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Europe's smallest gastropod: habitat, distribution and relationships of *Retrotortina fuscata* (Omalogyridae)

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Abstract: The gastropod *Retrotortina fuscata* is confirmed as belonging to the family Omalogyridae. It lives among subtidal coarse bioclastic sands in 10-30 m water depth, and ranges from the entrance of the British Channel to the West Mediterranean. It is new to the fauna of France, and an old record from the British Isles must be regarded as valid.

Résumé : *Le plus petit gastropode européen: habitat, distribution et position systématique de* Retrotortina fuscata *(Omalogyridae)*
La position systématique du gastropode *Retrotortina fuscata* se trouve confirmée dans la famille des Omalogyridae. Son habitat se situe dans des sables bioclastiques grossiers vers 10-30 m de profondeur, et sa distribution s'étend de l'entrée occidentale de la Manche, jusqu'en Méditerranée occidentale. C'est une espèce nouvelle pour la faune de France, et une mention ancienne pour les Iles Britanniques paraît de ce fait vraisemblable.

Keywords : Heterobranchia, Omalogyridae, Body size, Radula.

Introduction

The gastropod *Retrotortina fuscata* Chaster, 1896, originally described from a few shells collected from beach drift in Tangier bay, Morocco, has seldom been cited posteriorly to its description (Rolán, 1983; Palazzi, 1988; Bellocq & Nofroni, 1989), and has not been reported alive to date. It is the type species of the monotypic genus *Retrotortina* Chaster, 1896, and one of the smallest molluscs known, well within the size range of benthic foraminifers. Owing to conchological resemblance, it is currently classified either in the Heterobranch family Omalogyridae (Palazzi, 1988; Sabelli *et al.*, 1990; Bieler & Mikkelsen, 1998; CLEMAM checklist) or in the Prosobranch family Skeneopsidae (Rolán, 1983; Seaward, 1990).

Living specimens have now been found quite abundant on a sand gravel bottom at the entrance of the Strait of Gibraltar, and could be examined alive. This paper describes the external morphology and radula from this population, and reports additional localities where the species has been found.

Material and methods

Living specimens were collected by dredging in the bay of Barbate, in April 1994. The sample of ca. 20 litres of sediment was sieved in sea water on 10 mm, 5 mm, 2 mm,

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1 mm, 0.5 mm and 0.3 mm sieves. The fractions less than 1 mm were then further treated by having the lighter components winnowed away using a hose with a moderate water outflow and collected on the 0.3 mm sieve; the heavy fraction was discarded. This latter operation allows a considerable concentration of the living animals. The living specimens of *Retrotortina* were picked out from the fraction 0.3-0.5 mm and observed.

The additional material mentioned was obtained by using similar sieving procedures, but on preserved or dry samples.

Material examined

Spain, Cádiz province: Barbate (36°08.6'N, 05°53.4'W, 20-22 m), leg. E. Manjón, 7 April 1994, 20 specimens. Spain, Málaga province: Rincón de la Victoria, from sand dredged for beach restoration, 1 shell. — France, Finistère: Roscoff, "les Cochons Noirs", (40°43.0'N, 03°51.8'W, 20 m), leg. Gofas, Gentil, Finke, April 1992, 2 shells; id. leg. Gofas, June 1994, 3 shells; Anse de Bertheaume, from large-scale sand dredging for restoration of Moulin Blanc beach, 1978, 60 shells; off Concarneau, from commercially dredged "maerl", 50 shells. — Italy, Sicily: Favignana island (37°54.2'N, 12°19.0'E, 36 m), coarse sand, leg. R/V "Urania" December 1996, 20 shells.

Results

Morphology

The shell of *Retrotortina* (Figs 1-3, 7-9) consists of one protoconch whorl and 1.25 to 1.5 teleoconch whorls. Large specimens may reach a diameter of 0.75 mm, usually 0.5 to 0.7 mm. The protoconch (Figs 5, 10) has one whorl, 175 to 200 μm in diameter, quite smooth with an inconspicuous ridge along its short adapical suture, brown in colour. The shell surface of the teleoconch has conspicuous growth lines, and is also uniformly brown in colour. The aperture is rounded except for a straight columellar edge, and measures 0.20 to 0.22 mm in diameter. The operculum (Fig. 4) is paucispiral, coiling counterclockwise as seen from its outer surface, with flexible edges, and fits exactly the aperture when the animal is retracted.

The head-foot (Figs 6, 11) is colourless. There are two flat, semicircular cephalic flaps, and small black eyes near the centre of these. The sole of the foot is elongate, rounded anteriorly and posteriorly when extended, and its rear half folds 180° so as to bring the operculum closing the aperture when the animal is drawn in (Fig. 6).

The radula has a single row of robust, tall and triangular teeth, on a membrane three times as broad as the base of the teeth. The teeth have flat, parallel-sided surfaces on each side; they are articulated along their baseline and fit quite tightly one into another. One face of the tooth has an axial buttress, proximally bifurcate, and is excavated between this and the edges (Figs 12-14); the opposite side is excavated axially so as to accomodate the buttress, and has two bulges along the proximal edge, serving as articulation with the next tooth. The tip of the tooth is slightly deflected to the latter hollow side.

Taxonomic position

Sars (1878: pl. VIII fig. 1) figured the radula of *Omalogyra atomus* (Philippi, 1841), type species of *Omalogyra* Jeffreys, 1860, with a central tooth very similar to that of *Retrotortina* and one lateral plate on each side. We have confirmed the presence of this lateral plate which is very thin, lies flat on the broad radular membrane and can be seen in light microscopical examination but hardly under scanning electron microscopy. It is probably a lateral tooth, reduced to a thickening of the membrane. We did not find these plates in *Retrotortina*. Except for this, there are only minor differences in the shapes of the ridge and bulges of the central tooth.

The external morphology of the soft parts, with small flap-like, interconnected tentacles, a small eye in the centre of the base of each tentacle, no snout, no propodial elaboration, and no pedal nor pallial appendages are identical in *Retrotortina* and *Omalogyra*. *Skeneopsis planorbis* (Fabricius, 1780), the type species of *Skeneopsis* Iredale, 1915, has a very different taenioglossate radula (Warén *et al.*, 1993). A position for *Retrotortina* in the Skeneopsidae is thus ruled out.

Retrotortina is hyperstrophic (i.e. pseudosinistral), as shown by the coiling direction of the operculum (Fig. 4; see Robertson, 1993), and not sinistrally coiled as originally suggested. The deviation from planispiral coiling is definite, and makes the main difference with species of *Omalogyra* which are planispiral or slightly hyperstrophic. Some of the most asymmetrically coiled specimens of *Omalogyra atomus* may be mistaken for *Retrotortina*. As a rule of thumb, specimens where one hesitates to recognize the coiling as pseudosinistral belong to *Omalogyra*; *Retrotortina* is diagnosed by very contrasted flat adapical and umbilicate abapical sides (compare Figs 1 and 2).

Size range

The size of this species (0.5-0.75 mm) ranges among the smallest known molluscs. In the European fauna, shelled species with comparably small adult size include gastropods and bivalves. In the same family Omalogyridae, *Ammonicera fischeriana* (Monterosato, 1869) is nearly as small (large specimens may reach 0.8 mm) but is better known because it occurs on hard bottoms, sometimes intertidally, and may easily be collected by brushing the surface of the substrate; *Omalogyra atomus* is only slightly larger, reaching about 1.2 mm. The Tjaernoeidae also include such small species as *Tjaernoeia unisulcata* (Chaster, 1897), and also belong to the Heterobranchs. Species of *Graphis* (Graphidae) are high-spired and may be

Figures 1-10: Scanning Electron Micrographs (SEM) of *Retrotortina fuscata* Chaster.

Figures 1-6: specimens from Barbate, S. Spain. Figures 1-3: shells (actual sizes 0.73 mm, 0.60 mm, 0.60 mm). Figure 4: outer view of operculum (maximum diameter 0.24 mm), position as if closing a shell arranged as in Fig. 3. Figure 5: protoconch of the specimen Fig. 2 (scale bar 100 μm). Figure 6: head-foot: *(c)* cephalic flaps, *(f)* foot, *(op)* operculum; *(m)* mantle (scale bar 100 μm).

Figures 7-10: Specimens from Anse de Bertheaume, Brittany. Figures 7-9: shells (actual sizes 0.70 mm, 0.65 mm, 0.66 mm). Figure 10: protoconch of the specimen Fig. 8 (scale bar 100 μm).

Figures 1-10 : Micrographies de Microscopie Electronique à Balayage (MEB) de *Retrotortina fuscata* Chaster.

Figures 1-6 : Spécimens de Barbate, Espagne méridionale. Figures 1-3 : coquille (tailles réelles 0,73 mm, 0,60 mm, 0,60 mm). Figure 4 : vue externe de l'opercule (diamètre maximum 0,24 mm), orienté comme s'il fermait une coquille disposée comme Fig. 3. Figure 5 : protoconque du spécimen Fig. 2 (échelle 100 μm). Figure 6 : céphalopodium *(c)* lobes céphaliques, *(f)* pied, *(op)* opercule; *(m)* manteau (échelle 100 μm).

Figures 7-10 : Spécimens de l'Anse de Bertheaume, Bretagne. Figures 7-9 : coquilles (tailles réelles 0,70 mm, 0,65 mm, 0,66 mm). Figure 10 : protoconque du spécimen Fig. 8 (échelle 100 μm).

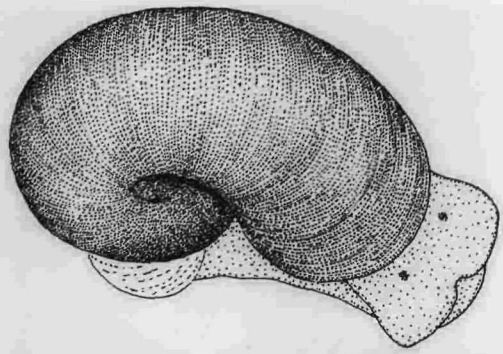


Figure 11: *Retrotortina fuscata* Chaster, from Barbate, S. Spain from a living animal (diameter of the shell: 0.6 mm).

Figure 11 : *Retrotortina fuscata* Chaster, de Barbate, Espagne méridionale d'après un animal vivant (diamètre de la coquille : 0,6 mm).

taller than 1 mm, but likewise have a maximum diameter of whorls hardly over 0.2 mm. Among the bivalves, *Phaseolus guilonardi* Hoeksema, 1993, reaching 0.8 mm, and *Notolimea clandestina* Salas, 1994, reaching about 1 mm, may be listed as the smallest species in the shelf fauna. On the Western side of the Atlantic, Bieler & Mikkelsen (1998) listed *Ammonicera minortalis* Rolán, 1992, with a still smaller size range (0.32-0.46 mm), as the smallest recorded species of gastropod, and the two Caribbean species of *Condylonucula* described by Moore (1977) may be the smallest bivalves (0.5 and 0.6 mm).

Through our experience of sorting a large array of benthic samples in the Eastern Atlantic and Mediterranean, including residues retained in the small sieve fractions down to 0.125 mm, we noted that only a couple of small species of Molluscs are missed by sieving on a 0.5 mm mesh, and that none are missed in a 0.3 mm sieve. Shells in the size range of *Retrotortina* will go through the 0.5 mesh when presented diagonally (flat, planispiral species) or axially (tall spired species).

The constraints limiting indefinite reduction in size may result from the number of cells needed to form the anatomical complexity of a mollusc. Approximating the body of *Retrotortina* with a tube 1 mm long and 0.1 to 0.2 mm diameter gives a volume of about 0.03 cubic mm. Assuming an average cell size in the order of magnitude of 10 μm, the total number of cells would be in the order of magnitude of 30,000 cells. However, eggs may be a lot larger, which would reduce the hypothetical cell number considerably although sperm cells may increase the number.

Habitat

The living specimens were collected in mixed sand consisting mainly of bioclastic debris, in 20-22 m water depth. The associated macrofauna includes, as most abundant species:

- bivalves *Laevicardium crassum* (Gmelin, 1791), *Digitaria digitaria* (Linné, 1758), *Clausinella fasciata* (da Costa, 1778), *Nuculana pella* (Linné, 1767), *Callista chione* (Linné, 1758), found constantly over the year;

- other species that are common, but not necessarily constant: *Chamelea striatula* (da Costa, 1778), *Gari pseudoweinkauffi* Cosel, 1989, *Parvicardium scabrum*, (Philippi, 1844) *Venerupis rhomboides* (Pennant, 1777), and gastropod *Turritella turbona* Monterosato, 1877.

Among the small species, the most abundant (over 100 living specimens) in the particular sample of 7 April 1994 are the polyplacophoran *Leptochiton cimicoides* (Monterosato, 1879), the gastropods *Dikoleps nitens* (Philippi, 1844), *Pusillina inconspicua* (Alder, 1844), *Bittium submamillatum* (de Rayneval & Ponzi, 1854), *Retusa mamillata* (Philippi, 1836), and the bivalve *Limatula subauriculata* (Montagu, 1803). The same sample also yielded 25 living specimens of the minute bivalve *Notolimea clandestina* and three shells of the rare gastropod *Parviturbo fenestratus* (Chaster, 1896), a species originally described in the same paper as *Retrotortina*.

This molluscan assemblage does not fit exactly the definitions given in the literature, but best approximates Cabioch's (1968) "Boreal offshore gravel association" which is also the assemblage defined at the Roscoff site where *Retrotortina* was collected. The best Mediterranean equivalent would be the "Biocénose des sables grossiers et des fins graviers sous l'influence des courants de fond" of Pérès and Picard (1964).

Distribution

In addition to the newly reported material, the species has been recorded in the literature from the following localities:

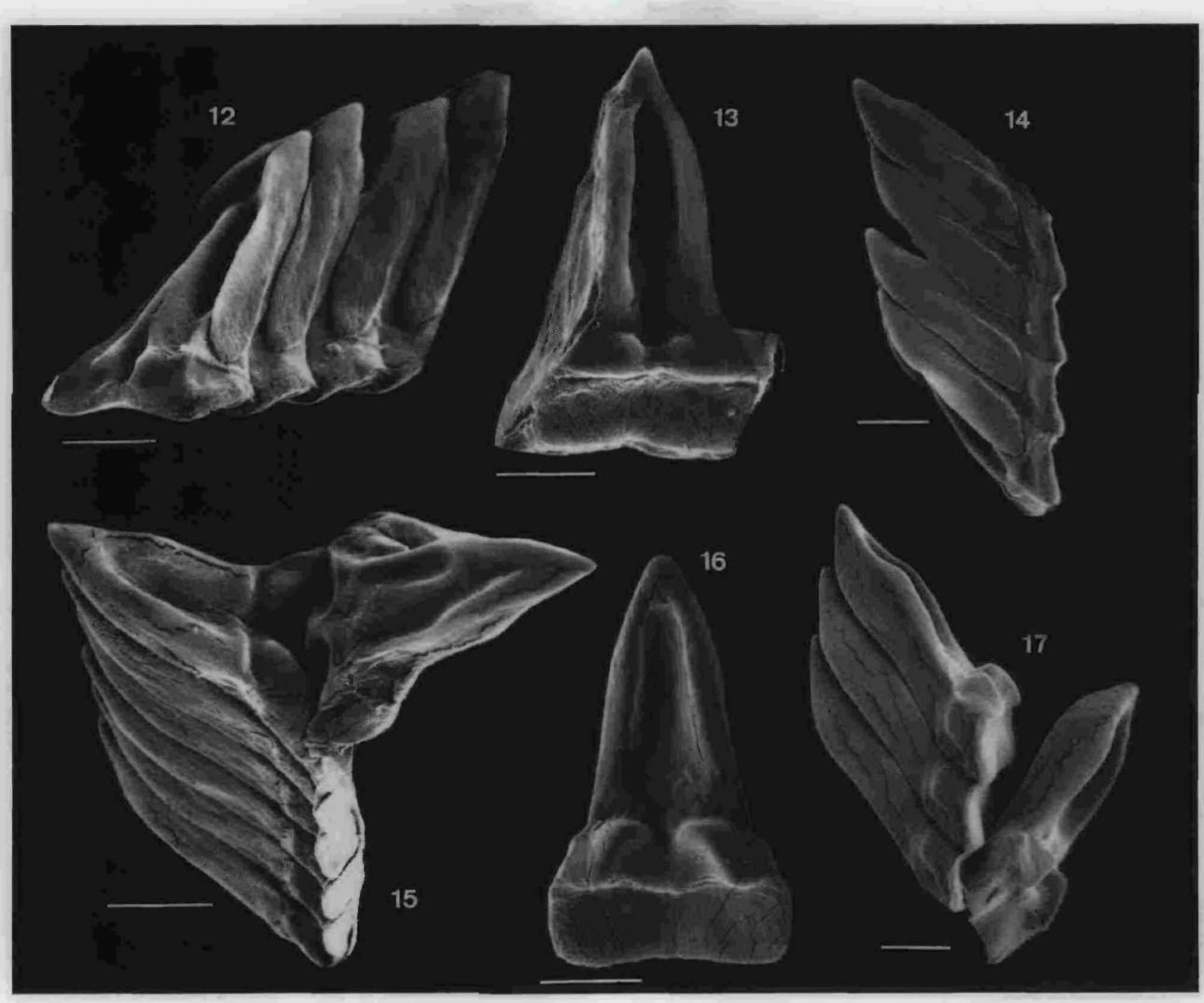
Morocco: Larache, from fishermen, 6 shells; Chafarinas 120-180 m, 30 shells (Bellocq & Nofroni, 1989).

Spain, Cádiz province: Getares, shore drift; Málaga province: S. Pedro de Alcantara, 60 m, 4 shells; Estepona/Marbella 50-70 m, 7 shells; Barcelona province: Barcelona 30 m, 1 shell (Bellocq & Nofroni, 1989). Vigo province: Ria de Vigo, "quite frequent, in sand" (Rolán, 1983: 126).

Italy, Sardinia: Buggerru (near Cagliari), 80 m, 100 shells; Strait of Bonifacio 100-200 m, 3 shells; Italy, Sicily: Acitrezza (Bellocq & Nofroni, 1989).

These records are accompanied with figures and may be considered reliable.

The record of a single shell of this species in southwestern Ireland waters by Chaster (1898), in mud dredged from Lough Hyne (51°29'N, 9°39'W) is treated as doubtful by Seaward (1990). The species is not listed in the fauna of the British Isles by Smith & Heppell (1991). Given the continuity in distribution demonstrated here, there is no



Figures 12-17: SEM micrographs of radular teeth.

Figures 12-14: *Retrotortina fuscata* Chaster, from Barbate, S. Spain. Figure 12: a series of four radular teeth, the first one to the left showing the axial buttress. Figure 13: the hollow side of a tooth. Figure 14: lateral view of a series of four teeth (scale bar 10 µm).

Figures 15-17: *Omalogyra atomus* (Philippi, 1841), from Flatey, Iceland. Figure 15: a series of seven radular teeth, the one to the right tilted so as to show the axial buttress. Figure 16: the hollow side of a tooth. Figure 17: lateral view of four teeth, the one on the right side is displaced below (scale bar 10 µm).

Figures 12-17 : micrographies (MEB) des dents radulaires.

Figures 12-14 : *Retrotortina fuscata* Chaster, de Barbate, Espagne méridionale. Figure 12 : une série de quatre dents radulaires, la première à gauche montrant la membrure axiale. Figure 13 : la face évidée d'une dent. Figure 14 : vue latérale d'une série de quatre dents (échelle 10 µm).

Figures 15-17 : *Omalogyra atomus* (Philippi, 1841), de Flatey, Islande. Figure 15 : une série de sept dents radulaires, celle de droite inclinée pour montrer la membrure axiale. Figure 16 : la face évidée d'une dent. Figure 17 : vue latérale de quatre dents, celle de droite est déplacée vers le bas (échelle 10 µm).

reason to doubt that Chaster found this species in southwestern Ireland waters. It is likely that appropriate processing of subtidal bioclastic sands will reveal more occurrences in the southwestern British Isles and Brittany.

The available data reveal a quite common, Lusitanian distribution, from the southern British Isles to Morocco and in the Western Mediterranean, and exclude *Retrotortina fuscata* as a short range endemic species.

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