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## **Tree-rings of Heldreich's pines growing on the Pollino Massif reveal the history of environmental changes in the Anthropocene**

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Tree growth patterns associated with extreme longevity: implications for the ecology and conservation of primeval trees in Mediterranean mountains. Anthropocene,

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### **Press release**

Discovering, studying and conserving old trees is a top priority for conservation biology because arboreal patriarchs have an irreplaceable landscape and ecological role. Moreover, old trees are unique natural archives for the reconstruction of the history of the environment.

A multi-year research funded by the Pollino National Park and coordinated by the University of Tuscia, that will be published soon by the international review Anthropocene have reconstructed the ecological history of the iconic Heldreich's pines in the Calabrian-Lucanian Apennines during the last millennium disentangling the effect of climate and people.

### **The discovery and reconstruction of the growth processes of the old pine population**

The multi-year campaign of dendroecological surveys has shown that cliff environments represent a conservative habitat of millennium old trees (e.g. age > 900 years). Thanks to an isolated location, in these rugged and steep environments the millenary pines live protected from direct anthropogenic disturbances such as cuts and fires. This study confirmed that cliffs are conservative habitats not only of endemic and rare species, but also of very old trees and shrubs. The rule for becoming a millennial tree is therefore to grow in remote environments and at a very slow rate (e.g. ring with rings about 0.5 mm). Trees that grow faster because of their location in more fertile lands become monumental in faster times, but due to a more vigorous growth they do not seem to have the ability to reach millennial ages as evidenced by the maximum age of large and impressive pines that are around 500-600 years old. It is interesting to note that, however, other pines of the same age (500-600 years) - but growing on cliffs and therefore of non-monumental dimensions (for

example of 70-80 cm of diameter) show trajectories of growth comparable with those of the millennial pines.

## **Historical ecology**

The Middle Ages represented a period of deep transformation of the forest landscape for Europe. In these centuries the mountains also suffered profound and widespread deforestation to make room for grasslands. However, in the case of the Pollino massif, some very remote areas have miraculously remained intact as witnessed by the presence of millennium-old pines. However the delightful landscape of the monumental open pine forests has its roots in more recent times ie in the late Middle Ages/Renaissance, when, following the demographic crisis of the 1300s, due to famines, wars and epidemics, the anthropic pressure on the mountain territory decreases. The land abandonment translates into a process of diffuse tree establishment favored also by an persisting negative phase of the North Atlantic Oscillation determining in the same period (1300-1600) a strong climatic deterioration.

However, from the end of the 1400s the reconquest of the Pollino by man finds a new demographic push also in the colonization of the Arbëreshë. The Albanians defeated by the Ottomans were forced to emigrate to Italy where they find hospitality in territories of the Kingdom of Naples founding new villages on the abandoned slopes of the Pollino Massif, a sort of “Far West”. With the repopulation of the massif and therefore the resumption of pastoralism, the expansion of the pine in the high mountain prairies slows down. However, many trees were left untouched by a widespread revival of human activities.

## **Climate changes**

But there was not only man to condition the life of these old trees. The older ones went through three major climate changes, namely the Warm medieval period, the Little ice age and finally the current warming, demonstrating a high plasticity for acclimation. Starting from 1850 the growth of these pines occurs in an almost perfect phase with the Atlantic multidecadal oscillation (AMO). However, this synchronization between the AMO and low frequency cycles of pine growth seems to begin with the industrial revolution.

## **Old trees status and their role in biodiversity conservation and climate change mitigation**

Turning to the present day, the good news is that Park these old pines have resumed growing surprisingly vigorously coming out of a dieback period (from 50s to 80s). This recently observed growth increases counter widespread reports of tree and forest decline in Mediterranean environments, and suggest that extreme longevity does not necessarily reduce stem increment.

In recent decades the pine tree has been reconquering many high mountain grasslands from which it was eliminated to make room for herding. The dissemination of old pines growing on cliffs is once again guaranteeing large-scale rewilding processes ensuring the conservation of rare species such as the *Buprestis splendens*, a beetle extinct from almost all the forests of Europe, found the last summer right in the vicinity of *Italus*, the oldest dated tree of Europe (1230 years).

However, unlike the late Middle Ages-Renaissance this time the wave of pine recruitment is not linked to a demographic crisis, but to a profound change in the socio-economic structures of the Mediterranean mountains that became a marginal territory destined to depopulation.

The foundation of the Pollino National Park is an important page of nature conservation that has its roots in conscious, though complex, choices of land use. The decision to leave the natural dynamics of large mountain areas is proving to be far-sighted as it will contribute to overcoming the great environmental challenges such as the conservation of biodiversity and the mitigation of climate change. These old habitat trees will guarantee the integrity of the trophic chains and their wood fix the CO<sub>2</sub> for centuries, in some cases even for over a millennium. A walk in these beautiful landscapes of rewilding thus becomes a healthy moment of regeneration of spirit and body. The case of the old Heldreich's pines witness of the Anthropocene can become another pivotal moment in the ecotourism route of the Pollino Park with the aim of relaunching the mountain economies of a territory of inestimable value where nature, art and culture often intertwine in such a way harmonic. The qualified governance of the Pollino Park is a candidate to become a reference model for the study and conservation of biodiversity in Mediterranean mountain environments, a case study that will be made known by the Italian Mountain Lab project.

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