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# FLORA OF VASCULAR PLANTS OF LAKE SMOLAK AND THE ADJACENT PEATBOG TWENTY YEARS AFTER THE END OF AN EXPERIMENTAL FERTILISATION

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A B S T R A C T. The study describes the current state of macrophyte flora of Lake Smolak and the adjacent peatbog, against changes induced by an experimental mineral fertilisation and liming in 1971-1974. Eight taxa of mosses and 61 taxa of vascular plants were found, including 6 protected, and 2 endangered species.

Key words: FLORA OF VASCULAR PLANTS, PROTECTED AND ENDANGERED SPECIES, DYSTROPHIC LAKE, EUTROPHICATION

## INTRODUCTION

In summer 1995, a floristic study of Lake Smolak and the adjacent peatbog was carried out. The lake is situated at the east end of Mazurian Lakeland, north of Lake Gołdapiwo. It is a small dystrophic reservoir of 5.3 ha, and maximum depth 5.7 m (data of the IFI, Olsztyn). Such lakes, due to specific environmental conditions, usually have poor biocenosis (Żmudziński 1997). In 1971-1974, the lake was experimentally fertilised and limed, and Canadian pondweed, *Elodea canadensis*, was introduced. Vascular plant communities before and during the experiment were described according to the data by Kondracki, Szostak (1960), and Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja (1977). Unpublished data were also used (Bnińska 1979, Radziej 1994).

## THE AIM OF STUDY AND METHODS

Dystrophic reservoirs having poor macrophyte flora are usually investigated during complex floristic studies of particular areas (Sokołowski 1990, Żukowski, Latowski, Jackowiak, Chmiel 1995), or during investigations of complex plant communities (Sobotka 1967, Polakowski, Chudyba, Dąbek, Dziedzic, Jutrzenka-Trzebiatowski, Korniak, Pietraszewski 1976, Sokołowski 1988, Pisarek 1996). Due to experimental fertilisation

and liming that disturbed its ecological balance, Lake Smolak became an interesting study site. Floristic studies were carried out in June and August 1995. Macrophytes were collected from the bottom, using a boat and an eight arm anchor, as well as along the lake shore. The collected herbal material helped to identify the plants represented a floristic documentation included in the Scientific Herbarium of the Department of Botany and Nature Protection of the Academy of Agriculture and Technology in Olsztyn. Together with vascular plants, mosses were also collected and identified using the papers by Szafran (1963) and Dierssen (1996). The nomenclature of moss species and their taxonomy were taken from Ochyra and Szmajda (1978). Vascular plants were identified according to the key by Szafer, Kulczyński, Pawłowski (1967), using the nomenclature presented in the register by Mirek, Piękoś-Mirek, Zając, and Zając (1995). In cases of changed species name, new and old names were used. Systematic register of the plants was compiled according to Szafer, Kulczyński, Pawłowski (1967) with the modification of Rothmaler (1994). Among the identified vascular plants, 6 protected species were found (Polakowski 1995), and 2 endangered ones (Zarzycki, Szeląg 1992).

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## FLORISTIC CONDITIONS BEFORE THE FERTILISATION

The first data on the vegetation of Lake Smolak and its surroundings were collected in 1953-1956 by Kondracki and Szostak (1960) who made a bathymetric map of the lake with fragmentary floristic information. A belt of sedges was noted around the lake (without identification to species), presence of roundleaf sundew (*Drosera rotundifolia*) at the west and south shore, and a patch of white water-lilies (*Nymphaea alba*) in the southern bay.

Just before the experiment in 1970, and until 1975, stations of selected plant taxa were registered (Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja 1977, Bnińska 1979).

At the beginning of the experiment (1970-1971), a single patch of white water-lilies (*Nymphaea alba*) was found at the central part of the west shore. Several specimens of common cattail (*Typha latifolia*) were noted in the southern bay of the lake, at the south shore. Around the lake, in sphagnum moss belt, the following species were

identified: roundleaf sundew, *Drosera rotundifolia;* water arum *Calla palustris, Comarum palustre,* and bogbean *Menyanthes trifoliata.* Sphagnum mosses and sedges were not identified to species.

## CHANGES IN PLANT SPECIES COMPOSITION IN 1972-1975

In the second year of the experiment (1972), when water pH of Smolak Lake stabilised at a level typical for eutrophic reservoirs, floating sphagnum mat began to disappear. An increase of water trophy caused the appearance of common reed (*Phragmites australis*), which was present in the lake until the end of the study, and considerable expansion of common cattail (*Typha latifolia*). In summer 1972 Canadian pondweed, *Elodea canadensis,* was also introduced to the system.

From 1973, the biomass of *Elodea canadensis* increased, while *Batrachium circinatum* appeared in a natural way. At the same time, floating sphagnum mat disappeared. Bogbean (*Menyanthes trifoliata)* and water arum (*Calla palustris)* withdrew from the lake shore, and cattail (*Typha latifolia)* expanded overgrowing one third of the shoreline length.

Next year the lake flora was enriched with another new species of abundantly developing submerged hydrophytes. In 1974, spiked water-milfoil (*Myriophyllum spicatum*), grass-wrack pondweed (*Potamogeton compressus*) and shining pondweed (*P. lucens* ) appeared (Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja 1977). Canadian pondweed (*Elodea canadensis*) dominated in the biomass of this plant group. Cattail (*Typha latifolia*) became stabilised at the lake shore and reached its maximum abundance in 1973. In the same year Bnińska (1979) observed curled pondweed (*Potamogeton crispus*) and broad-leaved pondweed (*P. natans*).

In 1975, the last year of the study, one more hydrophyte species appeared in a natural way viz. perfoliate pondweed (*Potamogeton perfoliatus*) (Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja 1977). Bogbean (*Menyanthes trifoliata*) was absent, and *Calla palustris* became very rare. Sedges (*Carex sp.*), and white water lilies (*Nymphaea alba*) were present throughout the study period.

In 1972-1974 a patch of about 100-150 $m^2$, composed of white water lily (*Nymphaea alba*) and yellow water lily (*Nuphar lutea*) was observed in south-west part of the lake, (Radziej 1994)

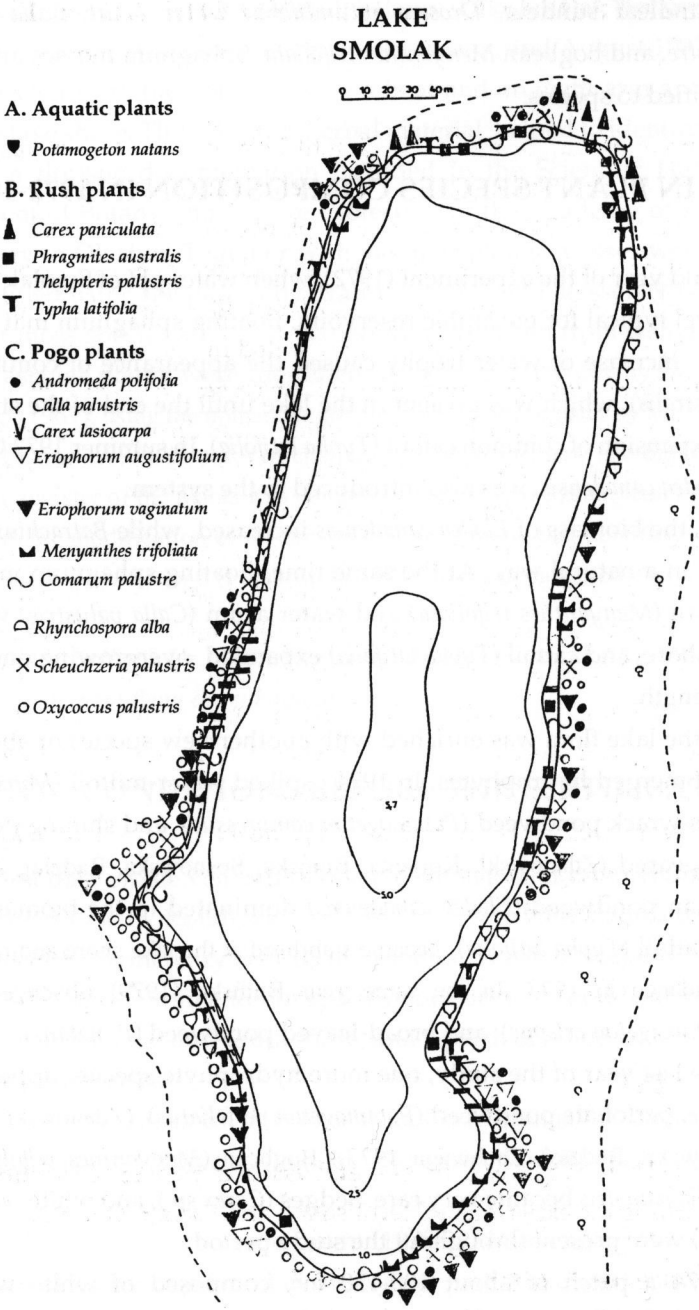


Fig. 1. Stations of selected water, rush, and peatbog plants observed in 1995

## CURRENT STATE OF LAKE FLORA AND THE ADJACENT PEATBOG

Since the end of the experiment in 1975 until 1994 no information was collected about the vegetation of Smolak Lake. The first preliminary floristic study was undertaken in 1994 (Radziej 1994). No submerged plants were found, and among the species with floating leaves, only several stations of white water lilies were observed, and a single patch of yellow water lily (*Nuphar lutea*). Eleven species of plants were found around the lake; their distribution is presented in the map. In the rush zone, common cattail (*Typha latifolia*), common reed (*Phragmites australis*), yellow flag (*Iris pseudacorus*), poison hemlock (*Cicuta virosa*), water- plantain (*Alisma plantago-aquatica*), marsh fern (*Thelypteris palustris*), and sedge (*Carex sp.*) were found. Floating sphagnum mat reappeared along 80% of the shoreline. It also contained roudleaf sundew (*Drosera rotundifolia*), cranberry (*Oxycoccus palustris*), Labrador tea (*Ledum palustre*), water arum (*Calla palustris*), and bogbean (*Menyanthes trifoliata*).

Floristic study of 1995 was performed twenty years after the experimental fertilisation and liming. It revealed 8 taxa of mosses, including 4 species of sphagnum, and 59 taxa of vascular plants. Stations of 15 selected species are shown in Fig. 1.

Six protected species were found (Polakowski 1995), and 2 taxa endangered in Poland (Zarzycki, Szeląg 1992). Their stations are shown in Fig. 2.

Among the protected species, *Nymphaea alba*, *Drosera rotundifolia*, and *Lycopodium annotinum* are subject to rigorous protection. *Ledum palustre*, *Frangula alnus*, and *Ribes nigrum* are partially protected.

*Viola epipsila*, and *Carex limosa* found within the floating sphagnum mat, are included in the „Red list of vascular plants endangered in Poland" (Zarzycki, Szeląg 1992).

## FLORISTIC LIST

The following list is a register of mosses and vascular plant species found at present as well as during the experimental fertilisation and liming (*Op. cit.*).

### *BRYOPHYTA*- BRYOPHYTES

*BRYOPSIDA* (MUSCI) – MOSSES

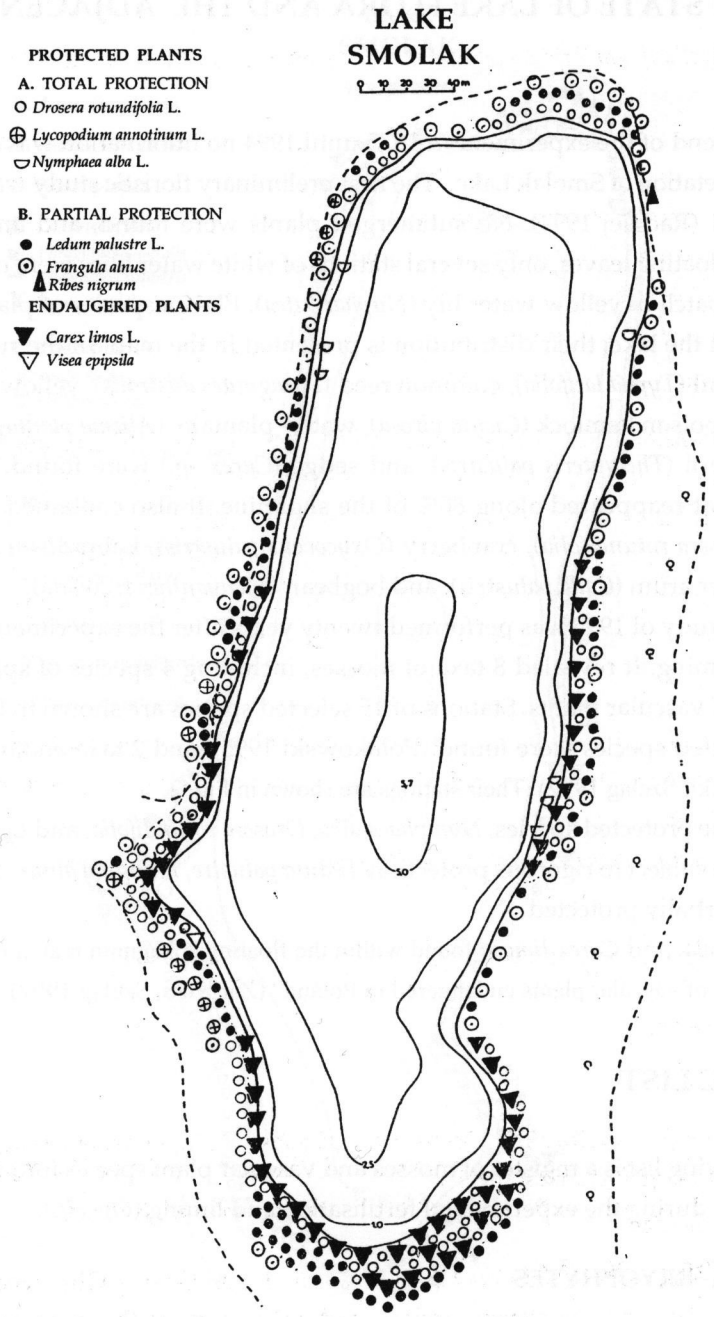


Fig. 2. Distribution of the stations of protected and endangered species observed in 1995

**Sphagnaceae**

*Sphagnum magellanicum* Brid. – Forms dense clumps around the lake within the old parts of sphagnum mat.

*Sphagnum palustre* L. = *Sph. latifolium* Hedw. – Common at the end of sphagnum bog adjacent to the forest.

*Sphagnum recurvum* P. Beauv. = *Sph. apiculatum* Lindb. – Forms heavily wetted belt of sphagnum mat adjacent to the water surface.

*Sphagnum rubellum* Wils. – Occurs at moderately wet stations, at clump slopes, and in older parts of sphagnum bog.

***Amblystegiaceae***

*Calliergon stramineum* (Brid.) Kindb. – Occurs around the lake, in depressions of floating sphagnum mat, and at stable sphagnum bank, together with sphagnum mosses: *Sphagnum magellanicum, Sph. palustre,* and *Sph. recurvum.*

*Calliergonella cuspidata* (Hedw.) Loeske = *Calliergon cuspidatum* (Hedw.) Kindb. – Observed at the sphagnum mat border adjacent to the lake, together with *Rhynchospora alba,* and on stable sphagnum margin.

***Polytrichaceae***

*Polytrichum commune* Hedw. – Occurs around the lake, at the forest-adjacent border of sphagnum mat, together with *Sphagnum magellanicum, Sph. recurvum,* and *Agrostis stolonifera.*

*Polytrichum strictum* Menz. ex Brid. – Common among the sphagnum, at stable sphagnum mat.

## *PTERIDOPHYTA* – PTERIDOPHYTES

### PTEROPSIDA – FERNS

***Aspidiaceae***

*Dryopteris carthusiana* (Vill.) H. P. Fuchs = *D. spinulosa* Mull. – Dispersed at the edge of sphagnum bog and marsh forest.

***Thelypteridaceae***

*Thelypteris palustris* Schott. = *Dryopteris thelypteris* (L.) A. Gray – Observed in 1994 (Radziej 1994), common among sedges and sphagnum at the edge of floating sphagnum mat (Fig. 1).

*Hypolepidaceae*

*Pteridium aquilinum* (L.) Kuhn – Numerous in marsh forest surrounding the lake and at the edge of sphagnum bog.

*LYCOPODIOPSIDA* – LYCOPHYTES

*Lycopodiaceae*

*Lycopodium annotinum* – Species under strict protection, common around the lake shore (Fig. 2).

*SPERMATOPHYTA* – SPERMATOPHYTES

*CONIFEROPHYTINA* – CONIFEROPHYTES

*Pinaceae*

*Picea abies* (L.) Karst = *P. excelsa* (Lam.) Lk. – Norway spruce, present in marsh forest, single specimen found at the edge of sphagnum bog.

*Pinus sylvestris* L. = *P. silvestris* L. – Scotch pine, occurs as the previous species.

*MAGNOLIOPHYTINA* (*ANGIOSPERMAE*) – ANGIOSPERMS

*DICOTYLEDONES* – DICOTYLEDONS

*Betulaceae*

*Betula pubescens* Ehrh.- White birch, present in marsh forest, forms a patch on the shore of south and north bay, found also in sphagnum mat.

*Alnus glutinosa* (L.) Gaert. – European alder, common at the edge of the forest, single specimen present on sphagnum bog.

*Salicaceae*

*Populus tremula* L. – European aspen, dispersed along the lake shore.

*Salix pentandra* L. – Occurs rarely as shrubs or trees.

*Salix cinerea* L. – Often present in shrubby clumps at the lake shore, and at the edge of stable sphagnum bog.

*Salix marsinifolia* Salisb. = *S. nigricans* Sm. – See the previous species.

***Ranunculaceae***

*Batrachium circinatum* (Sibth.) Fr. = *Ranunculus circinatus* Sibth. – Appeared in the lake in 1973, during the experiment, and was present until 1975 (*Op. cit.*). Now absent.

***Nymphaeaceae***

*Nymphaea alba* L. – White water-lily, under strict protection. Present in Smolak Lake in 1953-1956 (Kondracki, Szostak 1960), and in 1970-1975 (*Op. cit.*). Together with yellow water-lily formed a patch of 100-150 $m^2$ in south-west part of the lake (Radziej 1994). Still present in 1994 (Radziej 1994), forms small patches at east and west shore (Fig. 2).

*Nuphar lutea* (L.) Sibth. et Sm. = *N. luteum* (L.) Sm. – Yellow water-lily, under strict protection. Present in Smolak Lake in 1972-1974, and in 1994 (Radziej 1994). Now absent.

***Droseraceae***

*Drosera rotundifolia* L. – Roundleaf sundew, under strict protection. Observed in 1953-1956, 1970-1971, and in 1994 (*Op. cit.*). Now common on sphagnum mat (Fig. 2).

***Violaceae***

*Viola epipsila* Ledeb. – Endangered species included in the „Polish red book of plants" (Zarzycki, Kaźmierczakowa 1993). Found in Smolak Lake within the sphagnum bog, at the south extension of a small bay in the south part of west lake shore (Fig. 2). *Peucedanum palustre*, bog rosemary (*Andromeda polifolia*), marsh sedge (*Carex limosa*), and cranberry (*Oxycoccus palustris*) were found together with this violet.

**Saxifragaceae**

*Ribes nigrum* L. – Black currant, under partial protection. At Smolak Lake found at a single station, at the north end of the east shore (Fig. 2).

**Rosaceae**

*Rubus idaeus* L. – Raspberry, small gathering found near the black currant.

*Comarum palustre* L. – Common along the shore, and on sphagnum mat around the lake (Fig. 1). Observed also in 1970-1971, and 1994 (*Op. cit.*).

*Sorbus aucuparia* L. em Hedl. – European mountain-ash, dispersed along the shore, and at the edge of sphagnum bog.

***Lythraceae***

*Lythrum salicaria* L. – Spiked loosestrife, dispersed along the shore and in sphagnum bog.

***Halorrhagidaceae***

*Myriophyllum spicatum* L. – Spiked water milfoil, appeared in 1974, and expanded in 1975. In 1994 absent (*Op. cit.*), not found in 1995.

***Oenotheraceae***

*Epilobium parviflorum* Schreb. – Willow herb, dispersed along the shore and in sphagnum bog.

*Epilobium hirsutum* L. – Hairy willow herb, occurs in one spot with the raspberry, at the north end of the east shore.

***Rhamnaceae***

*Frangula alnus* Mill. – Alder dogwood, under partial protection, abundant along the shore and at the edge of stable sphagnum mat (Fig. 2).

***Apiaceae (Umbelliferae)***

*Cicuta virosa* L. – Poison hemlock, present in 1994 (*Op. cit.*), not found in 1995.

*Peucedanum palustre* (L.) Moench - Common in sphagnum bog and at the lake shore.

***Primulaceae***

*Lysimachia vulgaris* L.- Yellow loosestrife, abundant around the lake, on the shore and in sphagnum mat.

*Lysimachia thyrsiflora* L. – Tufted loosestrife, abundant at the edge of floating sphagnum mat and in wet parts of stable sphagnum bog.

***Ericaceae***

*Vaccinium myrtillus* L. – Bilberry, common around the lake at the edge of stable sphagnum bog and forest.

*Vaccinium vitis-idaea* L. – Cowberry, see the previous species.

*Oxycoccus palustris* Pers. = *O. quadripetalus* Gilib. – Cranberry, common on floating sphagnum mat and on stable sphagnum bog (Fig. 1). Present also in 1994 (*Op. cit.*).

*Ledum palustre* L. – Labrador tea, evergreen shrub under partial protection, occurring in peat bogs and bog forests. Observed in 1994 at Smolak Lake (*Op. cit.*). Often seen at

the edge of sphagnum bog and forest. Larger spots grow in the forest, at the south bay (Fig. 2).

*Andromeda polifolia* L. – Bog rosemary, dispersed in sphagnum bog (Fig. 1).

*Calluna vulgaris* (L.) Hull – Scotch heather, common at the edge of forest and in sphagnum bog.

***Lentibulariaceae***

*Utricularia vulgaris* L. – Bladderwort, a few specimens were found in an artificial cavity filled with water, in stable sphagnum bog in the south part of the west shore.

***Lamiaceae (Labiateae)***

*Lycopus europaeus* L. – Common in floating and stable sphagnum mat, in south part of the west shore.

***Menyanthaceae***

*Menyanthes trifoliata* L. – Bogbean, observed in 1970. Began to withdraw during the experiment, and disappeared in 1975 (Bnińska 1979). Observed again in 1994 (Radziej 1994), and in 1995. Grows in floating sphagnum mat and in stable and waterlogged sphagnum bog (Fig. 1).

***Rubiaceae***

*Galium palustre* L. – Bog bedstraw, observed around the lake, at the edge of floating sphagnum mat and in its older parts.

*MONOCOTYLEDONES* - MONOCOTYLEDONS

***Alismataceae***

*Alisma plantago-aquatica* L. – Water plantain, observed in 1994 by Radziej (*Op. cit.*), not found in 1995.

***Hydrocharitaceae***

*Elodea canadensis* Michx. – Canadian pondweed, introduced in 1972, in the next two years predominated the hydrophytes (*Op. cit.*). Not found in 1994 (Radziej 1994) and 1995.

***Scheuchzeriaceae***

*Scheuchzeria palustris* L. – Locally common in sphagnum bog, particularly in the central

and south part of the east shore, and in the central part of the west shore (Fig. 1).

***Potamogetonaceae***

*Potamogeton perfoliatus* L. – Observed among the hydrophytes in 1975 (Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja 1977). Absent in 1994 (Radziej 1994), not found also in 1995.

*Potamogeton crispus* L. – Present in 1974-1975 (Bnińska 1979). In 1994 absent (Radziej 1994), in 1995 also not found.

*Potamogeton lucens* L. - Observed in 1975 (Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja 1977). In 1994 absent (*Op. cit.*), in 1995 also not found.

*Potamogeton compressus* L. – See the previous species.

*Potamogeton natans* L. - Observed in 1975 (Bnińska 1979). In 1995 present only in north-east bay, at the depth 1.3-1.5 m, and at the east shore (Fig. 1).

***Iridaceae***

*Iris pseudacorus* L. – Yellow flag, observed in 1994 (Radziej 1994), in 1995 not found.

***Juncaceae***

*Juncus effusus* L. – Soft rush, present mainly at the east shore.

***Cyperaceae***

*Eriophorum vaginatum* L. – takes part in stabilising the sphagnum bog.

*Eriophorum angustifolium* Honck. – Cotton grass, dispersed in sphagnum bog.

*Rhynchospora alba* (L.) Vahl. – Beak sedge, grows at the edge of the floating sphagnum mat, mainly at the west shore (Fig. 1).

*Carex paniculata* L. – Numerous only in the north bay, at the edge of stable sphagnum bog (Fig. 1).

*Carex appropinquata* Schumach. = *C. paradoxa* Willd. – Observed in sphagnum bog, in south part of the west shore.

*Carex canescens* L. – Dispersed in sphagnum bog.

*Carex echinata* Murr. = *C. stellulata* Good – Dispersed at the edge of stable sphagnum bog.

*Carex elata* All. = *C. hudsonii* Benn. – Observed at the east shore, in the parts free of sphagnum.

*Carex gracilis* Curt. – Dispersed around the lake, mainly at the edge of sphagnum and forest.

*Carex limosa* L. – Endangered species (Zarzycki, Szeląg 1992). Quite numerous in peatbog belt of the south shore (Fig. 2).

*Carex rostrata* Stokes – Common at the edge of floating sphagnum mat and within it.

*Carex lasiocarpa* Ehrh – Forms a narrow belt at the edge of floating sphagnum mat, mainly at the west shore (Fig. 1).

***Poaceae (Gramineae)***

*Agrostis stolonifera* L. – Creeping bent, observed around the lake, at the edge of sphagnum and within it.

*Agrostis canina* L. – Velvet bent, noted at the edge of floating sphagnum mat, in the south part of the west shore.

*Calamagrostis epigejos* (L.) Roth. – Wood small-reed, recorded near the raspberry spot, at north end of the east shore.

*Calamagrostis canescens* (Weber) Roth. – Purple small-reed, observed around the lake, at the edge of sphagnum and within it.

*Calamagrostis stricta* (Timm.) Koeler – Narrow small-reed, present at the edge of floating sphagnum mat, in the south part of the west shore.

*Phragmites australis* (Cav.) Trin. ex Steud. = *Ph. communis* Trin. – Common reed, appeared in 1972, and was observed until 1975 (Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja 1977), noted also in 1994 (Radziej 1994). Now two patches are present in the north bay and a small single patch in the south bay (Fig. 1).

*Molinia caerulea* (L.) Moench – Purple moor-grass, common around the lake, in stable sphagnum bog and on the shore without sphagnum.

*Glyceria fluitans* (L.) R.Br. – Floating sweet grass, grows on small mineral patch in the north part of the east shore.

***Araceae***

*Calla palustris* L. – Water arum, observed in 1970-1975, but withdrawing by the end of the experiment withdrawing (*Op. cit.*), found in 1994 (Radziej 1994). Now participates in sphagnum bog formation (Fig. 1).

***Typhaceae***

*Typha latifolia* L. – Common cattail, in 1970 several specimens were found in the south bay, at the south shore. Expanded during the experiment until 1973. In 1974-1975 its stations stabilised. Present also in 1994 (Radziej 1994). In 1995 single specimen were found around the lake, at the edge of floating sphagnum mat, and in sphagnum-free parts of the shore (Fig. 1).

## VEGETATION OF SPHAGNUM BOG

In 1994 sphagnum bog covered about 80% of Smolak Lake shoreline (Radziej 1994). In summer 1995 sphagnum belt was best developed in the south part of the lake (Fig. 1). At the west shore of this part, sphagnum belt was 7-8 m wide, and at the south shore up to 20-25 m. Sphagnum in the north part of the lake was less abundant. North parts of the west and east shores have now only a narrow (2-3 m) sphagnum zone, which reaches 8-12 m in the north bay.

Within the floating part of the sphagnum belt, vegetation zones can be distinguished, similar to the zones described for closed humic Wigierskie lakes (Sobotka 1967).

The first zone, 0.2-0.5 m wide, adjacent to water consists of *Sphagnum recurvum*, with some vascular plants. *Carex lasiocarpa* forms a narrow belt over the water surface. *Carex limosa*, *Rhynchospora alba*, or *Thelypteris palustris* are also found just above the water. Other plants found in this zone were: common cattail (*Typha latifolia*), bogbean (*Menyanthes trifoliata*), *Comarum palustre*, water arum (*Calla palustris*), cranberry (*Oxycoccus palustris*), *Scheuchzeria palustris*, roundleaf sundew (*Drosera rotundifolia*),

Yellow loosestrife (*Lysimachia vulgaris*), and *Peucedanum palustre*. Among shrubs, *Salix cinerea*, and among subshrubs – bog rosemary (*Andromeda polifolia*) were found.

The second, waterlogged zone, 1-4 m wide, also consisted of *Sphagnum recurvum*, with an addition of *Sph. magellanicum*. Among the vascular plants, beak sedge (*Rhynchospora alba*), *Carex limosa*, roundleaf sundew (*Drosera rotundifolia*), *Scheuchzeria palustris*, cranberry (*Oxycoccus palustris*), and also some *Comarum palustre* and bogbean (*Menyanthes trifoliata*) were found.

The third zone, 2-5 to 10 m wide, formed on stable ground, was abundantly overgrown by *Sphagnum magellanicum* and *Sph. recurvum*, with some *S. rubellum*, *Calliergonella cuspidata*, and *Calliergon stramineum*, and some *Sphagnum palustre*, *Polytrichum commune*, and *Polytrichum strictum* at the edges. Among the vascular plants, *Eriophorum vaginatum* was the most numerous, and locally cotton grass (*E. angustifolium*). Clumps of Labrador tea (*Ledum palustre*), and single specimens of Scotch pine (*Pinus sylvestris*) were also noted.

Among the plants of sphagnum bog, three different syntaxonomic groups were found (Matuszkiewicz 1981). Peatbog communities consisted mainly of plants belonging to the phytosociological classes *Scheuchzerio-Caricetea* fuscae, and *Oxycocco-Sphagnetea*.

Moss (*Calliergon stramineum*) and vascular plants: *Carex canescens, C. limosa, C. echinata, C. lasiocarpa, Scheuchzeria palustris, Rhynchospora alba, Eriophorum angustifolium, Calamagrostis stricta, Agrostis canina, Menyanthes trifoliata, Comarum palustre,* and *Viola epipsila* belong to the class *Scheuchzerio-Caricetea fuscae.*

The following plants belong to the class *Phragmitetea: Carex gracilis, C. elata, C. rostrata, C. appropinquata, Phragmites australis, Typha latifolia, Galium palustre, Glyceria fluitans, Lysimachia thyrsiflora,* and *Peucedanum palustre.* The remaining species belong to the accompanying plant group.

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# STRESZCZENIE

STAN FLORY JEZIORA SMOLAK I PRZYLEGAJĄCYCH TORFOWISK PO DWUDZIESTU LATACH OD ZAKOŃCZENIA EKSPERYMENTU NAWOŻENIA

Podjęte latem 1995 roku badania florystyczne humusowego jeziora Smolak i przylegających mszarów torfowcowych miały na celu poznanie aktualnego stanu ich szaty roślinnej, na tle zmian z lat 1972-1975 wywołanych eksperymentalnym nawożeniem i wapnowaniem. ((Zdanowski, Korycka, Bnińska, Sosnowska, Radziej, Zachwieja 1977, Bnińska 1979, Radziej 1994). W trakcie eksperymentalnych badań w 1972 roku introdukowano moczarkę kanadyjską (*Elodea canadensis*), która rozprzestrzeniła się w następnych latach. W miarę stabilizacji warunków eutroficznych, następowało zanikanie torfowcowego mszaru i naturalny rozwój hydrofitów zanurzonych. W latach 1973-1975 notowano wystepowanie: wywłócznika kłosowego (*Myriophyllum spicatum*), rdestnicy ściśnionej (*Potamogeton compressus*), rdestnicy lśniącej (*P. lucens*) oraz rdestnicy kędzierzawej (*P. crispus*). Spośród nich w latach 1974-1975 bujnie rozwijała się moczarka kanadyjska (*Elodea canadensis*) i wywłócznik kłosowy (*Myriophyllum spicatum*). Z roślin o liściach pływających notowane wcześniej grzybienie białe (*Nymphaea alba*) rozwinęły się na nowych stanowiskach a od 1974 roku w jeziorze pojawiła się rdestnica pływająca (*Potamogeton natans*). Równocześnie z brzegów jeziora w 1973 r. ustąpił całkowicie torfowcowy mszar a w jego miejsce rozwinął się przerywany pas szuwarów, budowany przez notowaną w 1970 r. na pojedynczym stanowisku pałkę szerokolistną (*Typha latifolia*), oraz trzcinę pospolitą (*Phragmites australis*), która w naturalny sposób pojawiła się w 1972 roku.

Po zakończeniu eksperymentu wstępne rozpoznanie dotyczące występowania wybranych gatunków roślin wodnych i bagiennych przeprowadzono dopiero w 1994 roku (Radziej 1994). Stwierdzono całkowity zanik hydrofitów zanurzonych, nieliczne stanowiska grzybieni białych (*Nymphaea alba*) i grążela żółtego (*Nuphar lutea*) oraz rozwinięty mszar torfowcowy, który zajmował około 80% linii brzegowej jeziora.

W wyniku przeprowadzonych w 1995 roku badań florystycznych odnotowano występowanie dwóch gatunków hydrofitów o liściach pływajacych: rdestnicy pływajacej (*Potamogeton natans*) i grzybieni białych (*Nymphaea alba*) - rys. 1 i 2. Przy brzegach jeziora stwierdzono 10 gatunków roślin szuwarowych, w tym pałkę szerokolistną (*Typha latifolia*) i trzcinę pospolitą (*Phragmites australis*) - rys. 1. W budowie wykształconych płatów mszaru torfowcowego uczestniczyło: 8 taksonów mchów, w tym 4 taksony torfowców oraz 16 gatunków roślin naczyniowych charakterystycznych dla zbiorowisk torfowiskowych. Łącznie w jeziorze i jego najbliższym otoczeniu odnotowano 61 gatunków roślin naczyniowych. Stanowiska 15 wybranych gatunków roślin wodnych, szuwarowych i torfowiskowych przedstawiono na rys. 1. Osobno pokazano stanowiska 6 gatunków chronionych i 2 taksonów zagrożonych (rys. 2).

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