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GENERAL CHARACTERISTICS OF SELECTED SOIL PROFILES UNDER THE *Caltho-Alnetum* ASSOCIATION IN THE BABIOGORSKI NATIONAL PARK

OGÓLNA CHARAKTERYSTYKA WYBRANYCH PROFILI GLEB POD ZBIOROWISKIEM OLSZYNY GÓRSKIEJ (*Caltho-Alnetum*) W BABIOGÓRSKIM PARKU NARODOWYM

Abstract: *Caltho-Alnetum* associations belong to priority biotopes listed in the annex to 1st Habitats Directive of the European Union. Most of these habitats in the area of present Babiogorski National Park were reclaimed in the seventies. The present research compared the properties of soils and waters in the *Caltho-Alnetum* habitats, which were drained in the seventies with the analogous properties of habitats which were transformed by the anthropogenic factors only to a small degree. The studies revealed a significant effect of reclamation works conducted in the seventies on such parameters as organic carbon and mineral contents, degree of organic matter decomposition, degree of moorshing and groundwater level.

Keywords: *Caltho-Alnetum,* fens, organic soils, swamps

Hydrogenous habitats among which *Caltho-Alnetum* association may be counted fulfill important ecological functions, especially in the mountain areas. Thanks to conditions in the natural *Caltho-Alnetum* association with respect to the floristic composition, they belong to the richest plant associations of the Babiogorski National Park [1, 2].

A high groundwater level in the soils of these habitats, specific properties of waters and soils create favourable habitat conditions for the development of numerous stenotypic animal and plant species, among which many are rare and protected ones. However, the state of dynamic balance which occurs in these habitats may be easily disturbed by eg lowering of the groundwater level. Such a situation occurred on a majority of *Caltho-Alnetum* patches in the area of the Babiogorski National Park, which prior to their putting under protection as a national park, were reclaimed in the seventies in order to increase timber production in these areas.

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According to the Decree of the Minister of the Natural Environment dated 16 May 2005 on the types of natural habitats, plant and animal species which require protection in the frame of designed Nature 2000 areas, *Caltho-Alnetum* associations should be put under protection and the degraded habitats should be renaturized.

Before the proper renaturization measures could be taken a detailed inventory must be conducted in these habitats. It should comprise identification and comparison of the chemical and physical properties of soils and waters, as well as species composition of the vegetation covering *Caltho-Alnetum* which was not drained, with the analogous properties of the habitats, which were reclaimed in the seventies.

The conducted research aimed at determining the influence of the land reclamation conducted in *Caltho-Alnetum* associations in the area of the Babiogorski National Park on the essential properties of these habitats.

Materials and methods

Seven habitats under the *Caltho-Alnetum* association were selected in the area of the Babiogorski National Park. One soil pit, located in the central part was made on each of the selected habitats. Soil samples were collected from individual genetic horizons appointed for the soil profile studies. From among habitats selected for the analyses, five were in the decession stage (profiles 2–5), whereas two (profiles 1–2) were in the organic matter accumulation stage.

In the collected soil material, mineral content, organic carbon and nitrogen concentrations were assessed using methods suggested by Sapek and Sapek [3], pH with the potentiometric method in H_2O and 1 mol · dm^{-3} KCl solution. The groundwater level was measured in the soils of biotopes chosen for the research. The degree of peat decomposition was determined during the soil sampling on a ten degree von Post scale [4].

Results and discussions

Due to its specific habitat conditions, the *Caltho-Alnetum* association occurs rarely and usually covers small areas therefore it was considered a priority in the Nature 2000 network (*Poradnik ochrony siedlisk i gatunków Natura 2000. Bory i Lasy. Tom. 5 2004*). The habitats selected for the analyses may be divided into two groups. The first is constituted of habitats only slightly transformed by human activity (profiles 1 and 2) (Table 1). The other group comprises the habitats where water-air relationships were disturbed by the reclamation works conducted in the seventies (profiles 3–7) (Table 1).

The occurrence of the *Caltho-Alnetum* association is strictly connected with the presence of water in their soil profiles. On the basis of their hydrological feeding the analyzed habitats from the area of the Babiogorski National Park may be counted among soligenic fens fed by the underground waters flowing out of the aquifer outlets. The soils of the swampy *Caltho-Alnetum* association with natural water-air relationships (profiles 1, 2) were characterized by a peat-forming process of organic matter accumu-

lation occurring in the surface horizons under conditions of high moisture. A characteristic feature of these soils was a high groundwater level, fluctuating about 3–5 cm from the soil surface. The rate of organic matter accumulation in habitats of this type is very slow. A low rate of organic matter accumulation should be associated with high level of organic matter decomposition caused by a considerable oxygenation of waters feeding fens of this type. Nicia and Miechowka [5] found similar relationships between the oxygenation and a high degree of organic matter decomposition in the soils of low sedge mountain fens.

Table 1

Selected properties of analyzed soils

Profile	Fen name	Sample No.	Horizon	C [g · kg^{-1}]	Decomposition degree	pH	
						H_2O	KCl
Fens at accumulation stage							
1	Mokry Kozub	POtni	0–10	310.5	H_9	6.4	6.0
		Otni	10–19	183.8	H_8	5.2	4.8
		D	19–45	40.5	–	5.4	4.3
2	Pod Orawską Drogą	POtni	0–15	281.7	H_9	6.3	5.9
		Otni	15–30	128.6	H_8	6.0	5.6
		Otni	30–65	161.9	H_8	5.5	5.3
		D	< 65	87.0	–	6.2	5.7
Fens at decession stage							
3	Olszynka Markowa 1	Mtni	0–20	251.7	–	5.7	5.2
		Aa	20–35	103.6	H_8	5.8	5.1
		Aa	35–55	101.4	–	5.8	5.0
		D	55–80	33.6	–	6.0	5.1
4	Mokry Kozub 2	Mtni	0–16	233.5	–	4.6	3.9
		Otni	16–36	181.9	H_8	5.9	5.2
		Otni	36–55	260.7	H_8	5.9	5.6
		Otni	55–75	220.1	H_8	5.9	5.2
5	Cyrhlańska droga	Mtni	0–7	160.6	–	4.4	3.7
		Aa	7–18	114.0	–	5.0	4.1
		D	> 18	4.5	–	5.7	4.3
6	Olszynka Markowa 2	Mtni	0–25	100.6	–	5.2	4.4
		Aa	25–40	71.0	–	6.4	5.7
		D	< 40	16.8	–	6.6	5.1
7	Rybna rampa	Aa	0–15	33.5	–	5.8	4.4
		Agg	15–45	23.0	–	5.7	4.6
		ADgg	> 45	8.0	–	6.0	4.5

Most of the discussed *Caltho-Alnetum* associations from the area of the present Babiogorski National Park were drained in the seventies in order to increase forest productivity. The reclamation was realized by means of drainage ditches crossing the fen

surface. A similar drainage system was used also on the second group of fens with transformed water-air relationships (profiles 3–7), (Table 1). The depth of drainage ditches in these habitats was diverse and ranged from 0.3 to 0.9 m depending on the thickness of accumulated organic matter and the depth on which the mineral substratum, from which the discussed soil developed, was found. Depending on the surface of the drained fens and the physiographic conditions of the terrain on which they were dug, the spacing between the drainage ditches was between several and several dozens of meters. A dense and relatively deep network of the ditches draining water from the fens led to a decline of their groundwater level from 0.2 to about 0.75 m. Because the discussed habitats occur on slope locations, considerable velocity of water flow drained by the drainage ditches did not allow for their overgrowing and silting. Even after several dozen years these ditches drain considerable amounts of water, particularly during heavy rain, contributing to further degradation of these habitats.

Lowering the groundwater level caused inhibition of organic matter accumulation to the decession stage (profiles 3–7). The consequence of the groundwater level lowering in these profile was a change of pedogenic process direction. The moorshing process was in progress in the surface horizons of 3–7 profiles. The intensity of moorshing process in the soils of the analyzed habitats was diversified within each habitat and depended on the depth of drainage ditches, distance from them, area layout and yield of fen feeding springs. The highest intensity of the moorshing process was detected in each of the drained habitats, in places situated closest to the deepest drainage ditches, on the slopes with greatest inclination, fed with underground waters outflow of small capacity. Lower contents of organic carbon were determined in the soils of the *Caltho-Alnetum* associations which were involved in the moorshing process, in comparison with the soil at the stage of organic matter accumulation. It may be explained by an increased oxygenation of soil profiles caused by a lowering of the groundwater level, which stimulated the process of organic matter mineralization.

Fen soils which were drained revealed lower pH values in their surface horizons in comparison with fen soils in which the peat-forming process of organic matter accumulation was occurring under conditions of high moisture (Table 1). Lower pH values in the surface horizons of drained fens may be explained by a lowering of the groundwater level containing Ca^{2+} and Mg^{2+} ions, which reduced the possibility of neutralizing acid products of organic matter decomposition.

A change of essential chemical and physical properties of soils and waters of the *Caltho-Alnetum* associations caused by lowering the groundwater level influenced a change of habitat conditions leading to their degradation. A change of habitat conditions may threaten the occurrence in these habitats of many stenotypic animal and plant species, which are characterized by a very narrow tolerance range.

One of the measures for reducing degradation of *Caltho-Alnetum* is raising the groundwater level in the previously drained soil patches under grey alder. As has been demonstrated by the research conducted in the lowland areas, rising the groundwater level may restore the natural direction of plant succession in these areas [6, 7]. This process occurs slowly and should be monitored with respect to the most important properties of soils and waters determining the relationship between the vegetation and the habitat.

Conclusions

1. Reclamation of *Caltho-Alnetum* associations conducted in the seventies caused passing of these habitat soils from the accumulation stage to decession stage, at which the moorshing process occurred.

2. Due to the location of the of reclaimed habitats on slopes, sometimes with several degrees inclination, considerable water velocity drained by the drainage ditches prevented their overgrowing and silting.

3. The intensity of the moorshing process which occurred in the drained habitat soils depended on their distance from drainage ditches, their depth and capacity of underground water outflow feeding the fens.

4. Raising the groundwater level in *Caltho-Alnetum* associations through filling the drainage ditches might limit the degradation of these valuable habitats.

5. Elaborating methods of renaturization of *Caltho-Alnetum* associations requires further, detailed habitat research comprising the properties of soils and waters and their relationship between vegetation and the habitat.

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Abstrakt: Siedliska bagiennej olszyny górskiej należą do siedlisk priorytetowych wymienionych w załączniku I Dyrektywy Siedliskowej Unii Europejskiej. Większość tych siedlisk z obecnego terenu Babiogórskiego Parku Narodowego została zmeliorowana w latach siedemdziesiątych. W ramach badań porównano podstawowe właściwości gleb i wód siedlisk bagiennej olszyny górskiej, które w latach siedemdziesiątych zostały odwodnione, z analogicznymi właściwościami siedlisk w małym stopniu przekształconych przez czynniki antropogenne. Badania wykazały duży wpływ melioracji przeprowadzonych w latach siedemdziesiątych na takie parametry gleb, jak zawartość węgla organicznego i popielność, stopień rozkładu materii organicznej, stopień murszenia oraz poziom wód gruntowych.

Słowa kluczowe: olszyna bagienna, młaki, gleby organiczne, mokradła