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COURSE OF PLANT SUCCESSION IN THE POST-HARVEST AND POST-FIRE AREAS OF THE WIELKIE BŁOTO FEN IN THE NIEPOŁOMICKA PRIMEVAL FOREST*

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A b s t r a c t. The aim of this study was to identify plant species composition and the direction of vegetation transformation in the areas of the Wielkie Błoto lowland bog, which were degraded as a result of drainage and exploitation of the peat deposit and by fire. The present course of plant succession favours the development of non-peatforming plant communities. Most plant species form semi-natural or anthropogenic meadows and represent different phytosociological classes, especially *Molinio-Arrhenatheretea* and *Artemisietea vulgaris*.

K e y w o r d s: plant succession, post-exploitation areas, peatland fires

INTRODUCTION

Human activity influences the species composition of peat vegetation in many ways. One of the reasons for the transformation of peat vegetation is the exploitation of peat, which, regardless of the method used, requires the peat deposit to be drained and constitutes a profound interference in the structure of peat soils. This often has irreversible results in the form of accelerated decomposition of organic matter and thus changes in the physical, aqueous and chemical properties of soils. These processes have a considerable effect on the general disappearance of previously drained peat deposits, which is not without effect on the species composition of vegetation.

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Literature available on changes in drained peat bogs in Poland was discussed at length by Okruszko [14] and Lipka [6].

In recent years, peatland fires have been a common occurrence in Poland. This is mainly due to mindless and uncontrolled burning of dry grasses and other plants. Previously drained peatlands in a state of advanced decomposition are particularly prone to fires [3,8,10,11].

The aim of this study was to identify plant species composition and the direction of vegetation transformation in the area of the Wielkie Błoto lowland bog, which were degraded as a result of drainage and exploitation of the peat deposit and by fire.

MATERIAL AND METHODS

The Wielkie Błoto peat bog, 268 ha in area, is situated in the Niepołomicka Primeval Forest near Szarów. Both the peat bog and the peat deposit are of the lowland and soligenous type. They were formed in a sedimentation basin fed by water flowing from the surrounding hills.

They have a stratigraphic structure of rush peats: sedge (*Cariceti*), sedge and reed (*Cariceto-phragmiteti*), and moss (*Bryaleti*). Calcareous gyttja is also found locally. The average thickness of the peat deposit is 1.8 m, with a maximum thickness of 4.3 m. The average rate of decomposition is 33.0% and loss on ignition averages 23.1%. The peatland contains nine mineral islands, with a total area of 8.8 ha, which emerged due to the disappearance of the drained peat bog [5,9].

The Wielkie Błoto peat bog was first drained in 1890 [2] and re-drained during 1961-64 using a system of open ditches (ceramic and fascine drains were used in the western part of the peat bog). Water was carried into the Długa Woda stream (acting as a drainage ditch after regulation) which ran in the middle of the peat bog, and then to the Drwinka river. The peat deposit was mined between 1886 and 1975. Initially the peat was excavated for fuel and later for peat black production [5,9]. Uneven surfaces, which emerged following the peat excavation, covering approximately 65% of the peatland, made land management more difficult. After the land was developed in an area of over 200 ha, grassland farming was applied. Today grassland farming is almost completely abandoned and the land is being converted into forest.

Archival data on the plant cover of the Wielkie Błoto peat bog [7], from the former Department of Peat Science of the Agricultural Academy in Kraków, were used. Still earlier, Pajowska [16] made a description of the peat bog and its surroundings under the direction of Prof. Pawłowski.

In keeping with the study aim, we performed a phytosociological comparison of relevés made during the study period in the post-exploitation (1965-2005) and post-fire areas (1982-2005). A total of 34 phytosociological relevés were made

according to the Braun-Blanquet method, along two transect lines with a total length of 920 m (Fig. 1). Additionally, soil studies (12 soil pits and 2 natural exposures) were used as a basis for determining the degradation rate of peat soils and the humidity-soil complexes as graded by Okruszko [13,15].

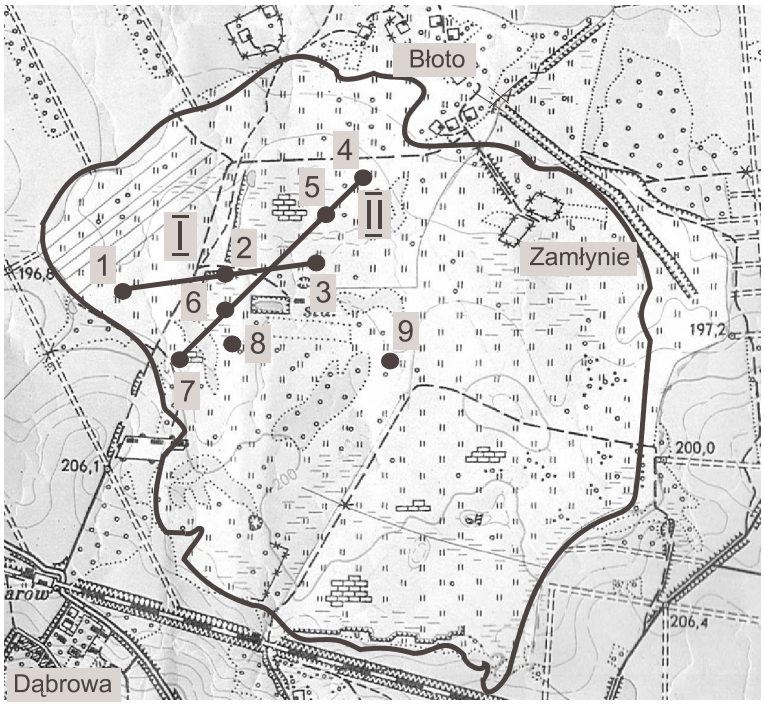

Fig. 1. Location of the Wielkie Błoto lowland bog: • measurement points; I, II - transect lines

RESULTS AND DISCUSSION

Over the past forty years, the plant cover of the Wielkie Błoto lowland bog has changed as a result of human activity. Transect lines (measurement sites), along which phytosociological relevés, were located across the areas degraded as a result of various processes (draining, exploitation of peat deposits, and fires). As a consequence, there are local differences in the species composition of growing vegetation according to area.

The results are presented briefly to give the number of species and plant coverage for syntaxonomic units (Tab. 1). The total number of species in the studied area increased from 89 in the first study period to 114 in 2005. Vascular plants were predominant, with 21 species of trees and shrubs.

Table 1. Number of species and coverage coefficient for distinguished syntaxonomic units

Syntaxonomic unit	1965, 1982		2005	
	Number of species	Coverage coefficient	Number of species	Coverage coefficient
Cl. *Molinio-Arrhenatheretea*	12	2238	16	1927
O. *Molinietalia*	20	1173	21	1372
O. *Arrhenatheretalia*	10	806	12	2728
Cl. *Artemisetea vulgaris*	5	51	11	2545
Cl. *Alnetea glutinosae*	4	646	7	517
Cl. *Stellarietea mediae*	1	33	4	32
Cl. *Phragmitetea*	9	1177	5	1044
Cl. *Querco-fagetea*	0	0	5	264
Cl. *Epilobietea angustifolii*	2	17	5	363
Cl. *Scheuzerio-Caricetea nigrae*	6	623	3	169
Others	20	1414	25	1060

Bryophytes appeared in post-exploitation areas in the initial stage of overgrowth. The post-peat reservoirs (points 2 and 7) were initially filled with stagnant water, on which duckweed (*Lemna minor*) developed. Mainly rush plants belonging to the class *Phragmitetea* and various species of willow occurred in the littoral zone. A similar course of post-peat reservoir overgrowth was reported by Podbielkowski [17]. At present, the post-peat areas are largely overgrown with shrubby and woody vegetation, mainly of the class *Alnetea glutinosae*. Willow and alder thickets are additionally grown with shrubby species such as the European ash (*Fraxinus excelsior*), spindle tree (*Euonymus europaea*), silver birch (*Betula pendula*), aspen (*Populus tremula*), and elder (*Sambucus nigra*).

Most species of herbaceous plants form semi-natural or anthropogenic meadow communities and represent different phytosociological classes, mainly *Molinio-Arrhenatheretea* (points 1, 4-6 and 8). In post-exploitation areas that were recently used as hay-growing meadows, the proportion of species typical of fresh (non-wet) habitats, such as *Arrhenatheretalia* (oat-grass, *Arrhenatherum elatius;* downy oat-grass*, Avenula pubescens*), is increasing. Ruderal species of the class *Artemisietea vulgaris*, particularly stinging nettle (*Urtica dioica*), which appears with great regularity, are also emerging. The presence of nitrophilous species such as *Urtica dioica, Galium aparine* and *Cirsium arvense* is evidence of high habitat fertility [1]. The high nitrogen level results from the mineralization of organic matter. This also concerns post-fire areas (points 3 and 9). Twenty-three years after the fire, about 80% of the burnt-out areas were covered by vegetation. Ruderal species, particularly giant goldenrod (*Solidago gigantea*) and stinging nettle are also prevalent. Several species of the class *Stellarietea mediae* were also found. At present, they are mostly in the first stage of growth in ruderal areas, and are replaced by perennial plant communities [12]. This area is gradually overgrown with shrubs, which results in its afforestation [11].

Plant succession is induced by external (natural or anthropogenic) factors. Because the hydrological regime is the principal factor of plant succession, any change in water relations induces a directed response of the vegetation [3].

Due to the degradation of the Wielkie Błoto peat bog, caused by the draining, exploitation and fire of the peat deposits, the organic matter begins to mineralize and the peat decomposes. In the analysed area there are peat and muck soils characterized by an average or strong degree of decomposition (MtII, MtIII); the soils contain the following humidity-soil complexes: periodically droughty (BC), droughty C), periodically dry (CD) and dry (D).

Under such conditions, plant succession in the Wielkie Błoto peat bog develops towards non-peatforming substitute vegetation communities, while regeneration of the peat land would only be possible if the area were again turned into a swamp.

CONCLUSIONS

1. Most species of herbaceous plants form semi-natural or anthropogenic meadow communities and represent different phytosociological classes, mainly *Molinio-Arrhenatheretea* and *Artemisietea vulgaris*.

2. The regular presence of nitrophilous species (mainly *Urtica dioica*) on developed meadows of peat and muck soils and on post-fire areas is evidence of high habitat fertility.

3. At present, the old post-peat areas are largely overgrown with shrubby and woody vegetation, mainly of the class *Alnetea glutinosae,* with an addition of shrubby species such as *Querco-fagetea* and *Epilobietea angustifolii*.

4. Plant succession in the Wielkie Błoto peat bog develops towards non-peatforming plant communities of meadow (particularly brush or forest) character.

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KIERUNEK SUKCESJI ROŚLINNEJ NA TERENACH POEKSPLOATACYJNYCH I POŻARZYSKACH NA TORFOWISKU NISKIM WIELKIE BŁOTO W PUSZCZY NIEPOŁOMICKIEJ

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S t r e s z c z e n i e. Celem pracy było poznanie składu gatunkowego i ustalenie kierunku przemian roślinności na obszarach torfowiska niskiego Wielkie Błoto, które uległy degradacji w wyniku dawnego odwodnienia i eksploatacji złoża oraz na skutek pożarów. Obecny kierunek sukcesji sprzyja rozwojowi nietorfotwórczych zbiorowisk roślinnych. Większość gatunków tworzy zbiorowiska łąkowe o charakterze półnaturalnym lub antropogenicznym i reprezentuje różne klasy fitosocjologiczne, głównie *Molinio-Arrhenatheretea* i *Artemisietea vulgaris*.

S ł o w a k l u c z o w e: sukcesja roślinna, doły potorfowe, pożary torfowisk