

EGG CAPSULES, EGGS AND EMBRYOS OF *TROPHON ACANTHODES* (GASTROPODA: MURICIDAE) AND ITS NEW GENERIC POSITION

GUIDO PASTORINO AND PABLO E. PENCHASZADEH

Museo Argentino de Ciencias Naturales, Av. Angel Gallardo 470, 3 piso lab. 80, C1405DJR Buenos Aires, Argentina

(Received 29 August 2008; accepted 22 March 2009)

ABSTRACT

The egg capsules, eggs and embryos of the muricid gastropod *Trophon acanthodes* are described for the first time. Egg capsules are sessile, bulliform, semi-circular, about 20 mm in diameter, with a plug in the centre of the dorsal side. Sutures divide the capsule into two slightly asymmetrical halves. Recently-laid egg capsules contained about 6,000 uncleaved eggs with a diameter of 213–236 µm. The number of early embryos was 7–9 with a size of 320 × 320 to 820–880 µm. Nine prehatching embryos of 3.94 mm maximum shell height were found inside an older egg capsule without intracapsular eggs. Therefore it is concluded that several thousand nurse eggs were present when laid. SEM illustrations of shell embryos and radulae are provided. Comparison of shell and radula of embryos with the protoconch and radula of adults of *T. acanthodes* confirms that the egg capsule belongs to this species. *Coronium coronatum* has an extremely similar protoconch and this, together with the similar egg capsule morphology that is different from that of *Trophon geversianus*, supports the reassignment of *T. acanthodes* to the genus *Coronium*.

INTRODUCTION

The study of the spawn, egg capsules and embryos of gastropods is important not only for studies of reproductive biology in general, but also for its implications for dispersal and biogeography (e.g. Johannesson, 1988; Arnaud *et al.*, 1976) and for taxonomy (e.g. sibling species of *Crepidula*, see Gallardo, 1979; Simone *et al.*, 2000; Penchaszadeh *et al.*, 2002; *Buccinanops* vs *Bullia*, see Pastorino, 1993; *Epitonium* spp., see Pastorino & Penchaszadeh, 1998; neogastropods, see D'Asaro, 1988).

The subfamily Trophoninae is one of the most numerous in species in the temperate waters of the southwestern Atlantic, despite the generally low diversity of this region. Previous studies (Houart, 1991; Pastorino, 1999, 2005; Pastorino & Harasewych, 2000; Pastorino & Scarabino, 2008) recorded around 20 species in two genera, *Xymenopsis* Powell, 1951 and *Trophon* Montfort, 1810. The latter includes *Trophon acanthodes* Watson, 1882, which is probably the largest species of the genus living in the Western Atlantic, with a maximum height exceeding 12 cm.

Trophon acanthodes has been assigned to different genera and families by several authors. It was originally described by Watson (1882) in the muricid genus *Trophon*, from two specimens collected in southern Chile. Later, Carcelles (1947) placed this species in the genus *Fusus*, because of its long siphonal canal, a combination also followed by De Castellanos (1970). *Fusus* is an unavailable name, so Rios (1975) placed the species in *Fusinus*, which belongs in the Fascioliidae. Nevertheless, Rios (1985) cited the same species under the subgenus *Trophon* (*Pagodula*), although he later (Rios, 1994) questioned the familial position and used the original generic combination, '*Trophon*' *acanthodes*, noting an uncertain placement. Furthermore, in the same catalogue, he proposed that *Murex clenchi* Carcelles, 1953 was an anomalous specimen of *T. acanthodes*. De Castellanos (1986) gave an imprecise drawing of the radula of the latter species and placed it again in the genus *Trophon*. Pastorino (2005: figs 77, 78) illustrated an SEM image of the radula of *T. acanthodes* and also mentioned a close

similarity of the shell to that of *Coronium coronatum* (Penna-Neme & Leme, 1978), the type species of *Coronium* Simone, 1996. However, he retained the generic assignment of *T. acanthodes* in *Coronium* is the distinctive protoconch of the latter genus, which is lost in most of the available adult specimens. Recently, Houart & Sellanes (2006) illustrated a juvenile specimen of what they identified as *Trophon wilhelmensis* Ramírez-Bohme, 1981 from southern Chile. This has a protoconch of *Coronium* shape, supporting allocation to that genus. However, in the same paper they retained *T. acanthodes* in *Trophon*, based on a drawing of the protoconch of a syntype and some variable radular characters.

The genus *Coronium* Simone, 1996 belongs in the subfamily Trophoninae and is represented in Uruguayan and Brazilian waters by only three species, which are still poorly known. In a recent paper Pastorino, Penchaszadeh & Scarabino (2007) described the embryo, egg and egg capsule of *C. coronatum* from material collected in Uruguayan waters.

New discoveries of similar capsules with a more southerly distribution and attributed to *T. acanthodes* Watson, 1882 allow the description of egg capsules, eggs and embryos and the recognition of its new generic position.

MATERIALS AND METHODS

Three capsules of *Trophon acanthodes* at different development stages were found attached to living or dead shells of the bivalve *Zygochlamys patagonica*. Two of them had embryos close to hatching and were collected by the Argentine ship RV *Canepa*, at 41°37.88'S, 58°08.85'W, at 90 m depth on 5 July 2007, and fixed in formalin. The other capsule of about the same size, but recently laid, was found at Banco Reclutas, off Buenos Aires province at a depth of about 100 m by the commercial ship *Erin Bruce* in 1996. Several adults of *T. acanthodes* were collected around 41°S, 58°W in about 90 m depth. In addition, adult specimens of this species from the Invertebrate Zoology Department collection of the Museo Argentino de Ciencias Naturales, Buenos Aires (MACN-In) were dissected

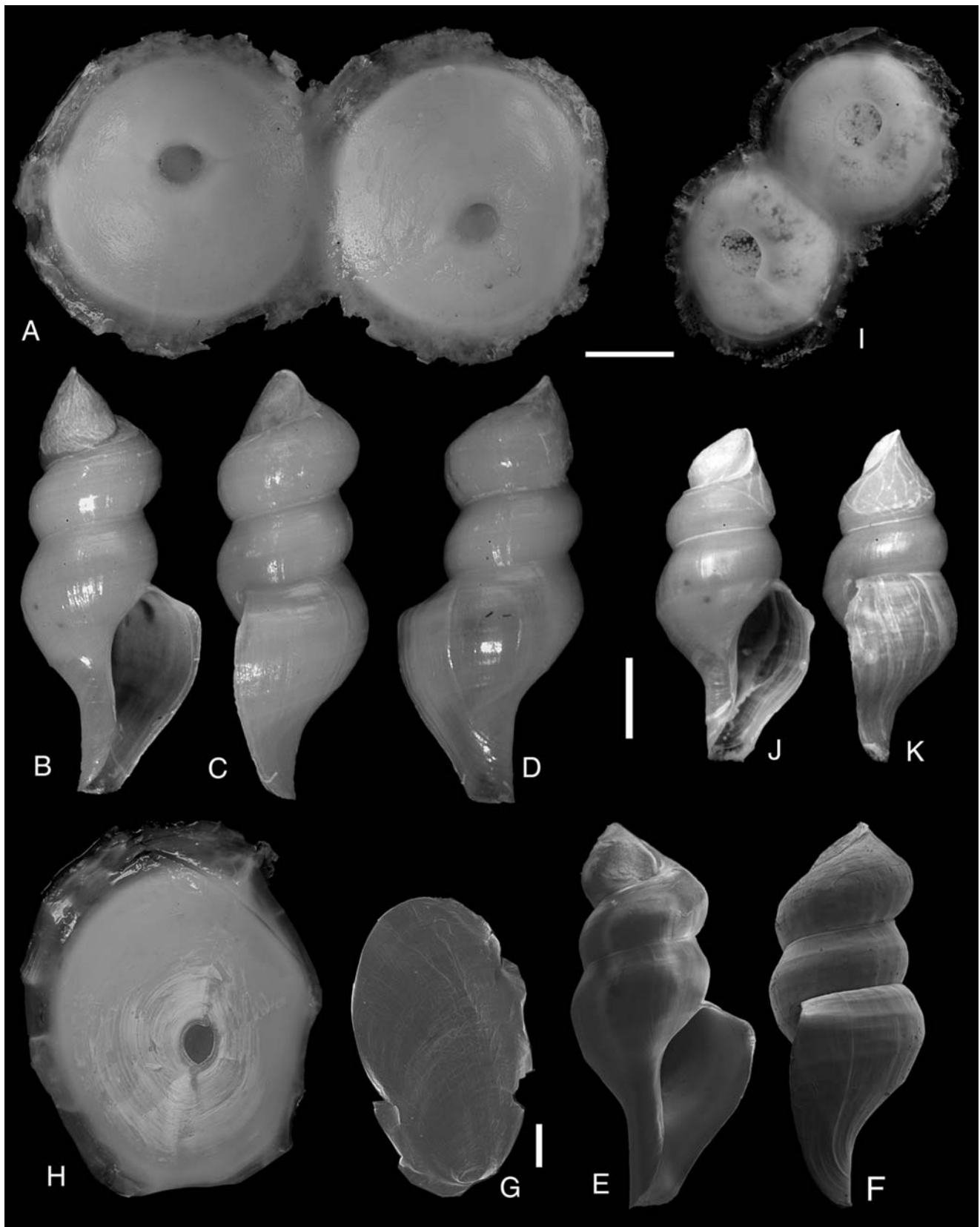


Figure 1. **A–H.** *Coronium acanthodes* (Watson, 1882). **A.** Two recently laid attached egg capsules, with nurse eggs and embryos, apical view, from 41°37.88'S, 58°08.85'W, at 90 m depth; scale bar = 5 mm. **B–D.** Three views of one prehatched embryonic shell. **E, F.** Two SEM views of another embryo. **G.** External view of the operculum of the embryo; scale bar = 200 μ m. **H.** Another egg capsule prior to hatching, apical view. **I–K.** *Coronium coronatum* (Penna-Neme & Leme, 1978). **I.** Two recently laid attached egg capsules, apical view. **J, K.** Two views of one prehatching embryonic shell. Scale bar for all shells = 1 mm.

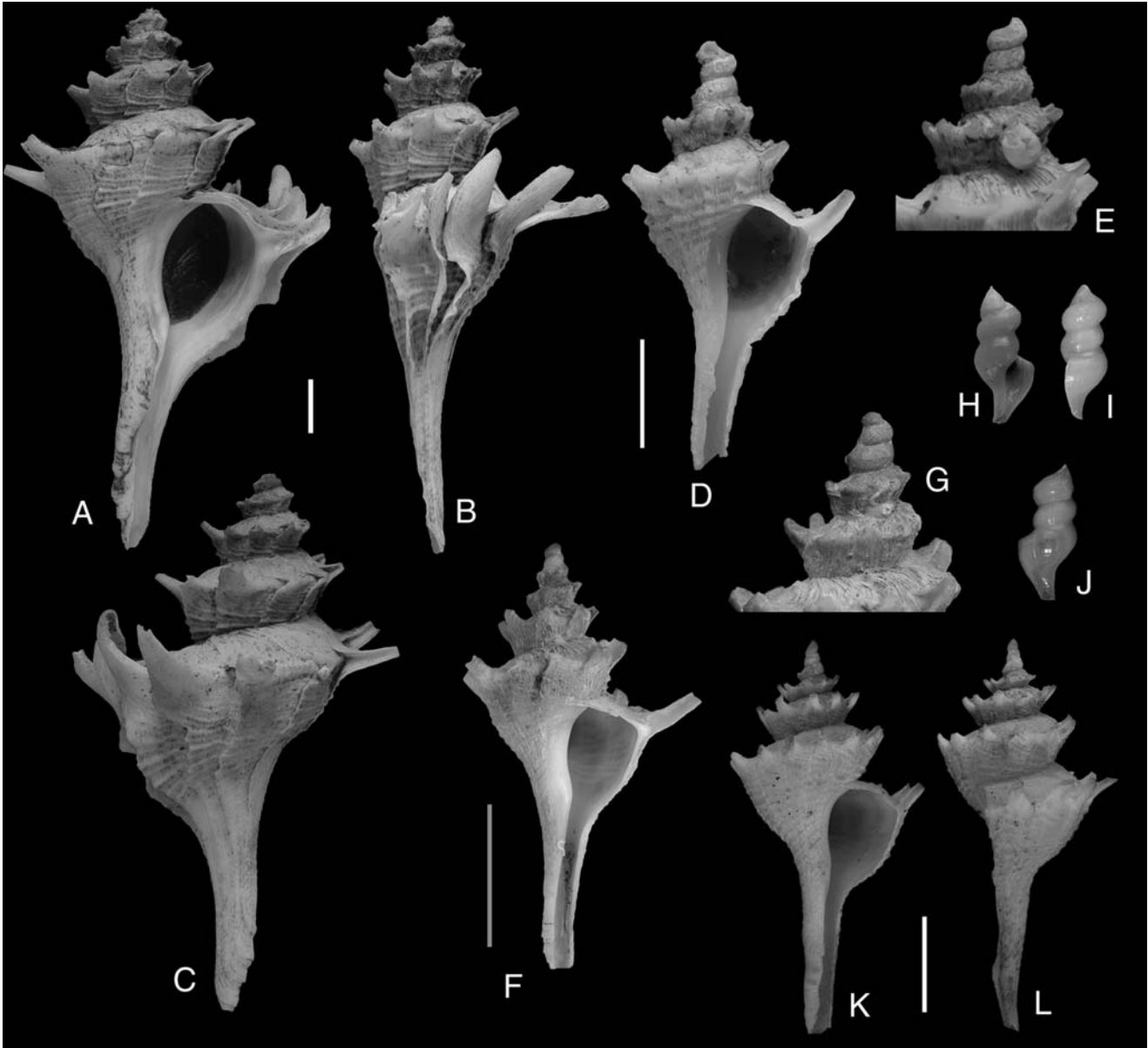


Figure 2. A–J. *Coronium acanthodes* (Watson, 1882). **A–C.** Three views of an adult shell, MACN-In 3765, 41°50'S, 58°10'W, 91 m depth; scale bar = 1 cm. **D.** Juvenile, MACN-In 37563, 42°24.95'S, 59°20.42'W, 95 m depth; scale bar = 5 mm. **E.** Protoconch of same specimen. **F.** *Trophon acanthodes* Watson, 1882, syntype NHM1887.2.9.569; scale bar = 1 cm. **G.** Protoconch of same specimen. **H–J.** Three views of one embryo to compare with protoconch in **E** and **G**. **K, L.** *Coronium coronatum* (Penna-Neme & Leme, 1978), adult specimen, MACN-In 24188; scale bar = 1 cm.

and radulae prepared for observation and SEM photography as described in Pastorino (2005).

RESULTS

The egg capsules are bulliform, hemispherical, circular in outline, transparent and 20 mm in maximum diameter ($n = 3$). The upper side of the hemisphere has a large circular plug of *c.* 2.7 mm diameter, which was closed in all the specimens when collected (Fig. 1A). Sutures can be seen running from the sides of the plug to the base, with an angle of *c.* 170° between them (Fig. 1H) and these divide the capsule into two slightly unequal halves. The entire capsule is surrounded by a translucent and irregular 1-mm rim, which extends beyond the base. Both base and upper surface of the capsule are usually transparent, allowing a clear view of the embryos inside.

Concentric fibres are faintly visible around the plug down to the base. One of the capsules was recently laid and contained about 6,000 uncleaved nurse eggs with a diameter of 213–236 μm (mean = 227.34 ± 6.53 , $n = 24$). Nine prehatching embryos with total shell lengths averaging 5.45 mm ($n = 9$, ± 0.26) were found inside each of the two remaining capsules. No nurse eggs were present. Shells of embryos are transparent (eyes can be seen through the shell), with four convex whorls and of fusiform shape. The first whorl is quite acute, while the last has an oblique subsutural shelf with a keel at the periphery. Whorls are convex and similar, but the first one is unusually larger than the second (Fig. 1B–F).

Radular teeth of the embryos (Fig. 3C, D) are somewhat different from those of the adult *Trophon acanthodes* (Fig. 3A, B). The rachidian teeth are proportionally narrower than in the adults, with a thin central cusp, inclined more posteriorly than

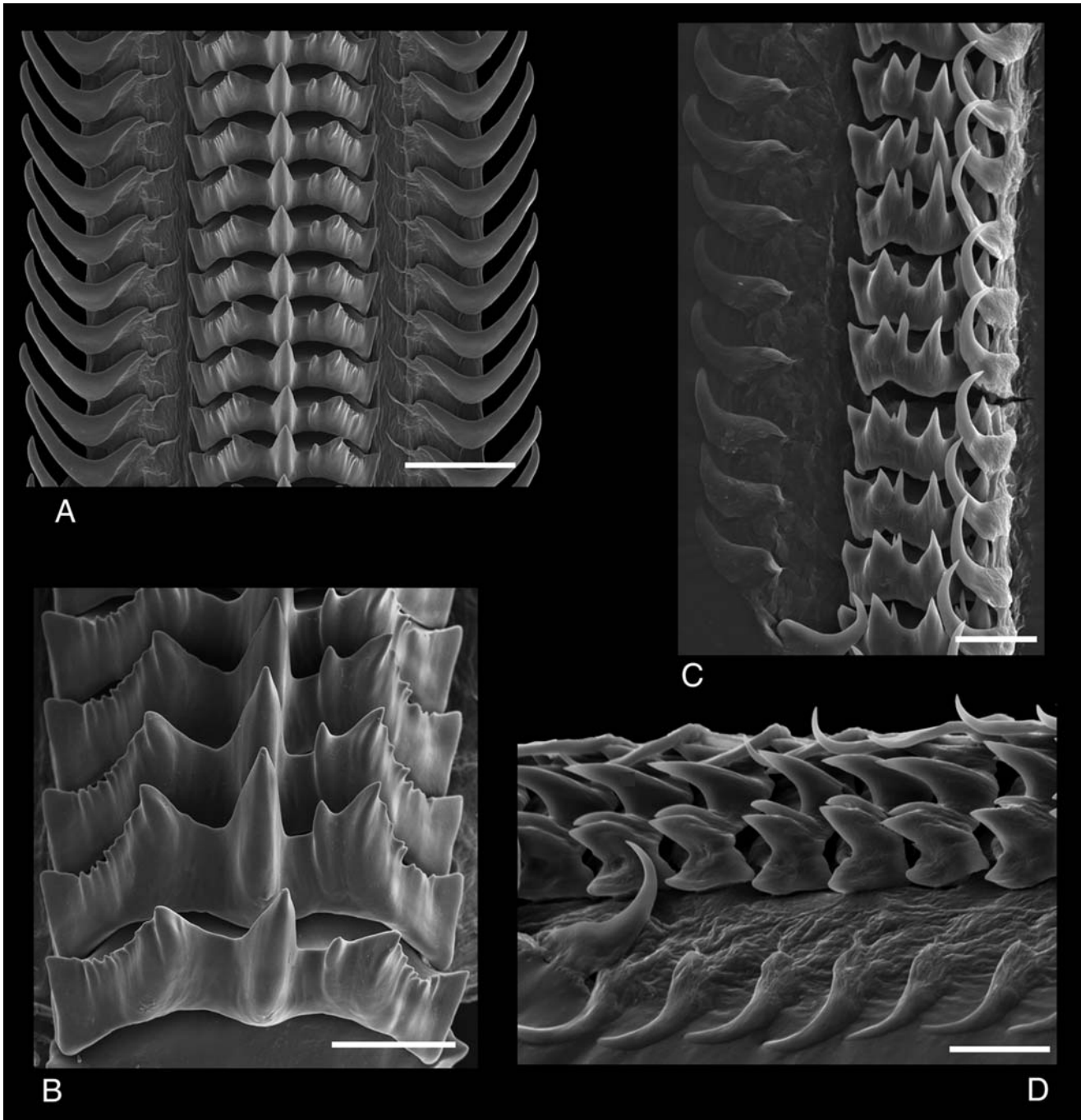


Figure 3. *Coronium acanthodes* (Watson, 1882). **A, B.** Two views of the radula of the adult specimen MACN-In 37564, 41°37.33'S, 58°08.49'W, 89 m depth; scale bars **A** = 100 µm, **B** = 50 µm. **C, D.** Two views of the radula of one embryo; scale bars = 10 µm.

the smaller lateral cusps. There is a thin and long denticle on the inner side of the lateral cusps that can be irregularly bifid. The area between the lateral cusp and the marginal cusp has no denticles. The sinuous base of the rachidian tooth curves 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 (Fig. 1G).

DISCUSSION

All known specimens of *Trophon acanthodes*, except two, have worn apices. In Figure 2E and G the two known specimens with a partially complete protoconch are illustrated. Unfortunately, the total shape of the protoconch is not visible. However, it is enough to establish a close similarity with shells of the embryos from the capsules here studied.

The morphology of these egg capsules is remarkably similar to those of *Coronium coronatum* as described by Pastorino, Penchaszadeh & Scarabino (2007). However the size is larger

and the diameter of the foramen is proportionally smaller in *T. acanthodes* capsules than in those of *C. coronatum*, allowing easy differentiation. In addition to the larger size, the embryos of *T. acanthodes* have a wider first whorl and a more extended labium as can be compared in Figure 1J and E. Moreover, none of the known specimens of *Coronium*, including the type species *C. coronatum*, were collected in southern Uruguayan waters. However, *T. acanthodes*, the only other species to which the capsules here described could possibly be assigned, is a common inhabitant of the pectinid banks of the temperate waters where the capsules were collected. Also, the large size of the capsules points again to *T. acanthodes* as the largest muricid living around the collecting area.

Thorson (1946), comparing the North Atlantic Trophoninae with *Trophon geversianus*, proposed that different morphologies among the capsules (bulliform or erect) could indicate generic separation. In fact, all the northern species included in *Trophon* at that time are now assigned to *Boreotrophon* (according to Bouchet & Warén, 1985). All known species of *Boreotrophon* have a bulliform capsule. In contrast, where it is known, all the South American species now included in the genus *Trophon* s. s. (*sensu* Pastorino, 2005) (type species *T. geversianus*) show erect egg capsules (Penchaszadeh, 1976; D'Asaro, 1991), quite different from those of *T. acanthodes* and *C. coronatum*.

Species of *Xymenopsis* are quite common in shallow waters of the Magellanic region and at least one species, *Xymenopsis muriciformis* (King & Broderip, 1832) (illustrated by Pastorino & Harasewych, 2000), has capsules somewhat similar to those described here for *T. acanthodes*. However, the maximum diameter is around 7 mm instead of 20 mm and the preformed exit aperture, although also situated at the centre of the dorsal surface, lies in a shallow, subovate depression. The protoconch of *X. muriciformis* is also clearly different, being multispiral, symmetrical, conical, with convex whorls and without any ornamentation.

In conclusion, the general morphology of the egg capsules assigned to *T. acanthodes* is closely similar to that of *C. coronatum* as illustrated and described by Pastorino *et al.* (2007). From the evidence of the morphology of egg capsules, embryonic shell and protoconchs, we propose the new generic combination *Coronium acanthodes* (Watson, 1882).

ACKNOWLEDGEMENTS

We are grateful to L. Schejter (Mar del Plata), who donated to the MACN-In collection part of the samples here studied. J. Taylor (Natural History Museum) and an anonymous reviewer helped with reviews that considerably improved the paper. This contribution was supported in part by the projects PICT 14419, 10975 and 942 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 the authors belong as members of the Carrera del Investigador Científico.

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