Puglia 2003 - Final Conference
Project IGCP 437

Coastal Environmental Change
During Sea-Level Highstands:
A Global Synthesis with implications
for management of future coastal change

Otranto / Taranto - Puglia (Italy) 22-28 September 2003
Quaternary coastal morphology and sea level changes

Project 437

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Dynamics and Risk Assessment along the rocky coast of Taranto (Puglia, Italy)

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Keywords: *Coastal dynamics, Risk Assessment, panchine, environmental unit, Taranto, Italy*

Introduction

This paper presents the results of the study of the dynamic and risk assessment of the rocky coast between C. San Vito and Punta San Francesco southern of Taranto (Apulia, Italy). The western area of Gulf of Taranto, is characterised by a continental shelf up to 14 km wide, which border is located between 30 and 150 meters of depth.

The continental slope develops up to 15 Km, has a maximum 8° pending and it's carved of a large number of canyon, in NW – SE direction, gets into Taranto Valley (Senatore et al., 1988).

The coastal environment is characterised by gently slope rocky coast shaped on algal calcarenite, locally named *panchine*, and interbedded pocket beaches (AA.VV., 1997; Caldara et al., 1998).

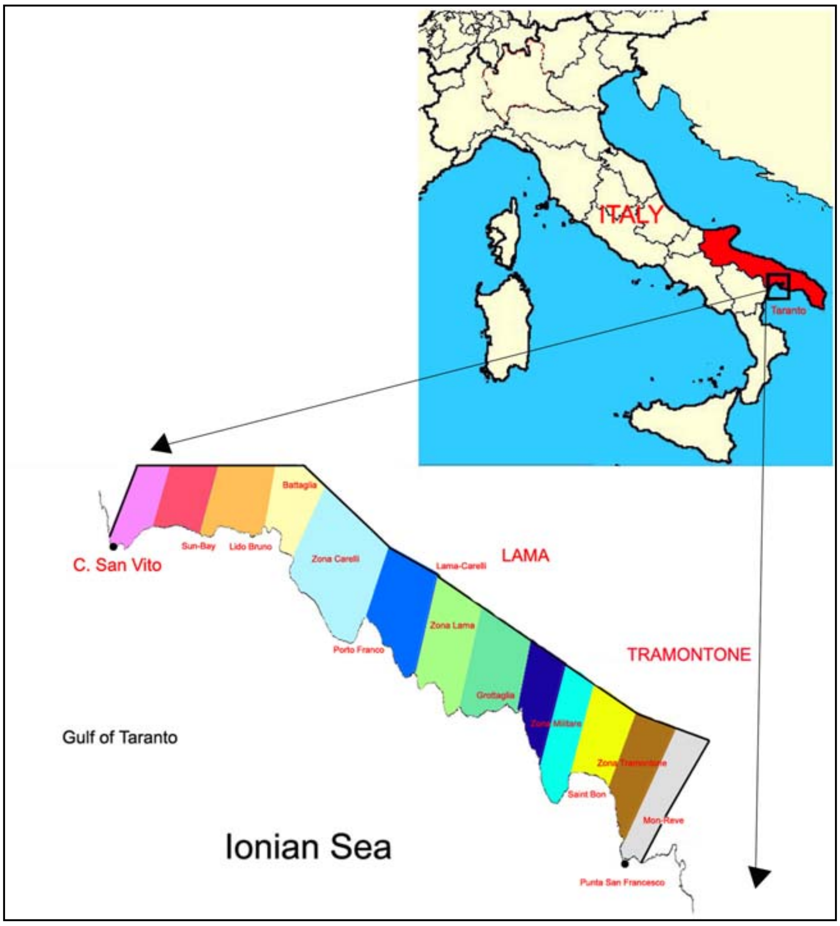

Figure 1. Localisation of studied area. Environmental Units (E. U.) are displayed with different tonality of grey.

In the main inlets cliffs up to 10 m a. m.s.l., are cut on Plio-pleistocene sequence of silty-clay at the base and algal calcarenite – locally named '*panchine'* - at the top.

Coastal dynamics

The coastal dynamics of studied area is strongly conditioned by the interaction of main litostructural features and of wind and sea actions on the relict landforms due to continental shape.

Figure 2. Evidence of cliff evalution in Capo San Vito area.

Major evidence are represented by deep inland in correspondence of presently/temporary water flood and by the network of main fractures. These last ones, are the effect of tectonic activity in the apulian area and are characterised by ricristallisation of the calcium carbonate. Conditioned by these heritage of the past, the normal wave action, sea storm and catastrophic wave induce paroxistic phenomena of slide and/or boulders disarticulation and accumulation inland (Bird, 1993; Bryant, 2001; Dawson, 2000).

Risk assessment

Using a topographic survey on 1:5000 scale, a land use capability map was realised, where homogeneous areas can be located for getting the value of territory. The homogeneous areas are those with analogue human settlements as bathing establishments, typology of residences (annual or summery), natural areas or cultivated lands. Especially, 15 lots has been individuated, nominated again ***environmental unit*** (EU), according to the definition of the project Ma R E P (Marine Reserve Evaluation Procedures) (Chemello and Russo, 2001): "*the environmental unit is a part of coast where the environmental features are rather homogeneous on great scale (exposure to wave – like motion, to rocky underlayer, biological – naturalistic aspects and degrading situations)"*. Then, the value classes have been selected for each EU to which have been allotted a certain beginning "score"; these numbers have been awarded after a land analysis during the wintry and the summery period and then to compare them and to determinate a final mean.

The classes and the calculation formalities are the followings:

- number of human lifes;
- buildings (civil, tourist and sports)
- military areas
- natural areas
- farm fields
- parking areas
- touristic service/bathing areas

The quantitative results got for classes each EU, permit to calculate a mean value (between 0 and 10) to get one only **value** for the Environmental Units.

Since the value calculation of a territory must be unbiased, two mean values, indicated as value 1 and values 2, have been got : the first dividing, in the mean calculation, values' sum for seven classes selected, the second dividing , in the mean calculation, values' sum only for the number of classes which have a value different of 0. Then value 1 is closer to reality, value 2 instead has a more subjective meaning, because it's been decided to leave out, in the final calculation, those classes hadn't score (then beginning value 0) in a particular EU. To the vulnerability evalutation in every 100 mt, the rocky coast morphological features has been surveyed, the parameters and the evalutation of risk assessment are in table 2. All necessary data have been comparated with map on scale 1:5000, to have a complete sight of previous features listed, for every 15 Environmental Units; numerical intervals have been selected to allot value 10 (greatest score) to the value 0 (lowest score).

Figure 3. Pleistocene sequence of raised marine deposits near Torre San Vito.

The mean of numerical values has been calculated, to get one only number corresponding to the EU vulnerability for every parameters studied. The hazard, between Capo San Vito and Punta San Francesco, has been estimated considering study of two specific factors: exceptional sea – storm and tsunami. Hazard of tsunami, has a low value but not negligible, similar for 15 EU selected.

AREA	VALUE (V)								VULNERABILITY (U)						HAZARD (H)					RISK
ENVIRONMENTAL UNITS (E.U.)	N° Human Lifes	Buildings	Military Area	Natural Area (ha)	Parking Area (ha)	Farm Field (ha)	Bathing Area	Tot. (0 - 10)	Rocky Coast Width (m)	Beaches Width (m)	N ° Cross Sheet Fractures	N ° Longitudinal Fracture	Falesia Height (cm)	Tot. (0 - 10)	Medium Hazard	High Hazard	Exceptional Hazard	Tsunami	Tot. (0 - 10)	R = U . V . H
E.U. 1 : Capo S. Vito	400	0	25	2	0	0	0,75	4	20,0	26	110	30	0,41	7	21,93	1,32	0,73	0,184	8	224
E.U. 2 : Residence "Il Tulipano"	228	63	0,6	0,6	0	0	0	3	12,3	0	130	26	0,40	8	21,93	1,28	0,73	0,184	7	168
E.U. 3 : Sun Bay	16	8	4,4	6,6	0	0	2,25	3	0,0	11,3	106	26	0,41	8	21,93	1,28	0,73	0,184	7	168
E.U. 4 : Lido Bruno	417	124	0	0,4	0	0,60	1,40	4	0,0	19,8	132	60	0,90	10	22,13	1,32	0,73	0,184	10	400
E.U. 5 : Zona Battaglia	552	143	10,15	0,3	0	0	0	5	25,0	0	62	56	0,61	7	22,13	1,32	0,73	0,184	10	350
E.U. 6 : Zona Carelli	0	0	0	1,5	0	0	0	1	11,2	0	106	90	0,70	10	21,93	1,28	0,73	0,184	7	70
E.U. 7 : Zona Raguso	320	95	0	0	0	0	0	4	9,5	0	50	56	1,73	10	21,93	1,28	0,73	0,184	7	280
E.U. 8 : Lama	32	9	0	3,1	7,4	0,25	0	3	7,0	0	46	60	0,43	8	21,93	1,28	0,73	0,184	7	168
E.U. 9 : Zona Grottaglia	638	174	0	8	0	0	0	6	15,0	0	59	78	0,57	8	21,93	1,28	0,73	0,184	7	336
E.U. 10 : Grottaglia Militare	0	0	7,5	0	0	0	0	2	25,0	0	50	70	0,60	7	22,13	1,32	0,73	0,184	10	140
E.U. 11 : Saint Bon	4	1	0	0	9	0	1,80	3	0,0	11	12	7	1,60	7	21,82	1,28	0,73	0,184	6	126
E.U. 12 : Tramontone	524	147	0	0	0	0	0	6	7,5	0	11	12	2,20	8	21,82	1,28	0,73	0,184	6	288
E.U. 13 : San Francesco	0	0	0,6	18	0	0	0	4	8,8	0	16	15	0,46	7	22,03	1,3	0,73	0,184	9	252
E.U. 14 : Mon Reve	182	61	0	1	0	0	7,50	4	10,0	n.d.	5	5	1,20	7	22,13	1,32	0,73	0,184	10	280
E.U. 15 : Pineta Blandamura	0	0	0	12,6	0	0	0	4	13,4	0	20	15	0,60	6	21,93	1,28	0,73	0,184	7	168

Table 1. Table shows the morphodynamic Risk Assessment (Russo and Valletta, 1995) along the rocky coast of Taranto (Apulia, Italy). In the first array are showed the value elements (n° human life, buildings – residence civil and touristic -, military area, natural area, parking area, farm field, bathing area) with the corresponding scores to each E.U.; in the second array are showed the vulnerability elements (rocky coast width, beaches width, n° cross sheet fractures, n° longitudinal fractures, falesia height) with the corresponding scores to each E.U; in the third array are showed the hazard elements with the corresponding score in % to each E.U.

The only representative case dates back to 5 december 1456, originated by a heavy in Taranto, in this case an anomalous wave has been generated and blocks of 80 tons has been moved to inland for about 40 meters. The most coastal modelling has been caused by exceptional sea – storm which number of cases has been got by a statistic analysis on anemometrical data (period 1968 – 2000) of Marina of Ginosa weather station.

Geological structure (90% algal calcarenite proof mechanically, retreat rate of 0.8 m/y) (Mastronuzzi and Sansò, 1998), the exceptional sea – storm, generated by a wind intensit > or = 35 marine knots, have been analysed. Only these sea – storm can determinate a real hazard in the test area. Considering the sea – storm period, three different stages of danger, associated to different drifts of source of events, have been individuated (Table 1) (IIM, 1984; Tenani, 1952; Munk, 1976):

a) Average danger, associated to sea – storms with intensity > or = 35 marine knots and utmost period of 3 hours;
b) High danger, associated to sea – storms with intensity > or = 35 marine knots and utmost period of 6 hours;
c) Exceptional danger, associated to sea – storms with intensity > or = 35 marine knots and utmost period of 9 or more hours.

The risk assessment table: discussions.

Analysis risk assessment table proves that some EU are more at " risk" than others.

In particular EU IV (lido Bruno) has the greatest Risk Assessment with a score of 400. This is caused by high vulnerability (10) with morphostructural instability of area and density of residential – tourist – recreative buildings (value 4) built near coastal line. Analysis Prevailing wind sector of this EU confirmes the exceptional cases come from different directions and this contributes to greatest hazard (10). EU VI (Carelli) has the smallest Risk Assessment with a score of 70. Lack of residential – tourist – recreative buildings generates lowest value (1). The most vulnerability index is instead 10 and the hazard is 7, in this area.

Others EU prove a score of Risk associated to contribution that every factor (value, vulnerability and hazard) shows in the studied area.

Conclusion

Study of geomorphologycal, meteomarine and landscape features permit to evaluate the short term morphodynamic Risk Assessment. Even if the exceptional sea – storms attendance's is reduced in the last years, the coastal structure and the progressive destruction and reduction of natural protections show coast, and what persists here, is greatly exposed to marine dynamic.

The division of coast in Environmental Units proves that some areas are more at risk than others either because in the territory uman activity has changed natural dynamics of area and the territory, for the increase of tourism, has had a greater economic value.

The demand to preserve the landscape as cultural heritage must not be conflicting with its importance in the ecosystem stability and the department economy; it must be column for the economy and for the environmental education. This study suggests a series of actions which aim is to reconstruct, defend and revolve the coastal environment.

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