Abstract

Fire is a fundamental environmental factor that directly shapes many terrestrial ecosystems on Earth. The present thesis attempts to provide a comprehensive overview of the fire dynamics in Central Europe over the course of the last 12,000 years. Based on extensive analyses of charcoal particles deposited in terrestrial and lacustrine sedimentary sequences and carbonized plant tissues deposited in soils, I was able to track past fire dynamics across a range of spatial scales – from the forest stand scale to the landscape scale. First, we described relationships between drivers of recent fire occurrence and proposed linkages to the spatial pattern of Late-Holocene biomass burning. We found factors related to relief characteristics, such as increased thermal flux or terrain roughness, to be important determinants of fire occurrence within the present-day landscape. Contrary to all expectations, anthropogenic drivers seem to have a weak influence at present. Because relief-based factors have been stable throughout the Holocene, it seems probable that habitats of certain types are more predisposed to increased burning. We hypothesized that recurrent fire disturbances may contribute to the long-term maintenance of Pinus sylvestris-dominated forests, which withstood the competitive pressure of broadleaf vegetation during the Holocene climatic optimum.

Based on multi-proxy evidence I reconstructed the fire history of and vegetation development within a sandstone landscape in northern Czechia. I found that the general pattern of fire activity corresponds to broad climatic trends but that it also reflects changes in human land-use practices during the Late Holocene. A major shift in the fire regime occurred during the Late Bronze Age and Iron Age, when the frequency of fires increased markedly as a probable consequence of landscape exploitation by humans. The pollen record suggests the possible practising of short-term slash-and-burn cultivation by people of the Lusatian culture and subsequent pastoral activity. Accordingly, a profound environmental transformation of sandstone landscapes during the Bronze Age was triggered or at least accelerated by widespread anthropogenic burning.

The next step towards a comprehensive overview of the fire history of temperate Central Europe was to employ a spatially-precise soil charcoal record, extensively dated using ^{14}C and combined with pollen and sedimentary charcoal. This approach allowed me to estimate stand-scale fire frequencies within a temperate mountain forest and to assess linkages between fires and soil development. I showed that biotic change from needle-leaf dominated Early Holocene forests to broadleaf vegetation induced a substantial decrease of fire activity. In addition, fire likely influenced the process of podzolization and partly contributed to the high degree of soil diversity in the region.

Finally, a synthesising effort was made to collected datasets on fire occurrence. Regional trends in biomass burning were identified by means of compositing multiple-site charcoal records. These were compared with long-term shifts in vegetation inferred from pollen data. I found that the elevated fire activity during the Early and Middle Holocene declined sharply as a response to a regional spread of Fagus sylvatica-dominated forest communities. Conversely, human activity resulted in an increase in biomass burning during the Late Holocene. This suggests that bottom-up controls such as vegetation composition and human activities are important determinants of fire activity in Central European forest ecosystems.