

# Development and functioning of *Sphagnum*-dominated peatlands in the Scots pine plantations in Central Europe

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## ABSTRACT

Monoculture plantations, including Scots pine plantations, are particularly susceptible to various types of disturbances and extreme events such as droughts, fires, strong winds, and insect outbreaks. This results from the simplified structure of the ecosystem, i.e., limited connections within the food web and lasting habitat changes such as soil impoverishment and acidification, as well as a lowering of the groundwater level. These phenomena pose a threat not only to the plantations themselves but also dangerous for the neighbouring ecosystems, including peatlands. The relationship between peatlands and Scots pine plantations in Poland has long remained poorly understood. Until recently, there has been little data on the impact of introducing planned forest management in northern and western Poland at the end of the 18th century on the condition of peatlands, as well as the consequences of disturbances and extreme events occurring within these monocultures for the functioning of peatlands.

This study fills the existing knowledge gap regarding the relationship between Scots pine plantations and the functioning of peatlands. The research involved high-resolution radiocarbon dating and multi-proxy palaeoecological analysis, including studies of plant macrofossils, testate amoebae, pollen, non-pollen palynomorphs, and charcoal. These data were supported by geochemical analyses (neodymium isotopes), geophysical analyses (Raman spectroscopy), dendrochronological and dendroclimatic data, remote sensing techniques, and the analysis of historical materials and archival cartographic studies. The research was carried out on three peatlands located within some of the largest pine plantation complexes in Poland — the Tuchola Forest (sites Jezierza and Stawek) and the Noteć Forest (site Miały).

The obtained results indicate changes in the hydrological and trophic conditions of the peatlands as a consequence of introducing planned forest management and accompanying activities and phenomena. Planned forest management, including monoculture pine planting, drainage works, as well as extreme events such as fires and insect outbreaks, has led to the acidification of peatlands, as confirmed by the recorded decrease in pH values. As a result, *Sphagnum* mosses have developed, replacing brown mosses and plants from

the Cyperaceae family. Additionally, the growing *Sphagnum* mosses gradually cut the peatlands off from their groundwater supply. These results are significant for forestry management, peatland management and their protection and restitution.

**Key words:** palaeoecology, peatlands, forest management, plant macrofossils

