3.3. Investigation of macrophyte – periphyton complex in Tisza Reservoir

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3.3.1. Introduction

Communities of aquatic plants play decisively important roles the life of shallow waters directly or indirectly through their effects on the development of aquatic habitats, as well as on the material circulation and energy flow. The functioning of macrophytes as agents in the changes and regulation of water quality is largely enhanced by the periphyton forming on the submerged parts of macrophytes.

Kisköre Reservoir is a shallow water reservoir that can be characterized by the determinant influence of the littoral zone, the area of which covered by aquatic vegetation (littoral phytal) gradually increases to the cost of the open water area (littoral pelagial). Consequently, the contribution of periphyton gains ever larger significance. The periphyton examinations performed in Kisköre Reservoir have focused on investigating the role of the aquatic macrophyte-periphyton (epiphyton) complex (Lakatos *et al.*, 1998) in transforming and indicating water quality, as well as on revealing the relationship between the host plant and the periphyton. The obtained results can add to the professional basis for the future water managing and biomanipulating intervention on the life of the reservoir.

3.3.2. Materials and Methods

In the summer of 1999, water, plant and periphyton samples were taken from the stands of the dominant aquatic plants at several sites of the basins, primarily the middle basins (Poroszlói and Sarudi basins), of Kisköre Reservoir, whereas local measurements (water depth, transparency, temperature, conductivity, pH, oxygen concentration and saturation) were also carried out. Where the proper depth of water allowed it, samples collected near the surface, in mid-depth and deep submergence were distinguished during processing the samples in order to survey the influence of their vertical stratification on the results. Horizontal differences were detected through taking samples both from the middle part of the plant stands and their edges.

The wet and dry mass of the periphyton samples were measured, and the organic matter, chlorophyll-a, nitrogen and phosphorus contents were established. The ash content of the samples was determined, while the identification of cations was made with the ICP-AES technique after wet exploration. The algal species composition of epiphyton samples was also revealed.

3.3.3. Results

In 1999 the results of the water chemical examinations support the view on the middle basins of the reservoir having different water qualities, as well as justify the role of the macrophyte-periphyton complex in the formation of local impacts, such as oxygen supersaturation, oxygen shortage or the evolution of 'peat' characteristics. A large part of the plant mass reproducing year by year is utilized in the detritus food-chain, while the algae and zoo-organisms of the periphyton constitute an important nutrient base for the fish (Simonian *et al.*, 1995).

A significant amount of periphyton was found on the surface of *Potamogeton lucens* leaves, with its bulk being ash from the silicon skeleton of diatoms. Similarly, large quantities were observed in the middle of the *Trapa* stand and the edge of the *Nymphoides* vegetation. According to the classification system based on the mass of the periphyton, the majority of the samples could be grouped as small-mass periphyton (Lakatos, 1983), and their ash contents showed considerable differences.

The results from the examinations performed on the mass and ash content of the periphyton proved that the macrophyte-periphyton complex actually determined the water currents, and indirectly the water quality, as well. The mass of the periphyton on the various plant species was found to be different in the middle basins of the lake. The periphyton of the saligot (*Trapa natans*) and cattail (*Typha angustifolia*) showed increases in the Poroszlói Basin, the amount on the bulrush (*Schoenoplectus lacustris*) decreased, while the saligot collected in the Sarudi Basin also had larger quantities of periphyton (22 g/m^2 dm). Data obtained on the ash contents of the periphyton partly reflected the differing suspended matter contents in the water of the various basins in Kisköre Reservoir, with the local effects being in work. Samples collected from the Poroszlói Basin, near the dead-arm at Óhalászi and at the end of the dead-arm at Csapó could be described by an inorganic periphyton group. Even when observing the very same sampling site, the periphyton of *Schoenoplectus* belongs to the organic periphyton group, whereas that of *Glyceria* could be classified as inorganic due to a significant amount of suspended solids deposition.

It is the marsh plant species and *Potamogeton lucens* that generally have large quantities of periphyton, while the dense stand of saligot can be characterized by a relatively small amount. Regarding the chlorophyll-a content, the periphyton types of larger masses brought about smaller values, which may be explained by the higher ash contents, that is more considerable presence of the inorganic fraction and indirectly the filtering and settling functions of the periphyton. The highest chlorophyll-a concentration (0.797 %) was observed in the periphyton taken from the saligot, while a decisively lower value (0.005 %) was measured in the case of *Potamogeton perfoliatus*.

The largest amount biomass of periphyton can be found in the middle part of stems of emergent macrophytes (*Typha, Phragmites*). This is valid for the organic matter and chlorophyll-a content too. It's necessary to know that the samples were taken from the edge of macrophyte stand, so the effect of waves is not negligible.

The N % content of the periphyton turned out to be the lowest in the case of the *Potamogeton lucens* sample (0.6 %), which can be due to the large ash content and the decisive role of the inorganic fraction, while for the bulrush, this value was much higher (3.6 %). The phosphorus concentration just partly responded to the values of the nitrogen content, and was the highest for the flowering rush (*Butomus umbellatus*), while in the case

of pondweed (*Potamogeton*) species, low concentrations were obtained. The macrophyte-periphyton complex has an essential tendency for retaining and absorbing nutrients (Smoot *et al.*; 1998, Havens *et al.*, 1999). As compared to the host, substrate pondweed (*Potamogeton*), the nitrogen and phosphorus contents of the periphyton can be up to three times larger, but at least show coherently higher values. The amount of plant nutrients retained and stabilized by the macrophyte-periphyton complex can be established and estimated for the whole of Kisköre Reservoir through attaining appropriate information on the submerged fraction of the emergent vegetation and the biomass of the pondweeds. The importance of periphyton in retaining nutrients had also been verified by the results of the former examinations on shallow lakes and wetlands (Lakatos and Bíró, 1991; Lakatos *et al.*, 1998).

On the basis of measurement of heavy metals in periphyton there is no essential difference among macrophytes but the periphyton of emergent plants contains more iron manganese and the extreme values of other heavy metals are also characteristic of these plants.

The accumulation of heavy metals by periphyton is an important fact in the development of water quality and establishes the effect of the biofiltration.

On the basis of analyses of algae the submerged and floating leaves macrophytes' periphyton characterized by large number of algae. The largest individual number but the lowest species number were determined in the periphyton of *Nymphoides peltata*. The most number of algae species was found in periphyton of *Hydrocharis morsus-ranae* and *Potamogeton natans*.

Periphyton of *Typha angustifolia* had a largest of algae compared with other emergent plants but its species richness was far below of reed-periphyton. The characteristic species of periphyton belong to the group of diatoms and green algae (46 and 38 % of total species number). The ratio of species number of cyanobacteria and euglenids is only 10 and 5%. The fitoplankton and algae in periphyton are bioindicators and useful for determine water quality.

42 macroscopic invertebrates taxa were identified in zootecton. The periphyton forming on submerged and floating leaves plants usually have more invertebrate animal taxa than the emergent. macrophytes' zootecton. Lots of insect larvae (mainly *Chironomidae*) were found in zootecton. The importance of invertebrates appears in material circulation and fish feeding.

3.3.4. Conclusion

Studying the basins of Kisköre Reservoir, which were partly formed by natural processes after the creation of the reservoir, as separate water regions is recommendable, since ensuring the various requirements of water utilization (irrigation, nature conservation, fishing, recreation, water sports, ecotourism, energy production, shipping, etc.) seems to be achievable exclusively in this way. The aquatic vegetation-periphyton complex has a decisive role in providing the proper water quality for these activities and fulfilling the varied demands of water utilization, and this role has to be taken into account when interfering in the life of the reservoir.

3.3.5. SUMMARY

Investigation of periphyton of different macrophytes was carried out in summer 1999 in Kisköre Reservoir. The wet and dry mass, organic matter, chlorophyll-a, nitrogen and phosphorus contents of periphyton were measured. The ash and cation content were also established. The algal and macroinvertebrate species composition of periphyton samples were also revealed. The emergent plant species and the submerged *Potamogeton lucens* have the largest biomass of periphyton. The larger mass of periphyton contains less chlorophyll-a because of the the higher inorganic fraction. The nitrogen and phosphorus content in periphyton are different and there is no significant correlation between them.

On the basis of our results there is no essential difference among the heavy metal content of periphyton. Most of the identified 151 alga species belong to the group of diatoms and green algae. The characteristic taxon in the biotecton are insects' larvae (mainly chironomids) and the total invertebrate taxon number is 42.

3.3.6. REFERENCES

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