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New ostracod species from Lower Pleistocene sediments from Capo Milazzo (NE Sicily)

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KEY WORDS - New marine ostracods, Early Pleistocene, Bathyal, Sicily.

ABSTRACT - The study presents the findings of four peculiar fossil species of Ostracoda from sandy-silty bathyal sediments of Early Pleistocene age from Punta Messinese (Capo Milazzo Peninsula, NE Sicily). Three species are newly described, Bythocypris antoniettae *n. sp.,* Cytheropteron italoi *n. sp. and* Cytheropteron rossanae *n. sp.; one species is assigned in open nomenclature to the genus* Buntonia *Howe & Chambers, 1935.*

RIASSUNTO - [Specie nuove di ostracodi del Pleistocene Inferiore di Capo Milazzo (Sicilia NE)] - *Durante lo studio dell'ostracofauna dei sedimenti batiali del Pleistocene Inferiore affioranti in località Punta Messinese all'estrema punta della penisola di Capo Milazzo, sono state rinvenute quattro specie fossili particolari: tre sono specie nuove,* Bythocypris antoniettae *n. sp.,* Cytheropteron italoi *n. sp. e* Cytheropteron rossanae *n. sp. la quarta, appartenente al genere* Buntonia *Howe & Chambers, 1935 viene descritta in nomenclatura aperta.*

INTRODUCTION

Along the steep slopes of the Capo Milazzo Peninsula (NE Sicily; Fig. 1), discontinuous lenses of yellowish fine sands and silts are exposed. These sediments (Fig. 2) were deposited unconformably on Miocene shallow water sediments and/or metamorphic rocks of the Calabride Complex (Fois, 1990a, b). The age of these sediments is mostly Gelasian (Early Pleistocene), but locally it may reach the Sicilian (Violanti, 1988, 1991).

The ostracod fauna of this sedimentary succession has been studied by Sciuto (2003, 2005, 2009); the lower Gelasian layers are characterized mainly by *Bythocypris obtusata* (Sars, 1866), *Henryhowella sarsii profunda* Bonaduce, Barra & Aiello, 1999, *Bairdoppilata profunda* Aiello, Barra & Bonaduce, 2000, *Costa tricostata pliocenica* Ruggieri, 1992, and also by *Quasibuntonia radiatopora* (Seguenza, 1880) and *Agrenocythere pliocenica* (Seguenza, 1880), the latter species listed among the psychrospheric ostracods by Benson (1972). The higher Sicilian layers are characterized by a significant increase of the specific diversity. The association consists again almost exclusively of bathyal taxa such as *Bythocypris obtusata* (Sars, 1866), *B. bosquetiana* (Brady, 1866), *Ruggieriella decemcostata* Colalongo & Pasini, 1980, *Henryhowella sarsii profunda* Bonaduce, Barra & Aiello, 1999, *Quasibuntonia radiatopora* (Seguenza, 1880), *Retibythere* (*Bathybythere*) *scaberrima* Brady, 1886, *Pseudocythere armata* Bonaduce et al., 1980 and *Bythocythere mylaensis* Sciuto, 2009. Also the *Krithe* group is well represented and reaches a dominance of 4.2% mostly with *Krithe compressa* (Seguenza, 1880). Further taxa such as *Cytheropteron testudo* Sars, 1869, *Paijenborchella malaiensis cymbula* Ruggieri, 1950, *Pedicythere phryne* Bonaduce, Ciampo & Masoli, 1975, *Typhloeucytherura calabra* Colalongo & Pasini, 1980 and *Profundobythere* sp. as well as *Sclerochilus* gr. *contortus* (Norman, 1861), *Paradoxostoma* spp. and *Paracytherois* spp. are rare.

The aim of this paper is to complete the analysis of the ostracod fauna from Capo Milazzo by a new sampling of the same productive layers and a re-examination of previously undetermined material.

MATERIALS AND METHODS

The new species described in this paper were recovered from two samples, belonging to the same stratigraphic horizon, of yellow calcareous sandy-silts and silts (Fig. 2). The outcrop is located at Punta Messinese, the western ending point of the Capo Milazzo Peninsula (samples Faro 1 and Faro 2; Tav. Milazzo, F.253 IV SO, 38°16'09"N, 15°13'27"E of the "Carta d'Italia alla scala 1:25.000"). Sandy silts locally overlay the Messinian *Porites* limestones, filling a previous depression. Owing to the presence of *Hyalinea baltica* (Schroeter, 1783) and *Globorotalia truncatulinoides excelsa* Sprovieri, Ruggieri & Unti, 1980 their age can be referred to the Sicilian Stage (sensu Gibbard & Cohen, 2008). This isolated sediment pocket represents the earliest bathyal layers so far recognised in the area.

The specimens were examined and measured under a LMU Tescan Vega II SEM.

The material is housed in the Museo Paleontologico of the Catania University. The repository number of three Holotypes (PMC. O 2-4H. 25.02.2012) and fifteen Paratypes (PMC. O 10-24 P. 25.02.2012) is given in the systematic descriptions.

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Fig. 1 - Geographical location of Capo Milazzo Peninsula and Punta Messinese.

SYSTEMATIC DESCRIPTIONS

Class Ostracoda Latreille, 1806
Order Podocopida Sars, 1866
Family Bairdiidae Sars, 1887
Subfamily Bythocypridinae Maddocks, 1969

Genus *Bythocypris* Brady, 1880

Bythocypris antoniettae n. sp.
(Pl. 1, figs 1-4)

1975 *Zabythocypris* sp. Breman, p. 209, Pl. 1, figs. 3a, b.
2005 *Bythocypris* sp. Sciuto, p. 222.

Derivatio nominis - From Prof. Antonietta Rosso, Palaeontologist at the University of Catania, Italy, for her research on Pleistocene and Recent invertebrates.

Material - 15 specimens.

Holotype - The carapace (PMC. O 2H. 25.02.2012) figured in Pl. 1, fig. 1 (L = 1470 µm, H = 950 µm).

Paratypes - The right valve figured in Pl. 1, fig. 4, two right valves from the same samples and seven carapaces (PMC. O 10- 20 P. 25.02.2012).

Type locality - Punta Messinese at the farthest end of the Capo Milazzo Peninsula (Tav. Milazzo, F.253 IV SO, 38°16'09"N, 15°13'27"E of the "Carta d'Italia alla scala 1:25.000"). Yellow sandy-silts from the *Globorotalia truncatulinoides excelsa* Zone of the Sicilian (upper part of the MPle 1 Zone to the lower part of the MPle 2 Zone).

Stratigraphic Range - Sicilian Stage to post Wurmian of the central Mediterranean area.

Diagnosis - *Bythocypris antoniettae* n. sp. is characterized by a smooth, flattened and bean- shaped carapace with strongly asymmetric valves.

Description - Large-sized carapace, bean shaped in lateral view (Pl. 1, fig. 1), compressed and fusiform in dorsal view.

Valves strongly unequal: right valve sub trapezoidal, left valve semicircular, more rounded and higher than the right valve. Length /Height ratio of the LV = 1.5. LV strongly overlapping RV, mainly dorsally.

In both valves: anterior margin wide and regularly arched, posterior margin rounded and slightly acute, ventral margin convex with a central marked oral curvature. Dorsomedian margin straight in the right valve, strongly arched in the left valve.

Outer surface smooth. Normal pore-canals simple and small, visible only on the inner surface of the valve (Pl. 1, fig. 4).

Inner lamella: anteriorly and posteriorly wide, reduced to the minimum ventrally; marginal zone narrow, vestibula present in the antero-ventral and postero-ventral areas. Marginal pore canals not visible.

Hinge adont and muscle scars as for the genus (Pl. 1, fig. 3).

No evidence of sexual dimorphism. Several juvenile specimens are present in the studied samples, but the specimens are not included in the type series.

Remarks - *Bythocypris antoniettae* n. sp. shows features which can be related to Bythocypridinae Maddocks, particularly the thin and smooth carapace, the adont hinge and the muscle scars. This subfamily includes two genera: *Zabythocypris* Maddocks, 1969 and *Bythocypris* Brady, 1880. Species belonging to the former genus show morphological features very similar to those of *B. antoniettae* n. sp. such as the very compressed, bean shaped, highly arched carapace but with the LV much higher than the RV. Nevertheless the type species of the genus *Zabythocypris ancipita* Maddocks, 1969, shows a spine in the left valve which was interpreted by Maddocks (1969) as an immature character. Conversely, Athersuch & Gooday (1979) attributed to this spine a diagnostic generic value. Particularly, this feature represents the main difference between the two genera. This excludes the attribution of the present species to *Zabythocypris*. Aiello et al. (1996a), believe that the characteristic of *Bythocypris* is the asymmetry of the valves and the overlap of the LV on the RV. Therefore, according to these authors, the species has been assigned to *Bythocypris*.

Bythocypris Brady, 1880 is a bathyal taxon, known from the Palaeozoic to the Recent, with a world wide distribution. This genus includes several species, fifteen of which still living (Maddocks, 1969). Three of them, namely *B. bosquetiana* (Brady, 1866), *B. obtusata* (Sars, 1866) and *B. reflexa* Breman, 1975, are present in the Recent Mediterranean Sea but are also known as fossils from the Cenozoic. *Bythocypris antoniettae* n. sp. is very different from all those species because of the strong asymmetry of the valves with LV strongly overlapping RV. Furthermore, none of the above reported species shows a L /H ratio of the LV so high (1. 5) as *B. antoniettae* n. sp.

On the basis of the remarks discussed above and of its peculiar morphology, *Zabythocypris* sp. reported by Breman (1975) is regarded here as a synonymous of *B. antoniettae* n. sp. *Zabythocypris* sp. was found only in core number 353 drilled from south-eastern part of the Adriatic Sea, at a depth of 1207 metres (Breman, 1975). The

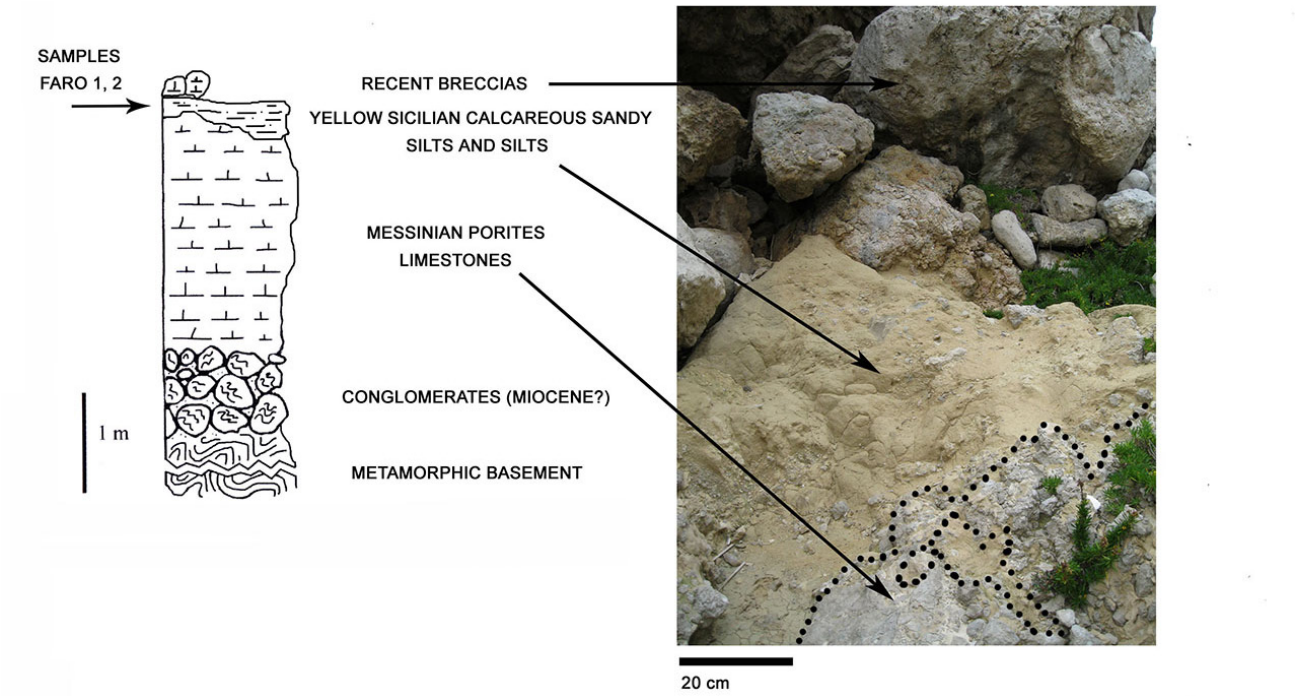


Fig. 2 - General lithologic log (simplified) in the surroundings of Punta Messinese with the studied level of yellow Sicilian calcareous sandy-silts and silts.

species was collected from sediments deposited during a very cold stage of the Early Pleistocene and was absent from the Upper Pleistocene and Holocene layers. In that core, *Zabythocypris* sp. was associated with other species such as *Bythocypris reflexa* and *Echinocythereis echinata* (Sars, 1866) pointing to a typical bathyal environment. Both species were considered by Breman (1975) as cold water indicators.

Bythocypris antoniettae n. sp. is very similar to species found in extra Mediterranean areas, i.e., *Zabythocypris ancipita* Maddocks (1969, p. 108, figs 59 A-B) from deep waters (between 1190 and 1829 metres wather depth) of Mozambique Channel. Particularly *Z. ancipita* shows size and L/H ratio comparable with those of *B. antoniettae* n. sp.

Family Cytheruridae Müller, 1894

Genus *Cytheropteron* Sars, 1866

Cytheropteron italoi n. sp.
(Pl. 1, figs 8-11)

2005 *Cytheropteron* sp. 1 Sciuto, p. 222.

Derivatio nominis - The species is named after Prof. Italo Di Geronimo, Palaeontologist at the University of Catania, Italy, for his research on Pleistocene and Recent invertebrates.

Material - 5 specimens.

Holotype - The right valve PMC. O 3H. 25.02.2012 (L = 530 µm, H = 396 µm) figured in Pl. 1, fig. 8.

Paratypes - The RV figured in Pl. 1, figs 9-10 and the LV figured in Pl. 1, fig. 11, from the same samples (PMC. O 21- 22 P. 25.02.2012).

Type locality - Punta Messinese at the farthest end of Capo Milazzo Peninsula (Tav. Milazzo, F.253 IV SO, 38°16'09"N, 15°13'27"E). Yellow sandy-silts from the *Globorotalia truncatulinoides excelsa* Zone of the Sicilian Stage (upper part of the MPle 1 Zone to the lower part of the MPle 2 Zone).

Stratigraphic Range - Sicilian Stage.

Diagnosis - *Cytheropteron italoi* n. sp. is characterized by a prominent ala with a large and elongate spine at its posterior attachment point.

Description - A medium-sized *Cytheropteron* species, characterized by elongate, sub rhomboidal carapace in lateral view. Valves unequal, RV strongly overlapping the LV dorsally.

Anterior margin wide and regularly rounded, dorsal margin arched and convex passing regularly to the caudal process of the posterior area. Caudal process elongate and acute. Ventral margin sinuous with a light oral convexity anteriorly.

Alar process strong, prominent, pointed and arched backwards, located in the central ventral area, slightly shifted forwards; only a single large and elongate spine at the posterior attachment point of the ala.

Anterior and posterior end acute in dorsal view, the latter one more sharpened than the former one. Alar process attached in central area with a sharply bending anteriorly, posteriorly forming a continuous wide arc to the center of which is the spine.

Outer surface smooth.

Inner lamella wide anteriorly, narrow postero-ventrally. Anterior vestibulum large, posterior one small (Pl.1, fig. 9).

Hinge merodont. Muscle scars not visible. No evidence of sexual dimorphism.

Remarks - The genus *Cytheropteron* Sars, 1866 includes eurybatic species, known from the Jurassic. It has a worldwide distribution and it is presently reported from the Mediterranean Sea with twelve living species (SIBM, 2005); several of them have been also reported from the Mediterranean area as fossils from Cenozoic sediments (Aiello et al., 1996b).

Cytheropteron italoi n. sp. shows a general shape similar to some species of the genus such as *C. vespertilio* (Reuss, 1850), *C. venustum* Bonaduce, Ciampo & Masoli, 1976, *C. pseudoalatum* Colalongo & Pasini, 1980 and particularly *C. lumalatum* Ayress et al., 1996. Nevertheless it is distinguishable from all of them because of its smooth surface, the shape of the alar process and the only one large and above all elongated spine at the posterior attachment of the alae.

Cytheropteron rossanae n. sp.
(Pl. 1, figs 12-16)

2005 *Cytheropteron* sp. 2 Sciuto, p. 222.

Derivatio nominis - The species is named after Prof. Rossana Sanfilippo, Palaeontologist at the University of Catania, Italy, for her research on Pleistocene and Recent invertebrates.

Material - 4 specimens.

Holotype - The RV PMC. O 4H. 25.02.2012 (L = 762 μm, H = 520 μm) figured in Pl. 1, fig. 12.

Paratypes - Two LV from the same samples (PMC. O 23- 24 P. 25.02.2012).

Type locality - Punta Messinese at the farthest end of Capo Milazzo Peninsula (Tav. Milazzo, F.253 IV SO, 38°16'09"N, 15°13'27"E). Yellow sandy-silts from the *Globorotalia truncatulinoides excelsa* Zone of the Sicilian Stage (upper part of the MPle 1 Zone to the lower part of the MPle 2 Zone).

EXPLANATION OF PLATE 1

New species from Lower Pleistocene of Capo Milazzo.

Figs 1-4 - *Bythocypris antoniettae* n. sp.

1 - Complete carapace in lateral view. Holotype PMC. O 2H. 25.02.2012 (scale bar 500 μm).

2 - Left valve, internal lateral view. Paratype PMC. O 10 P. 25.02.2012 (scale bar 200 μm).

3 - Muscle scars. Paratype PMC O 10P. 25.02.2012 (scale bar 100 μm).

4 - Right valve, internal view. Paratype PMC. O 11 P. 25.02.2012 (scale bar 500 μm).

Figs 5-7 - *Buntonia* sp. 1

5 - Right valve, external lateral view (scale bar 200 μm).

6 - Right valve, internal lateral view (scale bar 200 μm).

7 - Right valve, internal lateral view: hinge (scale bar 200 μm).

Figs 8-11 - *Cytheropteron italoi* n. sp.

8 - Right valve, external lateral view. Holotype PMC. O 3H. 25.02.2012 (scale bar 100 μm).

9 - Right valve, internal lateral view. Paratype PMC. O 21 P. 25.02.2012 (scale bar 100 μm).

10 - Right valve, internal lateral view. Paratype PMC. O 21 P. 25.02.2012 (scale bar 100 μm).

11 - Left valve, dorsal view. Paratype PMC. O 22 P. 25.02.2012 (scale bar 200 μm).

Figs 12-16 - *Cytheropteron rossanae* n. sp.

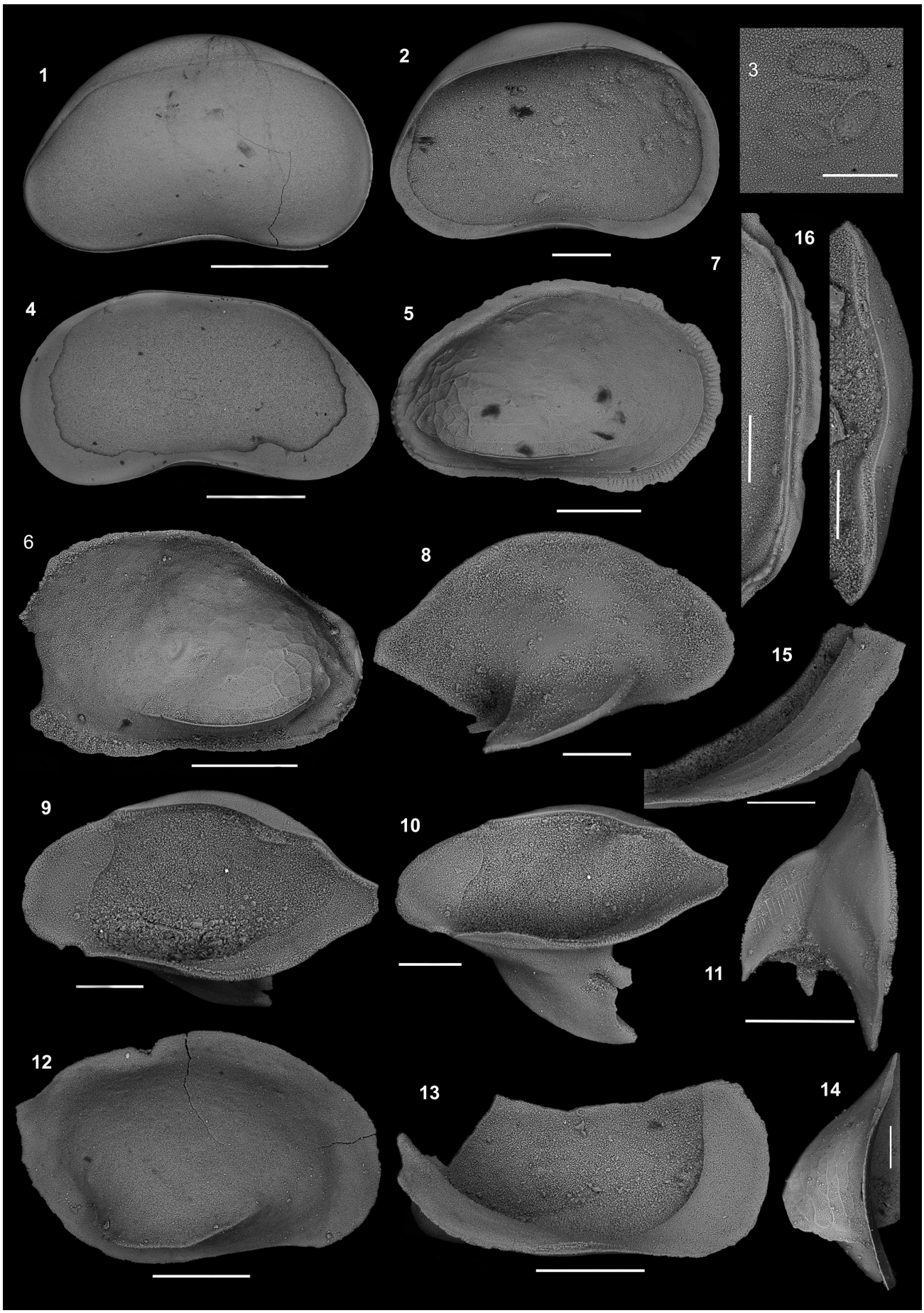
12 - Right valve, external lateral view. Holotype PMC. O 4H. 25.02.2012 (scale bar 200 μm).

13 - Left valve, internal lateral view. Paratype PMC. O 23 P. 25.02.2012 (scale bar 200 μm).

14 - Left valve, dorsal view: detail of alar process (scale bar 100 μm).

15 - Right valve, external lateral view: detail of the duplicature in the posterior marginal area (scale bar 100 μm).

16 - Right valve, hinge (scale bar 100 μm).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Stratigraphic Range - Sicilian Stage.

Diagnosis - *Cytheropteron rossanae* n. sp. is characterized by an inflated carapace sub-rhomboidal in lateral view, with short caudal process and short and rounded alae.

Description - A medium sized very thin-shelled *Cytheropteron* species, characterized by a sub-rhomboidal carapace in lateral view (Pl. 1, fig. 12).

Valves unequal, RV overlaps the LV dorsally. Anterior margin rounded, dorsal margin convex forming an obtuse angle at about half length; posterior margin almost straight with a short caudal process at two thirds of the height. Ventral margin sinuous with slight oral convexity. Anterior, posterior and dorsal marginal area flattened and wide. Central part of the valves inflated with alar process in central ventral areas marked by a thin and curved ridge.

Carapace inflated in dorsal view with marginal area flat and pointed, alar process rounded.

Outer surface smooth except for the lower surfaces of the alae showing a weak reticulation (Pl. 1, fig. 14).

Inner lamella wide anteriorly, narrow postero-ventrally. Vestibula present: the anterior one large, the posterior one narrow. Thin longitudinal ribs (Pl. 1, fig. 15) visible on the inner side of the postero-ventral marginal area.

Hinge entomodont (Pl. 1, fig. 16). Muscle scars not visible. No evidence on sexual dimorphism. Several juvenile specimens are present in the studied samples. However they are not included in the type series.

Remarks - This species has been confidently assigned to the genus *Cytheropteron* Sars, 1866 using morphological features such as the general shape of the carapace, the alar processes and the hinge, even if muscle scars are lacking.

Cytheropteron rossanae n. sp. is slightly similar to *Cytheropteron* sp. 1 described by Yasuhara et al. (2009) from Quaternary sediments of bathyal environments of the North Atlantic Ocean because of the inflated carapace and the flattened marginal areas. Nevertheless, *C. rossanae* n. sp. can be distinguished from Yasuhara's species because of its smooth surface and the curved ridge that marks the alar processes.

Family Trachyleberididae Sylvester-Bradley, 1948

Subfamily Buntoninae Apostolescu, 1961

Genus *Buntonia* Howe, 1935
(in Howe & Chambers, 1935)

Buntonia sp. 1
(Pl. 1, figs 5-7)

Stratigraphic Range - Sicilian Stage.

Material - 3 specimens.

Description - *Buntonia* sp. 1 possesses juvenile features and it is characterized by sub triangular valves in outline. Medium sized carapace, valves unequal. Anterior margin rounded passing to the dorsal margin through a marked obtuse corner. Dorsal margin straight and sloping towards the posterior margin. Posterior margin acute and rounded in RV, postero-dorsal zone raised in LV. Ventral margin sinuous with a marked oral curvature. In dorsal view wedge-shaped, obtuse at posterior end and acute at anterior end with the maximum thickness located at the postero-central zone.

Outer surface slightly reticulated especially in the posterior and ventral area; meshes are characterized by secondary ornamentation made of numerous very small pits (Pl. 1, fig. 5). A marked longitudinal ridge runs from the centro-ventral area to the postero-ventral end, in correspondence with the maximum carapace thickness. Two parallel series of tubercles run parallel to the posterior margin. Normal pore canal not visible.

Eye tubercles absent.

Inner lamella anteriorly and postero-ventrally narrow, reduced to the minimum ventrally.

Flange prominent, flattened and radially striated, larger anteriorly and narrower postero-ventrally. Selvage marked around the outline.

False pore canals numerous along the anterior and ventral margin.

Hinge merodont (Pl. 1, fig. 7): a straight groove parallel to the dorsal margin with one simple small and elongated tooth at the each extremity; hinge on the left valve complementary. Central muscle scars as for the genus (Pl. 1, figs 5-6).

Remarks - *Buntonia* sp. 1 is very similar to *Buntonia* cf. *B. mackenziei* Puri & Hulings, 1976 reported by Whatley & Coles (1987) from the Late Pliocene of the LEG 44 in Atlantic Ocean. Also this latter species shows juveniles features.

DISCUSSION

The ostracod fauna associated to the four species here described (*Bythocypris antoniettae* n. sp., *Cytheropteron italoi* n. sp., *Cytheropteron rossanae* n. sp. and *Buntonia* sp. 1) shows analogous composition and structure in both the examined samples and it is typical of bathyal environments (Benson, 1984; Dingle & Lord, 1990). *Bythocypris obtusata* (Sars, 1866), *B. bosquetiana* (Brady, 1866), *Bairdia conformis* (Terquem, 1878) and *Sclerochilus contortus* (Norman, 1861) dominate the fauna and constitute about 40% of the ostracod material. The 23% of the specimens is represented by *Cytherella vulgatella* Aiello et al., 1996, *Pseudocythere caudata* Sars, 1866, *P. armata* Bonaduce et al. 1980 (Fig. 3d), *Anchistrocheles interrupta* Aiello, Barra & Bonaduce, 1996c, *Krithe compressa* (Seguenza, 1880), *Argilloecia robusta* Bonaduce, Ciampo & Masoli, 1975 and *Bithocythere mylaensis* Sciuto, 2009 (Fig. 3b). About 70% of the total number of the species is represented by only a few specimens. Among these, remarkable is the presence of *Cytheropteron testudo* Sars, 1869 (Fig. 3a), *Quasibuntonia radiatopora* (Seguenza, 1880) (Fig. 3c) and *Retibythere (Bathybythere) scaberrima* Brady, 1886.

The fossil association contains some taxa whose distribution seems to be strongly influenced by temperature rather than by other factors. These are *R. scaberrima* Brady, 1886, *Q. radiatopora* (Seguenza, 1880), *C. testudo* Sars, 1869, *B. obtusata* (Sars, 1866) and probably also *B. mylaensis* Sciuto, 2009.

The first two species are indicated as psychrospheric by Benson (1972). *C. testudo* Sars, 1869 is a species with a present geographical distribution restricted from the Norwegian coasts to the Arctic bioprovince and it is considered one of the northern guest widespread in the Mediterranean during the Quaternary (Faranda & Gliozzi, 2011). This species has been found in western Laptev Sea, at 68 m water depth by Stepanova et al. (2003); along the Norwegian coast, at depth of 80-240 m, and in the Recent Atlantic, between 1380 and 3526 m water depth by Dingle & Lord (1990); in the Queensland Plateau (SW Pacific) in Holocene to Recent sediments deeper than 500 m by Swanson & Ayress (1999). As fossil the species has been reported from the Early Pliocene to the Quaternary from bathyal sediments of the Atlantic Ocean (Whatley & Coles, 1987); from MPL5 to the Early Pleistocene in bathyal sediments of the Mount S. Nicola section (Aiello et al., 1996b) and at the end, the last occurrence in the Mediterranean Sea corresponds to the Last Glacial (Montcharmont-Zei et al., 1985). Therefore *C. testudo* could be considered as a stenothermic species restricted to very cold waters independently of depth. Similarly *B. obtusata* has been reported from Norwegian and British coasts between 145-165 m water depth by Sars (1928), in the recent Mediterranean Sea at depths between 150-2905 m (Puri et al., 1969). Finally *B. mylaensis* has been collected from sediments sampled at 745 m depth in the Northern Ionian Sea dating from the post Würmian acme (Malinverno et al., 2010).

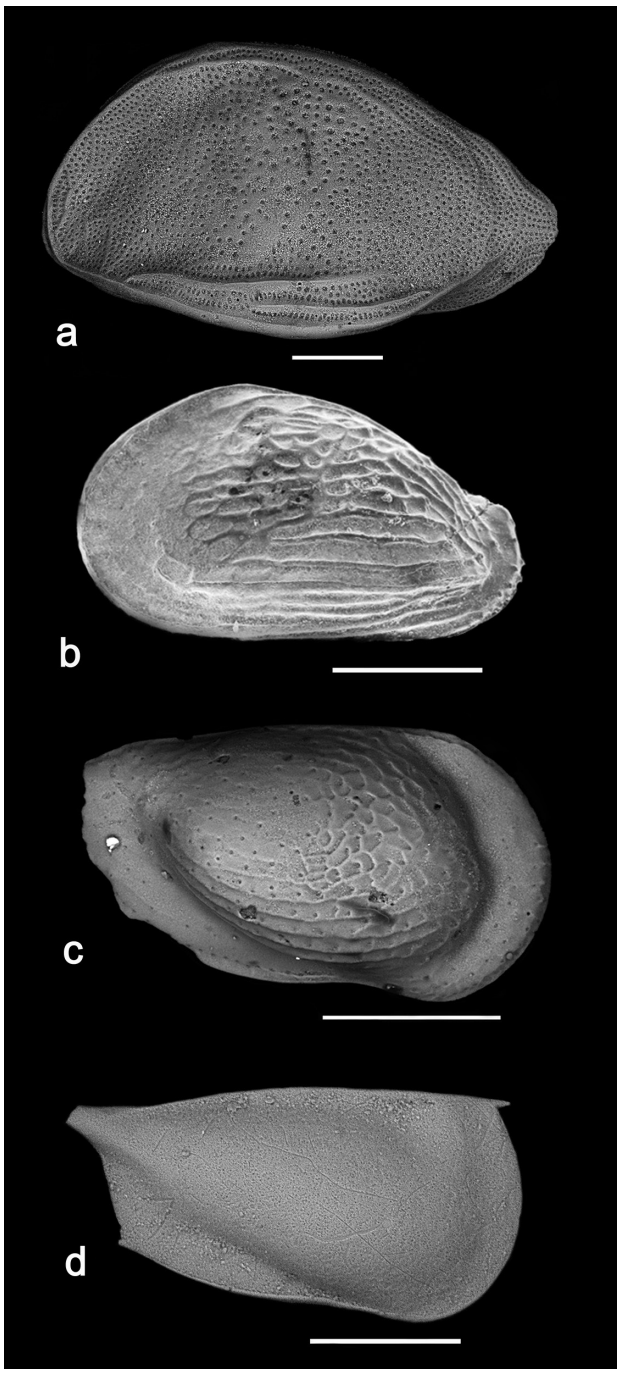

Fig. 3 - a) *Cytheropteron testudo* Sars, 1869, left valve (scale bar 100 µm). b) *Bythocythere mylaensis* Sciuto, 2009, right valve of male (scale bar 200 µm). c) *Quasibuntonia radiatopora* (Seguenza, 1880) left valve (scale bar 250 µm). d) *Pseudocythere armata* Bonaduce et al., 1980, right valve (scale bar 200 µm).

Consequently, these data showing that the determining factor in the ecological distribution of these species is the low water temperature and not the depth, allow to consider the ostracod association as indicative of marine environmental condition characterized by very low temperatures.

Particularly, *Bythocypris antoniettae* n. sp. was found by Breman (1975) in an interval of the core 353 in the bathyal sediments of Adriatic Sea, corresponding, according to Van Straaten (1966), to a very cold period of the Early Pleistocene. These data allow us to consider *Bythocypris antoniettae* n. sp. as a palaeoclimatic cold marker. Further findings of the other species here described will be able to provide data on their ecological distribution.

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