Managing European Shorelines and
Sharing Information on Nearshore Areas

messina

A Case Study
Documenting Coastal Monitoring and Modelling Techniques in Sicily, Italy – An Island Example

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North East South West
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1. INTRODUCTION

Sicily is the biggest island in the Mediterranean and has a very varied coastline, which covers almost a thousand kilometres (Randazzo and Scrofani 1996). The east coast, bordering the Ionian Sea, extends for about 160 kilometres between Cape Peloro and Cape Passero: 55% of this coast is made up of beaches (Amore *et al* 1996). The east coast can be divided into two areas separated by the southwestern Etna lava fluxes. These have reached the sea and formed the piers of Catania's port. The beaches of the north coast, crossed by steep streams (*fiumare*), are characterised by sand, grit and pebbles mainly of metamorphic origin. The south coast is mainly rocky and its inlets are often characterised by small beaches with medium and thin carbonaceous sands (Amore *et al* 1990 and 1992).

Almost 900,000 inhabitants live within the radius of influence of coastal erosion is Sicily, which makes Sicily the fourth most exposed Italian region in terms of population at risk, after Veneto (1,200,000 inhabitants), Tuscany (950,000) and Campania (915,000). However, Sicily comes just after the Veneto region in terms of urbanised area at risk (250 km2 within the radius of influence of coastal erosion) which is mainly explained by the presence of densely populated coastal settlements along the coasts such as the cities of Palermo, Messina, Catania, Syracuse, or Taormina. Moreover, the coastal urbanisation growth rate in Sicily (about 30%) between 1975-1990 is among some of the highest rates in Europe and it is estimated that Sicilian coasts shelter about 315 km2 of areas of high ecological value which are at risk of coastal erosion (*Eurosion report, 2004)*.

In July 2001, a joint study was undertaken by the Regional Province of Ragusa and the University of Messina (Department of Earth Sciences). The study looked into sedimentological and morphological monitoring of the Hyblaean coast. Topographic and bathymetric surveys were carried out along the coast along with the collection of shoreline sediment samples at 29 locations. These locations were divided up into coastal sedimentary cells based on morphological-sedimentary features and land usage. A total of 405 topographic profiles and 61 bathymetric-topographic profiles were recorded in the zones of Arizza – Spinasanta, Scoglitti – Punta Zafaglione, Punta Zafaglione – Mouth of the River Dirillo and bordering areas.

In addition to this a total of 1288 surface and sub-surface sediment samples were collected and analysed.

2. GEOGRAPHICAL OUTLINE

The coastline of Ragusa extends for a total of 87km between the mouth of the River Lavinaro Bruno to the east and the mouth of the River Dirillo to the north-west (*Biondi and Alessandro, 2005*). Approximately 64% of the coastline is low-lying and is characterized by extensive dune sections formed from sand and pebbles interspersed with areas of intense urbanization causing complete flattening of the dunes. 36% of the remaining coastline is formed from rocks with steep cliff faces plunging into the sea consisting of the sedimentary formations of the Irminio member of the Ragusa Formation along with marine limestone and terrace marine deposits dating back to the Upper Pleistocene era (*Biondi and Alessandro, 2005*).

The coastal stretch in question contains five port areas, these being the Port of Pozzallo, Port of Donnalucata, Port of Marina di Ragusa, Port of Punta Secca and finally the Port of Scoglitti. Most of these port areas have seen expansion in recent years for commercial and tourist reasons causing significant damage to the natural coastal environment. Despite this intense urbanisation and coastal squeeze in large areas of the Ragusa coastline, a small area (2%) remains protected as areas of national environmental importance.

The natural layout of the coast makes it possible to divide it into three areas; the eastern section, the central zone and the western section. These areas have been subjected to increased erosion rates over the years and, as a result, have seen numerous coastal defence strategies put in place. The eastern section of the coastline is bordered on the east by the Lavinaro Bruno River and by the Punta d'Aliga to the west (*Biondi and Alessandro, 2005*). The typical coastal sediment here is sand, with 24km of the coastal stretch being sandy beaches and only 8km as rocky outcrops and inlets.

The central zone is approximately 21km in length and is located between Punta d'Aliga up to Capo Scalambri. This area is characterised by low-lying coastal areas and low cliffs and rocky pavements. The western section, bordered by the Capo Scalambri in the east and the mouth of the Birillo River to the west, extends 35km. This coastal section features long, sandy curved sections, which extend for 17km, together with low cliffs (*Biondi and Alessandro, 2005*).

3. METHODOLOGY

The study of the Ragusa coastline involved the accurate positioning of 81 benchmarks evenly spaced throughout the region using Geographical Positioning System (GPS). These markers were placed in fixed structures that would be unlikely to move and would therefore provide a reference point from which further topographic surveys could be measured. From these accurate benchmarks, profile surveys were carried out along the coastline on a seasonal basis in order to gain an understanding of the variations in the evolution of the shoreline and the relative volume of beach material.

As well as the topographic land surveys, submerged shoreline surveys were also carried out on the most pertinent sectors and their bordering areas. These bathymetric surveys were undertaken with the aid of a digital sonic depth finder connected to the differential geographical positioning system (DGPS) and controlled by the Hypack navigation programme.

Topographic profile data was collected between autumn and spring with summer data being excluded from the analysis with the thought that daily bathing disturbances in the summer months would cause variations in the beach volume. By overlaying the two data sets for the winter and spring months, areas of precise accretion or erosion were identified; the seasonal volumetric variations being calculated using the cross-sectional area of the individual profile or the average cross-sectional area of all profiles within each of the 29 coastal cells multiplied by the length of the beach in the sedimentary cell (*Biondi and Alessandro, 2005*).

Sedimentary sampling on the emerged coastline was undertaken, together with the topographic surveys, by following the same alignment of the profiles taking about 500g of surface material. Two samples were taken per section representing the two different sediment types (beach deposits and sub-marine sediment), with accurate GPS positional measurements taken at each location. Samples were also taken at positions where there were obvious changes in the bathymetry of the seabed at isobaths of –1m, -3m, -5m, -7m, -10m, -12m and –15m. The sediment samples were then taken to the Sedimentology laboratory of the University of Messina for particle-size analysis.

4. CONCLUSION

The study of the Ragusa coastline is ongoing and the results collected so far are yet to be published. It is hoped that a formal report will be produced in 2006 with both the results and analysis of the monitoring data that has been collected to date. Despite the lack of any concrete evidence of long-term coastal evolution so far, the report has already bought about changes in future planning along the coast of the Ragusa region. The most vulnerable areas have been highlighted and measures are being put in place to protect such areas. The current programme of monitoring has proved both successful and valuable and has highlighted the need for future monitoring to continue.

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