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Preliminary information on the palynological research on sediments of Lake Charzykowskie (Zaborski Landscape Park)

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Abstract: This paper presents preliminary results of the palynological analysis of 136 samples taken from the bottom sediment core from Lake Charzykowskie at the border between the northern and middle basin of this large lake. The core from a depth of 8.4 m included homogenic carbonate sediments accumulated from the Younger Dryas.

Key words: Lake Charzykowskie, bottom sediments, palynological analyses, simplified pollen diagram.

Introduction

The drillings carried out constituted the first scientific penetration of the bottom sediments of Lake Charzykowskie within their entire thickness[1]. Pollen analyses represent the only pollen diagram from the sediments of this lake carried out so far. Current results of analyses of sediments of the lakes and peat bogs of the "Bory Tucholskie" National Park (located at the eastern shore of Lake Charzykowskie) justify the urgent need for undertaking more thorough studies based on complete series of samples (from the bottom to the top of limnic sediments) possible to obtain from the deep-water cores from the both neighboring lakes: Charzykowskie and Karsińskie. Those lake sediments include vast amounts of information, sought for particularly for comparative purposes, especially in situations not encountered so far. Such events occurred – among others – during the execution of the grant entitled: "*The genesis, dynamics, and environment-forming function of small lake-peat bog systems in the moraine and outwash plain areas of the Pomorze Region*".[2] One of the examples is the beginning of biogenic accumulation commencing as late as in the Younger Boreal period (compare Tobolski 2006, Fig. 67, p. 148).

Study site and methods

Lake Charzykowskie is a large lake filling an extensive glacial channel of the N-S orientation. The surface area of the lake (according to Choiński 2006) amounts to 1,336.0 ha. Its water level amounts to 120 m a.s.l. The maximum depth reaches 30.5 m, and the average depth – 9.8 m (Goszczyński, Jutrowska 1997). The water volume is estimated at the level of 134 533.2 m^3. In March 2006, a bottom sediment core was sampled from the ice-covered surface of Lake Charzykowskie (Fig. 1). The drilling by means of a Więckowski container was carried out in perfect ice conditions by a team from the Department of Hydrology of Lowlands at the Polish Academy of Sciences in Toruń. The drilling was located at a significant distance from the mouth of the Brda River and the Seven

[1] The chemical composition analysis of the surface sediments was carried out by Stangenberg and Żemoytel (1952)

[2] Grant KBN 2 P04G 066 27 (5.XI.2004 – 4.XI.2007)

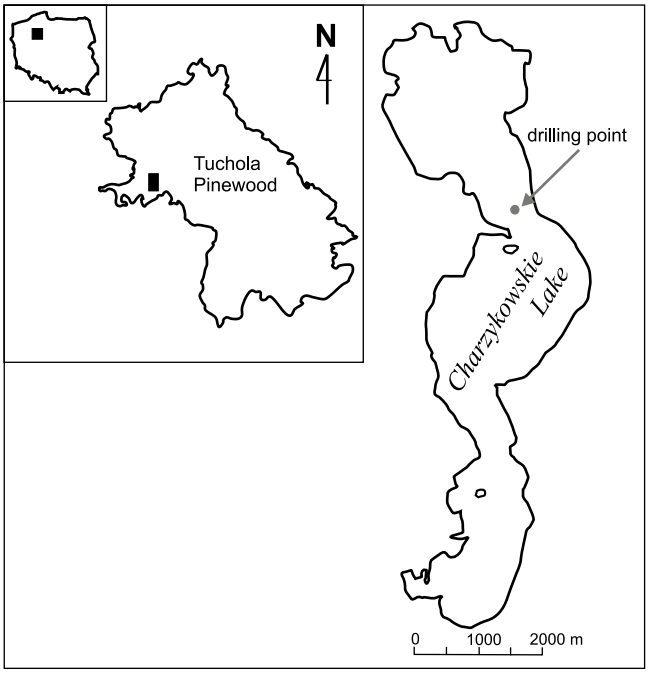


Fig. 1. Location of the drilling point

Lakes Stream (Fig. 1) in the lower part of the northern pool (lake basin) (compare Barańczuk, Borowiak 2010) with the surface area of 482.0 ha. The average water depth in the lake amounts to 5.8 m, and the water volume – 28 252.1 k m^3 (Goszczyński, Jutrowska 1997). The water depth at the drilling site reached 8.4 m, and the depth of drilling – 22.6 m. The total thickness of sediments amounted to 14.2 m and the diameter of core 5 cm (Fig. 2 and 3). The cores were carefully placed in fitted, foil-lined compartments of wooden cases. In the laboratory, the sediments were described, and samples were taken for palynological analyses (with the volume of 1 cm^3 each, by means of disposable, appropriately adjusted syringes). For the palynological survey, 150 samples were taken, 138 of which were analyzed. The simplified pollen diagram is presented in Fig. 4.

Main stages of the post-glacial development of forests

Distinguishing of local pollen assemblage zones (L PAZ) was based on the predominance of a few types of sporomorphs of trees and shrubs, and in one case, an indicative herbaceous plant genus – sagebrush (*Artemisia*) was used. Their stratigraphic distribution is presented in Fig. 4, supplemented with a graph including results of the CONISS statistical analysis.

Local pollen assemblage zones L PAZ

The pollen diagram (Fig. 4) is divided into eight local pollen assemblage zones (L. PAZ) designated with the symbol "CHA" derived from the name of Lake CHARZYKOWSKIE. They are supplemented with Roman numerals, Latin names of predominating plants, and their abbreviations. This paper presents only basic features enabling differentiation of units at the local zone level, and in one case also the subzone level.

CHA I Juniperus – Artemisia (Ju-Art)

Juniperus, *Artemisia*, *Salix*, and *Cyperaceae* curves with maximum percentage amounts in the entire diagram. Variable percentage proportion of pine, birch, and NAP, quite regular *Helianthemum* and *Chenopodiaceae*.

CHA II Betula (Be)

Maximum content of *Betula* pollen (excluding one spectrum in AT – probable contamination), decline of *Juniperus* pollen, and significant, but quite variable amounts of *Pinus*. Two spectra with the predominance of *Pinus* in the middle part of the zone was distinguished as Youngest Dryas – cold event (compare Behre 1978), identified with the Ganna-Oscilation (compare Schneider, Tobolski 1985).

CHA III Pinus – Corylus (Pi-Co)

This zone is characterized by the high content of *Corylus* with the first maximum. *Alnus* increases with more and more regularity, therefore the boundary with another zone, and simultaneously with another climatic-vegetation period (boundary with AT) is determined by an increase in the Alnus pollen percentage curve above 9%.

CHA IV Ulmus – Corylus (Ul-Co)

The feature of the zone is the occurrence of *Quercus* above 2%, and regular and maximum occurrence of *Ulmus* pollen.

CHA V Corylus – Quercus (Co-Qu)

Maximum contents of *Quercus*, *Corylus*, and *Alnus*.

CHA VI Quercus – Alnus (Qu-Al)

Decrease in *Corylus*, increase in the *Alnus* curve, and regular occurrence of *Carpinus*.

CHA VII Alnus – Carpinus (Al-Ca)

Large amount of *Alnus,* and maximum content of *Carpinus*. The section with maximum amount of *Carpinus* determines subzone Ca. A decrease in *Carpinus*, and increase of the *Fagus* pollen curve determine the boundary with zone VIII.

CHA VIII Pinus – Fagus (Pi-Fg)

Increase in the *Pinus* curve, large proportion

Fig. 2. Drilling from the ice surface in March 2006 (photo M. Gałka)

Fig. 3. Cores taken, packed and secured in a wooden case (photo M. Gałka)

of pollen of herbaceous plants (NAP), regular occurrence of *Fagus*. Decrease in *Fagus* and increase in NAP determine subzone NAP.

The analyzed sediment core from Lake Charzykowskie includes all Holocene climatic periods, and the bottom section of the sediments was accumulated during the Younger Dryas. The correlation of L PAZ and subzones with the CONISS statistical procedure diagram is presented in Fig. 4. This preliminary information does not include a list of L PAZ related to climatic-vegetation periods, because the radiocarbon dating results obtained require significant corrections.

A few years earlier, the beginning of accumulation of sediments of limnogenic peat bogs of the mouth of the Seven Lakes Stream (Struga Siedmiu Jezior), occurring in the Boreal, was correlated with an increase in the water level in the pre-lake Charzykowskie. Such a phenomenon, probably climate-dependent, must have occurred, because analyses in the place of the former bay (core Z1/05) indicate (Tobolski et al. 2005, p. 197) "*…that the water level in the pre-lake in a certain part of the Boreal was* […] lower *than the water level in the modern lake* by *2-3 m*". Hints concerning the initiation of biogenic accumulation in the Boreal were also found in a water body in vicinity of the western shore of Lake Charzykowskie. The bottom layer of sediments of the peat bog lake in the Małe Łowne Reserve included a sedimentation gap correlated with the Preboreal (Milecka, Tobolski 2008). Accumulation of sediments started again in the Boreal Period, most probably as a result of an increase in the water level in the neighboring basin of the modern Lake Charzykowskie. The thesis on the climatic correlation became more probable in view of the publication by Szeroczyńska and Zawisza (2010), presenting results of analyses of fossil Cladocera in the discussed core from a depth of 1820-1910 cm. A cold event, occurring 8200 calendar years BP, was distinguished in that core transect.

Final remarks

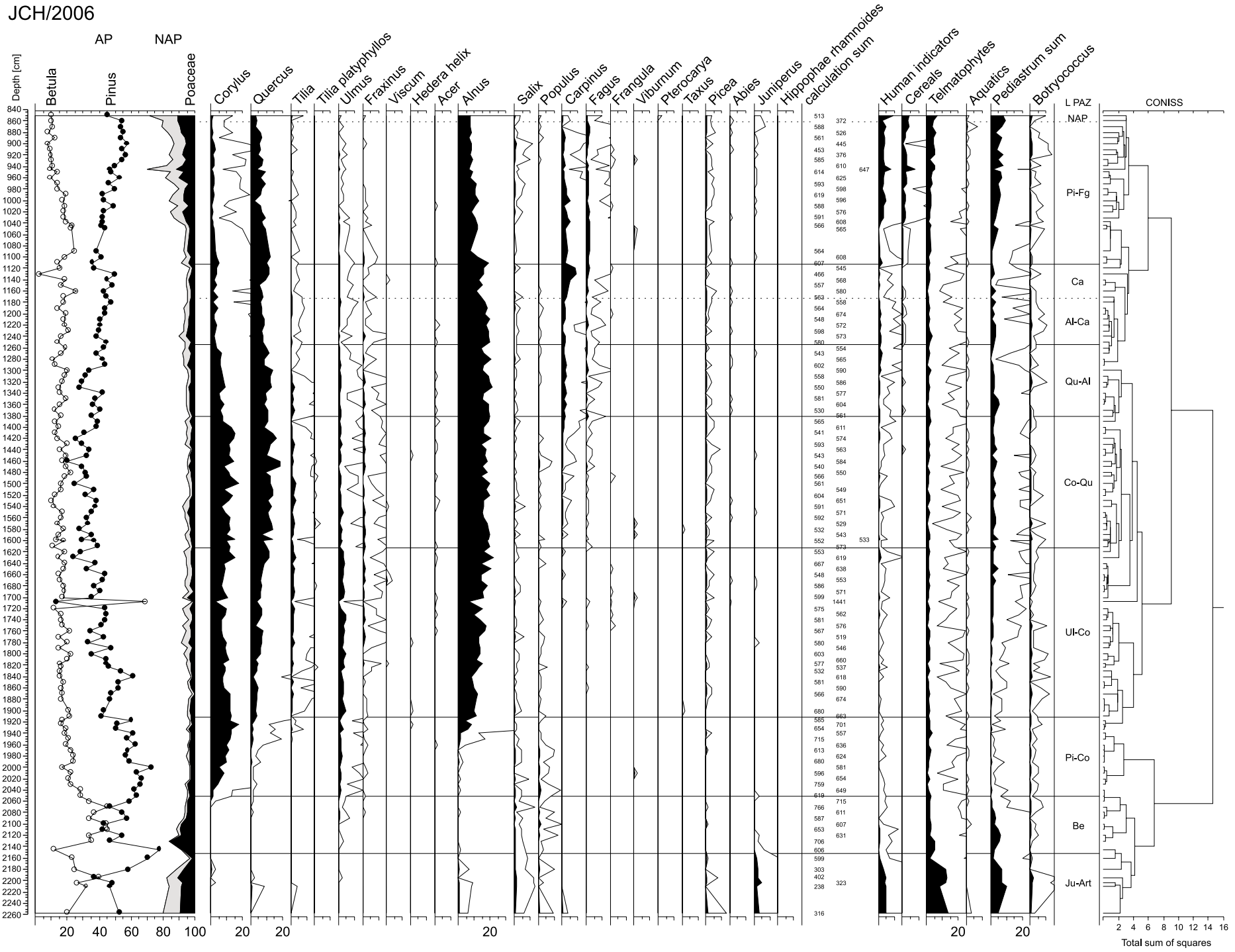
A new and so far not discussed palaeoecological-palaeolimnological issue concerning both adjacent large Lakes Charzykowskie and Karsińskie, as well as the neighboring lake-peat bog water bodies, is therefore emerging. After carrying out the pollen analyses, two further series of samples were taken from the core discussed, also covering the entire thickness of the drilled sediments. They were subject to subfossil Cladocera analyses (by Ph. D. E. Zawisza from the Institute of Geological Sciences at the Polish Academy of Sciences in Warsaw) and isotope analyses (by Ph.D. J. Mirosław-Grabowska from the same Institute). The authors of the analyses also obtained a series of 11 AMS datings.

The next paper, unifying the pollen, Cladocera, and isotope analyses, and supplemented with radiocarbon datings, will not only compare the local biostratigraphic approach with the material supplementing the chronostratigraphic division, but it will also be enriched in local units – summaries of subfossil Cladocera analyses and stable isotope analyses.

Well selected analyses of bottom sediments of those large lakes can contribute to the explanation of a few significant issues related to modern times. They will also be useful in explaining the genesis, and tracking the history of the smaller lake-peat bog water bodies located in their vicinity.

Most importantly, however, limnic studies will remain somewhat impoverished – not to say invalid – should they retain their current passive approach to the integral component of each lake, namely bottom sediments. Two volumes of the "Atlas of lakes…" of the Pomorze Region landscape parks did not manage to overcome this bad habit! Therefore, I hope that further editions of local atlases of lakes do not avoid information on sediments accumulated in lakes throughout thousands of years.

Fig. 4. (on the next page) Core JCH/2006. Simplified pollen diagram with local pollen assemblage zones and CONISS analysis


JCH/2006
AP
NAP
Depth [cm]
Betula
Pinus
Poaceae
Corylus
Quercus
Tilia
Tilia platyphyllos
Ulmus
Fraxinus
Viscum
Hedera helix
Acer
Alnus
Salix
Populus
Carpinus
Fagus
Frangula
Viburnum
Pterocarya
Taxus
Picea
Abies
Juniperus
Hippophae rhamnoides
calculation sum
Human indicators
Cereals
Telmatophytes
Aquatics
Pediastrum sum
Botryococcus
L PAZ
NAP
Pi-Fg
Ca
Al-Ca
Qu-Al
Co-Qu
Ul-Co
Pi-Co
Be
Ju-Art
CONISS
Total sum of squares

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