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Refuges of peat-bog plants in the complex near Chlebowo (Wielkopolska Province)

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Abstract. The peat-bog complex "Bagna" near Chlebowo is the largest in the Wielkopolska region, but was subject to strong disturbances caused by human activity in the 19th and 20th centuries. Despite the unfavourable changes, the flora of the complex is still rich (over 330 species) and contains many threatened species, such as *Empetrum nigrum*, *Drosera rotundifolia*, *Oxycoccus palustris*, *Andromeda polifolia*, *Ledum palustre*, *Vaccinium uliginosum*, *Sparganium minimum* and *Wolffia arrhiza*.

Key words: peat-bog, refuge, threatened species, vascular flora.

1. Introduction

Peat-bogs are colonized by a very specific group of plants. Besides numerous lakes, also bogs are common elements of the young post-glacial landscape in northern Poland. In older landforms they are rare and support interesting components of the flora. Because of the specific habitat, they are refuges of many plants.

Although fens are quite common in the Wielkopolska region, peat-bogs are rare there. The peat-bog complex "Bagna" near Chlebowo is the largest object of this type in Wielkopolska, covering an area of about 500 ha (Jasnowski 1975). It is located about 35 km north of the city of Poznań (fig. 1). The complex is situated in a basin, with a slight western exposure, surrounded from the north, west and south by dune ridges. Because of the drainage its outer zone is now occupied by meadow communities and intermediate mires, while the inner zone constitutes a dead peat-bog.

In this paper we present the results of the research on the conditions of bog plants in the highly transformed peat-bog area, which in some places is still exploited.

2. Methods

The first floristic explorations provided information on the bog near Chlebowo in the early 20th century. Works by Schulz (1916), Czubiński & Świtalska (1937), and Wodziczko et al. (1938) contain important comparative materials. Also in the Herbarium of the Department of Plant Taxonomy, Adam Mickiewicz University in Poznań, there are some specimens from this area. Detailed research on the vascular flora of this area, carried out since 1997, has formed the basis for the present paper. Herbarium specimens, as well as photographic, cartographic and floristic documentation were collected in all phenological seasons.

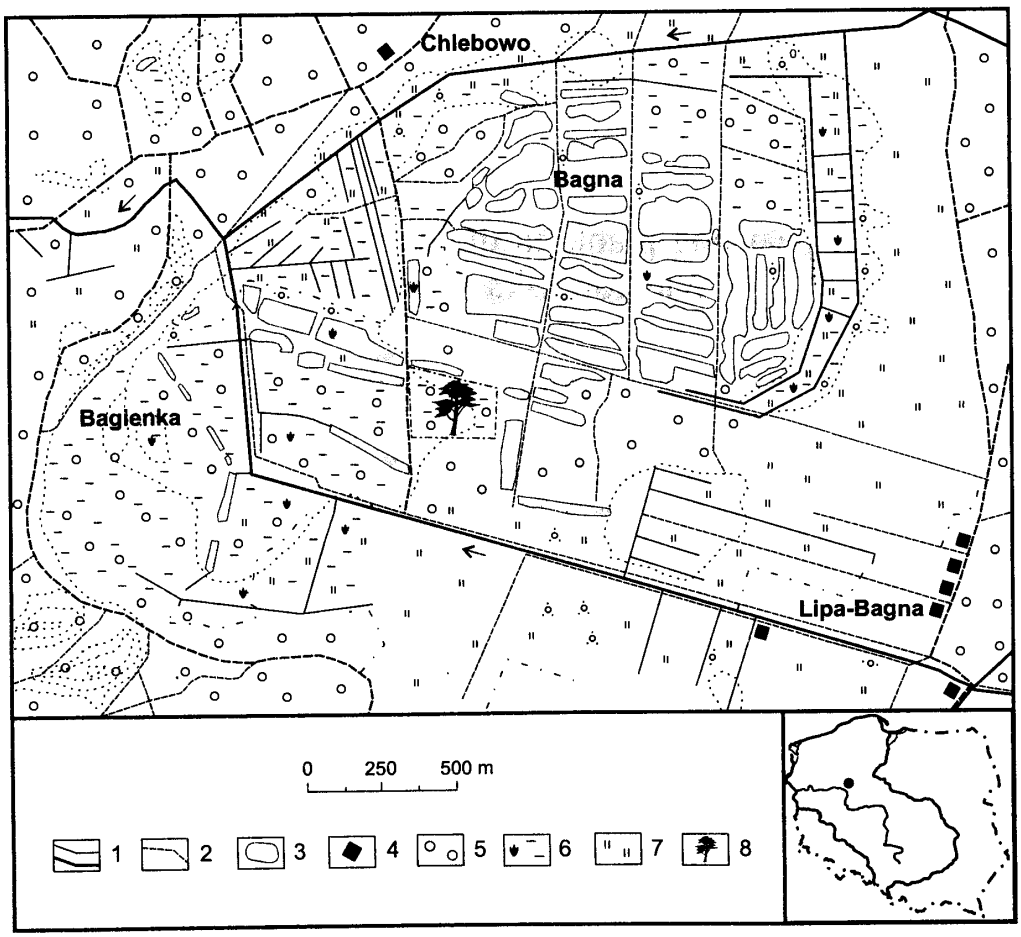

Figure 1. The peat-bog complex "Bagna" near Chlebowo (small map: location of the study area in Poland); 1 – watercourses, 2 – roads, 3 – post-extraction pits, 4 – buildings, 5 – woods, 6 – marshes, 7 – meadows, 8 – the nature reserve "Bagno Chlebowo"

3. Survival of peat-bog flora under human pressure

Since the 19th century the peat-bog near Chlebowo has been subject to strong human interference. Initially it involved drainage of the area by the Ludomicki Canal and a system of ditches. Lowering of the water-table enabled peat-cutting but caused a decline of bog vegetation (Schulz 1916). Two stages of peat exploitation can be distinguished. Till the end of the II World War peat was cut manually in the outer zone of the complex, particularly from the north and west. After the war, peat was cut mechanically in the central part of the bog, even from deep deposits. As a result, several dozen peat ponds were formed, of up to several hectares in area and several metres in depth (fig. 1). In some places peat is still exploited, so several ponds are being continuously enlarged.

Due to natural succession the outer zone, where peat was cut at a shallow depth before the war, is now covered to a large extent by forest and bush communities with *Betula pubescens* and *Pinus sylvestris*. Results of this process are the most conspicuous in the north-eastern part of the complex. Places where peat was exploited are now not easily distinguishable, as they are shallow depressions

overgrown with *Betula pubescens*, *Pinus sylvestris*, *Frangula alnus*, *Molinia caerulea*, *Eriophorum angustiofolium*, *E. vaginatum*, *Vaccinium myrtillus*, *Oxycoccus palustris* and *Sphagnum* mosses. In higher places between the ponds, there are old specimens of *Pinus sylvestris*, as well as *Dryopteris cristata* and *Vaccinium uliginosum*, both rare in this region. The last species is found in the north-eastern part of the peatland (fig. 2). Except for two clumps, it grows exclusively on the higher places between ponds, which used to be covered with wet pine forest. *Vaccinium uliginosum* forms there clumps of various size, which show no tendency to spread further. This is due to the present environmental conditions on those sites. They are currently devoid of the moss layer of *Sphagnum*, which seems to be necessary for rooting of the ascending shoots and spreading of this species. In contrast to both *V. myrtillus* and *V. vitis-idaea*, *V. uliginosum* does not form underground shoots (Gugnacka-Fiedor 1994). It propagates vegetatively only, by rooting of ascending aboveground shoots. This is easy if a plant is surrounded by growing *Sphagnum* mosses, but if they are missing vegetative propagation of *Vaccinium uliginosum* is virtually impossible.

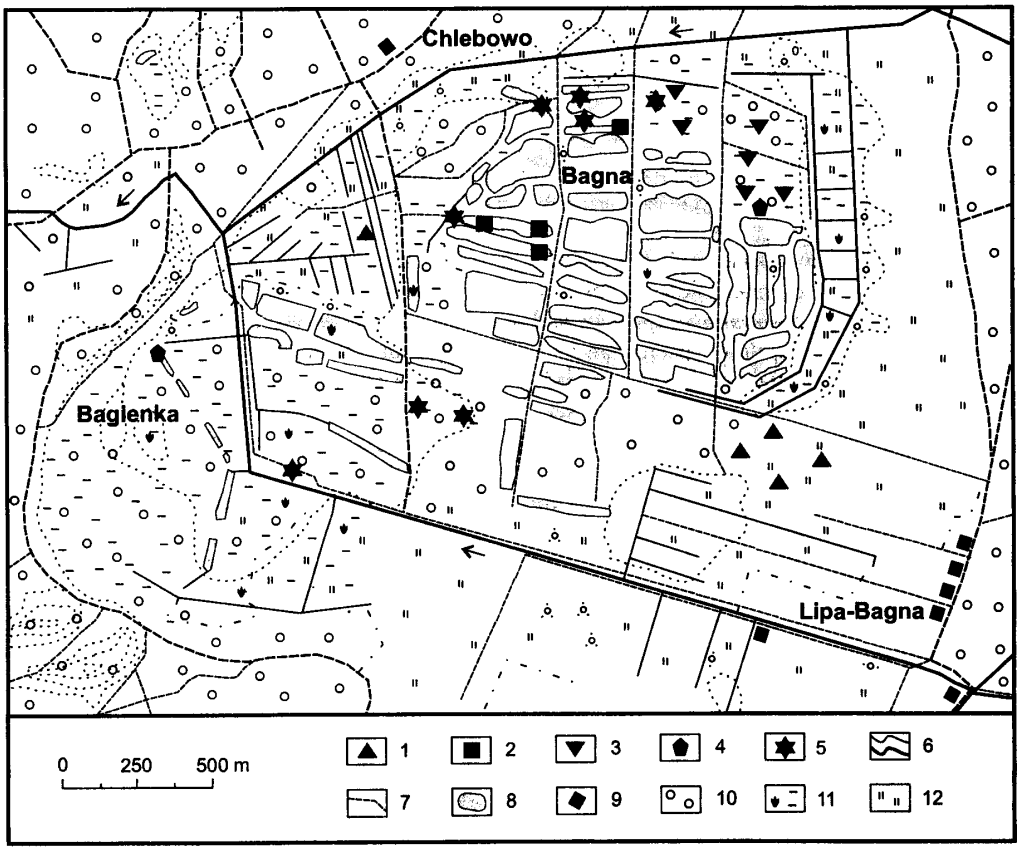

Figure 2. Distribution of the selected protected and threatened species in the peat-bog complex "Bagna" near Chlebowo; 1 – *Gentiana pneumonanthe*, 2 – *Wolffia arrhiza*, 3 – *Vaccinium uliginosum*, 4 – *Dryopteris cristata*, 5 – *Lycopodium annotinum*, 6 – watercourses, 7 – roads, 8 – post-extraction pits, 9 – buildings, 10 – woods, 11 – marshes, 12 – meadows

Drainage of the peat-bog has led to lowering of the water-table by about 0.6 m, and consequently to drying of the upper peat layer and drastic changes in the flora. Many species characteristic for the peat-bog, recorded earlier in that area, were not observed there in the 1930s. Despite substantial changes,

which took place in the peatland complex near Chlebowo, its flora is still rich and includes over 330 species. Eight of them are protected by the Polish law, and 24 are included in the list of threatened peat-bog plants (Jasnowska & Jasnowski 1977). It is noteworthy that 18 taxa of the last group were found in the study area in 1998–2002. 23 species from the "red list" for the Wielkopolska region (Żukowski & Jackowiak 1995) still exist there and 7 others need to be confirmed (figs 2, 3).

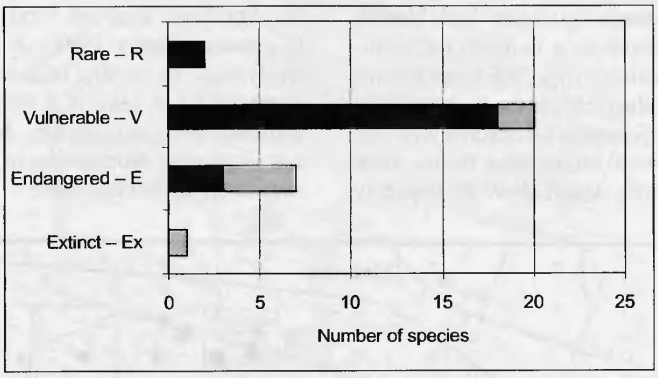

Figure 3. Contribution of taxa from the "red list" for the Wielkopolska region to the flora of the peat-bog complex "Bagna" near Chlebowo (localities confirmed recently are marked in black)

The peat ponds formed as a result of peat-cutting, enabled survival of many aquatic species, such as *Wolffia arrhiza*, *Sparganium minimum* and *Utricularia* spp. However, these species are usually absent from still exploited ponds and "cleaned" drainage ditches. Moreover, some of the more sensitive peat-bog species are gradually declining, for example: *Dryopteris cristata*, *Gentiana pneumonanthe* and *Andromeda polifolia*. Particularly the condition and number of the latter species have declined remarkably. Among the survived species there is *Potentilla anglica*, which was reported by Krawiec (1935) from the western part of the complex, and still occurs not only there but also in several places in the southern part. Some interesting species colonize old peat ponds in regenerated places: *Drosera rotundifolia*, *Oxycoccus palustris*, *Ledum palustre*, *Eriophorum vaginatum* and *E. angustifolium*. The most frequent are *Drosera rotundifolia* and *Oxycoccus palustris*, which sometimes form large patches (fig. 4). Also the population of *Ledum palustre* is in good condition, flowering and fruiting in some places.

One of the peculiarities of the study area is the population of *Empetrum nigrum*, isolated from the continuous range of this species (Celka & Szkudlarz 1999). This plant is a glacial relict, very rare and endangered in Wielkopolska (Kulczyński 1924; Czubiński 1950). The southern limit of its continuous range runs from Szczecin to Augustów, through the Drawa Lakeland, Kaszuby and the Mazurian Lakeland (Browicz & Zieliński 1973). Chlebowo is the southernmost locality of *Empetrum nigrum* on the lowlands. The species forms there only one patch covering about a dozen square metres. It is accompanied by characteristic species of three phytosociological classes: (1) *Vaccinio-Piceetea*: *Vaccinium myrtillus*, *V. vitis-idea*; (2) *Oxycocco-Sphagnetea*: *Oxycoccus palustris*, *Drosera rotundifolia*, *Andromeda polifolia*, *Eriophorum vaginatum*; and (3) *Scheuchzerio-Caricetea fuscae*: *Eriophorum angustifolium*, *Carex nigra*, *Menyanthes trifoliata*, *Comarum palustre*. Also *Ledum palustre*, which is a distinguishing species of the wet pine forest *Vaccinio uliginosi-Pinetum*, is common there. Despite changes taking place in its environment, the population of *Empetrum nigrum* is still in good condition, forming a dense, compact patch. Strong, ascending stems are covered with leaves from the base to the tip. They produce many female flowers but no male flowers, and no fruits were found. Unfortunately, the population is in danger of extinction because of the nearby pine trees, which are growing quickly (mainly due to the drainage) and may shade the patch completely.

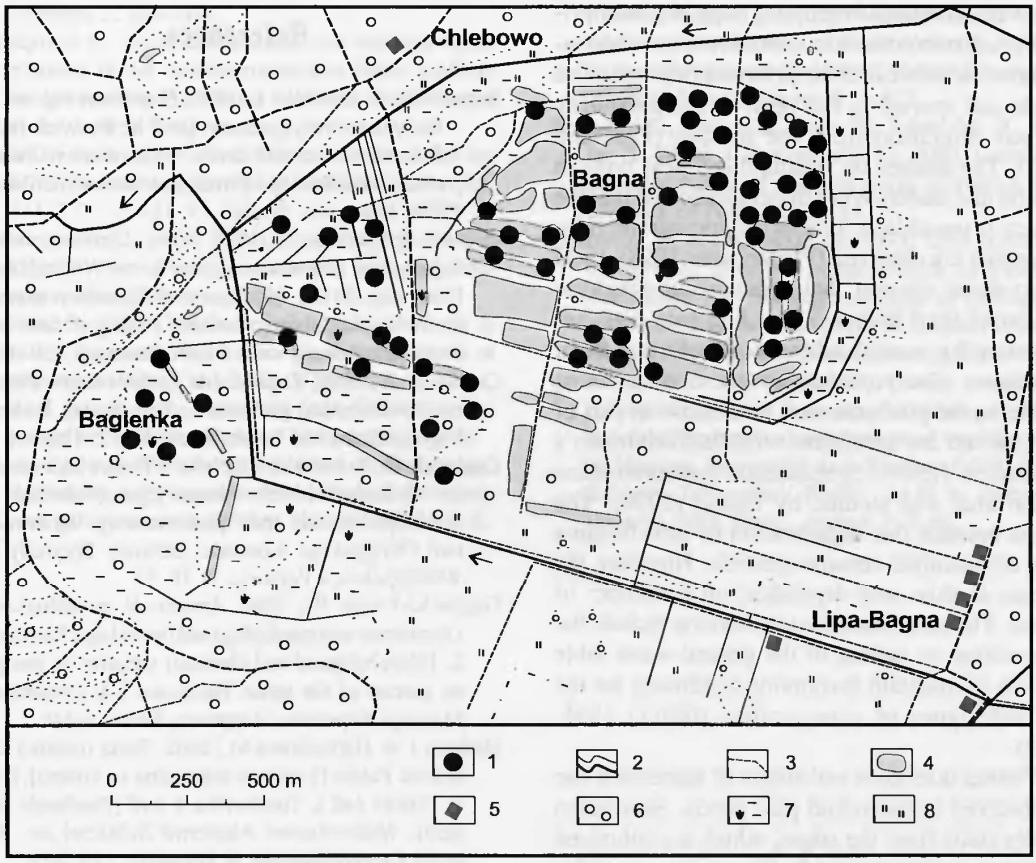

Figure 4. Distribution of *Oxycoccus palustris* in the peat-bog complex "Bagna" near Chlebowo; 1 – *Oxycoccus palustris*, 2 – watercourses, 3 – roads, 4 – post-extraction pits, 5 – buildings, 6 – woods, 7 – marshes, 8 – meadows

4. Discussion and conclusions

Desiccation and exploitation of the described peat bog have led to dramatic changes in the local vegetation and flora. A number of species typical for this habitat have receded or disappeared, while numerous synanthropic species with no peat-forming capability have colonised the bog. Similar changes have been observed in many Polish peat bogs (Jasnowski 1972; Herbich & Herbichowa 2002). Thanks to earlier observations (Czubiński & Świtalska 1937; Wodziczko et al. 1938) one can identify a group of species that persist despite of environmental changes. They include *Vaccinium uliginosum*, *Andromeda polifolia*, *Ledum palustre*, *Gentiana pneumonanthe*, *Dryopteris cristata*, *Potentilla anglica*, *Sparganium minimum*, *Wolffia arrhiza* and species of the genus *Utricularia*. For the most part they are typical of oligotrophic or mesotrophic, and most often also acidic habitats (Herbich & Herbichowa 2002; Zarzycki et al. 2002). Although some of those species have declined considerably, they survive in the flora of the peat-bog complex. There are taxa, such as *Sparganium minimum*, *Wolffia arrhiza* and *Utricularia* sp., which most probably survive thanks to human activity. Another species that has resisted unfavourable changes is *Empetrum nigrum*, whose presence in the peat bog was discovered recently, but which has certainly persisted there since much earlier times (Celka & Szkudlarz 1999).

The species makeup of plant communities arising in renaturalised high peat bogs depends primarily on microclimatic conditions, ground-water table variation, and the presence of propagules (seeds and spores) in the peat, or the possibility of their migration from the outside (Poschlod 1995). The studies on renaturalised peat bogs in Bavaria and Baden-Württemberg indicated that the process is possible as long as the appropriate rules of conduct are observed (Pfadenhauer 1998). Field observations suggest that spontaneous renaturalisation of the Chlebowo peat-bog area does not guarantee the re-establishment of its former floral abundance. The processes in question are most visible on the post-peat sites in the eastern part of the area and are consistent with Podbielkowski's description (1960). Spontaneous renaturalisation in that area was studied by Ilnicki (1996). The results indicate that regeneration of peat-forming plant communities remains possible. However, the process is slow and dependent on a number of factors. The most important conditions include the preservation or raising of the ground-water table in order to maintain favourable conditions for the desirable types of communities (Ilnicki 1996, 2002).

Various directions and stages of succession can be observed in individual peat ponds. Succession usually starts from the edges, which are colonized by swamp vegetation with *Phragmites australis*, *Typha latifolia* and *Eleocharis palustris* or covered by a floating bog mat with *Oxycoccus palustris*, *Drosera rotundifolia* and *Eriophorum vaginatum*. The bog mat is gradually overgrown with *Betula pubescens* and *Pinus sylvestris*. In large ponds, the spread of the mat is more difficult because of waves and periodical removal of waterweeds (e.g. *Potamogeton* and *Utricularia* spp.) by people. No species of the groups particularly sensitive to changes in water conditions was found in any of the vegetation patches. Nevertheless, processes of spontaneous renaturalisation, although not leading to restoration of the original taxonomic composition, result in formation of similar communities, composed of typical peat-bog species, e.g. *Eriophorum angustifolium*, *E. vaginatum*, *Oxycoccus palustris*, *Drosera rotundifolia*, *Ledum palustre*, *Carex rostrata*, *Typha latifolia*, *T. angustifolia*, *Sparganium minimum*, *Wolffia arrhiza*, and *Utricularia* spp.

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