

The objective of the project

The objective of the project is to reconstruct droughts and fires in northern Poland over the last 4000 years. This will be a first study of raised bogs in Poland (as well as in Europe), in which high-resolution reconstruction of droughts will be compared to fire history and compared along the continentality gradient.

The research will be carried out on seven raised bogs, that are located along a continentality gradient, from the western Poland where oceanic air masses are dominating, to the eastern part of Poland, where continental climate is dominating. The aim of the study is to answer following questions: What is the role of fire for raised bogs development? What was the frequency of fire in the past? Were drought and fire episodes occurring synchronously along the oceanic-continental climate gradient?

The reasons for choosing the research topic

Peatlands are important archives of past climatic changes and for years serve palaeoecologists for studying past environmental changes. In raised bogs peat is accumulated under anoxic conditions and thanks to this various palaeoecological proxies can accumulate there, e.g. plant macrofossils, pollen grains, testate amoebae shells, charcoal or human material culture objects. Studying changes in pollen or plant macrofossil composition allows to reconstruct vegetation history and estimate human impact on the environment. On the basis of charcoal analysis we can reconstruct fire frequency, the range of fire and fire regimes in a long-term scale. Testate amoebae can help to reconstruct water table changes and determine periods of droughts and periods of high water level on the peatland.

Studies of peatlands are crucial, because peatlands are important carbon stock and they play an important role in the global carbon cycle. Peatlands cover only 3% of the world's surface, but they contain ca. 30% of global soil carbon.

As an effect of global climate change, the rise of mean yearly temperatures is predicted in the near future. These changes will have serious consequences for ecosystems. Peatlands are among threatened habitats, as changing climatic conditions will affect their water balance. Predicted climate change will lead to peatland water table lowering, and consequent drought will make peatlands more susceptible to ignition and more frequent fires. Drought and peat fire will have an effect in lower carbon accumulation rates and rise of CO₂ releases to the atmosphere.

Polish raised bogs located in the middle part of Pomerania were already investigated in case of hydrological changes, vegetation history and human impact. However, none of the studies checked the influence of fire on their functioning. The information about water level changes and fires are crucial for climate modelling. Environmental reconstructions of this kind are highly important, as they allow quantifying human anthropogenic disturbances in the environment.

The basic research to be carried out within the project

From the chosen peatlands peat monoliths will be obtained. The cores will be sub-sampled and high-resolution palaeoecological analyses will be performed. Methods used in the study are: (1) testate amoebae analysis, that will enable to reconstruct past hydrological changes and droughts, (2) microscopic and macroscopic charcoal analysis, that will enable to reconstruct past fire activity and fire regimes, (3) pollen analysis and (4) plant macrofossil analysis will give an information about vegetation changes in the peatland and its surrounding, and (5) bulk density will help to estimate peat accumulation.

Peatlands chosen for the study are: bog Pawski Ług, kettle hole in the Bory Tucholskie National Park, bog Mszar, peatland next to the lake Jaczno on the Suwałki Lake District, Kusowskie Bagno, Mechacz Wielki and G zwa. Palaeoecological changes of the first four peatlands have never been studied. Peatlands Kusowskie Bagno, Mechacz Wielki and G zwa were studied in the case of vegetation history, past hydrological changes and peat accumulation, however, the analysis of past fire activity was not performed. In this project the lacking information about past fire activity will be supplemented, and thanks to this we will be able to estimate changes in fire regimes between western and eastern Poland.

On the basis of current knowledge about the functioning of raised bogs we hypothesize that: (1) the frequency of fire was driven mostly by climatic conditions, mainly by high temperatures and low precipitation and, consequently, that fires were more frequent and severe in eastern Poland under continental climatic conditions, (2) human activity in the last millennium intensified fires and lowered carbon accumulation.

We believe that results gained within this project will deepen the knowledge on how climate and human were influencing Polish raised bogs. Specifically, how climatic changes in the past had shaped raised bogs and what human disturbances were the most destructive for peatland ecosystem - fire ignitions, forest clearing or agricultural practices? The study will provide first high-resolution fire record from raised bogs with the focus on fire regime changes and local peat burning. This will be the first attempt to compare droughts and past fires along a climatic gradient in Poland. The correlation of fire record with droughts will help to understand how raised bogs will respond to global climatic changes and predicted droughts. This information is also crucial for practical purposes, mainly for nature conservation within Natural Parks, Nature2000 and Nature Reserves as well as for effective forest management.