Remarks on a method to quantify total biomass of the benthic communities on artificial substrata

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Although the artificial reefs were pointed out as an efficient tool in increasing fish production, up to now only few researches have contributed to quantify the biomass of benthic community settled onto the substrata (BOHNSACK and SUTHERLAND, 1985). In Mediterranean sea biomass studies were carried out on mussel beds settled on artificial reefs in Adriatic sea (FABI *et al.* 1985, BOMBACE, 1982), whereas RELINI and CORMAGI (1989) reported results on the fouling wet weight mesured on some panels of asbestos along the Ligurian sea.

Aim of this paper is to suggest a method to estimate benthic biomass on artificial substrata using data obtained with the usual sampling techniques for hard substrata.

A five-cube pyramid structure laid in the north Adriatic sea off Porto Garibaldi (see BOMBACE, 1982 and BOMBACE *et al.*, 1989 for further details) was sampled in July 1991, three years after its deployment. It was chosen a three-stage sampling. The reef had no available inner surface, because cubes were fused each other due to blocks movement on the soft bottom. From the population (the whole pyramid surface) a sample of four faces (an horizontal and a vertical one for each layer) was considered. Each one was divided into three equal size nonoverlapping strata and three 10x10 cm surface units were collected from it, one unit per strata. It was taken a census of any 100 cmq unit ; this area was pointed out as an adequate area, after plotting cumulative number of species against increasing areas in the same structure. It was used a non probabilistic scheme because in explorative survey it was proved to be more adequate than the probabilistic one and, in particular, the quota sampling was chosen at the second stage, owing to the high variance of the studied variable, the biomass. Zoobenthic biomass was measured as decalcified wet weight for each sampling unit. Identified taxonomic groups were put into trophic categories and their relative contribution was calculated.

To verify if the biomass distribution was associated to the identified strata, a chi-square test was performed both for the horizontal and the vertical surfaces. There was a mild association for the horizontal surfaces, whereas a really strong association was found for the vertical faces (SIEGEL, 1966).

In order to quantify the total reef biomass a bivariate interpolation technique, the G3GRID of SAS with the spline option, was used. Each sampling unit was identified by three coordinates: the first two indicate unit position on the reef (x,y) and the third rapresentes the biomass (z). The biomass of an area was considered as function of geographical coordinates, $z=f(x,y)$, of that area. A foundamental assumption was so made : the amount of biomass depends on the area position in the reef surface. Once obtained the biomass estimates for the four faces considered, a total biomass was evaluated for the whole structure and for the single cubes taking into accont the structure shape.

The three-dimensional graph hilights an increase of the total biomass from the lower to the upper layer on the horizontal surfaces, showing also maximum values on the central zone (Fig.1). The same trend is evident through the vertical faces but, in this case, low values are given in the central part (Fig.2). Difference on biomass distribution is probably due to effects of surface discontinuity (DI PISA & RIGGIO, 1982).

The biomass estimated is 4.59 Kg/m2 for the vertical faces of the upper boulder and 1.42 Kg/m2 for the horizontal one. The exposed faces of the bottom layer show 1.41 Kg/m2 on the vertical surfaces and 0.52 Kg/m2 on the horizontal. On the whole, the structure has 112.66 Kg as total amount of biomass calculated on the concrete surfaces (not including holes): 60.4% percent on the single cube of the upper layer and 39.6% on the four cubes below.

Benthic community is characterized by total absence of macroalgae, whereas vagile and sessile zoobenthos species are dominant. Filter-feeders represent 97.88% of the total samples biomass, 61.53% of which are mussels and oysters, 17.41% serpulids, sabellarids, small-sized bivalves, barnacles and ascidians and the last 18.94% non-active filter-feeders as hydroids and actinarians. Other trophic groups are deposit-feeders (0.74%), omnivorous (0.41%) and carnivorous (0.12%).

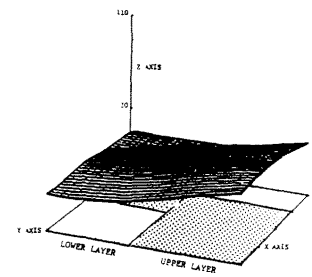

Fig.1 - Three-dimensional graph of total biomass for the horizontal faces.
View of the pyramid surfaces.

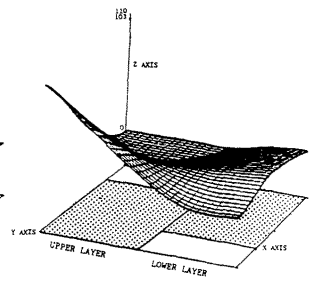

Fig.2 - Three-dimensional graph of total biomass for the vertical faces.
View of the pyramid surfaces.

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