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# TYPE REGION P-n: MASOVIA AND PODLASIE LOWLANDS

Altitude: 50—280 m a.s.l.
Climate: mean January temperatures —2.5 — —3.0°C, mean July temperatures 17.5±18.0°C, mean annual temperatures 8.0°C; mean annual rainfall below 500 mm $yr^{-1}$; growing season 210—220 days.
Geology: a Tertiary basin filled with glacial sands and tills.
Topography: monotonous denudated moraine plateau with incised of broad river valleys.
Population: 78.3 person/$km^{-2}$.
Vegetation: the site is located within the North Masovia area of the Masovia type region, with dominating pine forests and mixed forests with *Tilia cordata*, being in the same time the zone of disappearing Atlantic and Pontic elements.
Soils: a subsoil composed of glacial sands and tills forms a substrate for leached and brown soils, chernozems and mud soils.
Land use: the area is under cultivation besides few large forest complexes (Kampinos Forest).
Reference site: Lake Błędowo.
Location: latitude 52°32'N, longitude 20°40'E.
Altitude: 78 m a.s.l.
Age range: about 12 000 — 0 B.P.
Lake area is about 10 ha., max. depth 5.6 m, situated in a erosional cut of the Wkra River.
The analysed section of lake sediments about 15 m thick represents the time span from Alleröd untill the present. Four horizons are radiocarbon dated. In the pollen diagram 9 local pollen zones were distinguished (Fig. 1).
Local pollen zones:
B-1: *Pinus Betula*
B-2: *Juniperus*-NAP
B-3: *Betula* (*Pinus*)
B-4: *Corylus-Alnus-Ulmus-Quercus*
B-5: *Pinus-Betula-Ulmus-Quercus*
B-6: *Ulmus-Fraxinus-Quercus*
B-7: *Quercus-Corylus*
B-8: *Carpinus-Betula* (*Quercus*)
B-9: NAP-*Pinus*

Zone B-1, *Pinus-Betula*, is represented by two subzones. Subzone B-1a: predominated by *Pinus* (30 to about 70%) with a simultaneous decline of birch from about 30 to about 17%. NAP is formed mainly by sedges (being probably the local component) and grasses (over 20%). Shrubs are represented by *Juniperus* and *Hippophäe*. Predominance of forest communities with pine and birch, low and scarce in species NAP curve as well as the stratigraphic location enable to refer this subzone to the older part of the Alleröd chronozone (radiocarbon date 11 170±160 B.P.). Subzone

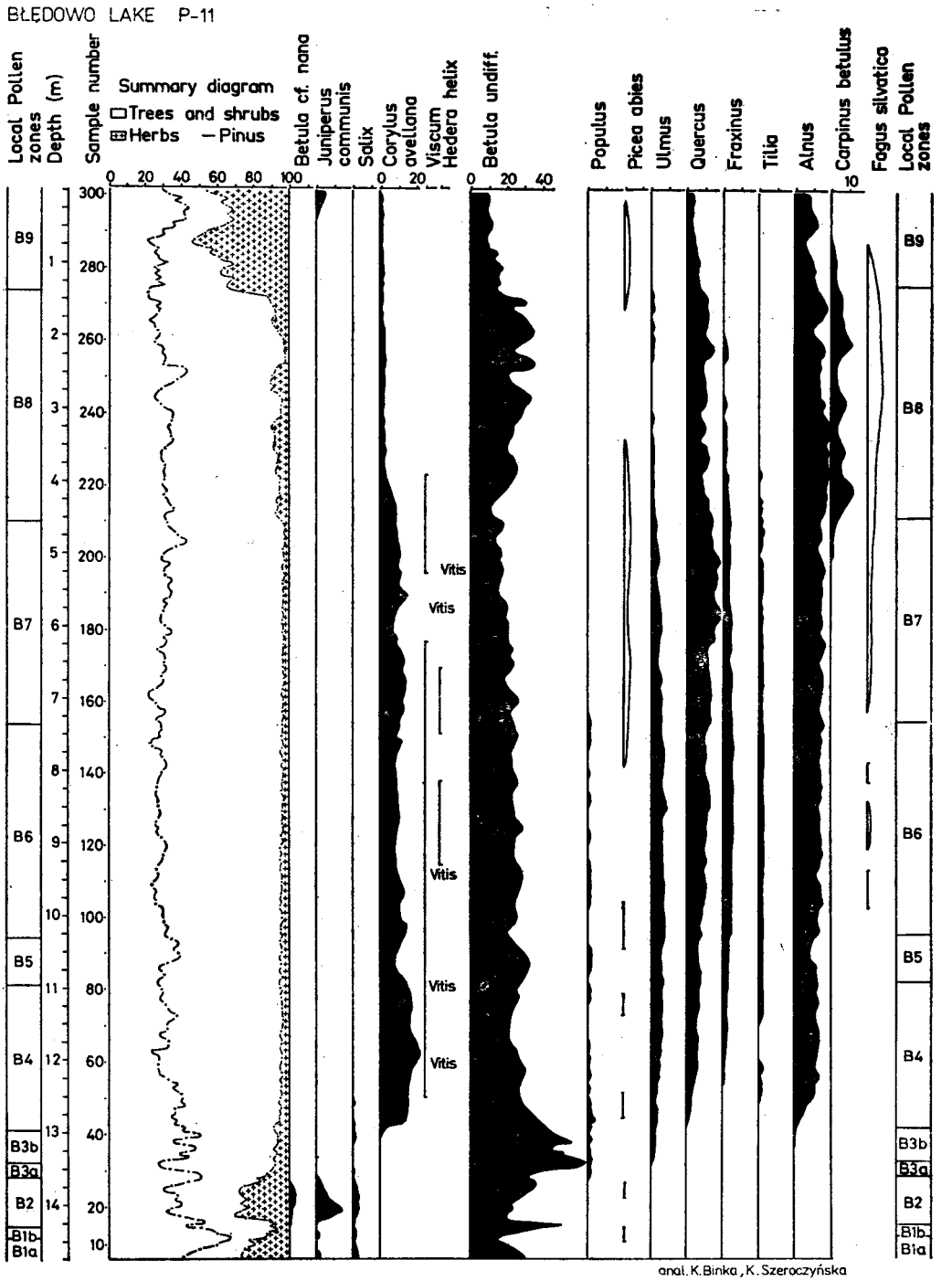


Fig. 1. The simplified pollen diagramm from the Lake Błędowo

B-1b is distinguished by a rapid rise of *Betula* to 40%, indicating a transitional time to vegetation with larger participation of heliophytes. Expansion of birch proves a close occurrence of a transitional zone between forest and tundra.

Zone B-2, *Juniperus*-NAP: NAP rise to maximum 30% with predominance of *Gramineae*, *Cyperaceae*, *Chenopodiaceae* and *Artemisia*, and sporadic other heliophilous plants as *Ranunculus acer* type, *Heliantemum nummularium* type, *Campanula*, *Pulsatilla*, *Dryas*, *Saussurea* type, *Anthemis* type, *Linum*, *Sanguisorba officinalis*, *Sedum*, *Potentilla*, *Polemonium*, *Botrychium*, *Selaginella selaginoides*, *Pleurospermum austriacum*, *Vicia* type, *Plantago lanceolata*, *Plantago maior-media*, etc. In the same time there is a rise in shrubs pollen, mainly of *Juniperus* (maximum 14%), *Betula nana* type, *Salix*, *Ephedra distachya* type, *Arctostaphylos* type, *Ledum*, *Empetrum*, *Hippophäe rhamnoides*. The progressing cooling resulted in a change of forest communities and development of open vegetation areas. In turn, it activated erosional processes, what resulted in an increased supply of mineral material to the lake. The pollen concentration is decreased (to about $30 \times 10^4$) if compared with neighboring zones.

Zone B-3, *Betula* (*-Pinus*): the retreat of tundra communities due to the amelioration of climate resulted in the expansion of pine (with its climax during the phase B-3a equal about 50%) and birch (beginning of the phase B-3b — over 60%), and the appearance of elm. The contribution of *Populus* in the pine and birch forests reached its maximum values during the first zones of the Holocene. The retreat of *Pinus* at the beginning of the phase B-3b and the expansion of *Betula* suggests a deterioration of climatic conditions. It is not, however, accompanied by any changes in other pollen curves. This cooling is interpreted by Behre (1978), and known also from the territory of Poland (Pawlikowski et al 1982; Latałowa 1982).

Zone B-4, *Corylus-Alnus-Ulmus-Quercus* is characterized by simultaneous spread of *Corylus*, *Alnus* and *Quercus*, and with a certain delay of *Fraxinus* and *Tilia*. There are occasional occurrences of *Acer*, *Frangula* and *Vitis* pollen. A radical reconstruction of forest communities was initiated by advance of hazel spreading in the understory of pine birch forests or forming its own communities, and of alder that occupied lake and river banks. The favorable conditions of this phase are underlined by a consistent occurrence of *Viscum* and occasional appearance of *Hedera* and *Vitis* pollen. Amidst herbs there are species of varying habitats: *Sanguisorba officinalis*, *Trollius*, *Mercurialis*, *Pulmonaria* and *Anthericum*. Their presence indicates the occurrence of areas with a rather open forest cover.

Zone B-5, *Pinus-Betula-Ulmus-Quercus*, is of a local significance. It represents a short period, of increased percentage values, primarily of *Betula* and at the end of the phase of *Pinus*, with an accompanying small decline of *Corylus*, *Ulmus*, *Quercus* and *Alnus*. During this phase *Pteridium aquilinum* entered communities of coniferous and mixed forests.

Zone B-6, *Ulmus-Fraxinus-Quercus*, is indicated by a simultaneous rise of *Quercus*, *Corylus*, *Ulmus* and *Alnus* pollen curves. Since that time elm linden and ash reach their maximum values defining the climatic optimum of the Holocene. The favorable temperature conditions are also emphasized by more frequent occurrence of *Viscum* and *Hedera* pollen. The renewed occurrence of *Anthericum ramosum* at the end of this phase can indicate, together with that of *Rhamnus cathartica* and *Cornus sanguinea* the presence of thermophilous shrubs, probably on steep slopes of river banks.

Zone B-7, *Quercus-Corylus*. This phase shows a monotonous course of pollen curves, with a gradual reduction of thermophilous elements and of birch. A rise is noted only in pollen curves of *Corylus* and *Quercus*. Plants of open areas are represented by occasional occurrence of *Echium*, *Pleurospermum austriacum*, *Gypsophila*, *Succisa pratensis*, *Helianthemum nummularium* type and *Rumex acetosella*.

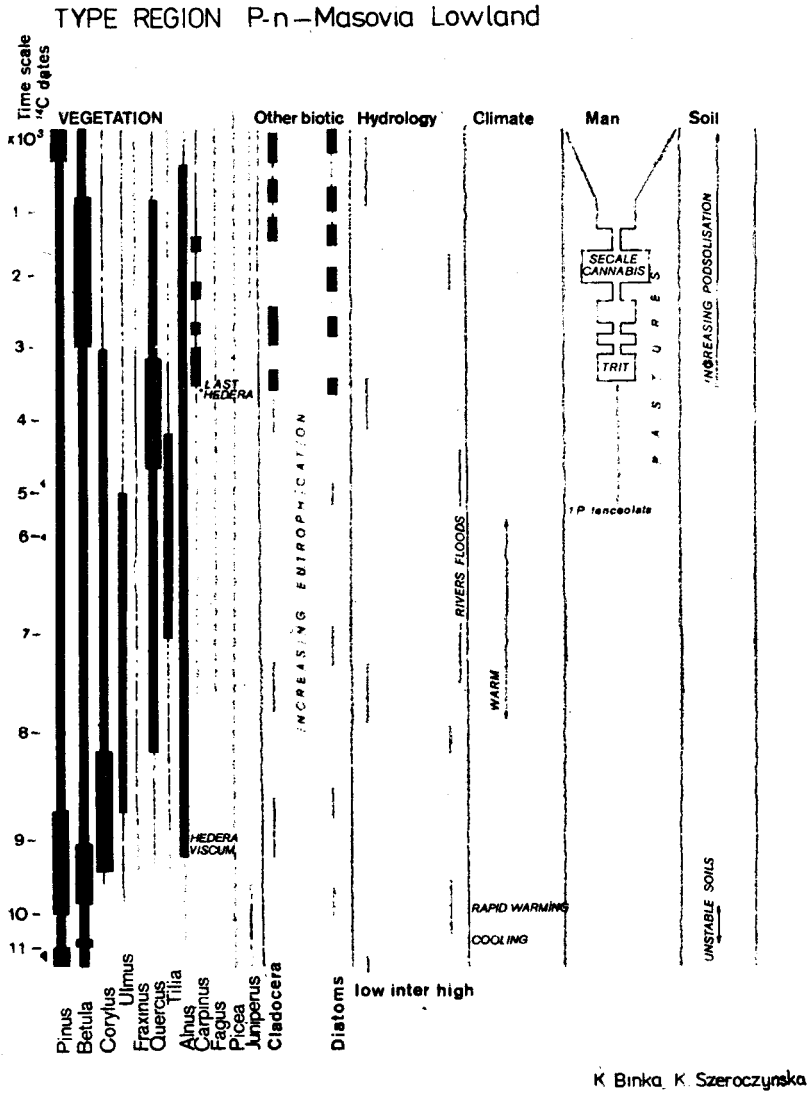


Fig. 2. The event stratigraphy table for the western part of the Masovia type region

Zone B-8, *Carpinus-Betula* (-*Quercus*) is determined by the expansion of *Carpinus betulus* into the forests (its pollen appears similarly as the pollen curve of *Fagus sylvatica*, at the beginning of the phase B-6), accompanied by the spread of *Betula* and *Alnus*. *Ulmus*, *Tilia* and *Fraxinus* do not play any significant role what may be not only a natural change but also the result of forest clearing. The pollen curves of hornbeam and other deciduous trees show considerable variations, determining the successive phases of settlement and forest regeneration on the area. As indicated in the event stratigraphy table (Fig. 2), the four peaks of *Carpinus* pollen curve separate the settlement phases: III (207—216), IV (221—226), V (230—239) and VI (244—253). During the breaks in land occupation the forest communities regenerated.

Zone B-9, NAP-*Pinus*, encloses probably the interval from the Early Middle

Ages until the present times. This period indicates an undoubted decline in pollen curves of all trees in favor of herbs. The pollen curves of *Cannabis*, *Humulus* are worthy of notice as hemp occurs at present in a wild state near the lake. The curve of *Cerealia* also reach high values. The extending use of the areas with poor soils resulted in a gradual expansion of *Juniperus* communis into the abandoned sandy lands.

Other biotic events: 7 phases of intensive lake eutrophication were distinguished on the basis of diatom and *Cladocera* analyses. The first phase, probably coinciding with the Boreal Period and the second one corresponding with the younger part of the Atlantic Period, were presumably connected with the more favorable climatic conditions. The other phases (3—7) are the effect of human activity as they can be well correlated with settlement phases distinguished by the palynologic method.

Hydrology: the variations of water level in the lake were defined on the basis of development of littoral and pelagic forms of *Cladocera*. The lake was more shallow during the Alleröd, the Boreal period and by the end of Subboreal and Subatlantic periods. On the other hand the development of pelagic species suggests a rise of water level during the Preboreal period, at the beginning of the Atlantic period and during the mid — Subatlantic period.

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