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BULLETIN OF THE ZOOLOGIGAL SURVEY OF INDIA

CONTENTS

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FILTH INHABITING FLIES (DIPTERA) OF CALCUTTA CITY

A. N. T. Joseph and P. Parui

Zoological Survey of India, Calcutta

ABSTRACT

The study of filth inhabiting flies of Calcutta City was conducted for one year from September, 1977 to August, 1978. The filth of the city can be broadly grouped into the following eight categories : human excreta, cowdung or cattle droppings, garbage and kitchen refuses, decaying fish and meat, municipal sewage and other liquid waste, carrion, decaying coconut, and sweets. Detailed information about the attraction of 6 species of Muscidae, 3 species of Sarcophagidae, 2 species of Seysidae and 1 species each of Calliphoridae, Borboridae, Milichiidae, Drosophilidae, Phoridae, Syrphidae, Stratiomyidae and Psychodidae towards different types of filth has been provided. It is seen that cowdung or cattle droppings attract a maximum number of 16 species belonging to as many as 9 familses followed by human excreta that attract 11 species of flies that fall under 5 families. The duration of life cycle from oviposition to emergence of 17 species of flies under 10 families in summer and winter has been recorded. Food preferences of larvae of *Musca domestica vicina, M. domestica nebulo, Chrysomyia megacephala, Sorcophaga ruficornis* and *Megaselia scalaris* has been studied in detail. It is observed that they take less time for completion of life cycle and their mortality rate is much lesser in their favourite food medium, *i.e.*, meat. Seasonal changes in fly population have been discussed.

Communicable diseases like cholera, typhoid, dysentery, enteric fevers, etc.come in the way of economic progress of the tropical and subtropical countries. The rapid growth of population and influx of refugees are the main causes that considerably lowered the sanitary conditions so much that the city of Calcutta has provided ideal breeding grounds for such dreadful diseases. Though considerable attempts are afoot for the prevention of these diseases, enough emphasis has not been given to the study of its root cause, *i.e.*, their vectors, the filth inhabiting flies, which transmit the pathogens of these diseases. Normally these flies feed and breed in filth. At the same time they also visit the food for human consumption thus transmitting the pathogens through contact with their body surfaces and sticky feet and through vomit drops and excreta. Hence the authors have taken up the present study which is of utmost importance to the public health and hygiene of Calcutta. It is for the first time such a study is conducted in Calcutta, though similar studies have been undertaken by Bohart and Gressit (1951) in Guam, Gill (1955) in Central Alaska, Webb and Graham (1956) in Canada, and Ameen and Huq (1973) in Dacca City. The present work was carried out for a year from September 1977 to August 1978 to find out the seasonal abundance of the flies, their food preferences, habitats, duration of life histories in different media and in different seasons.

Materials and Methods

This work includes the survey of different types of filth and the collection of the associated flies and their eggs, larvae and pupae. A brief account of the nature of the filth and flies associated with them, the survey procedure and the localities surveyed, the biology of the flies, the food preferences of their larvae, the seasonal changes in fly population and the diseases spread by them is given in order.

Filth and the Associated Flies

The piled up garbage forms a permanent breeding ground for the flies and filth is quite common in vegetable and fish markets. Slaughter houses and meat shops in their unhygienic conditions perpetually attract the flies. Scattered cattle sheds with their manure heaps and slums with their open latrines form natural breeding grounds. In the present work the following breeding areas for the vector insect has been taken into consideration :

1. *Human excreta* : It is one of the best attractants of the filth visiting flies and one of their most important sources of breeding. The flies favour isolated deposits of excrements in shades or partly covered with leaves than those directly exposed to the sunlight or in large masses. 5 species of Muscidae, 3 species of Sarcophagidae, and 1 species each of Calliphoridae, Milichiidae and Borboridae have been recorded from it (Table 1).

2. *Cow dung or cattle droppings* : 5 species of Muscidae, 3 species of Sarcophagidae, 1 species each of Calliphoridae, Borboridae, Milichiidae, Ephydridae, Syrphidae and Stratiomyidae, and 2 species of Sepsidae have been found associated with it (Table 1).

3. *Garbage and kitchen refuses* (*including vegetable and fruits*) : 5 species of Muscidae, 3 species of Sarcophagidae and 1 species each of Calliphoridae, Drosophilidae and Psychodidae have been recorded from this medium (Table 1). Of these, calliphorids (*Chrysomyia megacephala*) and drosophilids (*Drosophila ananassae*) were the most abundant flies.

4. *Decaying fish and meat* : A total number of 8 species of flies belonging to the families of Muscidae (3 species), Sarcophagidae (3 species), Calliphoridae (1 species) and Phoridae (1 species) were recorded from the discarded parts of fish and meat (Table 1).

5. *Municipal sewage and other liquid waste* : Usually the stagnant water contains various waste and decomposed material and the scum of green algae. *Lispa orientalis* (Muscidae), *Brachydeutera longipes* (Ephydridæ) and *Psychoda alternata* (Psychodidae) were abundant. Rarely *Eristalis tenax* (Syrphidae) were also seen (Table 1).

6. *Carrion* : Its offensive odour attracts flies to it which forms food for adults as well as larvae. 3 species each of Muscidae and Sarcophagidae and 1 species each of Calliphoridae and Phoridae have been found to occur in this medium (Table 1).

7. *Decaying coconut* : Tender coconuts are discarded after consuming their contents. They are seen in heaps in various stages of

TABLE 1. List of flies associated with different types of filth in Calcutta City

Family	Species	Human excreta	Cow dung or cattle droppings	Garbage and kitchen refuses	Decaying fish and meat	Municipal sewage	Carrion	Decaying coconut	Sweets
1	2	3	4	5	6	7	8	9	10
Psychodidae	*Psychoda alternata* Say	—	—	**	—	***	—	—	—
Stratiomyidae	*Sargus metallinus* (F.)	—	*	—	—	—	—	—	—
Syrphidae	*Eristalis tenax* L.	—	*	—	—	*	—	—	—
Phoridae	*Megaselia scalaris* (Loew)	—	—	—	***	—	**	—	—
Sepsidae	*Sepsis rufa* Macquart	—	***	—	—	—	—	—	—
	Sepsis pubipes Brunetti	—	***	—	—	—	—	—	—
Ephydridae	*Brachydeutera longipes* Hendel	—	*	—	—	***	—	—	—
Drosophilidae	*Drosophila* (*Sophophora*) *ananassae* Doleschall	—	—	***	—	—	—	—	—
Milichiidae	*Desmometopa m-nigrum* Zett.	**	***	—	—	—	—	—	—
Borboridae	*Leptocera* sp.	**	***	—	—	—	—	—	—
Calliphoridae	*Chrysomyia mega-cephala* (F.)	***	**	***	***	—	***	—	***
Sarcophagidae	*Sarcophaga ruficornis* (F.)	***	*	**	***	—	**	**	**
,,	*Sarcophaga hirtipes* Wiedemann	***	*	**	***	—	***	**	**

TABLE 1 (continued)

1	2	3	4	5	6	7	8	9	10
Sarcophagidae	*Sarcophaga dux* Thomson	***	*	**	***	—	***	**	**
Muscidae	*Musca (Musca) domestica vicina* Macquart	***	*	**	***	—	—	**	**
,,	*Musca (Musca) domestica nebulo* F.	**	*	**	***	—	—	—	—
,,	*Musca (Byomyia) sorbens* Wiedemann	**	***	**	***	—	***	**	**
,,	*Musca (Byomyia) pattoni* Austen	**	***	**	—	—	**	—	—
,,	*Musca (Ptilolepis) inferior* Stein	**	**	**	—	—	*	—	—
,,	*Lipsa orientalis* Wiedemann	—	—	—	—	***	—	—	—

*** Very common and abundant.
** Common.
* Rare.
— Not recorded.

decaying in several parts of the city. 5 species of flies belonging to Muscidae (2 speeies) and Sarcophagidae (3 species) were commonly seen in it (Table 1).

8. *Sweets* : Flies are attracted to the shops that sell sweetmeat and molasses. *Chrysomyia magacephala* (Calliphoridae) have been found to occur in abundance. *Sarcophaga ruficornis*, *S. hirtipes* and *S. dux* (Sarcophagidae) and *Musca domestica vicina* and *M. sorbens* (Muscidae) were of common occurrence (Table 1).

SURVEY PROCEDURE AND LOCALITIES SURVEYED

For the collection of the flies surveys were undertaken in eight different localities of Calcutta City (Fig. 1) once in a fortnight. They were collected during day time between 10.00 a.m. and 5.00 p.m. The localities were selected from different parts of the city to give a fair idea of the distribution of the fiies that are attracted to different kinds of filth. All these spots remained filthy throughout the year. The collection localities are included in the map provided. An account of the collection localities and the types of filth encountered there is as follows :

1. *Veterinary College, Belgachia* : In the campus there are cattle sheds, stables and kennels. Their droppings are deposited in one place while the dead animals are dumped in another. There are a number of stagnant drains also in the campus. All these spots attract a variety of flies.

2. *Belgachia Busty* : It (Busty No. 22) is situated on the side of the Belgachia Road, opposite to the Veterinary College. The collections were made from Birpara side from the common dumping ground of the kitchen refuses and also from stagnant drains.

3. *College Street Market* : It is situated in the northern part of the city. There is a separate fish market with a few meat shops at the sides. The dumping ground for the rotten vegetables is adjacent to the fish market.

4. *Bagjola Canal, Dum Dum* : The sewage of the city after being treated falls to this canal. Always there remains a layer of scum on the surface of the water. Collections were made from the water surface as well as from the sides.

5. *Dapha* : It is the main municipal dumping ground for the refuses of the city. Because of the abundance of all kinds of decomposed material, it is an ideal locality for the filth inhabiting flies. There is a large cattle shed nearby where heaps of dung lay accumulated.

6. *Machua Bazar Market* : It is the main wholesale market for fruits in Calcutta. Collections were made from fresh as well as decaying fruits of various kinds.

7. *Kidderpur Market* : It is a very big market situated in the southern part of the city. From the fish and meat stalls and from the dumping ground collections were made.

8. *Medical College Hostel* : The hostel is located near the Calcutta Medical College and is intended for about one hundred boarders. The kitchen refuses are dumped outside the campus along the side of a Corporation drainage. For want of proper garbage removal,

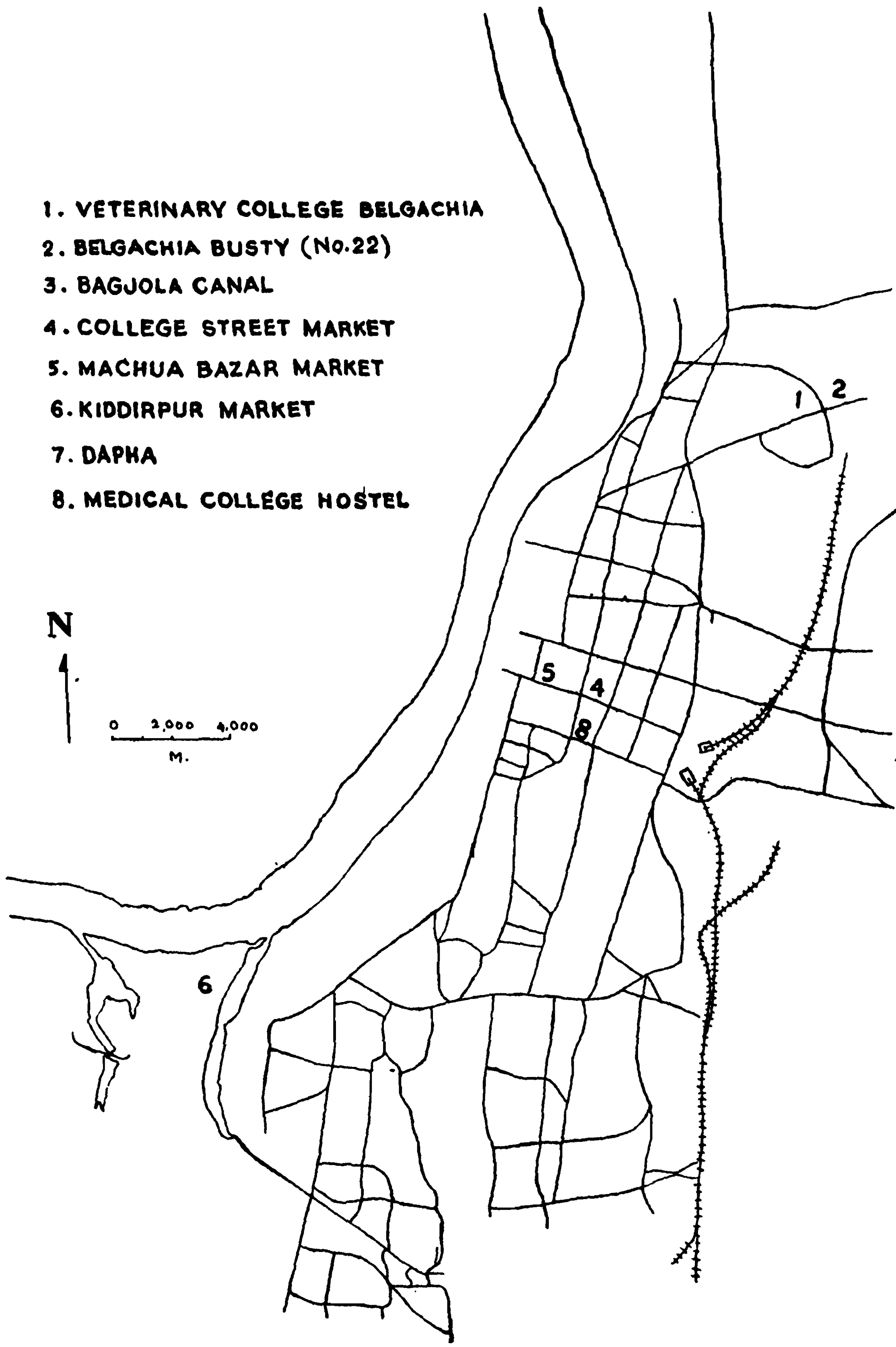

Fig. 1. Map of Calcutta showing the various collection localities.

TABLE 2. Duration of the various developmental stages of filth inhabiting flies in different media

Family	Species	Media	Season	Egg stage (In hours)	Larval stage (In days)	Pupal stage (In days)	Total time required (In days)
1	2	3	4	5	6	7	8
Psychodidae	*Psychoda alternata* Say	Sewage	Summer	15-17	4-5	3	7.6-8.7
		Mud and algae	Winter	18-20	7-8	5-6	12 8-14.8
Phoridae	*Megaselia scalaris* Loew	Fish and meat	Summer	18-20	4-5	6	10.8-11.8
		Fish and meat	Winter	20-22	5-6	13	18.8-19.9
Sepsidae	*Sepsis rufa* Macquort	Cow dung	Summer	12-14	4-5	5	9.5-10.6
		Cow dung	Winter	17-18	5	8-9	13.7-14.8
„	*Sepsis pubipes* Brunetti	Cow dung	Summer	12-14	5-6	5	10.5-11.5
		Cow dung	Winter	16-18	5	9-10	14.7-15.8
Ephydridae	*Brachydeutera longipes* Hendel	Sewage	Summer	18-20	5	6	11.8-11.9
		Sewage	Winter	20-22	6-7	9-10	15.9-17.9
Drosophilidae	*Drosophila* (*Sophophora*) *ananassae* Doleschall	Lemon, mango, banana	Summer	10-12	3	3-4	6.4-7.5
		Tomato, apple	Winter	13-14	3-4	4-5	7.5-9.5
Milichiidae	*Desmometopa m-nigrum* Zett.	Cow dung	Summer	—	3-4	8-9	11-13
		Cow dung	Winter	—	—	—	—
Borboridae	*Leptocera* sp.	Cow dung	Summer	—	4	5-6	9-10
		Cow dung	Winter	—	—	—	—

TABLE 2 (continued)

1	2	3	4	5	6	7	8
Calliphoridae	*Chrysomyia megacephala* (F.)	Fish and meat	Summer	11-12	7	4-5	11.4-12.5
		Fish and meat	Winter	14-16	7-9	5-6	12.6-15.6
Sarcophagidae	*Sarcophaga ruficornis* (F.)	Fish and meat	Summer	—	4-5	6-7	10-12
		Fish and meat	Winter	—	8-9	12-13	17-22
,,	*Sarcophaga hirtipes* Wiedemann	Fish and meat	Summer	—	5	6-7	11-12
		Fish and meat	Winter	—	5-6	15	20-21
,,	*Sarcophaga dux* Thomson	Fish and meat	Summer	—	5	9-10	14-15
		Fish and meat	Winter	—	5-6	18-19	23-25
Muscidae	*Musca (Musca) domestica vicina* Macquart	Fish and meat	Summer	8-10	3-4	4	7.3-8.4
		Fish and meat	Winter	14-15	5	5-6	10.6-11.5
,,	*Musca (Musca) domestica nebulo* F.	Fish and meat	Summer	8-11	4	4	8.3-8.5
		Fish and meat	Winter	13-15	5-6	6	11.5-12.5
,,	*Musca (Byomyia) sorbens* Wiedemann	Fish and meat	Summer	12-13	4	4	8.5-8.6
		Fish and meat	Winter	15-16	9	4	13.6-13.7
,,	*Musca (Byomyia) pattoni* Austen	Fish and meat	Summer	10-12	5	4	9.4-9.5
		Fish and meat	Winter	15-16	9-10	5	14.6-15.6
,,	*Musca (Ptilolepis) inferior* Stein	Fish and meat	Summer	12-14	5	5-6	10.5-11.5
		Fish and meat	Winter	16	9-10	4	13.6-14.6

this locality has decaying refuses which attracted the flies.

BIOLOGY

The dipteran flies have highly developed biology. The adults are free living and fliers, the larvae are aquatic or live in decaying vegetation, garbage, rotten fruits, carrion and free living tissues.

Most of the flies lay eggs but some such as sarcophagids being larviparous. The duration of the different stages of life vary from species to species and according to seasons. The present study shows, as can be seen from Table 2, that the larval period was considerably prolonged in winter season than in the summer as was earlier recorded by Ameen and Huq (1973).

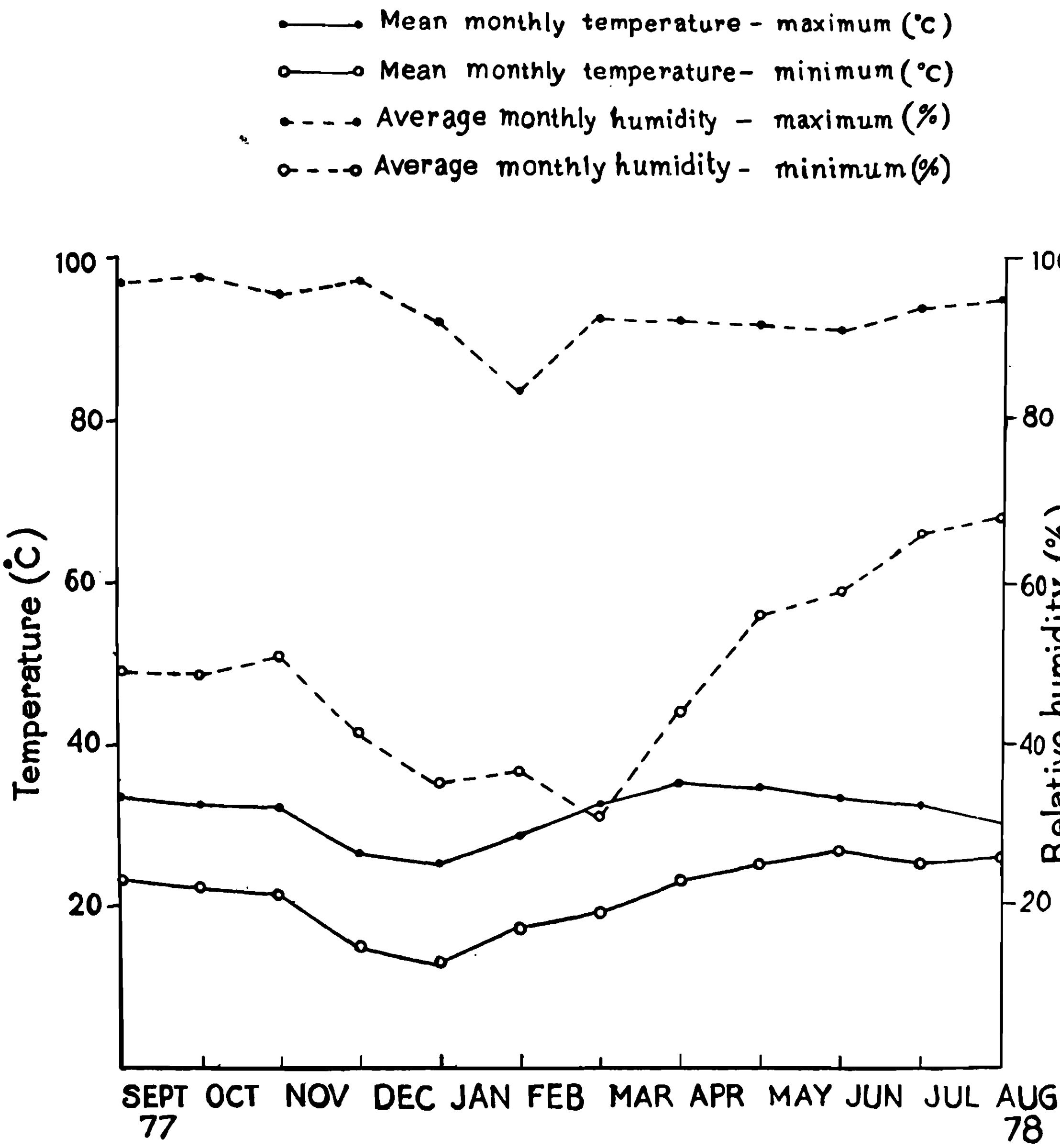

Fig. 2. Changes in temperature (maximum and minimum) and humidity (maximum and minimum) from September 1977 to August 1978.

Food Preferences of the Larvae

To know the food preferences of the larvae 2 species of Muscidae, 1 species each of Calliphoridae, Sarcophagidae and Phoridae were reared in more than one medium. It was observed that there are differences in the duration of the various developmental stages and that the favourable media help to develop more population in comparatively short duration.

Chrysomyia megacephala (Calliphoridae), *Sarcophaga ruficornis* (Sarcophagidae) and *Megaselia scalaris* (Phoridae) were reared in meat and fish. It was seen that in meat they complete the life cycle faster than in fish (Table 3).

Musca domestica vicina and *M. domestica nebulo* (Muscidae) were bred in fish, meat, and mixed bread, banana and sugar media. They completed the developmental stages faster in meat (Table 3).

Table 3. Duration of the various developmental stages of 5 species of flies in different food media

Family	Species	Media	Egg stage (in hours)	Larval stage (in days)	Pupal stage (in days)	Total time required (in days)
Muscidae	*Musca (Musca) domestica vicina* Macquart	Meat	8-9	3.5	4	7.3-9.3
		Fish	8-10	4	4	8.3-8.4
		Bread, banana and sugar	10-12	4	5	9.4- 9.5
,,	*Musca (Musca) domestica nebulo* F.	Meat	8-9	4	4	8.3-8.4
		Fish	8-10	4	5	9.3-9.4
		Bread, banana and sugar	10-11	5	5	10.4-10.5
Sarcophagidae	*Sarcophaga ruficornis* (F.)	Meat	—	4-5	6	10-11
		Fish	—	4-5	7	11-12
Calliphoridae	*Chrysomyia megacephala* (F.)	Meat	11	7	4	11.4
		Fish	11-12	7	5	12.4-12.6
Phoridae	*Megaselia scalaris* (Loew)	Meat	18-19	4	5.6	10-10.1
		Fish	18-20	4-5	6	10.7-11.8

SEASONAL CHANGES IN FLY POPULATION

The geographical location of an area, seasonal changes in temperature and humidity, etc. play a major role in the rate of growth and development of organisms and thus influence the abundance of animal population of that area. Graphs showing changes of temperature and humidity (Fig. 2) and rainfall (Fig. 3) are included to give an idea of the weather. Usually flies become abundant during summer. *Musca* population attain the highest in March-April, the next peak period being September. The flesh-flies, *Sarcophaga* species, reach their peak in May-June but are rare in winter. The blue-bottle flies, *Chrysomyia megacephala*, attain their highest in June-July. The small fruit-flies, *Drosophila ananassae*, are abundant in June-July but are rarely seen in winter. The *Megaselia scalaris* population attain their maximum in July-August.

FLIES AND DISEASES

Among the reared species, *Musca sorbens*, *M. domestica vicina*, *Chrysomyia megacephala*, *Sarcophaga ruficornis*, *S. dux*, *S. hirtipes* and *Megaselia scalaris* play the important roll of transmission of the diseases like typhoid, paratyphoid, dysentery, cholera, amoebic, giardial and balantidial dysentery, taeniasis, ascariasis, enterobiasis, etc. because of their abundance, domestic habits, food preferences, size and hairiness.

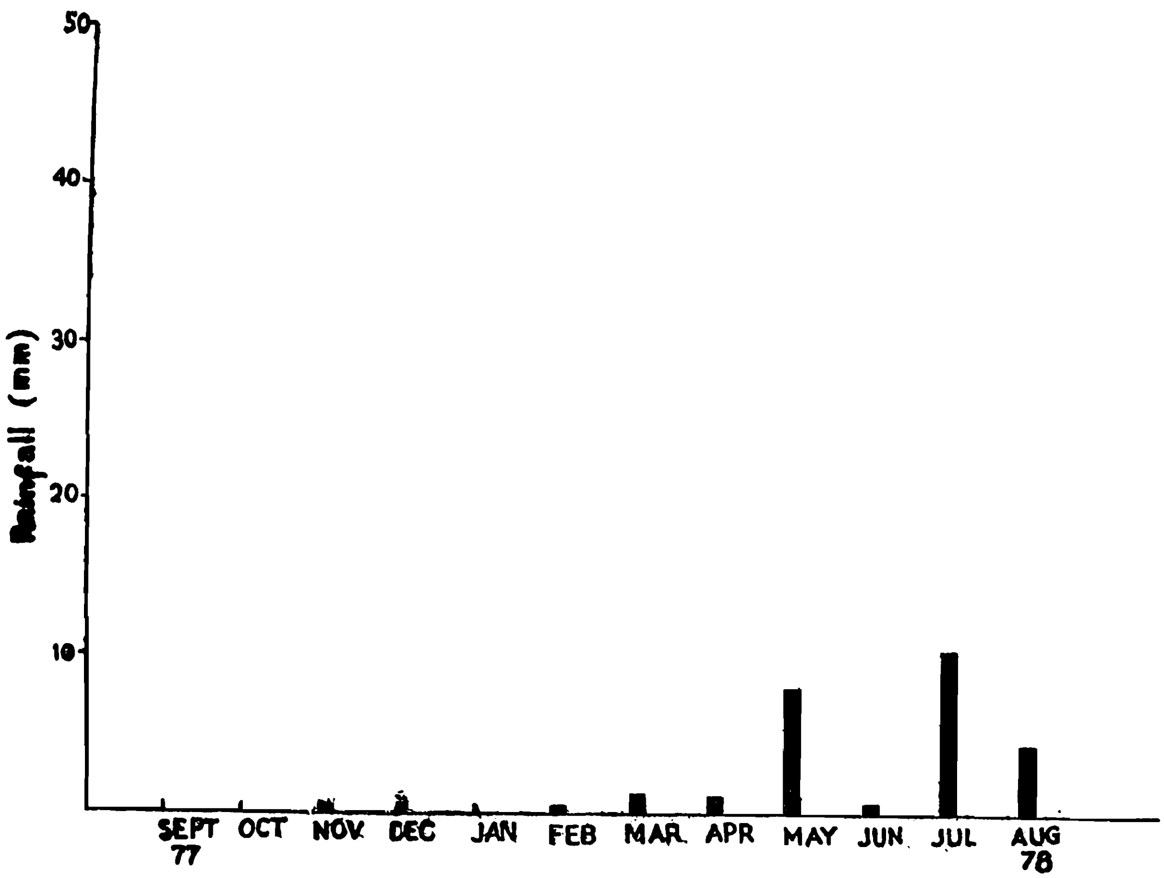

Fig. 3. Average monthly rainfall from September 1977 to August 1978.

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We are indebted to the Director, Zoological Survey of India, Calcutta, for facilities of work and his keen interest in this problem.

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Bull. zool. Surv. India, 3 (1 & 2) : 13-18, 1980

SALMOSTOMA KARDAHIENSIS SP. NOV. (PISCES : CYPRINIDAE) FROM MADHYA PRADESH, INDIA

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Abstract

The oriental genus *Chela* has been under continuous revision. The larger *Chela* with a specified number of gill rakers are assigned to an older available name *Salmostoma* though this genus requires further modification in its diagnosis. In the course of such an attempt, a new species named *S. kardahiensis* sp. nov. from the collection made in a small river at Jabalpur is described. The sexes and stages of this species hitherto unknown in this genus are also described.

Introduction

The taxonomic status of the genus *Chela* (Family Cyprinidae) has been disputed by several workers and has been revised several times. The latest revision is that of Banarescu (1968) who regarded that, taxonomically, all the larger *Chela* with a specified range of gill rakers can be included in one genus comprising 12 species. To this group, nomenclaturally, he applied an older available generic name *Salmostoma* Swainson 1839 with *Cyprinus bacaila* Hamilton as its type. Since several authors have confused upon their own diagnosis, it is not improper to assign an older available name in preference to a common name.

Banarescu's work too, along with others, is not without disadvantages. He had measured the lengths of several specimens from various localities but did not sort them out into sexes or immature specimens. It is dresumed however, that the lengths he had provided belonged to sexually mature specimens or adults though no statement has been made of the lengths at which adult size can be considered or, of sexes, if any difference has been shown by them since Silas (1958) stated atleast in one case that younger specimens of one species are shown as adults of another.

To avoid these anamolies, the genus *Salmostoma* needs further revision which will be undertaken in due course. For the present, there can be no doubt on the generic validity of *Salmostoma* though its generic diagnosis will be modified further. But, before doing so, each species has to be understood in its true perspective and composition. During the course of this attempt, a new species has been found which is described below. In order to augment its specific (or generic) limits, the structure of airbladder and gonad which are hitherto unknown in this genus are also studied, in both the sexes and in immature specimens.

In this paper, the total length is taken to measure from the tip of the snout to the end of the caudal fin. An adult is intended to mean a sexually mature specimen. Where an adult is not specified but only indicated as a male or a female, it is to be treated as a sexually mature specimen or an adult unless otherwise qualified.

The material for the new species is obtained from the collections made from Kardahi river and at several places along its course, located about 30 km from Jabalpur, M.P. This work was carried out at the Central Regional Station, Zoological Survey of India, Jabalpur. The new species is named after its locality.

Salmostoma Kardahiensis sp. nov.
(Fig. 1)

Material: 7 specimens collected from the Kurdahi river joining at Budagarh lake (*D. K. Harshey* coll. 2-9-78); 32 specimens collected from the river near dam site (*K. Reddiah* coll. 13-10-78); 48 specimens collected from the river before joining the Budagarh lake (*D. K. Harshey* coll. 24-8-78); 148 specimens collected at about 1 km ahead of dam site (*K. Reddiah* coll. 17-11-78).

Types: One ♀ (Holotype) and one ♂ (Allotype) and Paratypes (3 ♀ ♀ and 10 ♂ ♂) have been deposited in the National collections of the Zoological Survey of India, Calcutta.

Immature specimens: 50 examples of immature specimens of various lengths have also been deposited along with the types.

Type Locality: Kardahi river, a **nullah** type flowing across the jungle and **fields,** about 30 km from Jabalpur on Katni **Road** and at several places along its course.

Data on holotype

1. *Size*: Total length—112 mm and height—18 mm.

2. *Locality, date and other data*: Kardahi river, about 30 km from Jabalpur, M.P. on Katni Road, 2 km away from Budagarh; date of Collection 17-10-78; Longitude 79° 56′ E, Latitude 23° 10′ N.

3. *Sex*: Female.

4. *Developmental stage*: Mature, eggs usually polygonal, egg size—0.1 mm.

5. *Name of host*: Free living.

6. *Name of Collector*: Dr. K. Reddiah.

7. *Registration*, etc: Registered in the National Collection of the Zoological Survey of India, Calcutta. (FF 1279 to FF 1283)

8. *Elevation*: Below 300 m above sea level.

9. *Depth in which taken*: half a metre, in a shallow area.

10. *Geological age*: not applicable, living.

Description of the adult female: The body of the fish (Fig. 1A) is elongate and laterally compressed; its mouth and lower jaw directed upwards. A well devoloped knob on symphysis is present. Sub-orbital ring of bones usually wide. Thorax has a smooth

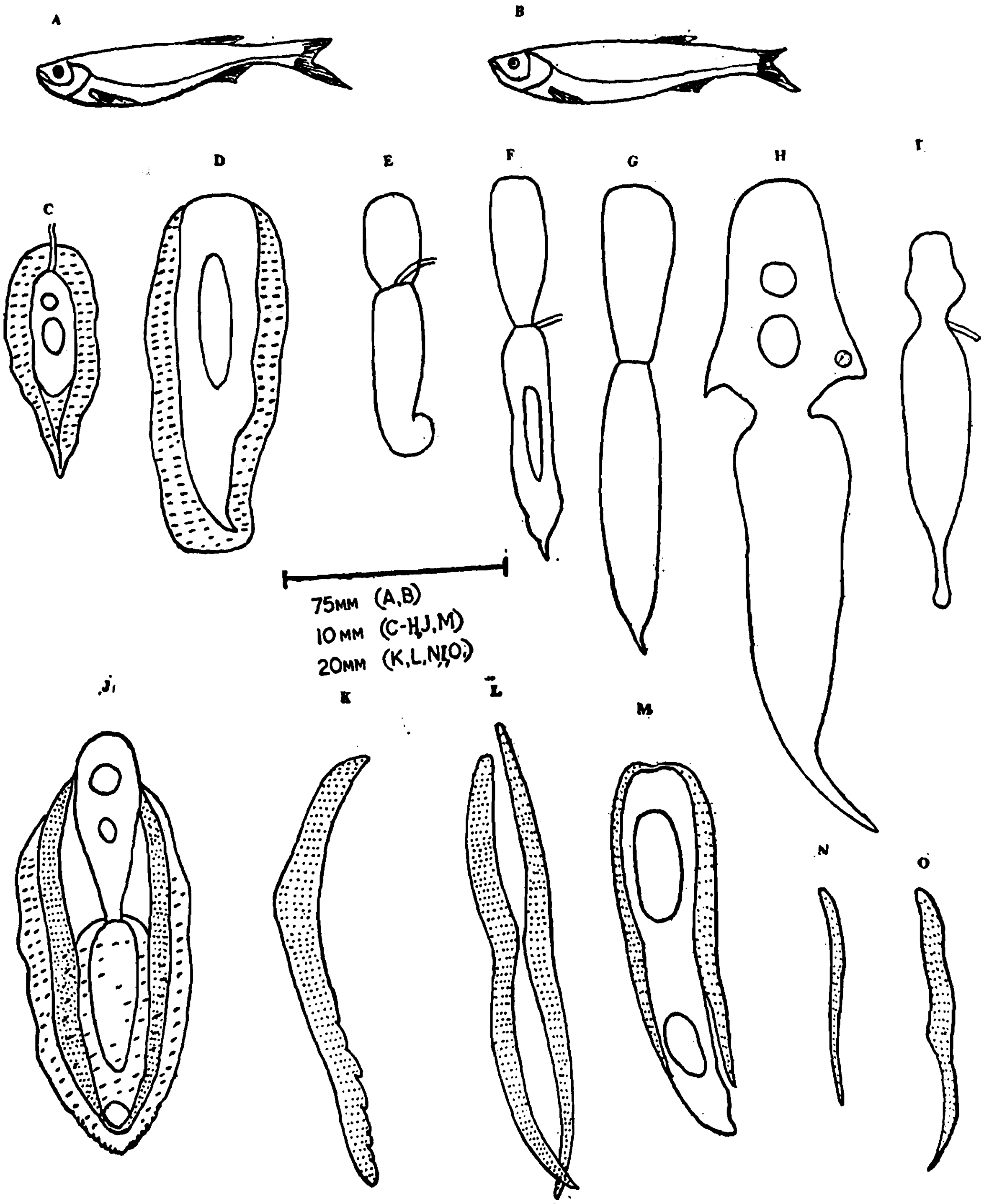

Fig. 1. *Salmostoma kardahiensis* sp. nov. ; A. adult ♀ B. adult ♂ ; C, D. air bladder in unsexed immature specimens ; E-F. air bladder in immature ♂ G. air bladder in mature ♂ ; H. air bladder in adult ♀ ; I. air bladder in adult ♂ J. Gonad in immature ♂ ; K, L. gonad in mature ♀ M. gonad and air bladder in immature ♂ ; N. gonad *in mature*.

edge without support by the bones of the forearm. Pharyngeal teeth hooked, in 2 or 3 rows. Fins generally larger, caudal forked, scales of moderate size, those near the anterior part of the body generally larger.

Fins: Dorsal arises from about half the length of the anal, Pectoral slightly longer than the head, with a wide gap before reaching ventral. Anal arises from about half the length of the dorsal, caudal lobed, the lower the longer.

Scales: Arranged in sinuous rows, those near the head generally larger, the one covering the last ray of the pectoral very large. 2 or 3 rows of scales between the ventral and lateral line and 3 or 4 rows of scales between it and the mid-dorsal line are present.

Body proportions: Length of head 5, of caudal 5.5, height of body 5.5, eye diameter 3.5 in length of head, about 1 diameter from the end of snout. In about 20 specimens of various length groups examined, there is a variation of 1 or 2 in fin rays, pectorals varying from 11 to 13 and of caudal 25 to 36, Ll scales 52-58, Sp. br. (gill rakers) from 36 to 50. Generally, the younger specimens have lower number especially with reference to gill rakers.

Air bladder: Anterior bladder (Fig. 1H) is 12 mm long, vase shaped with a narrow neck in a specimen of 97 mm in total length. Its postero lateral corners are winged and often contains 2 air bubbles. The posterior bladder is 20 mm long, carrot shaped with a short, thin, usually curved tapering tail.

D. 1/8 ; p. 12 ; v. 9 ; A13 ; C. 3/8-3/11 ; L 1 52 ; sp. br. 46.

Gonad: The gonad (Fig. 1L) is about 40 mm long, flat, its posterior 1/3rd measures its greatest width of 3 mm and bent inwards. Its inner margins are sometimes toothed. Mature egg size 0.1 mm., eggs of various shapes, usually polygonal or angular.

Size: Total length of 11 females range 71—112 mm, average 83 mm.
Height or width of 11 females range 12— 18 mm, average 16 mm.

Colour: Silvery white.

Description of the adult male: The numbers of males in relation to females are small in a sample. The males (Fig. 1B) of same sizes are compared with those of females but no significant differences are found in the skeletal features or in the proportions of the body parts. The differences appear to be chiefly internal. In a specimen of 115 mm, the anterior bladder (Fig. 1I) is 10 mm long, the posterior 27 mm long. The tail is thinner and longer sometimes with a knob at its tip (Fig. 1I).

The gonad measures 17 mm in length and 2 mm in width and hang like thin threads on either side of the air bladder.

Size: Length of 5 females range 74—113 mm—average 88 mm
Width of 5 females range 13— 18 mm—average 15 mm

Colour: Silvery white.

Immature Stages

The immature stages are recognised in this species up to 60 mm in length. Gonads begin to appear in the length groups 50 to

60 mm initially with a lustrous white band of peritonial membrane around air bladder. They differentiate between males and females in length groups 60 to 70 mm. Sexually mature individuals or adults are noted from 70 mm and above. The stages of development of air bladder and gonad in males and females are described below.

Air bladder : The development of air bladder is traced from the 50 mm length group in which it fiirst appears as a simple sac without division (Fig. 1C). The pneumatic duct originates from its anterior tip and may contain one or two air bubbles. The undivided bladder measures 6 mm in length and 2 mm in width. It is attached and surrounded by a thin layer of lustrous peritonial cover but without gonad even at this stage.

Immature male : In the male of 65 mm length group (Fig. 1E) a division appears with the anterior bladder somewhat squarish. The posterior bladder gradually tapers into a coil which differentiates later in a straightened tail. The pneumatic duct occupies a position anterior to the posterior bladder. The gonad appears as a thin filamentous structure suspended but attached anteriorly on either side. The male germ cells are in a developmental stage. The anterior bladder measures 4 mm and the posterior 7 mm. The gonad measures 6 mm long and 1 mm wide. In a male of 65 mm (Fig. 1F), a thin short tail is formed with the anterior bladder measuring 6 mm and the posterisr 10 mm with a width of 2 mm. A brownish gonad also appears.

In the 70 mm length group (Fig. 1G), the anterior bladder measures 8 mm and the posterior 12 mm with a short and blunt tail, sometimes knobbed at the end. A thin gonad of 1 to 2 mm wide (Fig. 1N) extends throughout the lenght of the air bladder. Fat globules gradually accumulate and a thin sheet of peritonium is present on either side of the gonad.

Immature females : In the females also up to the 70 mm length group, the air bladder follows the same pattern of development but in adults beyond this length the tail is much longer and broader. In the 100 mm group, the anterior bladder is produced into wings on either side.

The gonad : The development of gonad has been studied in 60-65 mm length groups in both sexes. The gonad appears only after the air bladder is fully developed. It appears first as a white streak in this length group suspended on either side of the air bladder and flanged by a thin sheet of peritonial membrane. The follicles develop and the germ cells are in the process of development.

Immature female : In the immature female of 61 mm (Fig. 1J), the gonad measures 20 mm long and 4 mm wide. Its upper surface is whitish and the under surface brownish. The gonad is speckled throughout indicating that follicular formation has begun. Its anterior ends are narrower but posteriorly it becomes confluent with the bladder and covered by fat bodies. The independent limbs of this gonad are not discernible until its next stage. The lustrous fold of the peritonium extends throughout its length.

Adult female : In the 100 mm length group, the gonad is 40 mm long and 5 mm wide. Its inner margins are sharply wavy or lobed. Its widest part is about its middle or slightly anterior to it. The pair of gonads develop as separate structures. The gonad presents no groove at any stage. Full description is provided earlier.

Immature male: The gonad of males (Fig. 1M) is shorter than air bladder in 65 mm length group. Its length is 10 mm and width 1 mm. The gonad is speckled indicative of the appearance of the follicles.

The pair of gonads hang like two filaments on either side of the bladder and joined by an epithelium underneath in the form of a boat-shaped structure in the preserved specimens, inside which the air bladder fits in. The chief differences in the gonad of females are in the total length of the gonad and its width. The size of gonad in males is almost half of that of the females.

Distinguishing Characters

Twelve species are included in the genus *Salmostoma* considered by Banarescu (1968) who distinguished these species chiefly on the basis of the length and the number of gill rakers. The new species differs from all the other species in having a gill raker range of 42-52. This character is fairly constant in a large number of specimens examined. In some immature specimens, the number is reduced to as much as 36 but this is not taken into account for the purpose of comparison of their immaturity. The only species of which the gill raker count is not known is *S. horai* from which the new species differs in the number of lateral line scales, anal rays and even in total length. In the total length, the new species is closer to *S. clupeoides* and *S. untrahi* from which the new species differs in the number of gill rakers.

In order to further subtantiate its specific identity, the measurements and shape of the air bladder and gonad are also taken into account to which published descriptions do not provide any clue for comparison.

Acknowledgements

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Bull. zool. Surv. India, 3 (1 & 3) : 19-21, 1980

OCCURRENCE OF *CALOTES* (REPTILIA : AGAMIDAE) IN THE PREHISTORIC SITE OF HARAPPA, PAKISTAN

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ABSTRACT

The skeletal remains of an agamid, lizard, *Calotes* found among the preserved animal remains from Harappa, a type site of Indus Valley Civilization (*Circa* 2500-1500 B.C.), are recorded in this paper. This is the first record of *Calotes* from the Indian Prehistoric sites.

INTRODUCTION

Among the animal remains from Harappa, preserved in the Zoological Survey of India, we found some fragments of unidentified bones. On examination, the material appeared to consist of remains of the agamid lizard, *Calotes* sp. Prashad (1936) reported only remains of caudal vertebra of monitor lizard from Harappa (Sub-order Lacertilia). As far as we could ascertain from literature (cf. Nath, 1968) no other remains of Lacertilians have been recorded so far from prehistoric sites of India. Our discovery of the skeletal remains of *Colotes* sp. from Harappa, therefore, constitutes the first record of this lizard from the Indian prehistoric sites. In the absence of more material it was not possible for us to run down to species with certainty.

The matarial under report was excavated by Shri Madho Swarup Vat, probably during the field session 1928 through 1930. Harappa, a type site of Indus Valley Civilization (*circa* 2500-1500 B.C.), is situated in Montogomery District, Punjab (now in Pakistan) and is contemporaneous with Mohenjodaro in chronology. The material of the lizard described here was recovered from the area 'H' in Harappa which was the cemetery area. Unlike the mounds in AB and D areas this was not on raised ground but was a low area believed to be the latest amongst the culture sites in Harappa. The remains were entombed in burial jars, buried under the earth, and were in a better state of preservation because of their confinement. The remains were fragile and were about 5000 years old. A detailed description of the material is given below.

SYSTEMATIC ACCOUNT

Phylum	CHORDATA
Class	REPTILIA
Order	SQUAMATA
Family	AGAMIDAE

Calotes sp.

Material
(Pl. I)

Total number of identified fragments—30.
Location—Harappa ; Cemetery H,
Square R 33, 34/35, 21 ; depth—71 cm.
Area H 231 (b) ; Fragments of mandible—2 ; Thoracic vertebra—3 ; Sacral vertebra with transverse process—2 ; Caudal vertebra—7 ; Right femur—1.
Area H 231 (c) ; Broken humerus—1 ; Broken radius—4 ; Ulna—2 ; Sternal rib—7 ; Episternum—1.

Description

The mandibular ramus includes parts of angular and dentary. The mandible has a distinct cleft, the crest possesses a row of regularly arranged teeth, few molar and the rest are pointed and with slightly recurved dentine. All the teeth are sheathed firmly above minute concave depressions. The mandible on comparison with that of recent specimens, was found to be similar to that of *Calotes* ; in size it is larger.

The vertebral remains contained three thoracic vertebrae, two sacral vertebrae and seven caudal vertebrae. The thoracic vertebrae were all procoelus and hypopopoyses were ill developed. These vertebrae bore thoracic ribs, sacral vertebrae were large in size and possessed transverse processes. The caudal vertebrae were similar to those of recent specimens in shape.

Only the right femur was found. The proximal portion was broken. The femur was stout with the distal portion having the marks of two ball-like condyles.

The above description relates to the material recovered from the Area H 231(b). From the H 231 (c) area the following skeletal remains were found.

Humerus was broken at the distal end, the proximal end was with swellings or condyles. The shaft was slightly curved.

There were 4 broken shafts of radius and two broken ulna. The shaft of radius and the narrow bones of ulna had short processes called olecranon process.

Besides these there were seven sternal ribs and one episternum.

The measurements could not be taken as the remains were fragile and could not stand handling.

The bones, on comparison with the corresponding bones of recent species of *Calotes*, undoubtedly appear to belong to the genus *Calotes*.

Discussion

Calotes is a very common genus of agamids in India and occurs in the locality from where the present remains were recorded. This lizard, unlike other species of animals like horse and dog frequently associated with burials in other prehistoric sites, do not seem to have any cultural significance. The burial jars were used to include food material and other earthly possessions (like ornaments made out of molluscan shells) that were buried along with the dead as was a common practice among the ancient people, and to this day lingers in several tribal communities. Only a single relict of *Calotes* has so far been discovered in such situation. The lizard might have strayed into the burial jar while the preparations for burial were being made and might have made itself comfortable inside the vast jar and ultimately buried. Academically speaking this is an interesting case, though zoologically it does not have any special significance. *Calotes* is very widely distributed in the Indian subcontinent and is quite abundant in inhabited localities, though not living in houses. Its find in a burial jar in this prehistoric site, therefore, appears to be by accident rather than by design. It is not improbable that the food material contained in the jar might have lured the animal.

ACKNOWLEDGEMENTS

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Skeletal remains of *Calotes* from Harappa excavation.
1—4. Fragmentary unidentified bones. 5. Episternum. 6. Broken right femur. 7—8. Sacral vertebrae. 12—17. Caudal vertebrae. 18—19. Portion of mandibles. 20—22. Fragments of ulna. 23. Broken humerus. 24—27. Broken radii. 28—32. Sternal ribs. 33. Fragmentary unidentified bones.

Bull. zool. Surv. India, 3(1 & 2) : 23-26, 1980

A NEW SPECIES OF *ATROBUCCA* (PISCES : SCIAENIDAE) FROM THE ARABIAN SEA

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ABSTRACT

A new species of the genus *Atrobucca* Chu, Lo & Wu, 1963, belonging to the family Sciaenidae, is described based on a unique specimen collected from off Bombay, in the Arabian Sea, by the bottom trawl operated by the Polish vessel M. T. *Muraena* at a depth of 60 m. This sciaenid probably lives considerably deeper in the benthic realm than from which the holotype was collected.

INTRODUCTION

As a result of trawling in the upper continental slope in the Arabian Sea off the north western coast of India by the Polish vessel M. T. *Muraena*, a unique specimen of an undescribed species of *Atrobucca*, belonging to the family Sciaenidae, was taken. Taxonomic recognition may be warranted when additional material is available but it does not seem prudent to await further specimens. The objectives of this paper are to describe the new species and to demonstrate that the species probably lives considerably deeper in the benthic realm perhaps off the continental shelf beyond the 100 fm (= 160 m) line, than from which the holotype was collected. I have great pleasure in naming this species after Colonel A. Alcock, the author of a most commendable review of the deepwater fishes of our region.

Sub-family OTOLITHINAE
Atrobucca alcocki sp. nov.

Material : HOLOTYPE (Fig. 1) a ♂ specimen, 154 mm in standard length, collected from the Arabian Sea off Bombay, *ca* 60 m by the bottom trawl, July-August, 1977, Zoological Survey of India regd. no. F. 7591/2.

DESCRIPTION

Depth of body 39.0 mm (25.3 % SL), length of head 58.5 mm (38.0% SL), snout length 13.0 mm (8.4% SL., 22.2% head), eye-diameter 14.5 mm (9.4% SL., 24.9% head), interorbital width 12.0 mm (7.8% SL., 20.5% head), length of upper jaw 24.5 mm (15.9% SL., 41.9% head), length of lower jaw 28.0 mm (18.1% SL., 47.9% head) and length of gill-filaments 8.5 mm (5.5% SL., 58.6% eye).

Body elongate, moderately laterally compressed. Snout blunt, not projecting ; mouth terminal, lower jaw with a moderate mental process ; maxilla ending below posterior part of iris ; gape at an angle of about 30° with the horizontal. Preopercular margin crenulate, opercular spines distinct. Inter-distance between origin of pelvic fin and vent considerably less than head length.

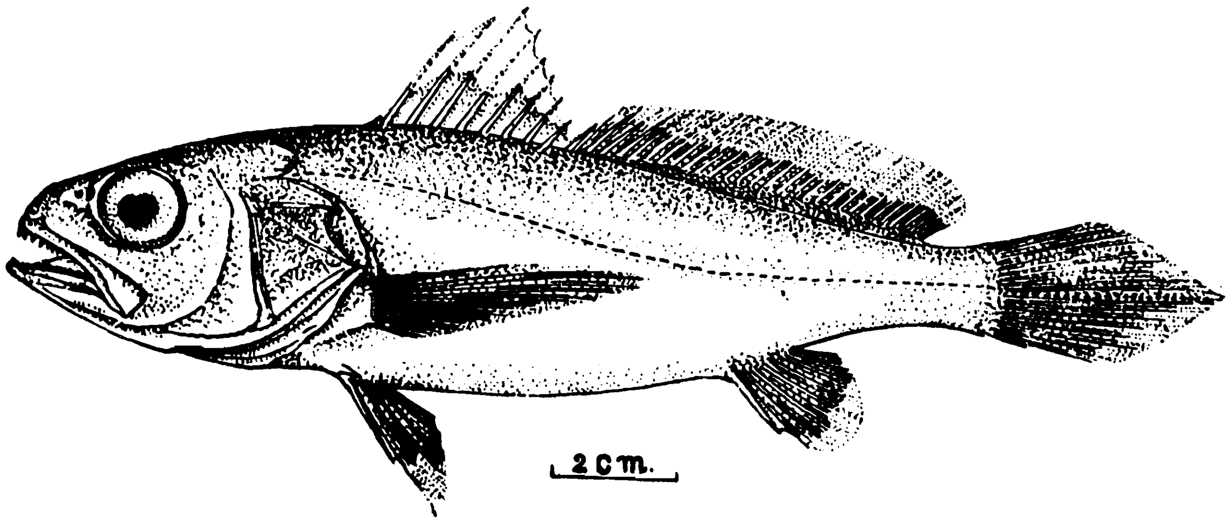

Fig. 1. *Atrobucca alcocki*, new species, holotype, 154 mm SL from off Bombay

Pores on snout : no upper found ; five marginal, the median above the edge of the rostral flap, inner pair under edge, lateral pair at edge in a very slight embayment. Three pairs of mental pores, the first minute, on front of chin separated by the symphysis of lower jaw ; the others small but conspicuous —such an arrangement has been referred to as the "*Argyrosomus*-form" or "Six-pored form" (Chu, Lo & Wu, 1963).

Teeth sharply differentiated in size in both jaws ; teeth of upper jaw with an outer series of sharp, needle-like, well-spaced enlarged teeth and a narrow inner band of minute teeth ; lower jaw with a group of strong teeth in front and an inner row of strong spaced teeth posteriorly with an irregular row of tiny teeth between and outside them.

Gill-rakers 4 + 1 + 10, lanceolate, on first arch.

Most of the scales are lost, but some cycloids remain on the snout and under the eye and some finely ctenoid on body.

Dorsal fin IX. I. 29, no deep notch between spinous and soft parts ; dorsal fin spines weak, the first minute. Anal fin II 7, 1st spine minute, 2nd spine moderate, 13.5 mm (8.7% SL). Pectoral fin long, *ca* 45.0 mm (*ca* 29.2% SL). Caudal fin (?) rhomboid.

Swim bladder carrot-shaped, with 30 pairs of appendages arising from the bladder along the whole length, all but the last pair arborescent, ramifying in a wedge of tissue flanking the bladder on eaeh side. The two anterior branch profusely between the bladder and the transverse septum. Behind these each appendage is first divided into well-developed dorsal and ventral limbs, the ventral with its axis so turned that its branches are directed anteriorly ; the dorsal limbs have their branches directed posteriorly, together forming an elaborate filgree pattern on the dorsolateral wall of the bladder, and near the posterior end nearly meet their fellows of the other side. The bladder ends just before the vent. The specimen is an immature male, with sonific muscles.

Colour : in alcohol, drab grey above, paler below ; symphysis of lower jaw dusky. Pectoral fin dusky ; pelvic fin pale. Lining of mouth speckled, branchial cavity dusky, peritoneum jet black.

RELATIONSHIPS

Current concepts of sciaenid classification are largely based on morphology of the swim bladder, otoliths (sagitta), and snout (rostral) and mandibular (mental) pores and/or barbels (Chu, Lo & Wu, 1963 ; Trewavas, 1962, 1977 ; Mohan, 1972 ; Chao, 1978). The species described above as new is referable to the genus *Atrobucca* primarily because of the similarity of the swim bladder structure. Its inclusion is further supported by other features apparent in the key to the genera of the tribe Otolithini drawn up by Trewavas (1977). The genus *Atrobucca* was established by Chu, Lo & Wu (1963) for the reception of *Sciaena nibe* Jordan & Thompson, 1911. The genus remained monotypic until Talwar & Sathiarajan (1975) added a new species *Atrobucca trewavasae* from the Bay of Bengal, and transferred (at Dr. E Trewavas' prompting) *Sciaena marleyi* Norman, 1922, from the Western Indian Ocean, to this genus. All the three species are caught offshore in the Indo-West Pacific.

The new species differs from both *Atrobucca nibe* (Jordan & Thompson) and *A. marleyi* (Norman) in the conspicuously larger eye (9.4 vs 7.2-8.3% SL), longer head (38.0 vs 32.5-34.3% SL), narrower interorbital width (20.5 vs 23.5-27.7% head), shorter lower jow (47.9 vs 51.4-56.0% head), and longer gill-filaments (5.5 vs 3.0-4.2%SL ; 58.6 vs 36.2-52.0% eye-diameter). The new species differs from *A. trewavasae* Talwar & Sathiarajan most obviously in the higher number of dorsal soft rays (29 vs 24-26) and the relatively larger eye (24.9 vs 17.0-20.0% head ; 9.4 vs 7.1-7.9% SL). Further, the new species has a slightly longer pectoral fin (*ca* 29.2 vs 25.5-28.5% SL) than the other three species of *Atrobucca*.

The new species has long gill-filaments (5.5% SL) and in this feature there is a striking resemblance with *A. trewavasae* (5.5-6.4% SL) as opposed to *A. nibe* and *A. marleyi* (3.0-4.2% SL). The lengths of both jaws are a lower percentage of the length of head in both *A. trewavasae* and *A. alcocki* but these measurements compare closely with those of *A. marleyi* and *A. nibe*. Trewavas (1977) concluded that it is the postocular part of the head that is enlarged in *A. trewavasae*, that is the part including the branchial chamber, and this is true also for *A. alcocki*. She surmised that the enlargement of the branchial chamber in *A. trewavasae* is the functional explanation of this striking difference and concluded that the greatly increased respiratory surface of this deep-water species is probably an adaptation to lower oxygen concentration. Her contention supports our suspicion that this very distinctive new species inhabits the deep water off the continental shelf beyond the 100 fm (=160 m) line.

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DYTISCIDAE : COLEOPTERA FROM HIMACHAL PRADESH WITH DESCRIPTION OF A NEW SPECIES

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ABSTRACT

This is a report on the collection of Dytiscidae received for identification from the High Altitude Field Station of the Zoological Survey of India, Solan, in connection with fauna of India project. It comprises 22 species spread over 10 genera including one new species. Seven species are being reported from Himachal Pradesh for the first time, for which remarks have been given, only the material examined has been mentioned for the other species. For bibliography and distribution, reference may be made to Catalogue of Oriental Dytiscidae by the author (1977).

Order COLEOPTERA

Family DYTISCIDAE

Subfamily LACCOPHILINAE

1. **Laccophilus inefficiens** Walker

Material examined—1 ex, Sirmour, 29. vii. 1972 (*M. Chandra*)

2. **Laccophilus flexuosus** Aube

Material examined—6 ex, Sirmour, 29. vii. 1972 (*M. Chandra*).

Subfamily HYDROPORINAE

3. **Hyphydrus renardri** Severin

Material examined—5 ex, Sirmour, 29. vii. 1972 (*M. Chandra*).

Remarks—This species extends from Rajasthan in the West to Burma in the East and Tamil Nadu in the South ; but it is not so far known from Himachal Pradesh, which constitutes a new record from that state and extends its Northern limits.

4. **Hyphydrus lindamannae** Guignot

Material examined—5 ex, Sirmour, 29. vii. 1972 (*M. Chandra*).

Remarks—This is the first record of this species since it was described from Rawalpindi in Pakistan. This present report, extends the range of the distribution of species, to the East and represents its first record from India.

5. **Potamonectes belli** Vazirani

Material examined—2 ex, Sirmour, 29. vii. 1972 (*M. Chandra*) ; 10 ex, Bilaspur Dist. : Changar Khud, 11. viii. 1972 (*K. K. Mahajan*).

6. **Potamonectes** (*s. sth.*) **satie n. sp.**
(Figs. 1A & B)

Holotype—1 ♂ India: Himachal Pradesh: Sirmour, 29. vii. 1972 (*M. Chandra*) Reg. No 8443/H_4A, Paratype—1 ex, Reg. No 8444/ H_4A with same particulars as holotype; in the National Zoological Collections, Zoological Survey of India, Calcutta.

Length—4.7-4.9 mm.

Head—testaceous; antennae testaceous, surface micro-reticulate; punctuation fine and dense, separated by less than its own diametre.

Pronotum—testaceous; black along the middle of anterior and posterior borders; reticulation similar but more impressed than on head; punctuation on disc fine and dense but a little larger than on head, also with a few larger scattered punctures; some irregular 2-3 rows of punctures along the middle of anterior and posterior borders; sides rebordered, slightly convex; posterior angles a little obtuse; somewhat depressed towards the base behind the disc.

Elytra—testaceous, with 6-7 black lines, excluding the sutural line, confluent at places; base not broader than the pronotum, pronoto-elytral angle not so prominent; two normal series of longitudinal/strial punctures distinct; reticulation prominent giving the surface mat appearance; punctuation moderate and very dense; some larger scattered punctures also

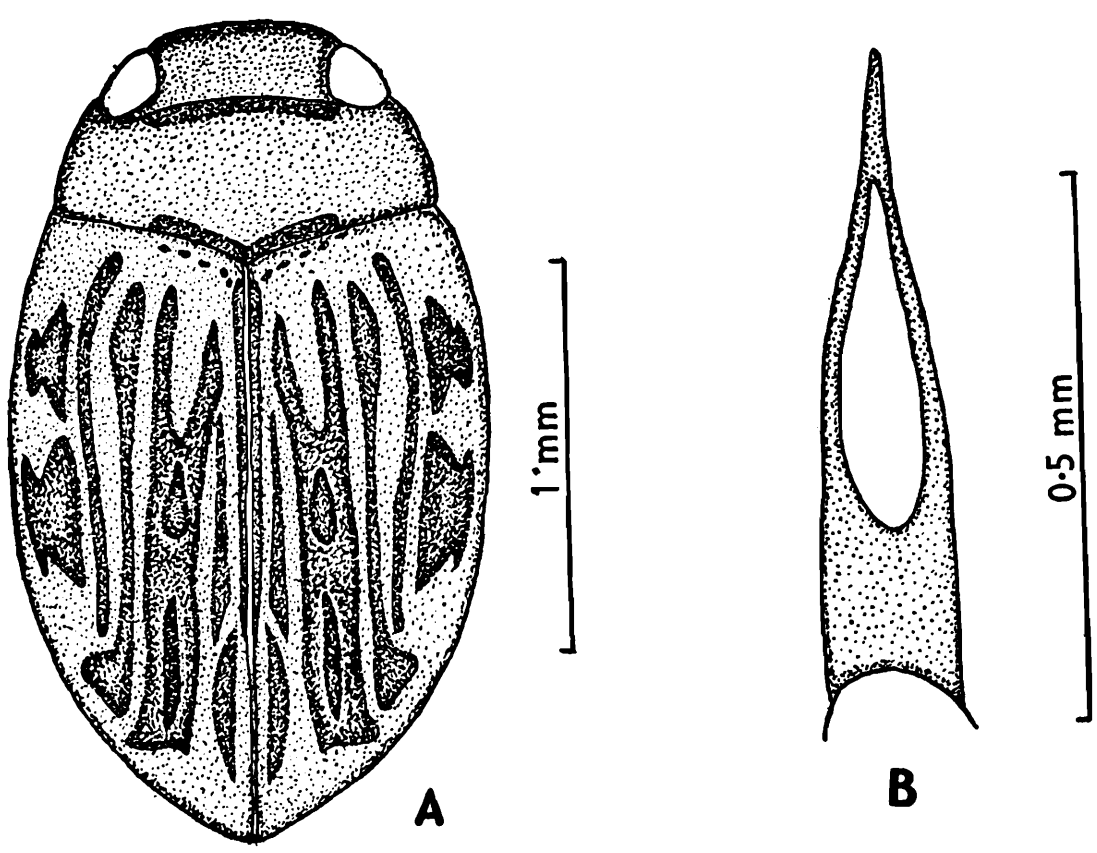

Fig. 1. *Potamonectes satie* n.sp., A—Dorsal view (with out legs). B—Dorsal view of penis.

present between the striae ; lateral margin without any teeth in the apical portion.

Ventral side—black except the legs, mid metasternum, median portion of abdominal sternites and epipleurae, which are ferruginous ; hind coxal lines entire, quite divergent in anterior half ; metasternum moderately punctate except narrow posterior portion.

Male—fore and middle tibiae with the basal three segments feebly dilated ; anterior tarsal claws unequal ; inner about half the length of outer ; penis (fig. 1B) acuminate in the apical one-third, strongly (about 90°) curved at base ; sides subparallel, then suddenly narrowing to the pointed apex.

Remarks—This species is closely related to the widely distributed species *griseostriatus* (Degeer) in the absence of antiapical denticles on lateral borders of elytra. However it differs from it in (i) head testaceous, without any markings, (ii) shape of pronotum normal, not trapezoidal, (iii) penis abruptly narrowed in apical one-third portion and pointed at apex as against not abruptly narrowed and blunt at apex.

Distribution—India.

Subfamily COLYMBETINAE

7. **Platynectes kashmirenus** Balfour Browne

Material examined—1 ex, Sirmour, 29. vii. 1972 (*M. Chandra*) ; 11 ex, Simla Dist. : Kaula Vill. near Matiana, 19. xi. 1972 (*H. P. Agarwal*).

8. **Agabus (Gaurodytes) conspersus** (Marsham)

Material examined—2 ex, Simla Dist. : Kufri, 28. xii. 1972 (*M. Chandra*)

9. **Agabus (G.) debilipes** Regimbart

Material examined—5 ex, Simla Dist : Kaula Vill. near Matiana, 19. xi. 1972 (*H. P. Agarwal*)

10. **Agabus (G.) amoenus sinuaticollis** Regimbart

Material examined—1 ex, Simla Dist. : Kufri, 28. xii. 1972 (*M Chandra*)

11. **Agabus (Dichonectes) nitidus** (Fabricius)

Material examined—1 ex, Simla Dist. : Kaula Vill. near Matiana, 19. xi. 1972 (*H. P. Agarwal*).

12. **Rhantus taprobanicus** Sharp

Material examined—15 ex, Simla Dist. : Kaula Vill. near Matiana 19. xi. 1972 ; 4 ex, Simla Dist. : Tara Devi, on Simla-Kalka road, 10. iv. 1972 : 4 ex, Sirmour Dist. : Tikker near Sarhan, 27. ix. 1973 ; 3 ex, Solan Dist : 5 km. from Arki, 20. iv. 1972—all *H. P. Agarwal* Colln. ; 1 ex, Sirmour, 29. vii. 1972 ; 3 ex, Simla Dist. : Kufri, 28. xii. 1972—all *M. Chandra* Coll.

Remarks : It is so far known from—INDIA : Uttar Pradesh, Bihar, Meghalaya, W. Bengal, Rajasthan, Maharashtra, Karnataka, Tamil Nadu and Pondicherry, besides Pakistan and Sri Lanka. It is now being reported from Himachal Pradesh.

13. **Rhantus sexualis** Zimmermann

Material examined—5 ex, Simla Dist. : Kufri, 28. xii. 1972 ; 1 ex, Sirmour, 29. vii. 1972—all *M. Chandra* Coll.

Subfamily DYTISCINAE

14. **Eretes sticticus** (Linn.)

Material examined—1 ex, Solan, 24. x. 1971 (*M. Chandra*).

15. **Hydaticus (Guignotites) incertus** Regimbart

Material examined—3 ex, Simla Dist.: Chail, 16. iv. 1972 ; 3 ex, Simla Dist.: Tara Devi, on Simla-Kalka road, 10. iv. 1972 ; 1 ex, Solan Dist.: 5 km. from Arki, 20. iv. 1972 ; 1 ex, (all *H. P. Agarwal* Coll.) ; Bilaspur Dist.: Changar Khud, 11. viii. 1972 (*K. K. Mahajan*).

16. **Hydaticus (G.) histrio** Clark

Material examined—1 ex, Solan Dist.: 5 km. from Arki, 26. iv. 1972 (*H. P. Agarwal*) ; 1 ex, Sirmour Dist.: Tikker near Sarhan, 27. ix. 1973 (*H. P. Agarwal*) ; 1 ex, Bilaspur Dist.: Swarghat, 20. viii. 1972 (*K. K. Mahajan*).

17. **Hydaticus (G.) vittatus** Clark

Material examined—9 ex, Sirmour Dist.: Tikker near Sarhan, 27. ix. 1973 (*H. P. Agarwal*) ; 1 ex, Bilaspur Dist.: Swarghat, 20. viii. 1972 (*K. K. Mahajan*).

18. **Sandracottus dejeani** Aube

Material examined—1 ex, Sirmour, 29. vii. 1972 (*M. Chandra*), 1 ex, Bilaspur Dist.: Bhakra Reservoir, 24. viii. 1972 ; 2 ex, Bilaspur Dist.: Swarghat, 20. viii. 1972 (*K. K. Mahajan*).

Remarks: Though quite common and widely distributed in India: Andhra Pradesh, Bihar, Madhya Pradesh, Orissa, Gujarat, Rajasthan, Uttar Pradesh and Tamil Nadu besides Pakistan, it is now being reported from Himachal Pradesh for the first time. It indicates its North-Western limit.

19. **Sandracottus festives** (Illiger)

Material examined—8 ex, Bilaspur Dist.: Swarghat, 20. viii. 1972 (*K. K. Mahajan*) ; 2 ex, Sirmour, 29. vii. 1972 (*M. Chandra*) ; 1 ex, Sirmour Dist.: Tikker near Sarhan, 27. ix. 1973 (*H. P. Agarwal*).

Remarks: Though not so common as *S. dejeani*, this is also quite widely distributed in India: Andhra Pradesh, Bihar, Orissa, Punjab and Tamil Nadu besides Pakistan, Sri Lanka & China. It is now being reported from Himachal Pradesh for the first time.

20. **Cybister (Melanectes) posticus** Aube

Material examined—1 ex, Sirmour, 29. vii. 1972 (*M. Chandra*); 1 ex, Solan Dist.: 5 km. from Arki 24. x. 1971 (*M. Chandra*); 1 ex, Bilaspur Dist.: Swarghat, 20. viii. 1972 (*K. K. Mahajan*) ; 1 ex, Simla Dist.: Tara Devi, on Simla-Kalka road, 10. iv 1972 (*H. P. Agarwal*).

Remarks: So far known in India: Assam, Manipur, Maharashtra, W. Bengal and Bangla Desh, it is now being reported from Himachal Pradesh for the first time. It thus extends the range of distribution to North-Western India.

21. **Cybister (Meganectes) cognatus** Sharp

Material examined—2 ex, Solan Dist.: 5 km. from Arki, 24. x. 1971 (*M. Chandra*).

Remarks: It is known from India: Bihar, West Bengal, Maharashtra & Goa and extends up to Indonesia in the East. The present record extends the range of its distribution to Himachal Pradesh.

22. **Cybister (M.) tripunctatus asiaticus** Sharp

Material examined—1 ex, Solan Dist.: 5 km. from Arki, 24. x. 1971 (*M. Chandra*).

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DISTINCTION, STATUS AND NOTES ON HABITS OF *RANA BREVIPALMATA* PETERS

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ABSTRACT

The close resemblance of *Rana brevipalmata* to *Rana limnocharis* has resulted in a lot confusion regarding the specific status of the former particularly because of intra-specific variations exhibited by the latter. A study of the two species collected from the montane forests of Western Ghats has brought out many more stable differences between the two, thus justifying the specific status of *R. brevipalmata*. Observations made on the behavioural patterns of the two also lend support to this.

The close resemblance of *Rana brevipalmata* to *Rana limnocharis* has already been remarked upon (Boulenger, 1920 ; Daniel, 1975). The former is distinguishable by its longer hind-limbs, shorter web and the better developed inner metatarsal tubercle. *R. limnocharis* which is one of the commonest and widely distributed frog shows considerable intra-specific variations, three races having been recognised in India other than the nominate one. The extent of its variations is so wide and the degree of resemblance with *R. brevipalmata* so strong that some consider *brevipalmata* as a subspecies of *limnocharis*. Gorham (1974) in the checklist of world Amphibians includes it under the synonymy of *R. limnocharis*. Boulenger (1920) considers them very close to var. *nilagirica* but feels that it is entitled to the specific rank assigned to it by the original author.

I have collected 19 specimens of this uncommon frog from the following localities in Western Ghats and compared them with *Rana limnocharis* (var. *nilagirica*) collected alongside.

Muthanga (Wynad)	...	11 ex.
Chedleth („)	...	1 ex.
Anamalai	...	1 ex.
Valparai	...	6 ex.

Measurements taken on specimens of comparable body lengths belonging to the two species show that there is little or no significant difference in the length of hindlimb. This removes one point of distinction between the two species. However, this study has brought out some more stable differences between the two.

The tympanum in *R. brevipalmata* is comparatively smaller (less than half diameter of eye) than that in *R. limnocharis* (more than half diameter of eye). Its anterior border is separated from the posterior cornea of eye by a distance equal to the diameter of tympanum in *R. brevipalmata* while this distance in *R. limnocharis* is only half or less its diameter. The less webbing in the former is expressed by the number of free digits in the two as follows.

	First	Second int.	Second ext.	Third int.	Third ext	Fourth int.	Fourth ext.	Fifth
R. brevipalmata	1½	2	1½	3	2½	3½	3	2
R. limnocharis	1	2	1	2	1	2	2	1

The membrane midway between the third and fourth toes extends upto the level of the proximal subarticular tulercle of the fourth toe while the same in *R. limnocharis* lies half way between the proximal and second tubercles. An external fringe of skin on the outer margin of the fifth toe which is distinct in *R. limnocharis* is totally nonexistant in *brevipalmata.* The inner metatarsal tubercle is much larger, compressed, elliptic and more than half the length of inner toe measured from distal end of tubercle while this is only one-third in *limnocharis.* The tarsus also presents distinctive characters which help in easy separation of the two. This in *R brevipalmata* is quite smooth, devoid of both tubercles and the tarsal fold while *R. limnocharis* has strong white-tipped tubercles scattered on the upper side of tarsus and tibia. The tarsal fold is also present as a distinct cutaneous elevation. Boulenger (1920) states that the outer metatarsal in *R. brevipalmata* is separated nearly to base as against half or one-third united in *R. limnocharis.* The present specimens show that the fusion is restricted to the basal one-third in both species when viewed from above. The lower side, however, shows an apparently complete separation in *R. limnocharis* unlike in *brevipalmata.* A vertebral line is more often present than not, having been observed in 16 out of the 19 specimens of *R. brevipalmata.* The very strong fold touching the lower border of the base of the arm noticed in one example from Malabar by Boulenger (1920 : footnote on p. 38) has been observed to be present in several examples belonging to both the species.

Apart from serving to distinguish the two frogs, the differences enumerated above also amply justify the specific status of *R. brevipalmata.*

Specimens of *R. brevipalmata* were collected from montane forests of Western Ghats with an altitudinal range of 600-700 metres along with specimens of *R. limnocharis* indicating a general similarity in the habitats of the two. All the same, one could discern a clear shift in the micro-habitat of *R. brevipalmata.* While *R. limnocharis* is essentially an animal living in very close association with and spending most of its time in or on the edge of water, *R. brevipalmata* has chosen a niche slightly farther away from water but never so far that it could, by a leap or two, reach it when alarmed. Its favourite haunts appear to be the sloping banks of streams with some undergrowth in well shaded parts of forests. I have observed a few near a culvert in the Mavinhalla forest at Muthanga Reserve. From the patchy shrubbery covering the banks I have seen them taking long and elegant leaps, rising in an arc and landing neatly in the water, at times even four metres away. While examining a small patch which contained earlier two frogs, I discovered two shallow pits excavated by them in the moist soil. I believe that they have their favoured haunts and that they forage for insects among the undergrowth taking to water only in times of danger. The morphology of the hindlimbs agrees well with the habits—long legs for long leaps, brief webbing indicating lesser dependance to water and compressed metatarsal tubercles for excavation of soil for making "nests". They are active during night and I have collected a few of them from cart-roads inside the Muthanga Reserve forest during one of my nocturnal excursions on a rainy night.

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LIMNOLOGICAL INVESTIGATIONS OF A SMALL LAKE EGELSEE WITH A VIEW TO FISHERIES

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ABSTRACT

The limnological conditions of Egelsee, a small lake near Mondsee in Scharfling, Austria observed during 1976 are recorded. Presence of healthy oxygen values and favourable pH values in the lake water are considered suitable for fish production. The water inflow and outflow may be important factors influencing the plankton composition of this lake.

INTRODUCTION

Egelsee, a small lake with an area of 1.8 ha. near Mondsee in Scharfling, Austria was studied during 1976 with a view to assess the limnological conditions. Similar type of studies were made for small lakes in north Austria (Kainz 1969, 1974). This work was undertaken since Egelsee was not studied previously and for its importance of nearer to the Institute. The maximum depth noted was 3.5 m.

MATERIAL AND METHODS

Water samples were collected with a Ruttner sampler from a station near the eastern side. Temperature was recorded immediately and samples collected for dissolved oxygen were fiixed. All samples were analysed according to standard methods. pH values were determined with WTW pH meter and conductivity was measured with a Metrohm conductivity meter. Phytoplankton samples were fixed in Lugol's Acetic acid solution and counted after sedimentation with an inverted microscope. Zooplankton samples were collected with a Schindler sampler and were made to one litre. From this 10 ml. was sedimented in a counting cell and counted through an inverted microscope. Diurnal variation studies were made by taking samples once in four hours. Primary productivity studies were made by using light and dark bottles.

RESULTS

(i) *Temperature*. The difference between the surface and bottom values is considerably high for this shallow lake (Table 1 & 2). The range of difference is between 3.4°C to 8.4°C. Since the temperature of the stream water from Scharfling pass mountain is also similar to the surface values of the lake, the constantly low bottom temperatures indicate nonmixing of waters and ground water influence. During the diurnal variation studies, at surface the

* Work carried out at Limnology Institute, Vienna, Austria.

TABLE 1. Diurnal variation studies. Physico Chemical data

Depth in m	Time 30.6.'76 14.00 hrs	18.00 hrs	22.00 hrs	1.7.76 2.00 hrs	6.00 hrs	10.00 hrs	14.00 hrs
				TEMPERATURE C			
0	24.2	24.1	22 8	22.1	21.0	22.0	23.8
1	21.3	21.3	20.4	20.2	18.2	20.2	21.5
2	17.1	16.8	16.9	16.3	16.6	16.6	17.6
3	15.8	14.8	15.5	14.9	14.0	15.6	16.0
				OXYGEN—mg/1 with % of saturation			
0	10.69 138	11.80 152	11.79 148	11.37 142	11.85 145	11.62 145	11.19 143
1	14.68 180	14.69 180	14.30 173	14.11 170	13.37 155	11.79 141.5	13.88 171
2	11.54 131	11.85 133	11.43 129	6.61 74	9.61 108	10.76 121	11.74 134.5
3	9.53 105	6.3 68	8.79 96.5	10.80 117	6.30 67.1	8.35 92	8.9 99
				pH value			
0	8.4	8.6	8.1	7.7	8.2	8.3	8.5
1	8.6	8.9	8.0	8.1	8.7	8.6	8.9
2	8.3	8.4	7.8	8.0	7.8	8.3	8.7
3	8.3	7.2	7.4	7.9	7.0	7.9	8.1
				CONDUCTIVITY—ms			
0	308	306	304	298	297	301	311
1	325	323	326	329	331	328	323
2	330	333	334	337	338	335	339
3	340	348	341	346	346	330	345

maximum and minimum temperatures were 24.2°C and 21°C and at bottom they were 16°C and 14°C.

(ii) *Dissolved Oxygen.* At surface, oxygen saturation values were in between 108% to 138% and at bottom it was in between 84.5% to 105% (Table 2). At one metre depth always higher values were noted. During diurnal studies (Table 1) the values were high during daytime. The maximum amount of 175% was noted only during daytime at one metre depth.

TABLE 2. Other physical and chemical data

Depth in m	Temperature C	Oxygen mg/1	Saturation %	pH value	Alkalinity	Conductivity	P/PO_4 mg/m3	N/NH_4 mg/m3	N/NO_3 mg/m3	SiO_2 mg/1	Fe mg/m_3
9.6.76											
0	17.3	9.48	108	7.90	3.40	322	—	—	—	—	—
1	15.3	9.40	103	7.80	3.45	328	0	55	1090	4.8	—
2	15.3	8.34	91.5	7.65	3.50	330	1.1	55	1130	4.8	—
3	10.7	8.60	85	7.65	3.50	334	5.8	55	1070	6.7	—
18.6.76											
0	16.9	10.47	118	8.30	3.45	326	—	—	—	—	—
1	16.0	11.14	123.5	8.20	3.45	329	—	—	—	—	—
2	14.1	10.07	107	7.90	3.50	336	—	—	—	—	—
3	13.5	9.40	99	7.85	3.55	339	—	—	—	—	—
30.6.76											
0	24.2	10.69	138	8.40	3.60	308	—	—	—	—	—
1	21.3	14.68	180	8.60	3.60	325	—	—	—	—	—
2	17.1	11.54	131	8.30	3.55	330	—	—	—	—	—
3	15.8	9.53	105	8.30	3.55	340	—	—	—	—	—
5.7.76											
0	23.0	10.72	136	8.35	3.75	338	2.2	35	196	3.5	37.9
1	21.4	—	—	8.40	3.75	338	—	—	—	—	—
2	19.5	10.97	130	8.10	3.80	340	1.1	65	317	4.5	45
3	16.5	7.53	84.5	7.65	3.80	346	1.0	65	280	8.9	70.5

In accordance with the seasonal changes the values were high during July than in June.

(iii) *pH value*. The values range in between 7.2 to 8.9 (Table 2). Considering the values in July, higher values were noted as that of dissolved oxygen values. Also the values were high during daytime especially at one metre depth (Table 1), maximum being 8.9.

(iv) *Alkalinity*. The methyl orange alkalinty values were in between 3.40 to 3.80 (Table 2). During diurnal studies not much variation was noted. But from surface the values increase towards bottom.

(v) *Conductivity*. The conductivity values were in the range of 308 ms. to 346 ms. (Table 2). The difference between the surface and bottom values was in the range of 8 ms. to 13 ms. During diurnal variation studies changes were noted both in the surface and other depths (Table 1). Comparing the alkalinity values and conductivity values, it is evident that conductivity is mostly due to hydrocarbonates.

(vi) *Other values*. The other values, namely Iron, Silicate, Phosphate, Nitrate nitrogen and Ammonia nitrogen (Table 2) indicate optimum levels. But the reason for wide difference in Nitrate nitrogen values is attributed to factors like rains and mixing of water in a shallow lake.

(vii) *Phytoplankton*. During the diurnal studies the phytoplankton was studied. *Synedra*, *Asterionella*, *Cyclotella* and *Dinobryon* were the dominant forms. Besides *Tabellaria*, *Fragilaria* and egg cases were noted at times, (Table 3). The difference in numbers were not following any specific pattern with reference to diurnal changes.

TABLE 3. Diurnal Variation Studies—Phytoplankton—Total number in percentage for each time

Time / Depth in m	30-6-'76 14.00 hrs	18.00 hrs	22.00 hrs	1-7-'76 2.00 hrs	6.00 hrs	10.00 hrs
0	24.6	17.5	11.1	30.1	51.2	37.8
1	44.9	40.8	57.7	13.6	5.9	35.8
2	18.3	27.9	17.4	31.4	16.0	25.7
3	12.2	13.8	13.8	24.9	26.9	0.7

(viii) *Zooplankton*. The dominant forms were the following Rotifers, namely *Keratella cochlearis*, *Keratella quadrata*, *Polyarthra trigla* and *Asplanchna* sp. Regarding copepods only nauplii and copepodites were noted and adults were very few. The variation in number (Table 4) were significant in relation to temperature and light.

TABLE 4. Diurnal Variation Studies—Zooplankton—Total number in percentage for each time.

Time	30-6-'76			1-7-'76			
Depth in m	14.00 hrs	18.00 hrs	22.00 hrs	2.00 hrs	6.00 hrs	10.00 hrs	14.00 hrs
1	21.7	52.6	61.6	42.7	7.4	29.5	5.7
2	31.9	14.8	13.7	52.8	35.7	33.3	32.4
3	46.4	32.6	24.7	4.5	6.9	37.2	61.9

(ix) *Primary productivity.* The period of incubation was for 12 hours at 0, 1, 2 & 3 m. depths. The values indicate for high gross production at the surface of the lake. The transparency values were in between 0.70 to 0.80 m.

DISCUSSION

There are no absolute fish production values for this lake but considering for fisheries, the favourable factors are the stream water and ground water. Running waters are generally rich in oxygen and ground waters will have constant temperature of their own. The lake is having healthy oxygen values. The pH values are in the range of 7.2 to 8.9 and this range is fovourable for fish production (EIFAC/T4). But the phytoplankton and zooplankton values could be unfavourable to fishes especially to plankton feeders. Considering the number of zooplankton, Rotifers occupy 80% but the role of Rotifers as fish food is still not known. As all the other factors are favourable, the water inflow and outflow of this lake may be one of the important factors influencing the plankton composition. Brook and Woodward (1956) have observed for small Scottish lakes that quantity of plankton is inversely proportional to the volume of inflow and outflow. Generally the magnitude of influence is higher in small lakes like Egelsee. In this connection it is suggested that some more studies have to be made on water quality and on the volume of inflow and outflow. Based on that the stream water into the lake can be regulated either by diverting the stream as practised in carp culture ponds (Bank and Krush 1963) or by some other means. Likewise the water outflow also has to be regulated. With this improvement there are ample opportunities for improvement in plankton and fisheries.

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INTRASPECIFIC VARIATIONS IN DIGENETIC TREMATODES III. *PLEUROGENOIDES GASTROPORUS* (LÜHE, 1901) (FAMILY LECITHODENDRIIDAE)

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ABSTRACT

Intraspecific variations in *Pleurogenoides gastroporus* (Lühe, 1901) have been studied. The effect of comparatively faster growth of posterior part containing uterus has been studied. The development of uterus causes displacement and compactness of various organs. *Pleurogenoides (Telogonella) sawanensis* (N. K. Gupta, 1954), *Pleurogenoides orientalis* (Srivastava, 1934) and *P. gastroporus* var. *equalis* (Mehra and Negi, 1928) are considered synonyms of *Pleurogenoides gastroporus* (Lühe, 1901).

The importance of intraspecific variations in assessing the validity of taxa of specific and infraspecific levels is well-known to workers on systematic zoology. This author has earlier studied intraspecific variations in *Ganeo tigrinum* (Gupta, 1977) and *Pleurogenoides sitapurii* (Gupta, *in press*). The earlier two papers and the present one indicate that the subject of intraspecific variations is not limited only to the dictionary meaning of this word. It leads us to next logical stage of studying the trends of variations in a species as a result of growth of individuals in a population. The three papers of this author show beyond doubt that at least the development of uterus sets in a trend of displacement and compactness of various organs and relatively faster growth of posterior part containing uterine coils in these species of digenetic trematodes. It could be expected that more studies on these lines will reveal some other factors governing the trends of intraspecific variations in different species of trematodes.

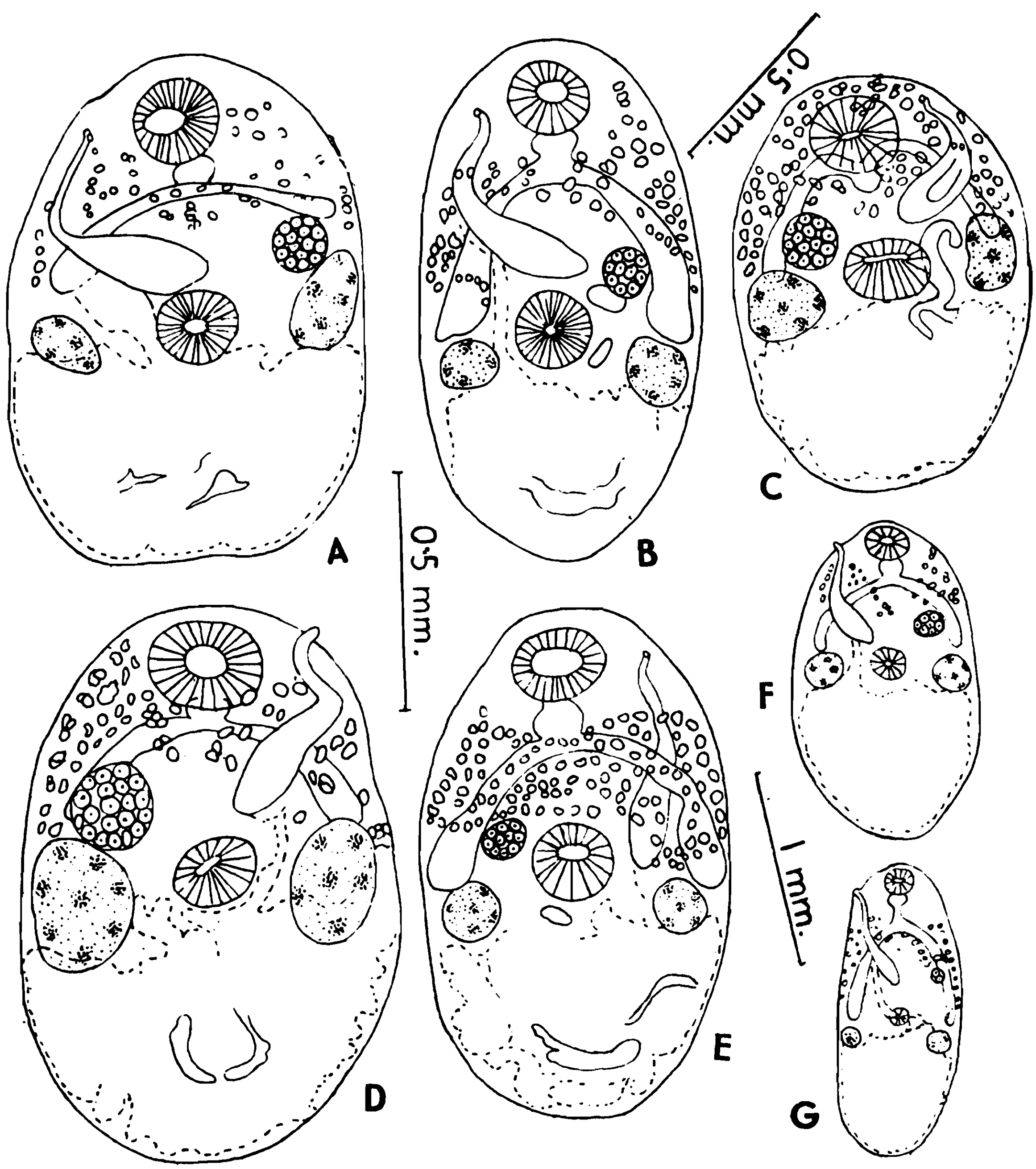
In the present paper intraspecific variations in *Pleurogenoides gastroporus* (Lühe, 1901) have been studied and validity of a few species examined in the light of variations observed.

Intraspecific variations in *Pleurogenoides gastroporus* (Lühe, 1901) : (Fig. 1)

Pleurogenoides gastroporus (Syn. *Pleurogenes gastroporus* Lühe, 1901) is known only from India. Mukherjee and Ghosh (1970) recorded variation of some characters of this species. A total of 80 worms of this species measuring 0.72-2.02 mm. were collected from frogs in the vicinity of Poona. This material consisted of only mature specimens. In all 30 characters concerning 12 main features of body have been studied. Unless absolutely necessary, measurements of organs have not been given. They have been studied in relation to one another.

Cuticular spines: They are generally visible in anterior part of body to the level of posterior margin of testes. On careful examination some specimens show presence of spines throughout the body. In the anterior part they are closely situated, posteriorly they become sparser.

Oral sucker: It is mostly spherical; some specimens have transversely elongated oral sucker. It is subterminal or terminal in position and larger than the ventral sucker. Ratio of the size of oral and ventral suckers is



Figs. 1 (A-G). Showing intraspecific variations in *Pleurogenoides gastroporus* (Lühe, 1901)

6 : 5 or 5 : 4. In one case it is smaller than the ventral sucker.

Ventral sucker: Its position is pre-equatorial, equatorial or post-equatorial. Shape of ventral sucker is generally round, sometimes elongated transversely or antero-posteriorly. It is generally situated with its centrum in level with the space between ovary and testes. Posteriorly it extends behind testes or lies entirely in the testicular zone. Its anterior border varies from the level of the middle part of ovary to middle part of testis. Sometimes it reaches the anterior border of the ovary. The acetabulum is situated entirely in the caecal zone, partly in caecal and partly in postcaecal area or completely behind caeca.

Oesophagus: Generally, it is absent but oesophagus measuring a maximum of 0.058 mm is found. Worms showing oesophagus have vitelline follicles much behind middle of oral sucker. Excepting one case, forms with longer oesophagus have some space between ovary and testes.

Intestinal caeca: Some forms have widely separating short caeca which run almost straight to lateral field. Other specimens have gradually separating longer caeca. In some cases caeca terminate in front of testes, in first-third of body length. In other cases they reach the equatorial plane, about middle of testes. Widely separating caeca terminate much anterior to ventral sucker. In other cases they reach centrum of acetabulum and in still rare cases they are either reaching posterior extremity of ventral sucker or slightly beyond, approaching the condition of *Pleurogenoides* (*Telogonella*) *sawanensis*. Posterior termination of caeca is rounded, pointed or notched to receive anterior margin of testis. In some cases they have uniform diameter, whereas in others the distal part is distended irrespective of the shape of its termination.

Ovary: It is generally spherical, sometimes subglobular, roughly triangular or elongated. The ovary in situated antero-lateral to ventral sucker. In one case it is entirely lateral to acetabulum, with its anterior border in level with that of acetabulum. Generally ovary is in intracaecal field, occasionally partly covered by caeca. In some cases ovary is situated close to body wall, behind caecum and in front of testis. One specimen has ovary partly outside and lateral to caeca. Position of ovary varies from anterior to posterior portion of second quarter of body length. It is smaller or rarely larger than ventral sucker. Its size varies from half to almost equal to that of testis.

Testes: They are spherical, subglobular, roughly triangular, elongated or reniform. Anterior border of testes lies from slightly in front of the anterior margin of the ventral sucker to sllghtly behind its centrum. Testes are mostly equal, sometimes unequal in size. They are in the same level but rarely one testis is slightly behind the other. They are situated close to caeca, or some distance behind them, or half in the intracaecal field. Anterior margin of testes is slightly pre-equatorial, equatorial or post-equatorial.

Cirrus sac: It is club- or retort-shaped with a long, narrow, anterior neck part which is straight, curved or sigmoid and the posterior broad part containing vesicula seminalis and pars prostatica. Posterior extension of cirrus sac varies from just in front of acetabulum to its centrum. When the cirrus sac is straight it is submedian in position. It bends gradually or abruptly at the level of intestinal bifurcation. In some individuals the posterior end of cirrus sac reaches the median plane in front of acetabulum. In relation to the ovary its posterior extension varies from half the length of ovary to behind it. In relation to the testis of its side, the cirrus sac terminates in front of testis or reaches half its length. Even in the case of bent cirrus sac, its posterior extension shows some variation in relation to the testis of its side.

Genital pore : The genital pore is marginal, generally situated in level with middle length of oral sucker. In extreme cases it lies in level with the third quarter of oral sucker. Genital papilla may be present or absent.

Vitelline follicles : Anterior and posterior distribution as well as arrangement of vitelline follicles show great variability. Anterior commencement of vitelline follicles varies from in front of oral sucker to behind the pharynx. This range of variation is seen even in the worms collected from the same individual host. Most of the specimens show commencement of vitelline follicles from middle of oral sucker, hence it should be treated as normal condition for *Pleurogenoides gastroporus*. The posterior extension of the vitelline follicles varies from anterior to posterior border of acetabulum, normal position being the level of its centrum. Mostly vitellaria reach posterior end of caeca but sometimes they terminate some distance in front of distal end of caeca. The arrangement of vitelline follicles shows great variation as continuous band, 'M' or 'W' shaped. A few specimens have vitelline follicles in two lateral groups. The posterior distribution of vitellaria is not correlated with their anterior distribution.

Uterus : The uterine coils occupy from less than one-third to slightly more than half of the body length. In a specimen one arm of uterine coils projects between testis and body wall (Fig. 4) as in the case of *Pleurogenoides sitapurii*. However, in this case the projecting arm does not extend in the pre-testicular field. The specimen reported by Mukherjee and Ghosh (1970) apparently represents a more advanced stage of growth of uterus. In the present series the development of uterus does not show any correlation with gradual or wide separation of caeca. The observation of Mukherjee and Ghosh (1970) that the massive growth of uterus causes anteriad displacement of ventral sucker, ovary and testes, is in conformity with the view expressed by this anthor elsewhere (Gupta, 1977 and *in press*) in the case of *Ganeo tigrinum* and *Pleurogenoides sitapurii*. Apart from the fact that growth of uterus causes some displacement and compacting of various organs, another fact has been pointed out in the case of *Tremiorchis ranarum* by Ali and Karyakarte (1970) and *Ganeo tigrinum* and in *Pleurogenoides sitapurii* (Gupta, 1977 and *in press*) that post-testicular part of these worms shows a faster growth rate than the anterior part during the attainment of maturity and gravid stages. This differential growth rate of uterine and gonadial parts of body affects the relative position and size of different organs in relation to body length as well as compared to one another.

DISCUSSION

N. K. Gupta (1954) described *Pleurogenoides (Telogonella) sawanensis* on the basis of two worms in early stage of maturity, collected from intestine of *Rana cyanophlyctis* at Hoshiarpur. This species was distinguished from other species mainly on the basis of its eaeca extending behind ventral sucker. *P.* (*T.*) *sawanensis* was distinguished from *P. orientalis* (Srivastava, 1934) on the basis of asymmetrical testes, position of ovary and extension of cirrus sac. The position of ovary towards median plane, curved shape of cirrus sac with its distal end reaching median part of body and the middle portion of ventral sucker, caeca reaching posterior margin of acetabulum, and position of genital pore have been described above as individual variations. While dealing with the uterus, the effect of differential growth of the posterior uterine part of these worms and displacement and compacting of other organs has been discussed above. *Pleurogenoides* (*Telogonella*) *sawanensis* is in the earlier stage of maturity, showing some differences from fully mature worms described as *Pleurogenoides gastroporus*. Therefore *P.* (*T.*) *sawanensis* should be treated as a synonym of *P. gastroporus*.

Srivastava (1934) described *Pleurogenoides orientalis* and distinguished it from *P. gastroporus* and *P. gastroporus* var. *equalis* on the basis of relative position and size ratio of suckers, absence of oesophagus, relative length of caeca, shape and disposition of vitellaria, topography of gonads, shape and position of cirrus sac and position of genital pore. *P. orientalis* comes in the range of variation of these characters described above, hence it should be treated identical with *P. gastroporus*.

Pleurogenoides gastroporus var. *equalis* Mehra and Negi (1928) was dropped by Bhalerao (1936) and Singh (1954). This author agrees with them in suppressing var. *equalis*.

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Bull. zool. Surv. India, 3 (1 & 2) : 47-50, 1980

PRELIMINARY OBSERVATIONS ON THE BREEDING OF THE BANDED POND SNAIL, *VIVIPARUS BENGALENSIS* (LAMARCK) (GASTROPODA : VIVIPARIDAE) IN WEST BENGAL

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ABSTRACT

Some aspects of breeding in *Viviparus bengalensis* have been studied. During June-July period 100% snails were gravid, with eggs and/or young in their uterine chamber while a gradual decline noticed in the subsequent months with a minimum 29.9% in January. Maximum number of young ones (80%) in uterus was observed in winter (December to February). This phenomenon is presumably associated with the fluctuation of water temperature in the pond.

INTRODUCTION

Viviparus bengalensis (Lamarck), a common fresh-water gastropod, is found in almost in all ponds and jheels in India and its neighbouring countries. During monsoon months it is very common in the paddy fields. This snail species is largely consumed by a number of fishes, birds (including poultry ducks) and mammals (including man). Inspite of its immense economic importance, virtually, no attention has been paid on the breeding biology of this edible gastropod mollusc. Annandale and Sewell (1921), however, gave a detailed anatomical account of this snail.

The present paper includes some aspects of its breeding cycle and the influence of seasons on the same.

MATERIALS AND METHODS

V. bengalensis of different size-composition were collected 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. From this lot females were separated from males based on character of the tentacles. The females were dissected and the uterine chamber of each snail was examined. The number of snails bearing eggs and young were counted separately in each month. Snails with shell less than 16 mm long were not considered for the study as the sexual maturity was noticed when the shell attains 16-18 mm long (Annandale and Sewell, 1921).

Water-temperature of the pond was recorded each time.

OBSERVATIONS

In course of 12 months 3258 female *V. bengalensis* were dissected and examined, of which

2389 (73.3%) snails were with eggs and young in their uterus. The phenomenon of carrying eggs and/or young has been noted throughout the year but the number varied from season to season. During June and July all the snails were with eggs and/or young while a gradual decline occured in the subsequent months with a minimum (only 29·9%) in January. Again it was at an increasing rate from February onwards. It is to be noted here that during winter (December to January) the uterine chamber is filled up with 80% young and 20% egg.

Water-temperature of the pond showed a wide range of variation during the period of observation (Fig. 1). Temperature was lowest during January (10°C) while it increased in subsequent months to as high as 38°C in June-July. The number of snails cramping the uterus with young and/or eggs has also been recorded throughout the year (Fig. 1).

Discussion

From the study it appears that *V. bengalensis* reproduces throughout the year but the rate of breeding is rather variable from season to season.

The variation in the per cent of snails bearing eggs and/or young from season to season is probably related with the temperature of the habitat. It is assumed that a higher temperature (above 25 C) favours breeding. On the other hand, lower temperature (9°C) for a few hours in a period of 24 hours during winter did not stop the breeding activity of this snail though hampered to a considerable degree. This suggests that a temperature range between 9-35°C does not play any role in keeping the eggs or young inside the uterus. But the rate of release of the young is dependent on the temperature of the water and obviously it is during high temperature (above 25°C) that the young ones are released. This is, probably with an anticipation that the young ones will not be able to survive in lower temperature or it may inhibit their growth. Thus maximum retention of young ones was observed during winter. However, temperature above 25°C encouraged breeding and multiplication of this snail species under observation. This may be indicated from the high percentage of gravid snail observed from March to August period.

Ecologists seem to agree that temperature is among the most important of the physical influence in any biotope, especially in freshwater. However, in snails this range of temperature is variable from species to species. The optimum temperature for oviposition of *Biomphalaria pfeifferi* is between 26-28°C while in planorbids (*Helisoma trivolvis*, *H. anceps* and *H. campanulatum*) 25-26°C is essential (Liang, 1973). Shiff (1964) found that up to a limit of 25°C the egg-laying of *Bulinus globosus* increased rapidly and that maturation was faster with rising temperature. Hyman (1967) stated that in the temperate regions pulmonates generally breed during the warmer part of the year. Thus it is evident that higher temperature is favourable for breeding in snails.

Annandale and Sewell (1921) reported that breeding did not take place during winter in *V. bengalensis*. From the present study it is clear that development of eggs and young is a continuous process even in winter but the release of young depends on the temperature of water.

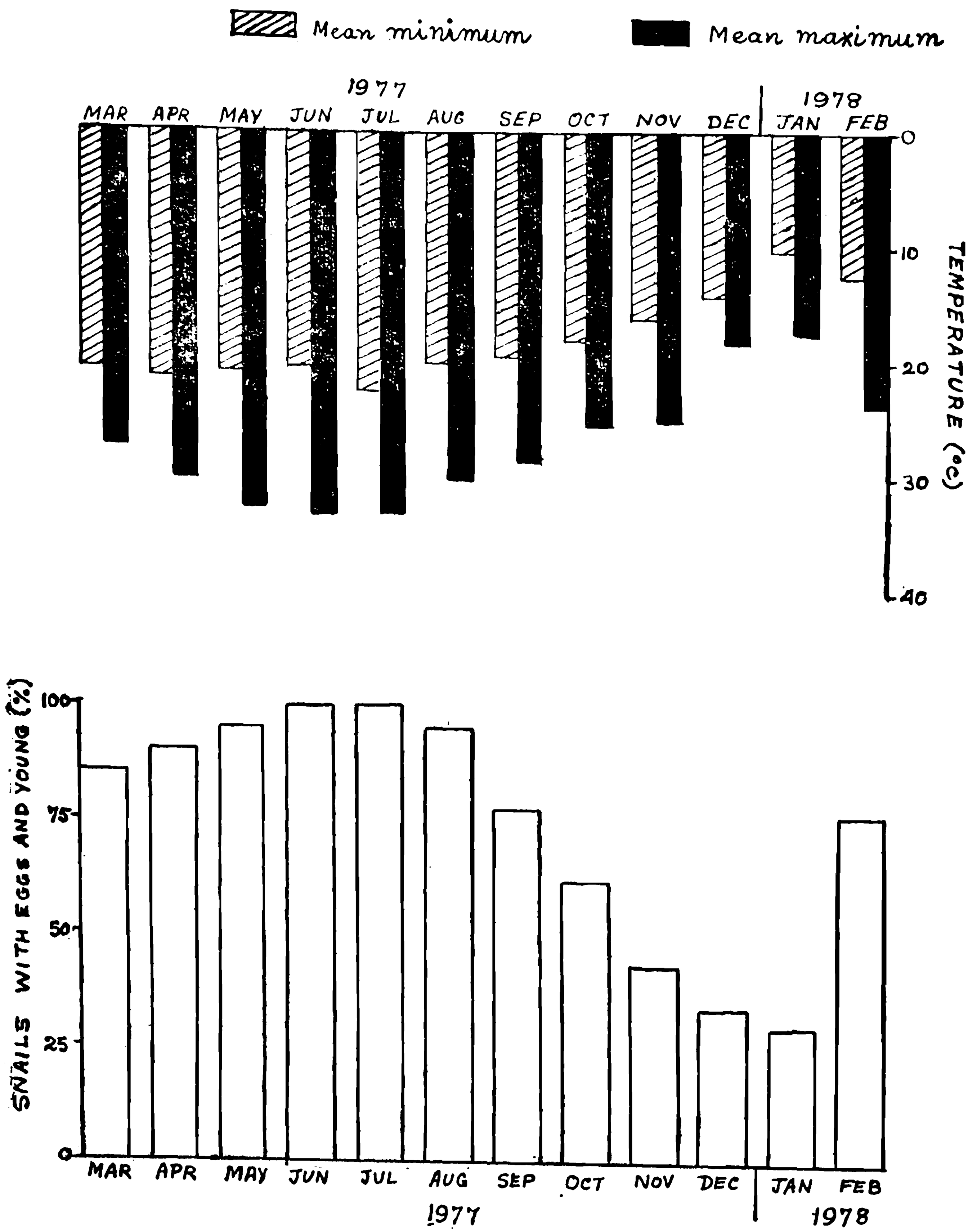

Fig. 1. Histograms showing the percentages of adult *Viviparus bengalensis* with eggs and/or young in relation to monthly temperature fluctuations of the pond-water near Port Canning, March 1977 to February, 1978.

As the low temperature appears to be unfavourable for the young, the snails developed the habit of retaining them till the advent of warmer weather—an adaptation towards successful survival and propagation of the snail.

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NEW SPECIES AND RECORDS OF *PHYTOSEIUS* MITES (ACARINA: MESOSTIGMATA) FROM SOUTH INDIA

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ABSTRACT

Four species of *Phytoseius* Ribaga from South Ind'a are treated in this paper. This includes a new species as well as a new record from India.

INTRODUCTION

The present paper is based on the material of the genus *Phytoseius* Ribaga from South India. Altogether, four species are treated here which includes a species that is new to science and another one the occurrence of which was not earlier known from India.

Setal nomenclature as that of Chant *et al.* (1974) is followed. All the material treated here were collected by the author himself. The measurements given in the text are in microns.

Types are being deposited in the National Collection of the Zoological Survey of India.

1. Phytoseius (Phytoseius) kapuri Gupta (Fig. 1A)

Phytoseius (Phytoseius) kapuri Gupta, 1969, *Israel J. Agric. Res.*, 19 : 115-117

Female: Dorsal shield 260 long, 160 wide. Measurements of setae $j_1 - 28$, $j_4 - j_6 - 4$ each, $J_2 - 8$, $J_5 - 4$; $j_3 - 68$, $z_2 - 16$, $z_3 - 48$, $s_3 - 9$, $s_4 - 96$, $s_6 (= L_6$ of Garman, 1948)-80, $Z_5 - 75$; $z_4 - 4$, $Z_4 - 76$; $r_3 - 40$, $R_1 - 12$. Ventrianal shield 92 long, 60 wide with 3 pairs of preanal setae. Leg IV with macrosetae on : genu - 29, tibia - 29, basitarsus - 25. Spermatheca as illustrated.

Material: 2 ♀ ♀, PONDICHERRY : on 4.xii. 1975 ; 3 ♀ ♀, KERALA : Trivandrum, on an unknown host, 14.xii.1975 ; 2 ♀ ♀, TAMIL NADU : Coimbatore, on brinjal, 19.xii.1975.

Distribution: India : West Bengal, Kerala (New record), Tamil Nadu (New record), Pondicherry (New record)

2. Phytoseius (Dubininellus) roseus Gupta (Fig. 1B)

Phytoseius (Dubininellus) roseus), Gupta, 1969, *Israel J. agric, Res.*, 19 : 119-120.

Female: Dorsal shield 270 long, 132 wide. Measurements of setae : $j_1 - 28$, $j_4 - j_6$, J_2 -

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$J_5 - 4 - 6$ each, $j_3 - 38$, $z_2 - 8$, $z_3 - 33$, $s_3 - 8$, $s_4 - 101$, $s_6 - 64$, $Z_5 - 60$; $z_4 - 6$; $Z_4 - 76$; $r_3 - 40$. Genital shield - 68 wide. Ventrianal shield 72 long, 49 wide with 3 pairs of preanal setae. Spermatheca as in figure. Leg IV with macrosetae on: genu - nil, tibia - 40, basitarsus - 21.

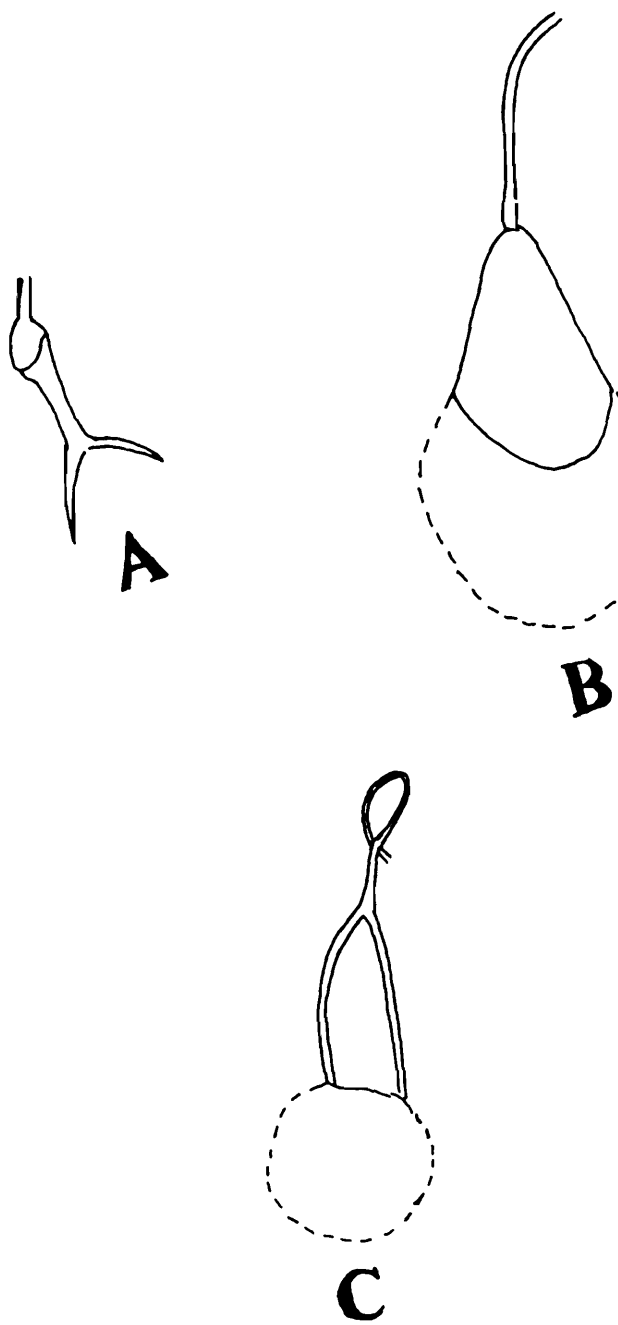

Fig. 1. A—*Phytoseius (Phytoseius) kapuri* (♀) spermatheca, B—*Phytoseius (Dubininellus) roseus* (♀) spermatheca, C—*Phytoseius (Dubininellus) rachelae* (♀) spermatheca.

Material: 1 ♀, TAMIL NADU: Madras Agri. Horticultural Garden, on papaw, 1.xii. 1975.

Distribution: India: West Bengal, Tamil Nadu (New record).

3. Phytoseius (Dubininellus) rachelae Swirski and Shechter (Fig. 1C)

Phytoseius (Dubininellus) rachelae Swirski & Shecher, 1961, *Israel J. agric. Res.*, 11: 108-109.

Female: Body elongated, narrow. Peritreme extends anteriorly up to j_1 and posteriorly upto coxa IV. Dorsal shield 268 long, 128 wide, well sclerotized with 14 pairs of setae; $j_1 = j_3$; s_4 being longest, $s_6 > Z_5 > Z_4$; measurements of setae: $j_1 - 28$, $j_4 - j_6$, $J_2 - J_5 - 4 - 5$ each; $j_3 - 28$, $z_2 - 8$, $z_3 - 20$, $s_3 - 14$, $s_4 - 100$, $s_6 - 80$, $Z_5 - 76$, $z_4 - 5$, $Z_4 - 64$; $r_3 - 40$. Sternal shield with 3 pairs of sternal setae, 4th pair lie on interscutal membrane. Genital shield wider than greatest width of ventrianal shield. Ventrianal shield 64 long, 44 wide with 3 pairs of preanal setae; 3 pairs of setae present around ventrianal shield, $JV_4 - 50$ long; one pair of metapodal plates present. Chelicera with 2 teeth on fixed digit and none on movable digit. Spermatheca with elongated 'Y' shaped cervix. Leg IV with macrosetae on: genu - 12, tibia - 48, basitarsus - 20, all with spatulate tip.

Material: 6 ♀ ♀, KERALA: Trivandrum, on *Hibitcus* sp., 14.xii.1975;

Distribution: India: Kerala. Hong Kong.

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

4. Phytoseius (Dubininellus) bandipurensis sp. nov. (Fig. 2A-D)

Female : Body narrow. Peritreme extends anteriorly upto j_1 and posteriorly slightly curves around coxae IV. Dorsal shield heavily sculuptured with 14 pairs of setae ; j_1 very close to each other ; j_1, j_3, z_3, s_4, s_6, Z_5, Z_4 and r_3 thick and serrate ; all other setae small ; $j_1 < j_3 = z_3$, $z_2 = s_3$, $s_4 > Z_5 > Z_4$, r_3 thicker and longer than z_3 ; measurements of setae : j_1 – 24, j_3 – 28, z_2, s_3 – 8 each, z_3 – 28, s_4 – 88, s_6 – 56, Z_5 – 64, Z_4 – 72, r_3 – 36. Sternal shield not clearly discernible. Genital shield wider than greatest width of ventrianal shield with a pair of genital setae. Ventrianal shield shorter, lateral margin deeply concave with 3 pairs of preanal setae ; 3 pairs of setae present around ventrianal shield, JV_4 – 40 long ; single pair of metapodal plates present. Spermatheca with long duct and 'Y' shaped cervix. Fixed digit of chelicera with 2 teeth, movable digit with one tooth. Macroseta present on leg IV : genu—18, tibia—40, basitarsus—16 and distitarsus—20 long, all macrosetae with spatulate tip.

Male : Unknown.

Material : *Holotype* : Reg. No. 3056/17 INDIA : Karnataka, Bandipur Sanctuary, on an unknown host, 30.xii.1975.

Remarks : This species differs from *Phytoseius* (*Dubininellus*) *woodburyi* De Leon 1965) in having ventrianal shield much shorter, in

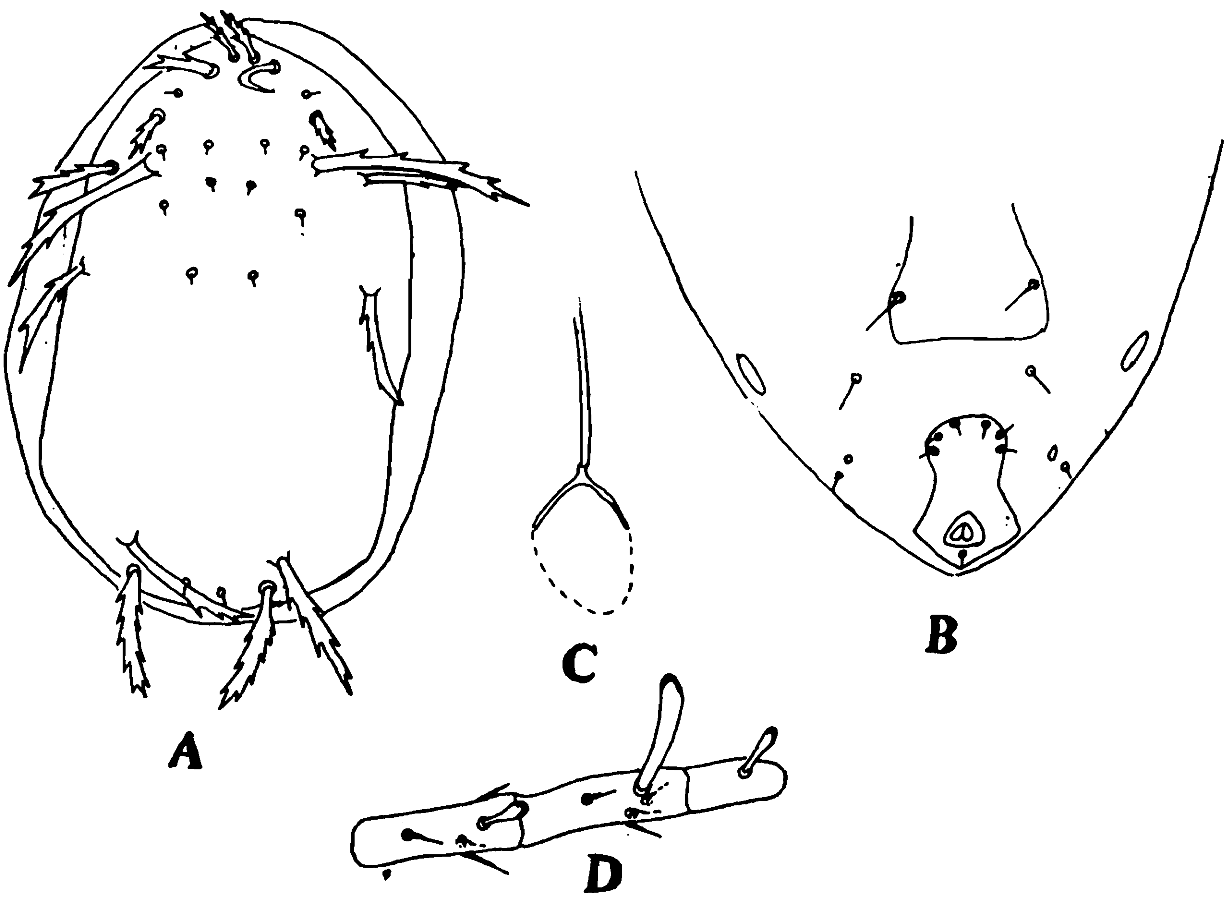

Fig. 2. (A-D) *Phytoseius* (*Dubininellus*) *bandipurensis* sp. nov. (♀), A—dorsal shield, B—posterior ventral surface, C—spermatheca, D—leg IV.

having shorter s_4 and the macrosetae on genu IV and basitarsus IV almost equal (macroseta on basitarsus longer than that of genu in *woodburyi*). Further, it differs from *P.* (*D.*) *macropilis* Banks (1909) in presence of 3 pairs of preanal setae on ventrianal shield, and in having shorter s_4 and macroseta on basitarsus IV shorter.

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LIFE CYCLE AND SEASONAL FLUCTUATION OF CHAETOGNATHA IN ENNORE ESTUARY, MADRAS

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ABSTRACT

Seasonal fluctuation in abundance of *Sagitta bedoti* Beraneck, *S. inflata* Grassi and their life cycle in Ennore estuary based on the samples collected during 1975 and 1976 are discussed.

INTRODUCTION

Estuaries play a main role as nursing grounds in the life cycle of many marine organisms. Several marine fishes and prawns periodically visit the estuaries for breeding, as it is a safe place, that ensures the life of young ones. So, the studies on estuarine habitats have become important and nowadays great attention is given towards the same. In this account the seasonal fluctuation and breeding habits of chaetognaths collected in Ennore estuary during 1975 and 1976 are dealt with.

Chaetognaths are one of the important constituents of marine plankton, play a vital role in food cycle and are good indicator organisms of watermasses. Though they are marine inhabitants, a few species are also seen in estuaries (Devasundaram and Roy, 1954 ; Dutta *et al.* 1954 ; George, 1958 ; Nair, 1972, 1973, 1978 ; Srinivasan, 1972, 1977 ; Srinivasan and Raghunathan, 1978).

TOPOGRAPHY

The estuary is situated at 15 km. north of Madras city. It is 3 km. long 1 km. wide and the depth ranges from 1.5 to 2.5 metres. During high tide the depth of the estuary increases due to the inflow of sea water through the narrow mouth of the estuary, which is mechanically kept open throughout the year by the dredging operations of the Ennore Thermal Station. The topography and hydrobiology of this estuary have been well studied by previous workers (Chacko, 1956, 1963 ; Chacko and Rajagopal, 1962 ; Evangeline and Subbiah, 1969 ; Srinivasan, 1977 ; Srinivasan and Raghunathan, 1978). But none of the earlier workers has studied the seasonal fluctuation and life cycle of the chaetognaths present in the estuary. So, an attempt is made here to study these aspects.

MATERIAL AND METHODS

The Chaetognatha sorted out from 50 zooplankton samples collected from two stations (Fig. 1) one near the bar mouth, and the other 1 km. away from the bar mouth, during May, 1975 to September 1976 were utilised for this investigation. These two stations were periodically visited once in a fortnight and zooplankton and water samples were regularly collected except during January and February, 1976 due to some unforseen circumstances. The samples were collected by towing a half meter nylon ring net from a country boat, at the surface for ten minutes, between 7 and 8 A.M. The collected samples were preserved in 5% formalin and after determining the volume by displacement method, the entire volume of the sample was analysed for Chaetognatha. They were sorted out, identified species wise, stage-wise and total number in each species was determined.

Chaetognaths of the Estuary

The examination of the samples have revealed the presence of *Sagitta bedoti* Beraneck, *S. inflata* Grassi and *S. pluchra* Doncaster, in Ennore estuary. 1437 specimens of chaetognaths were sorted out from these 50 samples

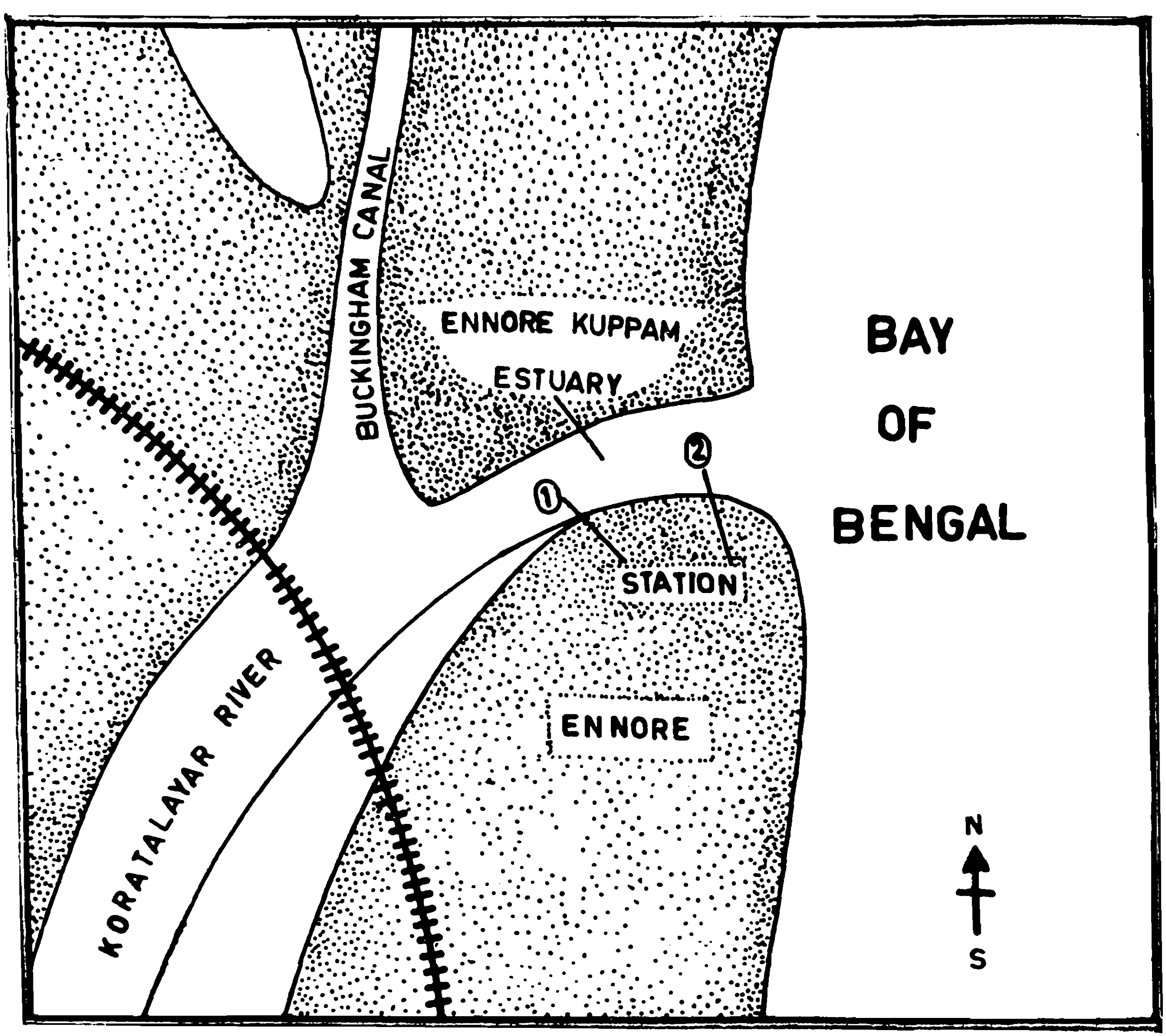

Fig. 1. Map of Ennore estuary, showing the station position.

and among these, 789 specimens are (55%) *S. bedoti* and 647 are (45%) *S. inflata*. *S. pulchra* is represented by only one specimen. Among chaetognaths *S. bedoti* and *S. inflata* are the most common estuarine species, that are seen in abundance (Nair, 1972, 1973, 1978 ; Srinivasan, 1972, 1977; Srinivasan and Raghunathan, 1978). Here *S. bedoti* ranks first in the order of abundance followed by *S. inflata*.

Both these species do not show any definite pattern of fluctuation in abundance as it is evident from Fig. 2, that there are several peaks and downs. *S. bedoti* is absent in the

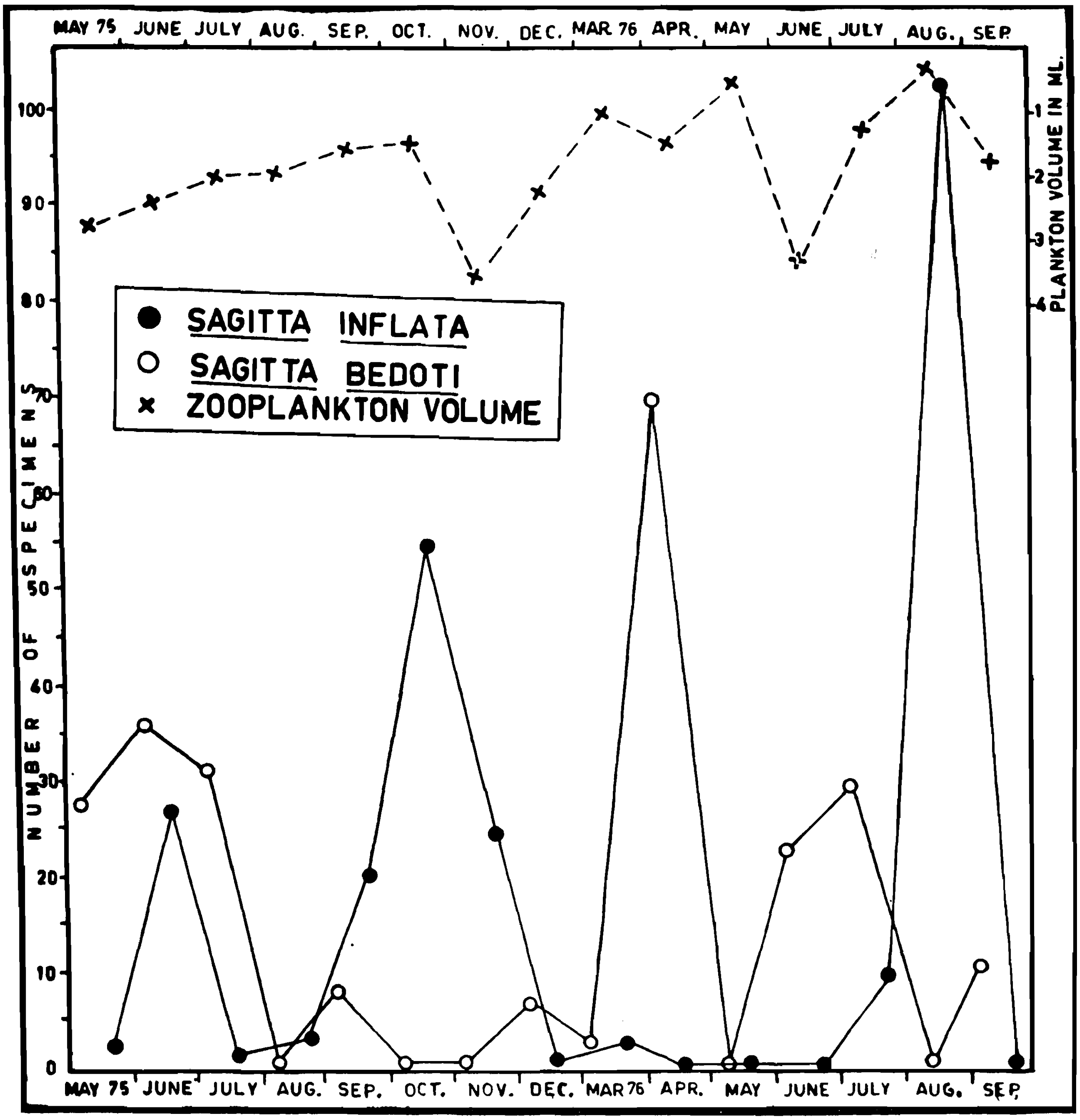

Fig. 2. Fluctuation of Zooplankton volume, *Sagitta bedoti and Sagitta inflata* in Ennore estuary.

samples collected from the estuary during the start of the North East monsoon (Oct.-Nov.), whereas *S. inflata* is not found in the samples during the start of South West monsoon period (April-June). Maximum number of specimens of *S. bedoti* was noted during April, 1976 and for *S. inflata* the maximum was during August, 1976. As both the species contain specimens of various maturity stages, it was possible to study the life cycle of both the species. Similar to the findings of Nair (1973) in Cochin Back-waters, in the samples collected from Ennore estuary also, matured specimens (Stage-IV) of *S. bedoti* and *S. inflata* are tolally absent and

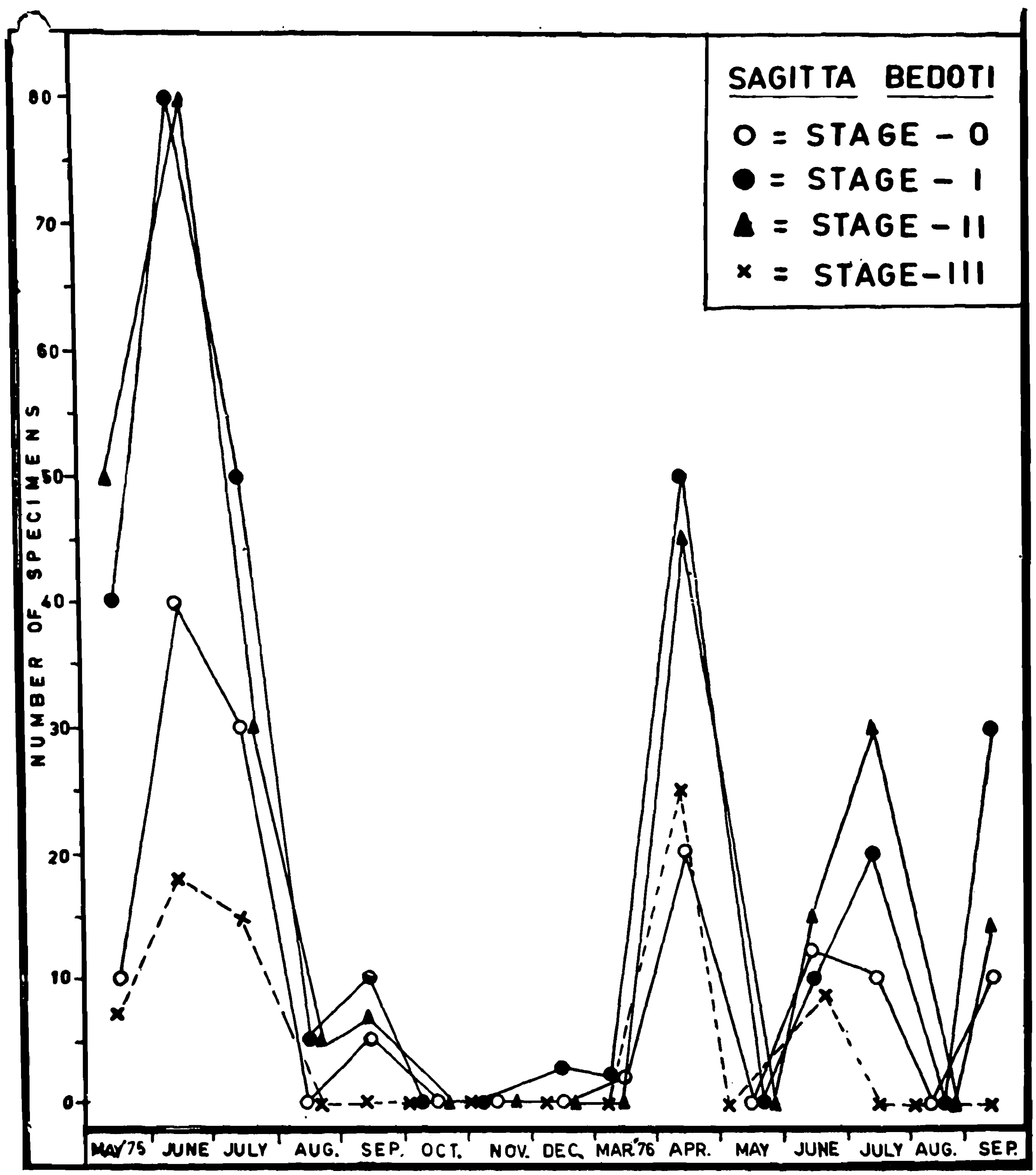

Fig. 3. Life cycles of *S. bedoti* in Ennore estuary during 1975 and 1976.

hence the specimens of other maturity stages (Stage 0 to III) are considered for life cycle studies.

BREEDING OF *SAGITTA* IN ENNORE ESTUARY

Details of breeding of *S. bedoti* and *S. inflata* in the Cochin backwaters along the West coast of India are known (Srinivasan, 1972 ; Nair, 1973). Along the east coast of India, Rao and Kelly (1962) had reported about the breeding habits of *S. inflata* in Lawson's Bay. All these earlier studies have reached a universal conclusion that *S. inflata* and *S. bedoti* are continuous breeders, because they are inhabitants of tropical waters. In this present investigation

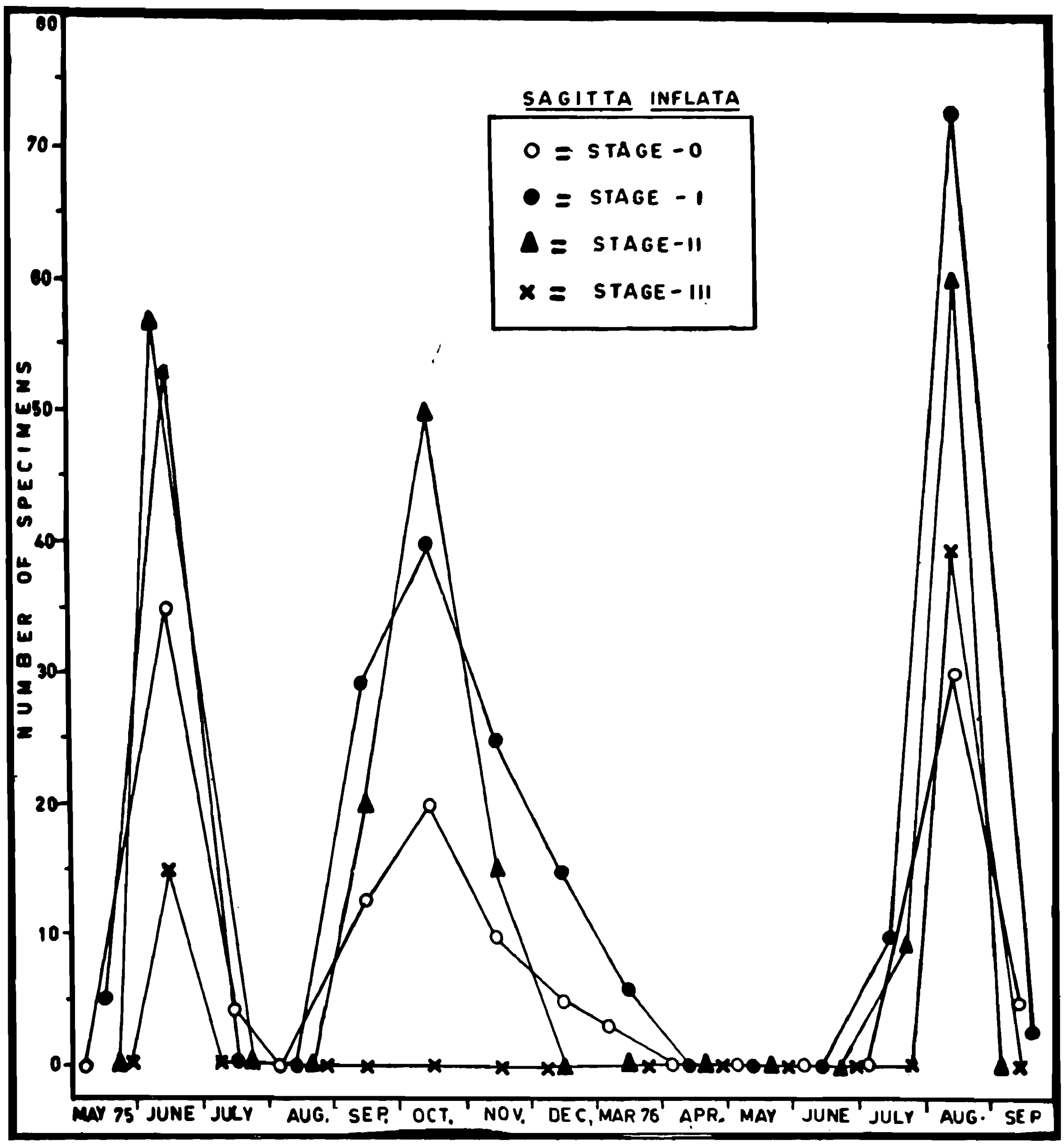

Fig. 4. Life cycles of *S. inflata* in Ennore estuary during 1975 and 1976.

the specimens included belong to 4 maturity stages (Stages 0, I, II, III).

Sagitta bedoti (Fig. 3) :—

Specimens of this species collected from this estuary range between 3 and 5 mm. in total length. The tail segment varies from 27 to 28.8% of the total length, whereas in the marine forms which measure 7 to 13 mm in total length the tail segment will be 23 to 25% of the animal length. The specimens of these collections ranged from 0 to III stages and the fully matured specimens (Stage-IV) are not found. From the Fig. 3 it is clear that there are two peaks followed by a small peak in the life cycle of *S. bedoti* during the period of investigation. Further, specimens of stages I and II are always higher in number than stages 0 and III during the period of observation.

Sagitta inflata : (Fig. 4) :—

Total length of the specimens varies from 3.6 to 9.2 mm and the tail length varies from 19 to 20% of the animal length. The specimens of stage IV are absent. During the period of study 3 peaks are noticed as seen in Fig. 4 during July, August and October. Throughout the period of observation the specimens of Stage I and II are higher in number followed by stage 0 and III as in *S. bedoti.* Specimens of stage III were noted in the collections made only during June and August and was absent in all the other month's samples.

Discussion

This investigation has clearly revealed that *S. bedoti*, and *S. inflata* are continuous breeders with 2 to 3 intensive broods followed by normal broods. It has already been pointed out (Dunbar, 1941) that the number of generations produced in each year increases with the distance from the poles. The presence of immature forms throughout the year in the estuary confirms the earlier conclusion that these species are continuous breeders. The fluctuations in abundance of the immature and fully matured forms indicating the periods of peak and lean breeding seasons further corroborates the conclusion that they belong to continuous breeding forms.

Another interesting feature that was noted during this investigation is the absence of fully matured specimens of both the species in the collected samples. In Cochin backwaters also (Nair, 1973) the same condition of rare occurrence of matured specimens of *S. bedoti* and *S. inflata* has been reported. So these interesting coincidence of absence of matured specimens of these species, throughout the period of observation, in the estuaries, suggests one to think the possibility of migration of these forms to the seas for spawning and re-entry of the young ones to the estuary. Intensive studies based on regular and frequent samples collected for several successive years are necessary before arriving at a definite conclusion regarding the breeding migration.

Specimens of *S. bedoti* and *S. inflata* present in the samples collected measured from 3 to 5 mm. and 3.6 to 9.2 mm. respectively. Total length of the specimens of both the species are very small, when compared to the specimens of the marine habitat. *S. inflata* of the coastal waters will be usually between 5 and 20 mm. or more in total length and *S bedoti* will be 7 to 13 mm. or more. This was already noted in the specimens of Cochin backwaters

(Srinivasan, 1972). The specimens of the same species that are living in estuarine waters, are smaller in size because the habitat in which they are living is controlled by a wide fluctuation of salinity conditions, as pointed out by Kinne (1964) that marine organisms are known to exhibit a reduction in final size in areas of their distribution, where the salinity is significantly reduced.

Further studies on the ecology of Ennore ecosystem based on several parameters are in progress and that are bound to give us a comprehensive knowledge on the life cycle, and on the breeding behaviour of these species.

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AN ACCOUNT OF THE GENUS *BREVICORYNE* VAN DER GOOT (HOMOPTERA : APHIDIDAE) IN INDIA WITH DESCRIPTION OF A SEXUAL MORPH OF *BREVICORYNE BARBAREAE* NEVSKY

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ABSTRACT

The paper provides an account of the genus *Brevicoryne* van der Goot infesting the cruciferous plants and its toxonomic affinity with other related genera like *Lipaphis* Mordvilko, affecting also cruciferous plants and *Hyadaphis* Kirkaldy affecting plants of Umbelliferae, a family related to Cruciferae, is discussed. A key to the identification of the species is also given. The hitherto unknown alate male of *Brevicoryne barbareae* Nevsky has been described for the first time. A discussion on the ecological aspect of the species is also incorporated in the paper.

INTRODUCTION

Only two species, *Brevicoryne barbareae* Nevsky and *B. brassicae* (L.) in the genus *Brevicoryne* van der Goot are so far known from India where they normally occur on the plants belonging to the family Cruciferae. In the present paper, details of each species including a key to the species based on Indian material of both parthenogenetic and sexual forms are provided. Besides, re-examination of the material reported as *B. brassicae* by Banerjee *et al.* (1969) from Kuti valley (*c* 11,613′—11,886′) reveals that those are alatiform apterae of *B. barbareae* Nevsky, the alate males of which are described for the first time.

Genus *Brevicoryne* van der Goot

Brevicoryne van der Goot, 1915, *Bietr. Z. Kenntider Holland*, Blattlause : 245.

Body elongated oval, pale to brown in colour. Head smooth or slightly wrinkled. Frons with low lateral frontal tubercles; median frontal prominence well developed. Antennae 6-segmented and shorter than body, antennal segment I imbricated, shorter than wide, segment II as long as segment I; flagellum strongly imbricated, without secondary rhinaria in apterae viviparae, intermediate forms, however, with up to 20 circular protuberant secondary rhinaria, alatae with numerous such rhinaria distributed irregularly on segment III, segment IV with 7-15, V with 5-19, VI with 0-2, primary rhinaria ciliated; flagellar hairs sparse, short with acute to acuminate apices; p.t. longer than base of segment VI. Rostrum normal, reaches midcoxae shorter than h.t. 2 and bears 4 secondary hairs. Prothorax in apterae viviparae with marginal brown patches and in alatae

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with a transverse pigmented band ; meso—and metathorax in apterae viviparae with such marginal patches in addition to the scattered pigmented ,patches and muscle-plates arranged pleurally ; mesothoracic furca with separate arms. Abdominal dorsum in apterae with pigmented irregular shaped wrinkled patches pleurally, these showing various degrees of coalescence with those occurring spinally on segments 1-7 and segment 8 with a spino-pleural band besides scattered muscle-plates on the antesiphuncular segments, in alate viviparae with spinopleural segmental bars on each segment, sometimes these on anterior segments broken, besides, marginal spinular pigmented patches occur on segments 2-5 along with muscle-plates ; dorsal hairs thick with blunt apices in apterae viviparae and with acuminate apices in alate viviparae placed on slightly raised bases. Siphunculi at most up to 0.14 of body length, usually barrel-shaped, in alate viviparae basal portion much constricted and wrinkled, faintly imbricated, almost without any apical flange. Cauda dark, triangular to elongate, shorter than siphunculus, bearing 5-7 hairs. Subgenital plate broadly oval, with 10 hairs in two groups posteriorly and 2 hairs anteriorly. Legs smooth with hairs having acute to subacute apices or faintly imbricated, tarsi with normal imbrications, F.T.C. 3,3,3 or 3,3,2. Wing venation normal. Nymphs with hindtibiae smooth.

Distribution : Cosmopolitan.

Remarks : The genus is mostly restricted to the plants of Cruciferae. Another aphid genus affecting only the cruciferous plants is *Lipaphis* Mordv. So, apart from the view point of host association, these two genera

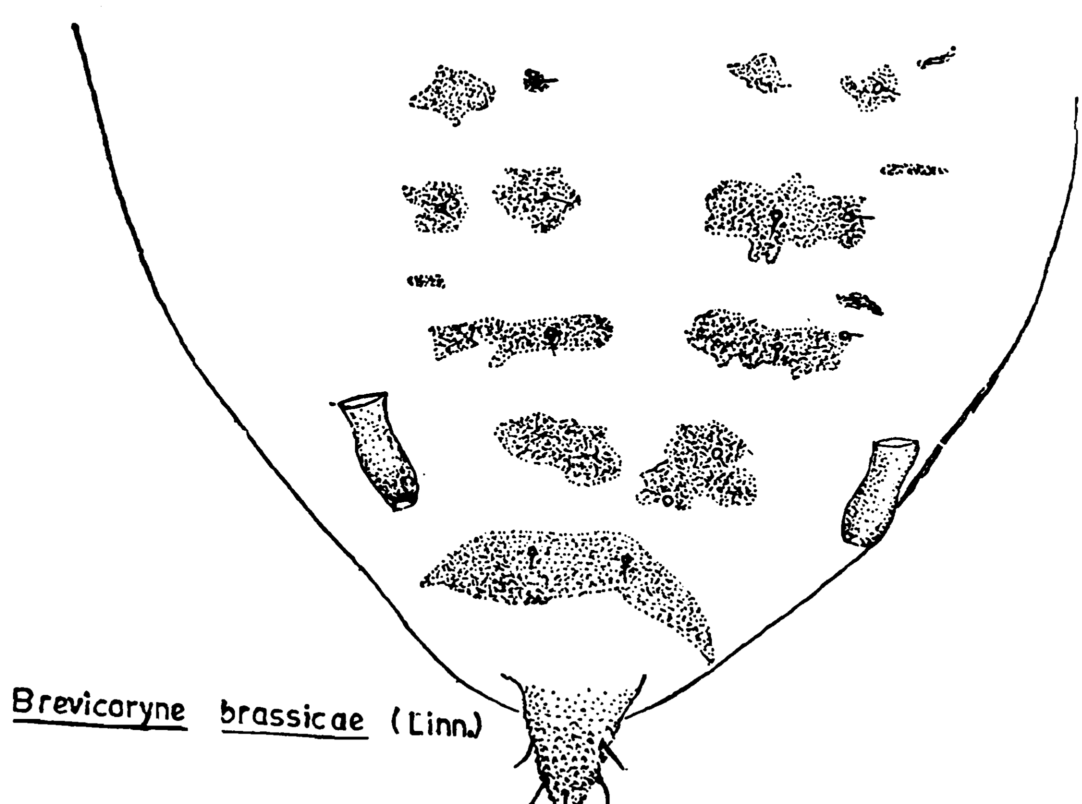

Fig. 1. *Brevicoryne brossicae* (Linn) ; posterior abdominal dorsum showing pigmentation, siphunculi and cauda.

also show close morphological resemblance excepting in the nature of siphunculi and cauda.

With regard to the nature of siphunculi, *Brevicoryne*, *Hyadaphis* and *Lipaphis* are very closaly related genera. But *Brevicoryne* differs from *Hyadaphis* in having triangular to elongated cauda and barrel-shaped to slightly clavate siphunculi (Fig. 1). In *Hyadaphis* cauda though elongated is with a median constriction and siphunculi distinctly clavate (Fig. 2A). Again, *Brevicoryne* differs from *Hyadaphis* in host association, i.e. the former infests cruciferous plants while the latter plants of Caprifoliaceae and Umbelliferae. Further, by the clavate nature of siphunculi, dorsal abdominal pattern, (Fig. 1) wax covered body in life and host-plant association with Cruciferae, *Brevicoryne* resembles closely with *Lipaphis* Mordvilko. But *Brevicoryne* can be easily separated from *Lipaphis* (Fig. 2B) by the length of siphunculi which is always shorter than cauda in *Brevicoryne*.

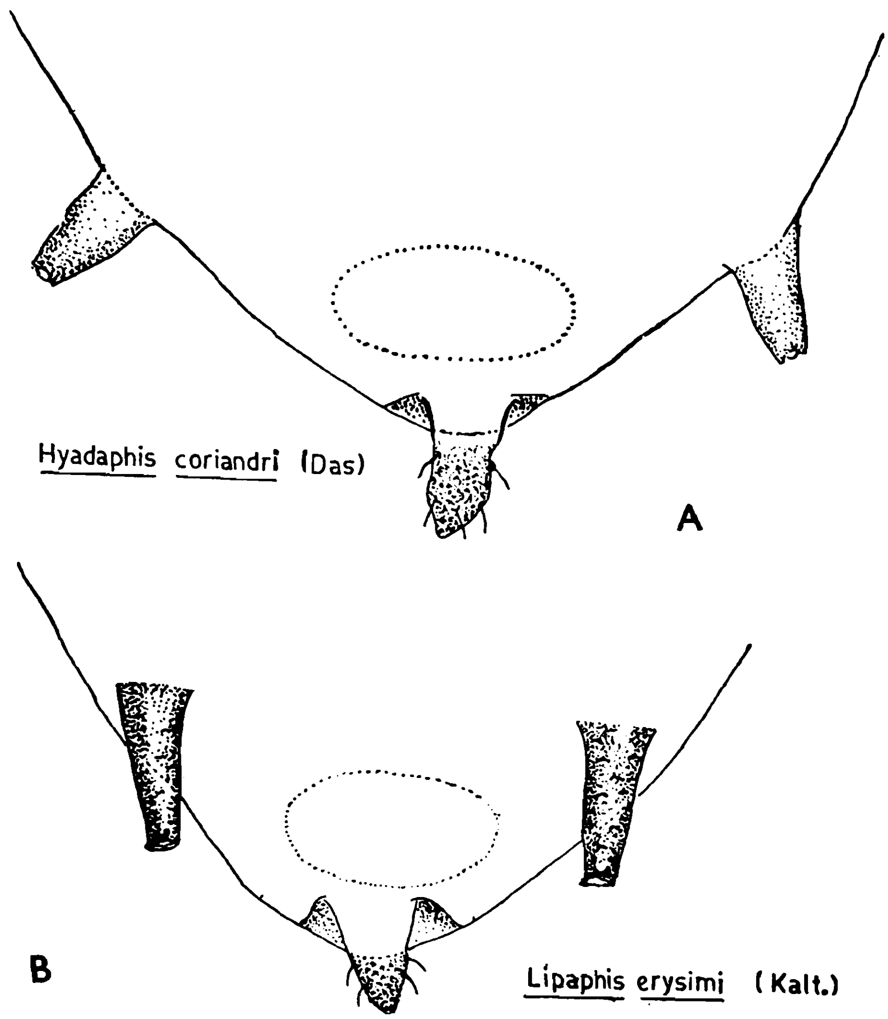

Fig. 2. A. *Hyadaphis coriandri* (Das) ; posterior abdominal dorsum showing siphunculi and cauda. B. *Lipaphis erysimi* (Kaltenbach) ; posterior abdominal dorsum showing siphunculi and cauda.

Though all the workers have given a separate generic status for *Brevicoryne*, Eastop (1966) states "*Hyadaphis* and *Brevicoryne* are difficult to separate from *Lipaphis* when the world fauna is considered" and possibly for this reason, he, under the genus *Brevicoryne* writes "the genus is closely related to *Lipaphis* and these two genera can at best be treated as subgenera of *Hyadaphis* Kirkaldy which is oldest of the three genera". Even with this comment, he writes in the same publication "Regarded as distinct here principally to preserve the well known name *B. brassicae*". It may be pointed out here that *Hyadaphis* infests the plants of Caprifoliaceae and Umbelliferae. So, from the view point of host plant association, it is difficult to reconsile Eastop's idea of considering *Brevicoryne* and *Lipaphis* as subgenera of *Hyadaphis*. Only transfer experiment in future can prove Eastop's contention. Morphologically also, *Brevicoryne* and *Hyadaphis* differ much too much in the shape of the cauda.

From the foregoing account, it is obvious that the generic status given to *Brevicoryne* can hardly be denied.

Key to the species of *Brevicoryne* van der Goot in India

Apterous viviparous female :

Siphunculi not typically barrel-shaped, but cylindrical to slightly swollen at the middle; cauda elongate, with 7-9 hairs; abdominal dorsum with broad separated spinopleural and marginal sclerites ... *barbareae* Nevsky

Siphunculi typically barrel-shaped; cauda triangular, with 5-7 hairs; abdominal dorsum with pleural irregular wrinkled sclerites ... *brassicae* (L.)

Alate male :

Cauda elongate, with 7-9 hairs; siphunculi cylindrical to slightly swollen at the middle; antennal segment III with at most 46 secondary rhinaria, IV with 7-11, V with 5-11 and VI with 0-2 such rhinaria ... *barbareae* Nevsky

Cauda triangular, with 5-7 hairs; siphunculi typically barrel-shaped; antennal segment III with never less than 60 secondary rhinaria, IV with 15, V with 19 and VI without any such rhinaria ... *brassicae* (L.)

Brevicoryne barbareae Nevsky

Brevicoryne barbareae Nevsky, 1929. *Zool. Anz.*, 82: 210.

Brevicoryne brassicae (L.) (misdet.): Banerjee, Ghosh and Raychaudhuri, 1969, *Orient. Inscets*, 3 (3): 257.

Brevicoryne barbareae Nevsky: David and Hameed, 1975, *Orient. Insects*, 9 (2): 216.

Material examined : 6 alate males, India: Uttar Pradesh: Kuti, on *Raphanus sativus*, 24. ix. 1968, coll. H. Banerjee; 6 apterous viviparous females, 3 alate viviparous females, 2 nymphs and 4 alate males, India: U.P.: Sangtang, on *Brassica* sp., 19. ix. 1968, coll. H. Banerjee.

Alate male :

Body elongate, about 1.26-1.44 mm long with 0.45-0.57 mm as its maximum width near the middle of abdomen. Head dark brown, frons smooth; cephalic hairs short, about 18 μ long. Antennæ 6-segmented, imbricated, dark brown except very base of segment III which is pale, about 0.85-0.95 x body; flagellar hairs short with almost acuminate apices, longest hair on antennal segment III about 0.44 x basal diameter of segment III; antennal segment III with 36-46 small, round secondary rhinaria distributed over its entire length, segment IV with 7-11, V with 5-11 similar rhinaria irregularly scattered on the segments, base of segment VI with 0-2 secondary rhinaria ; p. t. about 4.8-6.4 x base of segment VI. Rostrum normal ; u. r. s. reaching midcoxæ, with 2-4 secondary hairs, about 0.8-0.9 x h. t. 2. Abdominal tergites with broad, separate dorsal and marginal sclerites, dorsal sclerites sometimes coalescing, dorsal hairs short, about 15 μ long, about 0.55 x basal diameter of antennal segment III, hairs on 8th tergite about 0.66 x the mentioned diameter. Siphunculi about 0.75-0.88 x cauda which is 1.3-1.5 x its basal width and with about 7 hairs. F. T. C. 3, 3, 3. Wing-venation normal. Other characters much like apterous viviparous female.

Measurements (in mm) : Length of body 1.26-1.44, width 0.45-0.57 ; antennæ 1.08-1.11 ; antennal segment III 0.36-0.41, IV 0.16-0.20, V 0.15-0.19, VI (0.08 + 0.41 to 0.08 + 0.51) ; ultimate rostral segment 0.09-0.11 ; second joint of hind tarsus 0.11-0.12 ; siphunculi 0.08-0.9 ; cauda 0.09-0.12.

Host-plants : *Barbarea vulgaris*, *Brassica* sp., *Nasturtium* sp. and *Raphanus sativus* (Cruciferæ).

Distribution ; India : Himachal Pradesh, Uttar Pradesh and Turkestan.

Remark : David and Hemeed (1975) have reported the species from India. Males were hitherto unknown.

Brevicoryne brassicae (Linnneus)

Aphis brassicae Linnaeus, 1758, *Syst. Nat.*. 10 : 452.

Brevicoryne brassicae : Das, 1918, *Mem. Indian Mus.*, 6(4) ; 187-188.

Brevicoryne brassicae (Linn.) : David, 1958, *J. Bombay nat. Hist. Soc.*, 55(1) : 115.

Brevicoryne brassicae (Linn.) : Ullah, 1940. *Indian J. Ent.*, 2(1) : 13-25.

Brevicoryne brassicae(Linn.) : Gupta and Joshi, 1959, *Proc.* 46th *Indian Sci. Cong.* Pt. 3 : 503.

Brevicoryne brassicae (Linn.) : Ghosh, A. K., Chakrabarti, Chowdhuri and Raychaudhuri, 1969. *Orient. Insects*, 3(4) : 330.

Brevicoryne brassicae (Linn.) : Ghosh, A. K. 1974. *Indian Agric.*, 18(2) : 97.

Material examined : Many apterous and alate viviparous females and nymphs ; one alate male, India : Himachal Pradesh : Kusumuti on *Brassica oleracea*, 10.i.1969, coll.S. Chakrabarti, 5 apteræ and a few nymphs ; Garhwal Himalaya, Uttar Kashi, Bhujbus, on *Brassica* sp., 10. x. 1975, coll. H. Ghosh.

Host-plants : *Beta vulgaris* (Chenopodiaceæ), *Brassica campestris*, *Brassica juneca*, *Brassica napus*, *Brassica oleraceae*, *Brassica rapa*, *Capsella bursapastoris*, *Cardamine hirsuta*, *Iberis* sp., *Raphanus sativus* (Cruciferæ) ; Unidentified plants of Labiatæ ; unidentified plants of Moraceæ and unidentified plants of Solanaceæ.

Distribution : India : Himachal Pradesh, Uttar Pradesh, Punjab, West Bengal, South India and virtually cosmopolitan.

DISCUSSION

Of the two Indian species of the genus *Brevicoryne* v. d. Goot, *B. brassicae* (Linn.) is more sporadic on cruciferous plants than *B. barbareae* Nevsky which is a palaearctic species and so far reported only once from each of *Nasturtium* sp. and *Barbarea vulgaris* (Cruciferæ) from *H*imachal Pradesh and *Raphanus sativus* (Cruciferæ) from Kuti valley (Uttar Pradesh).

The cruciferous crops are widely cultivated in different parts of India. The plants are visited by a number of aphid species including *Lipaphis erysimi* Kaltenbach, *Brevicoryne brassicae* Linnaeus and *Brevicoryne barbareae* Nevsky.

Of the 3 above named aphid species, *B. barbareae* is so far restricted to areas lying at an altitude of *c* 12,282′ or above it in the Central and northwest Himalaya. But *L. erysimi* is reported from different parts of India while *B. brassicae* is known from northeastern, central and northwestern states of India. Only once it has been reported from the Nilgiri Hills in South India (David and Ghorpade, 1974). Interestingly enough, *B. brassicae* could never be found in places having altitude less than *c* 3,000′ and on the contrary, *L. erysimi* does never occur in places lying in altitude above *c* 8,000′

The above facts lead to the conclusion that the *Brevicoryne* species show preference for more cool climate while *L. erysimi* prefer less cool climate to thrive. Moreover, in view of limitations in vertical distribution the chances of competition for food is minimised. Here, *B. brassicae* perhaps avoids competition and overcrowding on the same host. As a result, *B. brassicae* possibly makes its abode at higher elevations.

Further, according to Gause's rule, no two or more species can build up peak population simultaneously on the same ecological niche where they occur.

Perhaps due to the facts stated above *B. brassicae* is found in the higher altitudes under Indian conditions where there is a chance of overlapping of *L. erysimi* and *B. brassicae.* Similar reasons may be put forward to account for occurrence of *B. barbareae* in very high altitudinal areas.

Sexuales of aphids which play significant role in the biology of aphid occur usually at the higher altitudes where cold climate prevails and day length is short. David (1958) and Ghosh *et al.* (1969) recorded male and female of *B. brassicae* occurring on Cruciferae at an elevation of above *c* 5,000′ in the Western Himalaya. This suggests that *B. brassicae* reproduces holocyclically at the higher elevations. This observation also accounts for the presence of this species at the higher elevations.

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Bull. zool. Surv. India, 3 (1 & 2) : 69-76, 1980

ON THE STATUS OF SOME GENERA OF THE SUBFAMILIES STOMACHICOLINAE YAMAGUTI, 1958, DINURINAE LOOSS, 1907 AND PROLECITHINAE YAMAGUTI, 1971 (DIGENEA : HEMIURIDAE)

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ABSTRACT

Three genera, *Cameronia, Segmentatum* and *Cestodera,* have been merged with *Stomachicola* Yamaguti, 1934. However, *Indostomachicola* Gupta and Sharma, 1973 is being tentatively retained till confirmation of the reported presence of a ventral pit below the caecal bifurcation, otherwise its type species, I. *Kinnei* Gupta and Sharma, 1873, is not at all different from *S. muraenesocis. Allostomachicola* Yamaguti, 1958 is revalidated and considered quite distinct from *Stomachicola* Yamaguti, 1934 as against the view of Verma (1973). Illustrations have been furnished to show generic differences between the two genera. *Magnapharyngium* Bilquees, 1971 has been considered congeneric with *Lecithocladium* Luhe, 1901 (Subfamily Dinurinae). *Follicovitellosum indicum* Gupta and Sharma, 1972 in the family Zoogonidae Odhner, 1911 is nothing but *Prolecitha obesa* Manter, 1961 in the family Hemiuridae. It also follows that Follicovitellotrematinae Gupta and Sharma, 1972 becomes synonymous with Prolecithinae Yamaguti, 1971. Moreover, reasons have been provided to disagree with Manter (1969), and to agree with Yamaguti (1971) that *Prolecitha* Manter, 1961 is distinct from *Dichadena* Linton, 1910.

While the author was studying digenean specimens collected from the marine fishes *Muraenesox cinereus, Stromateus argenteus, S. sinensis, Parastromateus niger, Belone strongylura, B. crocodila* and *Chirocentrus dorab,* he came across some recent literature on new hemiurid trematodes belonging to the subfamilies Stomachicolinae Yamaguti, 1951, Dinurinae Looss, 1907, and Prolecithinae Yamaguti, 1971 described from India and Pakistan. Jahan (1970) erected the genus *Acerointestinecola* (Type species : *A. karachiensis*) from a marine fish *Cybium* sp. from Karachi Coast, which is reported to be distinct from *Stomachicola* Yamaguti, 1934 and *Allostomachicola* Yamaguti, 1958 mainly in having no cirrus sac but having a long and coiled hermaphroditic duct in the preacetabular area. Bilqees (1971) proposed *Cameronia* (Type species : *C. octovitellarii* : Other species : *C. pakistani*), *Segmentatum* (Type species : *S. karachiensis* ; Other species : *S. qadrii, S. cinereusis, S. magnaesophagustum*) from the marine eel, *Muraenesox cinereus,* and *Cestodera* (Type species : *C. gastrocecus* ; Other species : *C. uniceus*) from the marine catfish, *Arius serratus* Day. Gupta and Sharma (1973) erected *Indostomachicola* (Type species : *I. kinnei*) from the stomach of a marine eel, *Leptocephalus conger* (Linn.), from the coast of Ratnagiri, India. These genera belong to the Stomachicolinae. Bilqees (1971) has also proposed another genus *Magnapharyngium* (Type species: *M. hexavitellarii*; Other species: *M. anteroporus, M. microcaudum. M. tetravitellarii, M. microductus, M. arabiana, M. octovitellarii*) belonging to the subfamily Dinurinae. Gupta and Sharma (1972) have also proposed a new genus, *Follicovitellosum* (Type species: *F. indicum*) in the family Zoogonidae from the marine fish, *Belone belone* (Linn.) from Ratnagiri, India. A careful study of these genera (viz. *Cameronia* Bilqees, 1971, *Segmentatum* Bilqees, 1971, *Cestodera* Bilqees, 1971, *Indostomachicola* Gupta and Sharma, 1973, *Magnapharyngium* Bilqees, 1971 and *Follicivitellosum* Gupta and Sharma, 1972) together with the relevant specimens in the author's collection revealed that distorted, doubtful, variable and insignificant characters have been used in proposing new genera. Even, at places, observational errors are involved, and some important papers were not consulted leading to erroneous judgements. In view of such errors, misjudgements and confused literature on the above genera, a reconsideration of them was necessitated. *Acerointestinecola* Jahan, 1970 has been excluded from considerations because its diagrams are not available. In the present communication an attempt has been made to set right the things in the light of the study of the collection of specimens of the genera in question.

The diagrams have been made with the aid of a camera lucida. The specimens have been deposited with the National Collection in Zoological Survey of India at Calcutta.

Subfamily STOMACHICOLINAE Yamaguti, 1958

Genus **Stomachicola** Yamaguti, 1934

Syn. *Cameronia* Bilqees, 1972 (Syn. Nov.)
Segmentatum Bilqees, 1972 (Syn. Nov.)
Cestodera Bilqees, 1972 (Syn. Nov.)

Stomachicola muraenesocis Yamaguti, 1934
(Fig. 1A & B)

Host: *Muraenesox cinereus* (Forskal), Silver conger eel, (Muraenidae)

Location: Stomach

Localities and Number of specimens: Chandipur (Orissa), 3; Machilipatnam (Andhra Pradesh), 2; Kakinada (Andhra Pradesh), 8; Yanam (Pondicherry), 2; Bakkhali (W. Bengal), 3; Bombay (Maharashtra), 3; Veraval (Gujarat), 4.

This is a very common fluke parasitising the stomach of the marine eel, *Muraenesox cinereus*, occurring along the sea coasts of Japan and India. When seen *in situ* after opening the stomach of the fish, they are red to dark red long worms which take some time to get detached from the walls of the stomach. After its recovery from the site of infection, it poses a problem to the worker in handling and processing for permanent preparation. This is predominantly due to the highly developed longitudinal muscles beneath the cuticular layer of body proper and powerful retractors of ecsoma or tail, and secondly, due to the contraction of the body as soon as fixative is applied to it during processing. The worker feels compelled to apply pressure for stretching the material properly for making microscopical studies. But, when pressure is applied during contraction, the normal configuration of the

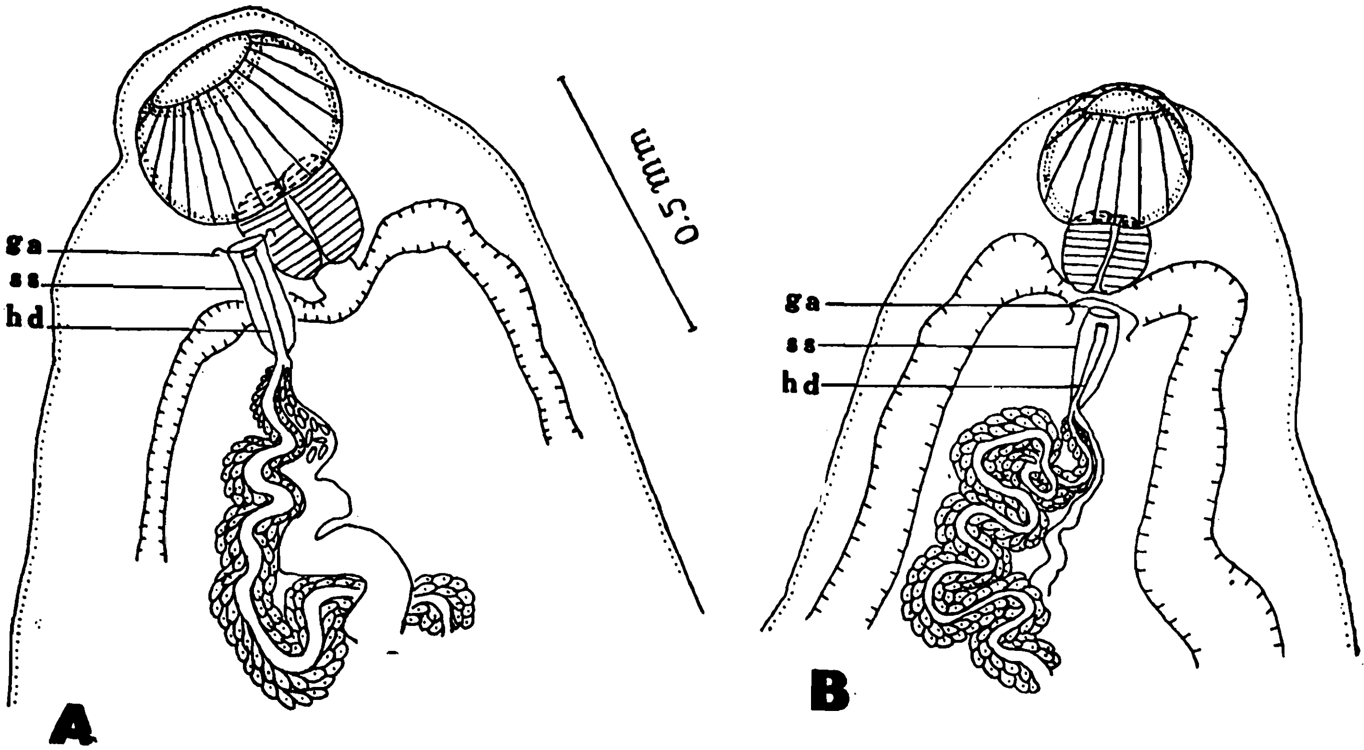

Fig. 1. (A-B) *Stomachicola muraenesocis* Yamaguti, 1934. A—Preacetabular part of a specimen showing position of genital pore at pharyngeal level, B—Precetabular part of another specimen of the same population showing position of genital pore at cecal bifurcation.

internal organs of the specimen gets disturbed, some structures get crushed and deshaped while in others distortions creep in the permanent preparation. As a result, the worker notices differences or variations in the specimens thus processed. By using the fixing and killing agent, the body proper as well as ecsoma get contracted to varying degrees so much so that cuticular transverse folds in the form of annulations appear. Sometimes they become deep, giving the appearance of segmentations. These so-called cuticular annulations or segmentations are not real, and appear as distortions due to contructions of body during processing. They are not seen in the living specimens. In some specimens, the short œsophagus becomes indistinct due to contraction. The position of the genital pore may vary from near the base of oral sucker to any position behind it. The separate male and female openings and absence of hermaphroditic duct (as reported in *Cameronia octovitellarii* Bilqees, 1971) appear to be erroneous observations. The number of long, winding and sometimes intertwining vitelline tubes varies to a great range as reported by Bhalerao (1943 : pp. 119—120). *Segmentatum magnaesophagustum* Bilqees, 1971 has been described probably from bad and decayed specimens. The presence of "Oral cuticular spines, cuticular modification at ventral margins of acetabulum, large esophagus, postacetabular union of ceca, and its union in the middle of tail in addition to the posterior union" are obviously the results of bad handling and processing of the specimens, or are due to distortions or erroneous microscopical observations. Therefore, they cannot be regarded as normal characters of the specimens collected from the stomach of *Muraenesox cinereus.* The observation that the ceca in *Cestodera unicecus* Bilqees, 1971 are "united by a transversely branch just above the ovary" does not seem to be correct. What has happened in her specimen which has been illustrated for the species is that the ceca above the ovary tended to form deep loops which due to excess pressure applied during processing got more elongated inwardly, and in some specimens they just touched each other and look like a transverse commissure connecting the two ceca. So far as the union and non-union of the excretory crurae dorsal to the pharyngo-oral region is concerned, the worker is prone to make faulty observations because the anterior region is highly muscular.

In view of the above account and the variations noted by Yamaguti (1934) and Bhalerao (1943), it becomes clear that the species described under the genera *Cameronia* Bilqees, 1971, *Segmentatum* Bilqees 1971 and *Cestodera* Bilqees, 1971 all conform to the original descriptions of *Stomachicola muraenesocis* Yamaguti, 1934, and Bilqees' genera become untenable and invalid. Therefore, *Cameronia Segmentatum* and *Cestodera* are presumed to be considered here as congeneric with *Stomachicola* Yamaguti, 1934. Author's attempts to get at the type material through correspondence, did not yield the desired results and hence the remarks on the status of the genera are made presumptively. Bilqees' (1971) histological studies in support of her observations in toto mounts are required to be confirmed.

Again, *Indostomachicola* Gupta and Sharma, 1973 also does not seem to be different from *Stomachicola* Yamaguti, 1934 except in the "presence of a ventral pit in the post bifurcal region", which requires rechecking and confirmation. A request to the authors of the genus was made to obtain the material on loan for rechecking and comparison but it was not received. The muscular bulgings with curved muscle fibres on either side of oral sucker are also found in *S. muraenesocis.* In some of the specimens in the author's collection such cases are found. Siddiqi and Hafeezullah (1975) reported a new species, *Stomachicola bayagbonai*, from Logos, Nigeria in which these bulgings are discernible.

Allostomachicola secundus (Srivastava, 1939) Yamaguti, 1958 (Fig. 2)

Host : *Chirocentrus dorab*, wolf herring, (Chirocentridae)

Location : Stomach

Locality : Ennore (Madras), Bay of Bengal

Number of Specimens : One

Verma (1973) considers the differences between *Allostomachicola* Yamaguti, 1958 and *Stomachicola* Yamaguti, 1934 as specific only and as a result she synonymised the former with the latter. Additionally, she described a new species, *Stomachicola mastacembeli*, from a freshwater eel, *Mastacembelus armatus*, from Bokaro, Bihar State. She characterises the new species mainly to have no hermaphroditic duct and no hermaphroditic pouch. Text-Figures, 1, 2 and 3 illustrate the terminal genitalia of *S. muraenesocis* and *A. secundus* respectively. In the opinion of the author the differences between the two sets of terminal genital ducts are such that the latter suggests a genus different from the former. Thus,

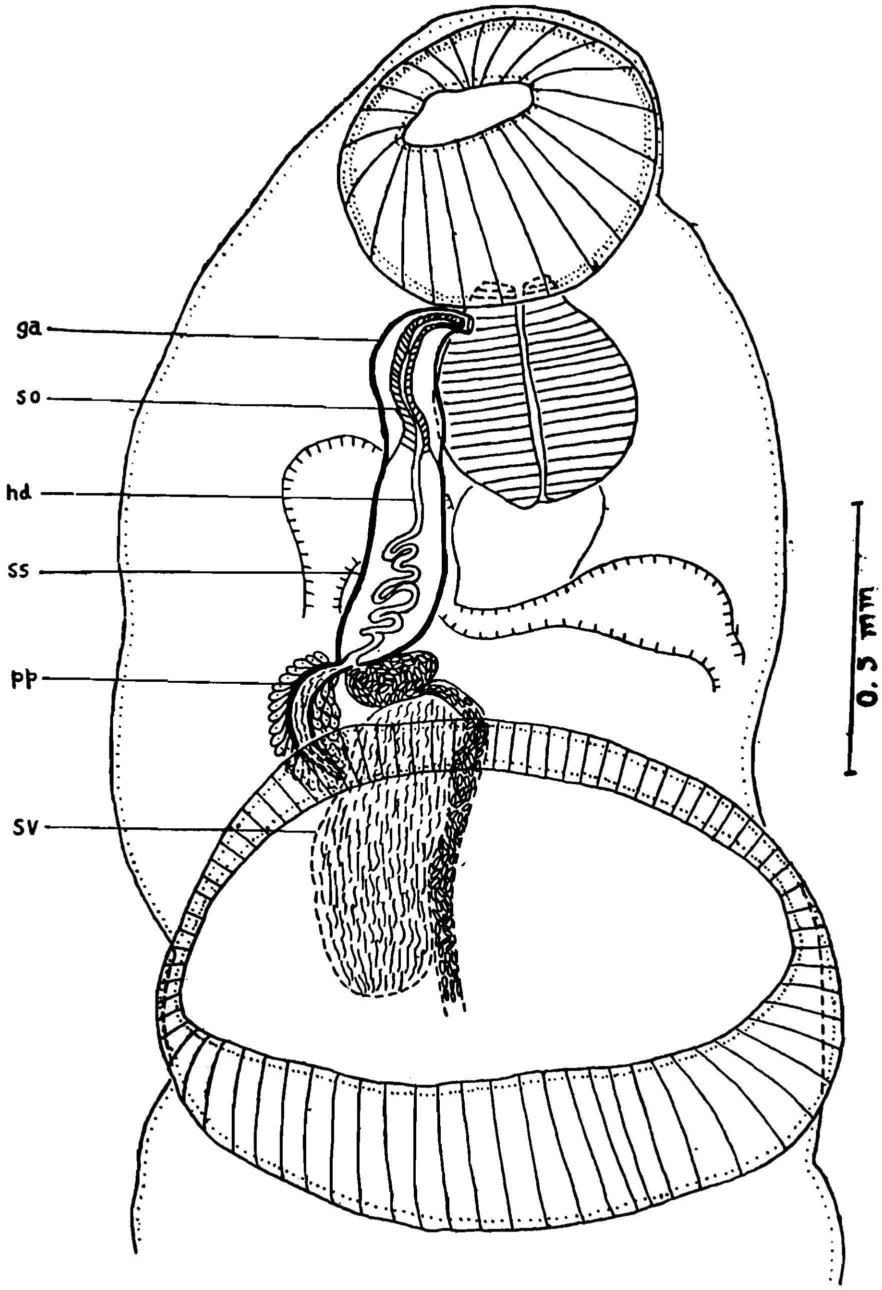

Fig. 2. *Allostomachicola secundus* Yamaguti, 1958. Anterior part showing details of terminal genitalia.

Allostomachicola Yamaguti, 1958 is revalidated as different from *Stomachicola* Yamaguti, 1934. If the reported absence of hermaphroditic duct and hermaphroditic pouch in *S. mastacembeli* Verma, 1973 is correct then, these two characters suggest a new genus different from *Stomachicola* and *Allostomachicola* which possess a hermaphroditic duct as well as a hermaphroditic pouch. However, in a population of specimens of *S. muraenesocis*, after processing these two characters are rendered indiscernible in some contracted ones leading to erroneous conclusions. In the light of this observation, the types and paratypes of *S. mastacembeli* require to be rechecked and the two main characters confirmed. Its occurrence in a freshwater eel which does not descend into sea is interesting.

Subfamily Dinurinae Looss, 1907

Genus **Lecithocladium** Luhe, 1901

Syn. *Magnapharyngium* Bilqees, 1971 (syn. Nov.)

Bilqees (1971) proposed the genus *Magnapharyngium* to distinguish it from *Lecithocladium* on the basis of a pharynx as long as or longer than oral sucker, funnel-shaped oral sucker, number of vitelline tubes, etc. etc. She described seven species under it as mentioned earlier in this paper. It may be pointed out that species in *Lecithocladium* mostly possess cylindrical pharynx which may be as long as or longer than oral sucker ; the oral sucker is cup-shaped or funnel-shaped ; the number of vitelline tubes is typically seven but may vary in some cases ; and the sinus sac or hermaphroditic sac may be short or long. In short, all the species described under *Magnapharyngium* Bilqees, 1971 come well within the concept of the genus *Lecithocladium* Luhe, 1901. *Magnapharyngium* is therefore unnecessary. It is considered here as congeneric with *Lecithocladium.* There is a need to examine the validity of the seven species described by Bilqees under the genus described by her, but the scope of this paper is limited to generic considerations only.

Subfamily Prolecithinae Yamaguti, 1971

Syn. Follicovitellotrematinae Gupta and Sharma, 1971 (syn. nov.)

Genus **Prolecitha** Manter, 1961

Syn. *Follicovitellosum* Gupta and Sharma, 1972 (syn. nov.)

Prolecitha obesa Manter, 1961
(Fig. 3)

Syn. *P. beloni* Nagaty and Abdal Aal, 1962
P. indicum Gupta and Sharma, 1972 (syn. nov.)

Host : *Belone strongylura* and *B. crocodila*, needle-fish, (Belonidae)

Location : Stomach

Localities : Rameswaram (Palk Bay) and Tuticorin (Gulf of Mannar)

Number of specimens : 8 + 1

Eight specimens of this species were collected by Dr. T. D. Soota and party from the marine fish *Belone strongylura* from Rameswaram in March, 1975 and one specimen was collected by the author from *Belone crocodila* from Tuticorin in November, 1975. All the nine specimens fully conform to the original description of the type species *Prolecitha obesa* Manter, 1961 and correction to it as provided by Manter (1969).

Gupta and Sharma (1972) proposed a new genus *Follicovitellosum* (type species : *F. indicum*) from the marine fish *Belone belone* (Linn.) from Ratnagiri (Arabian Sea) and placed it in the family Zoogonidae Odhner, 1911 creating a new subfamily Follicovitellotrematinae for its reception. The description of the type species fully conforms to the original description of *P. obesa* Manter, 1961. Manter (1969) provided amendments to his species to include the presence of a seminal receptacle and formation of a cyclocoel posteriorly. This is also the condition of the ceca in the specimens with the author. It is presumed that Gupta and Sharma (1972) errorneously reported the condition of the cecal ends in their specimens,

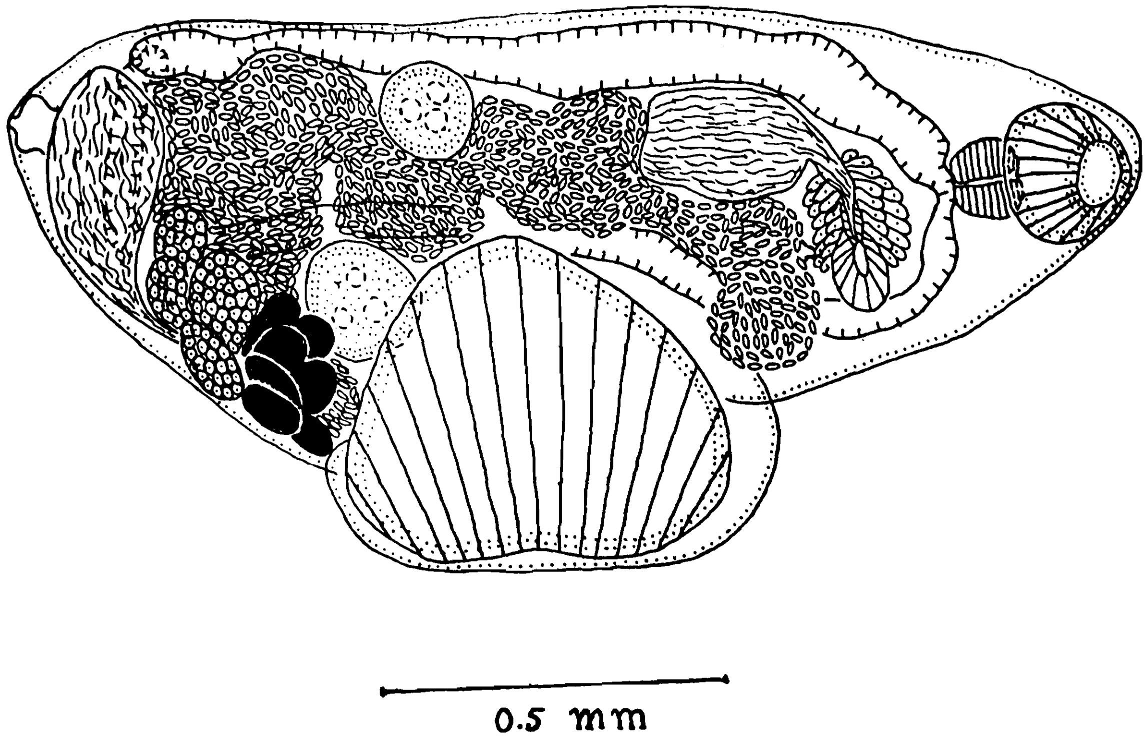

Fig. 3. *Prolecitha obesa Manter,* 1961. Lateral view.
Abbreviations :
ga—genital atrium ; hd—hermaphroditic duct ; pp—pars prostatica ; so—sinus organ ; ss—sinus sac ; sv—seminal

as Manter (1961) also had originally done, and their genus was also wrongly associated in the family Zoogonidae. The type species of their genus also agrees with the type species of Manter's genus. As a corollary to this, *Follicovitellosum* and Follicovitellotrematinae fall into synonymy with *Prolecitha* and Prolecithinae respectively.

Manter (1961) had described his Fijian specimens under a new genus and new species viz. *Prolecitha obesa,* but after studying his specimens from New Caledonia, he (1969) transferred his species to the genus *Dichadena* Linton, 1910. Yamaguti (1971 : p. 317 foot note) examined the holotypes of the genera *Prolecitha* and *Dichadena.* In addition to other differences in the terminal genitalia of both type species, he found the presence of a short hermaphroditic duct also in the type species *Dichadena acuta* Linton, 1910 whereas this structure is not formed in *P. obesa* Manter, 1961. The author fully agrees with Yamaguti (1971) in holding *Prolecitha* Manter, 1961 distinct from *Dichadena* Linton, 1910, and subfamily Prolecithinae Yamaguti, 1971 is accepted for the reception of Manter's genus.

ACKNOWLEDGEMENTS

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INTRASPECIFIC GEOGRAPHICAL VARIATIONS IN THE INDIAN LONG-TAILED TREE MOUSE, *VANDELEURIA OLERACEA* (BENNETT)

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ABSTRACT

The authors described in this paper the intraspecific geographical variations in the Indian long-tailed tree mouse, *V. oleracca* (Bennett). The colour in different subspecies is also briefly described. External and cranial measurements in different populations of *V. oleracea* are also examined.

Bennett (1832) described the species *Mus oleraceus* from Dukhun (=Deccan, South India) on the basis of its having a very long tail as compared to the body. Later, Gray (1842) erected the genus *Vandeleuria*, with *M. oleraceus* Bennett as its type. Its generic characters are : Postero-internal cusp retained in first and second upper molars, hallux clawless and opposable, and fifth finger and toe also clawless. Since then a number of species and subspecies have been described from India, Burma, Sri Lanka and Nepal by Hodgson (1845), Blyth (1859), Jerdon (1867), Ryley (1914), Thomas (1914, 1915) and Phillips (1929). Ellerman (1963) recognized only one species, namely, *Vandeleuria oleracea*, and treated all others, namely, *dumeticola* Hodgson, *nilagirica* Jerdon, *spadicea* Ryley, *rubida* Thomas, *modesta* Thomas and *nolthenii* Phillips as its subspecies, and synonymized *wroughtoni* Ryley with the nominate subspecies, and *provensis* Hodgson, *badius* Blyth and *marica* Thomas with *dumeticola* Hodgson.

During the course of identification of rodents, we have come across several specimens of *Vandeleuria oleracea* from different accepted subspecific ranges of distribution, which according to extant literature, cannot be distinguished from one another. Hence, it was felt necessary to study the geographical variation of the species afresh, based on the material present in the Zoological Survey of India, the Bombay Natural History Society and the data available in literature. The results of our study are presented in this paper.

All measurements are in millimetres and have been taken after Ellerman (1963). The body and cranial measurements of about 200 specimens belonging to different populations were statistically analysed. The measurements of type-specimens, wherever available, have been taken into consideration. Population range diagrams (Fig. 1 to 5) for different external and cranial measurements have been prepared according to the methods of Dice and Leraas (1936) and Hubbs and Perlmutter

(1942). The length of each ordinate represents the extremes of each set of measurements and a central cross-bar the mean ; a narrow shaded rectangle represents a distance equal to one stan dard deviation from the mean on either side of the mean, while the broad rectangle represents a distance equal to twice the standard error of the mean on either side of the mean. The colour names given with initial capital letters in the text are after Ridgway (1886).

Observations

Colour : The colour in different subspecies is briefly described below.

Vandeleuria o. oleracea : Dorsum ranging from Broccoli-Brown to Wood Brown and in

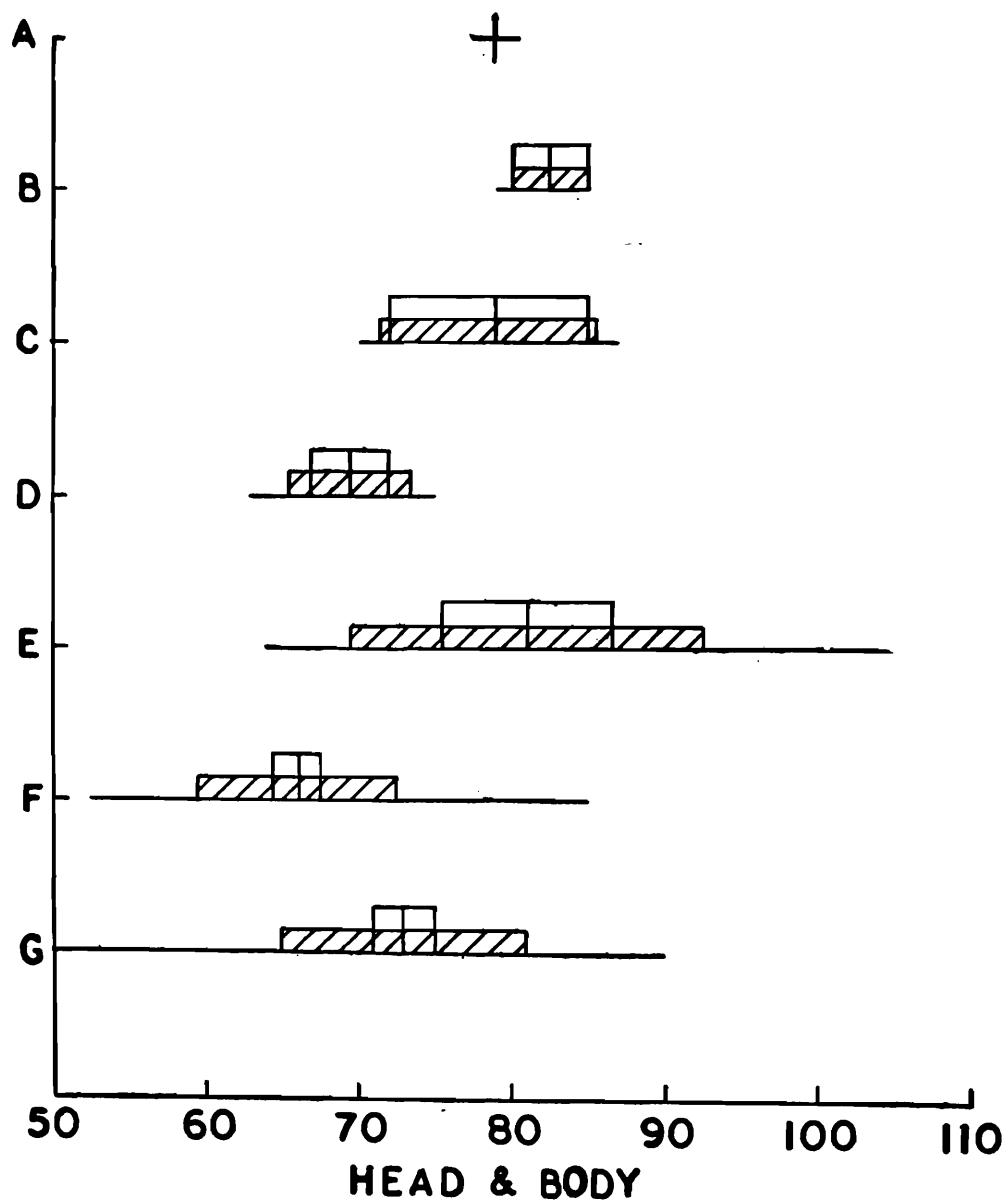

Fig. 1. Graphic comparison of head and body length (in mm) in seven populations of *Vandeleuria oleracea* (Bennett). A, *rubida* ; B, *spadicea* ; C, *nolthenii* ; D, *modesta* ; E, *nilagirica* ; F, *dumeticola* ; G, *oleracea.*

some light brown ; in two moulting specimens from Gwalior (Madhya Pradesh) Hair Brown. Sides slightly paler, no sharp line of demarcation between dorsum and venter. Ventral surface generally white, in some dirty white ; in many it is suffused with fulvous on chest and belly.

Vandeleuria o. dumeticola : Dorsum reddish ranging from pale Russet to deep Russet; in one specimen from Darjeeling and two from Bhutan Duars (West Bengal) light brown and in a specimen from Kathmandu (Nepal) Tawny Olive. A sharp line of demarcation present between dorsum and venter. Ventral surface generally white, sometimes inconspicuously suffused with fulvous on chest.

Vandeleuria o. rubida : The subspecies is known by the type-specimen only. Thomas (1914) described the colour as "dorsum bright rich rufous (Tawny of Ridgway)......sides paler,

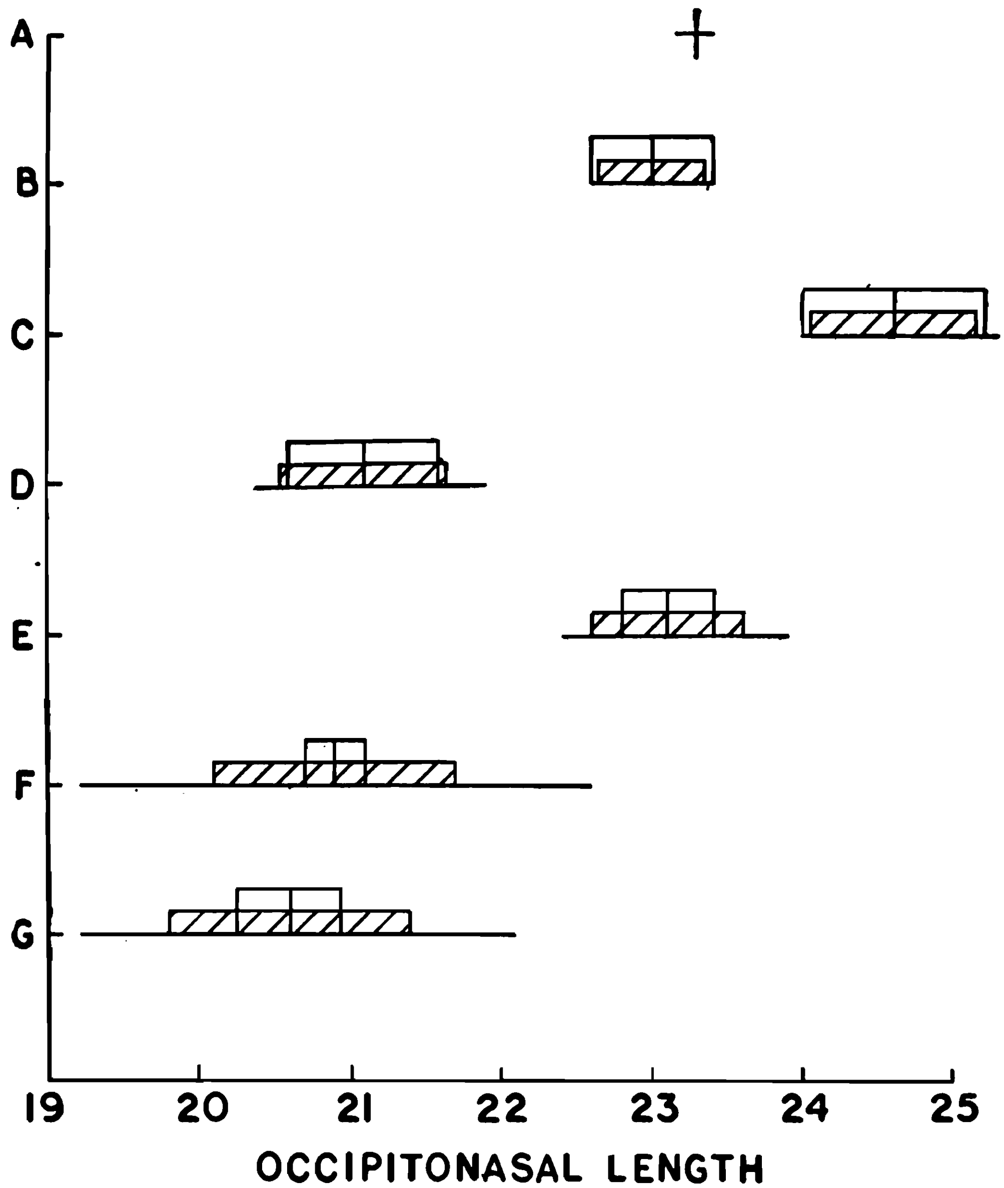

Fig. 2. Graphic comparison of length of tail as percentage of head and body in seven populations of *Vandeleuria oleracea* (Bennett).

edged with a narrow tawny line. Undersurface white, inconspicuously suffused with fulvous on belly"

Vandeleuria o. modesta : Dorsum ranging from Fawn (in two specimens from Ramnagar, Uttar Pradesh), Isabella (in one specimen from Ramnagar), pale Russet (in three specimens, one each from Ramnagar, Kalka and Nainital) to deep Russet (in one specimen from Nainital). Ventral surface white.

Vandeleuria o. nilagirica : Dorsum ranging from Broccoli Brown to Chestnut Brown. Ventral surface white, in some suffused with fulvous on belly. A line of demarcation present between dorsum and venter.

Vandeleuria o. spadicea : Dorsum paler, varies from pale sandy brown to light reddish fawn. Ventral surface white.

Vandeleuria o. nolthenii : Dorsum ranging from brown to dark brown. Venter bluish grey.

Tail uniformly brown all round in all the populations except in three specimens of *oleracea* (from Gwalior and Dharwar) and one of *dumeticola* (from Bhutan Duars) where undersurface is slightly paler. Hands and feet vary from dirty white, buffy, pale brown to dark brown irrespective of the localities.

Size : Head and body length : Head and body length is highly variable in all the popu-

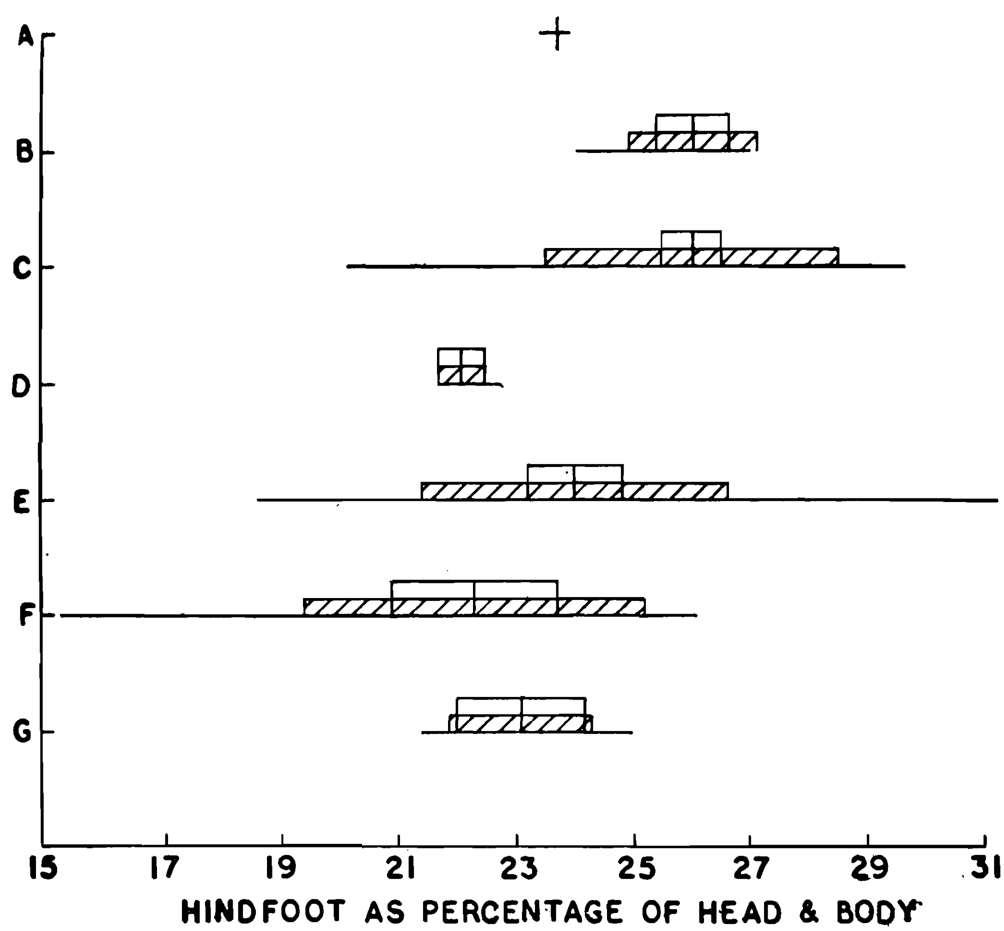

Fig. 3. Graphic comparison of length of hindfoot as percentage of head and body in seven populations of *Vandeleuria oleracea* (Bennett).

lations of *V. oleracea*. However, populations of *oleracea*, *dumeticola* and *modesta*, on an average, tend to be smaller (HB less than 75 mm.) than those of *rubida*, *spadicea*, *nilagirica* and *nolthenii* (HB more than 75 mm.). Further, *modesta* and *dumeticola* differ significantly from *rubida* in the head and body length (indicated by non-overlap of one standard deviation rectangles), but the latter population is known only by the type-specimen (Fig. 1).

Tail : Length of tail varies from 84 to 142 mm. As regards the absolute length of tail there is no difference between different populations. But the tail in relation to head

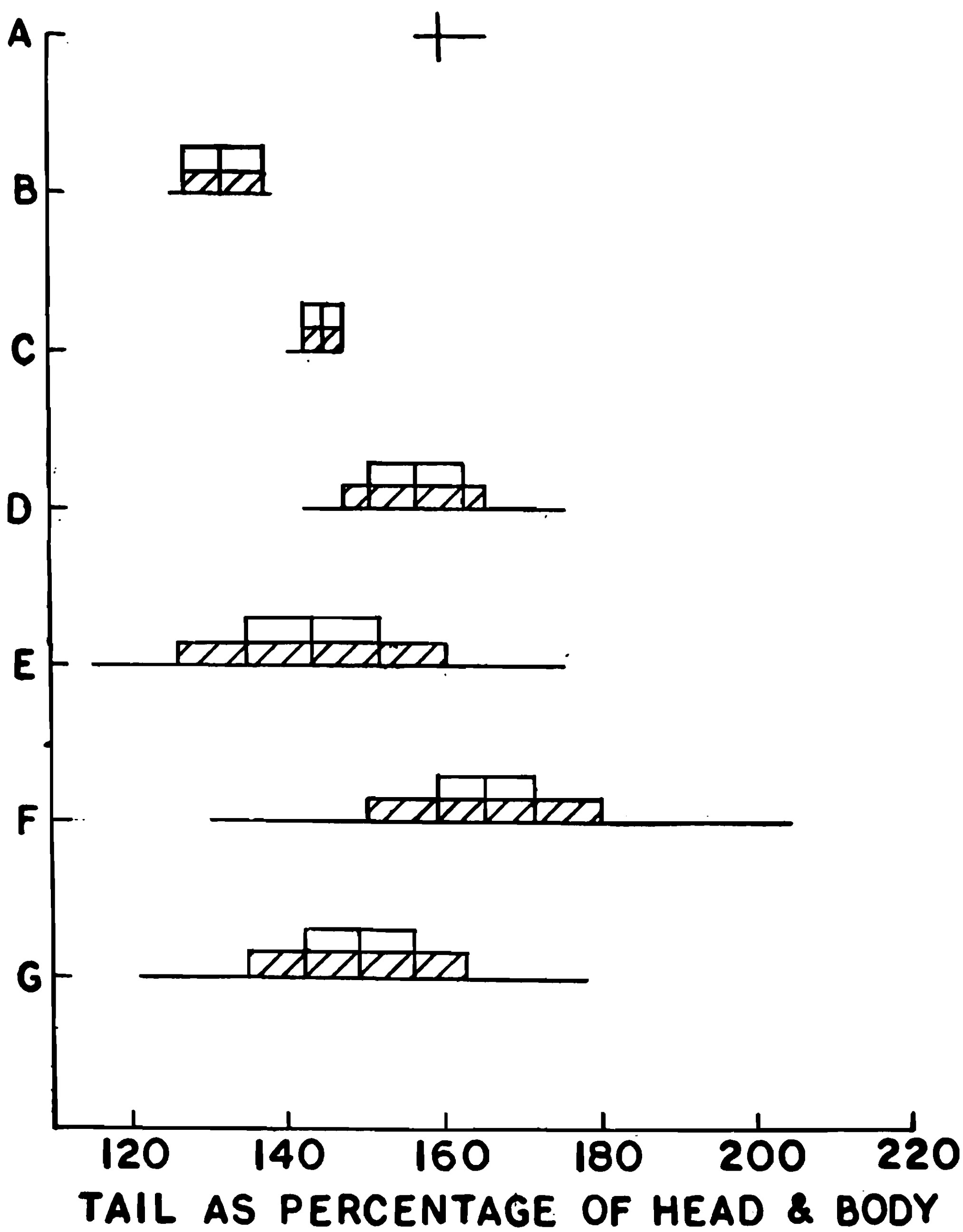

Fig. 4. Graphic comparison of occipitonasal length of skull (in mm) in seven populations of *Vandeleuria oleracea* (Bennett).

and body is, on an average, longer in *rubida*, *modesta* and *dumeticola* (more than 150%) than in *oleracea*, *nilagirica* and *spadicea*. However, the range of measurements from different subspecific zones overlap even at one standard deviation from the mean except for *spadicea* where the difference is significant (Fig. 2).

Hindfoot: Hindfoot in relation to head and body length is, on an average, longer in *modesta* and *dumeticola* (more than 25%) than in other populations (less than 25%). Although these differences are of probable significance (indicated by non overlap of the standard error rectangles of comparable lines) they are insufficient to warrant subspecific distinction (Fig. 3).

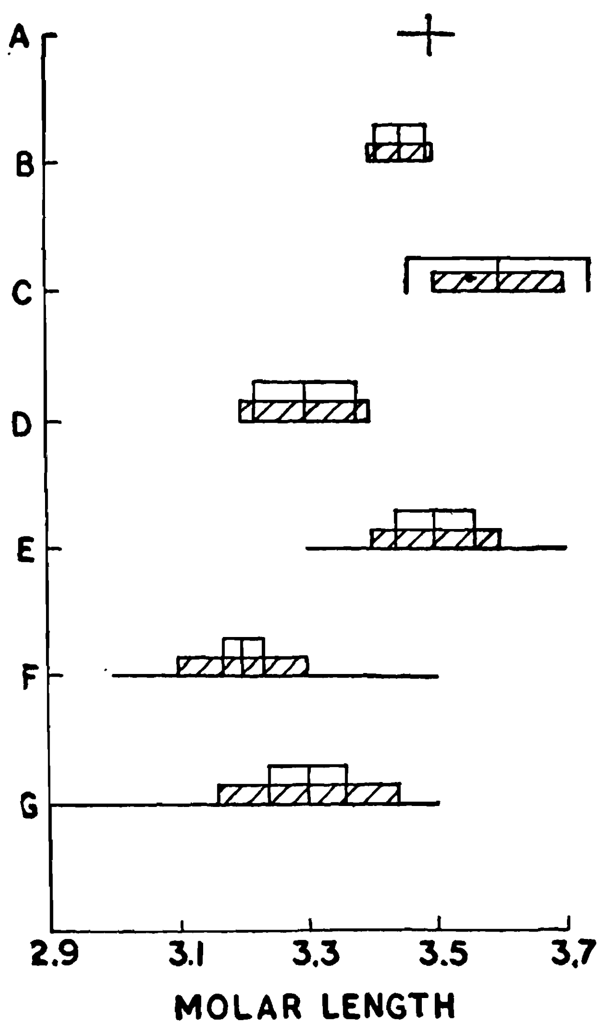

Fig. 5. Graphic comparison of molar length of skull (in mm) in seven populations of *Vandeleuria oleracea* (Bennett).

Skull: Small-sized, occipitonasal length ranging from 19.5 to 25.3 mm ; frontals considerably constricted; supraorbital ridges poorly developed ; palate less than half of occipitonasal length ; bulla quite large, more than 16% of occipitonasal length. First and second upper molars retain the posterointernal cusp.

The description holds good for all its subspecies except in the occipitonasal length of skull which shows some variations. From the data available, two distinct divisions can be made on the basis of the occipitonasal length, *viz* ONL less than 23 mm. in *modesta, dumeticola* and *oleracea*, and ONL more than 23 mm in *rubida*, *spadicea*, *nilagirica* and *nolthenii*, being largest in the lattermost population (ONL more than 24 mm.) (Figs 4 & 5). The same tendency is reflected in their molar length.

Discussion

In the light of the above study it is obvious that *nolthenii* can be distinguished from all other populations by its ventral coloration being bluish grey as against white. Similarly, populations of northern India, namely, *modesta*, *rubida* and *dumeticola* differ from those of the southern India namely, *oleracea*, *spadicea* and *nilagirica* by their dorsal colour, which is generally brighter (Fawn, rufous or Russet) as against dull (ranging from sandy brown to Broccoli Brown).

Ellerman (1963) separated *modesta* from *dumeticola* on the paleness of the dorsum *viz* brown in the former and reddish in the latter. But the colour in specimens of *modesta* from

Ramnagar (type-locality) varies much from Fawn, Isabella to pale Russet and resembles *dumeticola* from many localities. Hence, the separation of *modesta* from *dumeticola* on the basis of colour is not justified.

Ryley (1914) differentiated *spadicea* from *oleracea*, and Ellerman (1963) separated it from *nilagirica* on the basis of its lighter dorsal coloration. But the dorsal colour in some specimens of *oleracea* from Gwalior, Nasik and Panchgani is as light as that of *spadicea*. Moreover, the type-specimen of *spadicea* is not so pale as the other topo-typic specimens. Hence, it is possible to get more specimens of this subspecies which are as dark as that of *oleracea*. As regards the colour difference between *spadicea* and *nilagirica*, it is only perceptible when a series of specimens of both the populations are kept side by side.

Analysis of the head and body length from different populations reveals that there is no significant difference between them in this character (Fig. 1). However, specimens of *rubida*, *spadicea*, *nilagirica* and *nolthenii* have a tendency of being larger which is clearly reflected in the occipitonasal length of their skulls.

Ellerman (1963) distinguished *dumeticola*, *modesta* and *rubida* from *oleracea*, *spadicea*, *nilagirica* and *nolthenii* on the relative length of their tail. But it is obvious from the statistical analysis (Fig. 2) that this cannot be treated as a distinguishing character for differentiating the two groups of populations.

TABLE 1. External measurements in different populations of *Vandeleuria oleracea* (Bennett). Range, mean ±2 Standard error ; sample size in parentheses

	Head & body	Tail as % of HB	Hindfoot	Hindfoot as % of HB	Ear
V.o. oleracea	50—90 73±2 (53)	121—178 149±3.6 (53)	14—20 17.5±.32 (51)	18.6—31.2 24±0.74 (51)	12—18 15±0.3 (51)
V.o. dumeticola	53—85 66±1.4 (88)	130—204 165±3.2 (88)	15—20 17±0.22 (88)	20.1—30.6 26±0.54 (88)	11—16 14±0.16 (88)
V.o. modesta	63—75 69.5±2.4 (10)	142—175 156±6 (10)	17—19 18±0.48 (10)	24—27 26±0.65 (10)	14—15 14.5±0.3 (10)
V.o. rubida	78	159	18.5	23.7	15
V.o. spadicea	79—85 82.5±2.2 (4)	125—138 131±4.9 (4)	18—19 18.2±0.44 (4)	21.7—22.8 22.1±0.4 (4)	15—16 15.5±0.5 (4)
V.o. nilagirica	64—105 81±5.4 (18)	115—175 143±8.5 (18)	15—20.5 18±0.85 (17)	15.2—26.1 22.3±1.4 (17)	13—19 16±0.66 (18)
V.o. nolthenii	70—87 79±6.8 (5)	140—147 144±2.4 (5)	15—20 18.5±2.2 (5)	21.4—25 23.1±1.1 (5)	13—14 13.4±.44 (5)

TABLE 2. Cranial measurements in different populations of *Vandeleuria oleracea* (Bennett). Range, mean ±2 Standard error ; sample size in parentheses.

	Occipitonasal	Toothrow
V.o. oleracea	19.2—22.1 20.6±0.34 (23)	2.9—3.5 3.3±0.06 (23)
V.o. dumeticola	19.2—22.6 20.9±0.2 (59)	3—3.5 3.2±0.03 (59)
V.o. modesta	20.3—21.9 21.3±0.4 (6)	3.2—3.4 3.3±0.08 (6)
V.o. rubida	23.4	3.5
V.o. spadicea	22.6—23.4 23±0.4 (3)	3.4—3.5 3.45±0.05 (3)
V.o. nilagirica	22.4—23.9 23.1±0.5 (11)	3.3—3.7 3.5±0.06 (11)
V.o. nolthenii	24—25.3 24.6±0.6 (3)	3.5—3.7 3.6±0.14 (3)

There is neither any difference in the length of hindfoot nor in the ear in different populations.

Ellerman (1963) differentiated *rubida* from *dumeticola* (occipitonasal length more than 23 mm. *vs*. less than 23 mm.) and *spadicea* and *nilagirica* from *oleracea* (ONL more than 22 mm. *vs*. less than 22 mm.) on the length of skull. From our analysis of the occipitonasal length, it is clear that *nothenii*, *nilagirica*, *spadicea* and rubida have occipitonasal length greater than that of *oleracea*, *dumeticola* and *modesta* (Fig. 4). But *rubida* and *spadicea* are known only from the type-locality and are represented by only one and four specimens respectively. Hence, it is not improbable to get smaller specimens from these localities, similar to those of *dumeticola* or *oleracea*. However, on the basis of the present material *rubida* and *spadicea* are maintained as subspecies distinct from *dumeticola* and *oleracea* respectively by large size of their skull. As regards *modesta* and *dumeticola* there is neither any difference in coloration nor in body and skull measurements. Therefore, we would treat *modesta* as a synonym of *dumeticola*.

A key to identification of the subspecies of *Vandeleuria oleracea* as recognized by us is given below.

1. Underparts bluish grey ...*nolthenii*
   Underparts white. ...2
2. Colour of dorsum bright, being fawn, rufous or Russet ...3
   Colour of dorsum brownish ...4
3. Size large, occipitonasal length more than 23 mm ...*rubida*.

Size small, occipitonasal length less than 23 mm ......*dumeticola* (*modesta*).

4. Size large, occipitonasal length more than 22.4 mm ...5.
   Size small, occipitonasal length less than 22·4 mm ...*oleracea*

5. Colour of dorsum pale sandy brown ...*spadicea*.
   Colour of dorsum Broccoli Brown to Chestnut Brown ...*nilagirica*.

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Bull. zool. Surv. India, 3 (1 & 2) : 87-92, 1980

SOME OBSERVATIONS ON THE SEASONAL VARIATION IN THE GONADS OF *INDONAIA CAERULEA* (LEA)

[MOLLUSCA : UNIONIDAE]

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ABSTRACT

Studies on *Indonaia caerulea* reveal that the species is unisexual. Hermaphroditism or intermediate sex stage is not observed. Partial spawning starts in a few individuals in the month of March and gradually rises till July and August. Then the percentage of the fully spent individuals increases from September to November, which gradually decreases in later months. Thus the species is considered to be a continuous breeder throughout the year, but with peak spawning in the months of October and November. After the onset of spawning, lipid globules appear in the lumen of the follicles. Spermatocytical morulae appear after the start of the spawning.

INTRODUCTION

Pelecypods are either dioecious or monoecious. In some of them change of sex also takes place. A perusal of literature reveals that the work on sex and seasonal gonadal changes has been done mainly on oysters and a few other pelecypods. Coe and Turner (1938) studied the development of the gonads and gametes in *Mya arenaria*; Coe (1936) also studied the sequence of sexual phases in *Teredo*. Loosanoff (1937*a*, 1937*b*) studied the gonadal changes in *Venus mercenaria*. Bloomer (1930, 1931, 1934, 1935, 1939 and 1946) made observations on *Lamellidens marginalis* and *Anodonta cygnea* in respect of sex and gonadal changes. Patil and Bal (1967) and Agrawal (in press) have elucidated seasonal gonadal changes in *Parreysia favidens* var. *marcens* and *Parreysia corrugata* respectively. In the present paper some observations have been made on the different maturity stages in the gonads of *Indonaia caerulea*.

MATERIAL AND METHODS

The material for investigation was collected from Gwarighat located near Jabalpur *C.* 16 km. SW of Jabalpur (23°10′ N lat., 80°E long.) during the period March 1975 to February 1976. The sex and gonads condition of each specimen was recorded. Five broad gonad stages, were distinguished; these were immature stage, maturing stage, mature stage, partially spent stage and spent stage. Only full grown adults measuring 36.0 to 53.0 mm in length and 25.0 to 30.0 in height were examined. Shells of the mussel are elliptical, inequilateral; umbones not so prominent, shell covered with brown periostracum ; interior of the shell nacreous and tinged with pinkish yellow shade ; hinge narrow ; cardinal tooth lamelliform and somewhat oblique fitting into the opposite valve between two small unequal teeth, lateral teeth smooth and obliquely truncate at the posterior end.

Observations and Discussion

Indonaia caerulea is unisexual. The gonads are paired organs consisting of tubulo-alveolar follicles, surround the windings of the intestine. On either side, a gonoduct is present. It starts from the posterior end of the visceropedal mass and runs in the anterio-dorsal direction. The ductules of gonadal follicles unite to form lateral ducts which in turn open in the main gonoduct. Testis is whitish yellow and ovary pinkish in colour. The follicles show presence of globules as observed in *Parreysia corrugata* by Agrawal (in press).

Results of the different maturity stages in the gonads of the mussel are shown in the tables (1 & 2) and figures 1 and 2.

The sexual cycle in adult mussels during different months is as follows :

In March and April, mature mussels are found in maximum number. A few spawned individuals are also observed. In the females, mature oocytes are detached from the follicular wall and lie in its lumen. In the males, spermatogenesis starts resulting in the forma-

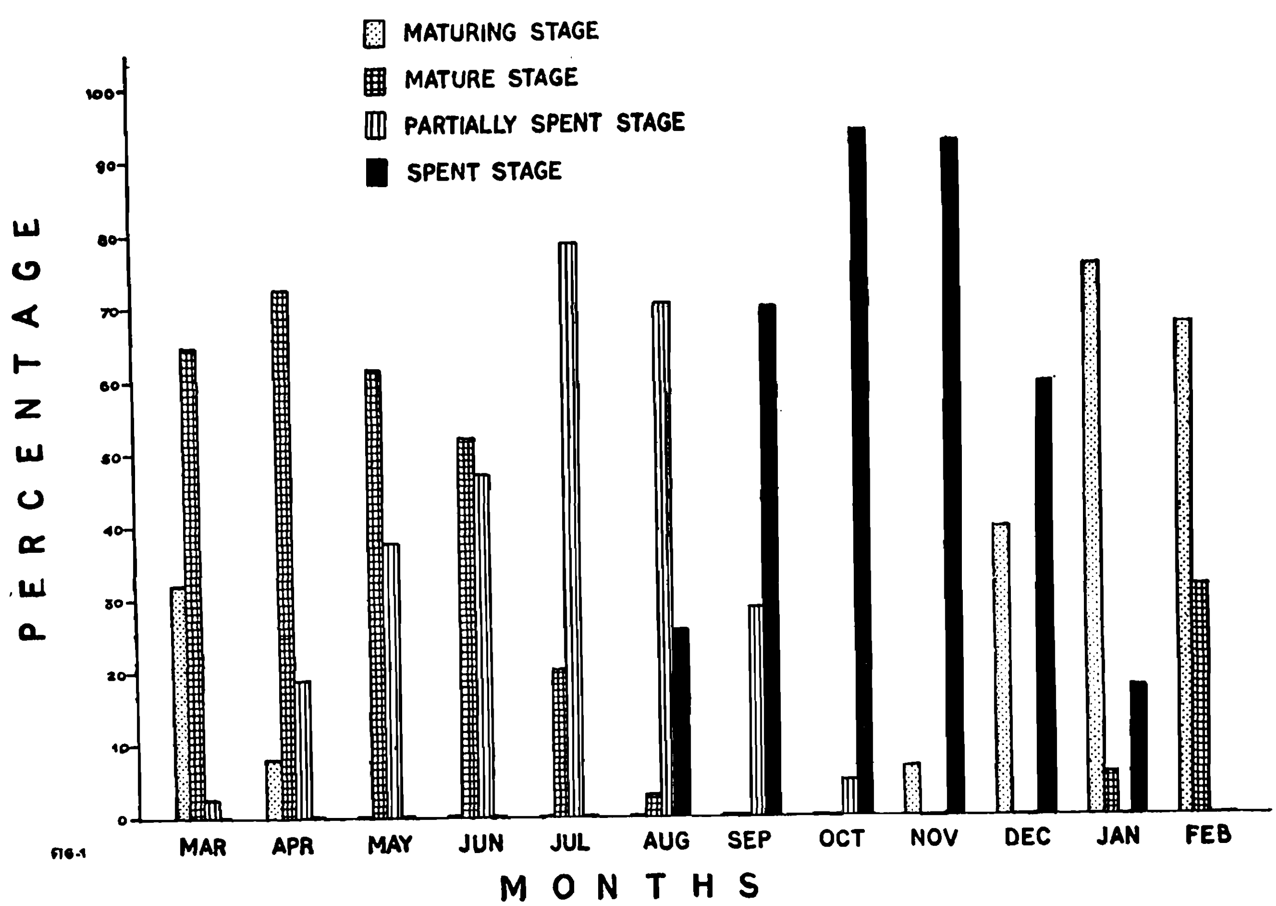

Fig. 1. Histograms showing the percentage composition of males and females respectively of *Indonaia caerulea* in different maturity stages during different months.

TABLE 1. Percentage composition of males of *Indonaia caerulea* in different maturity stages during different months.

Months	Maturing stage percentage	Mature stage percentage	Partially spent stage percentage	Spent stage percentage	No. of specimens examined
March	32.20	65.10	2.70	—	23
April	8.00	73.00	19.00	—	27
May	—	62.00	38.00	—	30
June	—	52.50	47.50	—	28
July	—	20.57	79.43	—	20
August	—	2.95	70.90	26.15	22
September	—	—	29.10	70.90	25
October	—	—	5.15	94.85	30
November	6.90	—	—	93.10	26
December	40.10	—	—	59.90	24
January	76.10	6.0	—	17.90	27
February	67.90	32.10	—	—	22

tion of the sperms. The spermatocytical morulae decrease in number. In both the follicles, lipid globules decrease in number. In mature individuals, the follicles are full of either with sperms or ova (oocytes), as the case may be, ready for discharge. In females, the interlamellar junctions of the gills are elongated. A partially spent condition is indicated by the individuals which have started spawning, the posterior part of the visceropedal mass becomes slightly thin than the anterior part. The follicles in the posterior part of the visceropedal mass show appearance of lipid globules.

In May, the specimens are either in the mature or partially spent stage. In the female, follicles have lipid globules and a few residual oocytes. In the male, spermatocytical morulae appear towards the periphery of the follicle.

During June and July, the partially spent mussels are considerably more than the mature ones, thus indicating beginning of peak spawning.

During the period August to October the percentages of partially spent specimens decreases and that of spent individuals increases. Since there is discharge of sperms or ova, the partially spent mussels enter into the spent condition. Such individuals have their visceropedal mass very thin containing watery fluid.

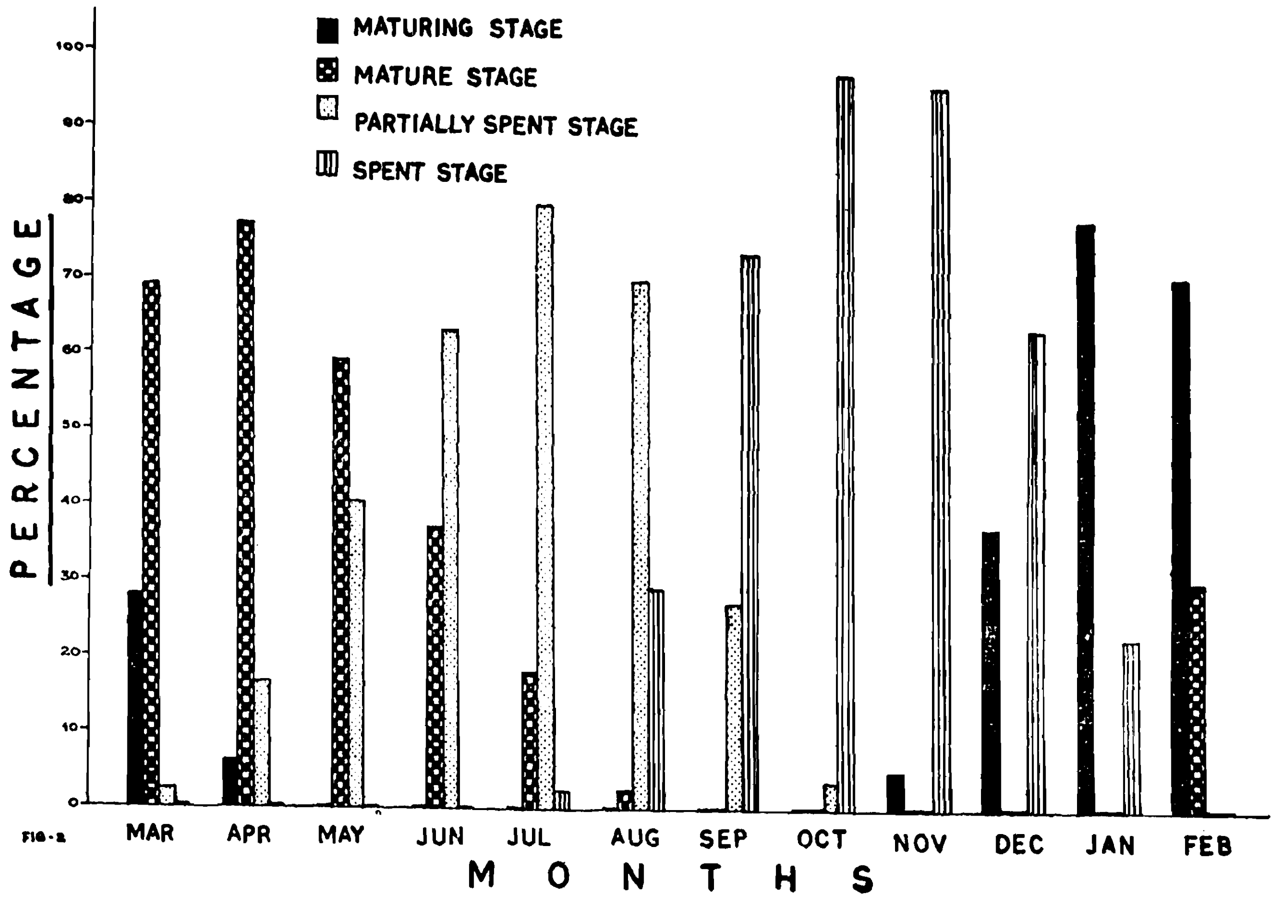

Fig. 2. Histograms showing the percentage composition of males and females respectively of *Indonaia caerulea* in different maturity stages during different months.

In females, the follicles have a few residual oocytes and lipid globules. In males, the follicles have many lipid globules, spermatocytical morulae and a few residual sperms.

In November, most of the specimens are observed in spent condition and the remaining in maturing stage. In the spent mussels the follicles have a functional germinal epithelium. Some of the follicles have well developed oogonia or spermatogonia. In maturing mussels posterior part of the viscero-pedal mass becomes somewhat thicker. The follicles contain maturing gametes.

In the month of December spent individuals are more than the maturing ones but the percentage of maturing individuals increases and that of spent ones decreases as compared with that of November month. The mussels after passing the spent stage enter into the maturing stage for the next breeding season.

In January, about 77% mussels are found in the maturing stage and rest of the specimens in the spent condition. In maturing mussels, the follicles of the posterior part of the viscero-pedal mass show rapid growth which results in the formation of fresh oocytes in the female and spermatocytes and sperms in the male. On the contrary, the follicles in the anterior part of the viscero-pedal mass show a large number of lipid globules. A few residual gametes indicate the spent condition.

TABLE 2. Percentage composition of females of *Indonaia caerulea* in different maturity stages during different months.

Months	Maturing stage percentage	Mature stage percentage	Partially spent stage percentage	Spent stage percentage	No. of specimens examined
March	28.25	69.00	2.75	—	18
April	6.00	77.05	16.95	—	20
May	—	59.40	40.60	—	15
June	—	36.95	63.05	—	16
July	—	18.00	79.60	2.40	18
August	—	2.40	68.60	29.00	21
September	—	—	27.00	73.00	24
October	—	—	3.45	96.55	20
November	5.10	—	—	94.90	21
December	37.00	—	—	63.00	17
January	77.50	—	—	22.50	21
February	70.05	29.95	—	—	18

In February, the percentage of mature mussels starts increasing and that of maturing starts decreasing.

The above description reveals that lipid globules in gonadal follicles are seen only after the beginning of spawning. The lumen of the follicle is full of lipid globules, showing spent condition. Gonadal follicles, spermatocytical morulae also appear after the beginning of spawning. The sexually inactive stage is very short. Peak spawning takes place in the months of October and November.

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REDERSCRIPTION OF AND LECTOTYPE DESIGNATION FOR *CALAMARIS FUSCA* BLYTH, 1854 [SERPENTES : COLUBRIDAE]

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ABSTRACT

The lectotype designation for *Calamaris fusca* Blyth, 1854 has been redescribed in this paper.

Introduction

During the course of our studies on the snakes of the family Colubridae, we came across a series of eleven well-preserved specimens of *Calamaria fusca* Blyth. It seems that this species has not been well described nor adequately illustrated. The species has, therefore, been redescribed here. Since some confusion exists in respect of the primary type designation by Blyth, this opportunity was also taken to designate a lectotype for this species.

Lectotype Designation

Blyth (1854) described *Calamaria fusca* from Darjeeling based on a series of eleven examples (198 to 365 mm in standard length). Later Günther (1860) after a critical examination of these specimens synonymised the species with *Trachischium fuscum* (Blyth). Boulenger (1890, 1893) agreed with Günther. Annandale (1904) while preparing a list of the ophidian collections accumulated after 1891 in the Indian Museum also confirmed these snakes as *Trachischium fuscum*. Wall (1909) redescribed it from a series of collections he made from Darjeeling, Kurseong and Pashok. He further observed "In the vicinity of Darjeeling this is by far the commonest species to be met with between about 5000 ft. and 7500 ft." Shaw *et al* (1939) also included this species in their comprehensive list of snakes of Northern Bengal and Sikkim.

Smith (1943) who examined the entire collection of the Indian Museum, Calcutta called attention to the fact that the type of *Calamaria fusca* [later synonymised with *Trachischium fuscum* (Blyth)] were lost. During the course of our examination we found that the types which Smith reported as lost, are presently lodged in the collections of the Zoological Survey of India, Calcutta.

All the eleven original specimens from Darjeeling on which Blyth based his description were catalogued in volume I of the Register of presentations to Indian Museum on August 12, 1860 with the registration numbers 7043 to

7053 (15c ASB). Among the syntypes nine are adult and two are juvenile specimens. All the eleven specimens are fairly in a good state of preservation. The head and tail of the specimen bearing the registration number 7052, is partly damaged.

Blyth's description is unfortunately rather generalised and too inadequate. From the published data none of the eleven specimens can be determined as the typical one. Therefore, of the eleven specimens, the one which is 305 mm in standard length and of an iridescent dull-black colour throughout and the ventrals being slightly margined paler and other characters are clearly decernible and not at all damaged, is hereby designated as the lectotype, whereas the remaining ten specimens are designated as para-lectotypes. The species is redescribed hereunder. The description is based on all the eleven specimens, unless otherwise stated.

Trachischium fuscum (Blyth)
(pl. II. A,C)

Calamaria fusca Blyth, *Journ. Asiat. Soc. Bengal*, 23 (1) : 288, 1854 (type locality ; Darjeeling).

Trachischium fuscum, Günther, *Proc. zool. Soc.*, 1860, p. 161 (name only).

Specimens studied.—Lectotype, one example, 305 mm in standard length, tail 49 mm ; loc : Darjeeling, (Darjeeling District, West Bengal, India) ; *Coll Capt. W. S. Sherwill* ; ZSI Regd. No. 7044.

Para-Lectotypes, ten examples, 198 to 365 mm in standard lengths, tail 36 mm to 57 mm ; loc : same data as above ; ZSI Regd Nos. 7043, and 7045 to 7053.

Description.—Maxillary teeth 18-20, subequal. Head not distinct from neck ; eye moderate, with rounded or vertically subelliptic pupil ; nostril between two nasals, directed forwards and outwards ; body cylindrical ; scales smooth, keeled in sacral region, without apical pits ; ventrals rounded ; tail short, subcaudals paired. Rostrals as broad as high or a little broader than high ; internasals much shorter than the prefrontals ; frontal twice or nearly twice as broad as the supraoculars, much shorter then parietals ; loreal twice as long as high ; a single prefrontal ; one postocular ; one long anterior temporal followed by two very short posterior temporals ; 6 supralabials ; 1st smallest, 6th largest, 3rd and 4th touching eye ; 4 infralabials in contact with anterior genials ; anterior genials twice or nearly twice as long as the posteriors. Scales in 13 rows, those on the sides of the posterior part of body and base of tail distinctly keeled in males, feebly or smooth in females. Ventrals 155-157 ; caudals 30-34 ; and anal undivided.

Colour.—After preservation for about 125 years in alcohol the specimens are still in fairly a good State. The adults are more or less iridescent dark brown or dull blackish above and slightly margined paler below, and with or without indistinct light longitudinal streak above ; the young are light brown, obscurely striated above with dark longitudinal rows of pale dots.

Distribution.—In India the species restricts its distribution to Loharganj, Garwhal district, Darjeeling and Assam. Elsewhere it is confind to Gilgit in Pakistan.

Wall (*lot. cit.*) attributed this species to be very common in the neighbourhood of Darjeeling at altitudes between 1604 m to 2246 m.

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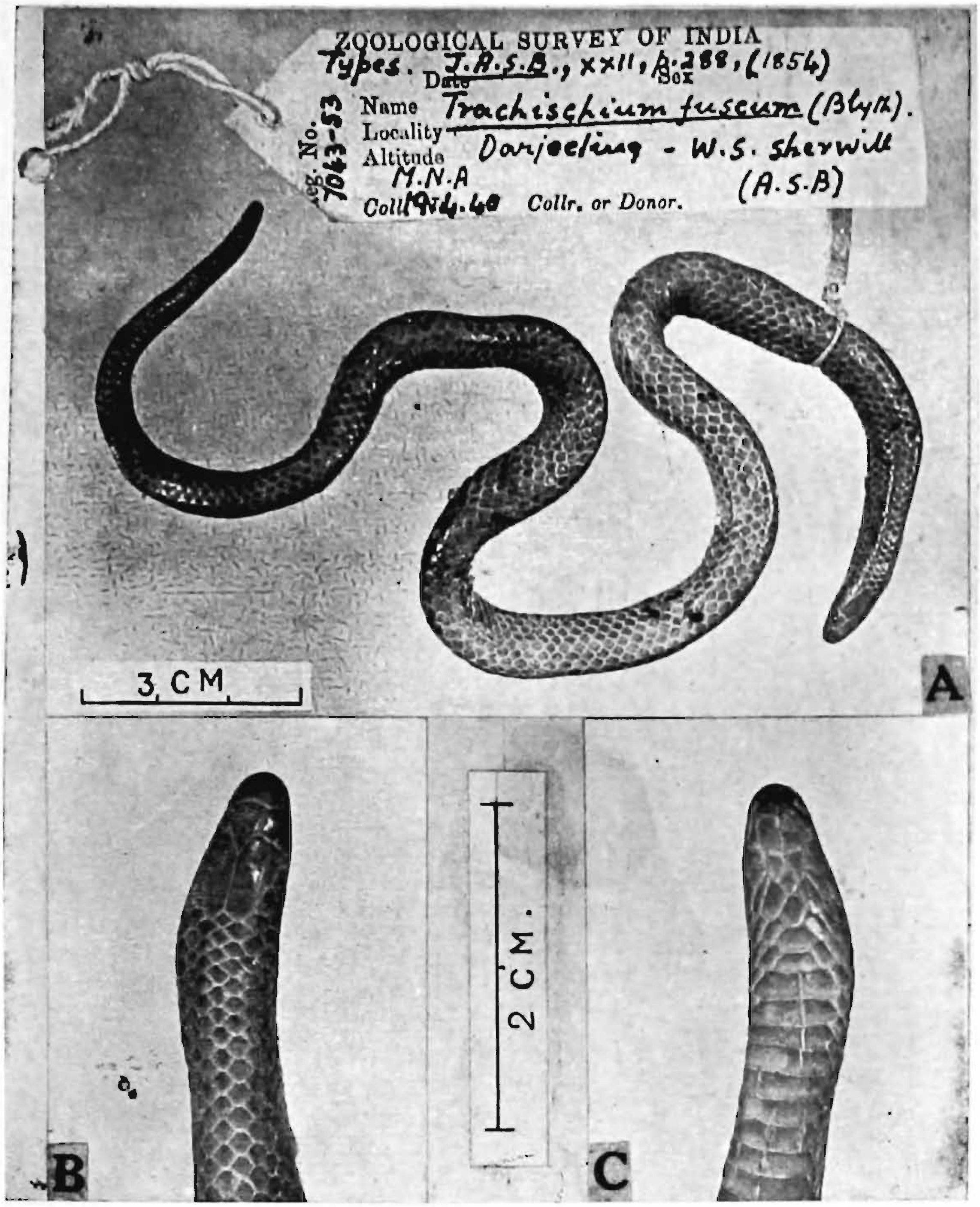

A. Showing the lactotype of *Trachischium fuscum* (Blyth)
B. Dorsal aspect of the head of the lactotype.
C. Ventral aspect of the head of the lactotype.

Bull. zool. Surv. India, 3 (1 & 2) : 97-101, 1980

ON A NEW SPECIES OF TOAD (ANURA : BUFONIDAE) FROM CAMORTA ANDAMAN AND NICOBAR, INDIA

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ABSTRACT

A new species of toad *Bufo camortensis* sp. nov. from Camorta, Andaman and Nicobar was described in this paper.

INTRODUCTION

While working out amphibian fauna of Andaman and Nicobar Islands, the authors came across eleven examples of toads collected from Camorta and Nancowry Islands (Latitude 8°.00'N approx. and Longitude 93°30 E approx.) by Dr. A. G. K. Menon, Ex-Deputy Director, Zoological Survey of India, Calcutta in 1972, and another lot consisting of four examples of toads collected from Camorta by Shri Humayun Abdulali of 15, Abdul Rehman Street, Bombay 400003 in 1976. All these fifteen examples proved to be difficult to determine upto species. After closer and perfect study in details these toads differentiated themselves from all other species of *Bufo* described, henceforth, and proved to be new to science.

Bufo camortensis sp. nov. (pl. III)

MATERIAL EXAMINED

Holotype : An adult ♂, Reg. No. A6955 (in spirit) collected from the compound of Camorta Guest House, Camorta, Andaman and Nicobar Islands, India on 22.3.1972 by Dr. A. G. K. Menon.

Paratypes : 14 adults (5 ♂ ♂ and 9 ♀ ♀), 7 examples (Reg. Nos. A 6956 to A 6962) collected from Camorta on 17—26.3.1972, 3 examples (Reg. Nos. A 6963 to A 6965) collected from Nancowry on 17.3.1972 by Dr. A. G. K. Menon and 4 examples collected from Camorta on 30.3.1976 by Shri Humayun Abdulali. All the type-specimens excepting those of Mr. Abdulali, have been incorporated and deposited in the National Zoological Collections of Zoological Survey of India, Calcutta.

Diagnosis : Medium-sized species of *Bufo* (adults measure less than 90 mm. from snout to vent) with prominent cranial ridges ; snout blunt, length of snout almost equal or less than that of eye ; nostril nearer to tip of snout ; tympanum conspicuous, more or less round, less than two-third in diameter than that of eye ; parotoids clearly visible, elongated, kidney-shaped ; fingers free, slender, blunt-tipped, subarticular tubercles of fingers prominent and double ; toes long, slender, blunt-tipped, half webbed (three phalanges of fourth toe free); subarticular tubercles of toes inconspicuous, single ; both inner and outer metatarsal tubercles prominent, tarsal fold present. Dorsal skin with irregular, prominent, less spiny warts, ventral skin wrinkled with microscopic granules ; upper surface dark brownish, throat, belly and lower surface of limbs light brownish ; shape of the body slender, not stout.

Description of Holotype

A medium-sized toad with the body length of 67 mm. from snout to vent ; head with prominent bony ridges,—a canthal, a praeorbital, a supraorbital, a postorbital and an orbitotympanic, head slightly broader than long (*i.e.*, head length is more than 3/4 of head breadth) ; snout short, blunt, slightly rounded in profile, shorter than eye ; Canthus rostralis angular, prominent, almost straight ridge formed of a single row of rounded tubercles ; loreal region concave ; nostril lateral, slightly swollen, nearly twice as near to the tip of snout as to the eyes ; interorbital width slightly broader than that of upper eyelid which is bordered with thick lining outwardly ; tympanum conspicuous, semicircular (vertically longer than broad), in diameter about half of that of the eye ; Parotoid glands well developed, elongated, slightly narrower at the posterior ends. Fingers free, tips blunt, not dilated, first finger slightly longer than second ; subarticular tubercles double but prominent ; a small inner and a large middle palmar tubercles. Toes half-webbed, nearly two and a half phalanges of the fourth toe free ; subarticular tubercles single but not very prominent ; two moderate metatarsal tubercles, the outer one slightly larger, an inner tarsal fold lined with spiny tubercles present ; heels do not meet but come nearer when the hind limbs are folded at right angle to the body-axis ; tibiotarsal articulation reaches to the middle of the parotoids ; tarsometatarsal articulation reaches to the middle of the eye. Skin of upper surface and exposed sides of limbs rough with scattered less spiny warts, warts in the middle of back and exposed areas of femer and tibia are well developed, skin on parotoids slightly rough with no wart, head rugose and smooth. Ventral skin wrinkled.

Colour : Dorsal surface including the exposed areas of limbs brownish ; Cranial ridges, parotoids, tips of dorsal warts, tips of fingers and toes, margin of upper lip slightly darker. Ventral surface including the unexdosed areas of limbs uniform reddish brown ; warts near the vent and behind the thighs reddish brown.

Variation : Holotype varies from few other paratypes by having more brighter colouration and less number of warts on back. Skin of the specimens, altogether three examples, from Nancowry is more smooth and the warts on the body show no spinosity.

Remarks : This species is closely allied to *Bufo melanostictus* Schneider (type locality "Ex India orientali") but can be differentiated by its less broader head, less broader interorbital space, more webbing of toes, less cornification of cranial ridges, jaws, tubercles and tips of fingers and toes, and different integument. In *Bufo camortensis* 2½—3 phalanges of the 4th toe free whereas more than 3½ phalanges of *Bufo melanostictus* do not have webbing. Both dorsal and ventral skin of *melanostictus* are covered with numerous well developed spiny warts, whereas upper skin of *Bufo camortensis* is with a few less developed, less spiny warts

Measurement of different parts of body in mm.

	HOLO TYPE	PARATYPES						
Regd. No.	A6955	A6956	A6957	A6958	A6959	A6960	A6961	A6962
From snout to vent	67	65	65	62	67	66	83	70
Head Length	19.5	19.5	18.5	17	19.5	20	24	19
Width of head	23	23	21	20	21	24	28	23
Snout	7	6.5	7	7	7	8	9	7
Snout to nostril	2.5	3	2.5	2.5	2.5	2.5	3	2.5
Eye	8.5	7	7	8	8	8	9.5	8
Interorbital width	6	6	7	7	7	8	9	8
U. Eyelid	5	5	5	5	5	6	6	5
Tympanum	4	4	4	4	5	4	5	4.5
Fore limb	37	42	42	37	38	43	53	50
First finger	5	8	6	6	6	6.5	6	6
Second finger	4	5	5	4	4	6	5	5
Third finger	7	8	7	8	9	8	9	9
Fourth finger	5	4	3.5	5	6	5.5	6	5.5
Hind limb	70	77	76	67	72	91	104	78
Tibia	21	22	20	20	22	24	27	22
Foot	20	23	21	20	21	25	26	22
First toe	3	3	3	3	2.5	3	3.5	3
Third toe	6	8	8	7	8	8	8	7
Fourth toe	10	10	12	11	11	13	14	12
Fifth toe	6	7	7	6	7	7	7	6
In. Metatarsal tub.	3	2.5	2.5	2	3	2.5	2.5	2
Tarsometa art.	Mid-eye	Mid/eye	Mid/eye	Mid/eye	Mid/eye	Beyond snout	Nostril	Mid/eye
Sex	♂	♀	♀	♀	♀	♂	♀	♀
Loc.	Cam-orta	Cam-orta	Cam-orta	Cam-orta	Cam-orta	Cam-orta	Cam-orta	Cam-orta

PARATYPES							
Regd. No.	A6963	A6964	A6965	—	—	—	—
From snout to vent	77	73	70	80	90	71	71
Head Length	20	21	21	21.5	26	20	21
Width of head	24	25	23	26	30	22	25
Snout	8	8	9	8.5	9	7.5	8
Snout to nostril	3	3	2.5	2.5	2.5	2.5	2.5
Eye	8	9	9	9.5	9	8.5	9.5
Interorbital width	6	8	9	8.5	10	8	8
U. Eyelid	6	6	5	5	6	6	6
Tympanum	4	4.5	4.5	5	5.5	5	5
Fore limb	46	46	45	47	52	46	45
First finger	6	6	6	6	6	6	6
Second finger	5.5	5	5	5	5.5	5	4.5
Third finger	9	9	8	9	9	8	7
Fourth finger	4.5	6	5	4	5	4.5	4
Hind limb	90	90	88	96	100	86	85
Tibia	24	25	23	26	26	24.5	24.5
Foot	26	25	23	25	25	24	24
First toe	3	3.5	3	4	4	3.5	3.5
Third toe	8	8	7	6.5	9	8	8
Fourth toe	13	14	12	13	15	14	14
Fifth toe	7	8	7	7	8.5	7	7
In. Metatarsal tub.	2.5	3	2.5	2.5	3	2	2
Out. Met. tub. present	2.5	2.5	2.5	2.5	2.5	2	2
Tarsometa art.	Mid/eye	Ant./eye	Ant./eye	Mid/eye	Mid/eye	Ant./eye	Ant./eye
Sex	♂	♂	♂	♀	♀	♂	♀
Loc.	Nancowry	Nancowry	Nancowry	Camorta	Camorta	Camorta	Camorta

and that of ventral is smooth or with microscopic tubercles.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India and Dr. B. Biswas, Deputy Director, Zoological Survey of India for favour of encouragement and facilities. They thank Shri Humayun Abdulali for some collections.

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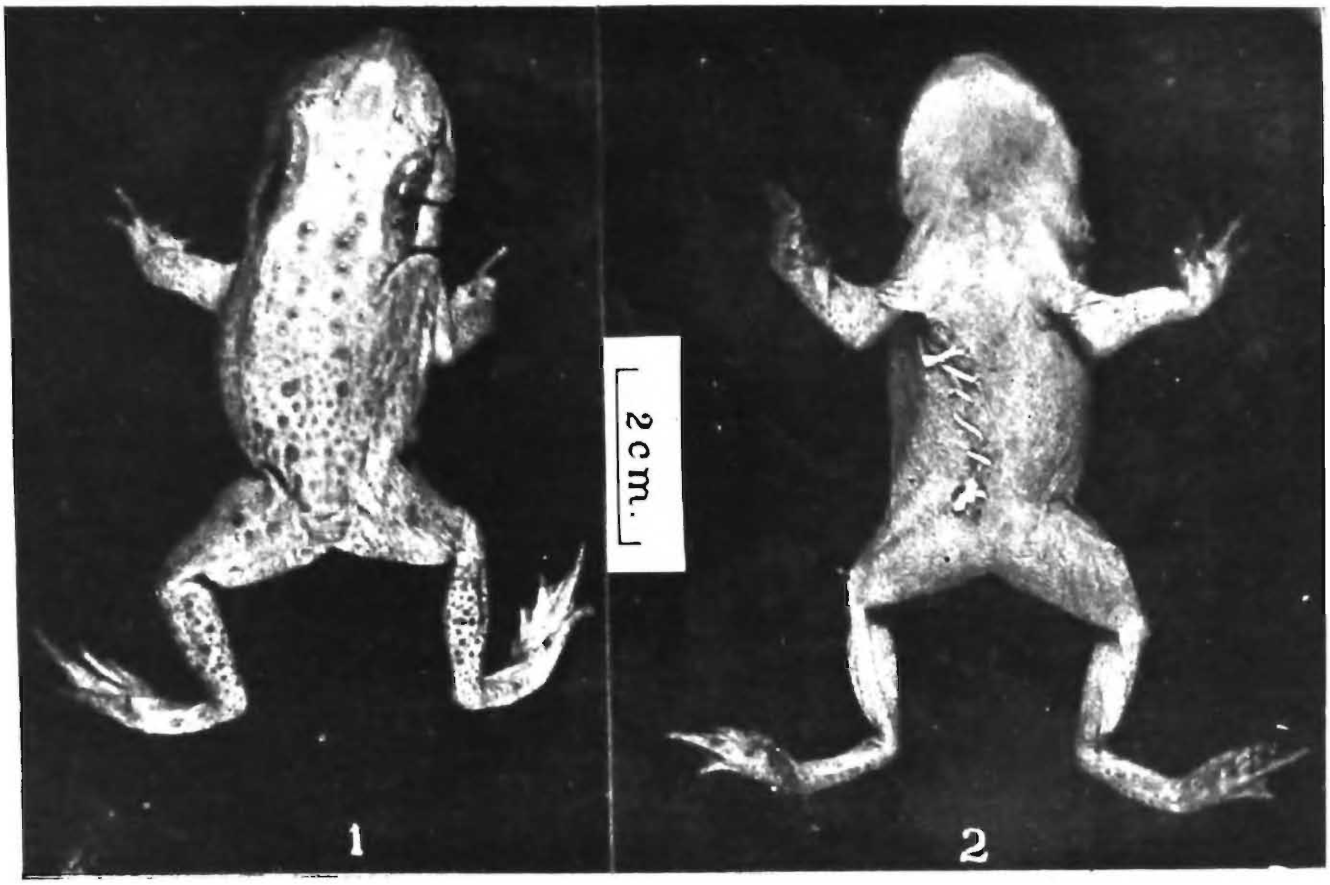
MANSUKHANI & SARKAR PLATE III



Bufo camortensis sp. n.
1. Dorsal view. 2. Ventral view.

Bull. zool. Surv. India, 3 (1 & 2) : 103-105, 1980

CHROMOSOMES OF FIVE SPECIES OF APHIDS (HOMOPTERA : APHIDIDAE)

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ABSTRACT

Chromosomes of five species of aphids viz. *Aphis nerii* B.d.F., (2n = 8) ; *Eriosoma lanigerum* (Hausman) ; *Myzus persicae* (Sulzer), (2n = 12) ; *Megoura lespedezae* (Essig & Kuwana) (2n = 14) and *Aulacorthum solani* Kalt. (2n = 10) were studied and their morphometric analysis was carried out.

INTRODUCTION

The chromosomes of Indian aphids have attracted the attention of workers very recently. Till date twenty three species of aphids are know chromosomally. Behura (1978) has given chromosome numbers in six species while Kurl & Mishra (1979) and Khuda-Buksh (1979) have given chromosome numbers in five species of aphids. Mishra & Kurl (1979) have reported variation in chromosome number in *Myzus persicae* (Sulzer). Sex chromosomes in seven species of aphids are delt with by Parida (1979). Behura & Bohidar (1979) and Behura & Dash (1979) have given chromosome numbers in eleven species of aphids. However the karyotypes in only two species of *Aphis* are available (Kulkarni & Kacker 1979).

The present paper deals with the chromosomes of five species of aphids viz. *Aphis nerii* B. d. F. ; *Eriosoma lanigerum* (Hausman) ; *Myzus persicae* (Sulzer) ; *Megoura lespedezae* (Essig & Kuwana) and *Aulacorthum solani* Kalt. The morphometric analysis of their chromosomes was carried out and karyotypes for these species were constructed.

Material & Methods :

Embryos from only apterous viviparous females were used for chromosome preparations. The detailed collection data for these species is given in Table I. The technique employed for cytological preparations was similar to that mentioned earlier by Kulkarni & Kacker (1979).

Observations and Remarks :

1. *Aphis nerii* B. d. F. : The diploid chromosome number in *Aphis nerii* B. d. F. was observed to be (2n = 8 plate IV A), which confirms the earlier observations (Behura 1978). However, we have been able to construct the karyotype for the species (Plate V a). The morphometric analysis of the chromosome pairs revealed that the relative percentage lengths in each of the four pairs were 40.83, 24.40, 22.25 and 12.50 respectively. This showed the considerable accumulation of the chromatin material in the first pair where as

TABLE 1

Sl. No.	Name of the species	Host	Date of collection	Locality
1.	*Aphis nerii* B.d.F.	*Calotropis gigentia*	22.2.79	Golf Club, Calcutta.
2.	*Eriosoma lanigerum* (Hausman)		12.3.79	Mashobra, Simla (H.P).
3.	*Myzus persicae* Sulzer	*Chrysanthum indicum*	8.3.79	Municipal rest house Solan (H.P.)
4.	*Megoura lespedezae* (Essig & Kuwana)	Unidentified	8.3.79	Narang, Solan (H.P.).
5.	*Aulacorthum solani* Kalt.	*Hydrenzia* sp.	10.3.79	Palace garden, Chail (H.P.)

TABLE 2

Table showing relative percentage lengths of autosomal pairs.

Sl. No.	Name of the species	Autosomal pair Nos.						
		1	2	3	4	5	6	7
1.	*Aphis nerii* B.d.F.	40.83	24.40	22.25	12.50	—	—	—
2.	*Myzus persicae* Sulzer	26.58	22.61	18.65	16.25	8.73	7.14	—
3.	*Megoura lespedezae* (Essig & Kuwana)	24.28	21.69	18.82	11.06	9.33	7.90	6.89
4.	*Aulacorthum solani* Kalt.	37.34	31.43	16.18	8.26	5.77	—	—

the second and third pairs are more or less equal in size. The last pair is considerably smaller in percentage length.

2. *Myzus persicae* (Sulzer) : 2n number in this species was observed to be 12, (Plate IV C & D). Rou Yen Sen and Robinson (1966) reported similar number. Size comparison between the chromosome pairs did reveal a difference but not as wide as that in the previous species. The chromatids were separated to a considerable extent and appeared like banded chromosomes. Difference in relative lengths when compared between pair numbers 1-2 ; 3-4 and 5-6 showed very similar lengths among themselves. One of the homologue of pair number two showed a deeply stained arm which may presumably due to non separation of the chromatid ; (Plate V b).

3. *Eriosoma lanigerum* (Hausman) : This species had the diploid chromosome number 12 ; (Plate IV B). Similar number for the species has been reported earlier by Rou Yen Sen and Robinson (1966). The chromosome preparation in this species was not satisfactory thus we were unable to construct the karyotype.

4. *Megoura lespedezae* (Essig & Kuwana) : Diploid chromosome number in *Megoura lespedezae* (Essig & Kuwana) was seen to be 14 ; (Plate IV F). On comparison of the karyotype it was found that first and second paris were the largest in the complement measuring 24.28% and 21.69% respectively, which accounts for nearly half of the total chromatin material. Remaining pairs showed a gradual size reduction (Table 2, Plate V C).

5. *Aulacorthum solani* Kalt. : 2n = 10 was observed in *Aulacorthum solani* Kalt. (Plate IV E). As revealed from the relative percentage lengths of each of the chromosome pairs (Table 2 ; Plate 2, d), first two pairs share considerable amount (approximately 69%) of the total chromatin material while the last pair constitutes only 6%.

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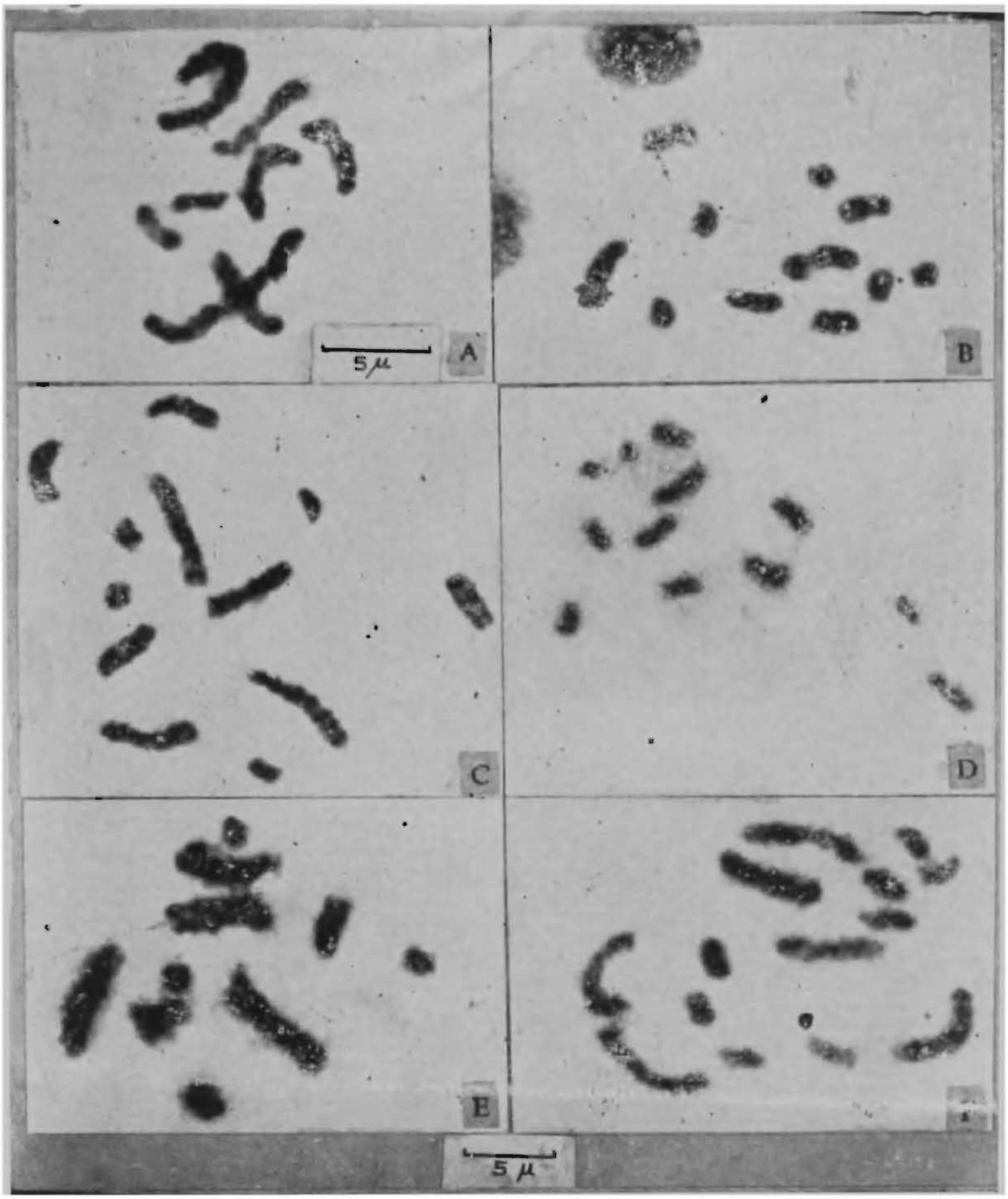
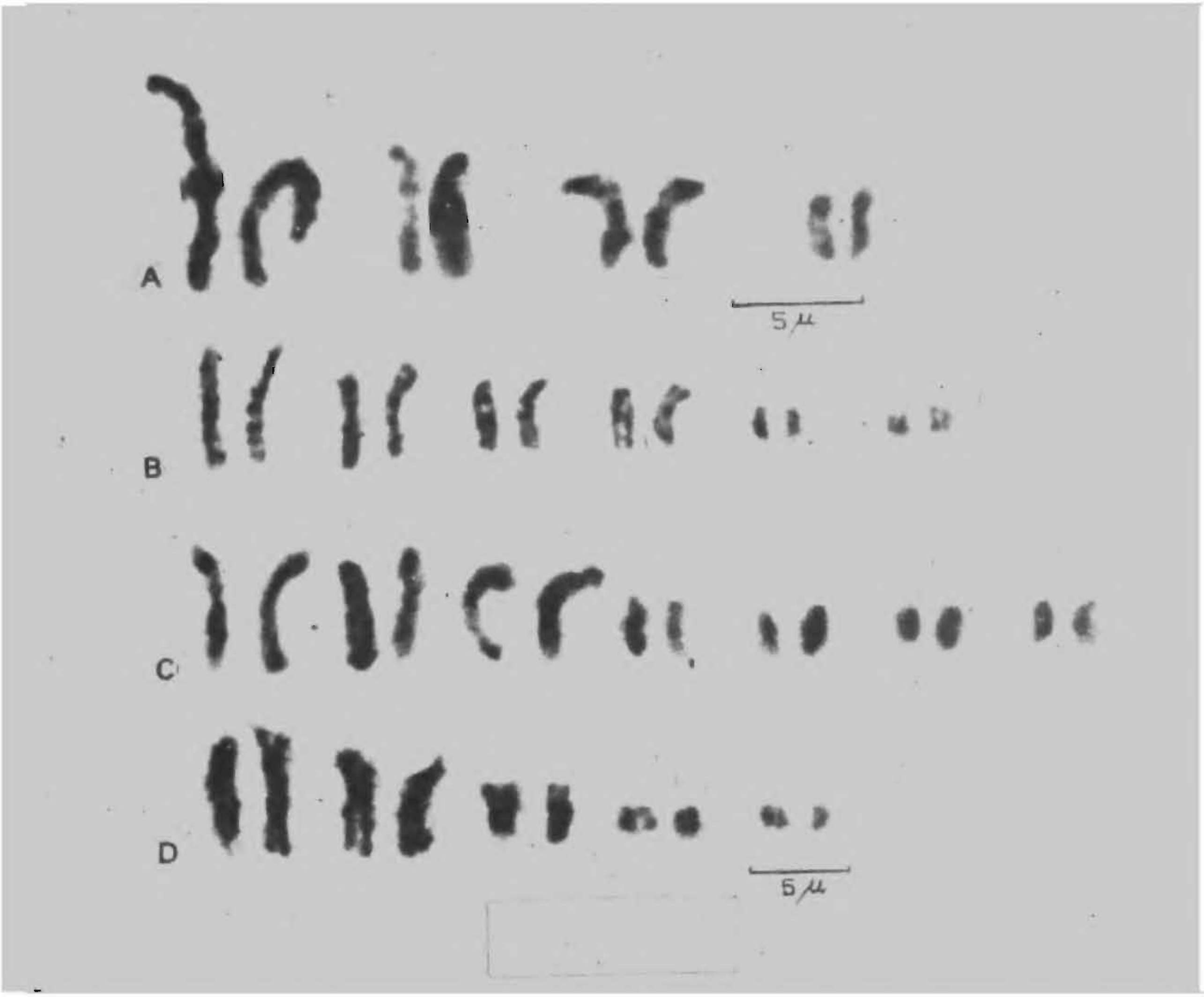
KULKARNI & KACKER PLATE IV



A. *Aphis nerii* B.d.F. 2n = 8 ; B. *Eriosoma lanigerum* (Hausman) 2n = 12 ; C, D. *Myzus persicae* (Sulzer) 2n = 12 ; F. *Megoura lespedezae* (Essig & Kuwana) 2n = 14 ; E. *Aulacorthum solani* Kalt. 2n = 10.



Karyotypes
A. *Aphis nerii* B.d.F. ; B. *Myzus persicae* (Sulzer) ; C. *Megoura lespedezae* (Essig & Kuwana) ; D. *Aulacorthum solani* Kalt.

SHORT COMMUNICATION

Bull. zool. Surv. India, 3 (1 & 2) : 107-109, 1980

FIRST RECORD OF THE GENUS *BOCCHARIS* (HETEROPTERA : LYGAEIDAE) AND A NEW SPECIES FROM INDIA

INTRODUCTION

Distant (1904) erected the genus *Boccharis* as the monotype with the type species *Boccharis significatus* Dist. from Burma. Slater (1964) in his catalogue also mentioned the species only from Burma. Later some specimens of the same genus were collected from Calcutta and other parts of India. Careful examination of these specimens show some distinctive features from *B. significatus* which necessitates to describe a new species *Boccharis indicus* Mukhopadhyay 1979.

Boccharis indicus sp. nov.

MORPHOLOGICAL FEATURES

Head, anterior lobe of the pronotum and anterior part of the scutellum blackish-brown with silvery-grey pubescence. Antennae ochraceous, with distal part of the first, fourth and both ends of the second joint usually infuscated. Eyes infuscated. A pair of black hairless depression (obscure) in front of ocelli. Head, anterior pronotal lobe finely and obscurely punctate. Posterior pronotal lobe, apex of scutellum, clavous and corium with dark deep punctures. Anterior hemelytra translucent, membrane completely hyaline. Posterior abdominal region, connexivum ochraceous with dorsolateral joint of the tergites dark infuscated.

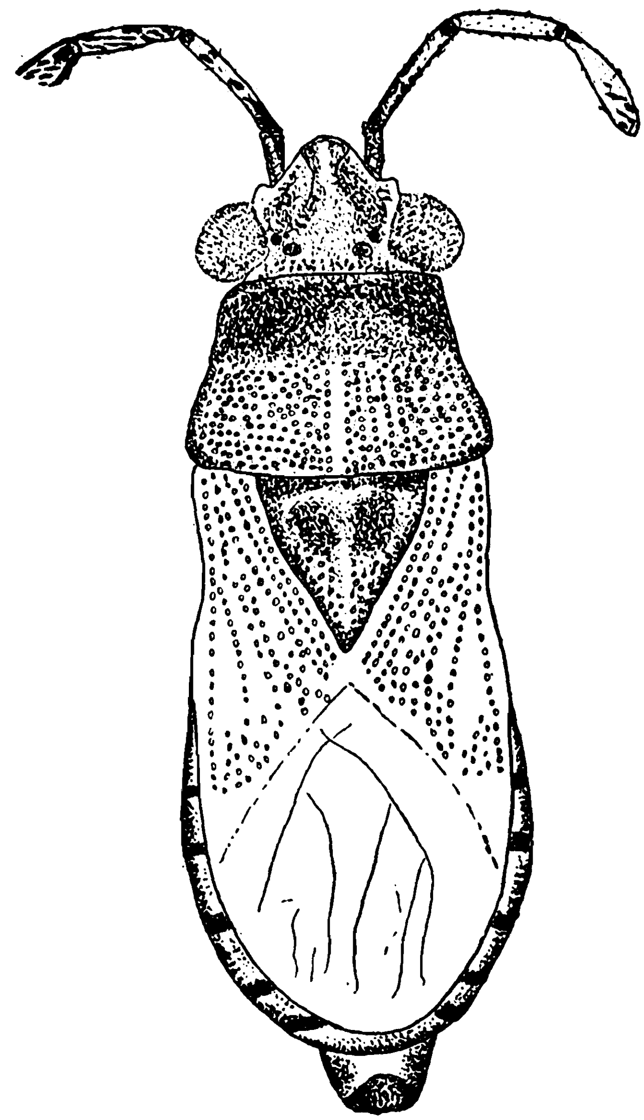


Fig. 1. *Boccharis indicus* Mukhopadhyay 1979. Dorsal view.

Pro—, meso—, metasterna piceous black ; ventromedian area of the abdomen ochraceous ; coxae, femora, tibiae and tarsi luteus. Anterior femora with minute spines on the ventral side (Fig. 2D) ; femur of the hind leg with a single dorsal infuscate spot (Fig. 2C). The pro—, meso—, and metapleura black to infuscate at regions, marked with small punctures. A pair of orange lobular structures on the metapleura ventrolaterally (Fig. 2C).

Length : ♂ ♂ 4 mm. : ♀ ♀ 4.5—5.5 mm.

Holotype ♂ (No. 729/H15, Zoological Survey of India), Calcutta, India, Date 17.5.1979. Ananda Mukhopadhyay.

Paratype: 2 ♂ ♂ : 2 ♀ ♀ (No. 730/H15, Zoological Survey of India), 1 ♂ Orissa, 17.11.1913 : 1 ♂ Madras, 18.2.1923. 1 ♀ W. Bengal, Calcutta, 25.11.1912. : 1 ♀ W. Bengal, Calcutta, 17.5.1979.

Remarks :

The new species differs from that of the monotypic one, *B. significatus* Dist., in the following characters :

No central spot formation by the punctures of the posterior pronotal lobe ; body beneath not entirely piceous ; femur of the hind leg with single dark spot near apex (Fig. 2C) ; no significant infuscation on third and fourth joints of antennae.

Note :

Some morphological characters observed at genus level differ from the description of *Boccharis* by Distant, 1904.

Basal joint of the antennae exceeding the apex (tylus) of head (Fig. 2a). Scutellum not prominently centrally carinate but with a whitish dividing line.

With the availability of few more specimens these characters may be taken into account in future for consideration of another distinct genus.

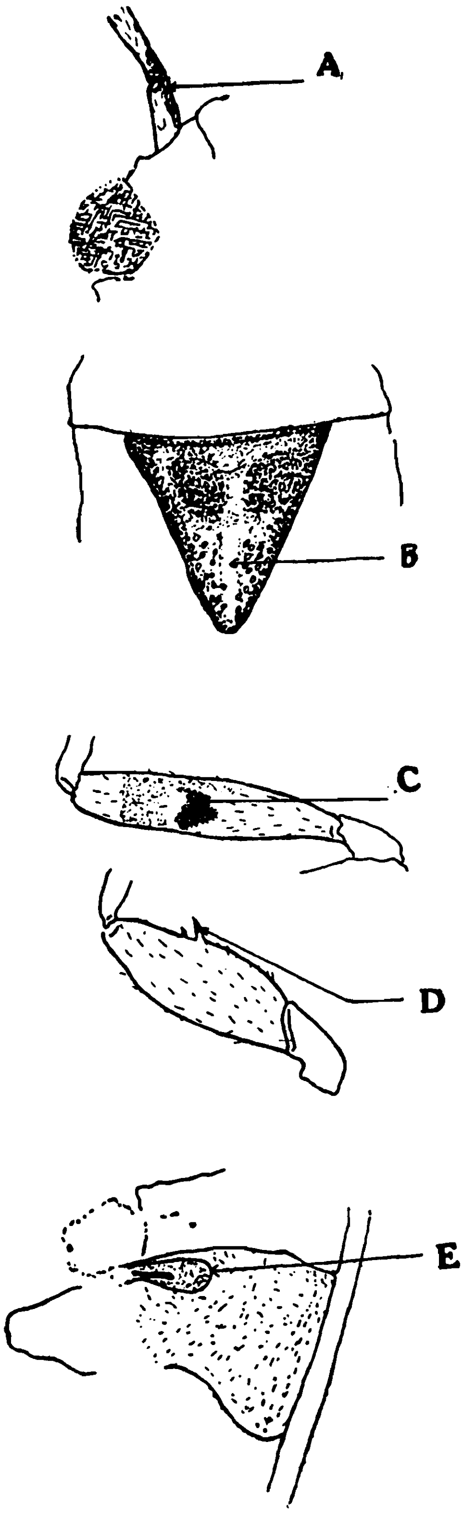


Fig. 2 A. First segment of the antenna exceeding the tylus. B. Scutellum : centrally dividing pale line. C. Femur of third leg : single dark spot. D. Femur of first leg : minute spine on ventral side. E. Ventrolateral side of the metapleuron with lobular structure.

ECOLOGICAL NOTE

Boccharis indicus sp. nov. has been found by the author from the leaf litters of peepul tree (*Ficus religiosa*). Some late instars of the same were also obtained from the same habitat. Its population was observed poor in Calcutta. The adults emerged from these nymphs when kept on a diet of Fig fruits (*Ficus cunius*).

ACKNOWLEDGEMENT

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Zoological Survey of India, Calcutta

ANANDA MUKHOPADHYAY

Bull. zool. Surv. India, 3 (1 & 2) : 111-112, 1980

DISCOVERY OF A LUMINOUS GECKONID LIZARD FROM INDIA

Introduction

While surveying the Madar foot hills near Ajmer (Rajasthan) in August 1973 during middle of night I came across this peculiar new Geckonid species on the uneven, barron, stony terrain. I was astonished to see that the lizard was shedding bright light in darkness from its body while moving slowly towards a bush. The mode of progression of the Gecko was so slow that it was easily captured and made a feeble attempt to escape. I at first took it for something else and it was only on carefully examining it subsequently that I found it to be a luminous Gecko. It was slowly moving like a chamaeleon on its four limbs, keeping its body sufficiently raised from the ground. The white bands and spots on the dorsum of the lizard were glowing constantly like a series of candles in darkness.

Cyrtodactylus madarensis n. sp.

Rajasthan Luminous Gecko (pl. VII A & B)

Material examined (*R. C. Sharma* Coll.) : Adult ♂, near Madar T. B. Sanitorium *C.* 5 km. N.W. of Ajmer (Rajasthan, India), Alt. 263. m. ; lat. 26°28'N. long. 74°42'E, 11. viii. 1973 (11.30 P.M.).

Description

Brownish-black above, with narrow white transverse bars upon the back and tail which meet each other laterally, thus enclosing rectangular black spots or bars ; a curved white mark upon the nape extending upto the top of snout, below eyes ; a white irregular spot about the shoulders ; white oblique streaks above the eyes ; white irregular spots on the head ; whitish below.

Head moderate ; snout equal to the distance between the eye and the ear opening, which is small as its greatest diameter being about one quarter that of eye ; 9 upper and 10 lower labials. Head covered above with minute rounded scales intermixed with rounded tubercles ; snout with pentagonal or hexagonal scales, intermixed with small rounded scales and are biggest on the anteriormost portion. Body above with small granular scales intermixed with large subtrihedral tubercles ; a feebly developed, but distinct lateral fold. Belly with rounded imbricate scales, 30 across the middle. The hind limb extends to the axilla ; subdigital lamellae well developed, as broad as the digit. Tail shorter than the head and body, cylindrical, segmented, not swollen at the base, tapering to a point, covered above with small scales, which are smaller than the ventral scales. No enlarged femoral scales. No femoral or preanal pores.

Measurements : Snout to vent length 50 mm. ; tail length 36 mm.

Type-specimens : Holotype : ♂ adult, vide material above D.R.S., Z.S.I. Reg. No. V/1215, deposited in National Zoological collections, Zoological Survey of India, Jodhpur.

Type-locality and distribution : INDIA.

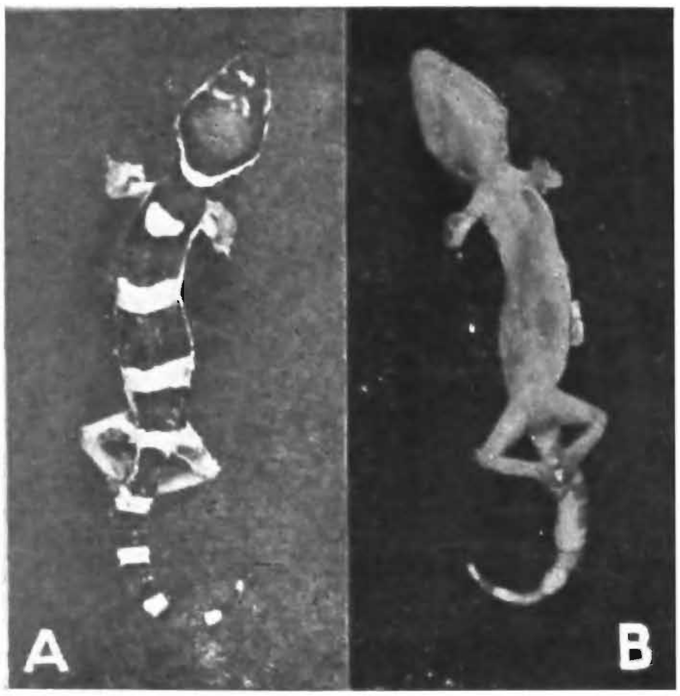
Type-locality : Rocky area near Madar T.B. Sanitorium *ca* 5 km. N.W. of Ajmer, Rajasthan.

Distribution : Known only from the type-locality.

Comparison : *Cyrtodactylus madarensis* n. sp. closely resembles *Cyrtodactylus stoliczkai* (Steindachner) from Kashmir, Ladak and Pakistan but differs from the latter as follows : (i) 10 lower labials (*vs*. 8), (ii) Body above having large number of enlarged subtrihedral tubercles (*vs*. enlarged dorsal tubercles are less in number and are feebly keeled), (iii) Lateral fold is absolutely distinct (*vs*. indistinct), (iv) Tail cylindrical, segmented, not swollen at the base (*vs*. tail depressed, swollen at the base). Marked difference in colouration.

Zoological Survey of India, Calcutta

R. C. Sharma



Crytodactylus madarensis n.sp.
A. Dorsal view. B. Ventral view.

Bull. zool. Surv. India, 3 (1 & 2) : 113-114, 1980

ON A NEW SPECIES OF *HALAMMOHYDRA* (ACTINULIDA, HYDROZOA) FROM SAGAR ISLAND, INDIA

While studying the collections of interstitial meiofauna inhabiting the intertidal sands of the Sagar Island located at the mouths of the Gangetic estuarine system, we came across specimens of the aberrant cnidarian, *Halammohydra* Remane, along with other groups of animals. On a detailed examination, it is found that the specimens do not agree with any of the species of the genus hitherto known. Hence, they are described here as a new species under the name *Halammohydra sagarensis*. (Pl. VIII) The first report on the occurrence of *Halammohydra* in Indian waters has earlier been made on the Waltair coast (Rao and Ganapati, 1966).

Description :—All the six adult specimens examined morphologically belonged to the same population and measured 140—210 μ in total length. Body in oval, white and sparsely ciliated. Gastric tube is oval, 100—180 μ long depending on the state of contraction, makes up about $\frac{8}{10}$ of the total body length and 65—80 μ wide. Neck is short and 4—5 μ long. Aboral cone is slightly elliptical, wider than long and about 20×30 μ in size. Aboral adhesive organ is little developed, shallow and cup-shaped, about 6×10 μ in size and occupies only about $\frac{1}{3}$ of the upper part of cone. Two distinct whorls of slender tentacles occur on the aboral cone, numbering $4+8$. Tentacles do not bulge or taper at their base. The first whorl of tentacles are nearly of the same size and attain about 170—250 μ in length. The second whorl of tentacles are longer and considerably vary in size ; one of these tentacles is usually longer than the others and attains about 400—560 μ in length. During locomotion, the anterior tentacles are directed forwards, while the posterior ones trail behind. Tentacles extend completely during locomotion, while some annulation often occurs distally when the animal is at rest. Four statocysts of the lithostyle type occur in a whorl alternating with the posterior tentacles and measure about 4 μ in diameter.

The cnidome consists of two types of nematocysts, *viz.*, small oval stenoteles of two size categories and atrichous isorhizas. Macrostenoteles are C. $4.2\text{-}5.0 \times 3.4\text{-}3.8$ μ ; microstenoteles C. $3.2\text{-}3.6 \times 2.4\text{-}2.8$ μ and isorhizas C. $2.2\text{-}2.6 \times 2.0\text{-}2.4$ μ. Sexes are separate. Males and females with one gonad only.

Holotype :—Female specimen 170 μ long, with gonad, collected by the authors on 3 May, 1979. Deposited with the Zoological Survey of India, Calcutta. Regd. No. p 3027/1.

Type locality :—Fine sand 5 cm below surface, intertidal zone, Gangasagar Beach, Sagar Island (Lat. 21° 38′ 02″ N and Long. 88° 05′ 12″ E), West Bengal, India.

Remarks :—Among the nine species of the genus *Halammohydra* hitherto known (see Clausen 1977), *H. sagarensis* n. sp. is closely related to *H. chauhani* Rao (1975) in the general organization of body, particularly in the shape of gastric tube, the structure, number and disposition of aboral tentacles and statocysts. But the new species clearly differs from the latter in the colour and size of body, shape of aboral cone, shape and size of adhesive organ, structure of cnidome and the number of gonads.

Ecology :—The halammohydrids were rarely collected in fine detritus sands 5 cm below surface between the low and half-tide levels of the intertidal zone. The sands are mostly silicious and angular ; their texture varied between 80—200 μ in mean diameter. At the time of collection, temperature in the habitat varied between 28°c—30°c, while the salinity of interstitial water ranged between 29 and 30%. The hydrozoan is active in habits and exhibits weak powers of adhesion. Locomotion is effected in the direction of aboral pole by ciliary gliding. The cnidarian appeared to feed on fine particles of detritus and other micrometazoans of sand.

ACKNOWLEDGEMENTS

We are grateful to the Director, Zoological Survey of India, for the facilities provided to carry out this work.

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AND
A. MISRA

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RAO

PLATE VIII

Halammohydra sagarensis n.sp. Adult, habit.

Bull. zool. Surv. India, 3 (1 & 2) : 115-117, 1980

THE DEEP-WATER ATLANTIC FISH *LIOSACCUS CUTANEUS* (GUNTHER) [TETRAODONTIDAE] IN INDIAN WATERS

During a cruise on the fishing trawler 'Valameen' of the Integrated Fisheries Project, Cochin (Kerala), two specimens of *Liosaccus cutaneus* (Gunther), belonging to the family Tetraodontidae, were collected by the otter trawl operated at 250 m. This is an Atlantic species which has also been found in the Western Indian Ocean from the Cape of Good Hope to Natal, down to 160 m. This fish is of special interest as it appears to be the only known representative of the family Tetraodontidae in the Indian Ocean recorded from deep-water (over 160 m.), The objectives of this note are to redescribe the species and document an extension of its range.

Liosaccus cutaneus (Gunther)
[Fig. 1]

Tetrodon cutaneus Gunther, 1870, *Cat. Fishes Br. Mus.*, 8 : 287 (type locality : St. Helena, Azores).

Spheroides dubius Von Bonde, 1923, *Fish. Mar. Biol. Surv.* Spec. Rep. 1 : 40, pl. 2, fig. 3 (type locality : off Natal, South Africa, 27 fms).

Sphaeroides cutaneus : Smith, 1953, *Sea Fishes of Southern Africa* : 417, pl. 95, fig. 1190.

Material

2 ex., 135-145 mm in Standard length, off Quilon (Kerala State), 250 m., 4-6 February 1977 ; Zoological Survey of India Regd. No. F 7558/2 (as *Sphoeroides cutaneus*).

Description

D 8 ; A 8 ; P i 13-14 ; C 9.

Body oblong, profile of back gently curved. Length of head 45.1-47.7% SL. Eye-diameter 24.5-26.1% head length, 75.4-87.8% in the flat interorbital space ; inferior border of eye free, upper half attached. Nasal papilla on each side raised above surface of snout, with two openings near the top. Gill-openings well developed, extending above upper edge of base of pectoral fin. Four teeth forming typical tetradont jaws.

Body smooth and naked (without any prickles), its skin finely striated. Upper lateral line rather indistinct, running from eye along upper part of caudal peduncle ; lower lateral line absent. No raised fold of skin on inferior part of tail.

Dorsal and anal fins short, anal fin entirely behind dorsal fin. Caudal fin truncate.

Colour : Olive grey above, becoming lighter along sides, belly whitish. Dorsal, anal and pectoral fins hyaline ; tips of caudal fin rays dusky.

Remarks : This species belongs to the group of tetradonts that Gunther (1860) called *Liosaccus*, characterised by having the body smooth and naked (without keels or spines). Surprisingly, De Beaufort and

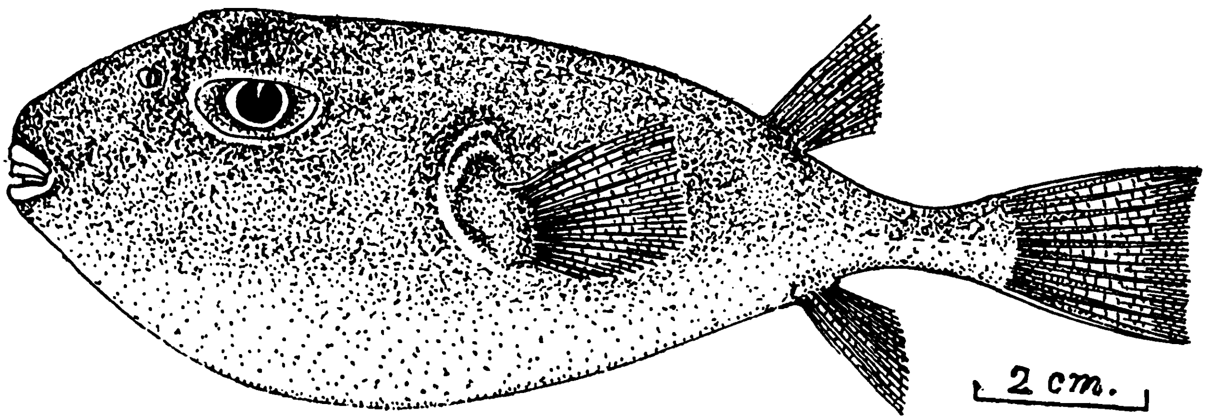

Fig. 1. *Liosaccus cutaneous* (Gunther) from India.

Briggs (1962) made no mention of this genus in their treatise, *The Fishes of the Indo-Australian Archipelego* though *Liosaccus aerobaticus* Whitley, 1928, has been described from the Indo-Australian region. Norman (1966) relegated the genus *Liosaccus* to the synonymy of *Sphoeroides* Lacepede but Whitley (1968) continues to use the former generic name which appears to be an appropriate generic allocation for these tetradonts which are fishes of the deep-waters.

The two specimens agree very well with Gunther's (*op. cit.*) original account of the species except for the fact that the inferior border of the eye is only free, the upper half being attached. The two types of *Tetrodon cutaneus* Gunther in the British Museum (Natural History) (regd. no. BMNH. 1867. 10. 8. 22-3) have also the lower half of the orbital rim free. Gunther's (*op. cit.*) description is evidently defective in this essential particular. The type of *Spheroides dubius* von Bonde now in the repository of the J. L. B. Smith Institute of Ichthyology, Grahamstown, and Smith's (1953) study material of *S. cutaneus*, have also the lower rim of the orbit free, and are clearly conspecific with *Liosaccus cutaneus* (Gunther) as demonstrated by Barnard (1927) for *dubius.*

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P. K. TALWAR
AND
A. A. CHAKRAVARTHY

Short Communication

Bull. zool. Surv. India, 3 (1 & 2) : 119, 1980

NEW RECORD OF THE SPECIES *INDOPHANES BARBARUS* (WALKER) [MYRMELEONTIDAE : NEUROPTERA] FROM INDIA

While working out the unnamed neuropteran material at Zoological Survey of India, the author has come across an interesting species indentified as *Indophanes barbarus* (Walker) which is not hitherto reported from India. It was originally described by Walker (1853) from Ceylon (now Sri Lanka) under the genus *Myrmeleon* Linnaeus and later transferred by Maclachlan (1867) to *Macronemurus* Costa. Banks (1940) segregated three species, viz., *Myrmeleon infestus* Walker from North India, *M. audax* Walker from Nepal and *M barbarus* Walker from Sri Lanka, and placed them under his genus *Indophanes* with the type, *Myrmeleon barbarus* Walker. He (*loc, cit.*) also added for the first time one more species *Indophanes sinensis* from China. Subsequently, Holzel (1972) described the species, *Indophanes vartianorium*, from Pakistan. Thus, the genus *Indophanes* Banks comprises a total of five species, all of which are restricted to the oriental region.

The species, *Indophanes barbarus* (Walker), constitutes new locality record for India. It is very much allied to the form from Sri Lanka but without any prominent black stripes on meso- and metanota which may be a minor local variation.

Measurements : Length of forewing : 30.5 mm ; of hind wing : 31 mm.

Material examined : INDIA : Maharashtra : Khandala Ghat : 1 ♀, Bhaja cave, 5.Xi. 1963 and 1 ♂, Echopoint, 8.Xi. 1963, Coll. B. K. Tikader.

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Zoological Survey of India, Calcutta

S. K. Ghosh

Bull. zool. Surv. India, 3 (1 & 2) : 121, 1980

PARENTAL CARE OF A GLOSSIPHONIID LEECH, *HELOBDELLA NOCIVA* HARDING

The reproductive processes of glossiphoniid leeches show interesting specializations including a well developed pattern of brood care (Mann, 1962). The present communication deals with the parental care of *Helobdella nociva*, kept in the laboratory.

During April 1978 observations were made from 18 leeches which showed that the eggs or the developing embryos were initially attached to the ventral surface of the body at about two-third distance from the oral end with a thin transparent membraneous sac-like covering, the cocoon, over them (Pl. VI A.). An average of 36 (33-42) eggs were counted inside a cocoon. The young leeches with well developed anterior and posterior suckers probably break free the transparent thin-walled cocoon within 4-8 days but continue to cling their mother's fold for another 1-2 days. Holding by their posterior suckers in heavy clusters (Pl. VI B) the young leeches enjoy swimming with the mother who often directs the side of her body downwards so as to form a shallow groove in order to afford additional protection to her brood. The young leeches were measured 2.2 mm. in length at which stage they led a life independent of the mother.

From a persual of literature (Harding and Moore, 1927; Mann, 1962) it has been revealed that there is no report on the breeding habits of this species. However, Mookherjee (1946) had described and illustrated the parental care of the leech *Glossiphonia reticulata* from this sub continent. He did not find any thin membraneous egg-cases typical for the glossiphoniid leeches although he mentioned that a groove of varying size formed for the lodging of the embryos. But the number of youngs per brood noted by him was 37, a figure parallels with the brood size of the present species.

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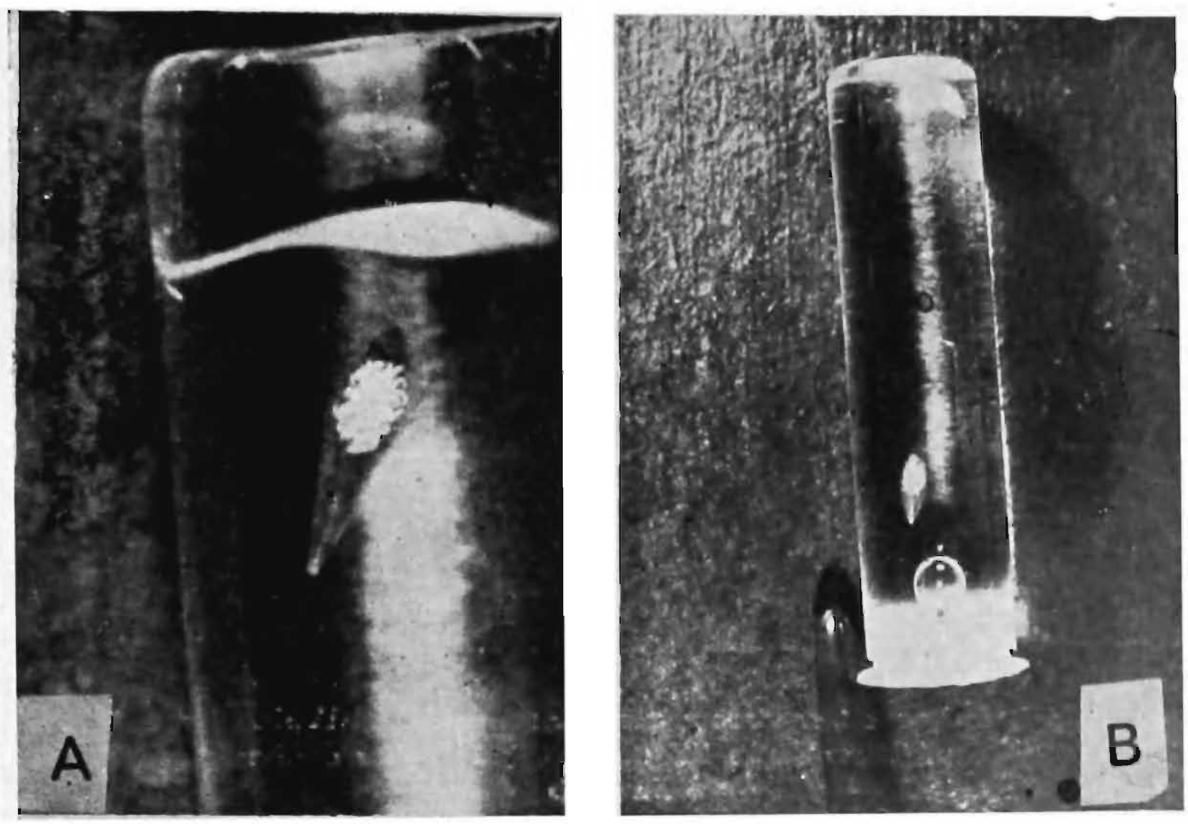
RUPENDU RAY

RAY

PLATE VI



A. A gravid leech, *Helobdella nociva* with cocoon at the ventral surface of the body

B. The mother leech with their youngs attached to the ventral surface in heavy clusters.

Short Communication

Bull. zool. Surv. India, 3 (1 & 2) : 123, 1980

TABANUS BISWASI NOM. NOV., A REPLACEMENT NAME FOR *TABANUS MINUSCULUS* DATTA AND DAS, 1978 (DIPTERA : TABANIDAE)

I am indebted to Professor L. L. Pechuman of the Cornell University, Ithaca, New York, for kindly drawing my attention to the fact that *T. minusculus* Datta and Das, 1978, is a junior primary homonym of *T minusculus* Hine, 1907, in the genus *Tabanus* L., and that a new specific epithet is indispensable. I am, therefore, pleased to name the species after the Collector, Mr. S. Biswas of this Organisasation for kindly taking an effort to make the interesting collection of horseflies. The relevant details are as follows :

1. **Tabanus biswasi** Datta, nom. nov.

Tabanus minusculus Datta and Das, 1978,

Bull. zool. Surv. India, 1 (2) : 183.

2. **Hybomitra minuscula** (Hine)

Tabanus minusculus Hine, 1907, *Ohio Nat.*, 8 (2) : 226.

Hybomitra minuscula (Hine) : Philip, 1947, *Amer. Midl. Nat.*, 37 (2) : 296.

Zoological Survey of India, Calcutta

M. Datta