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DATA ON THE PERIPHYTON OF THE BALATON

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Abstract

The author has processed the periphyton samples of reeds, bulrushes and of the hair-weed vegetation at five different points of the northern side of Lake Balaton. In one of the sample series the periphyton associations of the Paloznak-bay in the vicinity of Balatonfüred are discussed in this paper. It ascertains that there are differences in the composition of the periphyton both according to the undergrowth and to the levels of depth. The periphyton associations within the reeds and at their fringe towards the water differ from one another in the same way. He found particularly in the periphyton associations in the interior of reed banks numerous algae that are otherwise characteristic of the transitory bogs. The separation of types will only be possible after elaborating further partial results in the relation of the periphyton of the Balaton.

Introduction

From among the algal organizations of the Balaton those to be found in the "plankton" have been studied the most exhaustively. About the algae of the "benthos" we have less knowledge. (For explaining the quotation-marks = the Balaton is a shallow lake, its water is stirred till the bottom by strong enough waves. The organisms floating in it and those living fallen down to the surface of the sediment may esasily change their place. There are, therefore, in the plankton some organisms stirred up from the bottom and this is true just the other way round, as well.)

The least investigated and known biotope of the water of the Balaton is the sometimes considerable macrophyton zone of the inshore fringe (reeds, walrushes, etc.), the coating, living on the stems of plants, thus also the periphyton formed by the algae. This, however, belongs, according to a preliminary estimate, in respect of its biomass, its active total surface, to the same order of magnitude as the phytoplankton and phytobenthos of the lake.

It is beyond question that the periphyton of the macrophyton-zone of the lakeshore exerts its effect on the life of the lake in another way than the phytobenthos on the surface of the sediment. While the latter ones are in an intensive connection quasi with the whole of the lake water, the fixed algal associations living in the inshore macrophyton-zone — mainly in the internal part of the zone — exert their effect rather in the zone, including also their influence exerted on the waters flowing into the zone. Thus the periphyton there supposedly strongly contributes to the "filtering function" of the macrophyton-zone from both the direction of the open water and that of the shore. The degree of this contribution and generally the extent

of the "filtering function" of the macrophyton-zone are not revealed exactly, as yet, but they are rendered considerably probable with practical observations. We know, at any rate, since the investigations of FELFÖLDY and TÓTH (FELFÖLDY—TÓTH, 1957; TÓTH 1960a; 1960b), that in the macrophyton-zone peculiar water-chemical — and consequently peculiar plant-coenological — conditions can be formed. These peculiarities have been emphasized in the algological investigations until now, as well.

The periphyton of the Balaton was first investigated by CHOLNOKY (1929) and MESCHKÁT (1934) and, later on, such studies were made by TAMÁS (1958, 1964). It is to be seen from this enumeration, as well, that the researchers still have very much to do here, particularly if we think of that investigations like these took only place at few points of the Balaton, as yet. We are still far away from that, in possession of a richer series of data, we can recognize and separate of une another the different types of the periphyton in the Balaton.

Materials and Methods

In order to contribute to the knowledge of the periphyton in the Balaton, in 1976 and 1977 I studied it at several points of the northern shore of the Balaton.

I have taken my periphyton samples from the following points: from the reeds of the Paloznak-bay NE of Balatonfüred, from the reeds of the stretch named Sajkód of the western shore in the peninsula Tihany, from the reeds and bulrushes of the Bozsa-bay west from the neck of the peninsula Tihany, from the reeds of the shore-stretch before Zánka in the southern basin of the Balaton, and from one of the reeds of the bay at Keszthely.

In the composition, stand-density of the periphyton associations, there occur generally no quick changes, apart from the mechanical damages induced by very strong waves and the ice-covering. Thus the processing of the samples, taken in early summer and later, in late autumn-early winter — but anyhow before freezing of the Balaton — offers a good survey of the composition of the periphyton. On the other hand, it is necessary to uncover at both dates the different periphyton biotopes as detailed as possible. We take therefore samples from the reeds living at the water-side fringe of the reeds and from those inside of the reedy part, in particular from different levels of the single reeds, excised from as deep as possible (e.g., 0 cm, 20 cm, 40 cm, 80 cm, 100 cm, 150 cm) and from the periphytons being on the surface of other plants living among the reeds or in the "clearings" of reeds in rather high individual numbers, for instance from *Stratiotes aloides, Myriophyllum, Utricularia, Potamogeton pectinatus*. We take samples from older floating reeds, too. In bulrushes, as well, we can think of a similarly differenciated sampling, like in reeds.

The stem-parts detached from the different levels of reeds — after being fixed in a Lugol solution of sodium acetate and preserved with formalin of 1,5—2 percent end-concentration — are stored separately until being processed. Processing takes place on a matter scratched off from the stem-parts with a scalpel. The matter of examination, obtained from the surface of a unit (1 sq.cm), is suitable for getting absolute quantitative data (ind./sq. cm) while from the investigation of some matter, obtained not from a unit surface, relative quantitative data (frequency of the single taxons, expressed in the percentage of the occurrence of all the taxons) can be obtained, resp., in a simpler case, the dominance relations can be estimated.

In my investigations I was supported by more than one research worker of the Biological Research Institute of the Hungarian Academy of Sciences, by taking me with motorboat to the place of sampling and helping me in the difficult enough sampling, as well. The processing of samples was mostly carried out in the Institute in Tihany, included making microphotographs, as well. Special thanks are due for the help and for ensuring me the possibility of my research work.

On the periphyton of the reeds in the Paloznak-bay

Before publishing the detailed taxonomical-coenological data of my investigations, obtained until now into the periphytons of the Balaton, I am presenting in the following my major results concerning one of my areas investigated in detail, the bay at Paloznak.

The bay at Paloznak is a bay of the Balaton, S of the village Paloznak, with a 1.1 km wide opening, a 650 m slight incurvation, covered with uniform, dense, strongly growing reeds. One can enter the reeds in a boat, through a few narrow cuttings. In these cuttings, *Utricularia, Stratiotes* make here and there large stands and, at the fringe of these cuttings, also smaller *Typha*-stands variegate the reeds sporadically.

I want to present the varied, rich composition of the periphyton here, through characterizing the samples taken on 24 June, 1976.

1. The periphyton samples of the young reeds living in the fringe of reeds towards the water:

(a) In 10 cm water depth. — Quantitatively dominant (in individual number) (D): the pedunculated *Rhoicosphenia curvata* (KÜTZ.) GRUN. and *Gomphonema olivaceum* (LYNGB.) KÜTZ. var. *calcareum* CLEVE, as well as, among them, *Epithemia sorex* KÜTZ. — There are present subdominantly (SD), i.e., in lower but still obvious individual number: *Cymbella laceolata* (EHRBG.) van HEURCK, with large, pedunculated individuals (on this peduncle several *Achnanthes* sit, like *A. microcephala* KÜTZ., *A. minutissima* KÜTZ., *A. linearis* W. SMITH), as well as other *Cymbella*-species, like the individuals of *C. cistula* (HEMP.) GRUN. sitting on peduncle stems, and those of *C. prostrata* (BERK.) CLEVE, taking place in a peduncle sac. From among the 34 further algal taxons, found in this periphyton association, there are some fixed filaceous organisms (e.g. *Coleochaete divergens* PRINGSH., *Tolypothrix tenuis* KÜTZ.), some fixed unicellular organisms (e.g. *Gomphonema intricatum* KÜTZ.), some organisms "caught" by the periphyton (e.g. *Coelosphaerium naegelianum* UNG., *Lyngbya limnetica* LEMM., *Planctonema lauterbornii* SCHMIDLE, *Cosmarium meneghinii* BRÉB., *Cosmarium obtusatum* SCHMIDLE, *Staurastrum tetracerum* RALFS., *Epithemia zebra* (EHRBG.) KÜTZ., *Synedra acus* KÜTZ.).

(b) On the same reed, in 100 cm water depth. — D: *Cymbella lanceolata, Epithemia sorex, Rhoicosphenia curvata,* SD: *Gomphonema olicaceum* var. *calcareum, Epithemia zebra.* As compared with the former sample, there is only a minor redistribution of importance in the dominance relations. Apart from the above mentioned ones, further 30 algal taxons take part in forming the periphyton, among them a few diatoms of rather large size: *Gyrosigma attenuatum* (KÜTZ.) RABENH. *Synedra ulna* (NITZSCH) EHRBG. var. *biceps* (KÜTZ.) SCHÖNF., some Chlorococcales *Pediastrum boraynum* (TURP.) MENEGH., *Scenedesmus quadricauda* (RP.) BRÉB. var. *quadrispina* (CHOD.) G. M. SMITH and Desmidiales: (*Closterium parvulum* NAEG. and *C. setaceum* EHRBG.). From among the green algae, following a fixed course in life, the occurrence of *Aphanochaete pascheri* HEERING is interesting here.

2. The periphyton living on the single levels of reeds, taken from the inside of the reedy shore:

(a) Water-line (0 cm). — The "beard" made by *Spirogyra* sp. (*Spirogyra schmidti*? W. et G. S. WEST?), *Oedogonium* sp. and *Tolypothrix tenuis* KÜTZ. and therein *Epithemia sorex* dominate quantitatively. SD: *Rhopalodia gibba* (EHRBG.) O. MÜLL., *Epithemia zebra, Radiofilum flavescens* G. S. WEST. From among the further 45 algal taxons, observed in the sample, 11 are Cyanophytic organisms and 21 Chlorophytic organisms, the others are — with the exception of one Chrysophyceae taxon — all Bacillariophyceae. Some interesting occurrences are: *Scenedesmus balatonicus* HORTOB., *Coleochaete scutata* BRÉB., *Geminella interrupta* TURP.,

Gonatozygon brebissonii DE BARY, *Gloeobotrys limneticus* (G. M. SMITH) PASCHER, as well as a form of giant-cell of *Rhopalodia gibba*.

(b) 20 cm water depth. — Here a "beard" made by a *Cladophora* (*C. vadorum* (ARESCHOUG) KÜTZ.?) dominates quantitatively. SD:*Cocconeis placentula* EHRBG., *Epithemia sorex, Navicula radiosa* KÜTZ. From among the further 64 algal taxons, determined from the sample, there are not more than 6 Cyanophyta; on the other hand, the number of the Chlorophytic organisms is 32; the others — with the exception of 1 Pyrrophyta and 2 Xanthophyceae — are all Bacillariophyceae taxons. Fairly interesting occurrences are: *Palmellocystis planctonica* KORS., *Radiococcus nimbatus* SCHMIDLE, *Scenedesmus acutiformis* SCHRÖD., *S. balatonicus* HORTOB., *Cosmarium perforatum* LUND., *C. tinctum* RALFS., *Staurastrum alternans* BRÉB., *Ophiocytium cochleare* A. BR.

(c) 40 cm water depth. — The "beard" is formed hear, apart from the *Cladophora*, by an *Oedogonium* sp. But here these filaceous organisms are more covered with diatoms than on the level over it. The subdominant organism are found among these diatoms: *Epithemia sorex, Gomphonema acuminatum* AHR. forma, *Rhopalodia gibba*. Here and there the peculiar, 8–10 mm long thalluses of *Chaetophora incrassata* (HUDSON) HAZEN, of similarly subdominant occurrence, can be seen. On these lower individual numbers of *Tolypothrix tenuis, Epithemia zebra,* and *Rhopalodia gibba* settled. In addition to the afore-mentioned ones, I have determined from the sample further 31 algal taxons. From among these there are 5 Cyanophytic and 8 Chlorophytic organisms while the others — with the exception of one Euglenophytic and one Xanthophyceae organism — are Bacillariophyceae. Fairly interesting occurrences are: *Entosiphon polyaulax* Skuja forma (only half as large as described by Skuja), *Gongrosira prostrata* JAO, *Gonatozygon kinahanii* (ARCH.) RABENH., *Staurastrum teliferum* RALFS forma (with longer spines than at the type).

(d) 80 cm water depth. — In the composition of the filaceous coating, *Gogrosira prostrata* is dominant. Besides it, an *Oedogonium* sp. and, sitting on it, *Epithemia turgida* (EHRBG.) are also dominant quantitatively. *Eunotia lunaris* (EHRBG.) GRUN. var. *capitata* GRUN. and *Epithemia argus* KÜTZ. mean a peculiar subdominant occurrence. Apart from the listed ones, not more than 23 further algol taxons could be observed in the sample. There were among these one Cyanophytic and 6 Chlorophytic organisms, the others were — with the exception of one Xanthophyceae taxon — all Bacillariophyceae. Rather interesting occurrences are: *Microcystis aeruginosa* KÜTZ. f. *sphaerodictyoides* ELENKIN, *Tolypohtrix tenuis, Tribonema affine* G. S. WEST, *Eunotia lunaris* var. *subarcuata* (NAEG.) GRUN.

3. A sample taken from 0–15 cm water depth, from a *Typha* stem, at the fringe of a cutting with *Utricularia* within the reedy part. — The main mass of the coating is formed by a blue-green alga of filaceous structure: *Microchaete* sp. (*M. brunnescens* KOMÁREK?). Subdominantly *Amphipleura pellucida* KÜTZ. and *Navicula radiosa* are present. Apart from the mentioned ones, further 37 algal taxons could be determined from the sample. Rather interesting occurrences are: *Lyngbya aestuarii* (MERT.) LIEBMANN, *Aphanochaete repens* A. BR., *Bulbochaete* sp. (*B. elatier* PRINGSH.?), *Coleochaete divergens* PRINGSH., *Ophyocytium longipes* PASCHER. *O. maius* NAEG.

4. Algal coating on the leaves of the Stratiotes specimens of the cutting with *Utricularia* (Lichtung im Röhricht mit *Utricularia*-Bestand). D: *Epithemia turgida, Rhopalodia gibba,* SD: *Epithemia zebra* var. *porcellus* (KÜTZ.) GRUN., *Navicula*

radiosa. Apart from the above mentioned ones, I have determined 49 algal taxons from the sample. Among these, there were comparatively many, together 12 Desmidiales taxons. Rather interesting occurrences are: *Coleochaete pulvinata* A. BR., *C. scutata* BRÉB., *Quadriococcus ellipticus* HORTOB. forma (on the cell pole there is no cell-wall thickening), *Cosmarium bioculatum* BRÉB. f. *depressa* SCHAARSCHM., *Gonatozygon ehrenbergii* (BRÉB.) DE BARY.

5. Squeezing of *Utricularia* grass from the cutting with *Utricularia*. — Squeezing the extremely dense *Utricularia* grass, we have got a sample, strikingly rich in, taxons. Among the algae fixed here, there are some living fixed on the *Utricularia* itself, as well as some planktonic elements, caught by the dense, filter-like behaving grass, and there visibly further multiplying. D: *Navicula radiosa,* SD: *Amphipleura pellucida, Fragilaria construens* (EHRBG.) GRUN. Apart from these, 116 algal taxons could be determined from the sample. The taxonomical spectrum of the sample differs in numerous relations from the other periphyton samples, taken from the bay at Polaznak in this period. Cyanophyta: 16 taxons, Chlorococcales: 30 taxons, Desmidiales: 19 taxons, Chrysophyceae-Xanthophyceae: 4 taxons, Bacillariophyceae: 38 taxons. In the taxonomical composition, the comparatively large number of Chlorococcales and Desmidiales taxons is striking. Rather interesting occurrences are: *Entosiphon sulcatum* (DUJ.) STEIN, *Euglena pisciformis* KLEBS, *E. polytrophos* POCHM., *E. variabilis* KLEBS., *Phacus contortus* BOURR., *Gloeoactinium limneticum* G. M. SMITH, *Scenedesmus acutiformis* (8-celled coenobia, as well!), *Sorastrum spinulosum* NAEG., *Closterium ehrenbergii* MENEGH., *Cosmarium regnellii* WILLE, *C. undulatum* CORDA var. *crenulatum* (NAEG.) WITTR., *Sphaerozosma muticum* BRÉB., *Staurastrum polymorphum* BRÉB. forma (with a shallow hollow on the cell pole), *Geniochloris laevis* PASCHER, *Eunotia tenella* (GRUN.) HUST., *Pinnularia stauroptera* (RABENH.) CLEVE forma (it is significantly larger than the type).

The periphyton of the investigated individual reeds differred according to levels. There are differences in the dominance conditions, in the number of the algal taxons forming the periphyton and partly in its common taxonomical composition, too.

The periphyton associations of the water-side fringe of reeds and of the inside of reeds also differ from each other. The former ones are poorer, as a result of employing the water motion mechanically, both in respect of the number of taxons, and from the point of view of the population. Their depth levels, however, resemble each other much more. The latter ones are taxonomically richer, and contain several such organism (Desmidiales-taxons, *Eunotia* spp., etc.) which are characteristic of the transitory bogs.

The periphyton of bulrush stems differs from that of reeds in more than one essential trait. Similarly, the periphyton of the *Stratiotes* specimens, found in the cutting, fringe of reeds, differs from the periphyton of reeds.

The periphyton of the *Utricularia* grasses, living in the cuttings of reeds and being remarkably rich in species, contains — besides the typical fixed organisms — particularly numerous and in the given association further multiplying elements, although such elements can be found in every periphyton in a certain quantity.

The here discussed and other results of my investigations unambiguously refer to that, in the present-day water-chemical situation, the developing periphyton is considerably determined by its "undergrowth". The compared results of several such investigations will conduct to the recognition of types.

The periphyton associations developing on the macrophyton vegetation of the

Balaton contain a number of such algal taxons that can hardly or not at all found in our other water biotopes.

Even a simple microscopical examination of the periphyton-associations of the Balaton convinces us that the matter in question in the biomass, on the active surface, very considerable water associations are concerned, the role of which, played in the life on the Balaton, deserves to be revealed by the research as detailed as possible.

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