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Revision of some plant macrofossil collections from the Eemian interglacial deposits of central and western Poland

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ABSTRACT. Results of a revision of the macrofossil plant remains in collections of the Palaeobotanical Museum, of the W. Szafer Institute of Botany, Polish Academy of Sciences, from four localities referred to the Eemian interglacial in central and western Poland are presented. The state of each collection before and after the revision is presented on six tables. Short comments and correlation between Eemian floras of Poland and Belarus are also presented.

KEY WORDS: macrofossil plant remains, revision, Eemian interglacial, Poland, Belarus

INTRODUCTION

The collection of Eemian macroscopic plant remains, housed at the Palaeobotanical Museum of the W. Szafer Institute of Botany Polish Academy of Sciences in Kraków (KRAM-P), is considerably smaller than other comparable Pleistocene collections. These collections were studied during the 1920s and 1930s, but some of them were reinvestigated by Środoń in the 1950s based on more representative fossil materials and using more progressive palaeobotanical methods. This paper is a continuation of research commenced during the 1990s undertaking a revision of macrofossil plant collections from the Pliocene and Pleistocene floras of Poland. This work was necessary in order to correct determinations previously made for some of the taxa present, and to identify numerous specimens left that remained indeterminate within collections. In this work the same methods as described in Velichkevich and Mamakowa (1999) have been used. Results of the revision are published in several papers, including publications on exotic plants in the Mazovian interglacial (Mamakowa & Velichkevich 1993a, b), *Potamogeton* species from Pliocene

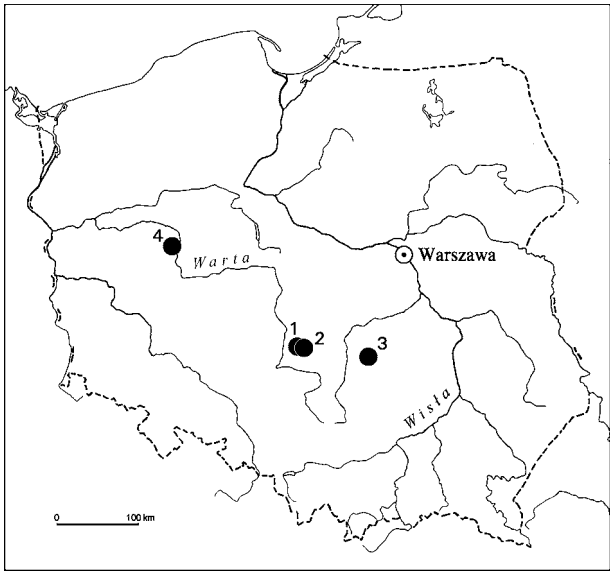

Fig. 1. Location of the revised floras: **1** – Dzbanki Kościuszkowskie, **2** – Szczerców, **3** – Bedlno, **4** – Szeląg

floras of Mizerna in Poland and Kholmech in Belarus, and Pleistocene floras from both countries (Velichkevich & Lesiak 1996, 1999, Velichkevich & Granoszewski 1996), and finally two large groups of macrofossil floras from the Vistulian glaciation and Mazovian interglacial in Poland (Velichkevich & Mamakowa 1999, 2003, Velichkevich et al. 2004). After revision each of these floras are more precisely known, providing the opportunity for basic studies of stratigraphic subdivision of Pleistocene profiles, correlation of interglacial floras, and palaeogeographic and palaeoclimatic reconstructions to be undertaken. This paper concerns revision of six carpological floras from the Eemian interglacial collected from 4 localities (Dzbanki Kościuszkowskie, Szczerców, Bedlno and Szeląg) in central and western Poland (Fig. 1).

RESULTS OF THE REVISION

DZBANKI KOŚCIUSZKOWSKIE AND SZCZERCÓW
(Tabs 1–3)

Organic sediments (gyttja, peat) in the Widawka valley (right tributary of the river Warta), in the vicinity of the village Dzbanki Kościuszkowskie near Szczerców, were first discovered in 1924 during geological explorations in this area (Premik 1925). On the basis of palaeobotanical investigations by Piech (1930) the age of the organogenic sediments has been determined only in general as interglacial. On Szafer's initiative special studies of interglacial sediments from the locality Dzbanki Kościuszkowskie were undertaken in 1929. This also resulted in finding new organic sediments on the right riverbank of Widawka to the north of Szczerców (Piech 1930). On the basis of pollen diagrams and analysis of macrofossils sediments the three profiles have been dated to the Masovien I interglacial (Piech 1932) – actually named Mazovian in the recent Pleistocene stratigraphic scheme. Subsequently, Woldstedt (1947) provided precise characteristics of many European interglacial pollen diagrams, and for several of them, hitherto determined as Masovien I (Mindel-Riss), changed the age to the younger Masovien II (Riss-Würm), and among them included Dzbanki Kościuszkowskie and Szczerców.

Piech (1932) listed all determined taxa from the Dzbanki Kościuszkowskie and Szczerców floras in one table, with remarks from which flora each taxon occurs in. In museum collections specimens from the two profiles from

Table. 1. List of macroscopic plant remains from Dzbanki Kościuszkowskie 1924 (KRAM-P-Q-125a)
Abbreviations: e – endocarp, f – fruit, fr – fragment, s – seed, st – sclerotium; [(a)] only in collection

After revision	Type of remains	Number of specimens	After Piech (1932)
Abies alba Mill.	s	1	*Iris pseudoacorus* L.
Acer campestre L.	f	2	*Acer campestre* L.
A. cf. *campestre* L.	s	1	[(a)] indet.
Betula sp.	f	1	[(a)] indet.
Brasenia holsatica (Web.) Weberb.	s	2	*Brasenia purpurea* Michx.
Carex cf. *extensa* Gooden	f	5	*Carex dioica* L.
Carex sp.	f	1	*Carex* sp.
Carpinus betulus L.	f	7	*Carpinus betulus* L.
C. betulus L.	f	1 fr	*Nuphar luteum* L.
Ceratophyllum demersum L.	f	143	*Ceratophyllum demersum* L. a/ var. *apiculatum* Cham. b/ var. *oxyacanthum* Garcke
Corylus avellana L.	f	1 fr	*Corylus avellana* L.
Najas marina L.	s	495	*Najas marina* L.
Nuphar lutea (L.) Sibth. & Sm.	s	4	*Nuphar luteum* (L.) Sm.
Nymphaea alba L.	s	6	*Nymphaea alba* L.
Potamogeton natans L.	e	2	*Potamogeton obtusifolius* Mert. & Koch
P. perfoliatus L.	e	1	*P. obtusifolius* Mert. & Koch
Scheuchzeria palustris L.	s	1	[(a)] indet.
Tilia cordata Mill.	f	1	*Tilia cordata* Mill.
Cenococcum geophilum Fr.	st	3	[(a)] indet.

Table. 2. List of macroscopic plant remains from Dzbanki Kościuszkowskie 1929 (KRAM-P-Q-125b)
Abbreviations: e – endocarp, f – fruit, fr – fragment, s – seed, sc – scale, ws – wing of seed; [a] only in collection

After revision	Type of remains	Number of specimens	After Piech (1932)
Abies alba Mill.	s	1	[a] indet.
Acer campestre L.	f	20 + fr	*Acer campestre* L.
A. campestre L.	f	1	*A. platanoides* L.
A. tataricum L.	f	1	*A. tataricum* L.
Alnus sp.	f	3 fr	[a] indet.
Betula sect. *Albae* Rgl.	f	2	*Betula "alba"*.
B. nana L.	f,sc	28,13	*B. nana* L.
B. pubescens Ehrh.	sc	1	*B. nana* L.
Betula sp.	f	1	[a] indet.
Brasenia holsatica (Web.) Weberb.	s	5	*Brasenia purpurea* Michx.
Carex cf. *diandra* Schrank	f	5	[a] indet.
C. pseudocyperus L.	f	2	*Carex pseudocyperus* L.
Carex sp.	f	fr	*Carex* sp.
Carex sp.	f	3	[a] indet.
Carpinus betulus L.	f	99	*Carpinus betulus* L.
C. betulus L.	f	2	*Viburnum opulus* L.
Carpinus ?	f	1	[a] *Carpinus ?*
Carpinus ?	f	1	[a] indet.
Ceratophyllum demersum L.	f	150	*Ceratophyllum demersum* L. a/ var. *apiculatum* Cham. b/ var. *oxyacanthum* Garcke
C. submersum L.	f	14	*C. submersum* L.
Cladium mariscus (L.) Pohl	f	11	[a] indet.
Corylus avellana L.	f	2 fr	*Corylus avellana* L.
Hippuris vulgaris L.	f	1	*Hippuris vulgaris* L.
Juniperus communis L.	s	1	[a] indet.
Menyanthes trifoliata L.	s	1 fr	[a] indet.
Najas marina L.	s	444	*Najas marina* L.
Nuphar lutea (L.) Sibth. & Sm.	s	8	*Nuphar luteum* (L.) Sm.
Nymphaea alba L.	s	3	*Nymphaea alba* L.
N. cf. *candida* C. Presl.	s	1	*N. alba* L.
Picea cf. *abies* (L.) Karst.	ws	1	*Picea excelsa* (Lam.) Link
Potamogeton filiformis Pers.	e	2	*Potamogeton gramineus* L.
P. cf. *obtusifolius* Mert. & Koch	e	1	*P.* cf. *pusillus* L.
P. natans L.	e	1	*P. pectinatus* L.
P. natans L.	e	1	*Potamogeton* sp.
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	f	4	*Scirpus tabernaemontani* Gmel.
Sch. tabernaemontani (C.C. Gmel.) Palla	f	1	[a] *Scirpus* sp.
Sparganium sp.	e	1	[a] *Valerianella ?*
Stratiotes aloides L.	s	3	*Stratiotes aloides* L.
Tilia cordata Mill.	f	2 + fr	*Tilia cordata* Mill.
Tilia cf. *cordata* Mill.	f	1	*T. platyphyllos* Scop.
T. platyphyllos Scop.	f	14+fr	*T. platyphyllos* Scop.
T. tomentosa Moench	f	2	*T. platyphyllos* Scop..
Tilia sp.	f	1 fr	*T. platyphyllos* Scop.

Dzbanki Kościuszkowskie collected in 1924 and 1929 as well as those from the Szczerców profile collected in 1929 are stored and registered separately. Therefore the results of the present revision are separately presented in Tables 1–3.

Following from the revision of these three profiles the floristic composition has been considerably enriched by determination of several taxa which were previously considered indeterminate, while some other taxa have had their taxonomic status changed. The floristic complexes of the three profiles are of the same age, and characterize vegetation of the Eemian interglacial and have a typical relationship between trees, shrubs, herbaceous

Table 3. List of macroscopic plant remains from Szczerców (KRAM-P- Q-124)
Abbreviations: ca – cone axis, e – endocarp, f – fruit, fr – fragment, s – seed; [(a)] only in collection

After revision	Type of remains	Number of specimens	After Piech (1932)
Acer campestre L.	f	4	*Acer campestre* L.
Aldrovanda vesiculosa L.	s	1	*Aldrovanda vesiculosa* L.
Alnus glutinosa (L.) Gaertn.	f	3	[(a)] indet.
Alnus sp.	ca	5	*Alnus* sp.
Batrachium sp.	f	5	*Potentilla silvestris* Neck.
Brasenia holsatica (Web.) Weberb.	s	91	*Brasenia purpurea* Michx.
Carex cf. *extensa* Gooden	f	151	*Carex dioica* L.
Carex sp. div.	f	35	*Carex* sp. div.
Carpinus betulus L.	f	24	*Carpinus betulus* L.
Ceratophyllum demersum L.	f	332	*Ceratophyllum demersum* L. a/ var. *apiculatum* Cham. b/ var. *oxyacanthum* Garcke
C. submersum L.	f	36	*C. submersum* L.
Frangula sp.	s	1 fr	*Acer campestre* L
Lycopus europaeus L.	f	1	*Lycopus europaeus* L.
Menyanthes trifoliata L.	s	12	*Menyanthes trifoliata* L.
Najas marina L.	s	189	*Najas marina* L.
Oenanthe aquatica (L.) Poir.	f	4	*Oenanthe phellandrium* (L.) DC.
Pinus sylvestris L.	s	1	*Najas marina* L.
Polygonum persicaria L.	f	1	[(a)] *Polygonum* sp.
Potamogeton cf. *acutifolius* Link	e	1	*Potamogeton obtusifolius* Mert. & Koch
P. filiformis Pers.	e	3	*P. gramineus* L. (*P. filiformis* Pers. after K.Wasylikowa & B.Pawlikowa)
P. filiformis Pers.	e	3	*Potamogeton* sp.
P. natans L.	e	30	*P. obtusifolius* Mert. & Koch
P. natans L.	e	1	*P. perfoliatus* L.
P. natans L.	e	1	*Potamogeton* sp.
P. obtusifolius Mert. & Koch	e	3	*P. trichoides* Cham. & Schl.
Ranunculus sceleratus L.	f	3	[(a)] *Potentilla* sp.
Rumex maritimus L.	f	1	*Rumex maritimus* L.
Sambucus nigra L.	s	6	*Sambucus nigra* L.
Sparganium microcarpum (Neum.) Raunk. vel *S. neglectum* Beeby	f	11	*Sparganium minimum* Fr.
S. minimum Wallr.	e	2	[(a)] indet.
Tilia cf. *platyphyllos* Scop.	f	2 fr	*Tilia platyphyllos* Scop.

and aquatic plants. In the forest, deciduous trees (*Acer campestre*, *A. tataricum*, *Carpinus betulus*, *Tilia platyphyllos*, *T. tomentosa*, *T. cordata*, *Alnus glutinosa*) were predominant, whereas conifers were represented in the profiles only by single needles of *Abies alba*, *Pinus sylvestris*, and *Picea abies*. It was very important to find in two profiles macroscopic remains of *Abies alba*, which confirm rather high concentration of this species in Eemian floras of central Poland, hitherto known from palynological data (Środoń & Gołąbowa 1956, Mamakowa 1989). Macrofossils of *Abies* have not been found in floras of the same age from eastern Poland and western Belarus (Velichkevich 1982).

A special characteristic for the Eemian interglacial is a complex of thermophilous aquatic and reedswamp plants (*Brasenia holsatica*, *Aldrovanda vesiculosa*, *Nymphaea alba*, *Stratiotes aloides*, *Cladium mariscus*, and *Trapa natans*). The presence of these species in the studied floras (Dzbanki Kościuszkowskie and Szczerców), collectively called the "*Brasenia* complex", provide the possibility to correlate Eemian floras of western Belarus from Bogatyrevichi (formerly Samostrzelniki), Pyshki, Timoshkovichi, Knyazhevodtsy not only with floras of the same age from Poland, but also with floras from western Russia and Lituania.

BEDLNO (Tabs 4, 5)

The interglacial sediments at Bedlno near Końskie found by Passendorfer in 1930 have been studied by Szafer (macroscopic plant

Table 4. List of macroscopic plant remains from Bedlno 1931 (KRAM-P-Q-34)
Abbreviations: e – endocarp, f – fruit, n – needle, s – seed, st – sclerotium; [a] only in collection

After revision	Type of remains	Number of specimens	After Szafer et al. (1931)
Abies alba Mill.	n	1	*Abies alba* Mill.
Abies sp.	n	1 fr	[a] indet.
Alnus glutinosa (L.) Gaertn.	f	7	*Alnus* sp.
A. glutinosa (L.) Gaertn.	f	5	[a] indet.
Batrachium sp.	f	4	*Batrachium* sp.
Betula sect. *Albae* Rgl.	f	1	*Betula "alba"*
B. cf. *nana* L.	f	1	*B. nana* L.
Carex sp. div. 2-sided.	f	13	*Carex* sp. div.
C. sp. div. 3-sided.	f	54	*Carex* sp. div.
Carex sp.	f	1	[a] *Betula nana* L.
Carpinus betulus L.	f	5	*Carpinus betulus* L.
Ceratophyllum demersum L.	f	6	*Ceratophyllum demersum* L.
C. demersum L.	f	1	*C. demersum* L. f. *apiculatum* Cham.
C. cf. *submersum* L.	f	1	*C. submersum* L.
Coniferae	n	5	[a] Coniferae
Corylus sp.	f	1 fr	[a] indet.
Menyanthes trifoliata L.	s	4	*Menyanthes trifoliata* L.
Myriophyllum spicatum L.	f	3	*Myriophyllum spicatum* L.
Najas marina L.	s	226	*Najas marina* L.
Nuphar lutea (L.) Sibth & Sm.	s	3 fr	*Nuphar luteum* (L.) Sm.
Nymphaea alba L.	s	4	*Nymphaea "alba"*
Picea cf. *abies* (L.) Karst.	n	2 fr	*Picea excelsa* (Lam.) Link
Picea sect. *Eupicea* Willk.	n	3 fr	*Picea excelsa* (Lam.) Link
Polygonum lapathifolium L.	f	1	[a] *Polygonum* sp.
Potamogeton alpinus Balb.	e	1	*Potamogeton* sp.
P. gramineus L.	e	1	*Potamogeton* sp.
P. gramineus L.	e	1	*Najas marina* L.
P. natans L.	e	4	*Potamogeton* sp.
P. cf. *nodosus* Poir.	e	1	*Potamogeton* sp.
P. praelongus Wulf.	e	1	*Potamogeton* sp.
P. rutilus Wolfg.	e	3	*Potamogeton* sp.
P. trichoides Cham. & Schlecht.	e	1	*Potamogeton* sp.
Potamogeton sp.	e	1 fr	*Potamogeton* sp.
Rubus cf. *idaeus* L.	f	1	*Rubus* cf. *idaeus* L.
Sambucus nigra L.	s	1	*Sambucus* sp.
Sparganium emersum Rehm.	s	1	*Carex* sp.
S. emersum Rehm.	e	1	[a] *Sparganium* sp.
S. minimum Wallr.	e	1	*Carex* sp.
S. minimum Wallr.	e	5+fr	[a] *Sparganium* sp.
Tilia tomentosa Moench.	f	4+fr	*Tilia ulmifolia* Scop.
Tilia tomentosa Moench.	f	4fr	[a] *Tilia* sp.
Cenococcum geophilum Fr.	st	2	[a] *Cenococcum geophilum* Fr.

remains), Trela (palynology), and Ziembianka (fossil woods). As a result of these studies the description of a rich macroscopic interglacial flora has occurred (37 taxa), which after Szafer represents the climatic optimum of the Masovien I interglacial and the beginning of the Varsovien I glaciation (Szafer et al. 1931).

During the course of the revision several taxa previously determined and listed by Szafer (Szafer et al. l931) were noted as missing. Specifically, from a rich collection of *Potamogeton*, marked by Szafer et al. (1931) as abundant (∞), only few specimens have been left for revision. From the remaining specimens the following species have been determined: *Potamogeton alpinus*, *P. gramineus*, *P. pusillus*, *P.* cf. *nodosus* – new for the flora, and *P. natans*, *P. praelongus*, and *P. trichoides*, determined also by Szafer (Szafer et al. 1931). It could be suggested that a considerable part of the *Potamogeton* endocarps previously available have been given to specialists for

Table 5. List of macroscopic plant remains from Bedlno 1956 (KRAM-P-Q-33)

Abbreviations: ca – cone axis, co – cone, e – endocarp, f – fruit, fr – fragment, l – leaf, n – needle, s – seed, sc – scale, st – sclerotium, ws – wing of seed; [(a)] only in collection

After revision	Type of remains	Number of specimens	After Środoń & Gołąbowa (1956)
Abies alba Mill.	n	5 fr	*Abies alba* Mill.
Acer campestre L.	f,s	1,1	[(a)] indet.
A. cf. *campestre* L.	s	1	[(a)] indet.
Alnus glutinosa (L.) Gaertn.	f	9	*Alnus glutinosa* (L.)Gaertn.
A. glutinosa (L.) Gaertn.	f	3	*Alnus* sp.
A. glutinosa (L.) Gaertn.	f	1	*Najas marina* L.
A. glutinosa (L.) Gaertn.	f	1	[(a)] indet.
Alnus sp.	f	2	*Betula "alba"*; *Carex* sp.
Alnus sp.	ca	2	[(a)] indet.
Arctostaphylos uva-ursi (L.) Spreng	s	1	*Potamogeton* sp.
Batrachium sp.	f	55	*Batrachium* sp.
Betula sect. *Albae* Rgl.	f	4	*Betula "alba".*
B. sect. *Albae* Rgl.	f	6	*Betula* sp.
B. sect. *Albae* Rgl.	f	1	*Carex* sp.
B. humilis Schrank	f,sc	9,3	*B. nana* L.
B. nana L.	f,sc	22,4	*B. nana* L.
B. nana L.	f	1	*Betula* sp.
B. nana L.	l	fr	[(a)] *B. nana* L.
B. cf. *pendula* Ehrh.	sc	1	[(a)] *B. "alba"* .
Brasenia holsatica (Web.) Weberb.	s	6+fr	*Brasenia purpurea* Michx.
Calla palustris L.	s	1	*Sambucus nigra* L.
C. palustris L.	s	4	[(a)] indet.
Carex pseudocyperus L.	f	1	*Carex* sp.
Carex sp. div. 3-sided	f	273	*Carex* sp.
Carex sp. div. 2-sided	f	18	*Carex* sp.
Carex sp. 3-sided	f	1	*Scirpus lacustris* L.
Carex sp. 2-sided	f	2	*Alnus* sp.
Carex sp. 2-sided	f	2	*Betula "alba"*; *Menyanthes trifoliata* L.
Carpinus betulus L.	f	37	*Carpinus betulus* L.
C. betulus L.	f	2 + fr.	[(a)] indet.
Ceratophyllum demersum L.	f	30	*Ceratophyllum demersum* L.
C. demersum L.	f	1	*Ceratophyllum* sp.
C. demersum L.	f	1	*C. submersum* L.
C. demersum L.	f	1	*Najas marina* L.
Cirsium palustre Scop.	s	1	[(a)] indet.
Cladium mariscus (L.) Pohl	s	7	*Cladium mariscus* (L.) Pohl
C. mariscus (L.) Pohl	s	1	*Najas marina* L.
Comarum palustre L.	f	1	*Carex* sp.
Cornus sanguinea L.	f	1	*Cornus sanguinea* L.
Corylus avellana L.	f	1 fr	[(a)] *Corylus avellana* L.
Dryas cf. *octopetala* L.	l	2 fr	*Dryas octopetala* L.
Eleocharis palustris (L.) Roem. & Schult.	f	1	[(a)] *Heleocharis* sp.
Hyoscyamus niger L.	s	1	[(a)] *Hyoscyamus niger* L.
Larix sp.	co	5 + fr	*Larix* sp.
Menyanthes trifoliata L.	s	3+11fr	*Menyanthes trifoliata* L.
M. trifoliata L.	s	fr	*Brasenia purpurea* Michx.
M. trifoliata L.	s	3fr	[(a)] indet.
Myriophyllum spicatum L.	f	22	*Myriophyllum spicatum* L.
M. spicatum L.	f	1	[(a)] indet.
M. verticillatum L.	f	8	[(a)] *Myriophyllum* sp.
Najas marina L.	s	1575	*Najas marina* L.
N. marina L.	s	1	Coniferae
Nuphar lutea (L.) Sibth. & Sm.	s	3+10fr	*Nuphar luteum* (L.) Sm.
N. lutea (L.) Sibth. & Sm.	s	6fr	[(a)] indet.
Nymphaea alba L.	s	8	*Nymphaea alba* L.

Table 5. Continued

After revision	Type of remains	Number of specimens	After Środoń & Gołąbowa (1956)
Nymphaea alba L.	s	11	*Nymphaea* sp.
N. alba L.	s	1	*Nuphar luteum* (L.) Sm.
Picea abies (L.) Karst.	n	78 fr	*Picea excelsa* (Lam.) Link
P. abies (L.) Karst.	s	9	[a] Coniferae
Picea sp.	n	2fr	*Carex* sp., [a] indet.
Picea sp.	s,ws	4,1	[a] indet.
Polygonum aviculare L.	f	1	*Carex* sp.
Potamogeton alpinus Balb.	e	27	*Potamogeton* sp.
P. compressus L.	e	1	*Potamogeton* sp.
P. filiformis Pers.	e	15	*Potamogeton* sp.
P. gramineus L.	e	3	*Potamogeton* sp.
P. natans L.	e	244	*Potamogeton* sp.
P. obtusifolius Mert. & Koch	e	2	*Potamogeton* sp.
P. pectinatus L.	e	1	*Potamogeton* sp.
P. perfoliatus L.	e	2	*Potamogeton* sp.
P. praelongus Wulf.	e	3	*Potamogeton* sp.
P. rutilus Wolfg.	e	19	*Potamogeton* sp.
P. sukaczevii Wieliczk.	e	32	*Potamogeton* sp.
P. trichoides Cham. & Schlecht.	e	12	*Potamogeton* sp.
P. vaginatus Turcz.	e	1	*Potamogeton* sp.
Potamogeton sp. div.	fr	16	*Potamogeton* sp.
Potentilla sp.	f	1	[a] *Potentilla* sp.
Ranunculus flammula L.	f	1	*Potentilla* sp.
R. flammula L.	f	1	[a] indet.
R. lingua L.	f	1	*Najas marina* L.
R. reptans L.	f	2	*Potamogeton* sp.
Rubus idaeus L.	f	2	*Rubus idaeus* L.
R. idaeus L.	f	4	*Rubus* sp.
R. idaeus L.	f	1	*Potamogeton* sp.
Sambucus ebulus L.	s	1	*Sambucus ebulus* L.
S. nigra L.	s	7	*S. nigra* L.
Schoenoplectus lacustris (L.) Palla	f	5	*Scirpus lacustris* L.
Sch. lacustris (L.) Palla	f	11	*Scirpus* sp.
Sch. lacustris (L.) Palla	f	1	[a] indet.
Silene sp.	s	1	[a] indet.
Solanum dulcamara L.	s	1	*Solanum dulcamara* L.
Sparganium hyperboreum Laest.	e	1	*Hippuris vulgaris* L.
S. microcarpum (Neum.) Raunk.	e	1	*Sparganium ramosum* Curtis
S. microcarpum (Neum.) Raunk.	e	1	*Carex* sp.
S. microcarpum (Neum.) Raunk.	e	1	[a] indet.
S. minimum Wallr.	e	23	*Sparganium minimum* Wallr.
S. minimum Wallr.	e	3	[a] indet.
Tilia cf. *cordata* Mill.	f	1	[a] indet.
T. platyphyllos Scop.	f	1	*T. platyphyllos* Scop.
T. tomentosa Moench	f	2	[a] *Tilia* sp.
T. tomentosa Moench	f	7	[a] indet.
T. cf. *tomentosa* Moench	f	8fr	[a] indet.
Cenococcum geophilum Fr.	st	∞	*Cenococcum geophilum* Fr.

determination and these may not have been returned to the collection. It appears also that in the collection being revised the following taxa listed by Szafer et al. (1931) are missing: *Sparganium* cf. *ramosum* L., *Scirpus* cf. *lacustris* L., *S. tabernaemontani* C.C.Gmel., *Montia rivularis* C.C.Gmel., *Pinus sylvestris* L., *Viburnum opulus* L., *Vaccinium myrtillus* L., *Potentilla anserina* L., *Potentilla* sp., *Ranunculus* sp., and *Viola* sp.

Following on from the revision the flora from Bedlno has been enriched by the determination of the above mentioned four species of *Potamogeton*, also some taxa determined

earlier only to the genus rank (*Sparganium*, *Sambucus*, *Alnus*), and some remains of the indeterminate group (*Corylus*). After revision the flora from Bedlno previously described by Szafer (Szafer et al. 1931) contains 36 taxa (Tab. 4), with a rich group of deciduous trees and shrubs together with *Abies alba.* This is a characteristic feature also for the floras from Dzbanki Kościuszkowskie and Szczerców. The composition of aquatic plants in the Bedlno flora is also similar to the above mentioned floras because elements of the "*Brasenia* complex" (*Nymphaea alba*, *Nuphar lutea*, *Najas marina*, *Potamogeton trichoides*), but without *Brasenia*, are present. This confirms Szafer's suggestion that the formation of the organic sediments at Bedlno took place at the end of interglacial climatic optimum.

After the suggestion of Professor Rühle, who realised new borings at the same site, new investigations of the sediments from Bedlno have been undertaken by Środoń and Gołąbowa (1956). Their paper presents a comprehensive list of taxa with nearly all taxa published earlier by Szafer et al. (1931), many new herbaceous plants, and some trees and shrubs. After the revision the flora of Bedlno contains 63 taxa of trees and shrubs, herbaceous plants and aquatics (Tab. 5). Among them deciduous trees (*Carpinus betulus*, *Acer campestre*, *Tilia cordata*, *T. platyphyllos*, *T. tomentosa*), and aquatics of the "*Brasenia* complex" with *Brasenia holsatica*, *Nymphaea alba*, *Nuphar lutea*, *Najas marina*, *Cladium mariscus*, *Sparganium microcarpum*, and *Potamogeton trichoides*, are typical for the Eemian interglacial. It is worthy of mention that among the rich group of *Potamogeton* species the extinct species *P. sukaczevii* is present. In the last years this species has been recorded in several Eemian floras in Poland (Velichkevich & Granoszewski 1996), and is common in many floras of the same age (Muravian) from Belarus (Velichkevich 1982). It should also be noted, similarly as in the flora from Dzbanki Kościuszkowskie, the presence of *Abies alba* and *Picea* in deciduous forests.

It should be particularly noted that a few cones of *Larix* have been found in the declining part of interglacial and in the beginning of the early Vistulian sediments from Bedlno. Contrary to this, in all Eemian floras from Belarus, Lituania and western Russia, no remains of *Larix* have been found, but fossil seeds and needles rather often occur in the early Vistulian floras of western part of Belarus. Moreover, the role played by *Larix* in analogous floras of Poland was much more important.

SZELĄG (Tab. 6)

The site of interglacial sediments from Szeląg near Poznań has been described by Pfuhl (1911), who mentioned only a few species of plants. Szafer and Trela (1929) specified the taxa and gave the results of palynological

Table 6. List of macroscopic plant remains from Szeląg (KRAM-P- Q-130)
Abbreviations: e – endocarp, f – fruit, fr – fragment, s – seed

After revision	Type of remains	Number of specimens	After Środoń (1956)
Alnus glutinosa (L.) Gaertn.	f	5	*Alnus glutinosa* (L.) Gaertn.
Carex sp. div. (3-sided)	f	5	*Carex* sp.
Carex sp. div. (2-sided)	f	28	*Carex* sp.
Carex sp.	f	1	*Carex* sp.
Carex sp. div.	f	4	*Carex* sp.
Carpinus betulus L.	f	9 + fr	*Carpinus betulus* L.
Najas marina L.	s	6 fr	*Najas marina* L.
Nuphar lutea (L.) Sibth. & Sm.	s	2 +2 fr	*Nuphar luteum* (L.) Sm.
Pinus sylvestris L.	s	2	*Pinus silvestris* L
P. sylvestris L.	s	1	*Ceratophyllum* sp.
P. sylvestris L.	s	3	*Menyanthes trifoliata* L.
Potamogeton gramineus L.	e	2	*Potamogeton* sp.
P. natans L.	e	1	*Potamogeton* sp.
Scirpus sp.	f	1	*Carex* sp.
Schoenoplectus lacustris (L.) Palla	f	2	*Carex* sp.
Stratiotes aloides L.	s	15 + fr	*Stratiotes aloides* L.
Tilia cf. *cordata* L.	f	1fr	*Carpinus betulus* L.

investigations. New sediments of gyttja and peat (8 samples) collected by Sawicki, have been studied again by Środoń (1956). He distinguished 12 taxa of macroscopic plant remains, and these have changed only a little the overall composition of the flora (Tab. 6). In abundance were found only fruits of C*arpinus betulus* and seeds of *Pinus sylvestris*. These trees have played the most important role in the mixed conifer-deciduous forests. Among aquatics *Stratiotes aloides*, *Najas marina*, *Nuphar lutea*, and *Schoenoplectus lacustris* were common. The composition of the macroflora is in accordance with the Środoń's stratigraphical suggestion (Środoń 1956), based on the results of pollen analysis, that the formation of interglacial sediments took place in the second part of the Eemian interglacial.

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