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TYPE REGION P-s: BORY TUCHOLSKIE

Altitude: 120—130 m a.s.l./morainic plateaux up to 180 m a.s.l.
Climate: Lakeland climate (Romer 1949). Mean January temp. —3.0°C in the northern part, —2.0°C in the southern part (—2.9°C for Chojnice), mean July temp. 16.5°C in the northern and 18.0°C in the southern parts (16.9°C for Chojnice). Total annual precipitation 500—600 mm (553 mm for Chojnice). Westerly winds prevailing (Augustowski 1977). Duration of the growing season 190—200 days.
Geology: Bory Tucholskie are located on Oligocene glauconitic sands and upper-Cretaceous marls. Miocene deposits, so-called lignite formation, are about 80 m thick, and at some places they crop out from underneath the Pliocene deposits. Quaternary deposits vary in thickness between 50 and 200 m. They consists of boulder clays, sands, gravels, silts and loams. Bory Tucholskie are situated in the front-moraine foreground in the area of the Brda Outwash, formed during the Pomeranian stage of the Baltic glaciation (Galon 1972).
Topography: an outwash plain relief with troughs, kettle holes, moraine monadnocks and dunes, and a considerable number of fairly large lakes (Augustowski 1977).
Soils: podzol soils, mainly sandy podzols formed of loose, poorly clayey and clayey sands, and podzols formed of tills and clay-underlain sands (Musierowicz 1958).
Vegetation: dominant in the wooded area of Bory Tucholskie are coniferous-forest communities with stands derived mainly from artificial planting. Deciduous-forest communities are found only on lake edges, riverside terraces and on lake-elevation slopes. Their development is often fragmentary (Boiński 1985).
Population density: 40—50 persons/km² (Szczepkowski 1973).
Land use: 45% of woodlands, 55% of arable land, meadows and pastures (Boiński 1985).
Reference site: Mały Suszek latitude 53°43′32″N, longitude 17°46′22″E, 113 m a.s.l. The age of the deposits ranges from about 250 to about 12 000 years B.P. A dystrophic lake surrounded by bogs (Fig. 1).

MS 1 12000—11800 B.P. *Pinus-Cyperaceae* paz
MS 2 11800—11150 B.P. *Pinus-Betula-Gramineae* paz
MS 3 11150—10100 B.P. *Juniperus-Gramineae-Cyperaceae-Artemisia* paz
3:1 11150—10850 B.P. *Juniperus* subzone
3:2 10850—10100 B.P. *Pinus-Betula* subzone
MS 4 10100— 9750 B.P. *Pinus-Betula* paz
MS 5 9750— 8950 B.P. *Pinus-Betula-Corylus* paz
5:1 9750— 9250 B.P. *Ulmus* subzone
5:2 9250— 8950 B.P. *Ulmus-Quercus-Alnus* subzone
MS 6 8950— 7300 B.P. *Pinus Betula-Corylus-Alnus* paz

6:1 8950 — 8650 B.P. *Ulmus-Quercus* subzone
6:2 8650 — 7300 B.P. *Quercus-Ulmus* subzone
MS 7 7300 — 5500 B.P. *Pinus-Betula-Corylus-Alnus-Ulmus* paz
7:1 7300 — 5600 B.P. *Quercus-Tilia-Fraxinus* subzone
7:2 5600 — 5500 B.P. *Quercus-Tilia* subzone
MS 8 5500 — 3700 B.P. *Pinus-Betula-Quercus-Corylus-Alnus* paz
8:1 5500 — 4050 B.P. *Ulmus-Tilia-Fraxinus* subzone
8:2 4050 — 3700 B.P. *Ulmus-Tilia* subzone
MS 9 3700 — 2150 B.P. *Pinus-Betula-Alnus-Carpinus* paz
9:1 3700 — 2900 B.P. *Quercus-Tilia-Corylus* subzone
9:2 2900 — 2150 B.P. *Quercus-Corylus-Fagus* subzone
MS 10 2150 — 750 B.P. *Pinus-Betula-Alnus-Carpinus-Fagus* paz
10:1 2150 — 1300 B.P. *Quercus-Corylus* subzone
10:2 1300 — 750 B.P. *Quercus* subzone
MS 11 750 — 0 B.P. *Pinus* paz
11:1 750 — 350 B.P. *Quercus-Pinus* subzone
11:2 350 — 0 B.P. *Pinus* subzone

On the basis of local pollen zones distinguished for Lake Wielkie Gacno — a reference site studied earlier (Hjelmroos-Ericsson 1981a, b, 1982) — and Mały Suszek, as well as for two other sites in Bory Tucholskie, regional pollen zones (BT) have been distinguished for the area under consideration.

BT 1 12000 — 11800 B.P. *Pinus-Cyperacea* paz
BT 2 11800 — 11200 B.P. *Pinus-Betula-Gramineae* paz
BT 3 11200 — 10050 B.P. *Juniperus-Gramineae-Artemisia* paz
BT 4 10050 — 9725 B.P. *Pinus-Betula* paz
BT 5 9725 — 8950 B.P. *Pinus-Betula-Corylus* paz
BT 6 8950 — 7250 B.P. *Pinus-Betula-Corylus-Alnus* paz
BT 7 7250 — 5500 B.P. *Pinus-Betula-Corylus-Alnus-Ulmus* paz
BT 8 5500 — 3700 B.P. *Pinus-Betula-Quercus-Corylus-Alnus* paz
BT 9 3700 — 2100 B.P. *Pinus-Betula-Alnus-Carpinus* paz
BT 10 2100 — 750 B.P. *Pinus-Betula-Alnus-Carpinus-Fagus* paz
BT 11 750 — 0 B.P. *Pinus* paz

The nature of the vegetation of the Late Glacial was more or less the same as in central and northern Poland (Fig. 1). The ages determined for Late-Glacial pollen zones seem to have been slightly overestimated. *Pinus* was the dominant tree species throughout the Holocene, for it found good conditions for growth on the infertile sandy soils. In more fertile habitats there occurred at first *Quercus*, probably with *Ulmus*, and from about 7000 years B.P. a mixed deciduous forest (*Quercetum mixtum*). After its retreat — about 3000 years B.P. — it was *Carpinus* that encroached upon the deserted habitats. Accompanied by *Quercus*, the species probably formed communities similar to the *Querco-Carpinetum* of today. In poor habitats that were more sandy there occurred mainly *Pinus* and *Quercus* which formed communities similar to the *Pino-Quercetum* known today. *Alnus*, and latter on also *Fraxinus* grew along streamsides and lake-edges. The period of absolute dominance of *Pinus* started about 750 years B.P. This was caused by the intensive felling of deciduous trees, and from the 18th century onwards by large-scale *Pinus* monoculture afforestation.

A similar nature of changes in the vegetation development in the whole Bory Tucholskie area is indicated by a comparison of the absolute, uncorrected data obtained for Wielkie Gacno and Mały Suszek. A simultaneous immigration time was observed for *Alnus* (about 9000 years B.P.), almost the same immigration time for *Corylus* (9800 and 9900 years B.P.), *Tilia* (7150 and 7200 years B.P.) and *Carpinus* (3800 and 3700 years B.P.). There were also some differences, as indicated by the

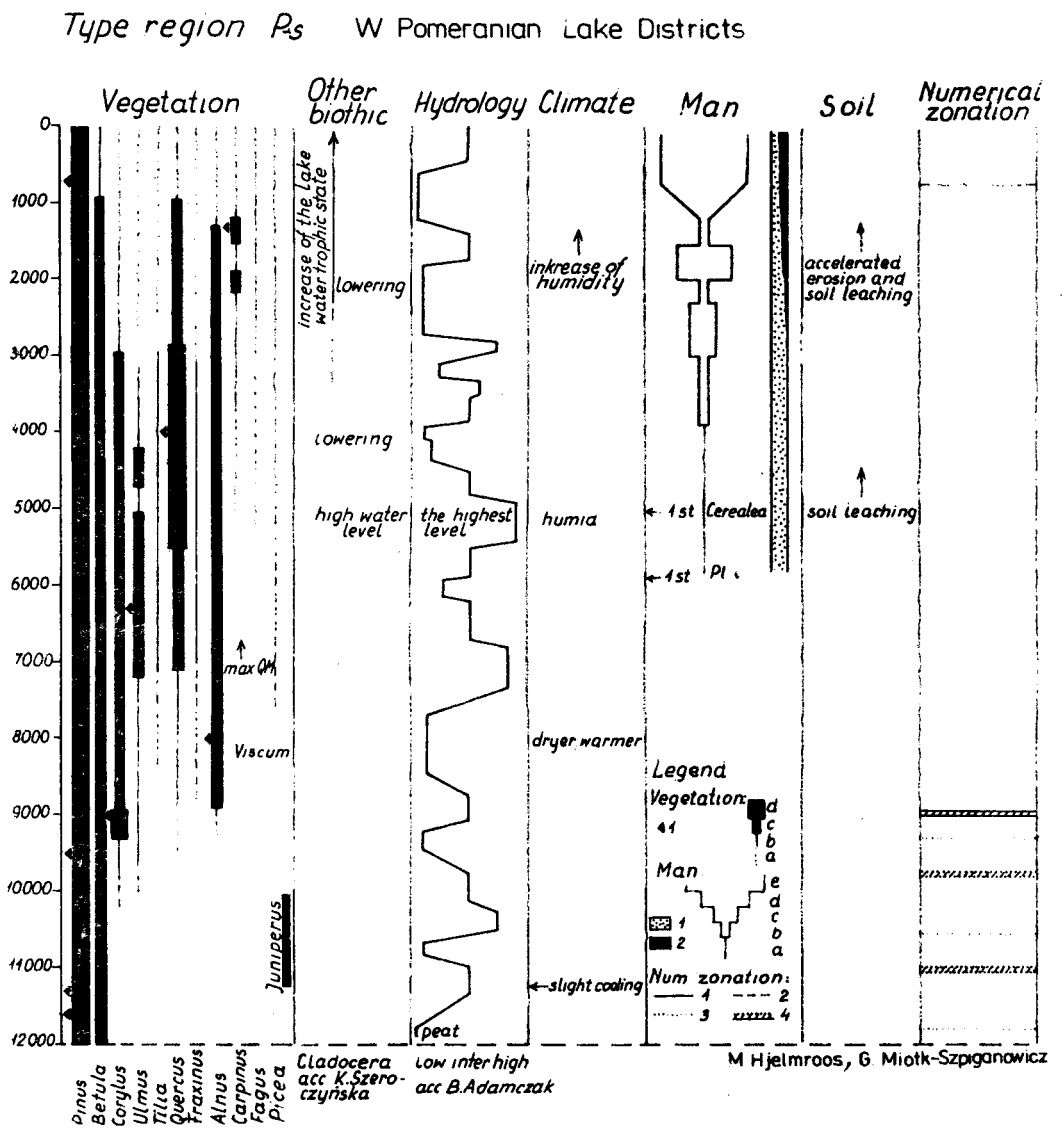

Fig. 2. Event stratigraphy. Vegetation — spread of trees and shrubs: a — presence hypothetical or slight, b — present, c — expansion or important part, d — common, 1 — maximum. Man — human impact: a — slight, b, c, d, e — increasing settlement and deforestation, 1 — grazing, 2 — agriculture. Numerical zonation: 1 — clear boundary, 2 — fairly clear boundary, 3 — faint boundary, 4 — boundary with a transition zone

different immigration times of *Ulmus* (9800 and 9650 years B.P.), *Quercus* (8750 and 9250 years B.P.), *Fraxinus* (6900 and 7200 years B.P.) and *Fagus* (2250 and 2750 years B.P.). This was probably due to differences in the soil conditions around the sites considered. Besides, in the neighbourhood of Lake Wielkie Gacno the presence of *Picea* was recorded, in relatively large numbers in the period from about 4000 years B.P. to 2000 years B.P., which has not been found in the environs of Lake Mały Suszek, nor in the southern part of Bory Tucholskie.

Differences in the duration of the last two local pollen zones distinguished for Lake Wielkie Gacno (Hjelmroos-Ericsson 1981) and Lake Mały Suszek, as well as of other events that took place chiefly in the last thousend years, resulted from the application of a graphical correction of ^{14}C datings for Lake Wielkie Gacno.

During the Neolithic Period and the Bronze Age man's economic activity consisted primarily in husbandry (Fig. 2). Towards the end of the Bronze Age and the beginning of the Iron Age there was a considerable growth of land cultivation in addition to animal husbandry, but an intensive growth of agriculture started only with the Roman Period. After the Bronze Age onwards human economic activity is more conspicuous in the southern, deforested the earliest, part of Bory Tucholskie.

Most marked in the numerical division into pollen zones is only the boundary of about 9000 years B.P. related to the spreading of *Quercus*, *Ulmus* and *Alnus*.

Results from diatom (Bogaczewicz-Adamczak M.S.) and *Cladocera* (Szeroczyńska M.S.) analyses show that water level of the Bory Tucholskie lakes was the highest about 5400—4900 years B.P., and the lowest from about 1200 to 600 years B.P.

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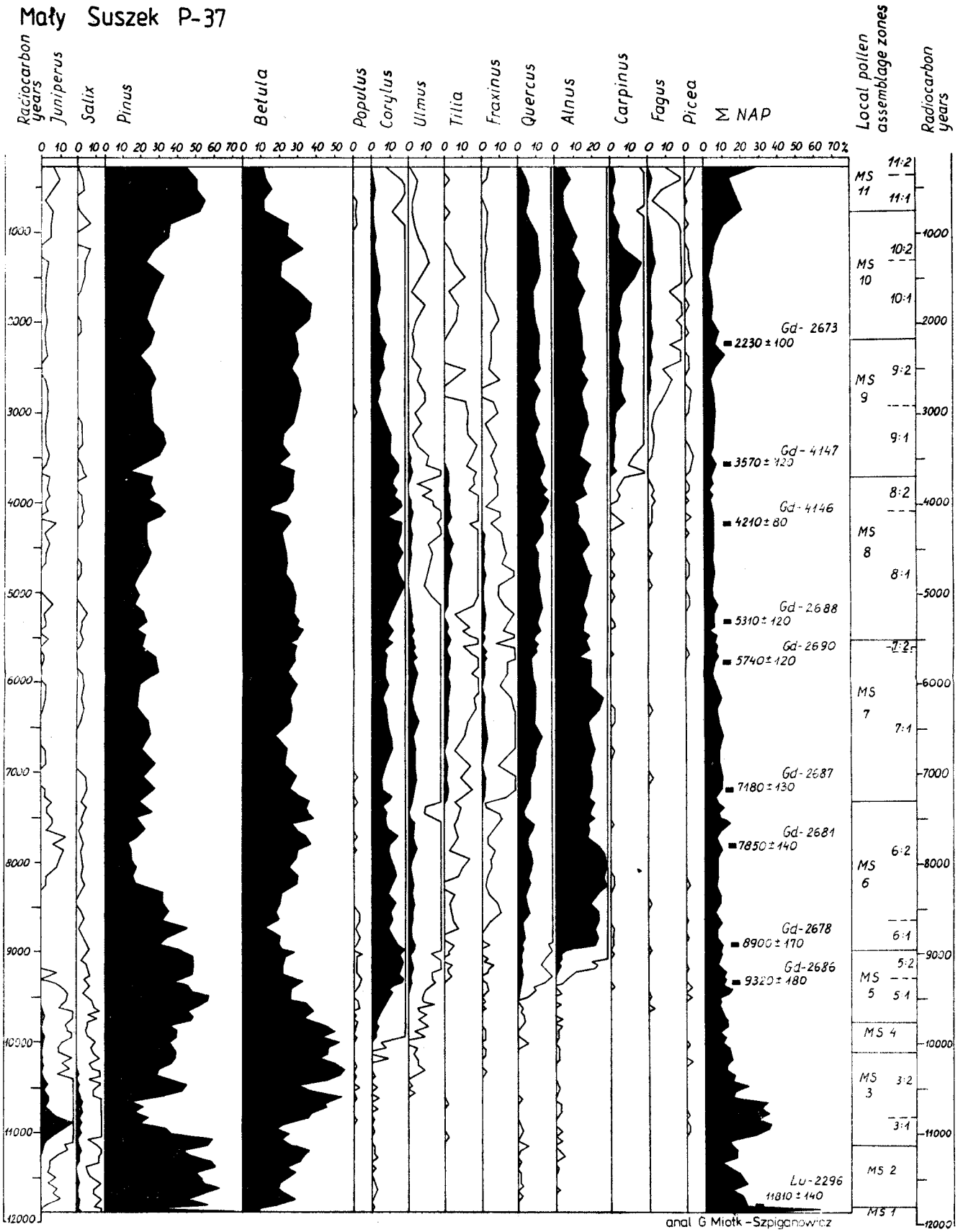

Fig. 1. Pollen diagram from Lake Mały Suszek. Curves of trees and sum of NAP only. All values are percentages of AP+NAP. Radiocarbon age is based on uncorrected ^{14}C dates