Tiscia (Szeged) Vol. XIX, pp. 69—78 (1984)

STUDIES ON THE QUALITATIVE AND QANTITATIVE COMPOSITION AND THE SEASONAL CHANGES OF PHYTOPLANKTON AT THREE SAMPLING AREAS OF THE DEAD TISZA AT LAKITELEK

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(Received May 12, 1983)

Abstract

The studies on phytoplankton were carried out at three sampling points of the dead Tisza a Lakitelek, in the Northern region being under nature conservancy. When processing the samples taken monthly over a period of one year, authors studied the qualitative and quantitative composition as well as the seasonal changes of phytoplankton. The biomass and diversity of phytoplankton were measured on the basis of the total algal count. With the help of cluster analysis authors searched for an answer to the question, what kind of similarities in time and space are manifested by the algal communities of the three sampling places? The changes in phytoplankton composition showed the differentiation of the three sampling places in Summer, following the uniformity of the water spaces in Spring. In the months of Autumn and Winter the samples taken from the 2nd and 3rd sampling places showed tight relationship and similar phytoplankton composition. The disconnected Northern region of the backwater was characterized throughout the whole year by plankton associations of differing compositions.

Introduction

The backwater at Lakitelek is a bend cut through during the course of the river control accomplished in the last century. It has still kept to this day its ancient state characteristic of backwaters along the river Tisza. The Northern section of the dead channel is a part of the Kiskunság National Park since 1975, standing under nature conservancy. Similar to our studies carried out between 1976—1980 at the Environment Protection Area at Mártély (DOBLER, KOVÁCS 1982, KISS 1982), our task is to estimate the present condition of the backwater, so that our results could be used for a basis of comparison when observing the harmful effects befalling the water space.

The estimation of the phytoplankton at the Lakitelek backwater of the Tisza was started by ISTVÁN KISS in the beginning of the 60s. Regular samplings (in every season) were started from 1975 (KISS 1978a, b). Comparing the phytoplankton associations of the Northern section under nature conservancy, with the Southern channel part not under protection author established that besides the exclusive occurrence of a few species, the difference between the two water spaces is manifested in the higher Euglenophyton species and individual number of the Southern section. UHERKOVICH (1971) performed phytoplankton studies of informative nature at the Tisza backwater of Lakitelek at the end of March, 1968. Apart from the high dominancy of *Synura uvella* EHR. and *Cyclotella* sp. in Spring, he determined that the

backwater's flowering plants and algal vegetation give evidence of a higher level of limnological individualization.

The nearby, similar geological and limnological backwaters show many related features to the qualitative and quantitative composition of the phytoplankton at the backwater of Lakitelek (KISS 1979, DOBLER, KOVÁCS 1984).

The phytoplankton studies at the Tisza backwater of Lakitelek were carried out according to the following viewpoints:

1. The composition, seasonal changes of the algal communities characteristic to the backwater, at the three sampling places.
2. Studies on the similarities in time and space between the various sampling areas.

Materials and Methods

Samples were taken between May 1982 and April 1983 throughout a year, monthly, from the middle of the water area by way of dipping about 20 cm below the surface.

a) Total algal count was determined from the samples.
b) The biomass of phytoplankton was counted (BARTHA 1977, DUSSART 1966, NAUWERCK 1963, SEBESTYÉN 1954, TAMÁS 1955, WILLEN 1961).
c) The Shannon species-individual number diversity values were calculated (SHANNON—WEAVER 1963).
d) The similarities of the samples originating from the different sampling places and taken at various intervals were measured by the Czekanowski (1909) similarity index. On the basis of the resulted similarity matrixes cluster analysis was performed using the average chain (UPGMA) method from the agglomerative, hierarchy methods (SNEATH-SOKAL 1973). It was investigated, which species are responsible, and in what ratio for the association of the most inner sample pairs of the similarity dendrogram (HAJDÚ—RAJCZY 1981).

Discussion of results

1. Characterisation of sampling areas, qualitative and quantitative composition as well as seasonal changes of the phytoplankton.

a) The No. 1. sampling place can be found in the shallow, marshy Northern end of the backwater (Fig. 1). It is characterized by water depth of maximum lm and thick precipitate containing black ferric sulphide. By the end of May the macrovegetative covering reaches 50%. Between the mosaics of *Nymphea alba* L.,

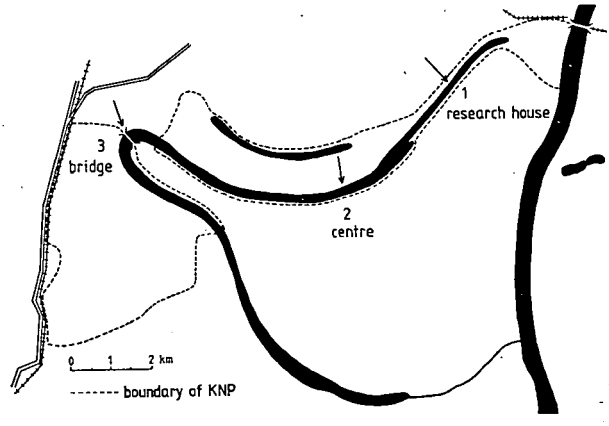

Fig. 1. Localization of the sampling areas at the dead Tisza at Lakitelek.

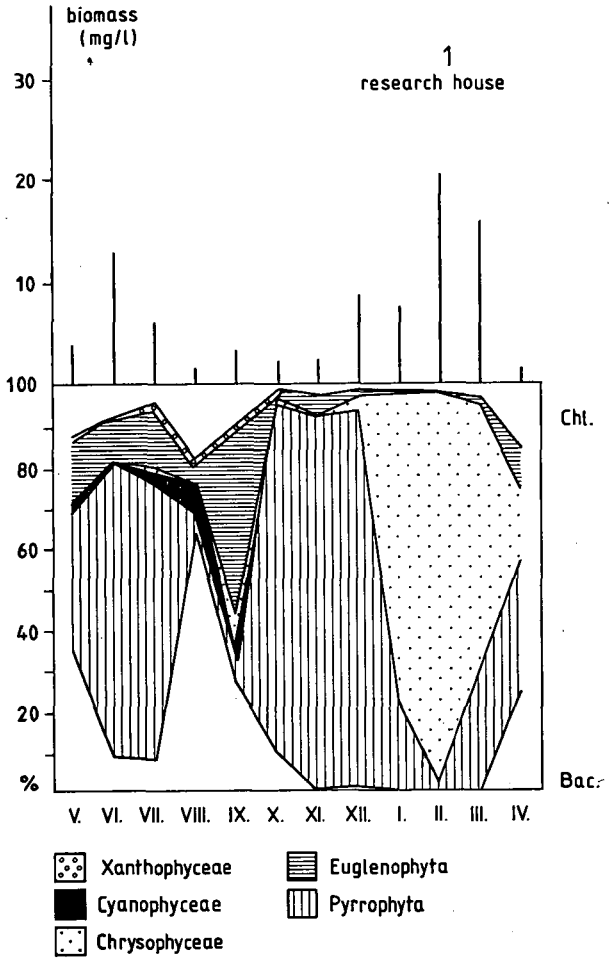

Fig. 2. Changes in the values of the phytoplankton biomass and the percental distribution of the biomass at the No. 1. sampling area (1982. V.—1983. IV).

Nuphar lutea (L.) SM., *Trapa natans* L. and the mesh of various types of reed-grass, opened water surface can only be found in the middle of the channel. It is segregated from the No. 2. sampling area by thick bulrush. The Northern end of the backwater is a disconnected channel section in the state of natural alluvium. The biomass values of the phytoplankton stand from the No. 1. sampling place are shown on Figure 2, below which the quota of the systemic groups can be seen, regarding the prevailing biomass as 100%. From the two biomass maximums that of June can be explained by the Pyrrophyta and Euglenophyta groups' large algae (*Trachelomonas volvocinopsis* SWIR., *Chroomonas acuta* UTERMÖHL, *Cryptomonas erosa* EHR.) and that of February by the mass appearance of Synura uvella Ehr. With the late Autumn devastation of the macrovegetation the shade effect and aliment competition cease, making possible the growth of the phytoplankton biomass.

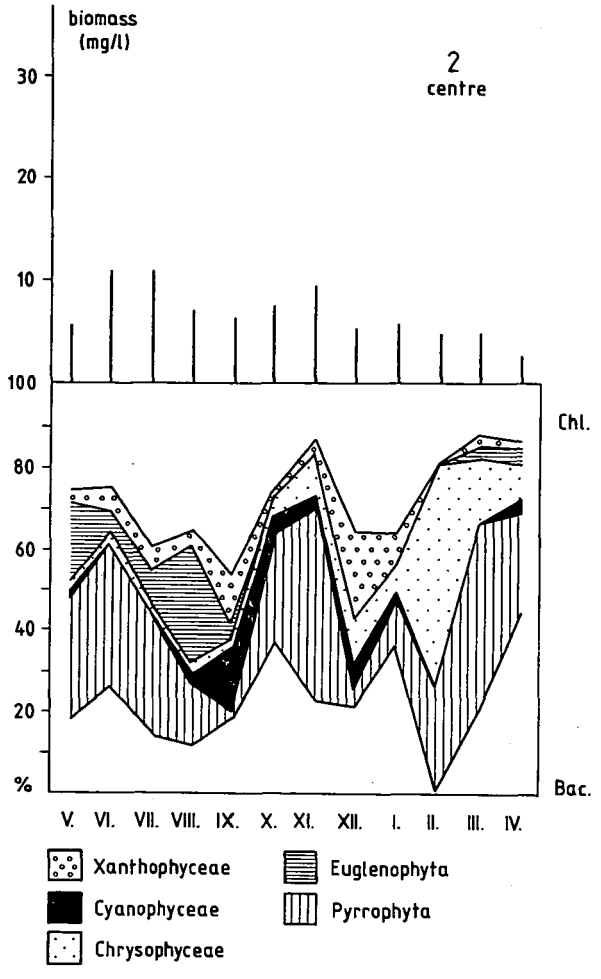

Fig. 3. Changes in the values of the phytoplankton biomass and the percental distribution of the biomass at the No. 2. sampling area (1982. V.—1983. IV).

b. At the No. 2. sampling place (Fig. 1) the maximal watar depth is 2 m. The macrovegetation of similar composition as the afore-mentioned is stricted to the narrow riverside zone. According to our experiences this sampling area represents well the natural conditions of the backwater. The results of our studies carried out at this area are summarized in Fig. 3. This water area is characterized by the whole-year uniformity of the phytoplankton biomass, with slight decrease in Winter. At Spring the biomass of Euglenophyta and Pyrrophyta groups is significant and by the end of Summer a larger amount of blue algal stand also develops. In the Autumn and Spring algal associations the biomass of the species belonging to the Pyrrophyta and Chrysophyta groups prevails (*Cryptomonas erosa* EHR., *Cryptomonas ovata* EHR., *Chroomonas acuta* UTERMÖHL, *Chromulina* sp., *Chrysococcus biporus* SKUJA). Regarding the diatoms in Spring and Winter the stand of *Stephanodiscus tenuis* HUST. is significant, the Summer and early Autumn months

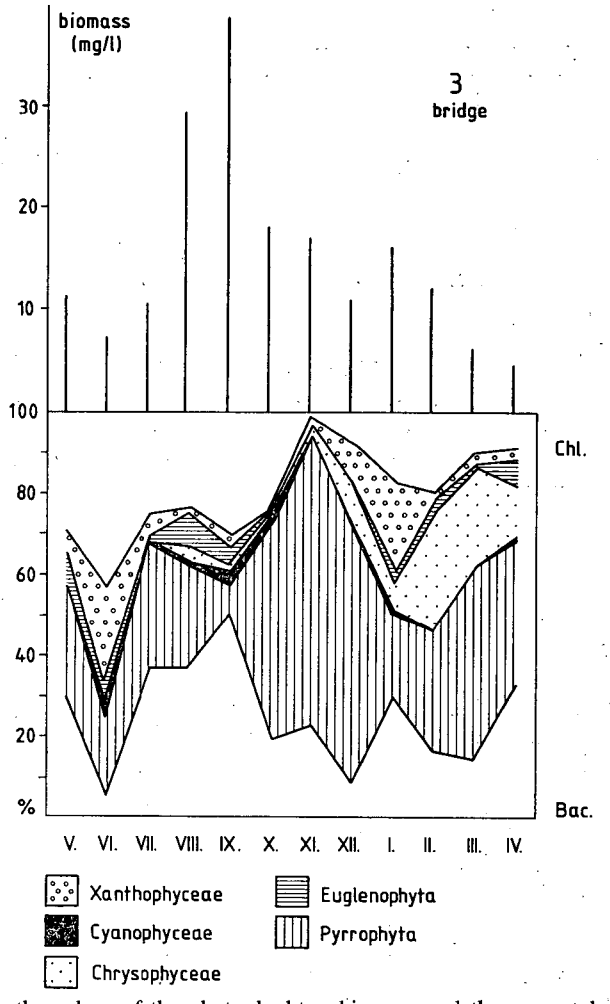

Fig. 4. Changes in the values of the phytoplankton biomass and the percental distribution of the biomass at the No. 3. sampling area (1982. V.—1983. IV).

are characterized by the large individual number of the *Stephanodiscus dubius* (FRICKE) HUST.

c) The No. 3. sampling place is situated at the bridge of Tőserdő (Fig. 1). It is characterized by a maximal water depth of 3 m and flowering water-plant associations with composition similar to that described at the other two sampling areas. These associations are also limited to the riverside zone. This area of the backwater is exposed to strong anthropogenic effects (bathing, rod-fishing, agricultural tilling). At this sampling place the development of the maximum at the end of Summer was registered (Fig. 4). The biomass of the green algae and diatoms was found to be strickingly large in this period. Apart from, the Pyrrophyta group characterizing the Autumn and Winter months, the proportion of the Chrysophyta strain also increased from January. The maximums of the diatoms having similar

composition to those of the No. 2. sampling area developed in Spring, Summer and Winter.

At all three sampling areas the highest values of diversity were experienced in the Summer months, indicating that the algal population maximums developing in Summer refer to the balanced phytoplankton associations of high diversity. The diversity index values decreasing in the Winter months at the time of the Winter biomass maximums are due to the outstandingly high individual number of a few species.

2. Similarities in time and space of the phytoplankton associations.

The values of the total algal number originating from every sampling area and time-point (a total of 36 samples) were used to calculate the similarities of the sample pairs. The percental values of the species responsible for the relatedness of the inner sample pairs of the groups are demonstrated beneath the dendrogram gained as the result (Fig. 5). At the No. 2. and 3. sampling areas our samples taken between May and October form a differentiating group. The fact that the samples taken at the same sampling area, but in different Summer months are more similar to each other than the algal associations originating from the same time-point, but from various sampling areas, refers to the variation of small degree of the two living places, developing in Summer. Few, but high individual numbered species are responsible for the tight relationship of the Summer samples taken from the No. 3. sampling area exposed to anthropogenic effects. It was found when analysing the sample pairs of the second group that many species — first of all green algae — contribute with low percental ratio to the increase in the value of the similarity index.

The linkage within group and the differentiation of the group related to the samples taken at the No. 2 and 3. sampling places in December and January are caused by the mass appearance of the *Asterogloea gelatinosa* PASCHER alga. The presence of small individual number of this species was also registered in the earlier years, nevertheless, the development of the population maximum (76,8 million, ind/l) was probably due to the mild Winter. On the basis of the experiences obtained in previous years the most characteristic species of the Winter algal associations at the Lakitelek backwater is the *Synura uvella* EHR., the individual number of which was minimal in the Winter of 1982.

The development of differentiating Summer and Winter algal associations is preceded by the development of phytoplankton associations of transitional composition, which can be characterized by lower total algal count and biomass values. The striking similarity observed at the No. 2. and 3. sampling areas in November and March is firstly caused by the *Asterogloea gelatinosa* PASCHER, and besides this species, the *Chrysococcus biporus* SKUJA as well as the *Chromulina* sp. species are those which contribute to the general similarity of the Autumn and Spring samples.

The IV/3, IV/2 and IV/1 groups indicate that the phytoplankton composition of the complete water area of the backwater is the most homogeneous in Spring. This conclusion is supported by the fact that the samples of the water area in front of the research house are only linked to the samples of the other two sampling places in these months.

Contrary to the Summer months, in the Autumn, Winter and Spring periods the samples originating from the various areas do not show expressed differentiation, the time-point of sampling is determinant in the development of the groups.

By the beginning of June the macrovegetation at the No. 1. sampling place reaches complete development. The aliment competition, the oxygen-deficient periods

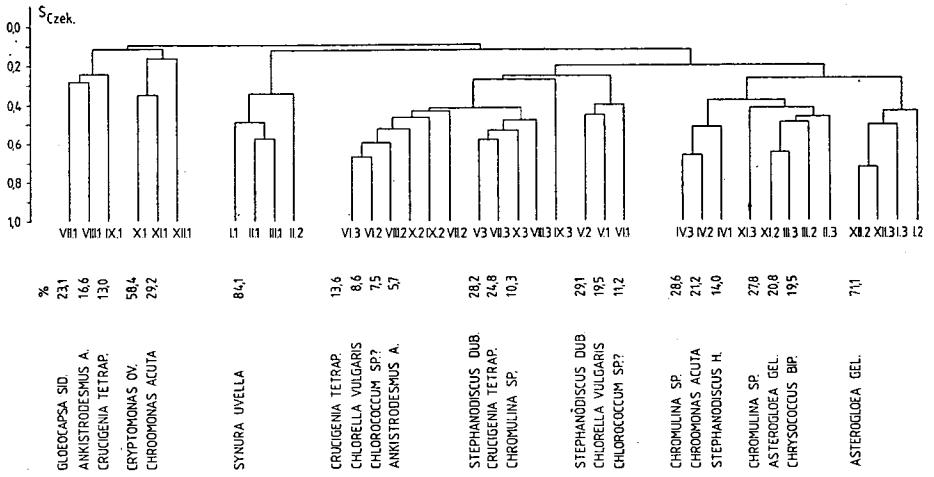

Fig. 5. Dendrogram of the phytoplankton samples (1982. V.—1983. IV).

during the night and furthermore, the shadiness depress the total algal number per litre as well as the value of the diversity index, establishing algal associations having compositions entirely different from the earlier ones. As a result, the Summer, Autumn and Winter groups of the sampling area are completely differentiated. The tight linkage of the Winter samples taken at the research house is determined by the mass occurrence of the *Synura uvella* EHR. and the *Chrysococcus biporus* SKUJA. The light microscopic pictures of the algae characteristic to the backwater are summarized in Tables I and II.

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A fitoplankton minőségi és mennyiségi összetételének, szezonális változásának vizsgálata a Lakiteleki holt-Tisza három mintavételi pontján

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Kivonat

Fitoplankton vizsgálatainkat a Lakiteleki holt-Tisza természetvédelem alatt álló északi részének három mintavételi pontján végeztük. Az egy éven át havonta vett minták feldolgozásakor vizsgáltuk a fitoplankton minőségi és mennyiségi összetételét, szezonális változását. Az összes algaszám alapján számoltuk a fitoplankton biomasszáját és a diverzitást. Cluster analízis segítségével kerestünk választ arra a kérdésre, hogy a három mintavételi hely algatársulásai térben és időben milyen hasonlóságot mutatnak. A fitoplankton összetételének változása a vízterek tavaszi egyöntetűvé válása után nyáron a három mintavételi hely elkülönülését mutatta. Az őszi és téli hónapokban a 2. és 3. számú mintavételi helyen vett minták kapcsolata szoros, fitoplankton összetétele hasonló. A holtág lefűződő északi részét egész évben eltérő összetételű plankton együttesek jellemezték.

Table I

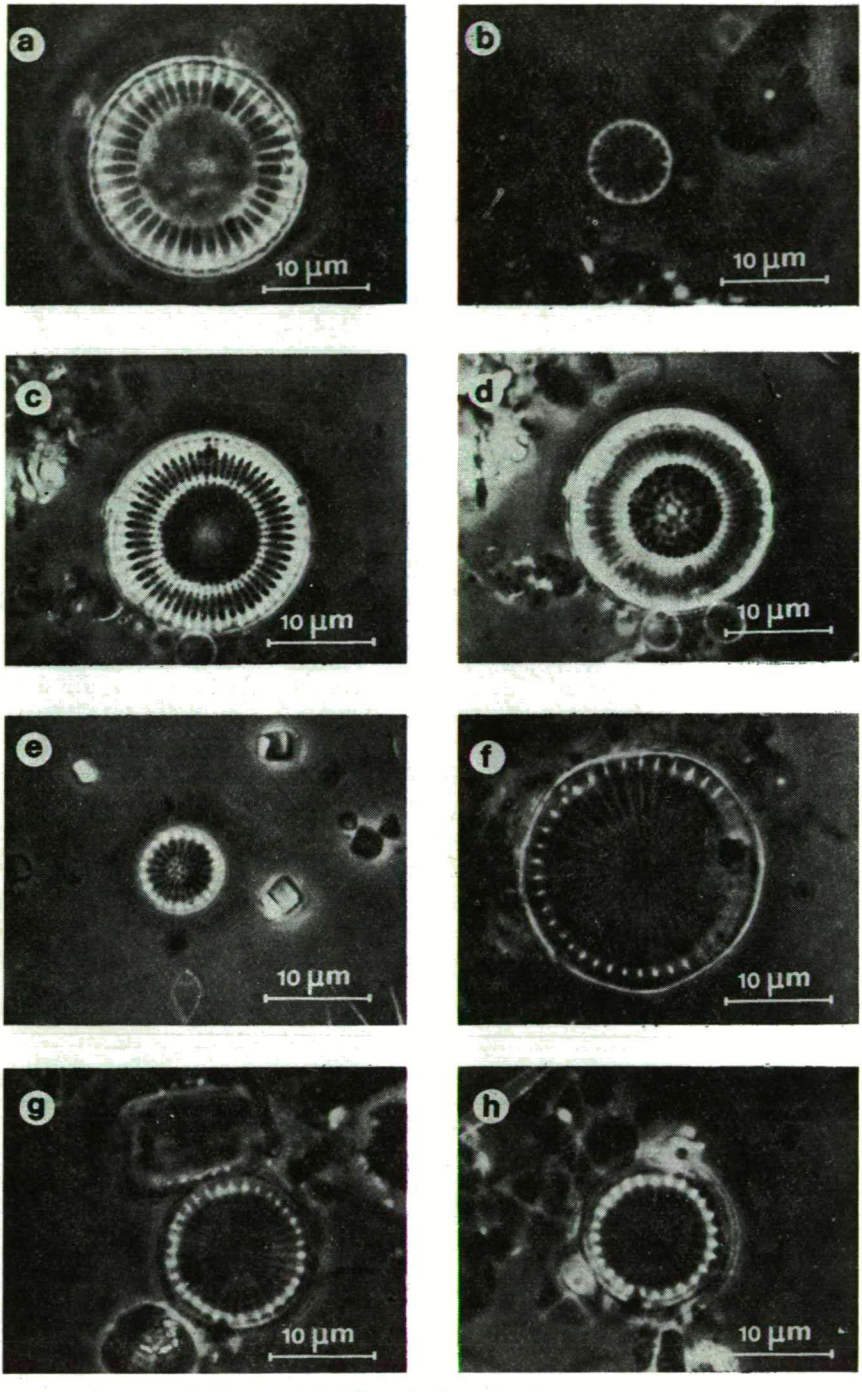
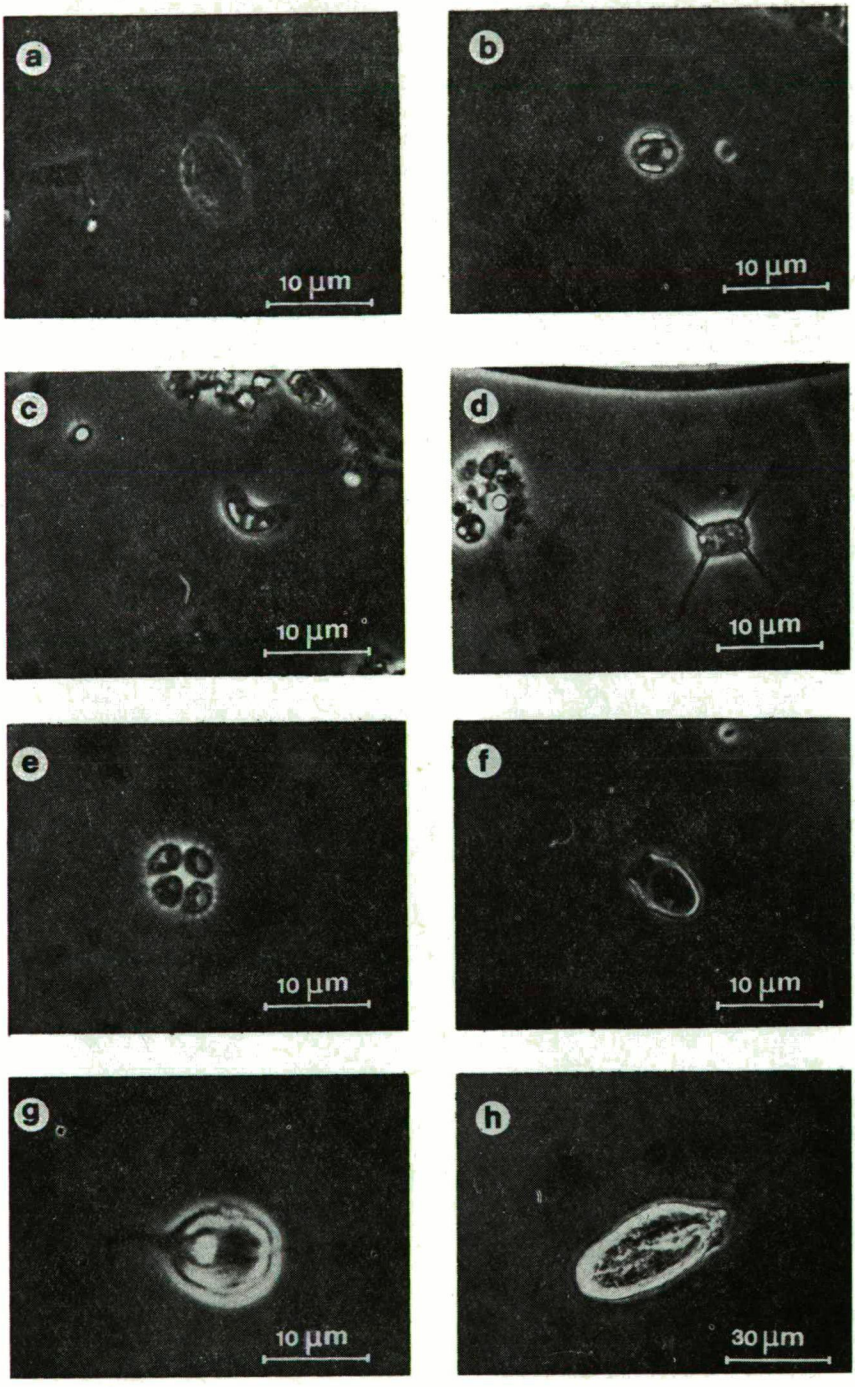


Table I and II: Microphotography by DÉNES BUDAI.

Table II



Исследование количественного и качественного состава и сезонных изменений фитопланктонов в трёх местах взятия пробы в мёртвом русле Тисы Лакителек

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Резюме

Исследования фитопланктонов мы проводили в трёх местах взятия проб в северной части мёртвого русла Тисы в районе Лакителек, объявленной заповедником. В течение года ежемесячно брали пробы, в ходе обработки которых исследовали количественный и качественный состав, а также сезонные изменения фитопланктонов. На основе общего числа водорослей подсчитывали биологическую массу фитопланктонов и дивергенцию. С помощью Кластер-анализа пытались найти ответ на вопрос о том, какое подобие в пространстве и во времени наблюдается в сообществе водорослей в трёх местах взятия проб. Изменение состава фитопланктонов летом после весеннего слияния вод показывает разграничение трёх мест взятия проб. Между пробами, взятыми в осенние и зимние месяцы во втором и третьем местах взятия проб, наблюдается тесная связь, состав фитопланктонов здесь подобен. Отделяющуюся от мёртвого русла северную часть в течение всего года характеризуют сообщества планктонов другого состава.

Kvalitativna i kvantitativna ispitivanja fitoplanktona na tri punkta u mrtvaji Tise kod Lakitelek-a u sezonskom aspektu

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Abstrakt

Ispitivanja su vršena na tri punkta severnog dela zaštićene mrtvaje Tise kod Lakitelek-a. Mesečne probe u toku godine poslužile su za utvrdjivanje kvalitativnog i kvantitativnog sastava fitoplanktone i njegove sezonske promene. Biomasa i diverzitet dobiveni su na osnovu ukupnog broja algi. Clusterovom analizom dobiven je odgovor na pitanje kakva je prostorna i vremenska sličnost zajednice algi na tri istraživane punkta. Nakon proletnje ujednačenosti, u toku leta javlja se razlika u sastavu fitoplanktona izmedju istraživanih punktova. U toku jeseni i zime fitoplankton na istraživanim punktovima br. 2 i 3 pokazuje veliku sličnost. Na severnom delu mrtvaje planktonska zajednica se tokom cele godine karakteriše različitim sastavom.