



Development of mires in Dury Reserve, Poland: implications for nature conservation

Krystyna Milecka and Grzegorz Kowalewski

Department of Biogeography and Paleoecology, Adam Mickiewicz University, Dziegielowa 27, 61-680 Poznań, Poland
 Phone: +48 61 8296214, Fax: +48 61 8296271, e-mail: milecka@amu.edu.pl, ichtys@amu.edu.pl

Summary

The Dury Reserve is located on the outwash plain of the Tuchola Forest, Poland. The research investigated basin infill processes, the rate of accumulation of organic sediments, gyttja and peat, differences in various accumulation basins and human influences in the past, especially on hydrology (changes of water table). The results show regional and local vegetation history from the Younger Dryas to the present; weak human influences; differentiated rate of accumulation of gyttja and peat; and an oligotrophic, acid type of environment in the basins that has not changed since at least 2000 years.

Key index words: peatland lake, accumulation rate, pollen analysis, macrofossil analysis, Tuchola Forest in Poland

Introduction

Reserve Dury (53°38' N, 18°22' E) is located on the outwash plain of Tuchola Forest, N Poland (Fig. 1A,B) and belongs to 'Wdecki Landscape Park'. It consists of five basins of organic sediment accumulation (Fig. 1C). Four of the basins have still some open water surrounded by floating peat and then raised and/or transitional bogs. Mire plant communities like *Vaccinio uliginosi-Pinetum*, *Caricetum lasiocarpae*, *Caricetum limosae* and mire plant species like *Vaccinium microcarpum* (Turcz. ex Rupr) and *Scheuchzeria*

palustris L. are protected in the Reserve. This area has been protected since 1975, but in the 1990s there was a need to prepare a new, detailed protection plan. Palaeoecological research was suggested to describe the development of water-mire ecosystems and the rate of overgrowing of the basins. We were especially interested in differentiation of accumulation rate and filling in the basins. Human influences were also regarded, as they could change hydrological conditions (water table), flora and vegetation in the Reserve.

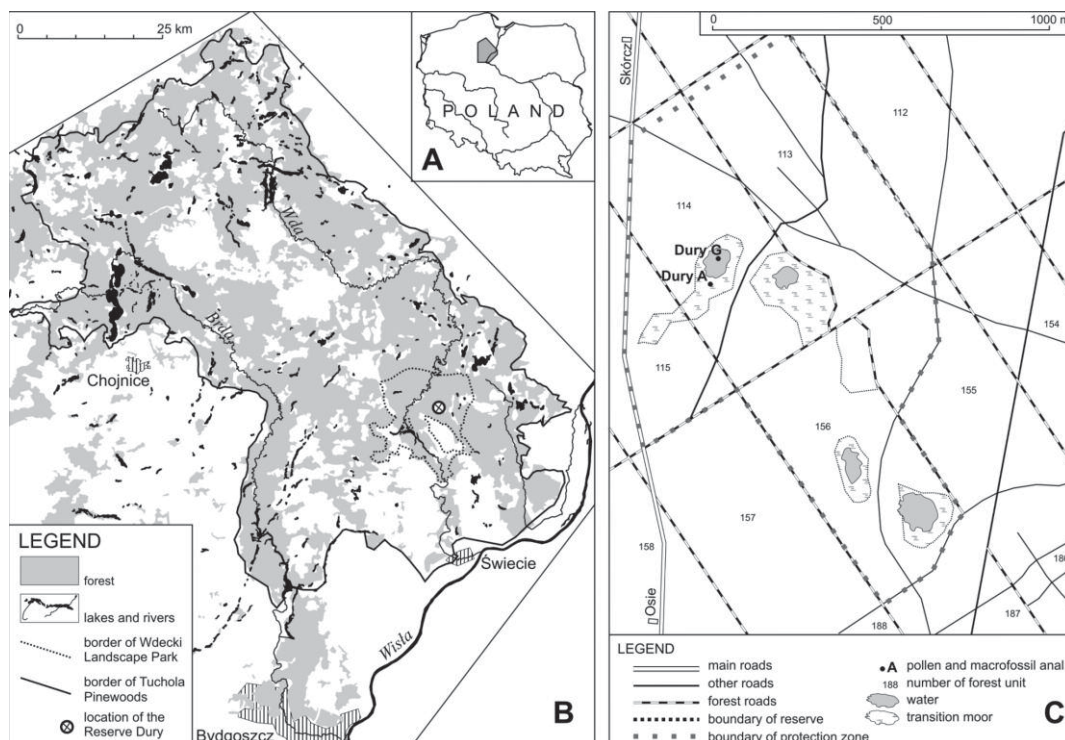


Figure 1. Location of Dury Reserve in Poland (A) and in Tuchola Forest (B). Basins of organic sediments accumulation and location of analyses cores Dury A and Dury G (C). (After Kowalewski & Milecka 2003, little changed)



Material and methods

General, stratigraphic-lithological research was done for the basins in the Reserve (Kowalewski and Milecka, 2003). Organic sediments were described according to Troels-Smith system (Troels-Smith, 1955; Tobolski, 2000). Detailed, geological structure of one basin was recognized on the basis of 14 drilling cores (13 from the mire and one core taken from the central part of the lake). They were completed with 22 macrofossil analyses from 5 cores (fig. 2). The transition of gyttja/peat was analysed first of all. Two cores (from 14) of sediments were taken for both pollen and macrofossil analyses: Dury A (980 cm) and Dury G (92 cm) which was taken from the depth 7.5 m. Pollen samples taken every 10 cm (Dury A) and every 2 or 4 cm (Dury G) were prepared according to standard method (Berglund and Ralska-Jasiewiczowa, 1986) with acetolysis for 3 min. Samples for macrofossil analysis were sieved with the mesh diameter 0.125 mm. Selected macrofossils were dated in Poznań Radiocarbon Laboratory. Dynamics of changes in open water area and floating peat was estimated on the basis of air photographs.

Results

Analysis of sediments filling the Dury I basin revealed that in the past three accumulation basins (lakes) existed (Fig. 2): the largest one (III), existing to the present in the north-western part of the basin and two fossil ones (I and II) in the south-western part. In the bottom layers of fossil basins, there were remains of *Potamogeton* and *Nymphaea alba* overlaid by *Menyanthes trifoliata*, *Carex* sp. and *Thelypteris palustris*. In the existing basin the overgrowing process was different. There was a layer of Bryales (*Calliergon*, *Meseta*, *Drepanocladus*) and *Sphagnum* only above them. In highly decomposed peat near the surface many charcoals were found (Fig. 2). This layer reaches ca 2 m of depth similar to the deepest gyttja.

Results of pollen analysis of core Dury A revealed the history of the local lake-mires ecosystem and regional vegetation since the Late Glacial (Younger Dryas) up to the present time. The deeper part of organic sediments (980 – 580 cm) was accumulated as limnic gyttja, during the lake stage of the basin. The upper part (580 – 0 cm) was accumulated as peat filling in the basin continuously since ca 3500 C14 years BP (palynological dating). Detailed results of pollen analysis of this core have been published (Kowalewski and Milecka, 2003).

The core Dury G taken from the peatland lake (Fig. 1C) is built by non-calcareous, detritous gyttja, containing some macrofossils. According to Troels-Smith system (1955; Tobolski, 2000) the composition is: Ld3Tb(Sphag.)1Dg+. The mean of the mineral matter is 10.8% and the proportion changes from 5.5 to 23.4% in the upper part. Value of pH decreases from 5.74 to 4.64 in the uppermost layer.

Macrofossil analysis of core Dury G showed that leaves and stems of *Sphagnum denticulatum* are the main components of the sediment. *Drepanocladus* macrofossils were also sporadically found like single idioblasts of *Nymphaea* and alchtonic bud scales of pine. Subfossils of

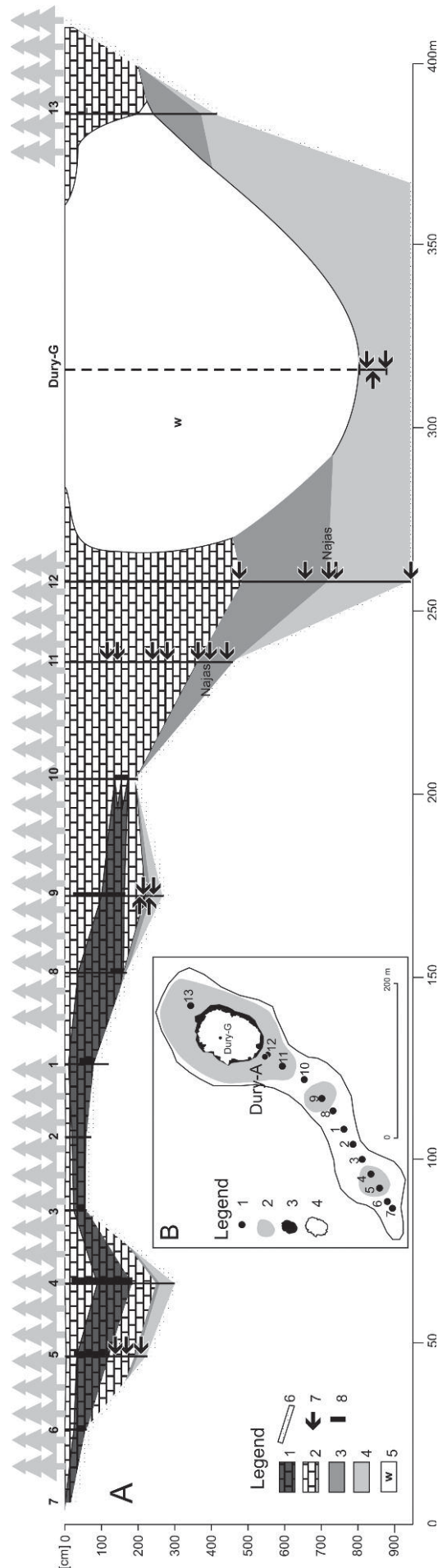


Figure 2. Geological cross-section of Dury basin. **A:** 1 – highly and medium decomposed peat, mostly bryophytic with layers of Eriophorum, 3 – detritous gyttja, 4 – fine detritous gyttja, 5 – water, 6 – mineral bottom, 7 – location of samples of macrofossil analysis, 8 – frequent presence of charcoals. **B:** 1 – drilling points, 2 – limit of fossil lakes, 3 – limit of floating peat according to air photo from 1996 (Kowalewski and Milecka 2003), 4 – the range of lake (Kowalewski and Milecka 2003).

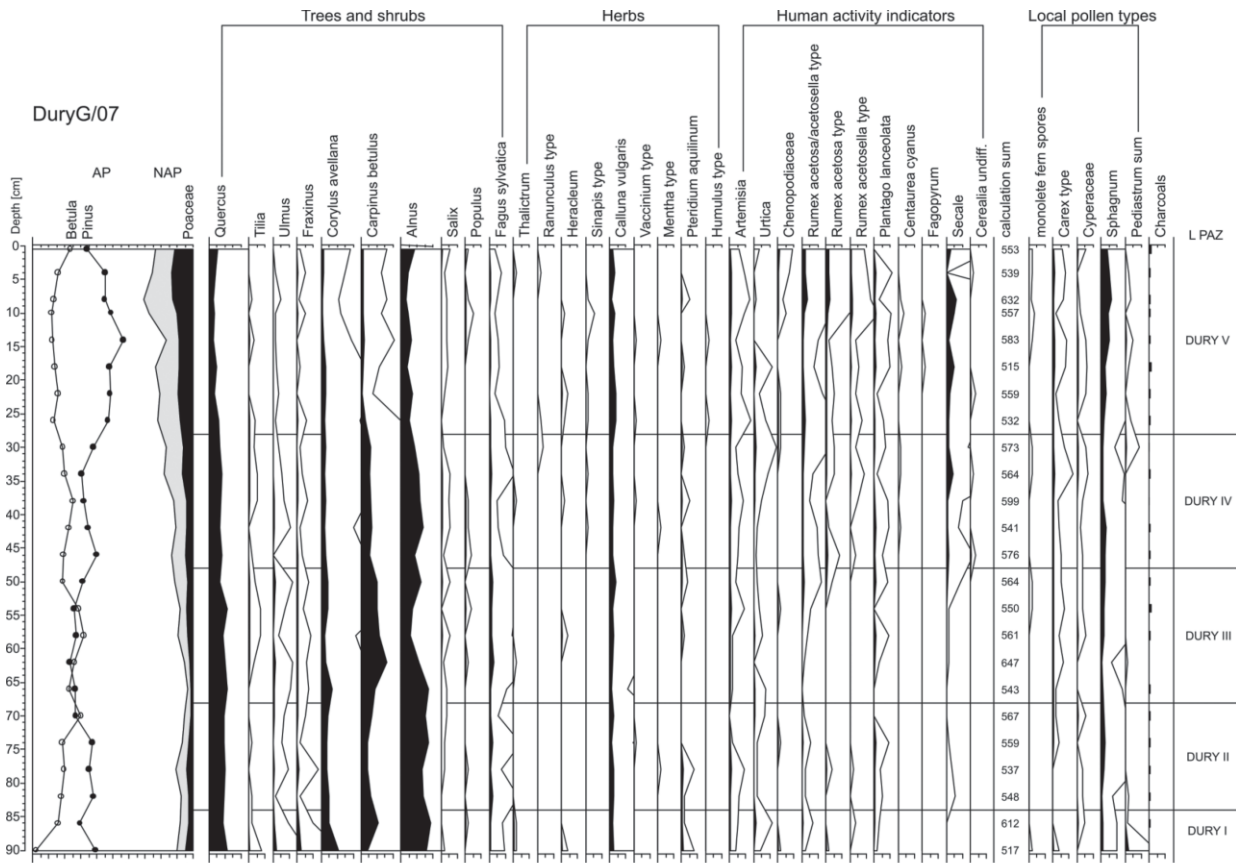


Figure 3. Pollen diagram of core Dury G. Selected curves of regional and local pollen types.

animals were more frequent. The highest proportion of Cladocera was found, ephippia of *Daphnia pulex* group and *Ceriodaphnia* between them. Floatoblasts of *Plumatella cf fruticosa* determined in younger samples were in pristine condition. There were also mandibles of *Chaoborus*, especially numerous in the sample 46-48 cm.

The pollen diagram of core Dury G revealed the vegetation history of over two last thousand years (Fig. 3). A more detailed interpretation is possible for this period of the Holocene as pollen samples were taken with higher resolution in this core. It allowed us to describe local changes of the ecosystem at the background of climatic, hydrological and anthropogenic influences. According to previously published results, Dury Reserve has been located in forested area with weak anthropogenic influences. Human activity reflected in pollen diagram (Fig. 3) is relatively low. There are only small amounts of indicators of human presence like *Artemisia*, *Rumex*, *Urtica* or *Plantago lanceolata*. Only the uppermost part shows higher curve of *Secale*. Single pollen grains of *Fagopyrum* are also present.

Discussion and conclusion

Plant macrofossil analysis reveals the vegetation succession of the mire plant communities. Two fossil basins (I and II) were filling in by meso-eutrophic plant communities. In the biggest basin (III), overgrowing typical for kettle mires is clearly found (gyttja, Bryales, *Sphagnum*) and changes towards oligotrophy are seen. Numerous charcoals indicate fires in the past of the mire.

Analysis of the sediments of core Dury G showed that the sediment accumulation conditions have not changed significantly and are similar to the present day. *Sphagnum denticulatum* is a typical species of the bottom of the lakes surrounded by mire and *Drepanocladus* sp often appears next to it (Gos and Banaś, 1999). Because both species are present in the deeper and upper parts of the core, it means that the lake has been oligotrophic and acid since at least 2000 years.

Three C14 dates revealed various rates of accumulation in lower and upper parts of the core (Fig. 4). The older part of the sediments accumulated over ca 1770 cal. Years, or at 0.25 mm of accumulation per year. The upper part (48 cm) is very young and accumulated during the last ca 380 cal years, or 1.26 mm/year. The youngest layers of gyttja are not compacted, however the difference in accumulation rate is very clear. A very low degree of decomposition of peat indicates a permanently high water level. Low, but stable curves of Cyperaceae, *Carex* type and *Sphagnum* also reflect stable and good hydrological conditions in the mire.

Dynamics of floating peat spreading during the second half of 20th century, estimated on the basis of aerial photographs, was not the same in every basin and differs from 15 m (single case) to few metres or not spreading at all. The factors influencing growth of floating peat and the dynamics of floating peat migration need more research.

Human influence estimated on the basis of paleoecological methods is very weak. There are few pollen grains of ruderal and cultivated plants. Within the cereals, *Secale*

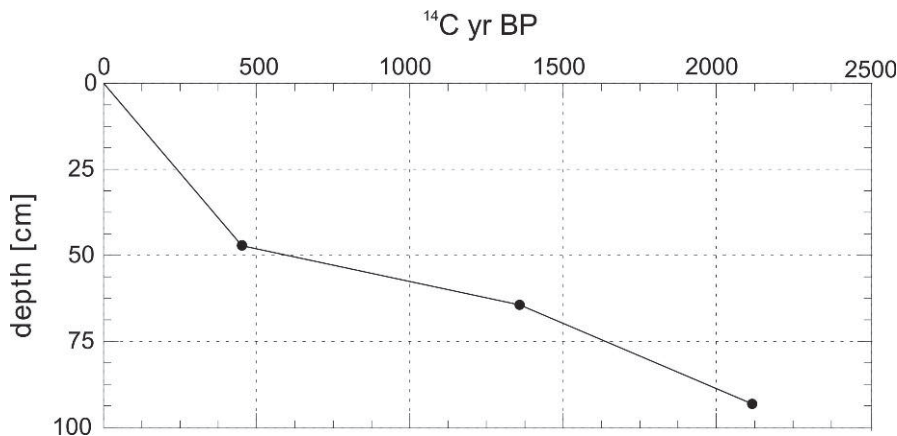


Figure 4. Depth/age scale of C14 datings of core Dury G.
 46-48 cm (Poz-23440), 470 ± 35 BP (ca 1570 AD)
 64-66 cm (Poz-23849), 1340 ± 35 BP (ca 800 AD)
 90-92 cm (Poz-23491), 2115 ± 30 BP (ca 200 BC)
 calibration acc. to OxCal. (Bronk, Ramsey 2001).

cereale dominates, which is a well-transported, wind-pollinated species. It is well represented in pollen diagrams, even if the distance from a field is quite far. Lack of pollen grains of other cultivated plants means there was no deforestation and human activity in adjacent areas. However appearance of *Pediastrum* in the youngest layers of Dury G could be related to a little bigger supply of nutrients to the lake.

Acknowledgements

Analysis of the core Dury G was a part of project of Polish Ministry of Science and Higher Education 2P04G 066 27. We appreciate financial support of its leader prof. K. Tobolski. Analysis of content of mineral matter was done in the Holly-Cross Mountains University in Kielce. We want to thank to prof. S. Żurek for the results.

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