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THE ITALIAN COAST BETWEEN PROTECTED AREAS AND LINEAR METROPOLIS: LINE OF ACTION FOR A DIFFICULT RECOVERY.

Abstract

Italian urban transformation over the last 50 years has been localized mainly in the coastal areas, where the anthropic transformation took place with low planning control and with a high average speed of urbanization. Nevertheless into the coastal areas important environmental and ecological values remain infact, italian peninsular coastal systems include over 500,000 ha of protected areas concerning all coastal regions. Moreover the urban development registered, during the period indagated, has caused important consequences on ecosystems. These geographical areas are highly attractive for tourism and for permanent residence, thanks to the good conditions of mobility and transports but, in many cases, the presence of natural values is neglected. The goal of this work is to highlight contradictions between the phenomena of urbanization and protection through the implementation of five indicators, which were calculated on a municipal basis for a costal belt of 1km. In view of this, it has been possible to obtain a classification of models for the settlement and residual values.

Introduction

The research described in this poster involved the entire coastline of the Italian peninsula, excluding the two large islands of Sicily and Sardinia. The purpose was to highlight the elements involved in the phenomenon of urban conversion of land, the presence of natural lands, and institutional policies for environmental protection. Currently, less than 10% of the peninsular perimeter is relatively intact and free of construction. It is estimated that the transformation of the coastline through building and urbanization has occurred at a rate of 10 km per year since the end of World War II (Romano and Zullo, 2014; Zullo et al, 2015; Tagliapietra et al, 2014). Multiple studies attest to the importance of coastal environments, even if besieged by intensely constructed areas, infrastructure, and continual threats of further degradation (Acosta et al, 2003; Carboni et al., 2009; Sargolini, 2010; Buffa et al, 2012; Ercole et al, 2014; ISPRA, 2015). The research carried out has highlighted the urban/environmental contradictions using five municipality-based statistical indicators.

Study Area

The study area was identified as a 1 km strip of coastal perimeter, divided by municipality, obtaining 430 statistical sections. However, the research data was processed for only 285 out of the 430 total sections, as the Basilicata and Calabria regions are not yet equipped with post-2000 digital land use cartography.

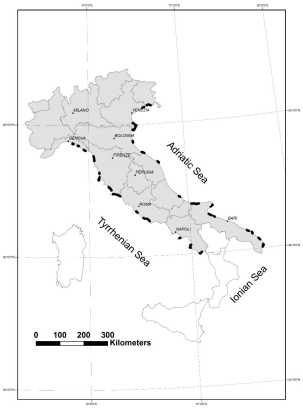


Fig.1 - Peninsular coastal segments longer than 5 km, free of urbanization and with higher density of ecological value.

Therefore, the sectors analyzed involved only 11 regions, with the following coastal lengths:

- **Adriatic**, all (1470 km);
- **Tyrrhenian**, with Liguria/Tuscany/Lazio/ Campania (1460 km out of 1760 km);
- **Ionic**, none, as the coast is located completely within Basilicata and Calabria.

The total area analyzed is the 74% of the entire coastline (2,930 km^2) and, for this reason, the results can be considered statistically significant.

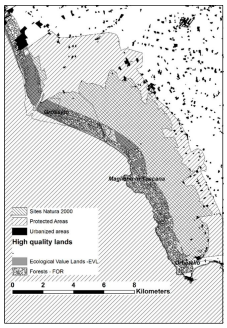


Fig.2 - One of the longest coastal segments in Italy free of urbanization and with high density of naturalistic value.

Fig.3 - One of the Italian coastal segments with high urban density.

Data and Methodology

The study was conducted using digital land use maps from the Italian regions, available with varying updates from 2000 to 2008. The CORINE Land Cover datasets were not used, as they are known to have little dimensional reliability for Italy with respect to the measurements of urbanized areas. Five indicators were identified (Fig. 4) to measure territorial density:

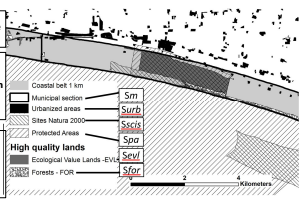
I_{URB} = urban density
I_{PA} = density of protected areas
I_{SCIS}= density of Natura 2000 sites (Sites of EU interest)
I_{FOR}= density of forestation
I_{EVL}= density of other lands of ecological value

where the denominator of the expression is always the surface of the relevant municipal section (Sm).

Iurb = $\frac{Surb}{Sm}$ Development pressure

Iscis = $\frac{Scis}{Sm}$ **Ipa** = $\frac{Spa}{Sm}$ Environmental protection

Ifor = $\frac{Sfor}{Sm}$ **Ievl** = $\frac{Sevl}{Sm}$ Ecological quality of topsoils



LAND USE	CLC Code	Class
Coniferous forest	312	FOR
Mixed forest	313	FOR
Plain woods	311	FOR
recent reforestation	323	FOR
Water courses	511	EVL
Moors and heathland	322	EVL
Beaches, dunes, sands	331	EVL
Inland marshes	411	EVL
Salt marshes	421	EVL

FOR = Forest areas
EVL = Ecological value areas

Fig.4 - Detail of the study area and formulation of indicators used.

Results

The diagrams in Fig. 5 and Fig. 6 show, along the two Adriatic and Tyrrhenian coastlines, the correlations and the pattern of average values for the indicators used, expressed using trend lines (polynomial order 6). The municipal statistics sections are in both cases geographically ordered from north to south.

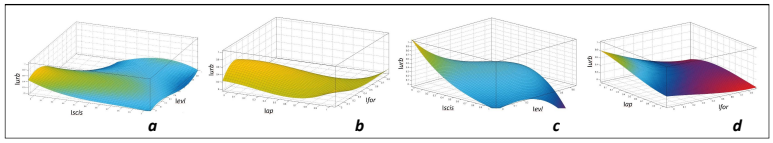


*Fig.5 - Correlations I_{URB} - I_{SCIS} - I_{EVL} and I_{URB} - I_{PA} - I_{FOR} along the Adriatic (**a** and **b**) and Tyrrhenian (**c** and **d**) line.*

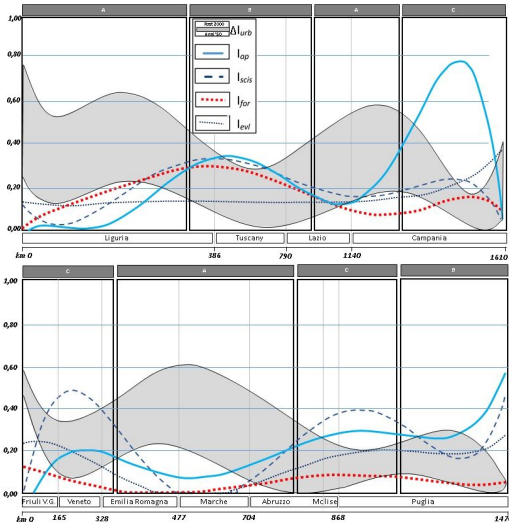


Fig.6 - Values of indicators along the Tyrrhenian (above) and Adriatic coastlines (below).

The previously defined indicators has also been added that related to the urban density of the 50s evaluated on the same reference area. The gray area gives information about the energy of urban growth in coastal areas considered. Along the Adriatic there emerges a notable limitation of the forest component (with I_{FOR} always less than 10% on average) and a decided impoverishment of all environmental characteristics of the territory in the geographical sector that runs from the center-north Emilia-Romagna through all of the Marche and ends in central Abruzzo. In this part of the coast, there is extremely high geographical selectivity of land, with average densities of up to 60% for construction and infrastructure, which have largely replaced any other topsoil of ecological value (with a density of not more than 10%). The remaining 30% of land is made of up agricultural areas. Along the Tyrrhenian coast, although in this case the total situation is clearly better for the forest areas (I_{FOR} always varying between 10% and 30%). The very densely urbanized Tyrrhenian coastal sectors, however, are extremely extensive, with average I_{URB} values oscillating between 50% and 60%. This happens along nearly all the Ligurian coast and between center-south Lazio and center-north Campania. All of Tuscany and the areas where it borders with Liguria and Lazio present a very special condition: all the indicators, with the exception of I_{EVL}, center on the same value of 30%.

	Municipalities	Length (km)	Type of environmental protection: Nature 2000	Type of environmental protection: Protected areas	Regions
Adriatic coast	Marano Lagunare	17	□		Friuli V.G.
	S. Michele Tagliamento-Caorle	7	□		
	Porto Viro-Goro	50	□		Veneto
	Ravenna	6	□		Emilia Romagna
	Gabicce-Pesaro	11	□		
	Sirolo	8	□		Marche
	Torino di Sangro	5	□		Abruzzo
	Chieuti-Serra Capriola	13	□		
	Lago di Lesina	14	□		
	Vieste-Mattinata	12	□		
	Zapponeta-Margherita di S.	11	□		
	Barletta	6	□	□	Puglia
	Carovigno-Brindisi	6	□	□	
	Brindisi-S. Pietro V.	7	□	□	
	Vernote	8	□		
	Otranto-S. Cesarea T.	10	□		
		191	191 km (100%)	19 km (10%)	

	Municipalities	Length (km)	Type of environmental protection: Nature 2000	Type of environmental protection: Protected areas	Regions
Thyrrenian coast	Camogli-S. Margherita L.	8		□	Liguria
	Levante-Moneglia	5			
	Riomaggiore-Portovenere	8		□	
	Viareggio-Pisa	15	□	□	Tuscany
	Bibbona-Castagneto Carducci	5			
	S. Vincenzo-Piombino	7			
	Grosseto-Orbetello	20		□	
	M. Argentario-Orbetello	7			
	Capalbio-Montalto di Castro	7			Lazio
	Roma-Pomezia	7		□	
	Nettuno-Latina	8	□		
	Latina-Sabaudia	15		□	
	Sorrento-Vico Equense	8	□		Campania
	Agropoli	6		□	
	Castellabate	5		□	
	Camerota-S. Giovanni a P.	12		□	
		143	31 km (22%)	96 km (67%)	

Fig.7 - Type of environmental protection on peninsular coastal segments longer than 5 km, free of urbanization and with higher density of ecological value.

Conclusions

The results obtained clearly show the effect that fifty years of relatively uncontrolled development have had on the landscape mosaic and coastal ecosystem, as well as the current condition of "besiegement" of natural spaces and semi-natural remainders, and areas protected for various reasons. It is true that at least 350 km of the coastline analyzed are still relatively unaltered and can constitute the base of a possible restoration under a territorial environmental retrofit policy (Onori, 2009) and adequate coastal management (Suárez de Vivero and Rodríguez Mateos, 2005; Forino et al, 2015). The considerations that emerged from analysis allow us to propose a typological classification of coastal sectors indicated and described in Fig. 8. The margins of action for territorial policies are rather restricted in A, but very broad in B and in C. The most effective actions can therefore be taken in these last zones and, in particular, the rather determined choices of protection should dominate over all the others. However, it would also be appropriate to systematically carry out environmental restoration projects using, for example, decommissioned areas. This type of action, oriented toward restoration under difficult daily conditions, appears to be the only way to improve technological/environmental conditions and hydrogeological risk to the coasts, which are by now saturated with construction.

Type A – Urban-dominant coastal strip (IURB>40-50%) and presence of environmental components and restrictions of less than 20% on average. Very limited incidence of protected areas and Natura 2000 sites (IAP and ISCIS of 0 to less than 10%- 15%). Environments highly compromised by construction coverage and infrastructure development, with very little natural area remaining.
Management policies:
Potential for ecological restoration is very difficult technically, politically, and socioeconomically.

Type B – Coastal sectors with attenuated development density (IURB also less than 20%-30%), equally present with some environmental restrictions such as protected areas and Natura 2000 sites (IAP and ISCIS between 20% and 40%), with consistent remainders of land with ecological value (IEVL > 20%). Environment still diverse, with widespread urban development, but with still-significant natural spaces.
Management policies:
Potential for ecological restoration medium-high, particularly through application of reticular repair models of interstitial protected areas, or those of naturalistic interest.

Type C – Predominantly environmental coastal sectors, with urban density (IURB) less than 20% and incidence of conservation restrictions (IAP and ISCIS) varying between 20% and 50-60% and IEVL > 20%. Scarcely-compromised environments, generally for reasons connected to geomorphological conditions that are incompatible with construction. High potential for acquisition of nodal functions of the coastal ecological network and between the coast and interior.
Management policies:
Areas to be subjected to strict development control policies to limit future compromises.

Fig.8 - Tipological classification of coastal sector through the used indicator.

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