GEOMORPHOLOGICAL FEATURES OF COASTAL DUNES IN THE MARINE PROTECTED AREA "TORRE CERRANO" (CENTRAL ADRIATIC COAST, ABRUZZO, ITALY)

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Panoramic view of the Torre Cerrano coastal area

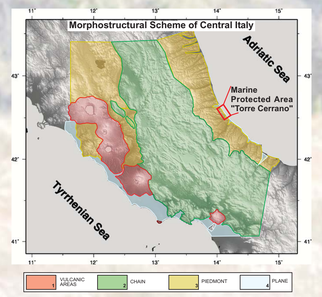
INTRODUCTION

The main geomorphological features of dunes/beaches were investigated along the central Adriatic coast of Italy (Abruzzo). Nine foredune areas typified by established dunes and incipient dunes were investigated through detailed geomorphological surveying and an analysis of historical maps and photographs (aerial and land).

The dunes are located along both low coasts and high coast. The morphology is typical of foredunes, with elongated fields parallel to the coastline. The total linear extension is ~15,500 m; established dunes are more extended than incipient ones and occupy the greatest portion of the total surface area (~1,500,000 m^2).

Out of nine main foredune areas typified by established dunes and incipient dunes present in the Abruzzo area (see Geological Setting and Dunes Location scheme), in this work the detail features of the coastal dunes which characterize the Marine Protected Area "Torre Cerrano", were investigated through (i) detailed geomorphological surveying, (ii) analysis of historical maps and photographs (aerial and land), (iii) accelerator mass spectrometry (AMS) 14C dating.

This work was carried out by the Laboratory of Tectonic geomorphology and GIS of the Department of Engineering and Geology. University "G. d'Annunzio" of Chieti Pescara.



METHODS

The work is based on:

i) detailed geomorphological surveying,
ii) analysis of historical maps and photographs (aerial and land),
iii) AMS ^{14}C dating.

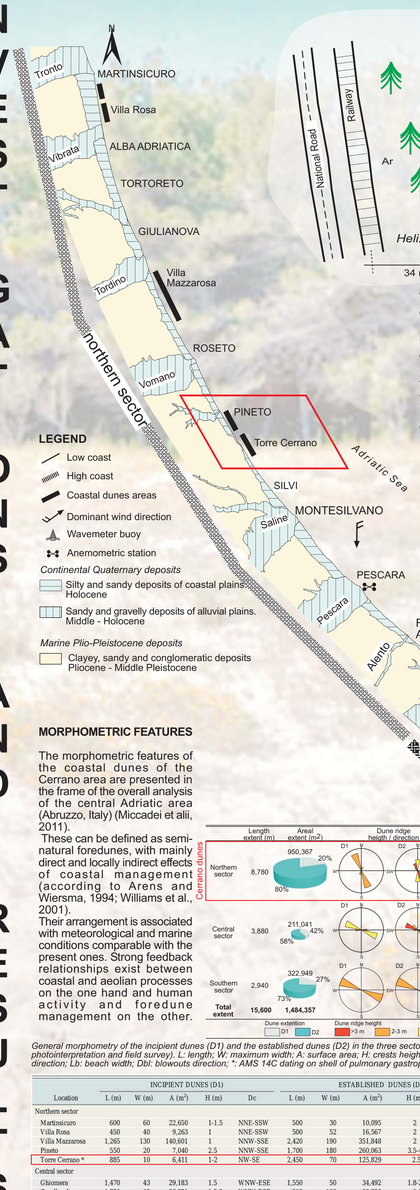
The geomorphological survey was carried out in two phases.

The first survey stage included interpretation of aerial photographs and colour ortho-images. This enabled measurement of beach width, recognition and mapping of the dune areas, measurement of dune main morphometric parameters, characterisation of their state of activity and local coastline direction. The subsequent field geomorphological survey (2004-2006) allowed for a detailed landform analysis, measurement of direction and height of dune crests, and direction of blowouts. Field surveys on coastal plain and hill slope areas also allowed to perform an analysis of the morpho-lithostratigraphical relations with the back-dune zones. Resulting data, representative of the current morphological conditions of the coastal dunes, were organised in a database and managed in GIS. The historical analysis has been performed using maps, aerial photos and colour ortho-images and land photos from 1811 to 1999 (Table 1). This phase of the research enabled the observation of variations occurred over the last two centuries all along the Abruzzo coast, and particularly within the nine dune areas, and the assessment of the relations with human development and urbanisation.

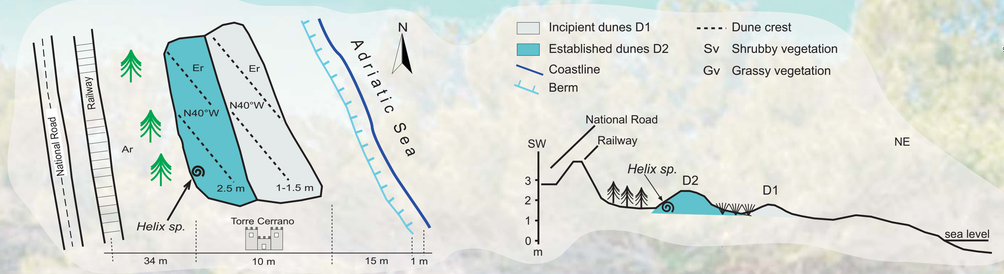
Radiometric dating with AMS ^{14}C on shells of pulmonary gastropods contributed to the general chronological characterisation of deposits. Finally, the correlation of present dune morphology, related surface landforms, historical variations, and dating, allowed for the delineation of the main geomorphological processes involving the dune areas and their present setting and historical evolution.

INVESTIGATIONS AND RESULTS

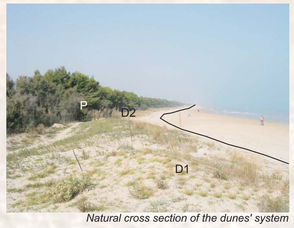
GEOLOGICAL SETTING and DUNES LOCATION



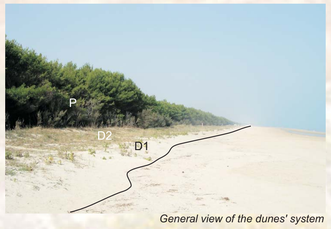
PINETO - TORRE CERRANO DUNES AREA



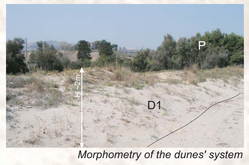
The dunes are located along a low coast segment backed by a narrow coastal plain (P) and by a sharp coastal slope (S) frequently affected by gravitational processes (landslides) and soil erosion. The morphology is typical of foredunes, with elongated fields of dunes slightly oblique to the NNW-SSW coastline, developed on a >20 m wide beach. The area is characterised by incipient dunes (D1), with sporadic grassy vegetation and located toward the beach, and established dunes (D2), stabilised by dense, mainly shrubby vegetation, and partly covered by extensive pinewood, developed behind the dunes. The orientation is mostly NW-SE on a NNW-SSE coast; the total dunes' length is ~2,500 m (height up to 2.5 m, width up to 70 m for a total area of >125,000 m^2) for established dunes with incipient dunes on at least a 900 m beach reach (height up to 1.5 m, width up to 10 m for a total area of >6,000 m^2); the orientation is mostly NW-SE parallel to the coast. These values, however, are varying and growing rapidly year by year, also due to the protection actions implemented within the Marine Protected Area "Torre Cerrano". The sand of the established dunes is characterised by plentiful shells and fragments of pulmonary gastropods Helix sp. Radiometric AMS 14C dating, obtained from the core of an established dune at a height of about 1 m asl and about 25 m from the coastline, provided an uncalibrated age of 730±40 years BP.



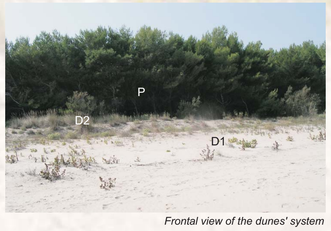
Natural cross section of the dunes' system



General view of the dunes' system



Morphometry of the dunes' system



Frontal view of the dunes' system

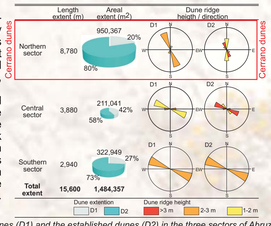
Samples collected in esteblished dune (D2) dated back to 730±40 years BP

MORPHOMETRIC FEATURES

The morphometric features of the coastal dunes of the Cerrano area are presented in the frame of the overall analysis of the central Adriatic area (Abruzzo, Italy) (Miccadei et alii, 2011).

These can be defined as semi-natural foredunes, with mainly direct and locally indirect effects of coastal management (according to Arens and Wiersma, 1994; Williams et al., 2001).

Their arrangement is associated with meteorological and marine conditions comparable with the present ones. Strong feedback relationships exist between coastal and aeolian processes on the one hand and human activity and foredune management on the other.



General morphometry of the incipient dunes (D1) and the established dunes (D2) in the three sectors of Abruzzo coast (from aerial photointerpretation and field survey). L: length; W: maximum width; A: surface area; H: crests height asl; Dc: crests direction; Dcl: coastline direction; Lb: beach width; Dbl: blowouts direction; *: AMS 14C dating on shell of pulmonary gastropod Helix sp.

Location	INCIPIENT DUNES (D1) L (m)	W (m)	A (m^2)	H (m)	Dc	ESTABLISHED DUNES (D2) L (m)	W (m)	A (m^2)	H (m)	Dc	Dcl	Lb (m)	Dbl
Northern sector													
Martinsicuro	600	60	22,650	1-1.5	NNE-SSW	500	30	10,095	2	~ N-S	NNW-SSE	20-32	~ E-W
Villa Rosa	450	40	9,263	1	NNE-SSW	500	52	16,567	2	~ N-S	NNW-SSE	10-15	~ E-W
Villa Mazzarosa	1,265	130	140,601	1	NNW-SSE	2,420	190	351,848	2	~ N-S	NNW-SSE	25-30	Not present
Pineto	550	20	7,040	2.5	NNW-SSE	1,700	180	260,063	3.5-4	NNW-SSE	NNW-SSE	25-30	~ NE-SW
Torre Cerrano *	885	10	6,411	1-2	NW-SE	2,450	70	125,829	2.5	NW-SE	NNW-SSE	15-25	~ NE-SW
Central sector													
Ghiomera	1,470	43	29,183	1.5	WNW-ESE	1,550	50	34,492	1.8-2	NW-SE	NW-SE	25-30	~ NE-SW; N-S
Casalbordino	1,750	45	36,851	1.5-2	WNW-ESE	800	100	68,328	3-3.5	WNW-ESE	WNW-ESE	25-30	~ N-S
Punta della Lotta	680	50	22,459	2-3	~ E-W	470	80	19,728	3	~ E-W	WNW-ESE	40-45	~ N-S
Southern sector													
Vasto Marina San Salvo	2,685	53	85,740	1-3	WNW-ESE	2,590	125	237,209	1.5-3	WNW-ESE	NW-SE	20-50	~ N-S

CONCLUSION

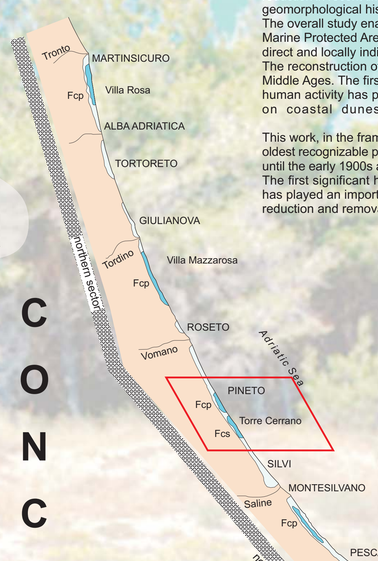
DUNES DISTRIBUTION, MORPHOTYPES AND CHANGES FROM 1800 TO PRESENT

Analyses of historical maps and photographs (aerial and land) led to the reconstruction of coastal dune morphology from the beginning of the 1800s to the turn of the 20th century, showing a strong surface reduction in recent times, while radiometric datings show that the Cerrano dune field has had a long centennial geomorphological history.

The overall study enabled the reconstruction of the geomorphological arrangements of the dune area of the Marine Protected Area "Torre Cerrano", allowing to define the dunes as semi-natural foredunes, with mainly direct and locally indirect management control.

The reconstruction of dune evolution identifies oldest recognizable period of aeolian deposition in the late-Middle Ages. The first significant human-induced processes began in the 1900s and over the last 50 years human activity has played an important role in the coastal morphogenesis, with direct and indirect effects on coastal dunes reduction and removal, heavily affecting the whole coastal system.

This work, in the frame the overal study of the Abruzzo's dunes (Miccadei et alii, 2011), identifies Abruzzo's oldest recognizable period of aeolian deposition in the late-Middle Ages; aeolian deposition was widely active until the early 1900s and dunes were a significant morphological component of the Italian coastal landscape. The first significant human-induced processes began in the 1900s; over the last 50 years human activity has played an important role in the coastal morphogenesis, with direct and indirect effects on coastal dune reduction and removal, heavily affecting the whole coastal system.



DUNES EVOLUTION FROM 1800 TO PRESENT