

# The Long-Term Human-Mediated Success of Olive Trees in the Central Mediterranean: A Multiproxy Perspective

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**Abstract** – This study investigates the long-term ecological history of olive trees (*Olea europaea*) in the Central Mediterranean through a high-resolution multiproxy analysis of sediment cores from Pantano Grande (a.k.a. Lago Ganzirri, northeastern Sicily). Integrating palynological, geochemical, and archaeological data, the research reconstructs 3700 years of land-use dynamics, highlighting the role of human societies in driving olive trees propagation. Major phases of expansion, decline, and resilience of *Olea* correspond to significant historical transitions, including the Bronze Age collapse, Greek colonization, Roman agricultural intensification, and post-medieval resurgence. The results underscore the adaptability of olive-based agroecosystems and their sensitivity to both climatic and sociopolitical change. This work contributes to understanding long-term human-environment interactions and the ecological legacy of ancient land use practices.

## I. INTRODUCTION

The long-term history of olive tree (*Olea europaea*) cultivation provides essential insights into the complex relationship between human societies and Mediterranean landscapes [1]. This summary presents the main findings from a high-resolution paleoenvironmental study conducted in northeastern Sicily, specifically at Pantano Grande (a.k.a. Lago di Ganzirri). The research integrates palynological, geochemical, archaeological, and historical evidence to reconstruct land-use dynamics, climate variability, and the ecological history of olive trees over the last 3700 years. The data discussed here are based on the previously published works of Palli and colleagues [2, 3].

## II. STUDY SITE AND METHODOLOGY

The sediment core analyzed was retrieved from Pantano Grande, a coastal marsh located in the Messina Strait region, a historically significant corridor of trade and

cultural interaction (Fig. 1).

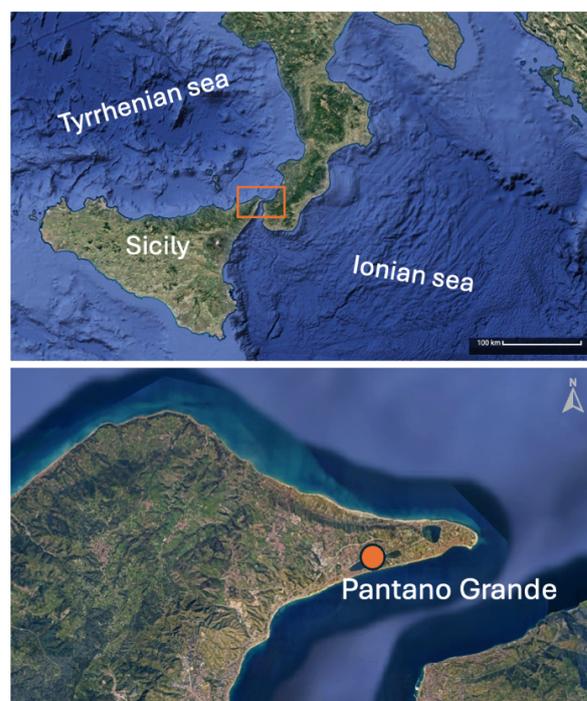
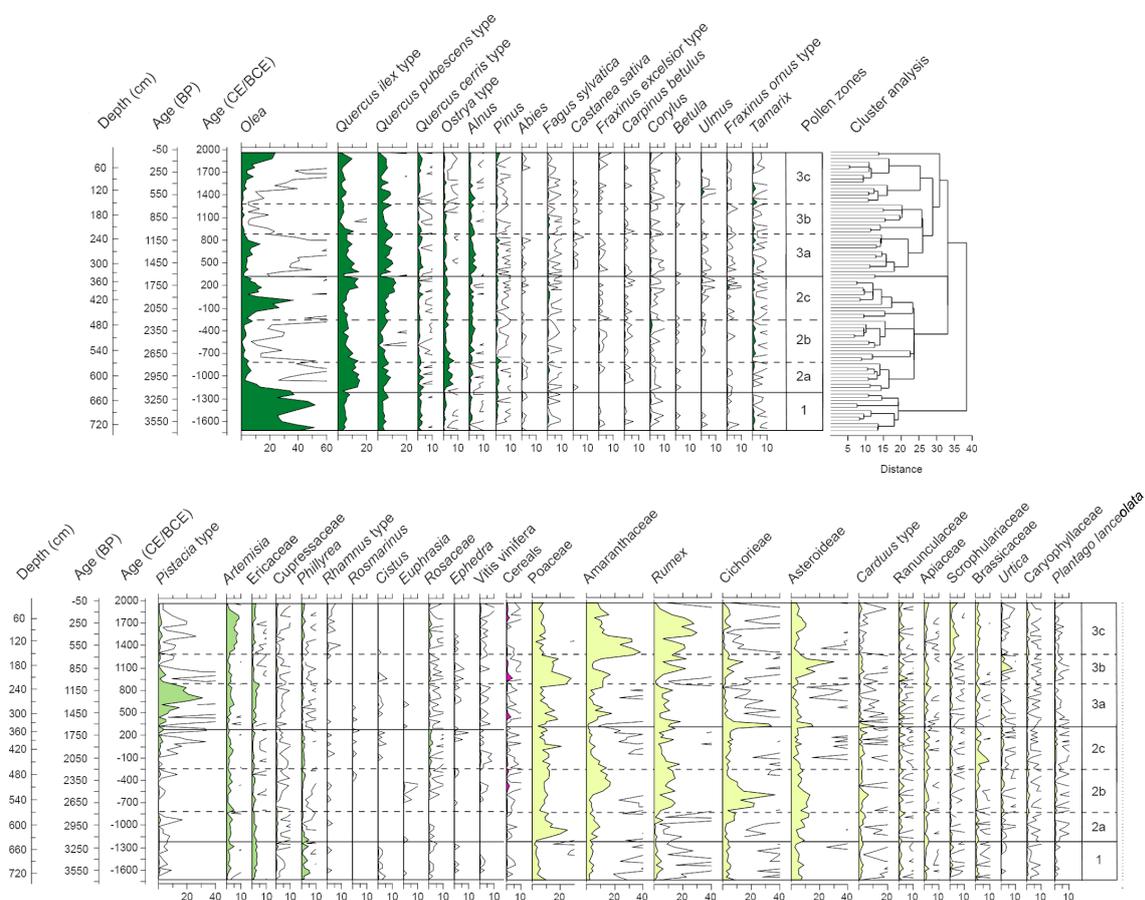


Fig. 1. Location of the study site Pantano Grande in the Mediterranean basin

A ~730 cm-long core was dated using radiocarbon dating on plant remains and geochemical fingerprinting of two tephra layers [2]. Pollen, microcharcoal, and sedimentological analyses were conducted to reconstruct land use patterns and natural vegetation dynamics. The temporal resolution allows the identification of anthropogenic and climatic drivers of landscape transformation.

### III. RESULTS

agricultural intensification, testified by increased



The high-resolution and continuous palynological sequence give an exceptional view of palaeoenvironmental and historical events. In particular, the pollen data allows to distinguish 6 phases, supported by clustering analysis (Fig. 2) [3].

- **Middle Bronze Age (ca. 3700 cal BP):** The earliest major increase in *Olea europaea* pollen is recorded, suggesting early human-driven olive trees propagation, likely associated with Middle Bronze Age societies. This anthropogenic signal coincides with archaeological evidence of local settlements and cultural connections between Sicily and the Aegean.
- **Late Bronze Age Collapse (ca. 3200 cal BP):** A sharp decline in olive pollen corresponds with broader regional crises and the arrival of Italic groups (e.g. Ausons). This collapse reflects a breakdown in land management systems and potential demographic decline, which also coincided with a massive Etna eruption (FL event).
- **Archaic and Classical Periods (ca. 2700–2500 cal BP):** The foundation of Greek colonies is associated with widespread land clearance and

cereal pollen percentages. Reduced occurrences of forest trees pollen supports the notion of landscape openness and intensified land use activity.

- **Roman Period (ca. 2100–1700 cal BP):** Olive pollen resumes, suggesting extensive olive cultivation, supported by archaeological evidence (e.g. olive presses, olive oil remains on pottery). Climatic stability and political organization likely favored agricultural expansion.
- **Late Antiquity and Early Medieval Periods:** A marked decline in *Olea* pollen may reflect sociopolitical changes, land abandonment, and rewilding. Nevertheless, olive trees persisted in the landscape, indicating the presence of wild or semi-natural nuclei which persisted in the area
- **Post-Medieval to Modern Era:** A renewed increase in *Olea* and cereal pollen reflects agricultural resurgence and demographic recovery. The data indicates the emergence of large-scale cultivation across Sicily and many other localities in Central Mediterranean. The

long-term history of olive cultivation testifies for the dynamic interaction between human societies and the environment across millennia.

#### IV. DISCUSSION

The results highlight the role of olive trees as both anthropogenic indicators and economic staples in the Central Mediterranean [4]. Human agency has been pivotal in shaping the success of *Olea europaea* over other Mediterranean wild plant species, while climatic shifts and historical disruptions modulated its cultivation. The integration of multiproxy data (see Figure 5 [3]) reveals a nuanced picture of continuity, collapse, and resilience in the landscape of central Mediterranean since the Middle Bronze Age.

In particular, the use of fossil pollen as a proxy allows for a direct link between vegetation change and human land use, especially in the case of cultivated species such as the olive tree [5, 6, 7]. The archaeological and textual evidence integrated into the study enhances the interpretive power of the palynological signal, reinforcing the association between olive peaks and socio-economic intensification phases, as shown in the pollen diagram (Fig. 2).

The collapse events, such as those around 3200 BP, mark periods when environmental stress or sociopolitical instability disrupted agricultural systems. Yet, the quick resumption of olive cultivation in subsequent periods—Roman and Modern times—demonstrates the high value attributed to the olive tree, both economically and symbolically as also attested by archaeological evidence from Roman Sicily [8].

Moreover, the study draws attention to the resilience of cultivated olive populations after phases of demographic decline and land abandonment. The persistence of the olive signal in pollen records, albeit reduced, attests to the ability of this species to easily occupy the niche of other similar sclerophyllous plants during phases when it is favored by human intervention. When this facilitation ends, the system tends to re-establish itself by recreating the balance in which *Olea* is just one component of the scrubland, equal to the others. Stratigraphic data (Fig. 2) confirm the continuous presence of olive remains even during phases of political instability and population decline [2].

By the post-medieval period, olive cultivation had again expanded, aligning with historical accounts of agricultural reforms and land reclamation. This long-term dataset thus provides a robust narrative of landscape transformation that is invaluable for both environmental history and conservation planning.

#### V. CONCLUSIONS

This study underscores the value of long-term ecological records for understanding the historical ecology of a key cultivated species in the Mediterranean area. Olive trees exemplify the enduring imprint of human activity on Mediterranean landscapes, revealing adaptive strategies and vulnerabilities across changing social and environmental contexts. The continuity of *Olea europaea* cultivation across 3700 years highlights both human ingenuity and the ecological significance of this culturally important species.

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