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CONTRIBUTION TO UNDERSTANDING THE EROSION PROCESSES IN ALGHERO COAST

CONSIDERAZIONI SUI FENOMENI EROSIVI COSTIERI DEL LITORALE DI ALGHERO

Abstract – The sandy shore comprised between Alghero and Fertilia (Alghero Gulf, NW-Sardinia) has been monitored through satellite and aerial images from 1977 to 2009 and uploaded in ARCGIS system. Results indicate that the area is suffering a severe erosion mainly due to the building of marina docks and breakwaters.

Key-words: coastal erosion, sediment distribution, coast, Mediterranean Sea, Alghero.

Introduction – Over 20% of the European coasts have been subjected to erosion, an increasing phenomenon possibly linked to climate change. Therefore, Public Institutions have been involved in coastal conservation management, mostly stimulated by the economic importance of shores for tourism (EUROSION project., 2005).

Coastal changes such as sediment transport and some rock-cliff collapse are occurring around Alghero Gulf, and in most cases in some of the highly visited seashores. All these changes are, therefore, producing negative economic, social and environmental effects.

Materials and methods – Satellite images, air photos and maps of several years, from 1977 to 2009, have been uploaded in ArcGis 9.3 - ESRI ArcMAP®. Coastal lines analyses have been performed using Digital Shoreline Analysis System (DSAS), v.3.2 - USGS Woods Hole, Massachusetts (Thieler *et al.*, 2005). Inter-annual image data have allowed to estimate the erosion rate through time.

DSAS can automatically generate orthogonal transects to the coastal line and define the coastal variation occurred between two times. The base line has been created using the “cast” function with 100 m interval (Jones *et al.*, 2008). The erosion rate has been calculated in 48 places, along a 4.5 km of sandy shore in 1977, 1989 and 2009.

Twenty samples of sand have been treated to perform grain size analysis. The data were statically elaborated with SW Gradistat.

Results - Alghero coastal area (Lido di S. Giovanni and Maria Pia, Fig. 1) is made of mesokurtic gently negative skewed sand deposits, composed of 70% siliciclastic and 30% bioclastic grains. Mean grain size of the swash zone is between 296 μm (medium sand) in the northern Fertilia area, 256 μm (medium sand) in central Maria Pia (just north of the Marine Hospital) and 145 μm (very fine sand) in the southern part (S. Giovanni). Next to Alghero marina (Fig. 1), along 450 m of coastal line, 6,868 m^3 of *Posidonia oceanica* beached debris have been estimated, they are spread over a surface area of 10,932 m^2 with an average thickness of 0.62 m. In the opposite side, next to Fertilia marina, an additional 2,600 m^2 storage area of *Posidonia oceanica* has been found.

For the area between 1st and 14th transects (Alghero marina), shoreline variation during 1977-2009 (EPR data, Fig. 2) shows an overall increase of 1.2 m a^{-1} $\text{SD}\pm 0.88$.

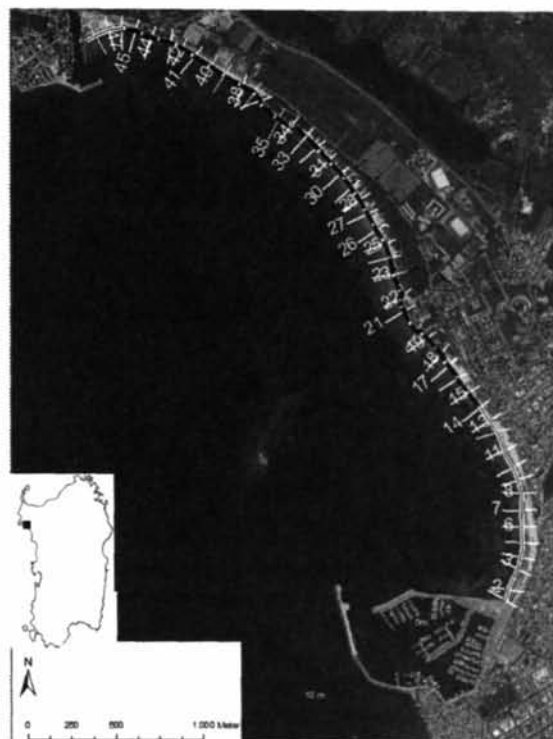


Fig. 1 - Localizzazione dei 48 transetti e linea di riva; (nera tratteggiata, in erosione; bianca continua, in avanzamento).

Alghero Gulf. Location of the 48 considered transects and shoreline (black line=erosion, white line=accretion).

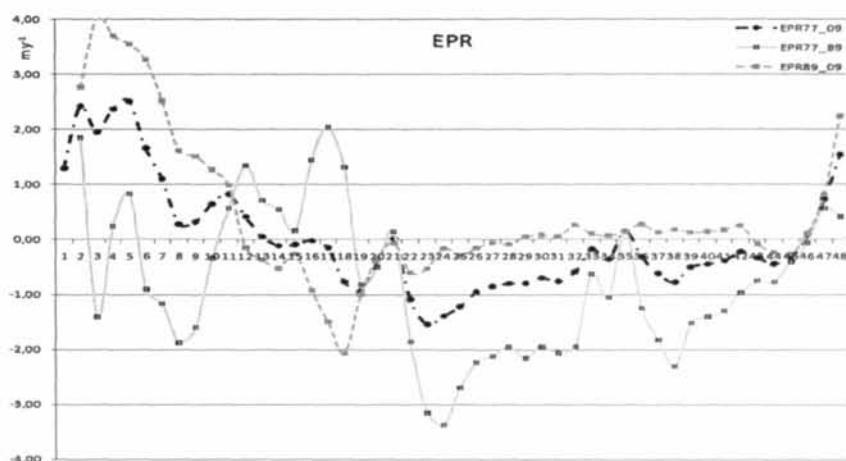


Fig. 2 - Tasso di erosione del litorale espresso come End Point Rate (EPR). I valori indicano le variazioni delle linee di riva nei transetti rispettivamente nei periodi 1977-89, 1989-2009 e 1977-2009; in ordinata i transetti come in Fig. 1.

Erosional rate as derived by End Point Rate (EPR). Values are indicative to shoreline variations along the measured transect during 1977-89, 1989-2009 e 1977-2009 time interval; x-axis=transects of Fig. 1.

Conversely, between 15 and 46 transects EPR is negative except for transect 35 where an average rate of -0.56 m a^{-1} $\text{SD}\pm 0.46$ has been calculated. The highest values are found between 23th and 27th transects where values are all larger than 1 m a^{-1} . Next to Fertilia marina an increase of 0.8 m a^{-1} , $\text{SD}\pm 0.76$ is found. During the considered time the Fertilia sandy shore covers an area of 11 ha: 5.5 are accreted and 5.4 are retreated. However, the retreating sandy shoreline is the most visited by tourists. During 1977-89 EPR highlights the effects of the breakwater barrier, built in the 1983. Positive values are found between 1th-18th transects, where a strong erosion just N of the Marine Hospital occurs (22th transect). During 1989-2009 EPR probably highlights the influence of the external marina Alghero dock. This shades winds coming from SW and allows accumulation of 4.5 ha of sand close to the eastern part of the marina. During this time period an evident erosion has occurred close to the Marine Hospital with an average EPR of -0.62 m a^{-1} (13th-20th transects), which is the highest rate we have estimated. This part during 1977-89 shoreline was, instead, increasing. Most likely, the causes of this strong erosion have to be found in both docks and breakwaters. Also the *Posidonia oceanica* meadow shows evidence of regression as the lower limit has become deeper with several matte discontinuities.

Conclusions - A detailed estimation of erosion which has been occurring through the last decades in Alghero area seems the only tool allowing evaluation of the present erosion rate and the urgency of management interventions. An appropriate estimation of temporal variability of the sandy shores can address activities to buffer the negative effects. The data collected provide some important evaluation to forecast the importance of future changes of the shoreline and to drive urban plans as management actions and land use. In the Alghero area cement actions, excessive human frequentation with no protection of the dune system, marinas constructions and breakwaters are all factors responsible of the weakness of the sandy shores, especially in the most visited areas. This work contributes to a much wider study which is needed and still to develop to address any management actions aiming to protect and re-establish the shores quality.

References

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