Zootaxa 603: 1–12 (2004)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

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Choniomyzon libiniae, sp. n. (Crustacea, Copepoda, Nicothoidae) from São Sebastião, SP, Brazil

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Abstract

A new nicothoid (*Choniomyzon libiniae* Santos and Björnberg, new species) was found on the eggs of the decapod crustacean *Libinia spinosa* collected at Anchovas Beach (São Sebastião Island, SP, Brazil). The material obtained was fixed in formalin, cleared in lactic acid and glycerin, and the different forms of the parasite were drawn with the aid of a microscope and a camera lucida. The parasite eggs were attached to the host's eggs. Nauplii, three forms of copepodids, and adult females and males were found. The 12-segmented first antennae, the segmented urosome, the long and branched caudal setae, the oval form of the female, the lecithotrophic nauplius, a copepodid similar to the one described for *Choniomyzon* permitted the inclusion in this genus. It differs from the species described (*C. panuliri* Pillai) by the ornaments of the antenna and of the female legs, also by the presence of three types of copepodids.

Keywords: Nicothoidae, crab parasites, nauplii, copepodids, South Atlantic

Introduction

The genus *Choniomyzon* Pillai, 1962 was first described as a member of the family Choniostomatidae. Boxshall (1984) incorporated the family Choniostomatidae in the family Nicothoidae.

Nicothoidae are copepods which parasite other crustaceans, such as Isopoda, Cumacea, Amphipoda and Decapoda (Hansen 1897; Connolly 1929; Gnanamuthu 1954; Johnson 1957; Stock 1958; Pillai 1962; Bowman and Kornicker 1967, 1968; Kornicker and Bowman 1969; Ritchie 1975; Bradford 1975, 1980; Boxshall and Defaye 1995).

The effects of the nicothoid copepods on their hosts are variable. When present in the marsupium of Ostracoda, for example, the copepod inhibits egg laying by its host (Bow-

Accepted by J. Olesen: 1 Jul. 2004; published: 11 Aug. 2004

man and Kornicker 1967). *Nicothoe astaci* Audouin & Milne-Edwards, a nicothoid copepod parasitic on the gills of the lobster *Homarus vulgaris* Milne-Edwards, sucks the host's blood (Mason 1959). Connolly (1929) found many specimens of *Choniosphaera cancrorum* Connoly feeding on the eggs of the crabs *Cancer amoenus* Herbst, *Cancer irroratus* Say and *Cancer borealis* Stimpson.

All stages of nicothoid copepods, except the nauplius, "have a distinctive sucking mouth cone, which is expanded into a disc through which piercing mandibles are extended" (Bradford 1975). To our knowledge, there has been no records of this family for Brazil until now. This paper describes a new species of the Nicothoidae which was found on the eggs of the crab *Libinia spinosa* H. Milne-Edwards (Crustacea, Decapoda) from São Sebastião Island, SP.

Materials and methods

The material separated from the host eggs was fixed in 10% formalin and cleared in lactic acid and glycerin, and then studied and drawn with the aid of a Nikon Labophot microscope equipped with a camera lucida. The setal formula (s. f.) refers to setae with Arabic numbers and to spines with Roman numerals, from proximal to distal joints. Aesthetascs are represented by **ae** in the setal formula. The holotype was deposited in the Museu de Zoologia da Universidade de São Paulo, Brazil (MZUSP). Paratypes were deposited in the Museu de Zoologia da Universidade de São Paulo, Brazil, and in the collection of Dr. Carlos F. Rocha.

Choniomyzon libiniae, sp nov.

Material examined

Holotype: adult female (MZUSP 15713), collected on *Libinia spinosa* H. Milne-Edwards (Crustacea, Decapoda, Majidae) from Anchovas Beach, São Sebastião Island, SP, Brazil, 15 December 2001.

Paratypes: eggs, nauplii, copepodid I, and copepodid II (MZUSP 15714, 15715, 15716, 15717), collected on *Libinia spinosa* (Crustacea, Decapoda, Majidae) from Anchovas Beach, São Sebastião Island, SP, Brazil, 15 December 2001; one male and one female (collection of Dr. Carlos F. Rocha), collected on *Libinia spinosa* (CCrustacea, Decapoda, Majidae).

Description

Eggs: The female nicothoid (Figs. 1a, 1b) attaches her eggs (0.12 mm in diameter) to the eggs (0.59 mm in diameter) of the host. Two eggs (pink in color) were attached by a short cord to each host´s egg (Fig. 2). From the copepod eggs, nauplii emerge.

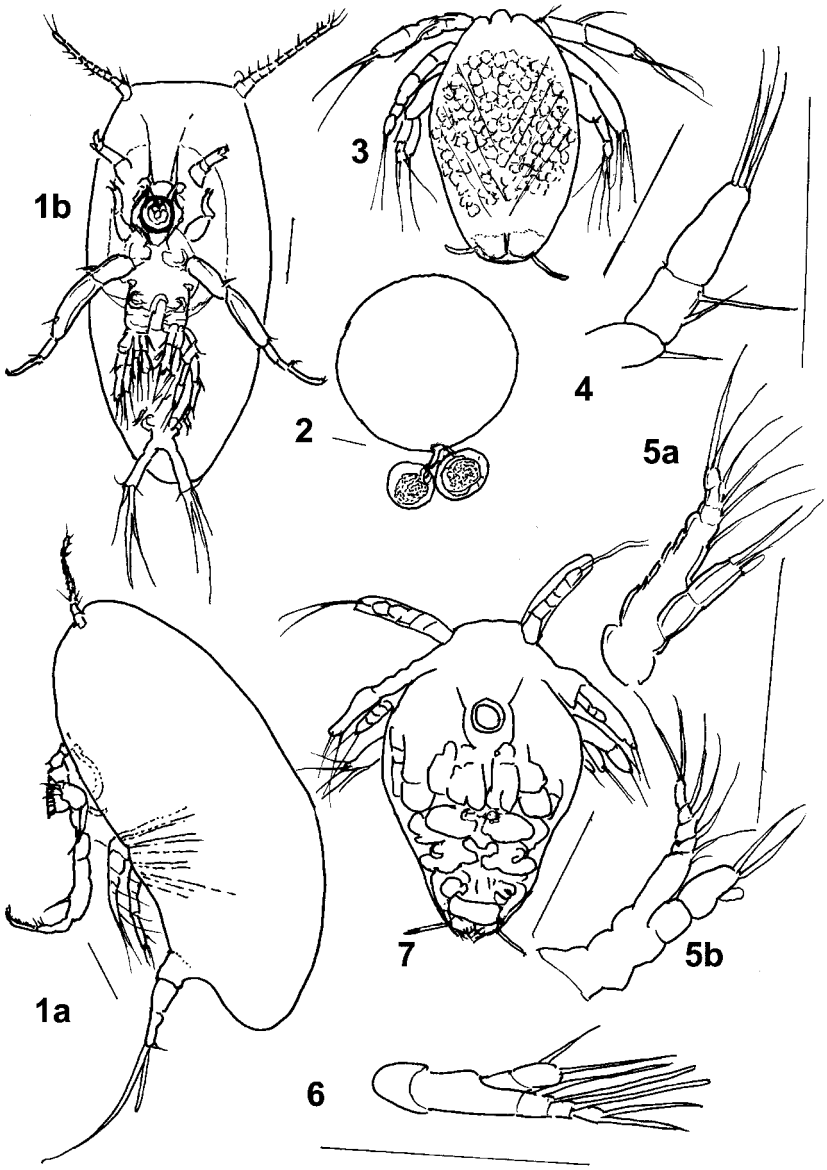

FIGURE 1 – *Choniomyzon libiniae*, n. sp.: a – Adult female, lateral view; b – Same, ventral view. **FIGURE 2** – Egg of host *Libinia spinosa* with 2 eggs of *C. libiniae* attached. **FIGURE 3** – Nauplius of *C. libiniae*, dorsal, yolk visible inside, muscles stippled. **FIGURE 4** – Antennule of nauplius of *C. libiniae*. **FIGURE. 5**: a – Antenna of nauplius of *C. libiniae*, lateral; b – Same, frontal view. **FIGURE 6** – Mandible of nauplius of *C. libiniae*. **FIGURE 7** – Nauplius of *C. libiniae* about to metamorphose into copepodid I, visible inside outer skeleton. All scale bars equal to 0.10 mm.

Nauplii (Figs. 3–7): Cyclopoid-like. Length 0.12–0.24 mm, ovoid in shape. Muscles parallel when seen laterally; V-shaped (Fig. 3) when observed dorsally, as in all cyclopoid nauplii. Antennule trimerous (Fig. 4) with s. f.: 1: 2: 3. Antenna (Figs. 5a, 5b) with coxa

and basis unarmed, not articulated with 5–jointed exopod (s. f.: 1: 1: 1: 1: 2); endopod 2–jointed with last joint bearing 2 terminal setae and a small, lateral ovoid aesthetasc (Figs. 5a, 5b) which is very transparent, and hardly visible. Mandible (Fig. 6) with separate coxa and basis; exopod 3-jointed and not articulated to basis; exopod with thick aesthetasc-like setae (s. f. 1: 1: 1: 2); endopod articulated with basis, 2-jointed (s. f.: 0: 2). Caudal armature: 2 short thick setae. Inside mature nauplius, next stage (the copepodid) is visible (Fig. 7).

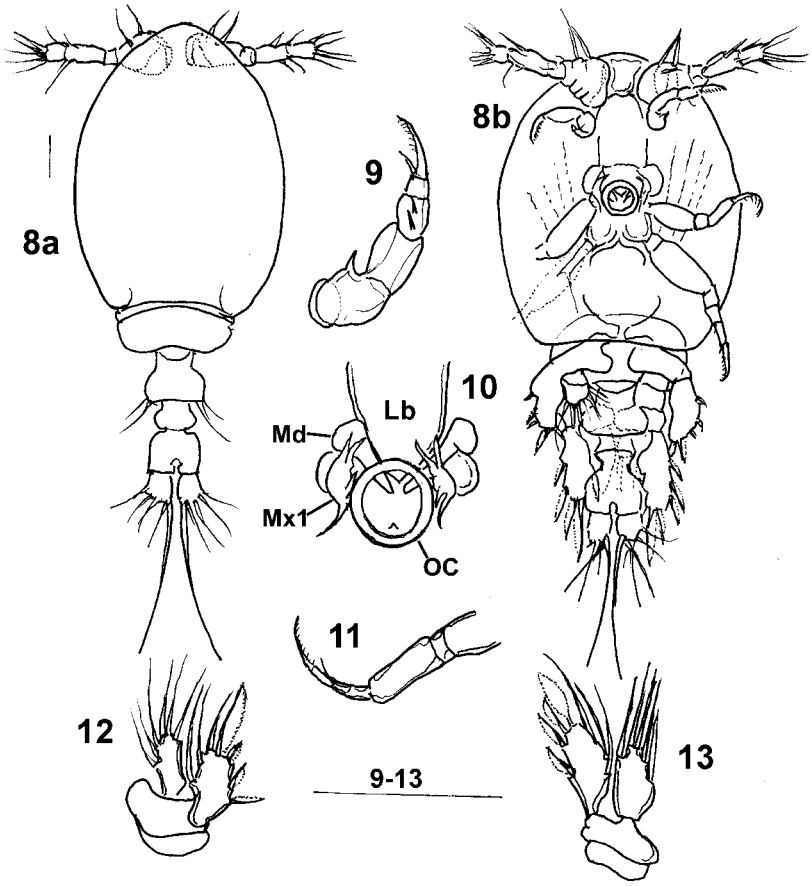

FIGURE 8 – a – Copepodid I of *C. libiniae*, dorsal view; b – Same, ventral. **FIGURE 9** – Antenna of *C. libiniae*. **FIGURE 10** – Oral cone (o. c.), mandibles (Md), maxillules (Mx1) and labrum (Lb) of copepodid I of *C. libiniae*. **FIGURE 11** – Maxilliped of copepodid I of *C. libiniae*. **FIGURE 12** – First leg of copepodid I of *C. libiniae*, right side, ventral. **FIGURE 13** – Second leg of copepodid I of *C. libiniae*, left side, ventral. All scale bars equal to 0.10 mm.

Copepodid I (Figs. 8–13): Cyclopiform, length 0.265–0.280 mm, well chitinized. Prosome oval: comprising cephalon fused with first thoracic segment, and one free segment. Urosome three-segmented. Caudal rami about as long as wide and bearing 5 setae each; 2 dorsal, 2 ventral plus very long internal seta (Figs. 8a, 8b). Antennule (Fig. 8b) 4–jointed: first joint indistinctly and incompletely subdivided; s. f. 2 + 1: 1: 4: 3 + 1 or 2 aes-

thetascs. Antenna (Fig. 9) 5–jointed (s. f. 0: I: 0: 2: 2); terminal pinnate setae, hook-like. Mandible (Fig. 10) blade-like, projecting into mouth, surrounded by sucker or cone-like projection with row of setules and transparent rim, the oral disc. Maxillule (Fig. 10 Mx1) very transparent, base with anterior and posterior branches or lobes and 4 thick setae.

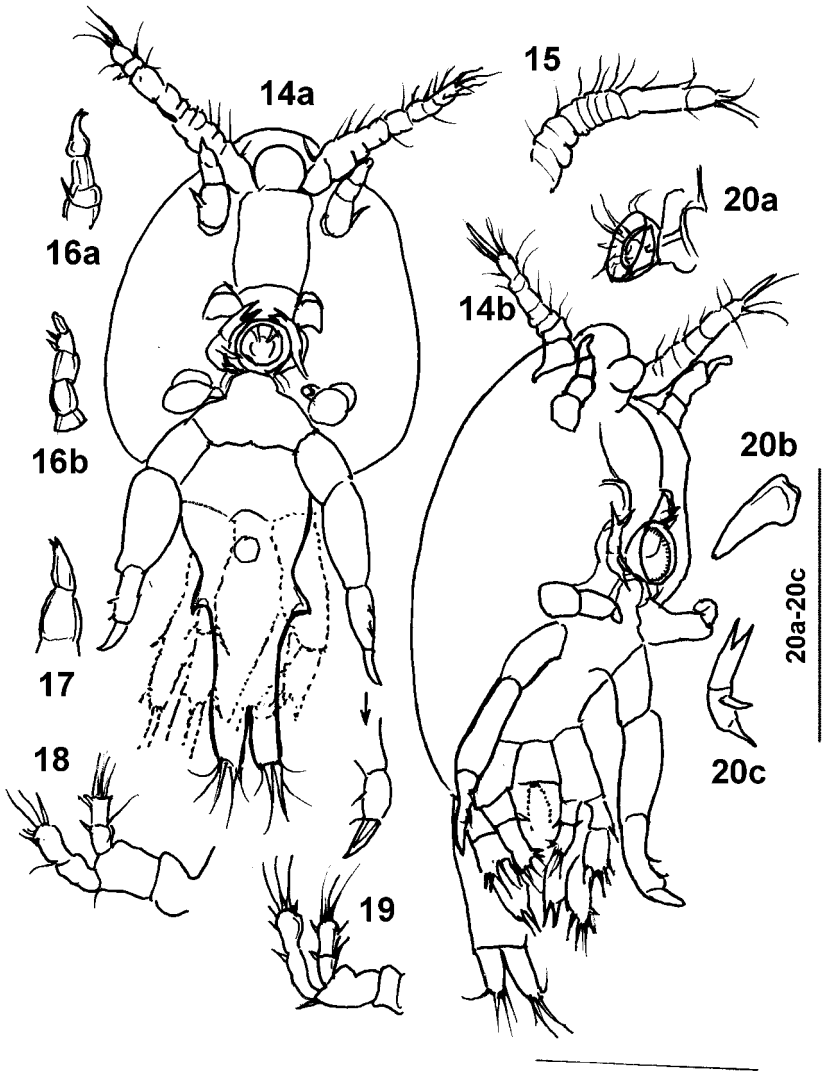

FIGURE 14 – Copepodid II of *C. libiniae*: a – ventral view, second legs omitted and first legs outlined; last joint of maxilliped, detailed; b – partly lateral view of the same. **FIGURE 15** – Antennule of copepodid II of *C. libiniae*, lateral. **FIGURE 16** – Antenna of copepodid II of *C. libiniae*: a – ventral and b – lateral views of the same appendage. **FIGURE 17** – Maxilla of copepodid II of *C. libiniae*. **FIGURE 18** – First leg, right, of copepodid II of *C. libiniae*. **FIGURE 19** – Second leg, right, of copepodid II of *C. libiniae*. **FIGURE 20**: a – Oral cone (oc), left mandible blade visible entering the cone laterally, maxillule right side, seen by transparency beyond the cone, left maxillule omitted, as well as right mandible-blade; b – Mandible blade; c – Maxillule. All scale bars equal to 0.10 mm.

Maxilla (Mx2) (Fig. 8b) trimerous, with hook-like terminal pinnate spine or seta. Maxilliped (Fig. 11) 6-jointed bearing hook-like terminal pinnate spine; fifth joint with one seta. First leg (Fig. 12): coxa and basis not ornamented, exopod with one joint (s. f.: III + I + 3); endopod one-jointed, with 6 setae. Second leg (Fig. 13): coxa and basis without ornamentation, endopod with 5 setae; exopod one-jointed (s. f.: III + I + 3). Posterior corners of first urosome segment each bearing two setae, one shorter than other (Fig. 8a).

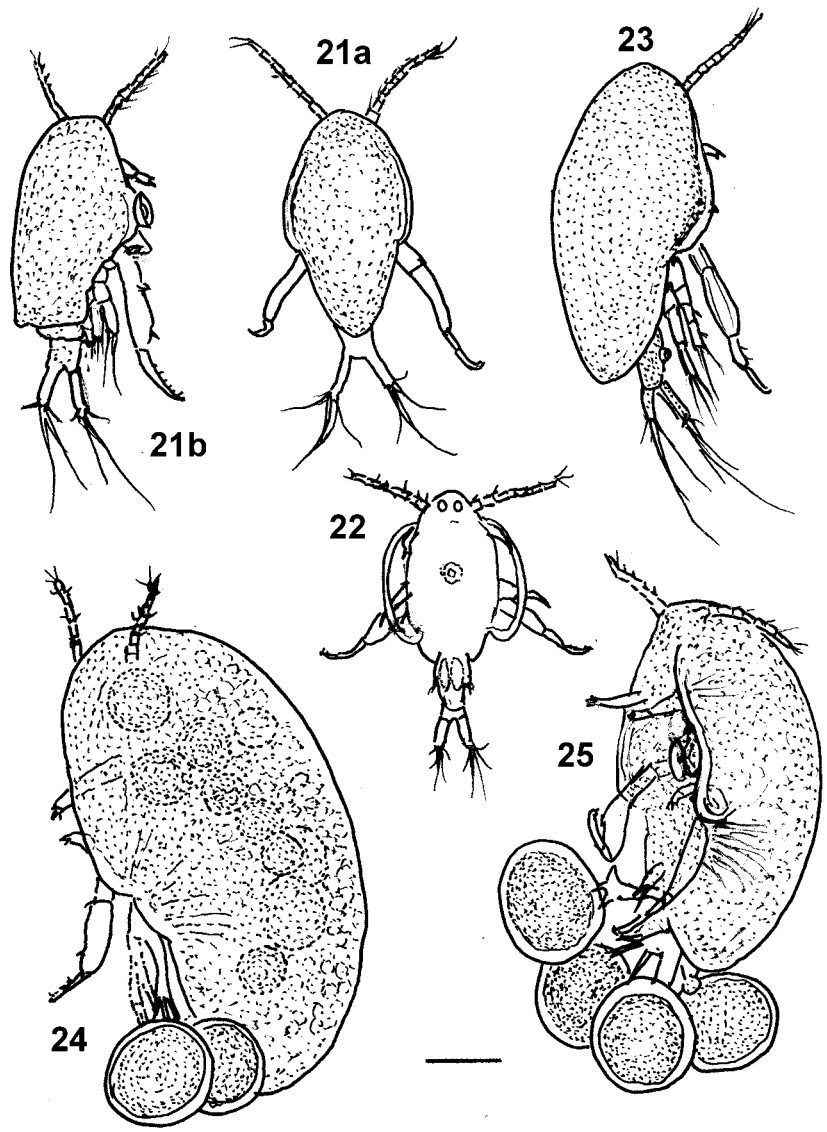

FIGURE 21: a – Copepodid III (pupa); b – Same, lateral view. **FIGURE 22** – Male. **FIGURE 23** – Young female. **FIGURE 24** – Ovigerous female. **FIGURE 25** – Spent female. All scale bars equal to 0.10 mm.

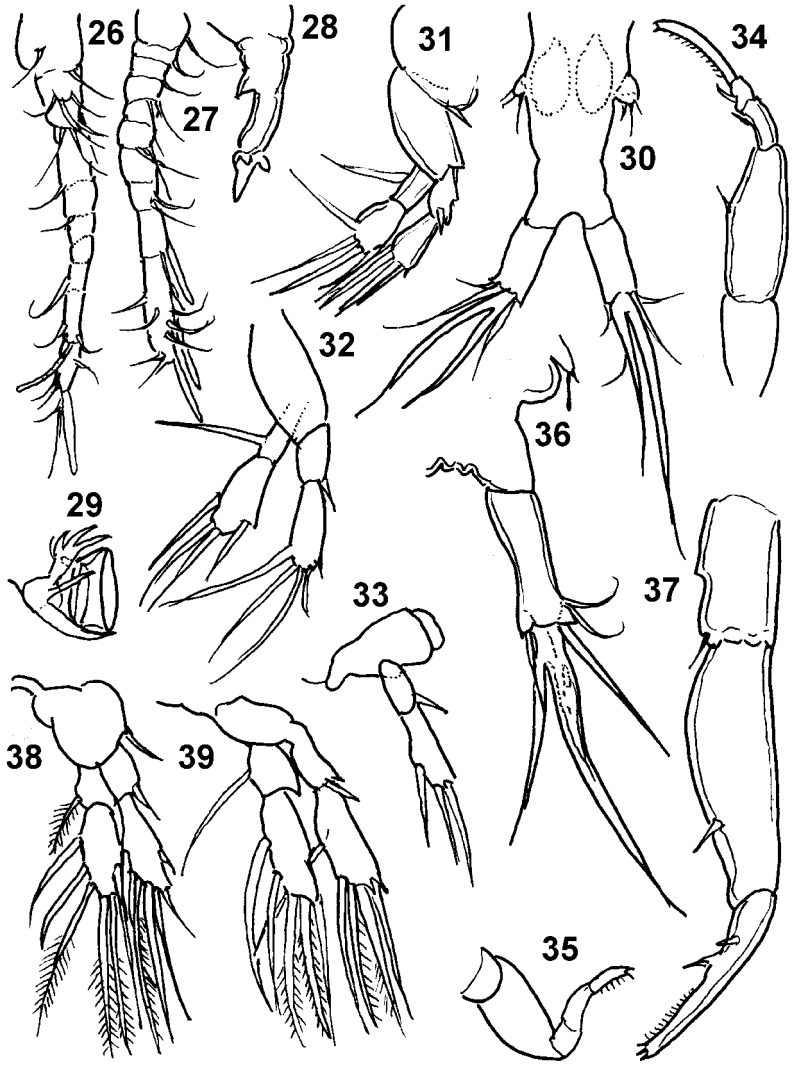

FIGURE 26 – Antennule of male. **FIGURE 27** – Antennule of copepodid III. **FIGURE 28** – Antenna of male. **FIGURE 29** – Oral cone of male. **FIGURE 30** – Male urosome. **FIGURE 31** – Male: second leg. **FIGURE 32** – Male: first leg. **FIGURE 33** – Male: deformed first leg. **FIGURE 34** – Male maxilliped. **FIGURE 35** – Male maxilla. **FIGURE 36** – Copepodid III: part of urosome and caudal ramus. **FIGURE 37** – Copepodid III maxilliped. **FIGURE 38** – Copepodid III first leg. **FIGURE 39** – Copepodid III second leg. All scale bars equal to 0.10 mm.

Copepodid II (Figs. 14a, 14b): Body globular, reduced towards urosome, less sclerotized than first copepodid; length 0.273–0.298 mm. Articulations not or hardly visible. Widest part of urosome, provided with 2 thorn-like lateral protuberances. Antennule with ten joints (s. f.: 1: 0: 1: 1: 1: 1: 1: 1: 2 + 1: 4); boundaries between joints indistinct (Fig. 15). Antenna (Figs. 16a, 16b) 4 or 3–jointed; second joint with spine-like protuberance

composed of two or three setae: last joint with cylindrical terminal protuberance and 2 lateral flanged spines. Mandibles (Fig. 14) blade-like, well sclerotized, protruding into sucker or oral disc, lateral to labrum. Oral disc, circular, cup-like, with thin transparent rim. Maxillule (Fig. 20): very thin, transparent structure, similar to maxillule of adult, with coxobasis and 2 lobes, one bearing thick pointed seta, protuberance with thin seta and anterior lobe with 2 setae visible over border of sucker or oral disc. Maxilla (Fig. 17) 2 or 3–jointed, ending in 2 minute spines. Maxilliped (Fig. 14a) indistinctly 4–jointed, with 2 lateral spines on third joint and last joint in form of thick spine. First leg (Fig. 18): coxobasis with one seta; endopod 2–jointed (s. f.: 1 + I: III + 3); exopod 2–jointed (s. f.: 1: II + 3). Second leg (Fig. 19): coxobasis with one outer seta; endopod indistinctly 2–jointed (s. f.: 1 + I: 1 + 3 + I); exopod 2–jointed (s. f.: I: II + 3 + 1).

Female copepodid (Figs. 21a, 21b): Size 0.335 mm. General form of copepodid II with very conspicuous lateral transparent margins (wings), visible dorsally and ventrally. Segmentation of appendages distinct. Antennule (Fig. 27): 10 or 11 segments. Antenna, oral cone, mandible, maxillule and maxilla, maxillipeds (Fig. 37) similar to those of copepodid II. First and second legs with 2-jointed endopods and exopods (Figs. 38–39). First leg with spine on coxobasis; endopod with s. f.: 1: 6; exopod, s. f.: I: II + 5. Second leg (Fig. 39) with bare coxobasis and endopod with s. f.: 1: 5; exopod with spine on first segment and spine-like distal and external protuberance, 2 spine-like external distal protuberances on second segment, plus 5 setae. Urosome (Fig. 36) showing two lateral round protuberances, characteristic of female urosome.

Adult female (Figs. 1a, 1b): Length 0.62–0.83 mm (5 specimens); body oval-shaped, without divisions in prosome, rounded and wider in front. Lateral "wing-like" fold protuberant on both sides of head. Margin of fold ornamented by transparent rim conspicuous in young females (semi lateral view), in gravid females hardly or not visible. Urosome narrow, short and overlapped by posterior region of prosome; indistinctly divided into 2 segments. Antennule (Fig. 40) 12–jointed (s. f.: 1: 1: 1: 2: 0: 1: 1: 1: 1: 3 + ae: 2: 4 + ae). Antenna (A2) (Figs. 41a, 41b) 3–jointed; first and second joints unarmed, third bearing 2 thick, finger-like structures one of which with 2 small pointed spines distally and a terminal denticulate or comb-like protuberance. Mandible: blade-like, tapering distally. Maxillule (Mx1) (Fig. 42b) situated lateral to oral cone with long pointed posterior lobe or seta, middle protuberance ending in pointed structure, and frontal lobe or joint indistinctly divided into two which projects over border of cone and is armed with 2 thick pointed setae and two thinner, smaller setae. In frontal view (Fig. 42a), it is possible to see mandibles (Md) protruding into the mouth of the specimen in form of two blades. Maxilla (Mx2) (Figs. 43a, 43b) 3–jointed: last joint with four short spiny protuberances – two of which longer. Maxilliped (Mxp) (Fig. 44) 5–jointed with first, second and third joints with seta or spine each, fourth joint with small lateral seta and spine, last joint with margin provided with row of thin setules and terminal comb-like structure ornamented with minute spines. First leg (P1) (Fig. 45): coxa unarmed, basis with external seta; exopod bimerous with s. f. = I + 0: I + I + 4; endopod bimerous, with s. f. = 0 + 1: 1 + 2 + 3. Second leg (Fig. 46):

coxa unarmed; basis I + 0; exopod bimerous, with s. f. = I + 0: I + I + 3 + 1; endopod I + 1: 1 + 2 + 2. Third leg single-jointed with two longer and one very short small seta. Urosome marked off from body by two cup-like protuberances (genital openings). Urosome cylindrical, not terminal, placed posterior to genital cups, with 2 or 3 indistinct segments, last of which divided into two branches which end in the elongate caudal rami, about three times longer than wide. Caudal rami ornamented with two lateral fine setae, one on each side; a long blade-like bipinnate seta and two double as long setae coalesced at base and bipinnate.

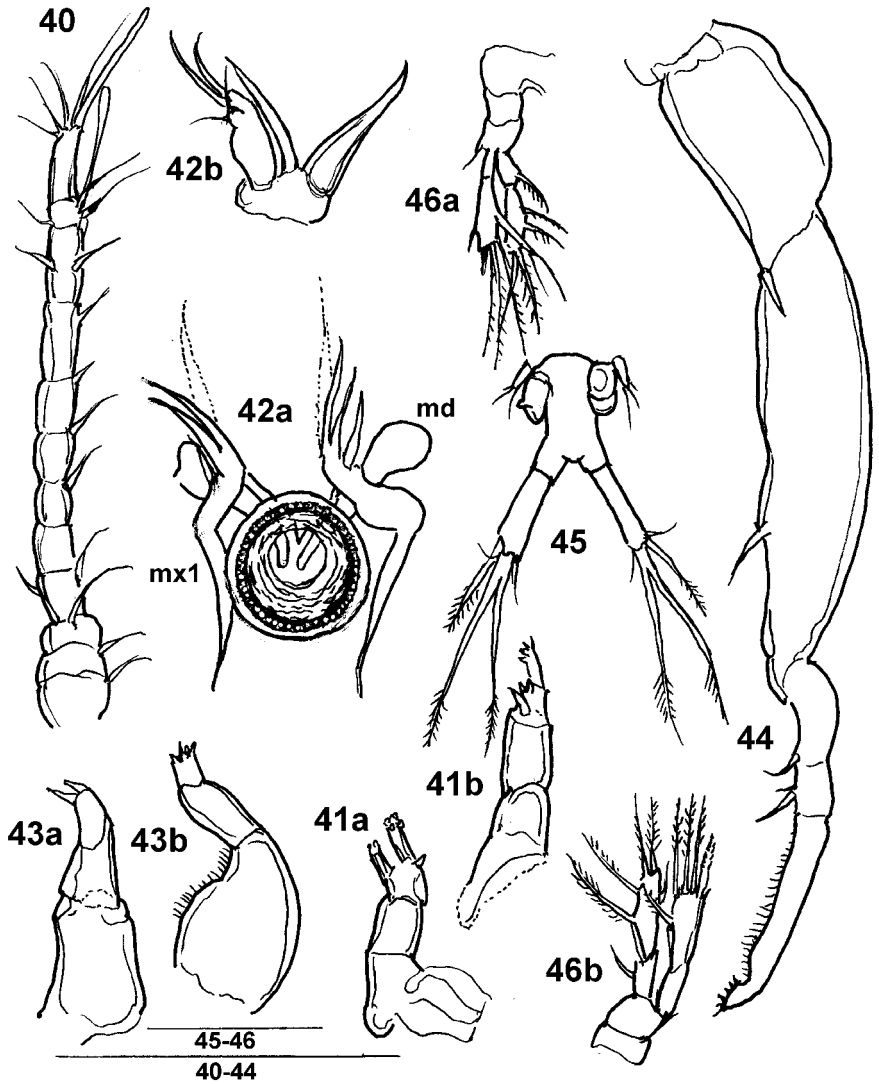

FIGURE 40 – Antennule of adult female of *C. libiniae*. **FIGURE 41** – Antenna of adult female of *C. libiniae*: a – ventral view; b – lateral view. **FIGURE 42** – Oral cone (o. c.); maxillule (mx1) and mandible (md): a – ventral view; b – lateral view of maxillule. **FIGURE 43** – Maxilla of adult female of *C. libiniae*: a – dorsal view; b – lateral view. **FIGURE 44** – Maxilliped of adult female of *C. libiniae*. **FIGURE 45** – Posterior region of urosome (adult female) and third leg. **FIGURE 46**: a – First leg of adult female; b – Second leg of adult female. All scale bars equal to 0.10 mm.

Male (Fig. 22): Size 0.320–0.350 mm. Characterized by transparency and by presence of wing-like protuberances on each side of body. Antennule (Fig. 26) has 10 segments. Antenna (Fig. 28) has long terminal finger-like protuberance, 4 times as long as wide. Maxilla of male (Fig. 35) with terminal segment 5 times as long as wide. Oral cone, maxillule, maxilliped (Fig. 34) similar to those of CII. First legs of male (Fig. 32) with spine or seta on the proximal segment of the endopod and exopod. Last exopod segment bearing 2 spines and 3 setae, and last endopod segment with 4 setae. Second legs (Fig. 31) with seta on first endopod segment and 4 setae on last. First segment of exopod with 2 spines; second segment with 4 setae and spine-like protuberance.

Legs of male (Fig. 33) frequently with deformed rami. Spine and protuberance with 2 minute setae representing third pair of legs on urosome (Fig. 30). Urosome unsegmented, containing 2 pear-shaped spermatophores. Caudal rami bearing 2 very fine lateral setae and 3 longer setae of which the 2 longest are coalesced at base.

In addition to the above mentioned forms of *Choniomyzon*, the following stages were also present in the samples and will be treated in more detail in a later paper: young female, ovigerous female and spent female (a female which has laid her eggs) (Figs. 23 to 25).

Diagnosis

The new species is characterized by the ovoid form and the indistinctly 3-segmented urosome, which is not terminal. The first and second legs do not show a button-like ornament as in *C. panuliri* Pillai. The antenna of the adult female bears finger-like projections, one or two of which have denticulate margins. The maxilla has four terminal spines and the maxillipeds have a terminal denticulate margin.

Etymology

The name of the species is a reference to its host, *Libinia spinosa*.

Discussion

Bradford (1975) in her general comments on the Nicothoidae (=Choniostomatidae) listed *Choniosphaera* and *Choniomyzon* as the only genera of the family which hatch as nauplii. The present species shares this character with both of these genera, as it also hatches as a nauplius. *Choniosphaera* (Connolly 1929; Gnanamuthu 1954; Johnson 1957) has no distinct urosome and the legs have very reduced endopods, in size and number of setal elements, whereas *Choniomyzon* has a distinct urosome (Pillai 1962; Bradford 1975) and two pairs of legs with 2-jointed rami of about the same size armed with five to seven elements on each ramus. Our species is therefore included in this genus, because it also has a distinct urosome and legs with about equal rami, armed with five to seven elements.

The nauplii of the Nicothoidae (Connolly 1929; Johnson 1957) are lecithotrophic and can be distinguished from all other known cyclopoid-like nauplii by the presence of a very

transparent, thin aesthetasc in the form of a minute ovoid flat leaf attached to the second antennae. When observed from a certain angle it looks like an almost rectangular structure (Figs. 5a, 5b).

The copepodid I can be considered the "family-typical stage" of development for the Nicothoidae, but it usually has four, three or fewer segments in the first antenna. The copepodid of *Choniomyzon panuliri* (Bradford 1975) has an interesting combination of features. It has the 3-segmented urosome of a CI and the prosome of a copepodid II with the antennule 12-jointed with 2-jointed endopods and exopods in the first and second legs, plus the lateral wing-like protuberances. Thus, it combines features of 2 larval stages (copepodids) of the *Choniomyzon libiniae* sp. nov.

Choniomyzon libiniae sp. nov. has three distinct forms of copepodids. The differences between the *C. panuliri* (= *C. p.*) and the *C. libiniae* (= *C. l.*) copepodids are: the presence of a strong spine on segment 2 and a terminal finger-like process on the antenna of *C. l.* II, whereas in the *C. p.* copepodid the spine is absent on segment 2 and there are two spines and a blade-like ornament on the distal part of segment 4; maxillule and maxillae of *C. l.* are provided with four thick setae, whereas in the *C. p.* copepodid there are 6 setae on the maxillule (Bradford, 1975, fig. 3n) and the maxilla seems to be bare, devoid of the 2 terminal minute pointed processes present in the *C. l.* maxilla; the maxilliped of the *C. p.* copepodid ends in a blunt setuled blade which in *C. l.* copepodid I is a pinnate spine or hook and in *C. l.* copepodid II is a spine-like tapering process. The caudal rami of *C. l.* copepodids are far shorter and wider than the caudal rami of the *C. p.* copepodids. The *C. p.* copepodid also bears a pair of un-segmented legs which in the *C. l.* copepodids I and II are probably represented by two lateral spines on each side of the first urosome segment of *C. l.* I and by two pointed protuberances on the urosome of *C. l.* II. The third copepodid differs from the copepodids of other Nicothoidae because it has a distinct urosome. It shows the primordia of the genital annular protuberances on the urosome, but has only 10 or 11 joints in the first antenna. At first sight it can be easily mistaken for a male, if it were not for its reduced transparency and absence of spermatophores. The transparent wing-like lappets on either side of the body of the male are more conspicuous than in the female.

Although the male of *Choniomyzon libiniae* has the same general shape as the male of *Choniosphaera*, the legs and leg setation are more similar to that of the female of its species. Neither Bradford (1975) nor Pillai (1962) figured the legs of the male of *C. panuliri* and the number of segments in the rami is not mentioned in the text. The male of *C. libiniae* differs from the copepodid III because it has fewer setae on the exopod of the first leg. More Nicothoidae should be studied with all their developmental stages to improve the understanding of these interesting small parasites and their relationships within the family and to other copepod families.

Acknowledgements

We are deeply indebted to Geoff A. Boxshall for reading and commenting on our paper.

We thank the staff and librarians of the CEBIMar (Centro de Biologia Marinha da Universidade de São Paulo) for their help and interest in our research. We are grateful to Cláudio G. Tiago for sharing space in his laboratory. We also thank Almir R. Pepato and Gisele Y. Kawauchi for helping with formatting the figures. Finally we are grateful to FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) for providing a scholarship (process number 01/01797-2) to CS.

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