ARCHIVES OF ENVIRONMENTAL PROTECTION
vol. 37 no. 2 pp. 81 - 92 2011
PL ISSN 0324-8461

INFLUENCE OF HUMAN ACTIVITY ON DIVERSITY OF PEATLAND PHYTOCENOSIS IN MIĘKINIA NEAR WROCŁAW

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Keywords: Low peatlands, phytocenosis degradation, peat forming communities.

Abstract: The subject of investigations was the fragment of low peatland complex located close to Miękinia, about 30 km from Wrocław. Within the range of the examined area of peat bog complex there can be distinguished three parts differing in their utilization and composition of species, namely: 1/ the area degraded by the attempt to afforest it with alder trees *Alnus glutinosa* (L.) Gaertner, 2/ occasionally used bog hay meadow and 3/ typical peat forming phytocenosis. Total number of determined species, belonging to 11 phytosociological classes, ranged 77, out of which more than a half constitute representatives of *Molinio-Arrhenatheretea* class. As far as a non-afforested area was concerned, there were determined 5 phytocenosis, including 4 classified as peat forming ones and one typical for post-bog meadows *(Alopecuretum pratensis*). The afforested area featured herbaceous plant composition which indicated that the area with *Alopecuretum pratensis* phytocenosis had been degraded. Analysis of environmental requirements, done with the use of ecological numbers, proved that prevailing number of species characterize similar requirements. It was mainly afforested part to feature taxons of broader ecological scale, e.g. *Polygonum bistora* L.*, Carex hirta* L. and *Plantago lanceolata* L.
The afforested area was purchased by a private person, therefore it can be assumed that the reason for such a way of peatlands utilization was obtaining EU subsidies at minimum work effort. A higher financial profit, however, would have been made by the owner if he had maintained a bog area as an extensive meadow.

INTRODUCTION

The surveys regarding changes of soil properties on drained low peatlands and resulting changes in floristic composition were published as early as the 1960s [17, 18]. Negligence of post-bog meadows utilization did accelerate the process of marshy soil degradation and degeneration of plants vegetation [1, 8, 10, 21]. Current times have brought additional threats to peatlands and post-bog meadows in the form of potential financial profits to be gained due to EU subsidies. An important element, from the point of view of nature protection, is Agricultural-Environmental Program for the years 2007–2013, especially its packages 4 and 5 dealing with protection of endangered species of birds and natural habitats both within and outside the range of the areas belonging to Nature 2000. Each package includes a number of different variants and the payments for their realization are

not equal, depending on localization of a particular object [19]. It is not difficult to classify habitats typical for raised bogs and transition bogs, yet most of low peatland habitats, characteristic for Poland, has not been included among the variants mentioned above [7]. Nevertheless, the same Agricultural-Environmental Program also covers packages facilitating extensive management, among others on semi-natural, one-cut meadows, to which low peatland complexes and moorgrass meadows are classified (from All. Molinion). Within the range of two – cut meadows there can be found damp meadows (All. *Caltion*), as well as fresh meadows (from All. *Arrhenatherion*). To be granted subsidies farmers taking part in the program have to successfully meet detailed requirements [2], which seem to be quite difficult to fulfill and, no wonder, the possibility of gaining subsidies due to afforesting the area, in this case low peatlands, proves to be more tempting. Unfortunately, not many people pay attention to the fact that this leads to degradation of moor ecosystems.

How disastrous human activity can be to the condition of bog and post-bog areas becomes evident when exemplified by bog meadow complex stretching between Miękinia and Przedmoście, near Wrocław.

CHARACTERISTICS AND RESARCH OBJECT

Low peatland complex, stretching between Miękinia and Przedmoście, is located 30 km from Wrocław (Fig. 1).

Till the end of the 1980s it had been utilized by a state farm (PGR) Kadłub, mainly as meadows. After the collapse of state farms the area became an idle land. In 2003 on the area near Przedmoście, there occurred beavers whose activity contributed to peat forming process in different parts of the complex. The part located close to Miękinia was purchased by a private person and initially it was cut at least once a year, yet in 2009 cutting was neglected altogether and the way of its utilization was changed.

MATERIAL AND METHODS

In 2010 there were carried out floristic-phytosociological examinations in the area of bog meadow complex, situated not far from Miękinia. Phytosociological surveys were taken according to the method by Braun-Blanquet, additionally supplied with floristic indices which followed the itinerary method. The names of herbaceous plants were reported after Mirek *et al.* [15]. Following the study by Matuszkiewicz [14] identified plant species were assigned to a particular phytosociological class and existing phytocenosis were determined as well. Detailed analyses involving habitat requirements of plant species were done with the use of the study by Zarzycki *et al.* [24]. The following indicators were taken into account: soil moisture (W), trophism (Tr), soil acidity (R), content of organic matter (H). To assess the requirements regarding soil richness in nitrogen data reported in the work by Ellenberg [4] were used.

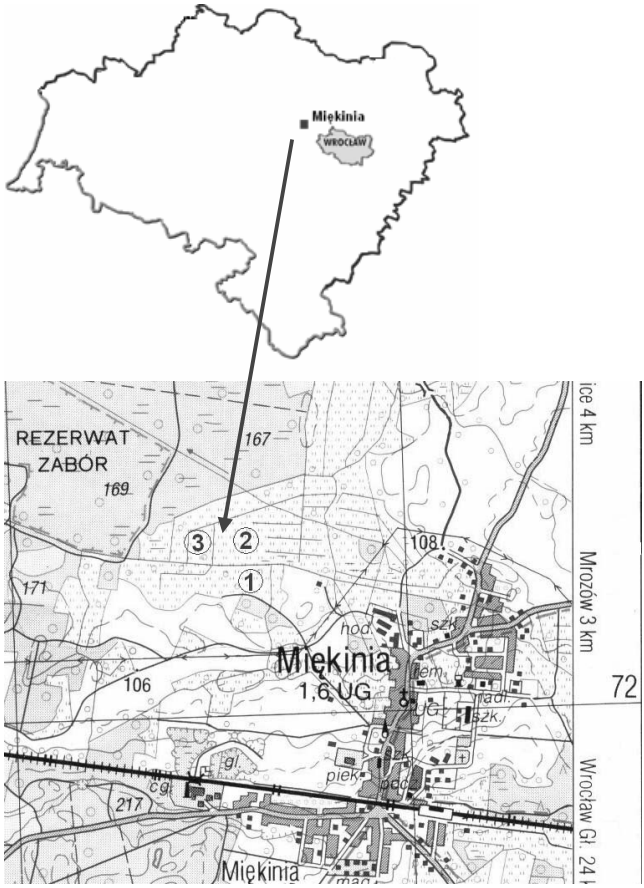

Fig. 1. Localization of the examined surfaces. 1, 2, 3 – analyzed areas: 1 – afforested ground, 2 – bog meadow, 3 – area with peat – forming phytocenosis

RESULTS OF RESARCHES

There were distinguished three different parts in the analyzed bog complex : 1/ the area degraded by the attempt to afforest it with alder trees *Alnus glutinosa* (L.) Gaertner, 2/ occasionally utilized bog hay meadow and 3/ typical peat-forming phytocenosis.

In a non-afforested area there were determined the following phytocenosis:

Class: *Phragmitetea* R.Tx. et Prsg. 1942
Order: *Phragmitetalia* Koch 1926
Alliance: *Phragmition* Koch 1926
Community: *Phragmitetum australis* (Gams 1927) Schmale 1939

Alliance: *Magnocaricion* Koch 1926
Community: *Caricetum rippariae* Soó1928
Caricetum acutiformis Sauer 1937

Class: *Molinio-Arrhenatheretea* R.Tx. 1937
Order: *Molinietalia caeruleae* W.Koch 1926
Alliance: *Caltion palustris* R.Tx. 1936 em. Oberd. 1967
Community: *Scirpetum sylvatici* Ralski 1931

Alliance: *Alopecurion pratensis* Pass.1964
Community: *Alopecuretum pratensis* (Regel 1925) Steffen 1931

Floristic characteristics

Total number of plant species identified within the whole area amounted 77 (Tab. 1).

The highest quantity of plant species occurred on a degraded and afforested part (51 plant species), then lower number of them featured occasionally cut bog hay meadow (47 species), while the lowest number characterized typical peat forming phytocenosis. The abovementioned species belong to 11 phytosociolocical classes with more than a half of them (54.7%) being representatives of *Molinio-Arrhenatheretea* class (Fig. 2).

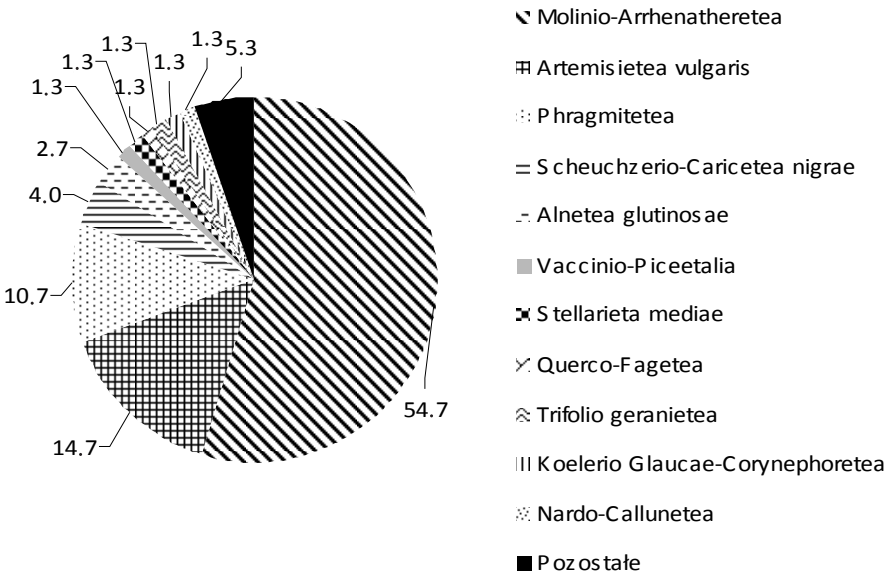

Fig. 2. Share of phytosociological classes in the whole examined area

There were detected merely 11 species originating from classes typical for low peatlands, which means 8 species from *Phragmitetea* class (10.7%) and only 3 species from *Scheuchzerio-Caricetea nigrae* class (4%).

The part of the examined area with preserved peat forming vegetation (Fig. 1) characterizes periodical stagnation of water layer up to the depth of 3 cm on peatland surface. There can be found the following phytocenosis: *Caricetum ripariae* and *Caricetum acutiformis* forming a mosaic of planes differing in size, common reed rushes *Phragmitetum australis*, as well as not numerous and small surface planes of *Scirpetum sylvatici*. These

Table 1. Species identified on the examined area and their membership in phytosociological classes
Symbols of classes: Vacc-Picee – *Vaccinio-Piceetea*, Aln-glut – *Alnetea glutinosae*, Mol-Arrh – *Molinio-Arrhenatheretea*, Artem – *Artemisietea vulgatis*, Phr – *Phragmitetea*, Scheu-Car. nigrae – *Scheuchzerio-Caricetea nigrae*, Stell med – *Stellarieta mediae*, Koel – *Koelerio glaucae-Corynephoretea,* Nardo-Call – *Nardo-Callunetea*

List of species	Class	Afforested part	Alopecuretum pratensis	Caricetum lipariae	Ecotone Phragmiteum australis	Ecotone Scirpetum sylvatici and Phragmitetum austarlis
Trees plantings						
Picea abies	Vacc-Picee	+	-	-	-	-
Alnus glutinosa	Aln-glut	+	-	-	-	-
Plants from natural habitats						
Salix aurita	Aln-glut	+	-	-	-	-
Achillea millefolium	Mol-Arrh	+	+	-	-	-
Alopecurus pratensis	Mol-Arrh	+	+	-	-	-
Campanula patula	Mol-Arrh	+	+	-	-	-
Carex hirta	Mol-Arrh	+	+	-	-	-
Centaurea jacea	Mol-Arrh	-	+	-	-	-
Cerastium holosteoides	Mol-Arrh	-	+	-	-	-
Cirsium oleraceum	Mol-Arrh	-	+	-	-	-
Cirsium palustre	Mol-Arrh	-	+	-	-	+
Dactylis glomerata	Mol-Arrh	+	-	-	-	-
Deschampsia caespitosa	Mol-Arrh	+	+	-	-	-
Festuca pratensis	Mol-Arrh	-	+	-	-	-
Filipendula ulmaria	Mol-Arrh	+	-	-	-	-
Galium mollugo	Mol-Arrh	+	-	-	-	+
Galium uliginosum	Mol-Arrh	-	+	+	-	-
Holcus lanatus	Mol-Arrh	-	+	-	-	-
Juncus conglomeratus	Mol-Arrh	-	+	-	-	+
Juncus effusus	Mol-Arrh	+	+	+	-	-
Lathyrus pratensis	Mol-Arrh	+	+	-	-	+
Leucanthemum vulgare	Mol-Arrh	+	+	-	-	-
Lotus uliginosus	Mol-Arrh	+	-	-	-	+
Lychnis flos-cuculi	Mol-Arrh	+	+	-	-	-
Lysimachia vulgaris	Mol-Arrh	-	+	+	-	+
Lythrum salicaria	Mol-Arrh	+	+	+	-	-
Pastinaca sativa	Mol-Arrh	+	-	-	-	-
Phleum pratense	Mol-Arrh	-	+	-	-	+
Plantago lanceolata	Mol-Arrh	-	+	-	-	-
Poa pratensis	Mol-Arrh	+	+	-	-	-
Polygonum amphibium	Mol-Arrh	+	-	-	-	-
Polygonum bistorta	Mol-Arrh	+	-	-	-	-
Potentilla anserina	Mol-Arrh	-	+	-	-	-

Potentilla reptans	Mol-Arrh	+	+	-	-	-
Ranunculus acris	Mol-Arrh	+	+	-	-	-
Ranunculus repens	Mol-Arrh	+	+	-	-	-
Rumex acetosa	Mol-Arrh	-	+	-	-	-
Rumex crispus	Mol-Arrh	+	+	-	-	-
Sanguisorba officinalis	Mol-Arrh	+	+	-	-	-
Scirpus sylvaticus	Mol-Arrh	-	-	-	-	+
Symphytum officinale	Mol-Arrh	+	-	+	-	+
Trifolium hybridum	Mol-Arrh	-	+	-	-	-
Trifolium pratense	Mol-Arrh	-	+	-	-	-
Viccia cracca	Mol-Arrh	+	+	-	-	-
Cirsium arvense	Artem	+	+	-	-	-
Cirsium vulgare	Artem	-	+	-	-	-
Epilobium parviflorum	Artem	+	+	+	-	-
Glechoma hederacea	Artem	+	-	-	-	-
Hypericum perforatum	Artem	+	+	-	-	-
Melandrium album	Artem	+	-	-	-	-
Myososton aquaticum	Artem	+	-	-	-	-
Solidago gigantea	Artem	+	+	-	-	-
Tanacetum vulgare	Artem	+	+	-	-	-
Urtica dioica	Artem	+	-	-	-	-
Veronica chamaedrys	Artem	+	-	-	-	-
Carex acutiformis	Phr	+	-	-	-	-
Carex gracilis	Phr	-	+	+	-	+
Carex riparia	Phr	+	-	+	+	-
Carex rostrata	Phr	-	+	-	-	-
Equisetum fluviatile	Phr	-	-	+	-	-
Peucedanum palustre	Phr	+	+	-	-	-
Phalaris arundinacea	Phr	+	+	-	-	-
Phragmites australis	Phr	-	-	-	+	+
Calamagrostis stricta	Scheu-Car nigrae	+	-	-	-	+
Carex echinata	Scheu-Car nigrae	+	-	-	-	-
Carex flava	Scheu-Car nigrae	+	-	-	-	-
Galeopsis tetrahit	Stell med	+	-	-	-	-
Scrophularia nodosa	Querco-Fagetea	+	-	-	-	-
Agrostis capillaris	Trifolio-Geranietea	+	-	-	-	-
Rubus plicatus	Rhamno-Prunetea	+	-	-	-	-
Galium verum	Trifolio-Geranietea	+	-	-	-	-
Anthoxanthum odoratum	Koel	-	+	-	-	-
Luzula multiflora	Nardo-Call	-	+	-	-	-
Carex pairae	-	-	+	-	-	-
Erigeron annuus	-	+	-	-	-	-
Mentha aquatica	-	-	+	-	-	-
Stellaria graminea	-	+	+	-	-	-
TOTAL: 75 species		**51**	**47**	**9**	**2**	**12**

phytocenoses are actually monocultures, yet it is possibile to find in them single representatives of other species, e.g. *Lysimachia vulgaris* L., *Lythrum salicaria* L. or *Symphytum officinale* L. The mentioned species indicate the fact that periodical and, at the same time, considerable oscillations of water level do take place. A slight expansion of reed *Phragmites australis* (Cav.) Trin. Ex Stendal, was observed in this area and, therefore, transitional zones between phytocenosis occur. Very poor, formed by only two species ecotone was observed between *Phragmitetum australis* and *Caricetum ripariae*, while the zone where reed grows together with wood bulrush seems to be much richer, as 12 plant species, out of which as many as 9 belong to *Molinio-Arrhenatheretea* class, could be identified there (Tab. 1). Total number of herbaceous plant species identified in that part of the area equaled 18.

The second part was bog peat meadow (Fig. 1) with 47 species including, among others, the ones of high feeding value, such as *Alopecurus pratensis* L., *Festuca pratensis* Hudson, *Phleum pratense* L., *Tiforium pratense L.*, and other, less valuable, such as: *Symphytum officinale* L., *Cirsium arvense* (L.) Scop. or *Solidago gigantea* Aiton (Tab. 1). Representatives of *Molinio-Arrhenatheretea* (32 species, i.e. 68.1% – Fig. 3) played a dominant role.

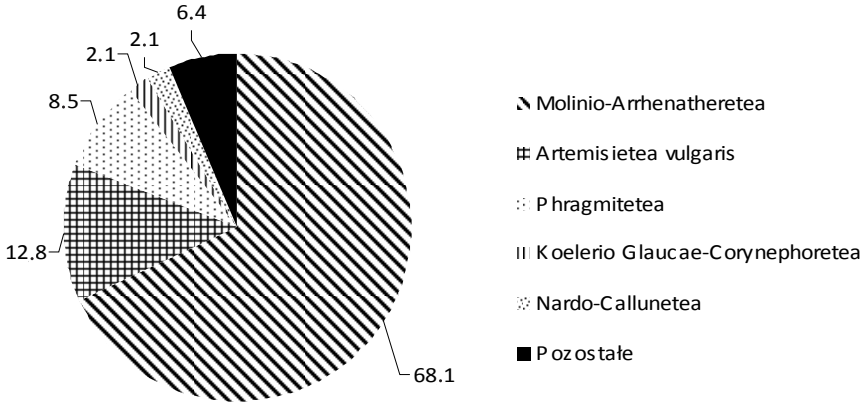

Fig. 3. Share of phytosociological classes in the part with *Alopecuretum pratensis*

There were recorded only 4 representatives of *Phragmitetea* class occurring in a small number: *Phalaris arundinaceae* L., *Carex riparia* Curtis, *Carex rostrata* Stokes and *Peucedanum palustre* (L.) Moench. Species composition resembles damp meadows with foxtail grass [7]. Matuszkiewicz [13] points to the fact that *Alopecuretum pratensis* is an anthropogenic community, occurring on muck attempt – peat meadows which require regular treatment. When neglected it degenerates easily. The meadow in question is not subjected to regular cutting and thus likely to become transformed.

Two years ago, relatively large areas of post-bog meadows (Fig. 1), partly even more boggy, with planes of *Caricetum ripariae*, underwent afforestation with black alder *Alnus glutinosa* (L.) Gaertner with the addition of *Picea abies* (L.) Karsten. The whole area was devastated by introduction of bed embankments with the difference between

ground lowering and the surface of the embankements ranging up to 80 cm. Total number of plant species identified there amounted 51 , but currently it actually is a community of *Cirsium arvense* (L.)Scop., which also includes trace quantities of other species, among others *Juncus effusus* L.*, Lathyrus pratensis* L.*, Lychnis flos-cuculi* L.*, Ranunculus acris* L., *Glechoma hederacea* L.*, Tanacetum vulgarae* L., *Galeopsis tetrahit* L. or *Rubus plicatus* W. et N. (Tab. 1). There were identified, in total, 61 species belonging to 11 phytosociological classes. The representatives of *Molinio-Arrhenatheretea* classes were dominant (Fig. 4), but their number was nearly by 20% lower than in the case of a post-bog meadow.

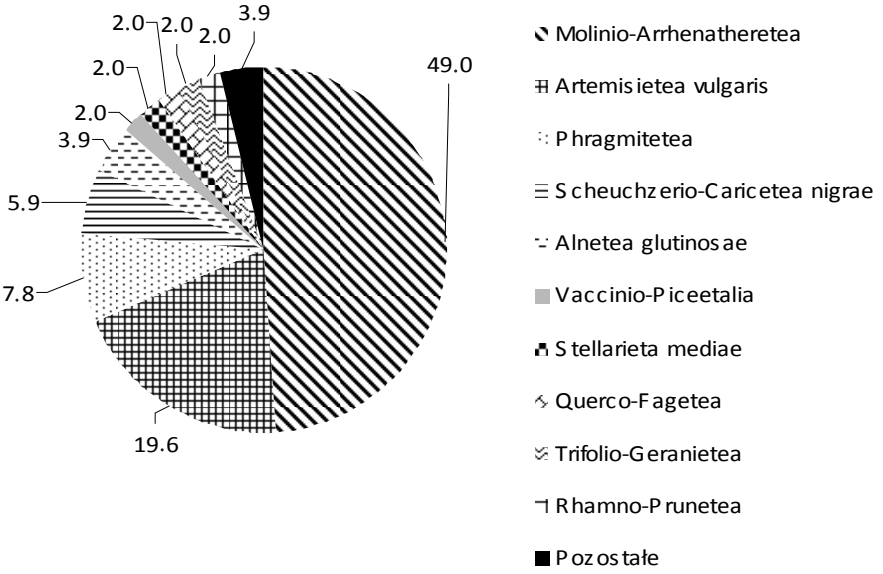

Fig. 4. Share of phytosociological classes in afforested part

Nevertheless, the species identified point to the fact that *Alopecuretum pratensis* was devastated. At this type of cultivation the process of decaying will gradually advance and in the years to come further unfavorable floristic alterations can be expected.

Habitat requirements

Most of the recognized plant species feature similar environmental requirements (Tab. 2). Their preferable habitats are from fresh (W 3) to wet ones (W 5), but most numerous are species of moisture humidity (W 4). The most of them require rich soils (Tr 4) from moderately acidic to alkaline (R 3–5). Vast majority of identified species need soils rich in organic matter (H 2–3). Only in transformed marsh habitats there begin to occur species adjusted to the environment poor in humus, like *Cirsium vulgare* (Savi) Ten. Slowly advancing degradation of phytocenosis is also shown by the occurrence of species characterizing a broader ecological scale. This phenomenon can be exemplified by *Polygonum bistora* L. from moist habitats (W4) of pH from 5 to 7, as well as *Carex hirta* L., which can grow in the environment ranging from dry to moist (W 2–4), from poor to rich (Tr 2–4) and moderately acidic to alkaline (R 3–5). Another example can be *Plantago*

lanceolata L. from habitats determined from dry to moist (W 2–4) and from mezo- to eutrophic ones (Tr 3–4).

Lowering of water level in a deposit contributes to initialization of the process of peat mineralization, accompanied by elevated values of nitrogen content. Nitrophilous species include (value 8 according to Ellenberg [4]) *Urtica dioica* L., which appeared on degraded (afforested) soil on the part of the examined area and *Cirsium vulgare* (Savi) Ten.*, Symphytum officinale* L., as well as *Erigeron annuus* (L.) Pers.

Mean values of coefficients (Tab.2) are similar. Significant differences are recorded regarding water requirements for phytocenosis *Caricetum ripariae* (W 5.4) and a transitional zone between *Scirpetum sylvatici* and *Phragmitetum australis* (W 5.25).

DISCUSSION ON THE RESULTS

Recognized phytocenoses on a non-afforested part of peatland belong to typical ones for utilized and not utilized low peatlands [5, 11, 23]. On a bog meadow in *Alopecuretum pratensis* community 47 plant species were identified. Their number is not high as compared to e.g. the data reported from the region of Wielkopolska by Kryszak and Grynia [13], although they resemble the ones, by the same authors, referring to the Bystrzyckie Mountains and to Dusznickie Lowland. The simplification in botanical composition was mainly affected by neglecting regular cutting, as well as by decreased water level resulting, among others, from diminished amount of precipitation. A number of authors [5, 11, 16, 22] reported the effect of intensity of bog meadows utilization and the degree of moisture content on the quality of phytocenosis. The latter one also constitutes an important factor enabling appropriate distinguishing of communities from *Molinio-Arrhenatheretea* class [20]. Analysis of environmental requirements proved that dominant species were those typical for fresh habitats. These results remain in agreement with the data obtained by other authors [12, 25].

The situation existing on the examined area indicates that ignorant human activity can pose a great danger for bog meadows. Afforestation at the area of *Alopecuretum pratensis* phytocenosis, featuring favorable conditions, resulted in the fact that a considerable part of this bog meadow complex should be treated as completely degraded. For many years there did exist an approach that afforestation introduced on peatland areas was a desired way of management of those so-called ,,idle" rounds [6], but nowadays, that attitude has been changed. Agricultural-Environmental Programs propose new, environmental – friendly forms of peatlands management [2]. Obviously, the only explanation of such a devastation of bog areas seems to be obtaining EU subsidies connected with afforestation. Unfortunately, agricultural advisors did not point to the fact that higher financial profits could have been obtained due to maintaining bog areas as an extensive one-cut meadow on bog areas. Thanks to that, the natural values of this area could have been secured. It is good to notice that some similar areas on the Lower Silesia are protected by low as ecological areas "Ścinawskie Swamps" [9].

CONCLUSIONS

Within the range of the examined bog complex three parts differing in the way of their utilization and species composition occurred. They include: 1/ the area degraded by

Table 2. Number of species regarding their particular environment al requirements in particular phytocenoses and mean value of coefficients for phytocenoses on the examined part of peatlands near Miękinia. Legend for coefficients: W – soil moisture coefficient, Tr – coefficient of trophism, R – soil acidity, H – humus content, N – nitrogen content. Values of coefficients according to the description by Zarzycki et al. [24] and Ellenberg [4]

Value of coeffi-cient	Afforested part					Alopecuretum pratensis					Caricetum ripariae					Ecotone *Phragmitetum australiss and Caricetum ripariae*					Ecotone *Scirpetum sylvatici and Phragmitetum australis*				
							c	o	e	f	f	i	c	i	e	n	t	s							
	W	Tr	R	H	N	W	Tr	R	H	N	W	Tr	R	H	N	W	Tr	R	H	N	W	Tr	R	H	N
1-2	.	.	.	1	.	.	.	1	1		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1-3	.	.	1	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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2-3	4	1	1	9	.	4	.	.	8		.	.	.	2	.	.	.	.	1	.	1	.	1	3	.
2-4	1	1	1	.	.	2	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	12	6	4	9	6	13	8	2	9	6	.	1	.	6	.	.	.	.	1	.	1	3	.	5	3
3-4	11	9	4	.		7	12	4	.		.	1	1	.	.	.	.	.	.	.	1	1	1	.	.
3-5	.	.	2	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	5	29	24	.	5	10	23	22	.	5	1	5	7	.	3	.	1	2	.	1	1	5	9	.	2
4-5	7	4	8	.	.	5	2	8	.		5	.	1	.	.	.	.	.	.	.	5	.	.	.	.
4-3	1	3	.	.	.	1	3	.	.	.	.	2	.	.	.	.	1	.	.	.	.	3	.	.	.
5	8	.	1	.	9	6	.	.	.	10	3	.	.	.	2	1	.	.	.	1	2	.	1	.	1
5-6	.	.	.	.	.	.	.	.	.		.	.	.	.	.	1	.	.	.	.	1	.	.	.	.
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7	.	.	.	.	7	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8	.	.	.	.	2	.	.	.	.	2	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.1
Mean value	3.74	3.76	3.91	2.27	4.94	3.66	3.68	3.91	2.22	5.00	**4.61**	3.72	4.00	2.78	5.00	**5.25**	3.75	4.00	2.75	4.50	4.25	3.58	3.92	2.54	4.40

attempted afforestation with alder trees *Alnus glutinosa*, 2/ occasionally utilized bog hay meadow and 3/ typical peat-forming phytocenosis.

On a non-afforested area there were identified 5 phytocenoses, including 4 classified to peat forming phytocenoses and one typical for post-bog meadows *(Alopecuretum pratensis*).

Total number of identified species equaled 77, they belonged to 11 phytosociological classes, out of them nearly a half were representatives of *Molinio-Arrhenatheretea* class.

Identification of herbaceous plants in afforested part points to the fact that the area with *Alopecuretum pratensis* phytocenosis became devastated.

Most species feature similar environmental requirements, while in afforested part there occurred taxons characterizing broader ecological scale, e.g. *Polygonum bistora* L.*, Carex hirta* L., or *Plantago lanceolata* L.

Afforested area was purchased by a private person, so it can be assumed that the reason for such a management of peatland was the possibility of obtaining EU subsidies at the smallest possible effort. Yet, a much higher financial profit could have been obtained by the owner if he had maintained bog area as an extensive one-cut meadow on bog areas. That way biodiversity of the area would have been preserved.

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Received: March 16, 2011; accepted: April 26, 2011.

Badania współfinansowane przez Unię Europejską ze środków Europejskiego Funduszu Społecznego w ramach projektu systemowego pn. „Przedsiębiorczy doktorant - inwestycja w innowacyjny rozwój regionu" *(Program Operacyjny Kapitał Ludzki, Priorytet VIII Regionalne Kadry Gospodarki, Działanie 8.2 Transfer Wiedzy, Poddziałania 8.2.2 Regionalne Strategie Innowacji)*.