An ecological history of resilience and rewilding of a tall forest in southern Italy

September 5 2024, by Jordan Palli

Understory of the secondary old-growth beech-fir forest in Gariglione (Sila National Park, southern Italy). Credit: Gianluca Piovesan

Human disturbance has altered the integrity and functionality of forests throughout the globe, with the greatest impact on regions characterized

by historical human cultural development and long-term natural resource exploitation. This is the case in the Mediterranean Basin, where terrestrial ecosystems have been shaped and simplified for thousands of years.

The challenge today is to restore primeval habitats and ecosystems through the implementation of effective recovery strategies based on actual dynamics of compositional, structural and functional recovery. Such knowledge would be pivotal to meeting biodiversity conservation and climate change mitigation targets.

A new study performed in southern Italy and published in *Science of the Total Environment*, reveals the patterns and processes of forest regrowth and ecological recovery in an open-air laboratory: the Gariglione Forest in the Sila National Park. This mixed beech-fir forest was extensively harvested between 1930 and 1950, removing up to 91% of the biomass to respond to the market's growing demand for wood.

After this period, the forest was managed using conservation practices and then led to passive rewilding. Today, Gariglione features a tall structure (up to 40 m in height), a complex vertical profile and secondary old-growth traits.

A team of researchers at the University of Tuscia, Accademia Italiana di Scienze Forestali and the University of Calabria in collaboration with the Sila National Park have reconstructed growth histories, climate-growth relationships and time-series of growth dominance of trees in the Gariglione Forest, revealing the mechanism of species and ecosystem resilience to large-scale perturbations in a hotspot of biodiversity and climate change.

"The presence of historical records describing the Gariglione Forest before the intense wood harvest along with detailed documentation about

harvesting operations, offered a unique chance to reconstruct and analyze patterns of forest biomass recovery after extensive and intensive disturbance," explains Gianluca Piovesan, Professor of Silviculture and Ecological Forest Planning at the University of Tuscia and coordinator of the study.

Vertical profile in the Gariglione Forest (Sila National Park, southern Italy). Credit: Gianluca Piovesan

Results indicate the role of trees that survived cuts in restoring a tall and complex forest structure in less than a century. "The presence of two late successional co-dominant species (beech and fir) has supported a quick forest regeneration and conferred community stability over the last decades," adds Michele Baliva, dendrochronologist at the University of Tuscia and first author of the study. The post-harvesting fir regeneration had a key role in the ecosystem restoration.

The study has also investigated long-term growth trends and the influence of climate change on tree growth in a network of mature and old-growth beech forests in southern Italy. Stand dynamics in the Gariglione beech forest show recent negative productivity trends in advanced rewilding stages.

Surprisingly, forests located at lower elevations showed increasing mean growth in the last decades, while high-mountain forests displayed a remarkably stable low oscillating growth. Also, the analysis of growth dominance revealed that large and old trees are showing growth acclimation despite increased aridity, demonstrating the importance of complex natural ecosystems in facing global changes.

The history of the Gariglione Forest is an example of the effective restoration of forest integrity in the Mediterranean mountains and win-win integration of environmental and social systems. Today, more than ever, it is strategic to guarantee strict protection to secondary old-growth forests.

"We would like to propose the inclusion of Gariglione in the World

Heritage Serial Site Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe because it is a unique example of resilience to human and global change disturbances in a Mediterranean mountain environment located at the extreme southern edge of the distribution of beech, fir and other temperate tree species," concludes Piovesan.

More information: Michele Baliva et al, The return of tall forests: Reconstructing the canopy resilience of an extensively harvested primary forest in Mediterranean mountains, *Science of The Total Environment* (2024). DOI: 10.1016/j.scitotenv.2024.175806

Provided by University of Tuscia

Citation: An ecological history of resilience and rewilding of a tall forest in southern Italy (2024, September 5) retrieved 5 September 2024 from https://phys.org/news/2024-09-ecological-history-resilience-rewilding-tall.html

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