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History of Forest fires and resin tapping as a tool in the management of the Varibobi forest

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Abstract This study examines the historical interrelation between forest fires and resin tapping in the Varibobi forest, which was significantly affected by the devastating fire of 2021. By analyzing tree-ring widths and chronology from both unburned and burned Aleppo pine stands, we identified and dated instances of fire and resin tapping. Our findings highlight the beneficial role of traditional resin tapping practices in mitigating forest fires and underline the importance of integrating such practices into forest management strategies.

Keywords: dendrochronology, Aleppo pine, climate change

1. Introduction

In 2021, devastating summer fires ravaged extensive areas of forests and agricultural land across the country, affecting more than 120,000 hectares. Notably, in NE Attica, the Varybobi fire consumed approximately 8,370 hectares of mixed urban and forested regions, leading to significant ecological and economic negative consequences. In response to this disaster, the *Baribobi-Reset* project initiated a comprehensive study focusing on the history of forest fires and resin tapping of Aleppo pine in the affected areas. This study aims to gather historical management data and ecological insights to contribute to sustainable forest management in the face of climate change.

2. Materials and Method

The study area is a forested area of, predominantly, Aleppo pine stands, both burnt and unburnt. Within this area, three distinct cases of Aleppo pine forests were identified for analysis: *1. Control Stand (Unburnt)*: This stand consists of Aleppo pine trees that exhibit no signs of fire damage or resin tapping in their trunks from previous years. *2. Slightly Burnt Stand*: The second case features Aleppo pine trees that show only minor traces of past fires on their trunks. *3. Stand with aparent signs of resin tapping*. The stands with trees that had obvious signs of previous fires or resin tapping, were chosen to be in locations of burnt Aleppo pine trees that were being cleared to facilitate the collection of cross-sectional samples from the trunks. All three sites share similar climatic and topographical conditions, with Aleppo pine stands of similar age and structure, the first and the second one in the location *Ktima Tatoiou* and the thrird one in the *Kapandriti*.

From the control stand, 14 dominant trees were selected to be sampled, with no oblvious signs of prunnings or injuries. Two tree-rings per tree and a total of 28 tree-ring cores were taken with the help of a Pressler-type core borer. The first sample was taken on the north side and the second on the south side of each tree. From the stands of burnt trees that showed signs of previous fires or resin tapping, 10 cross-sections were taken respectively at approximately breast height.

The radial increments or the cross-sections were prepared and cross-dated using dendrochronological techniques (Stokes and Smiley 1968; Yamaguchi 1991; Maxwell et al. 2011, Schweingruber, 1996). Subsequently, the tree-ring widths were measured to the nearest 0.001 mm using the program Windendro V. 2008g program (Regent Instruments Canada Inc., 2007). The cross-dating was statistically tested using the *Cofecha* program. Scars of fires and resin tapping were then identified in the dated samples and their history was reconstructed. Finally, from the time series of tree ring widths, the dynamics of the growth of these Aleppo pine forests were investigated and evaluated in the context of the new conditions formed by climate change.

3. Results – Discussion

A mean time series of tree-ring widths was developed for each group of trees (“without scars-control”, “with fire scars” and “with resin tapping scars”), the statistics of which are shown in Table 1.

Table 1. Descriptive statistics of the raw tree-ring width chronologies

	Trees without scars	Trees with fire scars	Trees with resin tapping scars
Number of trees (radii)	14 (28)	10	10
Period A.D.	1936-2022	1931-2020	1914-2020
Chronology length (years)	87	90	107
Mean ring width (mm)	2.03	2.45	2,01
Standard deviation	1.25	1.36	1,34
Mean sensitivity	0.28	0.28	0.28
First-order autocorrelation	0.79	0.73	0.81

Based on the dating of the trees with previous forest fire scars, only one forest fire was evidenced, the one in 1987. That year occured the first, in recorded history, deadly heatwave in Greece. From 20 to 31 July, the prolonged heat wave resulted in the death of at least 1,300 people in the Attica area. As far as resin tapping scars are concerned, these are shown per tree in Figure 1. This shows the year in which the resin tapping started, the number of resin-tapping fronts and the method of resin tapping method. Resin tapping in the studied stand started in the period 1936-1937 with the method of chipping, which, after 1972-1973, was continued with the method of peeling and the use of sulphuric acid paste. Resin tapping ceased in the stand towards the end of the 1980s. No traces of previous fires were found in the resin-tapped trees.

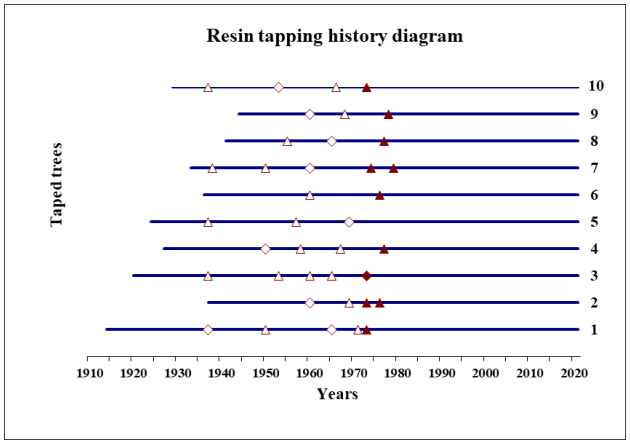

Figure 1. Chronology of tapped trees (line). Triangles indicate the year of face open (by dark triangles the chipping method, by fair the debarking one).

According to the diagram of the tree-ring widths data for the three groups of trees (Fig. 2), there is no difference in the radial growth of Aleppo pine trees until the 1980s, when resin extraction ceased, but also after that time, as it was shown in the Evia region (Papadopoulos 2013). An exception to this is the positive response, in terms of the growth behavior of the remaining burnt stand trees, after the 1987 fire for the following 5-10 years. This release is defined as an abrupt or sustained increase in radial growth which occurs in understory trees after removal of the canopy (release from suppression) or in canopy trees when one or more neighboring trees are removed (Lorimer and Frelich 1989; Johnson and Gutsell 1994).

The mean increase in tree-ring width is generally small, ranging from 2.01-2.45 mm, especially in the last decade, it is around 1 mm, indicating a decline of the trees. Considering the relatively high climate sensitivity of the forests, as indicated by the value of the mean sensitivity index (0.28), it seems that the decrease in rainfall and increase in temperature and drought expected with climate change (Bank of Greece 2011) will negatively affect the area's Aleppo pine forests.

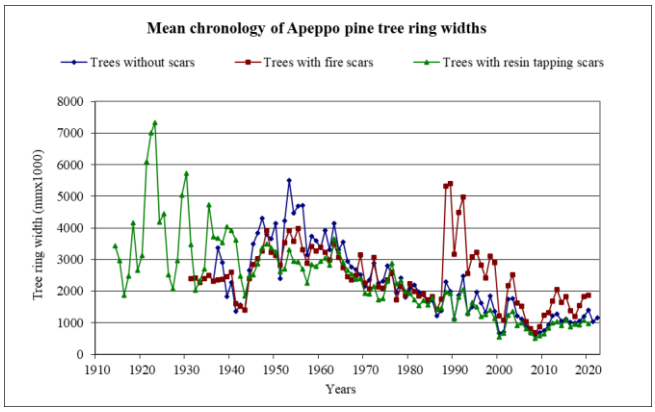

Figure 2. Mean chronologies of tree ring widths of 3 group of trees (without scars, with fire scars and resin tapping scars.

From the analysis of the history of these trees it appears that no forest fires have occurred in the stand of resin-tapped trees in the last 100 years, which shows that resin tapping, as a traditional economic activity, contributes positively to the protection of Aleppo pine forests from fires. Generally, the presence of humans in the forest and the activity of resin tapping, controlled grazing and beekeeping has an adverse effect on forest fires. It is therefore necessary to include resin tapping and other traditional uses in the management plans of these forests, in the interests of both production and fire protection.

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