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Lublin, 28.06.2019

Council of the Faculty of Biology and Biotechnology
Maria Curie-Skłodowska University
in Lublin

Hereby, I present a summary of my doctoral dissertation entitled: Bank of diaspores and its role in the regeneration of charophyte meadows, compiled and written under the supervision from dr hab. Piotr Sugier, prof. UMCS.

Summary

Charophytes are macro-algae colonising both fresh and marine waters regarded as sensitive bio-indicators of lake trophic status due to their preference for oligo- to poorly eutrophic waters. These organisms play an important role in the functioning of aquatic ecosystems. They bind biogens, stabilise sediments, and contribute to the so-called pure water status of lakes. In our climatic conditions, these plants either overwinter (evergreen forms) or die after the vegetation period. Oospores produced by charophytes, together with diaspores of other macrophytes, form an underwater seed bank deposited in bottom sediments and playing an important role in the dynamics and regeneration of vegetation.

The main objective of this dissertation research was to characterise the underwater seed bank in water reservoirs with different trophic status, vegetation history, and factors contributing to extinction of aquatic vegetation. The study was also focused on determination of the impact of the depth of diaspore deposition in bottom sediments on the species composition and structure of the underwater seed bank. Another objective was to determine the impact of the depth of deposition of *Chara intermedia*, *Ch. vulgaris*, and *Lychnothamnus barbatus* oospores in bottom sediments on the density, viability, and germinability of diaspores. The research also assessed the effect of drying of *Ch. intermedia* thalli on the morphological characteristics and degree of maturity of oospores as well as the influence of temperatures on the dynamics and germination capacity of diaspores. An attempt was made to

indicate the perspective of using the underwater seed bank deposited in bottom sediments in active protection aimed at restoration of aquatic vegetation in habitats where it has become extinct.

The goals of the study were possible to achieve after a preliminary analysis of literature data, vegetation maps, aerial and satellite photographs, climate data, and field observations. These steps allowed determination of the time and cause of extinction of the charophyte vegetation in lakes selected for the study and identification of water reservoirs (peat pits) that could be a source of material (charophyte thalli, oospores, bottom sediments) required for microscopic observations and experiments. I carried out these experiments both in vegetation chambers and in outdoor conditions. The microscopic analysis of the sediments revealed that the underwater seed banks from Lake Słone and Rogóźno were dominated by species that were also most abundant in plant communities forming the phytolittoral years ago, but there were additionally a large number of typical terrestrial taxa. The absence or negligible number of diaspores of other hydromacrophyte species that were present in the past probably implies their vegetative mode of propagation. The analysis of samples from bottom sediment cores collected in Lake Rogóźno and kept in conditions similar to those prevailing in very shallow water reservoirs demonstrated that the bank of *L. barbatus* diaspores, especially from the upper 10 cm layer, could be a source of vegetation restoration and an important tool for active protection of this endangered species. It was also found that the depth of occurrence of submerged vegetation had an impact on the formation of the underwater diaspore bank, which reflects the history of the spread of this species. The vegetation history has an impact on the formation of the underwater seed bank, and the persistence of *Lychnothamnetum barbati* phytocoenoses in time determines the distribution of *L. barbatus* diaspores in the sediment depth gradient, the percentage of potentially viable oospores, and their germination. In turn, the laboratory analyses demonstrated that the drying of charophytes in shallow water reservoirs significantly influenced the morphological diversity and maturity of oospores. This results in a variable diaspore germinability, which can determine the properties of the underwater seed bank. The results of the experiments conducted in the vegetation chambers showed higher germinability oospores deposited in bottom sediments than that of oospores collected from dried thalli, and the former play a more important role in the regeneration of *Ch. intermedia*. The experiment in which *Ch. intermedia* oospores were subjected to freezing showed that negative temperatures substantially limits germination of oospores forming “oospore rain” and constituting an underwater seed bank.

Therefore, longer periods with negative temperature in winter in littoral zones with shallow charophyte vegetation may affect the properties of the diaspore bank and determine its role in regeneration and dynamics of the vegetation.