JOURNAL OF CRUSTACEAN BIOLOGY, 14(2): 314–318, 1994

FIRST STAGE LARVA OF *AXIOPSIS SERRATIFRONS* (A. MILNE EDWARDS, 1873) REARED IN THE LABORATORY (DECAPODA: THALASSINIDEA: AXIIDAE)

Sérgio de Almeida Rodrigues

ABSTRACT

The first larval stage of *Axiopsis serratifrons* (A. Milne Edwards) is described and illustrated. The larva has a smooth carapace, abdominal somites 2–5 with dorsal spines, endopod of antenna with 3 setae, mandibles symmetrical, endopod of maxillule and maxilla 2-segmented, maxillipeds 1 and 2 with 3-segmented endopod, maxilliped 3 with unsegmented endopod, and telson without median process. This is the first larval stage of an *Axiopsis* to be identified with certainty.

The larval life of the Axiidae, a family containing about 100 species (Sakai and de Saint Laurent, 1989) is very poorly known. Larvae attributed to this family have been described by Gurney (1924, 1938), Lebour (1941), Kurata (1965), and Wear (1965), but in many cases it is not possible to recognize the genera or the family is doubtfully identified. A last-stage larva, obtained in a plankton sample from Bermuda, changed to a postlarva in the laboratory and was considered by Lebour (1941) as belonging to the genus *Axiopsis,* subgenus *Paraxiopsis,* now regarded as a junior synonym of *Eutrichocheles* Wood Mason (see Sakai and de Saint Laurent, 1989; Rodrigues and Kensley, 1991).

In four axiid species, larvae of known parentage have been described: (1) *Axius stirhynchus* Leach—The first and second stage and one postlarva were obtained from the plankton by Webb (1921); (2) *Axius plectorhynchus* Stahl—Gurney (1938) dissected ripe eggs and described the prezoea and some first stage larval characters observed through the embryonic cuticle; (3) *Calocarides coronatus* (Trybom)—Three larvae possibly representing the second stage were described by Elofsson (1959); (4) *Neaxius vivesi* (Bouvier)—A first stage larva obtained from the eggs by Berrill (1975) was figured in dorsal view, but not described. Virtually nothing is known about the larvae of representatives of *Axiopsis* and no first stage axiid larvae have been described from specimens reared in the laboratory.

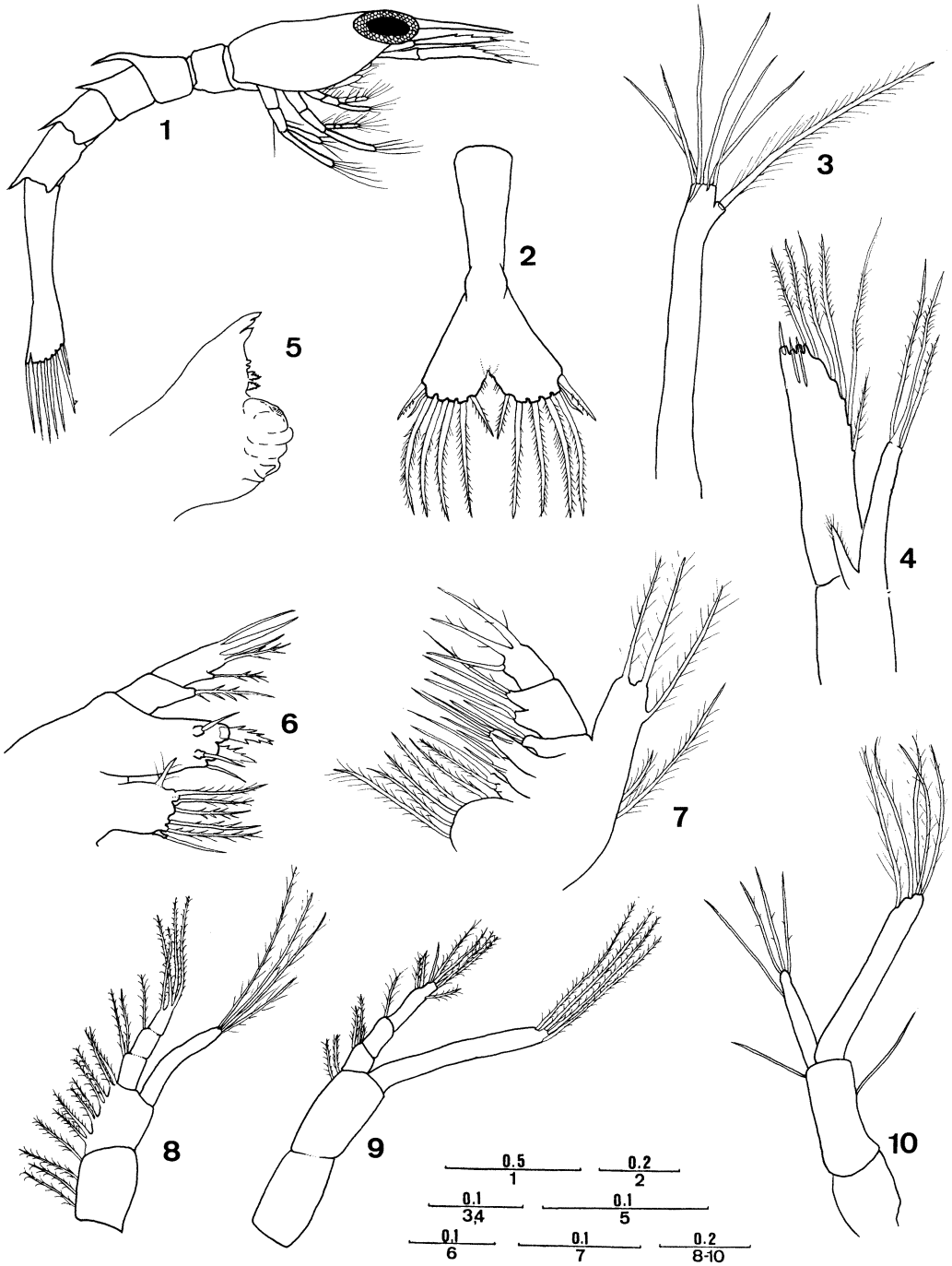
Of the closely related family Calocarididae, a taxon recently resurrected by Kensley (1989), only *Calocaris macandreae* Bell has had its larval life investigated. The first and second stage larvae were reared in the laboratory by Bull (1934), and several other stages were described from the plankton: second and third stages by Gurney (1942); third stage by Sars (1884); third stage and one postlarva by Björk (1913); but the complete larval development is still unknown (Bourdillon-Casanova, 1960).

In this paper the first stage larva of *Axiopsis serratifrons* (A. Milne Edwards) is described from material reared at Curaçao, Lesser Antilles, during a stay at the Caraibisch Marien-Biologisch Instituut (CARMABI). These results were included in an unpublished monograph submitted to the University of São Paulo, Brazil (Rodrigues, 1983) to obtain the degree of Privat-dozent.

Axiopsis serratifrons was first described from the Pacific Ocean (A. Milne Edwards, 1873), and later recorded from the Indian Ocean and the Red Sea (de Man, 1925). In the western Atlantic this axiid was recorded by Kensley (1980) who examined specimens from Bermuda, Florida, and Belize, and compared them with material from the Gilbert Islands, Bikini Atoll, and South Africa, concluding that the species was rather variable in its morphology and widely distributed in the shallow tropical seas. More recently, the species was recorded from Brazil (Rodrigues and Kensley, 1991) and the Pacific coast of Colombia (Lemaitre and Ramos, 1992).

MATERIALS AND METHODS

One ovigerous female was collected on 2 December 1966 at the entrance of Piscadera Baai, Curaçao, at a depth of about 2 m, in a burrow dug in coral debris. The eggs were attached to the first, second, and third pair of pleopods and were approximately 1 mm in



Figs. 1–10. *Axiopsis serratifrons,* first larval stage: 1, whole larva in lateral view; 2, telson in dorsal view; 3, antennule; 4, antenna; 5, mandible; 6, maxillule; 7, maxilla; 8, maxilliped 1; 9, maxilliped 2; 10, maxilliped 3. All scales in mm.

diameter. The yolk was entirely segmented and the ventral plate, without yolk, filled about one-fourth of the total egg mass. This aspect corresponds to stage 4 in the subdivision proposed by Boolotian *et al.* (1959: 216) for the embryology of decapods, and already used to describe the development of the thalassinidean *Callichirus major* Say (see Rodrigues, 1976: fig. 3). After 4 days, the yolk occupied half of the egg and the eyes became visible as 2 crescent-shaped dark spots (stage 5). On the sixth day, the yolk was reduced to the area of the cephalothorax, limb buds became visible, the eyes became elliptical, the heart started beating, and a

single red chromatophore appeared in the mouth region (stage 6). On the next day, 2 chromatophores appeared in the middle of the telson (stage 7). On the ninth day, the yolk was drastically reduced (stage 8) and the prezoea started moving actively inside the egg shell (stage 9). On the next day, the prezoea hatched (stage 10). Between stage 4 and stage 10, 10 days elapsed. Only one prezoea reached the first stage zoea, but died 3 days after, without molting to the second stage.

Another female carrying eggs was obtained from the same locality on 12 January 1967. The eggs were not examined in order to avoid disturbing the parent shrimp. Hatching took place 3 days later and 13 larvae were isolated in Petri dishes. Six days later, 2 of these died in the process of molting to the second stage. The others died without molting. These larvae showed several incompletely developed setae.

RESULTS

First Larval Stage (Figs. 1–10)

Body.—Total length about 3 mm. Laterally compressed and transparent, except for 3 reddish chromatophores, 2 on telson and 1 on buccal region, and dark pigment on eyes.

Carapace (Fig. 1).—Smooth, without teeth, serrations, linea thalassinica, or cervical groove; rostrum straight, slightly longer than half length of carapace, with few delicate short hairs near apex. Eyes elliptical and sessile.

Abdomen (Fig. 1).—5-segmented, somites 2–5 with dorsal spines, spine of somite 2 two times longer than remaining spines, somites 4 and 5 with small posterolateral rounded spines, somite 6 fused with telson (Fig. 2).

Antennule (Fig. 3).—Unsegmented; distal extremity with 6 smooth setae; exopod reduced to long plumose seta.

Antenna (Fig. 4).—Exopod with apical spine and 8 plumose setae on mesial margin, external margin smooth, straight; endopod reaching beyond midlength of exopod, with 3 apical plumose setae; protopod with strong plumose spine near base.

Mandibles (Fig. 5).—Symmetrical, cutting edge with 4 strong and 2 weak teeth; molar region slightly serrated; endopod absent.

Maxillule (Fig. 6).—Endopod 2-segmented with 3 apical smooth, 1 subapical plumose, and 2 marginal plumose setae; protopod distal lobe with 2 serrated teeth and 3 spiniform setae, proximal lobe with 1 short spinose, 5 long plumose, and 1 smooth setae.

Maxilla (Fig. 7).—Endopod 2-segmented, with 3 apical slightly plumose setae and 2–2 slightly plumose setae on proximal segment; exopod with 3 plumose setae, 2 apical, 1 subapical, and 2 marginal plumose setae; protopod with 5 endites bearing 2–4–3–2–5 setae from distal to proximal, all setae of proximal lobe and one of subproximal lobe plumose, others smooth.

Maxilliped 1 (Fig. 8).—Exopod and endopod about same length; endopod with 2 constrictions suggesting beginning of trisegmentation, 4 apical plumose setae and 1 or 2 plumose setae on mesial margin; exopod unsegmented, with 4 apical plumose setae; basis with 4 pairs of plumose setae on mesial margin, coxa with 4 plumose setae on mesial margin.

Maxilliped 2 (Fig. 9).—Endopod shorter than exopod, 3-segmented, distal segment with 8 plumose setae, 5 apical, 2 on mesial and 1 on external margin, remaining segments with 1 or 2 plumose setae on mesial margins; exopod unsegmented, with 4 apical plumose setae; basis with 2 plumose setae on distal portion of mesial margin, coxa naked.

Maxilliped 3 (Fig. 10).—Endopod one-half length of exopod, unsegmented, with 3 apical setae bearing few spinules and 1 subapical seta; exopod with 5 apical plumose setae; basis with 1 smooth seta on mesial and 1 on external margin, coxa naked.

Pereiopods and pleopods.—Not developed.

Telson (Fig. 2).—Approximately heart-shaped, without median process; posterolateral spine (spine 1) stout with 4 spinules on inner margin; spine 2 reduced to hair; spines 3–6 plumose, about same size and more than 3 times longer than spine 1; spine 7 as long as spine 1, but more flexible and plumose; central indentation of posterior margin slightly pilose.

Remarks

A comparison of the larva of *A. serratifrons* with previous descriptions available in the planktonic literature shows that only species A, stage 1, from Bermuda (Lebour, 1941: 418, fig. 42) is closely related to it. The outline and posterior spines of the tel-

son are alike, but in other aspects, such as the margins of the rostrum and carapace, the number of setae on the maxillipeds, and pigmentation, differences can be noted, precluding specific identification, perhaps even considering that the adults of *A. serratifrons* exhibit some degree of variation (Kensley, 1980).

In *A. stirhynchus, A. plectorhynchus,* and *C. macandreae,* development is abbreviated, the larvae hatching with pereiopods and pleopods (Webb, 1921; Gurney, 1938; Bull, 1934). In opposition, the absence of these appendages in *A. serratifrons* and the very simple morphology of maxilliped 3, with few setae and an unsegmented endopod, are indications of a long larval development, probably with five stages or even more. However, considering the wide circumtropical distribution of *A. serratifrons* (Kensley, 1980), a long planktonic life is not surprising, rather, it is to be expected.

Konishi (1989) compared the main zoeal characters among five thalassinidean families (Konishi, 1989: table 3). In contrast to the characters considered as typical of the axiids, the larva here described has less segmented endopods in all mouth parts and telson without median process. As remarked above, the small number of endopodal segments may be related to a long larval life. Concerning the absence of the telsonic median process, the first stage larva figured by Berrill (1975), as well as the species A of Lebour (1941), also lack this process. Thus, it is possible that this is a character common to several related species or genera within the family. However, knowledge of the larval life of axiids is still so scarce that it seems a temerity to attempt any generalization. The situation has not improved much since Gurney (1938: 300) considered that "it is perhaps rash to attribute to the Axiidae any larvae which do not show abbreviated metamorphosis and the characters common to the two species known."

Acknowledgements

The Netherlands Ministry of Education and Sciences provided a grant for a visit to the Caraibisch Marien-Biologisch Instituut, and this support is gratefully acknowledged. The manuscript was prepared for publication by Luciana Poli Preto, to whom I am most thankful.

Literature Cited

Berrill, M. 1975. Burrowing, aggressive and early larval behavior of *Neaxius vivesi* (Bouvier) (Decapoda, Thalassinidea).—Crustaceana 29: 92–98.

Björck, W. 1913. Beiträge zur Kenntnis der Decapodenmetamorphose. II. Über das postlarvale Stadium von *Calocaris macandreae* Bell.—Arkiv för Zoologi 8(7): 1–8.

Boolotian, R. A., A. C. Giese, A. Farmanfarmian, and J. Tucker. 1959. Reproductive cycles of five West Coast crabs.—Physiological Zoology 32: 213–220.

Bourdillon-Casanova, L. 1960. Le méroplancton du Golfe de Marseille: les larves de Crustacés Décapodes.—Recueil des Travaux de la Station Marine d' Endoume 30(18): 1–286.

Bull, H. O. 1934. The newly-hatched larva of *Calocaris macandreae* Bell.—Report of the Dove Marine Laboratory 3: 48–50.

Elofsson, R. 1959. A new decapod larva referred to *Calocarides coronatus* (Trybom).—Universitet i Bergen Arbok 7: 1–10.

Gurney, R. 1924. Decapod larvae.—Natural History Reports of the "Terra Nova" Expedition, Zoology 8: 37–202.

———. 1938. Larvae of decapod Crustacea. Part V. Nephropsidea and Thalassinidea.—Discovery Reports 17: 291–344.

———. 1942. Larvae of decapod Crustacea.—Ray Society, London, England. Pp. 1–306.

Kensley, B. 1980. Notes on *Axiopsis* (*Axiopsis*) *serratifrons* (A. Milne Edwards) (Crustacea: Decapoda: Thalassinidea).—Proceedings of the Biological Society of Washington 93: 1253–1263.

———. 1989. New genera in the thalassinidean families Calocarididae and Axiidae (Crustacea: Decapoda).—Proceedings of the Biological Society of Washington 102: 960–967.

Konishi, K. 1989. Larval development of the mud shrimp *Upogebia* (*Upogebia*) *major* (De Haan) (Crustacea: Thalassinidea: Upogebiidae) under laboratory conditions, with comments on larval characters of thalassinid families.—Bulletin of the National Research Institute of Aquaculture 15: 1–17.

Kurata, H. 1965. Larvae of decapod Crustacea of Hokkaido. 9. Axiidae, Callianassidae and Upogebiidae (Anomura).—Bulletin of Hokkaido Regional Fisheries Research Laboratory 30: 1–10.

Lebour, M. V. 1941. Notes on thalassinid and processid larvae (Crustacea Decapoda) from Bermuda.—Annals and Magazine of Natural History (11)7: 401–420.

Lemaitre, R., and G. E. Ramos. 1992. A collection of Thalassinidea (Crustacea: Decapoda) from the Pacific coast of Colombia, with description of a new species and a checklist of eastern Pacific species.—Proceedings of the Biological Society of Washington 105: 343–358.

Man, J. G. de. 1925. The Decapoda of the Siboga-Expedition. Part 6. The Axiidae collected by the Siboga-Expedition.—Siboga Expeditie 39ª(5): 1–128.

Milne Edwards, A. 1873. Description de quelques Crustacés nouveaux ou peu connus provenant du Musée de M.C. Godeffroy.—Journal des Museum Godeffroy 4: 77–88.

Rodrigues, S. de A. 1976. Sobre a reprodução, embriologia e desenvolvimento larval de *Callichirus major* Say, 1818 (Crustacea, Decapoda, Thalassi-

nidea).—Boletim de Zoologia, Universidade de São Paulo 1: 85–103.

———. 1983. Aspectos da biologia de Thalassinidea do Atlântico tropical americano.—Tese (Livre Docência) Departamento de Zoologia, Instituto de Biociências da Universidade de São Paulo. Pp. 1–144.

———, and B. Kensley. 1991. *Eutrichocheles pindatyba,* a new axiid shrimp (Crustacea: Decapoda: Thalassinidea) from Brazil.—Proceedings of the Biological Society of Washington 104: 556–560.

Sakai, K., and M. de Saint Laurent. 1989. A check list of Axiidae (Decapoda, Crustacea, Thalassinidea, Anomura), with remarks and in addition description of one new family, eleven new genera and two new species.—Naturalists [Tokushima Biological Laboratory, Shikoku Women's University, Japan] 3: 1–104.

Sars, G. O. 1884. Bidrag til Kundskaben om Decapodernes Forvandlinger. I. *Nephrops, Calocaris, Gebia.*—Archiv for Mathematik og Naturvidenskab 9: 155–204.

Wear, R. G. 1965. Zooplankton of Wellington Harbour, New Zealand.—Zoology Publications from Victoria University of Wellington 38: 1–31.

Webb, G. E. 1921. The larvae of the Decapoda Macrura and Anomura of Plymouth.—Journal of the Marine Biological Association of the United Kingdom 12: 385–417.

RECEIVED: 19 August 1992.
ACCEPTED: 23 June 1993.

Address: Departamento de Ecologia Geral, Instituto de Biociências and Centro de Biologia Marinha, Universidade de São Paulo, Caixa Postal 11461, CEP 05422-970, São Paulo, SP, Brazil.