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# BENTHIC ASSEMBLAGE IN A «CATINO» OF THE MELORIA SHOALS (SOUTHERN LIGURIAN SEA)

**Abstract -** This study was carried out to describe some edaphic features of a *catino* located in the Meloria Shoals (Ligurian Sea) and to investigate the structure and composition of the macrozoobenthic assemblage colonizing its bottom sediments. Five samples for sediment and benthic community analyses were collected over an area of 30 x 40 cm. Sediment samples were analysed for their particle size, organic matter content and nutrients. For benthic community analysis samples were sieved through 0.5 mm mesh sieve and then fixed in 10% buffered formalin. Specific Diversity inside the *catino* was estimated using Shannon-Weaver index. Organisms were identified to the lowest possible taxonomic level. A total of 3296 individuals belonging to 57 species or higher taxon were collected (Platyhelminthes, Nemertea, Nematoda, Annelida, Sipuncula, Mollusca, Artropoda and Acrania). High density values were observed (5505 ± 990 ind/m$^2$). Among others *Stenothoe elachista* accounts for considerable density (1292 ± 343 ind/m$^2$).
Copepods and Nematodes, although commonly considered as belonging to meiobenthos, were very abundant. Their widespread presence suggested that their size was large enough to be retained on a 0.5 mm mesh sieve. At the same time we found that many macrobenthic species were small sized.

**Key words -** Benthic communities, mesh size, *catini*, Meloria Shoals, South Ligurian Sea.

**Riassunto -** *Comunità bentoniche di un «catino» delle Secche della Meloria (Mar Ligure Meridionale)*. In questo studio è stato caratterizzato un *catino* delle Secche della Meloria ponendo particolare attenzione al macrobenthos la cui conoscenza è tuttora frammentaria. Il sedimento (5 repliche) è stato prelevato su superfici di 30 x 40 cm, per un volume di 4 litri e setacciato su maglia 0,5 mm. Un'aliquota del sedimento è stata utilizzata per l'analisi granulometrica e per la determinazione della sostanza organica e dei nutrienti. La diversità è stata calcolata attraverso l'indice di Shannon-Weaver.
Il campionamento ha portato alla raccolta di 57 specie o taxon per un totale di 3296 individui (Platelminti, Nemertini, Nematodi, Anellidi, Sipunculidi, Molluschi, Artropodi ed Acrani) a testimonanza di un'elevata densità del popolamento che supera i 5505 ± 990 ind/m$^2$.
Notevole contributo a tale valore è fornito dal taxon dei crostacei, in particolare dagli anfipodi come *Stenothoe elachista* che raggiunge densità medie molto elevate (1292 ± 343 ind/m$^2$). Anche Copepodi e Nematodi, sebbene tipicamente ascritti al meiobenthos rappresentano una componente cospicua del popolamento di questo *catino*. La loro elevata presenza indica che questi taxa hanno dimensioni particolarmente grandi, tali da poter essere facilmente trattenuti da una maglia al setaccio di 0,5 millimetri. Al contrario le specie tipicamente macrobentoniche mostrano in media taglie piccole.

**Parole chiave -** Comunità bentoniche, maglia di setacciatura, *catini*, Secche della Meloria, Mar Ligure Meridionale.

## INTRODUCTION

The Meloria Shoals have attracted the attention of different authors since sixties (see Bacci *et al.*, 1969) when several studies were carried out in order to collect and identify all the organisms living in the area (Cognetti, 1965; Sordi, 1969; Cinelli, 1969, 1971; Morselli, 1970; Cognetti & Varriale, 1972; Katzmann, 1972).
These various authors agreed that these shoals are a very particular habitat both from the morphological and biological point of view, in particular the rocky bottom benthic flora and fauna. Only recently a renewed interest forced the scientists to improve their knowledge about peculiar rocky pools, named *catini* from the local fishermen (Bacci *et al.*, 1969). These unique habitats, although widespread in the western part of the shoals (De Biasi & Gai, 2000), have received less attention in the past. In the last decade Huys & Todaro (1997) and Todaro & Kristensen (1998) investigating the sandy bottoms of the *catini* described a species and a genus of meiobenthos new to science suggesting that these pseudo-circular depressions are still poorly known. Recently further studies were carried out by De Biasi *et al.* (2003) focusing the attention on the biodiversity of the benthic communities living in these rocky pools.
Our study was carried out to describe some abiotic features of a *catino* and to investigate, for the first time from a quantitative point of view, the structure and composition of the macrozoobenthos living in its bottom sediments.

## MATERIALS AND METHODS

### Study area

The study was carried out during summer 2000 in Meloria Shoals (South Ligurian Sea, Italy), an area 30-40 km$^2$ wide located 3 miles off the Leghorn coast characterised by shallow rocky bottoms between 2 and 25 m depth.
The *catini* largely occur inside the calcarenitic platform (beach rock), in the western part of the shoals. Their bottom sediments are generally carbonatic and mainly constituted by sands or gravelly-sands.

### Sampling method

For sediment and benthic community analyses five samples were collected in one *catino* over an area of 30 x 40 cm by scuba divers. Samples were analysed for

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their particle size according to the Udden-Wentworth Phi classification. Each sample, has been soaked in 16% hydrogen peroxide for 24 hours, then it was wet sieved on a 63 μm mesh to sort the fine fraction. The sand fraction was sieved through a stack of geological test-sieves ranging from 0 Phi to +4 Phi.
The hydrodynamic conditions of the investigated area were estimated computing the skewness parameter according to Folk & Ward (1957).
For the organic matter analysis the Walkley-Black method was applied in order to measure the chemical demand of oxygen (C.O.D. - *Chemical Oxigen Demand*) necessary to oxidize the organic matter. This value was determined using the indirect volumetric method. Analysis of nutrients was carried out by means of CNR standard procedures (CNR, 1983).
For the benthic community analysis sediment was sieved through 0.5 mm mesh and fixed in 10% buffered formalin. Samples were sorted in the laboratory and organisms were identified to the lowest possible taxonomic level.
Specific Diversity inside the *catino* was estimated using Shannon-Weaver index (Shannon & Weaver, 1963).

## RESULTS

### General description of the *catino*

The *catino* is located NW off Meloria Tower on a shallow rocky bottom at 7 m depth.
Bottom sediments were constituted mainly by carbonatic very coarse sand and by medium gravel. A small percentage of fine grain fraction was also present (Tab. 1). The skewness (Sk = -0.18) and sorting index ($\sigma = 0.87$) are typical of slightly sorted sediments with well rounded particles. Nutrients and organic matter content indicated a low level of eutrophication (Tab. 1).
The walls of the *catino* were gently sloping, made partially by rocks and partially by *matte* of *Posidonia oceanica* where algal photophilic assemblages can settle. The most abundant species were *Padina pavonica* (L.) J.V. Lamouroux, *Halimeda tuna* (J. Ellis & Solander), *Acetabularia acetabulum* (L.) P.C. Silva, *Flabellia petiolata* (Turra) Nizamuddin J.V. Lamouroux, *Dictyota dichotoma* (Hudson) J.V. Lamouroux, and *Caulerpa prolifera* (Forsskål) J.V. Lamouroux. The bottom, where small ripple marks (less than 20 cm high) were observed, was mainly colonised by *Caulerpa racemosa* (Forsskål) J. Agardh (see Fig. 1 for details).

### Benthic assemblage

A total of 3296 individuals belonging to 57 taxa (Tab. 2) were identified. These taxa were mainly belonging to macrozoobenthos. Among them the most common were Crustacea, Polychaeta, Echinodermata and Mollusca. Only a single species of Cephalochordata (*Branchiostoma lanceolatum*) was collected. In addition a large number of organisms typically considered as meiobenthic such as Nematoda, Copepoda and Ostracoda were found.
Crustacea were the most abundant taxon with 1523 individuals (47% of the total abundance) belonging to 17 different species. Among them the Amphipoda represented 72% with 1094 individuals belonging mainly to the species *Stenothoe elachista* and *Caprella lilliput*. Polychaeta with 593 organisms belonging to 21 species reached 18% of the benthic assemblage. Among them the most abundant species were *Saccocirrus papillocerus* and *Protodrilus* sp. Echinodermata were represented almost exclusively by the genus *Amphiura* represented only by juvenile organisms reaching 10% of the total abundance. Mollusca accounted for a small percentage of the sampled fauna (2%) with only 70 individuals. Among the meiobenthic taxa Nematoda were the most abundant reaching 726 individuals (22% of the total abundance).
Collectively the *catino* was colonised by a very dense benthic assemblage (5505 ± 990 ind/m$^2$). A major contribution to this value was given by *S. elachista* and *C. lilliput* that reached 1292 ± 343 ind/m$^2$ and 458 ± 55 ind/m$^2$ respectively (average densities ± standard error, $n = 5$).
Specific Diversity calculated by Shannon index was 2.132 ± 0.15 (mean among replicates).

## DISCUSSION

The *catino* investigated in this study showed a morphological structure similar to the type «b» according to the description reported by De Biasi & Gai (2000). Sediment texture and statistical parameters indicated that the area is influenced by strong currents. As previously suggested by Fierro *et al.* (1969) these conditions are mainly related to the shallow depths and the strong wind action typical of these shoals. It is likely, as pointed out by De Biasi (1999), that the same hydrodinamic conditions may have generated the patchy distribution of the *Posidonia oceanica* meadow in the shallowest part of the shoal.

Tab. 1 - Results of grain size (%), nutrients and organic matter analysis (all in mg/kg; organic matter in g/kg).

| Granulometric analysis | | | | | | Nutrients | | | | | | | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Phi* | Gravel | *Phi* | Sand | *Phi* | Sil + Clay | P.tot | P.ino | P.org | N | $NH_4$ | $NO_3$ | $NO_2$ | |
| -2 | 13.49 | 0 | 61.56 | > 4 | 7.75 | 154 | 90 | 64 | 3.4 | 7.1 | 156 | 6.9 | 0.9 |
| -1 | 12.91 | 1 | 4.23 | | | | | | | | | | |
| | | 2 | 0.03 | | | | | | | | | | |
| | | 3 | 0.02 | | | | | | | | | | |
| | | 4 | 0.01 | | | | | | | | | | |

Ptot: total phosphorus; P.org: Organic phosphorus; P.ino: Inorganic phosphorus; O.M.: organic matter.

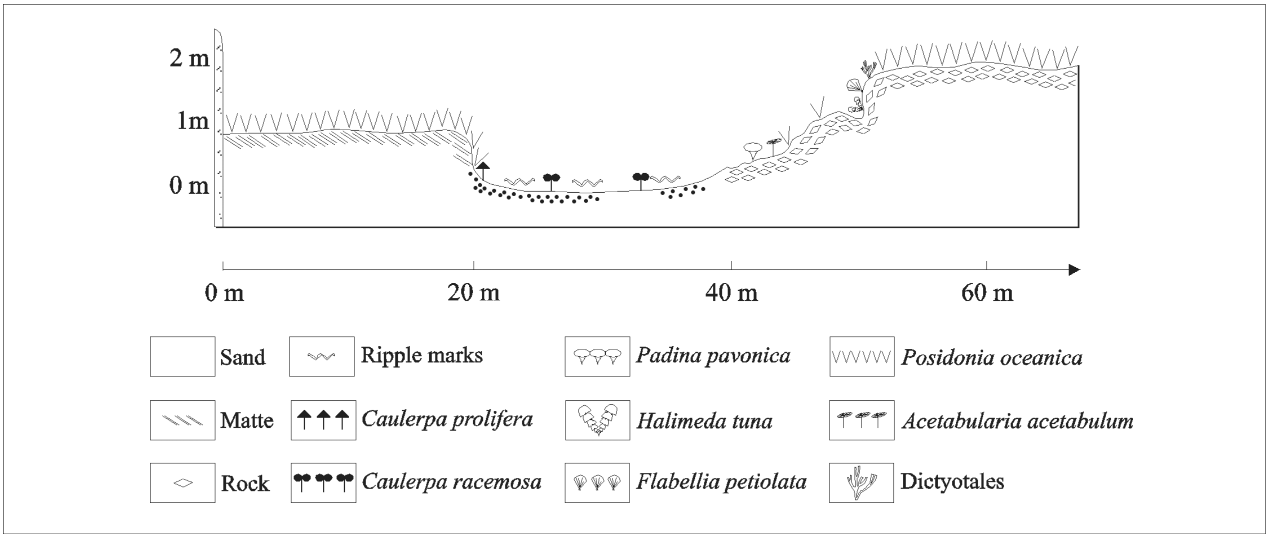


Fig. 1 - Bottom profile of the *catino*. The most abundant algal species are reported (symbols not in scale). From De Biasi & Gai (2000), modified.

The high energy conditions and the consequent coarse grain size are a convincingly explanation for the low nutrient and organic matter content.

The bottom sediments of this *catino* support a typical and abundant benthic assemblage, including some rare or noteworthy taxa such as *Stenothoe elachista* and *Caprella lilliput*. These species, even if not commonly found in the Mediterranean sea, resulted very abundant in the study location. This outcome can be probably connected with the particular environmental conditions present all over the area that appear suitable for these littoral amphipods. As described by Ruffo (1998) these two species endemic of the Mediterranean do prefer coarse sand shallow bottoms with strong currents that, as already mentioned, are typical of Meloria Shoals.

These environmental conditions are suitable for *Branchiostoma lanceolatum* as well. This species has been recorded in this area already since the eighties by Cognetti (1981) suggesting that this area has not been strongly modified in the last 20 years although being near an industrial harbour.

In a broad sense, the *catino* is colonised by a complex and abundant benthic assemblage. The high density of benthic fauna is partly due to the coexistence of taxa belonging both to macro and meiobenthos.

Meiofaunal organisms were too abundant to think that they were sampled only by chance. In addition our results can not be fully explained as a mesh size effect. It is well known that 0.5 mm mesh is widely used in macrobenthic investigation, especially in studies involving population dynamics as it provides an adequate estimate of abundance of individuals in small size classes, that is juveniles or newly settled macrofauna. This component represents the temporary meiofauna (mesobenthos of Bougis, 1950) which is defined only according to the screen mesh size.

However, our samples included a large number of permanent meiofauna (Copepods, Nematods) which is not an arbitrary part of the size spectrum but a group of taxa having their own functional and structural characteristics (size, number, generation time, physiological adaptation and so on, Warwick, 1982). Our observations indicated that meiofauna is exceptionally large sized and, by contrast, macrofauna is small-sized. Size variations have been observed by other authors and have been explained as clues of stress or adaptation to sediment granulometry (Petit, 1962; Warwick, 1982; Rapport *et al*., 1985). Our data were not planned *ad hoc* to find cause-effect relationships between size and environmental or biological variables or a combination of them. We can just formulate the following hypothesis. In many models, food supply to the benthos is depicted as a vertical flux. By contrast, in shallow waters, lateral flux are much more important for particle transport than vertical one. In more exposed areas, like Meloria Shoals, the wave and current action enhances turbulence and resuspension of particles strongly reducing the sedimentation rates. In addition, in coarse sediments the deposited detritus is washed away much more rapidly than in finer sediments which in turn affects the food supply for benthic organisms. So, a small fraction reaches the bottom and a smaller one will be trapped there. As reported by Rosenberg (2001) the immediate response to a settling phytoplankton bloom has been demonstrated by increased heat production and oxygen consumption in meiofauna compartment. Graf (1992) suggested that most macrofaunal species were too slow to obtain the freshly deposited phytoplancton which can be consumed only later. In addition, meiofaunal mechanisms in resource partitioning operate equally efficiently in the disturbed sediments of intertidal or very shallow water sites, while the macrofaunal mechanisms would rely on the more stable sedimentary conditions of deeper water (Warwick, 1984). The greater efficiency in exploiting resources allows the meiofauna to account for the largest part of the available food

Tab. 2 - Averaged density (± standard error $n = 5$).

| | Species | Density Indivduals/m² |
|---|---|---|
| Pol | Ampharetidae und. juv. | 6 ± 3 |
| | *Aricidea cerrutii* Laubier | 5 ± 3 |
| | *Eurysyllis tuberculata* Ehlers | 9 ± 6 |
| | Eusyllinae und. | 3 ± 2 |
| | *Glycera alba* (O.F. Müller) | 3 ± 2 |
| | *Glycera tesselata* Grube | 3 ± 2 |
| | *Lumbrineris impatiens* Claparède | 3 ± 2 |
| | *Nerilla antennata* O. Schmidt | 21 ± 12 |
| | *Odontosyllis gibba* Claparède | 6 ± 3 |
| | *Ophiodromus pallidus* (Claparède) | 30 ± 18 |
| | *Pettiboneia urciensis* Campoy & San Martin | 5 ± 3 |
| | *Pisione remota* (Southern) | 3 ± 2 |
| | *Polyophthalmus pictus* juv. (Dujardin) | 5 ± 3 |
| | *Protodorvillea kefersteini* (McIntosh) | 3 ± 2 |
| | *Protodrilus* sp. | 183 ± 110 |
| | *Pseudosyllis brevipennis* Grube | 11 ± 7 |
| | *Pterocirrus limbatus* (Claparède) | 3 ± 2 |
| | *Saccocirrus papillocerus* Bobretzky | 149 ± 90 |
| | *Sphaerosyllis brevifrons* Webster & Benedict | 6 ± 3 |
| | *Sphaerosyllis taylori* Perkins | 8 ± 5 |
| | *Trypanosyllis coeliaca* Claparède | 3 ± 2 |
| Cro | *Amphylochus* sp. | 3 ± 2 |
| | *Anapagurus* sp. | 3 ± 2 |
| | *Caprella lilliput* Krapp-Schickel & Ruffo | 92 ± 55 |
| | Copepoda und. | 307 ± 184 |
| | *Cyprideis torosa* (Jones) | 10 ± 6 |
| | Cypridinidae und. | 3 ± 2 |
| | *Eurydice affinis* Hansen | 3 ± 2 |
| | *Idunella nana* (Schecke) | 37 ± 22 |
| | *Leptochelia savignyi* (Kroyer) | 3 ± 2 |
| | *Leptognathia* sp. | 6 ± 3 |
| | *Leucothoe euryonyx* Walker | 8 ± 5 |
| | *Leucothoe incisa* Robertson | 3 ± 2 |
| | *Leucothoe* sp. | 3 ± 2 |
| | Ostracoda und. | 30 ± 18 |
| | *Pontocrates arenarius* (Bate) | 3 ± 2 |
| | *Stenothoe elachista* Krapp Schickel | 640 ± 384 |
| Mol | *Astarte fusca* (Poli) | 3 ± 2 |
| | Bullomorpha und. | 23 ± 14 |
| | *Caecum trachea* (Montagu) | 15 ± 9 |
| | *Dentalium* sp. | 3 ± 2 |
| | *Euparthenia* sp. | 6 ± 3 |
| | *Fusinus* sp. | 6 ± 4 |
| | *Gibbula* sp. | 3 ± 2 |
| | *Melanella polita* (Linné) | 3 ± 2 |
| | *Odostomia* sp. | 8 ± 5 |
| | *Tenagodus obtusus* (Schumacher) | 6 ± 3 |
| | *Volvulella acuminata* (Bruguière) | 11 ± 6 |
| Sip | *Aspidosiphon muelleri* Diesing | 3 ± 2 |
| Ech | *Amphiura* sp. juv. | 295 ± 177 |
| Ara | *Acarus* sp. | 7 ± 4 |
| | *Halacarus* sp. | 13 ± 8 |
| | *Litarachna* sp. | 8 ± 5 |
| Cep | *Branchiostoma lanceolatum* (Pallas) | 3 ± 2 |
| Neme | Nemertea und. | 11 ± 7 |
| Plat | Platyhelminthes und. | 8 ± 5 |
| Nema | Nematoda und. | 582 ± 349 |

Pol: Polychaeta; Cro: Crustacea; Mol: Mollusca; Sip: Sipunculida; Ech: Echinodermata; Cep: Cephalochordata; Neme: Nemertea; Nema: Nematoda; Plat: Platyhelminthes.

with consequent increase in biomass. In addition it is subjected to a reduced level of trophic pressure as macrofauna is constituted mainly by juvenile or small sized species.
What we suggest is only one of the possible interpretations for the observed pattern but it could be an useful starting point for future investigations using experimental designs which if planned *ad hoc* can support hypotheses of causal processes occurring in these shoals.

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