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ATLANTIC DEEP SEA GASTROPODS IN THE MEDITERRANEAN: NEW FINDINGS***

Riassunto

I campionamenti effettuati in Mediterraneo negli ultimi anni da parte di navi oceanografiche francesi e italiane hanno sensibilmente contribuito ad arricchire la conoscenza della malacofauna profonda di questo mare.

In questo articolo riportiamo il ritrovamento nel Mediterraneo occidentale di otto specie di Gastropoda Prosobranchia in passato ritenute esclusive dell'Oceano Atlantico, e cioè: *Claviscala richardi* (DAUTZENBERG & DE BOURY, 1897), *Torellia vestita* JEFFREYS, 1867, *Kryptos koehleri* (LOCARD, 1896), *Pleurotomella packardi* VERRILL, 1872, *Corinnaeturris leucomata* (DALL, 1881), *Xanthodaphne dalmasi* (DAUTZENBERG & FISCHER, 1897), *Lusitanops cingulata* BOUCHET & WARÉN, 1980, e *Lusitanops hyaloides* (DAUTZENBERG, 1925). Viene data inoltre documentazione dettagliata della presenza in Mediterraneo dell'Epitoniidae *Opaliopsis atlantis* (CLENCH & TURNER, 1952), già noto per depositi pleistocenici della Calabria, e di *Scaphander punctostriatus* (MIGHELS, 1841). La maggioranza delle specie discusse è stata rinvenuta allo stato di conchiglie subfossili di individui adulti e si suppone la loro provenienza da tanatocenosi premoderne in parte almeno dell'ultimo glaciale. Del Buccinidae *K. koehleri* invece è stato rinvenuto nel Mare di Alboran un solo esemplare giovanile ma vivente. Come dimostrato dalla sua distribuzione attuale nel Golfo Ibero-Marocchino questa specie a sviluppo lecitotrofico è euribata e pertanto la sua penetrazione in Mediterraneo può avvenire attraverso lo Stretto di Gibilterra. Le altre specie sono invece da considerarsi batiali in senso stretto ma presentano tutte sviluppo larvale planctotrofico che può averne favorito l'immigrazione attraverso lo Stretto allo stadio larvale con successiva metamorfosi nel Mediterraneo.

Abstract

Eight gastropod species previously known only from the Atlantic Ocean are recorded for the first time from the deep parts of the western and central Mediterranean: *Claviscala richardi* (DAUTZENBERG & DE BOURY, 1897), *Torellia vestita* JEFFREYS, 1867, *Kryptos koehleri* (LOCARD, 1896), *Pleurotomella packardi* VERRILL, 1872, *Corinnaeturris leucomata* (DALL, 1881), *Xanthodaphne dalmasi* (DAUTZENBERG & FISCHER, 1897), *Lusitanops cingulata* BOUCHET & WARÉN, 1980, and *Lusitanops hyaloides* (DAUTZENBERG, 1925). Mediterranean occurrences of *Opaliopsis atlantis* (CLENCH & TURNER, 1952) and *Scaphander punctostriatus* (MIGHELS, 1841) are discussed and additional information is supplied. Nearly all species are represented by empty shells, sometimes subfossil and belonging to submerged thanatocoenoses of possibly late glacial age. *Kryptos koehleri* has holobenthic larval development, but may have a continuous benthic distribution across the Gibraltar sill. All other species have planktotrophic larval development and probably are (or were) dispersed from the Atlantic as meroplanktonic larvae which metamorphosed in the Mediterranean. A bibliography on deep water Mediterranean molluscs is presented.

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Introduction

For many decades most of the information on the deep-sea mollusc fauna of the Mediterranean has been based on the somewhat fragmentary results of 19th century and early 20th century investigations (FORBES 1844; MARION 1875, 1883; MONTEROSATO 1880, 1890; JEFFREYS 1882, 1878-1885 and other papers listed by WARÉN 1980; STURANY 1896; LOCARD 1897-1898; D'AMICO 1912; SYKES 1904-1925).

In the last decades however a wealth of new information has been produced as a consequence of renewed interest in deep sea biology. Oceanographic expeditions have been carried out in the Mediterranean by French, German and Italian research vessels, and data on the mollusc fauna have been published in more than 20 papers listed in the bibliography.

Mediterranean malacology has also become very popular in Italy, and many active collectors have contributed significantly to our knowledge on the deep-water fauna, with the majority of numerous papers and notes published in the *Bollettino Malacologico* (Milano), *La Conchiglia* (Roma) and *Notiziario CISMA* (Roma); the more important of these contributions on deep-water Mediterranean molluscs are listed in the references.

However, despite these efforts and despite considerable interest of biogeographers in the Mediterranean, the census of the Mediterranean deep-sea mollusc fauna is still far from complete. Herein, we report the first Mediterranean records of 8 gastropod species from the bathyal zone of the western and central basins, and update the information about two others.

Sources of the new material

Cruises CS-71 (1971), CS-73 (1973) in the Strait of Sicily and cruise B-74 (1974) in the Balearic basin were conducted on R.V. «Bannock» for geological investigations, using a very heavy iron-chained dredge in order to detach rocks. The abundant malacological material obtained during cruises CS-73 and B-74 has already been partly reported by TAVIANI (1974, 1983), TAVIANI & COLANTONI (1979), MELONE & TAVIANI (1980, 1984), TAVIANI & SABELLI (1982), TAVIANI & TAVIANI (1986), GUIDASTRI et al. (1984), PIANI (1984) and BOUCHET & WARÉN (1985, 1986), and was the source for three new species of gastropods (*Solatisonax bannocki* (MELONE & TAVIANI, 1980), *Melanella glypta* BOUCHET & WARÉN, 1986, and *Papuliscala tavianii* BOUCHET & WARÉN, 1986).

Cruises BIOMEDE 1 (1976) and BIOMEDE 2 (1981) in the western Mediterranean were conducted on R.V. «Noroit» with biological perspectives and used epibenthic and other light dredges. BALGIM (1984) was conducted on R.V. «Cryos» in the western Alboran sea, the strait of Gibraltar, and nearby Atlantic; some material from that source has already been reported by BOUCHET & WARÉN (1986).

New information

Claviscala richardi (DAUTZENBERG & DE BOURY, 1897) - (fig. 2)

Material: B-74/3, 37°39N, 00°01W, 940-260m, 1 shell.

The single, chalky and fragmentary adult shell dredged in the Balearic basin is clearly subfossil but its age can only be approximately assessed. A scleractinian from the same station yielded a ^{14}C age of 33,000 yr BP, indicating the existence of a late glacial thanatocoenosis in the area (DELIBRIAS & TAVIANI 1985). This may also be the age of (at least part of) the deep-sea mollusc fauna associated with the corals (see also TAVIANI & TAVIANI 1986).

C. richardi is the largest and one of the most common N.E. Atlantic deep sea epitoniids; its Atlantic distribution extends between 38° and 52°N, with a mean depth range of 1011 ± 220m, based on 17 records (BOUCHET & WARÉN 1986). It has a planktotrophic larval development.

Another large sized epitoniid, *Gregorioiscala pachya* (LOCARD, 1897), has recently been reported by MICALI & VILLARI (1986) from Pleistocene (Sicilian) deep-sea deposits of southern Italy under the name *Scalaria longissima* (SEGUENZA, 1879). This species is not known as Recent in the Mediterranean. It has an Atlantic distribution between 38° and 44°N, with a mean depth range of 1294 ± 259m, based on 8 records (BOUCHET & WARÉN 1986). It has planktotrophic larval development.

Opaliopsis atlantis (CLENCH & TURNER, 1952)

Material: BALGIM st DR153, 35°56N, 03°45W, 480m, bottom of mud and dead coral branches, 1 old shell.

This record, already published by BOUCHET & WARÉN (1986), is here emphasized because it is from the strait of Gibraltar immediately East of the sill. The shell is suspected to be (sub)fossil, although a definitive age assessment is for the moment impossible.

The distribution of the species, previously known only from the W. Atlantic, has recently been considerably extended by its discovery in post-Sicilian deposits of Calabria (CROVATO & TAVIANI 1985) and in the bathyal zone of the E. Atlantic (BOUCHET & WARÉN 1986). In the Atlantic, it occurs between 22° and 38°N, with a mean depth range of 580 ± 140m, based on 5 records. *O. atlantis* has planktotrophic larval development.

Torellia vestita (JEFFREYS, 1867) - (figure 8)

Material: CS-71/4, 36°17N, 13°42E, 870-611m, 5 shells.

T. vestita lives in the upper abyssal and bathyal zones, on both sides of the North Atlantic; in the E. Atlantic, its southern limit is in the bay of Biscay (BOUCHET & WARÉN 1979). Off Scandinavia, it has been reported from as shallow as 90m (SARS 1878), but its habitat is deeper going southwards. The finding of five shells, subfossil but in good condition, in a submerged thanatocoenosis in the strait of Sicily is therefore of great interest.

It was also recently found in bathyal clays of Sicilian age near Reggio Calabria (ARCHI 87 Malacological Expedition of the University of Bologna, unpublished).

Considering its present mainly boreal distribution, we hypothesize that the species entered the Mediterranean during a period of climatic cooling. We believe that *T. vestita* is now extinct in the Mediterranean and that the shells dredged in the strait of Sicily derive from submerged glacial deposits. *T. vestita* might be considered a genuine «cold guest», to be added to the list of boreal immigrants into the Mediterranean (MALATESTA 1960, RUGGIERI 1967, TAVIANI 1976, RAFFI 1986).

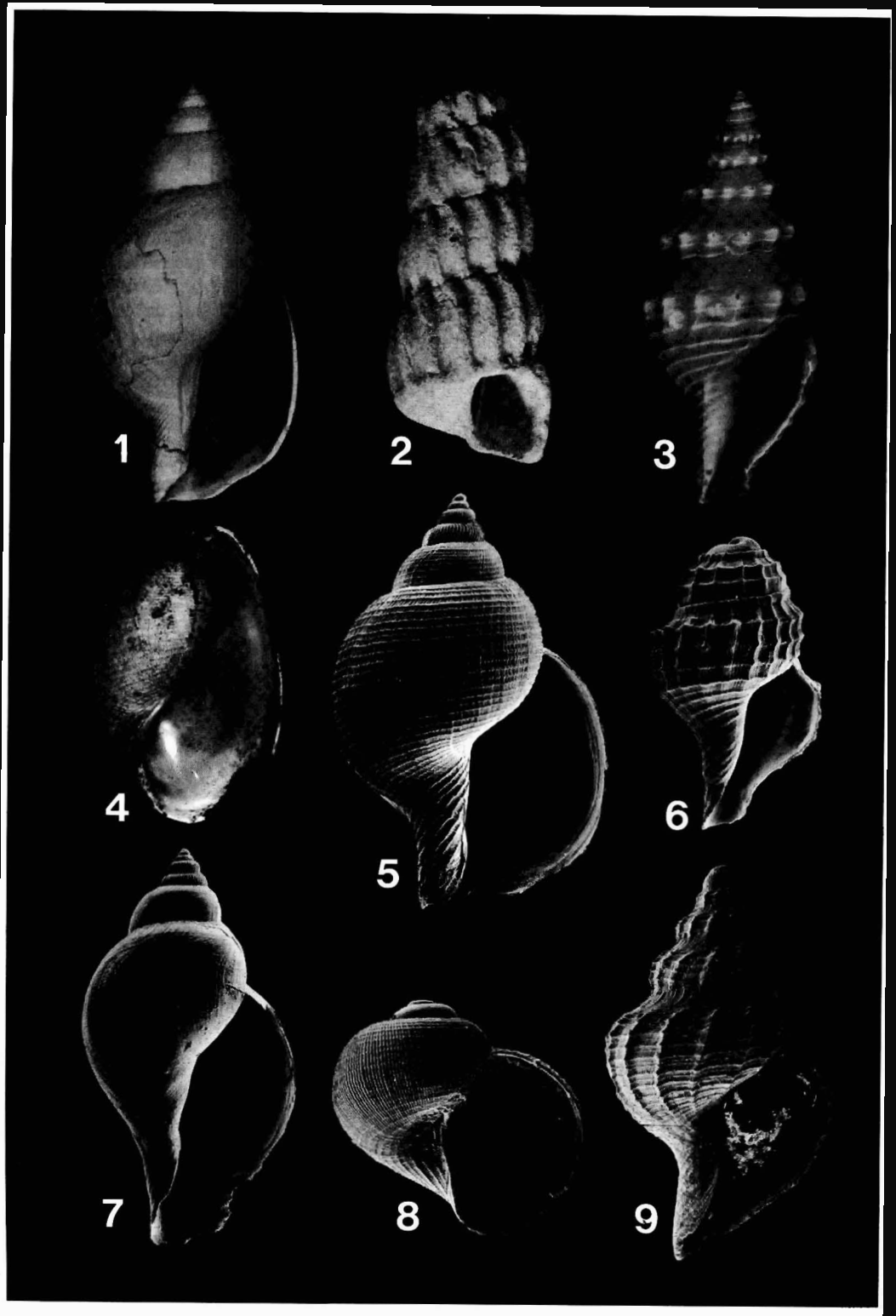
T. vestita has planktotrophic larval development.

Kryptos koehleri (LOCARD, 1896) - (figure 6)

Material: BALGIM st DW121, 35°56N, 05°02W, 556-582m, 1 young live-taken specimen.

From distributional information obtained during the BALGIM cruise, it appears that *K. koehleri* has a bathymetric distribution wider than was summarized in BOUCHET & WARÉN (1985). It has been collected several times in depths between 450 and 500m in the gulf of Cadiz. Despite its holobenthic larval development, its presence in the westernmost Alboran sea can tentatively be explained by a continuous distribution across the Gibraltar sill.

Figs 1-9.
1, *Lusitanops hyaloides*, height 11.3 mm;
2, *Claviscala richardi*, height 23.1 mm;
3, *Corinnaeturris leucomata*, height 9.7 mm;
4, *Scaphander punctostriatus*, BIOMEDE 1 st 10, height 11.1 mm;
5, *Lusitanops cingulata*, height 5.5 mm;
6, *Kryptos koehleri*, height 4.0 mm;
7, *Xanthodaphne dalmasi*, height 7.3 mm;
8, *Torellia vestita*, height 2.9 mm;
9, *Pleurotomella packardi*, height 6.7 mm.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Pleurotomella packardi VERRILL, 1872 - (figure 9)

Material: CS-73/5, 36°59N,13°13E/13°14E, 553-769m, 1 shell.

The single empty shell is subfossil, but in excellent condition. *P. packardi* is one of the more common bathyal turrids in the North Atlantic, where it is widely distributed between 32° and 76°N, with a mean depth range of 2442 ± 1080m, based on 59 records (BOUCHET & WARÉN 1980). The morphology of the protoconch indicates planktotrophic larval development. Empty shells of another deep-water Atlantic species of *Pleurotomella*, viz. *P. demosia* (DAUTZENBERG & FISCHER, 1896), have been recorded from the Western Mediterranean in 120-400m by BOGI (1986). It has a North Atlantic distribution between 32° and 40°N, with a mean depth range of 1223 ± 422m, based on 9 records. The morphology of the protoconch indicates planktotrophic larval development (BOUCHET & WARÉN 1980).

While this paper was in press, SMRIGLIO et al. (1988) also recorded independantly, on the basis of one empty shell, this species from the Tyrrhenian sea in ca. 500m; they also raise the hypothesis that the shell originates from wurmian thanatocoenosis.

Corinnaeturris leucomata (DALL, 1881) - (figure 3)

Material: BALGIM st DR118, 35°49N, 05°13W, 352m, mud, 1 small specimen.

This Mediterranean record is considerably shallower than the North Atlantic records which are all from depths greater than 1300m, with a mean depth range of 1588 ± 688m, based on 12 records. *C. leucomata* is known in the Atlantic between 15° and 46°N. The protoconch indicates planktotrophic larval development.

Xanthodaphne dalmasi (DAUTZENBERG & FISCHER, 1897) - (figure 7)

Material: BIOMEDE 2 st 17, 41°00N, 07°25W, 2775m, 1 shell.

The previously known distribution of *X. dalmasi* was the NE Atlantic between 28° and 40°N, with a mean depth range of 1663 ± 436m, based on 15 records. The present record is the first one in the Mediterranean. The species recorded under this name by DI GERONIMO & PANETTA (1973: 88) was identified as *Gymnobela subaraneosa* (DAUTZENBERG & FISCHER, 1897) by BOUCHET & WARÉN (1980: 66). The protoconch indicates planktotrophic larval development.

Lusitanops cingulata BOUCHET & WARÉN, 1980 - (figure 5)

Material: BIOMEDE 2 st 11, 40°20N, 06°43W, 2775-2795m, 1 shell.

L. cingulata was previously known from the holotype and one other specimen from two stations off the British Isles in 2500m. Its protoconch indicates planktotrophic larval development.

The presence of species of *Lusitanops* in the Mediterranean has been known since BOUCHET & WARÉN (1980), who recorded an unnamed species from the gulf of Taranto. The same species was taken at several BIOMEDE stations in the western basin of the Mediterranean and is still under study.

Lusitanops hyaloides (DAUTZENBERG, 1925) - (figure 1)

Material: B-74/3, 37°39N, 00°01W, 940-260m, 1 shell.

The single shell here reported from the Balearic basin is chalky and subfossil. The 6 known NE Atlantic records are scattered between 38° and 60°N, with a mean depth range of 1493 ± 113m. The protoconch indicates planktotrophic larval development.

Scaphander punctostriatus (MIGHELS, 1841) - (figure 4)

Material: BIOMEDE 1 st 2, 42°40N, 06°00E, 2370-2420m, 1 shell; st 10, 41°47N, 08°33E, 1380-1450m, 9 shells; st 14, 42°40N, 06°45E, 2520-2560m, 1 shell.

S. punctostriatus has been cited twice before from the W Mediterranean: MONTEROSATO (1880) cites a small and worn specimen («un piccolo e rotto esemplare») from his dredgings between Palermo and Ustica, 300m; D'AMICO (1912), on the basis of Jeffreys (1882a), cites it from WASHINGTON st 1, drag. 2 (not drag. 1 as mentioned by error in the text), 41°03N, 08°32E, 800-1003m, and st 20, drag. 24, 39°43N, 09°50E, 623-856m. These three records have been plotted by BOUCHET (1975) on the distribution map of the species, which occurs all over the NE Atlantic from a couple of hundred meters (in the northern part of its range, off Scandinavia) to over 2000m, further south.

The shells taken during BIOMEDE 1 are small for the species, and not very fresh. *S. puncostriatus* was not found during BIOMEDE 2, which sampled the abyssal plain between Sardinia and the Baleares, at depths between 2550 and 2800m.

S. punctostriatus has a protoconch indicating planktotrophic larval development (LEMCHE 1948).

Discussion

We have assumed that at least part of the Late Quaternary and Recent deep-sea mollusc fauna of the Mediterranean derives from the nearby Atlantic, drifting through the strait of Gibraltar as meroplanktonic larvae (BOUCHET & WARÉN 1980, TAVIANI 1985, BOUCHET & TAVIANI 1986). The findings discussed in the present paper fit well within this scheme.

Except the eurybathic *Kryptos koehleri*, the other 10 species discussed above are potentially able to cross the Gibraltar sill as planktonic larvae. The alternative, that these colonizers enter the Mediterranean as crawling metamorphosed postlarvae, can't be excluded *a priori*. This may well be the case for species with a bathymetric range compatible with the minimal depth of the sill (180m), but this hypothesis can hardly be hold for more stenobathic species.

There is now considerable direct and indirect evidence that the larvae of some bathyal and abyssal gastropods are capable of important vertical migratory movements towards the photic zone (BOUCHET 1976, BOUCHET & WARÉN 1979, BOUCHET & FONTES 1981, REX & WARÉN 1982, KILLINGLEY & REX 1985). When they have reached water layers close to the surface, these larvae can be passively dispersed by current drifts: in the case of the Mediterranean, such larvae can be carried passively through the strait by the eastwards surface current and metamorphose when favourable conditions are encountered.

The fact that many occurrences of Mediterranean deep-sea gastropods originate from supposedly late glacial thanatocoenoses seems to indicate that hydrological conditions during cooler periods of the Pleistocene were in some way more favourable to the settling of a diversified Atlantic type deep-sea fauna (DELIBRIAS & TAVIANI 1985, RAFFI & TAVIANI 1985, TAVIANI & COLANTONI 1984, ZIBROWIUS 1980).

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