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# Editorial: Lessons from the past: Linking the paleofire record and fire management in the context of a warming world

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Editorial on the Research Topic
Lessons from the past: Linking the paleofire record and fire management in the context of a warming world

Fire activity had a significant influence on vegetation composition and the evolution of ecosystems worldwide. Drivers of fire regimes over a long time and various spatial scales are complex and not easily separated i.e., climate, land cover and land use (Marlon et al., 2009; Feurdean et al., 2020; Margolis et al., 2022). It is, however, recognized that the use of fire by humans led to a substantial change in wildfire regimes and enabled the modification of ecosystems to support agricultural development. Currently, areas that did not experience fire activity in the past centuries are now affected by fire (Archibald et al., 2013). The situation may be even more dramatic under future warming scenarios (IPCC, 2022). The knowledge of long-term fire histories and reconstructions of past fire regimes allows a better understanding of the variability of fire at various spatial and temporal scales (Hessburg et al., 2019). It enables to study the causes and consequences of fire regime changes connected with vegetation composition, climate changes, and human-vegetation interactions, thus providing the basis for the development of fire management practices suitable under the climate warming scenarios (Słowiński et al., 2019).

The papers on this Research Topic cover various aspects of paleofire research, including long-term fire reconstructions, fire-vegetation interactions and fire modeling, comprising multi-proxy studies from various paleoecological archives. They present fire records from a wide range of ecological and geographical locations – boreal forests of Northern America, Fennoscandia and Siberia (Glückler et al.; Molinari et al.; Rodengen et al.), the primeval temperate forest of Central Europe (Zin et al.), tropical savannas in Australia (Rehn et al.), and paramo in High Colombian Andes (Espinoza et al.). The

papers also provide research from protected and highly biodiverse areas (Espinoza et al.; Rodengen et al.; Zin et al.) that are vital in the context of biodiversity loss and dynamics.

## Diverse records of fire-vegetation-human interactions

The case studies in this Research Topic explore a wide range of questions related to fire-vegetation-human interactions. Espinoza et al. investigated relations between fire, vegetation and climate in the context of biodiversity loss over the Holocene based on the peat record from the High Colombian Andes. The authors found several major transitions in the vegetation composition and the possible drivers of these shifts. For example, the vegetation shift in the early Holocene (8.7 ka) is explained by climate, that of the Mid-Holocene (6.1 ka) by fire, and that of the late Holocene (3.8 ka) by an interaction between climate, fires and intensification in human activity. They underline that the current vegetation composition of the Colombian Cordillera Oriental is an effect of complex interactions between various natural and anthropogenic factors.

The contribution by Zin et al. focused on past trends in forest fire size and frequency in temperate climate between 17$^{th}$ and 20$^{th}$ centuries based on dendrological analyses from Białowieza Primeval Forest in Central Europe. This study shows that the size of fire varied from 1 ha to as much as 500 ha over the past 3 centuries, whereas the frequency of fires was of ca. 11 years. They also demonstrated that most of these fires were ignited by humans. Zin et al. provide critical information for designing appropriate conservation and management strategies for European temperate forests.

Rehn et al., investigated changes in mid- and late Holocene fire regimes in tropical savannas in NW Australia based on two sediment records from Cape York Peninsula, a region affected by severe wildfires in recent years. The authors discovered that the reconstructed landscape openness was connected with active management by indigenous communities, and that the intensification of anthropogenic activity associated with European settlement increased fire occurrence and intensity. This study concludes that there is a need to implement active indigenous fire management into future management planning in Australian tropical savannas. Due to the high diversity between investigated sites, they also call for finer spatially resolved paleofire investigations from the study area.

Three studies explored long-term fire activity in boreal forests in both North America and Eurasia. Rodengen et al. use palaeoecological investigations in two mountain lakes in the boreal forest of British Columbia, Canada. They recorded two significant shifts in vegetation in both records, however, these shifts varied temporarily and ecologically between studied sites, due to elevation-driven climatic thresholds. These palaeoecological investigations suggest that future warming and fire activity changes will result in another compositional distinct vegetation transition in both areas. The authors also call for localized management strategies that consider ecosystem dynamics at a habitat scale. Molinari et al. present recent (the 20$^{th}$ century) fire activity based on model simulation and multiple charcoal records from Fennoscandia and Northern America. The results show a disagreement in biomass burning between the two proxies, which may be due to anthropogenic representation of the models, such as socio-economical patterns, forest management, and landscape fragmentation. The authors conclude that the uncertainty of fire modeling has to be considered when it comes to future projections, which should take into account type of archive and characteristic vegetation. Glückler et al. studied Holocene fire-vegetation feedbacks in Eastern Siberia, based on paleoecological records. The study showed that open larch-birch woodlands, common in the Early Holocene, experienced a shift to a larch-dominated closed forest in Mid-Holocene, comparable to modern forest composition in this area. The authors conclude that a critical increase in forest disturbance in recent years may lead to another shift in forest composition toward an open woodland that would promote increased fire activity. Because Siberia is already undergoing a substantial intensification in wildfire seasons, these results provide an important insight into the fire-vegetation feedback history of the Central Yakutia region.

## Conclusions and future directions

The studies published in this Research Topic provide insight into various aspects of past fire research in diverse ecological and geographical settings and types of paleoecological archives. The authors stressed that paleofire research covering long-temporal scales bears significant information into natural variability in fire regimes and enables the recognition of anthropogenic footprint on current fire regimes and vegetation changes (Espinoza et al.). Critically, these studies underline the importance of paleofire knowledge for creating more precise and effective forest management strategies and biodiversity conservation (Zin et al.). These include incorporating support of traditional or indigenous management practices into the novel management strategies in regions where the fire was actively managed in the past (Rehn et al.; Rodengen et al.). However, in more remote regions progressing climate change can result in shifts to vegetation composition resembling past ecosystems that were even more susceptible to fires (Glückler et al.). Fire modeling could give a helping hand in larger scale management planning, however, it still faces methodological challenges linked to an incomplete representation of human activities in simulations (Molinari et al.).

The knowledge of past fire activity and response of vegetation to long-term fire-climate-human interactions is a prerequisite for the construction of future forest management

strategies. Assessing management strategies currently operating in areas vulnerable to wildfire in the near future is crucial for biodiversity conservation.

## Author contributions

KM, AF, PG, and MS proposed the Research Topic. KM wrote the first draft. All co-authors edited the text and provided the final version of the manuscript. All authors contributed to the article.

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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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## References

Archibald, S., Lehmann, C. E. R., Gómez-Dans, J. L., and Bradstock, R. A. (2013). Defining pyromes and global syndromes of fire regimes. *Proc. Nat. Acad. Sci.* 110, 6442–6447. doi: 10.1073/pnas.1211466110

Feurdean, A., Vannière, B., Finsinger, W., Warren, D., Connor, S. C., Forrest, M., et al. (2020). Fire hazard modulation by long-term dynamics in land cover and dominant forest type in eastern and central Europe. *Biogeosciences* 17, 1213–1230. doi: 10.5194/bg-17-1213-2020

Hessburg, P. F., Miller, C. L., Parks, S. A., Povak, N. A., Taylor, A. H., Higuera, P. E., et al. (2019). Climate, environment, and disturbance history govern resilience of western North American forests. *Front. Ecol. Evol.* 7, 239. doi: 10.3389/fevo.2019.00239

IPCC (2022). "Impacts, adaptation, and vulnerability," in *Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change,* (eds.) H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, et al. (Cambridge: Cambridge University Press).

Margolis, E. Q., Guiterman, C. H., Chavardès, R. D., Coop, J. D., Copes-Gerbitz, K., Dawe, D. A., et al. (2022). The North American tree-ring fire-scar network. *Ecosphere* 13, e4159. doi: 10.1002/ecs2.4159

Marlon, J. R., Bartlein, P. J., Walsh, M. K., Harrison, S. P., Brown, K. J., Edwards, M. E., et al. (2009). Wildfire responses to abrupt climate change in North America. *Proc. Nat. Acad. Sci.* 106, 2519–2524. doi: 10.1073/pnas.0808212106

Słowiński, M., Lamentowicz, M., Łuców, D., Barabach, J., Brykała, D., Tyszkowski, S., et al. (2019). Paleoecological and historical data as an important tool in ecosystem management. *J. Environ. Manage.* 236, 755–768. doi: 10.1016/j.jenvman.2019.02.002