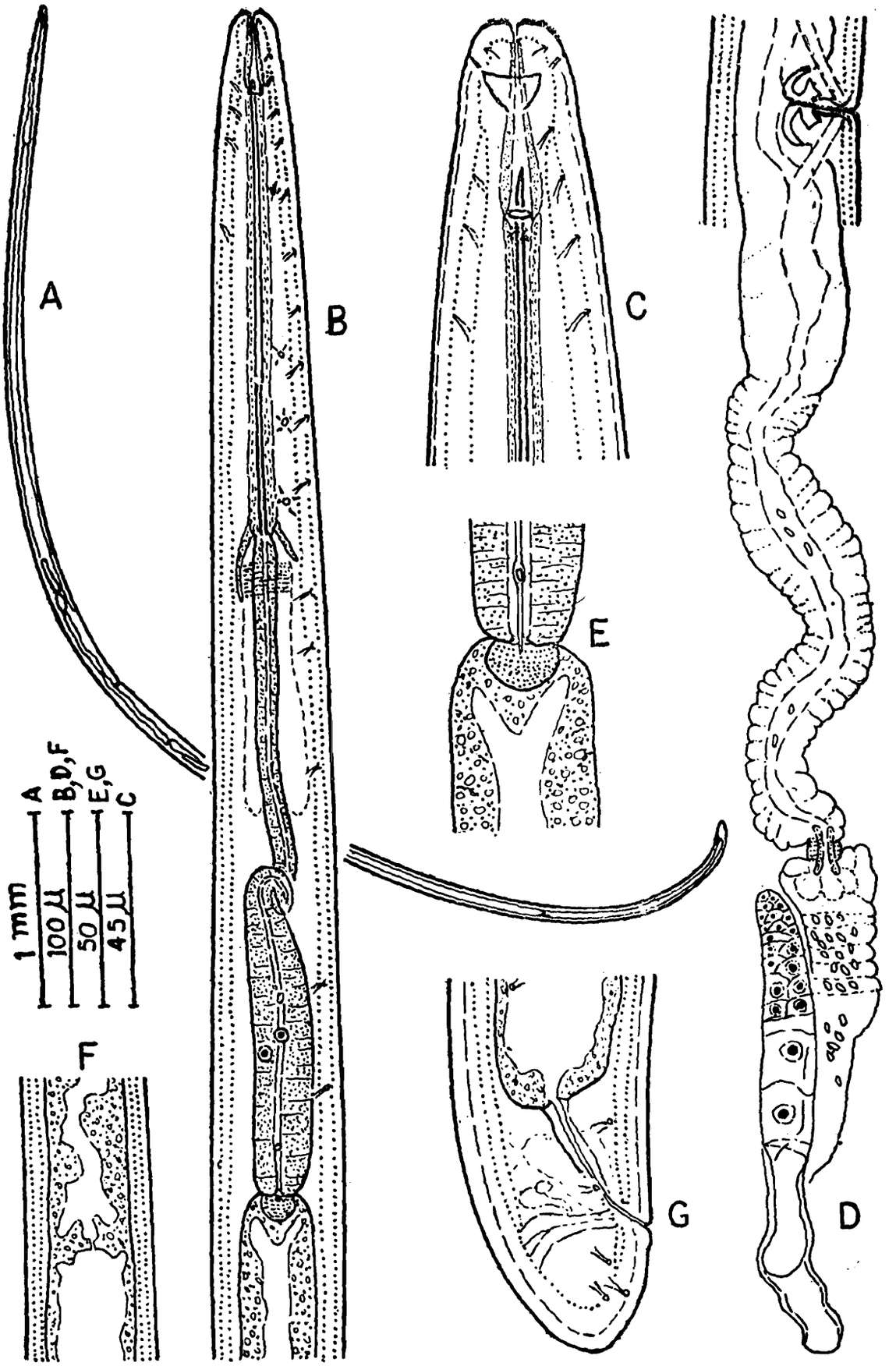


Fig. 1. *Paralongidorus distinctus* n. sp. A=Female entire, B=Oesophageal region, C=Head end, D=Posterior gound, E=Cardia region, F=Intestine prerectum junction, G=Tail.

tip). Lateral chords about ¼th of body-width near middle. Lateral body pores inconspicuous except at anterior and posterior ends. Dorsal body pores 4, situated in the odontostyle region ; ventral body pores 15 restricted to oesophageal region.

Lip region continuous with body, subtruncate. A slight depression is present at level of base of amphidial pouch. Amphids stirrup-shaped with slit-like apertures, 12 µm from anterior end and occupy about half of corresponding body-width. Sensillar pouches not seen. Odontostyle 161 µm or 6.5 lip region-widths long. Guiding ring 45 µm or 1.8 lip region-widths from anterior end of body. Odontophore 86 µm or slightly more than half of odontostyle length.

Basal expanded portion of oesophagus about 25% of oesophageal region. The oesophageal gland nuclei and their orifices are situated as below :

$DO = 74.9$ $S_1N_1 = 86{\cdot}6$ $S_2O = 96$

$DN = 75.7$ $S_1N_2 = 89.7$

$DO - DN = 0.8$

Nerve ring surrounds the anterior slender part of aesophagus at 302 µm or 47% of oesophageal region from anterior end of body. Cardia semi-conoid, enveloped by intestinal tissue. Prerectum 1.11 mm long or about 25 times the anal body-widths.

Vulva transverse. Vagina 42 µm or about half the corresponding body-width. Gonads amphidelphic. Uterus and oviduct separated by a well developed sphincter. Ovary reflexed ; oocytes arranged first in a single row, then in double row and at the tip in multiple rows. Sperms present in oviduct.

Tail obtusely rounded, 33 µm or about 0.7 anal body-width long with 3 caudal pores on each side.

Male : Not found.

Habitat : Soil around the grasses (unidentified) from Rohtang Pass, district Kulu, H. P.

Differential diagnosis : Paralongidorus distinctus n. sp., comes close to *Paralongidorus strelitzae* (Heyns, 1966) Aboul-Eid, 1970 but differs in having longer odontostyle (odontostyle 117-131 µm in *P. strelitzae*), anteriorly situated guiding ring (55-65 µm from anterior end in *P. strelitzae*), longer prerectum (three times the corresponding body-width in *P. strelitzae*), inconspicuous lateral body pores, and shorter and differently shaped tail (c= 148-161 in *P. strelitzae*).

ACKNOWLEDGEMENT

The authors are thankful to the Director of Zoological Survey of India, Calcutta, and Prof. S. Mashhood Alam, Head of the Zoology Department, Aligarh Muslim University, Aligarh, for providing the research facilities in their respective departments.

REFERENCE

HEYNS, J. 1966. Furthur studies on South African Longidoridae (Nematoda). *S. Afr. J. Agric. Sci.*, **2** : 927-944.

Bull. zool. Surv. India, 4(1) : 41-46, 1981

SPECIES OF THE SUBGENERA *PARAPHYTOSEIUS* AND *ASPEROSEIUS* FROM INDIA, WITH DESCRIPTION OF A NEW SPECIES OF *PARAPHYTOSEIUS*

S. K. GUPTA AND SABITA RAY*

Zoological Survey of India, Calcutta-13

ABSTRACT

The two subgenera, *Paraphytoseius* and *Asperoseius* are diagonised. One new species under former subgenus is described. *Amblyseius* (*P.*) *multidentatus* Swirski & Shechter is reported as new from India. Keys to all the Indian species under both subgenera are given.

INTRODUCTION

Swirski and Shechter (1961) erected the genus *Paraphytoseius* with *Paraphytoseius multidentatas* Swirski and Shechter as its type. But Chant (1965) synonymised it with *Amblyseius* Berlese, as like *Amblyseius*, the species of *Paraphytoseius* also possess four pairs of prolateral setae. However, Gupta (1979) re-established *Paraphytoseius* on the ground that the species of this genus exhibits some unique characters like : 1. dorsal shield leaves some portion of dorsum uncovered, 2. usually deep notch present at the level of s4, 3. a conspicuous pore present associated with z5 and 4. setae j1, j3, Z4, Z5 normally long, thick and serrate. These characters are not universally met with in the species of the genus *Amblyseius*. He recognised under the genus *Paraphytoseius* two subgenera, *viz. Paraphytoseius s. str.* having setae z2 and z4 smooth and S2 absent, while the subgenus *Tropicoseius*, which he proposed as new, having setae z2 and z4 serrate and S2 present. The latter subgenus was proposed to accommodate a species *P.* (*T.*) *nucifera* which was described as new. However, he was unaware of *Asperoseius* used as subgenus by Ehara and Bhandhufalck (1977) having similar characters as shown in *Tropicoseius* and therefore, realising the mistake he transferred *nucifera* from *Paraphytoseius* (*Tropicoseius*) to *Amblyseius* (*Asperoseius*) in one of his later papers (Gupta, 1979a). In that paper he stressed the need to follow the generic concepts of Chant (1965) as that gives the idea that mites of the family Phytoseiidae are of generalised characters which is in contrary to the idea of another school of thoughts who considered the generalised forms as supra generic categories and favoured to divide the family into a number of genera basing upon trivial minor characters. However, to make it easier to key out the species, he favoured to divide the genera into subgenera basing upon those characters which the other school of thoughts considered to be of generic importance. Accordingly, he recognised 9 subgenera under *Amblyseius* which included the subgenera *Paraphytoseius* and *Asperoseius*.

Now, it may be noted that the two subgenera are separated by two characters, *viz.* 1. setae z2 and z4 being serrate in *Aspero-*

* Present address : M. B. B. College, Tripura.

seius (smooth in *Paraphytoseius*) and seta S2 present in *Asperoseius* (absent in *Paraphytoseius*). But the first mentioned character does not appear to be a stable one as in one of the species, waich is described here as new under subgenus *Paraphytoseius*, possesses z2 and z4 serrate. Though at this stage it is not wise to merge the two subgenera because of inadequacy of our knowledge but in the long run it may be required to do so when more species under these two subgenera will be studied.

So far from Indiá, 4 species under subgenus *Paraphytoseius* and 1 under subgenus *Asperoseius* are in record. All those species are treated in this paper giving their brief descriptions and illustra'ions to help the future workers in easy identifictations. One of the 4 species under *Paraphyeoseius* is indicated here as misidentification. Bsides, one more species of subgenus *Paraphytoseius* is described here as new and another is recorded here for the first time from India. With these, the total number of species from India under the two subgenera comes to 5 under *Paraphytoseius* and 1 under *Asperoseius*. Key to subgenera and to all the known species under the two subgenera is given.

Type of the new species is deposited in the collection of the Zoological Survey of India, Calcutta. Setal nomenclature as of Rowell *et al.*, (1978) is followed here. The measurements in text are in microns.

Key to the subgenera and species of *Paraphytoseius and Asperoseius*.

1.	Dorsal shield with 13 or 14 pairs of setae, z2 and z4 normally smooth (except iu the new species described here), S2 absent, metapodal plates single paired.....Subgenus : *Parephyloseius*	2
	—Dorsal shield with 14 pairs of setae. z2 and z4 serrate, S2 always present, metapodal plates 2 paired.....Subgenus *Asperoseius* (*A.*) *nucifera*	
2.	Dorsal shield deeply notched at the level of s4....	4
	—Dorsal shield not notched at the level of s4.....	3
3.	Ventrianal shield constricted at the level of 3rd pair of preanal setae.....	*A (Paraphytoseius) nicobarensis*
	—Ventrianal shield not constricted as above..	*A. (P.) narayanani*
4.	S5 present.	5
	— S5 absent.	*A. (P.) bhadrakaliensis*
5.	z2 and z4 serrate. ..	*A.(P) sclerotícus* sp. nov
	—z2 and z4 smooth.	*A. (P.) multidentatus*

Amblyseius (Paraphytoseius) scleroticus

sp. nov. (Fig. 1)

Female : Dorsal shield reticulate, 260 long, 135 wide, with 14 pairs of setae. Setae jl, j3, z4, Z4, Z5, r3 being long, thick and serrate, setae z2 and R1 also serrate ; 4 pairs of pores present on dorsal shield, of those, the pair associated with z5 being largest. Measurements of setae : jl-25, j4-j6-8 each, J5-4, j3-56, z2-11, z4-20, s4-69, Z1-9, S5-11, Z5-69, z5-7, Z4-45, r3-20, R1-16. Sternal shield smooth, 90 long, 72 wide, with 3 pairs of long sternal setae. Genital shield 69 wide. Ventrianal shield 90 long, 50 wide with 3 pairs of preanal setae on one side and with 2 pairs on another side, para and post anal setae present as usual ; 4 pairs of setae present around ventrianal shield, JV5 56 long. Metapodal plates single paired. Chelicera not possible to examine because of position of the specimen. Spermatheca as figured. Macrosetae on long IV : genu-15, tibia-29, basitarsus-34 and distitarsus-34—all being with knobbed tip.

Male : Unknown.

Material : Holotype ♀, (ZSI Reg. No. 3176/17) INDIA : Uttar Pradesh, Barkot, 3. ix. 1979, ex undetermined host (coll. *S. K. Gupta*.

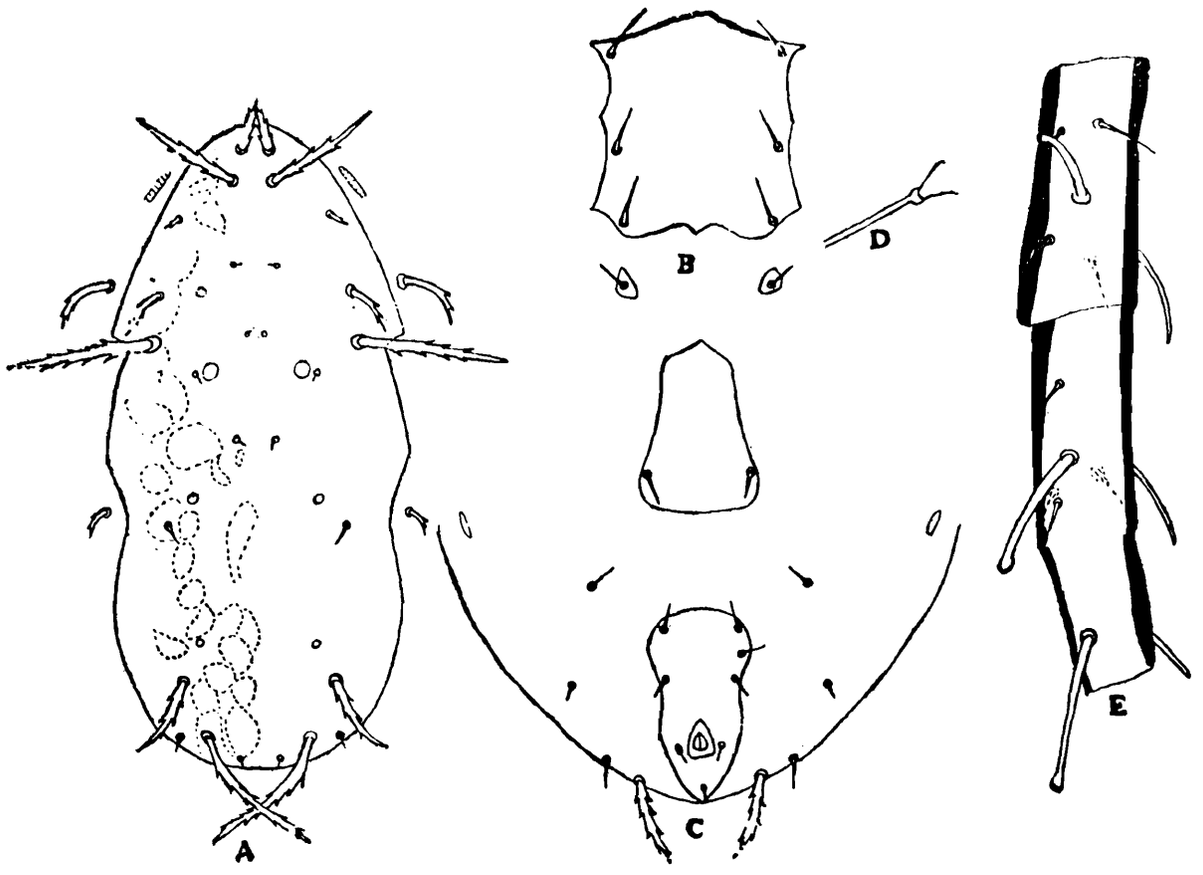


Fig. 1 (A—E) : *Amblyseius (Paraphytoseius) scleroticus* sp. nov. (♀) ; A—dorsal shield, B—sternal shield, C—posterior ventral surface, D— spermatheca, E—leg IV.

Remarks : This species is easily separated from other related species by having setae z2 and z4 serrate, by relative length of Z4 and Z5 and by shape of ventrianal shield and spermatheca.

Amblyseius (Paraphytoseius) multidentatus Swirski and Schechter (Fig. 2)

Paraphytoseius multidentatus Swirski and Shechter, 1961, *Israel J. agric. Res.* **11** : 114—116

Female : Dorsal shield smooth, elongate, deeply notched at the level of s4, 300 long, 150 wide with 14 pairs of setae. Setae j1, j3, s4, Z5, Z4 being long, thick and serrate measuring respectively, 30, 88. 120, 130, and 70. Seta S5-7 long. Sternal shield 90 long, 78 wide with 3 pairs of long sternal setae. Genital shield 90 wide. Ventrianal shield 90 long, 55 wide with 3 pairs of preanal setae, a pair of paraanal and a postanal seta also present., 4 pairs of setae present around ventrianal shield, JV5-24 long. Peritreme extends anteriorly upto j1. Spermatheca as figured. Fixed digit of chelicera multidentate and a strong pilus dentilis, movable with 3 teeth. Macrosetae on leg IV : genu 22, tibia 35, basitarsus-45 and distitarsus-50 long. Leg chaetotactic formula : genu II $\frac{2\ 1}{0\ 0}$—2, tibia II $\frac{1\ 2}{1\ 0}$—1, genu III $\frac{1\ 2}{2\ 0}$—1, tibia III $\frac{2\ 2}{1\ 1}$—0, $\frac{1\ 2}{2\ 0}$—0

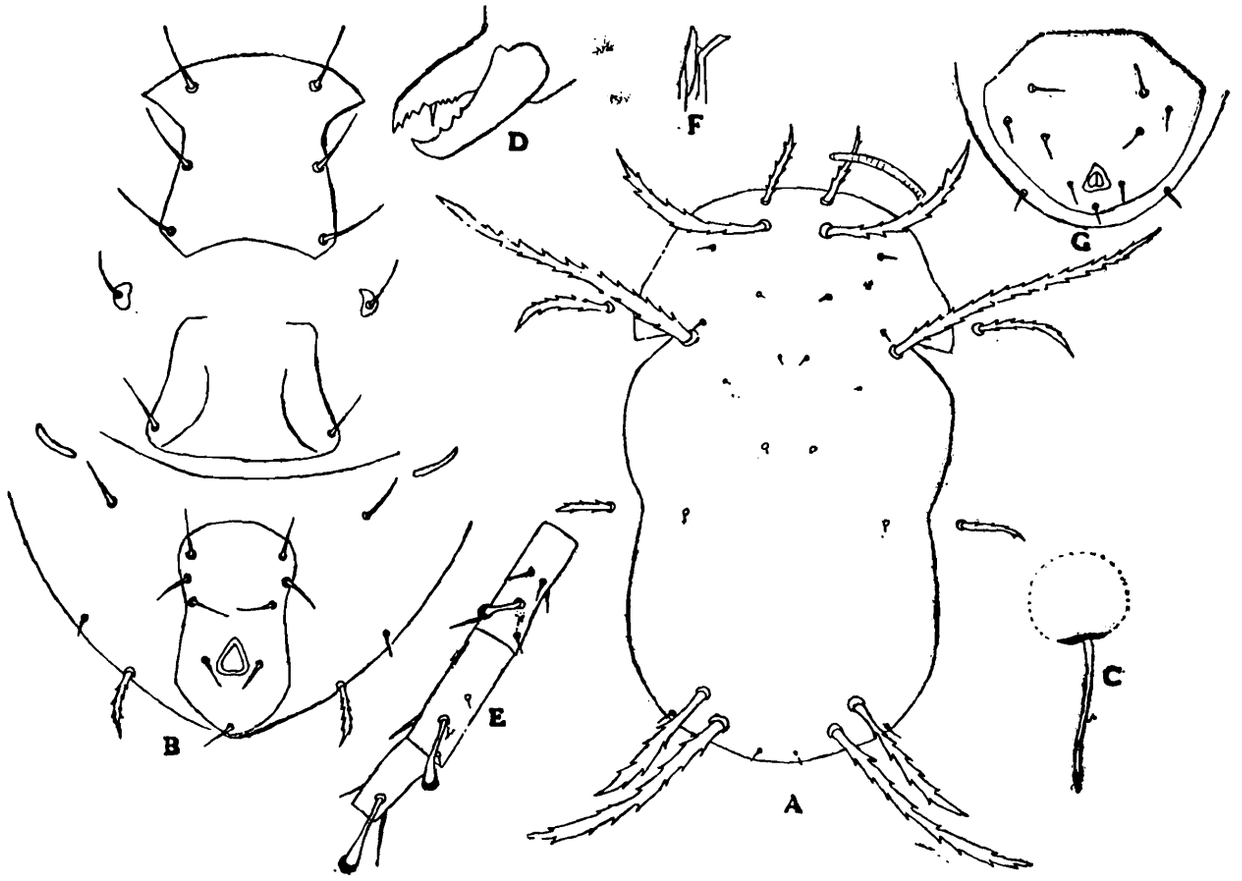


Fig. 2 (A—E): *Amblyseius* (*Paraphytoseius*) *multidentatus* Swirski and Shechter (♀) ; A—dorsal shield, B—ventral surface, C—spermatheca, D—chelicera, E—leg IV.
(F—G) : *A* (*P. multidentatus* (♂) ; F—spermatophoral process, G—ventrianal shield.

Male : Spermatophoral process and ventrianal shield as figured.

Material : 2 ♀♀, 1 ♂, Tripura, Fatikray, 18. x. 1979, ex *Eupatorium odoratum* (Coll. *S. Ray*). (ZSI Reg. No. 3179/17)

Remarks : This species is known from Hong-Kong and Malagasy (Ehara and Bhandhufalck, 1977). It agrees well with the original description of Swirski and Shechter (1961) but differs in respect of JV5 which is relatively smaller and Z5 longer in these specimens. This species was hitherto unrecorded from India.

Amblyseius (Paraphytoseius) narayanani

Ehara and Ghai (Fig. 3, A—B)

Typhlodromus (*Amblyseius*) *orientalis* Narayanan, Kaur and Ghai, 1960, *Proc. natn. Inst. Sci. India.*, **26** (B) : 394.

Amblyseius (*Paraphytoseius*) *narayanani*. Ehara and Ghai, Mushi, **40**(6) : 77.

Female : Dorsal shield with 13 pairs of seate of those, j1, j3, s4, Z5, Z4 being long, thick and serrate measuring respectively, 35, 107, 143, 118 and 78 ; other setae being minute. A large pore present associated with z5. Notch absent at the level of s4. Ventrianal shield elongated, triangular with 3 pairs of preanal setae. Fixed digit of chelicera multidentate, movable digit with 2 teeth. Spermatheca as figured. Leg IV with macrosetae on genu, tibia and basitarsus—all being spatulate.

Male : Spermatophoral process as figured.

Distribution : India : Maharastra.

Amblyseius (Paraphytoseius) bhadrakaliensis Gupta (Fig. 3, C—D)

Amblyseius bhadrakaliensis Gupta, 1969. *Bull. Ent.* **10** (2) : 127-128.

Female : Dorsal shield with 13 pairs of setae, notched at the level of s4, Setae j1, j3, s4, Z5, Z4, being long, thick and serrate measuring 34, 90, 117, 105, and 76, respectively ; other setae being small. Ventrianal shield 94 long, 68 wide with 3 pairs of preanal setae, JV5-80 long. Fixed digit of chelicera multidentate, movable digit with 2 teeth. Spermatheca as figured. Leg IV with macrosetae on genu-22, tibia-31, basitarsus-36 and distitarsus-40. Leg chaetatactic formula :

$$\text{genu II } \begin{matrix} 2 & 1 \\ 2— & —1, \\ 0 & 0 \end{matrix} \quad \text{genu III } \begin{matrix} 2 & 2 \\ 1— & —1, \\ 1 & 0 \end{matrix}$$

$$\text{tibia II } \begin{matrix} 1 & 2 \\ 1— & —1, \\ 1 & 1 \end{matrix} \quad \text{tibia III } \begin{matrix} 1 & 2 \\ 1— & —1. \\ 1 & 1 \end{matrix}$$

Male : Spermatophoral process as figured.

Distribution : India : West Bengal, Tamil Nadu, Karnatakea, Andhra Pradesh, Tripura (new record), Punjab, Andaman Isl., Jummu and Kashmir, Bihar.

The report of *Amblyseius horrifer.* Pritchard and Baker (Gupta, 1970) appears to be a case of misidentification and the species is same as *A* (*P.*) *bhadrakaliensis* Gupta.

Amblyseius (Paraphytoseius) nicobarensis Gupta (Fig. 3, E—F)

Amblyseius nicobarensis Gupta, 1977, *Orintal Ins.* **11** (4) : 631-632.

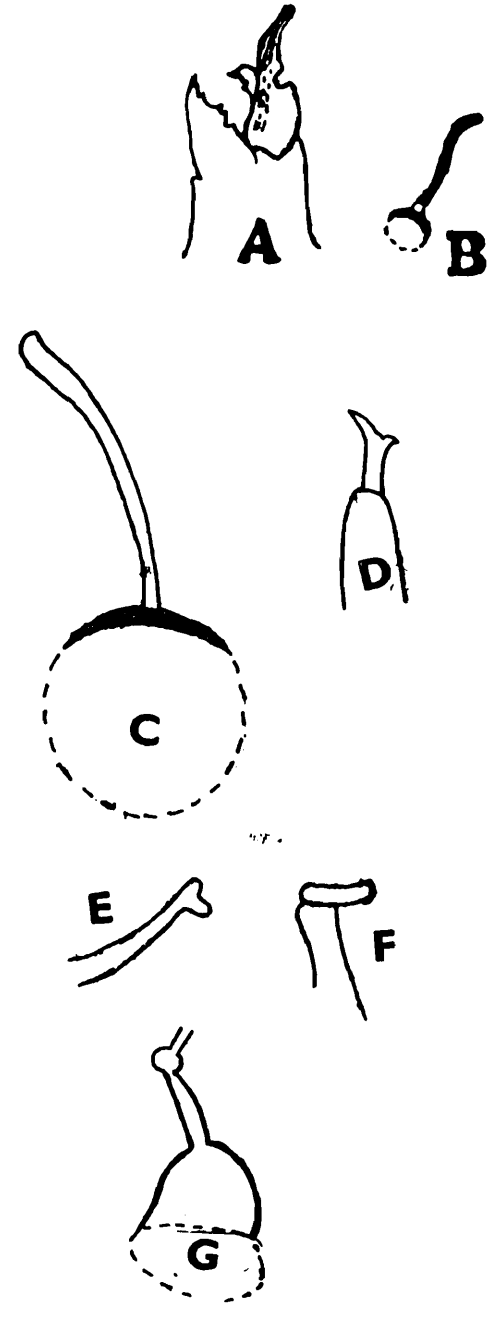


Fig. 3 (A—B) : *Amblyseius* (*Paraphytoseius*) *narayanani* Ehara and Ghai : A—spermatheca. B—spermatophoral process :

(C—D) : *Amblyseias* (*Paraphytoseius*) *bhadrakaliensis* Gupta : C—spermatheca, D—spermatophoral process.

(E—F) : *Amblyseius* (*Paraphytoseius*) *nicobarensis* Gupta : E—spermatheca, F—spermatophoral Process.

(G) : *Amblyseius* (*Asperoseius*) *nucifera* (Gupta). G—spermatheca.

Female : Dorsal shield 282 long, 184 wide with 13 pairs of setae. Setae j1, j3, s4, Z5, Z5, Z1 and r3 long, thick and weakly serrate and situated on protuberance, other setae being small. Measurements of setae : j1-32, j3-80, s4-100, Z5-85, Z4-60, Z1-32, r3-32. Ventrianal shield 84 long, 56 wide, 3 pairs of setae present around ventrianal shield, JV5 56 long. Spermatheca as figured. Fixed digit of chelicera multidentate, movable digit tridentate, Macrosetae on leg IV : genu-26, tibia-36, and basitarsus-42, all being spatulate.

Male : Spermatophoral process as figured.

Distribution : India : Car Nicobar.

Amblyseius (Asperoseius) nucifera (Gupta)

(Fig. 3, G)

Paraphytoseius (*Tropicoseius*) *nucifera* Gupta, 1979. *Bull. zool. Surv. India*, **2** (1) : 80-81.

Female : Dorsal shield 305 long, 165 wide, deeply notched at the level of s4. Measurements of setae : j1-28, j3-68, z2-16, z4-32, s4-80, Z5-76, Z4-68, S2-40, r3-56, R1-28. Sternal shield as long as wide (80), metasternal plate triangular with seta. Genital shield wider than greatest width of ventrianal shield. Ventrianal shield smooth, 80 long, 60 wide with 3 pairs of preanal setae, 3 pairs of setae present around ventrianal shield, JV5-28 long, 2 pairs of metapodal plates present. Fixed digit of chelicera multidentate. Spermatheca as figured. Macrosetae on leg IV : genu-44, tibia-36, basitarsus-64 and distitarsus-40.

Male : unknown.

Distribution : India : Kerala.

Remarks : This species was originally put under the genus *Paraphytoseius*.

ACKNOWLEDGEMENTS

The authors express grateful thanks to the Director, Zoological Survey of India, Calcutta, for the facilities. The junior author is also thankful to the Principal, M. B. B. College, Agartala, for encouragements and to the authorities of the University Grants Commission, New Delhi, for the financial help offered to her.

REFERENCES

CHANT, D. A. 1965. Generic concepts in the family Phytoseiidae (Acarina : Mesostigmata). *Can. Ent.*, **97** : 351-374.

GUPTA, S. K. 1970. Preliminary note on plant mites (Acarina) from West Bengal. *Sci. & Cult.*, **36** : 98-99.

GUPTA, S. K. 1979. The genus *Paraphytoseius* Swirski and Shechter with a new subgenus and one new species from India. *Bull. zool. Surv. India*, **2** (1) : 79-82.

GUPTA S. K. 1979a. A taxonomic review of oriental Phytoseiidae (Acarina : Mesostigmata). *Workshop Adv. Insect. Taxonomy Manali*, Oct. 9-12, 1979, p. 71 (Abstract).

EHARA, S. AND BHANDHUFALCK, A. 1977. Phytoseiid mites of Thailand (Acarina : Mesostigmata). *J. Fac. Ed. Tottori Univ.*, **27** : 43-82.

ROWELL, H. J., CHANT, D. A. AND HANSELL, R.I.C. 1978. The determination of setal homologies and setal patterns on the dorsal shield in the family Phytoseiidae (Acarina : Mesostigmata). *Can. Ent.*, **110** : 859-876.

SWIRSKI, E. AND SHECHTER, R. 1961. Some Phytoseiid mites (Acarina : Phytoseiidae) of Hong Kong, with description of new genus and seven new species. *Isreal J. agric. Res.* **11** (2) : 97-117.

Bull. zool. Surv. India, 4(1) 47-55, 1981

THE POPULATION AND PRODUCTION ECOLOGY OF THE CYCLOPOID COPEPOD, *MESOCYCLOPS LEUCKARTI* (CLAUS) IN A SMALL POND

RASHID A. KHAN

Zoological Survey of India, Calcutta

ABSTRACT

The population structure, dynamics, biomass and secondary productivity of a cyclopoid copepod, *Mesocyclops leuckarti* (Claus) have been studied in a eutrophic pond and in the laboratory. The species occurred abundantly throughout the year with the dominance of copepodite stages and nauplii always ranking second inspite of high birth rate. The developmental duration, as determined in the field (egg 3, naupliar 11, copepodite 20, adult 33 and total life span 67 days) did not differ much from the laboratory data (egg 3, naupliar 8, copepodite 18, adult 46 and total life span 75 days). Maximum growth of active instars took place at copepodite I. Reproductive activity, as determind by size of the breeding population, egg stock, clutch size and population birth rate, was continuously high throughout the year and four generations, spread over the entire year, could be detected. Reproduction and development did not appear to be affected by any of the prevailing environmental factors in the pond which revealed the high adaptibility of the species.

Mean daily biomass and daily production were also high throughout the year and mean values were 61.6 mg dw/m^3 and 4·775 mg dw/m^3 -day for biomass and production respectively, Mean daily P/B ratio fluctuated between 0·037 and 0·102 with a mean of 0.062.

INTRODUCTION

Inspite of the fact that researches on dynamics of zooplankton have long been shifted from merely descriptive study of their numerical fluctuations with seasons or their simple relationship with some physicochemical factors of the environment, to the exact structure and dynamics of the population of each species and its contribution to the production and energy flow to the ecosystem abroad, in India researches are still in preliminary stages. This has necessitated the detailed study of the population and production ecology of various zooplankton species in our tropical freshwaters, which differ markedly from temperate waters in several aspects. The present work has been carried out in a typical small pond of Calcutta in eastern India in order to work out in detail, the developmental duration, annual cycle, structure of population, reproductive activity, biomass and secondary productivity of a cyclopoid copepod *Mesocyclops leuckarti* (Claus). Laboratory studies were also carried out on instar duration, growth and fecundity.

Mesocyclops leuckarti is a cosmopolitan freshwater copepod species distributed widely throughout the world. Inspite of differences

in salinity, temperature and associated organisms in waterbodies of different regions, this species seems to be well established over a very large part of its range indicating its high adaptibility (Hutchinson 1961, Gophen 1978b).

Materials and Methods

Studies were carried out in Monohar Das pond of Calcutta, a small highly eutrophic pond already described (Khan 1979). Though studies were carried out for many years, the present report deals with the period November 1976 to October 1977. During November and early December sampling was done at alternate days in order to trace the development of various instars, and thereafter at fortnightly intervals. Zooplankton were collected by filtering 100 litre of water through a standard plankton net made of No. 21 cloth from 3 different centres of the pond. Samples of all the three centres were mixed together so as to obtain only one sample for particular sampling day and screened through several cloths of varying mesh sizes in order to facilitate species or sizewise separation. Samples were preserved in 4% formalin. In laboratory, samples were appropriately diluted and several 1 ml. sub-samples were examined under a binocular with varying magnifications. Identification and enumeration of total zooplankton and separation of each of the *Mesocyclops leuckarti* were done simultaneously. The size of each of stages was measured with the help of an ocular micrometer. Stages were recognised by the appearance and state of development. Since no other cyclopoid was present in sufficient number, When *M. leuckarti* dominated, not much difficulty was encountered. The development and duration of various instars in the field were determined by calculating the time interval between occurrence of peaks of two subsequent stages (Comita 1956). In laboratory pairs of adult *M. leuckarti* were kept in small petridishes containing 50 ml filtered water. Water was filtered so as to remove only crustacean zooplankton and rotifers and protozoan remained. Immediately after their release, eggs were taken out and as soon as first nauplii appeared, they were separated and kept in separate petridishes. Petridishes were examined daily and records of developmental duration of egg and various instars, total life span and fecundity were made. The temperature range in the laboratory was $28\pm3°C$, very close to that found in the pond water for major part of the year.

The size of breeding population was recorded by establishing the ratio of ovigerous female to the total female population, clutch size was established by counting the number of eggs/sacs for atleast 20 animals, egg stock of the population was calculated by multiplying the mean clutch size to mean number of ovigerous females and number of eggs in each clutch were recorded in laboratory and individual fecundity was worked out. Number of clutches produced by females in the pond was recorded indirectly by dividing the number of ovigerous females to egg development time (Chapman 1969). The reproductive rate was determined by calculating the eggs/female/day as suggested by Edmondson *et. al.* (1962) by formula $B=\frac{E}{D}$, where B is population birth rate, egg/♀/day, E is egg ratio observed in population as egg/♀ and D is duration of development. Egg ratio was derived by dividing the number of eggs by total number of ovigerous females.

The mean dry weight ($\overline{W}$) of each individual belonging to various developmental stages was determined by drying at least 300 individuals of the particular stage at 50°C for 2 days and weighing on a microbalance. The mean individual weight ($\overline{W}$) was worked out. All precautions were taken as suggested by Winberg (1971). For biomass and production studies, various instars were grouped in following 7 categories, egg, nauplii I-III, copepodite I—III,

TABLE I—Occurrence of peak, estimated duration, size and weight of various stages of *M. leuckarti* in pond and in laboratory.

Stages	Pond Animals			Laboratory Animals		
	Occurrence of Peak	Duration (days)	Size in mm	Duration (days)	size in mm.	Mean individual dry weight mg$\times 10^{-3}$
Egg	4.11.76	3	0.078	3	0.080	0.026
NI-III	7.11.76	3	0.175	2	0.185	0.055
N-IV	10.11.76	3	0.220	2	0.240	0.082
N-V	13.11.76	2	0.285	2	0.300	0.120
N-VI	15.11-76	3	0.330	2	0.370	0.160
CI	18.11.76	3	0.400	2	0.430	0.290
CII	21.11.76	3	0.522	3	0.580	0.410
CIII	24.11.76	4	0.680	4	0.700	0.540
CIV	28.11.76	6	0.860	5	0.880	0.780
CV ♂	4.12.76	4	1.010	4	1.050	0.930
♀			1.090		1.180	1.600
CVI ♂	8.12.76		1.100		1.160	1.300
♀			1.210		1.250	2.900
(Adults) Subsequent minimum in adult population of pond or period after which lab. animals died.	10.1.77	33		46		
TOTAL LIFE SPAN		67		75		

copopodite IV-V, adult male and female. The daily biomass was obtained by multiplying the number of individuals in each group (N) and mean dry individual weight ($\bar{W}$) of that group and summing up all groups. Daily production was determined by the method of Greze and Baldina (1964) as described by Winberg (1971). Absolute growth increment and specific growth rate (CW) in length and weight were calculated as described by Winberg (1971).

RESULT

Life cycle and instar duration :

Six nauplii and six copepodite stages were recorded in the life history of *M. leuckarti*, in addition to eggs. Sixth copepodites were adults. When studies started on November 4, 1976, adults and copepodite V dominated the pond population along with abundant egg bearing females. Though naupili N I—III started to increase in number but they formed peak on November 7 (The first 3 molts N I-III could not be separated as each of the stages took very short time to develop and therefore have been grouped together). Thereafter successive instar started forming peaks either at 2 or 3 days intervals (Table 1) until copepodite III, which took 4 days and cope-

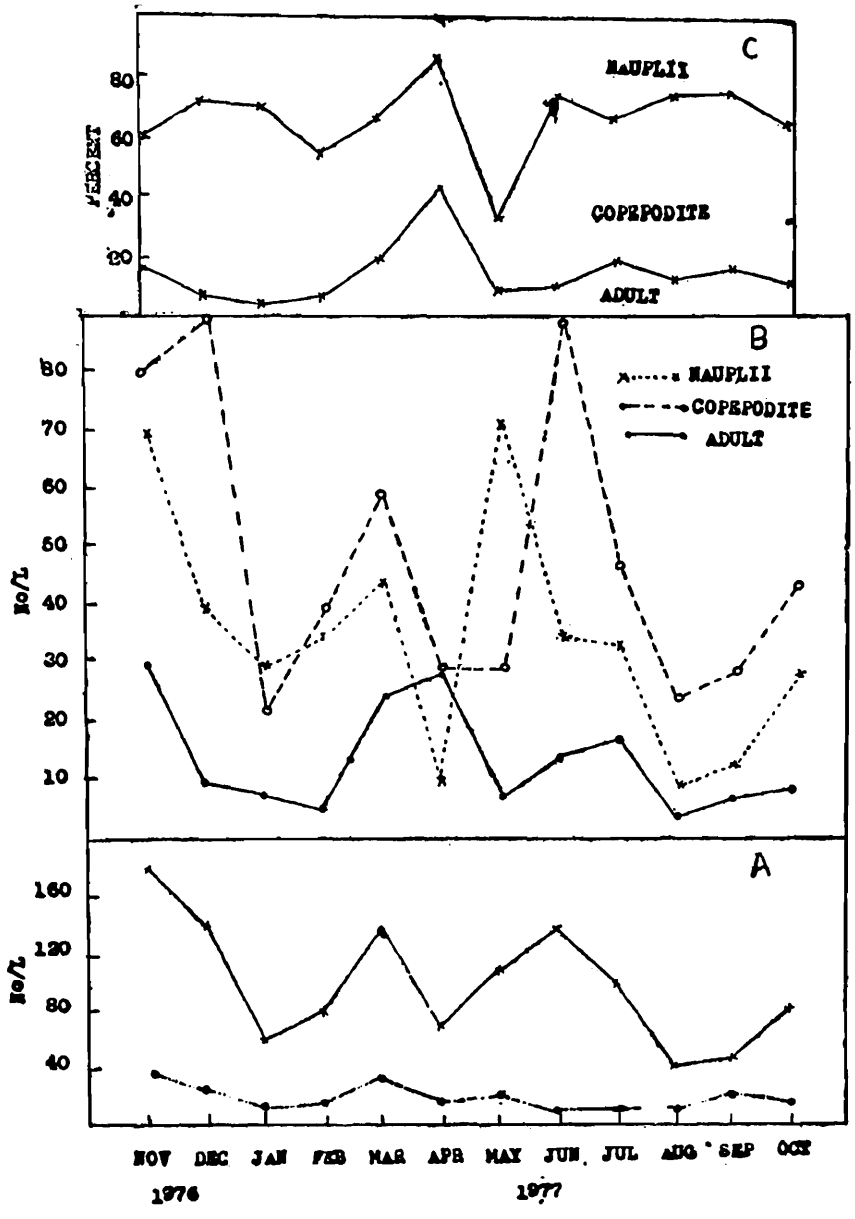


Fig. 1. Seasonal variations in the density of *M. leuckarti* (A) upper curve—Total, (except eggs), lower curve—eggs, (B) Nauplii, Copepodite and Adults (C) percentage composition of nauplii, copepodites and adults.

podite IV which took 6 days. Adults formed peak on December 8. The life of adults was computed indirectly by observing the subsequent minimum in their population which has been assumed to coincide with heavy mortality of the individuals of the aforesaid generation. Such minimum occurred on 10 January 1977 giving total adult duration of 33 days. If the development time of egg is taken as 3 days, as determined in laboratory, the total life span of pond animals (Table 1) is computed to be 67 days (eggs 3, nauplii 11, copepodites 20, adult 33 days). These results were very close to laboratory data (Table 1) where total life span was found to be 75 days (eggs 3, nauplii 8, copedite 18, adults 46 days).

The annual cycle :

Mesocyclops leuckarti were present throughout the year in fairly large numbers. Maximum concentration was found in November

TABLE 2—Absolute and specific growth rate in weight ($mg \times 10^{-3}$) and length of various stages of *M. Leuckarti*

Stages	Dry weight ($mg \times 10^{-3}$)		Length (mm.)	
	Absolute growth increment (dw/dt)	Specific growth rate (1/w w/t)	Absolute growth increment (dl/dt)	Specific growth rate (1/l l/t)
Egg	0.0096	0.3686	0.035	0.4725
NI-N_{III}	0.0090	0.1638	0.015	0.0850
N-IV	0 0126	0.1537	0.021	0.9940
N-V	0.0200	0.1660	0.022	0.0787
N-VI	0.0400	0.2480	0.023	0.0710
C-I	0.0400	0.1360	0.046	0.1120
C-II	0.0400	0.0960	0.043	0.0780
C-III	0.0600	0.1080	0.045	0.0660
C-IV	0.0800	0.1020	0.031	0.0366
C-V	0.0920	0.0980	0.025	0.0247
	0.3250	0.2030	0.030	0.0260

when it was 180/L (all nauplii, copepodites, adults) and minimum in August when it was 49/L (Fig. 1A). Three distinct peaks of total population were recorded first in November, second in March and third in June. Copepodites were found to dominate the population throughout the year with three distinct peaks similar to total population. Nauplii were also in sufficient number throughout the year (Fig. 1B). Copepodite constituted 49.8% of the total population followed by nauplii 35.7% and adults 14.5% (Fig. 1C). The eggs were also present throughout the year and their density ranged from 40/L in November to 6/L in August (Fig. 1A lower graph). When eggs were also included in the total population the percentage composition of eggs ; nauplii., copepodite and adult came to be 13.2%, 30.9%, 43.3% and 12.6% respectively. In every case the contribution of copepodite was highest.

Growth rate :

The absolute growth increment (dw/dt) and specific growth rate (1/W) (dw/dt) in dry weight and length (l) are given in Table 2. Besides eggs, maximum specific growth rate in length was noticed in case of copepodite I (0.1120 mm.). However, the naupliar (I—III) growth rate as a whole was higher than copepodite and adults. The growth rate of adult (CVI) was nearly lowest.

Like length, overall maximum growth in weight occurred in naupliar stages, highest being in nauplii VI (CW, 0.248×10^{-3}mg), excepting eggs. The growth in terms of weight of adult female was extraordinary (0.203×10^{-3} mg) which was due to appearance of eggs sacs. Besides all these, the growth rate, both in length and weight was highest in eggs.

Reproduction :

Active and continuous reproduction took place throughout the year as revealed by the abundance of eggs and ovigerous females during all months. The size of breeding population (ratio of ovigerous females to total population) ranged between 60 in November

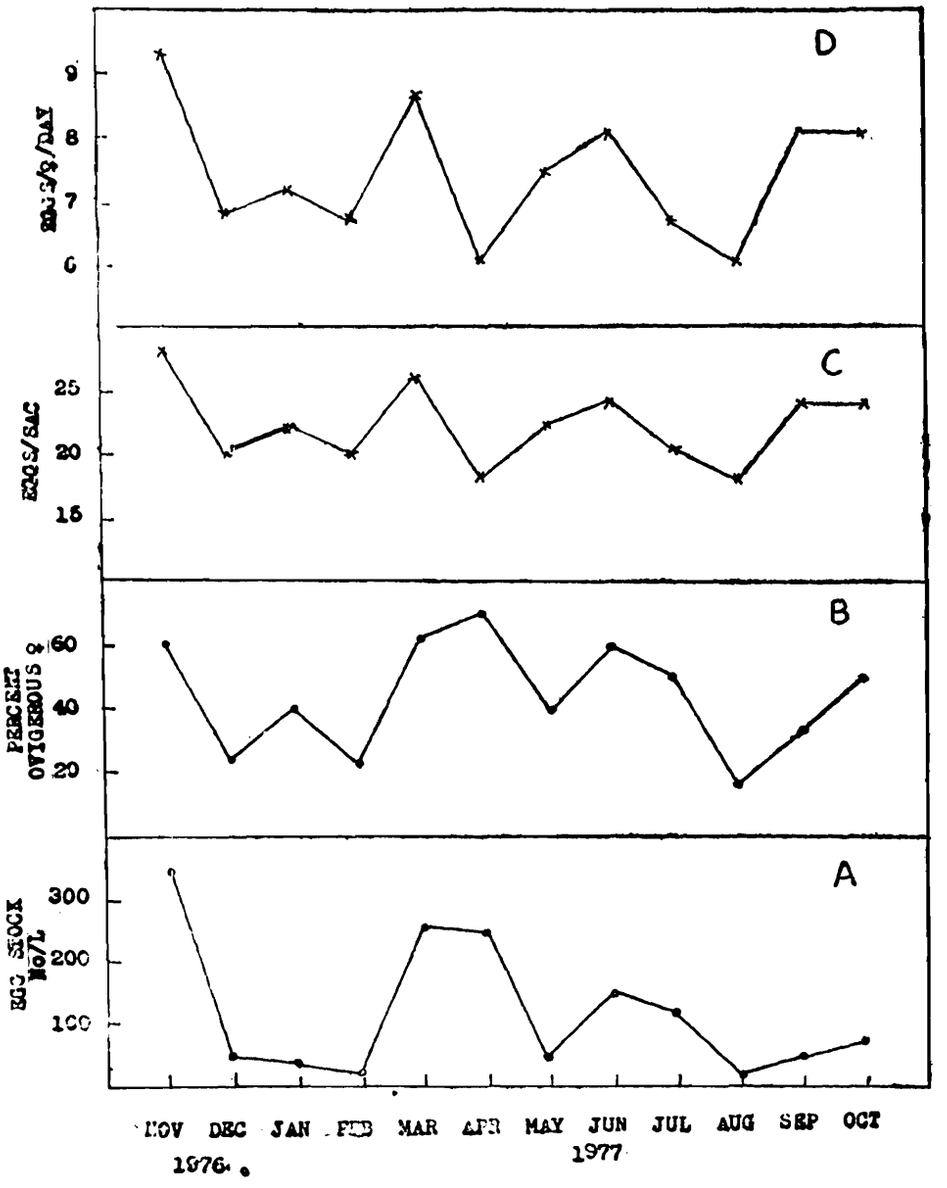


Fig. 2: Seasonal variations in egg ratio of the population (A) size of breeding population (B) clutch size (C) and reproductive rate (D) of *M. leuckarti*.

to 16 in August (Fig. 2B) with 4 peaks, in November, January, April and June, January peak being the smallest and April being largest. Similarly the egg stock of the population (Fig. 2A) also exhibited 4 peaks almost during the same months when size of breeding population formed peaks. These 4 peaks, probably denote the 4 generations of *M. leuckarti* which developed in one complete year.

Almost similar results were obtained when reproductive rate or population birth rate B was calculated in terms of egg/♀/day (Fig. 2D). 4 peaks are clearly visible almost during the same months except that there was a slight shift of 3rd peak which was recorded in March instead of April. This may be due to different calculation procedures. Like size of breeding population, the reproductive rate (egg/♀/day) was also high throughout the year.

The mean clutch size as egg/sac (Fig. 2C) was sufficiently high and did not vary much

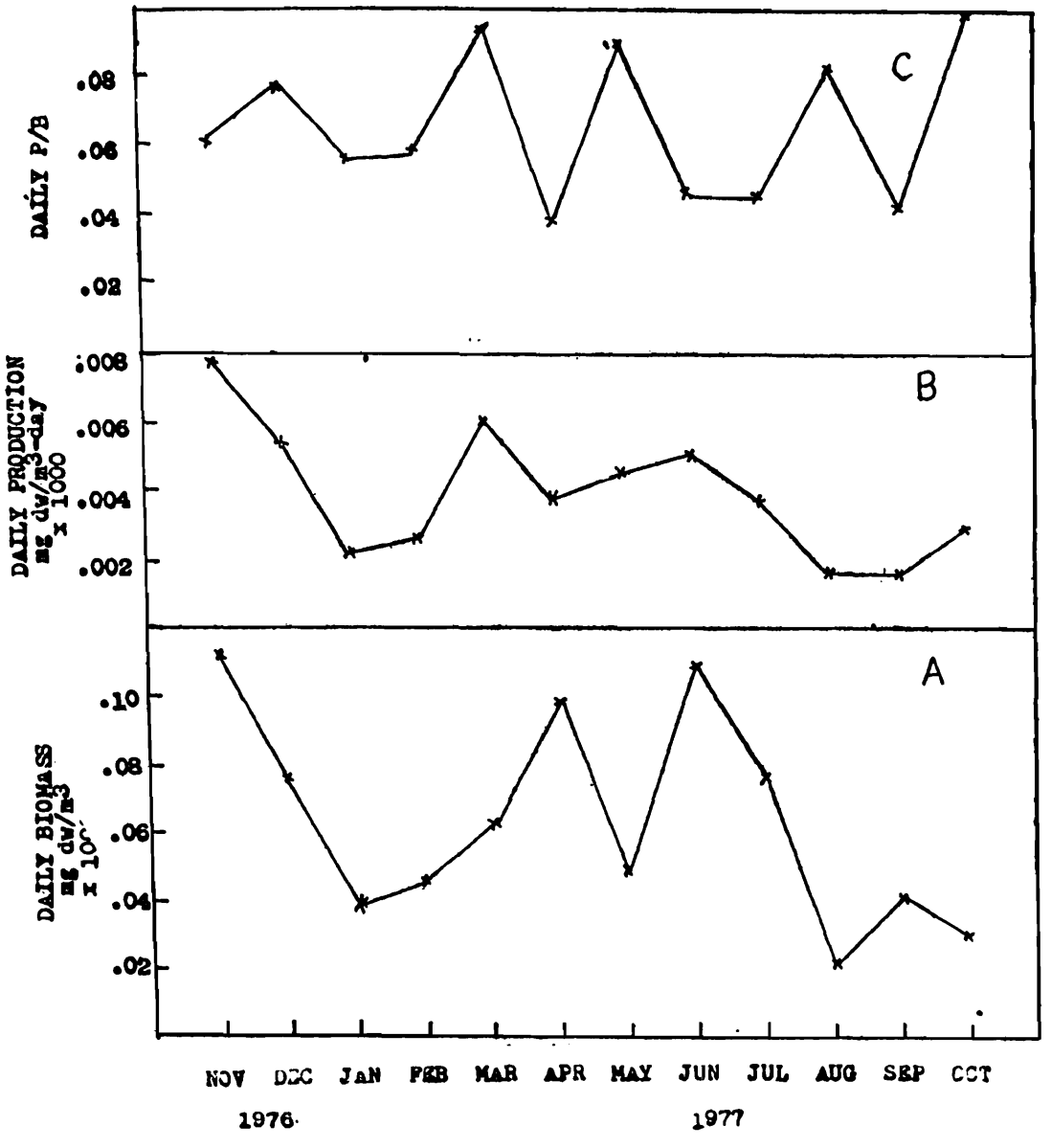


Fig. 3. Seasonal variations in Biomass (A) Daily secondary production (B) and Daily P/B (C) of *M. leuckarti*.

during different seasons (22.16±6). It appears that clutch size increases during the period of rapid reproduction as evident by 4 similar peaks as derived from other reproductive parameters.

Total number of egg/♀ (individual fecundity) was determined in laboratory. It was found that each female at an average produced 2.58 clutches with a mean of 52.8 eggs (range 20—93).

Biomass, secondary production and P/B :

Mean daily biomass, daily production and P/B ratio of *M. leuckarti* during November 1976—October 1977 are shown in Fig. 3. The daily biomass ranged between 21.51 mg dw/m^3 to 113.5 mg dw/m^3 with a mean of 61.6 mg dw/m^3, with 4 peaks, in November, April, June and September. The daily production varied from 1.756 mg dw/m^3-day to 7.930 mg dw/m^3-day (mean 4.775 mg

dw/m^3-day). Mean daily P/B ratio also fluctuated throughout the year (range 0.037 to 0.102, mean 0.062). Four peaks were also recorded here. Mean monthly P/B ratio was found to be 1.89.

Discussion

The occurence of all stages of *M. leuckarti* in fair numbers throughout the year reveals that species reproduced and flourished continuously in the pond without being affected by any of the prevailing environmental factors. In fact the most important factor governing the population cycle of animal in general, the temperature, was not of much importance as it varied only between 28±3°C throughout the year. Further being an eutrophic waterbody, food was always in abundance as rotifers and cladocerans, early stages of which are the chief food of *M. leuckarti*, also reproduced continuously. The drop in population during August, which is the peak monsoon month may be due to flooding and great dilution of water. As far as the effect of other physicochemical factors are concerned, it appears that *M. leuckarti* has well adjusted. This successful adaptation of *M. leuckarti* in the pond strengthens the view of Hutchinson (1967) and Gophen (1978b) that the species has high adaptability and has successfully adjusted over a major part of its range, inspite of great regional differences in environmental conditions.

The population of *M. leuckarti* was always dominated by copepodites and nauplii contributed less inspite of high reproductive rate and egg stock of the population. This low availability of nauplii may be attributed to high mortality of early stages as reported in copepods by Odum (1959), Burgis (1971) and Gehrs and Robertson (1975). Such heavy mortality of naupliar stages may probably be due to heavy predation upon them and their greater susceptibility to adverse conditions.

Most of the copepod species reported from temperate regions produce only one or two generations in a year. This is because reproductive activity is confined to a short time during summer and development is hampered during winter season (Ravera 1954, Comita 1956, McLaren 1969, Chapman 1969) Obviously such conditions do not occur in tropical waters, atleast in this region of the country and *M. leuckarti* found it convenient to reproduce and develop throughout the year. With the result four definite generations, spread over the entire year can be detected.

The development time of copepods has been found to vary from region to region depending upon different environmental conditions, particularly at different temperature. Eckstein (1964) observed that while *Diaptomus gracilis* took 115 days to develop at 5°C, it took only 38 days at 15°C. From that standard it appears that *M. leuckarti* has a higher developmental duration and life span, even at sufficiently high temperature as that of the pond.

Copepods and other crustaceans are often stated to increase their length by about the same proportion at each molt and follow Brooks law which reveals that such increase is about 25% at each molt. *M. leuckarti* was also found to follow the law as increase in length at each molt from NI — NIII onwards upto CIV ranged between 15.8 — 37.5%. The highest growth occurred at CI which was probably due to sudden increase in length as the animals took copepodite form. Like any other animal, the growth of *M. leuckarti* was found to decrease gradually as age increased.

Inspite of abundance of *M. leuckarti* throughout the year, its biomass and production rate were considerably lesser in Manohar Das Pond as compared to Lake Kinneret, Israel, where Gophen (1978a) found that its biomass and monthly production were 15500 mg. d.w/m^2 and 5000 mg. d.w./m^{-month}.

Similarly the monthly P/B ratio in Manohar Das Pond (1.89) was also lesser than the Lake Kinneret (3.1).

ACKNOWLEDGEMENTS

The author is thankful to the Director, Zoological Survey of India, for providing necessary laboratory facilities and constant encouragement.

REFERENCES

BURGIS, M. J. 1971The ecology and production of particularly *Thermocyclops hyalinusan* the tropical Lake George Uganda. *Fershwater Biol.*, **1** : 169-192.

CHAPMAN, A. 1969. The binomics of *Diaptomus gracilis* Sars (Copepoda : Calanoida) Loch Lomond, Scotland. *J.. Anim. Ecol.*, **17** : 15-26,

COMITA, G. W. 1956. A study of calanoid copepod population in arctic lake. *Ecology*, 37 : 576-591.

ECKSTEIN, H. 1964. Untersuchungen Uber den Einfluss des Rheinwassere auf die Limnologie des Schluchs es. IV. Untersuchunsen Uber die Einburgerung des *Epidieptomus gracilis* Sars in den Schluchsee. *Arch. Hydrobiol.* (Suppl), **28** : 119-182

EDMONDSON, W. T., COMITA, G. W. and ANDERSON C. G. 1962. Reproductive rate of copepods in and its relationship to phytoplankton population. *Ecology*, 43 : 625 636.

GEHRS, C. W. and ROBERTSON, A. 1975. Use of life table in analysing the dynamics of copepod populations. *Ecology*, **56** ; 665-672,

GOPHEN, M. 1978 a. Errors in the estimation of recruitment of early stages of *Mesocyalops leuckarti* (Claus) caused by the diurnal periodicity of egg production. *Hydrobiologia*, **57** : 59-64.

GOPHEN, M. 1978 b. The productivity of *Mesocyclops leuckarti* in Lake Kinneret (Israel). *Hydrobiologia*, **60** : 17-22.

GREZE, V. N. and BALDINA, E. P. 1964. Population dynamics and anneal production of *Acartia clausi* Giersbr. and *Centropages kroyeri* Giesbr. in the menetic zone of the Black sea. *Tr. Sevastop. Biol. Stn.*, **17** : 249-261.

HUTCINSON, G. E. 1967. *A treatise on Limnology*, John Wiley & Sons, Inc,. New York

KHAN, R. A. 1979. Primary productivity and trophic status of two tropical water bodies of Calcutta, India. *Bull. zool. Surv. India*, **2** : 129-138.

MACLAREN, I. A. 1969. Population and production ecology of zooplankton in Ogac Lake, a land locked Fiord on Barrin Island. *J. Fish, Res. Bd. Can.* **26** ; 1485-1559.

ODUM, E. P. 1959. *Fundamental of ecology*. Philadelphia.

RAVERA, O. 1954. La Strutture demographica die copepodi dal Lago Maggiore. *Mem. Inst. Ital. Idrobiol.*, **8** : 109-150.

WINBERG, G. G. 1971. *Methods for the estimation of production of aquatic animals*. Academic Press, London.

Bull. zool. Surv. India, 4(1) : 57-59, 1981

A NEW SPECIES OF *HAEMATOPOTA* MEIGEN (DIPTERA : TABANIDAE) FROM DARJEELING, INDIA

M. DATTA

Zoological Survey of India, Calcutta

ABSTRACT

A new species, *viz. Haematopota darjeelingensis* Datta is described and illustrated from Tiger Hill, Darjeeling.

Stone and Philip (1974), while revising the Oriental species of the tribe Haematopotini, have recorded two species of the genus *Haematopota* Meigen from Darjeeling. A small collection of Diptera received from the Department of Zoology, Darjeeling Government College, for identification, contains four unique specimens of a species of *Haematopota* Meigen described here as new. These have been taken on the body of the collector at Tiger Hill, Darjeeling.

The type-specimens are deposited in the National Zoological Collection of Zoological Survey of India at Calcutta.

Subfamily TABANINAE

Tribe HAEMATOPOTINI

Genus **Haematopota** Meigen

Haematopota Meigen, 1803, Illiger's Mag. f. Insenk. tenk. 2 : 267. Type-species : *Tabanus pluvialis* Linnaeus (Monotypy).

Haematopota darjeelingensis sp. n.

(Fig. 1—A, B, Pl. I).

A medium-sized greyish species having black, shiny and rugose frontal callus, with a small mid-dorsal projection ; upper parafacials with scattered speckling, somewhat fused above and below ; a pair of triangular interantennal black spots ; moderately swollen scape and flattened plate ; striped thorax and abdomen ; wings with single slender apical spot ; and hind tibiae with double rings.

Female—Length 8.0-10.0 mm ; wing 9.0-11.0 mm ; antenna 1.6-2.0 mm. Head : Eyes bare. Frons (Fig. 1-A) brownish, pollinose, dark-haired, width at vertex subequal to height, slightly wider below ; vertex whitish pollinose ; midfrontal spot small, velvety black, vertical ; paired spots large, nearly subquadrate, velvety black, touching eyes but separated from callus ; callus black, shiny and rugose centrally, nearly 3 times as wide as high, upper margin biconvex, with a small middorsal projection, lower margin biconcave with a midventral concavity and a curve downward laterally touching eyes ; subcallar area mostly occupied by a pair of large triangular interantennal velvety black spots ; face whitish pollinose and pilose ; parafacials whitish pollinose and pilose, with scattered speckling above, with dark hairs, somewhat fused above and below ; beard white. Scape (Fig. 1-B) dark reddish, shiny, cylindrical, gradually swollen distally, little more than twice as long as thick ; pedicel short, stout and somewhat crescentic ; flagellum dark, much longer than scape, first flagel-

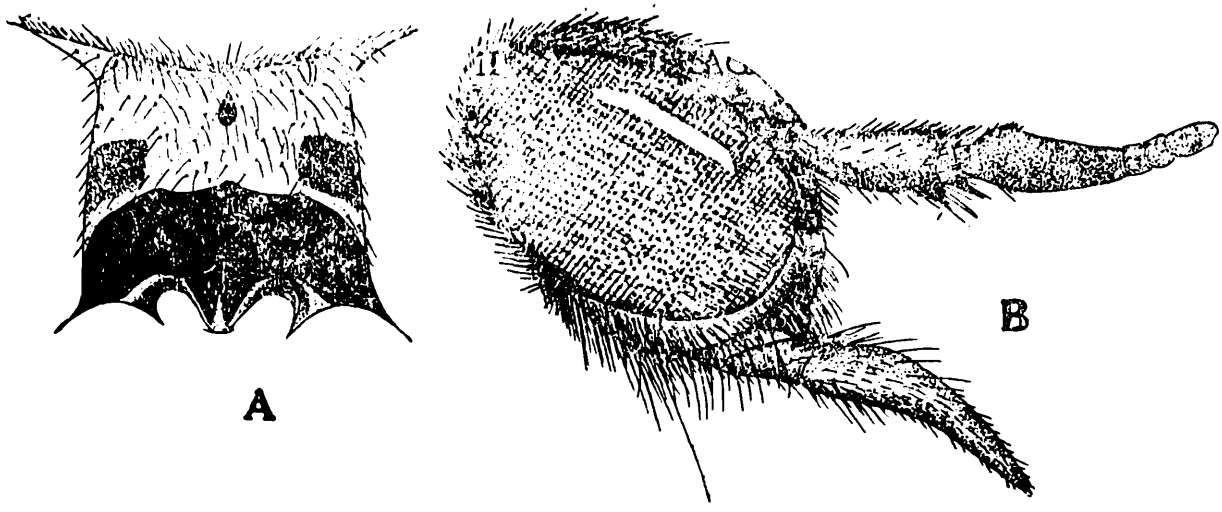


Fig. 1. *Haematopota darjeelingensis* sp. n.
A. Frons of holotype female (frontal view). B. Head of holotype female (lateral view).

lomere somewhat flattened, more than twice as long as wide at greatest width at base ; last flagellomere nearly equal in length to second and third flagellomeres together. Palpus (Fig. 1-B) slender, reddish grey, mostly dark-haired. Thorax : Scutum grey with golden hairs and pattern as follows :

Middorsal stripe and two wider submedian stripes extended from anterior margin to scuto-scutellar suture ; two sublateral stripes extended from transverse suture to scuto-scutellar suture ; humeral calli and antealares brownish pollinose like that of scutal stripes. Scutellum greyish with pale brown hind margin. Pleuron whitish pollinose. Wings (Pl. 1) brownish with pattern of slender paler spots ; subapical band slender widely separated from anterior and posterior margins ; no spot on hind margin of wing , spur vein present. Haltere with dark knob. Fore coxa, trochanter and femur grey, former whitish pollinose ; tibia grey with nearly one-third pale base ; tarsus grey. Mid coxa grey ; trochanter, femur and tibia reddish brown, latter with two pale bands ; first tarsomere mostly pale, rest of tarsus greyish. Hind coxa grey ; trochanter and femur reddish brown, latter with dark tip ; tibia also reddish brown, with two pale bands ; first tarsomere mostly brownish. Abdomen : Dorsum grey, dark-haired, with yellowish incisures, golden haired and with a yellow middorsal stripe. Venter grey, whitish pollinose and yellow pilose.

Holotype ♀, Z. S. I. Reg. No. 6530/H_6, INDIA : West Bengal : Darjeeling : Tiger Hill, 2500 m., 22.VII.1979, Coll. *S. S. Saha*. *Paratypes* : 3 ♀♀, Z. S. I. Reg. Nos. 6531/H_6, 6532/H_6 and 6533/H_6, same data as holotype.

Variations observed are in the frontal hue, degree of fusion of parafacial speckling, distance of paired spots from frontal callus, shape of midfrontal spot, intensity of stripes on thorax and abdomen, and dimension of spots and length of spur vein in wings.

This species runs to key-couplet 143 of Stone and Philip (1974) ; but having no pale spots on the hind margin of wing, it will not pass through the couplet. *Haematopota gregoryi* Stone and Philip, 1974, described from South China, has pale spots on the hind

margin of wing but spotting of upper parafacials is without any fusion and the frontal characteristics are quite different (*cf.* Stone and Philip, 1974). *H. albofasciatipennis* Brunetti, 1912, and *H. hardyi* Stone and Philip, 1974, recorded from Darjeeling, do not show close relationship. The former species is without any middorsal projection from upper margin of frontal callus and with a broad subapical band ; and the latter species has curved subapical band, extended nearly to margins and subcallar area with a strong interantennal spot among certain other differences.

ACKNOWLEDGEMENTS

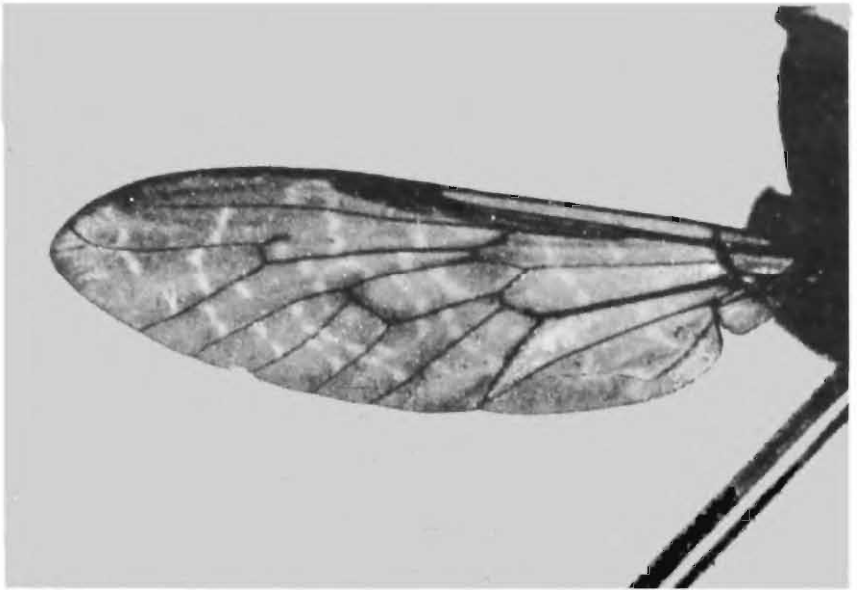
The author expresses his gratitude to the Director and the Officer-in-Charge of the Diptera Section, Zoological Survey of India, Calcutta, for their co-operation and encouragement. He is also grateful to Dr. B. Dasgupta, the Principal of Darjeeling Government College, for kindly permitting him to describe the species. Finally, he is thankful to Mr. S. S. Saha for collecting the unique specimens for his studies.

REFERENCES

BRUNETTI, E. 1912. New Oriental Diptera I. *Rec. Indian Mus* , 7 : 445-513.

STONE, A. and C. B. PHILIP. 1974. The Oriental species of the Tribe Haematopotini (Diptera. Tabanidae). *Tech. Bull. U. S. Dep. Agric.* ; No. 1489, 240 pp.

DATTA PLATE I



Wing of paratype female (dorsal view)

Bull. zool. Surv. India, 4 (1) : 61—66, 1981

DIVERSITY IN ZOOPLANKTON COMMUNITY AS AN INDICATOR OF ORGANIC AND INDUSTRIAL POLLUTION IN HUSSAIN SAGAR, HYDERABAD

M. BABU RAO, S. K. MUKHOPADHYAY, E. V. MULEY AND S. Z. SIDDIQUI

Zoological Survey of India, Freshwater Biological Station, Hyderabad

ABSTRACT

Hussain Sagar the freshwater man made lake, situated between tl e twin cities of Hyderabad and Secunderabad has been facing the severe threat of Organic and Industrial pollution for the last one and half decades. The hypereutrophication of the lake is consequently affecting the biota both qualitatively and in abundance. The present investigation deals with the systematic account of net Zooplankton species and their abundance in response to the environmental stress, viz. Organic and Industrial pollutants. The studies reveal that the copepodes and cladocerans form the dominant net zooplankton component followed by rotifers. Significant diversity in the abundance of netzooplankton species has been noticed at different sampling stations in the Hussainsagar lake. The results have been supported with the physico-chemical characteristics of the lake water collected simultaneously.

Hussain Sagar (Lake), situated between the twin cities of Hyderabad and Secunderabad, is the oldest of the five Freshwater takes spotting the hilly landscape of the twin cities. It is spread over three spuare miles, has present water spread of 450 hectares and is situated at an altltude of 345 met res above the sea level. It is a highly eutrophic lake, in fact hypereutrophic, and has been the focus of limnologic investigations since last two decades (Srinivasan et al, 1965 ; Zafar, 1966 ; Munnawar, 1970) in view of sharp increase in pollution (Zafar, 1974) since a good amount of industrial wastes (liquid wastes) and untreated domestic sewage are let into the lake. Its water, therefore, been rightly used only sparsely for secondary purposes and even the fish stocking endeavours of the local state fisheries department have been discontinued for about a decade and half from now.

Yet another feature of Hussain Sagar is the luxuriant growth pattern of water hyacinth, (*Eichornia crassipes*) blanketing vast stretches of the lake all along its circumference, often exhibiting erratic distribution pattern. This unusual but systematic ceaseless luxuriant growth of the *Eichornia* only goes to strengthen its recently established function as an *anti pollutant* and its promise as a pollution control agent through its ability to effectively absorb heavy metals. The poor abundance of carps and occurrence of only handful hard fish species like the Catfish *Mystus* (*Mystus*) *vittatus*, *vittatus* (Bloch), *Heteropneustes fossilis* (Bloch), *Notopterus notopterus* (Pallas) and *Puntius* species (*arenatus* and *stigma*) is only a small pointer to the effect.

Therefore, in view of the highly eutrophic nature of the lake it was reasoned that a study of the net zooplankton organisms and

their abundance, if any, in the various parts of the lake may reveal the effect of organic and industrial pollution on them, The precise nature of the liquid effluents and their effect on the available *biota* have been deferred for future detailed studies since they also involve use of sophisticated electronic analytical instruments and manpower in addition to more extensive limnologic survey and collections (net zooplankton and surface water samples) for meaningful interpretive studies. The present piece of investigations were carried out during the premonsoon months of the preceding year i.e. from April-June, 1979. Weekly limnologic collections of net zooplankton and surface water samples were made and raw water analysed for various water chemistry routines. These were followed by identification studies of the net zooplankton for qualitative and quantitative evaluation.

Systematic investigative studies on the species abundance of net zooplankton in Hussain Sagar are scanty (Dhanapathi, 1974, 1976) and therefore an endeavour has been made to assess these. The present communication is a part outcome of systematic investigations, in progress, in the limnology of Hussain Sagar since May, 1979 last and lay emphasis on the general relationship observed between the net zooplankton and their abundance, if any, in response to environmental stress (Organic and industrial pollutants).

Assuming that a study of the zooplankton species and their abundance and distribution in the different regions of the lake may reveal meaningful results, four sampling stations differing suitably in important limnologic features were selected along the circumference of the lake for the collection of net zocplankton and surface water samples (SWS) for purpose of identification and enumeration of biota and immediate chemical analysis of physico-chemical parameters of water like DO, free CO_2, total alkalinity and chloride besides measurements of pH, turbidity (JTU), temperature etc. The first station, in the immediate vicinity of Hyderabad Boat Club, located in the southern flank of the lake also has the government mint and associated effluent discharge. The second station in Khairatabad, slightly west of the city, is midway along the west flank of the lake and witnesses regular activity on account of the many washermen, human ablutions from the surrounding slums, cattle wading and grazing. The third station is situated in the north west zone of the lake, along the Khairatabad-Begumpeth rail line and is by far the most polluted zone of the lake. It is here that the lake receives its quota of effluents through the Kukatpally nallah that traverses the industrial (Sanath Nagar and Balanagar) belt of the twin cities and brings in its course diverse effluents, rich in industrial wastes. Understandably enough, the pollution influence is more pronounced during summer months following diminshed inflow, increased surface evaporation and related fall in the water level following no precipitation. The fourth station, Secunderabad Sailing Club, lies in the eastern flank of the lake and invariably has luxuriant population of water hyacinth. It too receives untreated domestic wastes from areas around (Fig. I).

The methodology for water chemistry routines are after standard method (APHA, 1975) while ones for collection of net zooplankton as also surface waters are after Babu Rao et. al. (1978). The means of the results of these studies for each station for the period were obtained, after analysis of data (Table 2). The net zooplankton organisms were identified and enumerated from each sample and the means for the month obtained. These results have been tabulated in table 2 while the relationship observed between the number of species (S) to the number of individuals in each species (N)

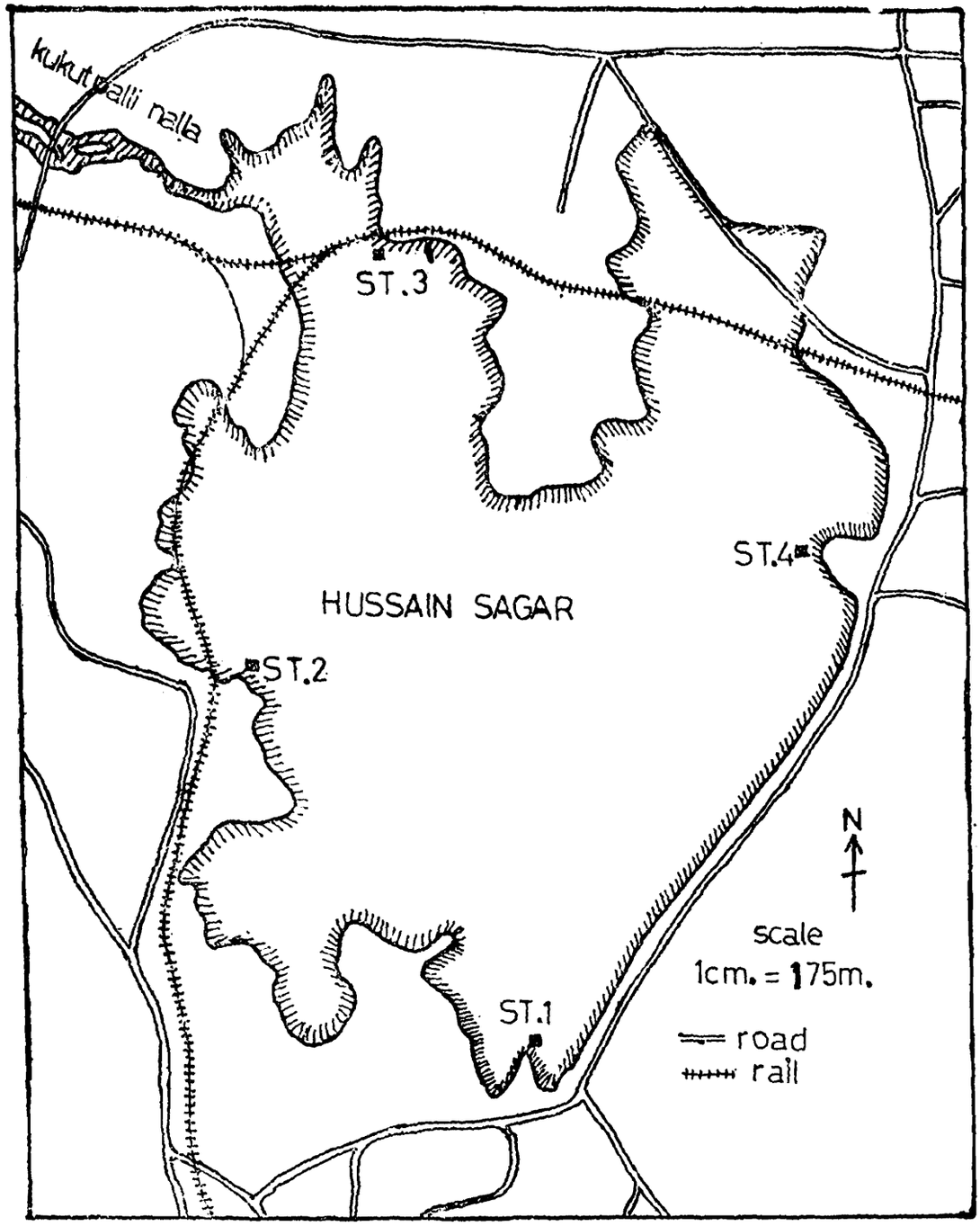


Fig. 1 Map of Hussain Sagar (Lake), Hyderabad showing sampling stations.

TABLE 1. Mean number of individual per species per liter of surface water in Hussain Sagar (Lake), Hyderabad.

Net Zooplankton	Sampling Station I (Hyderabad Boat Club)	Sampling Station II (Khairatbad)	Sampling Station III (Begumeth)	Sampling Station IV (Secunderabad Sailing Club)
I. COPEDODA				
Mesocyclops leucartii (claus)	43	43	07	27
Nauplii	27	07	41	07
Copepodite	07	11	12	14
Heliodiaptomus sp.	05	00	00	02
II. Cladocera (Water fleas)				
Ceriodaphnia				
Cornuta (Daphnidae)	67	27	12	05
Moina micrua Kurz (N inidae)	00	03	02	05
Diaphanosoma Sarai (Richard) [Sididae]	00	01	02	05
Daphni lumholtzi Sars (Daphnidae)	03	01	00	00
III. Rotatoria *Brachionus quadridentata* Herman (Brachionidae)	05	02	00	10
B. caudatus Borrois & Daday	10	02	00	10
B. calcyflorus Pallas	06	00	06	32
B. urceoloris	03	00	00	09
Keratella tropica (Apstein)	06	01	13	04
Platyias quadricornis (Ehrenberg)	00	00	00	02
TOTAL	183	98	102	148

expressed as ratio (N/S) are graphically represented in Fig. 2. [—Assuming the nauplii and copepodites recorded as belonging to *Mesoeyclops leucartii* (Claus)].

It was noted that the copepods and cladocerans form the dominant net zooplankton component followed closely by the rotifera. The adult net zooplankton organisms were found to be less numerous in zooplankton samples from Station 3, where there is more of pollution. The presence of less numerous zooplankton in samples from Station 2, may be attributed to pollution influence following intense washing activity by washermen, slums around, domestic effluents and like factors. Of the 14 species of net zooplankton recorded, only 8 species occur in samples from station 3, the lowest number of types when compared to populations from other sampling stations. These may be more due to pollution influence following inlet of industrial effluence (liquid waters) from the Kukatpally Nalla feeding the lake at this point. This effect appears to be more pronounced on rotifera which otherwise have good species

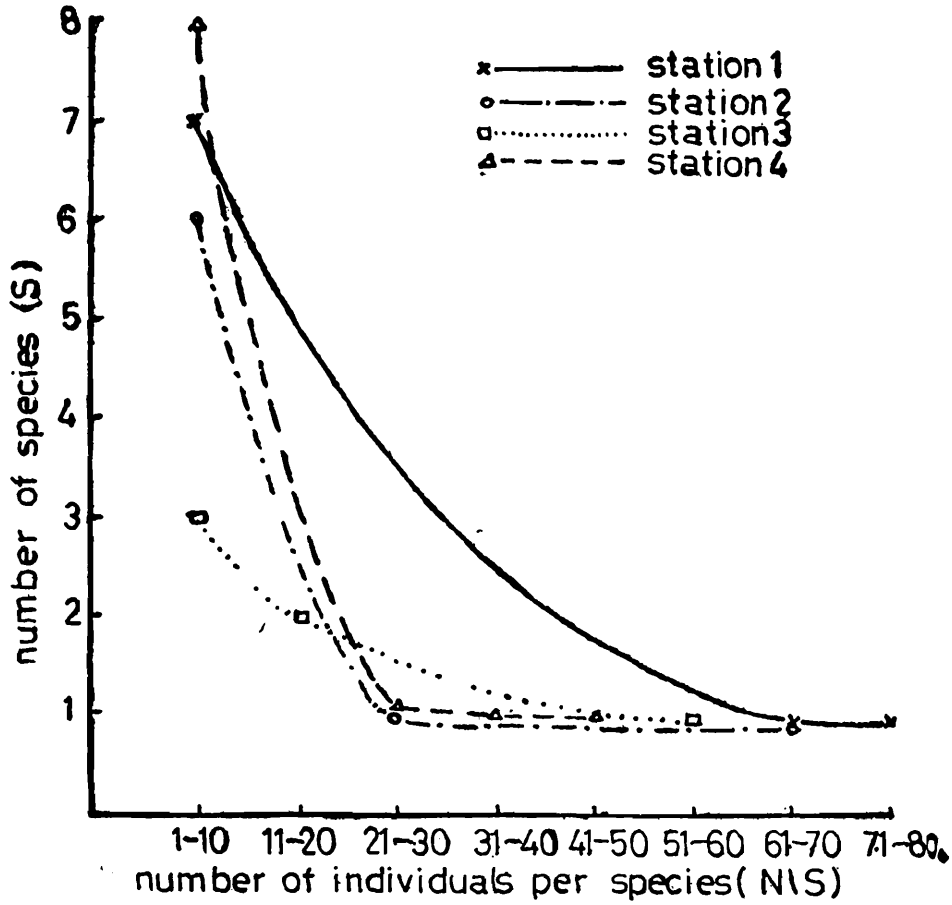


Fig. 2 Number of species (S) to Number of individuals per species (N/S) ratio of the Zooplanktonic Organisms.

TABLE 2. Chemical feature of surface water in Hussain Sagar, Hyderabad

	SS I	SS II	SS III	SS IV
Atm. Temperature	41°C	40°C	42°C	41°C
Wt, Temdesature	07°C	37°C	39°C	37°C
pH	7.9	8.4	8.0	8.3
Turbidity (JTU)	4	8	30	8
Dissolved Oxygen)	4.9 mg/1	1.2 mg/1	Traces	5.2 mg/1
Free CO_2	NIL	NIL	NIL	NIL
Aeidity	NIL	NIL	NIL	NIL
Co_3 Alkalinity	10.0mg/1	4.0 mg/1	80.0 mg/1	70.0 mg/1.
HCO_3 Alkalinity	21.0 mg/1	196.0 mg/1	91.0 mg/1	200.0 mg/1.

composition in other sampling points. Only two brachionid species– *Brachionus calcyflorus* and *Keratella valga* [Ploima, Brachionidae] appear in the samples from the station. Figure 2 graphically illustrates the lowest ratio (N/S) of species (S) to number of individuals (N).

The concave or hollow curves for S and

N/S ratio for Station 2 and 4 indicate absence of environmental stress (Organic and industrial pollutants, in this case) pointing diversity in species compositions in net zooplankton inhabiting these stations while the flattened curve for the same data for station 3 point out rigors due to environmental stress resulting in relatively less number of species having high number of individuals per species.

Table 2 illustrates the analysed chemical features of surface water in Hussain Sagar, during the period of study. The complete absence of dissolved oxygen in water samples from station 3 indicates stress so also low DO values for station 2 which is only second to station 3 in zooplankton species abundance.

Detailed systematic investigations on the influence of industrial effluents on the biota in the lake are in progress and a correlation between the two will emerge only after more samples are analysed from the various sampling points.

Acknowledgement

The authors are indebted to Dr. T. N. Ananthakrishnan, Director, Zoological Survey of India, Calcutta, for the facilities, encouragement, inspiration and guidance.

References

Srinivasan, T. K., Srinivasan, K., Seth, G. K., Murahari, Rao, P. & Venkatarao, D. 1965. Studies on raw water characteristics of the lakes in and around Hyderabad. *Environmental Health*, VII : 177-87.

Zafar, A. R. 1966. Limnology of Hussain Sagar lake Hyderabad, India, *Phykos*, 5 (1-2) : 115-226,

Zafar, A. R. 1974. *Assessment of organic pollution in the lakes of Hyderabad. The Hazards of Environmental pollution.* A Max Mueller Bhavan Publication, Bombay.

Munnawar, M. 1970. Limnological studies on freshwater Ponds of Hyderabad. Qudis I. The biotope. *Hydrobiologia*, 25 : (1) : 127-162.

APHA, AWWA, WPCF 1975. *Standard Methods for the examination of water and wastewater.* 14th edn. APHA, Washington.

Dhanapathy, M. V. S. S. S. 1974. A new brachionid rotifer, *Platyias quadricornis andhraensis* subsp. nov. from India. *Curr. Sci.*, 43 (11) : 358.

Dhanapathy, M. V. S. S. S. 1976. Rotifers from Andhra Pradesh India — III, family Lecanidae including two new species, *Hydrobiologia*, 48 (1) : 9-16.

Babu Rao, M., Mukhopadhyay S. K., and Mulay, E. V. 'Seasonals' and 'Socies' of Zooplanktonic organisms and their succession in two freshwater ponds at Wagholi, Poona, *Proc. Symp. on Ecology of Animal Populations*, Calcutta, 1978. (In press).

Bull. zool. Surv. India, 4(1) : 67—70, 1981

A NEW SPECIES OF THE GENUS *HOMALOPTERA* FROM SILENT VALLEY, KERALA, S. INDIA

T. J. INDRA AND K. REMADEVI

Zoological Survey of India, Southern Regional Station, Madras,

ABSTRACT

A new speeies of the genus *Homaloptera* Van Hasselt which differs from the single known Indian species. *H. montana* Herre from Anamalai, is described.

INTRODUCTION

While studying the fish material of the little explored Silent Valley and New Amarambalam Reserve Forests, twenty-one examples of interesting Homalopterid fishes were noticed. Detailed study revealed that these were not conspecific with the single species so far known from India under the genus, viz. *Homaloptera montana* Herre.

Silent Valley and New Amarambalam are adjoining forests with separate drainages. 18 specimens were collected from the Kunthi River (Silent Valley) and 3 specimens from Cherupuza River (New Amarambalam). The material was collected by the Zoological Survey of India team during the course of a multi-disciplinary expedition organised by the Geological Survey of India, Kerala circle. The new species is being named after the collector *Dr. R. S. Pillai.*

Earlier workers who dealt with the classification, bionomics of the family Homalopteridae were Hora (1932, 1941) and Silas (1950). Herre (1945) described a solitary species, *H. montana* of the genus *Homaloptera* Van Hasselt from Anamalai Hills, Western Ghats (South of Palghat gap). The discovery of yet another species of the genus from northern part of Palghat gap is of considerable importance.

Silent Valley (*Ca.* 530-816 m.) is situated in Palghat district of Kerala. It consists mostly of wet evergreen forest. The River Kunthi flows through the valley which has on either side a luxuriant riverine forest.

Homaloptera pillaii sp. nov.

(Pl. II. Figs. A & B)

Description :— D.1/7-9 ; A. 1-2/4-5 ; P. 7-9/11-13 ; V.2-3/8-9 ; L1.83-93. Depth of body 12.5-16.66 (M 14.33), Length of head 20.70-26-53 (M 24.51), length of caudal 16.0 -23.92 (M 21.19) in % of standard length. Snout 44.44-57.14 (M 49.02), eye diameter 10.0-20.0 (M 15.02), length of pectoral 89.29-120.5 (M 104.9) in % of head length. Eye 19.05-40.00 (M 30.21) in % of snout, 25.0-60.24 (M 42.63) in % of interorbital distance. Gape of mouth 35.71-58.14 (M 46.93) in % of width of head. Distance between anus and anal fin 10.72-22.22 (M 15.31) in % of distance between anus and pelvic fin base. Height of caudal peduncle 53.76-92.59 (M 73.18) in % of length of caudal peduncle.

These are small loach-like fishes in which the head and anterior part of the body is

depressed and ventral profile flattened, posterior half being laterally compressed. Mouth inferior, transverse and sightly arched. rostral fold and rostral groove slightly developed. Lips full, plain and continuous. Two pairs of rostral and a pair of maxillary barbels present. All are of equal size and nearly twice the length of the diameter of eye. Gill opening oblique, extending to ventral surface for a short distance. Head and ventralsur face up to the base of pelvic fin scaleless. Dorsal origin just behind that of pelvic base, and behind the middle of length. Pectorals not reaching pelvics. Anus nearer to anal fin than to the pelvics. Pelvics whith two simple rays except in one example were one side of the fin has three simple rays. Caudal fin emarginate. Lateral line complete with 83-93 small scales. Caudal peduncle 1.08-1.86 in its own length.

Colour in Alcohol : Body light to dark brown, mottled with numerous irregularly placed dark spots. Dorsal side of head with dark spots. Anal with poorly defined bean-shaped blotch at its base. All other fins are dusky brown and without any markings. Abdomen yellowish to light brown in colour.

Distribution : River Kunthi, Silent Valley and Sayivala, New Amarambalam Reserve Forest, Kerala.

Holotype : River Kunthi, Silent Valley, Kerala, 19.1.1979 standard length 69 mm. ; Collector *R. S. Pillai.*

Paratypes : Twenty specimens, out of which 17 standard length 33.0-53.0 mm. ; have the same data as that of holotype. 3 specimens with standard length 50.0-75.0 mm. ; were collected on 19.3.1979 from Sayivala, New Amarambalam Reserve Forest ; Coll. *K. R. Rao.*

Type : All the type specimens are temporarily kept at this Regional Station and will be eventually deposited in the Zoological Survey of India, Calcutta.

Relationship : This new species differs from *H. montana* Herre in the following characters :—

		H. montana Herre	*H. pillai* sp. nov
Dorsal Fin		2/6	1/7-9
Anal Ein		1/5	1-2/4-5
Pectoral fin		4/8	7-9/11-13
Pelvic fin		2-3/6-7	2-3/8-9
Lateral line scales		72	83-93
Length of caudal peduncle / Height of caudal peduncle		Twice	1.08-1.86
Shape of Caudal	Nearly truncate	Emarginate	
Colour	10 dark short bars across the body but not extending back to the lateral line	Dark spot irregularly scattered all over the body except on ventral side	
	Poorly defined dark longitudinal stripe below the lat. line from the eye to the Caudal base	Absent	

	A blackish brown spot on ventral fin base	Absent
	Caudal fin with black blotch at its tip	Absent
Locality	Puthutotam Estate, Anamalai Hills (South of Palghat gap)	Silent Valley, New Amarambalam Reserve Forest (North of Palghat gap)

FREQUENCY DISTRIBUTION OF MERISTIC CHARACTERS

DORSAL FIN

	SIMPLE	BRANCHED		
RANGE	1	7	8	9
No. of Ex.	21	1	18	2

PELVIC FIN

	SIMPLE		BRANCHED	
RANGE	2	3	8	9
No. of Ex.	20.5	0.5	2.5	18·5

PECTORAL FIN

	SIMPLE			BRANCHED		
RANGE	7	8	9	11	12	13
No. of Ex.	8	11.5	1.5	8	11.5	1.5

ANAL FIN

	SIMPLE		BRANCHED	
RANGE	1	2	4	5
No. of Ex.	8	13	4	17

ACKNOWLEDGEMENTS

We express our deep sense of gratitude to the director, Zoological Survey of India, Calcutta and to Dr. R. S. Pillai, Deputy Director and Officer-in-Charge, Southern Regional Station, Zoological Survey of India for guidance and for providing necessary facilities. We are grateful to Dr. K. C. Jayaram, Deputy Director, Zoological Survey of India, Calcutta for going through the manuscript and offering valuable suggestions. Our special debt of gratitude goes to Dr. A. G. K. Menon who has been our inspiring mentor throughout.

REFERENCES

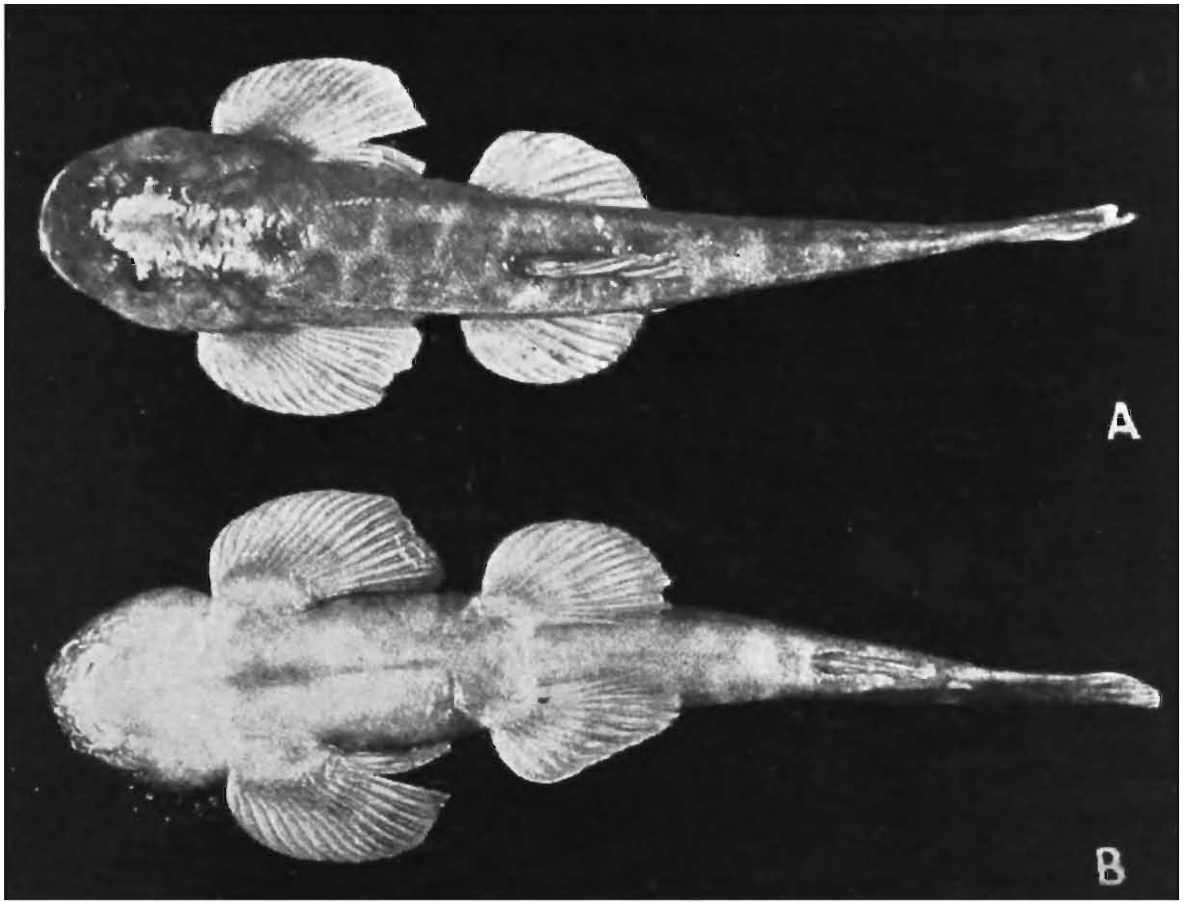
HERRE, A. W. 1945. Notes on Fishes in the Zoological Museum of Standford University. XX new

fishes from China and India. A new genus and a new Indian Record. *J. Wash. Acad. Sci.*, **35**, 399-404.

HORA, S. L. 1932. Classification, Bionomics and Evolution of Homalopterid Fishes. *Mem. Indian Mus.*, **12**, 263-330.

HORA, S. L. 1941. Homalopterid Fishes from Peninsular India. *Rec. Indian Mus.*, **43**, 221-232.

SILAS, E. G. 1952. Classification, Zoogeography and Evolution of the fishes of the Cyprinoid Families Homalopteridae and Gastromyzonidae. *Rec. Indian Mus.*, **50**(2) : 173-263.



A. Dorsal view of *Homaloptera pillaii* sp. nov.
B. Ventral view of *Homaloptera pillaii* sp. nov.

Bull. zool. Surv. India, 4 (1) : 71—84, 1981

TWO NEW TERMITES OF GENUS *GLYPTOTERMES* (KALOTERMITIDAE) FROM THE GREAT NICOBAR ISLAND, INDIAN OCEAN

P. K. MAITI AND S. K. CHAKRABORTY

Zoological Survey of India, Calcutta

ABSTRACT

The two new species, *Glyptotermes krishnai* and *G. nicobarensis* based on both Imagos and soldiers are described from the Great-Nicobar Island in the present paper. The former species can easily be separated from all other Oriental species of the genus *Glyptotermes* in having a much larger, thick, outer, apical tibial spur on the fore leg and very prominent tubercles on frons, on either side, a little above antennal sockets. The latter is compared with *G. almorensis* from U. P. and *G. minutus* from Sri Lanka. Incidentally the genus *Glyptotermes* with these two new species is recorded for the first time from the Great Nicobar Island, Indian Ocean.

INTRODUCTION

The genus *Glyptotermes* Froggatt (1896) is widely distributed in all the zoogeographical regions except the Palaearctic and the Nearctic Regions and is represented by one fossil and 74 living species of which 24 species are so far known from the Orient. However, while studying a fairly large collection of termites collected under a special project on "Xylophagous Insects of the Islands of Andaman and Nicobar", the authors came across two new species which are described in the present paper. Incidentally, this is the first record of the genus *Glyptotermes* from this island represented by these species.

1. Glyptotermes krishnai, new species

Material : One vial with 12 soldiers, 1 dealate, several pseudoworkers and imago-nymphs from Champa Bay, Great Nicobar Island, Stn. No. 14, F. C. No. 1, *P. K. Maiti and party coll.*, 31.xii.1975, ex. "stump of recently felled junglee Mewa".

Description : 1. IMAGO (DEALATE) Fig. 1, Table 1) :

Head-capsule, pronotum, wing-scale and abdominal tergites dark brown ; antennae, labrum, legs and sternites paler. Head and body sparsely hairy.

Head-capsule subround, as long as broad without eyes ; posterior margin broadly rounded. Fontanelle : Absent.

Eyes : Black, suboval, situated on the anterior one-third and at a distance of 0.14 mm. from the lower margin of head-capsule.

Ocelli : Oval, translucent, almost touching the ocular sclerite.

Antennae : Broken, basally sparsely and distally fairly, hairy ; segment 1 cylindrical, 2 longer than half of 1 and slightly shorter than 3, 3 and 4 subequal, 4-onward segments gradually increasing in length and broadly pyriform.

Clypeus : Post-clypeus strip like, paler than frons with substraight anterior margin. Anteclypeus whitish, much broader than long.

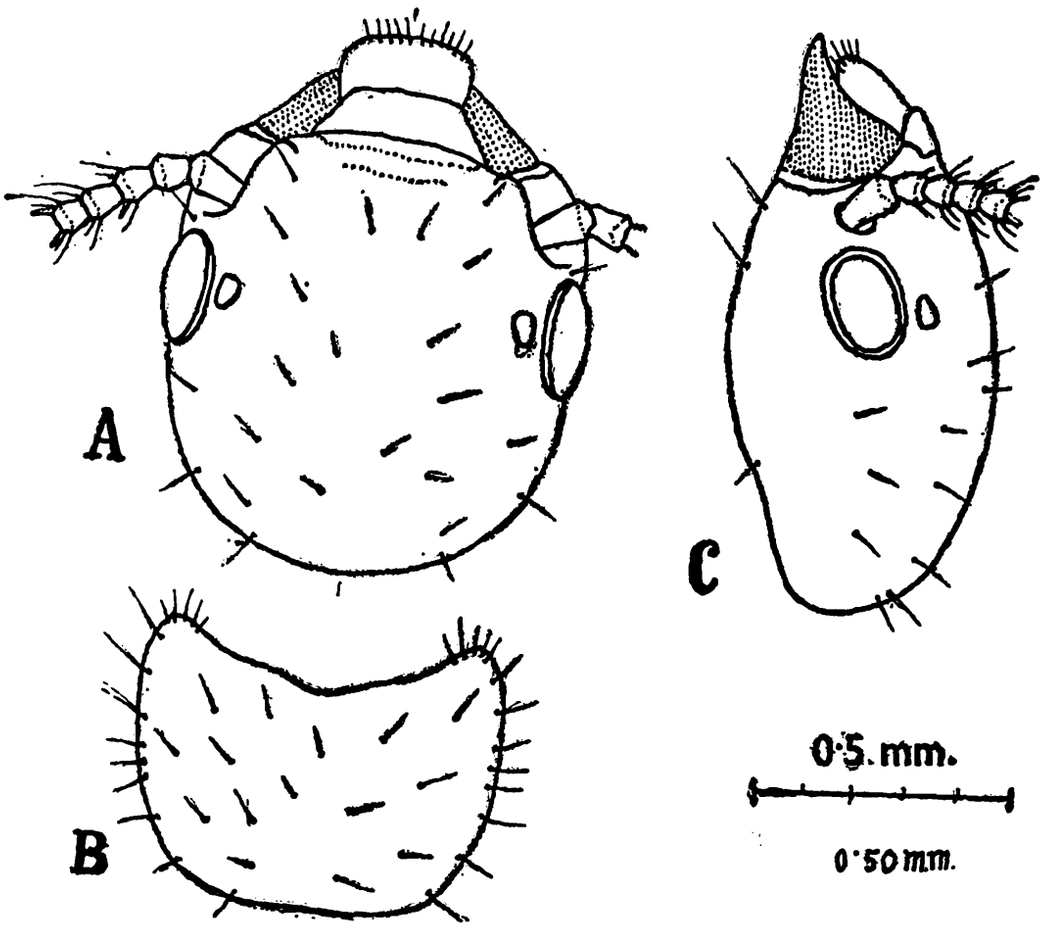


Fig. 1. *Glyptotermes krishnai*, new species. Imago (dealate). A. Head in dorsal view ; B. Pronotum, in dorsal view ; C. Head, in side view.

Labrum : Rounded and pilose apically, width more than double the length.

Mandibles : Subsquarish. Left mandible with an apical and two marginal teeth ; apical finger-like, 1st marginal shorter but thicker than apical, 2nd equal to 1st and slightly pointed with short posterior margin, margin between 1st and 2nd marginal teeth concave. Right mandible also with an apical and two marginal teeth ; apical finger-like, 1st marginal subtriangular, sub-equal to but stronger than apical, 2nd marginal short, the posterior margin a little longer than the molar plate.

Pronotum subrectangular, as broad as head-width without eyes, much broader than long, anterior margin concave without being any median notch, posterior margin with a weak median emargination. Anterolateral corners narrowly and posterolateral corners broadly rounded ; body with a few errect hairs. Legs short and hairy, apical tibial spur formula 3 : 3 : 3, outer spur longest and inner spur smallest in all the legs. Tarsi 4-segmented, arolium present. *Wings scale :* Fore-wing scale much longer than and covering the hindwing scale. Hindwing scale shorter.

Abdomen oblong, hairy ; cerci 2-segmented. Styli (in male) 1-segmented.

SOILDER (Fig. 2, A-G ; Table 2) : Head-capsule brown, gradually becoming black ante-

TABLE—1. Measurements (in mm.) etc., of *Glyptotermes krishnai* sp. nov. and *G. nicobarensis* sp. nov.

CASTE — Imago

	Body-parts	*G. krishnai* (1 Dealate)	*G. nicobarensis* (4 exs.)
1.	Total body-length with wings (excluding antennae)	—	6.00-6.70
2.	Total body-length without wings, (excluding antennae)	4.25	4.10-4.30
3.	Length of head to lateral base of mandibles	0.88	0.88-0.95
4.	Maximum width of head (with eyes)	0.84	0.84-0,92
5.	Maximum height of head	0.50	0.61-0.64
6.	Maximum length of post-clypeus	0.05	0.11-0.14
7.	Maximum width of post-clypeus	0.57	0.38
8.	Maximum length of labrum	0.26	0.23-0.26
9.	Maximum width of labrum	0.38	0.26-0.30
10.	Maximum diameter of compound eye (with ocular sclerite)	0.25	0.26
11.	Maximum diameter of lateral ocellus	0.07	0.07-0.08
12.	Minimum diameter of lateral ocellus	0.06	0.05-0.07
13.	Minimum eye-ocellus distance	Nil	0.02
14.	Minimum eye-antennal distance	0.03	0.02
15.	Maximum length of pronotum	0.57	0.53-0.56
16.	Maximum width of pronotum	0.80	0.82-0.86
17.	Length of fore-wing with scale	—	5.10-5.40
18.	Length of fore-wing scale	0.76	0.57-0.69
19.	Length of hind-wing with scale	—	4.60-4.80
20.	Length of hind-wing scale	0.61	0.19-0.23
21.	Number of antennal segments	broken	11

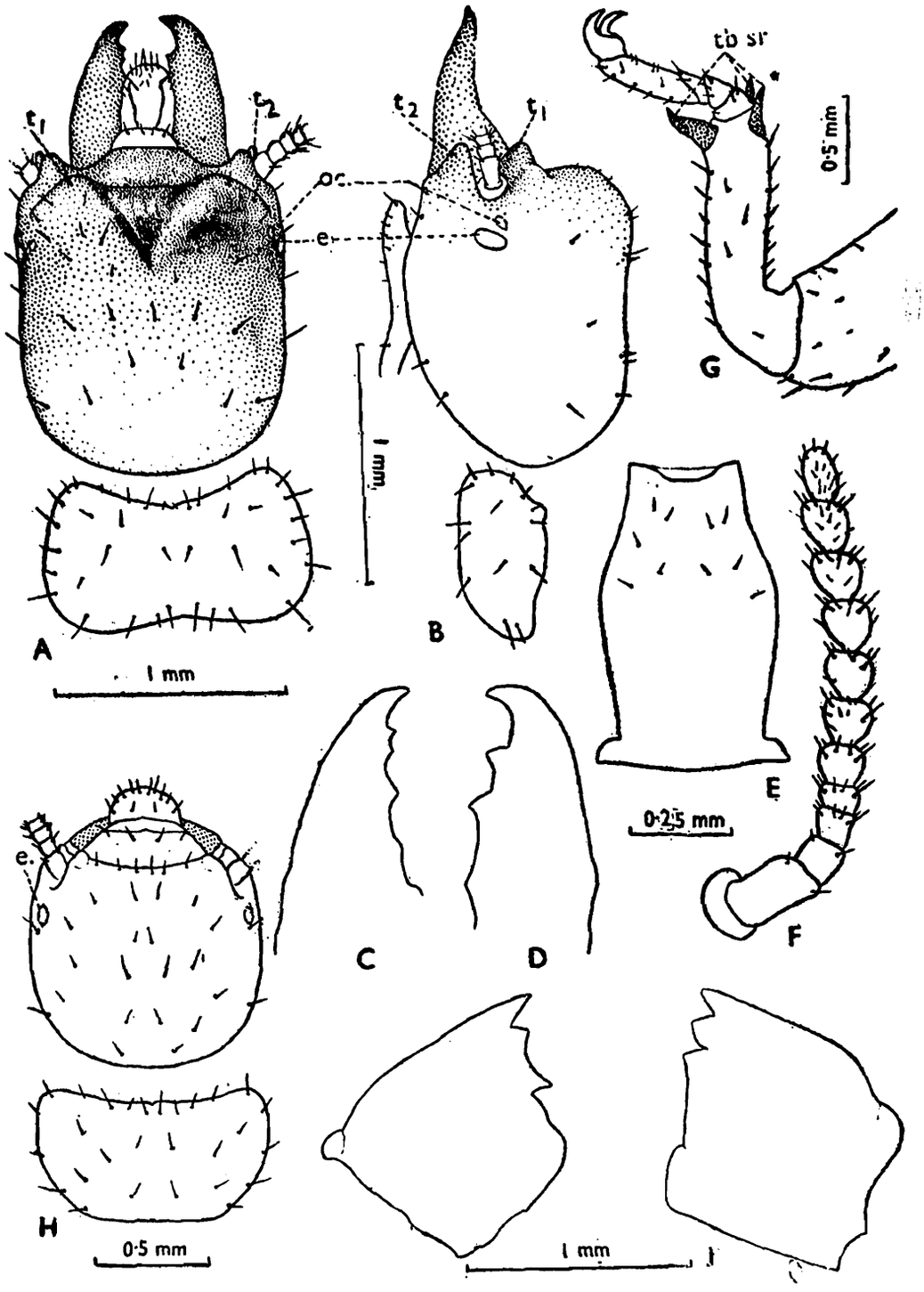


Fig. 2. *Glyptotermes krishnai* new species. Soldier and pseudoworker, A-G. Soldier A. Head and pronotum, in dorsal view ; B. Same in side view (t_1- projection on dorsal gena, t_2 horn-like projection on ventral gena, e- eye, o-ocellus) ; C. Left mandible ; D. Right mandible ; E. Postmentum ; F. Antenna ; G. Tibial spurs (tb. sr.) on right fore tibia. H-J. Pseudoworker. H. Head and pronotum in dorsal view ; I. Left mandible ; J. Right mandible.

TABLE 2—Measurements (in mm.), indices, etc. of *Glyptotermes krishnai* sp. nov. and *G. nicobarensis* sp. nov.

Caste — Soldier

Body-parts	*G. krishnai* Range (8 exs.)	*G. krishnai* Holotype	*G. nicobarensis* Range (4 exs.)	*G. nicobarensis* Holotype
1. Body-length including mandible	5.40—6.00	5.80	5.10—6.60	5.50
2. Length of head to lateral base of mandibles	1.15—1.23	1.15	1.50—1.73	1.69
3. Maximnm width of head	1.15—1,20	1.15	1.00—1.03	1.00
4, Maximum height of head	0.95—1.05	1.00	0.92—0.96	0.92
5. Head-index I (width/length)	0.97—1.00	1.00	0·59—0.66	0.59
6. Head-index II (height/width)	0.82—0.87	0,86	0.92—0.96	0.92
7. Head-index III (height/length)	0.82—0.85	0.85	0.54—0.62	0.54
8. Maximum length of labrum	0.25—0.27	0.26	0.23	0.23
9. Maximum width of labrum	0.23—0.26	0.23	0.25—0,27	0.25
10. Maximum length of mandibles (a) right mandible	0.62—0.67	0.65	0.61—0.69	
(b) left mandible	0.62—0.67	0.65	0.61—0.69	0.69
11. Head-mandibular index (left mandible length/head length)	0.53—0.54	0.56	0,35—0.41	0.41
12. Maximum diameter of eye	0.10—0.12	0.11	0.14—0.19	0.14
13. Minimum diameter of eye	0.05—0.07	0.06	0.11—0.14	0.11
14. Minimum eye-antennal distance	0.15—0.17	0.15	0.07—0.14	0.14
15. Minimum (median) length of postmentum	0.15—0.17	0.15	0.96—1.11	1.03
16. Maximum width of post-mentum	0.38—0.45	0.42	0.30—0.37	0.34
17. Minimum width of post-mentum	0.25—0.28	0.26	0.19—0.23	0.19
18, Post-mentum contraction index (min. width/max. width)	0.62—0.66	0.62	0.56—0.63	0.56
19. Maximum length of pronotum	0.67—0.75	0.67	0.53—0·61	0.57
20. Maximum width of pronotum	1.13—1.22	1.15	0.95—1.03	1.00
21. Pronotum index (length/width)	0.58—0.61	0.58	0.56—0.59	0.57
22. Head-pronotum width index (Pronotum width/head width)	0.98—1.01	1.00	0.95—1.00	1.00
23. Number of antennal segments	12	12	10—12	10

riorly ; mandibles blackish brown ; labrum dark brown ; antennae pale brown ; anteclypeus white and postclypeus black ; pronotum brown, abdomen and legs yellowish brown ; foreleg a little darker. Head and thorax moderately and abdomen fairly hairy ; each tergum with a row of hairs at posterior margin. Body-length (with mandibles, but without antennae) 5.4-6.0 mm.

Head-capsule subsquarish, slightly narrowed anteriorly, a little longer than broad ; posterior margin substraight ; la teral margins subparallel, with a little emargination just below the antennal carinae ; forehead bilobed, surface of lobes weakly rough and with a deep V-shaped depression in between lobes ; in profile, frons sharply turncated in front having median incurving ; ventral genae with a horn-like projection in between mand ible-base and below antennal socket ; a prominent tubercle on top of each of the antennal sockets ; head-dorsum with a very weak median depression. Y-suture absent.

Eyes : Suboval, white, spot-like placed a little below the antennal socket, eye-antennal distance 0.15-0.17 mm.

Ocelli : Oval and prominent.

Antennae : With 11-12 segments ; seg ments 1 and 2 sparsely, and the rest moderately pilose ; segment 1 stout, longest, 2 much smaller than 1,3 slightly smaller than 2, 3 and 4 subequal ; in some specimens 3 smallest (in 11 segmented antennae) in others 4 smallest (in 12 segmented antennae) ; 5-10 subequal and conical last one small.

Clypeus : Postclypeus strongly chitinized, broader than long, anterior margin substraight ; posterior margin not clearly demarcated from frons ; lateral margins raised a little to form a shallow median depression. Anteclypeus white, strip-like, sloping downwards ; much broader than long and weakly narrowing in front ; anterior margin weakly convex, provided with a few long hairs.

Labrum : Longer than broad, reaching much above half of the mandibles ; anterior margin sub-rounded ; lateral margins weakly convex ; a few hairs on the body.

Mandibles : Small, stout and with a weak basal hump on outer margin ; almost half the length of head to lateral base of mandible. Left mandible with three marginal teeth ; 1st and 2nd small and close to each other, with concave margin in between ; 3rd comparatively long and placed moderately below the 2nd. Right mandible with two stout marginal teeth ; 1st placed much below the apical tip (distance from tip, *ca.* 0.18-0.19 mm. ; 2nd stouter than 1st.).

Postmentum : Longer than broad, sparsely pilose anteriorly ; maximum width at the anterior one-third, whence the lateral margin narrowing both anteriorly and posteriorly ; anterior margin concave ; posterior margin weakly convex.

Pronotum : Almost as broad as head, with a few long and short hairs ; anterior margin broadly and deeply concave ; posterior margin fairly deeply emarginated ; anterolateral angles narrowly and posterolateral angles broadly rounded.

Legs : Short and stout ; foreleg a little stouter ; sparsely hairy ; apical tibial spur formula 3 : 3 : 3 ; foretibia with a thick conspicuous spur on outer side near the tip, much thicker and larger than other two apical spurs (Text-fig. 2, G) in the same tibia. Tarsi 4-segmented.

Abdomen elongate ; both tergites and sternites sparsely hairy. Cerci 2-segmented. Styli 1-segmented.

PSEUDOWORKER (Fig. 2, H, I) : Head-capsule and antennae white ; labrum, post-clypeus, pronotum, legs and abdomen brownish white. Head, thorax and abdomen fairly pilose. Body-length without antennae 4.50-5.65 mm.

Head-capsule subcircular ; almost as long as broad ; lateral margins weakly convex ; posterior margin ronnd. Eyes suboval, fairly large, white. Ocelli absent. Antennae with 12 segments, sparsely hairy ; segment 1 stout and longest, 2 much smaller than 1, 3 subequal to 2, 4 smallest, 5-11 conical, broader than long, last (12) ovate and small. Post-clypeus strongly chitinized, pilose. Labrum a little broader than long ; anterior margin substraight : lateral margins weakly convex ; with a few short hairs on body. Mandibles of typical Glyptotermes-type. Left mandible with an apical and two marginal teeth ; apical finger-like, 1st marginal small and close to apical, 2nd equal to 1st and widely separated from it, margin between 1st and 2nd without having any notch. Right mandible with an apical and two marginal teeth ; apical finger-like ; 1st blunt, equal and close to apical ; 2nd smaller and close to 1st, with a long posterior margin.

Pronotum broader than long, slightly narrower than head-width ; anterior margin broadly concave, posterior margin with a weak median emargination ; anterolateral corners narrowly and posterolateral corners broadly rounded ; long and short hairs on all margins. Legs short and pilose. Tibial spur formula 3 : 3 : 3. Tarsi 4-segmented.

Abdomen elongate and pilose. Cerci 2-segmented. Styli 1-segmented.

Measurements (in mm.) of pseudoworker (range of ten examples) : Length of head to tip of labrum 1.20-1.27 ; length of head to lateral base of mandibles 0.92-1.00 ; max. width of head 1.00-1.11 ; max. height of head 0.65-0.75 ; max. width of laburm 0.29-0.37 ; max. length of labrum 0.15-0.24 ; max. length of pronotum 0.60-0.69 ; max. width of pronotum 0.90-1.03.

Type-specimens : All specimen in spirit from a single source (vide "Material" above) deposited in separate vials, as follows :—

Holotype : Soldier (Z. S. I. Reg. No. 2528/H_{11}) from material above, in Z. S. I., Calcutta. Morphotype : 1 dealate and 2 pseudoworkers (Z. S. I. Reg. No. 2529/H_{11}) from holotype-lot, in Z. S. I., Calcutta. *Paratype* soldiers and *paramorphotype* pseudoworkers : (i) 9 soldiers and 5 pseudoworkers, (Z. S. I. Reg. No. 2530/H_{41}) in Z. S. I., Calcutta ; (ii) 1 soldier and pseudoworker, in Forest Research Institute, Dehra Dun, U. P. ; and (iii) 1 soldier and 1 pseudoworker in American Museum of Natural History, New York.

Type-locality etc. : Champa Bay, Great Nicobar Island. Known only from the type-locality.

Comparison : The soldier of *Glyptoiermes krishani* sp. nov. can easily be separated from all the other species of the genus in having a large, thick, outer apical tibial spur on the foreleg, and it is much larger than the other two apical spurs and in having very prominent tubercules on frons, one on either side, a little above antennal sockets.

Remarks : On primary examination, this species appears to belong to the genus *Calcari termes*, because of the presence of a large, thick outer spur near the tip of front tibia of soldier. Dr. Kumar Krishna of American Museum of Natural History, New York, kindly examined the specimens of this species. He, in personal communication, mentioned "On the basis of the tibial spur, the soldier belongs to the

genus *Calcaritermes*. However, in all the *Calcaritermes* in our collection which have the prominent front tibial spur, two of the three tibial spurs in the middle and hind tibiae are darker in colour and shorter than the third tibial spur in the same leg. I do not find this characteristic in the soldier which you gave me. Also your soldier has a prominent tubercle on top of the antennal socket, and this prominent tubercle is not found in any of the other *Calcaritermes* species. However, it is found in some *Glyptotermes*. In addition, if this species is placed in *Calcaritermes*, the distribution of the genus will be anomalous. The genus *Speculitermes* which was presumed to have such an anomalous distribution (Neotropical, Indomalayan), is now proving to be two separate genera. A tibial spur like the one found in your specimen, which is like that of *Calcaritermes* could have developed independently in *Glyptotermes*. I myself would be very hesitant to put it in the genus *Calcaritermes*. I would put in *Glyptotermes*, explaining that this character could have developed independently, though of course this will be difficult to prove. I have discussed this problem with Dr. Emerson, and he agrees with me." Basing on Dr. Krishna's opinion, the species has been placed in the genus *Glyptotermes*.

2. Glyptotermes nicobarensis, new species

Material : (i) One vial with 2 soldiers, sev. pseudoworkers, 8 imagos and sev. imago-nymphs from Laksman Beach, Campbell Bay, Great Nicobar ; Stn. No. 11, F. C. No. 2, *P. K. Maiti and party coll.*, 28.xii.1975, ex. "decaying fallen log lying on ground." (ii) One vial with 2 soldiers, sev. pseudoworkers, 2 imagos and imago-nymps from Rajendra nagar, 35 km. from Campbell Bay, Great Nicobar, *B. Nandi and party coll.*, 6.xii.1978, ex. "fallen log".

Description :

1. *IMAGO* (Figs. 3 and 4, Table 1) :

Head, thorax and tergites chestnut brown ; labrum, antennae, legs and sternites paler ; mandibles brown with dark brown toothed margines. Head and thorax sparsely and abdomen fairly densly hairy. Total body-length with wings 6.00-6.70 mm. without wings 4.10-4.30 mm.

Head-capsule as long as broad or slightly broader than long ; sides without eyes sub-straight, strongly rounded at the posterolateral corners ; posterior margin round.

Fontanelle : Absent.

Eyes : Medium sized, subcircular, separated from lower margin of head by less than half its diameter.

Ocelli : Oval, translucent, only slightly separated from the eye on its side.

Antennae : With 11 segments ; sparsely pilose ; segment 1 longest, cylindrical, 2 shorter than 3, 3 almost equal to 2 and 4 combined, 5 to the penultimate segments pyriform and gradually increasing in size ; the last one ovate, shorter than the others.

Clypeus : Subtrapezoid, Anteclypeus hyaline, strip-like, apilose. Postclypeus depressed and brown with few hairs.

Labrum : Slightly broader than long, anterior margin subround with a few hairs on its body.

Mandibles : Subsquarish. Left mandible with an apical and 2 marginal teeth ; apical finger-like ; 1st marginal shorter than apical ; posterior margin of 1st marginal tooth subequal to anterior margin of 2nd marginal

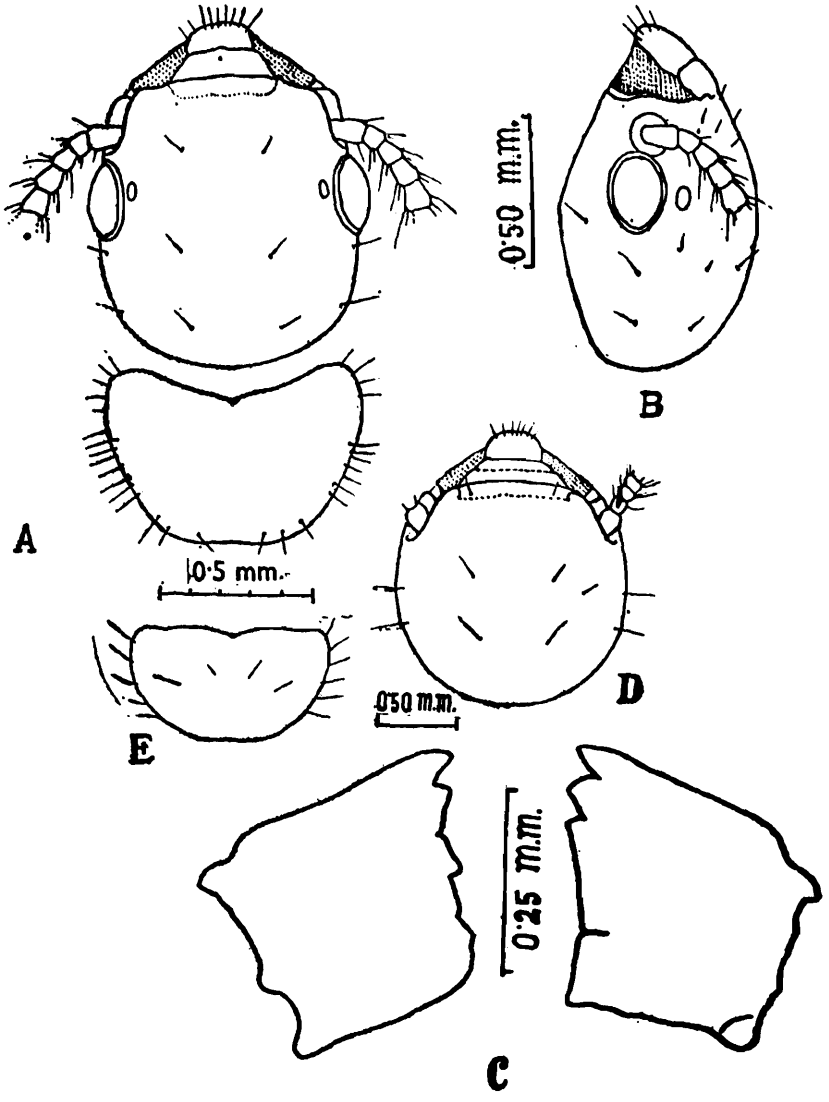


Fig. 3. *Glyptotermes nicobarensis*, new species. Imago and pseudoworker. A-C. Imago. A. Head and pronotum in dorsal view ; B. Same in side view ; C. Mandible of Imago. D-E. Pseudoworker. D. Head in dorsal view ; E. Pronotum in dorsal view.

tooth with a notch in between, 2nd equal to 1st. Right mandible also with an apical and 2 marginal teeth ; apical finger-like, 1st marginal triangular and broad. Posterior margin of 2nd very much long.

Pronotum : Slightly narrower than or as wide as width of head with eyes, much broader than long ; anterior margin deeply concave without a median notch ; anterolateral corners narrowly and posterolateral corners broadly, rounded ; posterior margin weakly convex, without distinct median emargination.

Legs : Short, stout and pilose ; tibial spur formula 3 : 3 : 3, Tarsi 4-segmented. Arolium present.

Wings : Darkbrown membranous, covered with prominent scales.

Fore wings : A little longer than hind wing ; scale also longer and covering the

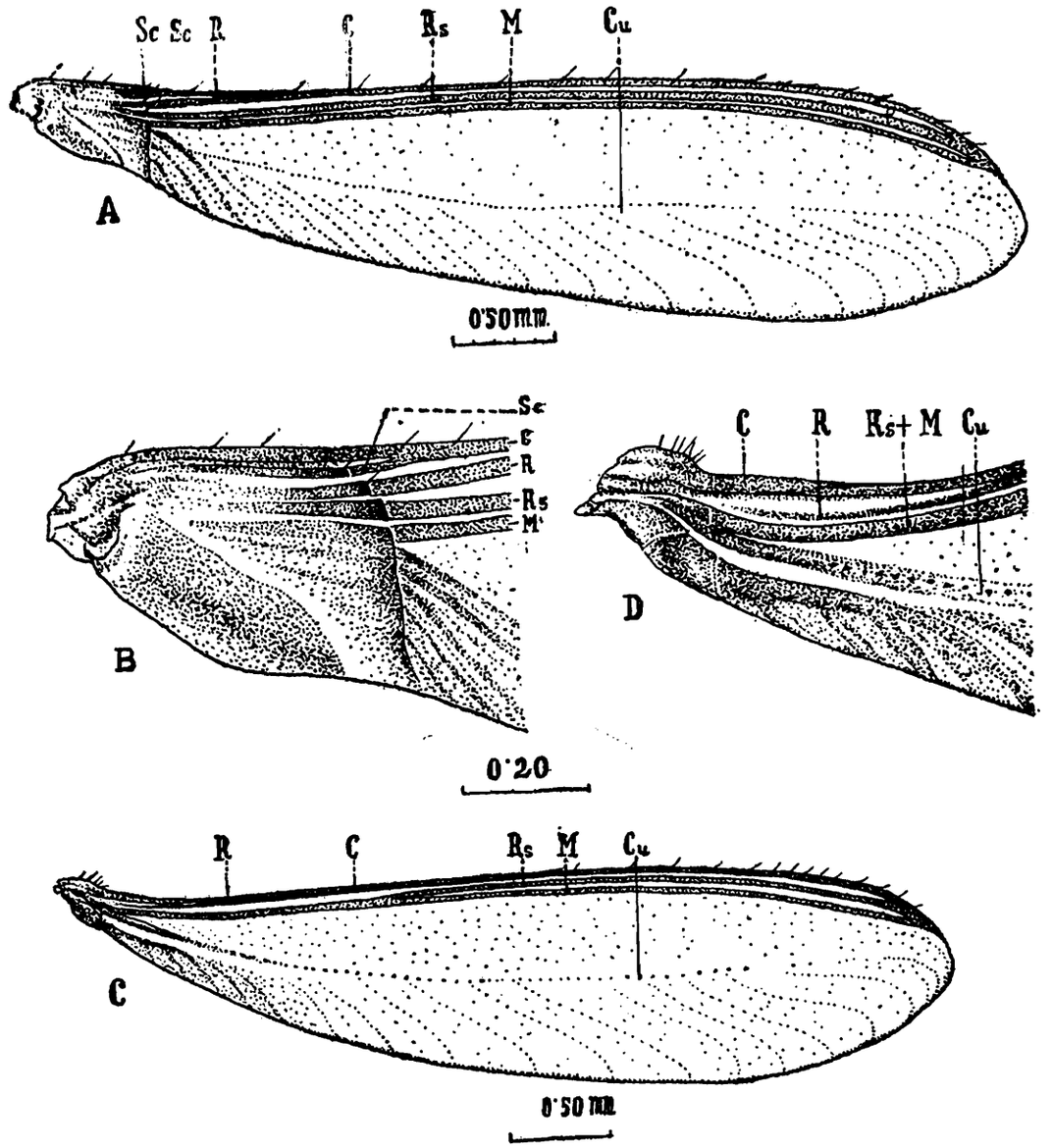


Fig. 4. *Glyptotermes nicobarensis*, new species. Wings. A. Forewing in dorsal view. B. Same, proximal portion enlarged. C. Hindwing in dorsal view. D. Same, proximal portion enlarged. C., costa ; Cu-, cubitus ; M., median ; R., radius ; Rs., radial sector ; Sc., subcosta.

hind wing scale. Costa, subcosta, radius, radial-sector and median strongly chitinised and thick ; cubitus generally weak but strong at its origin. Costa bordering the anterior margin and running upto distal end. Subcosta minute, fused with the costa a little outside the scale. Radius short, arising independently and fusing with the costa at the anterior one-sixth of the wing. Radial sector originating from the same stalk of radius inside the scale but arising separately from scale and running almost parallel with costa upto the distal end. Radial sector without any branches or cross veins. Median also a little curving up and running close to and parallel with radial sector. Cubitus running medially and with 11-12 branches to posterior margin ; cross veins between cubitus and median absent.

Hindwing : Costa, radius and radial-sector

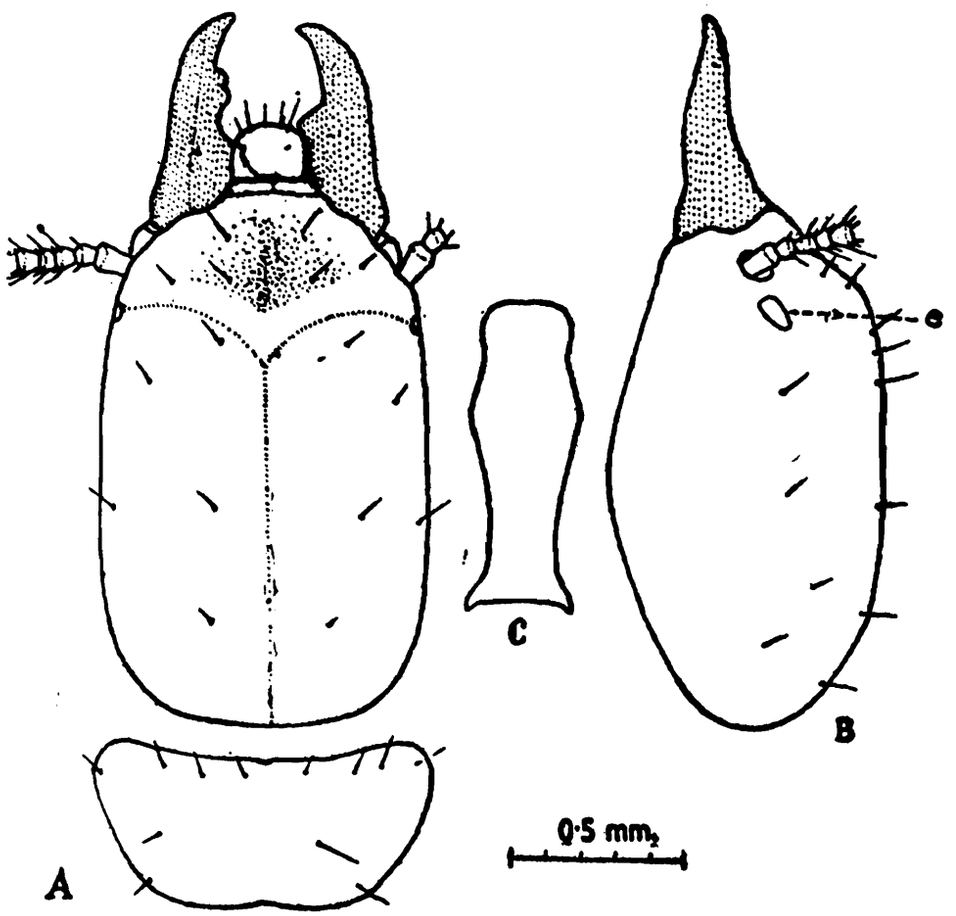


Fig. 5. *Glyptotermees nicobarensis*, new specise. Soldier. A. Head and pronotum in dorsal view ; B. Same in side view ; C. Postmentum.

as in fore-wing. Subcosta absent. Median arising from the radial-sector at about anterior one-third of wing membrane from the scale, and running close to and parallel with the radial sector upto the distal end. Cubitus as in forewing, with 12-13 branches to posterior margin ; cross veins between cubitus and median absent.

Abdomen-oblong ; sparsely hairy ; cerci 2-segmented with long hairs ; styli (in males) 1-segmented.

SOLDIER (Fig. 5, Table 2) :

Head-capsule reddish brown, paler posteriorly ; antennae, labrum, legs and abdomen pale yellowish brown ; mandibles black apically. Head and body sparsely pilose, Body-length 5.10-6.60 mm.

Head-capsule subrectangular : about more than one and a half times as long as broad ; anterolateral corners not prominent ; lateral margin substraight ; posterolateral corners broadly rounded ; frons smooth and weakly depressed medially and inclined at an angle of 45° ; Y-suture feeble.

Eyes : Subround, whitish ; eye-antennal distance less than maximum diameter of eye.

Ocelli : Absent.

Antennae : With 10-12 segments ; all segments except 1 and 2, fairly pilose ; seg-

ment 1 large and cylindrical, 2 smaller than 1 and a little larger than 3, the latter smallest and thinnest, 4 longer than 3, remaining segments except the last one broad anteriorly and narrow posteriorly, the last one narrower.

Clypeus : Postclypeus depressed dorsally and pilose anteriorly. Anteclypeus a translucent norrow strip and apilose. Labrum slightly broader than long, pilose near tip, subround anteriorly and lateral margin substraight.

Mandibles : Short, more than one-third as long as head-capsule, moderately hooked apically. Left mandible with 3 marginal teeth ; 1st weakly pointed upwards, 2nd blunt and close to 1st, 3rd minute and pointed, placed much below the 2nd, inner margin between 2nd and 3rd widely concave. Right mandible with two marginal teeth ; 1st marginal placed almost at the middle with long anterior margin, 2nd smaller than 1st and placed a little below the 1st.

Postmentum : Club-shaped, anterior two-third portion broad and posterior one-third narrow, anterior portion slightly less than double the minimum width, both anterior and posterior margin substraight.

Pronotum : Flat, as wide as head, length more than half the width, anterior margin broadly concave, lateral and posterior margin weakly convex, latter with a weak median emargination.

Legs : Short, slender and pilose. Tibial spur formula 3 : 3 : 3. Tarsi 4-segmented.

Abdomen elongate and cylindrical, sparsely hairy. Cerci 2-segmented, short and hairy. Styli 1-segmented.

PSEUDOWORKER (Fig. 3, D. E) : Body creamy white and elongated. Head capsule straw yellow ; antennae, thorax, leg and abdomen paler. Mandibles yellowish with dark brown tooth margin. Head and body sparsely hairy. Head : Head-capsule sub circular, as long as wide, side convex, posterior margin rounded. Fontanelle and Ocelli absent. Eyes : Subround, same colour as that of head. Antennae : With 9 segments, 2 longer than 3, 3 longer than 4, remaining gradually increasing in size. Clypeus : Indistinctly divided into an ante- and a post-clypeus with a few hairs near posterior margin. Labrum : Broadly tounge shaped broader than long ; with a few hairs near anterior margin and on body ; anterior margin subround. Mandibles : Like that of imago.

Pronotum : Wider than long with shalowly conncave anterior margin, lateral sides converging posteriorly. Legs ; Short and stout ; apical tibial spurs 3 on each leg. Tarsi 4-segmented.

Abdomen oblong, sparsely hairy. Cerci 2-segmented. Styli 1-segmented.

Measurements (in mm.) of pseudoworker (range five examples) : Length of head to tip of labrum 0.94-1.14 ; length of head to lateral base of mandibles 0.76-1.00 ; max. width of head 0.78-100 ; max. height of head 0.61 ; max. width of labrum 0.26-0.30 ; max. length of labrum 0.16-0.23 ; max. length of pronotum 0.38-0.57 ; max. width of pronotum 0.65-0.88.

Type-specimens : Specimens in spirit, deposited in separate vials, as follows :—

Holotype : Soldier (Z. S. I. Reg. No. 2531/$H_{1\ 1}$) from "Material (i)" above, in Z.S.I., Calcutta.

Morphotype : 1 Imago and 2 pseudo-

workers (Z. S. I. Reg. No. 2532/H_{11}) from holotype lot, in Z. S. I., Calcutta, paratype soldiers and Paramorphotype imagos : (i) 3 soldiers and 6 imagos and 5 pseudoworkers (Z. S. I. Reg. No. 2533/H_{11}) in Z. S. I., Calcutta. (ii) 1 imago in Forest Research Institute, Dehra Dun, U. P. (iii) 1 imago in American Museum of Natural History, New York, U. S. A.

Type-locality, etc. : Laksman beach, Campbell Bay, Rajendranagar, Great Nicobar Island. Known only from the type-locality.

Comparison : *G. nicobarensis* is very close to *G. almorensis* Gardner from Almora, U. P. and *G. minutus* Kemner, from Ceylon, but differs from them as follows : —

From *G. almorensis :*

Imago : (i) Antennae with 11 segments, 2nd shorter than 3rd (*vs.* antennae with 12 segments, 2nd longer than 3rd). (ii) Anterior margin of pronotum deeply concave, anterolateral corners narrowly and posterolateral corners broadly rounded, lateral margins strongly converging posteriorly (*vs.* weakly concave and both the antero- and postero-lateral corners broadly rounded, lateral margins almost parallel sided).

Soldier : (i) Mandible shorter, weakly hooked, more than one-third as long as head-capsule ; 1st and 2nd marginal teeth of left mandible blunt and very closely placed, 3rd widely separated from 2nd with strong concavity in between (*vs.* mandibles comparatively longer, strongly hooked, a little less than half the head-capsule ; 2nd and 3rd marginal teeth moderately pointed and not so closely placed, 3rd comparatively closely placed with weak concavity in between). (ii) Head index (Height/Width) 0.92-0.96 (*vs.* 0.80-0.87). (iii) Postmentum narrower 0.30-0.37 mm. contraction index 0.56-0.63, lateral margins anterior to maximum width incurved (*vs.* wider 0.40-0.43, contraction index 0.47-0.57 lateral margins almost straight.).

From *G. minutus :*

Imago : (i) Head thicker, 0.61-0.64 mm. (*vs.* thinner 0.47 mm.). (ii) 2nd antennal segment shorter than 3rd (*vs.* 2nd equal to 3rd). (iii) Ocelli slightly separated from the eye (*vs.* ocelli almost touching the eyes). (iv) Pronotum narrower than or as wide as head-width with eyes, anterior margin deeply concave, lateral margins strongly converging posteriorly (*vs.* pronotum much narrower, anterior margin shallowly concave, lateral margins almost parallel sided).

Soldier : (i) Head wider 1.00-1.03 (*vs.* narrower 0.74-0.92). (ii) Postmentum widest at the anterior one-third, lateral margins anterior to the maximum width incurved (*vs.* widest at the anterior one-fourth, lateral margins almost straight). (iii) Lateral margins of the pronotum converging posteriorly (*vs.* almost parallel sided).

ACKNOWLEDGEMENTS

The authors offer their grateful thanks to Dr. T. N. Ananthakrishnan, Director, Zoological Survey of India, Calcutta, for providing necessary facilities for the work and to Dr. O. B. Chhotani and Mrs. G. Chhotani for their unstinted help.

REFERENCES

AKHTAR, M. S. 1975. Taxonomy and Zoogeography of the Termites (Isoptera) of Bangladesh. *Bull. Zool. Panjab, Univ.* (N. S.), (7) : 1-200, Text-figures 1-89, Lahore.

CHHOTANI, O. B. 1975. Revision of the genus *Glyptotermes* Froggatt (Kalotermitidae) from the Indian region. *Rec. zool. Surv. India*, 68 : 109-159.

FROGGATT, W. W. 1896. Australian Termitidae. Part 2. *Proc. Linn. Soc. N.S.W.*, 21 : 510-552.

GARDNER, J. C. M. 1944. New Termitidae from India and Burma (Isoptera). *Indian J. Ent.* 6 : 103-110.

HOMGREN, K. and HOLMGREN, N. 1917. Report on a collection of termites from India. *Mem. Dep. Agric. India. ent. Ser.*, 5 (3) : 138-171.

MAITI, P. K. 1979. The composition and geographical origin of the termites (Isoptera) of the Great Nicobar Island, Indian Ocean. *Proc. Zool. Soc.*, 30 (1977) : 135—139.

MATHUR, R. N. and SEN-SARMA, P. K. 1960. *Glyptotermes nigrifrons* sp. n. from South India (Insecta : Isoptera : Kalotermitidae). *Entomologist*, 93 : 79-85.

SNYDER, T. E. 1949. Catalog of the termites (Isoptera) of the world. *Smithson. misc. Collns*, 112 : 1-490.

Bull. zool. Surv. India, 4(1) : 85—93, 1981

A COMPARATIVE ANALYSIS OF THE WESTERN AND EASTERN HIMALAYAN POPULATIONS OF *LABEO DYOCHEILUS* (MCCLELLAND) (PISCES : CYPRINIFORMES) WITH A DISCUSSION OF ITS SPECIFIC COMPOSITION

MRINAL K. DAS AND K. C. JAYARAM

Zoological Survey of India, Calcutta

ABSTRACT

Labeo dyocheilus (McClelland) is widely distributed in the Himalayan range and its base and is found in the Indus, Ganga, Jamuna, Brahmaputra and Mahanadi river systems. The Western Himalayan population of the species was segregated as a separate group by Mukerji (1934). He did not give any name but indicated the composition of the species according to its geographical distribution. Mirza and Awan (1976) described the Western Himalayan population as a subspecies *L. dyocheilus pakistanicus*. In this paper the infra-structure of the Western and Eastern Himalayan populations is statistically analysed and the provision of a subspecies rank for the Western Himalayan population is justified.

INTRODUCTION

Among the fishes of the carp family Cyprinidae, many species of the genus *Labeo* occupy a prime place in view of their fast growth, rich flesh content and popular demand. The genus is distributed through Africa, Syria, Pakistan, India. Bangladesh, Sri Lanka, Burma, Nepal, Thailand, Malay Archipelago to China.

Labeo dyocheilus was first described by McClelland (1839) from Brahmaputra river. It is widely distributed in the Himalayan range and its base and is found in the Indus, Ganga, Jamuna, Brahmaputra and Mahanadi river systems. The systematic status of this species has been in confusion and many specimens have often been misidentified with its allied species *Labeo dero* (Hamilton). Mukerji (1934) reporting upon the fish collections made by Lt. Col. R. W. Burton from the tributary streams of the Mali Hka river, Myitkyina Dist., Burma stated that "*Labeo dyocheilus* is a very variable species and according to its geographical distribution the species may be divided into the following groups :

1. Western Himalayan form.
2. Eastern Himalayan and Assamese form, *i. e., forma typica.*
3. Burmese and Siamese form."

Hora (1936) showed the material from Burma (Burton's coll.), which were identified by Mukerji (1934) as *L. dyocheilus*, as representing *L. dero*. Later Hora (*op. cit.*) separated the Burmese and Siamese form, which differ from the typical *L. dero*, as a new species—*Labeo devdevi* (see Jayaram and Das, 1980). Recently Mirza and Awan (1976) described the Western Himalayan population of *L. dyocheilus* as a different subspecies and named it *L. dyocheilus pakistanicus*. In the present study the Western and Eastern Himalayan populations are statistically analysed

and compared to ascertain their exact specific status by computing the degree of diversity and interrelationship among them.

Material Examined

A. *Western Himalayan Population* : Total 82 examples (Range of SL-44.35-295.0 mm).

1. ZSI F 4587/2, 40 exs., A branch of Pulin nala and its union with Tawi river, nearly 1.6 km east of Nagrota, Jammu Dist., R. Tilak coll., 28.10.64.

2. ZSI F 4607/2, two exs., Choe nala, 16.8 km west of Jammu Dist., R. Tilak coll., 18.10.64.

3. ZSI F 4585/2, two exs., A branch of Tawi river, nearly 3.2 km down stream from Nagrota, Jammu Dist., R. Tilak coll., 30.1.64.

4. ZSI F 4609/2, three exs., A branch of Tawi River, 200 yds down stream from Bridge, Jammu Dist., R. Titak coll., 21.10.64.

5. ZSI F 4608/2, seven exs., A branch of Tawi river, 1.6 km up stream from Jammu, R. Tilak coll., 24.10.64.

6. ZSI F 4586/2, 26 exs., Tawi river, 3.2 km down stream from Nagrota, Jammu Dist., R. Tilak coll., 30.10.64.

7. ZSI. 1533, one ex., Simla, Purchased F. day.

8. ZSI 1522, one ex., Hardwar, Purchased F. Day.

B. *Eastern Himalayan Population* : Total 46 examples (Range of SL=66.2—266.0 mm).

1. ZSI F 25542 17 exs., Belsari river, a tributary of Brahmaputra river, about 32 km from Lokra (Balipara Frontier Tract), Assam, S. L. Hora coll. 12.11.39.

2. ZSI F 1673/2, one ex., A stream, 6.4 km west of Sambhunath, Kathmandu valley, Nepal, A. K. Dutta coll., 22.6.58.

3. ZSI F 12279/1, one ex., Tarai, Nepal, F. M. Bailey coll., Feb., 1936.

4. ZSI Cat 698, five exs., Mandalay, F. Day coll.

5. ZSI Cat 700, one ex., Mandalay, Major Sladen coll.

6. ZSI F 2456/2, three exs., Amatulla river, 3.2 km south of Amatulla village, Kameng Fron. Div., NEFA, K. C. Jayaram coll., 8.3.61.

7. ZSI FF 1584, four exs., Assam, H.A.H. coll.

8. ZSI FF 1585, two exs., Calcutta bazar.

9. ZSI FF 1586, three exs., Rangoli Dam, Barkot Dist., Sambalpur, Orissa, T. K. Sen coll., 16.4.73.

10. ZSI FF 1123, three exs., Streams flowing by Ganapati Hills, South Kamrup, Assam, A. K. Mukherjee coll., 11.9.75.

11. ZSI FF 1587, four exs., Tezpur, Assam, T. K. Sen coll., 1975.

12. ZSI FF 1588, one ex., Birtalla village near Brahmani river, Banki, Orissa, T. K. Sen coll., 30.3.73.

13. ZSI FF 1589, one ex., Received from Tech. Advisor to the Settlement Officer, Khulna, Bangladesh, 3.5.26.

Description

Western Himalayan Population

Head and body laterally flattened. Body deepest just in front of dorsal fin. Head relatively large and covered with integument. Snout prominent, muscular, more or blunt anteriorly. Front part of snout covered with spiny tubercles and/or pores. Lateral lobe distinct. Mouth inferior, fairly large, crescentic and extending up to level of nostrils. Lips thick, Fleshy, continuous at angle of mouth. Dorsal surface of free portion of lower lip covered with series of ridges. Labial fold interrupted. Eyes prominent, situated laterally in middle or posterior half of head. Interorbital space slightly convex. Nostrils wide,

TABLE I—Frequency distribution of meristic counts*

Fin rays

Population	DORSAL			PECTORAL				PELVIC		ANAL	CAUDAL	
	iv/9	iv/10	iv/11	i/13	i/14	i/15	i/16	i/8	i/9	iii/5	9+9	10+9
W. Himalayan	4	77	1	—	15	59	8	80	2	82	3	76
E. Himalayan	1	41	4	2	6	32	6	46	—	46	1	45

Scales

Population	No. of LL Scales								No. of pre-dorsal scales					Circumpeduncular scales					
	37	38	39	40	41	42	43	44	14	15	16	17	18	20	21	22	23	24	25
W. Himalayan	1	—	1	7	25	30	12	1	9	53	11	2	1	—	18	48	7	5	2
E. Himalayan	—	—	1	8	5	14	11	2	3	22	8	4	—	7	12	21	3	—	—

Population	No. of L. tr. Scales							
	$7\frac{1}{2}/5\frac{1}{2}$	$7\frac{1}{2}/6\frac{1}{2}$	$7\frac{1}{2}/7\frac{1}{2}$	$8\frac{1}{2}/5\frac{1}{2}$	$8\frac{1}{2}/6\frac{1}{2}$	$9\frac{1}{2}/6\frac{1}{2}$	$9\frac{1}{2}/6\frac{1}{2}$	$9\frac{1}{2}/7\frac{1}{2}$
W. Himalayan	—	—	1	1	55	12	2	4
E. Himalayan	6	1	—	15	20	—	—	—

*Counts given only for undamaged specimens.

prominent, situated nearer eyes than tip of snout. One pair of small maxillary barbels at angle of mouth.

Dorsal fin inserted above tip of pectoral fin from 9th, 10th or 11th lateral line scale and almost equidistant between tip of snout and caudal fin base. Pectoral, pelvic and anal fins moderately long ; pectoral not reaching pelvic ; pelvic not reaching anal; in some specimens tip of anal just reaching caudal fin base. Caudal fiin deeply forked, upper lobe of caudal slightly longer than lower lobe in some. All rays of dorsal, pectoral, pelvic and anal fins with fleshy lateral lappets towards their base.

Lateral line complete.

Scales moderate sized, arranged in regular fashion on body, those on chest considerably reduced in size. Well developed scaly appendages at base of pelvic fins. The frequency distribution of certain scale and fin-ray counts are given in Table-I.

Colour :

In alcohol preserved specimens dark brown

on the dorsal and lateral sides and yellowish pink below.

*Body proportions** :

Length of head 3.13—4.29 (3.44), body depth 3.33—4.46 (3.94), pre-dorsal distance 1.95—2.41 (2.06), post-dorsal distance 1.66—1.9 (1.77), pre-pelvic distance 1.67—1.95 (1.82), pre-anal distance 1.22—1.34 (1.28), dorsal fin length 3.56—4.37 (3.97), pectoral fin length 4.24—5.38 (4.89), pelvic fin length 4.33—5.85 (5.36), anal fin length 4.69—5.95 (5.3) and caudal fin length 2.89—3.44 (3.12), all in standard length.

Head width 1.71—1.95 (1.81), snout length 1.97—2.77 (2.34), post-orbital length 2.06—2.74 (2.51), diameter of eye 3.83—7.17 (4.5), width of gape of mouth 2.5—3.91 (3.03), inter-orbital space width 2.16—3.36 (2.8), inter-nostrilar space width 2.99—4.8 (3.61), dorsal fin base width 1.26—1.94 (1.48), length of caudal peduncle 1.27—2.31 (1.81) and least height of caudal peduncle 1.87-3.0 (2.6), all in length of head,

Diameter of eye 1.45—3.57 (1.94) in snout length, 1.31—3.31 (1.61) in inter-orbital space width and 1.0—2.4 (1.25) in inter-nostrilar space width.

Least height of caudal peduncle 1.21—1.63 (1.44) in its length.

Pre-dorsal distance 1.51—1.99 (1.61) in pre-anal distance.

Eastern Himalayan Population :

Head and body laterally flattened. Body deepest in front of dorsal fin. Head relatively small, narrow and covered with a thick integument. Snout prominent, muscular, more or less pointed anteriorly. Front part of snout studded with spiny tubercles and/or pores all over. Lateral lobe distinct. Mouth inferior and crescentic. Lips thick, fleshy, continuous at angle of mouth. Dorsal surface of free portion of lower lip covered with series of ridges. Labial fold interrupted. Eye situated in posterior half of head. Inter-orbital space slightly convex. Nostrils wide, prominent, situated nearer eyes than tip of snout. One pair of maxillary barbels present at angle of mouth.

Dorsal fin inserted above tip of pectoral fin usually from 10th or 11th, rarely from 9th or 12th, lateral line scale and nearer tip of snout than caudal fin base. Pectoral, pelvic and anal fins long ; pectoral not reaching pelvic and pelvic not reaching anal ; in some cases tip of anal almost touching caudal fin base. Caudal deeply forked, long. All rays of dorsal, pectoral, pelvic and anal fins with thin fleshy lateral lappets towards their base.

Lateral line complete.

Scales moderate sized, arranged in regular fashion on body, those on chest considerably reduced in size. Well developed scaly appendages at base of pelvic fin. The frequency distribution of certain scale and fin-ray counts are given in Table—I.

Colour :

According to McClelland (1839) "the colours are bluish or brownish black above and on the extremities of the fins, but bluish white with various stains of red and yellow on the shoulders", while according to Day (1889) it is "of a dull green, darkest above ; fins darkest in the centre." In alcohol preserved specimens the colour is from a uniform reddish to greenish brown above and paler below.

Body proportions :

Length of head 3.38—4.33 (3.76), body

* Mean values are given in parentheses.

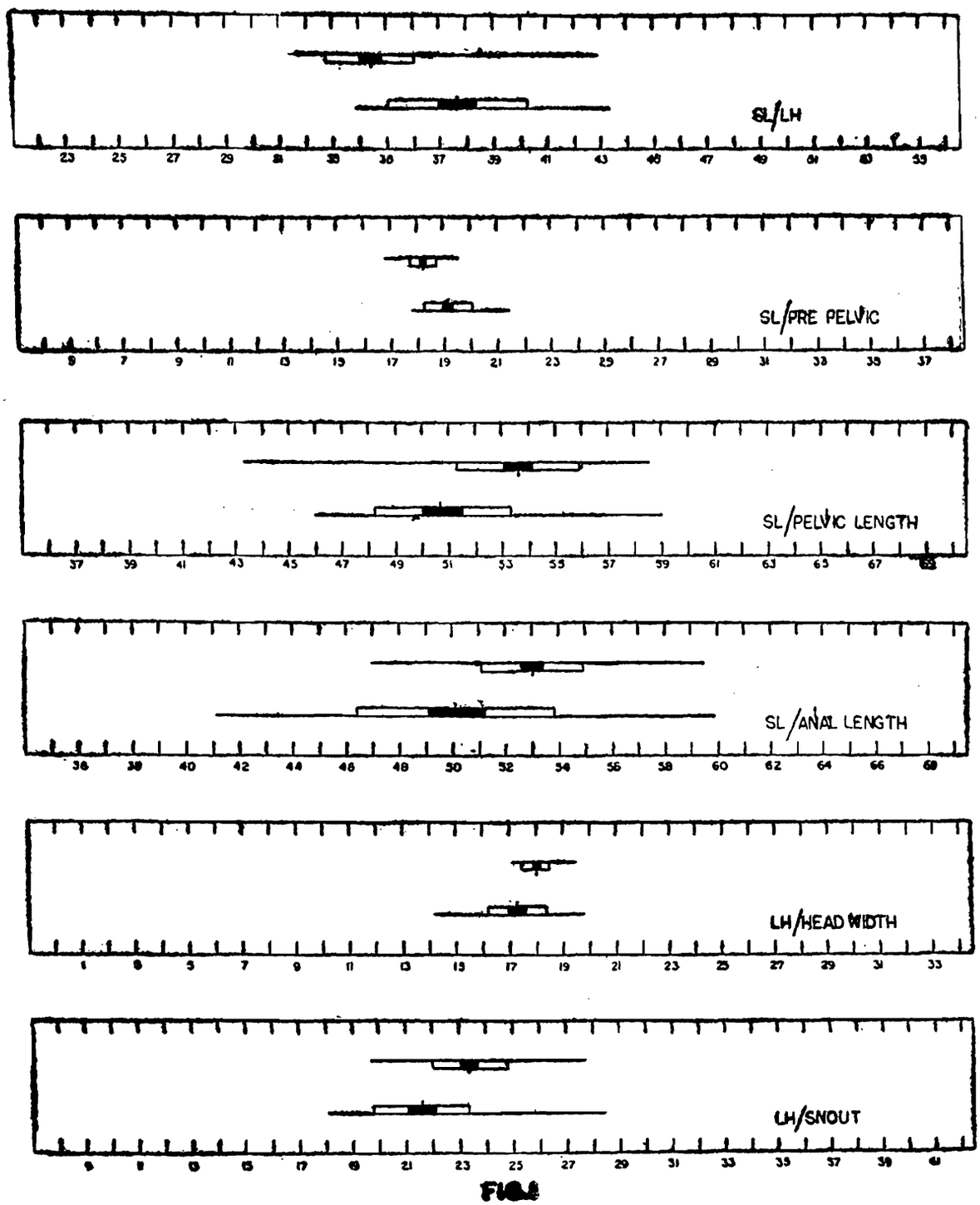


Fig. 1. Graphs showing the variation in some body proportions in the samples of two populations. Upper diagram and lower diagram in each graph represent *L. dyocheilus pakistanicus* and *L. dyocheilus dyocheilus* respectively.

depth 3.33—4.47 (3.88), pre-dorsal distance 1.93—2.28 (2.1), post-dorsal distance 1.59—1.91 (1.77), pre-pelvic distance 1.77—2.14 (1.91), pre-anal distance 1.25—1.45 (1.3), dorsal fin length 3.45—4.55 (3.98), pectoral fin length 4.38—5.51 (4.86), pelvic fin length 459—5.9. (5.07), anal fin length 4.11—5.99 (5.01) and caudal fin length 2.75—3.6 (3.09), all in standard length.

Head width 1.42—1.98 (1.73), snout length 1.81—2.85 (2.16), post-orbital length 2.33—3.04 (2.71), diameter of eye 3.87—7.01 (4.68), width of gape of mouth 1.96—4.29 (2.77), inter-orbital space width 2.0—2.96 (2.49), inter-nostrilar space width 2.65—3.67 (3.18), dorsal fin base width 1.12—1.71 (1.41), length of caudal peduncle 1.19—1.85 (1.55) and least height of caudal peduncle 1.87—2.68 (2.36), all in length of head.

Diameter of eye 1.67—3.73 (2.2) in snout length, 1.5—3.5 (1.92) in inter-orbital space width and 1.12—2.61 (1.49) in inter-nostrilar space width.

Least height of caudal peduncle 1.22—1.83 (1.53) in its length.

Pre-dorsal distance 1.44— 1.73 (1.61) in pre-anal distance.

Discussion

Taxonomic characters are generally found to intergrade between closely related populations when a large number of individuals are studied. To compare the two populations "Student's t-test" followed by Simpson, Roe and Lewontin (1960) was applied. Mean, standard deviation and degrees of freedom were calculated to determine the probability value at 95% confidence intervals. Before deducing any numerical conclusion, a hypothesis was established that the specimens of the two populations belonged to same species and the universally used rejection value of probability, *i.e.*, 5% was considered as a criterion for the rejection of the hypothesis. The result has shown that in case of most of the morphometric characters the probability value is below 5% which proves that the two populations are different.

How often a difference in a given character is likely to be obtained was determined by Dice and Lerans' graphical method as quoted by Hubbs and Perlmutter (1942). In this method, for each character, the range, mean and one standard deviation on each side of the mean and two standard errors on each side of the mean were delineated on a graph (Figs. 1 and 2). Even though this technique makes it possible to compare samples with ease, it does not indicate definitely whether the difference is of specific, subspecific or racial magnitude.

Taxonomic rank of the two populations were determined by measuring the degree of intergradation and divergence. Different methods of measuring intergradation and divergence have been proposed by different authors (Davenport and Blankinship, 1898 ; Pearl, 1930 ; Ginsburg, 1938 ; and Amadon, 1949). Ginsburg (*op. cit.*) used a simple method of measuring the intergradation and divergence of populations and indicated its superiority to the standard methods in taxonomic work. In the present study Ginsburg's method was followed and the result has shown that in case of most of the significant characters (SL/LH, SL/Pre-pelvic, SL/Pelvic fin length, SL/Anal fin length, LH/Snout, LH/Post-orbital, LH/Width of gape of mouth, LH/IOW, LH/LCPD, LH/HCPD) one population intergrades with the other

* Mean values are given in parantheses.

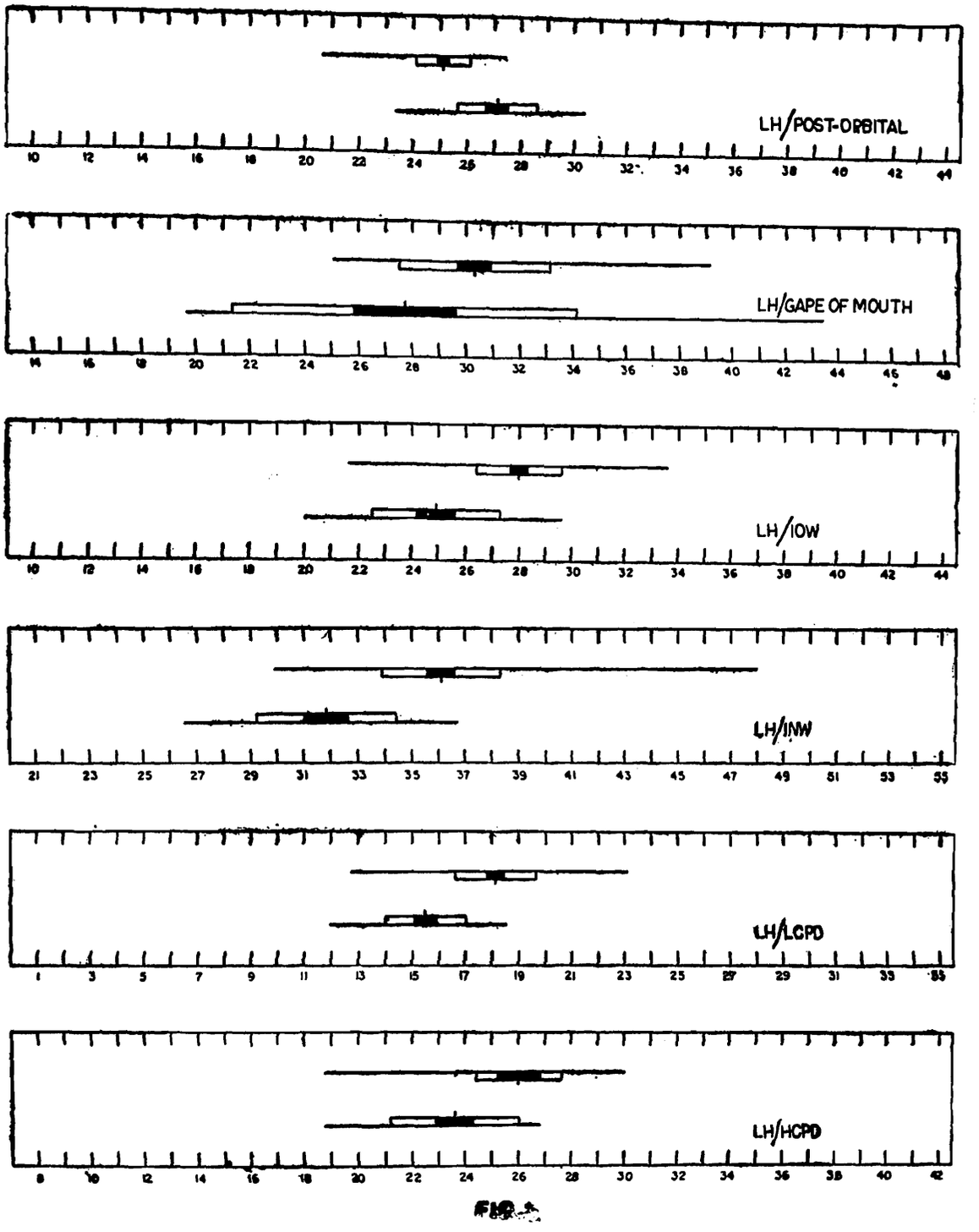


Fig. 2. Graphs showing the variation in some body proportions in the samples of two populations. Upper diagram and lower diagram in each graph represent *L. dyocheilus pakistanicus* and *L. dyocheilus dyocheilus* respectively.

TABLE II—Percentage of intergradation and divergence in respect of certain body proportions between *L. dyocheilus dyocheilus* and *L. dyocheilus pakistanicus*.

Sl. No.	PROPORTIONS	In percentage	
		Intergradation	Divergence
1.	Standard length (SL)/Length of Head (LH)	27.75	72.75
2.	SL/ Body depth	36.15	63.85
3.	SL/Pre-dorsal distance	37.55	62.45
4.	SL/Post-dorsal distance	31.36	68.64
5.	SL/Pre-pelvic distance	25.89	74.11
6.	SL/Pre-anal distance	39.23	60.77
7.	SL/Dorsal fin length	41.84	58.16
8.	SL/Pectoral fin length	37.53	62.47
9.	SL/Pelvic fin length	20.01	79.99
10.	SL/Anal fin length	25.96	74.04
11.	LH/Head width	29.37	70.63
12.	LH/Snout length	22.68	77.32
13.	LH/Post-orbital length	22.68	77.32
14.	LH/Diameter of eye	40.04	59.96
15.	LH/Width of gape of mouth	16.73	83.27
16.	LH/Inter-orbital space width (IOW)	18.11	81.89
17.	LH/Inter-nostrilar space width (INW)	17.5	82.5
18.	LH/Dorsal fin base width	38.8	61.2
19.	LH/Length of Caudal peduncle (LCPD)	20.68	79.32
20.	LH /Least height of Caudal peduncle (HCPD)	27.52	72.48
21.	IOW/Diameter of eye	33.62	66.38
22.	INW/Diameter of eye	32.56	67.44
23.	Snout length/Diameter of eye	35.94	64.06
24.	LCPD/HCPD	33.0	67.0
25.	Pre-anal dist./pre-dorsal dist.	42.75	57.25

qualifying for the rank of a subspecies (Table—II).

CONCLUSION

From the above statistical analysis it can be concluded that the provision of a subspecies rank for the Western Himalayan population of *Labeo dyocheilus* by Mirza and Awan as *L. dyocheilus pakistanicus* is justified. Moreover, *L. dyocheilus pakistanicus* is distinguished from the nominal form, *L. dyocheilus dyocheilus*, by its relatively large head, narrower mouth and shorter snout.

ACKNOWLEDGEMENTS

We are thankful to the Director, Zoological Survey of India for facilities provided and to Prof. M.R. Mirza, Lahore, Pakistan for having kindly gone through the manuscript.

REFERENCES

AMADON, D. 1949. The seventy-five percent rule for subspecies. *Condor*, **51** : 250-258.

DAVENPORT, C. B. and BLANKINSHIP, J. W. 1898. A precise criterion of species. *Science* (N. S.), **7** : 684-695.

DAY, F. 1889. *The Fauna of British India, including Ceylon and Burma. Fishes*, Vol. I. Taylor and Francis, London, XX + 548 pp.

GINSBURG, I. 1938. Arithmetical definitiou of species, subspecies, and race concept with a proposal for a modified nomenclature. *Zoologica*, **23** : 253-286.

HORA, S. L. 1936. On a further collection of fish from the Naga Hills. *Rec. Indian Mus.*, **38** (3) : 317-331.

HUBBS, C. L. and PERLMUTTER, A. 1942. Biometric comparison of several samples with particular reference to racial investigations. *Am. Nat.*, **76** : 582-592.

JAYARAM, K. C. and DAS, M. K. 1980. Systematic position of *Labeo devdevi* Hora with a description of the species (Pisces : Cypriniformes). *Bull. zool. Surv. India*, **2** (2 & 3) : 201-206.

MCCLELLAND, J. 1839. Indian Cyprinidae. *Asiat. Res.*, **19** (2) : 217-471.

MIRZA, M. R. and AWAN, M. I. 1976. Fishes of the Son-Sakesar valley, Punjab, Pakistan, with the description of a new subspecies, *Biologia*, **22** (1) : 27-49.

MUKERJI, D. D. 1934. Report on Burmese fishes collected by Lt. Col. R. W. Burton from the tributary streams of the Mali Hka river of the Myitkyina district (Upper Burma). Part II. *J. Bombay nat. Hist. Soc.*, **37** (1) : 38-80.

PEARL, R. 1930. Introduction to Medical Biometry and Statistics. Philadelphia and London.

SIMPSON, G. C., ROE, A. and LEWONTIN, R. C. 1960. *Quantitative Zoology*. Harcourt, Brace and Company. New York, vii + 440 pp.

Bull. zool. Surv. India, 4 (1) : 95—101, 1981

A FIELD STUDY OF SUBSPECIFIC VARIATION IN TAIL FORM AND CARRIAGE IN THE RHESUS MACAQUE, *MACACA MULATTA* (PRIMATES), IN SOUTH ASIA

M. L. ROONWAL* AND P. C. TAK†

ABSTRACT

(1) In the common subspecies, *Macaca mulatta mulatta* (Zimmermann) (North India to farther east), the tail is moderately hairy, tapers towards the tip and ends in a weak tuft. In the relaxed state (standing, walking) it is pendant, except in the most dominant or alpha male in which it is carried vertically up with a small, outward, terminal loop. (2) In the Himalayan subspecies, *M. m. villosa* True, the tail is uniformly thick, sharply truncated at the end, densely hairy and without a terminal tuft. In the relaxed state all individuals, except in those of certain categories (e. g., alpha males, etc.), the tail is bent down almost at a right angle (7-shaped). (3) In the giant rhesus of Chitral, *M. m. mcmahoni* Pocock, the tail form is as in *villosa* but with longer hairs, and the mode of carriage is not known. (4) The tail length is 35.7 — 62.5 per cent of head-and-body, the average being longer in subspecies *vilosa* (49.4) than in *mulatta* (44.6). (5) Tail length in males increases directly with that of head-and-body, but the percentage proportion decreases. (6) Variations in other cercopithecids are discussed. Subspecific variations in tail are found also in the pig-tailed macaque (*Macaca nemestrina*) and in the Hanuman langur (*Presbytis entellus*).

INTRODUCTION

The rhesus macaque, *Macaca mulatta* (Zimmermann) (Cercopithecidae, Cercopithecinae), is widespread in South Asia, from eastern Afghanistan and northwestern Pakistan, via North India (south to the R. Godavari), Nepal, Bhutan and Burma, east to Thailand, Vietnam and southern China. It has a short, more or less hairy tail which is about half the length of the head-and-body. Four subspecies** are recognised (Pocock, 1932 ; Roonwal and Mohnot, 1977 ; Roberts, 1977) as follows (three of them are high altitude ones which have a restricted distribution) :— (1) *M. m. mcmahoni* Pocock. NE Afganistan and NW Pakistan (Chitral and Dir). (2) *M. m. villosa* True. The Western Himalayas, e.g., NW Pakistan (Kaghan and Neelam Valleys, and Murree Hills) and NW India (southern Kashmir, upper Punjab, Himachal Pradesh, and the Kumaun Hills in Uttar Pradesh) (3) *M. m. vestita* Milne-Edwards. South Tibet (Tengri Nor). (4) *M. m. mulatta* (Zimmermann). Is very widespread and occupies the rest of the species range.

Nothing is known of tail differences in the

* Desert Regional Station, Zoological Survey of India, Paota B Road, 3rd Street, Jodhpur.

† Northern Regional Station, Zoological Survey of India, 13 Subhas Road, Dehra Dun.

** Hill (1974) has synonymised subspecies *vestita* with *mulatta* and added three more subspecies (from China). But Hill's taxonomic conclusions are so unreliable (as already discussed by Fooden, 1976) that we are unable to accept them until the genus is revised more competently.

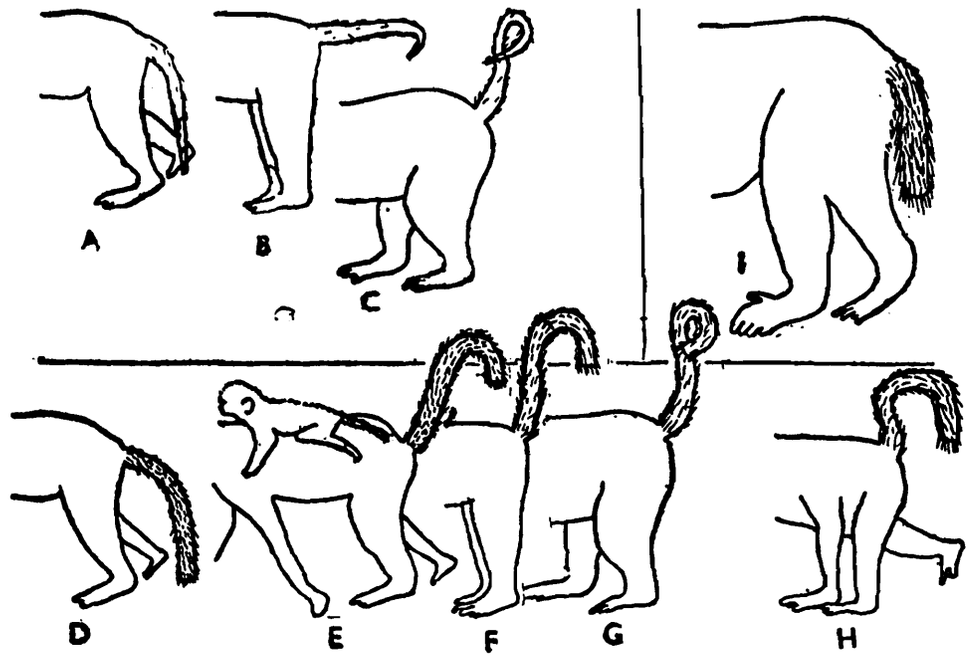


Fig. 1. Subspecific variations in relaxed tail carriage (standing, walking) in *Macaca mulatta* (A—C) *M. m. mulatta* (Rajasthan) : A. Female, with pendant tail. This mode characterises all adults except the alpha male. B. Female giving threat : Tail raised to subhorizontal, with the extreme tip curved downward. C. Alpha male : tail vertically up, with the distal end forming a small, outward, closed loop. (D—H) *M. m. villosa* (Kumaun Hills, except H) : D. Female (not carrying infant) and non-alpha males ; tail bent down at an angle (cf. A). E. Female carrying infant on back ; tail raised, with the distal end arched, F. Non-alpha male in the temporary absence of alpha (tail almost as in E). G. Alpha male (as in C). H. (Pakistan, ex Roberts : said to be normal for all : may be a local variant). I. *M. m. mcmahoni* (Chitral, ex Pocock, 1932 ; tail carriage depicted arbitrarily from museum specimen).

various subspecies. In the present paper we establish, on the basis of field observations, the existence and extent of such differences.

Material and Methods

The subspecies studied were *Macaca mulatta mulatta* and *M. m. villosa*. Field observations were made in the following locations : — (1) *M. m. mulatta* in the North Indian plains, especially Rajasthan and Uttar Pradesh. (2) *M. m. villosa* in the Kumaun Hills (NW Uttar Pradesh) in southern Kashmir (c. 22 km SE of Srinagar)' and in Kulu District (Hima-Pradesh).

Results

1. *Tail form and carriage*

In the common or plains snbspecies, *M. m. mulatta* (Table 1), the tail is on the whole rather thin and moderately hairy and is grey. It is thicker at the base and gradually tapers towards the tip, ending in a weak tuft. In the normal or relaxed state (standing and walking) it is wholely pendant (Fig. 1A), except in the most dominant or alpha male (Sade, 1971 ; Ojha, 1974 ; Roonwal, 1976, 1977) in which it is held vertically up, with a tiny, 'closed', backwardly directed, terminal loop (Fig. 1C). The loop involves about one-third of the distal part of the tail, and the tip has a tendency to cross the tail and point forward, though this may not happen in all cases. Ojha noted that in the temporary absence of the alpha male, the beta male raises the tail somewhat in the manner of

TABLE 1.—Tail form and carriage in adults of *Macaca mulatta*.

M. m. mulatta	*M. m. villosa*	*M. m. mcmahoni*
(A) *Tail form and structure*		
1. Tail thinner, tapering apically : apex rounded, not sharply cut. Only moderately hairy, with a weak terminal tuft. Colour greyish.	1. Tail thicker, uniformly thick throughout ; apex blunt aud sharply cut (as in a fox-terrier). Thickly hairy, with long hairs ; no terminal tuft. Colour olive brown.	1. Tail as in *M. m. villosa*.
(B) *Tail carriage in the relaxed state (standing, walking)*		
2. Wholely pendant (except in alpha male and in non-alpha males in the temporary absence of alpha). (Fig. IA)	2. Tail bent down at a right angle (almost 7-shaped), except in certain categories mentioned below. (Fig. ID)	Not known.
3. Amoug non-alpha males in the temporary absence of alpha, the tail of the beta male is raised, with the extreme distal end arched, outward in a semi-loop.	3. In females carrying infant on back and in non-alpha males in the temporary absence of alpha, tail raised vertically up with the distal half arched outward in a broad arch. (Figs. IE, IF)	
4. In alpha male tail carried vertically up with a small, closed, outward end-loop. (Fig. IC)	4. In alpha male as in *M. m. mulatta*. (Fig. IG)	

alpha ; and when threatening, females tend to raise the normally pendant tail to a sub-horizontal position (Fig. 1B).

In the Himalayan subspecies, *M. m. villosa*, the tail is uniformly thick throughout its length, densely hairy and olive brown. It does not taper but is sharply truncated as in a fox-terrier (a feature noted long ago by McMahon, 1901a, b), and is without a terminal tuft. In the relaxed state in all individuals (except in females carrying an infant on the back, alpha males and non-alpha males in the temporary absence of the alpha) it is bent down rather away from the body, almost at a right angle (nearly 7-shaped, Fig. 1D). In females carrying an infant on the back and in non-alpha males in the temporary absence of the alpha the tail is carried nearly vertically up with the distal half forming a broad arch (Figs. 1E, F). Females and non-alpha males in stress situations, as while giving a threat, raise the tail to the subhorizontal position but without the distal arch. In Kulu district, when negotiating steep slopes both uphill and downhill, *all* individuals carried the tail straight horizontally. The alpha male normally carries the tail vertically up, with a closed end-loop, as in *M. m. mulatta*. In the Murree Hills in northwestern Pakistan, according to Roberts (1977), in the normal

TABLE 2.—Summary of data on sizes of body-parts in adults of two subspecies of *Macaca mulatta*.
[Sources : Pocock, 1932 ; Roberts, 1977; and fresh measurements from collections in the Zoological Survey of India.]

R., range ; Av., average : n, number of examples.

Item	Length of Head-and-Body (mm)			Length of Tail (mm)		
	Males	Females	Both sexes	Males	Females	Both sexes
			1. *Macaca mulatta mulatta*			
R.	417 — 584	411 — 559	411 — 584	198 — 250	187 — 285	187 — 285
Av.	516.9	485.0	502.5	226.6	221.0	224.0
n=	14	12	26	14	12	26
			2. *Macaca mulatta villosa*			
R.	508 — 635	470 — 483	470 — 635	229 — 318	218 — 254	218 — 318
Av.	549.0	476.5	534.5	271.4	236.0	266. *
n=	12	2	14	13	2	14

* In examples from Pakistan, Roberts (1977) gave the tail average as 203 mm.

TABLE 3.—*Macaca mulatta*. Tail length as percentage of head-and-body length in adults.

Subspecies	Males		Females		Both sexes	
	Range	Average	Range	Average	Range	Average
M. m. mulatta	35.7—55.2 (n=14)	43.6	40.1—59.6 (n=12)	45.7	35.7—59.6 (n=26)	44.6
M. m. villosa	43.5—62.5 (n=8)	49.4	46.4—52.6 (n=2)	49.5	43.5—62.5 (n=10)	49.4

mode of carriage in *all* individuals the entire tail (not merely the distal half as in the Kumaun Hills) takes part in the formation of the arch, the tail assuming a ∩-shape (Fig. 1H). Whether the occurrence of the latter mode of carriage and the absence of variations, in contrast to those observed in the Kumaun Hills, are peculiarities of the Pakistan population or are due to paucity of opportunity for more detailed observations, is difficult to say without further study in the field.

Of the giant rhesus of Chitral (Pakistan) no field data are available, but Pocock (1932, Plate) figures a male with a pendant tail ; it is most likely that this figure *is* from a museum example and the tail *is* arbitrarily shown as pendant. Some other characters of the tail (Fig. 1 I) are, however, clear, *viz.*, that (i) the tail is uniformly thick throughout its length and does not taper ; (ii) it is densely hairy throughout ; and (iii) the tail tip is sharply truncated and is without a tuft. In all these respects it resembles the tail of *M. m. villosa*.

Nothing is known about the Tibetan subspecies, *M. m. vestita*.

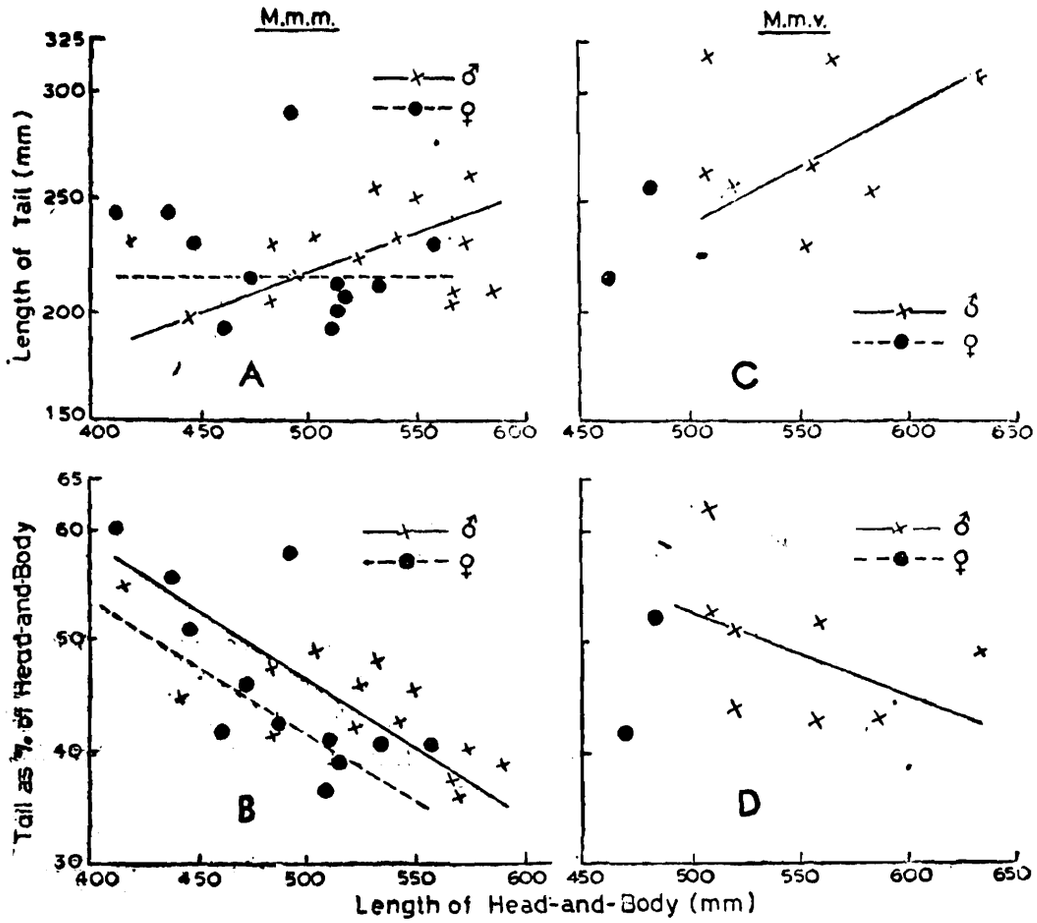


Fig. 2. *Macaca mulatta.* Graphs showing sub- specific variation in lengths of head-and-body and tail and the proportion (as percentage) of the latter to the former.
(A) *M. m. mulatta*, lengths. (B) Same, tail percentages. (C) *M. m. villosa*, lengths.
(D) Same, tail percentages.

[2. *Tail proportions*] (Fig. 2 and Tables 2 and 3).

Available data on flesh measurements of the lengths of head-and-body and tail (both as straight line distances, not along curves) in Indian examples (Table 2) show that in both respects *M. m. villosa* is larger thau *M. m. mulatta*, and in both subspecies males are appreciably larger than females. The average tail length (both sexes) is 224.0 mm. in *M. m. mulatta* and 264.3 mm. in *M. m. villosa*, but the Pakistan population of the latter subspecies, according to Roberts 1977), has a much shorter tail (average 209 mm only).

As regards tail length in relation to that of head-and-body the position is as follows : (i) In males of both *M. m. mulatta* and *M. m. villosa* the tail length increases directly with that of head-and-body (Figs. 2A, C). But in females of *M. m. mulatta* no such correlation is apparent, and in *M. m. villosa* the data are too scanty to permit any conclusion to be reached. (ii) The tail length is 35.7—62·5 per cent of head-and-body (Table 3). It is appreciably shorter in *M. m. mulatta* average 44·6 per cent of head-and-body) than in *M. m. villosa* (av. 49·4 per cent). (iii) In both subspecies the tail percentage decreases with the increase of head-and-body length (Figs. 2B, D).

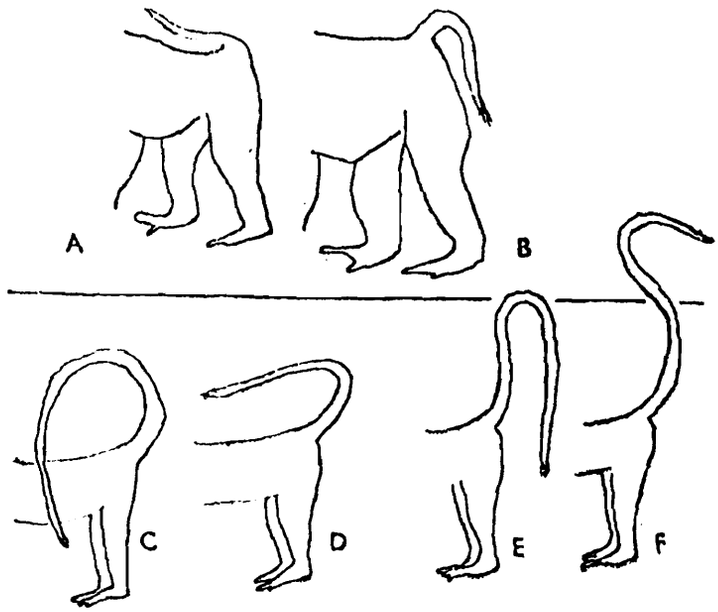


Fig. 3. Subspecific tail variation in some other cercopithecids. Upper row : *Macaca nemestrina* (adapted from Fooden, 1975). (A) *M. n. leonina*. (B) *M. n. nemestrina*. Lower row : *Presbytis entellus*. (C, D) Northern group (C, the plains, *P. e. entellus* ; D, the sub-Himalayas, *P. e. schistaceus*). (E, F) Southern group (E, *P. e. achates*, Karnataka : E. *P. e. thersites*, Sri Lanka.)

Fooden (1976, p. 230) gave the species range of the length ratio Tail/Head-and-Body for the species as 0·28—0·74 (the tail proportion is thus 28—74 per cent of head-and-body) ; subspecific differences were not mentioned by him. The very small tail (av. 203 mm) of the Pakistan population of *M. m. villosa* is noteworthy since the mode of tail carriage there is also said to be different from that of the Kumaun Hills (∩—shaped instead of 7-shaped). This would suggest that the Pakistan population, being long isolated from the Indian one, may have evolved different racial characteristics.

Discussion

Subspecific variation in tail form and carriage is known in two other cercopithecids from South and Southeast Asia.

In the pig-tailed macaque *Macaca nemestrina* (Linn.), which has 3 or 4 subspecies, Fooden (1975) has recorded taildifferences as follows :— In *M. n. leonina* (Blyth) [Fooden regards *M. n. blythi* Pocock as its synonym], which is found from Burma to Vietnam, the tail fur is dark brown to black dorsally and buff ventrally, there is no terminal tuft, and the tail is normally bent *forward* over the back, with the tip directed upward and forward (Fig. 3A). In *M. n. nemestrina* (Linn.), which is found in Malaya, Sumatra and Borneo, the tail is coloured as in *leonina*, has a weak terminal tuft, and is curved *backward* and downward (Fig. 3B). In *M. n. pagensis* Miller, which is confined to the Pagi Islands in the Mentawi group off the western coast of Sumatra, the tail is virtually naked so that the skin is clearly visible ; its mode of carriage is unknown (Fodden arbitrarily depicts it as bent backward). No special mode of tail carriage (as in *M. mulatta*) is known in the alpha male in *M. nemestrina*. The length ratio Tail/Head-and-body also shows some subspecific differences, being 0·24—0·34 in *M. n. pagensis*, 0·24—0·45 in *M. n. nemestrina*, and 0·30—0·46 in *M. n. leonina*.

In the Hanuman langur, *Presbytis entellus*

(Dufresne) (subfamily Colobinae), which has 15 subspecies, the relaxed tail carriage shows subspecific, geographical and clinal variations (Roonwal, 1976, 1979). In the Northern Group of subspecies (above about 20° N latitude) the tail is bent *forward* over the back, while in the Southern Group it is bent *backward* (cf. *Macaca nemestrina*) ; within each group there are further variations (Figs. 2C-F). The relative tail length also shows subspecific variations (see Roonwal, 1979 and in press).

ACKNOWLEDGEMENTS

We are indebted to the following officers of the Zoological Survey of India for assistance :— To Dr. B. S. Lamba (Deputy Director, Dehra Dun) for photographic and other facilities ; to Dr. B. Biswas (Deputy Director, Calcutta) for supplying measurements of several examples of the rhesus macaque ; and to Mr. Girish Kumar for field assistance.

REFERENCES

FOODEN, J. 1975. Taxonomy and evolution of liontail and pigtail macaques (Primates : Cercopithecidae). *Fieldiana (Zool.)* Chicago, 67: 8+II+169 pp.

FOODEN, J. 1976. Provisional classification and key to living species of macaques (Primates : *Macaca*). *Folia primatol* Basel 25 : 225—236.

HILL W. G. OSMAN. 1974. *Primates : Comparative Anatomy and Taxonomy.* VII. Cynopithecinae ; *Cercocebus, Macaca, Cynopithecus.* New York (Wiley and Sons).

MCMAHON, A. H. 1901a. Notes on the fauna of Chitral, *J. Asiat, Soc. Bengal,* Calcutta, 70 (pt. II, *Nat. Hist*). No. 1 : 1-7.

MCMAHON, A. H. 1901b. Notes on the fauna of Dir and Swat. *J. Asiat. Soc. Bengal,* Calcutta, 70 (pt. II, *Nat. Hist.*), No. 1 : 7-12.

OJHA, P. R. 1974. Tail carriage and dominance in the rhesus monkey, *Macaca mulatta. Mammalia,* Paris, 38 : 163-170.

POCOCK, R, I. 1932. The rhesus macaques (*Macaca mulatta*) *J. Bombay Nat. Hist. Soc.,* Bombay, 35 (3) : 530 551, 1 pl.

ROBERTS, T. J. 1977. *The Mammals of Pakistan.* xxvi + 361 pp., 4 col pls. London (E. Benn Ltd.).

ROONWAL, M. L. 1976. Dominance behaviour in South Asian primates. *J. sci. indust. Res.,* New Delhi, 35 : 244-260.

ROONWAL, M. L. 1977. Urbanization in primates and comparison with man. *J. sci. indust. Res.,* New Delhi, 36 : 179-187.

ROONWAL, M. L. 1979. Field study of geographical, subspecific and clinal variations in tail carriage in the Hanuman Langur, *Presbytis entellus* (Primates), in South Asia. *Zool. Anz.,* Jena, 202 : 235-255.

ROONWAL, M. L. (In press.) Intraspecific variation in size, proportion of body-parts and weight in the Hanuman Langur, *Presbytis entellus* (Primates), in South Asia, with remarks on subspeciation. *Rec. zool Surv, India* Delhi.

ROONWAL, M. L. and MOHNOT, S. M. 1977. *Primates of South Asia : Ecology, Sociobiology and Behavior.* xx + 422 pp. Cambridge (Mass.) and London (Harvard University Press).

SADE, D S, 1971. Communication by tail positions in rhesus monkeys (*Macaca mulatta*). *Am. J. phys. Anthrop.* (N. S.), 35 : 294.

Bull. zool. Surv. India, 4(1) : 103—109, 1981

NOTES ON THE GENUS *PLATYLABIA* DOHRN (CARCINOPHORIDAE : PLATYLABIINAE) WITH THE DESCRIPTION OF TWO NEW SPECIES FROM INDIA

G. K. SRIVASTAVA

Zoological Survey of India, Calcutta

ABSTRACT

The present paper deals with the description of two new species of the genus *Platylabia* Dohrn, from India besides the redescription of *P. major* (Dohrn). A key is provided for the separation of these three species.

The genus *Platylabia* was described by Dohrn (1867) with four new species of which first one, *P. major*, is now considered as the type of the genus and all other species belong to other genera. The original description of *P. major* is based on a female from Celebes. Subsequently this species was found to occur throughout the Oriental Region. Zacher (1910, fig. 11) for the first time figured the male genitalia of this species which possesses parameres about three times longer than broad, slightly broadened and turned externally near apex and provided with a faint tubercle close to inner apical angle. Distal lobes are provided with a distinct fine tubular virga. Therefore, those specimens which possess similar genitalia and agree with the original description and other subsequent diagnostic characters provided by Dubrony A. de (1879) and Burr (1910) are referred to this species. In the present work two new species are described which differ from the type species by the shape of male parameres besides other morphological peculiarities. Unfortunately females of all the three species look almost alike and cannot be satisfactorily placed to a particular species in the absence of males.

Genus *Platylabia* Dohrn

Platylabia Dohrn, 1867, *Stettin. ent. Ztg.*, 28 : 347 (Type—*P. major* Dohrn, 1867).

Labidophora Scudder, 1876, *Proc. Boston Soc. nat. Hist.*, 18 : 297 (New name for *Platylabia* Dohrn because of its similarity with *Platylabus* Wesmael, 1845).

Palex Burr, 1910, *Fauna Brit. India, Dermaptera* : 68 (Type—*Platylabia sparattoides* (Bormans, 1900)=*Platylabia major* Dohrn, 1867).

Diagonostic characters.—Body strongly flattened. Head transverse, smooth. Antennae 24 segmented, 1st stout, subclavate, shorter than the distance between antennal bases ; 2nd about as long as broad ; 3rd long and slender ; 4th globular or subclavate ; 5th longer than 4th, subclavate ; 6th longer than 5th ; 7th shorter or as long as 3rd, remaining gradually increasing in length and thinning. Elytra and wings well developed, latter often abbreviated. Legs normal, hind metatarsus shorter than protarsus, latter almost equal to combined length of meso-and metatarsus. Prosternum about three times longer than broad, not constricted between fore coxae ; meso-sternum quadrate hind margin straight, metasternum transverse, faintly emarginate in middle posteriorly. Pygidium vertical. Male genitalia with parameres narrow or flattened, distal lobes, paired one of which directed forward ; virga present.

Type-species—*Platylabia major* Dohrn, 1867

(Designated by Kirby 1891, *J. Linn. Soc. (Zool.)* 23 : 518).

Distribution.—Oriental Region.

KEY TO THE SPECIES (BASED ON MALES ONLY)

1(2). Pronotum with sides straight ; parameres narrower, apices obtuse ; distal lobes with virga short and curved.....*P. nathani* sp. n.

2(1). Pronotum with sides feebly convex in middle ; parameres comparatively broader, anteriorly with a small tubercle near inner apical angle, distal lobes with virga tubular (not curved).

3(4). Parameres a little over twice as long as broad ; virga thick, tubular with another chitinus rod ; forceps internally provided with a serrated flange terminated at both ends by a small tooth.....*P. brindlei* sp. n.

4(3). Parameres a little over three times longer than broad, virga thin tubular, distal lobes provided with chitinous teeth ; forceps armed internally with a sharp tooth in middle.... ....*P. major* Dohrn

Platylabia major Dohrn (Figs. 1-5)

Platylabia major Dohrn, 1867, *Stettin. ent. Ztg.*, 28 : 347 (♀ ; Celebes-Holotype in PAN Zoologiczny Instytut, Warszawa, Poland) ;— Dubrony, 1879, *Annali Mus. civ. Stor. nat. Giacomo Doria* 14 : 372 (♂ ; Java) ; Bormans, 1888, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 6 : 436 ; Bormans, 1894, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 14 ; 380 (Burma) ; Bormans, 1900, *Das Tierreich*, 11 : 74 ; Burr, 1904, *Trans. ent. Soc. Lond.*, : 300 ; Burr, 1910, *Fauna Brit. India, Dermaptera* : 125 ; Burr, 1911, *Genera Insect*, 122 : 43, pl. 4, figs. 6, 6a ; Burr, 1912, *Ann. naturh. Hofmus., Wien*, 26 : 27 and 82 ; Zacher, 1910, *Ent. Rdsch., nr.* 23, Jh. 27 : 185 (♂ genitalia) ; Borelli, 1923, *Boll. Musei. Zool. Anat. comp.* R. *univ. Torino*, 38 (NS 13) : 5 ; Borelli, 1926, *Treubia*, 8 : 259 ; Borelli, 1927, *Suppl. Ent.*, 15 : 70 ; Borelli, 1932, *Bull. Raffles Mus.*, 7 : 83 ; Borelli, 1932, *J. fed. Malay St. Mus.*, 17 (1) : 183 ; Hebard, 1927, *Proc. Acad. nat. Sci. Philad.*, 79 : 29 ; Hincks, 1945, *Proc. R. ent. Soc. Lond.*, (B) 14 : 60 ; Boeseman, 1954, *Zool Verh.*, Leiden, 21 : 57, figs. 15a-b ; Bey-Bienko, 1959, *Ent. Obozor.*, 38 : 610 ; Steinmann, 1979, *Fol. Ent. Hung.*, 32 (1) : 153 (Celebes, Lectotypus, female 1 ex.).

Labidophora major : Scudder, 1876, *Proc. Boston Soc. nat. Hist.*, 18 : 321.

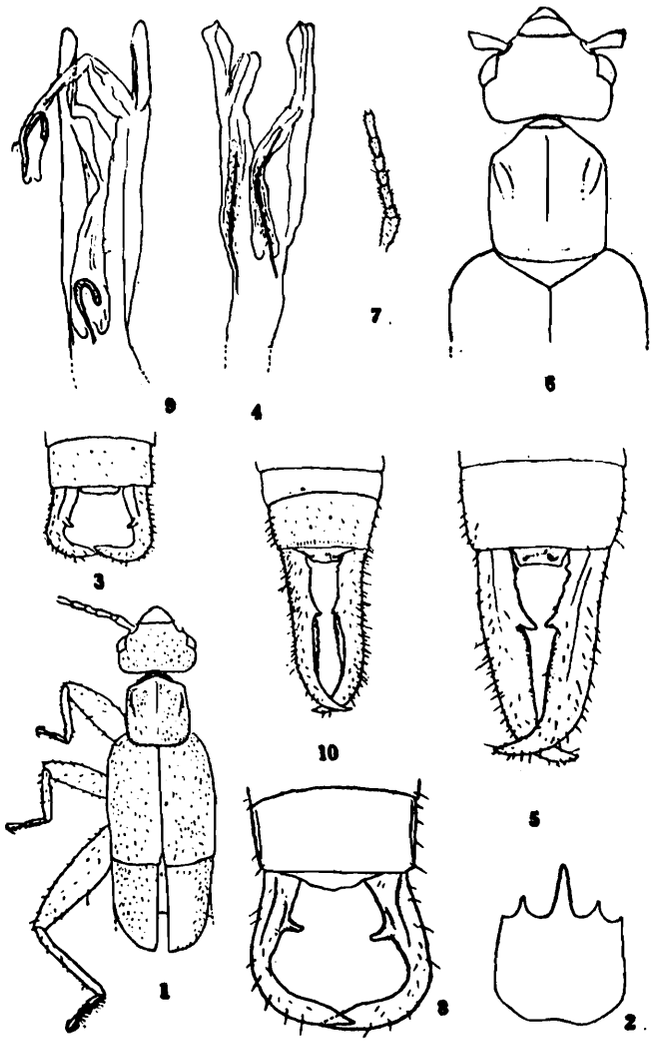
Platylabia sparattoides Bormans, 1900, *Annali Mus. civ. Stor. nat. Giacomo Doria*, (2) 20 : 459 (♂ ♀, Sumatra—Types at Museo Civico di Storia Naturale "Giacomo Doria", Genova).

Palex sparattoides : Burr, 1910, *Fauna Brit. India, Dermaptera* : 68, pl. 8, 77, 77a (Subfam. and Genera Nov.) ; Burr 1911, *Genera Insect.*, 122 : 43.

Material examined—VIETNAM : Mt Lang, Bian, 1500m 2000 m, 1 nymph ; Dalat, 6 kms, 1400-1500 m. 1 ♀, 9. vi.—7. vii.1966 (*N. R. Spencer*) ; 17 kms of Dilinh, 1300 m, 11 nymphs ; (at various stages of development), Dilinh (Dijiring), 1200 m, 1 ex (hind portion missing), 1 ♂, 22-28.iv.1960, ex under bark (*L.W Quate or S. Quate*); (NW), Chiangmai, Fang, 500 m, 7 nymphs (at different stages of development), ex dead tree, 15-19.iv.1958 ; Chiangmai Prov., Chiangdao, 450 m, 5 nymphs, ex rotten ficus fruit, dead tree or Banana plant, 5-11.iv.1958 (*T C. Maa*) ; Trang Prov., Khaoppha, Khaochung, 200-400 m, 1 ♀ (without head), 30-31.xii.1963 (*G. A. Samuelson*) ; (S), Banne, Chawang, nr Nabon, 7 m, 2 ♀♀, 6.ix.1958 (*J. L. Gressitt*). LAOS : Sedon Prov., Paksong, 1 ♀. 17.v.1965 (*P.D. Ashlok*) (B. P. Bishop Museum, Hawaii).

Description : Form depressed ; finely pubescent. Head, Pronotum, elytra and wings black ; antennae with basal two segments dark brownish black, remaining light yellowish brown ; legs yellow, abdomen and forceps reddish brown, often shaded with black.

Head depressed, transverse, obscurely punctate, hind margin feebly emarginate in middle. Eyes about half as long as the post-



Figs. 1-10 ; *Platylabia major* Dohrn : ♂, 1. Anterior portion of body ; 2. Penultimate sternite ; 3. Ultimate tergite and forceps ; 4. Genitalia ;♀, 5. Ultimate tergite and forceps ; *Platylabia nathani* sp. n., Holotype ♂ : 6. Anterior portion of body ; 7. A portion of antennae with 7 basal segments ; 8. Ultimate tergite and forceps ; 9. Genitalia ; Paratype ♀ ; 10. Ultimate tergite and forceps.

ocular length. Antennae (partly broken) 25 segmented or more, 1st segment stout, distinctly shorter than the distance between antennal bases ; 2nd small ; 3rd long and slender, longer than 4th to 6th, almost equal to 7th ; 4th subclavate, shorter than 5th ; 6th onwards segments gradually increasing in length and each narrowed basally except a few apical ones thin and rod shaped. Pronotum, longer than broad, smooth, apically convex, sides depressed but feebly convex, hind margin subtruncate and postero-lateral angles briefly rounded, median sulcus faintly marked by a depressed line ; prozona weakly raised, scarcely differentiated from flat metazona. Elytra well developed but short, feebly punctate ; often short, triangular scutellum visible. Wings well developed or only slightly projecting beyond elytra in the form of narrow, abbreviated lobes laterally, texture same as elytra. Legs normal, hind metatarsal segment shorter than protarsus which equals combined length of meso-and metatarsus, claw without arolium. Abdomen depressed, smooth or obscurely punctate, gradually enlarging posteriorly, lateral tubercles on 3rd and 4th tergites obsolete, sides of

segments convex. Penultimate sternite transverse, broadly rounded posteriorly, with faint emargination in middle. Ultimate tergite transverse, smooth, gently narrowed posteriorly, sides somewhat compressed with faint carina dorsally and ventrally, hind margin straight. Pygidium vertical, transverse, narrowed apically, posteriorly triangular with a faint tubercle in middle. Forceps with branches remote at base, sickle-shapad, tip pointed, internally armed with a sharp triangular tooth at about middle. Genitalia with parameres three times longer than broad, slightly broadened and turned externally near apex, provided with a small tubercle anteriorly near inner apical angle ; virga long, thin and tubular, distal lobes provided with rows of minute chitinous hooks.

Female : Agrees with males in most characters except that penultimate sternite broadly triangular posteriorly ; ultimate tergite comparatively more narrowed posteriorly with a row of fine striations ; pygidium vertical, more prominent, above feebly convex, with a small tubercle laterally, hind margin rounded with a minute median tubercle ventrally ; forceps long, depressed, almost straight, tapering apically, internal margin medially in basal half forming a serrated flange, terminating into a triangular tooth, directed posteriorly.

Measurements : (In mm)

	♂	♀
Length of body	9-10.2	7.2—9.5
Length of forceps	1.2-1.3	2—2.5

Distribution : Appears to be widely distributed in Oriental Region.

Remarks : The Holotype ♀ of this species, present in the PAN Zoologiczny Institute, Warszawa, Poland, has been examined by Steinmann (1979) together with other material from Java and 1 ex. from Burma (probably ex Bormans collection). *Platylabia sparattoides* Bormans (1900) from Sumatra is consideredas synonym since its description agrees well with the original description of *Platylabia major* and other males subsequently referred to it.

Platylabia nathani sp. n.

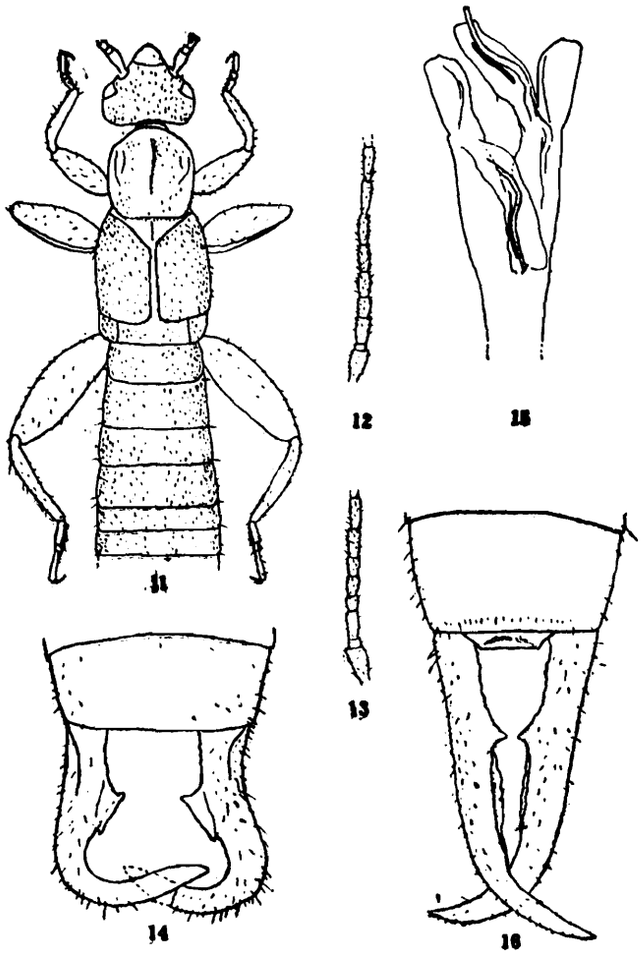
(Figs. 6-10)

Platylabia major : (nec Dohrn) Srivastava, 1970, *EOS*, 56 : 325 (♂, ♀ : India : Anamalai Hills, Cinchona, 3500', May, 1968).

Material examined : INDIA : Tamil Nadu : Anamalai Hills, Cinchona, 3500', Holotype ♂; Reg. No. 804-/H5 (genitalia mounted between two coverslips and pinned with the specimen), Paratype ♀, Reg. No. 8046/H6 May, 1968 (*P. S. Nathan*), deposited in the Zoological Survey of India, Calcutta.

Description : Whole body depressed, finely pubescent. General colour orange, often shaded with black on various body parts ; elytra and wings black.

Head triangular, transverse, obscurely punctate, sutures obsolete, hind margin emarginate in middle. Eyes only slightly shorter than the post-ocular length. Antennae partly broken (left antenna missing, on right side only 14 segments remaining) ; 1st stout, gently expanded anteriorly, shorter than the distance between the antennal bases and longer than eye ; 2nd small, about as long as broad ; 3rd long, slender ; 4th stout, gently expanded anteriorly ; 5th slightly longer than preceding ; 7th equal to 3rd but stouter, beyond this segments gradually thinning and increasing in length distally. Pronotum smooth, longer than broad, anteriorly convex, forming a sort of neck, sides depressed, straight, parallel, hind margin subtruncate, median sulcus distinct ; prozona weakly raised and metazona depressed. Legs normal. Elytra well developed, obscurely punctate ; a small triangular scutellum present. Wings normal, of same texture as the elytra. Abdomen



Figs. 11-16 ; *Platylabia brindlei* sp. n., Holotype ♂ ; 11. Anterior portion of body; 12. A portion of right antennae ; 13. A portion of left antennae ; 14. Ultimate tergite and forceps ; 15. Genitalia ; Paratype ♀ ; 16. Ultimate tergite and forceps.

almost parallel sided, faintly punctate, lateral tubercles obsolete, sides of segments convex. Penultimate sternite broadly rounded posteriorly with a faint emargination in middle. Ultimate tergite transverse, almost smooth, medially depressed, laterally compressed with dorsal border sharp, hind margin almost straight. Pygidium vertical, convex above, transverse, narrowed apically with a faint tubercle in middle. Forceps remote at base, sickle-shaped, apices crossing, pointed, trigonal in basal one third afterwards depressed, armed internally with a sharp triangular tooth at about middle with its tip bent downwards. Genitalia with parameres narrow, a little over three times longer than broad, almost of uniform width throughout, apex obtuse, distal lobes with a short and curved virga.

Female : Agrees with males in most characters except that penultimate sternite and ultimate tergite narrowed posteriorly ; pygidium vertical, convex above, but concave in middle basally, hind margin somewhat undulate ; forceps with branches, depressed, straight, tapering apically, internal margin dorsally forming a sharp serrated flange terminating into a triangular tooth in middle, ventral margin serrated.

Measurements : (in mm)

	Holotype	Paratype
	♂	♀
Length of body	8·4	8·5
Length of forceps	1·4	2·3

Distribution : Known from type locality only.

Platylabia brindlei sp. n.

Material examined : INDIA : Meghalaya : Cherrapunji, nr Mawsamai Cave (ex under bark of dead tree), 1300 m, Holotype ♂ ; Reg. No. 8047/H5 (genitalia mounted between two coverslips and pinned with the specimen), Paratype ♀, Reg. No. 8048/H5 25.v.1979 (*G. K. Srivastava*) ; deposited in the Zoological Survey of India, Calcutta.

Description : Form depressed, finely pubescent. General body colour brownish black, head, pronotum, elytra and wings black ; antennae fuscous brown with one or two preapical segments whitish ; legs blackish brown ; a few apical tergites and forceps brownish.

Male : Head transverse, smooth, hind margin emarginate, sutures obsolete. Eyes distinctly shorter than the post-ocular length. Antennae 24-segmented or more (appear to be partly broken, only 24 segments, on the left side and 18 segments on the right present) ; 2nd small, remaining segments same as in preceding species. Pronotum longer than broad, anteriorly convex, sides depressed but convex, hind margin subtruncate, median sulcus distinct ; prozona weakly raised and metazona depressed. Elytra normal, meeting along the medium suture ; a triangular scutellum visible. Wings abbreviated, scarcely projecting beyond the elytra as narrow lateral lobes. Legs normal. Abdomen depressed, gradually enlarging from base to apex, depressed, thickly pubescent, smooth, sides of segments convex. Penultimate sternite broadly rounded with a faint emargination in middle. Ultimate tergite transverse, obscurely punctate, depressed along the median line, sides compressed, hind margin almost straight. Pygidium vertical, strongly transverse, depressed, narrowed posteriorly hind margin straight. Forceps sickle-shaped, trigonal in basal third, apices pointed and crossing, internally armed at middle with a sharp, oblique flange terminated at both ends by a sharp tooth. Genitalia with parameres broad, length slightly exceeding double its width, a faint tubercle present apically close to inner apical angle ; distal lobes with a stout, tubular virga and an additional chitinous rod.

Female : Agrees with male in most characters except that the penultimate sternite and ultimate tergite narrowed posteriorly, latter striate near hind margin ; pygidium weakly transverse, vertical ; forceps depressed, almost straight, internally armed at middle with a triangular tooth and margin dorsally as well as ventrally serrated.

Measurements : (in mm)

	Holotype	Paratype
	♂	♀
Length of body	9·1	9·9
Length of forceps	1·6	2·7

Disiribution : Known from type locality only.

Remarks : Some variations in the relative length of antennal segments 4th to 7th of both sides have been noted (figs. 12, 13) in Holotype.

This species has been named after Mr. A. Brindle of Manchester Museum (U, K.)

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India, Calcutta for providing necessary facilities during the course of present work. My thanks are also due to Dr. F. J. Radovisky, Chairman, Department of Entomology, B. P. Bishop Museum, Honolulu, Hawaii (U. S. A.), for placing at my disposal unidentified material of Dermaptera referred to under *Platylabia major* (Dohrn).

REFERENCES

BURR, M. 1910. *Fauna of British India, Dermaptera*, xviii + 217 pp., 10 pls.

DOHRN, H. 1867. Neue und bischer nicht genügend bekannte Forficulinen. *Stettin. ent. Ztg.*. **28** : 343-349.

DUBRONY, A. DE. 1879. Enumeration des Orthoptères rapportés par MM. J. Doria, O. Beccari, et L. M. d' Albertes des régions Indinne et Austro *en* Malaise, par A Dubrony. *Annali. Mus. civ. Stor. nat. Giacomo Doria*, 14 : 348-383.

ZACHER, F. 1910. Tiergeographische, phylogenetische und biologische Bemerkungen zu Malcolm Burr's Dermapteren fauna von British Indien, Burma an Ceylon. *Ent. Rdsch.*, Nr. 23, Jh. 27 : 174-176.

Bull. zool. Surv. India, 4 (1) : 111—115, 1981

TWO DIGENETIC TREMATODES (FAMILY HEMIURIDAE) OF MARINE FISHES OF INDIA

M. HAFEEZULLAH*

Zoological Survey of India, Calcutta

ABSTRACT

The paper deals with the descriptions of two new species *Parahemiurus dussumieriai* from the host fish *Dussumieria acuta* Cuv. and Val., and *Aphanurus tuberculatus* from the fish hosts *Hilsa sinensis* (L.) and *Sardinella fimbriata* (Val.). They belong to the digenean family Hemiuridae.

The material for the present study was collected from Madras and Tuticorin (Bay of Bengal) and Bombay (Arabian Sea) in 1964 and 1965. They belong to the genera *Parahemiurus* Vaz and Pereira, 1930 and *Aphanurus* Looss, 1907. After they were recovered from the host fishes in living condition, they were processed according to the standard method using pressure of a small fragment of cover glass in order to avoid overstretching. AFA was used as fixative.

Gupta and Sehgal (1971) reported *Parahemiurus merus* (Linton, 1910) Woolcock, 1935 from a marine fish, *Dussumieria hasselti* (Bleeker), from Dhanushkodi, Palk Bay. They illustrated one of their two specimens and provided some measurements also. The author has not been able to consult Linton (1910) which contains the original description of *Parahemiurus merus* as *Hemiurus merus*. Manter (1940), however, gave specific diagnosis of *P. merus* and discussed some synonymies also. According to him, in *P. merus* the dorsal plications do not extend across the body posterior to the acetabulum, the acetabulum is 2 to 2·5 times oral sucker, the undivided seminal vesicle is spherical to ovoid with thick muscular wall, the pars prostatica is winding and extending some distance posterior to acetabulum, and the ovary and the two vitellarian masses are situated in the middle third of the body proper. This diagnosis of *P. merus* has not been disputed so far by any worker on the group. It is in these characters that Gupta and Sehgal's specimens materially differ from *P. merus* (Linton, 1910). The illustration provided by them shows that unlike *P. merus* their two specimens have almost parallel sides of body, the oral sucker is only slightly smaller than the acetabulum, the seminal vesicle is pyriform without thick muscular wall and lies removed from acetabulum posteriorly due to longer pars prostatica, and the ovarian complex along with masses of vitellaria are situated in the posterior third of the body proper. These characters suggest otherwise to their identification. The author has also collected identical specimens from a closely related fish host from adjoining areas. The comparative study of these specimens and report of Gupta and Sehgal reveal that they had specimens of a new species which they described as a known form. Therefore their specimens as well as mine are named as *Parahemiurus dussumieriai* n. sp. A fuller description and differential diagnosis of this new species are provided in this paper on the basis of the specimens of the author.

* Present address : Desert Regional Station, Jodhpur.

All measurements are in microns unless otherwise stated. The diagrams have been made with the aid of a camera lucida.

Host :

Site :
Number of specimens :
Localities :

Specimens deposited :

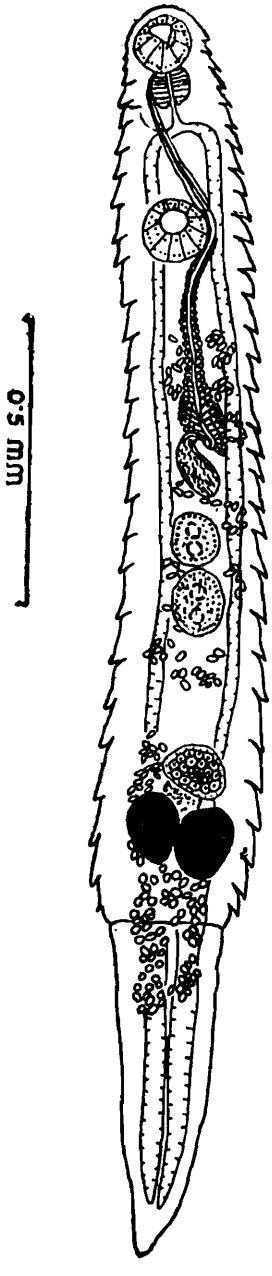


Fig. 1. *Parahemiurus dussumieriae*, entire worm, ventral view.

Parahemiurus dussumieriai n. sp.

(Figs. 1, 2)

Dussumieria acuta Cuv. and Val. ; dwarf round herring ; Dussumieridae

Stomach
8, on eight slides
Tuticorin (Gulf of Mannar, Bay of Bengal); Madras (Coromandel coast, Bay of Bengal) ; collected by the author in 1964-65

Z. S. I. Reg. Nos. Holotype w/7390/1, Paratypes w7391/1 to w7397/1

Description (Based on 3 good specimens) : Body proper 1.505-1.558 mm long, 0.246.0.252 mm wide, elongate with almost parallel sides ; anterior end rounded ; ecsoma 0.499-0.58 mm long, 0.18-0.195 mm wide, tapering posteriorly when fully extended. Tegument moderately thick with ventral plications all over body, proper extent of dorsal plications not constant ; tegument of ecsoma smooth. Acetabulum 101-112 by 108-115, spherical, and situated at 293-317 from anterior end. Oral sucker 84-91 by 91-94, spherical, subterminal ; preoral lobe 8-14 wide. Sucker ratio 1 : 1 to 1.2. Mouth ventroterminal ; prepharynx indistinct ; pharynx 75-84 by 63-70, oval, slightly overlapped by oral sucker ; esophagus 44-47 long followed by cecal bifurcation ; ceca simple, reaching a bit short of posterior end of ecsoma.

Testes 84-113 by 66-84, oval, entire, tandem, situated in anterior or middle part of posterior half of body proper, anterior testis and seminal vesicle separated by uterus. Seminal vesicle 112-147 by 56-70, pyriform without muscular wall, with anterior tapering portion bent backwards, disposed in front of anterior testis, far removed from acetabulum ; pars prostatica a long and winding duct, surrounded by well differentiated prostate cells up to posterior level of acetabulum only, not connected to seminal vesicle by a glandular duct, entering sinus sac near anterior margin

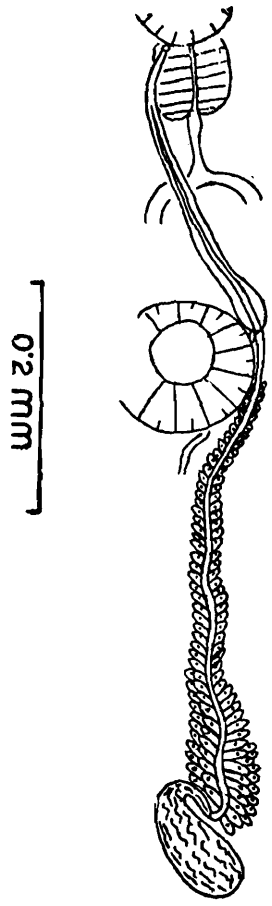


Fig. 2. *Parahemiurus dussumieriai*, genital ducts.

of acetabulum. Sinus sac a long tube, enclosing a narrow hermaphroditic duct, extending up to anterior margin of acetabulum. Genital pore at base of oral sucker.

Ovary 66-87 by 80-108, subglobular, entire, median, post-testicular. Shell gland complex dorsal to ovary and vitellaria. Vitellaria two compact masses, slightly indented in some specimens, post-ovarian, situated in front of junction of tail and body proper. Uterus descending into ecsoma, then ascending and entering sinus sac at its base. Uterine seminal receptacle not formed. Eggs 21 × 12. Excretory vesicle Y-shaped ; arms uniting dorsal to oral sucker.

In sucker ratio and nature of vitellaria this species comes close to *Parahemiurus clupeae* Yamaguti, 1953 but differs from it in having almost parallel sides of body proper, and the tail is very small as compared to the length of body proper. In *P. clupeae* the junction of body proper and tail "occurs a little behind midbody in three (of four) specimens including the type, but just at the middle in the other." In *P. clupeae*, the intestinal limbs are "very wide" whereas in the present species they are of normal width. Seminal vesicle in *P. clupeae* is fusiform with very thick muscular wall whereas it is pyriform with an anterior attenuation bent backwards and without thick muscular wall. The pars prostatica is longer removing the seminal vesicle more posteriorly with respect to the acetabulum as against the length of this structure in *P. clupeae*.

Aphanurus tuberculatus n. sp.

(Fig. 3)

Type host : *Hilsa sinensis* (L.) ; Chinese herring ; Clupeidae.

Other host : *Sardinella fimbriata* (Val.) ; fringe-scaled sardine Clupeidae.

Site : Stomach

Number of specimens : 18, on five slides

Locality : Bombay (West coast of India, Arabian Sea). Collected by Dr. A. H. Siddiqi in 1963

Specimens deposited : Z. S. I. Reg. Nos. Holotype w7398/1 Paratype w7399/1 to w7402/1

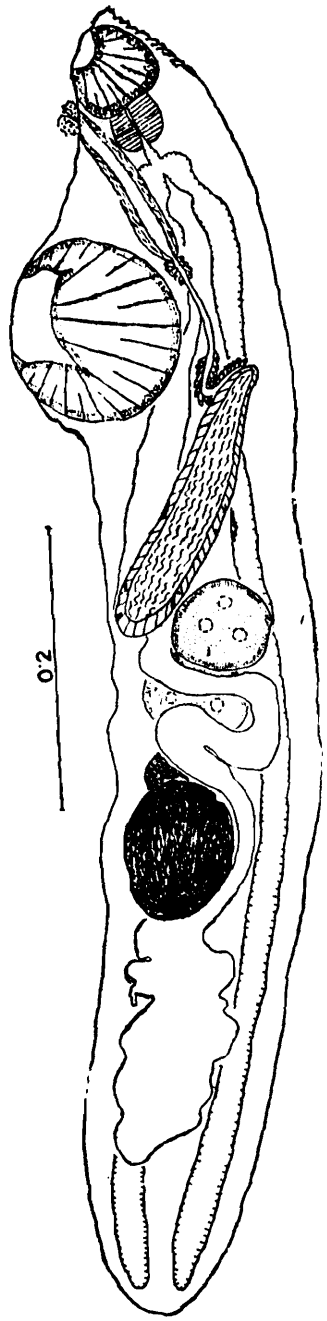


Fig. 3. ***Aphanurus tuberculatus,*** **entire worm, lateral view.**

Description (based on 5 good specimens) : Body 0.728-0.854 mm long ; 0.172-0.189 mm wide at acetabular level, subcylindrical, posterior end rounded, anterior end conical, bulging at the level of the acetabulum. No ecsoma. Tegument moderately thick with fine plications, more conspicuous in anterior region dorsally, extending to vitellarian zone on ventral side. Acetabulum 112-122 in diameter, spherical, prominent, situated at 108-140 from anterior end of body. Oral sucker 52 in diameter, spherical, subterminal. Sucker ratio 1 : 2.25. Prepharynx absent ; pharynx 35 in diameter, spherical slightly overlapped by oral sucker ; esophagus short ; cecal bifurcation in front of anterior border of acetabulum ; ceca simple, reaching short of posterior end of body.

Testes 45-66 by 45-73, globular, entire, diagonal, sometimes slightly overlapping each other, almost equatorial. Seminal vesicle 133-196 by 38, elongated, fusiform with fairly thick muscular wall, postacetabular, extending posteriorly ventral to posterior margin of anterior testis ; pars prostatica dorsal to acetabulum, surrounded by prostate cells near proximal and distal ends and naked in the middle. Sinus sac a longitudinal tube, extending from near anterior border of acetabulum to anterior border of oral sucker ; enclosing a straight hermaphroditic duct and a swollen knob-like sinus organ beset with fine tubercles projecting out through genital pore. Genital pore ventral to oral sucker.

Ovary 28-38 by 36-80, subglobular or transversely elongated, entire, median, immediately post-testicular. Vitellaria 91-98 by 84-112, globular, indented anteriorly, immediately post-ovarian. Uterus reaching posterior end, beyond ceca, uniting with male duct at base of sinus sac. Eggs 14-18 by 8. Excretory vesicle Y-shaped ; excretory arms uniting dorsal to pharynx ; excretory pore terminal.

Aphanurus tuberculatus is distinct from all other members of the genus *Aphanurus* Looss, 1907 in the presence of a sinus organ beset with fine tubercles.

ACKNOWLEDGEMENTS

Thanks are due to the Director, Zoological Survey of India, Calcutta for providing facilities, and to Dr. T. D. Soota, Superintending Zoologist for taking interest in the work.

REFERENCES

GUPTA, N. K. and SEHGAL, K. H. 1971. Studies on some hemiurid trematodes from marine food fishes in India. *Res. Bull. Punjab Univ. Sci.*, (1970), 21 : 227-239.

LINTON, E. 1910. Helminth fauna of the dry Tortugas, II. Trematodes. *Carneg. Inst. Washington Publ.*, No. 133 : 133.

MANTER, H. W. 1940. Digenetic trematodes of fishes from the Galapagos Islands and the neighbouring Pacific. *Rep. Allan Hancock Pacif. Exped.*, 2 (14) : 329-497.

YAMAGUTI, S. 1953. Parasitic worms mainly from Celabes. Part 3. Digenetic trematodes of fishes, II. *Acta Med. Okayama*, 8 (3) : 257-295.

YAMAGUTI, S. 1971. *Synopsis of Digenetic trematodes of Vertebrates Vols. I & II.* Keigaku Publishing Co., Tokyo, Japan.

Bull. zool. Surv. India, 4(1) : 117-118, 1981

RECORD OF NEW HOST PLANTS OF *OXYCARENUS LAETUS* KIRBY (LYGAEIDAE : HETEROPTERA) WITH NOTES ON ITS ECOLOGY FROM EASTERN INDIA.

A. MUKHOPADHYAY, T. N. ANANTHAKRISNAN* AND K. THANGAVELU**

ABSTRACT

The dusky cotton bug, (*Oxycarenus laetus* Kirby) is reported from two new malvaceous host plants, *Hibiscus mutabilis* L. and *H. abelmoschus* L. Short ecological notes on the mode of infestation of the capsules of *H. abelmoschus* primarily by a noctuid moth and then by *O. laetus* in the winter season of Eastern India are provided.

Maxwell-Lefroy (1906, 1907, 1909) first reported the dusky cotton bug, *Oxycarenus laetus* Kirby as a minor pest of cotton and described its habitat and nymphal instars. It is reported from almost all the cotton cultivating regions of India (Khan and Rao, 1960). Observation on its life history (Misra, 1921 ; Pillai, 1921 ; Fletcher, 1922), morphology (Prasad, 1956), feeding behaviour (Thangavelu, 1978a), host plant and factors influencing host specificity (Thangavelu, 1978 b) and population dynamics in relation to climatic variation (Thangavelu, 1978 c) are well documented.

Cotton is not conventionally cultivated in Eastern India, therefore the occurrence of the dusky cotton bug and its host plants from this region are of some interest. Capsules of *Hibiscus mutabilis* L. containing dry seeds were found heavily infested during the winter months, November and December at Saharanpur and adjoining areas of Uttar Pradesh (North India). A heavy infestation of the adults and nymphs were also noticed in feeding and breeding condition on the capsule bearing stalks, stored for use as fire wood.

In Eastern India, particularly in southern West Bengal *O. laetus* was recorded at a low incidence on the capsules of *Sida rhombifolia* L. which appears to be one of the alternative host plants in this region, however *Hibiscus abelmoschus* L. (Mushkdana), the seed of which are used as flavouring agent and medicine, appears to be the most favoured host plant. Besides infestation of the ripe seeds of the dehisced capsules of *H. abelmoschus* the undehisced capsules are also attacked, particularly when caterpillars of the noctuid moth, *Earias fabia* Stoll bore through the capsular wall and thereby leaving the passage for the dusky cotton bug to infest. Once inside the capsule bugs feed on ripe, as well as unripe seeds.

O. laetus could be successfully and easily reared on the dry seeds of *H. abelmoschus* through several generations in the laboratory and the seeds of the host plant could be stored for long without any fungal attack or decay. In southern West Bengal the maximum incidence of the dusky cotton bug could be recorded on the above host plant in the winter season (November—January) when tempera-

* Ent. Res. Unit, Loyala College, Madras.

** C. I. C. R. Regional Station (I. C. A. R.) Coimbatore.

ture and relative humidity range between 12·8 C.—26.3 C. and 38%—99% respectively in contrast to the earlier reports of peak population in summer and very low incidence in winter in South India.

REFERENCES

FLETCHER, T. B. 1922. Report of Imperial Entomologist ; *Sci. Rept. Res. Inst.* 1921-22 : 11-102.

MAXWELL-LEFROY, H. 1906. Indian Insect Pests, pp. 107-108.

MAXWELL-LEFROY, H. 1907. *Mem. Dept. Agric. India, ent., Ser.* **1**, 236-241

MAXWELL-LEFROY H. 1909. Indian Insect Life : pp. 686-688.

MISRA, C. S. 1921. *Oxycarenus laetus*, the dusky cotton bug : *Proc. 4th Ent. Meet., Pusa* pp. 84 92.

PILLAI, 1921, Entomological report ; *Travancore Dept.Agric.*, **10**, 86-87.

PRASAD, S. N. 1956. External Morphology of *O. laetus* (Lygaeidae; Heteroptera) the dusky cotton bug : *Indian J. Ent.*, **18**, 357-371.

KHAN, Q. and RAO. V. P. 1960. Insect and Mite pests of cotton in India : *Indian Cent. Cott. Comm. Bombay*, **2**, 217-301.

THANGAVELU, K. 1978a. Some notes on ethology of Lygaeidae of the scrub jungles in South India : *J. Nat. Hist.*, **12**, 481-486.

THANGAVELU, K. 1978b. Some notes on host specificity of dusky cotton bug. *O. laetus* Heteroptera: Lygaeidae). *J. Nat. Hist.*, **12**, 481-486.

THANGAVELU, K. 1978c. Population dynamics of the dusky cotton bug *Oxycarenus laetus* Kirby in relation to the climatic variation (Heteroptera : Lygaeidae) *Proc. Indian Acad. Sci.* 87*b* (Animal Science-4) (12) : 387-395.

Bull. zool. Surv. India, 4 (1) : 119—120, 1981

SOME OBSERVATIONS ON THE POPULATION OF *PRIESNERIOLA O'NIELLAE* ANANTHAKRISHNAN IN A GRASS FIELD IN CALCUTTA

During the course of an investigation on the grass inhabiting thrips in a field near Ballygunge Lake, Calcutta, the authors came across the unique species *Priesneriola o'niellae* Ananthakrishnan in quite good numbers along with some other species of thrips *P. o'niellae* Ananthakrishnan a slender bicolorous species, characterised by six segmented antennae, longer sixth segment, small pedicellate 3rd segment, large eyes and a slight anteocular projection was first reported from Madras (Ananthakrishnan, 1964) and the present discovery extends the range of its distribution from Peninsular India to the North Eastern region.

An analysis of the species composition of Thysanoptera during 1977-78 indicates that there are six species inhabiting this particular grass field. *Haplothrips ganglbaueri*, a widely

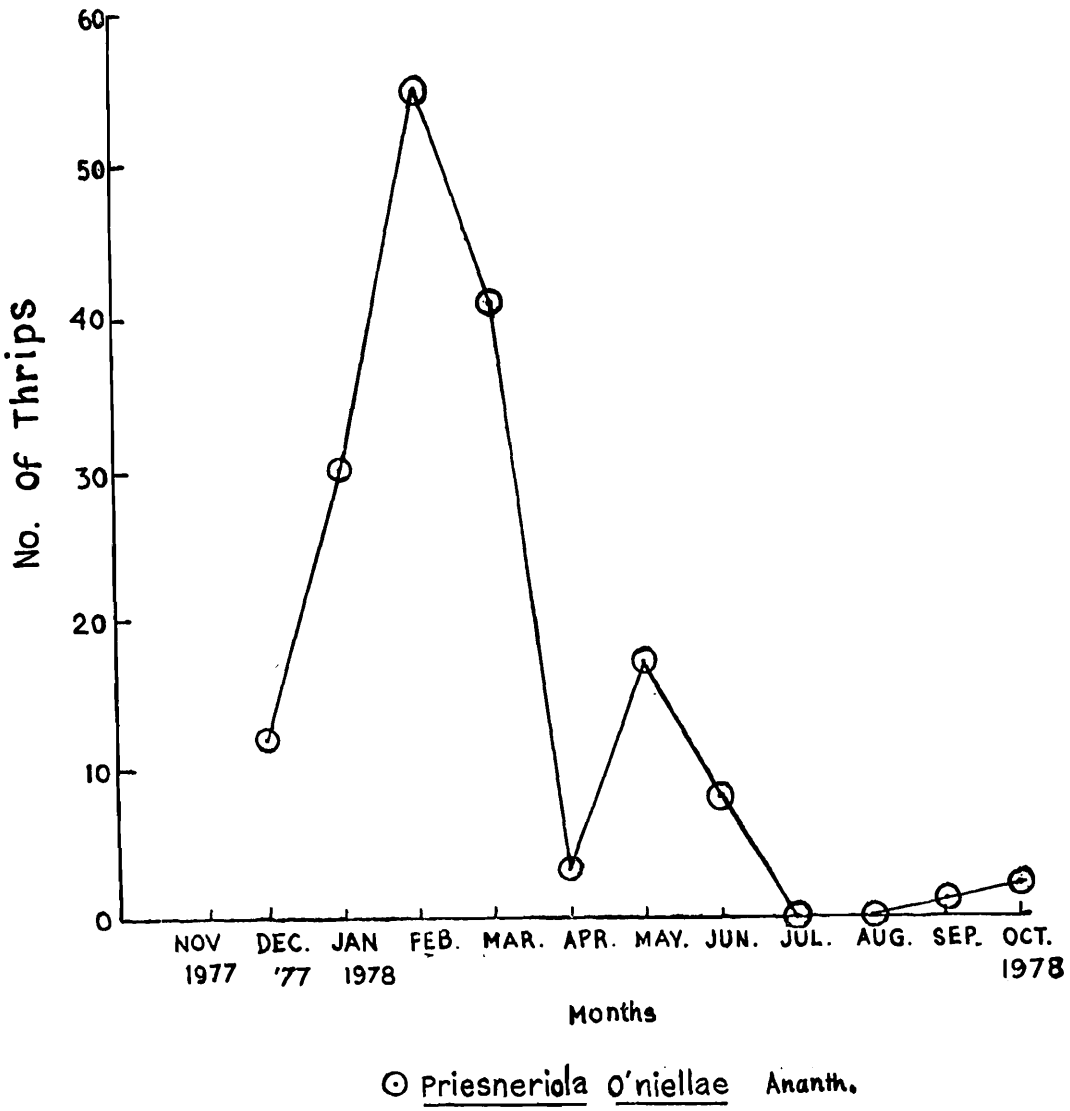


Fig. 1. Population fluctuation of *Priesneriola o'niellae* Ananthakrishnan.

distributed polyphagous species was the most common, found almost throughout the year and comprising 83.4% of the total thrips population. Other species, in order of dominance are *Priesneriola o'niellae* (10-03%), *Thrips hawaiiensis* (4.25%), *Caliothrips indicus* (1.07%), *Phibalothrips perungeyi* (0.86%) and *Anaphothrips sudanensis* (0.11%).

In view of the restricted distribution records and absence of males resulting in parthenogenitic mode of reproduction, observations were made on the numerical fluctuations of *P. o'niellae* during the period 1977 (Nov.)-1978 (Oct.) (fig. 1). Sampling was done once in every fifteen days over a peri d of twelve months and 10 beats were the standard adopted for the collection of thrips from this grass field. Populations of this species are available almost throughout the year except during the rainy months of July and August, and the maximum peak occurred during February-March, the beginning of summer months in Calcutta. Populations gradually decline during summer and totally disappears from the field during rainy season. *P. o'niellae* reappears in the field in September.

References

ANANTHAKRISHNAN, T. N. 1964. Indian Terebrantia i. *Bull. Ent.* **5**: 49-55.

Zoological Survey of India, Calcutta.

C. K. SENGUPTA
AND
N. K. PRAMANIK

Bull. zool. Surv. India, 4 (1) : 121—123, 1981

SILUROID FISHES OF INDIA BURMA AND CEYLON. 23. THE SPECIFIC STATUS OF *TACHYSURUS MALABARICUS* (DAY) (ARIIDAE : SILURIFORMES)

Day (1877) described *Tachysurus malabaricus* from a single specimen, 205 mm in standard length from Canara. Though Misra (1976) cited its distribution as India : "Canara, Mysore, Kerala", this species does not appear to have been recorded subsequent to Day, nor any material from Mysore, or Malabar are known. The type locality is also not pinpointed since "Canara" equals to the present day North and South Kanara of the Karnataka State which covers a wide area of 1,91,773 sq. km with a sea front of 320 km. long.

The Holotype is preserved in the National Zoological Collections of Z. S. I. and is registered as *Arius malabaricus* Day, Regd. No. 1305. The caudal and the anal fins are damaged though the total count of fin rays are discernible. The dentition is clearly seen as a single oval elongated patch on each side of the plate with granular teeth. The dentition pattern resembles very closely that of *T. maculatus* (Thunberg, 1792) also known from Kanara and other adjacent areas.

We have examined in the course of our studies on *Tachysurus*, 118 examples of *T. maculatus* collected from several localities of the west and eastern coast of India. The size range of the specimens examined by us is also wide (75—435 mm SL) which covers the size of the holotype (235 mm. SL) of *T. malabaricus*.

Chandy (1953) attempted to distinguish these two species by illustrating the arrangement and nature of teeth pattern on the palate but this character is not reliable since the teeth arrangement (dense or sparse) vary considerably with age and sex. In *T maculatus*, teeth patches on the palate are supposed to be densely packed but we have examined number of male adult specimens with sparsely arranged teeth on the palate. Misra (1976) differentiated *T malabaricus* from *T. maculatus* by the width of the premaxillary teeth band on the upper jaw which according to him is "10 times" as long as broad in the former *versus* 4 times in the latter. We have examined single specimen of *T malabaricus* known and available which Misra may also have examined. The premaxillary teeth band is only four times as long as wide and definitely not "10 times" as mentioned by Misra. It seems that Misra made an error in this respect. It may be mentioned here that Day (1877, 1889) correctly cited the width of the premaxillary teeth band as 4 times as long as broad. Further, *T maculatus* has often the first dorsal fin ray prolonged as a filament which is supposed to be absent in *T. malabaricus*. This character also can not be relied since even in *T maculatus* instances of the dorsal fin filament being absent is not rare and Day's specimen of *T malabaricus* may be one such example.

The statistical comparison of 20 morphometric proportions in respect of 118 examples of *T. maculatus vs.* the holotype of *T. malabaricus* also reveals that the latter species is merely a morpho-variant of the former (Table 1,.

In the light of above it is concluded that *T. malabaricus* (Day) is a junior synonym of *T maculatus* (Thunberg).

We are thankful to the Director, Zoological Survey of India for facilities provided.

TABLE – 1. Comparison of various morphometric proportions as percentage in the type specimen of *T. malabaricus* (Day) from Kanara with the sample means for these same proportions of 118, specimens of *T. maculatus* (Thunberg) from east and west coast of India.

	118 specimens of *T. maculatus* (Thunberg)			Type specimen of *T. malabaricus* (Day)			
	Range	$\bar{X}$	S	X	$\bar{X}$-x	t	p
Head length/ Total length	18.55-2[illegible].25	21.2137	1.8231	—	—	—	—
Body depth/ Total length	14.95-21.67	18.4356	1.9624	—	—	—	—
Head length/ Standard length	23.36-30.72	26.7319	2.2194	26.8290	-0.0971	-0.0435	More than 90%
Body depth/ Standard length	18.29-27.13	22.9831	2.1358	21.9512	1.0319	0.4819	60-70%
Predorsal length/ Standard length	31.95-39.73	36.8193	1.8902	35.1219	1.6974	0.8941	30-40%
Preanal length/ Standard length	65.93-76.15	68.9213	2.4284	69.1312	-0.2099	-0.0860	More than 90%
Pre-pectoral length/ Standard length	20.26-31.35	26.2956	2.8359	26.3143	-0.0187	-0.0[illegible]65	More than 90%
Width of dorsal fin base/width of anal fin base	50.78-72.45	59.9319	4.3183	60.1953	-0.8763	-0.0432	More than 90%
Head width/ Head length	63.21-84.79	73.1948	4.9361	75.6842	-2.4894	-0.5021	60%
Height of Head/ Head length	55.28-7[illegible].15	66.3189	4.3184	65.4545	0.8644	0.1993	80-90%
Snout length/ Head length	28.26.37.68	32.4581	2.3120	30.9090	1.5491	0.6671	50%
Eyediameter/ Head length	14.52-[illegible]3.45	18.4963	1.4210	16.3636	2.1327	1.4943	10-20%
Inter-nostril width/ Head length	18.14-24.78	21.4569	1.7231	20.00	1.4569	0.8274	40%
Inter-orbital width/ Head length	43.95-[illegible]6819	56.23.5	4.6312	52.7272	3.5043	0.7534	40-50%
Eye diameter/ Snout length	39.63-67.14	57.4361	6.3219	52.9411	4.4950	0.7080	40-50%
Internostril width/ Snout length	54.55--77.89	66.2319	6,1326	64.7058	1.5261	0.2477	80%
Internostril width/ Width of snout	43.14-58.31	49.7391	3.3162	50.00	-0.2609	-0.0783	More than 90%
Eye diameter/ Interorbital	26.19-47.35	33.4314	4.1531	31.0344	2.3970	0.5746	60%
Width of pre-maxillary band of teeth/length of pre-maxillary band of teeth	14.66-22.79	19.2956	2.1050	21.4285	-2.1329	-1.0088	30%
Height of caudal peduncle length of caudal peduncle	47.31-64.14	53.9604	4.3210	50.00	3.9504	0.9103	30-40%

REFERENCES

CHANDY, M. 1953. A key for the identification of the catfishes of the genue *Tachysurus* Lacépede with a catalogue of the specimens in the collection of the Indian Museum)Zool. Surv). *Rec. Indian Mus.*, 51(1).

DAY, F. 1877. *The fishes of India*. London, Wm. Dawson and Sons. 778 pp. 198 pls.

DAY, F. 1878. *The fauna ef British India including Ceylon and Burma*. Fishes 1: 169-192, Taylor and Francis London.

DHANZE, J. R. and JAYARAM, K. C. 1979. The family of cat fishes of the genue "Arius" (Siluriformes). *Curr. Sci.*, 48(22), 1008.

JAYARAM, K. C. and DHANZE, J. R. 1978. Siluroid fishes of India, Burma and Ceylon, 22. A preliminary review of the general of the family Ariidae (Pisces, Siluroidea). *Matsya*, 4, 43 51.

MISRA, K. S. 1976. *The fauna of India and the adjacent countries*. Pisces. 3, xxi+367 pp. 2nd Ed.

MUNRO, I. S R. 1955. *The marine and freshwater fishes of Ceylon*. Canberra. xvi+349 pp.

WEBBER. M. AND DE BEAUFORT, L F. 1913. *Thefishes of the Indo-Australian Archipelago* Leiden, E. J. Brill, Ltd., 2, xx + 405 pp.

Zoological Survey of India, Calcutta

K. C. JAYARAM
AND
J. R. DHANZE