8. Benthonic populations

Research unit
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Title
Evolution of benthonic populations of the ridge of Santa Croce (Gulf of Trieste).

Introduction
For more than thirty years the study of the benthonic population of the Upper Adriatic Sea and the Gulf of Trieste has occupied the Institute of Zoology and Compared Anatomy, followed by the Biology Department. The University of Trieste is dedicated to the knowledge of the sea.
Particular attention is focused on researching changes of these populations in relation to external stimuli; this *current* had experimental outlines especially from the end of the 70's when in the Gulf of Trieste were introduced artificial reefs for studying purposes.
The submerged artificial reefs are bodies, modules, handmade articles and objects placed in the sea in order to realize technical-ecological mechanisms or ecological engineering performing to increase fishing production (AA.VV., 1992).
Among the most significant functions the submerged artificial reefs perform are:
- protection of young phases of demersal neritic species living in coastal areas by creating dens and holes for sedentary species;
- deployment of trophic nets, which go from sessile organisms to fish object of fishing;
- protection of natural and areal biocoenosis to marine phanerogam.
Following the first experiences done at the Miramare Natural Reserve and the Marine Biology Laboratory in Aurisina (Falace, 1989-'90), we were able to notice how the excess of sedimentation represents an obstacle to the colonization of the submerged artificial reefs, issue which has already been highlighted by Orel (1988).
Since the area around the Ridge of Santa Croce is a shoal, therefore subject to currents, which keeps it free from excess of fine materials, this has resulted as one of the few areas of the Gulf of Trieste to be most suitable for laying the experimental submerged reefs. As a matter of fact the remarkable hydrodynamism

present here makes the area more undamaged by this edaphic unfavourable factor. The choice of the material used was of fundamental importance.

Objective of the program

Verify, thorough benthos samplings of soft bottoms, the evolution of benthonic populations in stations placed on the top, on the base and in the area near the Ridge of Santa Croce.

Materials and methods

The benthos samplings, under examination, were collected in 25 different stations positioned at the lower slopes (stations 1-10), at the base (stations 11-20) and in the close surrounding area (stations 21-25) of the Ridge of Santa Croce (Fig. 8.1). The sampling was conducted onboard of the "Castorino2" in the first ten days of August 2005.

The samples were collected from the surfaces by the use of a Van Veen 0.1m^2 grab. The displacement of the sample areas was chosen on the basis of the bathymetric and sedimentological information suggested by the studies conducted by the Marine Biology Laboratory on the geological, geo-morphological and geo-technical aspects of the area under examination (Brambati *et al*., 1996).

The number of haul sampling for each station was set according to the extension of the "minimum representative area", in this case 5 sampling units were sufficient to the type of study.

The samples collected represented all the types of sedimentological areas of the Ridge and in the nearby areas. The stations 2, 3, 4, 10 (Fig. 8.1) were located in high ratio sandy zones; the stations 7, 8, 9, 14, 17, 18, 19 belonged to the particle size class of the "very sandy pelite"; the most external stations 12, 23, 24, 25 presented sediments rich of silt, while the stations 11 and 19 were characterised by high ratio of clay.

The material collected was rinsed on a sieve having a 1mm mesh, subsequently fixed with sea water and 5% formalin and preserved in plastic pots appropriately signed. Eventually in the laboratory the *sorting* method was made. This procedure consists of separating the fixed organisms from the inorganic residue mainly caused by shell fragments of Gasteropods and Bivalves as well as by *Cladocora caespitosa* in the top stations.

Using then a tarred container and filled with a fixed quantity of water, the residue withheld was measured.

The organisms were determined with special determination keys (Cossignani *et al*., 1992; D'Angelo *et al*., 1978; Falciai *et al*., 1992; Fauvel, 1927a, 1927b; Naylor, 1972; Parenzan, 1974a, 1974b; Riedl, 1991; Soc. Mediterranean Association of Malacology, 1974; Tortonese, 1965).
In some cases the identification of the organisms to the level of species was impossible since the animals were damaged; in these cases the determination stopped at the highest rank of taxa.
The data obtained by the determination of the species present in the samplings collected were and grouped in a table, subsequently reengaged by adding the data regarding the 5 collections performed in every station (Tab. 8.1).
The elaboration of these data made use of different statistical techniques utilized accordingly to different analytical approaches.
The objective set the analysis of the data was verified by the structures of the macrobenthonic communities of the area under examinations.
To this end the characteristic species collected and the main ecological indexes connected to the diversity were determined.
Subsequently, to the matrix of the abundance prior transformation of values with square root was applied the Bray-Curtis similarity coefficient obtaining a triangular matrix of similarity from which applying the algorithm of the complete bond, we obtained a cluster of the 25 sampling stations (Fig. 8.7).
In order to describe the structure of the community, the main ecological indexes (Shannon index of diversity (H), Pielou index of equitability (J), Margalef index of richness (R)) were calculated for every single station (Tab. 8.2, Figs. 8.4-8.5-8.6).

Results

The 2005 sampling campaign enabled to collect and determine a total of 21836 individuals (of which 20042 were determined up to the level of species) and 203 different Taxa (of which 163 to the level of species). The 2005 sampling campaign enabled us to collect and determine in total 19260 individuals (of which 17265 were determined up to the level of species) and 211 different Taxa (of which 187 to the level of species) Fig. 8.2 and Fig. 8.3.
In 2005 four main taxonomic groups included the major part of the determined Taxa:
- Mollusks (59 species for a total of 1523 individuals);
- Polychaetes (70 species for a total of 11884 individuals);
- Crustaceans (37 species for a total of 3299 individuals);
- Echinoderms (11 species for a total of 512 individuals).

The species characteristic of the biocenosis present (Pérès & Picard, 1964; Picard, 1965, 1972; Febvre-Chevalier, 1969) have been summarised in Tab. 8.3.
In 2003 Shannon index of diversity (H) ranged between 4.14 (D3) and 5.07 (D13); Pielou index of equitability (J) showed values ranging between 0.70 (D9) and 0.90 (D17 and D21); Margalef index of richness (R) ranged between 7.02 (D21) and 10.55 (D25).

Even in 2003 four main taxonomic groups included the major part of the determined Taxa: with the following values:
- Mollusks (56 species for a total of 974 individuals);
- Polychaetes (63 species for a total of 9403 individuals);
- Crustaceans (30 species for a total of 1951 individuals);
- Echinoderms (12 species for a total of 110 individuals).

In 2003 Shannon index of diversity (H) ranged between 2.47 (D22) and 4.58 (D11); Pielou index of equitability (J) showed values ranging between 0.49 (D22) and 0.82 (D25); Margalef index of richness (R) ranged between 3.52 (D23 and D25) and 6.56 (D1).
The study investigated separately the different ecological aspects. Initially the macrobenthonic community was examined as a whole through a qualitative and quantitative survey of all the species present and of the main indexes connected.
The survey on the simple data of specific abundance distinguished the 25 sampling stations into three representative groups respectively the top part of the Ridge (stations 1-10), the slopes and the neighbouring area (stations 21-25) (Fig. 8.7). This division in three main groups of stations was observed also following a 2003 sampling.
Comparing the data concerning the abundance of the two-year sampling, we can witness a decrease of the total number of individuals (from 21836 in 2003 to 19260 in 2005); on the other hand it possible to notice an increase in the total number of species (from 163 in 2003 to 187 in 2005).
This situation was reflected on the trend of the calculated ecological indexes; as a matter of fact we can see how there has been a general increase of the biodiversity and of its components. The increase of the specific diversity is due to both the increase of the number of species found (richness) and to a better equipartition (equitability) of the individuals belonging to the same species in the surveyed stations.
In 2003 some particularly abundant species, (e.g. *Pomatoceros triqueter*, *Pisidia longimana*, *Corbula gibba*, …) decreased in the number of individuals in 2005.

This determined a widespread increase of equitability in the stations which, consequently, contributed to raise the diversity values.
The total bionomic structure resulting from the analysis of the characteristic species appeared unchanged (Tabb. 8.3 and 8.3bis): 12 species characteristic of the biocoenosis DC, 5 of the SVMC, 2 of the DE, 3 of the HP biocoenosis were observed in both years while an increase of three species was observed for the VTC biocoenosis, one specie for the SFBC biocoenosis, one specie for the AP. In 2005 the Coralligenous (C) biocoenosis disappeared as the only specie that represented it, *Lumbrinereis coccinea,* was not to be found any longer.
The comparison of the data of the two-year sampling enabled us to identify a halt of the evolution of the benthonic populations into biocoenosis typical of hard substrate (AP, HP and C). This situation, not only was it shown by the qualitative analyses regarding the study of the characteristic species, but it was partially confirmed also by the analyses of the values of the abundance of species, which, although not characteristic of any biocoenosis, requires hard substrates or small interstitial cavities free from excess of fine sediment such as *Pomatoceros triqueter* and *Pisidia longimana.*
The data collected during the 2003 campaign gave a picture of a not stable biocenotic composition, but somehow in evolution, probably induced by the hydrodynamism variations, sedimentary rhythm and quality of sediment caused by the constitution and colonization of the submerged structures.
Most probably, at the beginning we found an increase of activity becoming concretion and/or a change of hydrodynamic conditions so as to eliminate the fine material and to minimize the importance of VTC (Coastal Terrigenous Muds) and of DE (Muddy detritic bottoms), indicating a possible decrease of disturbing phenomena and therefore of instability.
The 2005 sampling campaign showed how the development of the structure, with a probable enrichment of organic material and fine particulate, determined mainly by the abundant detritus of colonizers organisms, halted this evolutionary phenomenon to bioceonoses connected to fine substrates such as VTC, SVMC and DE.