frontiers | Frontiers in Ecology and Evolution

TYPE Editorial
PUBLISHED 13 June 2023
DOI 10.3389/fevo.2023.1230753

OPEN ACCESS

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RECEIVED 29 May 2023
ACCEPTED 05 June 2023
PUBLISHED 13 June 2023

CITATION
Altieri S, Valor T and Battipaglia G (2023) Editorial: Forest adaptation to extreme environments and climate changes. *Front. Ecol. Evol.* 11:1230753.
doi: 10.3389/fevo.2023.1230753

Editorial: Forest adaptation to extreme environments and climate changes

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KEYWORDS

forests, climate changes, tree adaptations, extreme events, forest management

Editorial on the Research Topic
Forest adaptation to extreme environments and climate changes

Trees have a strong adaptive capacity to external events that may occur in the growing environment, even to extreme ones such as those related to climate change (Kijowska-Oberc et al., 2020). In recent decades, strong changes in precipitation and temperature patterns have been greatly stressing our forests, putting them under great strain by exposing them to events such as droughts, heat waves, storms, and flooding (IPCC 2021), thus leading to severe consequences such as the loss of productivity and carbon stock capacity (Keenan, 2015). Therefore, it is very important to understand forest adaptation mechanisms in order to eventually monitor early-warning signals of forest vulnerability and thus to assess management activities to mitigate the negative effects of extreme events (Vilà-Cabrera et al., 2018; Vacek et al., 2023).

Many studies have addressed this issue, moving from the analysis of the climatic and forest structure variables that rule the radial growth (Candel-Pérez et al., 2022) and passing through the investigation of the alteration of physiological rates (García-Valdés et al., 2020) to the study of the processes that induce trees mortality linked to drought and heat conditions (Allen et al., 2010).

The papers collected in this Research Topic cover different subjects and with different methodologies of approach, but all of them are related by a common element, which is the analysis of the mechanism of forest adaptation to disturbance elements linked to climate change.

Alfaro-Sánchez et al. assessed the drivers of reproductive maturity in two dominant and widespread boreal conifers, black spruce (*Picea mariana* Mill) and jack pine (*Pinus banksiana* Lamb), in two distinct ecozones of the Northwest Territories (NWT) in Canada, a region that is strongly impacted by an increasing severity and frequency of fires. The authors understood that multiple factors play a role in determining the post-fire resilience of the analyzed species, i.e., the fire severity and geomorphological characteristics of the site. They found that the reproductive efficiency of jack pine was three times greater than that of black spruce for a lower post-fire seedling recruitment of the second species due to the severe climatic and environmental conditions of the ecozone.

The Research Topic of the effects of climate change on the plant distribution was addressed by Guzmán-Vázquez et al., who analyzed the role of seed long-distance dispersal in the altitude migration of the conifer species *A. religiosa* and *P. hartwegii* in a mountain system situated in central Mexico by the use of computational modeling. To understand the dispersal capacity of the two species, they considered s seeds and tree traits as parameters and the wind speed and direction as data of the area. The simulations of the dispersion trajectories resulted in a greater dispersal potential of *A. religiosa*, thus favoring this species for advancing to higher elevations than *P. hartwegii* in a scenario of increasing temperatures.

Xie et al. presented a study on the effect of a strong cold spell, which occurred in 2016 in a coastal forest in China, on the morphology and physiology of the native Chinese tallow (*Triadica sebifera*) species. To establish the degree of the damage, they analyzed the crown, stem, branch, and leaf characteristics of the trees from an affected area and compared them to those of the trees from a non-affected area, dividing the individuals into different age classes. In addition, they measured the leaf gas exchanges by means of an LI-COR system. They found physiological adaptations in the impacted Chinese tallow, such as a significant reduction in the leaf area and mass or a decrease in the leaf gas exchange, with a major susceptibility noted in the younger trees.

Fungi represent an important component of forest ecosystems. Notably, they have a fundamental role in the carbon and nitrogen cycles, especially in the condition of external inorganic N fertilization. An interesting contribution on this topic was given to our Research Topic by Liang et al. They studied the influence of ectomycorrhizal fungi saprotrophs activity in a conifer Chinese plantation in terms of competition on N availability and supply of plants' C to soil *via* microbial biomass and necromass. To evaluate the microbes' interactions and responses to increasing N accessibility, they created an N fertilization gradient. They found that a major part of the plant-derived C could have been largely respired by ectomycorrhizal fungi and in minor part could have contributed to soil microbial biomass accumulation. In addition, they found that ectomycorrhizal fungi activity strongly prevails on saprotrophic fungi and bacteria, even at a high N level, suggesting a future amplified C accumulation in Chinese forests in a scenario of increasing inorganic N fertilization.

The presented Research Topic allowed a multidisciplinary analysis of the mechanisms that enable forest ecosystems to respond to extreme conditions caused by climate change, and it involved authors with different expertise. The particularity of these studies is that they have allowed an investigation of the different forest components, such as trees, microorganisms, and soils, under various kinds of disturbances such as fire, heat, frost, or nitrogen depositions. Surely, there is a need for more experiments and studies that also provide retrospective analyses to permit predictions of the effects of future climate change scenarios on forest ecosystems and that provide specific forest management perspectives.

Author contributions

SA: writing original draft. All authors: review and editing. All authors contributed to the article and approved the submitted version.

Acknowledgments

The authors want to thank: MIUR Project (PRIN 2020) "Unravelling interactions between WATER 380 and carbon cycles during drought and their impact on water resources and forest and grassland ecosySTEMs in the Mediterranean climate (WATERSTEM)" (protocol code: 20202WF53Z), "WAFER" at CNR (Consiglio Nazionale delle Ricerche), and MIUR Project (PRIN 2017) "The Italian TREETALKER NETWORK: continuous large scale monitoring of tree functional traits and vulnerabilities to climate change".

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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