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Functional strategies of major trees species across Italian pyroregions

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Fire disturbance operates as a global eco-evolutionary force, especially in mediterranean-type ecosystems, affecting plant species persistence and distribution. Pyrogeographic studies so far have identified pyroregions based on their similarity in climate and fire regime parameters. However, which fire-related traits tend to promote or hinder plant species persistence and distribution in different pyroregions remains underexplored. Here, based on a recent pyroregionalization for Italy (Elia et al 2022) we tested whether 1) species in different pyroregions **exhibit distinct fire-related trait values**, and, if so, 2) trait differences **suggest better abilities to cope with fire** and aridity in species distributed in more fire-prone regions

Data and methods

- Pyroregions from Elia et al. 2022 (built upon metrics of fire density, seasonality and severity).
- Species distribution across pyroregions by using data from the Italian Forest Inventory (focus on the 38 major tree species)
- Species values for fire-related traits (bark thickness, wood density, maximum height and resprouting capacity) extracted from literature (e.g. BROT database).
- Kruskal-Wallis test followed by a Dunn's Post-Hoc Test with Bonferroni correction (for categorical traits we performed a z-test for equal proportions)

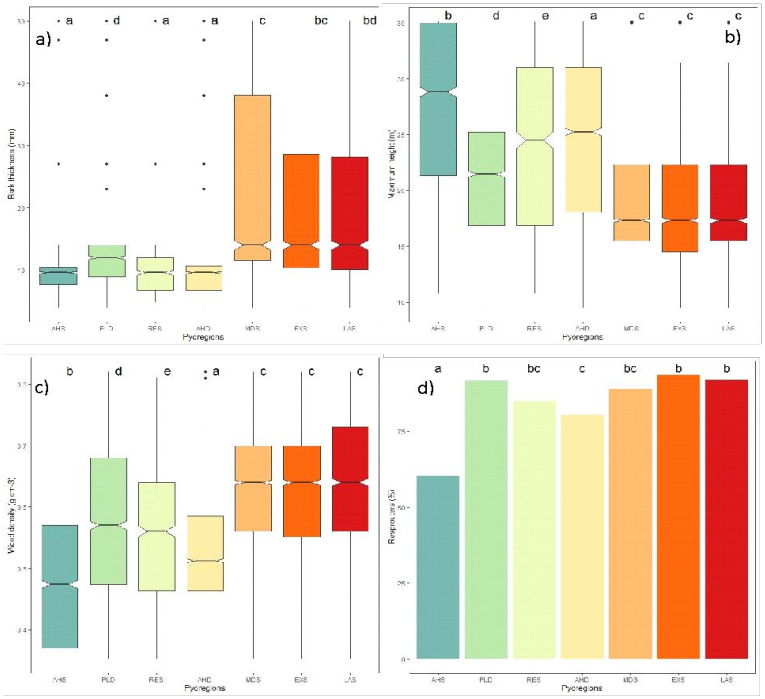

Figure 2. Boxplots showing the distribution of plant functional traits across pyroregions ordered along a fire-proneness gradient increasing from left to right (see **Fig. 1** for their location across the country). A) Bark thickness; B) Maximum height; C) Wood density; D) Resprouting capacity. Different letters identify significant differences (p-value ≤ 0.05).

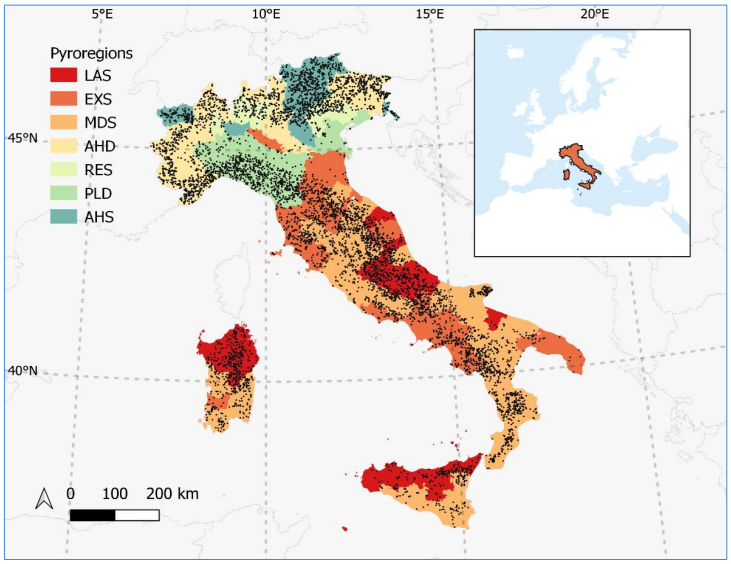

Figure 1. Italian pyroregions and forest plots. Italian administrative provinces grouped into the pyroregions proposed by Elia et al. (2022) based on fire regime metrics such as annual burnt area, fire frequency, seasonality and severity. Pyroregion colors represent an annual burnt area gradient indicative of fire proneness (red = more fire prone; green = less fire prone). Dots represent the location of study plots from the Italian Forest Inventory (IFI). Large summer wildfires (LAS), Extreme stand-replacing summer wildfire (EXS), Medium-density summer wildfires (MDS), Alpine high-density wildfires (AHD), Reduced stand-replacing wildfires (RES), Subalpine low-density wildfires (PLD), and Alpine High Stand-replacing wildfires (AHS).

Results

Plant functional trait values vary across pyroregions (**Fig. 2**) with some identifiable patterns; species in the most fire-prone pyroregions (LAS, EXS, MDS) are generally characterized by similar plant functional traits (BT, MH, WD), which however largely differ from trait values in the other four less fire-prone pyroregions (AHD, AHS, PLD, RES). BT and WD significantly increase along the fire-proneness gradient (i.e. higher values in more fire-prone pyroregions), whereas MH decreases (**Fig. 2**). RC instead shows no relationships (p-value = 0.4).

Conclusions

- Gain insights into which plant functional strategies tend to be advantageous across different fire regimens.
- Species distributed in more fire-prone and more arid pyroregions are characterized by trait values indicative of enhanced abilities to cope with fire and aridity (thicker barks and denser woods).
- We did not reveal a clear pattern for resprouting capacity .
- Future pyroregionalization exercises may explicitly include fire-related traits.

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