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# Ostracods from mid-outer shelf bottoms of the Ciclopi Islands Marine Protected Area (Ionian Sea, Eastern Sicily)

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*KEY WORDS - Ostracoda, dead assemblages, living assemblages, Ionian Sea, Sicily, circalittoral.*

*ABSTRACT - This study aims to contribute to the knowledge of the recent ostracod faunas of the Cyclops Islands Marine Protected Area (Western Ionian, Eastern Sicily). The distribution of live and dead ostracod assemblages has been analysed in relation to the environmental parameters and the biocoenoses recorded in the area.*

*RIASSUNTO* - [Ostracodi di fondi circalittorali dell'Area Marina Protetta delle Isole Ciclopi (Mar Ionio, Sicilia orientale)] - *Questo studio si propone di contribuire alla conoscenza delle faune attuali ad ostracodi dei fondali dell'Area Marina Protetta delle Isole Ciclopi (Mar Ionio centrale, Sicilia orientale) e di analizzare la distribuzione delle associazioni a ostracodi viventi e morti in relazione ai parametri ambientali e alle diverse biocenosi esistenti nella zona. Gli esemplari fanno parte di bio- e tanatocenosi che provengono da fondi mobili della zona circalitorale medio-profonda. In questa zona sono state identificate le biocenosi del Detritico Costiero (DC), del Detritico del Largo (DL), del Detritico Fangoso (DE) e loro transizioni. La distribuzione dell'ostracofauna appare prevalentemente influenzata dal tipo di substrato; gli ostracodi, infatti, sono tanto più abbondanti e diversificati, quanto maggiore è la percentuale di sabbie fini e peliti nel substrato. Relativamente ai viventi, i campioni in cui è stato riscontrato il maggior numero di specie (sette) e di esemplari (dodici) sono quelli della biocenosi DC, nei cui sedimenti misti la componente grossolana è piuttosto elevata.*

*Alcune specie ubiquiste, come* Neonesidea formosa*,* N. mediterranea *e* Cytherella vulgatella*, sono estremamente frequenti e abbondanti nei campioni. Altre specie, apparentemente limitate alla parte più superficiale della zona circalitorale, tra cui* Aurila convexa*,* Neonesidea corpulenta*,* Loxoconcha affinis *e* L. rhomboidea*, mostrano elevate dominanze nella biocenosi DC. Al contrario, alcune specie euribate profonde, come la rara* Kangarina abyssicola*,* Eucytherura gibbera*,* Macrocyprina succinea *e* Pseudocythere caudata*, sono state principalmente o esclusivamente trovate all'interno della biocenosi DL, mentre* Bosquetina dentata *e* Pterygocythereis jonesi *sono abbondanti in aree di transizione. Infine le specie* Cytheropteron *spp.,* Henryhowella *ex gr.* hirta*,* Buntonia sublatissima*,* Paradoxostoma *spp.,* Microcytherura angulosa *e* Propontocypris pirifera*, che hanno una distribuzione anche profonda, sono state registrate quasi esclusivamente nel DL e in zone di transizione.*

## INTRODUCTION

Along the Etnean Ionian coast of Sicily, few km north of Catania, three islets called "Ciclopi Islands" emerge near Aci Trezza (Fig. 1). These islets consist of columnar basalts which are locally covered by Pleistocene whitish clays. The zone is the site of the Ciclopi Islands Marine Protected Area (hereafter referred to as CIMPA) established in 1998. To define a reference state for the CIMPA, sea bottoms around the islets were investigated and bathymetric, sedimentological and bionomic maps were prepared (Rosso, 2001; Rosso et al., 2014).

The present work focuses on the ostracod assemblages found in samples collected in that occasion and preliminarily studied in Sciuto & Rosso (2002). The aims of the present work are to: 1) give a list of the ostracod species constituting the living and dead assemblages in the area; 2) investigate the composition and structure of these assemblages and their correspondence; 3) analyze the relations between these ostracod assemblages and the environmental features such as bathymetry, grain size of the bottom sediments and the benthic biocoenoses identified in the CIMPA through macrofaunas and according to the scheme by Pérès & Picard (1964).

## MATERIALS AND METHODS

The sampling area included in the CIMPA (Fig. 1) is part of the Ionian continental shelf and is located 12 km north of Catania (Ionian Sea, Eastern Sicily), between 37° 32' 43'' and 37° 34'11'' N.

Geologically, this area is formed by a complex of subvolcanic rocks, mainly consisting of columnar basalts, injected into the so-called blue clays of Sicilian age, which were deposited within the "pre-Etnean Gulf", as well as by effusive submarine products forming extensive fields of pillow lavas (Cristofolini, 1975; Corsaro & Cristofolini, 1997). The underwater topography, from the coastline down to 25-40 m depth, is characterized by a steep slope, largely consisting of in situ basaltic bedrock and locally of large volcanic blocks. Downwards, the bottom gently slopes down to the depth of 130-145 m, beyond the offshore limit of the CIMPA.

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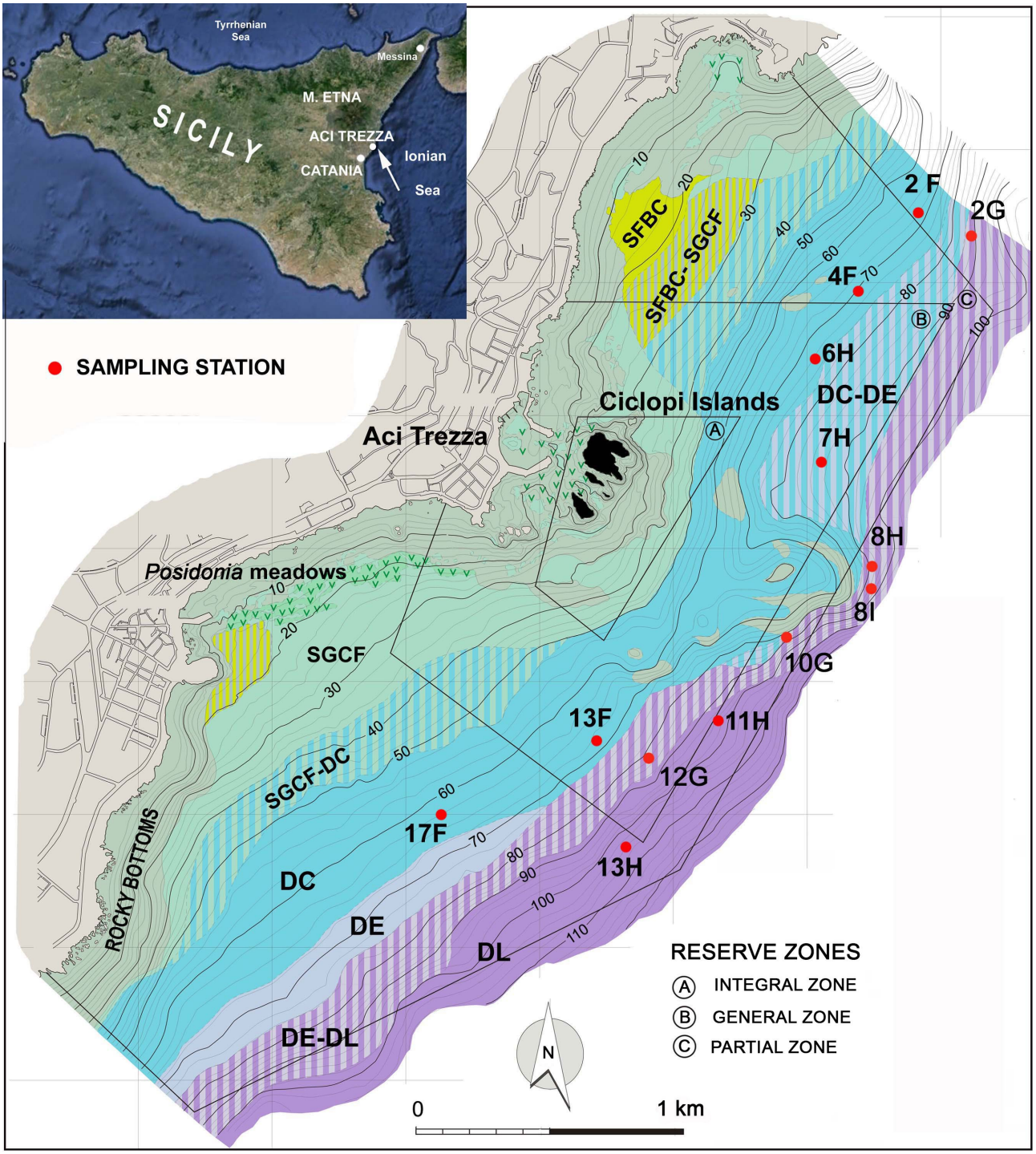



Fig. 1 - Bionomic map of the Ciclopi Islands Marine Protected Area, with sample stations (solid circles). Modified from Rosso et al. (2014). SFBC: Biocoenosis of the Fine-grained, Well Sorted Sands; SGCF: Biocoenosis of coarse Sands and fine Gravels under the influence of Bottom Currents; DC: Biocoenosis of the Coastal Detritic; DE: Biocoenosis of Detritic Muds; DL: Biocoenosis of the Offshore Detritic.

The sea bottom is covered by detrital sediments, ranging from gravels to muds, and showing a general increase in the pelitic portion with depth. The samples used for this study were collected in 2000, during a cruise of the RV "Marenostrum", finalised to the cartography of the sediments and benthic biocoenoses of the CIMPA. A total of 100 samples were taken using a Van Veen grab in the depth range of 63-105 m (Fig. 1). All samples were used for grain size analysis and sedimentological characterization as well as for faunal analysis. For the present study a group of ten samples was randomly selected among those restricted to the deeper sectors of the CIMPA. These samples fall within a relatively narrow bathymetric belt ranging from 63 to 105 m depth and represent the main biocoenoses and ecotones recognised in the area by Rosso (2001) by means of macrofaunas, following the biocenotic scheme of Pérès & Picard (1964). Most samples belong to the Coastal Detritic Assemblage

(DC) and the Shelf-edge Detritic Assemblage (DL); a subordinate number represents the transition between them and the Muddy Detritic Assemblage (DE), in the ecotones DC-DE and DE-DL (Fig. 1).

From each grab sample 300 cc of sediment were examined. Ostracods were picked from the >63 μm fraction. Both entire carapaces and disarticulated valves were counted. Juveniles were scored separately. The ostracod specimens were examined and measured under a stereomicroscope and photographed using a LMU Tescan Vega II Scanning Electron Microscope. The specimens examined are housed at the Museum of Paleontology of the University of Catania (inventory numbers PMC. O FS 29-48).

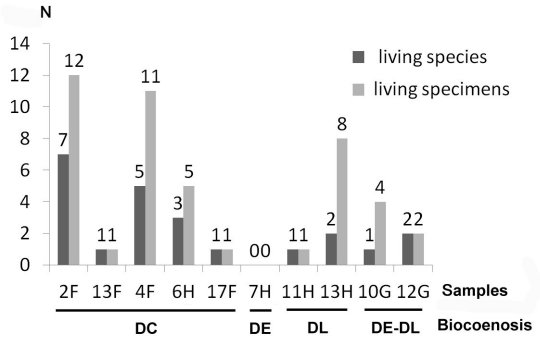



Fig. 2 - Distribution of living ostracod associations (species and specimens) in the sampling area of the Ciclopi Islands Marine Protected Area.

## RESULTS

Ostracod specimens from the examined samples were mostly identified at species level, except for some determined at genus level because largely consisting of juveniles and subordinately of poorly preserved valves. A total of 100 species were identified, 15 of which are shared between living and dead assemblages (Tabs 1-2). Living assemblages are present in nine out of the ten examined samples (Fig. 2). Live ostracods are altogether sparse and represented by a total of 17 species, one of which is exclusively represented by juveniles. Only two samples (2F and 4F) appear to be more diverse, including seven and five species and 12 and 11 specimens, respectively. Three further samples (6H, 13H and 12G) show intermediate species richness and specimen abundance, accounting for three, two and two species and for five, eight and two specimens, respectively. In contrast, the last three samples (13F, 17F and 11H) have a single species represented by a single specimen each.

More than half of the species (eight) are present in a single sample with a single specimen. Four further species, although restricted to a single sample, are present with two or three specimens (Tab. 2), whereas only the remaining four species are present in two or a maximum of three samples. They are *Neonisidea* gr. *mediterranea* (Müller, 1894) and *Aurila convexa* (Baird, 1850), present in three samples with a total of 13 and eight specimens, respectively, and *Buntonia sublatissima* (Neviani, 1906) and *Loxochoncha rhomboidea* (Fisher, 1855), found in two samples with a total number of four and two specimens, respectively.

Dead associations are much more diverse and rich in specimens, and again the species richness and the specimen abundance show a remarkable variability among samples (Tab. 1; Fig. 3). The species richness varies from a minimum of 18 species (sample 12G collected at 83 m depth) up to a maximum of 59 (sample 7H taken at 85

| **SAMPLE** | 17F | 2F | 13F | 4F | 6H | 7H | 12G | 10G | 11H | 13H |
|---|---|---|---|---|---|---|---|---|---|---|
| **DEPTH (metres)** | 63 | 68 | 69 | 71 | 75 | 85 | 83 | 85 | 94 | 105 |
| **LIVING ASSOCIATION** | DC | | | | | DC-DE | DE-DL | | DL | |
| *Cypridina* sp. | | | | 1 | | | | | | |
| *Cytherella vulgatella* Aiello et al., 1996 | | 1 | | | | | | | | |
| *Neonesidea corpulenta* (Müller, 1894) | | 2 | | | | | | | | |
| *Neonesidea formosa* (Brady, 1868) | | 2 | | | | | | | | |
| *Neonesidea* gr. *mediterranea* (Müller, 1894) | | 3 | | | | | | 4 | | 6 |
| *Bosquetina dentata* (Müller, 1894) | | | | | | | | | | 2 |
| *Acanthocythereis histrix* (Reuss, 1850) | | 1 | | | | | | | | |
| *Carinocythereis whitei* (Baird, 1850) | | | | | | | 1 | | | |
| *Celtia quadridentata* (Baird, 1850) | | | | | 3 | | | | | |
| *Pterygocythereis jonesi* (Baird, 1850) | | | | | | | 1 | | | |
| *Buntonia sublatissima* (Neviani, 1906) | | | | 3 | | | | | 1 | |
| *Aurila convexa* (Baird, 1850) | | 2 | | 5 | 1 | | | | | |
| *Aurila speyeri* (Brady, 1868) | | | 1 | | | | | | | |
| *Loxoconcha bairdi* Müller, 1894 | | | | 1 | | | | | | |
| *Loxoconcha minima* Müller, 1894 | | | | | 1 | | | | | |
| *Loxoconcha rhomboidea* (Fischer, 1855) | | 1 | | 1 | | | | | | |
| *Paradoxostoma striatum* Müller, 1894 | 1 | | | | | | | | | |
| **Total number of living species** | **1** | **7** | **1** | **5** | **3** | **0** | **2** | **1** | **1** | **2** |
| **Total number of living specimens** | **1** | **12** | **1** | **11** | **5** | **0** | **2** | **4** | **1** | **8** |

Tab. 1 - Ostracods found alive in sites of the Ciclopi Islands Marine Protected Area. For each species the number of specimens found in each sample is reported.

| SAMPLE | 17F | | 2F | | 13F | | 4F | | 6H | | 12G | | 10G | | 7H | | 11H | | 13H | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (metres) | 63 | | 68 | | 69 | | 71 | | 75 | | 83 | | 85 | | 85 | | 94 | | 105 | |
| BIOCOENOSIS | | | DC | | | | | | | | DE-DL | | | | DC-DE | | DL | | | |
| | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % |
| *Acanthocythereis ascolii* (Puri, 1963) | | | | | | | 1 | 0.8 | | | | | | | | | | | | |
| *Acanthocythereis histrix* (Reuss. 1850) | | | 5 | 4.9 | 1* | 1.3 | 2 | 1.6 | | | 1 | 1.0 | | | 4 | 2.2 | 2 | 1.3 | 4 | 1.4 |
| *Argilloecia minor* Müller, 1894 | 1 | 0.7 | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Aurila* cf. *A. interpretis* Uliczny, 1969 | | | 1* | 1.0 | | | | | | | | | | | | | | | | |
| *Aurila convexa* (Baird, 1850) | 5 | 3.5 | 12 | 11.8 | 5 | 6.3 | 20 | 16.1 | 4 | 7.4 | 2 | 2.1 | 5 | 9.8 | 9 | 4.8 | 6 | 3.8 | 15 | 5.3 |
| *Aurila prasina* Barbeito-Gonzalez, 1971 | | | 1* | 1.0 | | | | | | | 1 | 1.0 | | | | | | | | |
| *Aurila punctata* (Münster, 1830) | 1* | 0.7 | 8 | 7.8 | 2 | 2.5 | 3 | 2.4 | | | | | 2 | 3.9 | | | 1 | 0.6 | 3 | 1.1 |
| *Aurila* spp. juv. | 5 | 3.5 | 3 | 2.9 | 1* | 1.3 | 7* | 5.6 | 3 | 5.6 | 4 | 4.2 | 2 | 3.9 | | | | | | |
| *Bosquetina dentata* (Müller, 1894) | 1* | 0.7 | 4 | 3.9 | 1* | 1.3 | 3 | 2.4 | | | 10 | 10.4 | 6 | 11.8 | 8 | 4.3 | 9 | 5.6 | 18 | 6.4 |
| *Buntonia sublatissima* (Neviani, 1906) | 3 | 2.1 | | | | | 3 | 2.4 | | | | | 2 | 3.9 | 3 | 1.6 | 6 | 3.8 | 4 | 1.4 |
| *Buntonia subulata* (Ruggieri, 1954) | | | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Buntonia textilis* Bonaduce et al., 1976 | | | | | | | | | | | | | | | | | 1 | 0.6 | | |
| *Callistocythere adriatica* Masoli, 1968 § | 1* | 0.7 | | | | | | | | | | | | | | | 3 | 1.9 | | |
| *Callistocythere* cf. *C. pallida* (Müller, 1894) § | 1* | 0.7 | | | | | | | | | | | | | | | | | | |
| *Callistocythere flavidofusca* (Ruggieri, 1950) § | 1* | 0.7 | | | | | | | | | | | | | 1 | 0.5 | 1* | 0.6 | | |
| *Callistocythere folliculosa* Bonaduce et al., 1976 § | | | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Callistocythere littoralis* (Müller, 1894) § | | | | | | | | | | | | | | | 1* | 0.5 | 1 | 0.6 | | |
| *Callistocythere lobiancoi* (Müller, 1894) § | | | | | | | | | | | | | | | 2 | 1.1 | | | 2 | 0.7 |
| *Callistocythere rastrifera* (Ruggieri, 1953) § | 1* | 0.7 | | | | | | | | | | | | | | | | | | |
| *Callistocythere* sp. § | 2 | 1.4 | | | | | | | | | | | | | 1 | 0.5 | | | 2 | 0.7 |
| *Carinocythereis carinata* (Roemer, 1838) | 3 | 2.1 | | | 1 | 1.3 | 5 | 4.0 | 1 | 1.9 | | | | | 5 | 2.7 | 2 | 1.3 | 3 | 1.1 |
| *Carinocythereis whitei* (Baird, 1850) | | | 1* | 1.0 | | | | | 1* | 1.9 | 8 | 8.3 | | | | | | | 4 | 1.4 |
| *Celtia quadridentata* (Baird, 1850) | 1* | 0.7 | | | 4 | 5.0 | 3 | 2.4 | 3 | 5.6 | 1* | 1.0 | | | 5 | 2.7 | | | 3 | 1.1 |
| *Celtia emaciata* (Brady, 1867) | | | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Costa batei* (Brady, 1866) § | | | 2 | 2.0 | | | 1* | 0.8 | | | | | | | 1 | 0.5 | | | | |
| *Costa edwardsi* (Roemer, 1838) | 3 | 2.1 | | | 15 | 18.8 | 1* | 0.8 | | | 3 | 3.1 | | | 15 | 8.1 | 5 | 3.1 | 12 | 4.2 |
| *Costa* sp. juv. | | | | | | | | | | | 1 | 1.0 | | | | | | | 1 | 0.4 |
| *Cushmanidea elongata* (Brady, 1868) | 2 | 1.4 | | | | | | | | | | | | | 1* | 0.5 | | | | |
| *Cytherella alvearium* Bonaduce et al., 1976 | | | | | | | | | | | | | | | | | | | 1* | 0.4 |
| *Cytherella scutulum* Ruggieri, 1976 | 1 | 0.7 | | | 1* | 1.3 | | | 1* | 1.9 | | | | | 8 | 4.3 | | | 6 | 2.1 |
| *Cytherella* spp. juv. | 1 | 0.7 | | | | | 2 | 1.6 | 1 | 1.9 | | | 2 | 3.9 | | | | | | |
| *Cytherella vulgatella* Aiello et al., 1996 | 1* | 0.7 | 1* | 1.0 | | | 1 | 0.8 | 1 | 1.9 | | | 2 | 3.9 | 3 | 1.6 | 2 | 1.3 | 1 | 0.4 |
| *Cytherelloidea sordida* (Müller, 1894) § | | | | | | | | | | | 1 | 1.0 | | | | | | | | |
| *Cytheretta* sp. juv. § | | | | | | | | | | | | | 1 | 2.0 | | | | | | |
| *Cytheridea neapolitana* Kollmann, 1960 | | | | | | | 1* | 0.8 | | | 1* | 1.0 | | | | | 2 | 1.3 | 2 | 0.7 |
| *Cytheropteron latum* Müller, 1894 | | | | | | | | | | | | | | | 2 | 1.1 | 1 | 0.6 | 2 | 0.7 |
| *Cytheropteron monoceros* Bonaduce et al., 1976 | | | | | | | | | | | | | | | 1 | 0.5 | | | 2 | 0.7 |
| *Cytheropteron sulcatum* Bonaduce et al., 1976 | | | | | | | | | | | | | | | 2 | 1.1 | | | 1 | 0.4 |
| *Cytheropteron vespertilio* (Reuss, 1850) | 1* | 0.7 | | | 1* | 1.3 | | | | | | | | | 1 | 0.5 | | | | |
| *Cytheroptreron ionicum* Colalongo & Pasini, 1980 | | | | | | | | | | | | | | | 1 | 0.5 | | | | |

Tab. 2 - Ostracods found in the dead assemblages of sites in the Ciclopi Islands Marine Protected Area. For each species the number of specimens (N) found in each sample is reported, as well as its relative dominance (%). Species whose name is followed by § have been considered as displaced; an asterisk after abundance values indicates the number of complete carapaces.

| SAMPLE | 17F | | 2F | | 13F | | 4F | | 6H | | 12G | | 10G | | 7H | | 11H | | 13H | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (metres) | 63 | | 68 | | 69 | | 71 | | 75 | | 83 | | 85 | | 85 | | 94 | | 105 | |
| BIOCOENOSIS | | | DC | | | | | | | | DE-DL | | | | DC-DE | | DL | | | |
| | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % | Ab. | % |
| *Echinocythereis laticarina* (Müller, 1894) | 1* | 0.7 | 1* | 1.0 | | | 2 | 1.6 | 1* | 1.9 | 3 | 3.1 | 1 | 2.0 | 2 | 1.1 | 3 | 1.9 | 1 | 0.4 |
| *Echinocythereis* sp. juv. | | | | | 2 | 2.5 | | | | | | | 1 | 2.0 | | | | | | |
| *Eucythere declivis* (Norman, 1865) | | | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Eucythere* sp. juv. | | | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Eucytherura complexa* Müller, 1894 | | | | | | | | | | | | | | | | | | | 1 | 0.4 |
| *Eucytherura gibbera* Müller, 1894 | | | | | | | | | | | | | | | | | 1 | 0.6 | | |
| *Eucytherura mistrettai* Sissingh, 1972 | 1 | 0.7 | | | | | | | | | | | | | 4 | 2.2 | 8 | 5.0 | 3 | 1.1 |
| *Eucytherura* sp. juv. | 1* | 0.7 | | | | | | | | | | | | | | | | | | |
| *Hemicytherura gracilicosta* Ruggieri, 1953 | 2 | 1.4 | | | | | | | | | | | | | 1 | 0.5 | | | 1* | 0.4 |
| *Henryhowella* ex gr. *H. hirta* (Costa, 1853) | 1* | 0.7 | | | 1* | 1.3 | | | | | | | 1 | 2.0 | 1 | 0.5 | 4 | 2.5 | 2 | 0.7 |
| *Hiltermannicythere rubra* (Müller, 1894) | | | | | 1 | 1.3 | | | | | | | | | | | | | | |
| *Hiltermannicythere* sp. juv. | | | | | 1* | 1.3 | | | | | | | | | | | | | | |
| *Kangarina abyssicola* (Müller, 1894) | | | | | | | | | | | | | | | | | 1 | 0.6 | 1 | 0.4 |
| *Krithe praetexta* (Sars, 1866) | | | | | 2 | 2.5 | | | | | | | 2 | 3.9 | | | 1 | 0.6 | 1 | 0.4 |
| *Loxoconcha affinis* (Brady, 1866) | 4 | 2.8 | | | 3 | 3.8 | 5 | 4.0 | 2* | 3.7 | 1 | 1.0 | | | | | 3 | 1.9 | 3 | 1.1 |
| *Loxoconcha minima* Müller, 1894 | | | | | | | | | 1 | 1.9 | | | | | | | | | | |
| *Loxoconcha parallela* Müller, 1894 | | | | | | | | | 1* | 1.9 | | | | | | | | | | |
| *Loxoconcha rhomboidea* (Fischer, 1855) | 2* | 1.4 | 5 | 4.9 | 6 | 7.5 | 5 | 4.0 | 4 | 7.4 | 1 | 1.0 | 2 | 3.9 | 3 | 1.6 | 3 | 1.9 | 7 | 2.5 |
| *Loxoconcha* spp. juv. | 3 | 2.1 | 1* | 1.0 | 2 | 2.5 | 1* | 0.8 | 1* | 1.9 | 1 | 1.0 | 1 | 2.0 | | | 5 | 3.1 | 2 | 0.7 |
| *Loxoconcha stellifera* Müller, 1894 § | | | 1* | 1.0 | 1* | 1.3 | | | | | 1 | 1.0 | 2 | 3.9 | 12 | 6.5 | 6 | 3.8 | 3 | 1.1 |
| *Macrocyprina succinea* (Müller, 1894) | | | | | | | 1* | 0.8 | | | | | | | | | 3 | 1.9 | 6 | 2.1 |
| *Microcytherura angulosa* (Seguenza, 1880) | | | | | | | | | 1* | 1.9 | | | | | 1* | 0.5 | 2 | 1.3 | 2 | 0.7 |
| *Microcytherura* sp. | | | | | | | | | | | | | 1 | 2.0 | | | | | | |
| *Monoceratina oblita* Bonaduce et al., 1976 | | | 2* | 2.0 | 1 | 1.3 | 1 | 0.8 | | | 2 | 2.1 | 2 | 3.9 | 2 | 1.1 | 6 | 3.8 | 5 | 1.8 |
| *Neocythere complicata* (Ruggieri, 1953) | 1* | 0.7 | | | 1* | 1.3 | | | | | | | | | | | | | | |
| *Neocytherideis fasciata* (Brady & Robertson, 1874) | 1* | 0.7 | | | | | | | | | | | | | | | | | | |
| *Neonesidea corpulenta* (Müller, 1894) | 1* | 0.7 | 12 | 11.8 | 1* | 1.3 | 1* | 0.8 | 3 | 5.6 | 6 | 6.3 | 2 | 3.9 | 1 | 0.5 | | | 4 | 1.4 |
| *Neonesidea formosa* (Brady, 1868) | 3 | 2.1 | 14 | 13.7 | 2 | 2.5 | 3 | 2.4 | 3 | 5.6 | 4 | 4.2 | 5 | 9.8 | 3 | 1.6 | 2 | 1.3 | 8 | 2.8 |
| *Neonesidea longevaginata* (Müller, 1894) | 1* | 0.7 | | | | | | | | | | | | | | | 3 | 1.9 | 1 | 0.4 |
| *Neonesidea mediterranea* (Müller, 1894) | 19 | 13.2 | 20 | 19.6 | 10 | 12.5 | 20 | 16.1 | 12 | 22.2 | 24 | 25.0 | | | 14 | 7.5 | 18 | 11.3 | 65 | 23.0 |
| *Neonesidea* spp. juv. | | | 1* | 1.0 | | | | | | | 4 | 4.2 | 1 | 2.0 | | | | | | |
| *Occultocythereis dohrni* Puri, 1963 | | | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Occultocythereis* spp. juv. | | | | | | | 2 | 1.6 | | | | | | | | | 1 | 0.6 | | |
| *Paracypris polita* Sars, 1866 | | | | | | | | | | | 1 | 1.0 | | | | | | | 1* | 0.4 |
| *Paracytheridea* cf. *P. bovettensis* (Seguenza, 1880) | | | | | 3.0 | 3.8 | 2* | 0.8 | 2* | 1.9 | | | | | | | 2 | 1.3 | 4 | 1.4 |
| *Paracytheridea* gr. *depressa* Müller, 1894 | 2 | 1.4 | | | | | | | | | | | 1 | 2.0 | | | | | 1* | 0.4 |
| *Paracytheridea* sp. juv. | 1 | 0.7 | | | | | | | | | | | | | | | | | 1 | 0.4 |
| *Paracytheridea triquetra* (Reuss, 1850) | 2 | 1.4 | | | | | | | | | | | | | 7 | 3.8 | | | | |
| *Paradoxostoma atrum* Müller, 1894 | | | | | | | 1* | 0.8 | | | | | | | | | | | | |
| *Paradoxostoma* cf. *P. triste* Müller, 1894 | 1* | 0.7 | | | | | | | | | | | | | | | | | 3 | 1.1 |
| *Paradoxostoma parallelum* Müller, 1894 | | | | | | | 1* | 0.8 | | | | | | | | | | | | |
| *Paradoxostoma simile* Müller, 1894 | 1* | 0.7 | 1* | 1.0 | | | | | | | | | | | 3 | 1.6 | | | 4 | 1.4 |
| *Paradoxostoma striatum* Müller, 1894 | 2 | 1.4 | | | | | | | | | | | | | 2 | 1.1 | | | | |

Tab. 2 - Continuation.

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pontocypris acuminata* (Müller, 1894) | | | 1 | 1.0 | 1 | 1.3 | 2* | 1.6 | | | | | 1 | 2.0 | | | 3 | 1.9 | 3 | 1.1 |
| *Pontocypris* sp. | | | | | 1 | 1.3 | 1 | 0.8 | | | | | | | | | | | | |
| *Cushmanidea turbida* (Müller, 1894) § | | | | | 1* | 1.3 | | | | | | | | | 1 | 0.5 | | | | |
| *Propontocypris pirifera* (Müller, 1894) | | | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Propontocypris solida* Ruggieri, 1952 | 1* | 0.7 | | | 1 | 1.3 | | | | | | | | | | | | | | |
| *Pseudocythere caudata* Sars, 1866 | | | | | | | | | | | | | | | 1* | 0.5 | 1* | 0.6 | 3 | 1.1 |
| *Pterygocythereis jonesii* (Baird, 1850) | 4 | 2.8 | 2 | 2.0 | | | 3 | 2.4 | | | 14 | 14.6 | 3 | 5.9 | 4 | 2.2 | 3 | 1.9 | 11 | 3.9 |
| *Pterygocythereis siveteri* Athersuch, 1978 | 2 | 1.4 | | | 1* | 1.3 | 1* | 0.8 | 3 | 5.6 | | | | | 3 | 1.6 | 6 | 3.8 | 4 | 1.4 |
| *Sagmatocythere napoliana* (Puri, 1963 ) | | | | | | | | | | | | | | | | | | | 1 | 0.4 |
| *Semicytherura abdita* Bonaduce et al., 1976 | 1 | 0.7 | | | | | | | | | | | | | | | | | 2 | 0.7 |
| *Semicytherura acuta* (Müller, 1894) | 5 | 3.5 | | | | | | | 1* | 1.6 | | | | | 1 | 0.5 | 1 | 0.6 | 1 | 0.4 |
| *Semicytherura acuticostata* (Sars, 1866) | 2 | 1.4 | | | | | | | | | | | | | 2 | 1.1 | 1 | 0.6 | 1 | 0.4 |
| *Semicytherura alifera* Ruggieri, 1959 | 1* | 0.7 | | | | | | | | | | | | | | | | | | |
| *Semicytherura incongruens* (Müller, 1894) | 1* | 0.7 | | | | | | | | | | | | | 1 | 0.5 | 2 | 1.3 | 1* | 0.4 |
| *Semicytherura inversa* (Seguenza, 1880) | 2* | 1.4 | | | | | 1 | 0.8 | | | | | | | 2 | 1.1 | | | | |
| *Semicytherura mediterranea* (Müller, 1894) | 2 | 1.4 | | | | | | | | | | | | | 1* | 0.5 | | | 6 | 2.1 |
| *Semicytherura occulta* Bonaduce et al., 1976 | | | | | | | | | | | | | | | 1 | 0.5 | | | 1 | 0.4 |
| *Semicytherura paradoxsa* Müller, 1894 | 1* | 0.7 | | | | | | | | | | | | | 2 | 1.1 | 1 | 0.6 | 2 | 0.7 |
| *Semicytherura robusta* Bonaduce et al., 1976 | 2 | 1.4 | | | | | | | | | | | | | 1 | 0.5 | | | | |
| *Semicytherura ruggierii* (Pucci, 1956) | 2 | 1.4 | | | | | | | | | | | | | | | | | 2 | 0.7 |
| *Semicytherura* spp. juv. | | | | | | | | | | | | | | | 2 | 1.1 | 2 | 1.3 | | |
| *Semicytherura stilifera* Bonaduce et al., 1976 | | | | | | | | | | | | | 1 | 2.0 | | | | | | |
| *Slerochilus* sp. | | | | | | | | | | | | | | | 1* | 0.5 | | | | |
| *Tenedocythere prava* (Baird, 1850) | 7 | 4.9 | 1* | 1.0 | 1 | 1.3 | 1* | 0.8 | | | | | 1 | 2.0 | 4 | 2.2 | 2 | 1.3 | 2 | 0.7 |
| *Triebelina* sp. | 1* | 0.7 | | | | | | | | | | | | | | | | | | |
| *Urocythereis favosa* (Roemer, 1838) § | 1* | 0.7 | | | 1 | 1.3 | 1* | 0.8 | | | | | | | | | | | | |
| *Urocythereis labyrinthica* Uliczny, 1969 § | | | | | 1* | 1.3 | 1* | 0.8 | | | | | | | 1 | 0.5 | | | 1* | 0.4 |
| *Urocythereis* spp. juv. | 1* | 0.7 | 1* | 1.0 | | | | | | | | | | | | | | | | |
| *Verrucocythereis bulbuspinata* (Uliczny, 1969) | 1* | 0.7 | | | | | 3 | 2.4 | 1* | 1.9 | | | 1 | 2.0 | 1 | 0.5 | 3 | 1.9 | | |
| *Xestoleberis communis* Müller, 1894 | 12 | 8.3 | | | 1* | 1.3 | 5 | 4.0 | 3 | 5.6 | | | | | 6 | 3.2 | 14 | 8.8 | 12 | 4.2 |
| *Xestoleberis dispar* Müller, 1894 | | | | | 1 | 1.3 | 4* | 3.2 | 1* | 1.9 | | | | | 4 | 2.2 | 4 | 2.5 | 11 | 3.9 |
| *Xestoleberis* cf. *X. dispar* Müller, 1894 | 6 | 4.2 | | | | | 2 | 1.6 | | | | | | | | | | | | |
| *Xestoleberis plana* Müller, 1894 | | | | | | | 1* | 0.8 | | | | | | | 3 | 1.6 | | | | |
| *Xestoleberis* spp. | 2 | 1.4 | | | | | | | | | 1 | 1.0 | | | | | | | 1 | 0.4 |
| **SAMPLE** | **17F** | | **2F** | | **13F** | | **4F** | | **6H** | | **12G** | | **10G** | | **7H** | | **11H** | | **13H** | |
| **Total number of specimens** | **144** | **100** | **102** | **100** | **80** | **100** | **124** | **100** | **54** | **100** | **96** | **100** | **51** | **100** | **186** | **100** | **160** | **100** | **283** | **100** |
| **Total number of species** | **51** | | **20** | | **30** | | **35** | | **21** | | **19** | | **20** | | **59** | | **42** | | **56** | |
| **BIOCOENOSIS** | | | **DC** | | | | | | | | **DE-DL** | | | | **DC-DE** | | **DL** | | | |

Tab. 2 - Continuation.

m). Specimen abundances show an even more pronounced variability, from a minimum of 51 specimens (sample 10G from 85 m) to a maximum of 283 specimens (sample 13H from 105 m). Predictably, the samples which are poorly diversified are among the poorest in specimens, whereas the samples which are richest in species are also those with more specimens (Tab. 2).

Most specimens consist of disarticulated valves. Only a few species, namely *Aurila convexa* (Baird, 1850), *Occultocythereis dohrni* Puri, 1963, *Callistocythere lobiancoi* (Müller, 1894), *Pterygocythereis jonesii* (Baird, 1850) and *Costa edwardsi* (Roemer, 1838), show specimens with complete carapaces.

Dead assemblages consist of species which are present with different frequencies and abundances. Based on these features it has been possible to distinguish three groups (Tab. 1). A first group includes some species that are very frequent and particularly abundant. These species are: *Neonesidea mediterranea* (Müller, 1894), *N. formosa* (Brady, 1868), *N. corpulenta* (Müller, 1894), *A. convexa* and *Bosquetina dentata* (Müller, 1894), present in nine or ten samples, and *Pterigocythereis jonesii* (Baird,

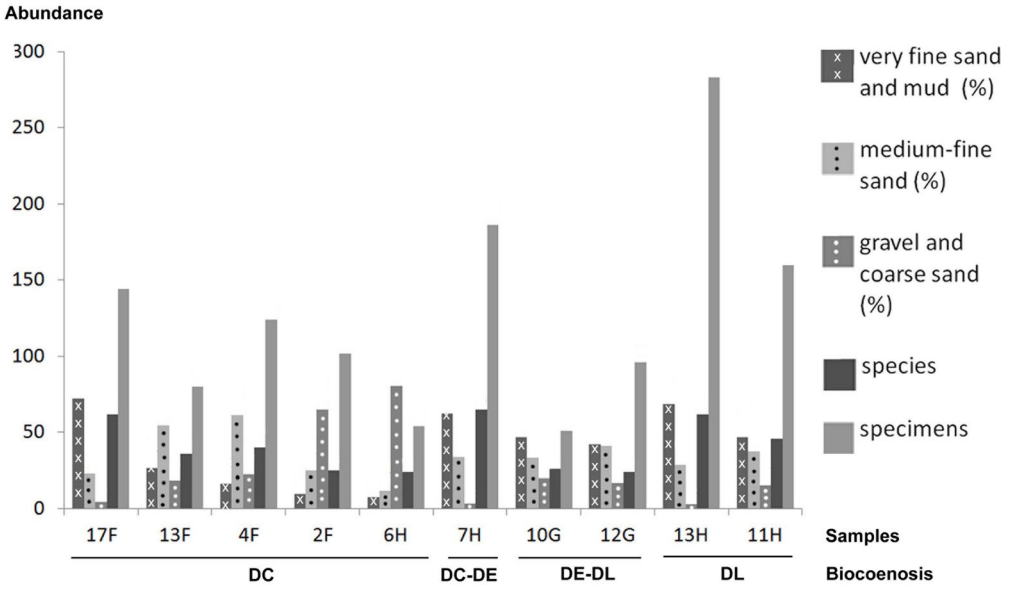



Fig. 3 - Relation between bottom sediment texture and dead ostracod association (species and specimens).

1850) and *Costa edwardsii* (Roemer, 1838), present in eight and seven samples, respectively. Although showing highly variable values of dominance from one sample to another, the species of this group account for dominances exceeding 10% in several of the samples were they are present (Tab. 2).

The second group is more numerous than the previous one and consists of both frequent and relatively less frequent taxa, which are less abundant than the previous ones. This group includes *Loxoconcha rhomboidea* (Fischer, 1855) and *Echinocythereis laticarina* (Müller, 1894), present in ten and nine samples, respectively, as well as *Pterygocythereis siveteri* Athersuch, 1978, *Tenedocythere prava* (Baird, 1850) and *Citerella vulgatella* Aiello et al., 1996, found in eight out of the ten examined samples. Further species are: *Monoceratina oblita* Bonaduce et al., 1976, *Loxoconcha affinis* (Brady, 1866), *L. stellifera* Müller, 1894, *Xestoleberis communis* Müller, 1894, *Carinocythereis carinata* (Roemer, 1838), *Acanthocythereis hystrix* (Reuss, 1850), *Celtia quadridentata* (Baird, 1850) and *Aurila punctata* Münster, 1830, all found in seven samples. The dominance of these species ranges from 3.1 to 8.8 in samples where they show the highest abundances. Further four species can be also added to this group, all being present in six out of the ten examined samples, and whose highest dominance reaches 3.9. These species are *Xestoleberis dispar* Müller, 1894, *Pontocypris acuminata* (Müller, 1894), *Buntonia sublatissima* (Neviani, 1906) and *Henryhowella* ex gr. *H. hirta* (Costa, 1853).

Finally, the third group consists of 76 species, i.e., 76% of the total number of species, which are rare or even occasional, very often present in a single sample or, at most, in three samples. Generally, these species are represented by few specimens. Among these, *Neocytherideis fasciata* (Brady & Robertson, 1874), *Semicytherura alifera* Ruggieri, 1959, and *Triebelina* sp. were only found in the shallowest sample, whereas *Kangarina abyssicola* (Müller, 1894), *Pseudocythere caudata* Sars, 1866, *Eucythere declivis* (Norman, 1865), *Microcytherura angulosa* (Seguenza, 1880), *Semicytherura stilifera* Bonaduce et al., 1976, *Sagmatocythere versicolor* (Müller, 1894), *Propontocypris pirifera* (Müller, 1894), *O. dohrni*, *Krithe praetexta* (Sars, 1866) and most species of the genus *Cytheropteron* were found only in the deeper samples.

*Comments on the distribution of some species*

Indications about bathymetric, geographic and stratigraphic distribution are given for some species, which are particularly abundant in the studied area or which have been poorly reported in the Mediterranean literature.

*Cytherella alvearium* Bonaduce, Ciampo & Masoli, 1976 (Pl. 1, fig. 1) is known only from the present-day Mediterranean Sea (Aiello et al., 1996), where it seems to have a very wide ecological distribution from the circalittoral zone to the bathyal zone (Montenegro et al., 1996). In the study area, only one specimen was found, in a thanatocoenosis at 105 m depth. A few isolated valves were found in the Strait of Messina, notably in a dead assemblage at 384 m depth (Sciuto, 2014).

*Cytherelloidea sordida* (Müller, 1894) (Pl. 1, fig. 2) was found in the CIMPA in a dead assemblage at 83 m depth. The species is known from the Early Pleistocene (Mostafawi, 1981) to the Recent. In the Early Pleistocene it is reported from very shallow waters of lagoonal environments from SE Sicily (Sciuto et al., 2015). Bonaduce et al. (1976) found *C. sordida* in the 10-20 m depth range. Specimens found at greater depths are surely displaced (Yassini, 1980; Sciuto, 2014).

*Neonesidea corpulenta* (Müller, 1894) (Pl. 1, fig. 3) was found alive at 63 m depth. It is also widely distributed in dead assemblages. *N. corpulenta* is considered as a nearshore species (Bonaduce et al., 1976) known from

the Pliocene to the Recent. The specimen figured by Barra (1997) and doubtfully attributed to *B. corpulenta*, may represent a fully mature specimen with a carapace showing pits stronger than those present in the specimens here studied (Pl. 1, fig. 3).

*Neonesidea mediterranea* (Müller, 1894) (Pl. 1, fig. 4) was found living between 63 and 105 m depth. Dead specimens are abundant and widely distributed in all the samples. Also this species is known in the Mediterranean area from the Pliocene to the Recent and has a distribution limited to shallow environments (from the infralittoral to the shallow circalittoral zone).

*Macrocyprina succinea* (Müller, 1894) (Pl. 1, fig. 5) was found in dead assemblages between 71 and 105 m depth. This species is widely recorded in the Mediterranean Sea with wide ecological distribution (Maddocks, 1990). It is known from the Pleistocene to the Recent.

*Pontocypris acuminata* (Müller, 1894) (Pl. 2, fig. 6) is rare in the sampled area and was found in dead assemblages between 68 and 105 m depth. In the Mediterranean Sea it is regarded a phytal shallow marine taxon and, therefore, it is considered as displaced in the present instance. It is known from the Early Pliocene to the Recent.

*Cytheridea neapolitana* Kollmann, 1960 (Pl. 2, fig. 7) is rare in the studied area. It was found only in dead assemblages. This species is known in the Mediterranean Sea and in the Atlantic Ocean as a shallow water taxon (infralittoral-shallow circalittoral zones). It has been reported from the Pliocene to the Recent.

*Buntonia sublatissima* (Neviani, 1906) (Pl. 1, fig. 8) has been reported from the Upper Miocene (Carbonel, 1985) to the Recent. In the Mediterranean Sea its presence seems to be restricted to the continental shelf (Puri et al., 1964; Bonaduce et al., 1976, 1988). In the CIMPA sampling stations this species was found in a dead assemblage at 85 m depth (sample 7H), as well as in living associations at 71 and 94 m depth. *B. sublatissima* has been reported alive also in the Biscay Gulf and along the Atlantic coasts of Morocco (Guernet, 2005).

*Costa batei* (Brady, 1866) (Pl. 1, fig. 9). This species is known from the Tortonian (Carbonel, 1990). In the Recent Mediterranean it is commonly reported from the infralittoral zone (Montenegro et al., 1996). In the sampling area it is quite rare, and only found in dead assemblages where it is considered displaced. In the Pleistocene it is reported from very shallow lagoon waters from SE Sicily (Sciuto et al., 2015).

*Pterygocythereis jonesii* (Baird, 1850) (Pl. 2, fig. 1). Only one living specimen of this species was found at 85 m depth. In dead assemblages the species is rather widespread and its abundance increases with depth. This species is commonly indicated as a circalittoral taxon and it is known from the Pliocene to the Recent. It has been reported from both the Mediterranean and the Atlantic Ocean.

*Henryhowella* ex gr. *H. hirta* (Costa, 1853) (Pl. 1, fig. 10). The species belonging to *Henryhowella* Puri, 1957 are exclusively marine, ubiquitous and known from the Badenian to the Recent (Guernet, 2005). Following the systematic criteria proposed for the genus *Henryhowella* by Mostafawi & Matzke-Karasz (2006) and Sciuto (2014a), the specimens here figured can be referred to *Henryhowella* ex gr. *H. hirta* (Costa, 1853), due to their particular morphological features. In the study area this species is present exclusively in dead associations, where it is relatively common. Its abundance seems to increase with depth. In the Straits of Messina (Northern Ionian Sea) living specimens of this species complex have been found at 545 m depth (Sciuto, 2014b).

*Cytheretta adriatica* Ruggieri, 1952 (Pl. 2, fig. 2) is known as a typical very shallow marine taxon. Numerous living specimens of this species have been found just outside the study area, close to the shoreline at few cm depth in medium sands (FS, personal observations). As a consequence, it can be argued that the single specimen found dead at 85 m depth has been displaced.

*Semicytherura incongruens* (Müller, 1894) (Pl. 2, fig. 3). As all species belonging to this genus, it is typical of the infralittoral and shallow circalittoral zones. In the sampled area it is rare and only recorded in a dead assemblage at 63 m depth.

*Semicytherura paradoxa* (Müller, 1894) (Pl. 2, fig. 4). Also this species has been recorded in a dead assemblage, at 63 m depth.

*Xestoleberis dispar* Müller, 1894 (Pl. 2, fig. 6). In the present-day Mediterranean, *X. dispar* is considered

EXPLANATION OF PLATE 1

Ostracods of the Ciclopi Islands Marine Protected Area.

Fig. 1 - *Cytherella alvearium* Bonaduce, Ciampo & Masoli, 1975. LV, external lateral view. PMC. O FS29.

Fig. 2 - *Cytherelloidea sordida* (Müller, 1894). LV, external lateral view. PMC. O FS30.

Fig. 3 - *Neonesidea corpulenta* (Müller, 1894). RV, external lateral view. PMC. O FS31.

Fig. 4 - *Neonesidea mediterranea* (Müller, 1894). LV, external lateral view. PMC. O FS32.

Fig. 5 - *Macrocyprina succinea* (Müller, 1894). RV, external lateral view. PMC. O FS33.

Fig. 6 - *Pontocypris acuminata* (Müller, 1894). LV, external lateral view. PMC. O FS34.

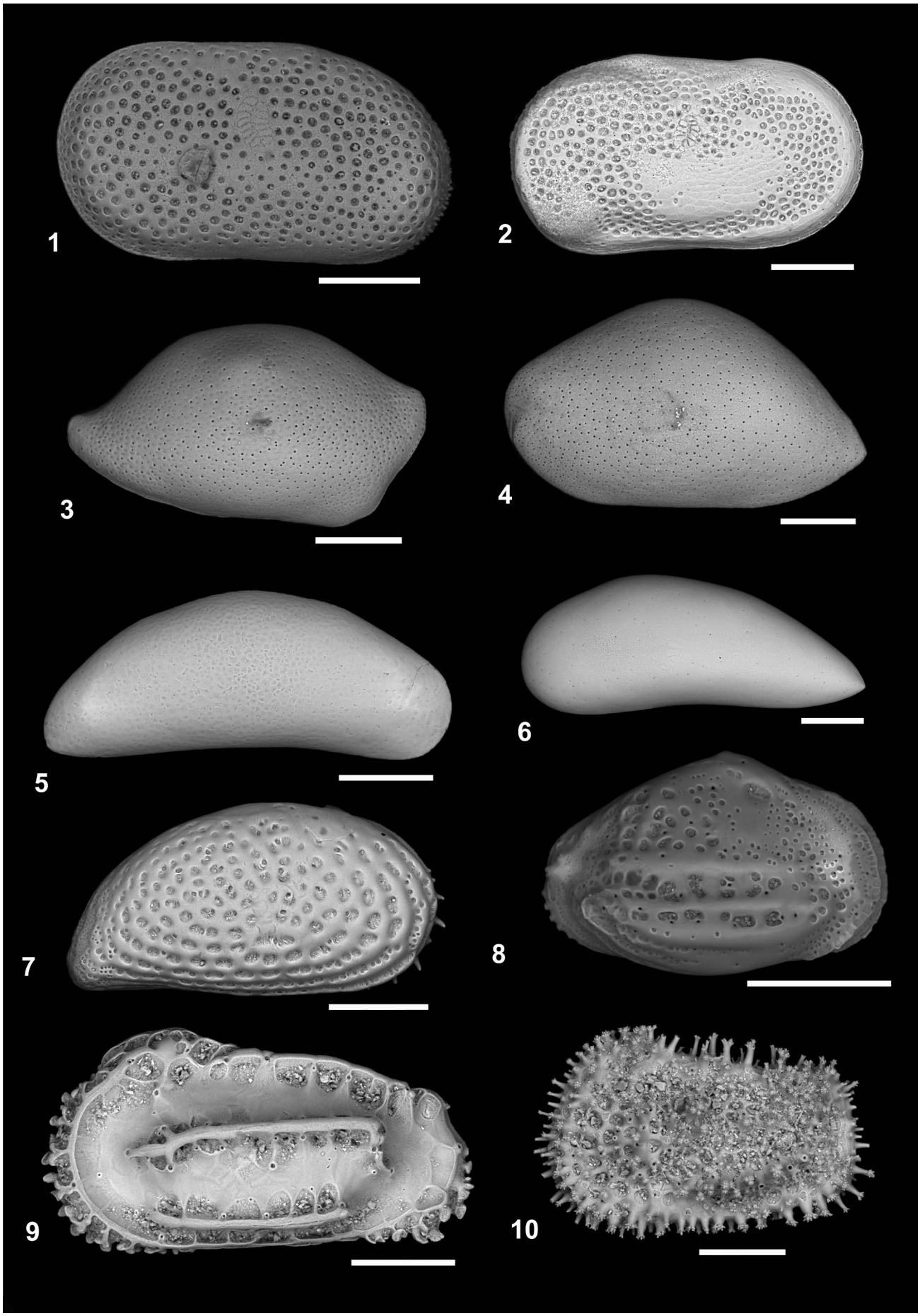
Fig. 7 - *Cytheridea neapolitana* Kollmann, 1960. RV, external lateral view. PMC. O FS35.

Fig. 8 - *Buntonia sublatissima* (Neviani, 1906). RV, external lateral view. PMC. O FS36.

Fig. 9 - *Costa batei* (Brady, 1866). LV, external lateral view. PMC. O FS37.

Fig. 10 - *Henryhowella* ex gr. *H. hirta* (Costa, 1853). LV, external lateral view. PMC. O FS38.

Scale bars correspond to 200 μm for all figures.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as a phytal shallow marine species. This species has a stratigraphical record since the Pliocene.

*Pseudocythere caudata* Sars, 1866 (Pl. 2, fig. 7). In the present-day Mediterranean, this species seems to have a very wide distribution from the shallow continental shelf to abyssal environments. However, it is known throughout the Pliocene and the Pleistocene, always from sediments presumably deposited in deep-water environments. In the Pleistocene sediments of Scoppo (Messina) several complete specimens of *P. caudata* were found associated to coral rudstone (FS, personal observations), in environmental conditions that can be considered as very similar to those currently found in the SML deep-water coral province (Rosso et al., 2010; Sciuto & Rosso, 2015). Such an abundance of *P. caudata* in deep environments may be explained by the abundance of food due to the presence of the coral colonies, as suggested for species belonging to *Paradoxostoma*, *Paracytherois* and *Sclerochilus* by Coles et al. (1996). In the CIMPA *P. caudata* was found in dead assemblages up to 85 m depth.

*Monoceratina oblita* Bonaduce, Ciampo & Masoli, 1976 (Pl. 2, fig. 8) has been found in dead assemblages in the sampling area, where it shows greater abundance at greater depths. This species is known in the Mediterranean from the shallow to the mid circalittoral zone.

*Paradoxostoma simile* Müller, 1894 (Pl. 2, fig. 9). Few specimens of this species were found, esclusively in dead assemblages. Despite being considered a phytal shallow marine taxon, this species has been repeatedly recorded also from deep environments, both recent (Coles et al., 1996; Sciuto & Rosso, 2015) and fossil (Sciuto & Rosso, 2002; Sciuto, 2005). This is probably due to food availability that pushes this species to migrate deeper.

## DISCUSSION

### *Live assemblages*

All ostracod species forming the living assemblages are known as presently thriving in the Mediterranean (Horne et al., 2001) and their reported bathymetric distributions include the depth range investigated in the present study. In particular, most species whose distributions include the infralittoral and upper circalittoral zones have been found in samples of the DC biocoenosis whereas assemblages from the DL biocoenosis mostly consist of ubiquitous taxa and species known from lower circalittoral and bathyal environments (Montenegro et al., 1996). The occurrence of some species is of particular interest because close to the known boundaries of their distribution. The finding of *C. whitei* and *P. jonesi* at 83 m depth is consistent with the lower limit of distribution of these species, whereas that of *B. dentata* at 105 m depth points to the upper distribution range for this deep species (Montenegro et al., 1996).

From the analysis of Tab. 1, it can be observed that the most diverse samples, including 3-7 species, come from sites (2F, 4F and 6H) located at shallow depths (68-75 m) although further samples (13F and 17F), collected at comparable depths (63 and 69 m), have assemblages consisting of a single species, as it is the case for samples 11H and 10G, from relatively deeper sites located at 94 and 85 m, respectively. A remarkably comparable trend appears when looking at the total number of specimens. It should be noted, however, that the observed differences, and particularly those related to species richness, are too feeble to draw final conclusions, above all taking into account the narrow depth interval of 63-105 m slightly exceeding 40 m within the circalittoral, which has been investigated in the present study. Interestingly, the three most speciose samples come from sites hosting the DC biocoenosis and having a sediment texture including variable percentages of sand and gravel but very low percentages of silt and clay (5.5-6.8%; Fig. 4). All these samples were collected in areas swept by bottom currents (Fig. 1). In contrast, sensibly lower values in both species and specimen abundances were detected in samples from the same biocoenosis collected in the southern CIMPA sector, where sediments include higher mud content. The intermediate species richness observed in samples from deeper areas (83-105 m depth) hosting the DL biocoenosis and the DE-DL ecotone, mostly relate to species different from those present in samples from the DC biocoenosis. These species, namely *C. whitei*, *P. jonesi* and *B. dentata,* could be more tolerant to pelite content and/or better adapted to colonise finer sediments. But again, present

EXPLANATION OF PLATE 2

Ostracods of the Ciclopi Islands Marine Protected Area.

Fig. 1 - *Pterygocythereis jonesii* (Baird, 1850). RV, external lateral view. PMC. O FS39.

Fig. 2 - *Cytheretta adriatica* Ruggieri, 1952. RV, external lateral view. PMC. O FS40.

Fig. 3 - *Semicytherura incongruens* (Müller, 1894). RV, external lateral view. PMC. O FS41.

Fig. 4 - *Semicytherura paradoxa* (Müller, 1894). RV, external lateral view. PMC. O FS42.

Fig. 5 - *Xestoleberis communis* Müller, 1894. RV, external lateral view. PMC. O FS43.

Fig. 6 - *Xestoleberis dispar* Müller, 1894. RV external lateral view. PMC. O FS44.

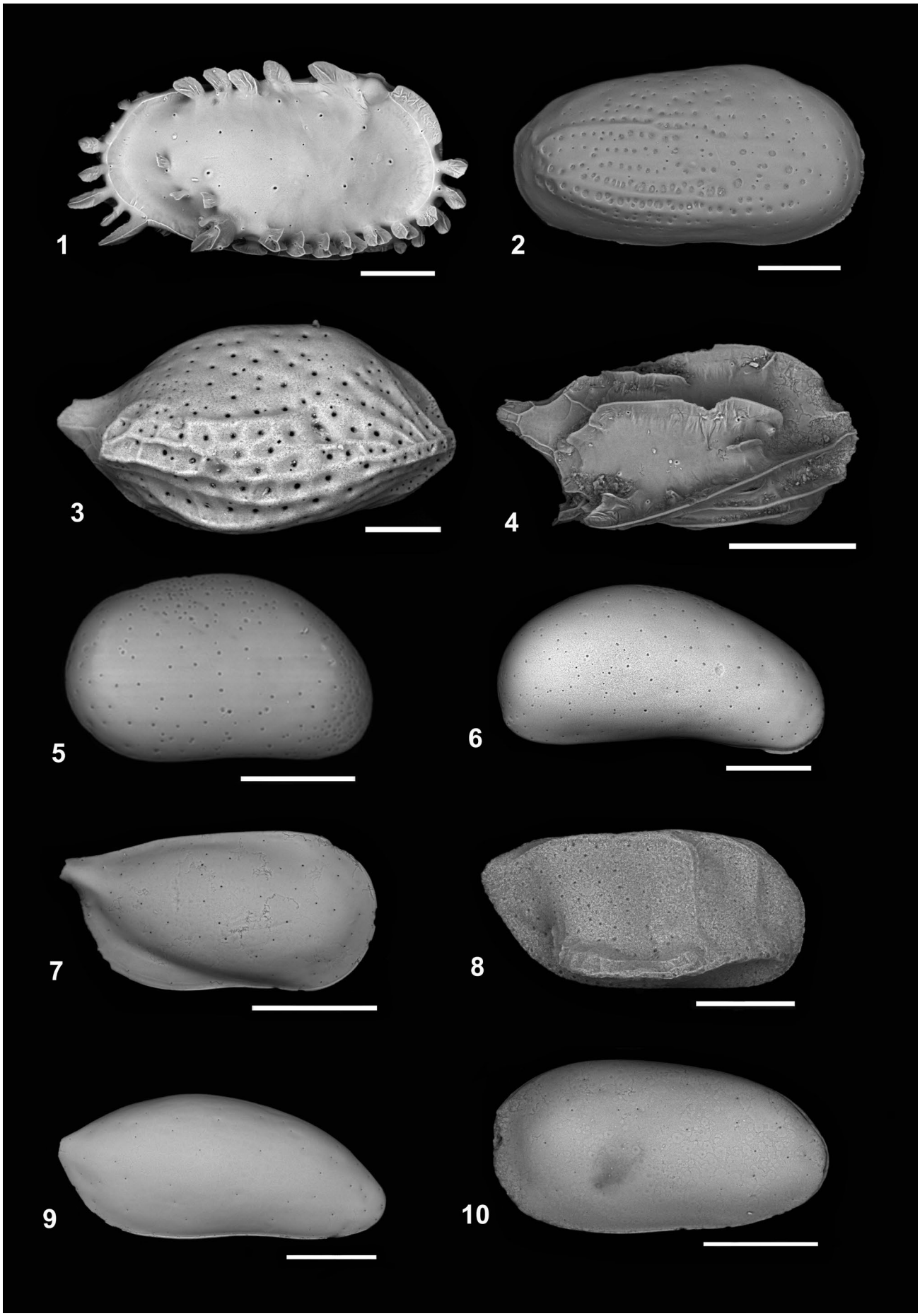
Fig. 7 - *Pseudocythere caudata* Sars,1866. RV external lateral view. PMC. O FS45.

Fig. 8 - *Monoceratina oblita* Bonaduce, Ciampo & Masoli, 1976. RV external lateral view. PMC. O FS46.

Fig. 9 - *Paradoxostoma simile* Müller, 1894. RV external lateral view. PMC. O FS47.

Fig. 10 - *Paradoxostoma atrum* Müller, 1894. RV external lateral view. PMC. O FS48.

Scale bars correspond to 200 μm for all figures, except for Fig. 3 (100 μm).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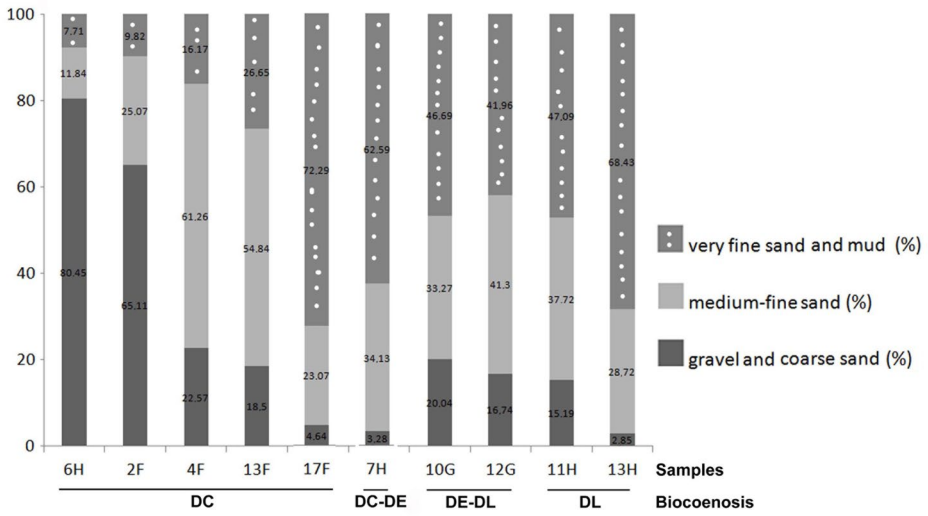


Fig. 4 - Bottom sediment texture distribution.

knowledge about particular behaviours and adaptations of ostracod species to particular environmental parameters is poor and each statement is likely to be speculative.

*Dead assemblages*

Dead assemblages include nearly all species constituting the present-day living assemblages, but total numbers of species and specimens are higher than in the living assemblages, as expected. This is clearly explained taking into account that the accumulation of skeletons at the sea bottom actually derives from the succession of several generations living in the same area during time (Kidwell & Bosence, 1991; Rosso, 1996; Rosso et al., 2010). As such, the increase in species number can be caused by the patchy distribution of some taxa and slight shifts in environmental conditions through time (Kidwell & Bosence, 1991). Moreover, the addition of skeletons displaced from shallower neighbouring biotopes can be often remarkable. This is also the case for the CIMPA where *L. stellifera, Costa batei, Cytherelloidea sordida* and *Cushmanidea turbida*, as well as all species belonging to the genera *Callistocythere* and *Urocythereis*, known as restricted to meso-infralittoral ecosystems (e.g., Guernet & Lethiers, 1989; Montenegro et al., 1996) can be considered as contaminations coming from adjacent sites.

Analogous to the living assemblages, species richness and specimens abundance does not appear to correlate with depth, both including or omitting species considered as displaced, often accounting for single or sporadic specimens in each sample. This in agreement with the assumption that water depth is not particularly relevant in structuring communities at the investigated depth range (Correge, 1993); in contrast, and again paralleling living assemblages, it seems that there is a relationship between species richness and abundance of the ostracod dead assemblages and the texture of the bottom sediments (Puri et al., 1964; Masoli, 1969; Bonaduce & Masoli, 1970; Carbonel, 1973; Bonaduce et al., 1976; Breman, 1978).

Some samples (13H, 11H, 7H and 17F) show ostracod assemblages which are extremely rich in both species (42-59, or 37-52 omitting species considered as displaced) and specimens (144-283, or 138-277 omitting specimens considered as displaced). Sediments (Fig. 4) consist of high percentages of sand (54-77%) with an abundant mud component (22-45%) and very low gravel percentages (0-3-3.1%).

A second group of samples (13F and 4F) shows relatively lower values for both numbers of species (30-35, becoming 26-32 omitting species considered as displaced) and specimens (80-124, becoming 76-122 omitting specimens considered as displaced). Sediments are even richer in sand (85-89%) in comparison to the previous group whereas both mud content (7-11%) and gravel (3.6-3.7%) are subordinate (Fig. 4).

The above reported distributions seem to be consistent with the general preference of ostracods for soft bottoms consisting of mixed sediments including a large amount of sand (and particularly of fine to very fine sand accounting for 36-67% in these samples) and a subordinate percentage of mud, but a negligible gravel content (Neale, 1964; Masoli, 1969; Carbonel, 1973; Bonaduce et al., 1975; Breman, 1978; Correge, 1993).

Finally, the last four samples (2F, 6H, 10G, 12G) share low values for both richness in species (19-21, or 17-21 when displaced species are discarded) and specimens (51-102, or 49-99 discarding displaced specimens). Nevertheless, sediments of samples 2F and 6H are coarser including high percentages of gravel (accounting for 25-65%) and coarse sand, and consequently seem to be unsuitable for ostracods to thrive, as expected. In contrast, the sediment texture of the last two samples (10G and 12G) is roughly comparable to that of the first group of samples, having the highest values for species and specimen richness.

This inconsistency may reflect the particular location of sampled sites, in an area temporarily affected by the sudden settlement of huge quantities of ash ejected from the Etna Volcano whose grain size depends from the magma composition, the energy of the event and the atmospheric/hydrological circulation. Volcanic ash represents a relevant part of the bottom sediments in the area (Rosso, 2008; Rosso et al., 2014), and the different nature and

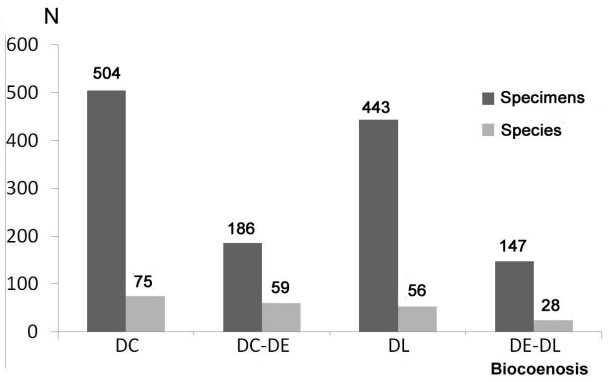


Fig. 5 - Quantitative relation between biocoenoses and ostracods (species and specimens).

features of single ash elements point to subsequent phases of production/deposition events and elaboration at the bottom. In particular, a significant amount of ash deposited a few times before sampling, due to the repeated paroxysmal events that occurred during 2000 (Behncke et al., 2006; Andronico & Corsaro, 2011) and was not sorted or removed by near-bottom currents. Recurrent ash deposition may be responsible for changes in the texture of the very superficial sediment layers masking previous features actually corresponding to the requirements of species which formed the past assemblages in the area documented by the dead assemblage.

## CONCLUSIONS

Ostracod living assemblages from the Ciclopi Islands Marine Protected Area are usually represented by one-two species up to exceptionally seven species, each accounting for a single to very few specimens. Although apparently scarce, such species richness and specimen abundances are comparable to those known from other shelf areas from the Mediterranean Sea (Horne et al., 2001). Therefore, it seems that ostracods are able to withstand rapid changes in the texture of bottom sediments caused from recurrent volcanic ash settlement in the area, possibly slightly changing the composition and structure of their assemblages accordingly. All species detected were found in situations consistent with their previously known distributions. Relationships between living ostracod assemblages and the biocoenoses from where they were collected seem to exist, related to species richness, specimen abundances and the distribution of particular species.

Nevertheless, further studies are needed including more numerous samples, possibly from comparable settings from different areas to put forward more conclusive assessments.

Dead assemblages are much richer in species and specimens than live assemblages (Tabs 1-2). They consist mostly of species that are within their distribution range, usually including taxa recorded as living from the same samples. Nevertheless, dead assemblages show an overall different composition and structure, including a high number of additional species, some with particularly elevated dominances. These differences are only subordinately accounted for by a low percentage of species displaced from infralittoral settings, although present in almost all samples. In contrast, the occurrence in dead assemblages of a high number of species absent from the present-day living assemblages in the area can be partly explained by the normal patchy distribution of species, as well as by possible changes in some environmental parameters during time. In this context, of particular interest can be local, presumably extremely recent changes in the sediment texture caused by the settlement of volcanic ash. To conclude, examination of presently available data suggests no clear correlation between living and dead ostracod assemblages from the same samples, as expected taking into account the environmental disturbance, mostly related to sedimentary noise. Analogously, no clear correlation can be traced between the composition and the structure of both living and dead ostracod assemblages and the biocoenoses (Fig. 5). Further study is needed, particularly to detect ostracod species that may be considered as indicative of particular biocoenoses, although this is hampered by the small size of these organisms allowing them to exploit restricted microhabitats with special parameters within macrohabitats (related to biocoenoses establishment) that reflect different general environmental conditions.

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