

Management and Protection of Coastal Area, the Importance of Coastal Processes during the Planning Phase

Author: Barbaro, Giuseppe

Source: Air, Soil and Water Research, 6(1)

Published By: SAGE Publishing

URL: https://doi.org/10.1177/ASWR.S12868

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at <u>www.bioone.org/terms-of-use</u>.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.



Open Access: Full open access to this and thousands of other papers at http://www.la-press.com.

Air, Soil and Water Research

Management and Protection of Coastal Area, the Importance of Coastal Processes During the Planning Phase

Giuseppe Barbaro

"Mediterranea" University of Reggio Calabria, Department of Civil, Energetics, Environmental and Materials Engineering, Via Graziella Località Feo di Vito, Reggio Calabria, Italy.

ABSTRACT: Coastal processes should be one of the main issues in coastal zone management; ignoring it could lead to wrong decisions which, in turn, could lead to environmental disaster. This letter shows some examples of coastal structures that are built without taking into account coastal processes, and discusses their impact on the environment, with the hopes that the examples provided can serve as a warning for any future decisions. The analyzed zone is the coast of the Calabria Region in southern Italy. The coast is being studied as part of an agreement between the Mediterranea University of Reggio Calabria and the Calabria Basin Authority, concerning the redaction of the Coastal Erosion Risk Mitigation Plan. All data and results are obtained from a preliminary study of the coastal processes in Calabria. Calabria, with more than 700 km of coasts, is affected by coastal erosion, so the proper management and protection of the coastal zone represents an important issue that cannot be avoided.

KEYWORDS: coastal processes, coastal erosion, coastal area management

CITATION: Giuseppe Barbaro. Management and Protection of Coastal Area, the Importance of Coastal Processes During the Planning Phase. Air, Soil and Water Research 2013:6 103–106 doi:10.4137/ASWR.S12868.

TYPE: Letter to Editor

FUNDING: Author(s) disclose no funding sources.

COMPETING INTERESTS: Author(s) disclose no potential conflicts of interest.

COPYRIGHT: © the authors, publisher and licensee Libertas Academica Limited. This is an open-access article distributed under the terms of the Creative Commons CC-BY-NC 3.0 License.

CORRESPONDENCE: giuseppe.barbaro@unirc.it

The protection and management of coastal areas should be supported by a deep knowledge of the coastal processes and of the interaction between water motion, seabed topography, and coastal structures, which affect the natural response of coastal systems. In some cases, these processes cause damage to the environment by permanently changing the coast's morphology.

Coastal morphology refers to the study of the adaptation of the coastline, which is driven by waves, currents, wind, and induced sediment transport. Coastal morphological models are indispensable and powerful tools that allow us to set up reliable protection and management plan for coastal areas.

Morphological models are based on various sub-models that are related to each of the phenomena involved in the dynamics of the coast, such as storms, waves, erosion, run-up, set-up, shoreline evolution, and wave structure interaction. A sea storm is defined as a sequence of sea states in which the significant wave height (H_s) exceeds a given threshold. The force of a storm that is acting on a coast can rapidly change its morphology, causing damage to urban areas. The definition and prediction of storms¹ is also an important issue in wave modeling and in structure design, since a reliable model for storm approximation provides an easy way to predict extreme waves.²

Erosion control is one of the main issues of coastal zone management; it is a natural process, but it can be accelerated by human activities that often interfere with the natural movement of sand along the coast through the construction of coastal structures. The long shore sediment transport (LST) is connected to the wave-induced current and to the energy dissipation caused by breaking waves in the surf zone. However, a part of this energy is partially converted into potential energy as run-up on the foreshore of the beach.





Figure 1. Aerial view of the Saline Joniche Port in 1984 and in 2013.

LST, set-up and wave run-up are the principal causes of coastal erosion and coastal flooding. The physical description and quantification of these phenomena are frequently carried out by means of simplified models.^{3–8} Many times, all natural processes are influenced by urbanization which, through the construction of coastal structures, affects the natural evolution of the shoreline.⁹ In these cases, it is important that a deep knowledge and investigation of the interaction between wave and structure is established in order to avoid the failure of an intervention.^{10–14}

Unfortunately, the coastal dynamic does not appear to play an important role in the planning phase, and many environmental disasters happen due to wrong decisions made during the planning or the design phases. In particular, the evaluation of the LST rate is necessary to prevent the occurrence of coastal erosion after the construction of a coastal structure. To support this hypothesis, many examples should be explored.

First of all is the case of Saline Joniche in southern Italy, where a port stops the natural movement of sand along the coast. The amount of LST is so big, and in 20 years, the entrance of the port has been subjected to a total obstruction; now, it is completely unserviceable (Fig. 1).⁹ The port also influences the coastal equilibrium of the northeast side, causing the disappearing of more than 20 hectares of beach in 5 km of coast (Fig. 2).⁹

A similar situation occurred in the near zone of the Cetraro Port, located in southern Italy. Here, a periodic dredging of the entrance is necessary to make the port serviceable. In fact, in 1988, the entrance was completely closed by sand (Fig. 3), and now, after 20 years, the silting process, which has never been stopped, is nullifying the interventions of dredging (Fig. 4). The movement of the sand goes from the northwest direction to the southwest direction, which is confirmed by the presence of a large and stable beach on the northwest side (it has an average width of 80 m), and by a strong erosion on the southwest side (Fig. 4).

The last two examples clearly demonstrate that the placement of a port should be subordinated to the evaluation of the LST rate which, in the first approximation, is more than 100,000 m³/year. In these cases, it is impossible to avoid the interference between the port and the coastal processes without the realization of a permanent bypass system that should restore the continuity of the natural movement of the sand along the coast.

Another example could be represented by the operation of coastal defense made in Lazzaro, in southern Italy. Here, in an attempt to restore the original beach, a groin was built. Unfortunately, it is too long (70 m) for the location, which is characterized by a limited surf zone due to the bottom slope, which is up to 10%. In this particular situation, a groin should be avoided; otherwise, a deep study and evaluation of different solutions should be done (Fig. 5).



Figure 2. Aerial view of the eroded area near the Saline Joniche Port, and a view of the eroded beach.





Figure 3. Aerial view of the Cetraro Port in 1988 before the dredging, and in 2000 after the dredging.



Figure 4. Aerial view of the actual situation of Cetraro Port, of the northwest side and of the southeast side.



Figure 5. Aerial view of the groin in Lazzaro.

These three cases are not the only examples that support the importance of the coastal dynamic in a coastal zone management and protection plan. I hope that such situations will never happen again.

Author Contributions

Conceived the concept: GB. Analyzed the data: GB. Wrote the first draft of the manuscript: GB. Made critical revisions: GB. The author reviewed and approved of the final manuscript.

DISCLOSURES AND ETHICS

As a requirement of publication the author has provided signed confirmation of compliance with ethical and legal obligations including but not limited to compliance with ICMJE authorship and competing interests guidelines, that the article is neither under consideration for publication nor published elsewhere, of their compliance with legal and ethical guidelines concerning human and animal research participants (if applicable), and that permission has been obtained for reproduction of any copyrighted material. This article was subject to blind, independent, expert peer review. The reviewers reported no competing interests.

REFERENCES

- Arena F, Barbaro G, Romolo A. Return period of a sea storm with at least two waves higher than a fixed threshold. *Mathematical Problems in Engineering*. 2013;2013:1-6.
- 2. Barbaro G. Estimating design wave for offshore structures in Italian waves. Proceedings of the Institution of Civil Engineers, Maritime Engineer. 2011;164:115–125.



- Barbaro G, Foti G, Malara G. Set-up due to random waves: influence of the directional spectrum. Proceedings of the 30th International Conference on Ocean, Offshore and Artic Engineering (OMAE). June 19–24;2011; Rotterdamn, the Netherlands.
- Barbaro G. The natural laboratory of Reggio Calabria. Proceedings of the 17th International Offshore and Polar Engineering Conference (ISOPE), 1-6 July 2007; Lisbon, Portugal. Lisbon: Portugal; Vol. II;1740–1749.
- Barbaro G, Martino MC. On the run-up levels and relative mean persistence. Proceedings 17th International Offshore and Polar Engineering Conference (ISOPE), 1-6 July 2007; Lisbon, Portugal; Vol. III:1816-1821.
- Arena F, Malara G, Barbaro G, Romolo A, Ghiretti S. Long-term modeling of wave run-up and overtopping during sea storms. *Journal of Coastal Research*. 2013;29(2):419–429.
- Tomasicchio GR, D'Alessandro F, Barbaro G. Composite modeling for largescale experiments on wave-dune interaction. *Journal of Hydraulic Research*. 2011;49:15–19.
- Tomasicchio GR, D'Alessandro F, Barbaro G, Malara G. A general long shore transport model. *Coastal Engineering*. 2013;71:28–36.
- 9. Barbaro G. Saline Joniche: apredicted disaster. Disaster Advances. 2013;6(7):1-3.
- Boccotti P, Arena F, Fiamma V, Romolo A, Barbaro G. Small-scale field experiment on wave forces on upright breakwaters. *Journal of Waterway, Port, Coastal and Ocean Engineering*. 2012;138:97–114.
- Barbaro G, Foti G. Shoreline behind a breakwater: comparison between theoretical models and field measurements for the Reggio Calabria Sea. *Journal of Coastal Research*. 2013;29(1):216–224.
- Boccotti P, Arena F, Fiamma V, Barbaro G. Field experiment on random-wave forces on vertical cylinders. *Probabilistic Engineering Mechanics*. 2012;28:39–51.
- Romolo A, Malara G, Barbaro G, Arena F. An analytical approach for the calculation of random wave forces on submerged tunnels. *Applied Ocean Research*. 2009;31:31–36.
- Barbaro G. A new expression for the direct calculation of the maximum wave force on vertical cylinders. *Ocean Engineering*. 2007;34(11–12):1706–1710.