EGU General Assembly 2024

EGU24-546, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-546
EGU General Assembly 2024

Integrating palaeoecological, dendrochronological and remote sensing data to explore the impact of climate and forest management on a *Sphagnum* peatland (Tuchola Pinewoods, N Poland)

Mariusz Bak[1], Mariusz Lamentowicz[1], Piotr Kołaczek[1], Daria Wochal[1], Paweł Matulewski[2], Dominik Kopeć[3,4], Martyna Wietecha[3,4], and Katarzyna Marcisz[1]

[1]Climate Change Ecology Research Unit, Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Poznań, Poland
[2]Anthropocene Research Unit, Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Poznań, Poland
[3]Department of Biogeography, Paleoecology and Nature Conservation, University of Lodz, Łódź, Poland
[4]MGGP Aero Sp. z o. o., Tarnów, Poland

Assessing the scale, rate and consequences of climate change, manifested primarily by rising average air temperatures and altered precipitation regimes, is a critical challenge in contemporary scientific research. These changes are accompanied by a variety of anomalies and extreme events that negatively impact ecosystems worldwide. Understanding how different ecosystems function under climatic and anthropogenic pressures is important for their conservation and management. Monoculture forests, including Scots pine monocultures, are particularly vulnerable to these changes due to their homogeneous structure and simplified ecosystem linkages compared to mixed forests, making them more sensitive to extreme events such as insect outbreaks, droughts, fires and strong winds. In the context of global warming, forest fires are becoming extremely dangerous, and the risk of their occurrence increases as average temperatures rise. The situation becomes even more dramatic when fire enters areas of peatlands, as these ecosystems effectively withdraw carbon from the rapid carbon cycle and store it for up to thousands of years. Consequently, peatlands become emitters of carbon dioxide into the atmosphere.

The aim of our research is to trace the historical development of peatlands situated in a Scots pine monoculture area over the last three centuries. Our focus is on the Okoniny peatland located within the Tuchola Pinewoods in northern Poland, one of the country's largest forest complexes. We delved into the phase when the peatland's surroundings transitioned from a mixed forest to a pine monoculture. We also investigated the impact of changes in forest management at the turn of the last three centuries on the local vegetation and hydrology of peatlands. In addition, we wanted to answer the question of how the peatland ecosystem responded to different types of disturbance. Our reconstructions are based on a multi-proxy approach using: pollen, plant macrofossils, micro- and macrocharcoal and testate amoebae. We also use *Pinus sylvestris* dendrochronological data to compare it with the peatland record. Our results show that a change in forest management and progressive climate warming affected the development of the peatland. Testate amoebae analysis showed an increase in acidity over the analysed period and a decrease in the water table over the last few decades. Pollen data revealed that the lake-peatland transition took place before 1930 and progressed with the strongest agricultural activity in the area. However, the 20th century was a period of continuous decline in agriculture and an increase in the dominance of Scots pine in the landscape as the effect of afforestation. Dendroclimatic data indicate a negative effect of temperature on Scots pine and pressure from summer rainfall deficiency. Additional remote sensing analysis, using hyperspectral and thermal airborne images, provided information about the current condition of the peatland vegetation. With the application of spectral indices and the analysis of land surface temperature, spatial variations in peatland drying have been identified. Considering the context of forest management and the protection of valuable ecosystems in monocultural forests, the conclusions are relevant for peatland and forest ecology, palaeoecology and forestry.

A study financed by the National Science Centre, Poland, grant no. 2020/39/D/ST10/00641.