

Monitoring of Ragusa Coastal Area (SE Sicily)

**M. Tagliente⁽¹⁾, G. Randazzo^(1,2), S. Buonmestieri⁽³⁾,
G. Biondi^(3,4) and G. Alessandro^(3,5)**

*(1) University of Messina, Department of Earth Sciences
Salita Sperone, 31 – 98166 Messina (Italy).*

Tel: +39 090 6765095 Fax: +39 090 392333

E-mail: mtagliente@unime.it

(2) E-mail: grandazzo@unime.it

*(3) Regional Province of Ragusa, Geological and Geognostical Department
Via G. Di Vittorio, 175 – 97100 Ragusa (Italy).*

Tel: +39 932 675553 Fax: +39 932 675522

E-mail: s.geologia@tin.it

(4) E-mail: giovannibiondi@tin.it

(5) E-mail: giuseppe.alessandro@tiscali.it

Abstract

The Department for Territory, Environment and Civil Protection of the Provincial Administration of Ragusa, with the scientific coordination of the Department of Earth Sciences, University of Messina, has begun to carry out a monitoring program for the sedimentological and morphological analysis of the Ragusa coastal area, between Dirillo River mouth and Punta Castellazzo headland.

The need to monitor the coastline of Ragusa stems from the awareness of the Provincial Administration that an uncontrolled process of deterioration and erosion of the entire coast is under way. The shoreline recession is a consequence above all to human interventions along the coast which have modified the natural equilibrium of the ecosystems.

The monitoring of the Ragusa coastal area, therefore, with topographic and bathymetric surveys, detailed computations of sand volume budget and grain size studies, will provide an important basic information source for local Coastal Planning and Management. Without an effective use of this information no form of sustainable development can take place in the coastal area.

Introduction

Over the last thirty years, the coast belonging to the Provincial Administration of Ragusa has suffered a continuous process of degradation, due for the most part to man-made interventions. This has upset the balance of the ecosystem, the most important effect of which has been a constant erosion along a number of stretches of the coast.

As a reaction to this widespread shoreline recession, very urgent protective measures have been taken without any long-term coastal planning or strategy. Almost all the interventions on the coast have been realized with hard measures (breakwater barriers and groynes) served to protect the original shoreline immediately behind them. Subsequently, this type of coastal defences have blocked the longshore currents and sediment transport, favouring so the development of progressive erosive processes in the downdrift areas.

It is clear that the various local Administrations can no longer ignore the importance of a regular monitoring of the coastal systems, in order to acquire a more complete knowledge of their processes and control factors and to establish a consistent policy of prevention and recovery.

This is the approach which the Department for Territory, Environment and Civil Protection of the Provincial Administration of Ragusa intends to pursue, with the scientific co-ordination of the Department of Earth Sciences of the University of Messina; and it is in this attitude that the present monitoring program of the entire shoreline of the Province has been undertaken.

The first year of the monitoring, carried out with the direct involvement of the research staff and equipment pertaining to the Department for Territory, Environment and Civil Protection of the Regional Province of Ragusa, is in progress and preliminary data will be available from the end of 2004.

All this basic information will be of considerable benefit to local communities and will permit the Provincial Authorities to acquire, by the end of the activity, the necessary specialised know-how to organize and carry out a regular and independent monitoring program of their own coastal territory.

The Study Area

The shoreline of the Province of Ragusa, situated in the southeast side of the island of Sicily, extends for about 80 km; it is confined to the West by the Dirillo River mouth, whose stream also marks the limit between the Provinces of Ragusa and

Caltanissetta; and to the East by the Pantano Longarini coastal wetland, on the border with the Province of Siracusa.

The diversity of the coastal landscape with wide sandy and gravelly beaches backed by large coastal dunes, alternated with rocky coasts, cliffs and shore platforms, makes the Ragusa coastal area particularly interesting and suitable for tourism (Amore et al., 1988; Amore and Randazzo, 1993).

The orientation of the coast follows a general NW-SE trend between the Dirillo River mouth and Punta Secca and a W-E trend between Punta Secca and the Pantano Longarini. Along the entire coastal zone there are four main rivers: the Dirillo, the Ippari, the Irminio and the Modica (Fig. 1).

Two of these four rivers, the Dirillo and the Irminio, are characterised by the presence of dams, built between 1960 and 1980; the Modica river has a prevalently torrential stream, with sporadic episodes of flooding, but often dry as a result of the scarcity of rain in the area; the River Ippari, although it has a regular flow of water, is partially occluded at the mouth. Erosion along the Ragusa coastal area is also associated to a reduced sediment supply from these rivers, especially from the Irminio River (Amore and Randazzo, 1997).

The Monitoring Program

On the basis of the morphological characteristics of the Ragusa coastal area and taking into consideration as much as possible the distinct physiographic units, the study area, between Dirillo River mouth and Punta Castellazzo headland, has been subdivided into three principal physiographic units (the eastern, central and western zone) and 22 sectors (Table 1).

The complete monitoring program includes a series of 80 topographic surveys in particularly significant sites along the coast belonging to the Provincial Administration of Ragusa. Topographic and bathymetric readings, spread out over three years, have been taken on a seasonal basis during the first year to continue on a four-monthly basis during the second year and six-monthly during the third.

During the first six months of monitoring program, about 160 profiles have been traced of emerged and submerged beach, carried out up to -1 m. isobath. Besides, sediment samples have been taken in all the 80 sections.

Topographic profiles have been referred to fixed landmarks, situated inland from the backshore in proximity of buildings or coast roads, whose positions and elevations are established by topographic readings by means of total points of reference. These 80 sections have been planned at a distance of about 1000 meters from one another, suitably distributed along the 80 km of the Ragusa coastal area.

The analysis of each section includes measurements of the beach in all its morphological components as far as the -1 m. isobath; the presence of dunes and berms, backshore and beachface, troughs and bars, where present, have all been examined.

Following the same axis established for the topographic sections on land, the bathymetric readings include the measurement and reconstruction, at a distance of 1 m from one another, of all the isobaths from -1 m to -15 m, underlining the most important morphological points (bars, troughs, rocky bottoms, changes in gradient).

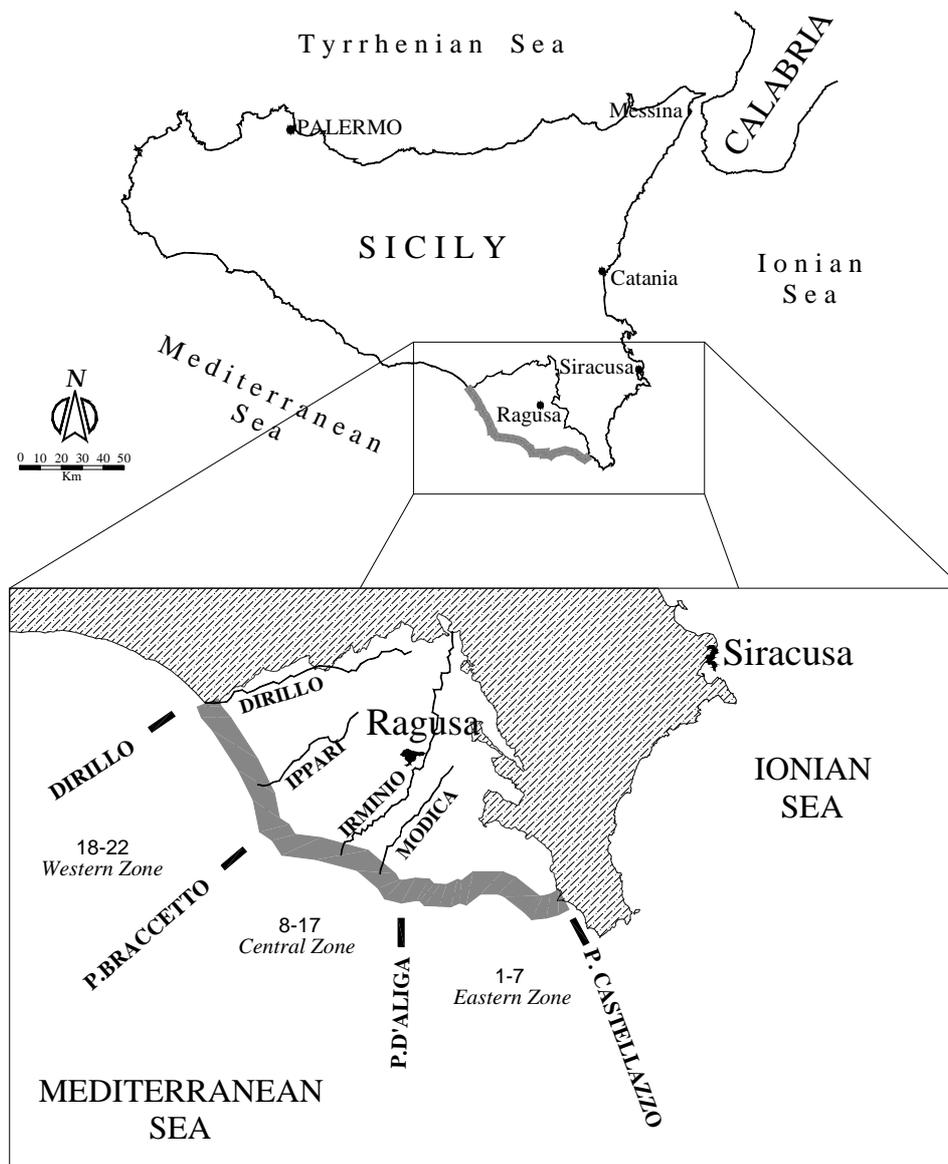


Fig. 1: Location of the study area with the three principal physiographic units.

Table 1: Monitoring program scheme of the study area.

Principal Physiographic Units	Secondary Physiographic Units		Sections (n° of topographic surveys)
	Sector	Site ubication	
Eastern zone	01	<i>Punta Castellazzo</i> headland	1
	02	<i>Punta Ciriga</i> headland – <i>Scoglio Iannuzzo</i> stack	1
	03	<i>S. Maria del Focallo</i> beach	7
	04	<i>Pietre Nere</i> beach	4
	05	<i>Punta Raganzino</i> headland – <i>Maganuco</i> beach	4
	06	<i>Marina di Modica</i> beach	3
	07	<i>Sampieri</i> beach	3
Central zone	08	<i>Punta d'Aliga</i> headland	1
	09	<i>Arizza-Spinasanta</i> beach	6
	10	<i>Donnalucata</i> beach	2
	11	<i>Playa Grande</i> beach	6
	12	<i>Marina di Ragusa</i> Eastern beach	3
	13	<i>Marina di Ragusa</i> Western beach	1
	14	<i>Casuzze</i> beach – <i>Punta Secca</i> headland	7
	15	<i>Punta Secca</i> headland	1
	16	<i>Punta Secca</i> headland – <i>Punta di Mezzo</i> headland	2
	17	<i>Punta Braccetto</i> Eastern beach	3
Western zone	18	<i>Punta Braccetto</i> Western beach	1
	19	<i>Punta Braccetto</i> Western beach – <i>Forgia di Cammarana</i> beach	8
	20	<i>Forgia di Cammarana</i> beach – <i>Scoglitti</i> beach	3
	21	<i>Scoglitti</i> beach – <i>Punta Zafaglione</i> headland	3
	22	<i>Punta Zafaglione</i> headland – <i>Dirillo</i> River mouth	10

Three sectors, Arizza-Spinasanta beach (n. 9), Punta Zafaglione-Scoglitti, (n. 21), Dirillo River-Punta Zafaglione (n. 22), where the tendency of the shoreline recession rate is most evident, has been given particular attention by the Provincial Administration.

Moreover, other 19 bathymetric profiles referred to the remaining 19 sectors, will be carried out on axis with the centre of the stretch of beach, repeated on a seasonal basis, for a total of 76 measurements per year. These readings will make it possible to define the closure depth of the submerged beach and therefore to keep its evolution under control.

Corresponding to the 80 sections, sediment samples will be taken from backshore to beachface, and also, where present, along the coastal dunes. Sampling will be carried out also on the submerged beach corresponding to the -1 m., -3 m., -5 m., -7 m., -10 m., -12 m. and -15 m. isobaths.

In the sections, along which only topographic profiles of the emerged beaches are traced, a complete series of samples will be taken, as described above, along the axis of the single topographic profile. The total number of samples taken during the first year of monitoring should be no less than 1088. All the samples will be analysed in laboratory according to the classic sedimentology methods, by means of sieving and densimetry. Statistical parameters will be calculated with the moment method proposed by Friedman (1979) and the graphic method of Folk and Ward (1957).

The Shoreline Evolution Model

On the basis of the data obtained a shoreline evolution model will be elaborated using the "BEACHPLANE" and "COSMOS-2D" models developed by HR Wallingford. These two computational models are usually utilized to study the littoral sediment transport in direction perpendicular and parallel to the shoreline, but also to evaluate the nearshore hydrodynamics and morphological changes.

The BEACHPLANE model predicts the evolution of a beach as it is subjected to wave attack. BEACHPLANE is a one-line model in that the modelled beach is described by the position of one contour alone, although the modelling of the movement of the beach, and the hydrodynamic processes which control this movement, is done in a quasi 3D way.

THE COSMOS-2D is a nearshore model, two-dimensional in the vertical and cross-shore horizontal dimensions, able to calculate the cross-shore and longshore sediment transport rates using an "energetics" approach.

Starting from the conditions of the wave movement in the open sea and from the bathymetry of the area examined, the field of wave movements of the coastal area is calculated, taking into account the interaction of the waves with the bottoms and the structures. The coastal circulation created by the wind and the wave movement is then determined, together with the sediment transport and the subsequent variations in the nearshore bottoms.

The mathematical model includes a two-dimensional representation of the field of currents created in the coastal area by wave movement and the evolution of the nearshore bottoms. It offers three numerical models which may be integrated together:

- Wave propagation model to study the present state of the insertion of new structures (emerged breakwater barriers, groins and harbours);
- Hydrodynamic model;
- Nearshore evolution model to analyse the littoral transport, the stability of nourishment activities, the influence of new structures and, where required, of the alterations to existing ones.

The Management of Information

This collection of basic information data will be used to elaborate site reviews and reports supported by tables, diagrams, graphs and thematic maps, which could become an integral part of future Manual Systems or Databases available for local planners, stakeholders and policy-makers.

The site reviews and reports will not only take into account all the data previously mentioned, but will also collect and synthesize all that vast quantity of data referred to processes and control factors which have a direct or indirect influence on the coastal area.

For this purpose the basic information data will be collected and published with reference to the local natural heritage, coastal resources and ecosystems, and above all the coastal zone use (urban and road communications development, demographic dynamics, etc.).

Conclusions

The project for sedimentological and morphological monitoring of the Ragusa coastal area aims to create a correct database for the co-ordinated planning of every intervention, which the Provincial Administration and the Municipalities, may intend to effect along the coast of the Province of Ragusa.

The absence of basic information is, in fact, one of the most common causes of failure in planning coastal works. The dynamics of funding often do not make it possible to acquire in advance all the data necessary for planning, and even the time limits for the development of plans do not always permit sufficiently detailed campaigns of investigation.

The realization of this monitoring program will make it possible to create a database which, correctly used, will collect all the basic information necessary in the field of

protection of the coastal environment for a responsible and co-ordinated planning and realization of all the activities involving the coast.

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