A biometrical study on deep red coral, *Corallium rubrum (L.)*, in NW - Sardinia

S. CUDONI, L.A. CHESSA & A. PAIS

Istituto di Zootecnica - Università di SASSARI **(Italy)**

In spite of the special importance of Sardinian waters for red coral fishing, some basic aspects of the exploitation of this species are still unknown (CUDONI & CHESSA, 1991). This is particularly true for colonies at 90 m and deeper, due to the obvious difficulties in studying them. In particular, the analysis of population parameters in a given region can provide the basis for their stock assessment and fix priorities in research and management (FAO, 1983). The aim of this work is to give preliminary data of this kind in order to contribute also to the improvement of the fisheries Regional Law.

Colonies of a base diameter > 4 mm were collected by professional divers 12 miles SW of Capo Caccia (NW Sardinia) from a depth of 90 to 105 m, during summer 1991. In a sample of 106 intact branches, 42 of them were monoplanar and 64 pluriplanar. The base diameter (mm), the maximum height (mm) and the weight (9), were considered for biometrical purposes. The frequency distribution of the base diameter (D), the height (H), and the weight (W) give average values of respectively mm 9.5±2.1s, mm 152±36s, and g 34±20s (Figs. 1, 2, 3). Considering also the maximum values of these parameters : mm 16 (D), mm 260 (H) and g 128 (W), there is evidence of the lack of strong fishing pressure. This can be explained by the fact that this area was closed for 11 years to red coral fishing.

In order to show the relationship between age classes and base diameter, six age classes, established using the formula : age = D/1.32, as suggested by GARCIA-RODRIGUEZ & MASSO (1986b, c), are plotted against the cumulative % frequency of D (Fig. 4). It emerges that the most abundant classes are those between 5-6 (II) and 6-7 (III) years, and that the maximum age reached by a colony is 12 years. It is also evident that D sizes ≥ 10 mm are the most exploited ones.

Regressions between W and H (not shown here) and between W and D (Fig. 5) were calculated. While the first is similar to that found by GARCIA-RODRIGUEZ & MASSO (1986a) for a red coral population off Gerona, the second is very different : $W = 0.606\ D^{1.74}$ (our data); $W = 0.086\ D^{2.198}$ (Authors cited). So, taking into consideration colonies with the same diameter, the weight of ramifications found off Alghero is almost double of those found off Gerona. This fact can be explained by two different hypotheses :

1°) differences in the number of branches of the colonies;

2°) differences in the compactness of the skeleton.

Our subsequent application of the above mentioned regressions to other samples from the same fishing area off Alghero (unpublished data), confirms that H is not a good parameter for the characterization of *Corallium rubrum* populations, and that D is better. This is undoubtedly due to the allometric growth of this species and is in agreement with the findings of GARCIA-RODRIGUEZ & MASSO (1984a).

Figs. 1, 2, 3. Frequency distribution of respectively : diameter, height and weight.
Fig. 4. Cumulative frequency of age classes.
Fig. 5. Regression of weight on base diameter.

Fig. 1

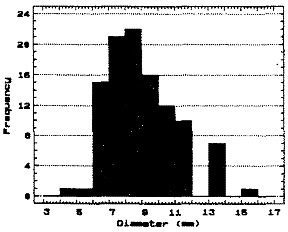


Fig. 2

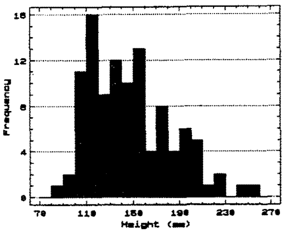


Fig. 3

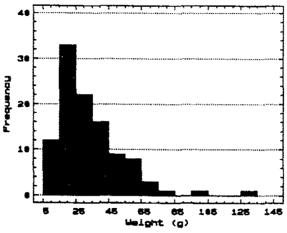


Fig. 4

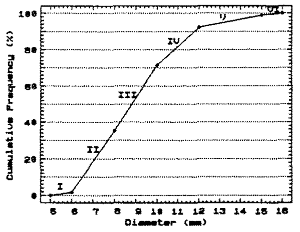
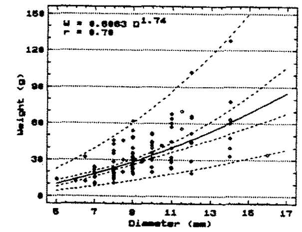


Fig. 5



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Benthic bacterial abundance and distribution in different areas of the Mediterranean Sea : relationships with organic matter

R. DANOVARO*, M. BOYER* and M. FABIANO°

*Istituto di Scienze Ambientali Marine, GENOVA **(Italy)**
°Dipartimento di Biologia Animale ed Ecologia, CAGLIARI **(Italy)**

It is well-known that benthic bacterial distribution is closely related to the sediment properties (such as grain size and organic content (DALE, 1974; DE FLAUN and MAYER, 1983). This paper summarizes data on the spatial distribution of benthic bacterial populations in different areas of the Mediterranean Sea in relation to the sediment organic matter content in order to point out factors relating to the bacterial distribution.

Surface sediment samples were collected from 8 Stations facing the river Entella, (July 1989), 5 Stations at the Portofino Promontory (July 1990), 1 Station in Posidonia bed sediment (from Dec. 90 to Dec. 91), 15 Stations at the mouth of the river Arno (November 1989), all-these from the Ligurian Sea and 22 Stations in Ionian and Aegean Seas (September 1989) using an Usnel 0.1 m^2 box-corer.

Sediment Organic Matter (TOM) was determined by the difference between the dry weight of the sediments (24 h, 60 °C) and the residue left after combustion (4 h, 550 °C).

Sediment Bacteria. Total bacterial number (TBN) in each sediment replicate (n=3, 1 cm^3) was analysed as described in MONTAGNA (1982). Bacterial Biomass (BBM) was calculated converting biovolume into carbon content, assuming 308 fgC x μm^3.

The entire data set did not show a significant correlation between TOM and BBM. Among the environmental conditions that can affect the benthic bacterial distribution and activity, two factors appeared to be significant in explaining the lack of correlation:

1) geographic and biogeochemical differences between the considered environments which determine the different foodsupply for benthic organisms.

2) large differences in hydrodynamic conditions (measured by using currentmeters placed at the water/sediment interface) in non food-limiting environments, as in coastal areas. Analysing the relationships between TOM and TBN or BBM in each area different patterns were found.

Entella Mouth was characterized by large amounts of organic matter (from 32.2 to 82.6 mg g^{-1} sed. d. w.) with an increasing gradient from shallower to deeper stations. This trend is related to the hydrodynamic conditions which are responsible for higher degree of resuspension in the shallower stations. Significative TOM vs TBN and TOM vs BBM correlations were found ($p<0.01$).

Arno Mouth. In sediments facing the river Arno (from 15 to 58 m depth) organic matter failed to correlate with bacterial density or biomass. This area was characterized by large amounts of sediment organic matter (from 52.1 to 80.9 mg g^{-1} sed. d. w.), mostly composed of refractory material because of the influence of riverine waters. Sediment texture appears to be largely homogeneous and a gradient of hydrodynamic stress between stations is lacking. This area is highly polluted because of the large heavy metal input from the river, and a negative relationship between Cadmium concentrations (FABIANO *et al.*, in prep.) and bacterial biomass was found.

Ionian and Aegean Seas. Analysis of sediment organic matter in the deep-sea generally shows very low concentrations (from 5.6 to 15.1 mg g^{-1} sed. d. w.). TOM significantly correlates with depth but not with benthic bacteria. The Eastern Mediterranean deep-sea can be considered a food limitating environment because of the low concentrations and mostly refractory composition of TOM. The factor controlling bacterial distribution was the amount of labile compounds (i.e. carbohydrate, lipid and protein). A significant relationship between bacterial number and carbohydrate content (unpubl. data) was found ($p<0.05$).

Posidonia Bed Sediments. In the studied sheltered bay (very low hydrodynamism), three main inputs of organic matter can be distinguished: algal bloom and decay, Posidonia leaf-fall and terrestrial input of organic matter brought to the sea by rains. Bacterial density and biomass show strong seasonal fluctuations but were not related to the amounts of sediment organic matter. Since food supply was never a limiting factor (TOM was annually on average 32 mg g^{-1} sed. d. w.) bacterial abundance depended on temperature (n=22, $p<0.01$) and on phosphate concentrations in interstitial waters (n=22, $p<0.001$).

To conclude, an analysis of the bacterial distribution along an hypothetical profile from 0 to 2400 m depth is shown in Fig. 1. The general trend seems to follow a bimodal curve with maximum bacterial densities in shallow water with little water movement (Posidonia bed sediments) and in deeper low energy environments rich in organic matter (muds from 60 to 135 m) confirming the results of NOVITSKY and MacSWEEN (1989) which observed higher TBN in protected sandy sediments than those which were exposed. Table I shows the environmental conditions characterizing the areas considered. The reported values were defined from very low (--) to very high (++++).

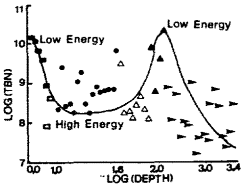

Fig.1

SEDIMENT TYPE	FOOD SUPPLY	ENVIRON. ENERGY	BACTERIAL BIOMASS
Posidonia	+ + +	–	+ + + +
Sandy Sediment	+	+ + +	–
Sandy Mud Sediment	+ +	+ +	+
Mud Sediment	+ + +	–	+ + +
Deep Sea Sediment	–	– –	+

Tab. I

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