

## ON THE ELLOBIOPSIDAE, PARASITIC PROTOZOA FROM ZOOPLANKTON

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### ABSTRACT

Two species, namely *Ellobiopsis chattoni* and *Amallocystis fagei* of the family Ellobiopsidae, parasitic Protozoa, are described and figured. *E. chattoni* was observed from the appendages of both females and males of the copepod *Undinula vulgaris*, from the females of *Cosmocalanus darwinii* and *Euchaeta marina* and also from the post larvae of the shrimp *Penaeopsis rectacuta*. *Amallocystis fagei* was found on the mid dorsal region of the carapace of the euphausiid *Pseudeuphausia lutifrons* which is a new record of its occurrence from the Bay of Bengal.

### INTRODUCTION

The family Ellobiopsidae is important in the sense that it includes parasitic protozoans infecting copepods and shrimp larvae which are important groups in zooplankton. The parasites absorb nutrition from the hosts deteriorating their health and eventually leading to their mortality. The family Ellobiopsidae has been studied by several authors (Scott, 1897; Caullery, 1910; Apslein, 1911; Chatton, 1920; Hovassa, 1925, 1951; MacDonald, 1927; Steuer, 1928, 1932; Jepps, 1937; Boschma, 1948, 1949, 1959; Bergan, 1953; Marshall, Nicholls and Orr, 1934 and Mauchline, 1966).

*Ellobiopsis chattoni* has been recorded from regions such as Arctic Ocean, Antarctic Ocean, Mediterranean, North Sea, Southern Baltic, Firth of Clyde and western Indian Ocean. Steuer (1928) reported this species from the western Indian Ocean at one station between South India and Madagascar. Sewell (1951) noticed only some remnants of specimens from the Arabian Sea and suspected the occurrence of this species while Wickstead (1963) recorded this species on *Undinula vulgaris* in the Zanzibar Channel. Detailed information regarding this parasite is lacking from the Arabian Sea and Bay of Bengal.

During the present study several specimens of *E. chattoni* were obtained from the Bay of Bengal region. This parasite had so far been known only from copepods. In the collection studied here, a post larva of the shrimp *Penaeopsis rectacuta* was also found infected with this species, and one species of copepod has been added to the list of its hosts.

*Amallocystis fagei* is a parasite infecting the euphausiids. This species has been previously recorded from the southern hemisphere and largely from the Antarctic region. Some of them were also recorded from the South Atlantic: off south Brazil, off Patagonia, Scotia Sea and off South Georgia. Others were from the South Pacific: Bellingshausen Sea and yet others were from the southern Indian Ocean: south and south-west coast of Australia. The present communication on *A. fagei* is its first record from the Bay of Bengal.

## MATERIAL AND METHODS

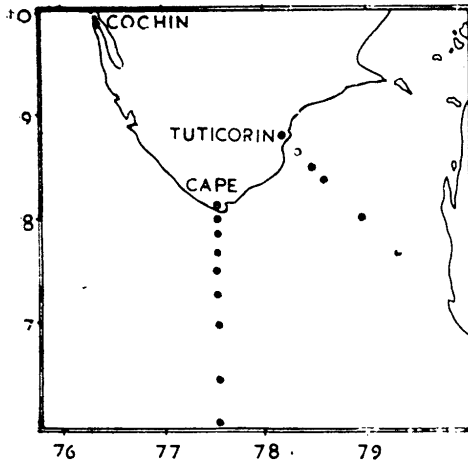


Fig. 1. Stations, sections at Cape Comorin and Tuticorin.

Zooplankton samples were collected under the Pelagic Fisheries Project during the egg and larvae survey of oil sardines and mackerals. These samples were processed at the Regional Centre, National Institute of Oceanography, Cochin. Plankton hauls with the Bongo 60, made of nylon material of 0.5 mm mesh width (60 cm ring diameter) with calibrated flow meter were taken from 80 stations from sections off Cape Comorin and Tuticorin (Fig. 1). The plankton samples were preserved in 4% formaldehyde solution in sea water. Samples were analysed for associates. Host specimens placed on a cavity slide under a coverslip were examined under a binocular microscope. Drawings were made with the aid of camera lucida.

## OBSERVATIONS

*Ellobiopsis chattoni*

This parasite was observed from the copepods *Undinula vulgaris*, *Euchaeta marina*, *Cosmocalanus darwinii* and from a post larva of the shrimp *Penaeopsis rectacuta*. The following account is based on 73 specimens obtained from the above four hosts. Table I shows the station location, number of hosts, sex, number of parasites etc.

Table I. Details of collection, parasite etc.

St. No.	Lat. N.	Long. E.	Date	Depth in m.	Host	No.	Sex	<i>Ellobiopsis chattoni</i> (No.)	Place of attachment
1	2	3	4	5	6	7	8	9	10
38	7°53'	77°33'	15-2-74	40	<i>U. vulgaris</i>	1	Female	2	on antenna
43	7°03'	77°33'	16-2-74	125	„	1	Female	1	on first maxilla
46	8°38'	78°27'	17-2-74	65	„	1	Female	3	one on both antennae and maxillule
47	8°31'	78°34'	17-2-74	100	„	2	Female	3	one on both antennae and right mandible
113	7°23'	77°33'	18-2-74	110	„	1	Female	1	antenna
177	7°54'	77°33'	25-5-74	25	„	11	Female	1	on antennule
								1	antenna
								1	mandible
								2	One on each antenna

1	2	3	4	5	6	7	8	9	10
177	7°54'	77°33'	25-5-74	25	<i>U. vulgaris</i>			2	One on each mandible
								2	One on maxillule, other on mandible
								1	antennule
								1	last swimming leg
								1	mandible
								1	maxilliped
								1	mandible
								3	One on antenna, one on each maxilliped
						3 Males		2	One on antenna & other, on maxilliped
								1	last swimming leg
					<i>Cosmocalanus darwinii</i>	1	Female	1	antennule
					<i>Euchaeta marina</i>	1	Female	1	last swimming leg
					Post larva of <i>Penaeopsis rectacuta</i>	1		1	first maxilla
178	7°43'	77°33'	25-5-74	50	<i>U. vulgaris</i>	1	Female	1	antennule
186	8°10'	78°56'	25-5-74	75	„	1	Female	2	One on each mandible
						1	Male	1	antenna
230	3°87'	78°27'	11-8-74	60	„	1	Female	3	One on antennule, other on second maxilla and another on last swimming lag.
231	8°31'	78°34'	11-8-74	75	„	1	Female	5	One on antenna and two on each first maxilla
235	7°53'	77°32'	11-8-74	40	„	1	Female	6	2 on one antenna-3 on other antenna and 1 on last swimming leg
240	6°53'	77°32'	11-8-74	50	„	1	Female	1	last swimming leg
360	8°09'6	78°55'	11-8-74		„	1	Female	4	One on each antennule and two on last swimming legs
422	8°09'6	78°55'	20-12-74		„	3	Females	9	One on each antenna, one on antenna 2 on mandible 2 on each antenna 2 on antennule
					„	1	Male	6	2 on one antennule 2 on each antenna.

All the specimens of *E. chattoni* were found attached on the appendages of the hosts (Fig. 2). The parasite is pyriform in shape and the largest specimen measures  $700\mu$  in length and  $350\mu$  in diameter. It possesses a stout stalk by which it is attached to the appendages of the host. The stalk encloses a bundle of fibres collected up from the head of the parasite. In moderately large specimens a "root-like" structure can be seen penetrating through an aperture into the appendage, always towards the host. Inside the appendage the fibres are again covered with a stiff investment which is thick at first but it soon dwindles along the course of the root. The root may be well developed by the time the head measures about  $45\mu$  in length.

The earliest size obtained in the present study is  $25\mu$ . Up to 6 specimens were found from a single specimen. Early stages are almost round (Fig. 3a). As they increase in size, the head assumes a pyriform shape (Fig. 3b, c and d). An apical structure can be noticed when it reaches about  $400\mu$  in length. Inside the raised-up wrinkled cone is a hyaline mass, 'the plug'. By the time the parasite reaches about  $650\mu$  in size it becomes segmented into two, apparently by a simple constriction passing in from its periphery, somewhat above the equator (Fig. 3d & 4). In some specimens the division takes place below the equator. The proximal trophomere is pear shaped, and the distal gonomere is rounded. Sporulation takes place in the gonomere. It is reported that the divisions begin at the free surface. Small buds about  $30\mu$  in diameter appear at the distal part of the gonomere each of which again undergoing a series of fissions into smaller buds with their nuclei usually invisible. Even in young specimens there is no sign of a nucleus, entire contents of the specimen appear to be granular. Hovassa (1951) observed sporulation in *E. fagei*. The spores were released in small masses having no flagella. Jepps (1937) and Marshall and Orr (1955) stated that after sporulation a new gonomere is budded off to repeat the process. In the present material



Fig. 2. Microphotograph of *Ellobiopsis chattoni* attached to the antenna of *Undinula Vulgaris*.

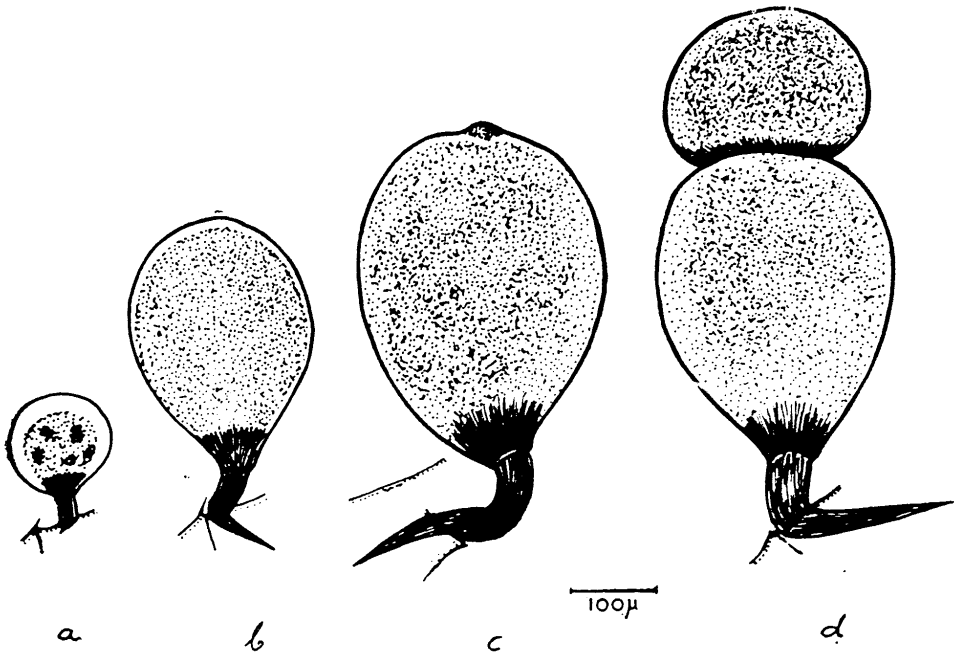


Fig. 3a, b, c and d. Different stages of growth of *E. chattoni*.

one specimen was observed with remnants of gonomere and perhaps it was the part left after sporulation of gonomere.

A total of 298 females and 75 males of *Undinula vulgaris* were examined from 14 stations where the parasites were observed. Out of those 26 females and 5 males were found to be infected with *E. chattoni*. Only one female specimen each of *Cosmocalanus darwinii*, *Euchaeta marina* and one post larva of the shrimp were found infected with the parasite. *E. Chattoni* has been chiefly found on the antenna, mandible, maxillae, maxillipeds and antennule. Rarely it was observed on the swimming legs of the copepod *U. vulgaris*. Details of place of attachment are given in Table I. It has been previously recorded from the following species of copepods, namely *Calanus helgolandicus*, *C. fimmarchicus*, *Pseudocalanus elongatus*, *Pleuromamma borealis*, *P. gracilis*, *Acartia clausi*, *Euchaeta marina*, *E. wolfendeni* and *Undinula vulgaris*.

#### *Amallocystis fagei*

This parasite is found attached on the mid dorsal surface of the carapace in the region of the genital gland of the Euphausiid *Pseudeuphausia latifrons*. This was first recorded by MacDonald (1927) as *Staphylocystis racemosus* (Coutiere), attached on the carapace of the host Euphaucea. As observed by Boschma (1949), since *S. racemosus* lives on the underside of the abdomen of the host Caridea, the specimens of MacDonald (1927) could not be *S. racemosus*. Einarsson (1945) described *Amallocystis* sp. and stated that this parasite was found on the Euphausiids *Thysanoessa inermis* and *Th. raschii* and was always attached to the dorsal side of the carapace, in the middle or



Fig. 4. Microphotograph of *E. chattoni* showing trophomere and gonomere.



Fig. 5. Microphotograph of *Amallocystis fagei* attached on the dorsal surface of the carapace of the Euphausiid, *Pseudeuphausia latifrons*.

behind the middle and rarely in the region of stomach. Boschma (1948) named this species as *Amallocystis fagei*. He (1949 & 1959) gave a detailed survey of the literature of the family Ellobiopsidae as a whole and the genus *Amallocystis* in particular. Except *A. fagei* all other species of the genus are found attached on to the under surface of the abdomen of the hosts, whereas this species is specific in its attachment on the dorsal surface of the carapace of Euphausiids.

Its external part consists of a bundle of cylindrical bodies which are divided into series of elements by distinct transverse grooves (Fig. 5). Each cylindrical trophomere has a separate short stalk extending from the external part of the organ of fixation. Gonomeres are globular in shape.

The trophomeres vary in length from 0.81 to 1.5 mm and their transverse diameter ranges from 0.12 to 0.13 mm.

The proximal part of the cylindrical body is the trophomere and others are the gonomeres. The distal gonomere may grow out into an elongated body and break off from the tip. Some distal gonomeres show at their free end a kind of filament (visible in Fig. 5) each consisting of the shrivelled cuticle of the preceding gonomere from which apparently the spores have been set free. The transverse diameter of the gonomere varies from 0.12 - 0.14 mm.

The present specimen was not sectioned for details of the internal parts since only one specimen was obtained. The sections of Boschma's specimen show that the internal parts of the organ of fixation is embedded in the ovary of the host, the fixing organ of *A. fagei* being more complicated, with sieve plates. It has a solid cuticle with folds in many parts. At the lower end of this organ there is a region in which the cuticle is pierced by numerous holes, the sieve plates (Fig. 6), through which the protoplasmic excrescences protrude into the ovary of the host, branching intricately to ensure a strong fixation into the host and to develop into a racemose structure for the absorption of food from the host.

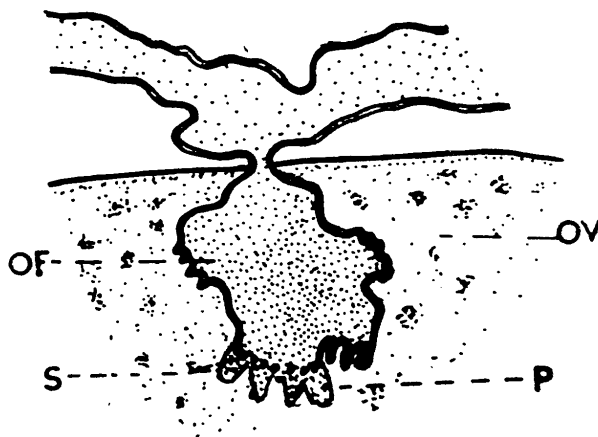


Fig. 6. Section showing the details of organ of fixation. S-sieve plate; P-protoplasmic excrescences; OF-organ of fixation; OV-ovary (taken from Boschma, 1949).

## DISCUSSION

The present specimens of *E. chattoni* are more similar to Steuer's (1928) material than to Caullery's material in which the division occurs below the middle portion. In most of the present material and Steuer's, the division occurs above the middle portion. Except Steuer, others have reported this species from the anterior appendages of the host, while Steuer (1928) observed it from the abdominal segments. The material obtained here was mostly found attached on the appendages of the anterior region especially on the oral appendages. Only a few occurred on the swimming legs.

According to Steuer (1932) *E. chattoni* inhabits 200-400 m depth layer in warmer seas and the upper strata in colder seas. But Wickstead (1963) has found this species in the upper 41 m in Zanzibar channel. The present record of the species also is from the upper strata and in no case the depth of sampling exceeded 125 m. It is of interest to point out that the maximum incidence of this organism is from a sample collected from 25 m depth (St. No. 177, Table I).

Data shows that the number of female hosts were more than those of males. In natural conditions in copepods males are lesser in number than females and perhaps this may be the reason for lesser infection in males. The disorders of the female reproductive system and the lesser number of eggs in the ovary may be due to the ill effect of the parasite. Jepps (1937) stated that the disorders of the female reproductive system are common and described large eggs which have broken loose into the body cavity and are swept round in the circulation being squeezed through the narrow channel in the body. Wickstead (1963) suggested that the inhibition of egg production which is a consequence of the parasitization and resultant starvation could be reverted to normal if in some manner, the parasite could be disposed of.

Parasitized specimens, as a rule, are less healthy and live shorter time than their healthy relations. Overstreet (1973) and Santhakumari and Gopalan (in press) noticed the harmful effects of *Zoothamnium* on shrimps. Previously *Zoothamnium* was considered as harmless and a mere epibiont. The root of *E. chattoni* not only penetrates into the appendage of the host serve as an organ of attachment but also as an organ of absorption and hence the harmful effects are much more than that of an epibiont.

In the case of *Amallocystis fagei* the organ of fixation is much more advanced than *E. chattoni*. It is deeply rooted into the genital organ of the host. Moreover it directly takes nourishment through the sieve plates. For the allied species, *Thalassomyces fagei* Mauchline (1966) pointed out the probability of production of spores or motile forms which are set free from the gonomeres into the water and are eaten by euphusiids. Passing from the gut to the reproductive tissues, they develop and produce trophomeres. But the full life cycle of the parasite has not yet been found out.

An interesting feature is the striking similarity between the two general *Ellobiopsis* and *Amallocystis*. In scrutiny it can be seen that *Amallocystis* is nothing but a compound *Ellobiopsis* with a complicated organ of fixation for the absorption of food. *A. fagei* has comparatively small number of trophomeres than other species of the genus *Amallocystis*. This parasite with its more complicated and elaborate fixing organ with sieve plates seem to be more harmful than *Ellobiopsis*, especially so because it directly injures the genital organs of the host.



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