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LONG-TERM ANALYSIS (1863–2002) OF ENVIRONMENTAL CHANGE IN THE CAPO FETO AREA (MEDITERRANEAN SEA)

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The area of Capo Feto represents one of the few remaining salt-marshy zones in Sicily. It lies within a site of importance for the Community (defined as a "sito di importanza comunitaria" (SIC)), which also includes Margi Spanò and Margi Milo. The Capo Feto and Margi Spanò marshlands have also been identified by the Ministry for the Environment as an area deserving special protection ("zona a protezione speciale" (ZPS)). Moreover, in 1999, 150 ha of the Capo Feto area were included in a project for environmental rehabilitation as part of the European Union "Life-Nature 2000" programme (Comitato Tecnico-Scientifico Area di Capo Feto, 1997). Prior to this, the area had become somewhat degraded due to numerous natural and man-made changes that had profoundly modified and badly affected the environment over the previous decades. The aim of the present study was to define the main morphological and environmental changes that have occurred in the Capo Feto area over the last 150 years and to characterize the natural and anthropogenic factors that caused them (Perego, 1988). By means of surveys of the area, a comparative study of existing maps and an interpretation of a digital colour orthophotograph of 1998, this work was developed in a GIS environment and describes the Capo Feto environment and how it has changed with time, focusing particularly on variations in the shoreline and the marshy area (Zecchi *et al.*, 2001).

Keywords: Capo Feto; Marshy area; Natural biotope; Modifications

1 INTRODUCTION

Marshy zones are particular environments that form a transition between the land and the sea, where freshwater blends with saltwater, giving life to a variety of habitats (e.g. cane-brakes, ponds, lagoons and sandy islands). These habitats are populated by an incredible variety of life forms, especially in the temperate regions, making them classifiable among the ecosystems with the greatest biodiversities.

The current condition of these habitats is often the outcome of the influence of hundreds of years of natural evolution and human presence. The incessant exploitation of these territories for economic purposes, which risked damaging them irreparably, has been limited to some degree by the Ramsar Convention, which recognizes that marshy zones are a resource of great economic, cultural, scientific and recreational value, and recommends their study, careful management and rational use. The subsequent introduction of

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European regulations in Italy also, therefore, aims to safeguard and preserve these areas of transition.

1.1 Description of the Area

Situated in the Mazara del Vallo area (TP) at the south-western end of Sicily (Fig. 1), to the north Capo Feto is connected to Margi Spanò (Petrosino), and further north, to the Marsalese area of the Islands of the Stagnone and the Trapani saltworks. To the south, Capo Feto is connected to the sandy shoreline that beyond Capo Granitola extends up to the mouth of the River Belice.

Capo Feto has level ground that, in some points, shows depressions with elevations that are topographically slightly higher than the mean sea level. This plain is composed of a substrate of Tyrrhenian terraces that gives rise to marshy zones near the sea and to recently formed dunes and alluvial expanses that represent the emerging parts of the area. The characteristic lithological group, resting on the substrate of the Tyrrhenian flat terrace, forms a particular morphology that, along with the contribution of water from the hydrological basin above the area, creates a marshy zone. This area, separated from the sea by a low, narrow sandbank, nearly overflows in winter and is almost dry in summer, with the exception of channels that cross it. The vegetation features a marked prevalence of halophytic forms that bear witness to a distinct hydrophilia and also to a certain soil salinity. The majority of the marshland is covered with a combination of *Juncetum maritimi* and *Phragmitetum*.



FIGURE 1 Location map of the study area.

Facing this zone, there is a marine environment characterized by the presence of *Posidonia oceanica*, which covers approximately 10,000 ha. Marine currents and the transparency of the water ensure nourishment and light for this plant that has continued to deposit in seasonal layers over the years, forming a barrier (known as a “récif barrière”) up to several meters thick. The rise in the level of the sea bed due to these plant layers is such that in some places, the plants nearly reach the surface of the water and enclose the shoreward stretch of sea. Every year, this forms a, mostly sandy, type of lagoon that protects the beach and is often covered with dead *Posidonia* leaves, forming typical “banquettes” (Pernice *et al.*, 2001).

2 MATERIALS AND METHODS

The methodologies used for the present study and the production of the maps were based on area surveys performed on a map with a scale of 1:5000. This enabled a preliminary identification of the morphological characteristics of the area and of the neighbouring zones, with particular reference to the current configuration of the shoreline and the marshy area. During the survey, cultivated fields in the inland zones, illegal buildings adjacent to the marshy area and other signs of human presence on the site were also located to yield an updated picture of human activities in recent years. A subsequent comparison with a digital colour orthophotograph taken in 1998 enabled not only a partial check on the results of the survey but also a comparison between the situation in the area today and that recorded in the 1980s. Finally, to better define the changes that had taken place in the area, a comparison was made between the various editions of the IGM maps that were available for the years 1863, 1896, 1928, 1937 and 1970 (Contini *et al.*, 1999).

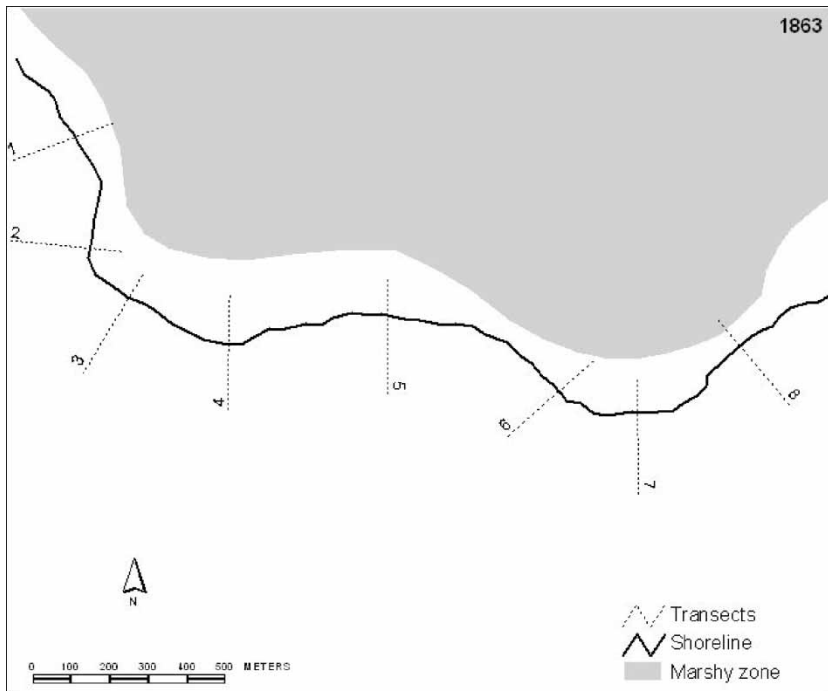


FIGURE 2 Situation of the area in 1863.

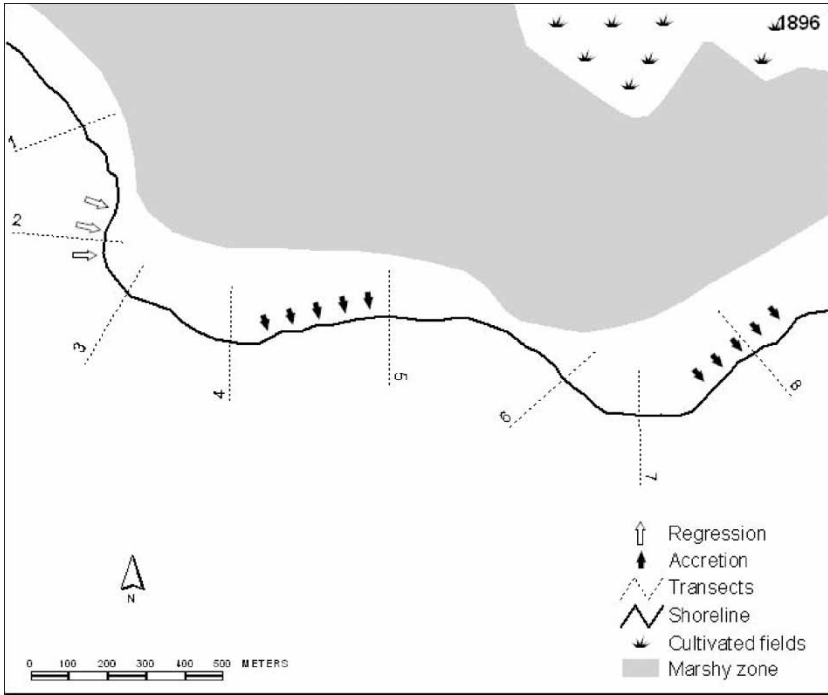


FIGURE 3 Situation of the area in 1896.

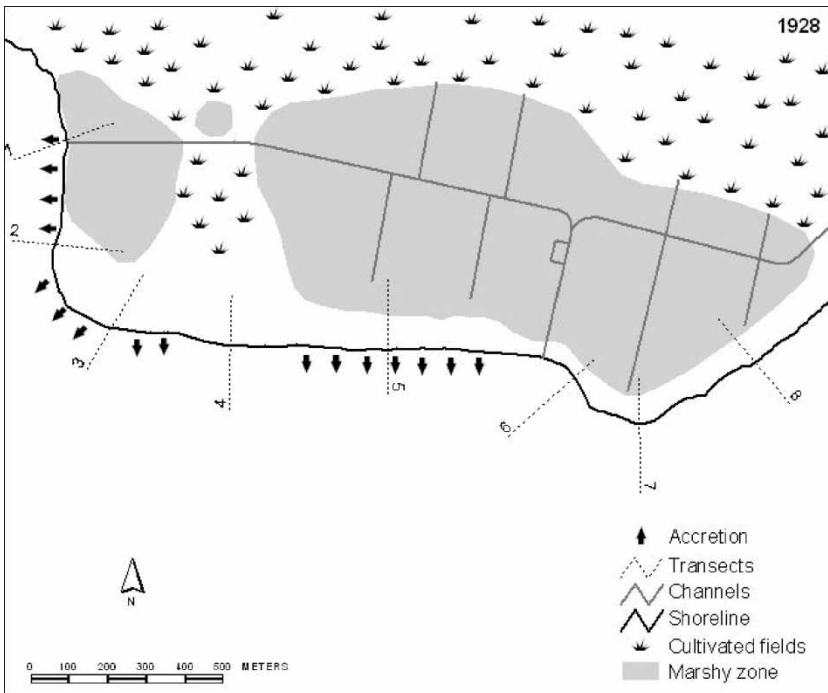


FIGURE 4 Situation of the area in 1928.

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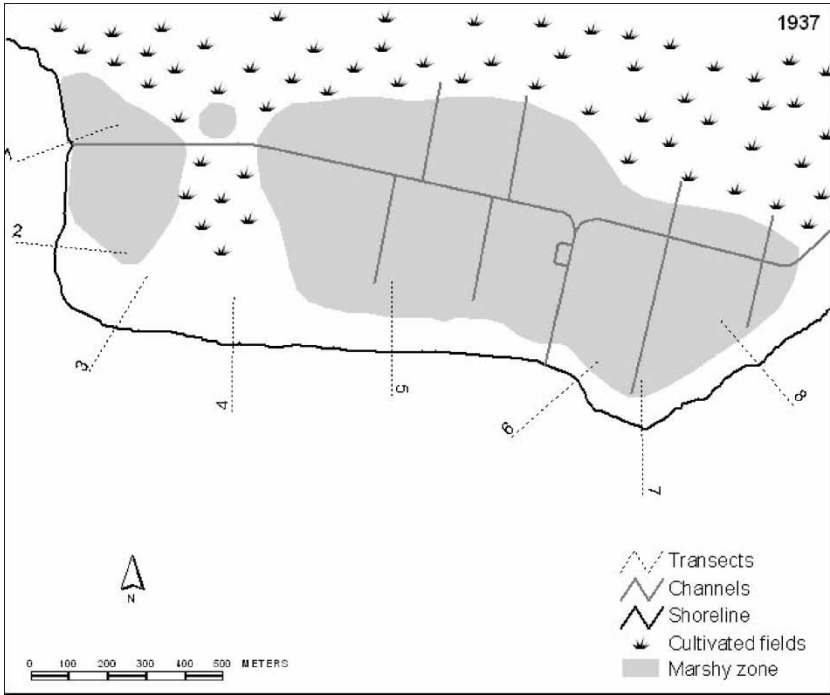


FIGURE 5 Situation of the area in 1937.

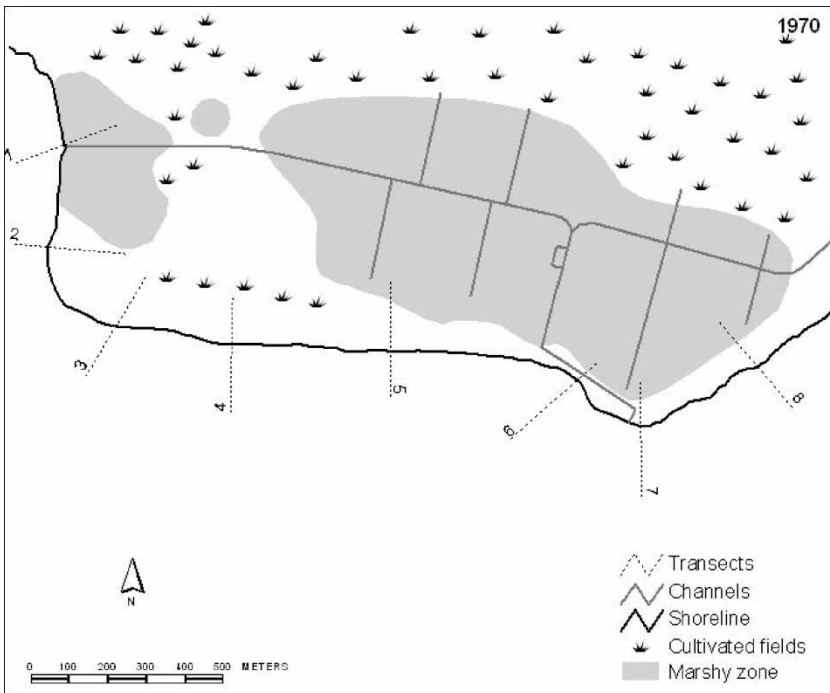


FIGURE 6 Situation of the area in 1970.

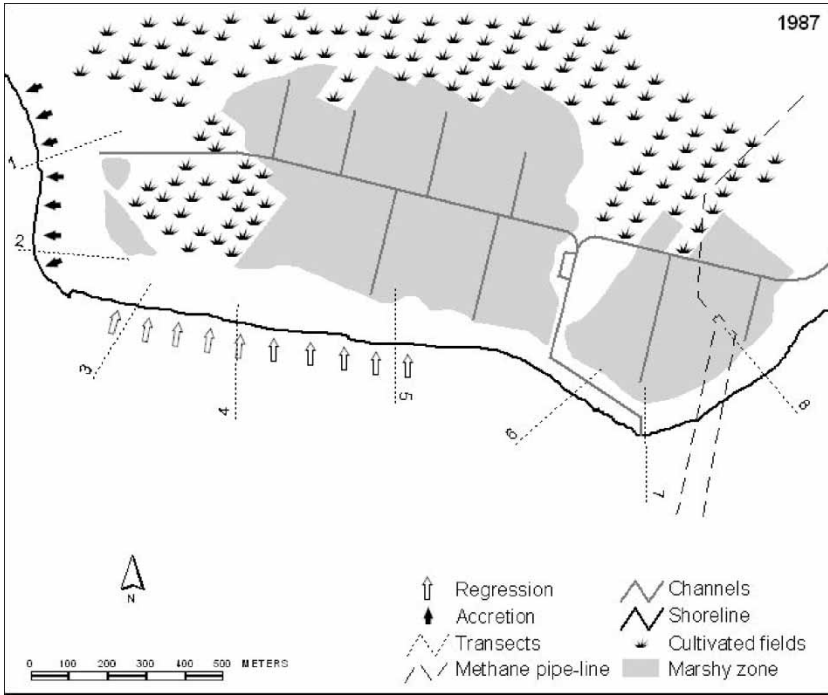


FIGURE 7 Situation of the area in 1987.

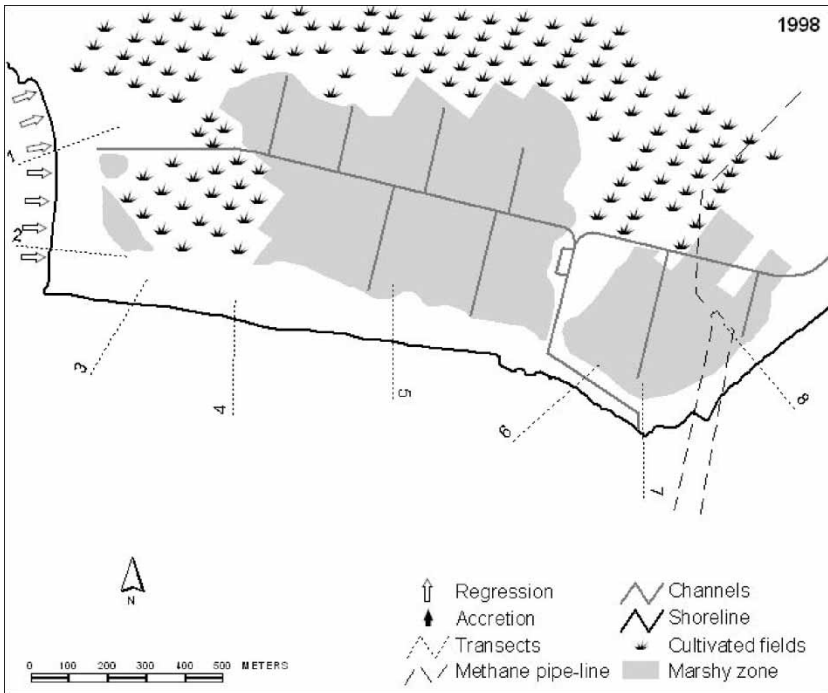


FIGURE 8 Situation of the area in 1998.

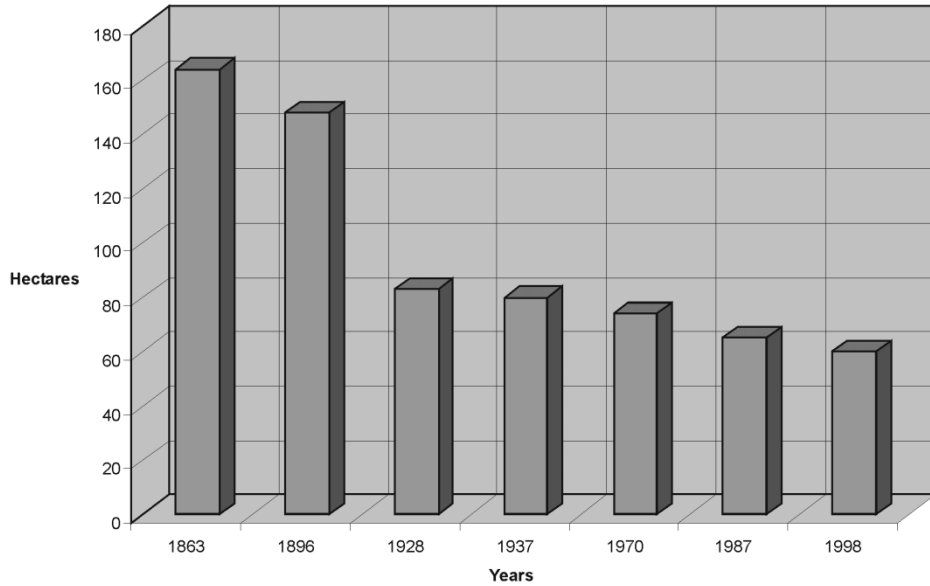


FIGURE 9 Extension of the marshy zone from 1863 to 1998

The topographical maps were acquired in digital raster format at 300 dpi, while the orthophotograph was at a resolution of 500 dpi. To ensure the valid geo-referencing of all of the maps, common datum points were identified that minimized potential errors because of the different ellipsoids taken for reference for the coordinates of the maps prepared in 1863 and 1896, vis-à-vis the maps of 1928, 1937 and 1970. Following this geo-referencing, all of the maps were returned to a single GIS platform to enable the preparation of seven maps that summarized the positions of the shoreline, the marshy area and the main human elements present (Figs 2–8).

The graph shown in Fig. 9 gives the values for the extension of the marshland, while Table I provides a numerical comparison between the coastlines that was obtained by dividing the coastline into sections using transects that were virtually perpendicular to the longitudinal line of the beach. For each transect, the distance of each stretch of coastline from that recorded previously was measured to determine the degree to which the coastline had advanced or receded with time.

TABLE 1 Accretion (+) or regression (-) of the shoreline along eight pre-established transects (m).

Years	Transects							
	1	2	3	4	5	6	7	8
1863–1896	-20	-35	+15	+20	+30	-10	+30	+55
1896–1928	+50	+130	+85	-15	+65	-40	0	+5
1928–1937	0	+5	-10	-10	0	0	+10	0
1937–1970	+10	+15	-10	-5	-5	-10	-5	0
1970–1987	+90	+50	-80	-70	-30	+35	+10	+10
1987–1998	-55	-45	+10	0	0	-15	+10	-25

3 RESULTS AND DISCUSSION

Judging from the 1863 maps, Capo Feto was characterized by an immense marshy zone that occupied the entire area (Fig. 2). In 1896, the situation appears to have changed very little. Here, the general morphology of the area was virtually the same, with the only addition being the appearance of the first cultivated fields that reduced the area of marsh from about 165 to about 150 ha. The coastline had receded slightly in line with transects 1 and 2, while it had advanced elsewhere (Fig. 3).

The situation in 1928 shows remarkable changes, however. The comparison shows that there was a considerable advance in the shoreline and a marked reduction in the marshy zone due to reclamation work for the development of agricultural activities in the area during the 1920s. The water was drained by means of the main north–south channel connected to a basin and a water-scooping machine. The channel was also intersected at right angles by an east-west channel, to which another eight perpendicular collector channels were connected (Fig. 4). The comparisons drawn with the maps for 1937 and 1970 show much the same situation (Figs 5 and 6).

In 1987, the situation in the area appears to have changed again, with an increase in the cultivated fields that spared only the wettest areas. This is the first map to show the SNAM pumping station for the Algeria–Italy methane gas pipeline that ran along the boundary of the marsh and was built in the early 1980s. Overall, the shoreline had advanced, except in the stretch between transects 3 and 5; here, the water-scooping machine was no longer in operation, which meant that no more drift material was being deposited, and the beach had receded by as much as 80 m (Fig. 7).

Comparing the situation in 1987 with that established from the interpretation of the 1998 orthophotograph, a further reduction in the marshy area can be discerned. In addition to the strictly anthropogenic changes, there have been modifications resulting from climatic changes. Indeed, the last decade has seen a decline in the annual mean rainfall that, together with indiscriminate exploitation of ground water through the use of wells for both agricultural and domestic uses, has led to a general lowering of the mean ground-water level (Fig. 8).

4 CONCLUSIONS

The present study has enabled a description of the main morphological and environmental changes that have occurred in the Capo Feto area over the past 150 years, prompting several considerations that can be summarized as follows:

- (1) The landscape is rather degraded due to numerous changes that have severely affected the ecological value of the site. In the past, the aspect of the area differed from that of today due to the presence of halophytic and hygrophilous shrubby species mixed with cane-brakes. This shrubby vegetation has now virtually disappeared, and the cane-brake is confined to a very narrow area between the beach and the marshy zone behind it.
- (2) The marshy area has suffered a marked reduction in size; i.e. before reclamation, it covered approximately 150 ha, whereas it now has a seasonally variable extension of between 5 and 60 ha (Fig. 9). In the summer, only 8% of the greatest extension of this area in the wet season remains marshy.
- (3) The shoreline has changed shape considerably, mainly as a consequence of reclamation work in the 1920s (Tab. I); since then, it has suffered more limited variations, partly due to the presence of *Posidonia oceanica*. This has continued to thrive (despite the damage

caused by the installation of the methane gas pipeline) and forms a barrier lying parallel to the coast that encloses the stretch of sea towards the river, forming a kind of sandy lagoon protecting the beach.

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