EGU24-4602, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-4602
EGU General Assembly 2024
© Author(s) 2024. This work is distributed under
the Creative Commons Attribution 4.0 License.

Fire's legacy: unraveling long-term fire regime and grass-tree interactions in European temperate grassy ecosystems

Angelica Feurdean[1], Diana Hanganu[2], and Andrei Cosmin Diaconu[3]
[1]Goethe University, Physical Geography, Frankfurt, Germany (feurdean@em.uni-frankfurt.de)
[2]ICUB Research Institute of the University of Bucharest, Romania
[3]Department of Geology, Babeş-Bolyai University, Cluj-Napoca, Romania

Grass-dominated ecosystems, encompassing steppe, forest-steppe, savanna, woodlands, and shrublands, cover approximately 40% of the global land surface and are critical for biodiversity, carbon storage, livelihoods, and culture. Grassland ecosystems are often assumed to be dominant in regions that are too cold or dry for tree growth and have limited soil development. Many grassy ecosystems are, however, found in warm and wet climates that could support forests. This pattern may be explained by grassy ecosystems also maintained by consumers of biomass, such as fire and herbivores, which tip the competitive balance in favor of grasses. Central Eastern Europe hosts some of the largest expanses of open ecosystems, notably steppe and forest-steppe woodlands, which humans have heavily impacted for millennia. Despite the critical roles fire may have had in these landscapes, our understanding of grassland fire frequency and intensity relies on contemporary ecological studies and remote sensing. The few long-term fire regime reconstructions worldwide based on charcoal records in grasslands have revealed that many assumptions about fires in grassy ecosystems rely on extrapolations from forested environments, revealing gaps in our knowledge regarding the natural occurrence and intensity of fires to climate, vegetation composition, and biomass dynamics in grassy ecosystems. To address these gaps, we conducted palaeoecological analyses, including pollen, charcoal morphologies, and morphometrics (L/W), in two contrasting grassy ecosystems in south-eastern Romania—Lake Oltina in the forest-steppe and Mangalia Herghelie in the steppe. Our research aims are to explore: i) the variation in biomass burning, fire frequency, and severity of fire over time in response to climate, vegetation changes, and human activities; ii) to compare trends in fire regime between ecosystems with (forest-steppe) and without (steppe) tree cover; and ii) to assess deviations in modern fire regimes from long-term trends. Additionally, we examine charcoal morphological and morphometrical assemblages as signals for reconstructing vegetation composition changes in regions with poor pollen preservation. Our analysis seeks to unravel the intricate interactions and feedback among fire, climate, and vegetation dynamics. Frequent fires in grass-dominated ecosystems act as a bottleneck for tree recruitment, sustaining the dominance of grasslands. We hypothesize that fire activity increases with decreasing rainfall but decreases with increasing rainfall, potentially influencing the transition from steppe to forest-steppe to woodland. The fire regime characteristics are expected to change during this transition, with decreasing fire frequency and increasing severity due to elevated fuel loads and reduced flammable grasses. In

the long term, this may lead to a shift towards a landscape dominated by woody vegetation, accompanied by lower frequency but higher severity fires. Human ignitions and the use of fire for land management alter these dynamics. Insights from this feedback and interaction will guide us in identifying thresholds in tree cover as indicators for a fire regime shift and determining tipping points in the balance between vegetation and fire. This study adds valuable knowledge to refine our understanding of the nuanced interplay between fire, climate, and vegetation dynamics in temperate European grasslands.