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"Lost" postglacial littoral environments in SE Italy: Anthracological evidence at Grotta delle Mura

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ABSTRACT

Research on charcoal remains from prehistoric caves located in the south Adriatic-Sea coast reveals the regional palaeovegetation composition and its strong relationship to rapid changes of the eustatic sea level, during the last glacial–interglacial cycle and early Holocene. We intend to characterize biogeographical conditions mechanically disturbed by the glacial–interglacial transgressive eustatic level, which destroyed the trees and shrubs managed by prehistoric Adriatic human populations. Thus it appears that some ligneous taxa, such as deciduous taxa (*Quercus*, Prunoideae, etc.) and the genus *Pistacia*, may be considered markers of the rapid eustatic changes within this littoral environment.

1. Introduction

The concept of climate-induced glacial tree refugia (Schönswetter et al., 2005) stimulates the collection of new data and critical discussions on the ecological dynamics of woody vegetation enduring the last glacial climate and successive postglacial cycle in the Mediterranean Basin.

Littoral caves, where *Homo sapiens neanderthalensis* and *Homo sapiens sapiens* have been living for tens of thousands of years, mostly profiting from the natural resources provided by littoral plains, may represent very important archives of past plant remains for the last glacial period (Cortes-Sanchez et al., 2008), and provide new contributions on the ongoing discussions (Willis and Whittaker, 2000; Tzedakis et al., 2002; Bennett and Provan, 2008; Magri, 2008). In particular, they can record the development of the coastal vegetation during glacial times when the sea level was lower than at present, and large extensions of land were available for plant populations. These "lost areas" are possible candidates for the location of refuge areas of evergreen and deciduous trees and shrubs during glacial times. During the non linear eustatic glacial–interglacial transgression following the last glacial maximum (LGM), sea level rise became a limiting factor for the survival of coastal plant communities (Cortes-Sanchez et al., 2008), as it affected the availability of land for human occupation (Shackleton et al., 1984) and determined new vegetation spatial dynamics.

However, very few coastal Adriatic caves have been palaeobotanically investigated so far (Follieri, 1968; Hansen, 1991, 2001; Maspero, 2004; Fiorentino, 2012), since the sea, showing multiple oscillations through the last glacial–interglacial transition, eroded and submerged most of them. Differently from pollen, which may be wind-transported from distant origins and represents regional vegetation, charcoal remains in caves are most useful to study the local vegetation, as their presence testifies to the activity of human communities exploiting woody taxa from nearby catchments (Vernet, 1997). Following the "principle of least effort" (Shackleton and Prins, 1992), ancient man used to collect local trees and shrubs to warm themselves, to cook, and produce objects.

In order to contribute with paleobotanical data to the knowledge of littoral refugia in southern Europe we present new anthracological data from Grotta delle Mura (GdM), a partially submerged cave in the Italian coast of the south Adriatic Sea (Fig. 1), where human occupation chronologically spanned from ca. 34,000 to 9000 cal BP.

2. Study area

Grotta delle Mura (GdM) (40°57′28″N, 17°18′47″E) is located in the Apulia region near Monopoli (Bari). It lies at the sea level, facing the Adriatic Sea (Fig. 2). The geological setting of the area is characterized by a thick Paleozoic–Mesozoic continental substrate (Praturlon, 1980), overlain by Ceno-Neozoic (Quaternary) strata (Boni et al., 1969; Ciaranfi et al., 1988). This plateau, the Murge, is characterised by

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Fig. 1. Entrance of the GdM cave from the sea.

outcrops of the Apulian foreland. It is a broad flat calcareous ridge lying on a NW–SE axis, bounded to the East by a succession of terraces sloping down towards the Adriatic sea and to the West by a morphotectonic scarp facing the Bradano foredeep (Fiorentino et al., 2013). Its maximum altitude exceeds 600 m in the western area, known as Murge Alte (High Murge). The western Murge Alte is characterised by a treeless, stony landscape with a honeycomb of large karst depressions, from hundreds of metres to a few kilometres in diameter, crossed by an erratic, inactive river network. The south-eastern High Murge is less rugged, partly as a result of centuries of cultivation.

The Murge Basse consists of a series of flat surfaces gradually sloping down towards the Adriatic Sea. The Quaternary sea-level oscillations caused these areas to be repeatedly submerged; marine abrasion levelled the surfaces and marine deposits filled in the karst depressions. As a result, these areas today are flat, with an almost continuous coverage of sediments whose nature is calcarenitic, sandy and sandy-clayey. The coastal area near GdM is characteristically built up by gently sloping limestone cliffs (5 m high), degrading in a plane continental platform, reaching 100 m below the sea level around 18 km offshore (Fig. 3).

From a bioclimatic point of view, the cave is included within a typical Mediterranean climate region (Lionello, 2012), type *Csa* according Köppen (1923). It is characterized by summer droughts and precipitations mostly provided by winter fronts crossing western Europe from the Atlantic Ocean. The mean annual temperature of the region ranges

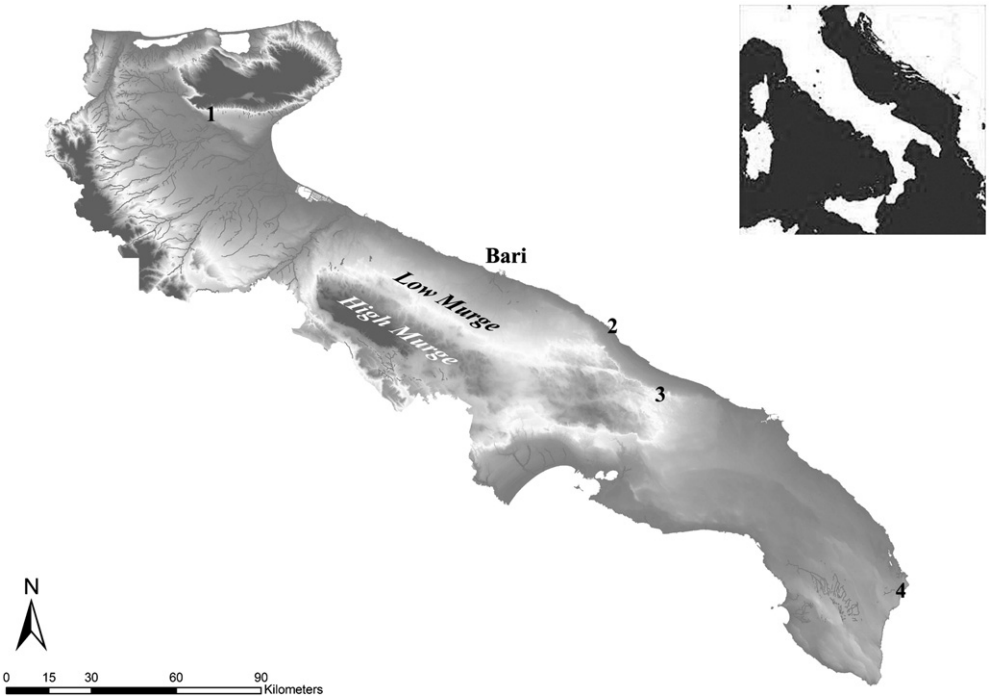

Fig. 2. Map of the Apulian region with the position of the principal caves with anthracological analysis: 1) Grotta Pagliacci, 2) Grotta delle Mura, 3) Grotta Santa Maria di Agnano, and 4) Grotta Romanelli.