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PHYTOCOENOTIC AND FLORISTIC DIFFERENTIATION AMONG THE CHOSEN LAKE – BOG ECOSYSTEMS OF THE WIELKOPOLSKA REGION

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A b s t r a c t: There are about 15 systems composed of lakes and bogs in the Wielkopolska region. Most of them are protected as strict reserves due to their unique habitat and floristic characteristics modified by two different processes to they undergo: eutrophication and dystrophication in a specific, dynamic equilibrium. The study reported aimed at a phytocoenotic and floristic comparative analysis of four mid-forest lake-bog ecological systems localized in different mesoregions of the Wielkopolskie Lakeland.

K e y w o r d s: bog, macrophytes, phytocoenoses, biodiversity, humic and eutrophic lakes

INTRODUCTION

Ecological systems composed of lakes and bogs belong to the rarest features of the lakeland landscape of the Wielkopolska region (mid-western part of Poland). There are about 15 ecosystems of this kind from amongst which only a few systems have not been regarded as worth protecting. Most of them are protected as strict reserves due to their unique habitat and floristic characteristics. However, their functioning in the Wielkopolska Region is modified by two different processes they undergo: eutrophication and dystrophication in a specific, dynamic equilibrium [2] which originate from a direct drainage basin such as acidic forest ecosystems and bogs. Interrelations in the "lake – drainage basin" ecological system are considered to be the most important mechanisms which initiate and stabilize such systems on one hand, and influence their changes in time, on the other [12].

The study reported aimed at a phytocoenotic and floristic comparative analysis of four mid-forest lake-bog ecological systems localized in different mesoregions

of the Wielkopolska Lakeland macroregion. The authors undertook recognition the ecological status of the systems studied against the background of data from literature.

STUDY AREA AND METHODS

The study reported was carried out in the years 1998-2001. The "lake-bog" systems studied belonged to the Wielkopolska Lakeland macroregion and three mesoregions [4]: the Gnieźnieńskie Lakeland: the Lakes Czarne Małe and Czarne Duże protected as strict reserves within the Zielonka Primeforest Landscape Park, the Poznańskie Lakeland – the Skrzynka Lake localized in the area of strict protection within the Wielkopolska National Park, the Torzymska Plain – the Popien-ko Lake near Rzepin. The lakes share a kind of transition zone between their basins and forest ecosystems covering the drainage basins developed as transitional bogs with high bog species. Morphometric data from the lakes studied were given in Table 1.

Table 1. Morphometric data on the lakes studied and some chosen physico-chemical properties of the midlake water

Properties	Lakes			
	the Czarne Duże	the Czarne Małe	the Skrzynka	the Popienko
Area (ha)	6	4	2.2	7
Max. depth (m)	5.1	5	3.5	0.9
Secchi disc (m)	1	2	0.6	0.9
Temp. of water	21.8	20.5	23.8	21.2
O_2 (mg l^{-1})	6.5	5.9	5	5.6
pH	7.7	7.6	7.1	8.01
Conductivity ($\mu S\ cm^{-1}$)	710	552	115	192
N-NH_4 (mg N/l)	0.01	0.19	0.07	0.16
N-NO_3 (mg N/l)	0.3	0.1	0.2	0.1
P-PO_4 (mg PO_4/l)	0.0	0.0	0.0	0.14

Plant associations of the lakes and bogs vegetation were distinguished with the use of mid-European methods by Braun-Blanquet. In the case of the Skrzynka Lake authors' own observations (summer 2001) together with literature data by Pełechaty and Nagengast [8], Nagengast and Pełechaty [6] were used. Syntaxonomical system, evaluation of syntaxon degree of natural character based on syngenesis and vulnerability by Brzeg and Wojterska [1] was applied. The nomenclature of vascular plant was given further to a checklist by Mirek *et al.* [5]. Charophytes names followed Dąmbska [3].

In July 2001, water samples were collected from the mid-lake part of each lake for chemical analyses of the mineral forms of nutrients and dissolved oxygen . During field investigations, physical determinations were also performed. Conductivity, pH, temperature and SD were taken into account. Nutrients were determined by the use of HACH DR 2010 analyser, conductivity and dissolved oxygen was determined by Elmetron CX-742 multifunction analyser and pH by Fisherbrand's Hydorus 100.

RESULTS

The results of physico-chemical analyses revealed no clear differences among the lakes studied (Table 1). Differences among them as far as conductivity and SD values were considered were more pronounced. Lower values of conductivity were noted in the Skrzynka Lake and the Popienko, whereas in other lakes conductivity was visibly higher. On the other hand, SD values proved better visibility in the Czarne Małe and Czarne Duże Lakes. Inconsistently with expectations, pH values were close to indifferent with an exception of the Popienko Lake. Higher values of ammonia nitrogen were noted in the Czarne Małe and Popienko Lakes than in the remaining lakes. In the same lakes, low values of nitrate nitrogen were found.

Phytosociological analyses revealed the presence of 49 associations belonging to 7 classes. Phytocoenotic composition of particular lakes was presented in Table 2. As could be seen from this table, all lakes studied differed from one another in the number of association classes taken into account, total number of communities found in individual lakes ranged from 13 to 21 and was similar in 3 out of 4 lakes. The highest qualitative phytocoenotic diversity was found in the Popienko Lake (phytocoenoses of 21 associations). Whereas, in the Skrzynka Lake the lowest number of association and classes was found. In this latter lake, communities representing *Charetea, Lemnetea minoris* and *Littorelletea uniflorae* classes were not observed, whereas in the rest of the lakes, they were found. It seems noteworthy to underline that in the Skrzynka Lake macrophytic vegetation was poor in the helophyte communities. On the other hand, in the Skrzynka Lake and the Popienko Lake more communities belonging to *Scheuchzerio-Caricetea fuscae* class were represented than in the Czarne Duże and Czarne Małe Lakes. In both latter lakes no charophyte communities were found. As specific feature of the macrophytic vegetation differentiating the Czarne Małe and Czarne Duże Lakes from the Skrzynka and Popienko Lakes were phytocoenoses of *Cladietum marisci* which dominated with *Typhetum angustifoliae* patches in the helophytic zone and formed the character of the emergenting vegetation.

Table 2. Syntaxonomical composition of vegetation of the lakes under study

Communities	Lakes			
	Czarne Duże	Czarne Małe	Po-pienko	Skrzynka
Kl. *Phragmitetea australis* Tx. et Prsg. 1942				
Scirpetum lacustris (Allorge 1922) Chouard 1924	+	+	+	+
Phragmitetum communis (Koch 1926) Schmale 1939	+	+	+	+
Thelypterido-Phragmitetum Kuiper 1957	+	+	+	+
Caricetum rostratae Rübel 1912 ex Osvalg 1923	+	+	-	+
Typhetum angustifoliae Soó 1927 ex Pignatti 1953	+	+	+	-
Cicuto-Caricetum pseudocyperi Boer et Siss. in Boer 1942	+	+	+	-
Typhetum latifoliae Soó 1927 ex Lang 1973	-	-	+	+
Cladietum marisci (Allorge *1922) Zobr. 1935*	+	+	-	-
Caricetum paniculatae Wang. 1916 ex Roch. 1951	+	-	-	-
Equisetetum fluviatillis Steff. 1931	+	-	-	-
Acoretum calami Eggler 1933 ex Kob. 1948	+	-	-	-
Caricetum ripariae Soó 1928	-	+	-	-
Community built by Eleocharis uniglumis (Link) Schult.	-	+	-	-
Caricetum acutiformis Eggler 1933	-	-	+	-
Eleocharitetum palustris Schennikov 1919 ex Ubrizsy 1948	-	-	+	-
Caricetum elatae W. Koch 1926	-	-	-	+
Kl. *Potametea* Tx. et Prsg. 1942 ex Oberd. 1957				
Potametum natantis Soó 1927 ex Tomaszewicz et Podbielkowski 1978	-	+	+	+
Nymphaeo albae-Nupharetum luteae Nowiński 1928	+	+	+	+
Myriophylletum verticillati Gaudet 1924	+	+	-	-
Nymphaetum albo-cadidae (Hejny 1950) Pass. 1957	-	-	+	-
Myriophylletum spicati Soó 1927 ex Podbielkowski et Tomaszewicz 1978	-	-	+	-
Polygonetum natantis Soó 1927 ex Brzeg et M. Wojterska 2001	-	-	-	+
Kl. *Charetea* Fuk. 1961 Krausch 1964				
Charetum contrariae Corillion 1957	+	+	-	-
Charetum tomentosae Corillion 1957	-	+	-	-
Charetum intermediae (Corillion 1957) Fijałkowski 1960	-	+	-	-
Kl. *Lemnetea minoris* de Bolós et Masclans 1955				
Lemno-Hydrocharitetum morsus-ranae (Oberd. 1957) Pass. 1978	-	+	+	-
Lemno-Spirodeletum polyrrhizae Koch 1954 ex Müller et Görs 1960	+	-	-	-
Lemno-Utricularietum vulgaris Soó 1928 ex 1947	+	-	-	-
Kl. *Litorelletea uniflorae* Br. - Bl. et Tx. 1943				
Sparganietum minimi Schaaf 1925	+	+	+	-
Community built by Utricularia minor L.	+	+	+	-
Littorello-Eleocharitetum acicularis (Baum. 1911) Jouanne 1925	+	-	-	-

Table 2. Continued

Communities	Lakes			
	Czarne Duże	Czarne Małe	Po-pienko	Skrzynka
Kl. *Scheuchzerio-Caricetea fuscae* (Nordhagen 1936) R. Tx. 1937				
Sphagno recurvi-Eriophoretum angustifolii Hueck 1925	+	+	+	+
Sphagno apiculati-Caricetum rostratae Osvald 1923 em. Steffen 1931	-	-	+	+
Scorpidio-Caricetum diandrae Osvald 1923 em Jonas 1923	-	-	+	+
Caricetum lasiocarpae Osvald 1923	-	-	-	+
Sphagno-Juncetum effusi Dzubałkowski 1928	-	-	+	-
Kl. Oxycocco-Sphagnetea Br.-Bl. et R. Tx 1943				
Ledo-Sphagnetum magelanici Sukopp 1959 ex Neuhäusl 1969	-	-	+	-
Total number of classess	6	6	6	3
Total number of communities	19	19	21	13
Natural communities	2	4	4	1
Natural auxochoris communities	7	6	6	6
Natural perdochoric communities	8	7	10	6
Xenospontaneous communities	1	-	-	-

Taking syngenesis and coenogenesis of associations into consideration (Table 2), a natural character of vegetation in the lakes studied with a significant share of natural perdochoric and auxochoris communities, especially in the Popienko Lake have can be stated. There was only one anthropogenically induced xenospontaneous association found in the Czarne Duże Lake.

CONCLUSIONS AND DISCUSSION

The lake-bog ecological systems presented above do not possess any typical dystrophic features although such properties might be expected due to the type of their direct drainage basins. However, the other kind of influences such systems are supposed to be subjected to in the Wielkopolska region [2], i.e., eutrophication, is also reflected to a limited extent (e.g., the presence of large areas of eutrophic macrophytes in the boggy habitats). The most probable factor determining vegetation character of all lakes studied might be morphometry. The highest number of association and also phytocoenotic diversity understood as comparable share of all associations to the area of phytolittoral were observed in the shallowest the Popienko Lake. The most significant share of natural perdochoric associations in

this lake can be regarded as resulting from such phytocoenotic diversity stabilizing the lake's ecological status by the clear water effect [9 after 7]. Another shallow the Skrzynka Lake revealed some features implying its dystrophic character (e.g. an area of a direct boggy drainage in relation to the surface area of the water body). However, transitional character of the peat-bog surrounding the lake and covering its riparian parts with floating mats as well as its neutral pH and an increasing level of nutrients do not allow its classification in the group of distrophic reservoirs [2,10]. In the case of the Czarne Duże and Czarne Małe Lakes the occurrence of charophytes represented by *Chara aculeolata* Kütz., *Ch. tomentosa* L. and *Ch. contraria* Kütz. as well as patches of *Cladium mariscus* (L.) Pohl did not reflect the external influences expected. Moreover, in all lakes studied, influences of water bodies on the floristic composition of bogs was noted e.g., *Phragmites autralis* (Cav.) Trin. ex Steud. or *Schoenoplectus tabernaemontani* (C.C. Gmel.). Palla building communities with mosses which were difficult to classify.

REFERENCES

1. **Brzeg A., Wojterska M.:** Plant Communities of Wielkopolska. Their knowledge and hazards (in Polish). Przewodnik sesji terenowych 52. Zjazdu PTB, 24-28 września 2001 (Red.: M. Wojterska). 39-110, 2001.
2. **Burchardt L., Kokociński M., Machowiak Bennett D., Messyasz B., Nagengast B., Owsianny P. M., Pełechaty M.:** Do the changes in phytoplankton community reflect the changes which take place in the littoral (1929-1998) of lake Skrzynka (Wielkopolski National Park) (in Polish). In: Freshwater ecotones – structure, types and functioning (Ed.: S. Radwan). Wyd. UMCS, Lublin, 257-262, 1998.
3. **Dąmbska I.:** *Charophyta* - Charophytes (in Polish). In: Freshwater Flora of Poland (Ed K. Starmach). PWN, Warszawa-Kraków, 1964.
4. **Kondracki J.:** Geography of Poland. Physico-geographical mesoregions (in Polish). Wyd. Nauk. PWN, Warszawa, 1994.
5. **Mirek Z., Pięknoś-Mirkowa H., Zając A., Zając M.:** Vascular Plants of Poland. A Checklist. Polish Bot. Studies, Guidebook Series, 15. Instytut Botaniki PAN, Kraków. 1995.
6. **Nagengast B., Pełechaty M.:** The hydrobotanical characteristics of water reservoirs of the Wielkopolski National Park and its protective zone (in Polish). In: Aquatic ecosystems of the Wielkopolski National Park (Ed.: L. Burchardt). Wyd. Nauk. UAM, Poznań, Biological Series 66, 29-40, 2001.
7. **Olrik K.:** Shallow lakes protection in Denmark (in Polish). In: Protection and recultivation of lakes (Eds: A. Giziński, S. Burak). IV International Scientific-Technical Conference, Przysiek 2000, 41-56, 2000.
8. **Pełechaty M., Nagengast B.:** The estimate of quality of water and substrate habitats present in the lakes of the Wielkopolski National Park according to the presence of definite water and emerged plants associations (in Polish). Przegląd Przyrodniczy, IX, 1/2, 235-238, 1998.
9. **Sheffer M.:** Ecology of Shallow Lakes. In: Population and Community Biology (Red.: M.B. Usher). Series 22. Chapmann & Hall. Series 22, 357, 1998.

10. **Siepak J., Burchardt L., Pełechaty M., Osowski A.:** Hydrochemical investigations on the area of the Wielkopolski National Park. Outline of investigations 1948-1998 (in Polish) UAM, Poznań, 1999.
11. **Szyper H., Romanowicz W., Gołdyn R.:** External threats to the Wielkopolska National Park lakes (in Polish). In: Aquatic ecosystems of the Wielkopolski National Park (Ed.: L. Burchardt). Wyd. Nauk. UAM, Poznań, Biological Series, 66, 427-427, 2001.

FITOCENOTYCZNE I FLORYSTYCZNE ZRÓŻNICOWANIE WYBRANYCH EKOSYSTEMÓW WODNO-TORFOWISKOWYCH WIELKOPOLSKI

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S t r e s z c z e n i e. Artykuł przedstawia określony na podstawie składu syntaksonomicznego roślinności status ekologiczny 4 ekosystemów jeziorno-torfowiskowych z 3 mezoregionów Pojezierzy Wielkopolski: Pojezierza Gnieźnieńskiego - Jezioro Czarne Duże i Jezioro Czarne Małe, Pojezierza Poznańskiego – Jezioro Skrzynka i Równiny Torzymskiej - Jezioro Popienko.

Ekosystemy te charakteryzują się specyficzną roślinnością, której wykształcenie modelowane jest wypadkową procesów dystrofizacji i eutrofizacji.

Na badanym terenie zidentyfikowano 49 zbiorowisk z 7 klas. Największą różnorodnością fitocenotyczną charakteryzuje się Jezioro Popienko, natomiast najmniejszą Jezioro Skrzynka, w którym nie stwierdzono zbiorowisk z klas *Charetea, Lemnetea minoris* i *Littorelletea uniflorae*. Jezioro Skrzynka wykazywało najbardziej dystroficzny charakter ze względu na duży udział zbiorowisk torfowiskowych tworzących pło otaczające jezioro oraz niewielki udział zbiorowisk szuwarowych. Specyficzną roślinnością charakteryzują się jeziora: Czarne Duże i Czarne Małe ze względu na obecność zbiorowisk unikających zakwaszenia – *Cladietum marisci* i łąk ramienicowych.

S ł o w a k l u c z o w e: torfowisko, makrofity, zbiorowiska, różnorodność, humusowe, eutroficzne jeziora