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COMMUNITY STRUCTURE OF SUMMER PHYTOPLANKTON IN PEAT PITS SITUATED ON OLIGOTROPHIC QUAKING BOG „KRUGŁE BAGNO" (POLESIE LUBELSKIE, EASTERN POLAND)

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Summary. Peat pits within mesotrophic mires can serve as good example of habitats having specific or even extreme environmental conditions. The dystrophic character of its waters is related to low pH, low nutrient content and poor light climate, thus influencing the structure of phytoplankton communities. A large number of peat pits one can find in the Polesie Region, including Poleski National Park and its surroundings.The research of Polesie peat pits to date has tended to focus on botanical and faunistic studies and the knowledge about phytoplankton communities in such habitats is still scarce.

This paper will focus on the determination of the phytoplankton structure in four small peat pits situated on the mesotrophic quaking bog. The structure of phytoplankton communities in studied peat pits was typical for dystrophic lakes. In all peat pits 42 taxa of phytoplankton were determined, which have belonged to nine taxonomical groups. The most numerous (in the sense of number of taxa) were green algae (Chlorophyta) with the most numerous group of desmids which represented 36% of total number of taxa. Each site can be characterized by having rather specific flora due to the fact that the total number of taxa was higher in comparison to those determined in each peat pit. Thus it can be concluded that there was a great number of species noted sporadically, so despite similar chemical conditions of studied peat pits and its proximity some differences in phytoplankton structure was noted.

Key words: peat pits, phytoplankton, dystrophic water reservoirs

INTRODUCTION

Mining activity often leads to the degradation of the wildlife and nature environment. For example, peat exploitation, produce hollows, which after filling with groundwater form a specific water bodies called peat pits. Although they are of anthropogenic genesis (mining activity), are subject the processes of biological succession and they became a „natural" constituent of the landscape enhancing the biodiversity values. The peat pits may serve as habitats for some rare species of fish [Wolnicki *et al*. 2011], beetles [Van Duinen *et al*. 2004, Cooper *et al*. 2005] or mussels [Ożgo and Abraszewska 2009]. The diversity of some plant, like *Sphagnum*, can be enhanced in the regional scale by spontaneous colonisation of old peat pits [Soro *et al.* 1999]. Small water bodies created as an effect of limited peat exploitation can help sustain rare species by reducing the distance between favourable habitats [Chapman *et al*. 2003].

A large number of peat pits is localized in the Polesie Region (eastern Poland), including Poleski National Park and its surroundings. The peat pits situated on this area are usually very small, shallow (depth < 2 m) and old. They were formed in 19th and 20th century as an effect of hand peat exploitation [Iwaniuk 1999]. Peat pits of Poleski National Park were formed mainly within rather nutrient-poor transition mires and quaking bogs. The research of Polesie peat pits to date has tended to focus on botanical and faunistic studies [Buczyński and Staniec 1998, Sugier 2006, Sender and Mysiak 2011] and the knowledge about phytoplankton communities in such habitats is still scarce.

This paper will focus on the determination of the phytoplankton structure in four small peat pits situated on the oligotrophic quaking bog in the Polesie Lubelskie region.

MATERIAL AND METHODS

The studied peat pits are situated in the nearby of the village Jelino, near the borders of Poleski National Park and Natura 2000 Special Area of Conservation PLH060013 (23°01'51" E, 51°25'09" N). It is a stable complex of wetlands, resistant to seasonal and long term water level fluctuations [Iwaniuk 1999]. The water bodies are very small (0.01–0.09 ha) and shallow (depth < 0.9 m) [Buczyński and Staniec 1998], situated within the transition fen (forming a kind of quaking bog) of about 6.5 ha. They are alimented probably with both precipitation and groundwater. The dystrophic character of their waters offers the specific and valuable habitat for biological organisms. The large population of swamp minnow (*Rhynchocypris percnurus*) was noted there, which gave the reason to establish the Special Area of Conservation PLH060095 „Jelino" [SFD Jelino].

The research was conducted in four unnamed peat pits marked as I, II, II and IV. We have chosen these objects taking into account theirs morphometry, the state of succession and the occurrence of vascular plant communities:

– site I with open water table and irregular shape, surrounded by the quaking *Sphagnum* bog;

– site II with irregular shape, situated on the border of the quaking *Sphagnum* bog and wet coniferous forest;

– site III with *Potamogeton* sp. cover and regular rectangular shape, situated on the border of the mire and wet coniferous forest;

– site IV with irregular shape, shaded by high stands of wet coniferous forest.

Sampling and physicochemical analyses were carried out in July of 2009. The water was sampled with the plankton net (mesh size 25 μm) in the central part of each water body from the surface layer due to the shallow depth of the peat pits. The microscopic analysis were carried out both on living and preserved (Lugol solution) samples. Additionally we have determined the chlorophyll *a* concentration with ethanol method [Nusch 1980]. Water temperature, dissolved oxygen concentration, pH and electrolytic conductivity (with YSI 556 Multi Probe, MPS) were measured *in situ*. To determine the level of floristic similarity among sites, the Jaccard's coefficient was calculated with the use of MVSP 3.1 software.

RESULTS

The studied peat pits had similar (one to another) physicochemical features (Tab. 1). Water pH was acidic and ranged between 4.1 and 4.9. We have noted also similar values of dissolved oxygen concentration and electrolytic conductivity among studied pits. The more differentiated were values of chlorophyll *a* concentrations, ranged from 5.5 μg dm^{-3} in site II to 22.0 μg dm^{-3} in site IV.

Table 1. Physicochemical parameters and chlorophyll *a* concentrations in the studied peat pits

Parameters	I	II	III	IV
Temp., ^oC	24.6	25.0	25.0	24.0
pH	4.9	4.1	4.8	4.9
EC, μS cm^{-1}	23.3	23.4	20.8	25.0
O_2, mg dm^{-3}	4.1	3.8	3.9	5.8
Chl *a*, μg dm^{-3}	7.3	5.5	12.8	22.0

EC – electrolytic conductivity, O_2 – dissolved oxygen concentration, Chl *a* – chlorophyll *a* concentration

In all peat pits 42 taxa of phytoplankton were determined, which have belonged to nine taxonomical groups. The most numerous in terms of species richness were green algae (Chlorophyta), with among which desmids were 36% (Fig. 1). Nine taxa (19%) belonged to blue-greens (Cynaoprocaryota), six (12%) to diatoms (Bacillariophyceae) and four (8%) to euglenids (Euglenophyceae). A few taxa were identified from other groups (Chrysophyceae, Dinophyceae, Cryptophyceae, Raphidophyceae).

The taxonomical structure of phytoplankton communities among four studied peat pits was quite similar in the sense of dominating groups: green algae with great share of desmids predominated in all samples. In site I 22 taxa was determined with seven belonging to desmids while in site II ten out of total 12 phytoplankton taxa were determined from Conjugatophyceae. In the other two sites, greens were not so numerous: in site III we have found six taxa and in the site IV – five taxa (Fig. 2).

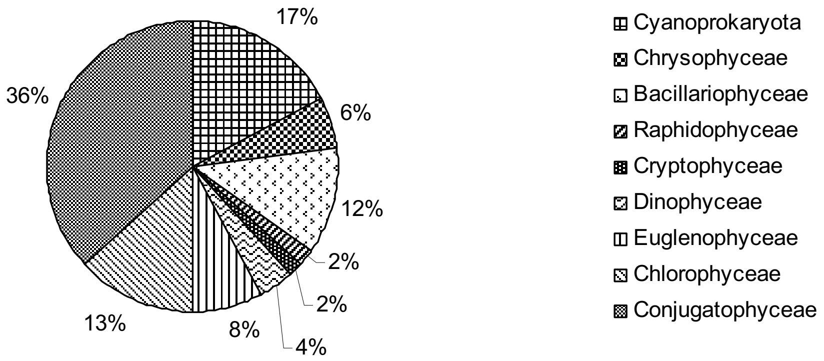

Fig. 1. The percentage participation of the specific groups of algae in phytoplankton of studied peat pits

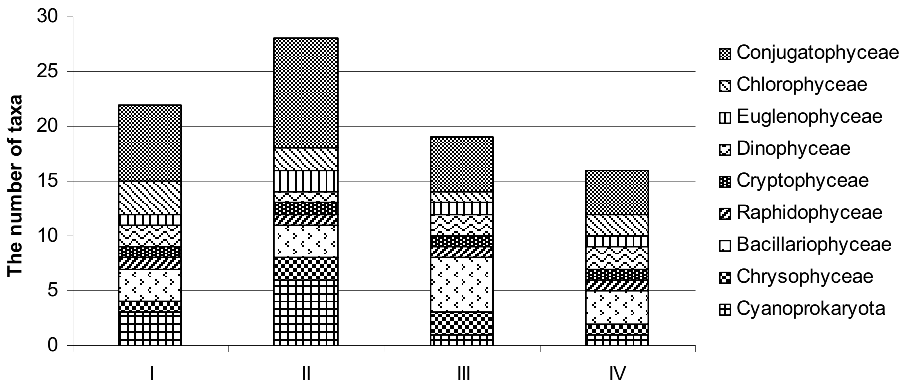

Fig. 2. The share of the taxonomic groups of algae in phytoplankton of studied peat pits

Table 2. Jaccard's coefficients of floristic similarity among studied sites

Sites	I	II	III	IV
I	-	0.25	0.21	0.28
II	0.25	-	0.28	0.21
III	0.21	0.28	-	0.42
IV	0.28	0.25	0.42	-

Among the most often noted species from desmids in all sites were: *Cylindrocistis brebissonii* Menegh., *Bambusina brebissonii* Kütz., *Closterium acutum* Bréb., *Closterium kuetzingii* Bréb. and *Staurastrum margaritaceum* (Ehr.) Menegh. The common for all sites cyanobacterial species was *Chroococcus minutus* (Kütz.) Nag. We have also noted other species which occurred in all four peat pits: *Euglena mutabilis* Schmitz. (Euglenophyceae), *Dinobryon divergens* Imhof. (Chrysophyceae), *Cryptomonas* sp. (Cryptophyceae), *Eunotia bilunaris* (Ehrenb.) Mills. (Bacillariophyceae), *Gonyostomum semen* (Ehr.) Dies. (Raphidophyceae) and *Peridinium umbonatum* Stein. (Dinophyceae).

Besides that there were common pattern of dominating groups and species, we have found several taxa which have occurred sporadically, only in specific sites. It was reflected in low values of Jacaard's coefficients (showing degree of floristic similarity among sites), which usually had a range between 0.21–0.28 (Tab. 2). The highest coefficient had ben found between sites III and IV (0.42).

DISCUSSION

Wetlands and small lakes situated there, as being very fragile ecosystems and the objects of anthropogenic pressure, including agriculture and landscape drainage, are in category of endangered habitats. However, the knowledge about its biodiversity and ecosystem functioning is scarce and far from clear understanding, as compared to other freshwaters [Hilbricht-Ilkowska 1998]. Small water bodies within mesotrophic mires can serve as good example of habitats having specific or even extreme environmental conditions. The dystrophic character of its waters is related to low pH, low nutrient content and poor light climate, thus influencing the structure of phytoplankton communities [Górniak 1996, Wojciechowski 1996, Hutorowicz 2001]. However, it is hard to clearly determine which of the factors is a key one shaping the plankton communities of peat habitats, due to the fact that algae are limited by a resultant of several environmental conditions [Matuła 1995].

The phytoplankton community of studied peat pits was predominated by algal species typical for dystrophic waters. What is interesting, each site can be characterized by having rather specific flora due to the fact that the total number of taxa was higher in comparison to those determined in each peat pit. Thus it can be concluded that there was a great number of species noted sporadically, so despite similar chemical conditions of studied peat pits and its proximity some differences in phytoplankton structure was noted. It was also confirmed by low values of Jaccaard's coefficients among samples. The differences was visible between open-area sites (surrounded by *Sphagnum* quaking bog) – site I and II – where the highest number of taxa was determined (22 and 28, respectively) and sites III and IV (situated next to the wet forest) in which the number of taxa was smaller and the Jaccard's coefficient was the highest. Those differences may be related to shading by tree stands or to dense macrophyte cover, which occurred in some peat pits. In shallow and small habitats, macrophyte structures enhance diversity of life forms [Vakkillainen 2005], including epiphytic algae, which temporarily enrich plankton communities [Brook 1959]. In peat pits this role can be played also by *Sphagnum* mosses, which create very specific habitats for algae, especially desmids [Woelkerling 1976]. In studied water bodies there was a considerable amount of periphytic filamentous species like green algae *Mougeotia* sp. or *Bulbochaete* sp. Also some desmids commonly noted in plankton community (like *Bambusina brebissonii*) can be considered as tychoplankters, normally attached to macrophytes.

The differences between study sites were shown also in chlorophyll *a* concentration (being the highest in site III and IV), which pointed to the various levels of domination in the phytoplankton structure (as these sites have lower species richness). Unfortunately, we have not collected quantitive samples, so any conclusions would be only of speculative value.

The algal species richness in each peat pits was rather low and comparable to those noted in acid dystrophic lakes [Fiszer and Burchardt 1993, Luścińska and Soska 1998, Górniak *et al.* 1999). The most species-rich group of algae were desmids (19 out of total 26 green algae taxa). This group often dominated algal flora of peatbogs and dystrophic lakes [Woelkerling 1976, Kowalski 1985, Hutorowicz 1998, Tomaszewicz 1988]. Despite them the typical algal components of acid habitats are often: Cyanoprokaryota and trichal and coccal forms of Chlorophyceae [Łaźniewska 2001, Szczurowska 2006]. In studied peat pits the most common blue-green algae was *Chroococcus minutus,* the species typical for oligo-mesotrophic habitats [Komarek and Anagnostidis 1998]. We have noted also numerous flagellates from the genus *Cryptomonas, Peridinium* and *Dinobryon*. It is a group of algae having such adaptation abilities like mixotrophy, which enables them to acquire the alternative sources of carbon [Reynolds 1980]. Another common for all peat pits species was *Gonyostomum semen*, which is also a typical dystrophic species [Kawecka and Eloranta 1994]. This invasive flagellate started to occur in dystrophic and humic waters of the eastern Poland in the last decade of the 20^{th} century [Pęczuła 2007].

CONCLUSIONS

1. The structure of phytoplankton communities in studied peat pits was typical for dystrophic lakes.
2. We have noted some differences in taxonomical phytoplankton structure among studied water bodies, despite theirs chemical similarity and space proximity.
3. The studied peat pits offer unique habitats for very specific algal flora, which confirms the need of its protection as the Special Area of Conservation.

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STRUKTURA ZBIOROWISK LETNIEGO FITOPLANKTONU W WYROBISKACH POTORFOWYCH NA OLIGOTROFICZNYM TORFOWISKU KRUGŁE BAGNO (POLESIE LUBELSKIE, POLSKA WSCHODNIA)

Streszczenie. Wyrobiska potorfowe zlokalizowane w obrębie torfowisk oligotroficznych są przykładem siedlisk o swoistych i ekstremalnych warunkach środowiskowych. Ich dystroficzny charakter związany z kwaśnym odczynem wody, niską koncentracją substancji biogenicznych, ograniczonym dostępem światła ma wpływ na kształtowanie się struktury zbiorowisk glonów. Znaczna ilość tego typu drobnych zbiorników wodnych znajduje się na Polesiu Lubelskim, m.in. na terenie Poleskiego Parku Narodowego oraz w jego otulinie. Torfianki Polesia do tej pory były rozpoznane głównie pod kątem botanicznym i faunistycznym, natomiast badania struktury zbiorowisk fitoplanktonu są sporadyczne.

Celem badań było poznanie struktury fitoplanktonu w czterech dystroficznych wyrobiskach potorfowych, znajdujących się na obszarze oligotroficznego torfowiska przejściowego.

Struktura zbiorowisk fitoplanktonu była typowa dla zbiorników dystroficznych. Na podstawie analizy jakościowej letniego fitoplanktonu czterech badanych wyrobisk potorfowych oznaczono 42 taksony glonów pro- i eukariotycznych, należących do 9 grup systematycznych. Najliczniejszą grupę glonów stanowiły zielenice, spośród których 19 taksonów to desmidie, stanowiące aż 36% ogólnej liczby taksonów. Ogólna liczba taksonów glonów była wysoka w porównaniu z liczbą taksonów oznaczonych w poszczególnych torfiankach. Wskazuje to na znaczną liczbę taksonów notowanych sporadycznie. Mimo zbliżonych warunków chemicznych w badanych wyrobiskach potorfowych, stwierdzono pewne różnice w strukturze zbiorowisk fitoplanktonu.

Słowa kluczowe: wyrobiska potorfowe, fitoplankton, zbiorniki dystroficzne