A NEW TRANSPLANTING METHOD OF *POSIDONIA OCEANICA* (Linnaeus) Delile, 1813 PLANTS

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Abstract - The seabed of the port of Piombino was to be modified, increasing the depth, to allow the arrivals of cruise ships. The great problem to overcome was the presence, in the port area, of *Posidonia oceanica* (Linnaeus) Delile, 1813 meadows.

P. oceanica is a protected species by the Berne Convention (Annex 1), by the Barcelona Convention (SPA/BIO protocol) and by the Habitat Directive 1992/43/EEC.
Initially, the project was to remove and grind the plants of the meadow causing a considerable environmental damage. The Port Authority of Piombino asked the Institute of Marine Biology and Ecology to study an alternative project.

Having studied the *P. oceanica* prairies and their ecology for over twenty years along the coast of all Tuscany and knowing the short results of the methods of replanting *P. oceanica* plant by plant we decided to transplant 340 clods of *P. oceanica* of 2 m^2 to a nearby meadow (fig. 1).

Our transplanting method has been used in the Gulf of Follonica (Italy).

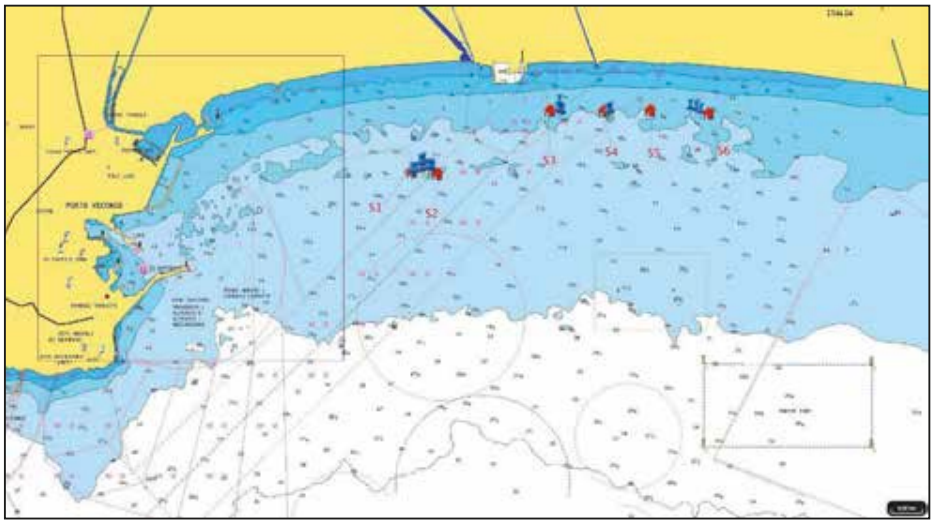

Figure 1 - Map of the replanting areas. The red symbols, from S1 to S6, represent the reference areas while the blue symbols represent where the dredger deposited the clods of *P. oceanica*.

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Introduction

P. oceanica meadows are in regression across the Mediterranean sea because of anthropic activities which cause the consequent retreat of the beaches since the meadows dampen the impact force of the waves.

P. oceanica is a plant and not a seaweed so it is closely related to the substrate of the settlement [6]. If we transfer the plants from one bottom to another the plant, which has fed on the same type of sea bottom for many years, must necessarily try to activate a series of adaptations very difficult to find.

On the contrary, if we can carry hundreds of plants together with 2 m x1.50 m x1.20 m meters of substrate settlement, where they have lived for many years, it will be easier for them to adapt (fig. 2). Another very serious problem to be solved is tearing the plant from the bottom because it anyway suffers a damage.

Figure 2 - Clod of *P. oceanica.*

Material and Methods

Before the clods are moved from the seabed, an underwater biologist captured the species of the vagile fauna living on or among the leaves of the *P. oceanica* by a hand-operated plankton net (fig. 3).

The transfer of the *P. oceanica* clods was carried out using a spilt-barge motor ship (fig. 4). This ship opens and lets water enter where the clods will be positioned (fig. 5). The clods are removed from the seabed by the boat crane.

Figure 3 - Biologist during sampling with the hand-operated plankton net.

Figure 4 - Spilt-barge motor ship used for the removal of clods.

In this way all the marine organisms living on the rizoms, between the leaves or in the “matte”, remain alive until the positioning of the clods on the seabed. The clods were positioned both close to the upper limit of the meadow and in the intermatte channels to be more protected from the force of the waves (fig. 6).

Figure 5 - Opening which enable the water to fill the housing for the clods.

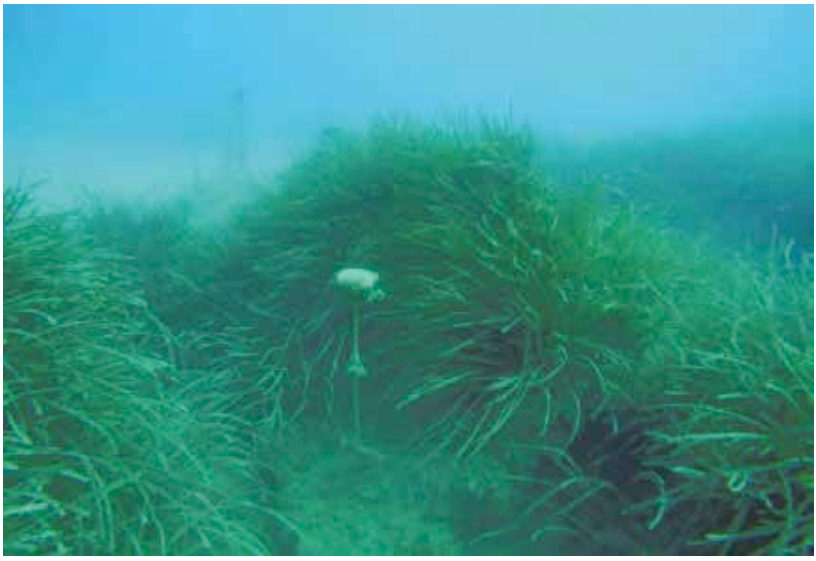

Figure 6 - Clod provided by a signaling buoy positioned in an intermatte channel.

To find the exact point where to drop the clod an underwater biologist identified the appropriate area of the bottom and signalled it with buoys sent to the surface (fig. 7).

The clods were anchored to the sandy bottom by four pegs 1.5 m long (fig. 8).

Figure 7 - The red arrows highlight the presence of the buoys which signalled the exact area where to deposit the clod.

Figure 8 - Anchoring of the clod to the sandy substrate.

Results

The results were that with our method 92 % of the plants survived. The most important result obtained has been that during the three years many new plants have sprung up from most of the clods, since vegetative reproduction by stolonization is the most common (fig. 9).

Figure 9 - The yellow arrows indicate the new plants which have expanded from the clod.

Each clod was placed in the upper limit in the patches of plants or in front of the prairie upper limit. The clods either were anchored to the bottom by four pegs 1.50 m long carrying a small numbered little float for its identification during the monitoring camaigns.

The fact that new plants were born meant that the *P. oceanica* clods have perfectly adapted to the new settlement ground having brought part of the old seabed with them.

Moreover, a great conservation of the species that live on the leaves, in the matte and the species in the juvenile stages was observed.

Discussion

For the first time, hundreds of *P. oceanica* plants in one block were transferred and above all together with the substrate where they had lived for many years.

P. oceanica forms an extremely important ecosystem throughout the Mediterranean sea that the Habitat Directive has designated as a priority habitat. For this reason, transplants must be carried out only in case of need without alternatives, because taking tens and sometimes hundreds of thousands of plants from one site to another causes a damage to the former.

Instead for absolutely necessary works such as the expansion of the breakwater of Piombino harbour to an area where there is a *P. oceanica* meadow, part of it will be destroyed so the transfer of plants is necessary as a damage mitigation.

Since one of the most important functions of the meadows is to act as nursery for many marine species, our method of catching hundreds of invertebrates (fig. 10) and vertebrates (fig. 11) to transfer them to the areas where the clods are placed is the first transplanting method to care about this very important meadow function.

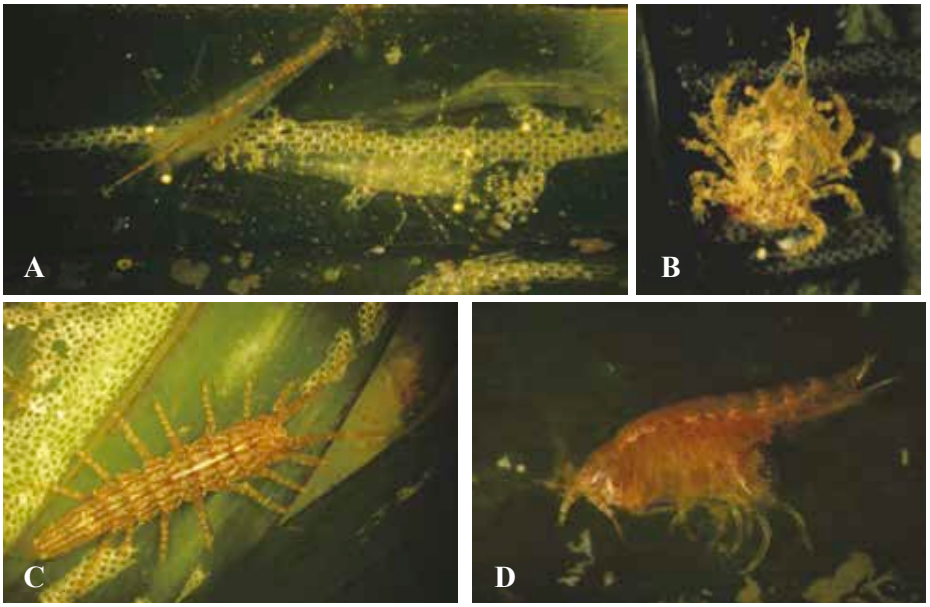

Figure 10 - Examples of invertebrate species sampled on 1 cm wide *P. oceanica* leaves: A) *Hippolyte inermis* Leach, 1816, B) *Sirpus zariquieyi* Gordon, 1953, C) *Idotea granulosa* Rathke, 1843, D) *Lysianassa costae* H. Milne Edwards, 1830.

Figure 11 - Example of vertebrate sampled on 1 cm wide *P. oceanica* leaves: *Diplecogaster bimaculata* (Bonnaterre, 1788)

Conclusions

The criticality of the use of single plants removed from the meadow to be transplanted is that they are easily damaged and above all they lose all the species that use it as a nursery, because they are individuals of a few millimeters. Another critical issue in reforestation plant by plant is that the plant is removed from a very particular and specific substrate where it used to feed for hundred, sometimes thousands of years and it must adapt to a sometimes extremely different substrate.

On the contrary, if we transplant clods of 2 m^2 with 2 m x1.50 m x1.20 m of substrate settlement the plants that continue to live in their original settlement are not damaged. Another advantage in transplanting clods with a large sediment mass is that they retain the species which live among the leaves but also those which live inside the "matte" (fig. 12).

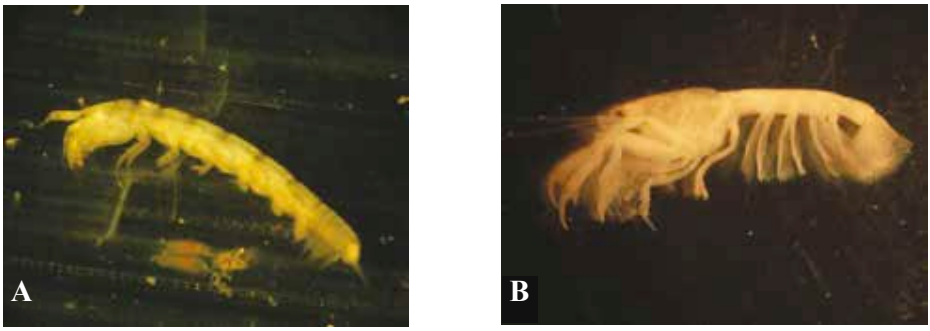

Figure 12 - Examples of species sampled on 1 cm wide *P. oceanica* leaves: A) *Leptochelia savignyi* (Krøyer, 1842), B) *Upogebia tipica* (Nardo, 1869).

Acknowledgements

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