

# EGG CAPSULES, EGGS AND EMBRYOS OF THE SOUTHWESTERN ATLANTIC GASTROPOD *CORONIUM CORONATUM* (GASTROPODA: MURICIDAE)

GUIDO PASTORINO<sup>1</sup>, PABLO E. PENCHASZADEH<sup>1,2</sup>  
AND FABRIZIO SCARABINO<sup>3</sup>

<sup>1</sup>Museo Argentino de Ciencias Naturales, Av. Ángel Gallardo 470 3° piso lab. 80, C1405DJR Buenos Aires, Argentina;

<sup>2</sup>Depto. Biodiversidad y Biología Experimental, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Ciudad Universitaria, Pab. II, C1428EHA Buenos Aires, Argentina; and

<sup>3</sup>Museo Nacional de Historia Natural y Antropología, C. C. 399 – C. P. 11.000, Montevideo, Uruguay

(Received 18 March 2006; accepted 10 October 2006)

## ABSTRACT

The egg capsules, eggs and embryos of the muricid gastropod *Coronium coronatum* are described for the first time. Capsules are sessile, bulliform, semi-circular, with a plug in the dorsal center. Sutures split the capsule into two asymmetrical halves. Recently laid capsules showed the presence of 3639 ( $n = 2$ ) uncleaved nurse eggs with a diameter of 180–210  $\mu\text{m}$  (mean =  $197.4 \pm 8.9$ ). The number of early embryos was 9–11. The size of the embryos was  $320 \times 320$  to  $820\text{--}880 \mu\text{m}$ . Nine pre-hatching embryos of 3.94 mm ( $n = 8$ ,  $\text{SD} = 0.32$ ) were found inside the older capsule. SEM illustrations of embryos and radulae are provided. Comparison of shell and radula of embryos with the protoconch and radulae of adults of *C. coronatum* revealed that the capsule belongs to this species.

## INTRODUCTION

The Muricidae are diverse components of southwestern Atlantic neogastropod faunas, particularly the genus *Trophon* which includes at least 15 species with others still undescribed (Pastorino, 2005). Additionally, there are some endemic muricids such as recently described *Coronium* Simone, 1996 (south-eastern Brazil to Uruguay), and the typically Patagonian *Xymenopsis* Powell, 1951, which includes several species from the Magellanic region that are locally common (Pastorino & Harasewych, 2000).

Zaixso (1973), Penchaszadeh (1976) and D'Asaro (1991), described several egg capsules of the muricid genus *Trophon* while Pastorino & Harasewych (2000) illustrated the capsules of *X. muriciformis* (King & Broderip, 1832). As far as we know no description or illustrations of capsules or embryos referable to *Coronium* have been published up to date. In this paper we describe the egg capsules, eggs and embryos of *Coronium coronatum* (Penna-Neme & Leme, 1978). This species is of some phylogenetic interest because it was, until recently, classified in the family Turbinellidae rather than Muricidae (Simone, 1996).

## MATERIAL AND METHODS

Three capsules of the genus *Coronium* in different development stages were found attached to living or dead shells of the bivalve *Pteria hirundo* (Linnaeus, 1758). Only one of them had embryos near hatching. It was collected by the Uruguayan ship R/V *Aldebaran*, Cruise 2005/1 at  $35^{\circ}56'5''\text{S}\text{--}53^{\circ}51'4''\text{W}$  to  $35^{\circ}55'4''\text{S}\text{--}53^{\circ}49'4''\text{W}$  at 64 m depth on 20 July 2005 and fixed onboard with 5% buffered formalin. Two other capsules of the same size but at an earlier development stage were collected by the same ship, Cruise 2005/4 on 14 November 2005,  $35^{\circ}46'5''\text{S}\text{--}53^{\circ}34'1''\text{W}$  to  $35^{\circ}48'5''\text{S}\text{--}53^{\circ}34'7''\text{W}$ , 69–75 m. Additionally, two half-grown specimens of *C. coronatum* were collected at Cruise 2005/04, on 14 November 2005, from  $35^{\circ}38'\text{S}\text{--}53^{\circ}08'6''\text{W}$  to  $35^{\circ}39'6''\text{S}\text{--}53^{\circ}09'6''\text{W}$ , 104–105 m.

Correspondence: G. Pastorino; e-mail: pastorin@mail.retina.ar

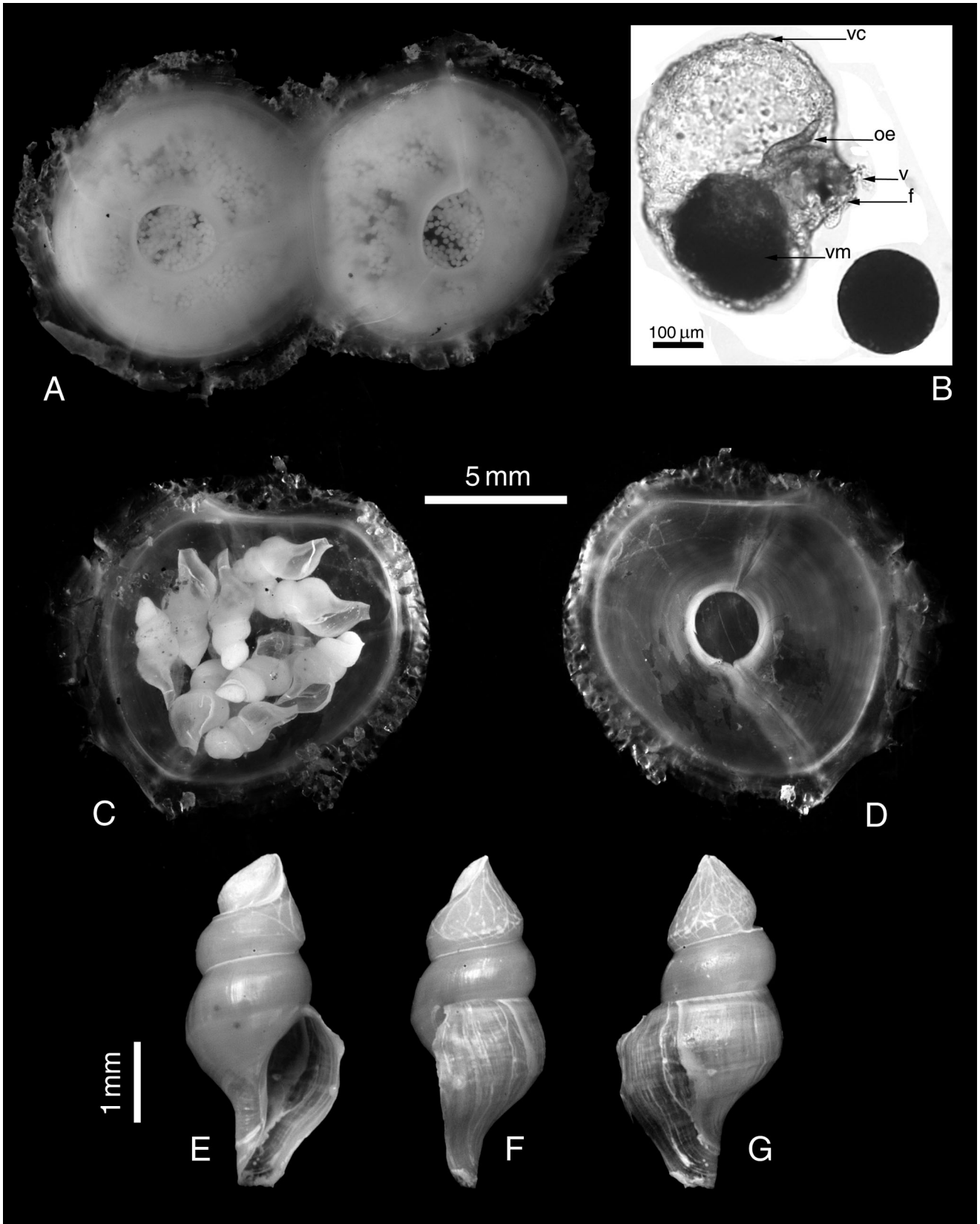
Adult specimens of *C. coronatum* from the Invertebrate Zoology Department collection of the Museo Argentino de Ciencias Naturales, Buenos Aires (MACN-In) were dissected and radulae prepared for observation and SEM photography as in Pastorino (2005).

## RESULTS

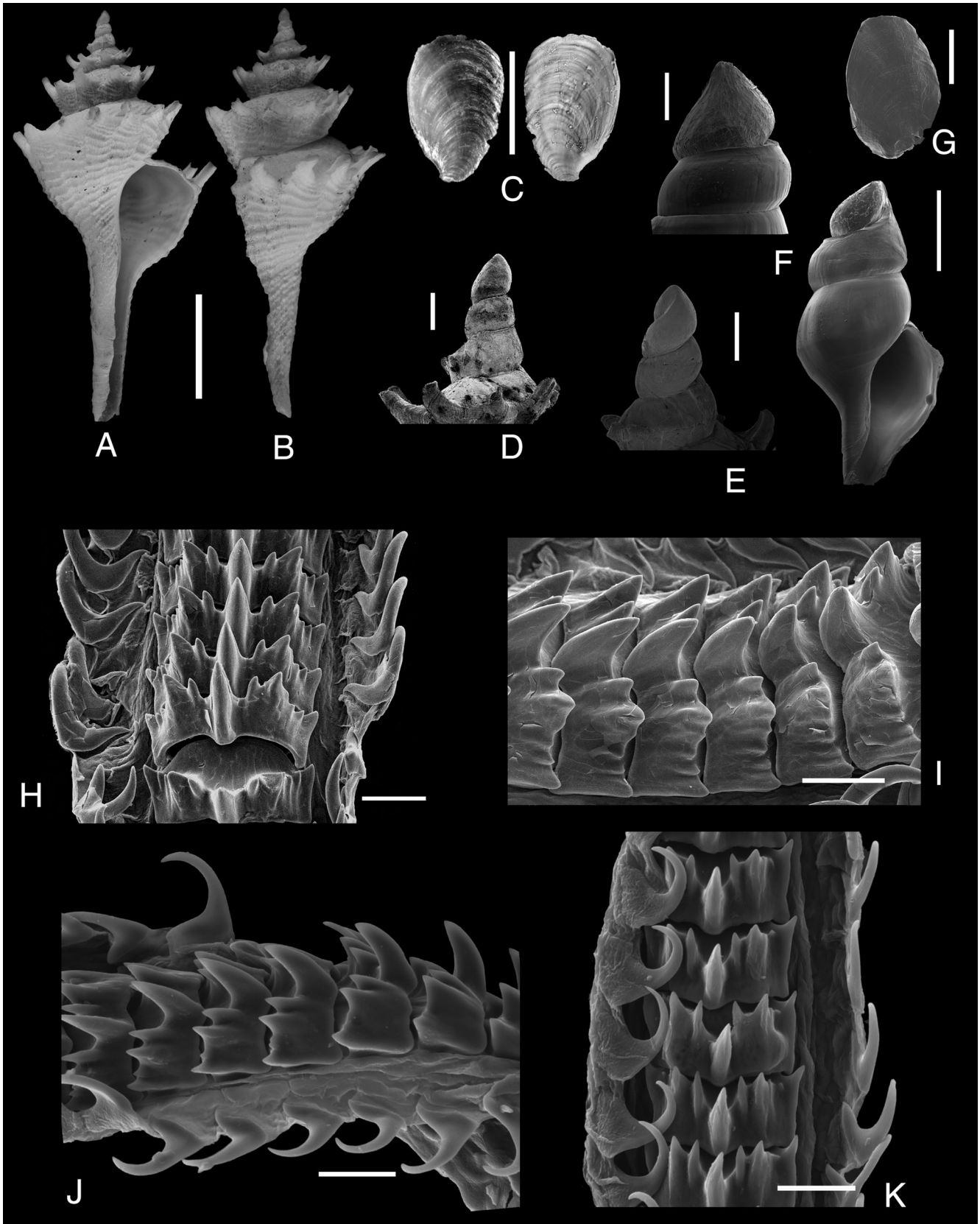
The egg capsules are bulliform, hemispherical, circular in outline, transparent and 10 mm in maximum diameter ( $n = 3$ ). The uppermost component of the hemisphere has a circular plug of approximately 2.2 mm diameter, which was closed when collected (Fig. 1A). Sutures can be seen from the sides of the plug to the base, with an angle of approximately  $110^{\circ}$  between them (Fig. 1D). Sutures divide the capsule into two unequal halves. The entire capsule is surrounded by a translucent rim 1 mm wide, that extends beyond the base. Both base and upper surface of the capsule are transparent allowing a clear view of the embryos. Concentric fibres are faintly visible around the plug down to the base.

Two of the collected capsules were recently laid, one slightly overlapping the other (Fig. 1A). They contained 3639 ( $n = 2$ ) uncleaved nurse eggs with an average diameter of 180–210  $\mu\text{m}$  (mean =  $197.4 \pm 8.9$ ). The size of the early developing embryos was  $320 \times 320$  to  $820\text{--}880 \mu\text{m}$ . These embryos were at a post-gastrula pre-veliger stage showing ectodermal vacuole cells, the nutritive visceral mass, a foot, an incipient velum and oesophagus (Fig. 1B). The embryo of *Coronium coronatum* is very similar to the descriptions made for the same stage of *Chicoreus ramosus* (Linnaeus, 1758) (as *Murex incarnatus*, in Gohar & Eisawy, 1967) and *Fusinus syracusanus* (Linnaeus, 1758) (as *Fusus*, in Fioroni & Portmann, 1968).

Nine pre-hatching embryos with total shell lengths averaging 3.94 mm ( $n = 8$ ,  $\text{SD} = 0.32$ ) were found inside a single older capsule. Shells of embryos are transparent (eyes can be seen through the shell), with  $3\frac{1}{2}$  convex whorls and fusiform in shape. The first whorl is quite acute, somewhat fibrous; while the last whorl has an oblique subsutural shelf with two keels on the periphery.



**Figure 1.** *Coronium coronatum* (Penna-Neme & Leme, 1978). **A.** Two recently laid attached egg capsules with nurse eggs and embryos. **B.** Post-gastrula pre-veliger stage embryo and a nurse egg (right). **C.** Egg capsule prior to hatching, basal view. **D.** Same egg capsule apical view, with plug and sutures. Scale bar for **A**, **C** and **D** = 5 mm. **E–G.** Views of one pre-hatched embryonic shell. Scale bar = 1 mm. Abbreviations: f, foot; oe, oesophagus; v, incipient velum; vc, vacuole cells; vm, nutritive visceral mass.



**Figure 2.** *Coronium coronatum* (Penna-Neme & Leme, 1978). **A, B.** MACN-In 24188 Scale bar = 1 cm. **C.** Two views of the operculum of the same specimen. Scale bar = 0.5 cm. **D, E.** Two views of the protoconch of the specimen in **A, B** Scale bar = 500  $\mu\text{m}$ . **F.** Two views of one embryo, SEM. Scale bar = 1 mm. **G.** External view of operculum of the embryo of Fig. **E**. Scale bar = 1 mm. **H, I.** Two views of the radula of the specimen of Fig. 1 **A, B**. Scale bar = 30  $\mu\text{m}$ . **J, K.** Two views of the radula of one embryo. Scale bar = 10  $\mu\text{m}$ .

Radulae of the embryos match those of the adults (Fig. 2H–K). The rachidian teeth are wide, with a thick central cusp, inclined more posteriorly than the lateral cusps. Lateral cusps are smaller with a wide base. There is a sharp denticle on the inner side of the lateral cusps and irregular and very weak external side denticles are present in the area between the lateral cusp and the marginal cusps. The base of the rachidian tooth is curved and inserts under the base of the succeeding tooth. The marginal area of the rachidian has a conspicuous single cusp. The lateral teeth have single, long, curved cusps and a wide, attached, basal plate. The operculum is oval, extremely thin and transparent with a terminal nucleus. The external surface is covered by concentric, irregular, weak growth lines, while the inner surface bears some faint scars in the attachment area (Fig. 2G).

## DISCUSSION

*Coronium coronatum* was originally described under the genus *Columbarium* of the Columbariinae, a subfamily of Turbinellidae (Penna-Neme & Leme, 1978), because of the similarity of shell shape. In 1996, Simone described the new genus *Coronium* to include this species with two others under the family Muricidae. He illustrated a sketch of the radula and opened the discussion about the subfamilial affinity of these species suggesting that they belong in the Trophoninae.

The unusual shape of the protoconch of *Coronium* allows undoubted placement of the egg capsules and embryos here described in this genus (Fig. 2D, E). Also, the radula of the embryos is quite similar to that of the adults of *C. coronatum*, leaving no doubt about the specific assignation.

The embryonic radulae share similarities with those of the adults of the northeastern Atlantic *Ocenebra erinacea* (Linnaeus, 1758) (as it can be seen on Kool, 1993: Figs 41–43). The position of the central cusp relative to the laterals is very similar. However, in adult *C. coronatum* this similarity is almost lost. The attachment of the lateral tooth is quite wide in the embryonic radula but very thin in the adult *Coronium* and also in *O. erinacea*. By contrast, the marginal cusp of the rachidian tooth is always bifid in *O. erinacea*, a remarkable feature that is always absent in the southwestern Atlantic Trophoninae, including the embryos studied here.

In his review of muricid egg capsules, D'Asaro (1991) distinguished three main capsule shapes: ampulliform, vasiform and bulliform. Most Muricidae species have ampulliform or vasiform capsules. Among nine species of Trophoninae listed by D'Asaro, seven have bulliform capsules. This type of capsule occurs widely in several neogastropod taxa and in most cases there is no way to determine which species produced the capsule.

The morphology of the egg capsules described here is somewhat similar to those of *Boreotrophon clathratus* (Linné, 1767) according to Thorson's (1940) illustration and description (as *Trophon* in the original). They have the same bulliform, lenticular, general shape of the capsule, albeit slightly smaller (*Boreotrophon* ~6–7 mm vs *Coronium* 9.9 mm diameter). Lebour (1936) briefly described the capsules of *Trophonopsis muricatus* (Montagu, 1803) which also slightly resemble the one described here, but once again the size is clearly smaller (2.5 mm). Also, the author never mentioned or illustrated anything resembling the sutures that are usually present in all the other known species of Trophoninae. *Xymenopsis muriciformis*, a common Patagonian muricid, has capsules of similar size to those of *B. clathratus*, but the plug is situated in a shallow depression and sutures are visible (Pastorino & Harasewych, 2000).

The egg capsules of *Trophon geversianus* (Pallas, 1774) are erect, discoidal in shape with one side flat and the other convex and with a peduncle. Melvill & Standen (1898: 100) and Strebel (1904: 173) produced the first accurate identification of egg

capsules of the genus *Trophon* from the southwestern Atlantic. Others were later described and illustrated by Zaisso (1973), Penchaszadeh (1976) and D'Asaro (1991). The differences in morphology between the capsules of *T. geversianus* and *C. coronatum* supports a clear generic distinction, as was suggested by Thorson (1946: 226) for the North Atlantic Trophoninae species. However, despite the different morphology of the egg capsules, the presence of nurse eggs as supplementary food for intracapsular development of embryos seems to be a common feature of all the muricid species from the southwestern Atlantic (Penchaszadeh, 1976). These facts, together with the adult radula (Fig. 2H, I) which is quite similar in general shape to that of the type species of the genus *Trophon*, i.e. *T. geversianus* and other species of the same genus (Pastorino, 2005), leave no doubt about the inclusion of *Coronium* in the subfamily Trophoninae.

The southernmost species of *Coronium*, i.e. *C. coronatum* (Penna-Leme & Leme, 1978), was recorded very close to the locality where the capsules were collected (Fig. 2A, B). The first mention of this species was made unwittingly by Carcelles (1947) who illustrated one specimen from several housed in the Museo Argentino de Ciencias Naturales (MACN-In 24188) (Fig. 2A–C, H–I). At that time the author confused these specimens with *Trophon acanthodes* Watson, 1882, a comparable species living at approximately the same latitude (or further south) and depth. These four specimens were collected alive by the ship ARA *Bahía Blanca*, at 184 m, from 35°42'S to 52°52'W. Simone (1996) recorded it in Uruguayan waters from off the Río de la Plata (36°30'S–53°45'S) at 230–340 m depth. Other specimens cited by the same author and studied in different institutions allow us to circumscribe the geographic range of *C. coronatum* to Uruguayan and Brazilian waters, from the state of Rio de Janeiro (Brazil) to the northern margin of the Rio de la Plata, at depths of 64–320 m.

## ACKNOWLEDGEMENTS

We are grateful to L. Paesch, E. Delfino, S. Saucó and all the rest of the crew of the R/V *Aldebaran* 2005-01 cruise, as well as to W. Norbis (DINARA, Montevideo), who provided the opportunity to collect the samples. A. Averbuj gave technical assistance. J. Taylor and M. Griffin made valuable corrections to the English version. This contribution was supported in part by the projects PICT 14419 and PICT 10975 from the National Agency for Scientific and Technical Promotion, Argentina. We acknowledge funding by the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) of Argentina, to which GP and PP belong as members of the Carrera del Investigador Científico y Técnico.

## REFERENCES

- CARCELLES, A. 1947. Notas sobre algunos gastrópodos marinos del Uruguay y la Argentina I–VI. *Comunicaciones Zoológicas del Museo de Historia Natural de Montevideo*, **2**: 1–27.
- D'ASARO, C.N. 1991. Gunnar Thorson's world wide collection of prosobranch egg capsules: Muricidae. *Ophelia*, **35**: 1–101.
- FIORONI, P. & PORTMANN, A. 1968. Zur Morphogenese der Verdauungsorgane und der Larvalorgane von *Fusus* (Gastropoda, Prosobranchia). *Revue Suisse de Zoologie*, **75**: 833–882.
- GOHAR, H.A.F. & EISAWY, A.M. 1967. The egg-masses and development of five rachioglossan Prosobranchs (from the Red Sea). *Publications of the Marine Biological Station Al-Ghardaqa (Red Sea)*, **14**: 216–268.
- LEBOUR, M.V. 1936. Notes on the eggs and larvæ of some Plymouth prosobranchs. *Journal of the Marine Biological Association of the United Kingdom*, **20**: 547–565.

- MELVILL, C.J. & STANDEN, R. 1898. Notes on a collection of marine shells from Lively Island, Falklands, with list of species. *Journal of Conchology*, **9**: 97–105.
- PASTORINO, G. 2005. A revision of the genus *Trophon* Montfort, 1810 (Mollusca: Muricidae) from southern South America. *Nautilus*, **119**: 55–82.
- PASTORINO, G. & HARASEWYCH, J. 2000. A revision of the Patagonian genus *Xymenopsis* Powell, 1951 (Gastropoda: Muricidae). *Nautilus*, **114**: 38–58.
- PENCHASZADEH, P. 1976. Reproducción de gastrópodos Prosobranquios del Atlántico suroccidental. El género *Trophon*. *Physis, Sección A*, **35**: 69–76.
- SIMONE, L.R.L. 1996. *Coronium*, a new genus of Muricidae (Mollusca, Neogastropoda) from off the southeastern coast Brazil, with description of two new species. *Bulletin of Marine Science*, **59**: 45–52.
- STREBEL, H. 1904. Beiträge zur Kenntnis der Molluskenfauna der Magalhaen-Provinz. *Zoologischen Jahrbüchern. Abteilung für Systematik, Geographie und Biologie der Tiere*, **21**: 171–248.
- THORSON, G. 1940. Notes on the egg-capsules of some North-Atlantic prosobranchs of the genus *Troschelia*, *Chrysodomus*, *Volutopsis*, *Sipho* and *Trophon*. *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i Kobenhavn*, **104**: 251–265.
- THORSON, G. 1946. Reproduction and larval development of Danish marine invertebrates, with special reference to the planktonic larvae in the Sound (Øresund). *Meddelelser Fra Kommissionen For Danmarks Fiskeri-og Havundersøgelser. Serie Plankton*, **4**: 1–523.
- ZAIXSO, H. 1973. Observaciones sobre el desove y embriología de *Trophon geversianus* (Pallas, 1774). *Neotropica*, **19**: 152–155.