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Editorial: Evidence-based options and forward-looking approaches for the conservation and management of diverse wet forests in times of rapid climate change

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Editorial on the Research Topic
Evidence-based options and forward-looking approaches for the conservation and management of diverse wet forests in times of rapid climate change

Worldwide, landscapes, ecosystems, and species are facing unprecedented stress factors in the wake of rapid climate change, without the time they need to adapt on the long term. Accordingly, research is needed which supports evidence-based options and forward-looking approaches for the conservation, management, and restoration of diverse forests. With this Research Topic, we particularly address forests and forest management in the southern hemisphere, namely in Central and South America. These forests are particularly sensitive to overheating and desiccation. Being productive and biomass-rich, they may pose an increased risk of forest fires in the future. Additionally, their characteristic and indigenous biota and entangled life are fire-intolerant. They thus include the ecosystems that are most sensitive to climate change and are on the threshold of tipping points for irreversible ecosystem degradation.

Four studies are presented in our Research Topic. In the first approach, Bava and Caselli discuss Central European management practice applied to native Patagonian forests in the context of climate change. Climate change strongly affects Patagonian forests, particularly the increasing forests fires, on the one hand, and a lack of traditional forest management or even climate smart forest management on the other hand. At present, the northern Patagonian forests are not under focus of timber production and most of the wood comes from forests more than 2,500 km away. Since the principles of sustainable management of native forests have been developed and applied in Central Europe for more than 200 years it is worth to take adaptation of silvicultural systems that were

developed in Central European temperate forests into consideration. The authors highlight that a reasonable recommendation for Patagonian native forests would be an adaptative management forest approach that minimizes the changes caused to the forest, an approach that has been applied in other parts of Europe.

The second paper from Zaret and Holz addresses forest-peatland ecotones in Western Patagonia, Chile. There, the altered fire regimes, combined with a warmer and drier climate, have been eroding the resilience of temperate rainforests and peatlands and leading to alternative post-fire vegetation communities. In this study, post-reburn field data were collected and modeled in order to examine mechanisms through which *Pilgerodendron uviferum* forests may recover following fire or become locked into alternative development pathways by comparing biophysical factors of a reburned ecotone to those of an unburned (control) ecotone. The results suggest that fire can push edaphically wet *P. uviferum*-dominated sites toward a non-forested state by reducing the diversity of microsite structure and composition, thereby placing *P. uviferum* seedlings in direct competition with *Sphagnum* mosses and potentially limiting the availability of microsites that are protected from both seasonal inundation and seasonal drought. Consequently, if wildfires continue under increasingly warmer and drier conditions, the forest-peatland ecotone of western Patagonia may be susceptible to large-scale transformation toward a non-forested state.

In the third paper, Loguercio et al. investigate carbon density and sequestration in the temperate forests of northern Patagonia, Argentina. The study is driven by the fact that forests are a crucial part of the global carbon cycle, and their proper management is of high relevance for mitigating climate change. Accordingly, there is an urgent need to compile reference data on the carbon stock density and carbon sequestration rate of the manifold forest types all over the world to support evidence-based conservation and management decisions in terms of climate change mitigation and adaptation. Particularly, in the Andean mountains of northern Patagonia, extensive areas of temperate forest have developed after massive anthropogenic fires since the beginning of the last century. Applying a transect approach along the steep climate gradient of those forests, reference values of carbon storage and annual C sequestration were determined in total live (above- and belowground biomass) and deadwood mass, as well as in the soil organic layer and mineral soil in different forest types dominated by *Nothofagus* species and *Austrocedrus chilensis*. The study revealed that northern Patagonian temperate forests actually store fairly high carbon stocks. However, the current high stand densities of these forests which are due to low forest management, may affect their future carbon storage capacity in a warming climate, and they represent a growing threat of high-intensity fires with the risk of a further extension of burned areas in the future.

With a fourth paper, tropical mountain rain forests are addressed by Finegan et al. Given that there are no specific approaches for the assessment of their vulnerability at the landscape and local scales necessary for management for adaptation, the authors address the challenge of evaluating the ecological sensitivity of those forest types to temperature. A multidimensional approach in protected areas has been applied over a 440–2,950 masl altitudinal gradient in Costa Rica, synthesizing results of a long-term research programme (2012-present). The sensitivity to the current spatial temperature gradient of 11 ecosystem properties is evaluated in three categories which are forest composition and diversity, thermal characteristics of forest stands, and forest structure and dynamics. All 11 ecosystem properties have been found to be substantially sensitive, so changes in their values are expected under rising temperatures. In conclusion, lowland forests may be vulnerable to degradation and biotic attrition, showing current basal area loss, high mortality and climate debts.

These studies highlight that ecological research is crucial for the adaptation of forest management to climate change and that there is no solution that fits all. It has been shown that studies along gradients can reveal distinct ecological differences which should be taken into consideration for adaptive management strategies. Adapted nature conservation management must critically assess under which environmental conditions and in which habitats disturbance processes (e.g., wildfires) should proceed unhindered, and where intervention management is the better strategy to fulfill biodiversity conservation objectives. Adapted forest management must incorporate increasing regional and local risk potentials as well as specific and intraspecific drought tolerances and response patterns of trees, their genetic diversity, successional status and plant functional traits in order to ensure ecosystems functions and services.

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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.

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