ACTA AGROBOTANICA
Vol. 67 (3), 2014: 29–38
Original Research Paper
DOI: 10.5586/aa.2014.031

# THE VASCULAR PLANT SPECIES OF THE KRUGŁE BAGNO AQUATIC PEATLAND COMPLEX (ŁĘCZNA – WŁODAWA LAKELAND)

**Barbara Banach, Magdalena Pogorzelec, Artur Serafin, Agnieszka Szczurowska, Alicja Buczek**

University of Life Sciences in Lublin, Department of General Ecology
Leszczynskiego 58, 20-068 Lublin, Poland
e-mail: barbara.banach@up.lublin.pl

Received: 25.10.2013

A b s t r a c t

This paper presents the richness of vascular plant species of the Krugłe Bagno aquatic peatland complex and its structure.

A field study was carried out in the growing seasons of 2008–2010.

The aim of the study was to determine the species richness of the flora and its characteristics as well as to document changes in its composition taking place in successive years of the study.

Based on the obtained results, it can be concluded that the stability of the qualitative and quantitative structure of the phytocoenoses and abiotic environmental factors bodes well for the maintenance of this aquatic peatland complex in good condition. However, due to the specificity of its species composition (a large proportion of stenobiontic species), it seems advisable to monitor regularly the biotic and abiotic conditions of this habitat.

**Key words:** vascular plant species, peatland plants, dynamic trends, Krugłe Bagno

## INTRODUCTION

Plant species composition is expressed as the number of taxa occurring in a specific area. Monitoring and conservation of biodiversity, including plant species richness, have become priority actions both in the implementation of nature conservation strategies and in the restoration of natural systems [1]. These actions cover different types of ecosystems, with special attention given to aquatic peatland habitats. Peatlands and peat pits are an important habitat for specific organisms which affect the stability of ecosystems and their biodiversity. Many peat pits, despite their anthropogenic origin, have great natural values and often deserve protection [2,3].

Stenotopic, and thus sometimes rare and protected, plant species are often associated with this type of ecosystems. Their specific abiotic requirements and low flexibility to changes in habitat conditions, on the one hand, allow them to occupy such extreme habitats, while on the other hand, small changes can cause disturbances in the functioning of their populations or even threaten their existence. The species of raised and transitional bogs are therefore a good indicator of any habitat disturbances [4]. The changes in peatland plant species composition is reflected in a reduction in the number of locations of the most sensitive taxa [5]. Research on the distribution of adventive species in wetland ecosystems in Poland has revealed that peatlands are relatively resistant to their expansion [6], although in large complexes of raised and transitional bogs significant enrichment of the flora with foreign elements is sometimes observed [7].

The aim of the study was to determine the richness of the vascular flora and its characteristics as well as to document changes in its composition taking place in successive years of the study.

## MATERIALS AND METHODS

The research site of this study was the Krugłe Bagno aquatic peatland complex located in the village of Jelino in the Łęczna – Włodawa Lakeland, south-eastern Poland. The present study covered the area of an open peat bog formed on the edges of overgrown pits left after peat extraction. It is a Site of Community Importance – SCI Jelino (PLH060095) – due to

the occurrence of endangered fish species *Eupallasella percnurus* (Pall.). Krugłe Bagno is located in the south-western part of the Łęczna – Włodawa Lakeland, in the buffer zone of the Polesie National Park (N 51° 25' 29", E 23° 02' 14'') . This is a grouping of several small peat pits, characterized by an irregular bankline and surrounded by raised and transitional bogs which were created as a result of peat extraction at the beginning of the 20th century. Since then, they have been significantly overgrown with sphagnum mats. These are water bodies with an average depth of 0.6 m, a maximum depth of 1.5 m, and an area of up to 0.8 ha. The catchment of the study area includes forests and agricultural land [8,9].

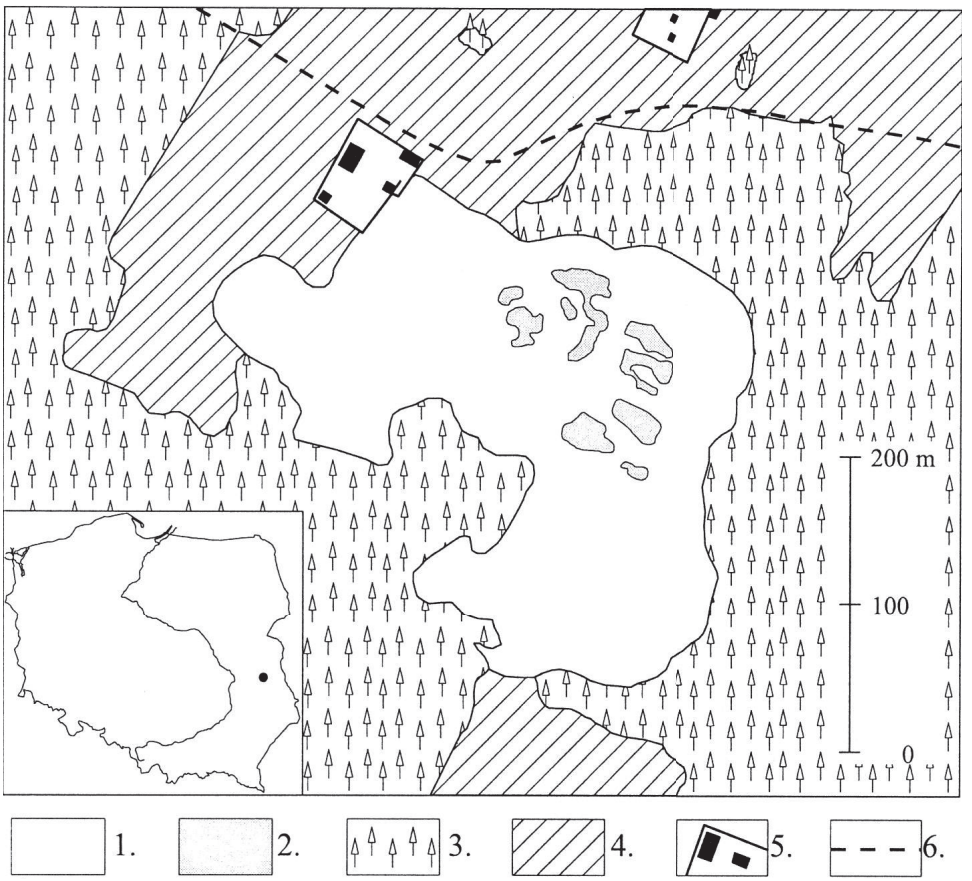


Fig. 1. Krugłe Bagno aquatic peatland complex location and its surroundings [8] (1 – peatbog; 2 – post-excavation peat pools; 3 – forest; 4 – fields and meadows; 5 – buildings; 6 – roads)

The vascular plant species of the Krugłe Bagno aquatic peatland complex were the object of the study. A field study was carried out in the growing seasons of 2008–2010.

An inventory was made of all vascular plant species found in the entire area of the peat bog, taking into account species cover-abundance expressed as the degree of cover and using the Braun-Blanquet scale (with a modification). The degrees of cover for each species were used to calculate weighted mean values to determine habitat conditions existing in the study area. Botanical nomenclature followed Mirek et al. [10]. Syntaxonomic nomenclature followed Matuszkiewicz [11]. The following features were analysed: the biomorphological structure of the species composition according to Raunkiaer [12], the taxonomic and syntaxonomic structure at the class level following Matuszkiewicz [11], the historical-geographical structure and geographical elements of the flora following Chmiel [13].

In analyzing the taxonomical data, the flora systematic diversity index was used, which was based on the following formula:

$Z_S$ = the number of species + 5 x the number of genera + 25 x the number of families [14, cited after Olaczek, personal communication].

The degree of threat to the taxa was determined based on the Regulation of the Minister of the Environment of 5 January 2012 concerning plant species conservation [15] and on Zarzycki et al. [12].

The plant species composition of Krugłe Bagno was analyzed in terms of the number of locations of par-

ticular species in Poland as well as their dynamic trends over the last decades according to Zarzycki et al. [12]. Based on the weighted mean values of some indicators of Zarzycki et al. [12] (light and temperature, soil moisture content, trophic state and soil acidity), habitat conditions existing in the study area were determined. Three times a year, *in situ* measurements were made of groundwater pH (using a field pH-meter) and of electrolytic conductivity (using a field conductometer).

# RESULTS

## Species richness and taxonomic structure

Within the entire area of the Krugłe Bagno aquatic peatland complex, the occurrence of 25 vascular plant species was recorded and they represented 19 genera belonging to 16 plant families (Table 1).

Table 1
Species richness of Krugłe Bagno and its changes in 1997–2010

| Plant families | Vascular plant species | Krugłe Bagno 2008–2010 (own research) | Krugłe Bagno 1997–1998 [16] |
|---|---|---|---|
| Pinaceae | *Pinus sylvestris* L. | + | + |
| Araceae | *Calla palustris* L. | + | + |
| Potamogetonaceae | *Potamogeton natans* L. | + | |
| Typhaceae | *Typha angustifolia* L. | + | |
| | *Typha latifolia* L. | + | + |
| Juncaceae | *Juncus conglomeratus* L. | + | |
| | *Juncus effusus* L. | + | + |
| Cyperaceae | *Carex canescens* L. | | + |
| | *Carex nigra* Reichard | + | + |
| | *Carex rostrata* Stokes | + | + |
| | *Carex vulpina* L. | + | |
| | *Eriophorum angustifolium* Honck. | | + |
| | *Eriophorum vaginatum* L. | + | + |
| | *Eleocharis palustris* (L.) Roem. & Schult. | | + |
| Droseraceae | *Drosera rotundifolia* L. | + | |
| Rosaceae | *Comarum palustre* L. | + | + |
| Rhamnaceae | *Frangula alnus* Mill. | + | |
| Fagaceae | *Quercus robur* L. | + | |
| Betulaceae | *Betula pendula* Roth | + | + |
| | *Betula pubescens* Ehrh. | + | |
| Lentibulariaceae | *Utricularia minor* L. | + | |
| Primulaceae | *Lysimachia thyrsiflora* L. | + | + |
| | *Lysimachia vulgaris* L. | + | + |
| Ericaceae | *Andromeda polifolia* L. | + | |
| | *Ledum palustre* L. | + | |
| | *Oxycoccus palustris* Pers. | + | + |
| Menyanthacae | *Menyanthes trifoliata* L. | + | |
| Asteraceae | *Bidens tripartita* L. | + | |

The flora systematic diversity index was constant and it was 520 throughout the study period.

The Cyperaceae (4 species) and Ericaceae (3 species) plant families were represented by the most plant species.

## Biomorphological structure of the species composition

In the plant species composition of the Krugłe Bagno peatland complex, a predominance of two groups of plant biomorphological forms can be clearly

seen, notably hemicryptophytes (31%, 10 taxa) and hydrophytes (24%, 8 taxa). Only one species was included in the groups of therophytes (*Bidens tripartita*) and herbaceous chamaephytes (*Comarum palustre*; Fig. 2)

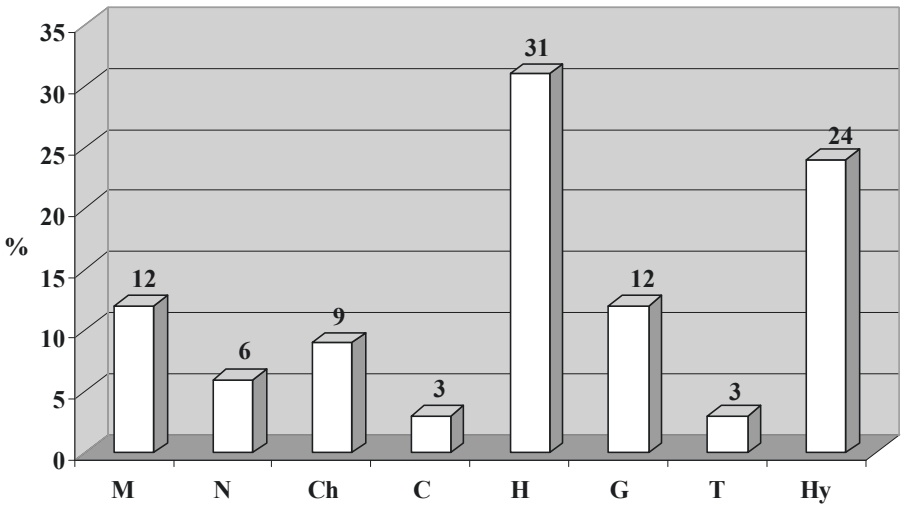


Fig. 2. Percentage of biomorphological forms in the Krugłe Bagno plant species composition
Explanation: M – megaphanerophytes; N – nanophanerophytes; Ch – woody chamaephytes; C – herbaceous chamaephytes; H – hemicryptophytes; G – geophytes; T – therophytes; Hy – hydrophytes

## Syntaxonomic structure

The vegetation found in the Krugłe Bagno bog showed a diverse syntaxonomic structure. The taxa currently present in the study area represented 8 classes. Rush plants of the class *Phragmitetea* (5 taxa), peatland plants of the class *Oxycocco-Sphagnetea* (4 taxa), and species of the classes *Molinio-Arrhenatheretea* and *Scheuchzerio-Caricetea nigrae* (3 taxa each) had the highest percentage contribution (Fig. 3).

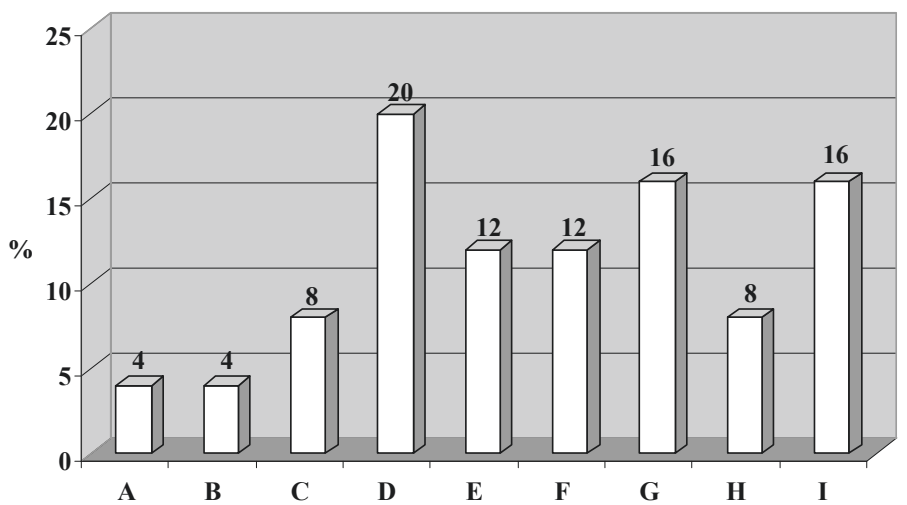


Fig. 3. Syntaxonomic structure of the Krugłe Bagno vegetation
Explanation: species characteristic of the following classes: A – *Bidentetea tripartite*; B – *Epilobietea angustifolii*; C – *Potametea*; D – *Phragmitetea*; E – *Molinio-Arrhenatheretea*; F – *Scheuchzerio-Caricetea nigrae*; G – *Oxycocco-Sphagnetea*; H – *Vaccinio-Piceetea*; I – companion species

## Historical-geographical structure

Only and exclusively native species were found to occur in the plant species composition of the investigated area and hence spontaneophytes accounted for 100% of the plant species. Among them, non-synanthropic spontaneophytes constituted 76% (19 species), while apophytes, being members of synanthropic native plant species, accounted for 24% (6 species).

## Rare and protected species

The presence of 5 species legally protected under the Regulation of the Minister of Environment [15] was recorded among all vascular plant taxa found in the study area. These were *Drosera rotundifolia*, *Ledum palustre* and *Utricularia minor*, which are fully protected species, as well as *Frangula alnus* and *Menyanthes trifoliate*, which are partially protected. At the same time, Zarzycki et al. [12] included *Drosera rotundifolia* and *Utricularia minor* in endangered species.

Taxa that have a large number of locations in Poland predominated in the species composition of the phytocoenosis of the studied peat bog (Fig. 4). A major part of these species have been observed to show a large decline in the number of locations or a decrease in population numbers in our country (Fig. 5).

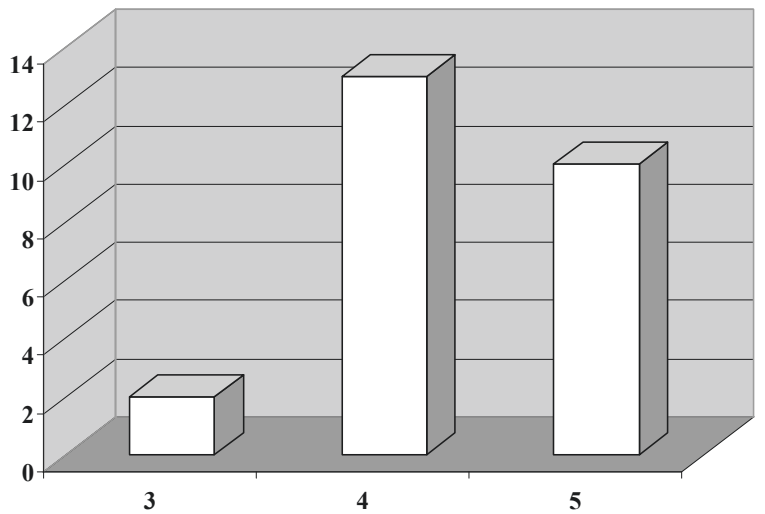


Fig. 4. Contribution of plant species to the Krugłe Bagno plant species composition with a different number of sites in Poland
Explanation: 3 – large number of sites, mainly in one region; 4 – large number of sites in many regions; 5 – common across Poland

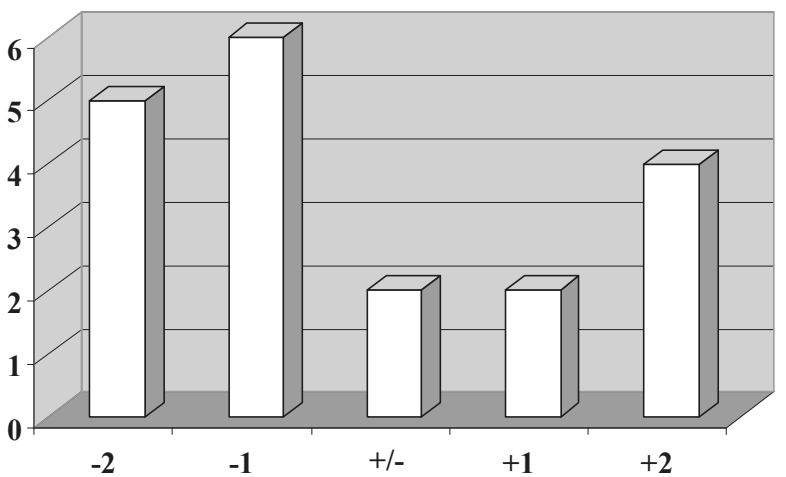


Fig. 5. Contribution of plant species to the Krugłe Bagno plant species composition with different dynamics of occupying new sites in Poland over the last decades
Explanation: -2 – large decrease in the number of sites; -1 – decrease in the number of sites or reduction in the number of individuals; +/- – disappearance of sites and appearance of new ones in balance; +1 – increase in the number of sites, marked increase in the number of individuals at sites; +2 – large increase and occupation of new sites

## Habitat conditions

A decisive majority of plant species found in the study area preferred moderate light conditions (84 %). Few preferred semi-shade or light, but these were taxa of wider ecological tolerance.

The analysis of the temperature indicator values showed that a high percentage of species preferred

moderately cool (44%) or moderately warm (43%) climatic conditions.

Based on the habitat preferences of the species determined on the basis of the indicator properties of plants according to Zarzycki et al. [12], it can be said that the plant species of Krugłe Bagna is predominantly composed of wet habitat species (57%) and moist habitat species (23%; Fig. 8) which prefer soils moderately poor (34%) or poor in biogenic elements (27%; Fig. 9) and which are primarily found in soils with acidic pH (pH 4 ≤ pH < 5; 25%) to moderately acidic pH (5 ≤ pH < 6; 28%) to neutral pH (6 ≤ pH < 7; 25%; Fig. 6).

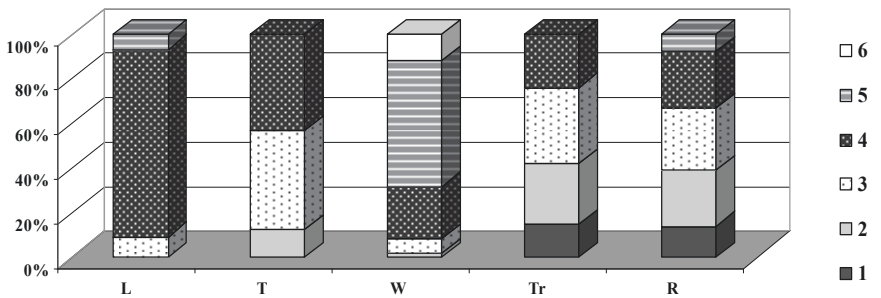


Fig. 6. Percentage of plant species with different habitat preferences in the Krugłe Bagno plant species composition according to ecological indicator values following Zarzycki et al. [12]

Explanation: L – light value (3 – semi-shade, 4 –moderate light, 5 –full light); T – temperature value (2 –moderately cold areas, 3 –moderately cool climatic conditions, 4 –moderately warm climatic conditions); W – soil moisture content value (2 –dry, 3 – fresh, 4 – moist, 5 –wet, 6 – aquatic); Tr – trophic state value (1 – extremely poor soil (water), extremely oligotrophic, 2 – poor soil (water), oligotrophic, 3 –moderately poor soil (water), mesotrophic, 4 – rich soil (water), eutrophic); R – soil (water) acidity value (1 –highly acidic soils, pH <4; 2 – acidic soils, pH 4 ≤ pH < 5; 3 – moderately acidic soils, 5 ≤ pH < 6; 4 – neutral soils, 6 ≤ pH < 7; 5 – alkaline soils, pH > 7)

In the studied peat bog, the groundwater was acidic. In all years of the study, the mean water pH ranged from 5.21 to 5.31 in spring, 4.41 to 4.43 in summer, while in autumn these values were from 4.26 to 4.29. The mean electrolytic conductivity ranged from 50.6 to 61.3 in spring, 58.7 to 84.9 in summer, while in autumn from 42.3 to 48.7 μS × $cm^{-1}$ (Table 2).

Table 2
Descriptive statistics of some groundwater parameters in the Krugłe Bagno peat bog

| | Acidity (pH) | EC (μS × $cm^{-1}$) | Acidity (pH) | EC (μS × $cm^{-1}$) | Acidity (pH) | EC (μS × $cm^{-1}$) |
|---|---|---|---|---|---|---|
| Season | Spring | | Summer | | Autumn | |
| | | | 2008 | | | |
| Mean | 5.31 | 53.6 | 4.43 | 84.9 | 4.26 | 42.5 |
| SD | 0.79 | 20.2 | 0.38 | 23.7 | 0.38 | 13.2 |
| Max | 6.57 | 105 | 5.19 | 120 | 4.99 | 65.0 |
| Min | 4.52 | 32.0 | 3.92 | 46.0 | 3.82 | 25.0 |
| Median | 4.89 | 50.5 | 4.42 | 91.5 | 4.32 | 33.8 |
| | | | 2009 | | | |
| Mean | 5.21 | 50.6 | 4.41 | 58.7 | 4.29 | 42.3 |
| SD | 0.83 | 22.7 | 0.35 | 17.8 | 0.32 | 11.6 |
| Max | 6.56 | 88.0 | 5.1 | 94.0 | 4.89 | 66.0 |
| Min | 4.37 | 27.0 | 3.92 | 38.0 | 3.89 | 28.0 |
| Median | 4.86 | 44.0 | 4.47 | 57.0 | 4.40 | 42.0 |
| | | | 2010 | | | |
| Mean | 5.29 | 61.3 | 4.43 | 81.0 | 4.28 | 48.7 |
| SD | 0.82 | 32.7 | 0.37 | 18.6 | 0.38 | 22.6 |
| Max | 6.58 | 120 | 5.13 | 115 | 4.93 | 102 |
| Min | 4.37 | 33.0 | 3.91 | 44.0 | 3.81 | 25.0 |
| Median | 4.88 | 43.0 | 4.52 | 80.0 | 4.42 | 42.0 |

## DISCUSSION

The species richness of vascular plants in the Krugłe Bagno peat bog is characteristic of oligotrophic aquatic wetland ecosystems of the temperate climate. At the studied site, 25 higher plant species were recorded. The species composition of the vascular plants of the peat bog remained unchanged throughout the study period. It was also similar to that observed in 1997 by Buczyński and Staniec [8]. In a floristic inventory characterizing animal habitats of Krugłe Bagno, Buczyński and Staniec [8] mentioned the occurrence of small clusters of *Hydrocharis morsusranae* L. in the water of the peat pits, but its presence was not recorded during the period 2008–2010. In 1997 and 1998 Iwaniuk [16] conducted an investigation of the Krugłe Bagno plant species composition. At that time, he recorded three taxa (*Carex canescens*, *Eleocharis palustris* and *Eriophorum angustifolium*) whose presence was not confirmed during the present study (Table 1). In 2001 Buczyński [17] recorded the presence of *Carex lasiocarpa* Ehrh., *Utricularia vulgaris* L., and *Eleocharis palustris* in the study area, but they were not found in 2008–2010. It can therefore be said that the species richness and taxonomic structure of Krugłe Bagno are characterized by relatively low stability.

In spite of the close vicinity of human settlements, the naturalness of the plant species composition is confirmed by its geographical and historical analysis. Krugłe Bagno, as a habitat of anthropogenic origin partially adjacent to land used by humans, has been colonized by native plant species characteristic of natural ecosystems. No encroachment of alien species is observed in this area.

Among 25 taxa whose presence was recorded in the Krugłe Bagno peat bog, 5 are legally protected species. Not only the number of species, but primarily the significant numbers of their populations are evidence of their good condition at the studied site. Taking into account the relatively small number of taxa found in the study area, the proportion of environmentally valuable species in the plants of Krugłe Bagno is substantial.

The species composition of the plants at the studied site was also used to determine the type of habitat. Krugłe Bagno is a peat bog of problematic classification. Species characteristic of both raised and transitional bogs are found there. Among the species recorded in Krugłe Bagno, *Oxycoccus palustris* and *Ledum palustre* are taxa characteristic of the continental stage of a raised bog [18], while *Carex rostrata* and *Menyanthes trifoliata* are considered to be peat-forming species for transitional bogs. On the other hand, *Drosera rotundifolia* is found in both types of bogs [19].

The peatland communities located in the Polesie National Park also show large variations. The close proximity of Krugłe Bagno to these ecosystems allows one to refer to the studies conducted within the Polesie National Park. When observing the transitional bogs in the Polesie National Park, it can be noticed that their characteristic feature is the presence of sphagnum mats. The Krugłe Bagno peatland complex is an area whose major part is covered by a moss and turf blanket mainly consisting of *Spagnum sp.* The acidic water pH, ranging 4–5 there, is not irrelevant, either [18]. Water pH measurements in the Krugłe Bagno peat bog made by Buczyński [8] show that its water pH is at a level characteristic of transitional bogs, with its average value of about 4.7. It is accompanied by low mineralization, which is evidence of weak decomposition of organic compounds and water stagnation. These characteristics indicate that Krugłe Bagno is a transitional bog which at the next stage of succession, after terrestrialization, will be transformed into a raised bog [18].

The analysis of published data and of the field observations in the study area do not allow the vegetation of Krugłe Bagno to be classified unambiguously. The plant species composition and vegetation pattern confirm the findings of Buczyński [8] who claimed that this bog has a mixed nature. An area of well-developed sphagnum mats overgrowing the peat pits can be classified as a transitional bog, while the higher situated areas with a large proportion of *Ledum palustre* and *Eriophorum vaginatum* as a raised bog [8].

The plant species recorded in the study area, represented by *Oxycocco-Sphagnetea* and *Phragmitetea* classes, are closely associated with high moisture content in the habitat and additionally with specific habitat requirements. The plant communities recorded in the study area (taxa of the classes *Oxycocco-Sphagnetea* and *Phragmitetea*) are closely associated with high moisture content in the habitat and additionally with specific habitat requirements. Matuszkiewicz [11] says that plant communities of the class *Oxycocco-Sphagnetea* occur in acidic oligotrophic or dystrophic habitats supplied only or mainly with rainwater. Associations of the class *Phragmitetea* are of enormous importance in the process of overgrowing water bodies [11].

The plant species composition of a habitat is strictly dependent on the abiotic environment. Thanks to the analysis of the species composition in terms of habitat preferences of particular species, habitat conditions of the studied site can be determined. The study conducted in the period 2008–2010 confirmed that the open space of the peat bog was characterized by high moisture content, this habitat was poor and extremely poor, and most species recorded there also indicated moderately acidic and acidic habitats. The waters of the peat bog were described as dystrophic by Kolejko and Sender [20]. The acidic nature of the habitat was confirmed by Buczyński and Staniec

[8] as well as by Kolejko et al. [9], and their results were close to those obtained in 2008–2010.

The stability of the qualitative structure of the phytocoenoses as well as of the abiotic environmental factors bodes well for the maintenance of this aquatic peatland ecosystem in good condition. However, due to the specificity of its plant species composition (a large proportion of stenobiontic species), it seems advisable to monitor regularly the biotic and abiotic conditions of this habitat.

## Acknowledgments

The research was supported by the project OKO/DS2 from the University of Life Sciences in Lublin, Poland.

Co-financed by National Fund
for Environmental Protection
and Water Management

## Authors' contributions

The authors have made the following declaration about their contributions: study conception and design – BB, MP, AB; acquisition of data – BB, MP, AS, ASz, AB; analysis and interpretation of data: BB, MP, AS, ASz; drafting of manuscript – BB, AB.

## REFERENCES

1. Sienkiewicz J. Koncepcje bioróżnorodności – ich wymiary i miary w świetle literatury. Ochr Śr Zasobów Nat. 2010; 45: 7–29.
2. Kucharski L. Przyrodnicze znaczenie zagłębień bezodpływowych w rolniczym krajobrazie Pojezierza Kujawskiego. Przegląd Nauk Wydz Melior Inż Śr. 1996; 10: 33–38.
3. Łachacz A. Użytki ekologiczne w Kotlinie Kurpiowskiej. Zesz Probl Post Nauk Rol. 1997; 435: 85–97.
4. Dierssen K. Peatland vegetation and the impact of man. In: Bragg OM, Hulme PD, Ingram HAP, Robertson RA, editors. Peatland ecosystems and man: an impact assessment. Dundee: Department of Biological Sciences, University of Dundee; 1992. p. 67–93.
5. Jasnowska J, Jasnowski M. Zagrożone gatunki flory torfowisk. Chrońmy Przyr Ojcz. 1977; 33(4): 5–14.
6. Pawlaczyk P. Torfowiska w obliczu zagrożeń powodowanych przez rozwój obcych gatunków inwazyjnych. In: Dajdok Z, Pawlaczyk P, editors. Inwazyjne gatunki roślin ekosystemów mokradłowych Polski. Świebodzin: Wydawnictwo Klubu Przyrodników; 2009. p. 19–20.
7. Budyś A. The synanthropisation of vascular plant flora of mires in the coastal zone (Kashubian coastal region, N Poland): range, reasons for and spatial characteristics. Łódź: Polish Botanical Society; 2008. (Monographiae botanicae; vol 98).
8. Buczyński P, Staniec B. Waloryzacja godnego ochrony torfowiska Krugłe Bagno (Pojezierze Łęczynsko-Włodawskie) w oparciu o wybrane elementy jego fauny. Rocz Nauk Pol Tow Ochr Przyr Salamandra. 1998; 2: 95–107.
9. Kolejko M, Wolnicki J, Radwan S. Preliminary studies on the occurrence of swamp-minnow Eupallasella Perenurus (Pallas 1814) in the Aquatic Ecosystems of Polesie Lubelskie (Poland). Acta Agrophys. 2006; 1(1): 395–397.
10. Mirek Z, Piękoś-Mirkowa H, Zając A, Zając M, editors. Flowering plants and pteridophytes of Poland – a checklist. Cracow: W. Szafer Institute of Botany, Polish Academy of Sciences; 2002. (Biodiversity of Poland; vol 1).
11. Matuszkiewicz W. Przewodnik do oznaczania zbiorowisk roślinnych Polski. Warsaw: Polish Scientific Publishers PWN; 2005. (vol 3).
12. Zarzycki K, Trzcińska-Tacik H, Różański W, Szeląg Z, Wołek J, Korzeniak U. Ecological indicator values of vascular plants of Poland. Cracow: W. Szafer Institute of Botany, Polish Academy of Sciences; 2002. (Biodiversity of Poland; vol 2).
13. Chmiel J. Flora roślin naczyniowych wschodniej części Pojezierza Gnieźnieńskiego i jej antropogeniczne przeobrażenia w XIX i XX wieku. Poznań: Sorus; 1993.
14. Zielińska K. The influence of roads on the species diversity of forest vascular flora in Central Poland. Biodiv Res Conserv. 2007;5–8:71–80.
15. Rozporządzenie Ministra Środowiska z dnia 5 stycznia 2012 r. w sprawie ochrony gatunkowej roślin. Dz. U. 2012 nr 0 poz. 81.
16. Iwaniuk A. Dynamika roślinności wyrobisk potorfowych [PhD thesis]. Akademia Rolnicza w Lublinie, Katedra Ekologii Ogólnej; 1999.
17. Buczyński P. Ważki (Insecta: Odonata) torfowisk wysokich i przejściowych środkowo-wschodniej Polski [PhD thesis]. Uniw. Marii Curie-Skłodowskiej, Wydział Biologii i Nauk o Ziemi; 2001.
18. Radwan S, editor. Poleski Park Narodowy: monografia przyrodnicza. Lublin: Morpol; 2002.
19. Tobolski K. Torfowiska na przykładzie Ziemi Świeckiej. Świecie: Towarzystwo Przyjaciół Dolnej Wisły; 2003.
20. Kolejko M, Sender J. Biocenotic conditions of some lake minnow habitats in the Polesie Lubelskie region. Teka Kom Ochr Kształt Śr Przyr. 2008; 5: 67–74.

## Rośliny naczyniowe kompleksu wodno-torfowiskowego Krugłe Bagno (Pojezierze Łęczyńsko-Włodawa)

Artykuł przedstawia bogactwo gatunkowe roślin naczyniowych kompleksu wodno-torfowiskowego Krugłe Bagno oraz analizę jego struktury. Badania terenowe przeprowadzono w sezonach wegetacyjnych, 2008–2010. Celem badań było określenie bogactwa gatunkowego flory oraz jej charakterystyka i udokumentowanie zmian w jej składzie w kolejnych latach badań.

W oparciu o otrzymane wyniki można stwierdzić, że stałość struktury jakościowej i ilościowej fitocenoz oraz abiotycznych czynników środowiska prognozuje zachowanie tego ekosystemu wodno-torfowiskowego w dobrej kondycji. Jednak ze względu na specyfikę flory (duży udział gatunków stenobiontycznych) celowym wydaje się stałe monitorowanie warunków biotycznych i abiotycznych siedliska.

Handling Editor: Elżbieta Weryszko-Chmielewska