

The composition and density of epiphyton on some macrophyte species in the partly meromictic Lake Verevi

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Key words: epiphyton, chlorophyll *a*, biomass, algal groups on different host plants

Abstract

The epiphyton on 22 macrophyte species was studied in the hypertrophic stratified Lake Verevi mainly in the midsummer of 2000 and 2001. Some material from 1998 and 1999 was used as well. Chlorophyll *a* (Chl *a*) level was high: 330–360 $\mu\text{g g dw}^{-1}$ on emergent plants, and an average of 117–200 μg on floating-leaved plants and 820–920 $\mu\text{g g dw}^{-1}$ on submerged plants. Biomass was 15–23, 5–10 and 35–53 mg g dw^{-1} , respectively. The richest in epiphyton were submerged plants with densely growing and fine branchlets such as *Ranunculus*, *Ceratophyllum*, *Myriophyllum*, *Utricularia*, *Potamogeton pectinatus* L. and *P. friesii* Rupr. The share of Chl *a* in biomass was higher in 2001 (2.3%) than in 2000 (1.7%), which can be associated with lower irradiance in summer 2001. Filiform chlorophytes were dominating on most plants; 60% of biomass on submerged, 69% on emergent and 80% on floating-leaved plants; in some cases, the share of filamentous species was 95%. Diatoms formed 29, 12 and 7%, cyanobacteria 8, 16 and 10% of the same ecotopes, respectively. As a rule, the epiphyton was quite sparse on large *Potamogeton* leaves. Cyanobacteria were more abundant on large *Potamogeton* and *Nuphar* leaves, *Elodea*, on stems of *P. natans* L., *Nuphar* and on some emergent plants with a smooth and soft stem surface, as *Butomus* and *Typha*. Diatoms played the most important role on some *Potamogeton* species and in single samples of *Ceratophyllum* and *Ranunculus*. The morphology of plant species appears to be the main factor of epiphyton richness in L. Verevi.

Introduction

Epiphyton plays an important role in the primary production of small lakes even in case they are deep. Its share forms about one-third of total production (Putz, 1997), 31% of phytoplankton in the euphotic zone (Cattaneo et al., 1998), two-thirds of plankton production (Ilmavirta, 1979; cit. Kairesalo, 1984), 23–40% of macrophyte production (Szczepanska, 1970), or most of primary production in the lake (Burkholder & Wetzel, 1989). Abundant *Cladophora* mats among macrophyte stands can form the majority of the biomass of the whole lake, e.g., more than 800 g dw m^{-2} (Marvan et al., 1978). It is obvious that epiphyton

is richer in eutrophic lakes, while its share in total primary production of the lake can be larger in oligotrophic ones, as macrophytes reach deeper areas. Light can be the most important factor determining epiphyton abundance and distribution, and the need for light is the most important factor affecting the species composition of epiphyton. Some diatom species prefer heavily shaded biotopes, while others dominate in well-irradiated biotopes (Marvan et al., 1978). According to Havens et al. (1996), the trend of the epiphyton amount is opposite to that of water transparency; however, turbidity does not affect attached algae near the surface layer. Experiments with shading showed that algal abundance reduced about 40%

(Hepinstall & Fuller, 1994). Light is a limiting factor for thick macrophyte beds (Kairesalo, 1984; Cattaneo et al., 1998).

Besides light conditions, several other factors control the abundance and composition of epiphyton. Many papers are dedicated to the role of nutrients; camouflaged by other factors, relationships between nutrients and surrounding water are not clear. Several papers present contradictory results of nutrient enrichment experiments. Most authors assert the relationship with mineral nitrogen, particularly green filiform algae; on the contrary, Cattaneo (1987) notes the relationship of green filiform algae with total P in Canadian lakes. In Florida Everglades, fertilizing caused the disappearance of most filamentous green algae (Vymazal et al., 1994). The N:P ratio can be important in the relationship between algal groups. However, it is not sufficient to be confined to total N:P content ratio; the ratio of the available forms of nutrients, as the mineral forms of N, to suspended particulate P may be totally different (Paterson et al., 2002). Kairesalo (1983, cit. Kairesalo & Uusi-Rauva, 1983) asserts that within an *Equisetum fluviatile* stand the seasonal fluctuation of N:P ratio in epiphytic communities was significantly weaker than that of the surrounding water, suggesting that epiphyton was not solely dependent on the nutrient sources of water. It is proved that the host plant is the source of nutrients for epiphyton. According to Burkholder & Wetzel (1990), epiphyton takes 25–60% of P from its host plant; according to Kairesalo & Uusi-Rauva (1983), all phosphorus released by *Equisetum fluviatile* was fixed by epiphyton. However, the knowledge of the nutrient content of the host plant is not sufficient, since some species excrete nutrients profusely, while others scantily; at the same time, other factors also be involved. According to Sand-Jensen (1990), in Danish lakes of different trophy, Si appears to be an important controlling element of the species composition of epiphytic algae. Organic matter excreted from the host plant also plays an important role causing epiphyton peaks on some submerged plants (Kassim & Al-Saadi, 1995).

The problem is whether the host plant or the growing site is more important in the life of epiphyton. Blindow (1987) in her profound study concludes that the plant species is of more importance; yet, significant differences were found in

single epiphyton taxa for the same host plant at different sites. The character of the host plant is undoubtedly of significance; however, this is most obvious in oligotrophic and moderately eutrophic lakes. In highly eutrophic lakes, differences in epiphyton are small (Eminson & Moss, 1980, cit. Kairesalo, 1984). Nevertheless, some differences depend on the plant's morphology and the character of its surface: thick and finely branched submerged plants as *Myriophyllum* or *Ranunculus circinatus* are usually richer in epiphyton than large-leaved pondweeds (*Potamogeton*). Some incrusting *Chara* species have different epiphytes in comparison with non-incrusting species at the same growing site (Blindow, 1987). Stem structure and surface play an important role in the case of emergent plants (Marvan et al., 1978). The toxic influence of the excretions of some emergent plants on algae, particularly cyanobacteria, has been established experimentally: *Myriophyllum* (Gross et al., 2002), *Ceratophyllum* (Iványi et al., 2002) and *Chara* (Wium-Andersen et al., 1982, cit. Blindow, 1987).

Grazing is one of the factors, which can influence the amount and composition of epiphyton and has also been proved by experimental studies (Jernakoff & Nielsen, 1997). Consumers can be scrapers and epiphytic deposit-feeders (snails and amphipods) in thick *Chara* stands, and deposit- and filter-feeders (cladocerans, copepods, chironomid larvae) in sparser stands of *Potamogeton pectinatus* L. (Hart & Lovvorn, 2000). The effect of grazing changes during the vegetation period. In L. Pääjärvi, a maximum of epiphytes was followed by a maximum of grazers (Kairesalo, 1984). According to the same author, gastropods can influence the N:P ratio. Some authors claim that diatoms prove to be more desirable food than green or blue-green algae (cit. Kairesalo, 1984). Thus, many factors can control the amount and composition of epiphyton.

The morphometric characteristics of Lake Verevi (Ott et al., 2005) represent peculiar features of its ecosystem. Different lengths (or total lack) of spring turnover cause shifts in the start of thermal and chemical stratification and nutrient depletion in the lake. In absence of spring turnover, several phenomena unusual for the lake will occur, e.g. changing of ordinary phytoplankton and macrophyte communities during summer stagnation