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## Preface

The “Study of the primary productivity and secondary production of the submerged artificial reefs placed by the Ridge of *Santa Croce* (Gulf of Trieste, Upper Adriatic Sea), included in the Operative Programme INTERREG II Italy – Slovenia (1999 - 2001), has led to the publication of one volume of the same title, written in three languages (Italian, French, English) and published by the Autonomous Region of Friuli-Venezia Giulia (Regional Office European Affairs) care of S.T.E.A. Printers-Editorial Service of the University of Trieste (November 2001 - 323 pp.)

The general conclusions of this study have led to suggest continuing the researches aiming to:

- exceed the limits of a period of experimentation necessarily short (just over 2 years) on the basis of which the spontaneous colonization is to be considered still only at an early stage;
- start those studies which, in the first phase (INTERREG II), revealed to be premature. As a matter of fact the CS had necessarily privileged the deployment of manufactured products (as a different typology of design and materials) even to reach a minimum significant area of the submerged artificial reef, facing, in terms of priority, its costs;
- test, on a longer basis of period of time, albeit more convincing, the tigmotropic influence of the submerged artificial reefs by means of the use of different techniques, integrable to one another, convinced of the fact that:
  - as far as the halieutics fauna is concerned, some promising signals were yielded by the research in the sea when, already in the November 2000 fishing, the maximum number of species was found inside the reef in relation to a controlling site;
  - as far as the edible molluscs are concerned, we hoped to obtain, on the basis of further on-the-spot investigations, a confirmation of the purification effect and the passive repopulation performed by the S.S.M.L.. A consistent presence of grommets (*Protopecten glaber*) was indeed noticed anchored to the FAD, by means of a byssus.;
- evaluate how much it is possible to “pilot artificially” the natural ecosystem to determined objectives (restoration of the environment,

exploiting the resources,...), by the same standard as done centuries ago in agriculture.

- Verify the applicability of integrated (in laboratory and on the field) ecophysiological methodologies to have a self synecologically crossed comparison on macroalgal species, especially perennial cycle, characterised by outstanding abilities to adapt physiologically to different environmental parameters (for instance light/depth along the column of water) as well as from:

- Abundant presence in natural sites of the Adriatic Sea;
- High primary production with consequential development of abundant biomass;
- High ability of ‘spontaneous’ or ‘conditioned’ anchoring/covering, by the use of transplantation, in order to improve the ‘productivity’ of the manufactured products, without introducing unnatural species to the ecosystem and therefore with a minimum environmental impact.

Delighted by the results obtained through those experiences, the then Councillor to the Environment of the Friuli-Venezia Giulia, Paolo Ciani, diligently (see Presentation – 2001) included the present project of research in the following Operative Program INTERREG III Italy – Slovenia, financed by the European Fund of the Regional Development (F.E.S.R.), for the period 2000 – 2006.

The presentation of this Project took place in the first months of 2002 laying the basis on the : ***“Study of the primary and secondary productivity of the submerged artificial reefs placed nearby the Ridge of Santa Croce (Gulf of Trieste, Upper Adriatic Sea)”***.

In order to overcome the administrative-financial hiatus very much foreseeable in terms of time to enter into an agreements and other, we applied for a private finance to the Fondazione CRTrieste, for some 21% of the total finance foreseen in the Operative Programme. This finance was requested also in order to prevent interruptions of the works (see: Relation I – Action I of 20 October 2004), which could have damaged in terms of continuity of the research, as well as losing a good number of those human and intellectual resources, who in the meantime became specialised during the previous studies. The sensitivity of the Fondazione CRTrieste management has contributed concretely to the overcome of these contingent difficulties.

The scientific committee appointed to the Project, met on 12 July 2003 and 11 May 2005, agreed on the detailed Operative Programme, as shown in the following points, verifying at the same time the possibility of development:

• *Hydrological approach* aimed to the characterisation of the chemistry-physics of the water by or around the underwater Oasis by:

- Acquisition data of: salinity, temperature, suspended particles, dissolved oxygen, chlorophyll *a* , nutrients dissolved organic particle, yields, according to an appropriate clause in the agreement, from the samplings carried out by the LBM in accordance with the Programme “Study of the trophic phase and anomalies of the Upper Adriatic system” – INTERREG IIIA : Italy- Slovenia, by the Station T01 located at about half mile from the site;
- Acquisition of data concerning the *bio-optical* characterization of the water column by means of the:
  - Attenuation coefficients (spectrophotometer);
  - Descending irradiance and ascending irradiance (selective radiometers);
  - Spherical irradiance (PAR radiometers);

In space-temporal coincidence with salinity and temperature findings (CTD multiparametric probe).

• *Algological approach* oriented to the study of the macrophytobenthic component present on the reefs of the Ridge of *Santa Croce*, both in terms of *spontaneous* colonization (function of the species present in-shore and off-shore in the Gulf of Trieste), and the colonization artificially induced (by transplantation). The spontaneous colonization was characterised by the development of an algal tentum (*turf*), strongly thickened. The importance of the *turf* in the ecosystem must be evaluated from one side by ecophysiological studies focused to the quantification of the number of species present and by the biomass and oxygen production, from the other side by ecological studies directed to the evaluation of the action of grazers and of the competition for space with the molluscs.

• *Zoological approach:*

-to the *prestigious fish fauna* aimed to the knowledge of the “Evolution of the fish populations of the Ridge of *Santa Croce*”. This reasons of this study are to verify the tigmotropic capability of the submerged reefs and to evaluate the possible increase of the fish biomass on the basis of the observations collected with different techniques such as:

METHOD

		METHOD	
		invasive	non invasive
		direct	indirect
measure	-objective -quantitative	<b>Traditional fishing</b>	<b>Echosounder recording</b>
evaluation	-subjective -qualitative		<b>visual census</b>

-to benthonic populations and edible molluscs with the attempt to resume almost entirely the previous piece of work (study of the top, base layer and areas surrounding the artificial reefs submerged on the Ridge of Santa Croce). Particular attention is given to the *Mytilus galloprovincialis*, *Ostrea edulis* populations and to the pectinids, taking as an element of comparison (“white”) an area located 1 mile NW from the Ridge. The different evolution between soft and hard substrates must be assessed.

...and “not included in the financing”, because not strictly connected to the theme of the productivity under examination, but with the same dignity for the possible implications inherent the research itself:

- *Geomorphological characterization* of the Ridge to understand the possible transformations of the surrounding bottom following the submerging of the artificial reefs and to the possible modification of the hydrodynamism in areas by the handiworks. To be able to meet this objective it has been necessary to define in details the structure of the Ridge and, in the light of the present paleontological knowledge about its origins, outline predictably the future evolution identifying possible limits of environmental acceptability.

For this purpose an R.U. was involved constituted by paleontologists and geologists, prof. Nevio Pugliese (coordinator, *pro parte*), prof. Antonio Brambati, prof. Ruggero Marocco, prof. Michele Pipan, dr.ssa Ester Colizza, dr.ssa Romana Melis and dr.ssa Thalassia Giaccone.

In the course of the researches currently under way, researchers will be guaranteed a logistic support for their studies by the FIPSAS, even in collaboration with the section of the Environmental Geology of the Experimental Geophysical Observatory.

- *Study of the influence of the artificial reefs submerged on the Ridge of Santa Croce on the surrounding environment* (evaluation of the Environmental Impact currently under way). Strictly related with the previous point and in terms of surveillance action, therefore preventive, the site is kept under control for any *possible gathering of cysts of Dinoflagelates* potentially toxic in the sediment around the Ridge. The objective of the planned research is to study a series of mini borers collected in direction of eight radials which depart from one only origin (point of sinking of the handicrafts). Each radial will be made of three points each, to verify if the turbulence of the bottom currents influences on the different distribution of the cysts in the sediment.