APPENDIX 1

Results of pollen and plant macro-remain analyses, radiocarbon dating and description of sediment lithology

Biostratigraphy (Mangerud et al., 1974; age cal BP – [1]Litt et al., 2001; [2]Starkel et al., 2013)	Depth [cm]	Sediment	Results of analyses (pollen spectra*, other analyses**)
End of the Plenivistulian before 14450[1] cal BP	PI: 1430–900.	PI: grey organic silt, laminated in part (1205–1198cm).	L PAZ: PI: NAP–*Pinus*–*Betula* Pollen spectra: P: dominance of *Pinus sylvestris* (mean: 43.13%) and NAP (mean: over 20.0%). The highest content of *Juniperus communis* (maximum: 4.5%) and *Betula nana* (maximum: 9.0%). Pollen grains of *Ephedra*, *Populus* and *Hippophäe rhamonides* appear. Among herbaceous plants, an absolute maximum is attained by Apiaceae (20.0%) and *Artemisia* (5.0%), accompanied by high amounts of Poaceae (mean: 5.74%) and Cyperaceae (mean: 3.53%). Taxa such as Chenopodiaceae, *Dryas octopetala*, *Helianthemum*, *Saxifraga*, and *Selaginella selaginoides* are recorded as well. Numerous broken and redeposited pollen grains of *Corylus avellana*, *Ulmus*, *Tilia*, *Alnus*, *Quercus*, *Fraxinus*, *Carpinus betulus*, *Fagus sylvatica*, and *Picea abies*, as well as Neogene grains, are observed (Fig. 7). Concentration of pollen grains: PI: below 25 × 10^5/cm^3. Radiocarbon dating: PI: depth of 1200 cm, 19368–18901 cal BP (95.4%) (15850 ± 80 BP conv., Poz–46881) – organic sediment was dated; depth of 940 cm, 38081–35540 cal BC (95.4%) (32530 ± 460 BP conv., Poz–46880) – organic sediment was dated.
pre–Allerød before 13350[1] cal BP	GI: 875–873; GII: 1515–1501.	GI: grey organic silt; GII: grey organic silt (1520–1505 cm), detritus (1505–1502 cm) and mineral (1502–1501 cm) gyttja.	L PAZ: GI: *Pinus*–NAP, GII: *Pinus*–NAP Pollen spectra: dominance of *Pinus sylvestris* (mean: 45.5% – GI, 80.0% – GII) and low content of *Betula* (mean: 37.4% – GI, 9.5% – GII). NAP content up to several percent, dominated by Poaceae, Cyperaceae and *Cichorioideae* (Figs. 4 and 5). Concentration of pollen grains: GI: below 50 × 10^5/cm^3, GII: below 40 × 10^5/cm^3. Macro–remain analysis: GII: low content of plant remains; oospores of Characeae, ephiphdia of *Daphnia*, statoblasts of *Cristatella mucedo*, and small pieces of charcoal are present. Radiocarbon dating: GII: depth of 1508 cm, 13580–12740 cal BC (95.4%) (11340 ± 220 BP conv., Gd–19149) – organic sediment was dated.
Allerød 12680–13350[1] cal BP	GI: 873–860; GII: 1501–1475; GV: 482–476.	GI: peat (to 865 cm), carbonate gyttja; GII: mineral (to 1490 cm) and detritus gyttja; GV: peat.	L PAZ: GI: *Pinus*–*Betula*, GII: *Pinus*–*Betula*, GV: *Pinus*–NAP. Pollen spectra: G: dominance of *Pinus sylvestris* (mean: 70.1% – GI,67.8% – GII, 64.5% – GV); NAP content ranges from few (GI and GV) to several (GII) percent – dominant by Poaceae, Cyperaceae and *Artemisia*. Herbaceous taxa such as *Dryas octopetala*, *Helianthemum* and *Selaginella selaginoides* are recorded (Figs. 4–6). Concentration of pollen grains: GI: attains 50 × 10^5/cm^3, GII: attains ca. 75 × 10^5/cm^3, GV: attains ca. 30 × 10^5/cm^3 Macro–remain analysis: GI: moss peat with *Aulacomnium palustre* as main component (873–865 cm) GII: frequency of plant remains increases; numerous remains of trees and shrubs, including *Betula nana/humilis*; occurrence of endocarps of *Potamogeton*, abundant remains of Characeae, *Daphnia* and *Cristatella mucedo* as well as small pieces of charcoal.

			GV: moss peat with *Aulacomnium palustre* as main component Radiocarbon dating: GI: depth of 870–868 cm, 13228–11220 cal BP (95.4%) (10550 ± 410 BP conv., Gd–18499) – organic sediment was dated. GII: depth of 1501 cm, 13450–12745 cal BP (95.4%) (11260 ± 190 BP conv., GdS–602) – organic sediment was dated; depth of 1494 cm, 13419–12707 cal BP (95.4%) (11170 ± 210 BP conv., Gd–30154) – organic sediment was dated.
Younger Dryas 12680–11590[1]/11500[2] cal BP	GI: 860–850; GII: 1475–1405.	GI: carbonate gyttja; GII: detritus (to 1470 cm) and mineral gyttja.	L PAZ: GI: *Juniperus–Artemisia*, GII: *Juniperus–Artemisia*. Pollen spectra: G: variable content of *Pinus* and *Betula*; absolute maximum of *Juniperus*; high content of *Betula nana* and *Salix*. NAP content increases to several percent (nearly 15% – GI, exceeds 25.0% – GII) and dominated by Poaceae, Cyperaceae and *Artemisia*. Chenopodiaceae, Apiaceae, *Dryas octopetala*, *Helianthemum*, *Saxifraga* are observed. Redeposited pollen grains of *Corylus avellana*, *Ulmus*, *Tilia* and *Alnus* are found (Figs. 4 and 5). Concentration of pollen grains: GI: attains ca. 150 × 10^5/cm^3, GII: attains ca. 50 × 10^5/cm^3. Macro–remain analysis: GII: decrease in the amount of remnants; only remains of aquatic invertebrates, such as *Daphnia*, and *Cristatella mucedo*, are numerous. Radiocarbon dating: GII: depth of 1439 cm, 13323–13085 cal BC (95.4%) (11370 ± 60 BP conv., Poz–43480) – organic sediment was dated.
Preboreal 11500–10200[2] cal BP	GI: 850–810; GII: 1405–1340; PI: 900–790.	GI: carbonate (to 840 cm) and mineral gyttja (to 820 cm), lacustrine sand (very high content of medium– and coarse–grained sand at 820–810 cm); GII: mineral (to 1400 cm) and carbonate gyttja; PI: gray organic silt separated a sharp boundary (890 cm) from mineral (to 840 cm) and carbonate gyttja.	L PAZ: GI: *Betula–Pinus*, GII: *Pinus–Betula*, PI: *Pinus–Betula*. Pollen spectra: G: *Betula* attains it's absolute maximum (67.2% – GI, 63.5% – GII); constants curves of *Alnus*, *Corylus avellana*, *Quercus* and *Ulmus* appear. NAP content attains a mean of few percent and is dominated by Poaceae, Cyperaceae and *Artemisia* (Figs. 4 and 5). P: variable content of *Pinus* and *Betula*; constant curves of *Salix*, *Corylus avellana* and *Quercus*. Sporomorphs of *Ephedra*, *Juniperus communis* and *Hippophäe rhamonides* appear occasionally. NAP content attains a mean value of ca. 10%, with the highest values for Poaceae and *Artemisia*. The constant curve of Apiaceae disappears; pollen grains of *Dryas octopetala*, *Helianthemum* and Chenopodiaceae are found occasionally (Fig. 7). Concentration of pollen grains: GI: attains ca. 250 × 10^5/cm^3, GII: exceeds 350 × 10^5/cm^3, PI: attains ca. 120 × 10^5/cm^3. Radiocarbon dating: PI: depth of 890 cm, 20547–20010 cal BP (95.4%) (16810 ± 100 BP conv., Poz–46879) – organic sediment was dated.
Boreal 10200–9600[2] cal BP	GI: 810–740 cm GII: 1340–1070 cm GV: 476–466 cm; PI: 790–712 cm.	GI: mineral (to 780 cm), carbonate (to 760 cm) and detritus gyttja; GII: carbonate (to 1140 cm) detritus gyttja; GV: carbonate gyttja; PI: carbonate gyttja.	L PAZ: GI: *Corylus–Ulmus*, GII: *Corylus–Ulmus*, GV: *Corylus–Ulmus*, PI: *Corylus*. Pollen spectra: G: few (GV) to several (GI, GII) percent high content of *Corylus avellana*; content of *Ulmus* and *Quercus* increases; curves of *Tilia*, *Fraxinus* and *Alnus* appear (Figs. 4–6). NAP content attains ca. few percent. P: content of *Corylus avellana* attains a mean of 10.2%; content of *Quercus* and *Ulmus* increases; curves of *Tilia*, *Fraxinus* and *Alnus* appear (Fig. 7). NAP content attains ca. few percent. Concentration of pollen grains: GI: attains ca. 350 × 10^5/cm^3, GII: exceeds 400 × 10^5/cm^3, GV: attains ca. 220 × 10^5/cm^3, PI: attains ca. 120 × 10^5/cm^3

* – G – the Gronowo site, P – the Piotrkowo site

** – GI – Gronowo I core, GII – Gronowo II core, GV – Gronowo V core, PI – Piotrkowo I core