

SPATIAL STRUCTURE OF MACROPHYTES IN THE ROTCZE LAKE  
(LUBLIN POLESIE REGION)

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**A b s t r a c t.** Spatial structure of macrophytes in the Rotcze Lake was analysed. The thickness cover was observed in the vegetation of two groups of elodeids and charophytes. A vertical range of all groups distinguished was similar. Differentiation in species frequency was noted in all groups, with the highest in elodeids, where two species, i.e.: *Elodea canadensis* and *Ceratophyllum demersum* were dominant. A disproportion in the quantity of some species was also observed. Some of them visibly prevailed in floristic composition.

**K e y w o r d s:** macrophytes, spatial structure, Rotcze Lake, Lublin Polesie Region

INTRODUCTION

Changes of vegetation in the water-peat ecosystems result from the lowering of water levels, in both surface and underground water, due mainly to agricultural drainage [5,8]. The lowering of the lake water levels results in a change of habitat conditions for macrophytes which in turn influences their dynamics. This leads to an overgrowing of the lake and to its shallowing by the accumulation of the growing amounts of organic matter [1,5].

Water macrophytes have a considerable impact on the shaping of the habitat conditions in water basins [10,11]. They play a significant role in the reclamation processes [9], lower wave motion and support the process of organic matter deposition. They contribute to the oxygenation of water and bottom deposits which plays the key role in phosphoric compounds inactivation and in the inhibiting of eutrophication processes [10]. They react very quickly to the fluctuations of the lake water level [4].

A diminishing number of macrophytes, and in some dramatic cases their disappearance, is a sign of lake water degradation relating to an advanced eutrophication [2,4,7]. Macrophytes *Characeae* are considered to be the most sensitive species in this respect. Their presence in lakes is a sign of water purity and a reflection of the present status of the lake [6].

The research conducted aims at the describing of the spatial structure of the submerged vegetation and is a stage of a broader work which will allow to estimate the ecological status of the Łęczna-Włodawa Lakeland lakes in comparison to the European lakes. They will also become a basis for macrophytes monitoring a good index of the ecosystem changes. Monitoring is necessary for the preservation of these ecosystems and for the elimination of causes of disturbances which affect them.

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#### INVESTIGATED AREA AND METHODS

The Rotcze Lake is an eutrophic water basin with a water surface of 42.7 ha, an average depth of 1.9 m and the maximum depth of 4.3 m [12]. It is located in the catchment of the second category of susceptibility to degradation, and belongs to a group of lakes with the lowest Ohle rate [3].

The field research of water plants was done in the peak of vegetation period in the years 2000 and 2001. Data concerning location and spatial structure of the submerged macrophytes were collected along the transects connecting the opposite lake shores and running near its centre. Altogether 10 such transects were marked. They were situated at the same distance along the whole lake shoreline. In each of them, at points located every 20 m starting from the riparian belt, the following parameters of water vegetation were measured:

- quantity of particular groups (floating-leaved, charophytes and elodeids);
- quantity of species belonging to the aforementioned groups observed in control points (species occurring sporadically outside control points were neglected);
- vertical range (thickness of the plant layer constituting a given group).

For the quantity estimation, a 11-grade scale was used in which the following grades corresponded to a particular range of surface vegetation cover of the surface: + - up to 5%, 1-6-10%, 2-11-20% ... 10-91-100%. Moreover, the depth of the water basin was measured at each of the control points. The characteristics of the

spatial structure of macrophytes submerged in the Rotcze Lake was presented taking into account average rates of the above mentioned parameters.

## RESULTS

In the macrophyte flora, 15 associations were noticed together with 17 species of plants building them and belonging to charophytes, floating-leaved and elodeids. The charophytes included: *Chara fragilis*, *Chara hispida* and, sporadically appearing: *Chara vulgaris*, *Ch. intermedia* and *Ch. contraria*. Floating leaves were a less numerous group represented chiefly by: *Nymphaea candida*, *Nuphar lutea* and *Potamogeton natans*. The highest number of species was observed in the group of elodeids. The following species belonged here: *Elodea canadensis*, *Stratiotes aloides*, *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Potamogeton lucens*, *P. pectinatus*, *P. crispus*, *P. rutilus*. and, again sporadically, *Potamogeton compressus*.

The submerged vegetation covered almost all the bottom area of the Rotcze Lake. The fragments of the bottom surface free from vegetation occurred mainly in the coastal parts of the water basin, in the zone next to the riparian vegetation, and near the bathing place located in the eastern part of the lake. Elodeids had the biggest average cover reaching almost up to 50% (Fig. 1). A slightly smaller quantity was reached by *Characeae*. An average cover of floating leaves, however, was very small and did not exceed 2%.

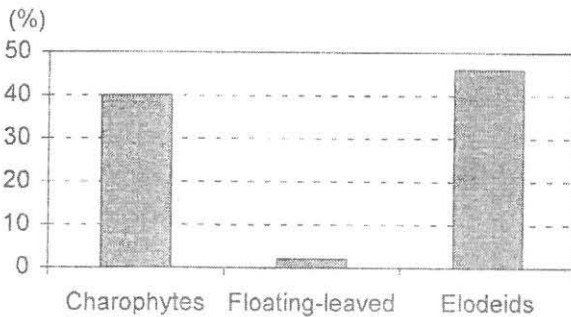


Fig. 1. An average cover of ecological groups

vegetation belt was a considerable gradient of the slope in the coastal zone of the littoral occupied mostly by patches of *Phragmitetum australis* (especially in the eastern and east-southern parts of the shoreline).

The vertical range of charophytes and elodeids was identical and appeared

in the basin depth reaching from 0.4 up to 4 m. Only at some control points located at a depth exceeding 4 m, a complete lack of the submerged vegetation was noticed. Due to the limitations resulting from the morphology of species, floating leaves, occurred at a depth from 0.8 to 1.5 m (Fig. 2).

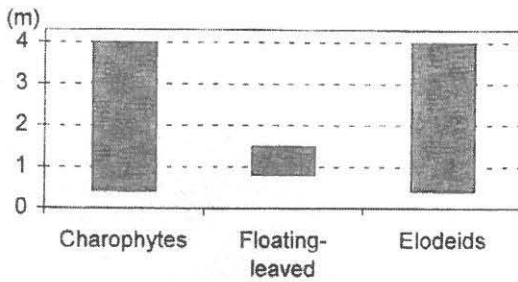


Fig. 2. A vertical range of ecological groups

with a changeability range starting from 0.3 m and ending at 1.6 m. A considerable length of *Elodea canadensis* and *Ceratophyllum demersum* shoots, reaching up to 1.2-1.4 m in the some parts of the basin more than 3 m deep was worth noticing. The thickness diversity of elodeids was affected by *Stratiotes aloides*, too. At places, it created underwater meadows of a vertical range from 0.5 to 1.0 m. Long shoots were also developed by *Myriophyllum spicatum* and *Potamogeton lucens*. The thickness of charophytes, on average reaching 0.56 m (Fig. 3), was also considerably varied. *Characeae* developed longest shoots while growing together

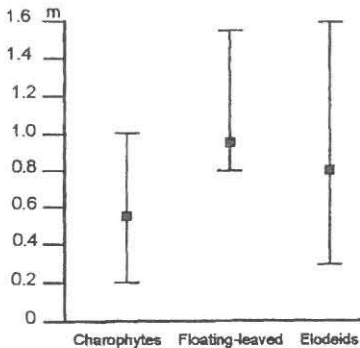
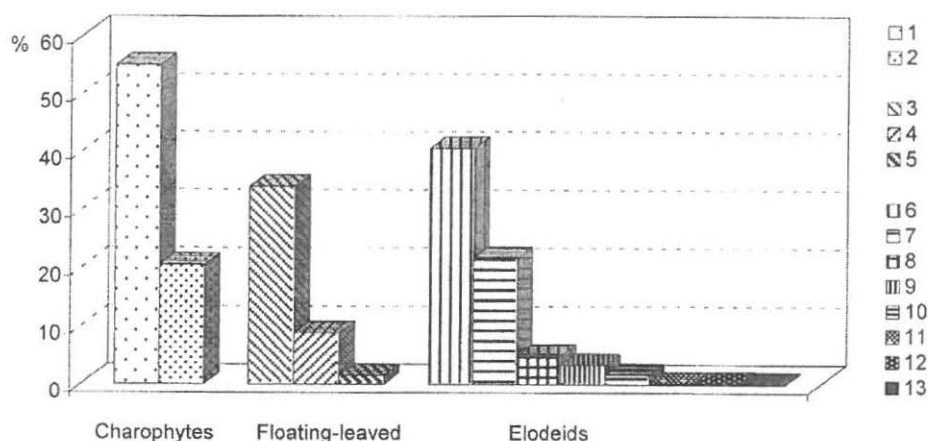


Fig. 3. The average

with *Ceratophyllum demersum* and *Stratiotes aloides*. When they occurred in one-species conglomerations or when they built patches consisting of both species of *Chara*, their shoots were shorter. An average thickness of nymphaeids was the highest of all the vegetation groups and it was determined chiefly by the considerable gradient of the littoral slope.

A significant disproportion in the average cover was observed between both kinds of *Characeae* (Fig. 4). *Chara hispida* was definitely prevailing over *Chara fragilis*. Both taxons created one-species conglomerations but they also occurred together. In the former location method, patches built exclusively of *Chara fragilis* individuals were more frequent. In the patches built of both species, *Chara fragilis* usually dominated. An even greater diversity of an average cover was observed among the species of floating – leaved (Fig. 4). *Nymphaea candida* was definitely predominating in this group (cover 34%); a rate of the average cover measured for *Nuphar lutea* was almost four times

An index suitable for the evaluation of life expectancy, especially for charophytes and elodeids, is an average thickness of the vegetation layer. This parameter was high in all the three groups. Elodeids built a layer with an average height of almost 0.9 m,



**Fig. 4.** An average cover of species from ecological groups; explanations. 1 – *Chara fragilis*; 2 – *Chara hispida*; 3 – *Nymphaea candida*; 4 – *Nuphar lutea*; 5 – *Potamogeton natans*; 6 – *Elodea canadensis*; 7 – *Stratiotes aloides*; 8 – *Ceratophyllum demersum*; 9 – *Potamogeton pectinatus*; 10 – *Potamogeton lucens*; 11 – *Potamogeton rutilus*; 12. *Myriophyllum spicatum*; 13. *Potamogeton crispus*

smaller. *Potamogeton natans* appeared less frequently than both of the aforementioned taxa because the area available for this species settlement was limited by the depth of the basin. Among elodeids, the quantitative domination of *Elodea* was clearly noticed; its average cover reached 40.6%. The plants of this taxon occurred most frequently in the company of *Ceratophyllum demersum*; in the deepest parts of the basin, however, they built one-species patches. They were met together with both kinds of *Characeae* only sporadically. As far as the quantitative participation is concerned, *Stratiotes aloides* was the second among elodeids. Unlike other shallow eutrophic lakes of the Łęczna-Włodawa Lakeland, in the basin studied, this species did not build patches floating on the water surface but occurred as more or less dense underwater stretches. It was usually accompanied by *Ceratophyllum demersum*, *Elodea canadensis* and *Chara fragilis*. At a depth of 1.5-2 m *Stratiotes aloides* was also met in dense one-species conglomerations. An average cover exceeding 1% was also observed in the case of *Ceratophyllum demersum*, *Potamogeton pectinatus* and *P. lucens*. *Ceratophyllum demersum* was most frequent in the deeper parts of the lake (more than 1.5 m deep), growing together with *Stratiotes*. Yet, it was missing from the parts less than 1 m deep. In this range of depth mostly small one-species patches of *Potamogeton pectinatus* were met, although this species inhabited deeper parts of the lake, as well. *Potamogeton lucens* appeared in the western part of the lake only building loose groups of several dozens of acres, in places where water depth exceeded 1.5 m. The remaining species of elodeids

built a negligible cover and their occurrence was observed in some of the control points only.

The comparison of species frequency within particular groups brings similar results to those provided by the quantitative analysis (Fig. 5). Out of two charo-

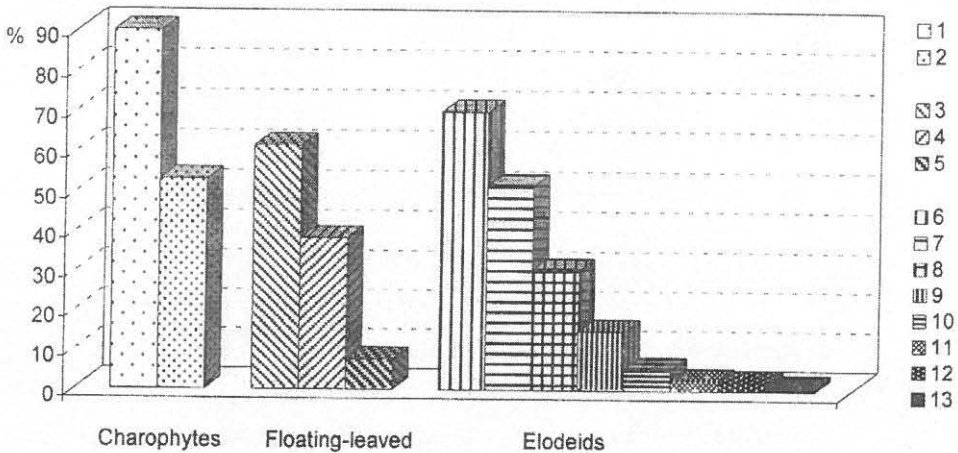


Fig. 5. Frequency of species from ecological groups. Expl. – see Fig. 4

phyte taxa, *Chara fragilis* (90%) occurred much more frequently. *Chara hispida* was present in half of the control points in which plants of the former one appeared. A considerable diversity of occurrence took place among floating leaved as well, where *Nymphaea candida* was the most commonly observed species. The disproportion in frequency between this taxon and *Nuphar lutea* was smaller than the one in their quantity. The last of floating – leaved, *Potamogeton natans*, did not exceed the 10% frequency threshold. The most frequent elodeid species included *Elodea canadensis* and *Stratiotes aloides* which create a core of the submerged vegetation. Frequency of each of the taxa exceeded 50%. High occurrence of *Potamogeton pectinatus* was also worth noticing. This species, despite its failure to create large and dense conglomerations, was nevertheless present as an admixture of vegetation in numerous parts of the lake investigated. Frequency exceeding 10% was noticed also in the case of *Ceratophyllum demersum*, whereas the remaining species *Myriophyllum spicatum*, *Potamogeton lucens*, *P. crispus*, *P. rutillus* as has already been mentioned, were relatively rare.

## CONCLUSIONS

1. The submerged vegetation of the Rotcze Lake, which included 17 species, covered almost all surface of the basin bottom. Its spatial structure is best illustrated by an average cover of the distinguished ecological groups, by their vertical range and by the thickness of the vegetation layer. Elodeids and charophytes had the thickest cover, and the cover of floating leaved was considerably smaller.

2. A vertical range of the groups distinguished was similar. Elodeids and charophytes were observed in the whole range of the basin depth, while floating leaves settled in the zone not exceeding 1.5 m in depth.

3. Thickness of the vegetation layer reached high rates in all three groups, with the highest rates observed in the groups of floating – leaved.

4. Differentiation of species frequency was noted in all the groups. The most striking differences were noted in the group of elodeids where a clear dominance of some taxons was observed (*Elodea canadensis*, *Ceratophyllum demersum*).

5. In all the groups distinguished, a disproportion in quantity between specific species was noted. In the group of charophytes, *Chara fragilis* was visibly prevailing; out of the three taxa of floating leaved, *Nymphaea candida* was most numerous; while the core of elodeids consisted of two species *Elodea canadensis* and *Ceratophyllum demersum*.

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## STRUKTURA PRZESTRZENNA ROŚLINNOŚCI ZANURZONEJ JEZIORA ROTCZE (POLESIE LUBELSKIE)

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**S t r e s z c z e n i e.** Badania terenowe nad roślinnością wodną jeziora Rotcze przeprowadzono w szczycie wegetacji w latach 2000, 2001. Dane dotyczące rozmieszczenia i struktury przestrzennej makrofitów zanurzonych gromadzone były wzdłuż transektów łączących przeciwległe brzegi jeziora i przebiegających w pobliżu jego środka. W każdym z nich dokonywano oceny następujących parametrów charakteryzujących roślinność wodną: ilościowość poszczególnych grup (nymfeidów, charofitów oraz elodeidów) oraz gatunków wchodzących w ich skład oraz zasięgu pionowego (miąższość warstwy roślin tworzących daną grupę).

Największe pokrycie posiadały elodeidy i charofity, natomiast znacznie mniejsze nymfeidy. Podobnie przedstawiał się zasięg pionowy wyróżnionych grup. W całym zakresie głębokości zbiornika odnotowano występowanie charofitów (z dominacją *Chara fragilis*) i elodeidów (z dominacją *Elodea canadensis* i *Ceratophyllum demersum*), zaś nymfeidy zasiedlały strefę jeziora do głębokości 1,5 m. Miąższość warstwy roślin osiągała wysokie wartości we wszystkich trzech grupach, przy czym największą stwierdzono w grupie nymfeidów. Największe zróżnicowanie frekwencji gatunków zaobserwowano w grupie elodeidów.

**S ł o w a k l u c z o w e:** makrofity, struktura przestrzenna, jezioro Rotcze, Polesie Lubelskie