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## Climate, environment and society in southern Italy during the last 2000 years. A review of the environmental, historical and archaeological evidence

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### ABSTRACT

This paper examines the interrelationship between the natural and human history of Sicily over the last 2000 years. It presents a close comparison of the data from the key multi-proxy site of Lago di Pergusa – located inland in the eastern part of Sicily – with the existing archaeological and textual evidence on the socio-economic processes. The article also includes a review of the available natural proxy archives from the Central Mediterranean. On the basis of the isotope and pollen data from the Lago di Pergusa core PRG2, we identified two humid periods (ca. 450–750 AD and ca. 1400–1800 AD) as well as a dry one (ca. 1100–1350 AD); our evidence corresponds closely with other environmental palaeoclimate proxies from the Mediterranean region. In our synthesis of the environmental, historical and archaeological evidence from southern Italy, we argue that during both periods of increased humidity – that is during the late antique-Byzantine times and during the late medieval and early modern periods – intense agricultural use of the Sicilian landscape developed on an unprecedented scale. This in turn contributed to the impressive demographic and economic expansion visible during these periods. A sudden period of aridity followed the first of these eras of humidity-related agricultural growth. This climatic shift, dated to around 750 AD, corresponds to a decrease in synanthropic taxa and a recovery of arboreal vegetation. We argue that in this case a climatic change contributed to socio-economic decline. Moreover, as this change occurred prior to the Arab invasion of Sicily in AD 827, the environmental processes may help to explain the collapse of Byzantine society on Sicily which, in turn made the Muslim conquest possible. After this event, there occurred a longer period of agricultural decline, lasting until around 1000 AD, after which we see the first signs of a slow recovery. Ongoing research in nearby archaeological sites will help defining if it was a local change or a regional, potentially climate-induced phenomenon. Although textual evidence records considerable population losses during the later Middle Ages as a result of the Black Death, the effects of the plague are not obviously apparent in the pollen data, except for some short term fluctuations.

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### 1. Introduction

This article reviews the existing environmental evidence from southern Italy for the last two millennia and at compares it with the relevant historical and archaeological data. In this way it hopes to integrate the history of climatic and environmental changes with the socio-economic, political and cultural developments that took place in this part of the Mediterranean during the pre-modern

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period, that is from the Roman Empire until the Unification of Italy.

Such a synthesis is needed in order to fill in an important gap in recent scholarship on the societal impact of climatic fluctuations in the Mediterranean. Although there is a significant scientific literature about the complex interactions between climate and prehistoric societies (Magny et al., 2013; Mercuri and Sadori, 2014; Roberts et al., 2011; Zanchetta et al., 2013), the period covered in this paper has been studied less frequently. Existing studies focus on either the western (Cheyette, 2008; Morellón et al., 2011; Pèlachs et al., 2009; Valero-Garcés et al., 2006) or eastern parts of the Mediterranean (Haldon et al., 2014; Hirschfeld, 2004; Izdebski, 2011; for a rare case of a general overview, see McCormick et al., 2012), but they do not include Italy. Moreover, a recent review of the currently available climate evidence for the last two thousand years (in the following, thousand years = ka) demonstrates that the climate proxies often do not seem to express similar trends, even within the same region (Luterbacher et al., 2012). Therefore, with this paper we wish to establish the pattern of climatic changes that has taken place in southern Italy over the last two millennia and, at the same time, we also hope to demonstrate the potential of this region for the study of the socio-economic impact of climatic changes in the past.

Many recent articles that have presented environmental data from sites in the Mediterranean assume that modern societies must have been capable of either managing or adapting to climatic change. However this is not an obvious fact, as we will demonstrate in this article, and the reactions of the various societies must be addressed on a case by case basis. Unfortunately, the impact of human life, which has been dominant and extensive throughout the Mediterranean region over the past several millennia, also introduces distortions in estimating recent climate variability with the use of environmental proxies (Roberts et al., 2008, 2011); human activities may thus have obscured the true cause of changes in the climate signal. To give a simple example, forest opening can be the result of an arid trend in climate or of intensive land use. Table 1.

In order to better distinguish between human and climate factors behind environmental changes we need to analyse as many different palaeoenvironmental data as possible. Stable isotope variations in lakes are one suitable tool (Roberts et al., 2008; Zanchetta et al., 2012b) even though changes in hydrological conditions also can be human induced (Hunt, 1998). By combining isotope analysis with pollen analysis from the same lake, the potential to distinguish between competing processes behind observed changes can however be increased (Sadori et al., 2015b). These in turn can then be used to interpret the pollen diagrams, which reflect both climatic and anthropogenic impacts. In the absence of an instrumental physical record of past weather conditions, historical sources are of great importance. Historical

documentation allows us to identify extreme events that severely stressed human and natural systems, such as droughts and floods.

Variations in the hydrological cycle are very important when discussing the Mediterranean region, as the availability of water has always been crucial for both societies and ecosystems. Unfortunately, well-dated and detailed records of past environmental conditions are rather scarce and are rarely taken into full account when studying the societal impact of climatic changes. There have, as yet, been rare attempts to integrate the environmental records of the past with the available historical records of extreme events (Woodward and Lewin, 1995; see also Bersani and Bencivenga, 2001; Camuffo and Enzi, 1994, 1995 as they are used in Giraudi, 2014 and Pepe et al., 2013).

We have decided, in the present study, to make the inland site of Lago di Pergusa (Enna, central Sicily) our key reference site for all of Sicily and southern Italy. There are two reasons for this choice. First of all, this lake is particularly sensitive to climatic changes, which is clearly visible in its well-dated high-resolution isotopic data for the last two millennia, which is published here for the first time. Second, the territory around Lago di Pergusa witnessed significant and continuous human occupation over the course of the past two millennia; this, combined with pollen data from Pergusa (Sadori et al., 2013), provides us with an excellent multi-proxy record through which we may investigate the role of climatic fluctuations within the socio-economic history of the region.

Pollen data has often been misused to assess either the degree of climate change, or the level of human involvement. In fact, the vegetation record is the result of both human and natural factors (Mercuri, 2014), and they can be difficult to disentangle using either archaeobotany (Mercuri et al., 2015) or palynology alone. A forest opening, for instance, may have been caused by climate change, but it could just as easily have been the result of wood cutting. In more complicated cases, an increase in ruderal pollen curves may be caused by either a lowering in the lake level or an increase in human activity (Sadori et al., 2013, p. 1980, 1981). By contrast, stable isotopes on lacustrine deposits tend to be less affected by human impact (see discussion in Roberts et al., 2008, 2011; Zanchetta et al., 2012b) and are therefore better indicators of hydrological variability – including evaporation processes – within the catchment area of the lake. It is important to remember that bulk carbonate is chiefly indicative of spring–summer conditions, when algal bloom promotes carbonate precipitation (Leng and Marshall, 2004), even if the isotopic composition of the lake water is also affected by the winter recharge. In the Mediterranean region, it has in fact been demonstrated that the amount of rainfall and the residence time of water in lakes both determine the final oxygen isotope composition of the lake carbonates (e.g., Roberts et al., 2008). Consequently, higher isotopic values are usually considered to indicate drier phases, whereas lower values indicate the opposite (e.g. Leng et al.,

**Table 1**  
Key dates in the history of South Italy, AD 1–2000.

Year AD	Key events and reigns
440	After six centuries of peace, South Italy becomes target of the Vandal attacks
476	The dissolution of the Western Roman Empire; South Italy becomes part of the Italian state of Odoacer and Theodoric the Great
535	South Italy is conquered by the Eastern Roman Empire (Byzantium); for the next two decades, the peninsula suffers devastating warfare, Sicily remains largely intact
568	The Lombards invade Italy and subsequently create one of their states in inland South Italy; Sicily remains intact and continues to be a Byzantine province
827	Start of the Islamic conquest of Sicily
878	Syracuse conquered by the Arabs; the end of the Byzantine province of Sicily
1091	The Normans complete the conquest of Sicily; in subsequent decades they unite South Italy in one Christian kingdom
1282	The rebellion of the Sicilian Vespers: as a result Sicily becomes a separate political entity as opposed to the Kingdom of Naples
1347	Black Death comes to Sicily for the first time
1494	Kingdoms of Sicily and Naples united by the king of Aragon (Spain)

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