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Urban development of the coastal system of the Italian largest islands: Sicily and Sardinia

L. Fiorini^{*}, F. Zullo, B. Romano

University of L'Aquila, Department of Civil Engineering, Architecture and Environment, Via Giovanni Gronchi, 18, 67100, L'Aquila, Italy

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ABSTRACT

The phenomenon of urban sprawl has already been recognized as one of the major anthropic threats to natural ecosystems. This study investigates the spatial distribution of urban expansion with reference to two Italian Islands, Sicily and Sardinia, from post-war to the first decade of the 2000s (i.e. noughties). The two Regions are an important tourist destination in the Mediterranean basin, owing to their landscapes and climate. The analysis produced a series of interesting results, such as the average annual speed of transformation of the coastal strip or the size and modalities of urban development, correlated with demographic and morphological parameters. The study also focused on the urban transformations that have affected the protected areas within these Regions. The final part of the work is fully devoted to the policies and techniques that should be adopted in the remaining coastal stretches, that is those not yet affected by urban transformation. In fact, for these areas policies should be focused on the preservation of community habitats and the protection of ecological connections with relevant consequences in the national biodiversity conservation. With regards to the processed data allowed to draw a map of management responsibilities at municipal and regional levels for the review of future urban planning in terms of sustainable governance.

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1. Introduction

The extreme urban conversion of natural land is an issue that has been considered seriously at European level only in recent years, mainly by the European Environmental Agency (EEA, 2004; 2006). Only some European countries more sensitive to the foregoing consequences have adopted regulations to deal with this phenomenon. (Bundesregierung, 2004; Hall et al., 1973; Hauri et al., 2006; Irwin and Bockstael, 2007; Zaninetti, 2006; Mellor, 1983; Yanitsky, 1986; Illy et al., 2009; Garcia-Call, 2011).

Land take is one of the human activities that is inevitably changing the naturalness of the earth. Moreover, various related studies highlight how humans are a major factor in landscape transformation. These studies also consider humans as geological and geomorphological agents, through settlement and widespread industrialization and urbanization, leading to the recognition of a new geologic time unit known as the Anthropocene. Indeed, the Anthropocene is stratigraphically distinct from the Holocene and

earlier epochs because the physical transformations of the ecosystems, which can be measured in terms of their impact magnitude and rate, are much more extensive and faster. (Ellis and Ramankutty, 2008; Ellis et al., 2010, 2013; Ellis, 2011; Crutzen and Stoermer, 2000; Crutzen, 2002; Price et al., 2011; Hobbs et al., 2013; Waters et al. 2016).

Furthermore, according to consolidated scientific opinions, land use caused by urbanization is one of the main causes of political and social conflicts (Plotkin, 1987), as well as of the altered environmental quality of land (Ellis and Ramankutty, 2008; Sala et al., 2000; The Worldwatch Institute, 2007; Frenkel and Ashkenazi, 2008; Jaeger et al., 2010; Ding and Zhao, 2011; Barrington-Leigha and Millard-Ball, 2015).

In Italy, the phenomenon of “urban sprawl” has long been considered as one of the causes of urban functional disorganisation, in terms of use of services and transport efficiency (INU, 1990; Indovina, 1990; Gambino, 1996; Indovina and Savino, 1999; Camagni et al. 2002). However, there are not many studies in literature regarding the Italian case (Bonifazi and Heins, 2001; Capello, 2001; Romano and Zullo, 2012, 2014; Zullo et al., 2015; Romano et al., 2015), except for a few regions that have provided information on land use over the past 50 years. The negative

^{*} Corresponding author.

E-mail address: lorena.fiorini@graduate.univaq.it (L. Fiorini).

aspects of this phenomenon are still considered only marginally by the scientific, communication and land governance bodies (Pileri, 2007).

We are still far from having systematic and consistent data collection that would make comparisons and assessments both possible and credible. Therefore, the research presented in this paper is focused on investigating urban development as one of the most relevant factors of landscape changes in the two biggest Italian islands (Sicily and Sardinia) over half a century. In particular, the aims of the study are as follows:

- to investigate the spatial distribution of urban expansion on the coastal systems of Sicily and Sardinia from the post-war period to the first decade of the 2000s. The phenomenon of urban sprawl, in fact, has already been recognized as one of the major anthropic threats to natural ecosystems.
- to evaluate the average annual speed of transformation of the coastal strip or the size and modalities of urban development, correlated with demographic and morphological parameters.

Furthermore, the final part of the work is fully devoted to the policies and techniques that should be adopted in the remaining coastal stretches.

2. Study area: Sicily and Sardinia

This paper investigates the development of land urbanization in the Mediterranean area, with particular regard to Sicily and Sardinia, the two biggest Italian islands.

Sicily is located in the far south of Italy and, with a little less than 26,000 square kilometers of surface, it is Italy's biggest region, organized in 390 municipalities. Likewise, Sardinia's territory is characterized by a surface of nearly 24,000 square kilometers and it is organized in 377 municipalities. Both islands, however, have very different features when considering the significant difference in the amount of inhabitants and population density. Sicily, in fact, is much more populous than Sardinia, the former with 5 million inhabitants compared to 1.6 million inhabitants of the latter (about one third of Sicily). Furthermore, Sicily has a higher population density than Sardinia: 196 inh/Km², that is the national average value, against 69 inh/Km², as shown in table (Table 1).

Also from historical and economic viewpoints, these two islands have other elements of convergence and divergence:

- Sicily's economy is more related to agriculture, while Sardinia's has a higher tourist vocation (OESAAS, 2007; La China M.L., 2007; Pie I Ninot and Rosa Jiménez, 2013; Nebot, 2013; Serra, 2012).
- Sicily has a "smoother" land compared to Sardinia, which has a higher impact on urban development.

Table 1

Table with general features and distribution of protected area systems for Sicily and Sardinia.

	Sicily	Sardinia
General features		
Number of Municipalities	390	377
Total Area (km ²)	25,832	24,100
Inhabitants at 2011	5,002,904	1,639,632
Population Density (inhabitants/km ²)	194	69
Protected Areas		
National Parks	0	3
Regional Parks	5	10
Marine Parks	6	6
SICIs	223	91

First of all, the study analyzes Sicily's and Sardinia's demographic evolution.

The graph (Fig. 1) shows Istat data: the dashed dark and grey lines represent the demographic evolution of the Regions in their whole, while the continuous dark and grey lines show the demographic evolution for the coastal municipalities, from 1961 to 2011 for Sicily, and from 1951 to 2011 for Sardinia (different time periods were considered because of the different availability of urban data, as explained in Chapter3 – Methodology). The black lines (Fig. 1), referring to Sicily, by comparing the two lines it is possible to see that between 1961 and 1971 the region experienced a small decrease in population, while in the same period, the coastal municipalities slightly increased; whereas, in the following years, the trend was the same in both cases. It is important to know that in the 40 year period taken into account, the population grew by nearly 6%; therefore, the Region's inhabitants increased from 4.7 million in 1961 to nearly 5 million inhabitants in 2011, 62% of whom live in the coastal municipalities, with nearly 3.1 million inhabitants. While the grey lines (Fig. 1), referring to Sardinia's demographic evolution, the two lines have the same trend. In both cases and for the entire period analyzed, the population increased more from 1951 to 1981 compared to the period from 1981 to 2011. Actually, in 60 years, there has been a 28% increase reaching nearly 1.6 million inhabitants compared to 1.2 million inhabitants in 1951; and in Sardinia about half of the population lives in coastal municipalities.

It is also important to specify that Sicily's and Sardinia's coasts are characterized by a higher percentage of high and rocky coasts than low and sandy coasts. This fact is also confirmed by a study carried out by ENEA, in cooperation with the Italian Ministry for the Environment, Land and Sea, concerning the physical characterization of the entire national coastal territory. The mentioned study showed the following percentages: 59% of high and rocky coasts against 41% of sandy coasts. In particular, for the scope of this study, ENEA's analysis showed that Sicily's 1400 km of coastline are characterized by slightly more than 970 km of rocky coastline (68%), while Sardinia's 1709 km coastline have about 1351 km (79%) of high and rocky coasts (Ferretti et al., 2003 - Rapporto Tecnico ENEA).

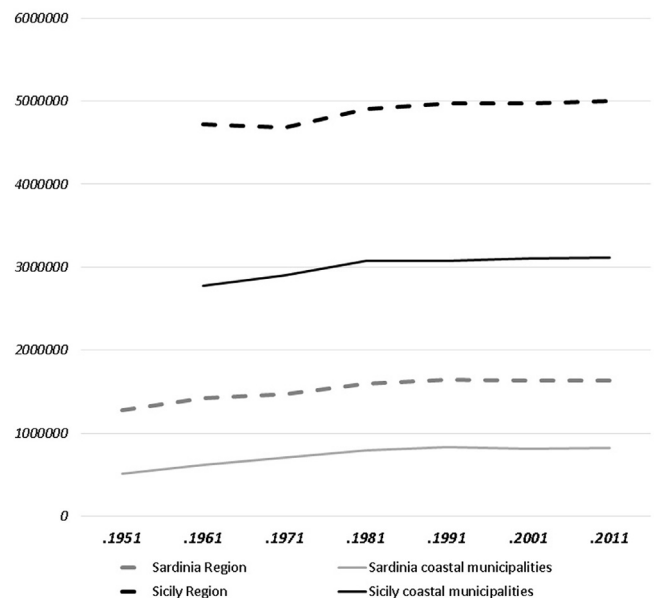


Fig. 1. Demographic evolution in Sicily (from 1961 to 2011) and Sardinia (from 1951 to 2011).

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