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Some observations on the maërl distribution in the northern Adriatic Sea

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This paper forms part of a wider research into changes among the deepest phytocoenoses of the Northern Adriatic Sea.

The area is featured by organogenous rocks rising from a sandy bottom and rather strong deep currents thus explaining the presence of adapted species such as: Lithophyllum racemus *(Lamarck) Foslie,* Lithothamnion corallioides *Crouan et Crouan,* Phymatolithon calcareum *Pallas,* Spongites (Lithothamnion) fruticulosa *(Kuetzing) Foslie and* Lithothamnion valens *Foslie. These species are calcareous perennial structures which form a part of the sediment. This meant it was necessary to distinguish between living and dead algae during the mapping of the facies.*

The area from Grado to Venice was investigated with 15 sampling sites each of which had 5 grab picks. In order to understand how the environment may act on the distribution of maërl, the samples were identified, then divided according to colour-vitality and finally dried and weighed. Data were analyzed by means of multivariate methods.

The results indicate trends similar to those already suggested by previous works since the elaborated data show one abundance gradient stretching from Grado to Venice and another located in-offshore near Venice. These gradients are further confirmed by a greater presence of living algae near Venice.

INTRODUCTION

This work is a part of a wider research involving mapping of both the previous and present situation of the animal and vegetal benthos of the circalittoral plane of the Northern Adriatic Sea.

The peculiar characteristics of this basin, such as the currents on the sea bottom and the beach rocks, and the previous reports about the biocoenoses distribution (OREL, VIO and ZANITTI, 1982) led us to think that the circalittoral plane of this area might be characterized by the presence of rhodoliths and maërl bottoms (cf. BOSENCE, 1983).

There are no reports about the distribution of rhodoliths of the Northern Adriatic circalittoral plane, except for OREL, VIO and ZANITTI (1982) and the fishing map of 1968, while there is quite a lot of literature regarding Brittany (BLUNDEN *et al.*, 1977; CABIOCH, 1969, 1970), Ireland (KEEGAN, 1974; SHIN, 1980), the Canary Islands (CARRILLO, 1982), Brasil (SILVA *et al.*, 1987) and the north-western coast of the Mediterranean Sea (BOURCIER, 1982; GOMEZ *et al.*, 1986; BARCELO, 1983).

These phytocoenoses can be a useful source of information about both the previous and the present environmental conditions when

their thalli are studied in terms of presence/absence, abundance/dominance and vitality. In terms of space, the distribution of these coenoses is affected by environmental changes due to currents and a changed sedimentary rythm (CABIOCH, 1969). In terms of time, since the studies conducted by HUVE and PICARD (1962), it has been known that quantitative fluctuations in the presence of these species may be registered even over short periods of time, as for example seasonal fluctuation. In terms of ecophysiology, BOROWITZKA (1977), GINSBURG *et al.* (1972) showed that carbonate deposits in the cell wall are affected by variation in pH, salinity and water temperature.

These are the premises for this research which aims at registering recent environmental variation on the western coast of the Northern Adriatic Sea, by means of changes in the distribution of such a sensitive facies.

MATERIAL AND METHODS

The area under study stretches from a theoretical line drawn between P.ta Sdobba (Lat. 45°43'40" and Long. 13°33'10") and P.ta Maestro (Lat. 45°00'20" and Long. 12°30'20") in the SE, to the Italian coast in the NW (Fig. 1).

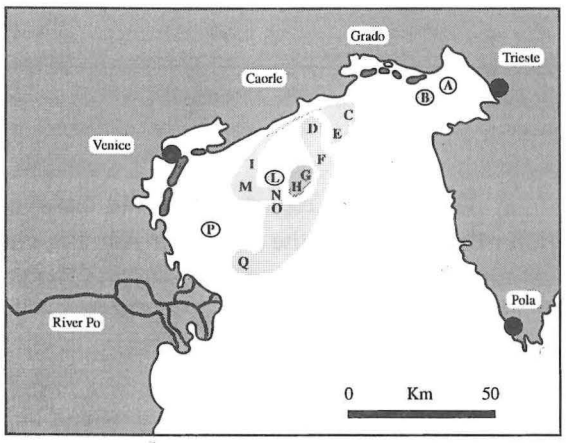

Fig. 1. Map of the sampling sites

cluster 1
cluster 2
cluster 3
cluster 4
cluster 5

The main geomorphological and hydrological feature of this zone are: beach rocks cropping out from a sandy substratum of differing grain size; a relatively low depth (max. 25 m.); bottom energy produced by a synergy of tidal, gradient and hydrodynamisms; p(r sea trasparency due to suspended earth particles following heavy rains, which are more frequent in autumn and spring (STRAVISI, 1983).

15 sampling sites were set up from Grado to Venice and marked thus:

A = lat.45°38'64" long.13°27'51"
B = lat.45°37'60" long.13°21'68"
C = lat.45°33'42" long.13°03'65"
D = lat.45°27'54" long.12°55'77"
E = lat.45°30'51" long.12°59'25"
F = lat.45°23'90" long.12°50'34"
G = lat.45°22'45" long.12°47'00"
H = lat.45°20'98" long.12°14'22"
I = lat.45°28'08" long.12°38'12"
L = lat.45°21'90" long.12°40'53"
M = lat.45°20'36" long.12°37'57"
N = lat.45°19'65" iong.12°40'19"
O = lat.45°19'70" long.12°39'88"
P = lat.45°13'60" long.12°28'85"
Q = lat.45°10'05" long.12°33'10"

The calcareous species found in the zone sampled are:
Lithophyllum racemus (Lamark) Foslie
Lithothamnion corallioides Crouan et Crouan
Lithothamnion valens Foslie
Spongites (Lithothamnion) fruticulosa (Kuetzing) Foslie

The voucher specimens of each species are deposited in the Biology Dept. of the University of Trieste.

The species *Spongites (Lithothamnion) fruticulosa* was excluded from the species studied in this work because the thallus incorporated substrata (shells or pebbles) during its growth, and this would have altered the data expressed in weight.

Samples of calcareous algae were collected during the sea expedition which began on 8th August 1989 and ended on 18th August 1989.

Five grab picks (with a Petersen grab) were carried out at every point, in order to ensure that the sample taken was representative.

The thalli sampled were identified with the help of the descriptions furnished by CABIOCH (1965), BRESSAN (1974) and WOELKERLING (1985) and sorted according to: species, site and colour (Table 1).

accordance with WESTHOFF and VAN DER MAAREL (1978). The groups were checked with the Chi Square test.

RESULTS

The data expressed in dry weight are collected into the Table 1.

	Genus	species	SAMPLING SITES A	B	P	L	C	I	E	M	N	O	D	F	Q	H	G
LIVING	Lithophyllum	racemus	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.02
	Lithothamnion	corallioides	0.00	0.00	0.00	0.00	0.01	0.08	0.00	0.00	0.05	0.05	0.00	0.00	0.06	0.75	0.19
	Lithothamnion	valens	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00
	Phymatolithon	calcareum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DEAD	Lithophyllum	racemus	0.00	0.33	0.06	0.00	0.00	0.02	0.23	0.98	0.71	0.61	1.13	0.90	0.76	3.91	0.04
	Lithothamnion	corallioides	0.00	0.50	0.54	0.30	2.56	2.84	4.69	5.71	6.63	9.08	11.88	13.43	20.94	142.55	55.17
	Lithothamnion	valens	0.00	0.00	0.21	0.00	0.00	0.28	0.10	0.00	0.00	0.00	0.46	0.00	0.00	0.14	0.00
	Phymatolithon	calcareum	0.00	0.00	0.00	0.02	0.65	0.47	1.26	0.04	0.40	0.55	1.11	0.52	0.00	4.55	0.00

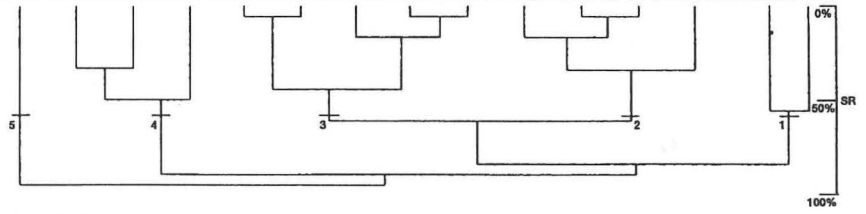

Table 1. Average abundance of thalli in gr.

We would like to point out that a preliminary study previous to paper (NICHETTO & GHIRARDELLI, 1992) into the photosynthetic capacity of the thalli of calcareous *Rhodophyceae* for different pigmentations (colour), enabled us to be reasonably certain when distinguishing living thalli, red or pinkish (scale SEGUY, 1936, n° 9,14,72,74,89,105,143,148) from dead thalli, mainly greyish or brownish (scale SEGUY, 1936, n° 112,131,133,193,199,201).

The samples were dried (in an oven at 104°C for 24h) and weighed. The weights were expressed as the mean values of 5 grab picks at each site and tabulated (Table 1).

Data were elaborated via multivariate analysis tecnique for qualitative aspects (weight in grams). In this way were obtained an automatic classification (cluster analysis) of the samples (by applying the "Similarity Ratio" in

The elaboration, applied on the column of this table, conducted to the identification of 5 groups of sites similar in distribution of living/dead thalli (HG;CEIMN; QOFD; PLB;A) (Table 1).

When the group thus identified, an abundance of thalli, both living and dead, is evident in sampling sites around the Venice area and on the contrary they are scarce in the sites around Grado.

From the same figure it is possible to note, in the area of Venice, an increase of abundance of living -dead thalli towards offshore.

The abundance data relative to living thalli only cannot be usable for an appreciable quantitative distinction since they are so scarce; we therefore proceeded in terms of presence - absence as shown in Table 2.

	Genus	species	SAMPLING SITES A	B	P	L	M	F	D	E	C	H	N	Q	G	I	O
LIVING	Lithophyllum	racemus	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1
	Lithothamnion	corallioides	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Lithothamnion	valens	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	Phymatolithon	calcareum	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

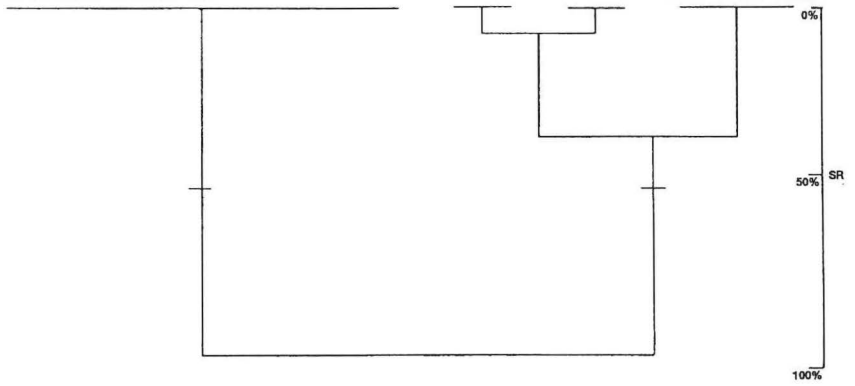

Table 2. Presence and absence of thalli

On this basis it has been evidenced a complete absence of living thalli in the Grado sites and quite a substantial amount in the Venice sites.

DISCUSSION

In the light of a scarce literature about rolling calcareous algae in the Northern Adriatic basin and from these results it has been possible to show:

- in terms of productivity (in weight) of the species considered, a greater abundance of samples in Venice sites (Table 1), in a wider context of progressively poorer towards the more northern areas, located around Grado (Fig. 1). In the same terms, always near Venice, it seems possible to identify a further abundance gradient coast-offshore (Fig. 1);

- in terms of vitality, a greater presence of species towards Venice and a smaller one near Grado (Table 2), thus confirming, also in physiological terms, the above gradient.

This preliminary description of variation in quality (presence of species, vitality) and quantity (abundance in weight) of free, rolling calcareous algae can be interpreted in terms of an adaptation of the species to different variation, also non exclusive, of:

- sedimentary rhythm of suspended earth particles of the Northern Adriatic basin;

- grain size of the substratum;

- trophic regime of the basin (eutrophy/oligotrophy related to coast/offshore gradient).

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Neka opažanja o raspodjeli "maerl"-a u sjevernom Jadranu

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KRATKI SADRŽAJ

Ovaj je rad dio opširnijeg istraživanja promjena u fitocenozama najvećih dubina Jadranskog mora.

Područje obilježavaju organogenetske stijene koje se izdižu sa pjeskovitog dna kao i prilično jake dubinske struje koje razjašnjavaju prisutnost prilagođenih vrsta kao: *Lithophylum racemus*

(Lamarck) Foslie, *Lithothamnion coralloides* Crouan et Crouan, *Phymatiolithon calcareum* Pallas, *Spongites (Lithothamnion) fruticulosa* (Kuetzing) Foslie and *Lithothamnion valens* Foslie. Ove su vrste trajne vapnenačke strukture koje su dio sedimenta. Stoga je bilo neophodno razlučiti koje su vrste alga nađene žive a koje uginule kada se radila karta facijesa.

Područje izmedju Grada i Venecije istraživano je na 15 postaja od kojih je svaka postaja uzorkovana grabilom pet puta. Kako bismo shvatili kako okoliš djeluje na raspodjelu "maërl"-a obavljena je identifikacija vrsta, uzorci su podijeljeni prema boji - vitalnosti te na kraju osušeni i izvagani. Podaci su analizirani pomoću metode multivarijacije.

Rezultati pokazuju trendove slične onima opisanim u prethodnim radovima budući da obrađeni podaci ukazuju na gradijent abundancije koji se proteže od Grada do Venecije i drugi u smjeru od obale prema pučini u području Venecije. Prisutnost ovih gradijenata potvrđuje i veća obimnost algi u blizini Venecije.