

COASTAL EROSION IN THE GULF OF FOLLONICA AND BARATTI AND COASTAL DEFENSE METHODS

Roberto Bedini¹, Paolo Colantoni², Christine Pergent-Martini³

¹Istituto di Biologia ed Ecologia Marina, Piazza G. Bovio ¾, 57025, Piombino (LI)
phone +39 0565 225196, fax +39 0565 227021, e-mail: bedini@biomare.it; museomare@biomare.it

²Istituto di Geodinamica e Sedimentologia – Università di Urbino

³Université de la Corse (FR)

Abstract – From 1988 to the present the Institute of Marine Biology and Ecology of Piombino has studied the marine environmental situation of the Gulf of Follonica (Italy), in collaboration with the Universities of Siena, Pisa, Urbino, Sassari, Corte (FR) and the CNR of Pisa. A particular attention has been given to the study of biocenoses and to the *Posidonia oceanica* (Linnaeus) Delile, 1813 meadows. In the year 2000 a cartography of the meadows of the whole Gulf was made with the changes of the profile of the coast in front of it (fig. 1).

In recent years erosion has drastically changed the sandy beaches mainly as a consequence of the constant retreat of the *P. oceanica* meadows whose possible causes have been studied. The increase of the beach was the method adopted to make the beaches usable but with temporary results.

Also in the Gulf of Baratti the methods adopted for the defense of the beach have been inadequate.



Figure 1 - Cartography of the *P. oceanica* meadows (green patch) of the Gulf of Follonica.

Introduction

To understand the origin of the erosive phenomena of the beaches of the Gulfs of Baratti and Follonica we used experienced researchers in the various areas of investigation necessary to understand the reasons of the backspace of the beaches. If you don't know what is causing the damage, you cannot repair it.

A survey of the coastal strip of the Gulf of Follonica was made by the Institute of Marine Ecology and Biology using the filming of a drone. The footage shows, if there was need for, that where the beach rocks exist the coast has endured the storms while where there are no rocks or there are breaks in the rocks erosion has changed the beach, causing it to decline (fig. 2). Flat beach-rocks perform a function similar to that of *P. oceanica* meadows: they dampen the impact force of the waves that arrive at the beach and they keep the sand removed from the beach when the waves come back.



Figure 2 - Flat beach-rocks dampen the impact force of the waves that arrive at the beach. Where there are breaks in the rocks erosion has changed the beach (yellow arrows).

Materials and Methods

The underwater shooting to map the *P. oceanica* meadows of the Gulf of Follonica was carried out by the G.A.I.T. oceanography and marine geophysics company and developed by the Geodynamic and Sedimentology Institute of the University of Urbino. Ecological data and the distance of the upper limit of the meadow from the coast line were carried out by marine biologists using transects 500 m long perpendicular to the coast line.

Attempts have been made for the dune reforestation to keep much more sand during sea storms using planting squares of fascines with plants inside to hold the sand with

the roots (fig. 3). On the beach, close to the dunes, sticks and piles of logs tied by a rope have been placed (fig. 4).

In the Gulf of Baratti sacks of geotextile cloth containing sand have been used to defend beaches from erosion (fig. 5).



Figure 3 - Protections used to improve the success of the dune reforestation.



Figure 4 - Sticks and piles of logs tied by a rope.



Figure 5 - Sacks of geotextile cloth containing sand.

Results

The results were negative for all the methodologies used in the Gulfs of Follonica (fig. 6 and 7) and Baratti (fig. 8).



Figure 6 - The planted vegetation inside the protections had completely died.



Figure 7 - The sticks and piles of logs tied by a rope were dispersed in the sea by the storms.



Figure 8 - Some sacks of geotextile cloth containing sand were completely destroyed (red arrows) by sea storms.

Discussion

The problems of the coastal erosion, and the methods used for its defense, are usually faced by engineers and geologists without the contribution of marine biologists. The extent of beach erosion problems also depends on what the waves encounter before reaching the shore such as *P. oceanica* meadows, flat beach-rocks or other types of seabed. This is the marine biologist's field of study who can make an important contribution to establish the methods of intervention. If I put in defense of a beach sacks of geotextile cloth containing sand I should know that during the storms stones or wooden logs thrown against them will destroy them.

Conclusions

Coastal erosion is a growing phenomenon in our seas often linked to anthropic activities. To fight it you need skills on what to do both on the coast and in the sea in front of it. The impact force of the waves must be dampened before it reaches the sandy beaches. The continuous retreat of *P. oceanica* meadows in front of the beaches of Baratti and the Gulf of Follonica has caused their consequent great erosion. So if we want to imitate the function of the *P. oceanica* meadows and beach rocks it is necessary to operate in the sea in front of the beach and not on it.

Acknowledgements

Thanks to Arianna Trafeli for the compilation of the research text.

References

- [1] Acunto S., Canali M.G., Bedini R., Cinelli F. (1997) - *Dinamica stagionale delle praterie di Posidonia oceanica (L.) Delile nei Golfi di Follonica e Baratti: struttura, fenologia e comunità epifita*, Ambiente Mare: Ecologia e Nuove Tecnologie Di Ricerca, Regione Toscana, collana Ricerca Scientifica e Tecnologica 12, 59-78.
- [2] Bedini R. (1995) - *L'ecosistema a Posidonia oceanica (L.) Delile come biondicatore della qualità delle acque*, Lo stato dell'Ambiente in Toscana, Edizioni Regione Toscana 4, 27-42.
- [3] Bedini R., Bedini M., Piazzini L., Bonechi L. (2016) - *Cartografia bionomica dell'area marina costiera attigua alle vasche di Colmata del Porto di Piombino*, Proceedings from Codice armonico, Sesto congresso di scienze naturali Ambiente Toscano, Castiglioncello, Italy, 13-15 October 2016, pp. 129-138.
- [4] Bedini R., Canali M.G., Baldi C. (2001) - *Prove di coltivazione in laboratorio di Posidonia oceanica (L.) Delile a partire dai semi*, Proceedings from Geoitalia 2001: 3° forum italiano di scienze della terra, Chieti, Italy, 5-8 September 2001.
- [5] Bedini R., Canali M.G., Bulleri F., Bedini A., Fantini R., Magnarini L., Franca A., Colantoni P. (2000) - *Mappatura del limite superiore di alcune praterie di Posidonia oceanica lungo la costa Toscana*, Biologia Marina Mediterranea 7 (1), 499-508.
- [6] Bedini R., Frassinetti S., Maschera M.C., Sbrilli G. (2006) - *Indagine preliminare sugli scarichi a mare del Golfo di Follonica (GR)*, Proceedings from V Convegno Nazionale CoNISMa: "Il Mare: centralità d'interessi nel XXI secolo. Capacità scientifiche italiane e risorse nel competere", Viareggio, Italy, 14 -18 November 2006.
- [7] Bedini R., Nannelli A., Battistini F. (2013) - *Restoration of Posidonia oceanica (L.) Delile meadows: is there an effective methodology?*, Journal of Life Sciences 7 (7), 722-726.
- [8] Bedini R., Nannelli A., Giachini F., Maestrini M., Boccia B. (2006) - *Indagine preliminare sulle praterie di Posidonia oceanica (L.) Delile antistanti Ansedonia e Talamone (Grosseto)*, Proceedings from Codice Armonico - Primo congresso di scienze naturali della Regione Toscana, Castiglioncello, Italy, 2006, pp. 141-144.
- [9] Bedini R., Piazzini L. (2012) - *Evaluation of the concurrent use of multiple descriptors to detect anthropogenic impacts in marine coastal systems*, Marine Biology Research 8 (2), 129-140.
- [10] Morelli D., Bedini R., Magnarini L., Fantini R., Colantoni P. (2001) - *Estensione della Posidonia oceanica (L.) Delile in alcuni tratti di litorale dell'Isola d'Elba e del Golfo di Follonica (Tirreno settentrionale)*, Proceedings from Geoitalia 2001: 3° forum italiano di scienze della terra, Chieti, Italy, 5-8 September 2001.