

The Adriatic seaweed *Fucus virsoides* (Don.) J. Ag. is able to penetrate into low-salinity areas and is rather tolerant to environmental stresses. It was cultivated in diluted seawater as well as in two different types of natural mineral waters in order to find out whether this eulittoral fucooid is able to survive in media other than seawater.

Salinity influence on the chemical composition and physiological properties of fucoids was reported (MUNDA and KREMER 1977) and the Adriatic *Fucus virsoides* was studied separately regarding its autecology and responses to different ecological stresses, such as dilution, excess of nutrients and heavy metals (KREMER and MUNDA 1982). In this preliminary contribution the influence of two different natural mineral waters on the survival and growth of *Fucus virsoides* is dealt with. One of the waters used in the present experiments originates from a typical acrothermal spring (Dobrna - spring temperature 35.6°C), which contains 74 mg.l<sup>-1</sup> of Ca, 21 mg.l<sup>-1</sup> of Mg, 1 mg.l<sup>-1</sup> of Cl, 318 mg.l<sup>-1</sup> of HCO<sub>3</sub> and traces of V, Li, Fe, Al, Cu, Zn. The other mineral water (Radenska spring) is rich in free CO<sub>2</sub> as well as in Ca (219 mg.l<sup>-1</sup>), Mg (96 mg.l<sup>-1</sup>), Na (480 mg.l<sup>-1</sup>), with 47 mg.l<sup>-1</sup> of Cl, 89 mg.l<sup>-1</sup> of SO<sub>4</sub> and 2370 mg.l<sup>-1</sup> of HCO<sub>3</sub>.

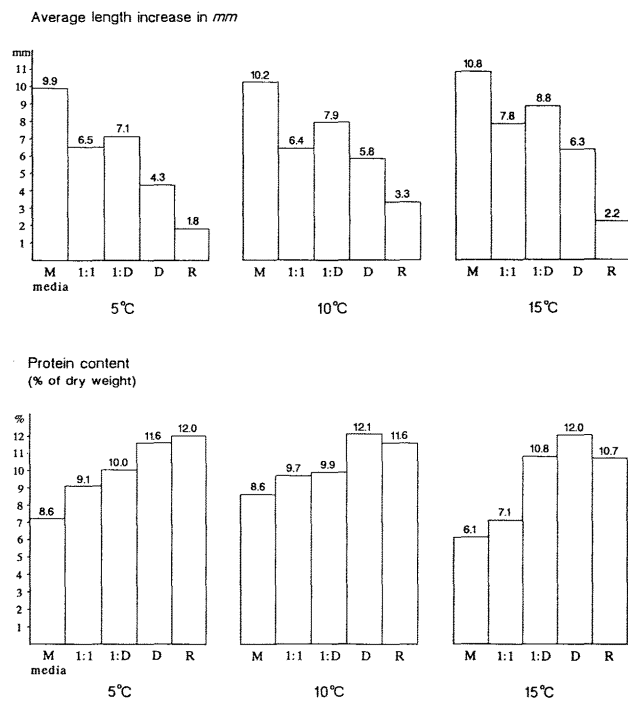
#### Methods

Adults plants of *Fucus virsoides* were collected at Piran in the Gulf of Trieste during different seasons. Ten subsequent series of experiments were run with winter, spring, late spring, summer and autumn material of this species. Small individuals from the same population or pieces of bigger plants (3 - 5 cm long) were kept in stagnant media in 500 ml glass dishes at 5°C, 10°C, 15°C, and in some series also at 20°C. The following media were used: filtered seawater - salinity 37.87‰ (M) diluted seawater - salinity 17.61‰ with a - freshwater (1 : 1), b - with water from the Dobrna spring (1 : D), water from the Dobrna (D) and the Radenska (R) springs. Media were changed every third day. The length increase (in mm) of the experimental plants was measured after two, four, eight and twelve weeks incubation. At the end of the experiments the protein content was determined by micro Kjeldahl procedure.

#### Results

Results of all the experimental series indicated that *Fucus virsoides* is able to survive and even grow slightly in media other than seawater viz. natural mineral waters. Values (elongation in mm and protein content) for one of the series run with spring material are presented in the figure. The overall trend of media-dependent growth performance showed the usual dilution (induced, decrease in the 1 : 1 medium whereas dilution of seawater with the Dobrna spring water (1 : D) enhanced growth. In some of the series it even surpassed that of the control plants. In the two mineral waters growth was decreased to about one half in the Dobrna water and even more in the Radenska water, as related to the controls. Growth maxima were indicated at 15°C for plants kept in the diluted media and the Dobrna water, whereas in the Radenska water growth was decreased at the higher temperatures. In the latter necrosis was noticed after four weeks and in some cases even earlier, while the Dobrna water allowed survival and growth even after a twelve weeks incubation. Plants collected during different seasons did not deviate from this trend, though some variations regarding the growth expressions and temperature optima were notable (10°C for the winter and the early spring material and 15°C or 20°C for the rest). The relation between growth performances in the two extreme stress media varied with the seasons in which the plants were collected. Growth was lowest in the summer material where necrosis occurred soon in the two stress media. The protein content, measured at the end of the experiments exhibited the usual trend of dilution induced increase. In all the experimental series it was highest in plants kept in the two mineral waters, reaching up to 16% of dry weight in the summer material.

Media-induced growth strategies varied, however, with the time when the plants were collected. Growth was highest in the material collected in late spring. In this case growth of plants kept in the 1 : D medium surpassed that of the controls, while pure Dobrna water induced a relatively high growth performance.



#### REFERENCES

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This study is a part of a wider research to investigate the transformations in time and space of the phytozoenoses typical of the Northern Adriatic Sea (and particularly in the Gulf of Trieste).

Attention has been concentrated on the circalitoral zone and specifically on the facies with sea bed currents.

The vegetal sampled forms are: *Lithophyllum racemus* (LAMARCK) FOSLIE, in the bioceenosis of the coarse sands and fine gravels under bottom currents (SGCF); *Lithothamnion corallioides* CROUAN et CROUAN and *Phymatolithon calcareum* (PALLAS) ADEY et MC KIBBIN characteristic species of the maërl, facies of the bioceenosis of the coastal detritic (DC); and *Spongites* (*Lithothamnium*) *fruticulosa* KUTZING and *Lithothamnion valens* FOSLIE, facies of DC (PERES, 1967).

These species are very useful as indicators of environmental changes: both from the spatial point of view, as rolling algae because of their dependence on the currents and as calcareous structure because of their dependence on the water variation of pH, salinity and temperature; and from the temporal point of view, because they are perennial species, reflecting the variations of many years.

The mapping of maërl distribution has involved a wide area from Grado to Venice (NICHETTO, 1990) including 15 sampling sites in Italian waters and one reference taken at Rovinj (Croatia).

Five samples have been taken from each sampling site; the algae have been defined, weighed (dry weight), submitted to physiological checking (photosynthetic analyses, to discover the relationship between pigments and functionality) and as well as being submitted to isotopic analysis (in order to show up possible differences among the sampling areas); the data were combined into matrix and thereafter elaborated by multivariate analysis (BRESSAN & NICHETTO, 1992).

A gradual increase in biomass from the samples taken from the area of Grado to that of Venice (fig 1 & 2) has been noted.

This observation has been confirmed by the results of the eco-physiological experiences (analysis of photosynthetic capability of thalli with different pigmentation (NICHETTO & GHIRARDELLI, in presentation), that show that the majority of living samples are found near Venice, and propose again, in functional terms, the gradient of average abundance (fig. 2).

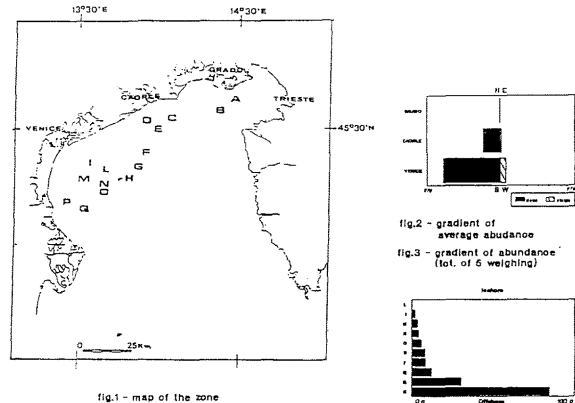
The results are also confirmed by isotopical analyses conducted on calcium carbonate of ground samples of thalli, that show up quite big differences between the sampling areas of Grado, Caorle and Venice (NICHETTO, 1990).

From a temporal point of view we noted a contraction in the areals since the previous situation as described by the "Carta di pesca del Golfo di Trieste (CNR, 1968) and by BRESSAN (1968, personal communication) and OREL, VIO & ZANITTI (1981-82).

In synthesis two gradients of abundance and luxuriance of calcareous species can be seen: the first parallel to the coast line (from the Grado to the Venice one) and the second (in Venice area) perpendicular to the coast, towards the centre of the Adriatic Sea (fig. 3). This first description of the event could be interpreted by environmental means with a better knowledge of: a) variation of sedimentary rhythm (continental waters) of the Northern Adriatic Sea and consequent adaptation of the maërl species in the investigated areas; b) granulometric gradient (inshore/offshore); c) hydric trophism and therefore eutrophy/oligotrophy gradient (inshore/offshore and surface/bottom).

These first results are also confirmed by observing one particularly rich reference sampling site (S. Giovanni in Pelago - Rovinj - Croatia). The data from this site are very different from those previously referred to.

Therefore the Rovinj site seems to be closer to the climax of maërl facies.



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