

Lobelia dortmanna L. seeds in lake sediments from the Tuchola Forest (Pomerania, northern Poland)

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ABSTRACT. Lobelian lakes are a group of oligotrophic or mesotrophic basins with specific physical and chemical features. They are thought to be vulnerable because of trophic disturbances caused primarily by human impact. *Lobelia dortmanna* L., *Isoëtes lacustris* L., and *Littorella uniflora* (L.) Asch. are important plant species in the vegetation of lobelian lakes that contain low amounts of calcium compounds in the water and bottom sediments. We describe *Lobelia dortmanna* seeds from lake sediments which were found during plant macrofossil analysis from one core taken in the lake from Tuchola Forest (Pomerania, northern Poland). A short diagram of plant macrofossils distribution including *Lobelia dortmanna* from Lake Nierybno (Tuchola Forest) has been constructed.

Knowledge about the Holocene history of plant communities with *L. dortmanna* allows understanding of the onset and development of lobelian lakes and it helps to protect those valuable ecosystems. Accordingly, the conclusion is that cores taken from central parts of lobelian lakes gives much information about the appearance of *Lobelia dortmanna* and seeds transport, and results should be compared with studies from the littoral zone.

KEY WORDS: *Lobelia dortmanna* seeds, lobelian lakes, oligotrophic and mesotrophic lakes, plant macrofossil analysis, Tuchola Forest, Pomerania, Poland

INTRODUCTION

Lobelian lakes are a group of oligotrophic or mesotrophic basins with specific physical and chemical features (Kraska et al. 2000). They are regarded as vulnerable because of problems of acidification, eutrophication and alkalisation (Kraska et al. 2000, Szymeja et al. 2000, Arts 2002, Smolders et al. 2002). Lobelian, soft water lakes, characterize the occurrence of isoetids – the specific, submerged plants with low trophic requirements. The name “lobelian lakes” comes from the Latin name of the taxon – *Lobelia dortmanna* L. This species is very rare therefore it has been included in the Polish Red Data Book of Plants (Każmierczakowa & Zarzycki 2001) as threatened species. Some of the lobelian lakes are located within National Park boundaries, Landscape Parks or Nature Reserves and fur-

thermore, relevant protection plans are recommended to isolate each of these basins from anthropogenic influences as much as possible. In the next ten years a significant number of the lobelian lakes should be studied with palaeoecological methods. However, their ecological past is not so well scrutinized. Gacno Wielkie in the Tuchola Forest is the only lake from which sediments have been studied investigating pollen, plant macrofossil and diatom analyses (Hjelmroos-Ericsson 1981), and this investigation did not find *Lobelia dortmanna* seeds. A short period of the occurrence of plant communities characteristic of lobelian lakes was found in Lake Racze (Latałowa 1992).

Most of the lobelian lakes are located in north-western Poland and originated from the last Vistulian glaciation. The published list

describing those basins classified as lobelian lakes identified about 150 such lakes in Poland (Kraska et al. 1996). *Lobelia dortmanna* L. with *Isoëtes lacustris* L. belong to the vegetation class – *Littorelletea uniflorae* Br.-Bl. et R.Tx. 1943. There are papers describing modern conditions of the lakes (Banaś et al. 1997), their physical and chemical features (Szmal 1959, Kraska et al. 2000), plankton biology (Burchardt et al. 1993, Szeląg-Wasielewska 1998), development and ecology of macrophytic plants (Szmeja 1987a,b,c, Kraska 1994, Kraska et al. 2000), but a full catalogue of all the lakes has not been prepared and published until today. It seems to be an urgent matter within the next few years, especially considering the perspective of developing areas of interest for the Nature 2000 network and also intensive trophic disturbances of lakes in Poland.

MATERIAL AND METHODS

Sediments from lake Nierybno in Tuchola Forest (Fig. 1) were taken in 1999 with a gravity corer. The core was 120 cm long and 6 cm thick. It was divided lengthwise into two parts and one of them was the subject of macrofossils analysis.

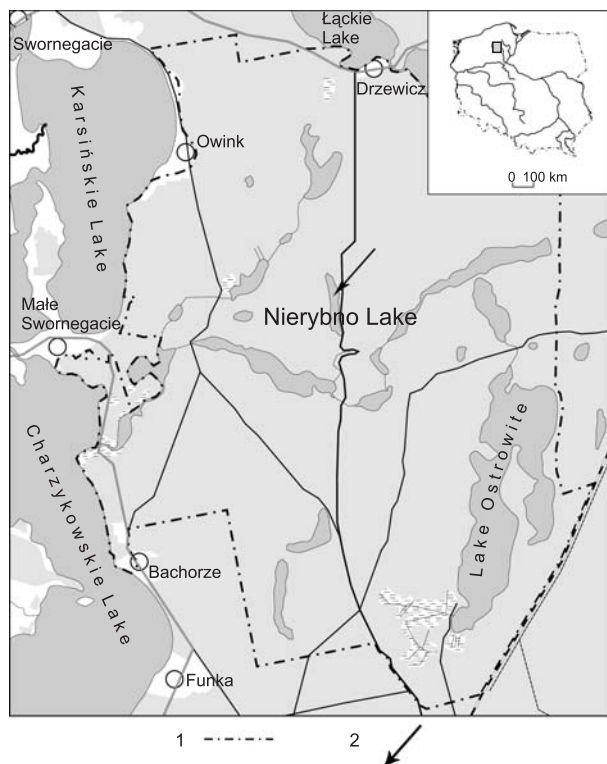


Fig. 1. Location of core Nie 99 and lake Nierybno in Tuchola Forest National Park, 1 – border of Tuchola Forest National Park, 2 – coring site

To check the presence of seeds in the lake sediment 5-cm slices of the core (about 150 cm³ in volume) were sieved and the fossil remains were identified using a stereo light microscope. This allowed finding the seeds of *Lobelia*. Three keys (Bertsch 1941, Beijerinck 1947, Kats et al. 1977) for seeds and fruits were used for identification that contained drawings of seeds produced by *Lobelia dortmanna*.

RESULTS AND DISCUSSION

DESCRIPTION OF THE SEEDS

Seeds of *Lobelia dortmanna* L. are oval with dimensions of 0.63–0.81 × 0.41–0.49 mm, and possess a characteristic elongated sculpture on the surface observable under light microscope (Fig. 2) and scanning electron microscope (SEM, Figs 3, 4). The cover relief and oval shape are the most important diagnostic features of this species. Seeds from the deeper parts of the sediments are flat, clearly fossilized and devoid of the hard outside layers of the testa. Sometimes there is only the inner layer of testa preserved with the relief of the cover. In the higher part of the core, the seeds are less destroyed and circular in a cross section. They are very similar to modern ones.

Twelve seeds of *Lobelia dortmanna* were measured (Tab. 1). Mean length amounted to 0.73 mm and 0.46 mm in width (SD = 0.056).

On the basis of macrofossil absolute content a diagram was prepared (Fig. 5), showing that seeds of *Lobelia dortmanna* are more or less regularly present in the profile. Pollen analysis of this core let us to determine the age of the

Table 1. Measurements of *Lobelia dortmanna* seeds from the core Nierybno 99

No.	Length (mm)	Width (mm)	Length/width ratio
1	0.71	0.44	1.61
2	0.81	0.44	1.83
3	0.81	0.46	1.73
4	0.63	0.41	1.52
5	0.66	0.49	1.35
6	0.78	0.46	1.68
7	0.78	0.49	1.60
8	0.71	0.46	1.52
9	0.68	0.46	1.47
10	0.73	0.44	1.66
11	0.71	0.46	1.52
12	0.76	0.46	1.63
Mean	0.73	0.46	1.59
SD	0.056	0.021	–

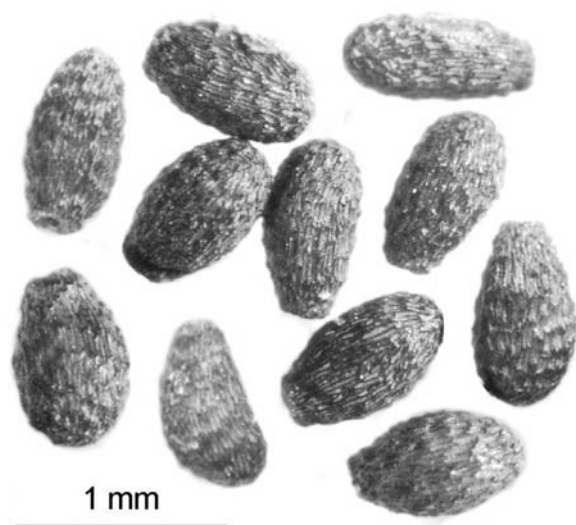


Fig. 2. Seeds of *Lobelia dortmanna*, light-microscope, phot. K. Milecka

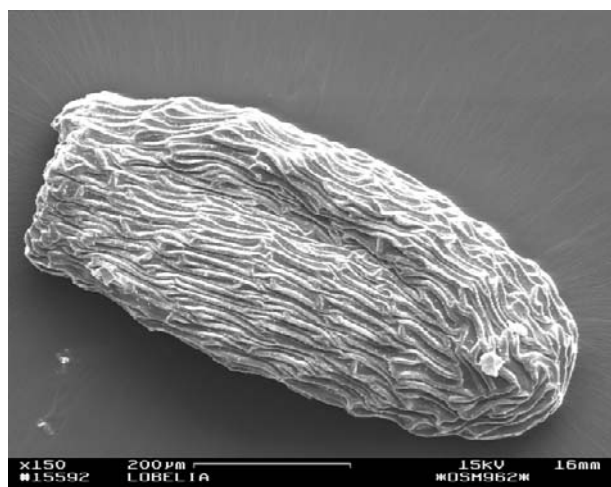


Fig. 3. Seed of *Lobelia dortmanna*, SEM, phot. K. Milecka in Geoforschungszentrum in Potsdam

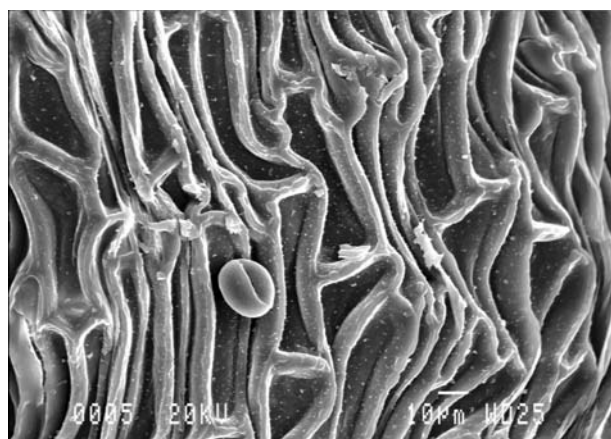
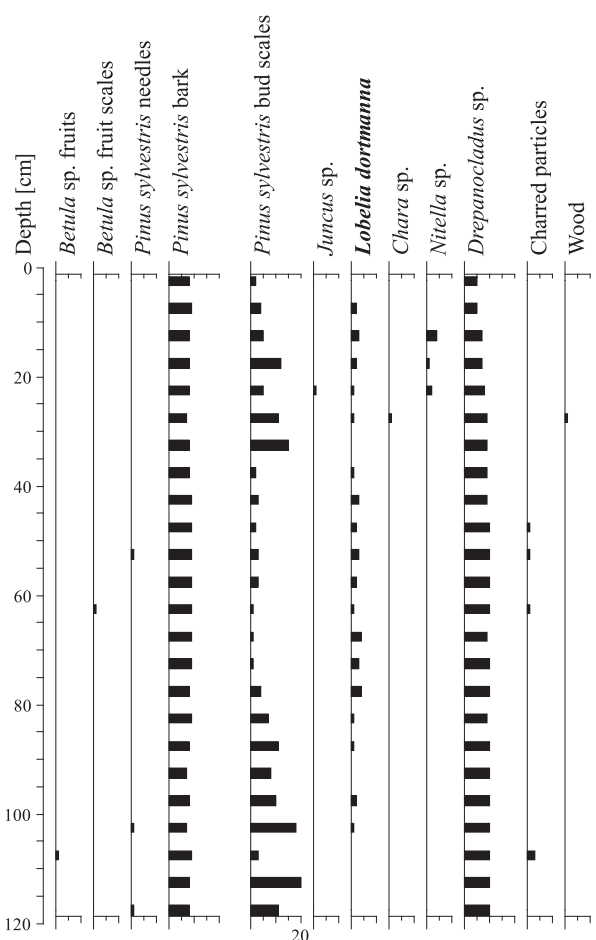


Fig. 4. Seed of *Lobelia dortmanna*, SEM, phot. M. Lamentowicz in Scanning Microscope Laboratory of Geological Institute, Polish Academy of Sciences in Warsaw



Anal. G. Kowalewski & M. Lamentowicz

Fig. 5. Plant macrofossil diagram of core Nie 99

deepest sediment layer (Milecka & Obremska 2002), for the turn of the Subboreal and the Subatlantic periods. *Lobelia dortmanna* seeds appeared ca 2000 ^{14}C years BP what means probable the onset of this species in the lake.

Since this time some plant macrofossil diagrams of lobelian lakes in Tuchola Forest were done (e.g. Nawionek, Okoń Wielki and Moczadło). All of them contain *Lobelia dortmanna* seeds (Milecka 2004).

Thorough and time-consuming palaeoecological analysis is required to study the past of the lobelian lakes (Milecka et al. 2002, Milecka & Obremska 2002). Unfortunately, pollen analysis is not able to provide the sufficient data about the vegetation history of these ecosystems. *Lobelia dortmanna* belongs to the group of plants which pollen is very poorly represented in lacustrine sediments as it is pollinated by insects (Podbielkowski & Tomaszewicz 1979). Consequently, pollen grains are exceptionally rare in palynological analysis and their absence does not prove an

absence of the plants in the lakes history. Consequently, we have no opportunity to yield the data on occurrence of the species in the lake vegetation from palynological analysis this way. Seeds of *Lobelia dortmanna* are better indicator of the presence of this plant in the lake ecosystem because expenditure of biomass in the generative propagation as seeds production is large (Szmeja 1987b, 1992).

The results do not show high numbers of seeds found in each sample (1–7 per sample), however, allow us to observe the process of propagated dispersal into the central part of a lake. The conclusion is that cores taken from the central part of lobelian lakes give information about seeds transport. Together with *Lobelia dortmanna* seeds or *Isoetes lacustris* spores (not found in this core) and *Nitella* oospores, there can be determined the time of the appearance of the vegetation community.

Detailed description and interpretation of macro remains from the core Nie 99 together with the results of analysis of other lobelian lakes sediments in Tuchola Forest (e.g. Nawonek, Okoń Wielki and Moczadło) will be the subject of a future publication.

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