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THE NAUPLIAR DEVELOPMENT OF *OITHONA OLIGOHALINA*, FONSECA & BJÖRNBERG, 1976

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Synopsis

The naupliar stages of Oithona oligohalina are described and compared with those of O. ovalis.

Introduction

Oithona oligohalina has been recently described from a Brazilian tropical estuary, in the Cananéia region, South littoral of the State of São Paulo, Brazil (Fonseca & Björnberg, 1976).

Santos (1970) identified a second species of *Oithona* from Cananéia waters as *O. hebes*. Later on Fonseca & Björnberg (1976) described this species as *O. oligohalina*. Björnberg (1968, 1972) recorded two forms of *O. ovalis* nauplius VI. Fonseca (1976) studied the annual variation of the *Oithona* species in Cananéia waters and verified that the two forms recorded by Björnberg (*op. cit.*) corresponded to the nauplius VI of *O. ovalis* and *O. oligohalina*.

The present paper describes for the first time naupliar development of *O. oligohalina* and these are compared to the developmental stages of *O. ovalis*.

Material and methods

The material studied was obtained from fixed samples and from animals reared in the laboratory.

The study was undertaken in the Cananéia region. Plankton samples were taken monthly (June, 1973-May, 1974) at the three following fixed stations: the first (St. I) located in the inner part of Taquari River, the second (St. II) at the entrance of it and the third (St. III) in Trapandé Bay. The influence of coastal water decreases from St. III to St. I. Surface plankton samples were taken by means of a zooplankton net type WP3 reduced to half the size and mesh aperture 75 µm, because of the small depth of the river.

The first and second naupliar stages of *O. oligohalina* were obtained from ovigerous females in the laboratory. The females were collected at Station I.

Nauplii I and II of *O. ovalis* were also obtained in the laboratory to make sure of the identification of both species. They were reared at Ubatuba, North littoral of São Paulo State, Brazil.

The same method was used to rear the two species:

Ovigerous females were isolated and placed in Petri dishes containing filtered sea-water collected in the same environment as the animals. The animals were fed with a culture of *Chlamydomonas*. The water was renewed every 8 hours to avoid the excess of bacterial proliferation. The animals were kept at 20°C ± 1 and were observed under a estereoscopic M5-Wild microscope. Soon after spawning the females were taken out the culture dishes. Some of the nauplius I were also picked out and preserved. The rest of the nauplii were left to continue their development to nauplius II and then were also preserved for posterior observations.

The morphological observations of the specimens were made under a binocular M20-Wild microscope. A micrometric eye-piece was used for measurements and a camera lucida for drawings.

Descriptions of the developmental stages of *Oithona oligohalina*

Symbols used to describe the segmentation and setation of the appendages:

Numbers alone=number of setae; spine=s; (+) indicates separate groups of setae; (:) separates setae belonging to different segments; (0) indicates the absence of setae on the segment; term=terminal; S-segment (Nomenclature used according Björnberg, 1972).

Nauplius I (Fig. 1a)

Length = 0.11 mm (1 specimen).

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Oval shape, almost round. Caudal armature: 2 fine setae. Antennule, 0:0:1:2. Antenna with coxopod, 1; basipod, 1; endopod, 1+2; exopod, 6. Mandible with coxopod, basipod, endopod (2s: 2+2), exopod (0:4).

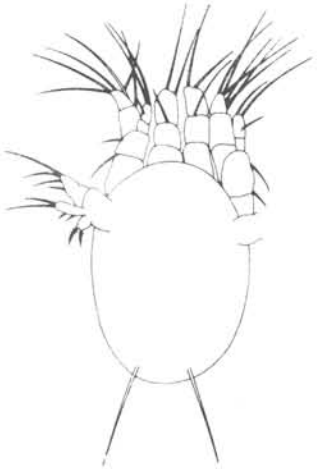

Fig. 1a. Nauplius I, *Oithona oligohalina*, 0.11 mm.

Nauplius II (Fig. 1b)

Length = 0.13 mm (1 specimen).
Oval shape, almost round. Labrum, not observed. Caudal armature = 2 thin posterior setae, 2 thin ventral setae (= maxillules). Antennule, 0:1:2:3 + tuft of setules. Antenna with coxopod, 1 large spine + 1 setae; basipod, 2; endopod, 2 + 2; exopod, pre-terminally segmented, 0:3 + 3. Mandible with coxopod, basipod, 1; endopod, 3:3 + 1; exopod, 4S, 4.

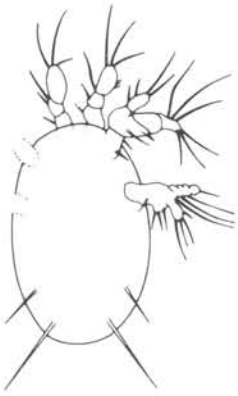

Fig. 1b. Nauplius II, *O. oligohalina*, 0.13 mm.

Nauplius III (Fig. 1c)

Length = 0.14 mm (1 specimen) and 0.13 mm (2 specimens).
Oval shape. Labrum, rounded anteriorly and crenate posteriorly, with setose margin. Caudal armature = 2 pairs of latero-terminal thin setae, 2 spines, shorter than the setae, and placed

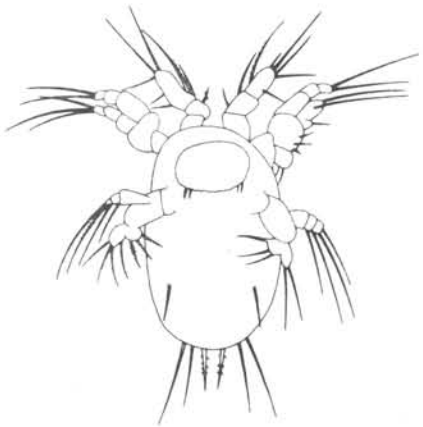

Fig. 1c. Nauplius III, *O. oligohalina*, 0.14 mm.

between them. Antennule (Fig. 2a), 0:1:2:3 + 4 term. Antenna (Fig. 2b) with coxopod, 2s; basipod, 2; endopod, 2 + 2 term; exopod, 1:3 + 3. Mandible (Fig. 2c) with coxopod, basipod, 2; endopod, 3:4; exopod, 4S, 0:1:1:2. Maxillule, 2s, one on each side of the body, placed ventrally and pre-caudally.

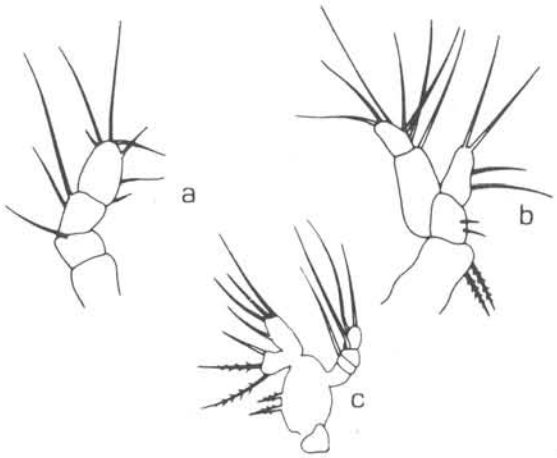

Fig. 2a. Nauplius III, antennule from Figure 1c.

Fig. 2b. Nauplius III, antenna from Figure 1c.

Fig. 2c. Nauplius III, mandible from Figure 1c.

Nauplius IV (Fig. 1d)

Length = 0.16 mm (8 specimens) and 0.15 mm (2 specimens).
Oval shape, beginning segmentation in the posterior part of the body (Fig. 1d). Labrum = anterior margin with a small medium protuberance, posteriorly crenate, with lateral tufts of setules and two bigger setae between them. Caudal armature like stage III, although the 2 spines placed between the lateral terminal setae are longer, reaching in this stage the

Fig. 1*d*. Nauplius IV, *O. oligohalina*, 0.16 mm.

same length as the setae. Antennule, (Fig. 2*d*) 0:1:1 + 1:5 or 6 setules + 4 term. Antenna (Fig. 2*e*) with coxopod, 2s; basipod, 2; endopod, 2 + 3 term; exopod, 5S, 1:1:1:1:2. Mandible (Fig. 2*f*), like in stage III, but the setae are more developed. Maxillule (Fig. 2*g*) with lobe I (2s lateral + 2 setae), lobe II (2s, short, distal + 1 long seta).

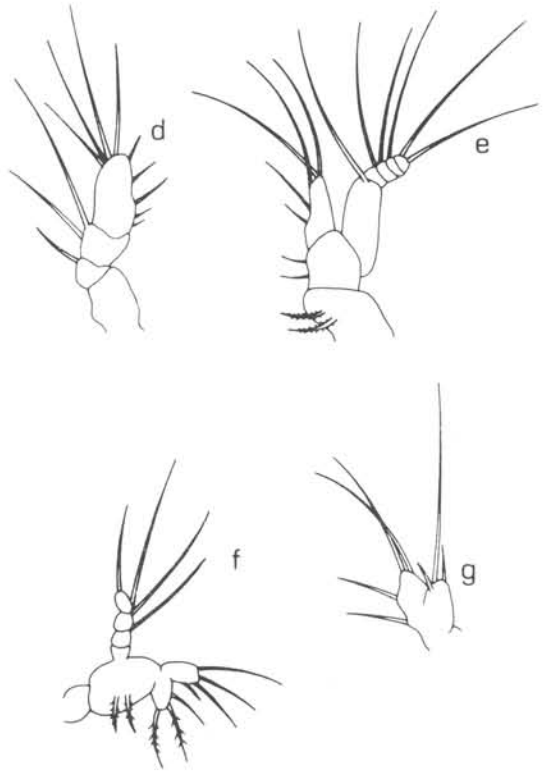

Fig. 2*d*. Nauplius IV, antennule from Figure 1*d*.

Fig. 2*e*. Nauplius IV, antenna from Figure 1*d*.

Fig. 2*f*. Nauplius IV, mandible from Figure 1*d*.

Fig. 2*g*. Nauplius IV, maxillule from Figure 1*d*.

Nauplius V (Fig. 1e)

Length = 0.17 mm (6 specimens) and 0.18 mm (4 specimens).
Body elongated with the caudal region tapering (Fig. 1*e*). Labrum like nauplius IV. Caudal armature=terminal setae,

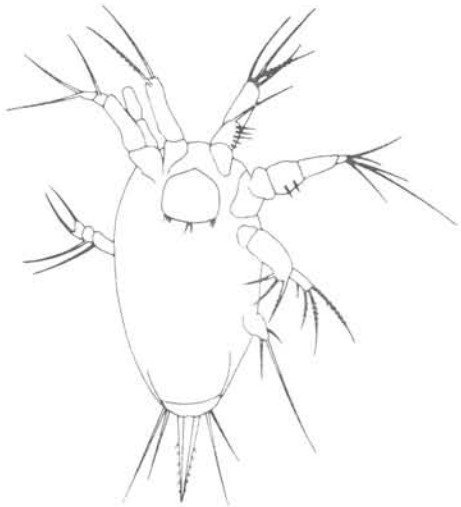

Fig. 1*e*. Nauplius V, *O. oligohalina*, 0.17 mm.

lateral setae and the two terminal spines between them are more developed than in stage IV. Antennule (Fig. 2*h*), 0:1:1:1 (long and thick): 6 + 4 term. Antenna (Fig. 2*i*) with coxopod, 2s; basipod, 2; endopod, 2 + 3 term; exopod, 6S, 1:1:1:1:1:2. Mandible (Fig. 2*j*) like stage IV. Maxillule (Fig. 2*k*) with basipod; lobe I, 3 + 1 long term; lobe II, 2 + 1 long term.

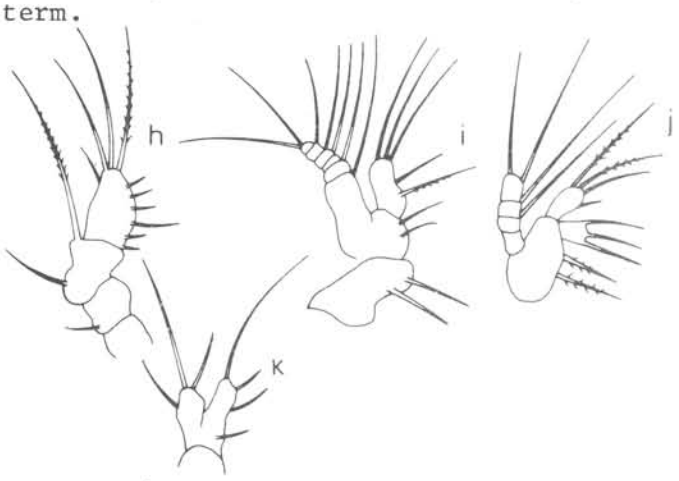

Fig. 2*h*. Nauplius V, antennule from Figure 1*e*.

Fig. 2*i*. Nauplius V, antenna from Figure 1*e*.

Fig. 2*j*. Nauplius V, mandible from Figure 1*e*.

Fig. 2*k*. Nauplius V, maxillule from Figure 1*e*.

Nauplius VI (Fig. 1f)

Length = 0.20 mm (5 specimens), 0.21 mm (4 specimens) and 0.22 mm (1 specimen). Body shape similar to stage IV and segmentation more pronounced than in the preceding stage (Fig. 1♂). Labrum like in stage V, although with tufts of setules on the anterior margin. The terminal spines

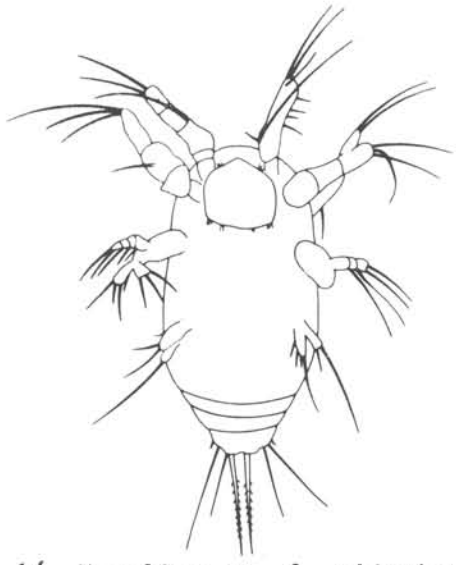

Fig. 1♂. Nauplius VI, *O. oligohalina*, 0.20 mm.

of the caudal armature are longer than the lateral setae. Presence of two more small setae laterally to the two pairs of lateral setae, one on each side of the body. Antennule (Fig. 2ℓ), 0:1:1:1 long and thick, 8 lateral setae + 4 or 5 term. Antenna (Fig. 2m), coxopod, 2s + 1; basipod, 2; endopod, 2 + 3

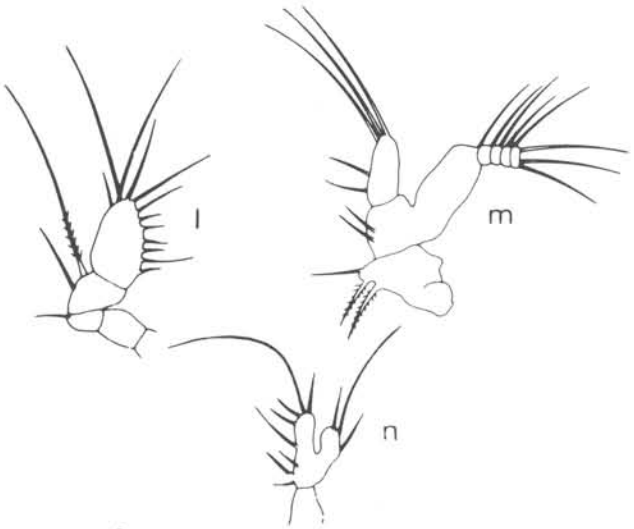

Fig. 2ℓ. Nauplius VI, antennule from Figure 1♂.

Fig. 2m. Nauplius VI, antenna from Figure 1♂.

Fig. 2n. Nauplius VI, maxillule from Figure 1♂.

term; exopod, 1:1:1:1:1 + 3; mandible, as in the stage V. Maxillule (Fig. 2n), basipod, 2 + 1s; lobe I, 3 + 2 term; lobe II, 2 + 1 long term.

Discussion

The naupliar stages of *O.ovalis* and *O. oligohalina* are similar but some small morphological difference exist. These small details make the two species recognizable since the first stage of development.

The nauplii of *O. oligohalina* are larger than those of *O. ovalis* described by Björnberg (1968, 1972) and Fanta (1976).

The present material also shows these differences in size of the two species (Table I):

The body shape of the *O. oligohalina* is oval and that of the *O. ovalis* is more rounded.

The stage IV, V and VI of both species differs in many aspects, especially the structure of the caudal armature: the terminal spines which are placed between the two pairs of lateral terminal setae of *O. oligohalina* are longer than those of *O. ovalis*.

Table II lists the differences for each stage of both species.

Similarities among nauplii of the genus Oithona

Gibbons & Ogilvie (1932-33), after Ramamohana Rao (1958), have shown the taxonomic value of the labrum structure for the identification of the nauplii of the genus *Oithona* and that the caudal armature is useful for the identification of the different stages of each species.

Björnberg (1972) establishes two evolutive lines among the species of *Oithona*. The first includes *Oithona similis*, *O. nana* and *O. ovalis* and *O. minuta*, the second *O. plumifera* and *O. helgolandica*. The author adds that *O. minuta* probably is the most primitive form due to its unspeciallized caudal armature and because the simplicity of the setal appendages. The species *O. nana* follows and could have evoluted to *O. ovalis* in estuarine waters and to *O. plumifera* in oceanic waters. *O. oligohalina* can be added to the *O. ovalis* group.

The lack of intermediate forms among the naupliar stages of both species confirms the validity of *O oligohalina* and *O. ovalis*. The two species were found to

Table I - Length (mm) of the naupliar stages of *Oithona ovalis* and *O. oligohalina*

Nauplius	*Oithona ovalis* (after Björnberg, 1968)	*Oithona ovalis* (after Fanta, 1976)	*Oithona ovalis* (after Fonseca, 1976)	*Oithona oligohalina* (after Fonseca, 1976)
I	0.091 and 0.081	0.0883	0.094	0.11
II	0.100 to 0.110	0.1076	0.114	0.13
III	0.115 and 0.110	0.1230	0.122	0.13 and 0.14
IV	0.124 and 0.125	0.1346	0.137	0.15 to 0.16
V	0.115 and 0.140	0.1551	0.153	0.17 to 0.18
VI	0.145 to 0.185	0.1735	0.179	0.20 to 0.22

Table II - Morphological comparison between naupliar stages of *Oithona ovalis* and *O. oligohalina*

	Oithona ovalis	*Oithona oligohalina*
Nauplius I	A_1 - 0:0:1:3	A_1 - 0:0:1:2
Nauplius II	A_1 - 0:0:2:3+tuft of setules	A_1 - 0:1:2:3+tuft of setules
	A_2 - cx,1s+1 st; bs, 2; en,2+2 or 3; ex, 1:3:3	A_2 - cx,1s+1 st; bs, 2; en,2+2;ex, 0:3+3
Nauplius III	A_1 - 0:1:2:3+3 term.	A_1 - 0:1:2:3+4 term.
	Md - cx;bs,2;en,3:3; ex,4S, 0:1:1:2	Md - cx;bs,2;en,3:4; ex,4S, 0:1:1:2
Nauplius IV	Labrum without medium protuberance in anterior margin.	Labrum with medium protuberance in the anterior margin.
	A_2 - cx,2;bs,2; en, 2 term+2;ex,5S, 1:1:1:1:1:2	A_2 - cx, 2s;bs,2;en, 2+3 term;ex, 5S, 1:1:1:1:2
	Mx - 1b I (2s, short, lt + long), 1b II (2s short, distal+ 1 long).	Mx - 1b I (2s lt+2), 1b II (2s short, distal + 1 long)
Nauplius V	A_1 - 0:0:1+1th+1 long and thick: 5+4 term	A_1 - 0:1:1:1 (long and thick): 6+4 term.
	A_2 - cx,2s; bs, 2; en, 2 term+2; ex, 6S, 1:1:1:1:1:2	A_2 - cx, 2s; bs,2;en, 2+3term; ex,6S, 1:1:1:1:1:2
	Md - ex, 5S	Md - ex, 4S
	Mx - bs,1; 1bI(2+1 term long); 1b II (2 + 1 term long)	Mx - bs,,0;1bI(3+1term long);1b II (2 + 1 term long)
Nauplius VI	A_2 - cx,2s+1 or 2; bs, 2; en, 2 term+2 lt, ex, 1:1:1:1:3	A_2 - cx, 2s+1;bs, 2; en,2+3 term, ex, 1:1:1:1:1 + 3
	Md - ex, 5S	Md - ex, 4S
	Mx - bs,2+1s; 1b I, 2+3 term; 1b II, 2 + 1 long	Mx - bs, 2+1s; 1b I, 3+2 term;1b II, 2 + 1 term long
	Two small setae between the two terminal spines of the caudal armature.	Two small lateral and anterior setae to the two pairs of the terminal setae of the caudal armature.

A_1 - antennulle; bs - basipod; lb - lobe; A_2 - antenna; en - endopod; st - setae; Md - mandible; ex - exopod; lt - lateral; Mx - maxillule; s - spine; th - thin; cx - coxopod; S - segment; term - terminal

occur simultaneously within a small salinity range in the Cananéia region (Fonseca, 1976).

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