

Disentangling human-fire-climate linkages at mid-elevations in the Šumava Mountains of central Europe

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1

We examined human-driven vs. naturally-driven fire regimes at Pékna peat bog in the Šumava Mountains, central Europe

2

We used a high-resolution multi-proxy approach including testate amoebae derived depth to water table (DWT), macro- and micro-charcoal, charcoal morphologies, pollen, non-pollen palynomorphs, plant macrofossils, XRF and archaeological evidence

3

Continuous presence of fungal spores since ~5,500 years ago indicate grazing (i.e. humans) at Pékna

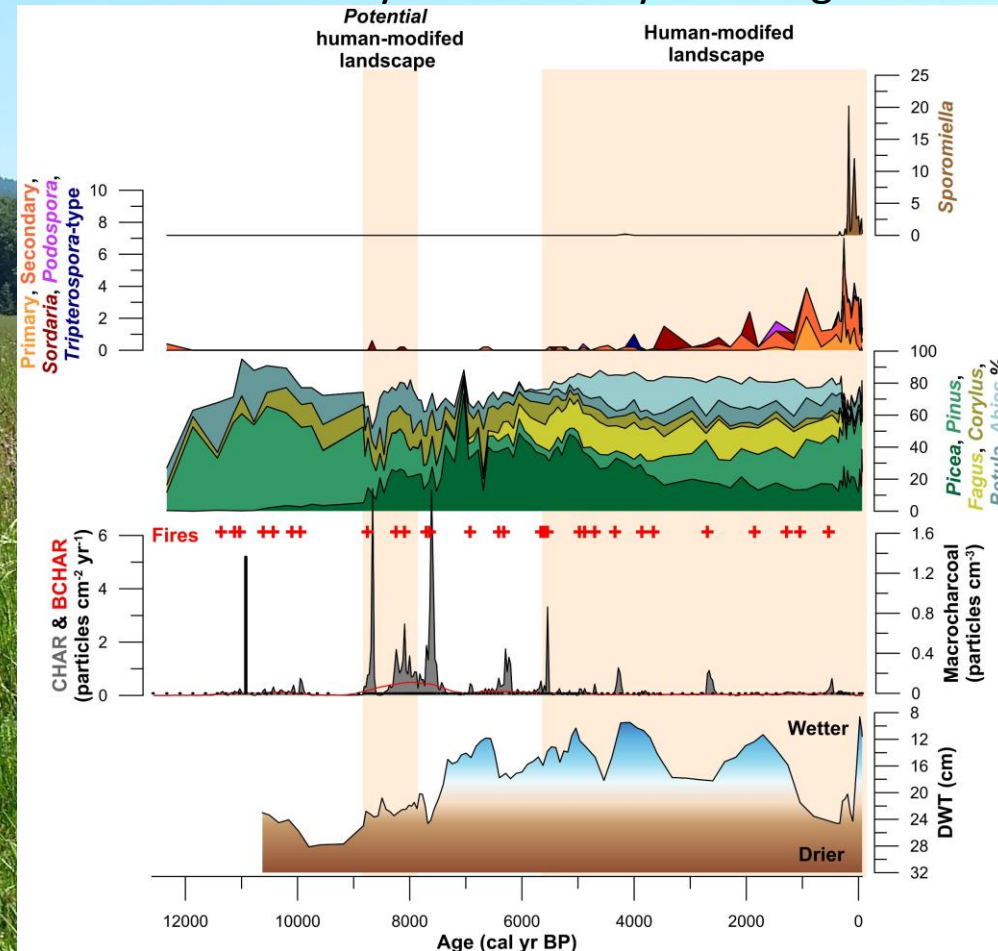
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Fires continued despite high water table depths during the mid-Holocene further supporting human ignitions

5

Future research requires statistical analysis and modeling to determine drivers of past fire

Our Key *Preliminary* Findings



BOBAFIRES
BOhemian-BAvarian Fire REgimeS

GACR
GRANTOVÁ AGENTURA ČESKÉ REPUBLIKY



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• Abstract

To distinguish human-caused from naturally-caused fire regimes, palaeoecological records must demonstrate that observed changes in vegetation and fire are in response to changes in human activity rather than driven by natural climate-fire relationships. Here, we use a high-resolution multi-proxy approach (testate amoebae derived depth to water table (DWT), macro- and micro-charcoal, charcoal morphologies, pollen, non-pollen palynomorphs, plant macrofossils, and XRF) from Pékna, a mid-elevation peat bog situated near Lipno Reservoir - an area rich in human land use - to investigate human-driven vs. naturally-driven fire regimes in the Šumava Mountains. Our results span the entire Holocene and illustrate that humans have been consistently modifying the landscape since 5,500 cal yr BP. Specifically, during the mid-Holocene (7,000 – 4,000 cal yr BP) when water table was at its highest at Pékna, relatively frequent, low-severity fires occurred and was accompanied by the prolonged presence of coprophilous fungi, secondary human indicators and an opening of the forest, suggesting human activities. Human land use intensified ~1,500 cal yr BP as indicated by increases in primary human indicator species, an increase in early successional tree species (*Pinus* and *Betula*) indicating an opening of the forest canopy, and the development of regional mining is suggested by a marked increase in the concentration of lead (Pb). While water table depths decreased indicating drier conditions ~1,500 cal yr BP, local fires persisted, burning generally at low severities as indicated by the continued presence of charred herb macrofossils. The most intensive land use occurred in the last 500 years with the highest abundance of primary and secondary human indicator species, and coprophilous fungi. Locally, marked increases in the concentration of both redox-sensitive elements such as iron (Fe), calcium (Ca), sulphur (S), and chlorine (Cl), and detrital elements potassium (K), aluminum (Al) and Titanium (Ti) over the last 500 years indicate major changes in the depositional environment, possibly due to peat draining. However, this time period witnessed decreased biomass burning as a result of a more open landscape and less fuels to burn. These results contribute to a growing body of literature illustrating the importance of prehistoric impact in the mid-mountains of Central Europe.

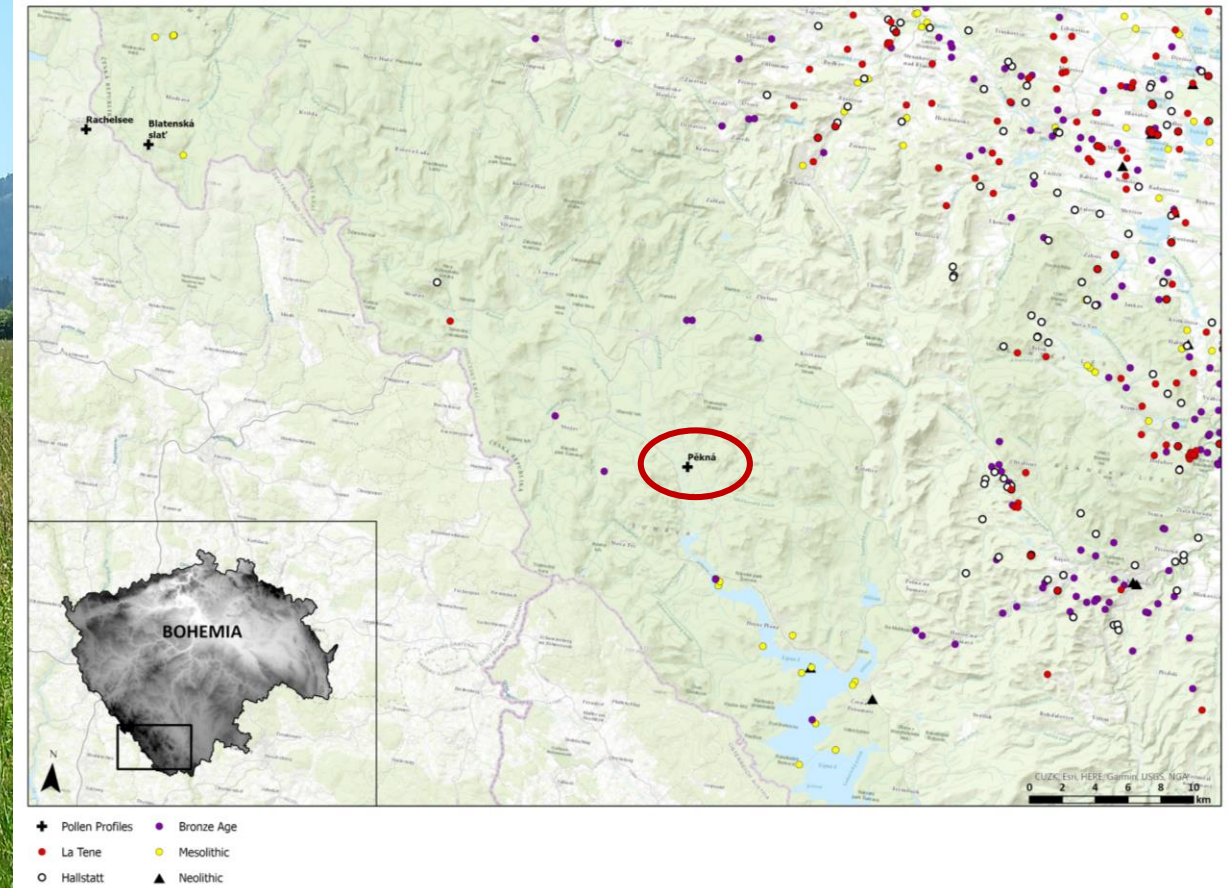
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- **BOBAFIRES Project**
 - **Bohemian-Bavarian Fire REgimeS**
- **Goal of the BOBAFIRES project** is to assess spatio-temporal patterns and drivers of biomass burning in central European spruce-beech forests.
 - **Objective 1.** Reconstruct the spatio-temporal patterns of fire and fire regime components along an elevation and aspect (i.e. north-to-south) gradient. **Hypothesis 1.** Fire has been a prominent forest disturbance agent in the Bohemian/Bavarian Forests throughout the Holocene at all elevations.
 - **Objective 2.** Determine the role of climate, vegetation (i.e., fuel), and humans as drivers of fire regimes in the Bohemian/Bavarian Forests. **Hypothesis 2a.** Climate and human activities result in distinct fire spatial patterns with different burning frequencies and/or severities. **Hypothesis 2b.** Dominant vegetation type found across different elevations has resulted in different fire regimes.
 - *The results from Pékna will be used to assess this objective and working hypotheses.*

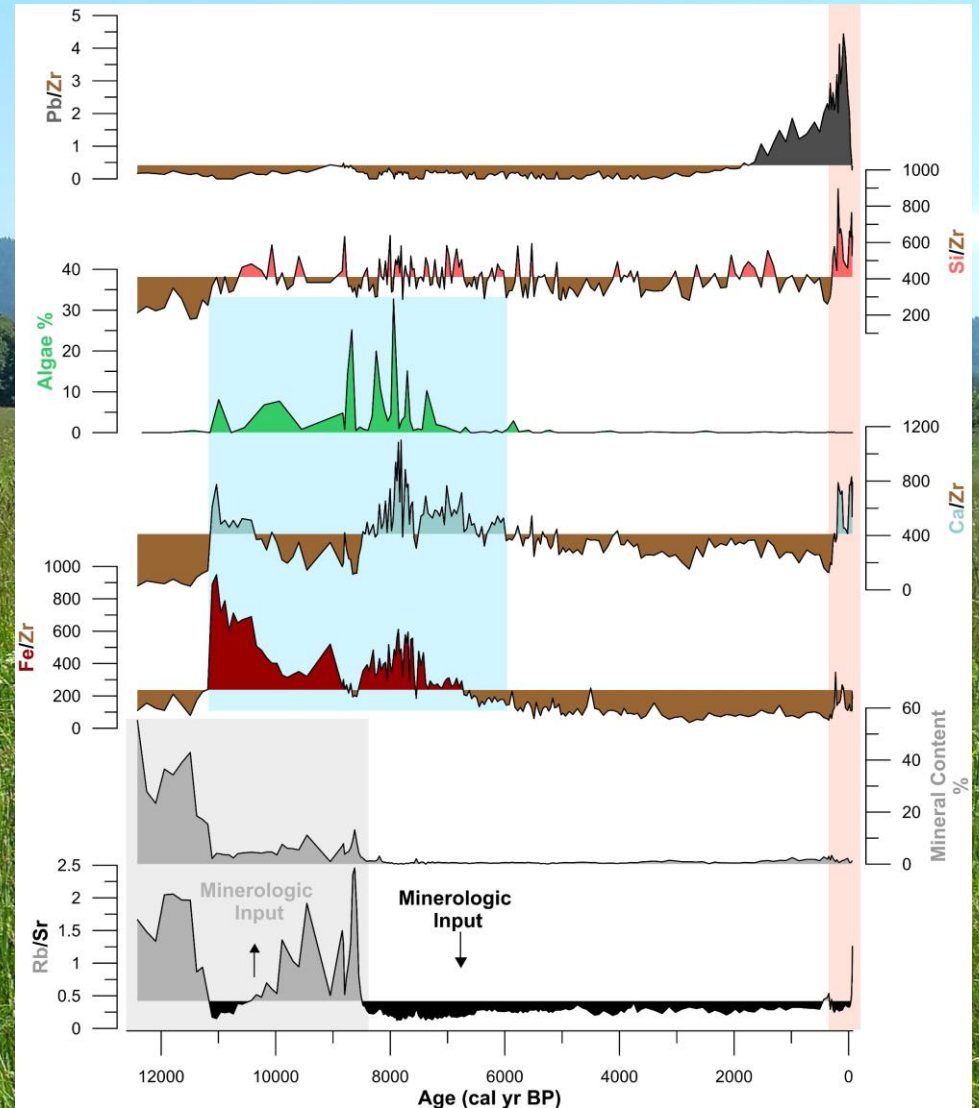
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- Study Site:
 - Pékna, Czechia (730 m asl)
 - A peat bog located ~50 m from the Vlatva River and ~5 km from the Lipno Reservoir
 - Study site is located within ~10 km of several Mesolithic, Neolithic, La Tene and Bronze Age sites
 - Pékna valley may have been used as a trading route
- Other BOBAFIRES Sites:
 - Rachelsee and Blatenská slat – both high elevation sites (>1000 m asl). Please see Gabriella Floresu's vEGU presentation for more on these two sites



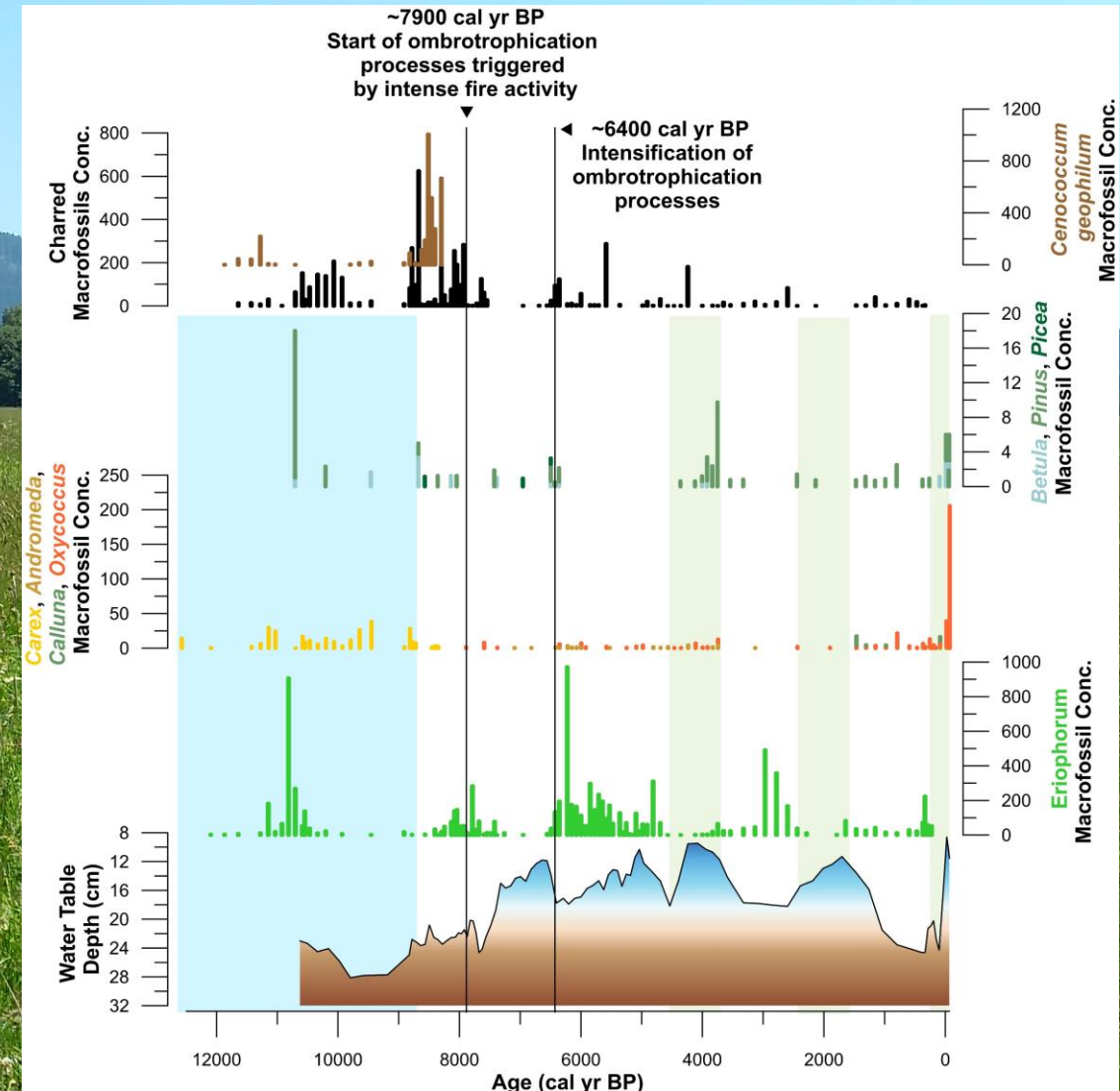
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- Preliminary data from Pékna: XRF
 - Elements were standardized using Zr – a mineralogic element
- Gray box (12,500-~8,200 cal yr BP)
 - Increased mineralogic input suggests increased fluvial input from the Vlatva River
- Blue box (11,000-~6,000 cal yr BP)
 - Increased Fe, Ca and Algae suggest standing water
- Orange box (last 300 years)
 - Increased Rb, Fe, Ca, Si and Pb support human land use
 - **No XRF evidence to support earlier human land use**



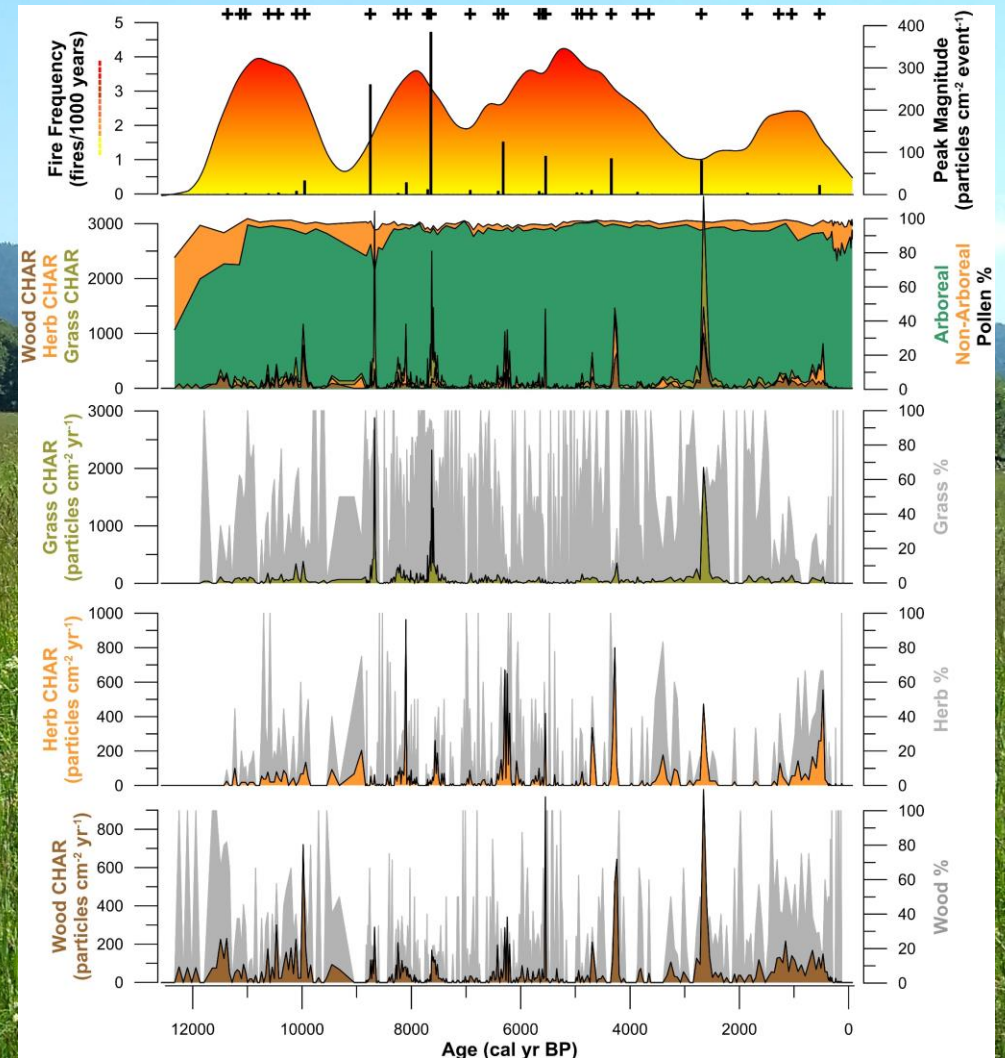
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- Preliminary data from Pékna: Macrofossils
 - Blue Box (12,600-~8,700 cal yr BP) high *Carex* indicates oligotrophic to mesotrophic standing water
 - ~7,900 cal yr BP – *Sphagnum* dominates indicating the start of ombrotrophication processes due to intense fire activity
 - ~6,400 cal yr BP – spread of *Andromeda polifolia* and *Oxycoccus palustris* indicates wet and poorly aerated soils and strong acidity i.e., intensification of ombrotrophication
 - Green boxes (~4,000, ~2,000 and 300 cal yr BP) *Sphagnum* dominates indicating high water table
 - Fires continued to burn at Pékna even during periods of higher water table potentially suggesting human-caused fires



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- Preliminary data from Pékna: Macrocharcoal Morphologies
 - No clear signal of human-caused fires prior to ~1,500 cal yr BP.
 - Herb and Wood morphotypes increase between ~1,500-~500 cal yr BP



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- Next steps towards disentangling human-fire-climate linkages at Pékna:
 - PCA Analysis
 - Generalized Additive Models
 - Create a summed probability density curve to indicate human activity over time in the area
 - Review data and write manuscript 😊