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## ANTHROPOGENIC CAUSES OF PEATLAND SPECIES VANISHING IN THE GLINNO ŁUGI AREA

**Abstract:** The paper presents information about the occurrence and state of preservation of valuable peat-bog species as well as about the threats facing them. The anthropopressure-related changes which occurred in the habitat of the Glinno Ługi peatland and their influence on the flora are presented and discussed.

**Key words:** flora, wetlands, peat bog, human impacts, nature protection, Central Poland

### 1. INTRODUCTION

Wetland habitats such as fen meadows or peat bogs are characterised by unique flora that includes numerous vulnerable species. Peatland plants are among the most endangered in Poland (PAWLACZYK *et al.* 2002; HERBICHOWA *et al.* 2004; ZARZYCKI, SZELĄG 2006). There are 36 “red list” species in Central Poland which are strictly connected with raised bogs of the *Oxycocco-Sphagnetea* class and with rheotropic and transitional peatlands of *Sheuchzerio-Caricetea nigrae* (JAKUBOWSKA-GABARA, KUCHARSKI 1999). Among them six species are already extinct (one preserved *ex situ*), thirteen are on the border of extinction and six are threatened with extinction. The preservation and conservation of peatlands and peatland species are one of the main aims of nature protection (HERBICHOWA *et al.* 2004; KUCHARSKI 2004).

The paper presents valuable plant species which occur in the Glinno Ługi peatland, their distribution, state of preservation, current and potential threats and suggestions for effective conservation.

## 2. STUDY AREA

Glinno Ługi is situated about 3 km east of the “Jeziorsko” water reservoir, in the River Jadwiczna valley (the part within the old system of the Warta River valley; Fig. 1). It is located in the eastern part of the Sieradzka Basin mesoregion (KONDRACKI 2002). Its geographical position is marked by the co-ordinates: 51°43'40"-51°44'20" N and 18°42'40"-18°43'34" E. The area encompasses about 100 ha of degraded peatland, surrounded from the south, west and north-west by mostly forested sandy dunes. The peat deposit filled the plain basin of the Holocene valley of the Warta River (KLATKOWA, ZAŁOBA 1992; FORYSIAK 2005). The larger part of the area has been degraded due to long-lasting anthropogenic influences.

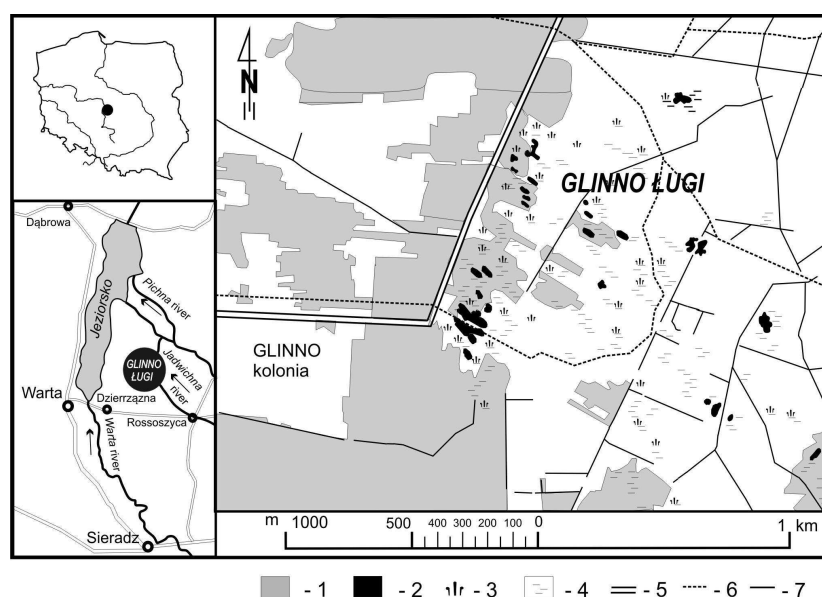


Fig. 1. Location of the study area. Explanation: 1 – forests and thick brush woods; 2 – peat pits filled with water; 3 – reed rushes and sedges; 4 – wet and fresh meadows and pastures; 5 – road from Glinno to Ferdynandów village; 6 – main tracks; 7 – permanent flow and drainage ditches.

The spatial mosaic of current vegetation is formed by water, rush, sedge, shrub and forest plant communities, such as: an unattached floating aquatics community with duckweeds *Lemnetum trisulcae* and with frogbit *Hydrocharitetum morsusranae*, a community of rooted aquatics with floating leaves *Hottonietum palustris*, a rush community with common reed *Phragmitetum australis*, also with ferns *Thelypteridi-Phragmitetum*, brushwoods with willows *Salicetum pentandrocinereae*, natural forest communities: bog pine forest *Vaccinio uliginosi-Pinetum*, wet pine forest *Molinio-Pinetum*, swampy alder forest *Ribeso nigri-Alnetum*, *Betula-Phragmites* and *Betula-Salix* communities as well as anthropogenic forest communities: *Pinus-Phragmites* and *Alnus glutinosa-Carex acutiformis*.

At present the flora of Glinno Ługi encompasses 316 vascular plant species, 78 mosses and 12 liverworts.

### 3. MATERIAL AND METHODS

The data concerning the occurrence, distribution and state of preservation of valuable species in the Glinno Ługi peatland have been collected during own field investigation in the years 2007-2009. Valuable species include species protected by the law (ROZPORZĄDZENIE 2004), endangered and threatened vascular plant species on a national (ZARZYCKI, SZELĄG 2006) and regional scale (JAKUBOWSKA-GABARA, KUCHARSKI 1999) and locally rare wetland species.

The history of human impact on peat bog vegetation and peatland habitat has been described on the basis of historical sources (maps, aerial photos and available printed data).

### 4. RESULTS

#### 4.1. Valuable species in the Glinno Ługi peatland

Peatmosses: *Sphagnum palustre*, *S. fimbriatum*, *S. teres*, *S. fallax*, *S. squarossum*, *S. capillifolium*, *S. girgensohnii* and *S. russowii* (*Sphagnaceae*).

*Sphagnum* mosses are the most characteristic components forming the ground cover of bogs and the most important peat-building plants. They form a dense “carpet” with hummocks 30 to 40 cm high only in the southern part of the Ługi

peatland. Small patches of peatmosses occur quite often in the degraded part of the peatland, mostly on the peat pit shores. In the driest places the moss hummocks are also built by *Polytrichum commune* and *Aulacomnium palustre* (mosses characteristic of the *Oxycocco-Sphagnetea* class).

*Sphagnum palustre*, *S. fimbriatum*, *S. teres* are strictly protected by the law and *Sphagnum fallax*, *S. squarrosum* are partially protected in Poland.

***Drosera rotundifolia*** (*Droseraceae*) – common sundew – grows in an open, partly sunny place with a high water table, around a shallow depression. The dominance of *Sphagnum* in the moss layer indicates an acidic habitat poor in nutrients. *D. rotundifolia* tolerates flooding for several weeks but dry periods only for a very short time. Sundews can naturally invade disturbed bog sites where other vegetation has been removed.

***Oxycoccus palustris*** (*Ericaceae*) – cranberry – The slender, slight stems with small evergreen leaves densely cover the peatmoss „carpet” and hummocks. The berries are edible, but no instances of cranberry fruit picking have been noted in Ługi.

***Ledum palustre*** (*Ericaceae*) – A few marsh tea (Labrador tea) shrubs grow only in the patches of the *Vaccinio uliginosi-Pinetum* bog pine forest in the south-eastern part of Ługi.

***Andromeda polifolia*** (*Ericaceae*) – The only one (!) small cluster of bog rosemary exists in the bog pine forest.

***Vaccinium uliginosum*** (*Ericaceae*) – bog blueberry – A few low shrubs grow on the less waterlogged hummocks in the bog pine forest. Bog blueberry has low tolerance to drought and restricted water conditions.

The low-growing woody plants with small leathery leaves of the *Ericaceae* family are an important part of bog communities on acid peat. Ericoids are vulnerable to fire, grazing and competing sedges and grasses, e.g. *Eriophorum vaginatum* or *Molinia caerulea*.

***Eriophorum vaginatum*** (*Cyperaceae*) – common tussock cottongrass – In drained peatlands it can become dominant with the disappearance of the *Sphagnum* mosses.

*Eriophorum angustifolium* (Cyperaceae) – common cottongrass – It grows up to about 60cm and inhabits shallow, standing water or wet, peaty ground.

*Dryopteris cristata* (Aspidiaceae) – gray crested shield fern, *Carex diandra* (Cyperaceae) – lesser paniced sedge, *C. flacca* (Cyperaceae) – glaucous sedge, *Ranunculus lingua* (Ranunculaceae) – water buttercup, *Menyanthes trifoliata* (Menyanthaceae) – bogbean and *Comarum palustre* – marsh cinquefoil (Rosaceae) are other valuable wetland species, worthy of note (Tab. 1).

Table 1. Valuable vascular plant species occurring in the Glinno Ługi peatland.

Species	Strictly protected by law	Partially protected by law	Threatened in Poland	Threatened in Central Poland	Locally rare
<i>Drosera rotundifolia</i>	•		•	•	•
<i>Ledum palustre</i>	•			•	•
<i>Menyanthes trifoliata</i>		•			•
<i>Ranunculus lingua</i>			•		•
<i>Dryopteris cristata</i>			•	•	•
<i>Andromeda polifolia</i>				•	•
<i>Carex diandra</i>				•	•
<i>Carex flacca</i>				•	•
<i>Oxycoccus palustris</i>				•	•
<i>Comarum palustre</i>					•
<i>Equisetum fluviatile</i>					•
<i>Eleocharis palustris</i>					•
<i>Eriophorum vaginatum</i>					•
<i>Eriophorum angustifolium</i>					•
<i>Vaccinium uliginosum</i>					•

## 4.2. The impact of human land use and natural vegetation changes on peatland species in the Glinno Ługi – the past and present of peatland plants

In the 19<sup>th</sup> and 20<sup>th</sup> centuries drastic and usually irreversible anthropopressure-related changes occurred in the habitat of the Glinno Ługi peatland (Fig. 2). The degeneration of the habitat caused the degradation of numerous precious species and changes in vegetation.

### 4.2.1. Peat extraction

Peat extraction is the main cause of bog habitats and peat-bog species loss in Glinno Ługi. The most intensive peat extraction took place in the nineteenth century

and it ceased completely at the beginning of the twentieth century. Peat deposits were extracted as a raw material for a domestic use, mainly as a source of energy. The plain surface of the peatland was changed into a system of parallel lines of pit peats and causeways (they determine the borders of private properties). The habitat of bog communities was almost completely destroyed. The larger part of the degraded peatland with partially saved peat seams was classified as wasteland, abandoned and excluded from any management. The peat pits have slowly overgrown with rush and sedge communities as a result of the natural development of vegetation. The causeways have changed into dense willow brushwoods or birch “forest lines”.

#### **4.2.2. Peatland drainage and agriculture**

Drainage of the peatland to win area for agriculture in the twentieth century caused a significant decrease of the groundwater layer. The eastern, less wet parts of Glinno Ługi have gradually been converted into meadows and pastures, and nowadays they are used extensively or intensively by local farmers. The grassland soils are enriched with chemical and organic fertilizers. Consequently the whole wetland area receives increased nutrient inputs. Plant communities connected with oligotrophic habitats are substituted by meso- and eutrophic vegetation.

Some of the drainage ditches have little by little overgrown with reed rushes and sedges, and the flow of water into the River Jadwiczna is limited. It creates favorable conditions for peat accumulation and regeneration of peatland vegetation. The areas too wet for agriculture are gradually invaded by willows or trees.

#### **4.2.3. Afforestation**

Trees such as pines, birches, and spruces naturally occur in peatland areas, but they are stunted in growth because of the intensive moss growth and poor substance of peat soils.

The significant land reclamation of the Glinno Ługi wetland enabled its afforestation. The western and south-western areas were partly used for forestry. The afforestation with the Scots pine *Pinus sylvestris* and with the alder tree *Alnus glutinosa* has been more intensive since the 1950s. The development of the tree

stand has caused changes of habitat conditions and has indirectly reduced the occurrence of bog species which prefer open and sunny places.

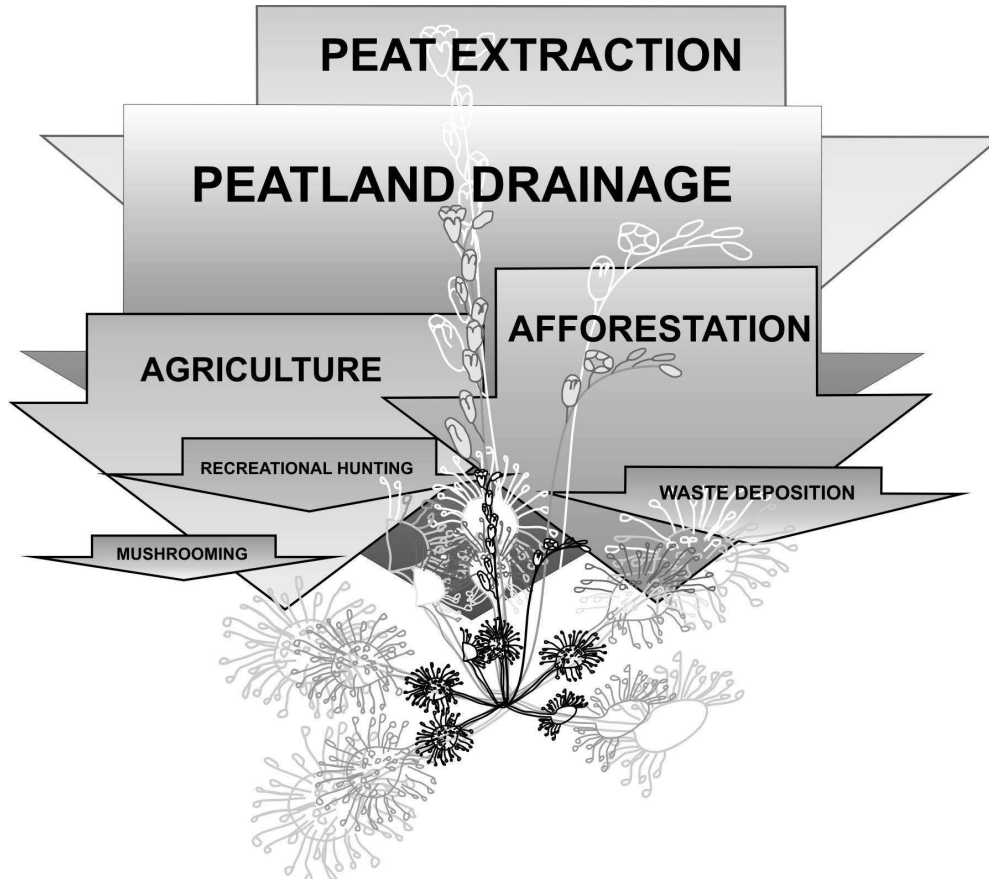


Fig. 2. Forms of human land use threatening peat-bog plant species in the Glinno Ługi peatland.

#### 4.2.4. Recreational hunting and mushrooming

A number of wild animals – invertebrates, amphibians, reptiles, birds and mammals inhabit the Glinno Ługi peatland. The biggest herbivores and omnivores such as roe deer *Capreolus capreolus* and wild boars *Sus scrofa* occur permanently or periodically due to food richness and the diversity of habitats for resting. They destroy the surface of the peat deposit but, on the other hand, they create new open microhabitats for bog plant seeds. The boars usually rest in swampy places in shallow peat pits. The common sundew *Drosera rotundifolia* grows around this kind of boar “bathing place”. This plant may be destroyed by big animals, but its survival

may also depend on boars' "activity" – they locally remove the vegetation cover and form open spaces for vegetative and generative reproduction of sundews.

The deer and boars are objects of recreational hunting. The hunting, as well as mushrooming, may pose a threat to the survival of the sensitive bog habitat and bog plants. Those activities are usually connected with intensive walking, which may cause the destruction of the bog surface.

#### **4.2.5. Unlawful waste dumps**

The abandoned degraded peatlands, classified as wastelands, are often the site of unlawful waste dumps. A number of small waste deposits are located in the vicinity of the Ługi peatland or within it. The domestic rubbish litter the landscape. They are also the source of seeds of geographically or ecologically alien plants such as *Galinsoga ciliata*, *G. parviflora*, *Bidens frondosa*, *Conyza canadensis* and many other synanthropic (segetal and ruderal) plants, which may threaten the peatland flora.

## **5. DISCUSSION AND CONCLUSIONS**

The main factor causing peat bog plants extinction is the drainage of wetland area and the decrease of water level.

Variable water level with a lowering tendency stimulates the encroachment, and then mass appearance of purple moor grass *Molinia caerulea* (HERBICHOWA *et al.* 2004, 2007). This grass forms high, compact tussocks, strongly reducing the occurrence of true peatland species. The encroachment of individual specimens of *Molinia caerulea* in the Ługi peatland habitat can already be observed. Mass occurrence of purple moor grass is also a sign that the mineralisation process of the upper peat layer has advanced and that phosphorus in a form available to plants has been released (HERBICHOWA *et al.* 2004, 2007). Decrease in water level has led to an invasion of woody species from the surrounding forest such as the Scots pine *Pinus sylvestris* or the silver birch *Betula pendula* – the succession process towards brushwood and forest communities is accelerated.

Where woody vegetation is dense, it has lowered the water table and may result in subsequent alterations of the composition of the vegetation (HERBICH 2001;



PISAREK, POLAKOWSKI 2001; HERBICHOWA *et al.* 2004; KUCHARSKI *et al.* 2004). As a result of the progressive decrease of groundwater surface, the preserved fragment of the *Vaccinio uliginosi-Pinetum* bog pine forest in Ługi will change into wet pine forest *Molinio-Pinetum* and then into mixed forest *Quercus robur-Pinetum*. The most valuable plants such as peatmosses, common sundew, marsh tea, cranberry, and cotton grasses will die and disappear gradually.

One of the most important concerns in the conservation of species richness is the conservation of the habitats in which these more specialised species can survive. A stable hydrological regime is a prerequisite for the maintenance of wetland flora biodiversity of the Glinno Ługi peat bog. Moreover, we ought to control and actively reduce the spread of reeds *Phragmites australis* and willows *Salix* to limit the succession of rush and brushwood vegetation into open areas of the bog pine forest.

This valuable natural site with unique peatland flora is worthy of preservation and the establishment of the Warciańskie Ługi nature protected area is suggested. The maintenance and active restoration of less eutrophicated habitat in wetlands is a necessity for maintaining overall species diversity.

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